# APPENDIX C: SUMMARY ECOLOGICAL CLASSIFICATION SWAN RIVER BASIN, MONTANA

# SUMMARY

# ECOLOGICAL CLASSIFICATION

# SWAN RIVER BASIN

# MONTANA

*Prepared for:*

**Plum Creek Timber Company, L.P.**
**Columbia Falls, Montana**

*Prepared by:*

**White Horse Associates**
**Logan, Utah**

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# Ecological Classification
# Swan River Basin
# Montana

## ACKNOWLEDGEMENTS

This report is a compilation of map and descriptive information from several sources. Dean Sirucek (Soil Scientist, Flathead National Forest) provided descriptions of Landtype Associations, identified habitat types, was principally responsible for the riparian landtype mapping and descriptions, facilitated transfer of Forest Service information to White Horse Associates and reviewed the draft report. Vicki Bachurski (Flathead National Forest) assisted in extending mapping of riparian landtypes from Forest Service Lands to intermingled private lands in Swan River Basin. John Krogstad (GIS Specialist, Flathead National Forest) facilitated the transfer of Forest Service map information to White Horse Associates. Most of the classification and inventory information was compiled from maps and reports provided by the Flathead National Forest.

Brian Sugden (Forest Hydrologist, Plum Creek Timber Company) coordinated the study and reviewed the draft document. Brian Gilbert (Wildlife Biologist, Plum Creek Timber Company) reviewed mapping and descriptions of habitat types and reviewed the draft report.

The report was compiled by Sherman Jensen (Physical Ecologist, White Horse Associates) and Ted Dean (GIS Specialist, White Horse Associates).

## EXECUTIVE SUMMARY

An ecological classification was conducted for Swan River basin in northwest Montana. The basin is 408,630 acres with a stream network totaling about 1,257 linear miles. The ecological classification provides a framework and descriptive attributes from which interpretations regarding habitats and the effects of land uses can be interpreted.

The framework is an ecological classification that facilitates analysis from several perspectives. Hierarchical levels include ecoregion, geologic district, subsection, landtype association, landtype, habitat type and riparian landtype. Descriptive attributes include elevation, slope, aspect, annual precipitation and ownership. Descriptive attributes can be summarized for any combination of the hierarchical layers.

The Swan River basin falls within a single ecoregion (Northern Rockies) and geologic district (Precambrian Sedimentary). Three (3) subsections were discriminated by geologic structure: 1) Alpine glacial sedimentary scarp slope; 2) Alpine glacial sedimentary dip slope; and 3) Continental glacial sedimentary valley. Eleven (11) Landtype associations were identified by the Flathead National Forest and group landtypes with distinctive erosion potential and sediment delivery efficiency. Landtypes were identified as part of an Order III Land System Inventory in the northern Rocky Mountains of northwest Montana (Martinson and Basko 1983) and from an Order IV survey of landtypes in the Mission Mountain Wilderness. A total of 46 Order III and IV landtypes were combined into eleven (11) more general landtype classes. Sirucek (1994) developed a map of habitat types (described by Pfister et al. 1977) from empirical models, forest stand data and an existing layer of forest structural classes. Twelve (12) major habitat types and twenty six (26) minor habitat types were identified. Riparian landtypes are defined by valley-bottom gradient, dominant streambed materials and dominant vegetation community type. They were mapped and described for Forest Service lands in the Flathead National Forest (Sirucek and Bachurski 1995). In a cost-share agreement with Plum Creek Timber, the Flathead National Forest also extended the riparian landtype mapping to private lands in the Swan River basin and to the Mission Mountain wilderness.

A Geographical Information System (GIS) was used to compile hierarchical map layers, plot maps and to output map data summaries. Maps, descriptions and data summaries are provided for each hierarchical level. Digital GIS map layers have also been provided to Plum Creek Timber and to the Flathead National Forest.

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## 1.0 INTRODUCTION

An ecological classification was conducted for the 408,630 acre Swan River basin in the Northern Rocky Mountains of northwest Montana. The ecological classification provides a framework and descriptive attributes from which interpretations regarding habitats and effects of land uses can be interpreted. The framework consists of a hierarchical classification that facilitates analysis of the project area from several different perspectives. Hierarchical levels include ecoregion, geologic district, subsection, landtype association, landtype, habitat type and riparian landtype. Descriptive attributes include elevation, slope, aspect, annual precipitation and ownership, each assembled as a separate map layer. Descriptive attributes can be sorted and summarized for any combination of hierarchical layers. Descriptive attributes can also serve as stand-alone map layers (e.g. elevation) or combined map layers (e.g. elevation/aspect/precipitation) for specific applications. Digital map files (ARC-INFO format) have been provided to facilitate subsequent analyses.

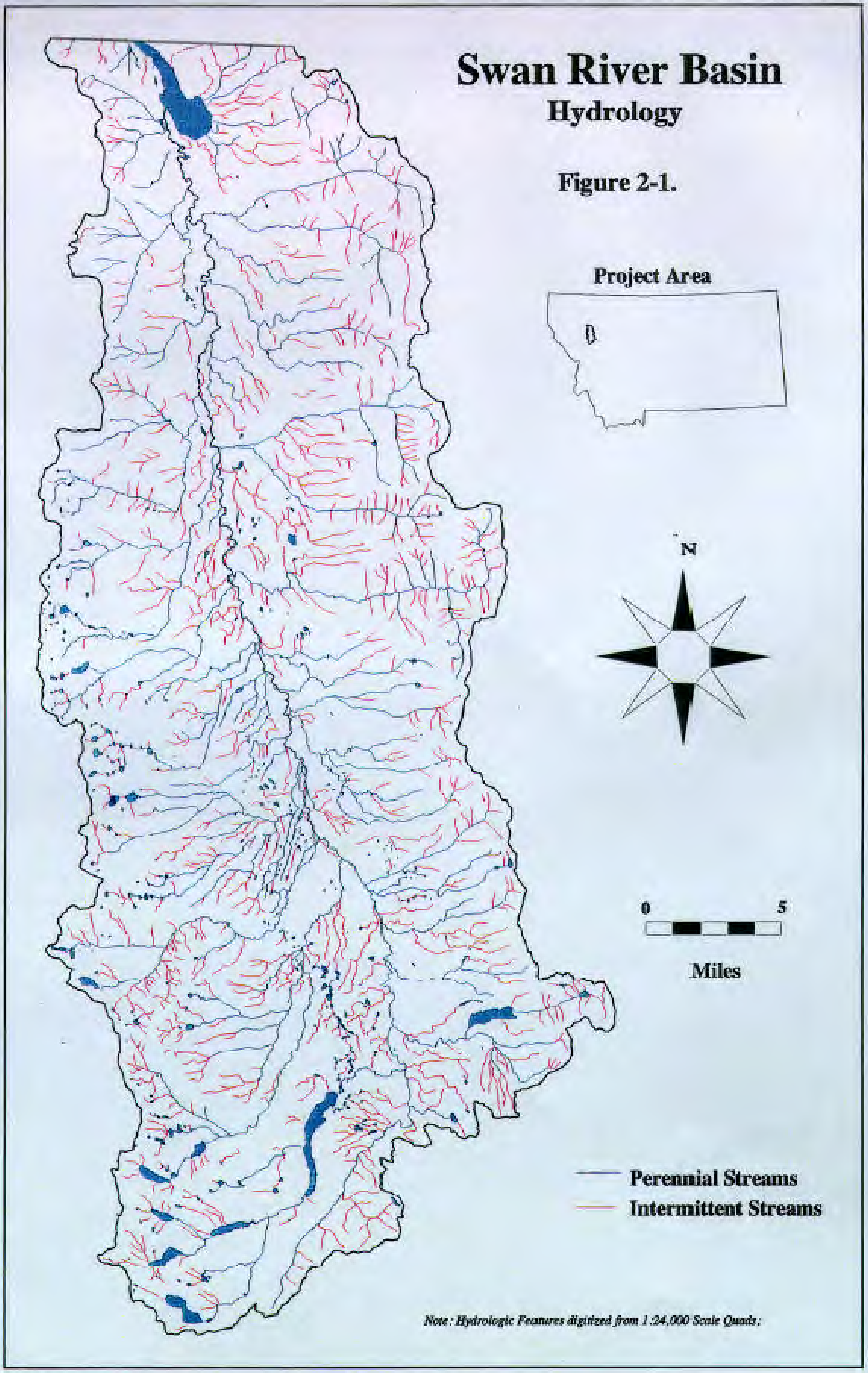
## 2.0 SWAN RIVER BASIN PROJECT AREA

The Swan River basin is shown in Figure 2-1. It is bounded on the west by the Mission Mountain Range and on the east by the Swan Range. A subtle divide separates the headwaters of the Swan River basin from the headwaters of the Clearwater River.

Elevations range from 9,402 feet at Glacier Peaks in the Swan Range to 3,066 feet at Swan Lake. Elevation, slope and aspect classes were generated from 1:24,000 scale Digital Elevation Models (DEMs). The distribution of elevation, slope and aspect classes for the Swan River basin are illustrated in Figure 2-2. Maps of elevation, slope and aspect classes are presented as Figures 2-3, 2-4, and 2-5, respectively.

The Swan Valley lies between the Mission Range on the west and the Swan Range on the east. Both ranges are Precambrian sedimentary formations. The Swan Valley was created in response to block faulting, with the upthrust fault scarp along the east side of the valley (Swan Range) and the dip slope along the west side of the valley (Mission Range). Glacial processes are evident in the topography of the Swan River basin (Figure 2-6). A lobe of the Cordilleran ice sheet pushed south through the Swan River valley during the Bull Lake ice age (Alt and Hyndman 1986). During the subsequent Pinedale glaciation it is believed that a Swan Valley glacier arose in the Swan and Mission mountains and flowed north to meet the south flowing Cordilleran ice sheet near Big Fork (Johns 1970; Witkind 1978). Evidence of glaciation include U-shaped canyons carved to the base of the mountains and an undulating valley floor with a myriad of small lakes and bogs. Nearly 50 percent of Swan River basin is mantled by secondary glacial deposits.

Annual precipitation ranges from 20 to 30 inches at lower elevations in Swan Valley to 80 inches along the highest mountain crests (Figure 2-7). The distribution of precipitation classes is shown in Figure 2-8. Average annual precipitation over the Swan River basin, estimated as the mid-point of precipitation classes, is about 1,482,404 acre-feet.


Swan River Basin
Hydrology
Figure 2-1.
Project Area
N
0
5
Miles
Perennial Streams
Intermittent Streams
Note : Hydrologic Features digitized from 1:24,000 Scale Quads ;

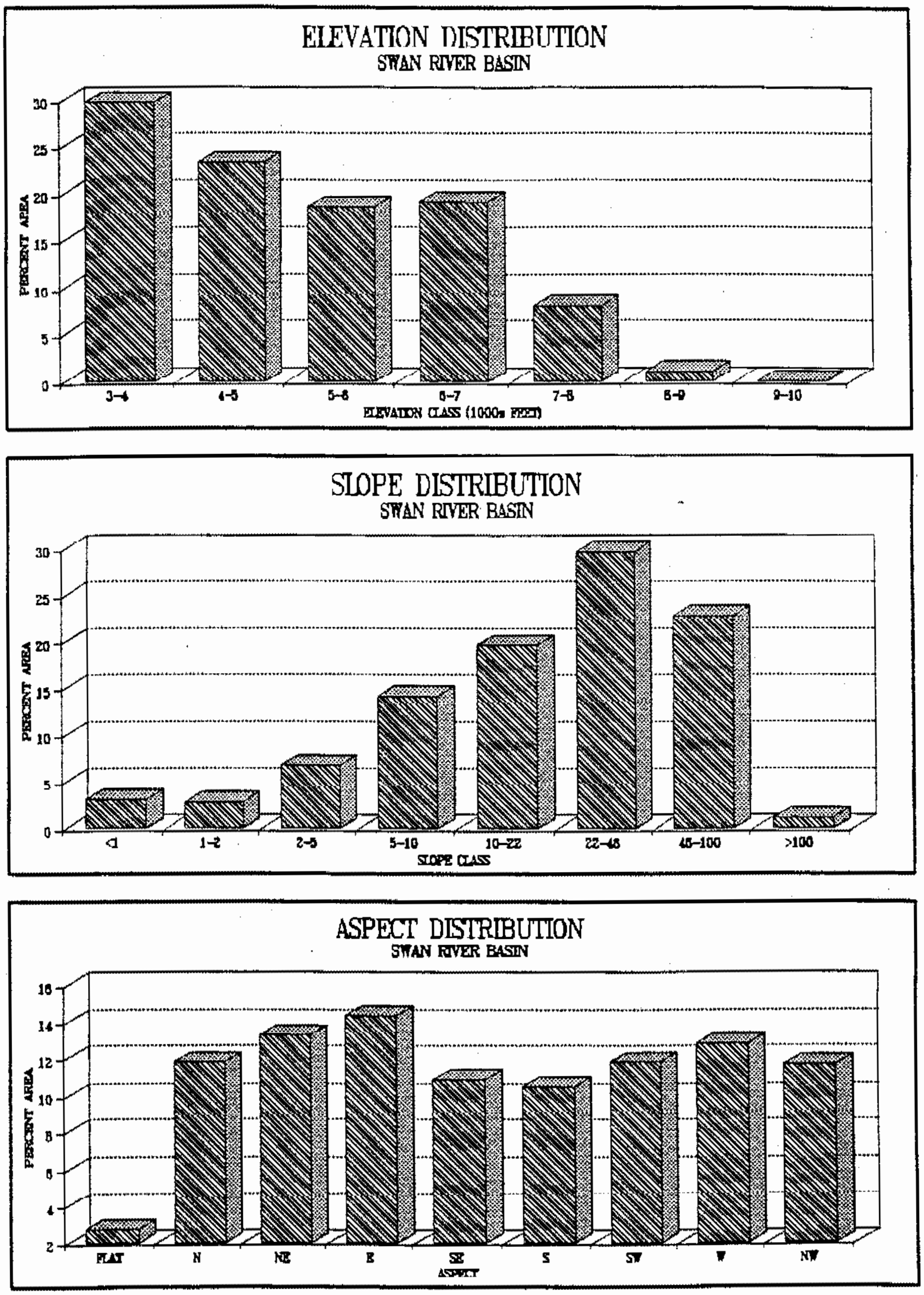
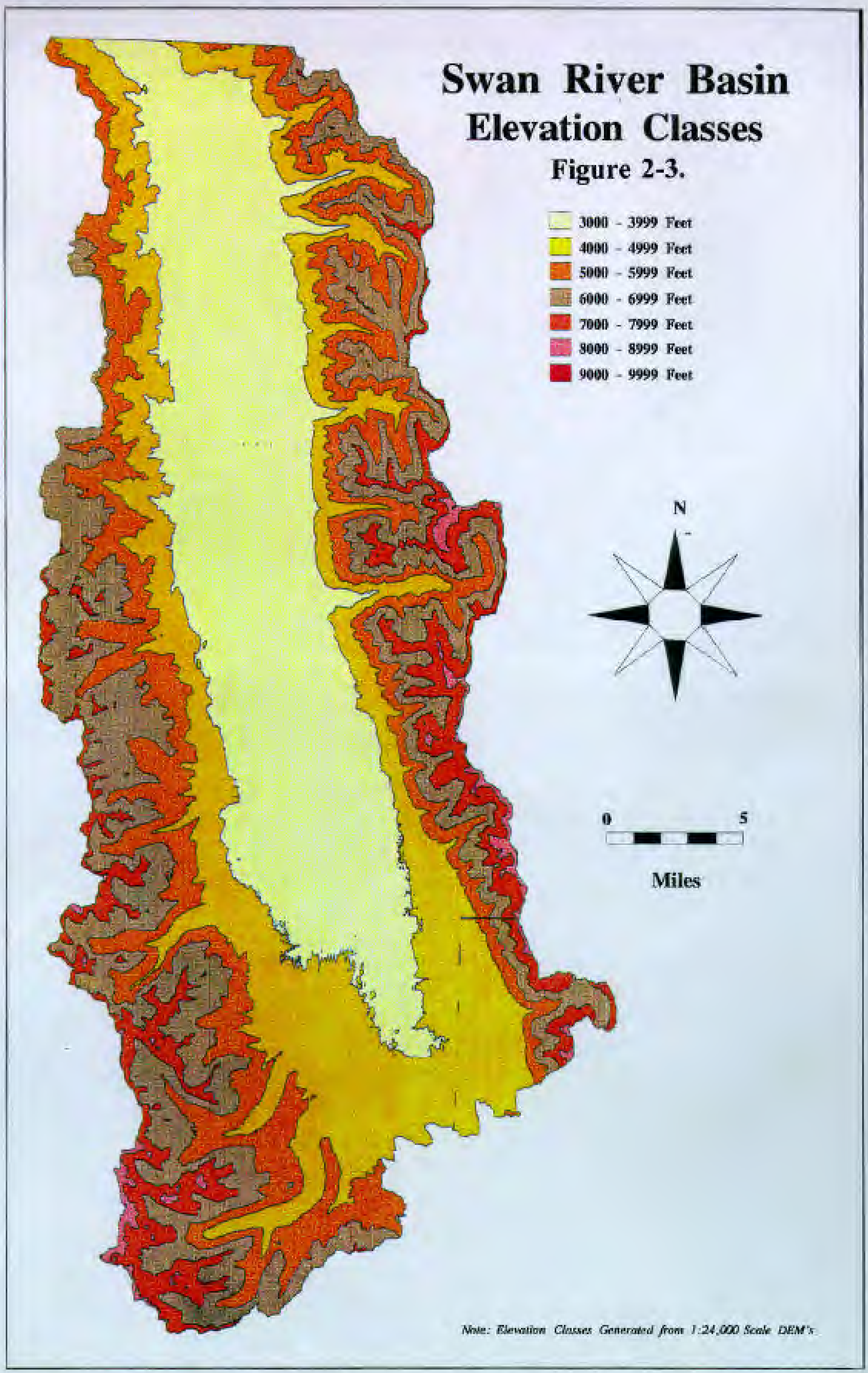
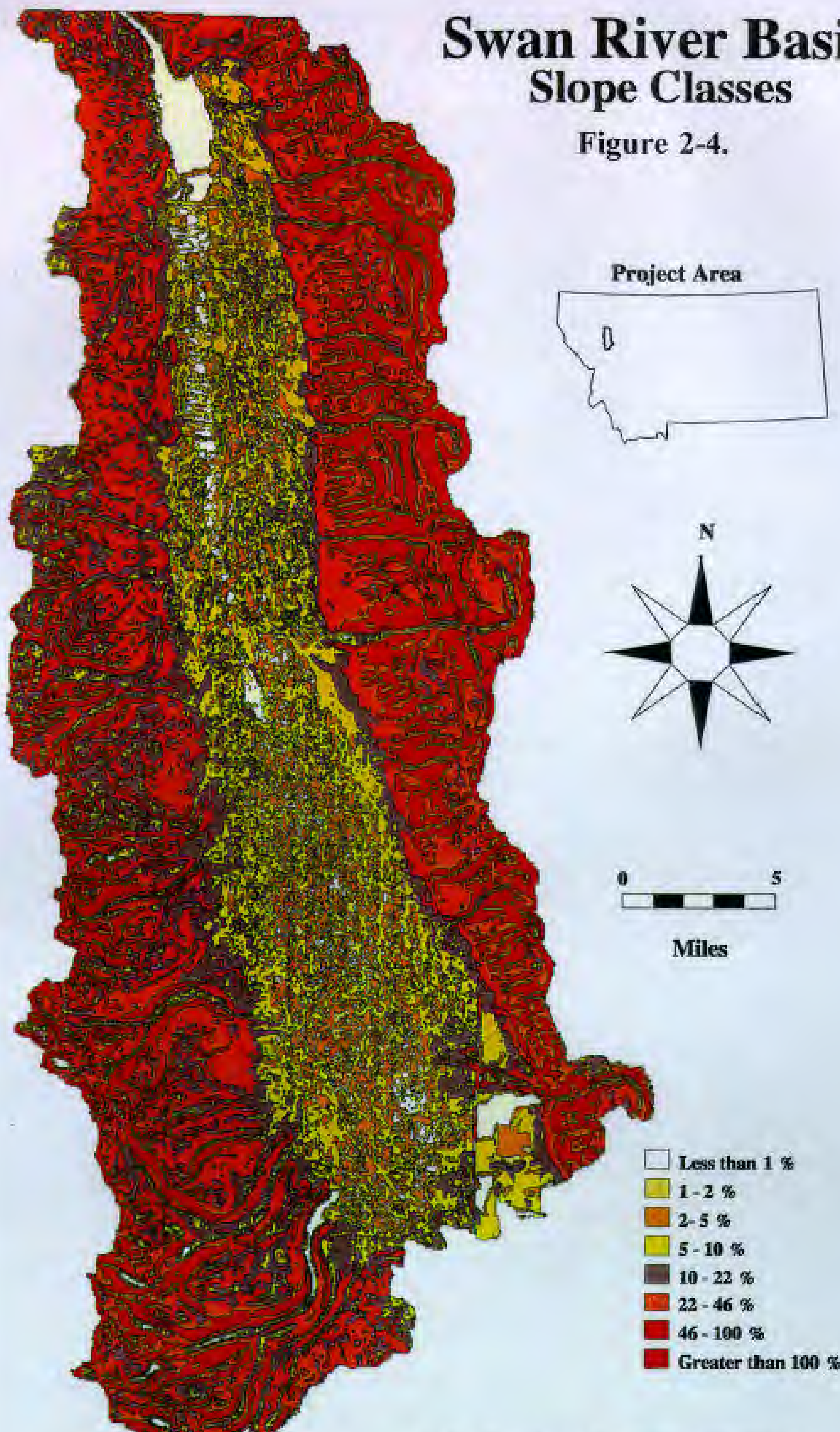



**Figure 2-2. Elevation, slope and aspect distributions, Swan River basin.**


Swan River Basin
Elevation Classes
Figure 2-3.
3000 - 3999 Feet
4000 - 4999 Feet
5000 - 5999 Feet
6000 - 6999 Feet
7000 - 7999 Feet
8000 - 8999 Feet
9000 - 9999 Feet
N
0
5
Miles
Note: Elevation Classes Generated from 1:24,000 Scale DEM's

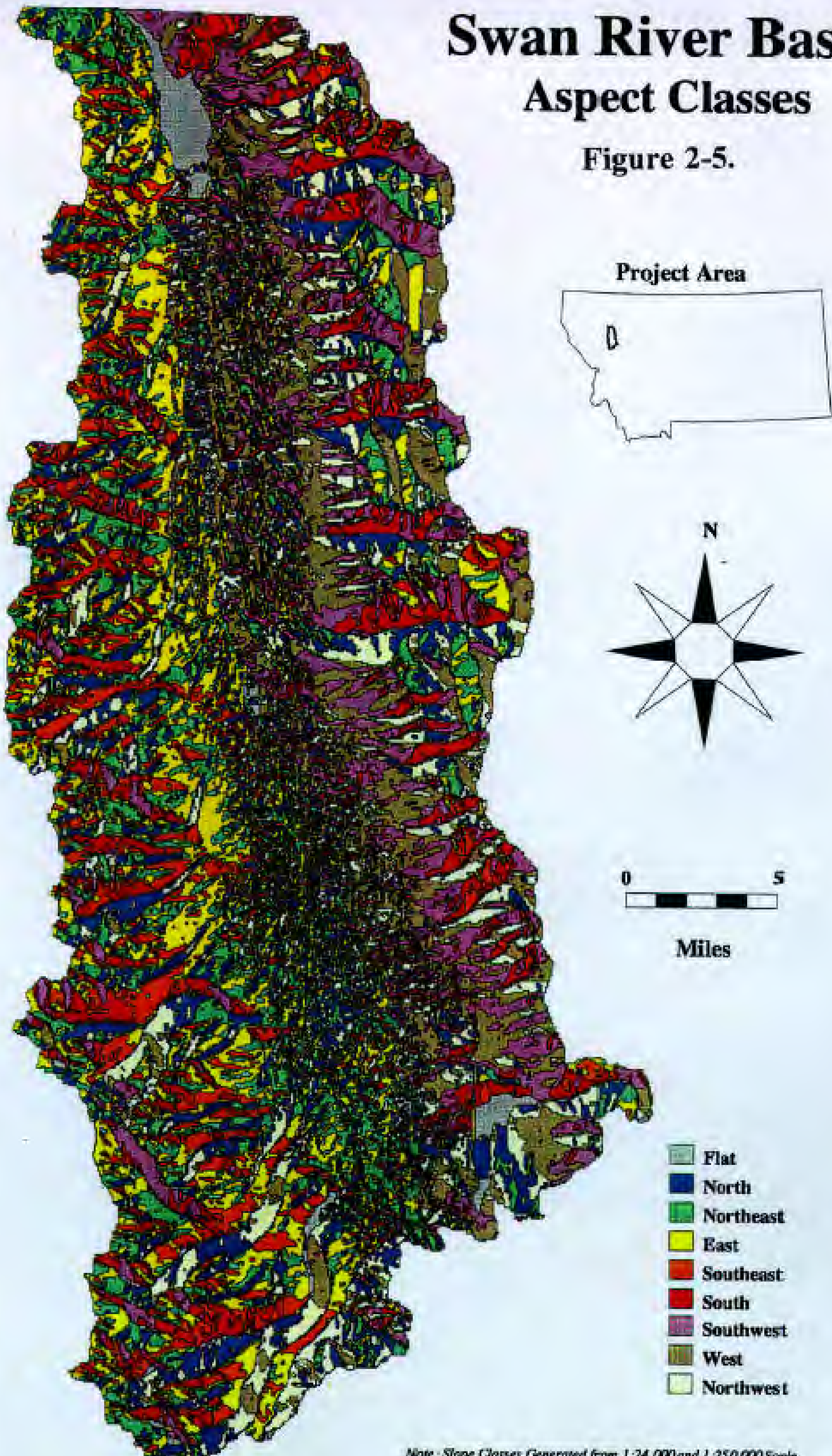
# Swan River Basin
## Slope Classes

Figure 2-4.

