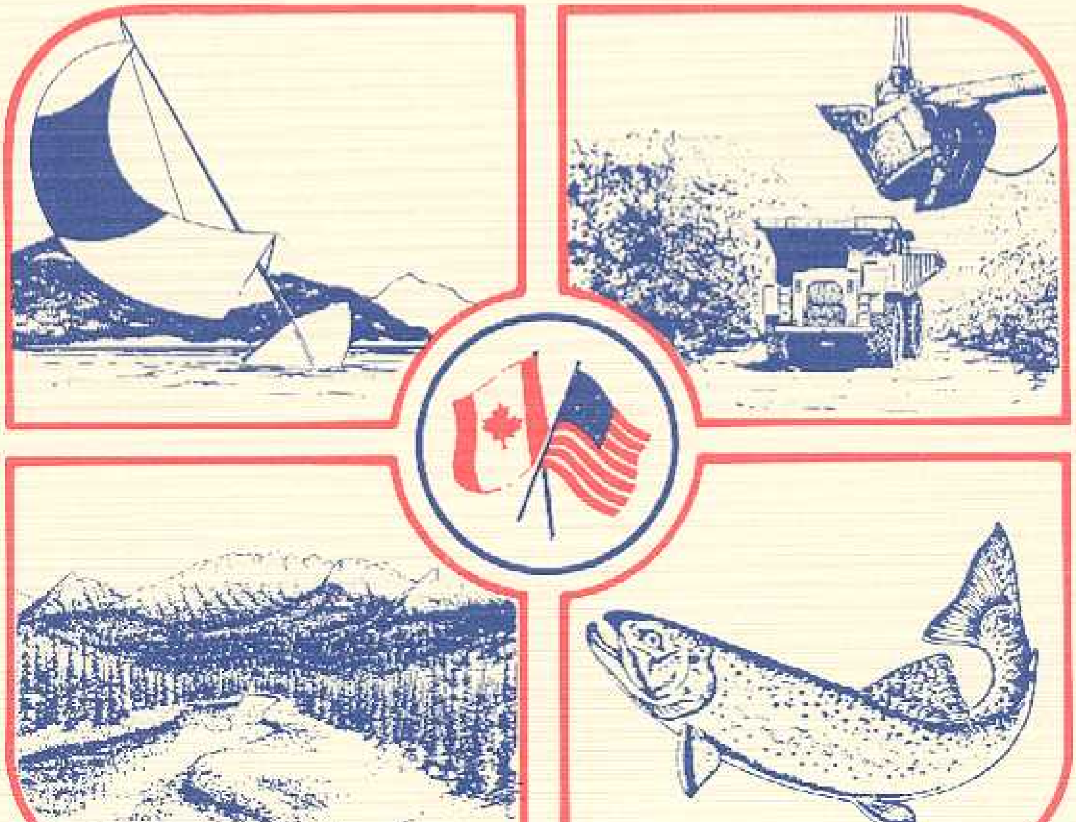
# FLATHEAD RIVER

## INTERNATIONAL STUDY



## WATER USES COMMITTEE
## TECHNICAL REPORT

# WATER AND ASSOCIATED SOCIO-ECONOMIC ACTIVITIES IN THE FLATHEAD RIVER BASIN OF SOUTHEAST BRITISH COLUMBIA AND NORTHERN MONTANA

BY

WATER USES COMMITTEE

FLATHEAD RIVER INTERNATIONAL STUDY BOARD

December 1987

# Water and Associated Socio-Economic Activities in the Flathead River Basin of Southeast British Columbia and Northern Montana

by

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Flathead River International Study Board

December 1987

We, the undersigned, members of the Water Uses Committee, appointed by the Flathead River International Study Board, have prepared the following report: "Water and Associated Socio-Economic Activities in the Flathead River Basin of Southeast British Columbia and Northern Montana" and fully endorse its contents.

| CANADIAN SECTION | U.S. SECTION |
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## LIST OF ABBREVIATIONS

| | |
|---|---|
| International Joint Commission | IJC |
| Water Uses Committee | WUC |
| United States Forest Service | USFS |
| U.S. Forest Service Recreation Information Managment Center | RIM Center |
| Federal Highway Administration | FHA |
| U.S. Environmental Protection Agency | EPA |
| U.S. Department of Transportation | DOT |
| U.S. Army Corps of Engineers | COE |
| U.S. Soil Conservation Service | SCS |
| United Nations Educational, Scientific, and Cultural Organization | UNESCO |
| Montana Department of Fish, Wildlife, and Parks | MDFWP |
| Montana Department of State Lands | MDSL |
| Montana Department of Natural Resources and Conservation | MDNRC |
| Montana Department of Health and Environmental Sciences | MDHES |
| MDHES Water Quality Bureau | WQB |
| Montana Department of Highways | MDH |
| Burlington Northern Railroad Company | BN |
| Pacific Power and Light | PPL |
| Statute | Stat. |
| Environmental Impact Statement | EIS |
| Final Environmental Impact Statement | FEIS |
| Environmental Assessment | EA |

## LIST OF ABBREVIATIONS (concluded)

| | |
|---|---|
| U.S. National Environmental Policy Act | NEPA |
| State of Montana Preliminary Environmental Review | PER |
| National Priorities List | NPL |
| Water Quality and Quantity Committee | WQQC |
| Biological Resources Committee | BRC |
| dissolved oxygen | DO |
| total suspended solids | TSS |
| thousand board feet | MMBF |
| hectares | ha |
| meters | m |
| kilometers | km |
| square kilometers | $km^2$ |
| meters per kilometer | m/km |
| feet | ft |
| miles | mi |
| feet per mile | ft/mi |
| gallon (U.S. gallon) | gal |

## EXECUTIVE SUMMARY

The Governments of the United States and Canada forwarded a reference to the International Joint Commission (IJC) in 1984 December 19 and 1985 February 15, respectively, requesting the Commission, pursuant to Article IX of the Boundary Waters Treaty of 1909, "to examine into and report upon the water quality and quantity of the Flathead River, relating to the transboundary water quality and quantity implications of the proposed coal mine development on Cabin Creek in British Columbia near its confluence with the Flathead River, and to make recommendations which would assist governments in ensuring that the provisions of Article IV of the said Treaty are honored." In April 1985, the Commission established the Flathead River International Study Board (FRISB) to undertake the investigations requested by the International Joint Commission.

The FRISB developed a Plan of Study in June 1985 which called for the establishment of four technical committees. One of the committees was the Water Uses Committee (WUC). The FRISB assigned the following tasks to the WUC.

1. Identify all existing socio-economic activities which consumptively or non-consumptively use or affect water in the Study area (as defined in Section 1.3 Study Area, Draft Study Plan, except that the study area in British Columbia shall include all of the Flathead River Basin in British Columbia); (the term "activities" includes uses of water such as drinking, fishing, swimming, and irrigation and also includes activities which affect the drainage basin, such as logging and sewage treatment);
2. identify all water-related development activities in the study area (e.g., timber sales, recreational, subdivisions, tertiary sewage treatment, etc.) which have been approved or licensed (and whose impacts are not yet reflected in current water quality or quantity conditions of the study area);
3. collect all available information related to existing

activities which use or affect water in the study area;

4. assess the impacts of existing socio-economic activities identified in paragraph (a) above on water quality and quantity of the study area;
5. assess the impacts of committed socio-economic activities identified in paragraph (b) above in terms of expected effects to water quality and quantity of the study area; and,
6. based on information provided by the Water Quality and Quantity Committee, the Biological Resources Committee, and the Mine Development Committee, and also assessments and information developed by the Water Uses Committee, carry out an analysis of the effects resulting from construction, operation, and reclamation of the proposed Cabin Creek Coal Mine on water-related activities in the Flathead River Basin south of the International Boundary.

The WUC completed these tasks by dividing its efforts into a Phase 1 study and a Phase 2 study.

Phase 1. Collection of socio-economic information within the Flathead River Basin (hereinafter referred to as the Basin) in order to complete tasks 1 to 5.

Phase 2. Using information and data which was already available or became available from the other committees during the course of the investigations, complete task 6.

To assist the WUC organize its Phase 1 efforts, the study area was divided into eight designated sub-basins:

1. North Fork, Flathead River in British Columbia;
2. North Fork, Flathead River in Montana;
3. Whitefish River/Stillwater River;
4. Middle Fork, Flathead River;
5. South Fork, Flathed River (upstream of Hungry Horse Dam).
6. Flathead River-Mainstem;
7. Swan River/Swan Lake; and,
8. Flathead Lake.

Chapters 2 through 9 identify the current and/or committed socio-economic activities which consumptively or non-consumptively use water, or are potentially impacted by changes in the water quality and/or water quantity in each of the eight sub-basins. Chapter 10 briefly reviews the relationships between several socio-economic activities in the entire Flathead River Basin and the quantity of water available in this Basin. Chapter 11 briefly reviews the relationships between several socio-economic activities in the entire Flathead River Basin and the suitability of the water quality in the Basin. Chapter 12 provides a limited evaluation of the impact of potential changes in water quality, water quantity and biological resources on socio-economic activities south of the International Boundary.

The North Fork, Flathead River in British Columbia is essentially uninhabited with an estimated population of 10. Timber harvesting is its only significant socio-economic activity. There is limited oil and gas exploration. The proposed coal mine would be constructed and operated in this sub-basin. There are a few recreational sites in this sub-basin, however, the number of visitors is unknown. Fishing, hunting, and trapping are the main recreational activities in this designated sub-basin.

Timber harvesting is an important socio-economic activity in the North Fork, Flathead River in Montana. Glacier National Park is part of this sub-basin; the North Fork is part of the Federal Wild and Scenic Rivers system. Recreation is an important activity in this sub-basin. Fishing, swimming, sightseeing, hunting, river floating, camping, and hiking are the predominant recreational activities. The United States Government owns approximately 94 percent of the land. The estimated permanent population is 140 people; there are no incorporated communities in this sub-basin. Glacier National Park is part of the Waterton-Glacier International Peace Park. Glacier National Park is a Biosphere Reserve, and has been nominated as a World Heritage Site.

The Whitefish River/Stillwater River sub-basin socio-economic activities contribute sediments to the Flathead River-Mainstem/Flathead Lake sub-basins. This sub-basin, however, would not be directly impacted by the proposed coal mine since it is not directly downstream from the proposed mine site. Parts of this sub-basin are intensively managed for timber harvesting. The portion of this sub-basin nearest to the Flathead River-Mainstem supports agriculture. There are numerous public and private recreational facilities. Fishing, hunting, camping and hiking are the predominant recreational activities. The estimated population of this sub-basin is 13,500. Whitefish, with a population of 3700, is the only incorporated community. The Whitefish sewage treatment system is being upgraded with tertiary treatment capability to reduce phosphorus discharges to 1.0 milligram of total phosphorus per litre.

The primary developmental activity in the Middle Fork, Flathead River sub-basin is also timber harvesting. The Middle Fork is part of the Wild and Scenic Rivers system. The most important recreational activities in this sub-basin are fishing, camping and whitewater floating. The Middle Fork (and its tributaries) is an important production area for the cutthroat trout, kokanee salmon and bull trout living in the Basin. There are no incorporated settlements. The estimated permanent population at this sub-basin is approximately 450.

An important socio-economic activity in the South Fork, Flathead River sub-basin is timber harvesting. Power generation is also an important developmental activity. The Hungry Horse Dam generates electricity which is sold within and outside of the State of Montana. Virtually all of the South Fork, Flathead River sub-basin is federally owned. The seasonal population of the sub-basin is estimated to be 50. The South Fork, Flathead River is part of the National Wild and Scenic River system. Water-based recreation includes fishing and boating. Hiking, hunting, and camping occur in the surrounding Flathead National Forest and the Great Bear and Bob Marshall Wilderness areas. This sub-basin would not be directly impacted by the proposed coal mine because it is not directly downstream of the proposed coal mine.

The Flathead River-Mainstem begins at the confluence of the Flathead River's North and Middle Forks at the southwest boundary of Glacier National Park. the estimated population of this sub-basin is 33,400. Most of the land in this sub-basin is privately owned. There are many recreational sites in this sub-basin. Fishing, hunting, hiking, camping, and rafting are major recreational activities in this sub-basin. This sub-basin supports a very important kokanee fishery. The incorporated communities of Kalispell and Columbia Falls, are located in this designated sub-basin with estimated populations of 10,700 and 3100, respectively. The majority of agricultural activity in Flathead County occurs in this sub-basin. The total cropland is estimated at 44,000 ha (108,000 acres). The two largest acreages are used to graze beef cattle and grow barley. Point and non-point source contamination of the Flathead River-Mainstem has been attributed to residential and community development in this sub-basin. The Columbia Falls and Kalispell sewage treatment systems are being upgraded with tertiary treatment capability to reduce phosphorus discharges to 1.0 mg per litre. The Aluminum Plant at Columbia Falls is the largest industrial activity in this sub-basin. There are also a number of timber-related industrial facilities in the Flathead River-Mainstem sub-basin.

Timber harvesting is the most important socio-economic activity in the Swan River/Swan Lake sub-basin. Most of the area consists of National Forest, State Forest and large corporate forest lands. There are two small unincorporated settlements, Condon and Swan Lake. The permanent population of this sub-basin is approximately 1800. The primary recreational activities are fishing and boating. There is little agricultural and industrial activity in this sub-basin.

The Flathead Lake sub-basin includes Flathead Lake and all streams (excluding the Flathead and Swan Rivers) that flow directly into the Lake. The northern boundary is where the Flathead River-Mainstem enters the Lake. The southern boundary is Kerr Dam which is located on the Flathead River 6.4 km (4 mi) downstream from Flathead Lake. Four small communities, Bigfork, Somers, Lakeside, and Polson, are located on

Flathead Lake. The estimated population is 9700. Flathead Lake is a major recreational attraction in Montana. It is considered to have both regional and national recreational significance. Fishing, boating, water skiing, swimming and sightseeing are important recreational activities. Seven state recreation areas and two state parks are found around Flathead Lake.

The only incorporated community in the Flathead Lake sub-basin is Polson with an estimated population of 2800. The remaining population lives in rural homesites or unincorporated communities surrounding the shoreline of Flathead Lake. There are a substantial number of people who use Flathead Lake for their domestic water source. Approximately 18 percent (16,000 ha/40,000 acres) of the land area in this sub-basin is farmland. The eastern shoreline has numerous orchards.

The WUC made an attempt to evaluate the contribution of contaminants to surface waters in the Flathead River Basin. Point and non-point source activities cause contamination. The most important point source appears to be sewage treatment plants. Forest activities and septic systems appear to be important non-point sources.

The Water Quality Branch, Montana Department of Health and Environmental Sciences (WQB, MDHES) has prepared an estimate of sewage treatment plants discharges. However, it was not possible to provide an estimate of non-point source contamination. The Flathead National Forest has attempted to develop quantitative estimates of non-point source contamination caused by timber harvesting. It is experiencing difficulty developing these estimates for individual timber sales. Information is available to document that failed septic systems are discharging contaminants to surface and shallow ground water (e.g., Whitefish lake and Evergreen). There is a paucity of quantitative information available to estimate non-point source contamination from septic tanks.

There are efforts underway to address non-point source contamination. The Flathead National Forest has committed to implement procedures to minimize non-point source contamination. Lake and Flathead Counties in Montana have added procedures to restrict the sale of detergents containing phosphorus. The WQB, MDHES has imposed requirements to reduce discharges from septic systems. These include more restrictive siting, hook ups to community sewage systems that route wastes to sewage treatment plants, and 50-year non-failure requirements for newly installed septic systems.

Under existing conditions, water quantity appears adequate for water uses occurring in the North Fork, Flathead River in British Columbia; North Fork, Flathead River in Montana; and, Flathead River-Mainstem designated sub-basins. The remaining sub-basins were not evaluated because construction of the proposed mine in British Columbia would not directly impact their water quantity. The Flathead Lake sub-basin was not evaluated because the WUC concluded that water quantity in the Flathead River system was adequate.

Fishery concerns have apparently been addressed by securing claims for instream water use in the North Fork, Flathead River in Montana and the required 99.1 $m^3/s$ flow from October to April in the Flathead River-Mainstem. These flows, however, appear to only support existing fish populations and increased, and more stable, flows at certain times of the year may be required for increased fish populations.

Timber harvesting may adversely affect water quantity at local sites, but normally approximately 25 percent of a watershed must be recently clear-cut for changes in water flows to become apparent. None of the three preceding sub-basins in the Basin approached the 25 percent figure and a quick review of the remaining five sub-basins indicated that these sub-basins did not approach the 25 percent figure.

Water quality was evaluated in terms of generalized water uses in the North Fork, Flathead River in Montana and the Flathead River-Mainstem designated sub-basins. The analysis was restricted to these two sub-basins as they were felt to be the only ones that may be subject to water quality influences from the proposed coal mine. Thirty-four water quality characteristics and constituents were screened using general criteria used by various agencies. The existing water quality met the requirements of all known general categories of water use with the exception of four metals, suspended sediment, turbidity, oxygen, total inorganic nitrogen and the Stress Index.

The exceedance of the cadmium and lead criteria may be significant to aquatic life and consumers of fish whereas the exceedance of the aluminum and chromium criteria are unlikely to be significant. Suspended sediment and turbidity levels exceeded the selected criteria during the freshet period by a large margin. These criteria are also occasionally exceeded during the remainder of the year. High Stress Index values also suggest conditions are less than ideal for fish during freshet. Recreational, aesthetic, drinking and aquatic life uses are limited by existing suspended sediment and turbidity levels in the North Fork, Flathead River in Montana and the Flathead River-Mainstem mainly during April, May and June. Occasional dissolved oxygen levels below the criterion also may be stressful particularly to cutthroat trout. The exceedance of the total inorganic nitrogen criterion is not significant to any water uses in view of the very low levels of periphyton growth in the North Fork, Flathead River in Montana and the Flathead River-Mainstem designated sub-basins.