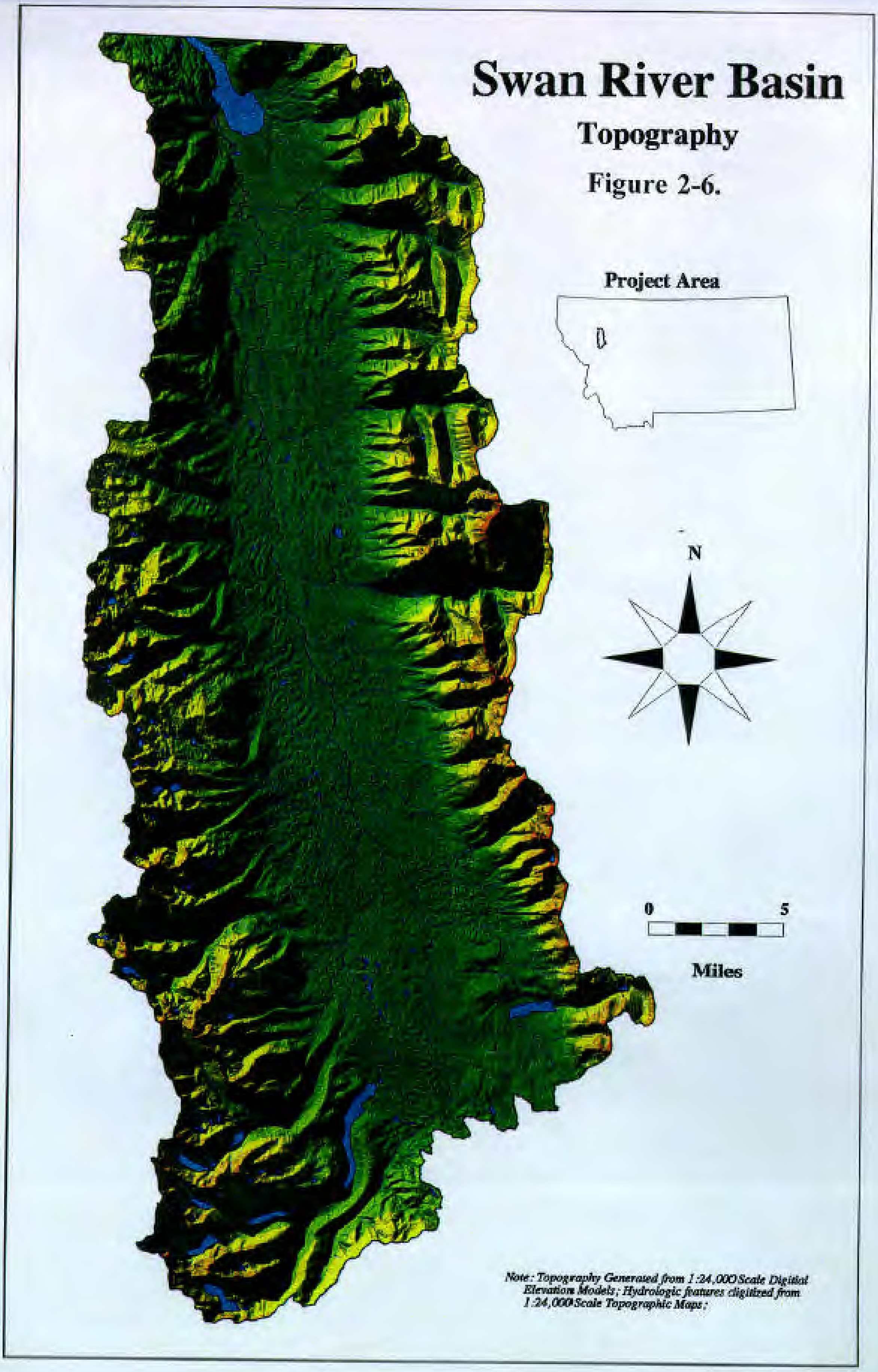


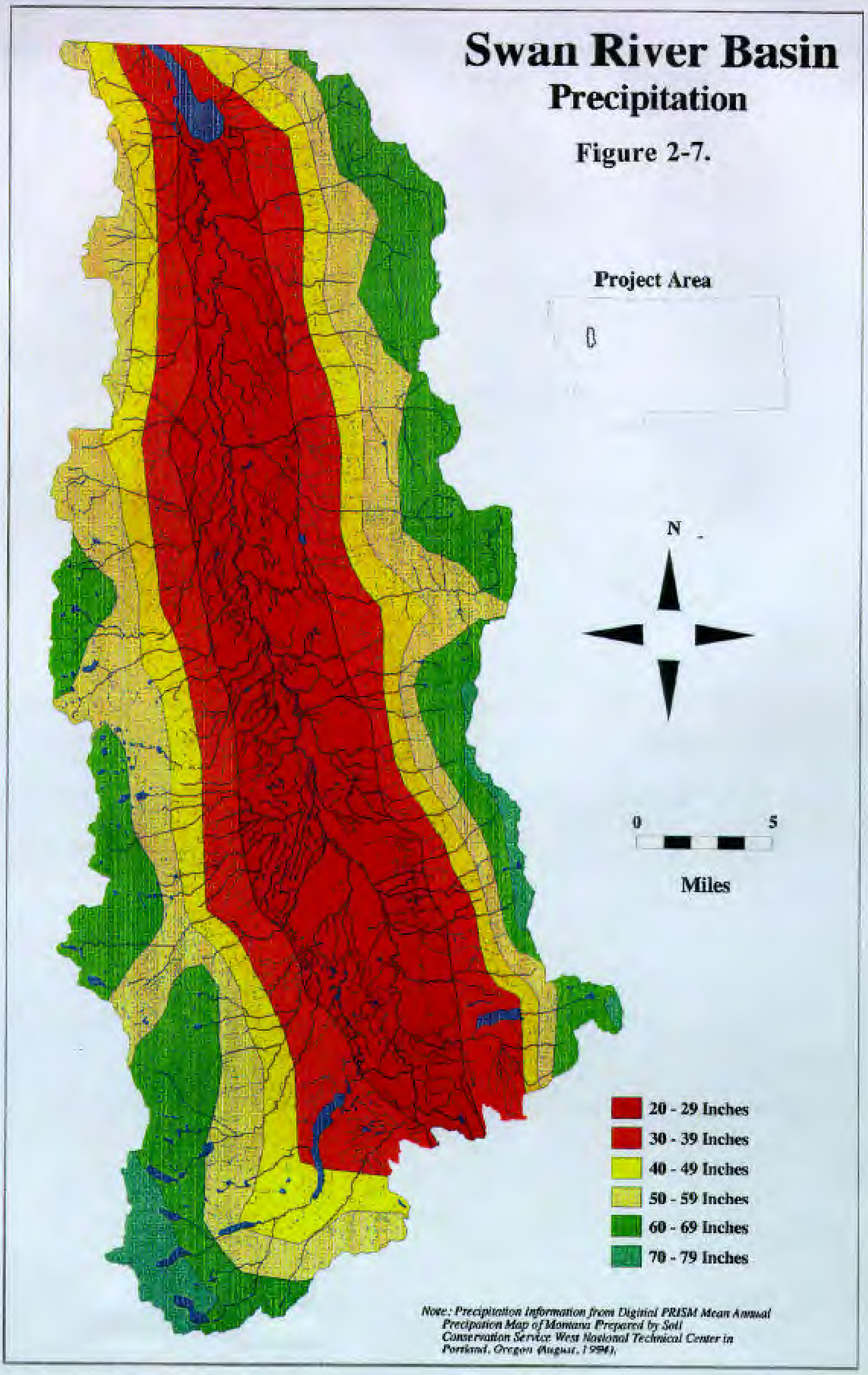

*Note: Slope Classes Generated from 1:24,000 and 1:250,000 Scale Digital Elevation Models, resampled to 90meter pixels.*

# Swan River Basin
## Aspect Classes
### Figure 2-5.




*Note: Slope Classes Generated from 1:24,000 and 1:250,000 Scale Digitial Elevation Models, resampled to 90meter pixels;*


Swan River Basin
Topography
Figure 2-6.
Project Area
N
0
5
Miles
Note: Topography Generated from 1:24,000 Scale Digital Elevation Models; Hydrologic features digitized from 1:24,000 Scale Topographic Maps;


Swan River Basin
Precipitation
Figure 2-7.
Project Area
N
0
5
Miles
20 - 29 Inches
30 - 39 Inches
40 - 49 Inches
50 - 59 Inches
60 - 69 Inches
70 - 79 Inches
Note: Precipitation Information from Digital PRISM Mean Annual Precipation Map of Montana Prepared by Soil Conservation Service West National Technical Center in Portland, Oregon (August, 1994).

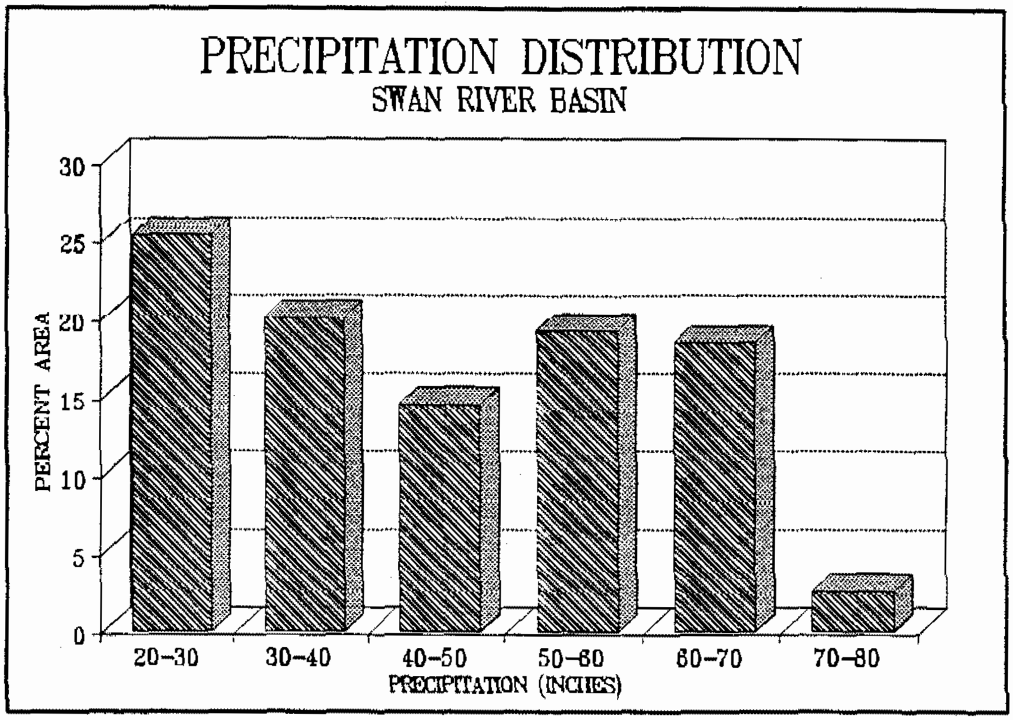



**Figure 2-8. Distribution of precipitation classes.**

The stream courses marked on Figure 2-1 are from the 1:24,000 scale quads. The upstream and downstream elevations of stream reaches were estimated from 1:24,000 scale DEMs. Grade was calculated as:

$$((E_u - E_d)/L) * 100$$

where: $E_u$ = Upstream elevation of reach
$E_d$ = Downstream elevation of reach
L = Length of reach

A stream order based on Strahler (1957) was assigned to each reach. The headwater tributaries marked on 1:24,000 scale are Order 1. The convergence of two Order 1 streams makes an Order 2 stream. The convergence of two Order 2 streams makes an Order 3; etc. At Swan Lake, the Swan River is Order 6. Streamflow regime (intermittent versus perennial) was also assigned to each reach, as marked on the 1:24,000 scale quads. Stream attributes are summarized in Table 2-1. About 46 percent of the total stream length is perennial with an average gradient of 7.9 percent. Intermittent streams are much steeper with an average grade of 18.3 percent. Also included in Swan River basin are about 554 lakes and ponds with a total area of 7,656 acres and 311 linear miles of shoreline.

Table 2-1. Stream attribute summary[1].

| ORDER | -----INTERMITTENT----- | | | ------PERENNIAL------ | | | --------TOTAL-------- | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Length (mi) | Grade (%) | N | Length (mi) | Grade (%) | N | Length (mi) | Grade (%) |
| 1 | 839 | 580.0 | 20.0 | 140 | 109.0 | 15.9 | 979 | 689.0 | 19.3 |
| 2 | 186 | 78.9 | 10.2 | 261 | 199.8 | 9.6 | 447 | 278.7 | 9.8 |
| 3 | 25 | 12.5 | 5.9 | 200 | 126.6 | 5.8 | 225 | 139.0 | 5.8 |
| 4 | 4 | 1.2 | 3.3 | 104 | 75.1 | 2.0 | 108 | 76.3 | 2.0 |
| 5 | 1 | 0.4 | 1.3 | 41 | 18.5 | 0.8 | 42 | 18.9 | 0.8 |
| 6 | 16 | 7.8 | 0.5 | 77 | 46.9 | 0.4 | 93 | 54.6 | 0.4 |
| TOTAL | 1071 | 680.7 | 18.3 | 823 | 575.9 | 7.9 | 1894 | 1256.6 | 13.6 |

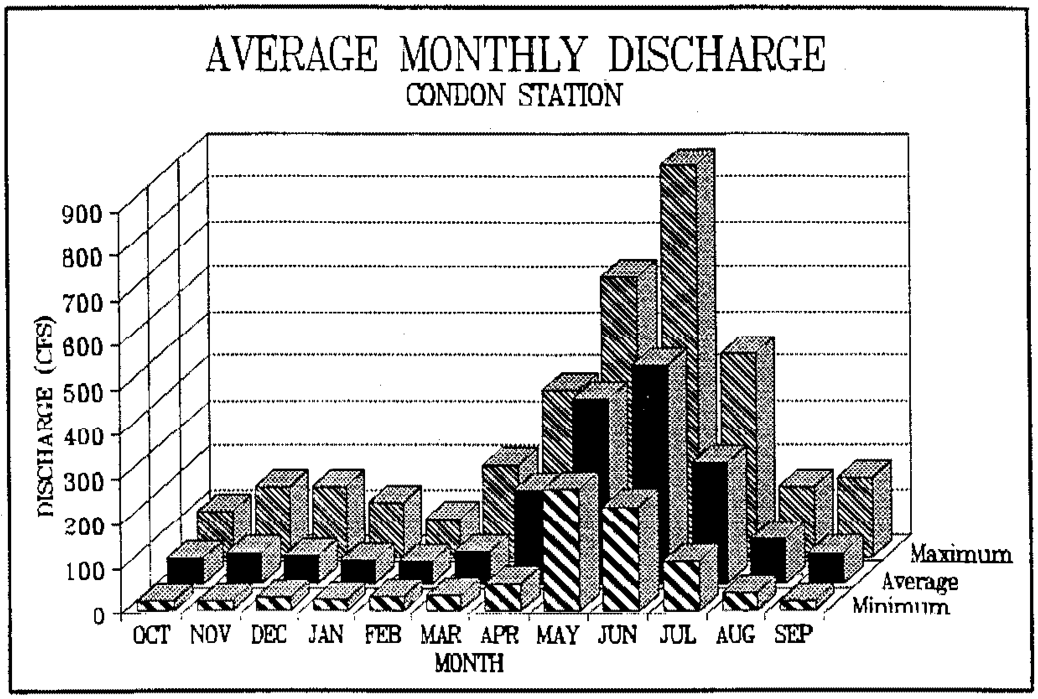
[1] data compiled from 1:24,000 scale quads and 1:24,000 scale DEMs.

Stream gaging stations are monitored by USGS on the Swan River at Condon (20 year period of record from 1973 to 1992), located in the upper part of the Swan River Valley and at Big Fork (72 year period of record from 1922 to 1993), just above Flathead Lake. Average monthly flows (minimum, mean, and maximum) are compared for each gaging station in Figure 2-9. Average annual yields at Big Fork are 841,941 acre-feet. About 640,643 acre-feet (43 percent of average annual precipitation) is lost to evapotranspiration and percolation to deep groundwater.

Lands are managed by the U.S. Forest Service, Plum Creek and other private owners (see Figure 2-10 and Table 2-2).

Table 2-2. Land ownership summary.

| OWNERSHIP | AREA | | | STREAM LENGTH | | | |
|---|---|---|---|---|---|---|---|
| | | | | Perennial | | Intermittent | |
| | N | (ac) | (%) | (miles) | (%) | (miles) | (%) |
| Forest Service | 81 | 256152 | 62.7 | 303.5 | 52.7 | 421.9 | 62.0 |
| Plum Creek | 123 | 82718 | 20.2 | 137.7 | 23.9 | 145.6 | 21.4 |
| Private | 48 | 27874 | 6.8 | 72.6 | 12.6 | 47.9 | 7.0 |
| State | 29 | 39624 | 9.7 | 55.7 | 9.7 | 61.9 | 9.1 |
| Wildlife Refuge | 1 | 2261 | 0.6 | 6.4 | 1.1 | 3.4 | 0.5 |
| TOTAL | | 408630 | 100 | 575.9 | 100.0 | 680.7 | 100.0 |



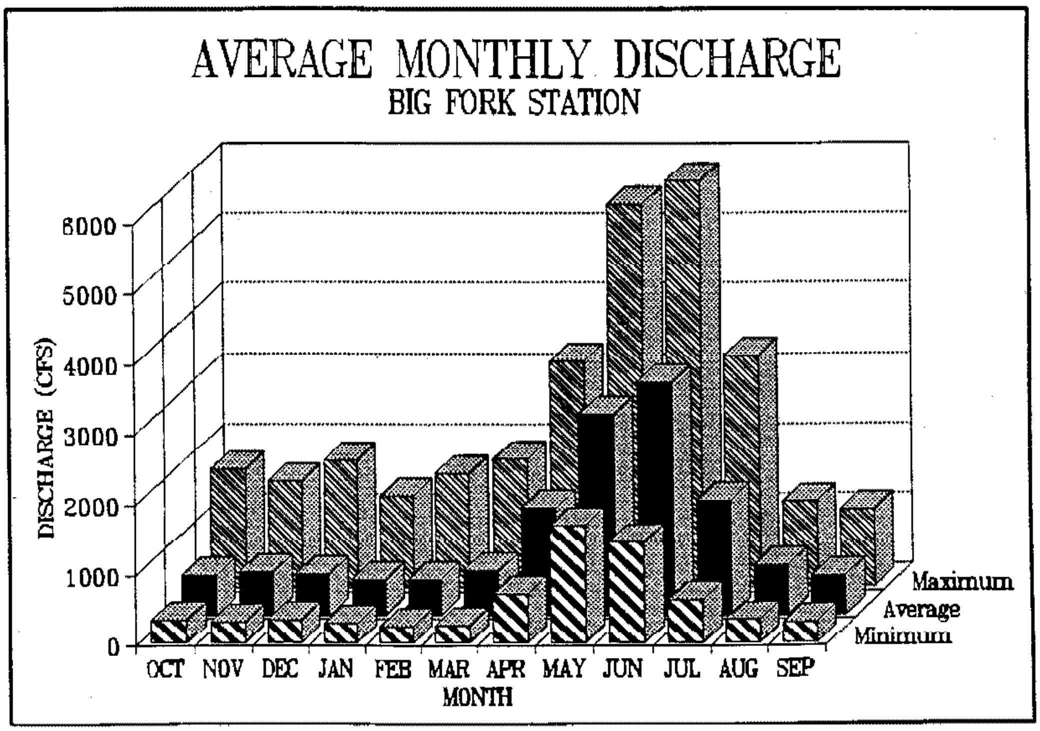
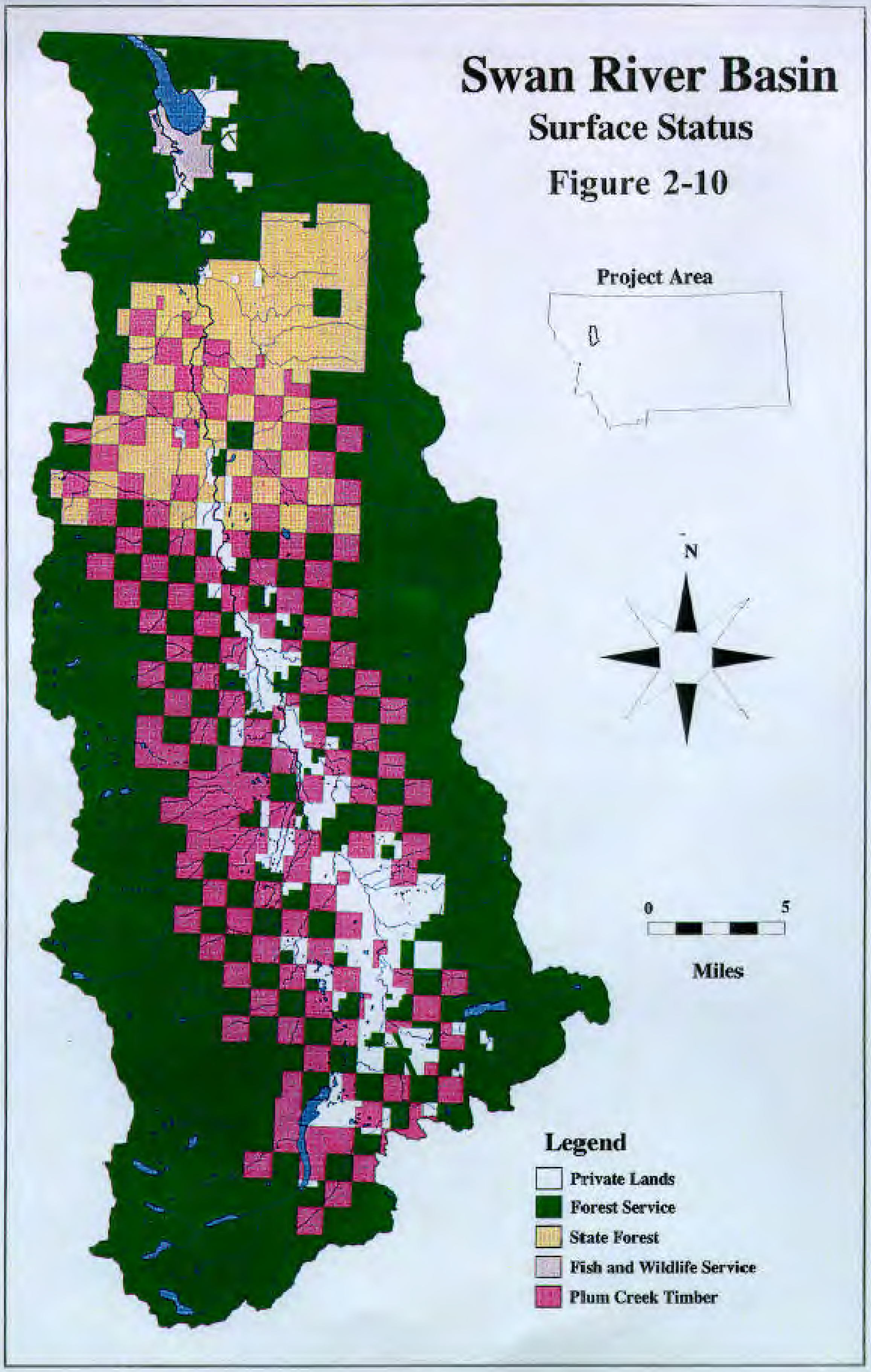




**Figure 2-9. Average monthly flows, Swan River.**



Swan River Basin
Surface Status
Figure 2-10
Project Area
N
0
5
Miles
Legend
Private Lands
Forest Service
State Forest
Fish and Wildlife Service
Plum Creek Timber

## 3.0 CLASSIFICATION AND INVENTORY

The classification is hierarchical and consists of seven levels (Table 3.0-1). Classes of the top levels are based on regional criteria from small-scale maps and general information sources. Classes of the lower levels are based on information from large-scale maps and on more quantitative, site-specific criteria. The intent of the classification is to identify landscapes that evolved in response to distinctive processes that have resulted in distinctive structure, function and ecological potential. Landscapes have evolved in response to the interaction of climatic, geologic, geomorphic, hydrologic and biotic processes. From a "high-perspective" (e.g., 1:2,500,000 scale), differences in regional climate and geologic structure are apparent between the Columbia Plateau and the Northern Rocky Mountain Ecoregions. When viewed from a "mid-perspective" (e.g., 1:100,000 scale), differences in geologic districts (e.g., granite versus basalt) and landtype associations (e.g., glacial versus fluvial) become discernable, corresponding with landscapes of more distinctive structure, form and ecological potential. From a "low-perspective" (e.g., 1:24,000 scale) areas of still more distinctive form and position relative to environmental gradients are used to discern landtypes, habitat types and riparian landtypes.