In its Phase I work, the WUC identified extensive water-based recreation activities in the Basin that could be sensitive to changes in water quality, water quantity and biological resources. As a result of work completed by the Water Quality and Quantity Committee and the Biological Resources Committee, potential changes in water quality and quantity variables and the biological resources were identified at the proposed Cabin Creek coal mine site, at the International Boundary and, in the case of the biological resources, at Flathead Lake. The WUC concluded that if these changes were to occur, socio-economic activities at the mine site and south of the International Boundary to Flathead Lake could be affected. However, because of the limited information, the elimination of the bull trout population of Howell and Cabin Creeks was found to be the only relevant measureable potential impact associated with the proposed coal mine development. Therefore, the WUC Phase 2 work was limited to determining an estimate of economic loss to the State of Montana as a result of the complete loss of the Howell and Cabin Creeks' bull trout population due to the potential Cabin Creek coal mine development in British Columbia. There was not sufficient time, human or financial resources to complete a proper on-site study.

Recent information from creel censuses indicated that the three relevant designated sub-basins, (North Fork, Flathead River in Montana; Flathead River-Mainstem; Flathead Lake) annually supported approximately 97,220 bull trout angler days. Information from relevant studies provided a range in the value of an angler day in 1986 dollars ($17.36 to $143.00). Because the bull trout fishery was considered a high quality fishery, the WUC used a higher value of $51.15 (1986 dollars) for a bull trout angler day. Therefore, bull trout angling in the three designated sub-basins was estimated to have an annual economic value of approximately $5 million (1986 dollars).

Recent studies of the bull trout population estimated that approximately 9.36 percent of the relevant population originated from Howell and Cabin Creeks. Using the sensitivity of angler days to changing fish populations denoted from other studies, the 9.36 percent decline in bull trout population was estimated to result in an annual potential loss in economic value (user value) to the State of Montana of approximately $300,000 to $800,000 (1986 dollars).

The Flathead River Basin's recreational value is of regional and national significance. This recreational value is closely tied to the quality of the Basin's water. In each of the seven sub-basins in the State of Montana, significant numbers of individuals participated in recreational activities such as fishing, swimming, boating, hunting, hiking, camping, and sightseeing.

Timber harvesting is an important socio-economic activity in most of the eight sub-basins. This activity has the potential to contribute substantially to non-point source contamination of the surface water in the Basin. Other potential sources of non-point source contamination are agricultural activities (Flathead Lake sub-basin) and septic tanks. More technical information is required before the impact of non-point source contamination on water quality and biological resources, and subsequently on socio-economic activities south of the International Boundary can be determined.

The total estimated population of the Basin is 59,000 people. The North Fork, Flathead River in British Columbia is essentially uninhabited. Fifty-seven percent of the estimated population in the study area lives in the Flathead River-Mainstem sub-basin. The largest incorporated communities are Kalispell (10,700), Columbia Falls (3100), Whitefish (3700), and Polson (2800).

Wastewater discharges from sewage treatment plants are the most important point sources contributing contamination to surface waters of the Basin. Sewage treatment plants at Kalispell, Whitefish, Columbia Falls, and Bigfork are being upgraded with tertiary treatment to reduce phosphorus levels in the effluent to less than 1.0 milligram per litre.

Based upon information provided to the WUC, the apparent impact from construction, operation, and reclamation of the proposed coal mine in British Columbia is limited to a loss of approximately 10 percent of the Basin's bull trout population. However, the WUC remains concerned with the suitability of the existing information to evaluate the impacts of the proposed mine on the waters of the Flathead River Basin. The quality of available information made it difficult to make other than subjective or "it is difficult to really know" conclusions. Therefore, in light of the quality of the available information, the Water Uses Committee developed the most definitive conclusions possible.

## ACKNOWLEDGEMENTS

To the many individuals and organizations that contributed to this effort, thank you!

# 1. INTRODUCTION

## 1.1 BACKGROUND

The Governments of the United States and Canada forwarded a reference to the International Joint Commission (IJC) in 1984 December 19 and 1985 February 15, respectively, requesting the Commission, pursuant to Article IX of the Boundary Waters Treaty of 1909, "to examine into and report upon the water quality and quantity of the Flathead River, relating to the transboundary water quality and quantity implications of the proposed coal mine development on Cabin Creek in British Columbia near its confluence with the Flathead River, and to make recommendations which would assist governments in ensuring that the provisions of Article IV of the said Treaty are honored."

In 1985 April 18, the Commission, in turn, established a Flathead River International Study Board to undertake, through appropriate agencies and individuals in the United States and Canada, the investigations requested by the Commission. The Board was directed by the Commission "to examine and report to the Commission upon the following:

a. the present state of water quality and water quantity of the Flathead River at the Border (including fluctuations);

b. current water uses (including water dependent uses such as recreation) in the Flathead River basin together with their effects on present water quality and quantity;

c. the nature, location and significance of fisheries currently dependent on the waters of the Flathead River and its tributaries, Howell and Cabin Creek;

d. effects on the present state of water quality and water quantity of the Flathead River at the border which would result from the construction, operation and post-mine reclamation of the proposed Cabin Creek Coal Mine;

e. effects on current water uses (including water dependent uses such as recreation) which would result from effects on the present state of

(i) water quality, and

(ii) water quantity

which have been identified under paragraph (d); and

f. effects which the construction, operation and post-mine reclamation of the proposed Cabin Creek Coal Mine would have on the habitat for fisheries in Canada in the waters of the Flathead River and its tributaries Howell and Cabin Creek, and consequent effects on fisheries in the United States."

In order to undertake the investigations requested by the Commission, the Board in 1985 June 5 developed a Plan of Study which called for the establishment of four technical committees: Mine Development Committee, Water Quality and Quantity Committee, Water Uses Committee (WUC), and Biological Resources Committee. The Board assigned the following tasks to the Water Uses Committee (Flathead River International Study Board 1985):

1. Identify all existing socio-economic activities which consumptively or non-consumptively use or affect water in the Study area (as defined in Section 1.3 Study Area, Draft Study Plan, except that the study area in British Columbia shall include all of the Flathead River Basin in British Columbia); (the term "activities" includes uses of water such as drinking, fishing, swimming, and irrigation and also includes activities which affect the drainage basin, such as logging and sewage treatment);
2. identify all water-related development activities in the study area (e.g., timber sales, recreational, subdivisions, tertiary sewage treatment, etc.) which have been approved or licensed (and whose impacts are not yet reflected in current water quality or quantity conditions of the study area);
3. collect all available information related to existing activities which use or affect water in the Study area;
4. develop information which reflects tolerances and requirements necessary to assess the effects on water-related activities identified in paragraph (a) and

(b) above. This information was developed by the Water Quality Criteria Subcommittee that included members from the existing committees;

5. assess the impacts of existing socio-economic activities identified in paragraph (a) above on water quality and quantity of the study area;
6. assess the impacts of committed socio-economic activities identified in paragraph (b) above in terms of expected effects to water quality and quantity of the study area; and,
7. based on information provided by the Water Quality and Quantity Committee, the Biological Resources Committee, and the Mine Development Committee, and also assessments and information developed by the Water Uses Committee, carry out an analysis of the effects resulting from construction, operation, and reclamation of the proposed Cabin Creek Coal Mine on water-related activities in the Flathead River Basin south of the International Boundary.

## 1.2 PROCEDURE

The tasks assigned to the WUC required the development and completion of a work plan consisting of two phases and preparation of a final report:

Phase 1. Collection of socio-economic information within the Flathead River Basin (hereinafter referred to as the Basin) in order to complete tasks 1 to 3 and 5 to 6.

Phase 2. Using information and data which is already available or becomes available from the other committees during the course of the investigations, complete task 7.

The WUC used existing information and data from published sources and personal communication with knowledgeable individuals; no original on-site studies were conducted.

In completing its Phase 1 work assignments, the WUC received excellent co-operation from various levels of government agencies in both the United States and Canada as well as from individuals in the private sector. The WUC hired a consultant to carry out some initial work on collection of socio-economic activity information and its interrelationship with the water resources. In addition, a consultant was also hired to prepare a series of designated sub-basin maps illustrating the spatial distribution of the socio-economic activities in the study area.

Phase 2 work examined only one potential impact associated with the proposed coal mine development on Cabin Creek. Conclusions reached by the other committees limited the potential measurable impact of the proposed mine to elimination of the bull trout populations of Howell and Cabin Creeks. Therefore, Phase 2 work was limited to estimating the potential direct user loss in value as a result of the reduced bull trout population.

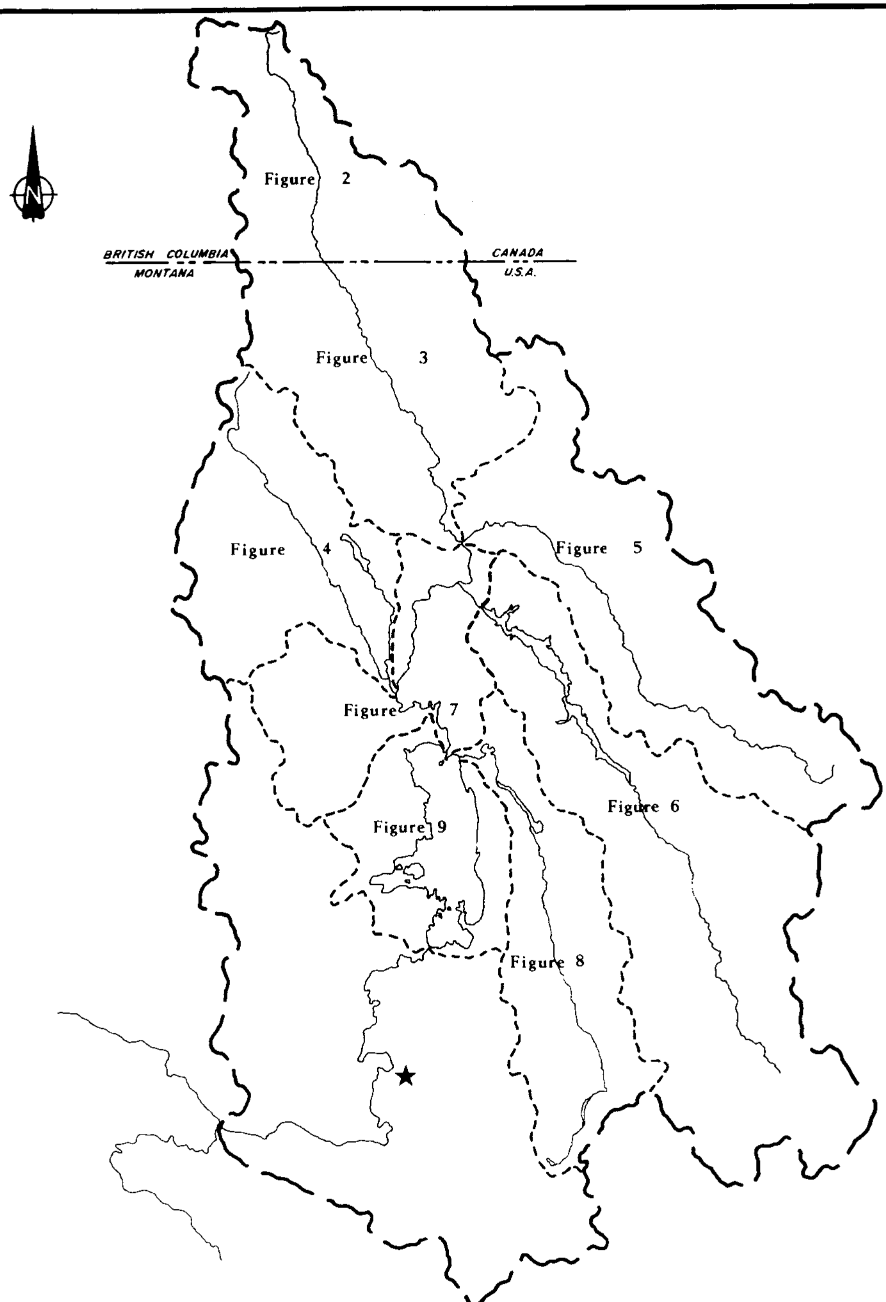
## 1.3 OBJECTIVE - PHASE 1 STUDY

The objective of the Phase 1 study is to identify the current and/or committed socio-economic activities which consumptively or non-consumptively use water or activities that have a potential impact on or are potentially impacted by changes in the water quality and/or water quantity in the study area. Figure 1 provides a map outline of the study area. To assist in the identification of socio-economic activities and the spatial display of the information, the study area was divided into eight (8) designated sub-basins:

1. North Fork, Flathead River in British Columbia;
2. North Fork, Flathead River in Montana;
3. Whitefish River/Stillwater River;
4. Middle Fork, Flathead River;
5. South Fork, Flathead River (upstream of Hungry Horse Dam);
6. Flathead River-Mainstem;
7. Swan River/Swan Lake; and,
8. Flathead Lake

Socio-economic activities that use and/or affect water in the study area have been reviewed and denoted from two different points-of-view. As such, the information is provided in the following format:

# FIGURE I
# MAP OF THE FLATHEAD BASIN STUDY AREA

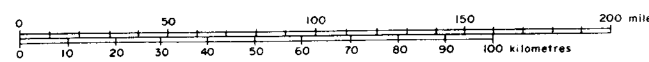



designated sub-basins:

| | |
|---|---|
| Figure 2 | North Fork, Flathead River in British Columbia |
| Figure 3 | North Fork, Flathead River in Montana |
| Figure 4 | Whitefish River / Stillwater River |
| Figure 5 | Middle Fork, Flathead River |
| Figure 6 | South Fork, Flathead River |
| Figure 7 | Flathead River – Mainstem |
| Figure 8 | Swan River / Swan Lake |
| Figure 9 | Flathead Lake |
| ★ | Flathead River South of Kerr Dam; existing or committed socio-economic activities in this sub-basin will be evaluated only if information is provided that determines that, as a result of proposed coal mine, water quality changes at the outlet of Flathead River |

*LEGEND*

- *Flathead River Drainage Basin Boundary*
- *Sub-basin Boundary*
- *International Boundary*
- *River*



1. <u>Current socio-economic activities</u> - an ongoing activity as of the date of the acceptance of the reference by the IJC; and,

2. <u>Committed socio-economic activities</u> - an activity that is approved or licensed and, therefore, expected to occur. Examples are proposed timber harvests, planned sewage treatment plant improvements, and proposed restrictions on construction and siting of septic tanks. Certain activities that are possible or have been proposed are not included as committed activities in this report because, in the opinion of the WUC, they are not likely to occur within several years (e.g., development of oil and gas leases).

## 1.4 OBJECTIVE - PHASE 2 STUDY

The objective of the Phase 2 work was to evaluate the socio-economic impact of the proposed Cabin Creek coal mine development on water-related activities in the Basin south of the International Boundary. In its Phase 1 work, the WUC identified extensive water-based recreation activities in the Basin that could be sensitive to changes in water quality, water quantity and fisheries. As a result of work completed by the other Committees, it was concluded that if the coal mine development were to proceed, the bull trout populations of Howell and Cabin Creeks would be eliminated. As this was found to be the only relevant measurable potential impact associated with the proposed coal mine development, the WUC Phase 2 work was limited to estimating the potential annual direct loss in economic value to the State of Montana as a result of the complete loss of the Howell and Cabin Creeks' bull trout populations.

There was not sufficient time, human or financial resources to complete on-site studies for this Phase 2 work. However, in order to best meet the objective of the Phase 2 work, the WUC reviewed other studies that examined both the economic value of sport fishing activities and the sensitivity of fishing and the associated economic value to changes in fish populations. Then, available information on the Basin's bull trout populations and bull trout angling was utilized and an estimate of potential direct loss in economic value established as a result of the complete loss of the Howell and Cabin Creeks' bull trout populations.

## 1.5 REPORT OUTLINE

The report is assembled in twelve chapters. This introductory chapter deals with background, procedure, study objectives and study area. The next eight chapters provide an overview of the socio-economic activities in the study area: one chapter for each of the eight designated sub-basins. The discussion for each sub-basin is divided into two parts. The first part discusses those existing and/or committed socio-economic activities that are affected by changes in water quality and/or water quantity, whereas the second part examines those activities that potentially affect water quality and/or water quantity. Some activities, such as recreation, are discussed in both parts whereas other activities, such as forestry, are only discussed in the second part as it is highly unlikely that potential changes in water quality and/or quantity will have any impact on forestry activities. Chapter ten reviews the relationship between water quantity and current and/or committed socio-economic in the Basin and chapter eleven examines the suitability of existing water quality for the current and/or committed socio-economic activities of the Basin. Finally, chapter twelve examines one potential economic impact associated with the proposed Cabin Creek coal mine development.

# 2. NORTH FORK, FLATHEAD RIVER IN BRITISH COLUMBIA

## 2.1 INTRODUCTION

This sub-basin has an area of approximately 1666 $km^2$ (639 $mi^2$). Figure 2 shows the sub-basin boundary, major roads, river tributaries and lakes. Roughly one-half of the surface area of this sub-basin is characterized as relatively flat valley bottom consisting of a thick layer of unconsolidated glacio-fluvial gravels and tills, and recent alluvium. The remainder of the sub-basin is mountainous, with mountains to the west, north, and east directing drainage south to the United States. The western and northern portions of the sub-basin contain small areas of Mesozoic rock which contains coal. This Canadian portion of the Basin falls within the Engelmann Spruce-Subalpine Fir biogeoclimatic zone (Krajina 1973). The sub-basin is virtually unpopulated and undeveloped, and logging is the only major activity.