Table 3.0-1. Hierarchical levels of classification.

| | |
|---|---|
| Ecoregion | Areas of distinctive land-surface form, potential natural vegetation, land-use and soil (Omernik 1987); identified from small scale (1:2,500,000) maps, they may contain few to many geologic districts. |
| Geologic District | Areas of distinctive parent materials that differ from surrounding districts in structure, degree of weathering, dominant size-fractions of weathering products and water- handling characteristics (e.g., porosity, permeability, runoff potential); includes both uplands and bottom-lands; it may contain one to several landtype associations. |
| Subsection | A division of a geologic district, distinguished by geologic structure for the Swan River basin. |
| Landtype Association | A hierarchical level of the Land System Inventory applied by the USDA Forest Service. Sirucek (1995) reported that landtype associations were mapped for the Flathead River basin by grouping landtypes identified by Martinson and Basko (1983) with distinctive erosion potential and sediment delivery efficiency. |
| Landtype | A hierarchical level of the Land System Inventory applied by the USDA Forest Service. Martinson and Basko (1983) distinguished landtypes by landform, patterns of soil and climax plant community. |
| Habitat Type | Forested habitat types of Montana were described by Pfister et al. (1977) and identify climax plant communities, usually identified at a scale similar to landtypes. |
| Riparian Landtype | Riparian/wetland habitats that were described and mapped by the Flathead National Forest (Sirucek and Bachurski 1995). Riparian landtypes were distinguished by valley gradient, dominant stream substrate and dominant overstory vegetation. |

Hierarchical levels may be thought of as layers of information. The top layers (e.g., ecoregion) consist of large polygons that are described in terms of general criteria. At successively lower levels, polygons are divided into smaller areas that are described in terms of more refined criteria, from which increasingly specific interpretations can be drawn. The classification is applied from the top level down, thus accounting for variance at the broadest level possible. The various scales used in the classification allow interpretation and generalization at perspectives ranging from regional to more specific. More specific information for lower levels can also be integrated to support interpretations for higher levels.

## 3.1 Ecoregion

Ecoregion (Omernik 1987) is the broadest level of classification. Ecoregions are based on factors that cause regional variation in ecosystems or on factors that integrate the causes of regional variations. Principal factors used to identify ecoregions are land surface form, potential natural vegetation, land use and soils. Ecoregions have been used to identify streams of similar potential to facilitate impact assessments (Hughes et al. 1986; Rohm et al. 1987) and for identifying streams with similar biotic and physicochemical characteristics (Hughes et al. 1987; Whittier et al. 1988).

The diversity within ecoregions is not consistent. Some are similar throughout; others encompass great variation. The range in elevation and topographic diversity are relative measures of the diversity within an ecoregion. The scale at which the diversity is apparent also varies. In the High Desert/Snake River Plain, comprised mainly of rather flat lava, the variance occurs over large areas and can be shown on small (e.g., 1:1,000,000) scale maps. In the Northern Basin and Range Ecoregion, with numerous high ranges separated by basins, the diversity occurs within comparatively small areas and must be indicated on larger (e.g., 1:500,000) scale maps. More inclusive analyses, at larger scales, are necessary to develop quantitative understanding of the variance within and between ecoregions (Omernik 1987).

The Swan River basin is within the Northern Rocky Mountain Ecoregion (Figure 3.1-1). This ecoregion is characterized as high mountains with cedar/hemlock/pine, western spruce/fir, grand fir/Douglas-fir and Douglas-fir potential natural vegetation. Major land uses include harvest of forest and woodland products. Soils are described as Eastern interior mountain soils with acidic rock types, mostly Inceptisols.

# Ecoregions of the Western United States
## (Omernik, 1993)

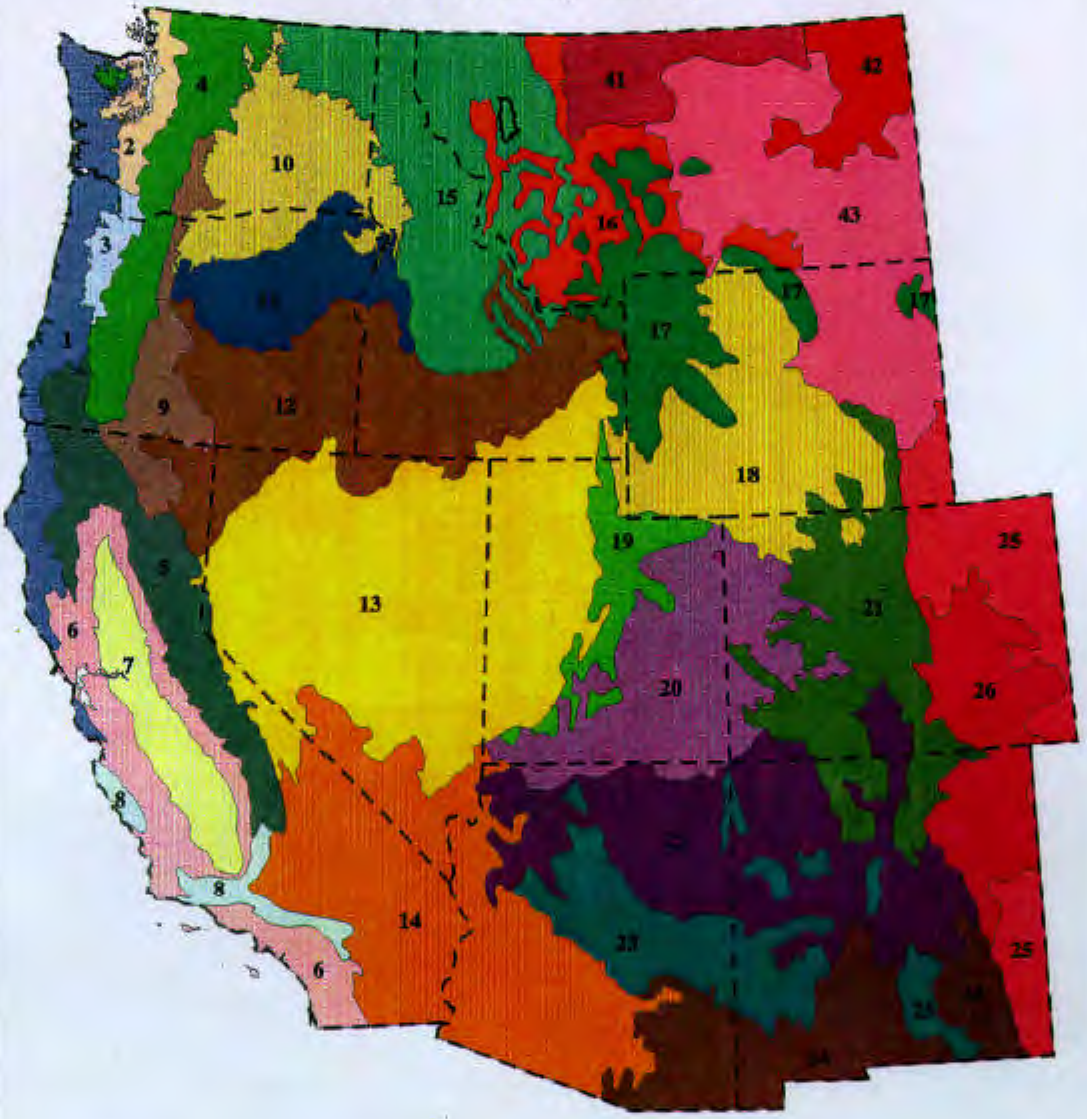
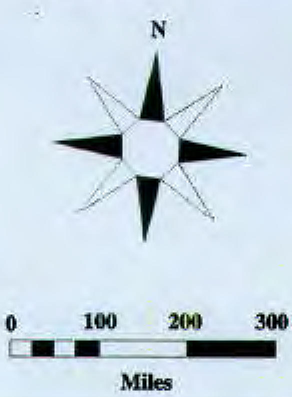



**Figure 3.1-1.**



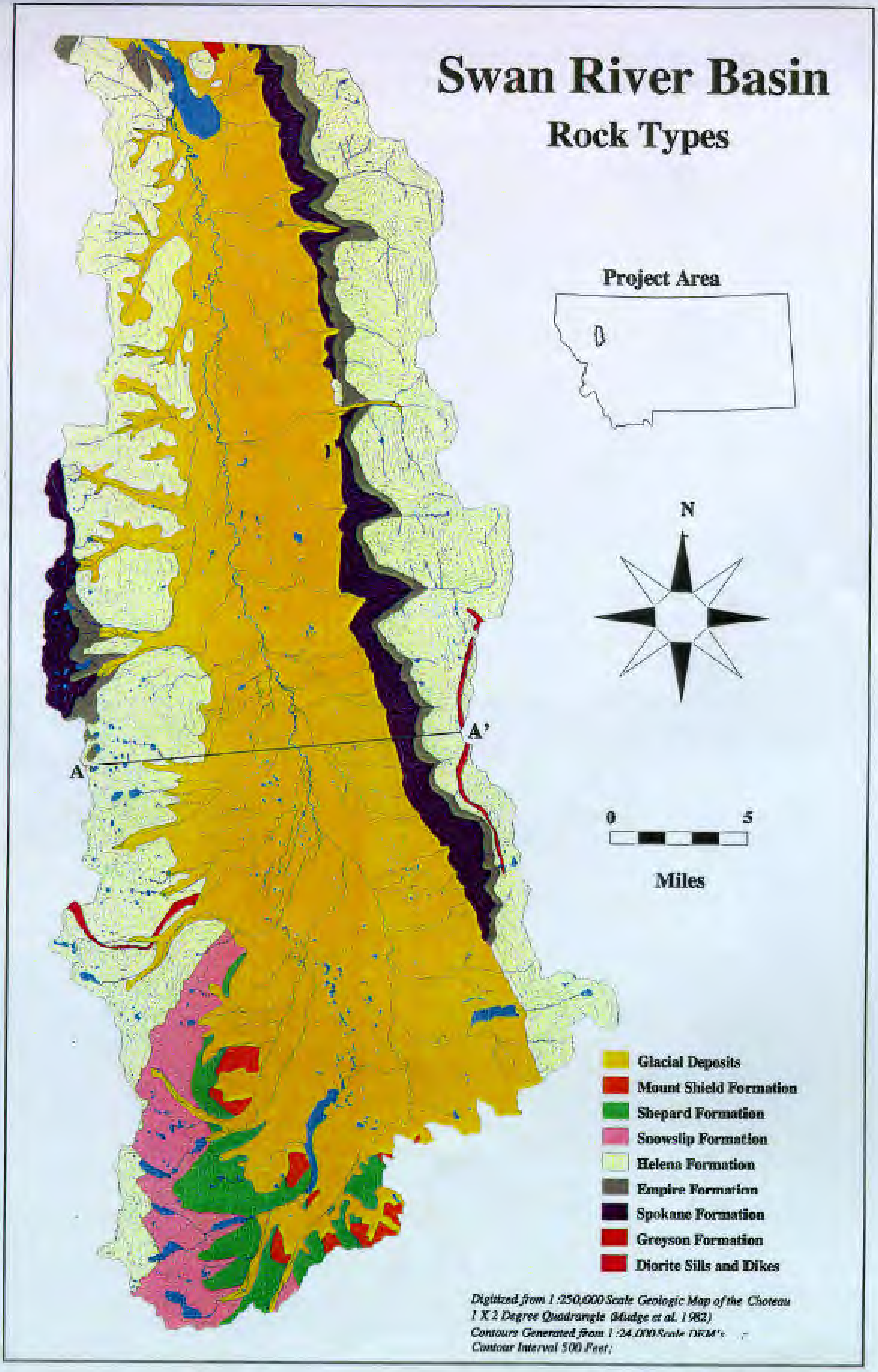

- 1 Coast Range
- 2 Puget Lowlands
- 3 Willamete Valley
- 4 Cascades
- 5 Sierra Nevada
- 6 Southern and Central California Plains and Foothills
- 7 Central California Valley
- 8 Southern California Mountains
- 9 Eastern Cascades Slopes and Foothills
- 10 Columbia Plateau
- 11 Blue Mountains
- 12 Snake River Basin/High Desert
- 13 Northern Basin and Range
- 14 Southern Basin and Range
- 15 Nothern Rockies
- 16 Montana Valley and Foothill Praries
- 17 Middle Rockies
- 18 Wyoming Basin
- 19 Wasatch and Uinta Mountains
- 20 Colorado Plateaus
- 21 Southern Rockies
- 22 Arizona/New Mexico Plateau
- 23 Arizona/New Mexico Mountains
- 24 Southern Deserts
- 25 Western High Plains
- 26 Southwestern Tablelands
- 41 Northern Montana Glaciated Plains
- 42 Northwestern Glaciated Plains
- 43 Northwestern Great Plains

## 3.2 Geologic Districts

Geologic districts are areas of distinctive rock types or parent materials. They often correspond with distinctive assemblages of upland potential plant communities and areas of distinctive hydrologic character. The hydrologic character of landscapes is also influenced by the degree to which parent material has been weathered (producing sediment) and the water-handling characteristics (e.g., porosity, retention, etc.) of the parent rock and its weathering products. The hydrologic character of hard rock (e.g., quartzite) that weathers slowly to mixed sizes (e.g., silt, sand, gravel and cobble) is different from that of soft rock (e.g., tuff) that weathers rapidly to fine-textured sediment.

Geologic districts may be 10's to many 100's of square miles in size. They are identified at about the same scale as subsections identified in U.S. Forest Service Land System Inventories (Wertz and Arnold 1972). Geologic districts do not change (to other types) in response to cultural practices. They include both uplands and bottom-lands.

Swan Valley was created in response to block faulting, with the upthrust fault scarp forming the steep Swan Range on the east side of the valley and the dip slope forming the Mission Range along the west side of the valley. Surficial rock types identified in Figure 3.2-1 and 3.2-1b are from a 1:250,000 scale Geologic Map of the Choteau Quadrangle (Mudge et al. 1982). A legend of rock types is presented as Table 3.2-1. The areas of surficial rock types in Swan River basin are listed in Table 3.2-2. Because of the universal similarity of parent materials, a single geologic district was identified for the entire basin - the Precambrian Sedimentary geologic district.


Swan River Basin
Rock Types
Project Area
N
A
A'
0
5
Miles
Glacial Deposits
Mount Shield Formation
Shepard Formation
Snowslip Formation
Helena Formation
Empire Formation
Spokane Formation
Greyson Formation
Diorite Sills and Dikes
Digitized from 1:250,000 Scale Geologic Map of the Choteau
1 X 2 Degree Quadrangle (Mudge et al. 1982)
Contours Generated from 1:24,000 Scale DEM's
Contour Interval 500 Feet;

# Geologic Cross-section of Swan River Valley

## Figure 3.2-1b.

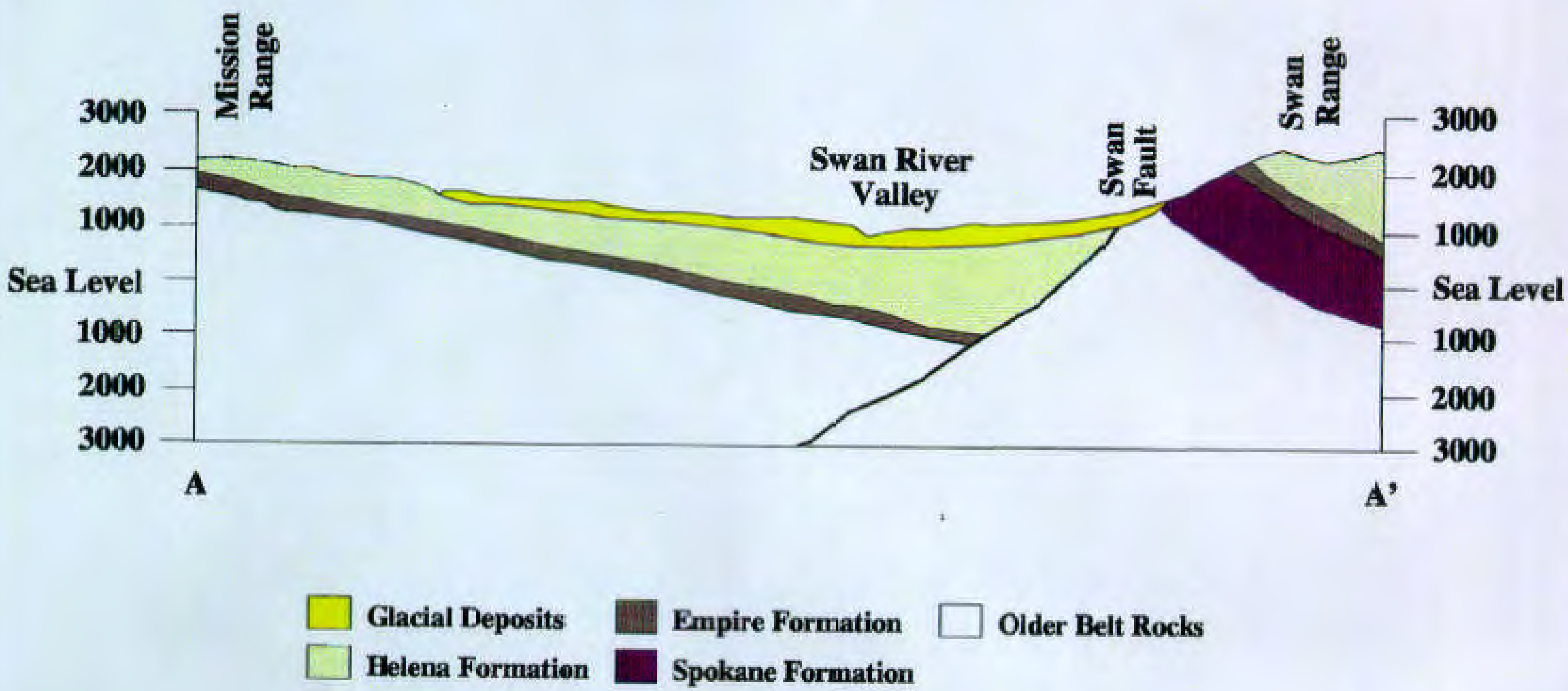


Table 3.2-1. Rock type legend, Swan River basin (Mudge et al. 1982).

| ERA<br>Period | SYMBOL | NAME | DESCRIPTION |
|---|---|---|---|
| RECENT | | | |
| Holocene/Pleistocene | Qg | Glacial deposits | Drift, heterogeneous mixture of rock fragments in silty clay matrix. Forms hummocky topography. Includes deposits from alpine and continental glaciations; as much as 100 meters thick in Swan River valley where thickness of mostly sand and gravel deposits exceeds 300 meters. |
| PRECAMBRIAN | | | |
| Proterozoic | Yms | Mount Shields Form. | Mostly bright reddish brown, thinly laminated, micaceous siltite, argillite, and thin-to-thick bedded quartzite. A grayish-green siltite unit with local interbedded dark-gray fissile shale is widespread in the upper part of the formation. The quartzite beds are mostly fine to medium grained and more common in the middle and lower pats of the formation. |
| Proterozoic | Ysh | Shepard Formation | Consists mostly of greenish-gray to grayish-yellow micaceous siltite and some silty limestone and argillite. Beds of maroon siltite and argillite widespread in the middle part and locally in the upper part. |
| Proterozoic | Ysn | Snowslip Formation | Consists of pale-red to reddish-brown beds and interbedded greenish-gray beds of argillite and siltite with some thin beds of very fine to fine-grained quartzite. |
| Proterozoic | Yh | Helena Formation | In most places the Helena is divisible into three units. The upper unit consists of beds of limestone interbedded with dolomite, siltite, and argillite. The middle unit, comprising most of the formation, consists of light to medium-gray, thin to thick-bedded silty limestone, dolomite and calcitic dolomite that weathers to a yellowish gray to grayish orange. The lower unit consists mostly of calcareous or dolomitic siltite with some beds of dolomite and quartzite. |

Table 3.2-1. Continued.

| ERA<br>Period | SYMBOL | NAME | DESCRIPTION |
|---|---|---|---|
| PRECAMBRIAN (CONTINUED) | | | |
| Proterozoic | Ye | Empire Formation | A transitional unit between the Helena and Spokane Formations. Mostly greenish gray argillite and siltite with interbeds of quartzite, dolomite, and locally stromatolitic and oolitic carbonate rock. |
| Proterozoic | Ys | Spokane Formation | Mostly pale-purplish-red and grayish-red siltite and argillite interbedded with lithologically similarly greenish-gray beds. |
| Proterozoic | Yg | Greyson Formation | The oldest unit exposed in and near the map area. Consists of light-gray to greenish-gray, thinly bedded siltite with some quartzite, grading down into dark gray, greenish-gray, very thinly laminated argillite and siltite in the lower part. |
| Proterozoic | Zd | Diorite sills & dikes | Mostly diorite and quartz diorite, locally minor diorite-grabbro and monsonite. Dark gray, weathers grayish brown. |

Table 3.2-2. Areas of surficial rock types. Swan River basin.

| SYMBOL | NAME | N | ACRES | PERCENT |
|---|---|---|---|---|
| Qg | Glacial deposits | 1 | 201150 | 49.2 |
| Ye | Empire Formation | 13 | 13193 | 3.2 |
| Yg | Grayson Formation | 1 | 260 | 0.1 |
| Yh | Helena Formation | 16 | 134587 | 32.9 |
| Yms | Mount Shields Formation | 10 | 3371 | 0.8 |
| Ys | Spokane Formation | 7 | 23028 | 5.6 |
| Ysh | Shepard Formation | 11 | 12652 | 3.1 |
| Ysn | Snowslip Formation | 2 | 18711 | 4.6 |
| Zd | Diorite sills and dikes | 5 | 1680 | 0.4 |
| TOTAL | | 66 | 408630 | 100.0 |

Both the Mission Mountains on the west and the Swan Mountains on the east are Precambrian sedimentary formations. Dominant parent materials are siltite, argillite, limestone and quartzite of the Mount Shields, Shephard, Helena and Empire Formations. Nearly 50 percent of Swan River basin is mantled by secondary glacial deposits, most derived from these same dominant parent materials. These similar parent materials were combined as the Precambrian Sedimentary geologic district for the Swan River basin.

### 3.3 Subsections

Subsections were defined to distinguish parts of the geologic district with distinctive geologic structure and geomorphology. The Swan Valley was created in response to block faulting, with the upthrust fault scarp along the east side of the valley (Swan Range) and the dip slope along the west side of the valley (Mission Range). Nearly 50 percent of Swan River basin is mantled by secondary glacial deposits.

During the Bull Lake ice age that peaked roughly 100,000 years ago, the northern end of the Mission Range split the Cordilleran ice sheet that moved south from British Columbia, sending one lobe of the glacier through the Swan Valley (Alt and Hyndman 1986). That branch of the Cordilleran ice sheet plowed through the Swan Valley and continued south into the Clearwater River basin, which drains south. This glacier left moraines that form many of the hills just south of Clearwater Junction. Ice advanced through the Swan Valley again to the lower end of Salmon Lake during the Pinedale ice age, which reached a maximum about 15,000 years ago.

After the mass of ice that filled Swan Valley was gone, large glaciers repeatedly plowed down the valleys of the Mission and Swan Ranges. The later advances of these alpine glaciers left high moraines that now enclose Holland and Lindbergh Lakes, as well as others at the mouths of canyons in the Mission and Swan Ranges. Johns (1970) and Witkind (1977) suggest that the alpine glaciers may have merged to form a very large ice sheet in Swan Valley that flowed north to meet the Cordilleran ice sheet near Big Fork. These authors speculate that giant glacial grooves cut in the northern tip of the Mission Range and further south along the east flank of the Mission Mountains and the west flank of the Swan Range were scoured by the south flowing Cordilleran ice sheet and/or the north flowing Swan Valley glacier.

Three subsections were identified in the Swan River basin (Figure 3.3-1). The areas of subsections are listed in Table 3.3-1. Stream attributes for subsections are listed in Table 3.3-2. Stream gradients are compared for different subsections in Figure 3.3-2 and drainage density (linear miles stream/square miles) are compared in Figure 3.3-3. Descriptions of subsections follow.

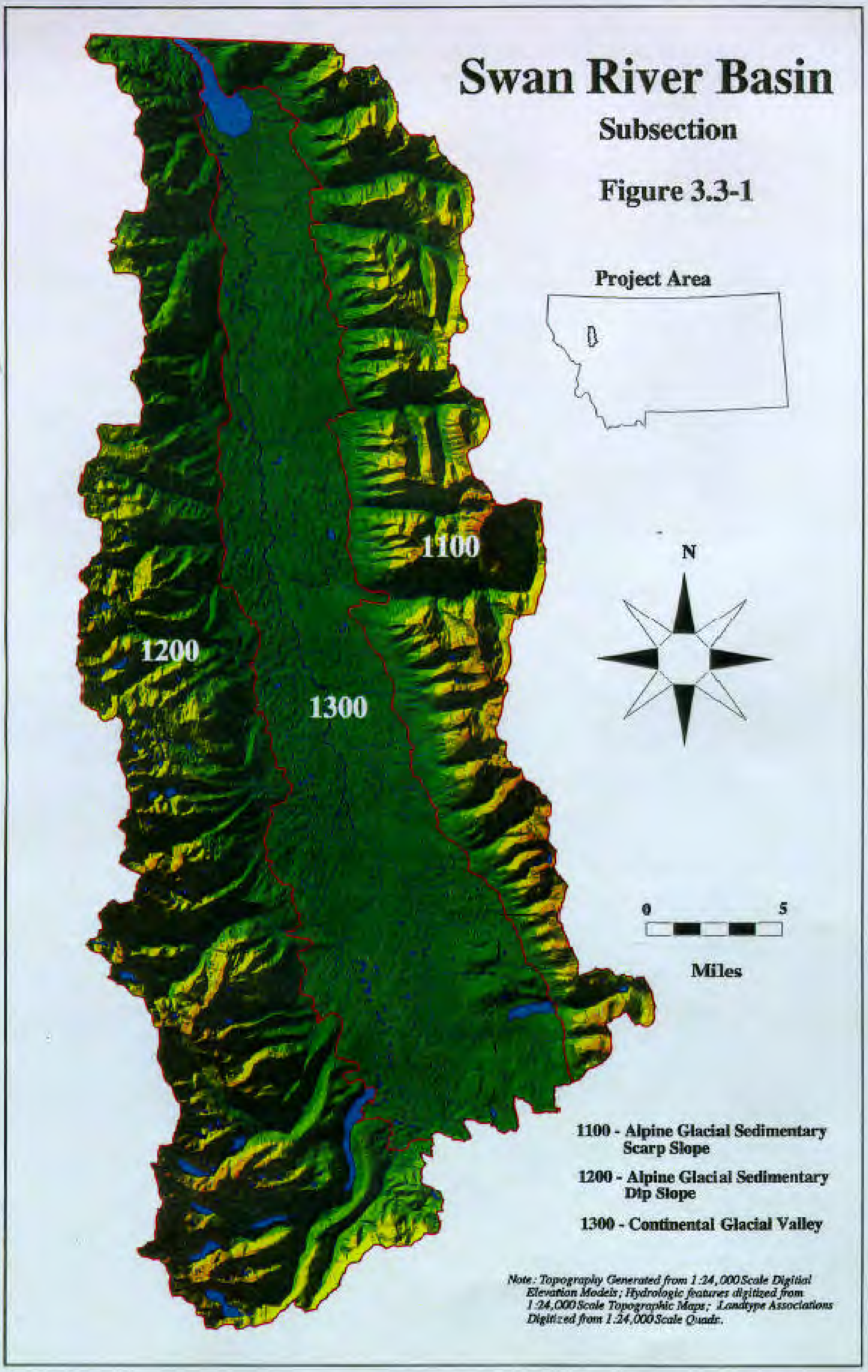
Table 3.3-1. Subsections, Swan River basin.

| CODE | Subsection | AREA (acres) | AREA (%) |
|---|---|---|---|
| (1100) | Alpine Glacial Sedimentary Scarp Slope | 109,948 | 26.9 |
| (1200) | Alpine Glacial Sedimentary Dip Slope | 166,140 | 40.7 |
| (1300) | Continental Glacial Sedimentary Valley | 132,542 | 32.4 |
| | TOTAL | 408,630 | 100.0 |

Table 3.3-2. Stream attributes for subsections[1].

| SUBSECTION (CODE) Order | PERENNIAL Length (mi) | PERENNIAL Grade (%) | INTERMITTENT Length (mi) | INTERMITTENT Grade (%) | TOTAL Length (mi) | TOTAL Grade (%) |
|---|---|---|---|---|---|---|
| ALPINE GLACIAL SEDIMENTARY SCARP SLOPE (1100) | | | | | | |
| 1 | 34.1 | 24.7 | 191.5 | 33.4 | 225.6 | 32.1 |
| 2 | 49.5 | 18.5 | 10.2 | 25.6 | 59.7 | 19.7 |
| 3 | 29.3 | 9.0 | 0 | | 29.3 | 9.0 |
| 4 | 6.5 | 4.3 | 0 | | 6.5 | 4.3 |
| **TOTAL** | **119.4** | **17.1** | **201.8** | **33.0** | **321.2** | **27.1** |
| ALPINE GLACIAL SEDIMENTARY DIP SLOPE (1200) | | | | | | |
| 1 | 49.4 | 16.6 | 205.1 | 22.3 | 254.5 | 21.2 |
| 2 | 75.4 | 10.7 | 26.7 | 16.5 | 102.1 | 12.2 |
| 3 | 43.9 | 8.0 | 3.7 | 14.9 | 47.6 | 8.5 |
| 4 | 16.0 | 3.0 | | | 16.0 | 3.0 |
| **TOTAL** | **184.8** | **11.0** | **235.5** | **21.5** | **420.3** | **16.9** |
| CONTINENTAL GLACIAL SEDIMENTARY VALLEY (1300) | | | | | | |
| 1 | 24.9 | 2.7 | 183.3 | 3.0 | 208.2 | 3.0 |
| 2 | 71.7 | 2.7 | 41.9 | 2.4 | 113.6 | 2.6 |
| 3 | 57.1 | 2.3 | 8.7 | 2.1 | 65.8 | 2.2 |
| 4 | 52.5 | 1.4 | 1.2 | 3.3 | 53.7 | 1.5 |
| 5 | 18.4 | 0.7 | 0.4 | 1.3 | 18.9 | 0.8 |
| 6 | 46.8 | 0.4 | 7.8 | 0.5 | 54.6 | 0.4 |
| **TOTAL** | **271.5** | **1.8** | **243.3** | **2.8** | **514.7** | **2.3** |

[1] Stream attributes generated from 1:24,000 scale quads and 1:24,000 scale DEMs.


Swan River Basin
Subsection
Figure 3.3-1
Project Area
1100
1200
1300
N
0
5
Miles
1100 - Alpine Glacial Sedimentary Scarp Slope
1200 - Alpine Glacial Sedimentary Dip Slope
1300 - Continental Glacial Valley
Note: Topography Generated from 1:24,000 Scale Digitial Elevation Models; Hydrologic features digitized from 1:24,000 Scale Topographic Maps; Landtype Associations Digitized from 1:24,000 Scale Quads.

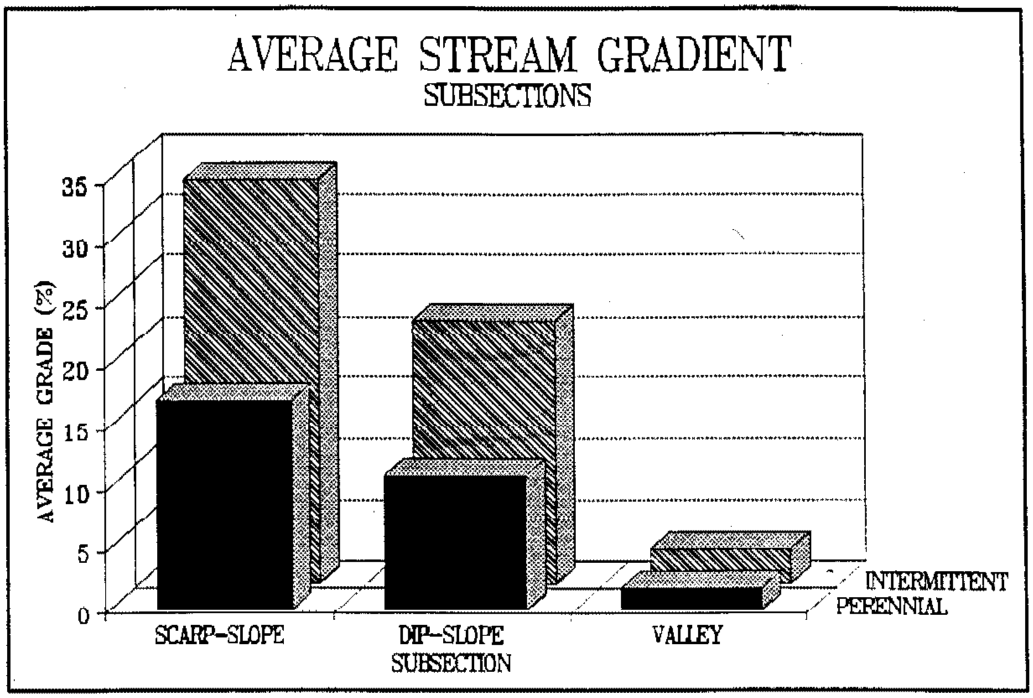



Figure 3.3-2. Stream gradients for subsections.

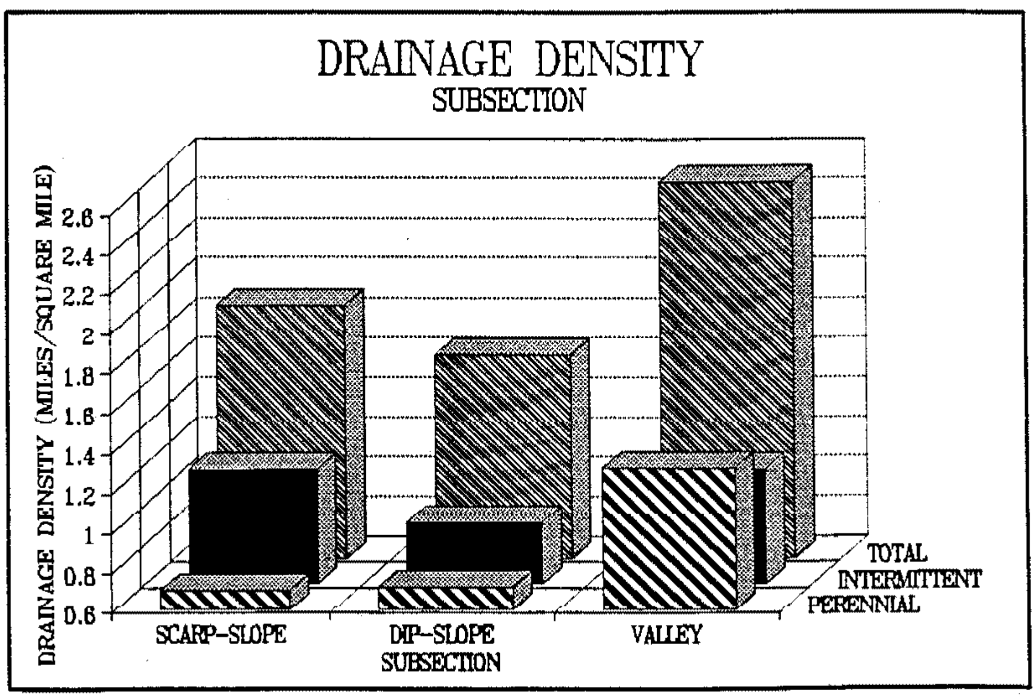



Figure 3.3-3. Drainage density for subsections.

### 3.3.1 Alpine Glacial Sedimentary Scarp Slope (1100)

As the name implies, this subsection is an up-thrust block (scarp slope) of sedimentary rock that has been scoured by alpine glaciation in the Swan Range. Also, the Cordilleran ice sheet covered lower elevations of this subsection. One polygon of this subsection comprises 109,949 (27 percent) of the Swan River basin.

The distributions of elevation, slope and aspect for the 1100 subsection are illustrated in Figure 3.3.1-1. Elevations are mostly from 4,000 to 8,000 feet. The dominant slopes are 22 to 100 percent. Given the general north-to-south orientated fault scarp, western aspects are prevelent.

This subsection includes 321 miles of Order 1 through 4 streams of which 119 miles (37 percent) is perennial. The weighted average stream grade for perennial streams is 17.1 percent for perennial streams and 33.0 percent for intermittent streams (see Table 3.3-2). This subsection includes 24 lakes with a total area of 186 acres.

This subsection is differentiated from the Continental Glacial Sedimentary Valley (1300) by higher elevations, steeper slopes and more rugged topography. It is different from the Alpine Glacial Sedimentary Dip Slope (1200) subsection in having a higher proportion of very steep (46 to 100%) slopes, steeper perennial and intermittent streams in narrower valley-bottoms and higher intermittent drainage density, in addition to having fewer lakes.

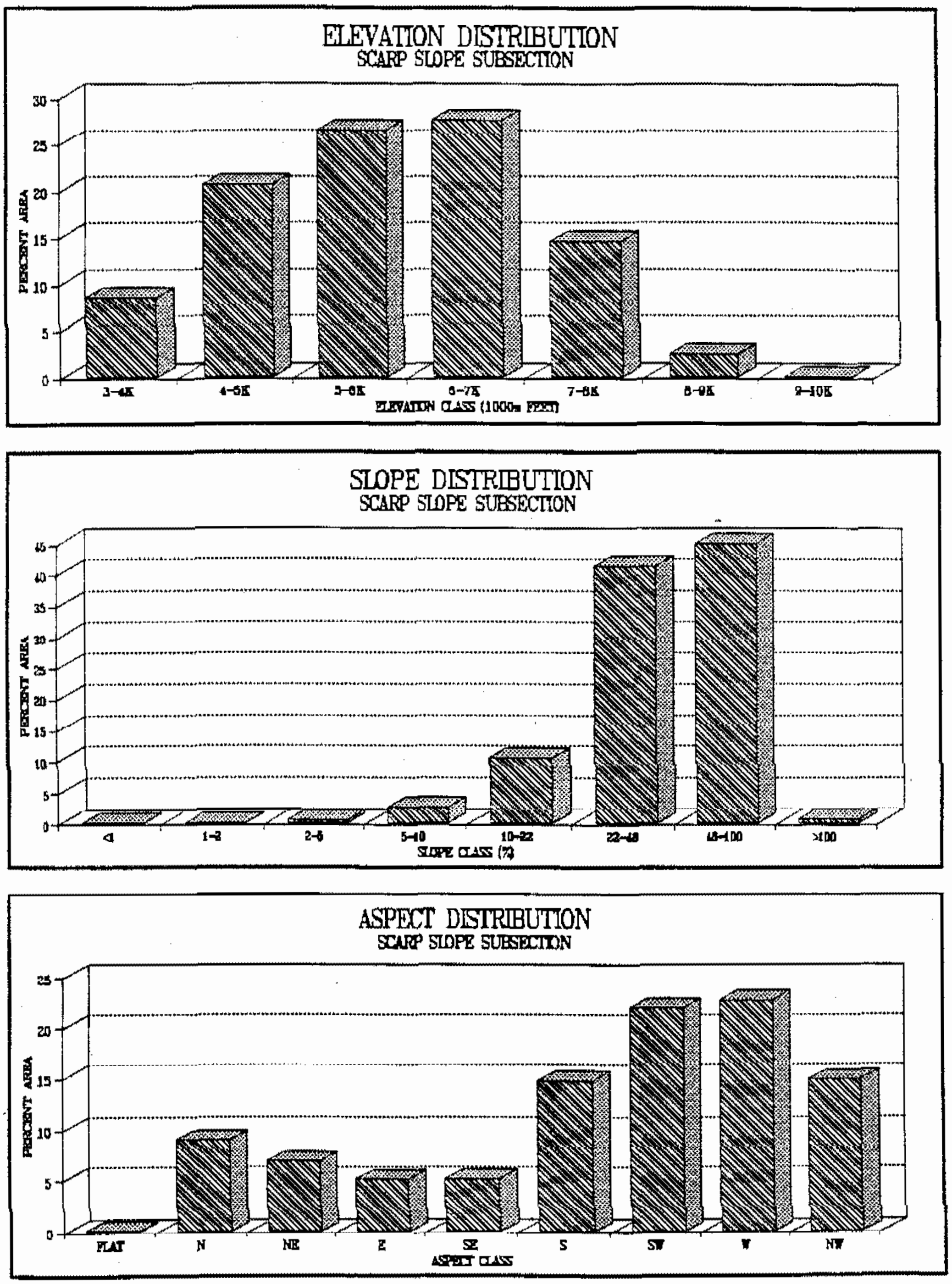



Figure 3.3.1-1. Elevation, slope and aspect distributions, scarp-slope subsection.

### 3.3.2 Alpine Glacial Sedimentary Dip Slope (1200)

This subsection is an down-thrust block (dip slope) of sedimentary rock that has been scoured by alpine glaciation in the Mission Range. Also, the Cordilleran ice sheet covered lower elevations of this subsection. It comprises 166,140 acres (41 percent) of the Swan River basin (Figure 3.3-1).

The distribution of elevation, slope and aspect is presented as Figure 3.3.2-1. Dominant elevations are similar to the 1100 subsection, from 4,000 to 8,000 feet. Dominant slopes are more gradual and range from 10 to 46 percent. Given the general north-to-south orientated fault scarp, eastern aspects are prevelent.

This subsection includes 420 miles of Order 1 through 4 streams of which 185 miles (44 percent) are perennial. The weighted average stream grade for perennial streams is 11.0 percent for perennial streams and 21.5 percent for intermittent streams (see Table 3.3-2). This subsection includes 243 lakes with a total area of 3,421 acres.

This subsection is differentiated from the Continental Glacial Sedimentary Valley (1300) in having dramatically higher elevations, greater slopes and more rugged topography. It is different from the Alpine Glacial Sedimentary Scarp Slope (1100) subsection in having a lower proportion of very steep (46 to 100%) slopes, streams with lower average gradient, wider valley-bottoms and more lakes.

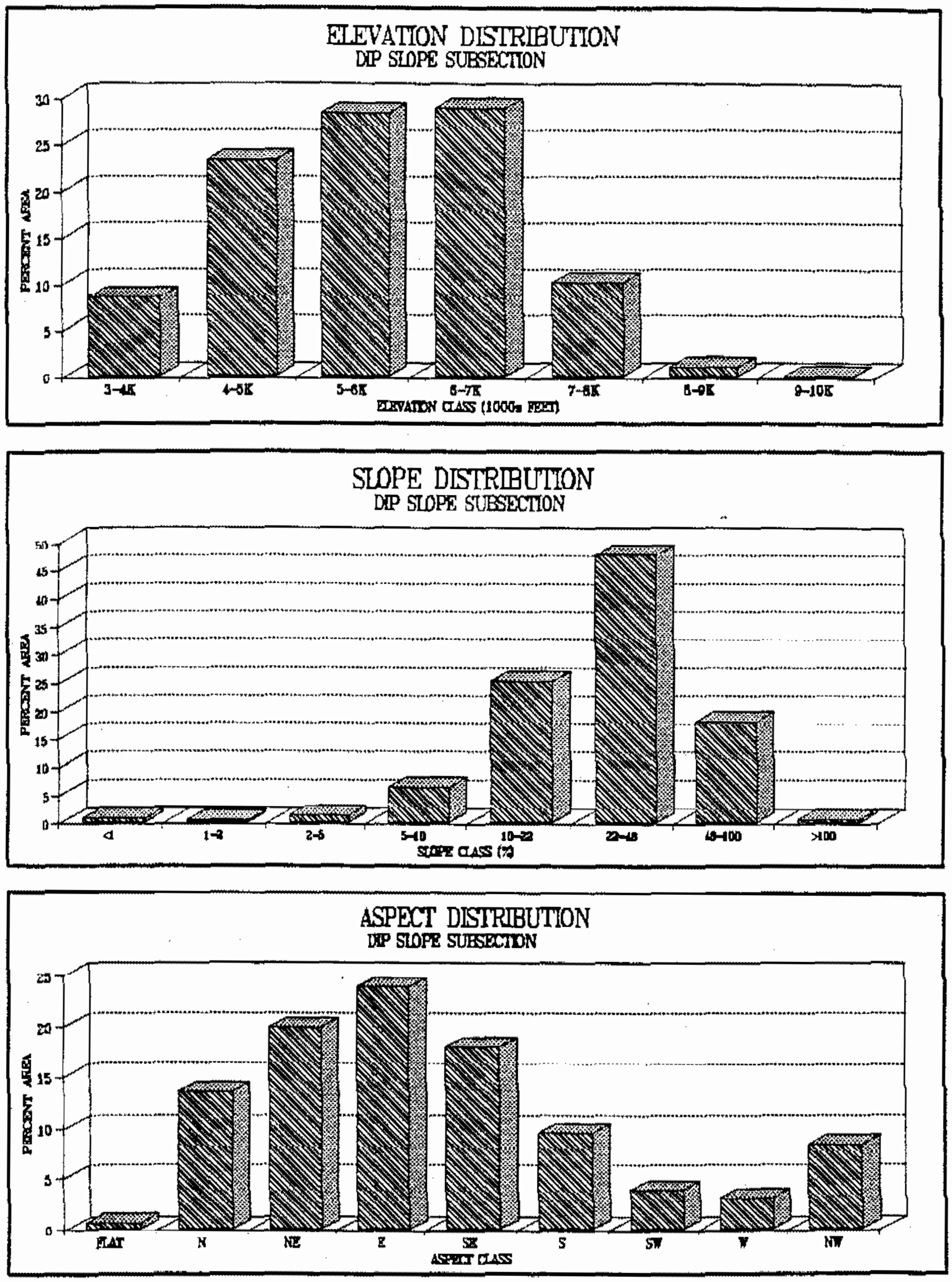



Figure 3.3.2-1. Elevation, slope and aspect distributions, dip-slope subsection.