## 2.2 SOCIO-ECONOMIC ACTIVITIES POTENTIALLY IMPACTED BY CHANGES IN WATER QUALITY AND/OR WATER QUANTITY

### 2.2.1 Recreation

The Canadian portion of the Flathead River Basin attracts visitors mainly during the summer and fall seasons (Sage Creek Coal Limited 1982). The most popular activities (ranked, starting with most popular) are: hunting, fishing, off-road four-wheel driving, camping, and snowmobiling (Bailey and Nessman 1982).

Fishing, hunting, camping and sightseeing are the major activities in the vicinity of the mine site. The Flathead River and Howell Creek attract anglers seeking cutthroat and bull trout (not Dolly Varden), mostly during July and August. Elk, moose, deer, and other game are hunted in the fall. Guides bring 40 to 50 hunters per season to the southern portion of this sub-basin (Sage Creek Coal Limited 1982).

There are no reliable data on actual numbers of hunter or angler days for this sub-basin. A telephone and questionnaire survey of residents living east of Cranbrook in southeastern British Columbia (Coal Block area) found that this sub-basin area was ranked third out of eight zones for a hunting or fishing destination.

The survey determined there are approximately 6600 anglers and 2700 hunters residing in the Coal Block area. It was estimated that 50 percent of all Coal Block residents (1976 population = 11,128) participate in some form of outdoor recreation in this sub-basin each year (Bailey and Nessman 1982). In addition, the Tobacco Plains Indian Band of Grasmere, British Columbia have trapping rights to the lands within the proposed mine site (Sage Creek Coal Limited 1982).

### 2.2.2 Settlement

Some maps indicate the existence of a rural development called Flathead in the northern section of the sub-basin. However, there are in fact no people or buildings at such a location. The only permanent residents in the sub-basin are a guide with family and a few other individuals. The total permanent population is estimated to be less than 12 (January 1986, D. Valiela, Inland Waters & Lands, Environment Canada, Vancouver, British Columbia, personal communication).

There are two water licences for consumptive use for the sub-basin; both are on small tributaries (Fontana and Fillmore Creeks) upstream of the proposed mine site (Figure 2A). Presumably, the other people living in the sub-basin rely on well water or have unlicensed surface water intakes. The 20 to 30 exploration personnel working for Shell Canada Resources Ltd. are located between Harvey Creek and Howell Creek (Figure 2A), and rely on well water supplies.

### 2.2.3 Agriculture

No information was found on agricultural activity in this sub-basin.

### 2.2.4 Preservation

It has been proposed that the headwaters of the Kishinena-Akamina, Starvation, and North Kintla Creeks, located in the extreme southeast corner of the sub-basin, be designated as a Recreational Area and/or Provincial park (Figure 2A). This area would be adjacent to Waterton Lakes National Park in Alberta and Glacier National Park in Montana. The Recreational Area designation would result in restrictions on certain developments and in the establishment of hiking

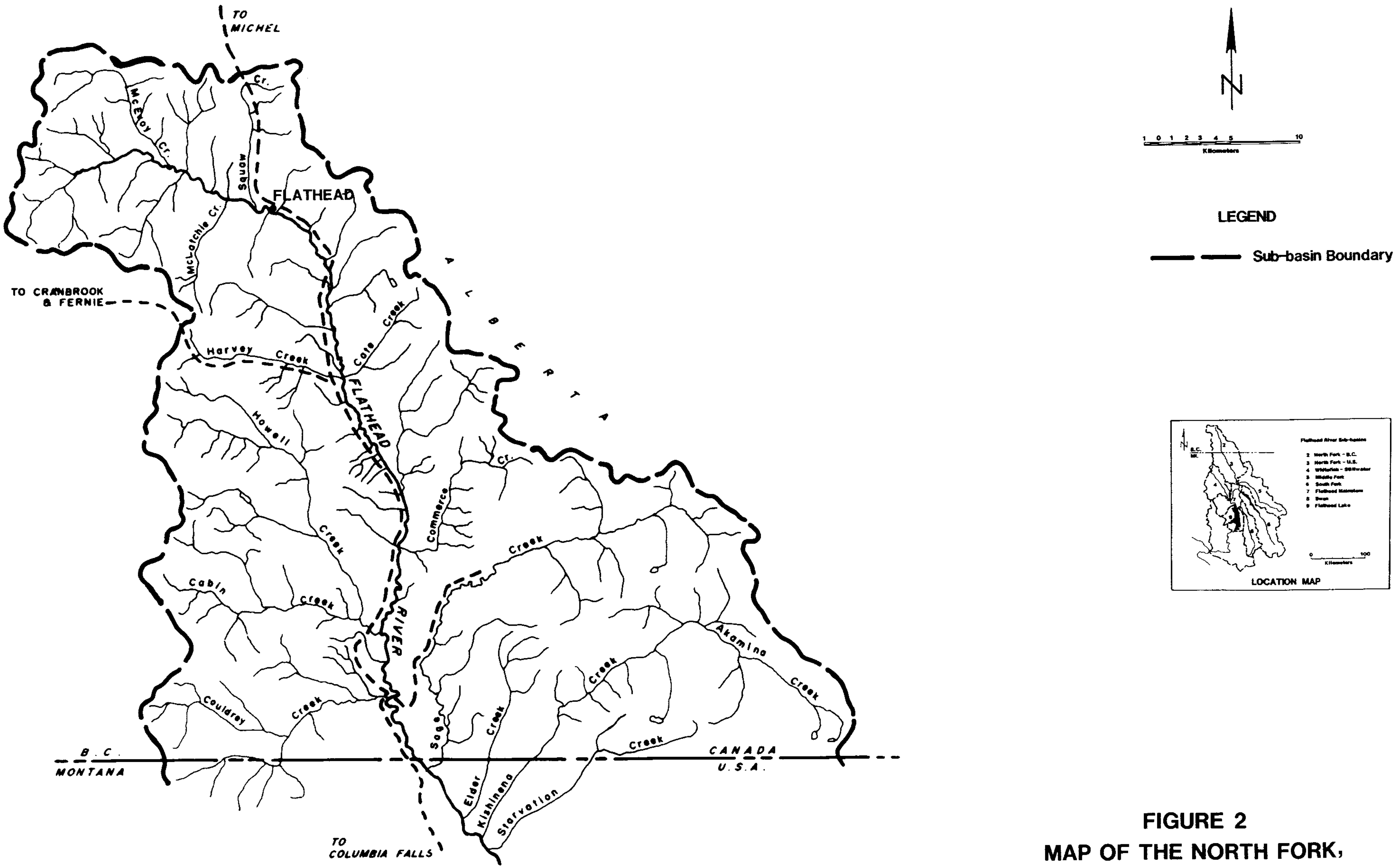
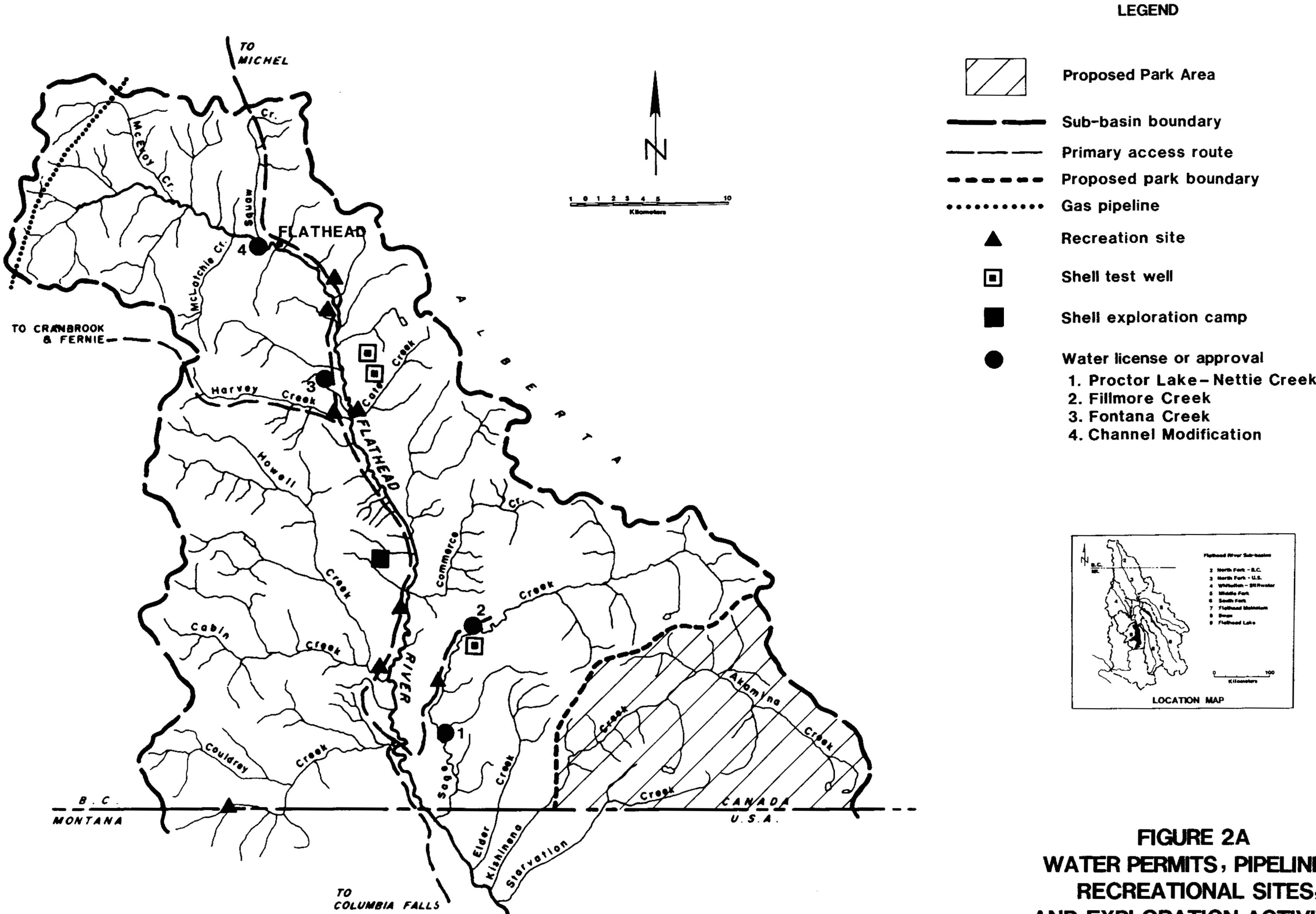



FIGURE 2
MAP OF THE NORTH FORK,
FLATHEAD RIVER IN BRITISH COLUMBIA




## FIGURE 2A
## WATER PERMITS, PIPELINES, RECREATIONAL SITES, AND EXPLORATION ACTIVITY,
NORTH FORK, FLATHEAD RIVER IN BRITISH COLUMBIA

trails. This type of designation is less restrictive than a park designation, and would not necessarily preclude the extraction of certain mineral resources (December 1985, Phil Whitfield, British Columbia Ministry of Lands, Parks, and Housing, Kamloops, British Columbia, personal communication).

Early in the 1980's, the Kootenai Tribal Council submitted a comprehensive land claim to the Government of Canada. This claim included the majority of this sub-basin. While such a claim can result in recognition of traditional use and occupancy of some portion of the sub-basin, negotiations under the process regarding retention or compensation have not yet been scheduled. However, during future discussions, it is expected that the Tribal Council will make a number of proposals that could influence the future use of water and related resources in this sub-basin.

## 2.3 SOCIO-ECONOMIC ACTIVITIES THAT POTENTIALLY AFFECT WATER QUALITY AND/OR WATER QUANTITY

### 2.3.1 Recreation

There are eight designated recreation sites in this sub-basin (Figure 2A). All of these sites are primitive camping sites equipped with outhouses, tables, and litter barrels. Use of these sites is greatest during July and August. Usage is apparently light. There are no known quantitative data on actual use (refer to Section 2.2.1). It is assumed recreational activities have no measurable impact on water quality.

### 2.3.2 Settlement

There are no organized communities in this sub-basin and as has been previously stated, the total permanent population of the sub-basin is estimated to be less than 12. The Shell Canada Resources Ltd. exploration base camp discharges sewage from 20 to 30 personnel into a septic tank drainfield (see Section 2.3.5.).

In addition to the two water licenses mentioned in Section 2.2.2, there have been two approvals given for alterations to surface waters. This includes a minor channel modification on the

Flathead River near Flathead, and the construction of a dyke on Proctor Lake and the diversion of Nettie Creek into Proctor Lake (Figure 2A).

2.3.3 Agriculture

See Section 2.2.3.

2.3.4 Forestry

Current and committed logging has been the most significant activity which could potentially impact water quality and/or water quantity (Figure 2B). In recent years (1978 to present), the majority of logging has been aimed at salvaging lodgepole pine infested with mountain pine beetle, mainly in the southeast section of the sub-basin. The streams in this area (Sage, Elder and Akamina-Kishinena Creeks) enter the Flathead River south of the International Boundary. Smith et al. (1984) attempted to assess the impact of logging on water quality. Their study concluded that "no deterioration in the water quality of Kishinena Creek was apparent from the limited amount of data collected after logging commenced." Smith et al. (1984) caution, however, that "since the post-logging samples were taken in summer, changes best observed during spring, such as increases in concentrations of suspended sediments, may have been missed."

Qualitative observations (August 1985, Doug Martin, Habitat Protection Biologist, British Columbia Ministry of Environment, Cranbrook, British Columbia, personal communication) indicate that in the recent past, stream sedimentation has resulted from logging activities in Kishinena, Couldrey, Howell and Sage Creeks, the Flathead River near the locality of Flathead. Sedimentation was thought to be transitory. The impacts, however, were not measured quantitatively.

Logging and associated road construction can impact suspended sediment, temperature, water chemistry, and the timing and quantity of water discharge. However, due to the transient, highly variable, and site specific nature of these characteristics, ascribing water quality/quantity impacts to logging without extensive study is not possible.

Areas logged during 1980 to 1985 and expected to be logged during 1986 to 1990 are listed in Table 2.1 and 2.2, respectively, and shown in Figure 2B. Detailed information is contained in Table 1, Addendum A.

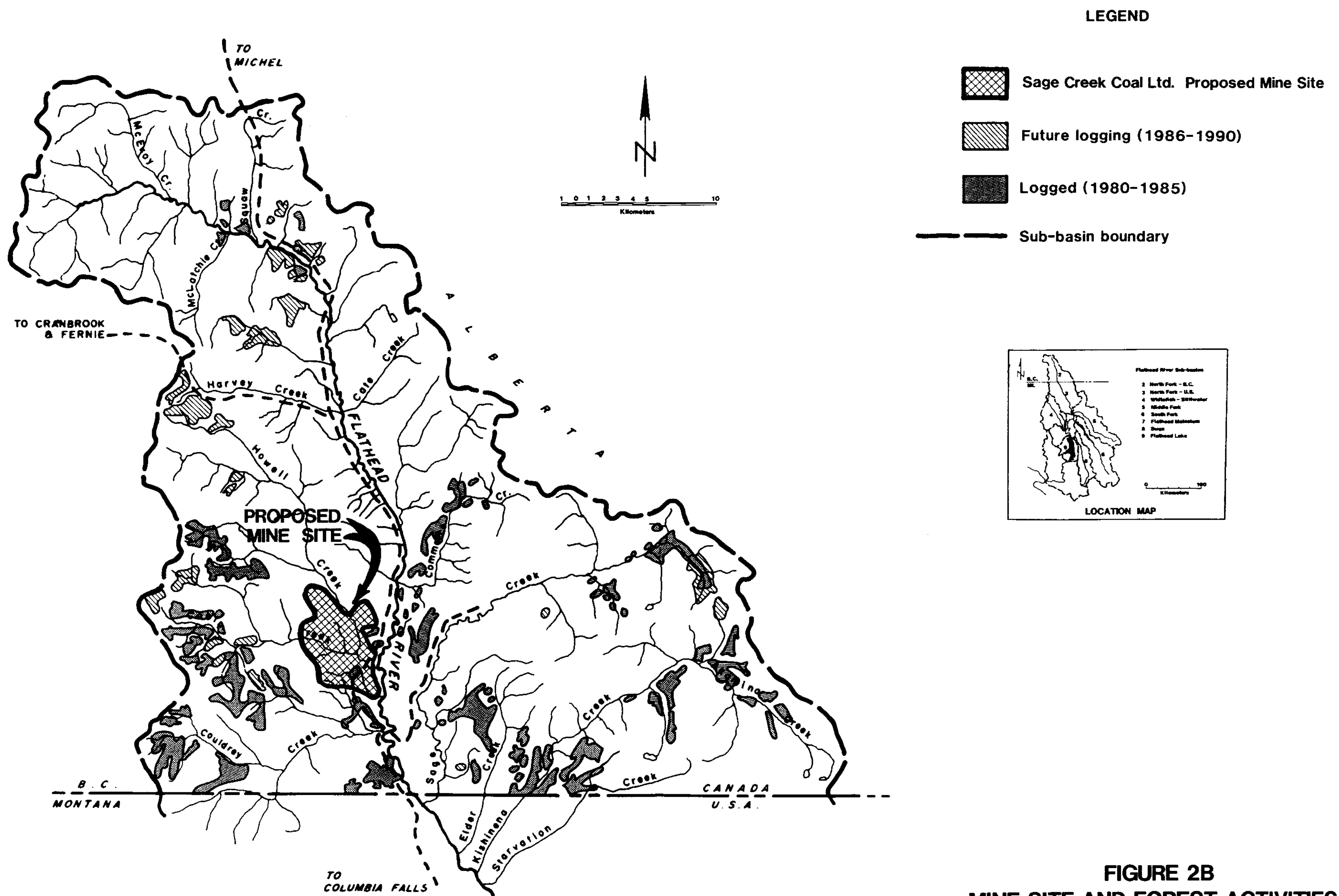



**FIGURE 2B**
**MINE SITE AND FOREST ACTIVITIES,**
**NORTH FORK, FLATHEAD RIVER IN BRITISH COLUMBIA**

Table 2.1. Current timber harvesting in the North Fork, Flathead River in British Columbia, 1980 to 1985

| Timber Harvests Area | |
|---|---|
| Hectares | Acres |
| 5710 | 14,110 |

Source: 1:50,000 scale timber supply maps prepared by Don Embury, British Columbia Ministry of Forests, Cranbrook, British Columbia.