### 3.3.3 Continental Glaciated Sedimentary Valley (1300)

This subsection is a block-fault valley underlain by sedimentary rock and mantled with thick deposits of glacial debris left by continental glaciers that moved generally south from British Columbia. This subsection comprises Swan Valley and is 132,542 acres or 32 percent of Swan River basin (Figure 3.3-1).

The distributions of elevation, slope and aspect are illustrated in Figure 3.3.3-1. Dominant elevations range from 3,000 to 5,000 feet. Dominant slopes are less than 22 percent. It is interesting to note that south and southeast aspects, the direction the continental glacier flowed, are minimized. Glacial deposits tend to be elongated ridges oriented parallel to the direction of glacial flow.

This subsection includes 515 miles of Order 1 through 6 streams of which 272 miles (53 percent) are perennial. The weighted average stream grade for perennial streams is 1.8 percent for perennial streams and 2.8 percent for intermittent streams (see Table 3.3-2). Excluding Swan Lake, this subsection includes 275 lakes with a total area of 1,483 acres. The portion of Swan Lake in the study area is 2,034 acres.

This subsection is differentiated from the Alpine Glacial Sedimentary Scarp Slope (1100) and the Alpine Glacial Sedimentary Dip Slope (1200) subsections in having dramatically lower elevations, more gentle slopes and topography, and lower gradient streams.

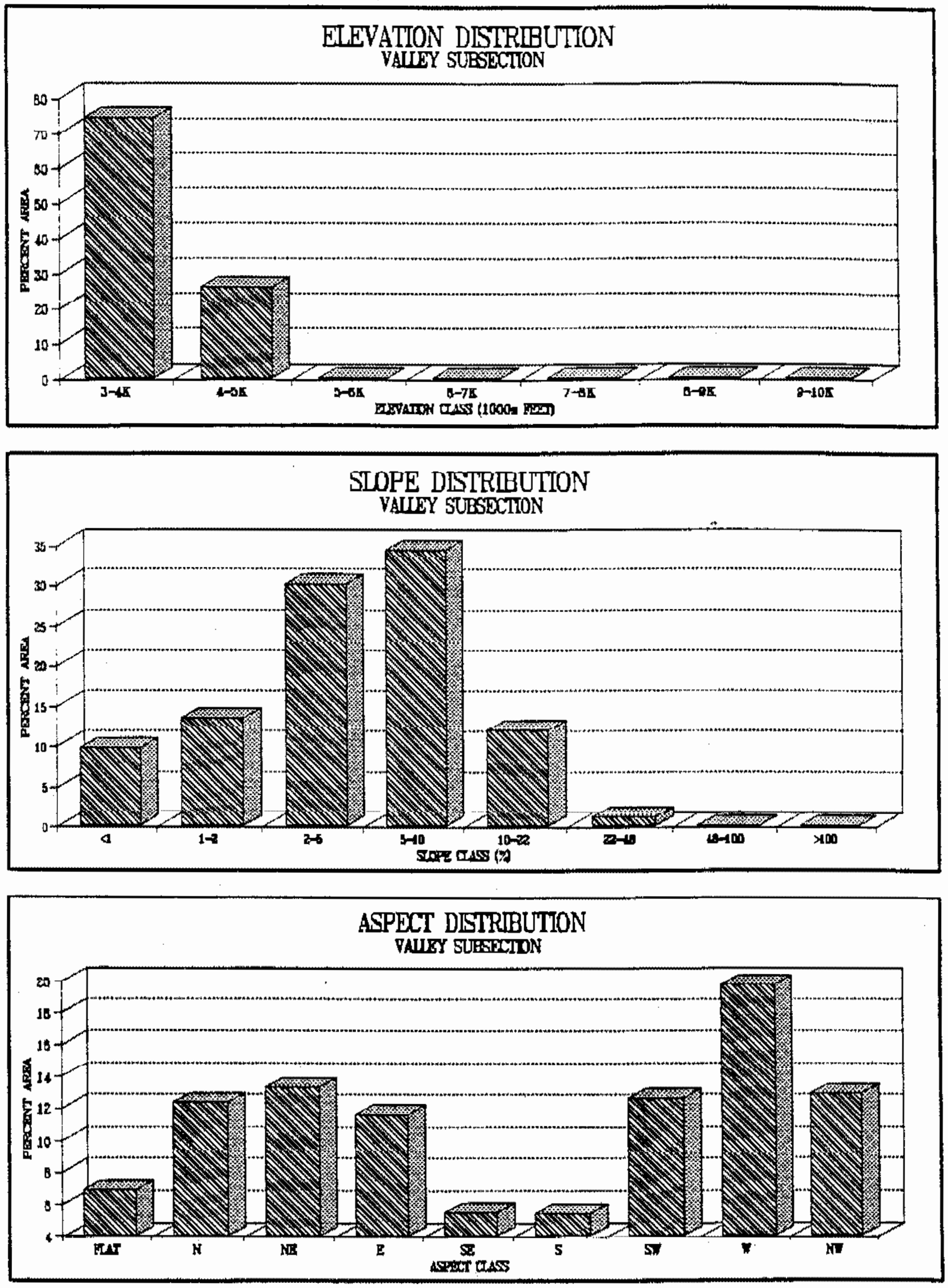



Figure 3.3.3-1. Elevation, slope and aspect distributions, valley subsection.

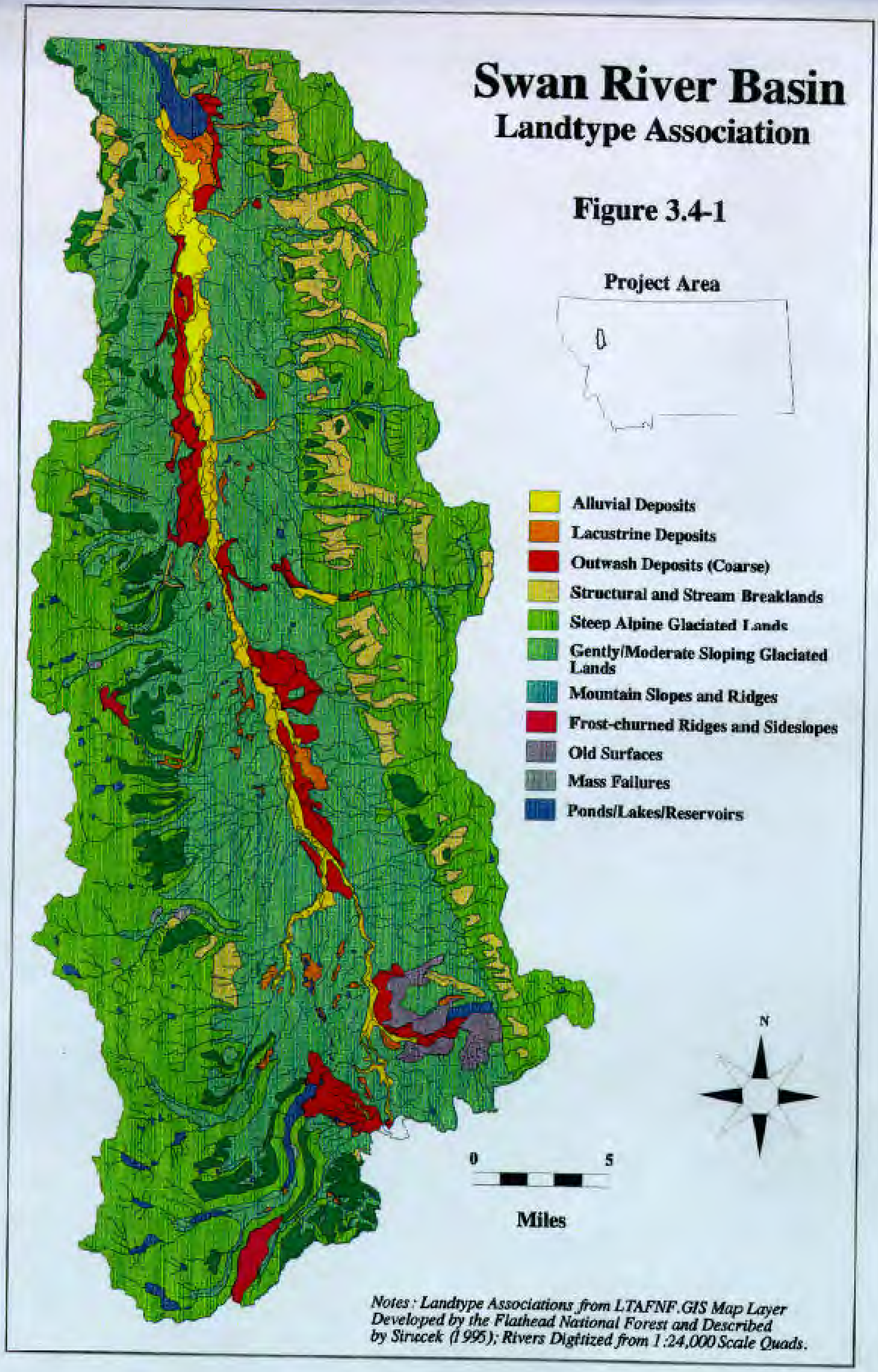
## 3.4 Landtype Association

In 1994 the Flathead National Forest compiled a landtype association map layer as part of a region-wide Columbia River Basin assessment. Landtype association mapping was done at a scale of 1:100,000 with a minimum map unit size of 80 to 100 acres. The landtype associations were defined to group landtypes with distinctive erosion potential and sediment delivery efficiency. The differentiating criteria for the map units were landform classes that were further subdivided by classes of bedrock lithology. For lands in the Flathead National Forest, landtypes identified in a previous inventory (Martinson and Basko 1983) were grouped and then subdivided by bedrock lithology to create the landtype association map units. A map of landtype associations for the Swan River basin is presented as Figure 3.4-1. The areas of landtype associations identified in the Swan River basin are listed in Table 3.4-1.

Table 3.4-1. Landtype association legend.

| CODE | LANDTYPE ASSOCIATION | N | -----AREA------ (ac) | (%) |
|---|---|---|---|---|
| 10 | Alluvial Deposits (Coarse) | 6 | 14111 | 3.5 |
| 11 | Lacustrine Deposits | 43 | 4536 | 1.1 |
| 12 | Outwash Deposits (Coarse) | 19 | 16191 | 4.0 |
| 20 | Structural and Stream Breaklands[1] | 48 | 23773 | 5.8 |
| 40 | Steep Alpine Glaciated Lands[1] | 52 | 158394 | 38.8 |
| 50 | Gently/Moderate Sloping Glaciated Lands[1] | 32 | 156625 | 38.3 |
| 60 | Mountain Slopes and Ridges[1] | 76 | 22135 | 5.4 |
| 70 | Frost-churned Ridges and Sideslopes[1] | 4 | 1816 | 0.4 |
| 80 | Old Surfaces[1] | 3 | 4067 | 1.0 |
| 90 | Mass Failures | 6 | 493 | 0.1 |
| 99 | Miscellaneous (Ponds/Lakes/Reservoirs) | 89 | 6004 | 1.5 |
| | TOTAL | 541 | 408660 | 100.0 |

[1] Metasedimentary parent material;


Swan River Basin
Landtype Association
Figure 3.4-1
Project Area
Alluvial Deposits
Lacustrine Deposits
Outwash Deposits (Coarse)
Structural and Stream Breaklands
Steep Alpine Glaciated Lands
Gently/Moderate Sloping Glaciated Lands
Mountain Slopes and Ridges
Frost-churned Ridges and Sideslopes
Old Surfaces
Mass Failures
Ponds/Lakes/Reservoirs
N
0
5
Miles
Notes: Landtype Associations from LTAFNF.GIS Map Layer Developed by the Flathead National Forest and Described by Sirucek (1995); Rivers Digitized from 1:24,000 Scale Quads.

## 3.5 Landtypes

Landtypes have distinctive landform, soil patterns and climax plant community. Landtypes were identified as part of an Order III Land System Inventory in the northern Rocky Mountains of northwest Montana (Martinson and Basko 1983). The Order III survey included most of the Swan River basin, but excluded the Mission Mountain Wilderness. Sirucek (unpublished) extended an Order IV survey of landtypes for the Mission Mountain Wilderness and provided "cross-walks" between the Order III landtypes and the more general Order IV landtypes.

Local landforms were used to develop landtype map units. Soils were classified using criteria adopted by the National Cooperative Soil Survey and documented in Soil Taxonomy (USDA SCS 1975). Potential vegetation was classified using Habitat Types of Montana (Pfister et al. 1977).

A total of 46 Order III and IV landtypes were identified in the Swan River basin. These 46 different landtypes were combined into 11 general **landtype classes**. A map of general landtype classes is presented as Figure 3.5-1. The area of landtypes are listed in Table 3.5-1 by general landtype class. A descriptive legend of landtypes is presented as Table 3.5-2. The distribution of landtype classes by subsection is listed in Table 3.5-3. Because this version of the Ecological Classification is abriged, the reader is referred to Martinson and Basko (1983) and Sirucek (Unpublished) for detailed map unit descriptions.

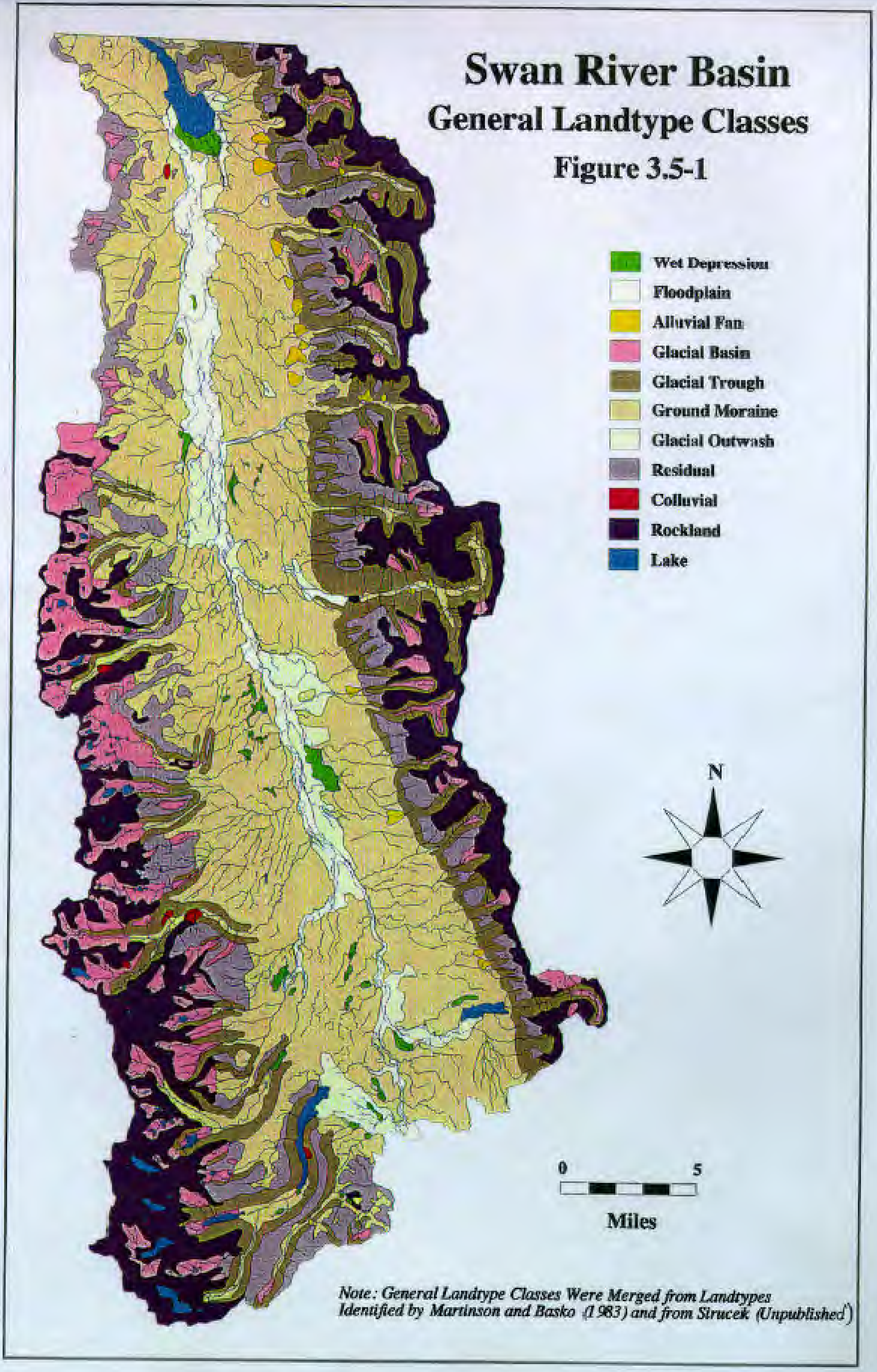

Swan River Basin
General Landtype Classes
Figure 3.5-1
Wet Depression
Floodplain
Alluvial Fan
Glacial Basin
Glacial Trough
Ground Moraine
Glacial Outwash
Residual
Colluvial
Rockland
Lake
N
0
5
Miles
Note: General Landtype Classes Were Merged from Landtypes Identified by Martinson and Basko (1983) and from Strucek (Unpublished)

Table 3.5-1. Distribution of Order III and IV landtypes, Swan River basin.

| GENERAL CLASS | ORDER | LANDTYPE | LANDFORM | N | ACRES | PERCENT |
|---|---|---|---|---|---|---|
| Lake | III | Lake | Lake | 114 | 5653 | 1.4 |
| Wet Depression | III | 12 | Depression in ground moraine/lacustrine deposit | 19 | 2073 | 0.5 |
| Wet depression | III | 14-3 | Low basin/depression in rolling ground moraine | 14 | 1295 | 0.3 |
| Wet Depression | IV | Ia | Wet, grass/sedge meadow | 2 | 57 | 0.0 |
| **Wet Depression** | | **TOTAL** | | **35** | **3425** | **0.8** |
| Floodplain | III | 10-2 | Well drained floodplain | 10 | 2408 | 0.6 |
| Floodplain | III | 10-3 | Poorly drained floodplain | 5 | 14183 | 3.5 |
| **Floodplain** | | **TOTAL** | | **15** | **16591** | **4.1** |
| Alluvial Fan | III | 16 | Alluvial fan | 22 | 1976 | 0.5 |
| Glacial Basin | III | 21-8 | Alpine glaciated basin, 20-40% slope | 47 | 9219 | 2.3 |
| Glacial Basin | III | 21-9 | Alpine glaciated basin, 40-60% slope | 15 | 3331 | 0.8 |
| Glacial Basin | IV | II | Glacial cirque basin | 38 | 15978 | 3.9 |
| Glacial Basin | IV | VIa | Scoured glacial basin | 7 | 4498 | 1.1 |
| **Glacial Basin** | | **TOTAL** | | **107** | **33026** | **8.1** |
| Glacial Trough | III | 73 | Glacial troughwalls (Subalpine fir series) | 57 | 39923 | 9.8 |
| Glacial Trough | III | 78 | Glacial troughwalls (Douglas-fir series) | 10 | 7139 | 1.7 |
| Glacial Trough | IV | VII | Forested, cool aspect breakland | 27 | 7842 | 1.9 |
| **Glacial Trough** | | **TOTAL** | | **94** | **54904** | **13.4** |

Table 3.5-1. Continued.

| GENERAL CLASS | ORDER | LANDTYPE | LANDFORM | N | ACRES | PERCENT |
|---|---|---|---|---|---|---|
| Ground Moraine | III | 14-2 | Well drained depression in moraine | 4 | 1110 | 0.3 |
| Ground Moraine | III | 23-8 | Moraine from argillite, limestone and siltite, 20-40% slope | 5 | 4376 | 1.1 |
| Ground Moraine | III | 23-9 | Moraine from argillite, limestone and siltite, 40-60% slope | 9 | 14925 | 3.7 |
| Ground Moraine | III | 26A-7 | Moraine from limestone, 0-20% slope | 15 | 13057 | 3.2 |
| Ground Moraine | III | 26A-8 | Moraine from limestone, 20-40% slope | 16 | 9931 | 2.4 |
| Ground Moraine | III | 26A-9 | Moraine from limestone, 40-60% slope | 5 | 3452 | 0.8 |
| Ground Moraine | III | 26C-7 | Moraine from argillite and siltite, 0-20% slope | 19 | 50619 | 12.4 |
| Ground Moraine | III | 26C-8 | Moraine from argillite and siltite, 20-40% slope | 29 | 22175 | 5.4 |
| Ground Moraine | III | 26C-9 | Moraine from argillite and siltite, 40-60% slope | 9 | 4606 | 1.1 |
| Ground Moraine | III | 26D-7 | Moraine from quartzite, 0-20% slope | 9 | 20544 | 5.0 |
| Ground Moraine | III | 26D-8 | Moraine from quartzite, 20-40% slope | 19 | 9132 | 2.2 |
| Ground Moraine | III | 26D-9 | Moraine from quartzite, 40-60% slope | 2 | 449 | 0.1 |
| Ground Moraine | III | 26G-7 | Moraine from Tertiary sediment, 0-20% slope | 1 | 38 | 0.0 |
| Ground Moraine | III | 26L-7 | Moraine from old surface material, 0-20% slope | 2 | 1420 | 0.3 |
| Ground Moraine | III | 26L-8 | Moraine from old surface material, 20-40% slope | 1 | 2196 | 0.5 |
| Ground Moraine | III | 74 | Fluvial breaklands in moraine | 10 | 1730 | 0.4 |
| Ground Moraine | IV | III | Forested ground moraine | 17 | 4115 | 1.0 |
| **Ground Moraine** | | **TOTAL** | | **172** | **163875** | **40.1** |
| Glacial Outwash | III | 27-7 | Kame/stream terraces/pit and kettle topography, 0-20% slope | 14 | 7039 | 1.7 |
| Glacial Outwash | III | 27-8 | Kame/stream terraces/pit and kettle topography, 40-60% slop | 5 | 3529 | 0.9 |
| Glacial Outwash | III | 28-7 | Outwash plain, stream terrace and bench, 0-20% slope | 6 | 3475 | 0.9 |
| **Glacial Outwash** | | **TOTAL** | | **25** | **14043** | **3.4** |
| Residual | III | 57-8 | Glacial scoured hillsides and ridgetop, 20-40% slope | 48 | 13163 | 3.2 |
| Residual | III | 57-9 | Glacial scoured hillsides and ridgetop, 40-60% slope | 29 | 7472 | 1.8 |
| Residual | III | 76 | Extremely steep structural breaklands, >60% slope | 24 | 14194 | 3.5 |
| Residual | III | 77 | Extremely steep structural breaklands, >60% slope | 7 | 3936 | 1.0 |
| Residual | IV | Va | Forested high elevation ridge | 4 | 2131 | 0.5 |
| Residual | IV | Vb | Forested smooth residual slope | 14 | 4360 | 1.1 |
| **Residual** | | **TOTAL** | | **126** | **45256** | **11.1** |

Table 3.5-1. Continued.

| GENERAL CLASS | ORDER | LANDTYPE | LANDFORM | N | ACRES | PERCENT |
|---|---|---|---|---|---|---|
| Colluvial | III | 32 | Block glides with dipping bedrock | 3 | 299 | 0.1 |
| Colluvial | IV | IV | Slump land | 3 | 206 | 0.1 |
| **Colluvial** | | TOTAL | | 6 | 506 | 0.1 |
| Rockland | III | 55 | Rockland on low-to-mid elevation hillside, 40-60% slope | 3 | 176 | 0.0 |
| Rockland | III | 72 | Rockland on over-steepened cirque headwall & alpine ridge | 14 | 31702 | 7.8 |
| Rockland | III | 75 | Rockland on cliffs | 12 | 3259 | 0.8 |
| Rockland | IV | VI | Peaks and alpine ridge | 6 | 34238 | 8.4 |
| Rockland | | TOTAL | | 35 | 69375 | 17.0 |
| TOTAL | | TOTAL | TOTAL | 751 | 408630 | 100.0 |

Table 3.5-2. Descriptive legend for landtypes.

| Landtype[1] | Landform | Geology | Map Unit Component | Soil Classification | Vegetative Series[2] | Slope (%) |
|---|---|---|---|---|---|---|
| **GENERAL LANDTYPE CLASS** | | | | | | |
| **WET DEPRESSION** | | | | | | |
| 12 | Depression in moraine and lacustrine deposits | Undifferentiated | Poorly drained organic deposits | Borosaprists | Wet herbaceous, shrubs | 0-2 |
| 14-3 | Basins and depressions in moraine | Undifferentiated | Somewhat poorly drained lacust. dep. | Aquepts | ABLA | 0-5 |
| Ia | Wet, Grass-sedge Meadows | Alluvium | Alluvial and lacustrine deposits | Aquepts and Aquolls | Water tolerant shrubs | NA |
| **FLOODPLAIN** | | | | | | |
| 10-2 | Floodplain | Undifferentiated | Well drained formed in alluvium | Complex of Ochrepts and Fluvents | ABLA, PSME | 0-5 |
| 10-3 | Floodplain | Undifferentiated | Poorly drained alluvial deposits | Aquents | ABLA | 0-5 |
| **ALLUVIAL FAN** | | | | | | |
| 16 | Alluvial fan | Undifferentiated | Coarse textured in colluvium | Ochrepts and Orthents | ABLA | 5-30 |
| **GLACIAL BASIN** | | | | | | |
| 21-8 | Alpine glaciated basin | Undifferentiated | Ash loess over glacial till | Andic Cryochrepts & Entic Cryandepts | ABLA, PIAL | 20-40 |
| 21-9 | Alpine glaciated basin | Undifferentiated | Ash loess over glacial till | Andic Cryochrepts & Entic Cryandepts | ABLA, PIAL | 40-60 |
| II | Glacial cirque basins | Undifferentiated | Ash loess over till & residuum | Andic Cryochrepts & Cryorthods, Typic Cryandepts | ABLA, PIAL, PICEA | NA |
| VIa | Glacial scoured basins | Undescribed | Undescribed | Undescribed | Undescribed | NA |
| **GLACIAL TROUGH** | | | | | | |
| 73 | Glacial troughwalls | Undifferentiated | Ash loess over residuum & till | Ochrepts and Boralfs | ABLA | >60 |
| 78 | Glacial troughwalls | Undifferentiated | Ash loess over residuum | Dystrochrepts | PSME | >60 |
| VII | Forested, cool aspect breaklands | Undifferentiated | Residuum, drift & colluvium | Andic Cryochrepts and Lithic Cryandepts | PICO, ABLA, PICEA | >60 |

[1] Landtype Codes that are Roman Numerals (Ia, II, III, IV, Va, Vb, VI, VIa) are from an Order 4 survey of the Mission Mountain Wilderness in Swan River basin (Sirucek, unpublished). The other landtype codes are from an Order 3 survey (Martinson and Basco 1983).