Table 2.2. Committed timber harvesting in the North Fork, Flathead River in British Columbia, 1986 to 1990.

| Timber Harvests Area | |
|---|---|
| Hectares | Acres |
| 1905 | 4706 |

Source: 1:50,000 scale timber supply maps prepared by Don Embury, British Columbia Ministry of Forests, Cranbrook, British Columbia.

Site preparation by Sage Creek Coal Limited may result in the clearing of a total of 1695 ha (4097 acres) in the Howell Creek and Cabin Creek watersheds (Figure 2B). Approximately 1454 ha (3515 acres) consist of spruce, fir and pine forests. (Sage Creek Coal Limited 1982).

2.3.5 Industry

Shell Canada Resources Ltd. has been carrying out seismic exploration and test drilling to evaluate the occurrence of carbon dioxide. Shell is considering recovering natural carbon dioxide deposits and piping the gas to Alberta to enhance oil recovery.

The exploration activities are focused on the portion of the sub-basin east of the North Fork, Flathead River in British Columbia. Four test wells have been drilled to date (Figure 2A); 10 to 20 wells may be drilled to complete the exploration.

These activities have been carried out under the supervision of British Columbia Ministry of Environment, Regional Fish and Wildlife personnel. Road construction, the main concern with respect to water quality, has been kept to a minimum. No drilling mud discharge to surface water occurs. No water quality impacts from the exploration activities are expected.

### 2.3.6 Transportation

Other than logging roads, only two major unsurfaced public roads exist (Figure 2A). Most of the road traffic is seasonal in nature; the impact of fugitive dust and runoff from these roads has not been monitored.

About 10 years ago a gas pipeline was constructed which transects the extreme northwest headwaters of the Flathead River. Inspections by British Columbia Ministry of the Environment have shown no impact on water quality (August 1985, Doug Martin, Habitat Protection Biologist, British Columbia Ministry of Environment, Cranbrook, British Columbia, personal communication).

# 3. NORTH FORK, FLATHEAD RIVER IN MONTANA

## 3.1 INTRODUCTION

The drainage area of this sub-basin is approximately 2643 $km^2$ (1014 $mi^2$) (Figure 3). The 94 km (56 mi) stretch of the North Fork, Flathead River in Montana flows in a southerly direction, forming the western boundary of Glacier National Park. The vast majority of land in this sub-basin is publicly-owned and managed as National Forest, State Forest and National Park. There are about 23 major tributaries in this sub-basin; 12 flow from Glacier National Park on the east, and 11 flow from the National and State Forest areas on the west. The gradient of the North Fork is relatively uniform. It averages 2.9 m/km (15.3 ft/mi) from the International Boundary to its intersection with the Middle Fork, Flathead River in Montana.

The principal socio-economic activity in this sub-basin is forestry on the Flathead National Forest and the Coal Creek State Forest lands. A county road parallels the river to the International Boundary, providing access to National Forest lands, private property, and to the Glacier National Park entrances at Camas Creek and Polebridge. Based on the 1980 census, the permanent population of this sub-basin is estimated to be 136.

## 3.2 SOCIO-ECONOMIC ACTIVITIES POTENTIALLY IMPACTED BY CHANGES IN WATER QUALITY AND/OR WATER QUANTITY

### 3.2.1 Recreation

Fishing, swimming, sightseeing, river floating, camping, and hiking are the major recreational activities that take place in this sub-basin. There are five public campground sites. Three are National Park Service and two are National Forest campgrounds (Figure 3A).

The three developed Glacier National Park campgrounds are Kintla Lake, Bowman Lake, and Logging Creek. In 1985, the Park Service reported 7418 Camper Nights at these sites. A Camper Night is defined as one individual using a site overnight. An additional 2104 Camper Nights were counted at other dispersed sites within Glacier Park in this sub-basin (February 1986, Gary Gregory, Glacier National Park, Montana, personal communication).

The two National Forest campgrounds are located at Tuchuck Creek and Big Creek (adjacent to the North Fork Flathead River in Montana). The Forest Service maintains seven other developed sites. They include boating, fishing, picnicking, winter sports, and information sites. The total 1985 reported recreational use on all nine sites was 11,100 Visitor Days. A Visitor Day is defined as 1 person occupying a site for 12 hours or 2 persons occupying a site for 6 hours or any combination of people and hours at a site which equals 12.

The Forest Service also maintains records on recreation use in dispersed areas. Seven areas have been identified. The total 1985 use in these areas was 70,500 Visitor Days (U.S. Forest Service 1986).

The North Fork, Flathead River in Montana is designated under the National Wild and Scenic River Act as scenic or recreational. Consequently, river-based recreation is a significant part of visitor use in this sub-basin. The Forest Service estimates that there were 13,100 Visitor Days associated with the river in 1985 (Table 3.1). These data are part of the 81,600 Visitor Days reported in the two preceding paragraphs.

Table 3.1. Summary of recreational activities on the North Fork, Flathead River in Montana, 1985.

| Type of Activity | Visitor Days (thousands) | Percent |
|---|---|---|
| Canoeing | .8 | 6.1 |
| Other watercraft | 1.7 | 13.0 |
| Swimming & water play | .5 | 3.8 |
| Fishing, cold water | 3.3 | 25.2 |
| Camping, general day | 1.6 | 12.2 |
| Camping, auto | 1.5 | 11.5 |
| Camping, trailer | 1.6 | 12.2 |
| Camping, tent | 1.2 | 9.2 |
| Picnicking | .3 | 2.3 |
| Hunting, big game | .2 | 1.5 |
| Hunting, waterfowl | .1 | .8 |
| Nature study, hobby, education | .3 | 2.3 |
| Total Visitor Days | 13.1 | 100.0 |

Source: U.S. Forest Service January 1986.

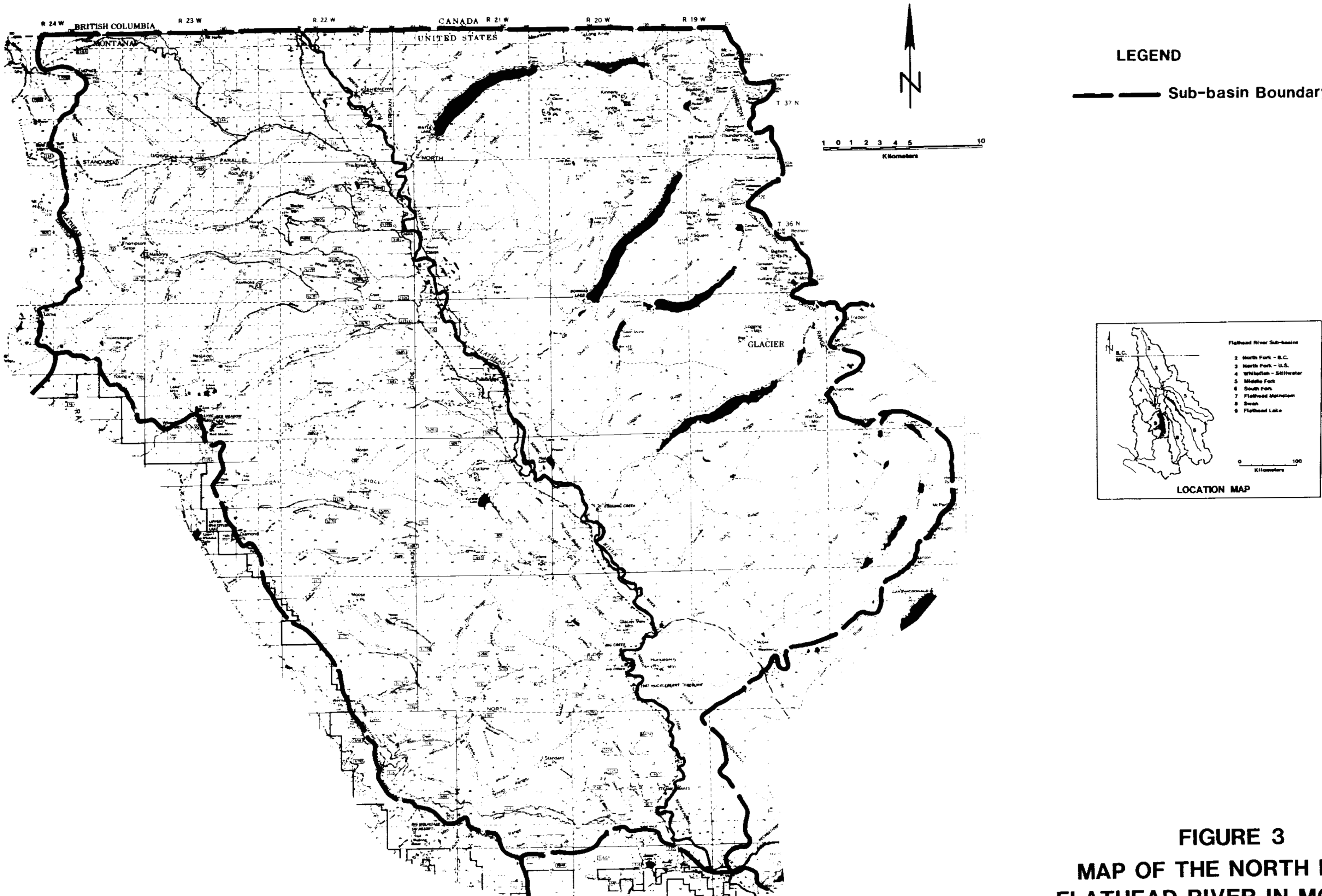



**FIGURE 3**

**MAP OF THE NORTH FORK, FLATHEAD RIVER IN MONTANA**

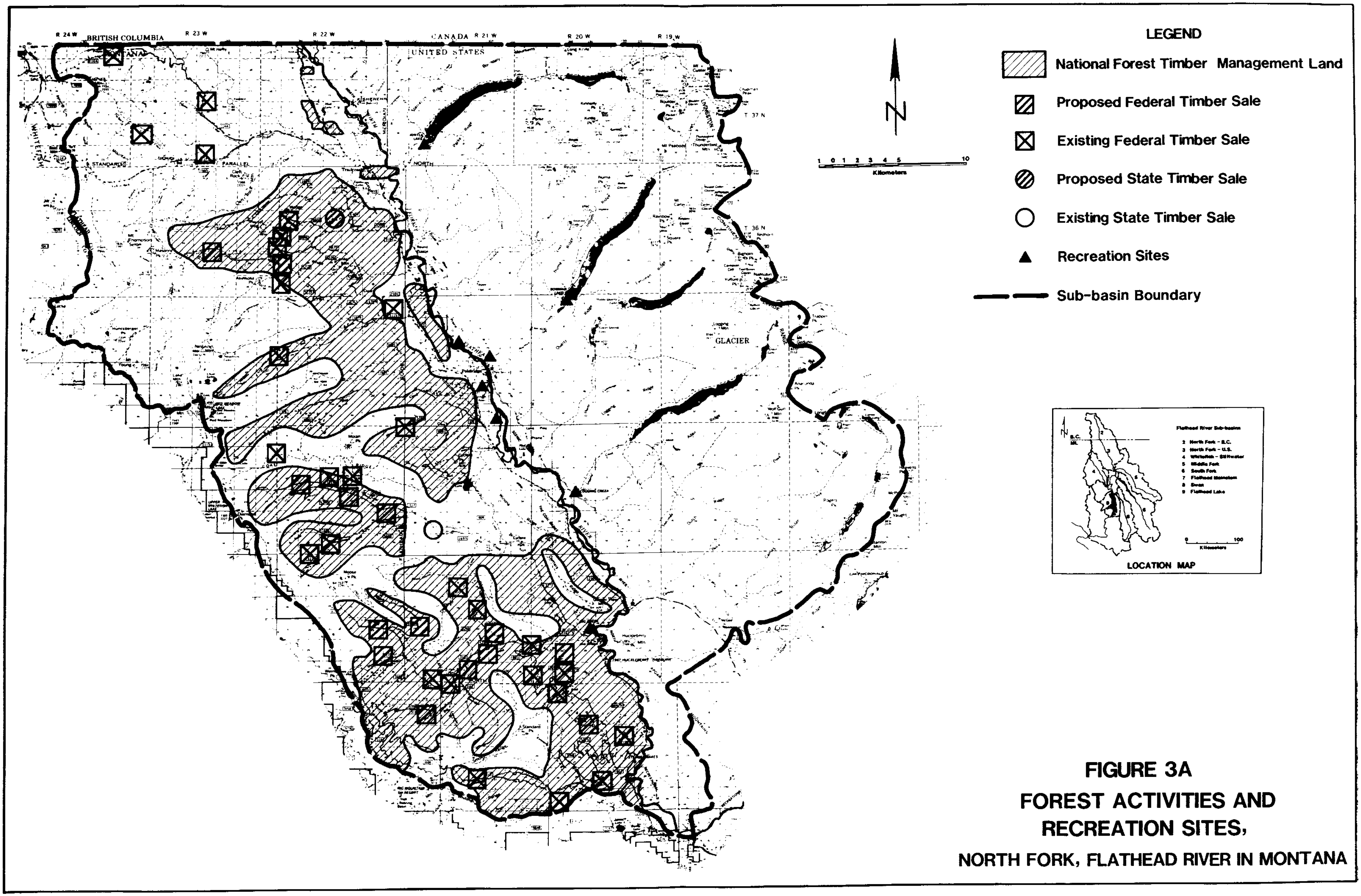



FIGURE 3A
FOREST ACTIVITIES AND RECREATION SITES,
NORTH FORK, FLATHEAD RIVER IN MONTANA

The U.S. Forest Service has developed information on floating use on the North Fork, Flathead River in Montana using two camera stations on the River. In 1985, 410 river craft were counted between the United States/Canadian International Boundary and Big Creek. The total number of river floaters was estimated to be 1353. Of these floaters, 19 rafts with 75 people were with commercial outfitters. From Big Creek to Blankenship Bridge, 393 river craft were counted. The number of river floaters was estimated to be 1286. Of these floaters, 20 rafts with 78 people were with commercial outfitters.

3.2.1.1 Fishing. The Montana Department of Fish, Wildlife and Parks (MDFWP) conducted a census of fishermen in this sub-basin from 1981 May 16 to September 7. This inventory did not include the Glacier National Park side of the North Fork, Flathead River in Montana. The census was undertaken as part of the five-year baseline inventory of resources of the Flathead River Basin (Fredenberg and Graham 1983).

The study divided the North Fork, Flathead River in Montana (NF) into three segments.

1. NF 1, Confluence of Middle Fork and North Fork to confluence of North Fork and Camas Creek, 29.4 km (18.3 mi). This is the most southern segment.
2. NF 2, Mouth of Camas Creek to mouth of Bowman Creek (Polebridge), 24.5 km (15.2 mi). This is the middle segment.
3. NF 3, Mouth of Bowman Creek (Polebridge) to United States-Canada International Boundary, 39.9 km (24.8 mi).

The census and harvest data showed that bull trout and westslope cutthroat were the most important gamefish in the North Fork, Flathead River in Montana. Whitefish were also frequently caught, but kokanee were rarely harvested. The census and harvest data appearing in this information must be interpreted in light of State-established possession limits at the time of this study:

1. Westslope cutthroat, 4.5 kg (10 lbs) and 1 fish or 10 fish, whichever is reached first.
2. Bull trout, one fish, which must be at least 45 cm (18 in) in length.

The creel census was conducted for the 115-day peak fishing season. The data were collected using aerial counts from fixed wing aircraft and concurrent on-the-ground interviews. The MDFWP has designated the westslope cutthroat and bull trout as "species of special concern".

Table 3.2 shows distribution of fishermen use on each of the three segments of the North Fork, Flathead River in Montana. This table illustrates fishing pressure at different locations along the river. It is not an estimate of the total fishing pressure for the entire year.

Table 3.2. Fishermen use on the North Fork, Flathead River in Montana, 1981.

| River Segment | Fisherman Hours | Percent of Total |
|---|---|---|
| NF 1 | 2012 | 56 |
| NF 2 | 1216 | 34 |
| NF 3 | 385 | 10 |

Source: Fredenberg and Graham 1983.

Seventy-eight percent of the fishermen were residents of Flathead County (local), eleven percent were Montana residents living outside of Flathead County, and eleven percent were out-of-state or foreign country residents (Fredenberg and Graham 1982). Table 3.3 shows the fish species composition of the catch and the species catch rate.

Table 3.3. Species composition of fish catch and species catch rate on the North Fork, Flathead River in Montana, 1981.

| Fish Species | Percent of Total | Catch Rate Fish/Hour |
|---|---|---|
| Westslope Cutthroat | 93 | 0.70 |
| Bull Trout | 3 | 0.02 |
| Whitefish | 4 | 0.03 |

Source: Fredenberg and Graham 1983.