[2] Vegetation Series are from Habitat Types of Montana (Pfister 1977). Acronyms are the first two letters of the genus and the first two letters of the species: ABLA = subalpine fir (*Abies lasiocarpa*); ABGR = grand fir (*Abies grandis*); LAOC = larch (*Larix occidentalis*); PIAL = whitebark pine (*Pinus albicaulis*); PICO = lodgepole pine (*Pinus contorta*); PICEA = spruce (*Picea spp.*); POTR = aspen (*Populus tremuloides*); PSME = Douglas-fir (*Pseudotsuga menziesii*); THPL = Western red cedar (*Thuja plicata*).

Table 3.5-2. Continued.

| LANDTYPE CLASS<br>Landtype[1] | Landform | Geology | Map Unit Component | Soil Classification | Vegetative Series[2] | Slope (%) |
|---|---|---|---|---|---|---|
| **GROUND MORAINE** | | | | | | |
| 14-2 | Basins and depressions in moraine | Undifferentiated | Well drained lacustrine deposits | Glossic Cryoboralfs | ABLA, PSME | 0-20 |
| 23-8 | Ground moraine | Argillite, limestone and siltite | Ash loess over till & silt loam | Andeptic Cryoboralfs & Andic Cryochrepts | ABLA, ABGR, THPL | 20-40 |
| 23-9 | Ground moraine | Argillite, limestone and siltite | Ash loess over till & silt loam | Andeptic Cryoboralfs & Andic Cryochrepts | ABLA, ABGR, THPL | 40-60 |
| 26A-7 | Ground moraine | Limestone | Ash loess over till & silt loam | Andeptic Cryoboralfs | ABLA, ABGR, THPL | 0-20 |
| 26A-8 | Ground moraine | Limestone | Ash loess over till & silt loam | Andeptic Cryoboralfs | ABLA, ABGR, THPL | 20-40 |
| 26A-9 | Ground moraine | Limestone | Ash loess over till & silt loam | Andeptic Cryoboralfs | ABLA, ABGR, THPL | 40-60 |
| 26C-7 | Ground moraine | Argillite, siltite | Ash loess over silty till | Andeptic Cryoboralfs | ABLA, ABGR, THPL | 0-20 |
| 26C-8 | Ground moraine | Argillite, siltite | Ash loess over silty till | Andeptic Cryoboralfs | ABLA, ABGR, THPL | 20-40 |
| 26C-9 | Ground moraine | Argillite, siltite | Ash loess over silty till | Andeptic Cryoboralfs | ABLA, ABGR, THPL | 40-60 |
| 26D-7 | Ground moraine | Quartzite | Ash loess over sandy loam till | Dystric Cryochrepts | ABLA, PSME | 0-20 |
| 26D-8 | Ground moraine | Quartzite | Ash loess over sandy loam till | Dystric Cryochrepts | ABLA, PSME | 20-40 |
| 26D-9 | Ground moraine | Quartzite | Ash loess over sandy loam till | Dystric Cryochrepts | ABLA, PSME | 40-60 |
| 26G-7 | Ground moraine | Tertiary sediments | Ash loess over silt loam till | Typic Eutroboralfs | PSME | 0-20 |
| 26L-7 | Ground moraine | Old surface material | Ash loess over vg SiL and g SiCL | Glossic Cryoboralfs | ABLA | 0-20 |
| 26L-8 | Ground moraine | Old surface material | Ash loess over vg SiL and g SiCL | Glossic Cryoboralfs | ABLA | 20-40 |
| 74 | Fluvial breaklands in ground moraines & uplands | Undifferentiated | Glacial till & residuum | Ochrepts and Orthents | PSME, ABLA | >60 |
| III | Forested ground moraine | Undifferentiated | Loamy drift & residuum | Typic and Andic Cryoboralfs | PICO, POTR | NA |
| **GLACIAL OUTWASH** | | | | | | |
| 27-7 | Kame, stream terrace & pit and kettle topography | Undifferentiated | Loam in loess over glacial outwash | Dystric Eutrochrepts | ABLA, PSME | 0-20 |
| 27-8 | Kame, stream terrace & pit and kettle topography | Undifferentiated | Loam in loess over glacial outwash | Dystric Eutrochrepts | ABLA, PSME | 20-40 |
| 28-7 | Outwash plains, stream terraces and benches | Undifferentiated | Sandy soils in glacial outwash | Dystric Eutrochrepts | ABLA, PSME | 0-20 |
| **RESIDUAL** | | | | | | |
| 57-8 | Glacial scoured hillsides and ridgetops | Undifferentiated | Ash loess over residuum | Andic Cryochrepts | ABLA | 20-40 |
| 57-9 | Glacial scoured hillsides and ridgetops | Undifferentiated | Ash loess over residuum | Andic Cryochrepts | ABLA | 40-60 |
| 76 | Extremely steep structural breaklands | Undifferentiated | Ash loess over residuum | Cryochrepts | ABLA | >60 |
| 77 | Extremely steep structural breaklands | Undifferentiated | Ash loess over residuum | Cryochrepts | ABLA | >60 |
| Va | Forested high elevation ridges | Undifferentiated | Ash loess over residuum | Andic Cryochrepts | PIAL, PICO | 25-50 |
| Vb | Forested smooth residual slopes | Undifferentiated | Ash loess over residuum | Andic Cryochrepts | PICO, LAOC | 25-60 |
| **COLLUVIAL** | | | | | | |
| 32 | Block glides associated with dipping bedrock | Undifferentiated | Colluvium & residuum | Boralfs and Ochrepts | ABLA | 30-50 |
| IV | Slump land | Undifferentiated | Fine slump material with boulders | Typic and Andic Cryoboralfs | PICO, PSME, ABLA, PICEA | NA |
| **ROCKLAND** | | | | | | |
| 55 | Low to mid-elevation hillsides | Undifferentiated | Rockland | Rockland | Herbaceous, shrub, trees | 40-60 |
| 72 | Cirque headwalls and narrow alpine ridges | Undifferentiated | Rockland, talus, ash loess & residuum | Rockland and Andepts | ABLA, PIAL | >60 |
| 75 | Rock cliffs | Undifferentiated | Rockland | Rockland | Shrub, grass, small tree | >60 |
| VI | Peaks and alpine ridges | Undifferentiated | Rockland, talus & scree | Rockland | Sparse small trees | NA |
| **MISCELLANEOUS LANDTYPE** | | | | | | |
| Lake | Lake | Undifferentiated | Not applicable | Not applicable | Not applicable | NA |

Table 3.5-3. Distribution of Landtype Classes (LTC) by Subsection.

| SUBSECTION | LTC | ------AREA------ (ac) | (%) |
|---|---|---|---|
| Scarp Slope | Wet Depression | 0 | 0.0 |
| Dip Slope | Wet Depression | 242 | 7.1 |
| Valley | Wet Depression | 3183 | 92.9 |
| **TOTAL** | **Wet Depression** | **3425** | **100.0** |
| Scarp Slope | Floodplain | 29 | 0.2 |
| Dip Slope | Floodplain | 497 | 3.0 |
| Valley | Floodplain | 16063 | 96.8 |
| **TOTAL** | **Floodplain** | **16589** | **100.0** |
| Scarp Slope | Alluvial Fan | 1096 | 55.5 |
| Dip Slope | Alluvial Fan | 18 | 0.9 |
| Valley | Alluvial Fan | 862 | 43.6 |
| **TOTAL** | **Alluvial Fan** | **1975** | **100.0** |
| Scarp Slope | Glacial Basin | 6783 | 20.5 |
| Dip Slope | Glacial Basin | 26227 | 79.5 |
| Valley | Glacial Basin | 0 | 0.0 |
| **TOTAL** | **Glacial Basin** | **33010** | **100.0** |
| Scarp Slope | Glacial Trough | 36781 | 67.0 |
| Dip Slope | Glacial Trough | 17921 | 32.6 |
| Valley | Glacial Trough | 195 | 0.4 |
| **TOTAL** | **Glacial Trough** | **54896** | **100.0** |
| Scarp Slope | Ground Moraine | 13362 | 8.2 |
| Dip Slope | Ground Moraine | 54527 | 33.3 |
| Valley | Ground Moraine | 95955 | 58.6 |
| **TOTAL** | **Ground Moraine** | **163844** | **100.0** |
| Scarp Slope | Glacial Outwash | 0 | 0.0 |
| Dip Slope | Glacial Outwash | 216 | 1.5 |
| Valley | Glacial Outwash | 13825 | 98.5 |
| **TOTAL** | **Glacial Outwash** | **14041** | **100.0** |
| Scarp Slope | Residual | 18390 | 40.6 |
| Dip Slope | Residual | 26829 | 59.3 |
| Valley | Residual | 32 | 0.1 |
| **TOTAL** | **Residual** | **45250** | **100.0** |

Table 3.5-3. Continued.

| SUBSECTION | LTC | ------AREA------ (ac) | (%) |
|---|---|---|---|
| Scarp Slope | Colluvial | 0 | 0.0 |
| Dip Slope | Colluvial | 506 | 100.0 |
| Valley | Colluvial | 0 | 0.0 |
| **TOTAL** | **Colluvial** | **506** | **100.0** |
| Scarp Slope | Rockland | 33501 | 48.3 |
| Dip Slope | Rockland | 35863 | 51.7 |
| Valley | Rockland | 0 | 0.0 |
| **TOTAL** | **Rockland** | **69364** | **100.0** |
| Scarp Slope | Lake | 7 | 0.1 |
| Dip Slope | Lake | 3245 | 57.3 |
| Valley | Lake | 2411 | 42.6 |
| **TOTAL** | **Lake** | **5663** | **100.0** |

## 3.6 Habitat Types

Habitat types described by Pfister et al. (1977) were identified by Sirucek (1994) for the Flathead National Forest. The map of habitat types in the Swan River basin (Figure 3.6-1) was developed from: 1) empirical models; 2) forest stand data; and 3) an existing map layer of forest structure classes.

Statistical analyses of ECODATA plots served as a basis for the empirical models (Sirucek 1994).. Primary parameters for distinguishing habitat types were elevation, slope, aspect and geographical subdivision. A few habitat types were also distinguished by landtype. Criteria listed in Table 3.6-1 were used to predict habitat types for the Swan Lake Ranger District. A map layer of "modelled" habitat types was generated.

Next Sirucek (1994) listed all timber stands where the habitat type had been field identified. Where several habitat types were identified in a timber stand, the most frequently sampled habitat type was identified for the stand. A digital map of habitat types for timber stands was developed and inset to the modelled map layer. Timber stands were primarily at low to middle elevations in areas suitable for commercial harvest.

Finally, Sirucek (1994) used a forest structure map to identify forb/grass, bare/rock and lakes/rivers and inset it to the modelled/stand map layer. These procedures yielded a forest-wide habitat type map layer on 50 by 50 meter pixels. The accuracy of the habitat map layer has not been reported, but an assessment is anticipated. The author lists the primary limitation of the habitat type map layer is that modelling parameters were generalized for a typical situation and do not account for variation in site characteristics. Also, only the most frequently sampled habitat of a timber stand was identified. Habitat types identified in the Swan River basin by empirical modelling, from timber stand data and from existing maps of forest structure are listed in Table 3.6-2.

Major habitat types comprising more than 0.5 percent of Swan River basin are those that were predicted by the empirical model, some of which were also identified for timber stands. Minor habitat types comprise less than 0.5 percent of Swan River basin, were not predicted by the empirical model, but were identified for timber stands. Minor habitat types were combined with the adjacent major habitat type sharing the longest common boundary. A map of major habitat types, Swan River basin is presented as Figure 3.6-1.

Brief descriptions excerpted from Pfister et al. (1977) follow. More comprehensive descriptions of both major and minor habitat types are presented in Forest Habitat Types of Montana (Pfister et al. 1977).

Table 3.6-1. Criteria for modeled habitat types, Swan Lake Ranger District (Sirucek 1994).

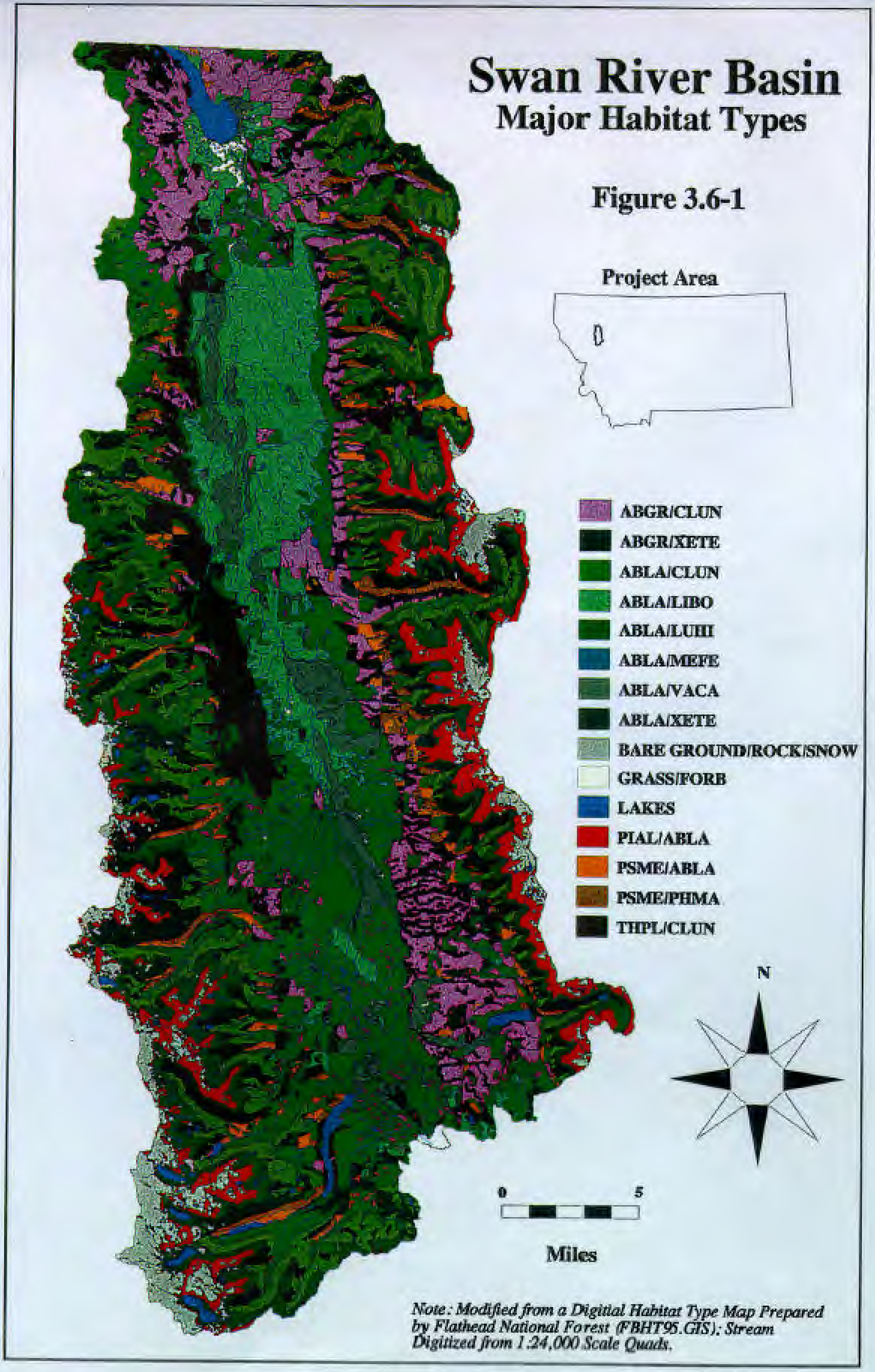
| HT | ELEVATION (ft) | ASPECT | SLOPE (%) | OTHER |
|---|---|---|---|---|
| ABGR/CLUN | 3800 to 4599 | SE,W,NW,N,NE,E,F | None | Swan Range |
| | 3800 to 4599 | S,SW | None | Mission Range |
| ABGR/XETE | 3800 to 4599 | S,SW | None | Swan Range |
| ABLA/CLUN | 3600 to 3799 | All | All | None |
| | 3800 to 4599 | W,NW,N,NE,E,SE,F | <15 | Mission Range |
| | 4600 to 5399 | W,NW,N,NE,E,F | All | Swan Range |
| ABLA/LIBO | 2800 to 3599 | All | All | None |
| ABLA/LUHI | 6200 to 6899 | W,NW,N,NE,E,F | All | None |
| | 6500 to 6899 | SW,S,SE | ALL | None |
| ABLA/MEFE | 5400 to 6199 | W,NW,N,NE,E,F | All | None |
| ABLA/VACA | >2800 | All | All | LTs 10-2, 27-7, 28-7 |
| ABLA/XETE | 5400 to 6499 | SW,S,SE | All | None |
| LALY-ABLA | >7200 | N | ALL | None |
| PIAL-ABLA | 6900 to 7199 | N | ALL | None |
| | >6900 | NE,E,SE,S,SW,W,NW,F | ALL | None |
| PICEA/CLUN | 3200 to 4399 | All | 10 to 20 | None |
| PSME/PHMA | 4600 to 5399 | SE,S,SW | >40 | None |
| PSME/SYAL | 4600 to 5399 | SW,S,SE | <40 | None |
| THPL/CLUN | 3800 to 4599 | All | All | 200 m wide along streams; Swan Range |
| | 3800 to 4599 | SE,W,NW,NE,E | >15 | Mission Range |

Table 3.6-2. Habitat types, Swan River basin.

| HABITAT | N | ------AREA------- (ac) | (%) |
|---|---|---|---|
| Major Habitat Types from Empirical Modelling | | | |
| ABGR/CLUN | 624 | 35463 | 8.7 |
| ABGR/XETE | 388 | 6227 | 1.5 |
| ABLA/CLUN | 549 | 95816 | 23.4 |
| ABLA/LIBO | 229 | 39392 | 9.6 |
| ABLA/LUHI | 270 | 42647 | 10.4 |
| ABLA/MEFE | 324 | 33930 | 8.3 |
| ABLA/VACA | 122 | 13677 | 3.3 |
| ABLA/XETE | 425 | 30755 | 7.5 |
| PIAL/ABLA | 1011 | 24536 | 6.0 |
| PSME/SYAL | 418 | 8672 | 2.1 |
| PSME\PHMA | 257 | 8097 | 2.0 |
| THPL/CLUN | 382 | 30350 | 7.4 |
| SUBTOTAL | 4999 | 369560 | 90.4 |
| Minor Habitat Types from Timber Stands | | | |
| ABGR/LIBO | 24 | 848 | 0.2 |
| ABLA-PIAL/VASC | 1 | 178 | 0.0 |
| ABLA/ALSI | 18 | 898 | 0.2 |
| ABLA/ARCO | 2 | 23 | 0.0 |
| ABLA/CACA | 15 | 343 | 0.1 |
| ABLA/GATR | 3 | 104 | 0.0 |
| ABLA/OPHO | 11 | 317 | 0.1 |
| ABLA/VAGL | 3 | 58 | 0.0 |
| LALY/ABLA | 199 | 835 | 0.2 |
| PICEA/CLUN | 47 | 1677 | 0.4 |
| PICEA/EQAR | 13 | 358 | 0.1 |
| PICEA/GATR | 1 | 7 | 0.0 |
| PICEA/LIBO | 3 | 40 | 0.0 |
| PICEA/VACA | 15 | 423 | 0.1 |
| PIPO | 4 | 72 | 0.0 |
| PSME/ARUV | 2 | 62 | 0.0 |
| PSME/CARU | 15 | 550 | 0.1 |
| PSME/FEID | 4 | 214 | 0.1 |
| PSME/LIBO | 13 | 388 | 0.1 |
| PSME/VACA | 27 | 1018 | 0.2 |
| PSME/VAGL | 22 | 1029 | 0.3 |
| THPL/OPHO | 14 | 524 | 0.1 |
| TSME/CLUN | 7 | 134 | 0.0 |
| TSME/LUHI | 3 | 136 | 0.0 |
| TSME/MEFE | 8 | 618 | 0.2 |
| TSME/XETE | 2 | 122 | 0.0 |
| SUBTOTAL | 476 | 10974 | 2.7 |

Table 3.6-2. Continued

| HABITAT | N | AREA (ac) | AREA (%) |
|---|---|---|---|
| Miscellaneous Types from Forest Structure Map | | | |
| BARE/ROCK/SNOW | 497 | 18244 | 4.5 |
| GRASS/FORB | 864 | 2483 | 0.6 |
| LAKES | 787 | 7369 | 1.8 |
| SUBTOTAL | 2148 | 28096 | 6.9 |
| TOTAL | 7623 | 408630 | 100.0 |




# Swan River Basin
## Major Habitat Types

**Figure 3.6-1**

The grand fir series is climax on low to middle elevations with maritime influenced climate in northwestern and west-central Montana. The series is bounded on drier sites by the Douglas fir series and on cooler sites by the subalpine fir series. The boundary between grand fir and subalpine fir may be diffuse. Three grand fir habitat types were identified in the Swan River basin:

**ABGR/CLUN** (*Abies grandis/Clintonia uniflora;* grand fir/queencup beadily): Found on relatively moist sites from 2,400 to 5,000 feet elevation on valley bottoms and benches; all aspects. Grand fir is the dominant climax component but subalpine fir may persist as a minor climax component. Seral trees include Douglas-fir, western Larch, spruce and lodgepole pine. Moist-site herbs, western twinflower (*Linnaea borealis*) and are prominent in the understory.