The cutthroat trout catch varied little between river segments, but the bull trout catch rate improved moving upstream, peaking at 0.05 fish per hour in NF 3. The total fishing pressure on the North Fork, Flathead River in Montana during the 1981 sampling period was estimated to be 21,911 hours or 9485 man-days (2.31 hours per completed trip). Shore anglers accounted for 71 percent of the total fishing pressure; boat anglers accounted for 29 percent. Table 3.4 shows this pressure for each of the three river segments.

Table 3.4. Estimated total fishing pressure on the North Fork, Flathead River in Montana, 1981.

| River Segment | Fishermen Hours | Percent | Man-Days |
|---|---|---|---|
| NF 1 | 13 641 | 62 | 5905 |
| NF 2 | 3 329 | 15 | 1441 |
| NF 3 | 4 941 | 23 | 2139 |

Source: Fredenberg and Graham 1983.

Gamefish harvests are based on 1979 and 1981 information. Tables 3.5 and 3.6 show the gamefish harvest. The total estimated one year's harvest is 17,996 gamefish. Fishing pressure and total estimated harvest for five fishing seasons is depicted in Table 3.7.

Beginning in 1979, Glacier National Park initiated an evaluation of angler use. Data for 1979 to 1981 has been published. The Park used voluntary creel census cards and interviews at check stations to collect the information. The interview indicated that approximately 10 percent of all Park visitors were fishermen. A total of 119,896 visitors were estimated to have fished in 1979 and 138,371 in 1980. The information was limited to fishing in this sub-basin inside the Park. This included the North Fork, Flathead River in Montana and all tributary streams and lakes inside Glacier National Park. Table 3.8 shows the species composition as an average of the three years of published census data. Very small numbers of grayling, lake trout, and brook trout were also caught.

Table 3.5. Total estimated fish harvest on the North Fork, Flathead River in Montana, 1981.

| Species of Gamefish | Harvest | Percent |
|---|---|---|
| Westslope Cutthroat | 16 381 | 91 |
| Whitefish | 1 101 | 6 |
| Bull Trout | 404 | 2 |
| Rainbow Trout | 73 | 1 |
| Grayling | 37 | 1 |

Source: Fredenberg and Graham 1983.

Table 3.6. Total estimated fish harvest on segments of the North Fork, Flathead River in Montana, 1981.

| | River Segments (Percent) | | |
|---|---|---|---|
| Fish Species | NF 1 | NF 2 | NF 3 |
| Westslope Cutthroat | 58 | 18 | 24 |
| Bull Trout | 33 | 10 | 57 |
| Whitefish | 30 | 2 | 68 |

Source: Fredenberg and Graham 1983.

Table 3.7. Fishing pressure and total estimated harvest for five fishing seasons, North Fork, Flathead River in Montana.

| | | Fish Species | |
|---|---|---|---|
| Year | Fishermen Days | Westslope Cutthroat | Bull Trout |
| 1968 | 10 008 | NA | NA |
| 1975 | 9 562 | 9 994 | 532 |
| 1976 | 10 414 | NA | NA |
| 1981 | 9 485 | 16 381 | 404 |
| 1982 | 11 267 | NA | NA |

Source: Fredenberg and Graham 1983.

Table 3.8. Species composition and fish species catch rate, North Fork of the Flathead River, Glacier National Park, 1979 to 1981.

| Fish Species | Percent of Total | Catch Rate Fish/Hour |
|---|---|---|
| Westslope Cutthroat | 65.9 | 0.58 |
| Bull Trout | 8.6 | 0.07 |
| Kokanee | 8.3 | 0.07 |
| Whitefish | 6.1 | 0.06 |
| Rainbow Trout | 7.6 | 0.10 |

Source: U.S. Fish and Wildlife Service Undated.

During the 1979 to 1981 period, the average annual fishing pressure was estimated to be 4051 fisherman hours. The average number of hours fished per day was estimated to be 2.85 hours. The average annual fishing pressure was estimated to be 1421 angler days. Table 3.9 provides an estimate of the annual average fish harvests for the Glacier National Park portion of the North Fork, Flathead River in Montana between 1979 to 1981. Because of physical access limitations, it is assumed that very little double counting has occurred between the MDFWP and Glacier National Park information. Therefore, Table 3.10 provides a summation (Tables 3.5 and 3.9) of the estimated total annual fish harvest in the North Fork, Flathead River in Montana.

Table 3.9. Estimated fish harvest in Glacier National Park, North Fork, Flathead River in Montana, 1979 to 1981.

| Species | Annual Estimated Harvest |
|---|---|
| Westslope Cutthroat | 2061 |
| Bull Trout | 254 |
| Whitefish | 233 |
| Rainbow | 462 |
| Kokanee | 232 |

Source: U.S. Fish and Wildlife Service Undated.

Table 3.10. Total annual estimated fish harvest in the North Fork, Flathead River in Montana.

| Species | Annual Estimated Harvest |
|---|---|
| Westslope Cutthroat | 18 442 |
| Bull Trout | 658 |
| Whitefish | 1 334 |
| Rainbow Trout | 535 |

The annual fishing use on the North Fork, Flathead River in Montana can be characterized by fishermen days of effort to catch a species of gamefish. Table 3.11 depicts this effort. Although both the harvest and catch rate of the westslope cutthroat is much higher than those of the bull trout, the effort (fishermen days) is nearly equal.

Table 3.11. Fishermen days of effort, North Fork, Flathead River in Montana, to catch each species of gamefish.

| | Fishermen Days | | |
|---|---|---|---|
| Species of Fish | State of Montana | Glacier National Park | Total |
| Westslope Cutthroat | 10 130 | 1 247 | 11 377 |
| Bull Trout | 8 783 | 1 296 | 10 079 |

### 3.2.2 Settlement

Approximately 94 percent of the land in this sub-basin is Federally-owned, 3 percent is State-owned, and 3 percent is privately-owned. The private lands are generally situated in corridors along the west side of the North Fork, Flathead River in Montana.

The pattern of land ownership is shown on Figure 3B. The estimated population is 136 people. (U.S. Census 1980 derived) The projected 1990 population is 150 people (Flathead River Basin Environmental Impact Statement 1983, medium scenario, p. 58). The total number of housing units in the sub-basin is approximately 237 (U.S. Census 1980 derived). It is estimated that approximately 50 percent of these dwellings are summer houses. All of the housing units are assumed to have individual septic tank and drainfield systems.

The private land consists of 6920 ha (17,100 acres). There are about 600 separate tracts and 400 landowners. About 75 percent of the tracts are under 8 ha (20 acres) in size. Less than 20 percent of the landowners are year-round residents (Draft Land Use Plan 1985).

There are no incorporated communities in the sub-basin. The small settlement of Polebridge is located approximately 30 km (19 mi) south of the International Boundary on the North Fork road. Services at

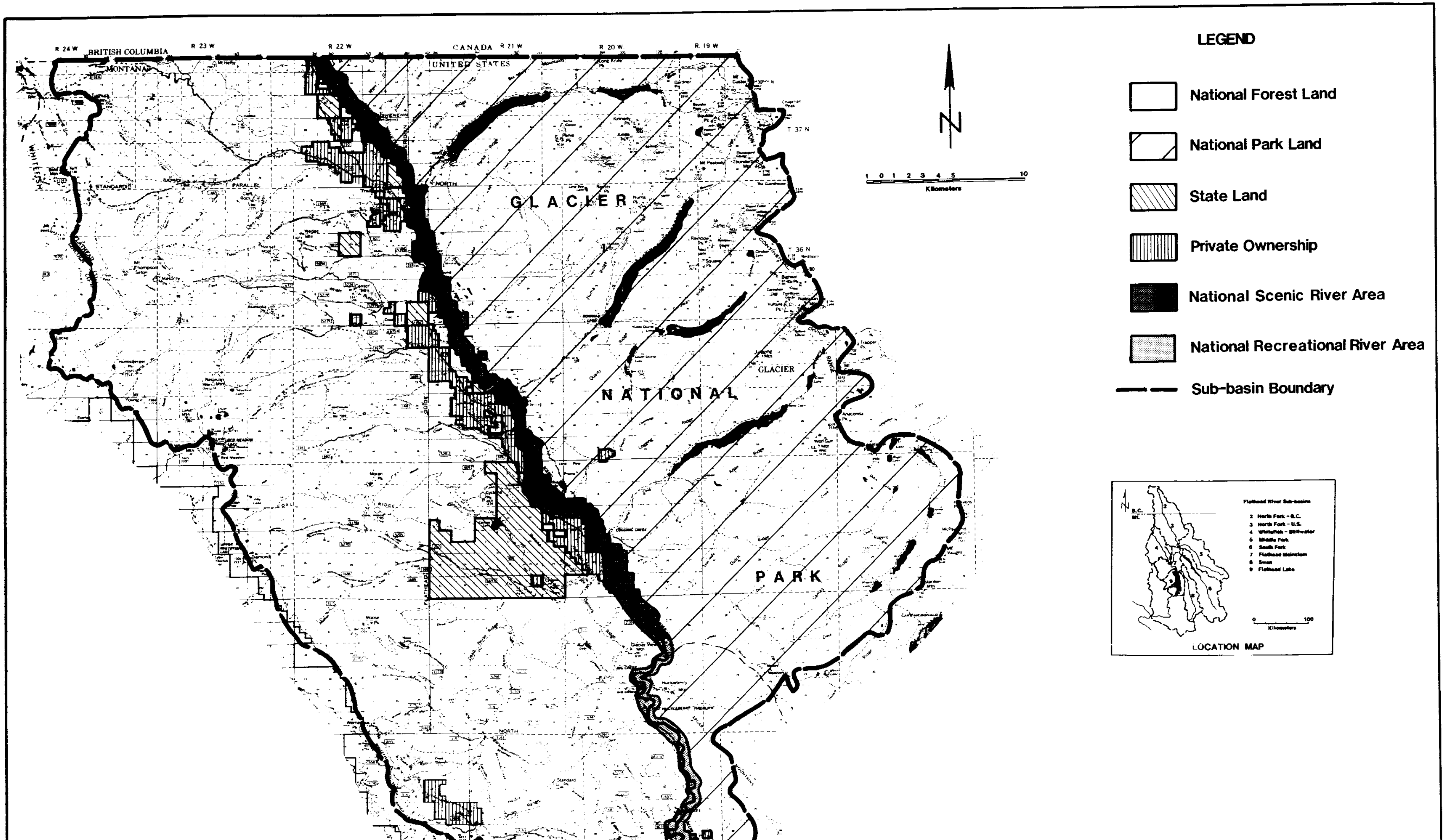



FIGURE 3B
LAND OWNERSHIP,
NORTH FORK, FLATHEAD RIVER IN MONTANA

Polebridge include a gas station, grocery store, restaurant, post office, cabin rentals, and a youth hostel.

In 1984, the residents of the North Fork area started a "grassroots" planning effort to develop a land use plan with State/Federal resource agencies with area management responsibilities. An Interlocal Agreement was executed to further this process. Parties to the agreement include private landowners, Flathead County Commissioners, Montana Department of State Lands (MDSL), Montana Department of Fish, Wildlife and Parks (MDFWP), Glacier National Park, and the Flathead National Forest. The parties adopted a land use plan in the fall of 1986. The plan identifies areas where development can take place with the least amount of impact on the natural resources. A major concern is the protection of the fishery and water quality resources (February 1986, Michael Conner, Flathead National Forest Supervisor's Office, Kalispell, Montana, personal communication).

Fifty-nine water use permits have been issued on the North Fork with the Montana Department of Natural Resources and Conservation (MDNRC). The locations of these permits are shown on Figure 3C. The type, number, and water volume of the permits are listed on Table 3.12. (Montana Department of Natural Resources and Conservation 1986). Furthermore, fish, wildlife, and recreation, and electrical power generation are non-consumptive in-stream uses.

Table 3.12. Water use permits, North Fork of the Flathead River in Montana.

| Use | Number | Annual Volume Cubic Meters (1000's) | Annual Volume Acre Feet |
|---|---|---|---|
| Irrigation and Stock Watering | 20 | 531 | 431 |
| Domestic | 18 | 36 | 29 |
| Commercial/Industrial | 3 | 2 | 2 |
| Fish/Wildlife/Recreation | 17 | 2 118 513 | 1 718 259 |
| Power Generation | 1 | 1 785 | 1 448 |
| Total | 59 | 2 120 968 | 1 720 169 |

Source: Montana Department of Natural Resources and Conservation 1986.

3.2.3 Agriculture

Because of the forested terrain and relatively short growing season, very little agricultural activity takes place in this sub-basin. There is some grazing of cattle on private and forest land. Eighty hectares (200 acres) of land has also been cultivated for hay crops (February 1986, Michael Conner, Flathead National Forest Supervisor's Office, Kalispell, Montana, personal communication).

3.2.4 Preservation

3.2.4.1 Wild & scenic rivers designation. The Wild and Scenic Rivers System was established by federal legislation, the Wild and Scenic Rivers Act, Public law 90-542, 90th Congress, 1968 October 2. The Public Law contains the following definitions.

Wild river areas: Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.

Scenic river areas: Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.

Recreational river areas: Those rivers or sections of rivers that are readily accessible by road or railroad, that may have undergone some impoundment or diversion in the past.

Public Law 94-486 of 1976 October 12 amended the Wild and Scenic Rivers Act to add portions of the North, Middle and South Forks of the Flathead River, Montana. These rivers are administered by agencies of the Departments of Interior and Agriculture. The U.S. Forest Service (Flathead National Forest) has been designated the primary management agency for the Flathead Wild and Scenic Rivers. The North Fork, Flathead River in Montana was designated "Scenic" from the International Boundary downstream to Camas Creek and "Recreational" from Camas Creek to the confluence with the Middle Fork (Figure 3A).

The Flathead National Forest has developed a River Management Plan which states:

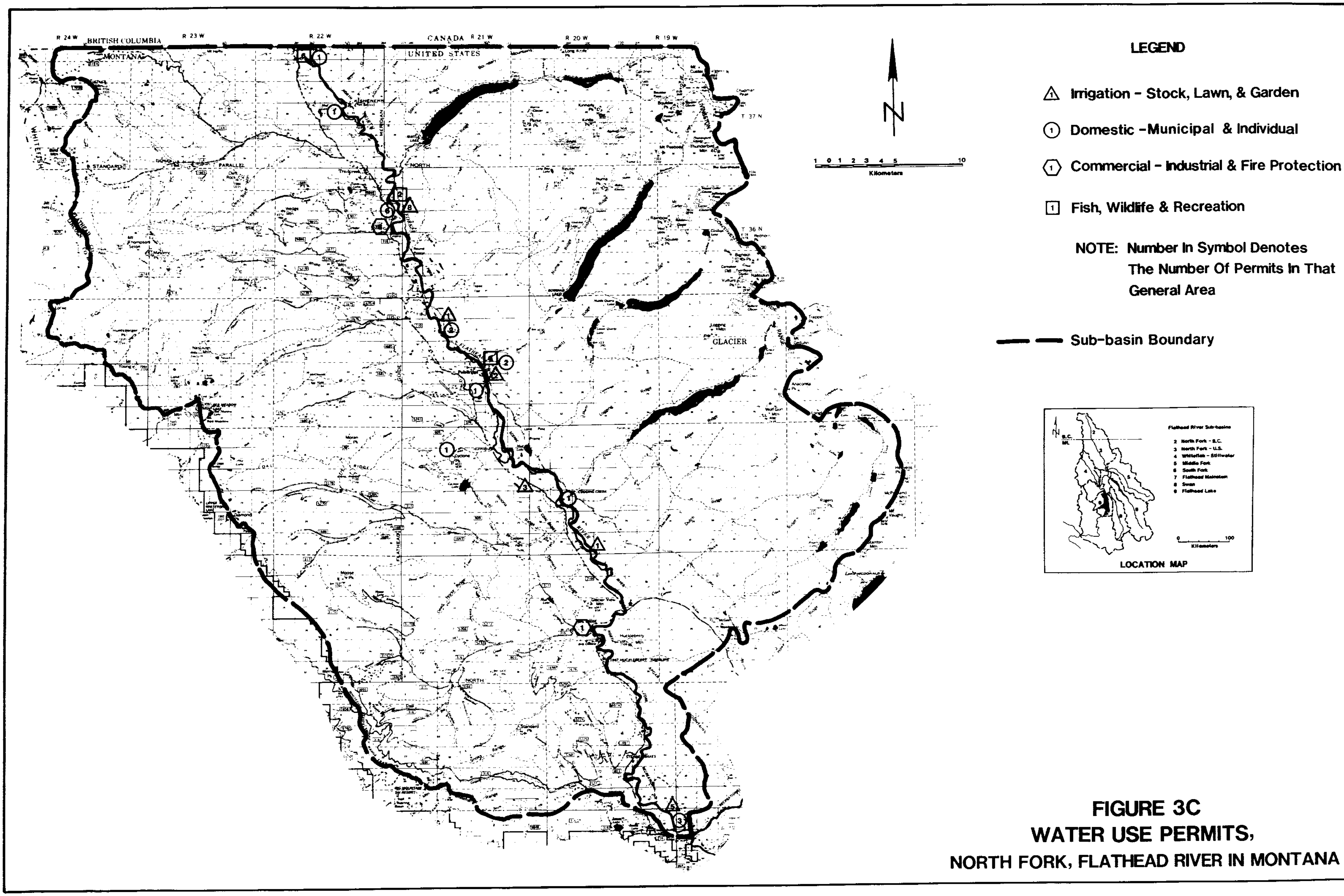



**FIGURE 3C**
**WATER USE PERMITS,**
**NORTH FORK, FLATHEAD RIVER IN MONTANA**

"The river area will be managed with emphasis on preserving scenic quality. Key values are its (1) free-flowing character, (2) limited river access, (3) largely undeveloped and primitive shorelines, (4) unpolluted water, and (5) outstanding features such as scenery and wildlife."

The Plan also states that:

"In cases of conflict with water quality and other resources, uses, and activities, protection of water quality will take precedence. Alterations of natural channels of the streambank which significantly affect (1) the free flow of water, (2) the appearance of the stream, or (3) fish habitat will not be permitted except those necessary to protect existing major man-made improvements such as highways and bridges. Water quality and quantity monitoring will be continued at established stations. If adverse trends are detected and found to be man-caused, appropriate action will be taken to correct the problem." (emphasis added).

3.2.4.2 Glacier National Park and Waterton-Glacier International Peace Park. In 1910 May 11, the United States Congress established Glacier National Park (36 Stat. 354). The purpose of Glacier National Park was to preserve an outstanding mountain area characterized by spectacular Northern Rocky Mountain topography, active glaciers, and unique plant and animal communities for the benefit and enjoyment of the public. Glacier National Park is located in northwestern Montana and shares a 64 km (38 mi) boundary with British Columbia and Waterton Lakes National Park in Alberta. Glacier National Park draws approximately two million visitors annually, 20 percent coming from nations other than the United States. The North Fork, Flathead River in Montana constitutes the western boundary of Glacier National Park, while the Middle Fork of the Flathead River represents the southern boundary of the park (more specifically, the Park's boundary extends to the middle of the North Fork and only to the northwestern bank of the Middle Fork). The purpose of Glacier National Park was expanded by Presidential Proclamation Number 2003 of 1932 June 30, and by Act of Royal Assent of the Canadian

Parliament, to commemorate the friendship and goodwill of Canada and the United States through the joint establishment and management of the world's first international peace park. This park was named the Waterton-Glacier International Peace Park.

Glacier National Park is a rugged mountainous preserve of 405,089 ha (1,000,570 acres) characterized by spectacular topography, active glaciers, numerous glacial lakes, and unique biotic communities. Glacier National Park is adjacent to a series of designated United States wilderness areas on the south, including the Great Bear, Bob Marshall, and Scapegoat Wildernesses. Nearly 400,000 ha (988,000 acres), over 92 percent of the area of Glacier National Park, is managed by the National Park Service as de facto wilderness; legislation is currently pending in the United States Congress to formalize this action. Wildlife in Glacier National Park is abundant and includes such species as mountain goat, big horn sheep, deer, grizzly and black bear, moose, wolf, and lynx. Park fish resources include westslope cutthroat trout, bull trout, kokanee salmon, rainbow trout, and eastern brook trout.

3.2.4.3 Biosphere reserve. In 1976, Glacier National Park was designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a Biosphere Reserve under the Man and Biosphere Program. This designation recognized Glacier National Park's conifer forests, alpine tundra, diverse biotic communities, and other unique environmental qualities. The designation was based on the largely unaltered natural condition and ecological integrity of the area. It should also be noted that this designation lent support to Glacier National Park's themes of Preservation (to conserve for present and future human use the diversity and integrity of biotic communities and to safeguard the genetic diversity of species) and Research and Education (to provide areas for ecological research, including baseline studies, both within and adjacent to the Park) while also allowing for human use. In 1979, Waterton Lakes National Park was also designated as a Biosphere Reserve by UNESCO.

3.2.4.4 World heritage site nomination. In 1984, Glacier National Park was nominated to the World Heritage List under the Convention Concerning

Protection of the World Cultural and Natural Heritage. In the case of Glacier National Park, the World Heritage List nomination was based on a natural ecological preserve of outstanding universal significance. More specifically, the nomination indicated the Park's genetic diversity, unique geological features, complex biomass, and spectacular scenic beauty. The nomination is currently under review by the World Heritage Committee and no final decision has yet been made.

## 3.3 SOCIO-ECONOMIC ACTIVITIES THAT POTENTIALLY AFFECT WATER QUALITY AND/OR WATER QUANTITY

### 3.3.1 Recreation

There are nine developed sites in the National Forest. Use is principally during the summer, and ranges between 107 and 134 days. The U.S. Forest Service has developed a statistical sampling method for Theoretical Seasonal Capacity. Actual use on all sites ranged from 6 to 26 percent of the theoretical capacity (U.S. Forest Service 1986). The impact of recreational use on water use and quality has not been quantified, but appears to be insignificant.

### 3.3.2 Settlement

All of the homes in the area are served by individual septic tanks and drainfields. The WUC has not been able to find information which describes the potential water quality impacts from sewage discharges in this sub-basin. If a sewer system is found to have failed, Flathead County can order that it be abandoned and an acceptable system installed.

As mentioned under Section 3.2.2., the residents in the area have organized a local planning process to direct future growth to minimize adverse impacts on fish and natural resources. General land use and parcel density are shown on Figure 3D and 3E, respectively.

### 3.3.3 Agriculture

There is minimal agricultural activity. Irrigation water use and irrigation return flows are minimal. The impact on water use and/or quality is small.

### 3.3.4 Forestry

3.3.4.1 Current. The primary impact to surface waters of the sub-basin from timber harvest activities would be the contribution of suspended sediments resulting from surface disturbances such as: log removal, construction and use of log landings and haul roads, and the site preparation following harvest (scarification, etc.). As time passes after the period of disturbance, stabilization of disturbed areas gradually occurs and the rate of sediment yield diminishes concurrently.

The relative intensity and areal distribution of current timber harvest activity is best expressed in terms of the recently completed and ongoing timber sales of the major land managing entities in the sub-basin. In the North Fork, Flathead River in Montana, they are the Flathead National Forest and Coal Creek State Forest. The current timber sales and road development data are shown on Table 2 in Addendum A and shown on Figure 3A. The data are summarized in Table 3.13.

Table 3.13. Current timber sales and road development in the North Fork, Flathead River in Montana, 1981 to 1985.

| Forest Manager | Timber Sales | | Road Development | |
|---|---|---|---|---|
| | Volume | Area | Construction/Reconstruction | |
| | (MBF) | (Hectares) | (Kilometers) | |
| Flathead N.F. | 71 098 | 6 433 | 47.3 | 150 |
| State Forest | None | None | None | None |
| Totals | 71 098 | 6 433 | 47.3 | 150 |
| | (71.1 MMBF) | (15 883 acres) | (29.4 miles) | (93.3 miles) |

Source: Flathead National Forest Timber Sales Awarded or in Progress, FY 81 through FY 85, received from Supervisor's Office, Kalispell, Montana, 1986 February 21, derived.

3.3.4.2 Committed. Large areas of timbered property are potentially available for harvest, as reflected by the timber sale program plans of the major forest managers in the sub-basin. The detailed, future timber

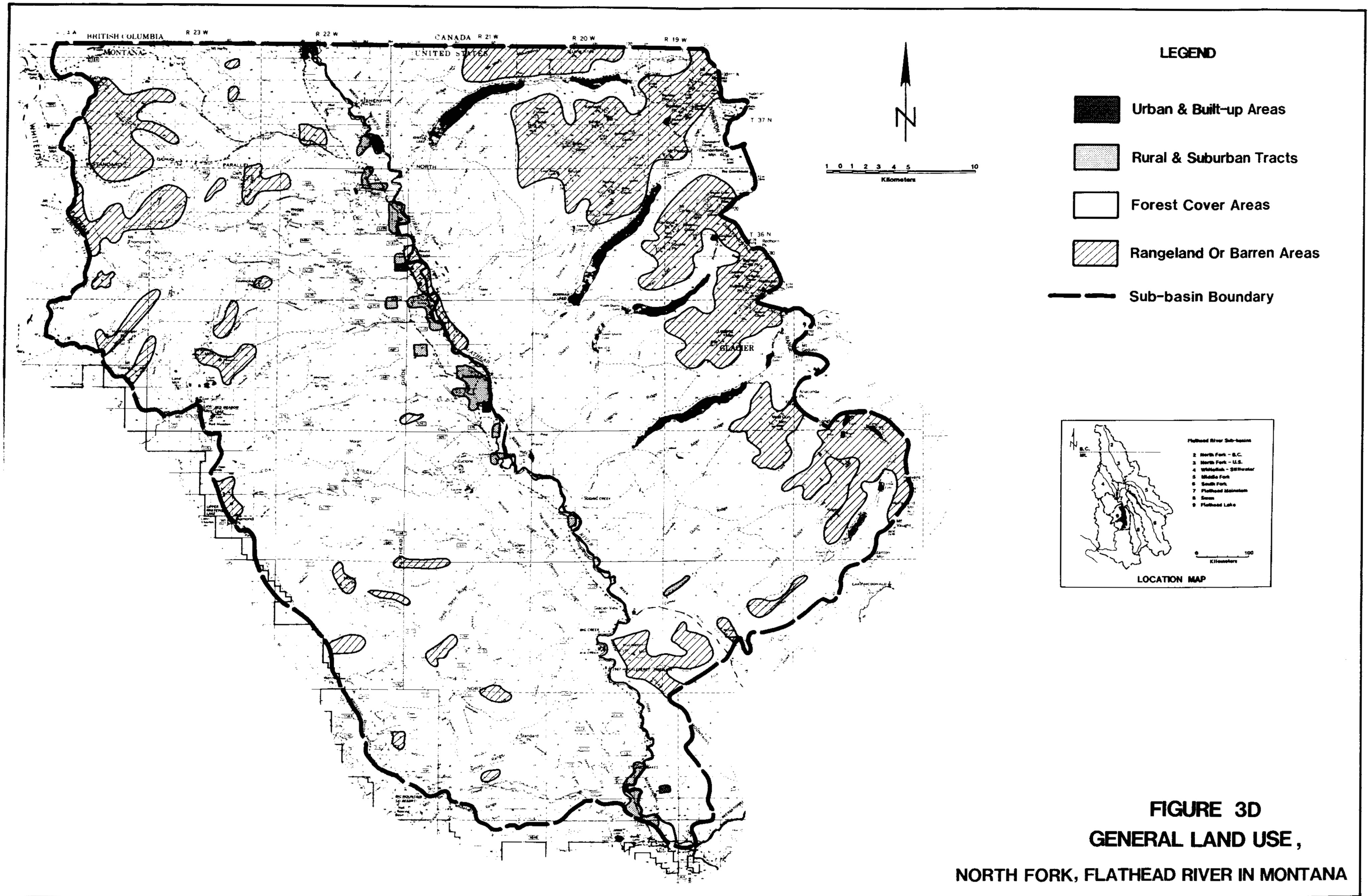



**FIGURE 3D**

**GENERAL LAND USE,**

**NORTH FORK, FLATHEAD RIVER IN MONTANA**

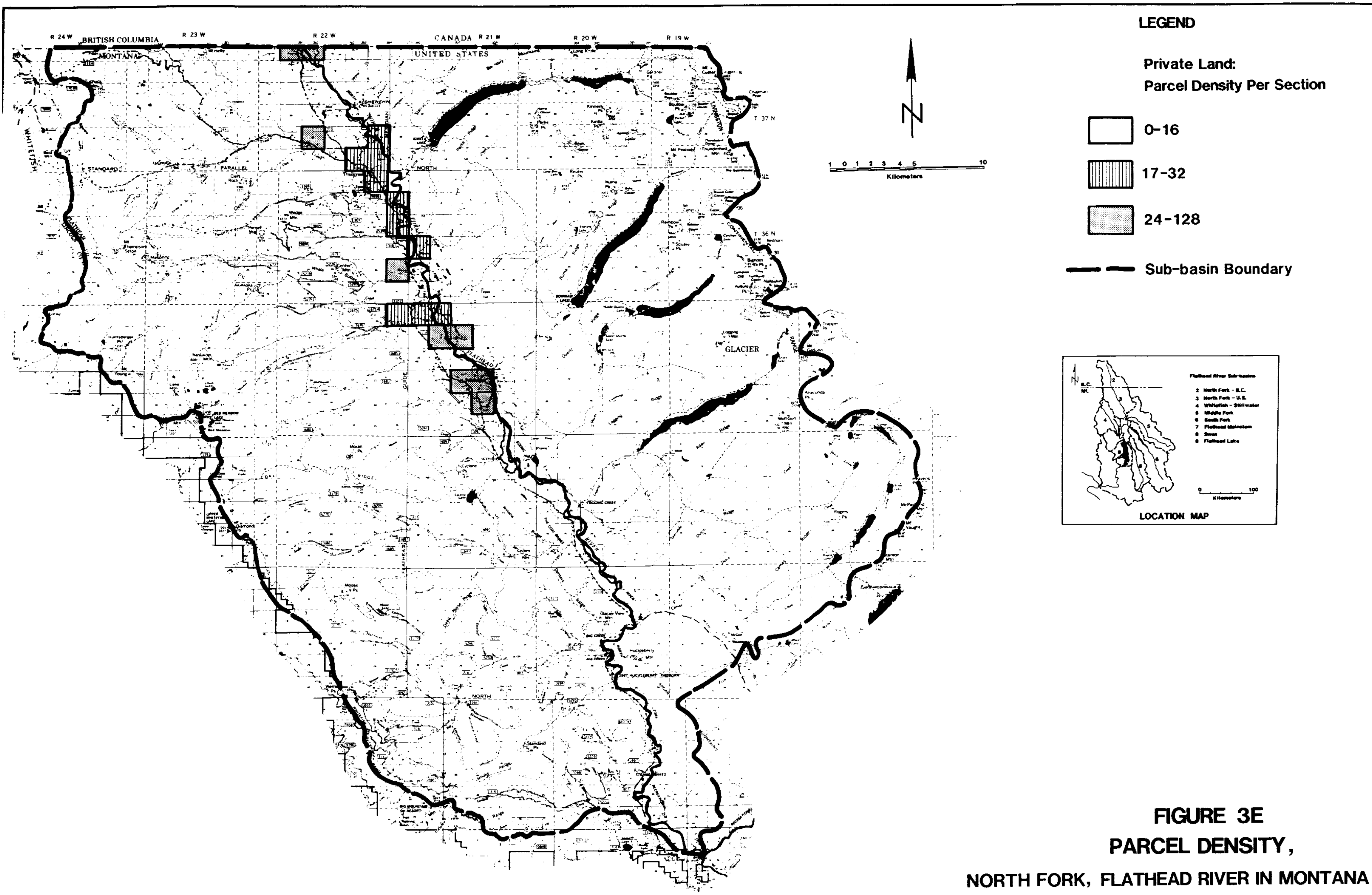



**FIGURE 3E**
**PARCEL DENSITY,**
**NORTH FORK, FLATHEAD RIVER IN MONTANA**

sale planning by these organizations varies from three to five years hence. The committed timber harvest activity and road development are found in Table 3, Addendum A, and illustrated in Figure 3A. The data are summarized in Table 3.14.

Table 3.14. Committed timber sales and road development in the North Fork, Flathead River in Montana.

| Forest Manager | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|
| Flathead N.F. | 82 700 | 1804 | 77 | 13.5 |
| State Forest | None Planned | | | |
| TOTALS | 82 700 (82.7 MMBF) | 1804 (4454 acres) | 77 (47.9 miles) | 13.5 (8.4 miles) |

Source: Flathead National Forest December 1985 derived.

### 3.3.5 Industry

There are no ongoing industrial activities in this sub-basin. Extensive seismic exploration has been done over the last five years. Most of the National Forest and State lands have been leased to oil interests. The State of Montana has approved the Operating Plan for a proposed exploratory well in the Coal Creek State Forest. The approval was granted after the MDSL conducted a Preliminary Environmental Review (PER). The PER concluded that the Operating Plan, with conditions, would not adversely impact water quality. The conditions included measures to prevent erosion, maintain water quality, and minimize visual impacts. The PER included a provision that in the event of a productive oil strike, the MDSL will prepare an Environmental Impact Statement (EIS). This EIS would include a multi-agency review of potential cumulative impacts of oil development in the North Fork. At this time, the proposed Cenex well is on hold due to a question of land ownership (Montana Department of State Lands 1984).

The Flathead National Forest has granted oil leases on approximately 101,000 ha (250,000 acres). These leases have been placed on hold since March 1985 because a Federal District Court decision ruled they were invalid. The Federal Court decided that the U.S. Forest Service did not comply with the National Environmental Policy Act (NEPA) in issuing the leases. The Forest Service has appealed the Federal District decision. This issue has been referred to the Ninth Circuit Court of Appeals. A decision is expected by 1987.

If the Federal District Court decision is reversed, leasees may apply to the Flathead National Forest for an Application to Drill. The Forest Service will then determine whether to conduct an Environmental Assessment (EA) or Environmental Impact Statement (EIS) on the proposed permit. Each stage of the oil process, including exploration, development, and production will require separate permits and public review. Impacts on water quality will be evaluated during each review (February 1986, Ed Fivas, Flathead National Forest Supervisor's Office, Kalispell, Montana, personal communications).

### 3.3.6 Transportation

The main transportation route is Montana Forest Highway 61 (Flathead County Route 486). It begins at Columbia Falls and runs to the United States-Canada International Boundary. The route parallels the North Fork, Flathead River in Montana and is commonly referred to as the North Fork Road. The route is 92 km (58 mi) in length. The road is generally 6 to 7 m (20 to 24 ft) wide and gravel surfaced. The average traffic during summer months is 245 vehicles per day between Canyon Creek and Camas Junction.