**ABGR/XETE** (*Abies grandis/Xerophyllum tenax*; grand fir/beargrass): Found on well-drained slopes between 4,700 and 5,300 feet. It is the driest of the grand fir habitat types in Montana. Grand fir is predicted to be the dominant climax component of the overstory. Seral stands often dominated by Douglas-fir, western Larch and lodgepole pine. Undergrowth is sparse.

**ABLA/CLUN** (*Abies lasiocarpa/Clintonia uniflora;* subalpine fir/queencup beadily): Occurs at lower elevations (3,200 to 5,500 feet) on relatively warm and moist sites, on all but the driest southern aspects. Subalpine fir is the dominant climax species with spruce, Douglas-fir, western Larch, lodgepole pine and western white pine associated in seral stands.

The subalpine fir series includes all climax forests potentially dominated by subalpine fir, mountain hemlock, whitebark pine or alpine larch. This is the dominant series at higher elevations in the Rocky Mountains of Montana. At lower elevations it often borders moist forests where shade-tolerant grand fir, western red cedar and western hemlock are the climax species. At its upper limits this series is bordered by alpine tundra. Lightning-caused fires have allowed Douglas-fir, western larch and lodgepole pine to dominant most stands at lower elevations. Five habitat types in the subalpine fir series were identified in Swan River basin:

**ABLA/LIBO** (*Abies lasiocarpa/Linnaea borealis;* subalpine fir/twinflower): Occurs at 5,000 to 7,000 feet on moist, north aspects and benches. Seral stands are dominated by Douglas-fir, lodgepole pine and spruce. Understory composition is variable.

**ABLA/LUHI** (*Abies lasiocarpa/Luzula hitchcockii*; subalpine fir/wood-rush): a major upper subalpine forest habitat type with a 700 feet elevation zone between ABLA/XETE or ABLA/MEFE below and PIAL-ABLA above. Whitebark pine, Engelmann spruce and lodgepole pine are the principal seral species.

**ABLA/MEFE** (*Abies lasiocarpa/Menziesia ferruginea*; subalpine fir/menziesia): occurs in moist, higher elevation forests of western Montana with maritime climate. In northwestern Montana it occurs on all cool aspects between about 5,300 and 6,500 feet. Subalpine fir is usually dominant in old-growth stands, but Engelmann spruce may be more conspicuous. Lodgepole pine and Douglas-fir are usually present.

**ABLA/VACA** (*Abies lasiocarpa/Vaccinium caespitosum;* subalpine fir/dwarf huckleberry): confined largely to well-drained sites on benchlands and in cold air sinks. Elevations range from 6,000 to 7,200 feet. Pinus contorta is dominant in nearly all stands and is the persistent seral dominant.

**ABLA/XETE** (*Abies lasiocarpa/Xerophyllum tenax;* subalpine fir/beargrass): makes up a major portion of the subalpine fir series west of the Continental Divide in Montana, on seep dry exposures between 5,200 and 7,000 feet. Subalpine fir is dominant at climax but spruce is a minor component of most stands. Lodgepole pine and Douglas-fir typically dominant seral stands.

**PIAL/ABLA** (*Pinus albicaulis-Abies lasiocarpa;* whitebark pine-subalpine fir): Occurs at timberline where stunted forms of whitebark pine, subalpine fir and Engelmann spruce occur with variable under-stories.

Douglas fir habitat types are associated with well-drained mountain slopes and valleys and extend from the lower elevations of forest growth up to about 5,500 feet on southern aspects. The Douglas-fir series is bordered on warmer, drier sites by ponderosa pine, limber pine or grassland series. Spruce and grand fir series are usually adjacent along more moist boundaries. Two Douglas fir habitat types were identified in the Swan River basin:

**PSME/SYAL** (*Pseudotsuga menziesii/Symphoricarpos albis:* Douglas-fir/snowberry): a common habitat on warm slopes and benches in Montana. Seral stands at lower elevations are frequently dominated by ponderosa pine. At higher elevations Douglas-fir is dominant through most successional stages.

**PSME/PHMA** (*Pseudotsuga menziesii/Physocarpus malvaceous;* Douglas fir/ninebark): occurs mostly on cool and moist aspects at elevations from 2,000 to 5,700 feet. The overstory is dominated by Douglas fir. Ponderosa pine, western larch and lodgepole pine are minor seral components.

The western red cedar and western hemlock series occupy moist areas with maritime climate. In Montana these habitats are generally confined to bottomland or northerly aspects between 2,000 and 5,000 feet where annual precipitations is 32 inches or more. A single habitat type was identified in the Swan River basin:

**THPL/CLUN** (*Thuja plicata/Claytonia uniflora;* western redcedar/queencup beadily): Relatively common in northwestern Montana typically associated with bottomlands, benches and north aspects from about 2,000 to 5,000 feet. Western redcedar is the indicated climax species and is dominant in most stands. Subdominant seral components include grand fir, Douglas-fir, larch and subalpine fir.

## 3.7 Riparian Landtypes

Riparian landtypes are map units with distinctive valley bottom gradient, dominant streambed materials size-class and dominant vegetation community type. Riparian Landtypes were mapped and described for Forest Service lands in the Flathead National Forest (Sirucek and Bachurski 1995)[1]. Subsequent mapping of riparian landtypes for private and state lands in the Swan River basin was conducted by Flathead National Forest personnel (unpublished). A legend of riparian landtypes identified in Swan River basin is presented as Table 3.7-1. The first two letters of the riparian landtype code denote the valley bottom gradient glass (FL = flat; NL = nearly level; SL = slightly sloping; MS = moderately steep; VS = very steep). The third digit of the code denotes the dominant streambed substrate (1 = clay, silt, fine sand and medium sand; 2 = coarse sand, gravel and cobble; 3 = stone and boulder; 4 = bedrock; 5 = undifferentiated). The last letter of the code denotes the dominant vegetation community types (A = subalpine fir habitat types; B = grand fir habitat types; C = Engelmann spruce habitat types; D = black cottonwood habitat types; E = willow and sedge community or habitat types; G = snow avalanche chute plant communities). Maps denoting valley bottom gradient classes, stream substrate classes and dominant vegetation types are presented as Figures 3.7-1, 3.7-2 and 3.7-3, respectively.

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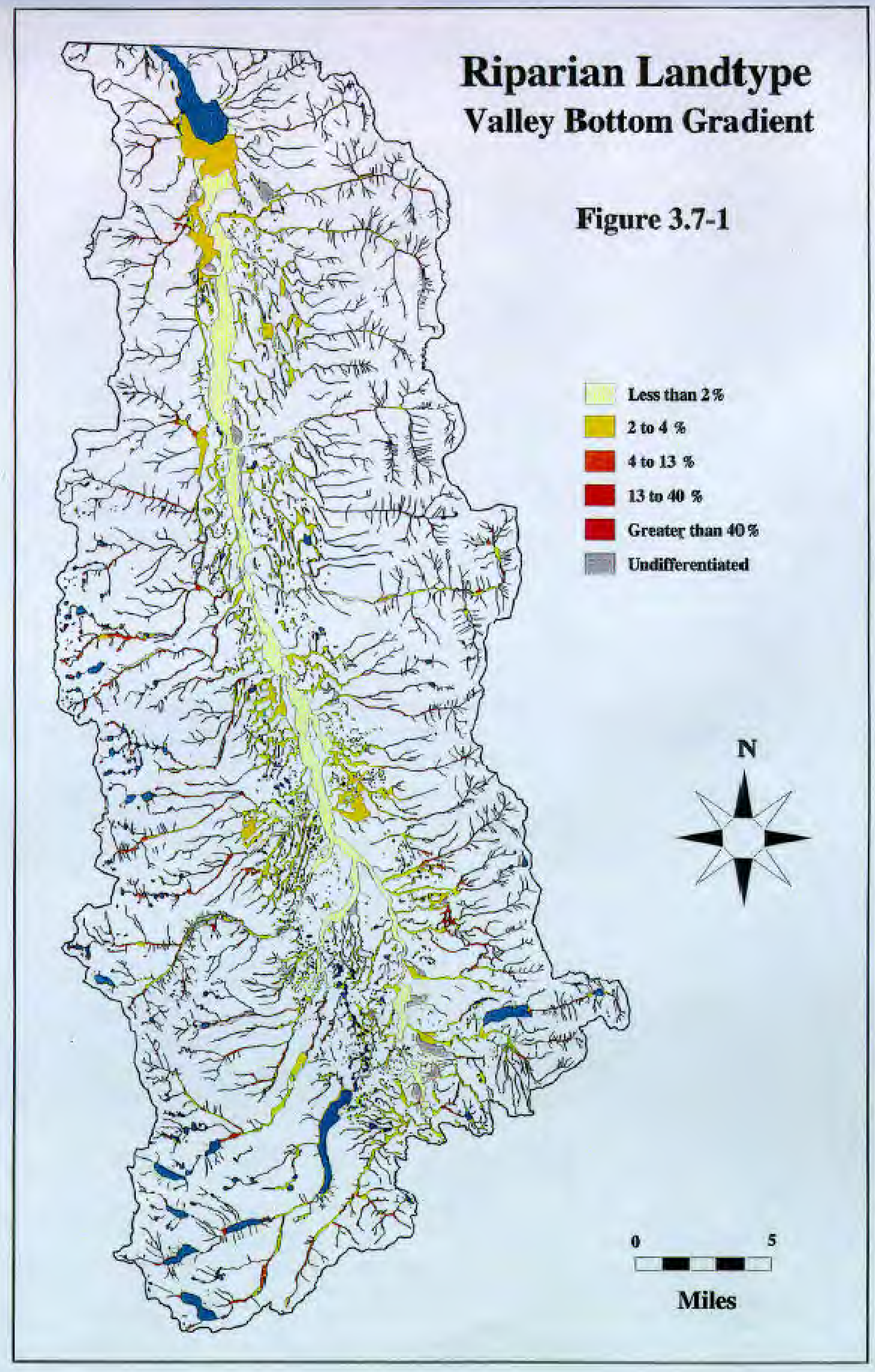
[1] Forest Service riparian landtype digital map files were modified to include stream arcs digitized from 1:24,000 scale quads. The stream often crossed in and out along the boundary of a riparian landtype with upland. A small buffer was placed on the stream to merge it with the adjacent riparian landtype - riparian landtypes in modified map files are slightly larger than riparian landtypes in the Forest Service digital map file.

The Forest Service mapped some very narrow riparian landtypes as lines. These were converted to polygons by placing a buffer on each side of the stream course. The width of the buffer is that specified by Sirucek and Bachurski (1995) as the typical width of the riparian landtype on each side of the stream.

Table 3.7-1. Riparian Landtype (RLT) legend.

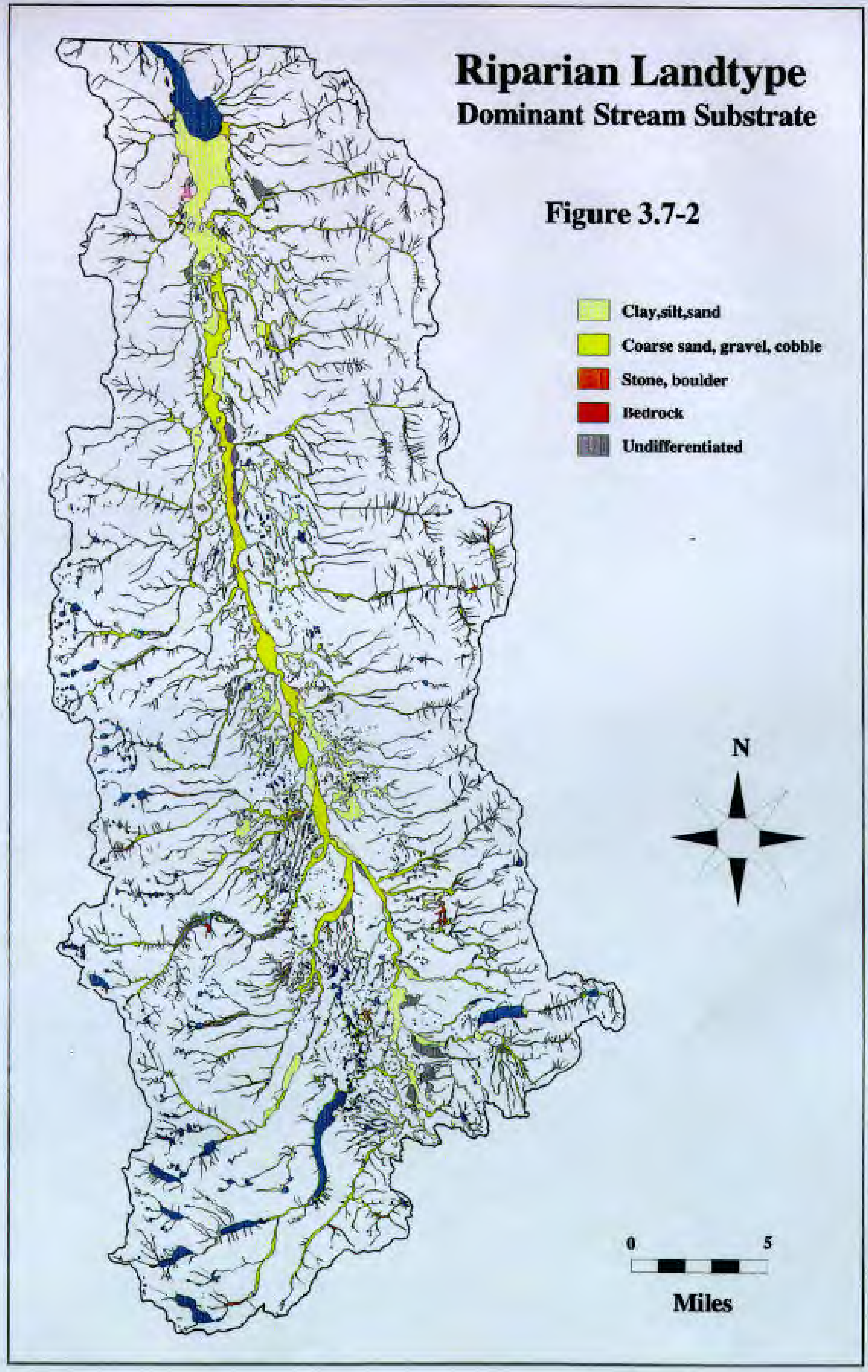
| RLT CODE | VALLEY BOTTOM GRADIENT (%) | DOMINANT SUBSTRATE | DOMINANT HABITATS |
|---|---|---|---|
| FL1C | <2 | clay, silt, sand | Engelmann spruce |
| FL2C | <2 | coarse sand, gravel, cobble | Engelmann spruce |
| FL2D | <2 | coarse sand, gravel, cobble | cottonwood/Engelmann spruce |
| NL1A | 2 to 4 | clay, silt, sand | subalpine fir |
| NL1E | 2 to 4 | clay, silt, sand | willow and sedge |
| NL2A | 2 to 4 | coarse sand, gravel, cobble | subalpine fir |
| SL2A | 4 to 13 | coarse sand, gravel, cobble | subalpine fir |
| SL2B | 4 to 13 | coarse sand, gravel, cobble | grand fir |
| SL3A | 4 to 13 | stone, boulder | subalpine fir |
| SL3B | 4 to 13 | stone, boulder | grand fir |
| SL5A | 4 to 13 | undifferentiated | subalpine fir |
| MS3A | 13 to 40 | stone, boulder | subalpine fir |
| MS3B | 13 to 40 | stone, boulder | grand fir |
| MS4A | 13 to 40 | bedrock | subalpine fir |
| MS5A | 13 to 40 | undifferentiated | subalpine fir |
| VS3A | >40 | stone, boulder | subalpine fir |
| VS4A | >40 | bedrock | subalpine fir |
| VS4G | >40 | bedrock | avalanche chute |
| WL5A | undifferentiated | undifferentiated | subalpine fir |
| WS5A | undifferentiated | undifferentiated | subalpine fir |

The areas of riparian landtypes in the Swan River basin are listed in Table 3.7-2. Stream length and grade are listed by stream order for riparian landtypes in Table 3.7-3. The riparian landtype map and legend is presented as Figure 3.7-4. The 21 individual quad map sheets outlined in Figure 3.7-4 were removed for this abridged version of the Swan River Basin Ecological Classification.




# Riparian Landtype
## Valley Bottom Gradient

Figure 3.7-1



Riparian Landtype
Dominant Stream Substrate
Figure 3.7-2
Clay,silt,sand
Coarse sand, gravel, cobble
Stone, boulder
Bedrock
Undifferentiated
N
0
5
Miles

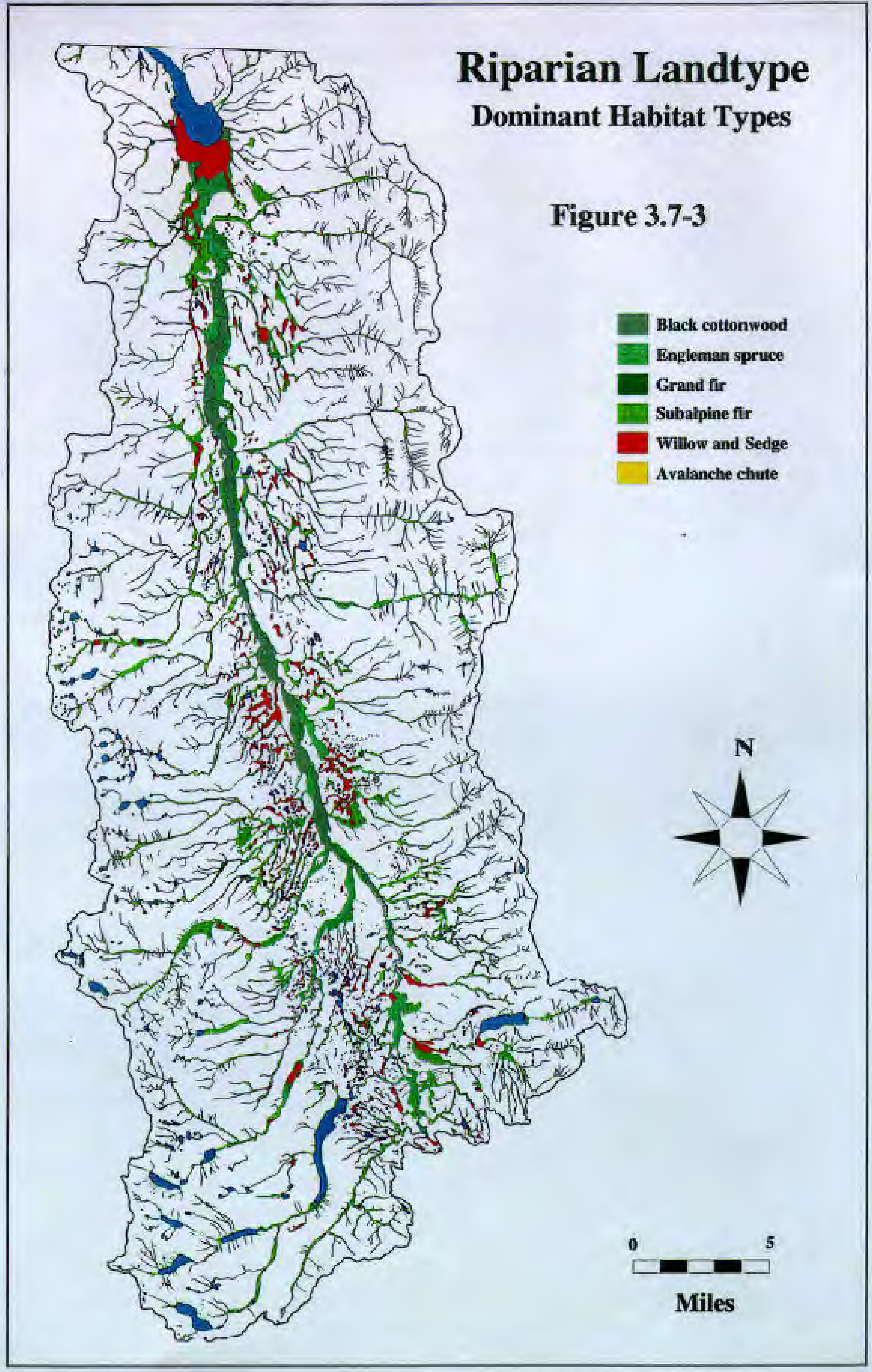

Riparian Landtype
Dominant Habitat Types
Figure 3.7-3
Black cottonwood
Engleman spruce
Grand fir
Subalpine fir
Willow and Sedge
Avalanche chute
N
0
5
Miles

Table 3.7-2. Areas of Riparian Landtypes (RLT), Swan River basin.

| RLT | N | AREA acres) | (%) |
|---|---|---|---|
| FL1C | 72 | 5005.0 | 9.3 |
| FL2C | 22 | 2592.7 | 4.8 |
| FL2D | 12 | 5675.6 | 10.6 |
| **TOTAL** | **106** | **13273.3** | **24.8** |
| NL1A | 390 | 5384.1 | 10.0 |
| NL1E | 1667 | 10868.0 | 20.3 |
| NL2A | 120 | 4745.8 | 8.9 |
| **TOTAL** | 2177 | 20997.8 | 39.2 |
| SL2A | 228 | 2925.6 | 5.5 |
| SL2B | 42 | 590.7 | 1.1 |
| SL3A | 66 | 476.1 | 0.9 |
| SL3B | 17 | 150.2 | 0.3 |
| SL5A | 515 | 4196.4 | 7.8 |
| **TOTAL** | **868** | **8339.0** | **15.6** |
| MS3A | 391 | 1543.8 | 2.9 |
| MS3B | 64 | 254.6 | 0.5 |
| MS4A | 438 | 976.2 | 1.8 |
| MS5A | 20 | 336.0 | 0.6 |
| **TOTAL** | 913 | 3110.5 | 5.8 |
| VS3A | 75 | 96.8 | 0.2 |
| VS4A | 287 | 378.0 | 0.7 |
| VS4G | 432 | 561.7 | 1.0 |
| **TOTAL** | **794** | **1036.4** | **1.9** |
| WL5A | 287 | 5420.6 | 10.1 |
| WS5A | 797 | 1408.4 | 2.6 |
| **TOTAL** | **1084** | **6829.0** | **12.7** |
| **GRAND** TOTAL | **5942** | **53586.1** | **100.0** |

Table 3.7-3. Stream lengths and grades by flow and order for Riparian Landtypes (RLT).

| RLT | ORDER | -PERENNIAL- Length (mi) | Grade (%) | -INTERMITTENT- Length (mi) | Grade (%) | ----TOTAL----- Length (mi) | Grade (%) |
|---|---|---|---|---|---|---|---|
| FL1C | 1 | 0.00 | NA | 6.74 | 1.8 | 6.74 | 1.8 |
| FL1C | 2 | 1.97 | 2.5 | 5.18 | 1.1 | 7.15 | 1.5 |
| FL1C | 3 | 3.45 | 1.1 | 0.79 | 1.3 | 4.24 | 1.1 |
| FL1C | 4 | 9.00 | 0.9 | 0.00 | NA | 9.00 | 0.9 |
| FL1C | 5 | 3.75 | 0.4 | 0.00 | NA | 3.75 | 0.4 |
| FL1C | 6 | 12.82 | 0.4 | 1.88 | 0.7 | 14.70 | 0.5 |
| FL1C | TOTAL | 30.99 | 0.8 | 14.60 | 1.4 | 45.58 | 1.0 |
| FL2C | 1 | 4.12 | 2.1 | 3.47 | 2.2 | 7.59 | 2.2 |
| FL2C | 2 | 4.85 | 1.9 | 0.00 | NA | 4.85 | 1.9 |
| FL2C | 3 | 16.03 | 1.8 | 0.00 | NA | 16.03 | 1.8 |
| FL2C | 4 | 23.46 | 1.4 | 0.88 | 2.7 | 24.35 | 1.5 |
| FL2C | 5 | 8.35 | 1.0 | 0.42 | 1.3 | 8.77 | 1.0 |
| FL2C | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| FL2C | TOTAL | 56.81 | 1.6 | 4.78 | 2.2 | 61.59 | 1.6 |
| FL2D | 1 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| FL2D | 2 | 2.47 | 1.1 | 0.73 | 1.5 | 3.20 | 1.2 |
| FL2D | 3 | 4.77 | 1.1 | 0.72 | 0.9 | 5.50 | 1.1 |
| FL2D | 4 | 1.59 | 0.8 | 0.00 | NA | 1.59 | 0.8 |
| FL2D | 5 | 6.39 | 0.8 | 0.00 | NA | 6.39 | 0.8 |
| FL2D | 6 | 31.58 | 0.5 | 5.89 | 0.4 | 37.47 | 0.5 |
| FL2D | TOTAL | 46.80 | 0.7 | 7.34 | 0.6 | 54.14 | 0.7 |
| NL1A | 1 | 6.49 | 2.8 | 36.71 | 2.2 | 43.20 | 2.3 |
| NL1A | 2 | 16.46 | 3.4 | 15.13 | 2.4 | 31.58 | 2.9 |
| NL1A | 3 | 9.51 | 2.2 | 3.07 | 1.9 | 12.59 | 2.2 |
| NL1A | 4 | 3.60 | 1.6 | 0.00 | NA | 3.60 | 1.6 |
| NL1A | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| NL1A | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| NL1A | TOTAL | 36.06 | 2.8 | 54.91 | 2.2 | 90.97 | 2.5 |
| NL1E | 1 | 0.00 | NA | 11.79 | 5.5 | 11.79 | 5.5 |
| NL1E | 2 | 22.56 | 1.2 | 6.26 | 1.9 | 28.82 | 1.4 |
| NL1E | 3 | 6.37 | 1.7 | 1.25 | 2.5 | 7.62 | 1.8 |
| NL1E | 4 | 7.45 | 0.7 | 0.00 | NA | 7.45 | 0.7 |
| NL1E | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| NL1E | 6 | 1.91 | 0.1 | 0.00 | NA | 1.91 | 0.1 |
| NL1E | TOTAL | 38.28 | 1.2 | 19.30 | 4.1 | 57.58 | 2.2 |

Table 3.7-3. Continued.