Construction is ongoing to improve a 17 km (10.2 mi) stretch of highway between Canyon Creek and Camas Junction. Before construction, an EIS was completed by the Federal Highway Administration (FHA). In the EIS, five alternatives were considered. They ranged from no action to rebuilding the road to a 80 km (50 mi) per hour design speed with an asphalt paved surface. The selected alternative was to rebuild the road to a 60 km (35 mi) per hour design speed with a gravel surface closely following the existing alignment. The EIS found that the construction will cause a temporary localized increase in suspended sediment and turbitity.

The existing cut and fill slopes currently erode, and these would be improved by revegetating the raw cuts and fills. A sediment and erosion control plan is required for the construction (U.S. Department of Transportation 1983). There has been ongoing discussion about paving the entire North Fork Road, but this issue is very controversial and no plans currently exist to proceed with the project.

# 4. WHITEFISH RIVER/STILLWATER RIVER

## 4.1 INTRODUCTION

The Whitefish and Stillwater Rivers originate approximately 26 and 64 km (16 and 40 mi) northwest of Kalispell, respectively (Figure 4). After the two rivers join, the Stillwater River enters the Flathead River at Kalispell. The Stillwater and Whitefish Rivers follow roughly parallel courses over the lower 26 km (16 mi). The total area of this sub-basin is approximately 2096 $km^2$ (804 $mi^2$).

Swift Creek is the major tributary of the Whitefish River, north of Whitefish Lake. Swift Creek has a relatively low gradient and mean elevation. It principally drains State Forest and Corporate Forest (private) lands. Whitefish Lake is located at the outskirts of the town of Whitefish. The Lake is surrounded by private settlement and experiences heavy recreational use. The Whitefish River flows through agricultural land to its confluence with the Flathead River.

The Stillwater River has a much larger drainage basin than the Whitefish River. It primarily drains National Forest land. This basin has a much lower relief and average elevation than that of the North, Middle and South forks of the Flathead River. Most of the basin is intensively managed for timber production. There are numerous small lakes and streams at the headwaters of the Stillwater River. As with the Whitefish River, the lower part of the Stillwater River also passes through agricultural land and settlements.

## 4.2 SOCIO-ECONOMIC ACTIVITIES POTENTIALLY IMPACTED BY CHANGES IN WATER QUALITY AND/OR WATER QUANTITY

### 4.2.1 Recreation

4.2.1.1 Fishing. The Stillwater River/Whitefish River sub-basin was not included in the Flathead Basin fisheries studies of the early 1980's; therefore, fisherman use and harvest data are not readily available. Studies have shown that during the early 1980's, the Whitefish River contributed about 2 percent to the Flathead Lake kokanee spawning. This compares with 13 percent for the Flathead River-Mainstem and 77 percent for the Middle Fork sub-basins (Fraley, McMullin and Graham In Draft).

Table 4.1 shows the estimated fishing pressure for 1982 May 1 to 1983 April 30 for this sub-basin.

Table 4.1. Estimated fishermen days for the Whitefish River/Stillwater River, 1983.

| Location | Total | Resident | Non-Resident |
|---|---|---|---|
| Stillwater River | 3266 | 2815 | 452 |
| Whitefish Lake | 4288 | 3056 | 1232 |
| Whitefish River | 2975 | 2564 | 411 |
| Total | 10529 | 8564 | 2095 |

Source: Montana Department of Fish, Wildlife and Parks undated.

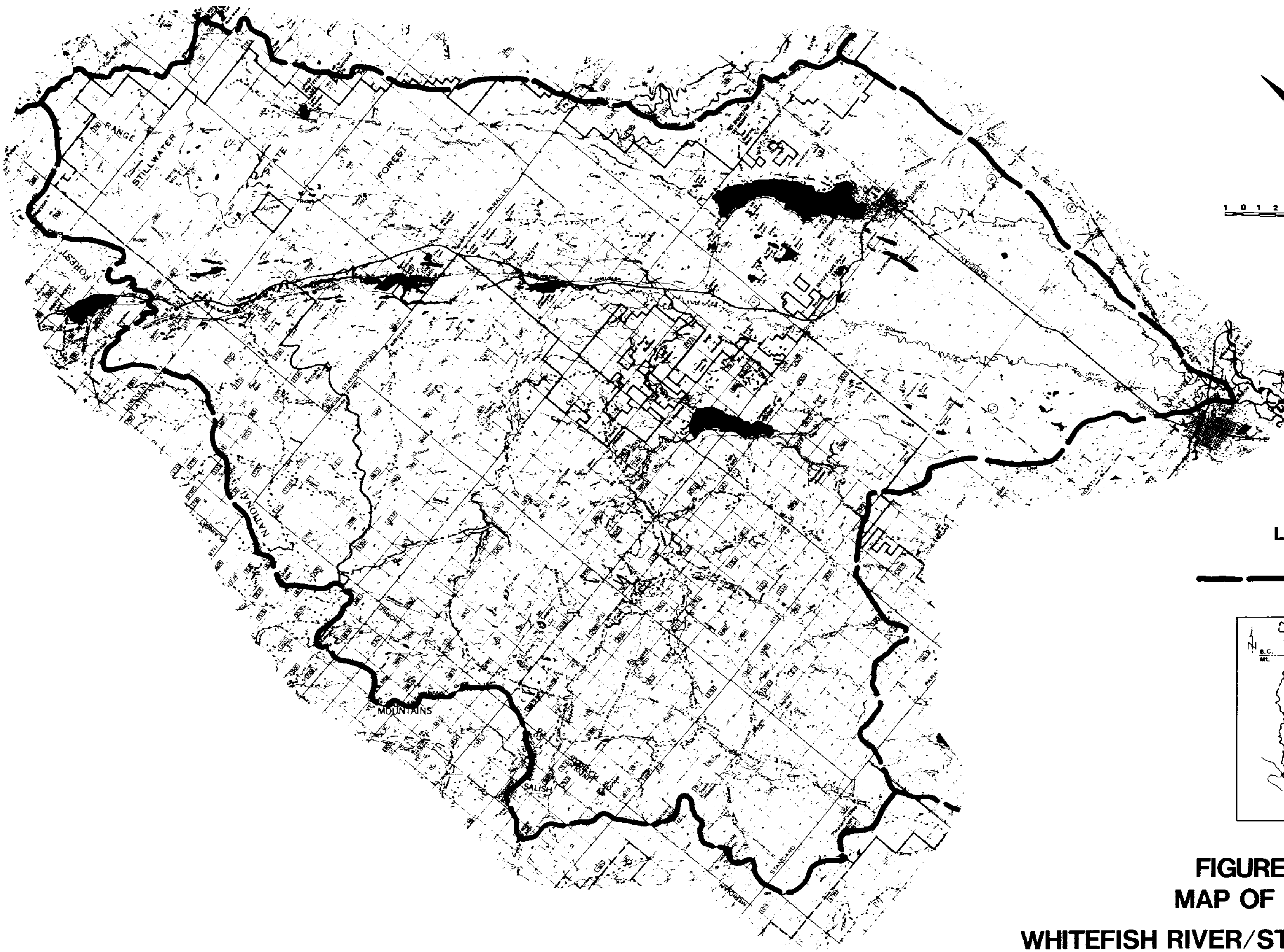
### 4.2.2 Other Socio-Economic Activities

This sub-basin is not downstream from the site of the proposed mine. Any change in water quality or water quantity that would be a direct result of the proposed mine cannot enter this sub-basin; therefore, it would not have a direct impact on the other socio-economic activities in this sub-basin.

## 4.3 SOCIO-ECONOMIC ACTIVITIES THAT POTENTIALLY AFFECT WATER QUALITY AND/OR WATER QUANTITY

### 4.3.1 Recreation

There are numerous public and private recreational facilities in this sub-basin. The U.S. Forest Service oversees or maintains 10 developed sites. They include: a ski resort (Big Mountain), nordic skiing area, campgrounds, picnic grounds, swimming sites, and recreation trails. The total reported recreational use at these developed sites in 1985 was 153,100 Visitor Days. The Forest Service also maintains records on 10 dispersed areas in this sub-basin. The total Recreation Visitor Days at these areas reported by the Forest Service in 1985 were 30,900. Table 4.2 identifies the Recreation Visitor Days by activity. The managed season for the 10 developed sites on the National Forest ranges from 69 to 157 days. Actual use on all developed sites ranged from 1 percent to 87 percent of Theoretical Seasonal Capacity (U.S. Forest Service 1986).



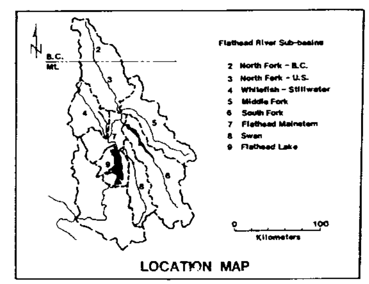




**FIGURE 4**
**MAP OF THE**
**WHITEFISH RIVER/STILLWATER RIVER**

Table 4.2. Types of recreational activities on U.S. Forest Service Land in the Whitefish River/Stillwater River, 1985.

| Type of Activity | Visitor Days (Thousands) | Percent |
|---|---|---|
| Viewing scenery | 1.3 | .7 |
| Viewing activities (spectator) | .3 | .2 |
| Automobile travel | 8.2 | 4.5 |
| Motorcycle & scooter travel | 1.1 | .6 |
| Ice & snow craft travel | 1.9 | 1.0 |
| Boat, powered | .5 | .3 |
| Aerial trams & lifts | .9 | .5 |
| Hiking & walking | 1.9 | 1.0 |
| Horseback | .8 | .4 |
| Other watercraft | .4 | .2 |
| Games & play | .1 | .1 |
| Swimming & water play | .9 | .5 |
| Fishing, cold water | 2.3 | 1.2 |
| Camping, general day | 3.3 | 1.8 |
| Camping, auto | 1.8 | 1.0 |
| Camping, trailer | 3.3 | 1.8 |
| Camping, tent | .7 | .4 |
| Picnicking | .7 | .4 |
| Resort & comm. pub. service | 26.4 | 14.3 |
| Resort lodging | 24.0 | 13.0 |
| Skiing, downhill | 90.7 | 49.3 |
| Cross-country skiing, snowshoeing | 1.3 | .7 |
| Hunting, big game | 6.6 | 3.6 |
| Hunting, small game | .2 | .1 |
| Hunting, upland birds | .1 | .1 |
| Hunting, waterfowl | .8 | .4 |
| Nature study, wildlife, birds | .1 | .1 |
| Gathering forest products | 3.1 | 1.7 |
| Viewing interpretive exhibits | .1 | .1 |
| General information | .3 | .2 |
| Total Visitor Days | 184.1 | 100.0 |

Source: U.S. Forest Service 1986.

The State of Montana administers one campground on Whitefish Lake and three fishing access sites on rivers in this sub-basin (Figure 4A). In 1985 the total number of overnight users at the Whitefish Lake site was 1866, and the total number of day users at this site was 902 (Montana Department of Fish, Wildlife and Parks 1985).

Seven private commercial facilities were identified as Recreation Facilities in the Co-operative Study of the Clark Fork in the Columbia River Basin (1977) (U.S. Department of Agriculture 1977).

The adverse impact of recreational use on water quantity and quality has not been quantified. It does not appear to be significant. (Flathead Drainage 208 Project "Recreation and Water Quality" 1977.)

### 4.3.2 Settlement

Figure 4B shows the pattern of land ownership within this sub-basin. The estimated population is 13,581 people. Whitefish is the only incorporated community. Although Figures 4 to 4D include references to the community of Kalispell, it is not included in this designated sub-basin; Kalispell is discussed as part of the Flathead River-Mainstem sub-basin. It had a 1980 population of 3695 (U.S. Census 1980 derived). The projected 1990 population for the sub-basin is 14,926 (Flathead River Basin Environmental Impact Study 1983, medium scenario, p. 58). There are a total of 5738 housing units in this sub-basin; 246 are seasonal homes. The municipal sewer system in Whitefish serves 1695 homes. Individual septic tanks and drainfields serve 4043 homes (U.S. Census 1980 derived).

Whitefish Lake water quality is declining. The lake shows signs of eutrophication as evidenced by an oxygen deficit. The University of Montana Biological Station at Yellow Bay, Flathead Lake, has conducted a fluorometric survey of Whitefish Lake to detect the presence of septic leachate (Golnar and Stanford 1984). The U.S. Environmental Protection Agency (EPA) has also conducted an infra-red aerial survey of the area to detect failing systems. These surveys detected numerous leachate plumes and possible septic system failures (Whitefish County Water and Sewer District 1984).

The Whitefish Water and Sewer District was formed in 1982. The District has adopted a Management Plan. Its overall goal is water