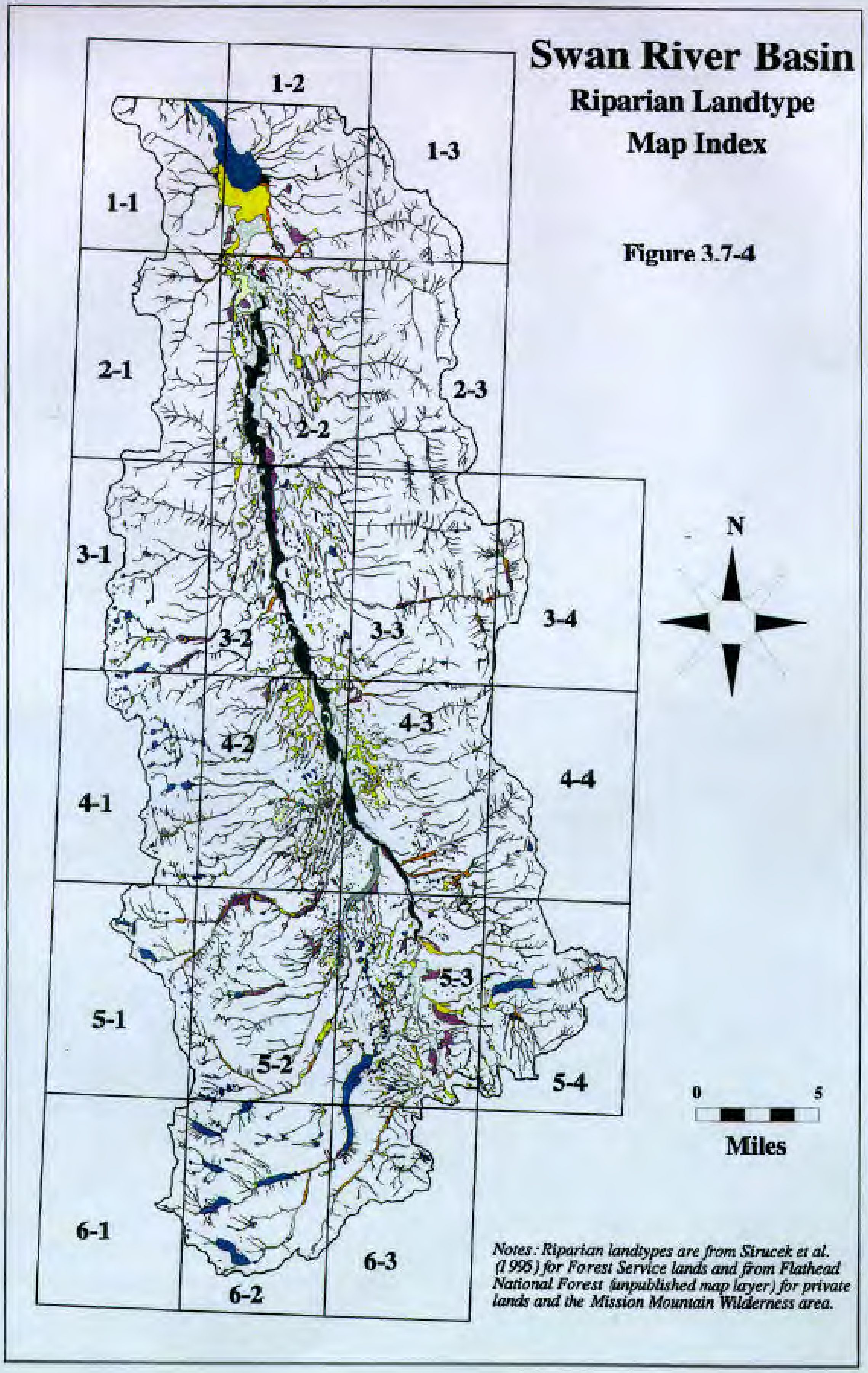
| RLT | ORDER | -PERENNIAL- Length (mi) | Grade (%) | -INTERMITTENT- Length (mi) | Grade (%) | ----TOTAL----- Length (mi) | Grade (%) |
|---|---|---|---|---|---|---|---|
| NL2A | 1 | 18.52 | 7.2 | 37.51 | 8.5 | 56.04 | 8.1 |
| NL2A | 2 | 23.27 | 3.8 | 2.70 | 4.4 | 25.97 | 3.8 |
| NL2A | 3 | 25.58 | 3.1 | 0.47 | 4.7 | 26.05 | 3.2 |
| NL2A | 4 | 21.32 | 2.7 | 0.10 | 0.9 | 21.42 | 2.7 |
| NL2A | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| NL2A | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| NL2A | TOTAL | 88.70 | 4.1 | 40.77 | 8.2 | 129.47 | 5.4 |
| SL2A | 1 | 0.45 | 9.1 | 8.36 | 8.6 | 8.81 | 8.7 |
| SL2A | 2 | 39.15 | 8.3 | 4.72 | 11.4 | 43.87 | 8.6 |
| SL2A | 3 | 28.28 | 7.3 | 1.43 | 8.0 | 29.71 | 7.3 |
| SL2A | 4 | 2.21 | 4.6 | 0.19 | 8.1 | 2.40 | 4.9 |
| SL2A | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| SL2A | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| SL2A | TOTAL | 70.09 | 7.7 | 14.70 | 9.4 | 84.78 | 8.0 |
| SL2B | 1 | 2.16 | 9.9 | 9.28 | 13.5 | 11.44 | 12.8 |
| SL2B | 2 | 7.32 | 8.7 | 1.00 | 6.2 | 8.32 | 8.4 |
| SL2B | 3 | 7.30 | 6.6 | 0.51 | 3.6 | 7.80 | 6.4 |
| SL2B | 4 | 0.94 | 7.1 | 0.00 | NA | 0.94 | 7.1 |
| SL2B | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| SL2B | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| SL2B | TOTAL | 17.72 | 7.9 | 10.79 | 12.3 | 28.50 | 9.6 |
| SL3A | 1 | 2.12 | 13.3 | 18.27 | 11.6 | 20.39 | 11.8 |
| SL3A | 2 | 10.36 | 10.1 | 2.52 | 9.7 | 12.88 | 10.0 |
| SL3A | 3 | 3.35 | 8.6 | 1.07 | 4.8 | 4.42 | 7.6 |
| SL3A | 4 | 0.40 | 8.6 | 0.00 | NA | 0.40 | 8.6 |
| SL3A | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| SL3A | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| SL3A | TOTAL | 16.23 | 10.2 | 21.86 | 11.1 | 38.08 | 10.7 |
| SL3B | 1 | 4.47 | 7.8 | 0.00 | NA | 4.47 | 7.8 |
| SL3B | 2 | 2.31 | 10.1 | 0.00 | NA | 2.31 | 10.1 |
| SL3B | 3 | 2.49 | 8.3 | 0.00 | NA | 2.49 | 8.3 |
| SL3B | 4 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| SL3B | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| SL3B | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| SL3B | TOTAL | 9.27 | 8.5 | 0.00 | ERR | 9.27 | 8.5 |

Table 3.7-3. Continued.

| RLT | ORDER | -PERENNIAL- Length (mi) | Grade (%) | -INTERMITTENT- Length (mi) | Grade (%) | ----TOTAL----- Length (mi) | Grade (%) |
|---|---|---|---|---|---|---|---|
| SL5A | 1 | 1.67 | 34.5 | 7.34 | 39.3 | 9.01 | 38.4 |
| SL5A | 2 | 3.48 | 6.8 | 5.22 | 7.4 | 8.70 | 7.1 |
| SL5A | 3 | 1.59 | 9.2 | 0.58 | 21.7 | 2.18 | 12.5 |
| SL5A | 4 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| SL5A | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| SL5A | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| SL5A | TOTAL | 6.74 | 14.2 | 13.14 | 25.8 | 19.89 | 21.9 |
| MS3A | 1 | 24.49 | 20.6 | 94.28 | 22.3 | 118.77 | 22.0 |
| MS3A | 2 | 29.33 | 18.2 | 5.51 | 20.0 | 34.84 | 18.5 |
| MS3A | 3 | 6.88 | 14.6 | 0.00 | NA | 6.88 | 14.6 |
| MS3A | 4 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| MS3A | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| MS3A | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| MS3A | TOTAL | 60.70 | 18.7 | 99.80 | 22.2 | 160.50 | 20.9 |
| MS3B | 1 | 19.59 | 18.2 | 93.92 | 22.8 | 113.50 | 22.0 |
| MS3B | 2 | 3.23 | 18.1 | 0.26 | 4.8 | 3.49 | 17.1 |
| MS3B | 3 | 1.88 | 17.0 | 0.00 | NA | 1.88 | 17.0 |
| MS3B | 4 | 0.44 | 14.9 | 0.00 | NA | 0.44 | 14.9 |
| MS3B | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| MS3B | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| MS3B | TOTAL | 25.13 | 18.1 | 94.18 | 22.7 | 119.31 | 21.8 |
| MS4A | 1 | 2.76 | 9.4 | 0.15 | 5.1 | 2.91 | 9.2 |
| MS4A | 2 | 11.59 | 15.3 | 12.35 | 20.1 | 23.93 | 17.8 |
| MS4A | 3 | 6.87 | 16.7 | 0.07 | 14.2 | 6.94 | 16.7 |
| MS4A | 4 | 0.90 | 11.4 | 0.00 | NA | 0.90 | 11.4 |
| MS4A | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| MS4A | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| MS4A | TOTAL | 22.11 | 14.9 | 12.57 | 19.9 | 34.67 | 16.7 |
| MS5A | 1 | 10.09 | 3.4 | 60.92 | 2.4 | 71.01 | 2.5 |
| MS5A | 2 | 4.53 | 5.4 | 0.02 | 22.4 | 4.56 | 5.5 |
| MS5A | 3 | 3.43 | 4.1 | 0.00 | NA | 3.43 | 4.1 |
| MS5A | 4 | 3.27 | 2.5 | 0.00 | NA | 3.27 | 2.5 |
| MS5A | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| MS5A | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| MS5A | TOTAL | 21.33 | 3.8 | 60.94 | 2.4 | 82.27 | 2.8 |

Table 3.7-3. Continued.

| RLT | ORDER | -PERENNIAL- Length (mi) | Grade (%) | -INTERMITTENT- Length (mi) | Grade (%) | ----TOTAL----- Length (mi) | Grade (%) |
|---|---|---|---|---|---|---|---|
| VS3A | 1 | 6.71 | 33.8 | 48.65 | 46.6 | 55.36 | 45.0 |
| VS3A | 2 | 3.09 | 37.3 | 0.50 | 30.8 | 3.59 | 36.4 |
| VS3A | 3 | 0.01 | 38.6 | 0.00 | NA | 0.01 | 38.6 |
| VS3A | 4 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| VS3A | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| VS3A | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| VS3A | TOTAL | 9.80 | 34.9 | 49.15 | 46.4 | 58.95 | 44.5 |
| VS4A | 1 | 4.59 | 34.7 | 52.34 | 46.0 | 56.93 | 45.1 |
| VS4A | 2 | 4.27 | 34.6 | 2.23 | 41.7 | 6.51 | 37.0 |
| VS4A | 3 | 0.28 | 32.1 | 0.47 | 30.3 | 0.75 | 30.9 |
| VS4A | 4 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| VS4A | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| VS4A | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| VS4A | TOTAL | 9.14 | 34.6 | 55.04 | 45.7 | 64.18 | 44.1 |
| VS4G | 1 | 3.25 | 14.9 | 18.63 | 8.7 | 21.88 | 9.6 |
| VS4G | 2 | 1.94 | 26.9 | 2.06 | 40.0 | 4.00 | 33.6 |
| VS4G | 3 | 0.00 | NA | 0.31 | 36.6 | 0.31 | 36.6 |
| VS4G | 4 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| VS4G | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| VS4G | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| VS4G | TOTAL | 5.19 | 19.4 | 21.00 | 12.2 | 26.19 | 13.6 |
| WL5A | 1 | 9.31 | 17.4 | 59.39 | 19.3 | 68.70 | 19.0 |
| WL5A | 2 | 2.21 | 11.5 | 3.83 | 1.6 | 6.04 | 5.2 |
| WL5A | 3 | 1.80 | 6.7 | 1.08 | 2.3 | 2.88 | 5.0 |
| WL5A | 4 | 0.48 | 6.2 | 0.00 | NA | 0.48 | 6.2 |
| WL5A | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| WL5A | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| WL5A | TOTAL | 13.81 | 14.6 | 64.30 | 17.9 | 78.10 | 17.4 |
| WS5A | 1 | 0.00 | NA | 0.01 | 3.3 | 0.01 | 3.3 |
| WS5A | 2 | 4.84 | 16.1 | 5.05 | 9.7 | 9.89 | 12.9 |
| WS5A | 3 | 0.37 | 17.7 | 0.34 | 1.9 | 0.71 | 10.2 |
| WS5A | 4 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| WS5A | 5 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| WS5A | 6 | 0.00 | NA | 0.00 | NA | 0.00 | NA |
| WS5A | TOTAL | 5.22 | 16.3 | 5.39 | 9.2 | 10.61 | 12.7 |



Swan River Basin
Riparian Landtype
Map Index
Figure 3.7-4
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4-2
4-3
4-4
5-1
5-2
5-3
5-4
6-1
6-2
6-3
N
0
5
Miles
*Notes: Riparian landtypes are from Sirucek et al. (1995) for Forest Service lands and from Flathead National Forest (unpublished map layer) for private lands and the Mission Mountain Wilderness area.*

# Riparian Landtypes Legend

- LAKE
- FL1C
- FL2C
- FL2D
- MS3A
- MS3B
- MS4A
- MS5A
- NL1A
- NL1E
- NL2A
- SL2A
- SL2B
- SL3A
- SL3B
- SL5A
- VS3A
- VS4A
- VS4G
- WL5A
- WS5A
- UPLAND

The distribution of riparian landtype by subsections (see chapter 3.3) is illustrated in Figure 3.7-5. The scarp slope subsection (Swan Range) has the lowest proportion of riparian landtype (4 percent). The dip slope subsection (Mission Range) has about 8 percent riparian landtype. Most of the riparian landtype is found in the valley subsection, which is about 28 percent riparian landtype. The distributions of riparian landtypes for general landtype classes are listed in Table 3.7-4. About 69 percent of the riparian landtype in the Swan River basin is associated with ground moraine and floodplain landtypes. Riparian landtypes are major components of wet depression (65 percent), floodplain (75 percent), glacial outwash (24 percent) and colluvial (29 percent) landtypes.

The reader is referred to Sirucek and Bachurski (1995), for more detailed unit descriptions. For more detailed descriptions of survey methods and map units, refer to Riparian Landtype Inventory of the Flathead National Forest (ibid.). A legend of riparian community and habitat types mentioned in riparian landtype descriptions is presented as Table 3.7-5. Those interested in more detailed description of riparian types are referred to Classification and Management of Montana's Riparian and Wetland Sites (Hansen et al. 1995).

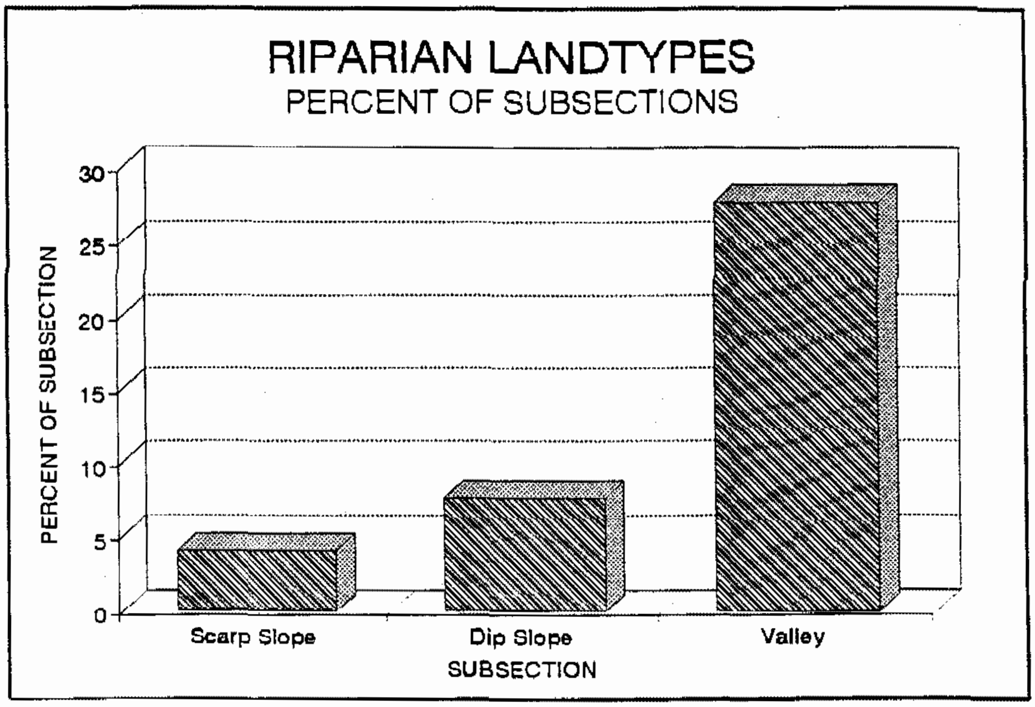


Figure 3.7-5. Proportion of subsections that are riparian landtypes.

Table 3.7-4. Distribution of Riparian Landtypes (RLTs) for Landtype Classes (LTCs).

| LANDTYPE CLASS | DISTRIBUTION OF RLTs (ac) (1) | (%) (2) | LTC (ac) (3) | RLT/LTC (%) (4) |
|---|---|---|---|---|
| Lake | 3319 | 6.1 | 5653 | 58.7 |
| Wet Depression | 2216 | 4.1 | 3425 | 64.7 |
| Floodplain | 12381 | 22.9 | 16591 | 74.6 |
| Alluvial Fan | 130 | 0.2 | 1976 | 6.6 |
| Glacial Basin | 2975 | 5.5 | 33026 | 9.0 |
| Glacial Trough | 2710 | 5.0 | 54904 | 4.9 |
| Ground Moraine | 24679 | 45.7 | 163875 | 15.1 |
| Glacial Outwash | 3360 | 6.2 | 14043 | 23.9 |
| Residual | 739 | 1.4 | 45256 | 1.6 |
| Colluvial | 146 | 0.3 | 506 | 28.8 |
| Rockland | 1349 | 2.5 | 69375 | 1.9 |
| TOTAL | 54003 | 100.0 | 408630 | |

[1] Total area of riparian landtype in respective landtype class.

[2] Percent of the total riparian landtype for Swan River basin in respective landtype class.

[3] Total acres of landtype class.

[4] Percent of landtype class that is riparian landtype.

Table 3.7-5. Riparian community and habitat type legend.

| ACRONYM | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| ABGR/ATFI | *Abies grandis/Athyrium filix-femina* | Grand fir/lady fern |
| ABGR/OPHO | *Abies grandis/Oplopanax horridum* | Grand fir/devils club |
| ABLA/ACRU | *Abies lasiocarpa/Actea rubra* | Subalpine fir/baneberry |
| ABLA/CACA | *Abies lasiocarpa/Calamagrostis canadensis* | Subalpine fir/bluejoint reedgrass |
| ABLA/LEGL | *Abies lasiocarpa/Ledum glandulosum* | Subalpine fir/Labrador tea |
| ABLA/LIBO | *Abies lasiocarpa/Linnaea borealis* | Subalpine fir/twinflower |
| ABLA/OPHO | *Abies lasiocarpa/Oplopanax horridum* | Subalpine fir/devils club |
| ABLA/STAM | *Abies lasiocarpa/Streptopus amplexifolius* | Subalpine fir/twisted stalk |
| ABLA/VACA | *Abies lasiocarpa/Vaccinium caespitosum* | Subalpine fir/ |
| ALIN | *Alnus incana* | Mountain alder |
| ALSI | *Alnus sinuata* | Sitka alder |
| CARO | *Carex rostrata* | Beaked sedge |
| COST | *Cornus stolonifera* | Red-osier dogwood |
| PICEA/COST | *Picea/Cornus stolonifera* | Spruce/red-osier dogwood |
| PICEA/EQAR | *Picea/Equisetum arvense* | Spruce/field horsetail |
| PICEA/GATR | *Picea/Galium triflorum* | Spruce/sweetscented bedstraw |
| PICEA/LIBO | *Picea/Linnaea borealis* | Spruce/twinflower |
| POTR/COST | *Populus tremuloides/Cornus stolonifera* | Aspen/red-osier dogwood |
| PSME/COST | *Pseudotsuga menziesii/Cornus stolonifera* | Douglas-fir/red-osier dogwood |
| SADR | *Salix drummondiana* | Drummond willow |
| SADR/CACA | *Salix drummondiana/Calamagrostis canadensis* | Drummond willow/blue-joint reedgrass |
| SADR/CARO | *Salix drummondiana/Carex rostrata* | Drummond willow/beaked sedge |
| SAEX | *Salix exigua* | Sandbar willow |
| SAPL | *Salix planifolia* | Plainleaf willow |
| THPL/GYDR | *Thuja plicata/Gymnocarpium dryopteris* | Western red cedar/oak fern |
| THPL/OPHO | *Thuja plicata/Oplopanax horridum* | Western red cedar/devils club |

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