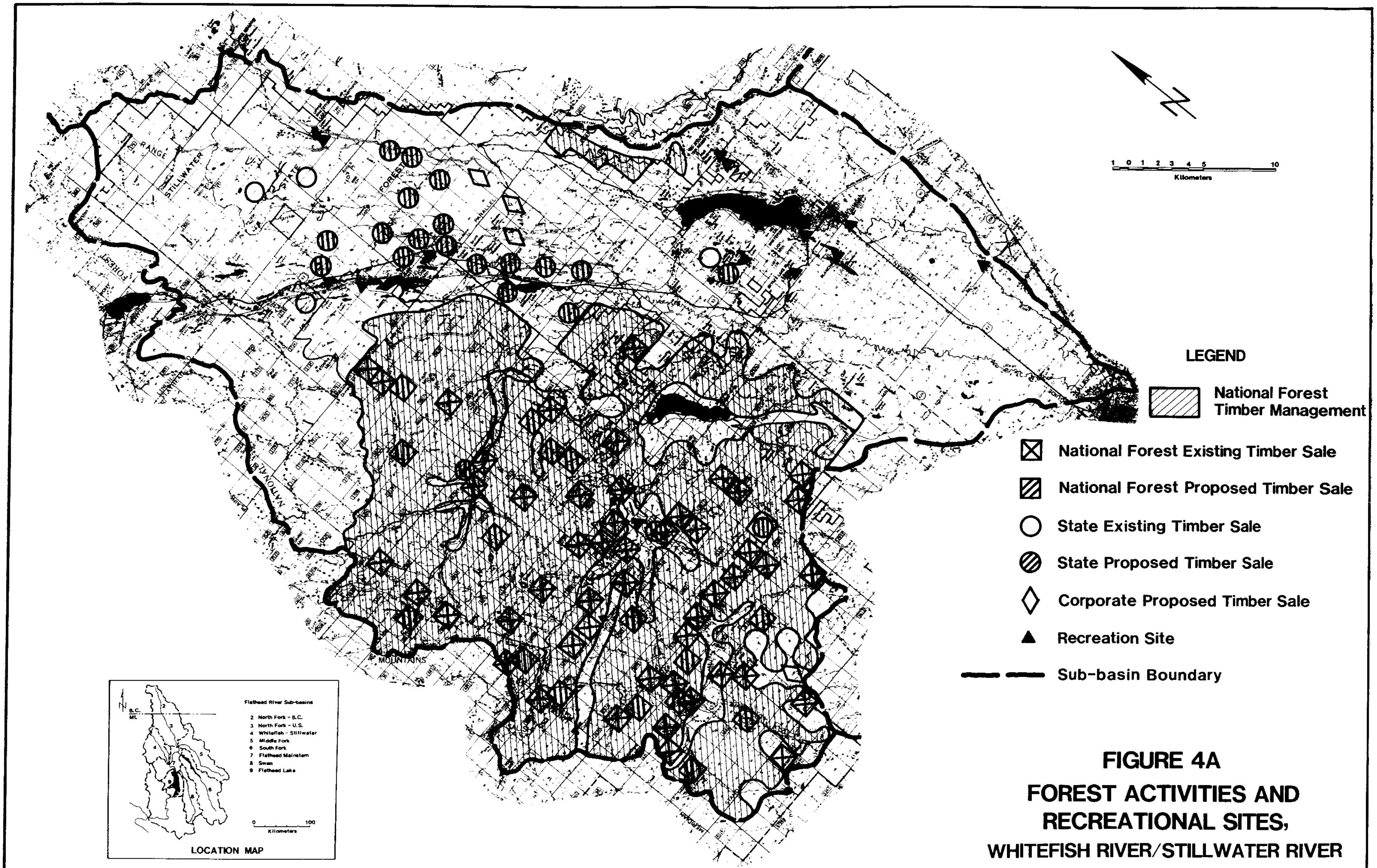



**FIGURE 4A**
**FOREST ACTIVITIES AND RECREATIONAL SITES,**
**WHITEFISH RIVER/STILLWATER RIVER**

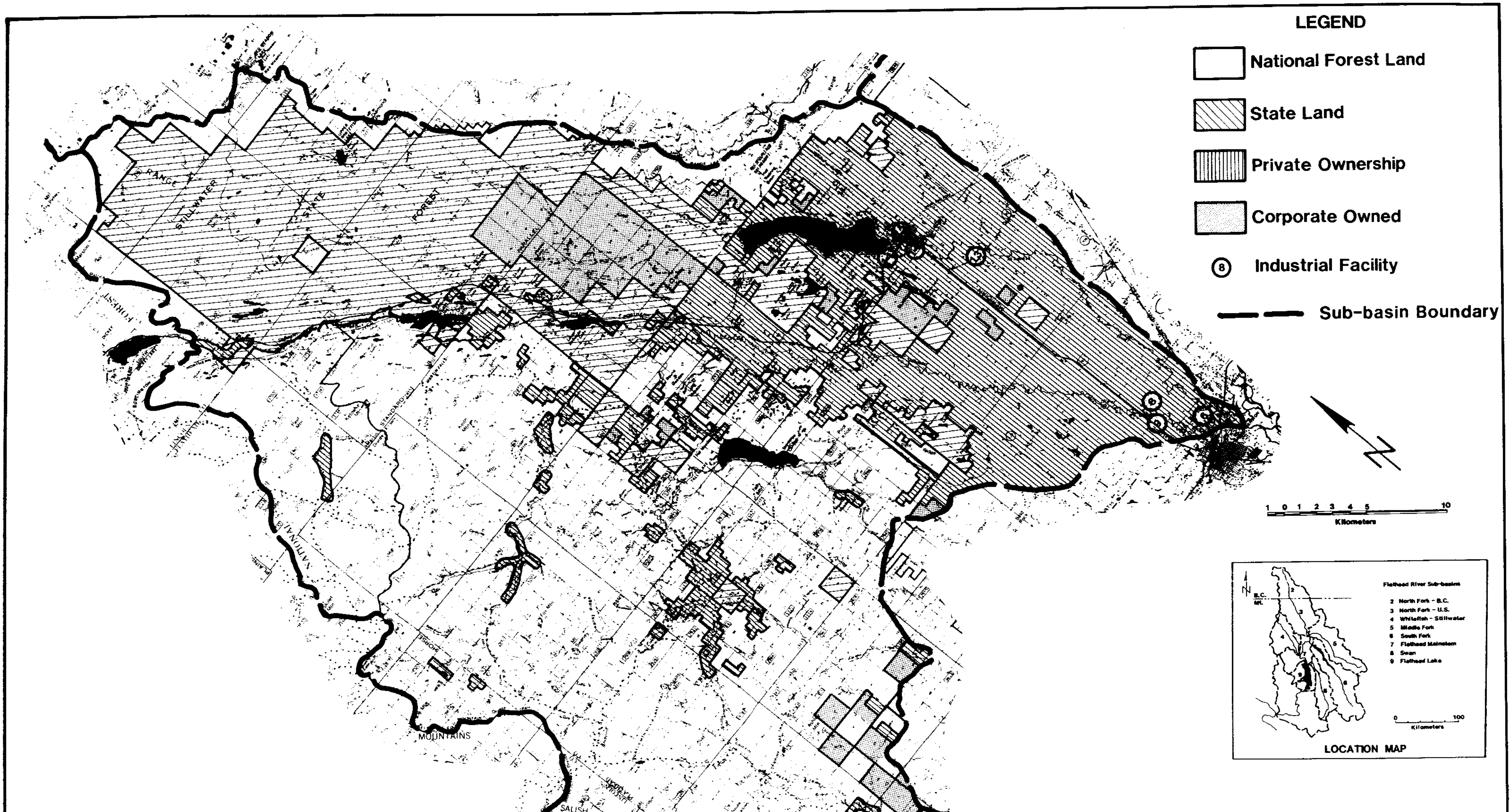



**FIGURE 4B**
**LAND OWNERSHIP AND INDUSTRIAL FACILITIES,**
**WHITEFISH RIVER/STILLWATER RIVER**

quality management in the Whitefish Watershed. Actions identified in the plan include providing advanced wastewater treatment in critical areas and requiring replacement of failed septic systems (Whitefish County Water and Sewer District 1985).

The location of the City of Whitefish sewage treatment plant discharge point is shown on Figure 4B. The Montana Department of Health and Environmental Sciences (MDHES) has ordered the city to upgrade its sewage treatment plant to remove phosphorus. The city has completed an engineering report on the required plant and submitted a compliance schedule which indicates the plant will be completed in 1988. See Section 9.3.3 for additional discussion of the State of Montana's phosphorus strategy. Figure 4C shows the population density in this sub-basin (U.S. Census 1980 derived).

### 4.3.3 Agriculture

The most productive agricultural lands are generally found in bottom lands and along several stream terraces. Figure 4D shows general land use (location of major farm operations of over 65 ha [160 acres]). The most important crops are small grains and hay. Other uses of agricultural land are pasture and christmas trees (Whitefish County Water and Sewer District 1984).

In the spring of 1976, the Flathead Drainage 208 Project established water quality sampling stations on the Stillwater and Whitefish Rivers. Sampling continued through February 1977. Their report states: "The impact on these two rivers from agriculture does not appear to be as great as one might expect. There are increases in nutrients and coliforms but these are not great. Based upon observation, we feel that the slumping of the banks is at least aggravated by over application of irrigation water. The slumping partially accounts for the increase in suspended sediment." (Montana Department of Health and Environmental Sciences 1977.)

The Whitefish Water and Sewer District has identified agricultural practices as a contributor to water quality degradation. Its Management Plan stresses the importance of sound management practices and conservation techniques such as proper use of fertilizers near stream courses; irrigation practices to avoid overwatering; proper use of pesticides and herbicides; limited grazing animal access to streams and lakes; and maintenance or establishment of buffer strips adjacent to streams. The Water and Sewer District is working with local farmers and the Flathead County Conservation District to implement these practices/techniques (Whitefish County Water and Sewer District 1985).

### 4.3.4 Forestry

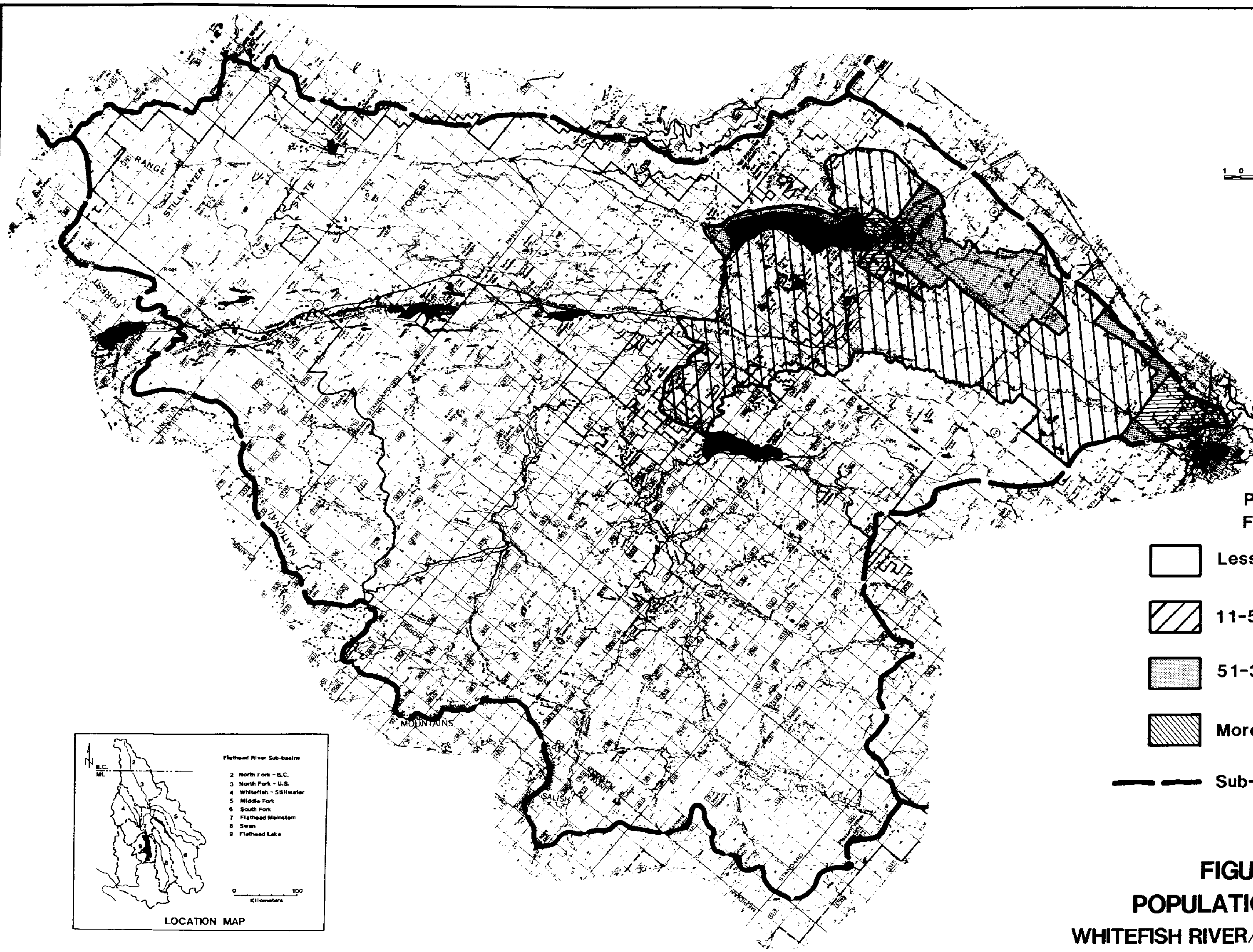
4.3.4.1 Current. The relative intensity and areal distribution of current timber harvest activity is best expressed in terms of the recently completed and ongoing timber sales of the major land managing entities in the sub-basin. The current timber sales and road development data are found on Tables 4 to 5 in Addendum A and shown on Figure 4A. The data are summarized in Table 4.3. Information on corporate forest lands was not available.

Table 4.3. Current timber sales and road development in the Whitefish River/Stillwater River, 1981 to 1985.

| Forest Manager | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|
| Flathead N.F. | 319 833 | 21 760 | 362 | 352 |
| State Forest | 60 708 | None | 9.6 | 0 |
| Plum Creek Timber Company | | | Not Available | |
| Totals | 380 541 (381 MMBF) | 21 760 (53 718 acres) | 372 (231 miles) | 352 (218.6 miles) |

Source: MDSL, Northwestern Land Office, Kalispell, Montana, Montana State Forest Timber Sale Data Table, Ongoing Program, February 1986, and Flathead National Forest Timber Sales Awarded or in Progress, FY 81 through FY 85, received from Supervisor's Office, Kalispell, Montana, 1986 February 21, derived.

4.3.4.2 Committed. Large areas of timbered property are potentially available for harvest, as reflected by the timber sale program plans of




LEGEND

People Per Sq. Mile
From U.S. Census, 1980

- Less than 10
- 11-50
- 51-300
- More Than 300
- Sub-basin Boundary

**FIGURE 4C**
**POPULATION DENSITY,**
**WHITEFISH RIVER/STILLWATER RIVER**

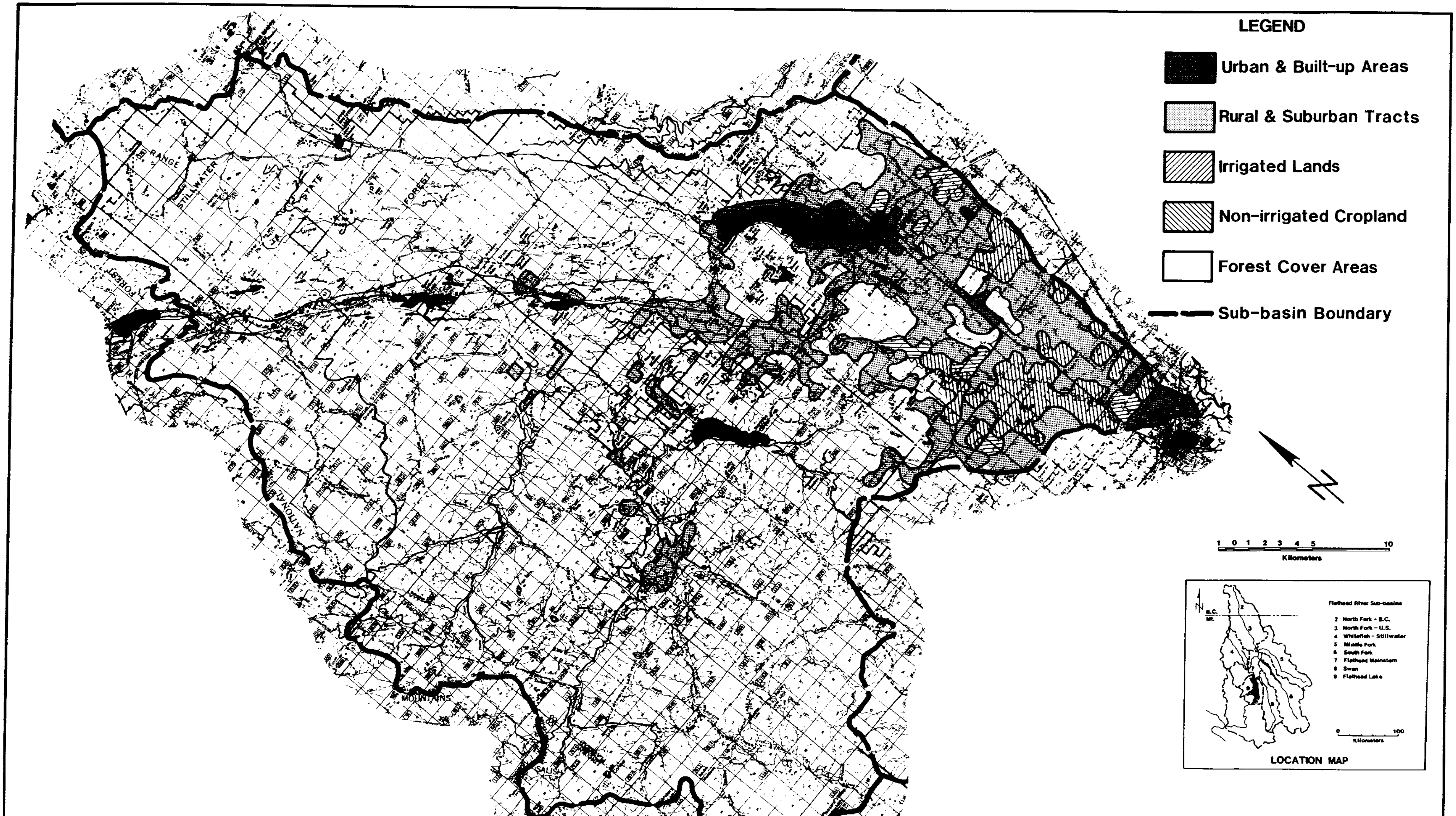



**FIGURE 4D**
**GENERAL LAND USE ,**
**WHITEFISH RIVER/STILLWATER RIVER**

the major forest managers in the sub-basin. The detailed, future timber sale planning by these organizations varies from three to five years. The committed timber harvest activity and road development are found in Tables 6 to 8, Addendum A, and on Figure 4A. The data are summarized in Table 4.4.

Table 4.4. Committed timber sales and road development in the Whitefish River/Stillwater River.

| Forest Manager | Fiscal Years | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|---|
| Flathead N.F. | 1986-90 | 150 000 | 2775 | 53 | 0 |
| State Forest | 1987-92 | 54 090 | 3411 | 51 | 0 |
| Plum Creek Timber Company | 1986-88 | 14 800 | 486 | Not Available | |
| Totals | | 219 000 (219 MMBF) | 6672 (16 474 acres) | 104 (66 miles) | 0 (miles) |

Sources: Flathead National Forest, Forest Plan, December 1985; MDSL, Northwestern Land Office, Kalispell, Montana, Montana State Forest, Timber Sale Data Table, Planned/Committed Program, 1986 March 14; and Plum Creek Timber Company, Timber Sales Data Table, November 1985, derived.

4.3.5 <u>Industry</u>

There are seven industrial sites in this sub-basin (Figure 4B). Table 4.5 identifies the name, type, and size of these operations (January 1986, Tom Jens, Senior Planner, Flathead Regional Development Office, Kalispell, Montana, personal communication).

The only industrial operation that has a point source discharge in this sub-basin is the Burlington Northern (BN) Railroad roundhouse in Whitefish. BN collects contaminated wastewater and ground water from the roundhouse, and spillage from the fueling area in two separate lagoons. Chemical treatment and reclamation of oil take place at the lagoons. Wastewater is then transferred to a stabilization lagoon. Final discharge

Table 4.5. Summary of industry in Whitefish River/Stillwater River.

| Site Name | Figure 4B Key | Type | Size Hectares | Size Acres |
|---|---|---|---|---|
| Idaho Timber | 11 | Lumbermill | 4 | 10 |
| Pack & Company | 13 | Asphalt Batch Plant | 2 | 5 |
| Hamilton Sand & Gravel | 14 | Gravel Pit | 4 | 10 |
| Burlington Northern Rail Yards | 12 | Railyards | 45 | 110 |
| [a]Plum Creek Plywood Plant | 6 | Plywood & mill | 8 | 20 |
| [a]Semi-Tool | 8 | Electronics | 2 | 5 |
| [a]Pack & Company | 9 | Gravel pit, batch plant | 24 | 60 |

[a]Adjacent to the Stillwater River

is into the Whitefish River. A point source discharge permit has been issued for this operation by the MDHES. It expires in 1987. The permit requires monitoring of total suspended solids, oil, grease, and pH. In 1983, several oil and grease discharges exceeded established standards.

### 4.3.6 Transportation

The major transportation route in this sub-basin is U.S. Highway 93. It runs due north between Kalispell and Whitefish, and then runs northwest parallel to the Stillwater River. The other main transportation is the Burlington Northern Railroad route. It runs from Columbia Falls to Whitefish, along the west shore of Whitefish Lake, and then parallel to U.S. Highway 93.

No major new construction is planned on the U.S. Highway or the BN Railroad. There is no information to evaluate the impact of transportation facilities on water quality. The impacts are thought to be minor.

# 5. MIDDLE FORK, FLATHEAD RIVER

## 5.1 INTRODUCTION

The Middle Fork, Flathead River originates in the northern part of the Bob Marshall Wilderness (Figure 5) and was included in the National Wild and Scenic Rivers System in 1976. It flows in a northwesterly direction through the Great Bear Wilderness to U.S. Highway 2. At this point, it flows parallel to that highway. The river forms the southwest boundary of Glacier National Park to its confluence with the North Fork. The Middle Fork, Flathead River drains an area of approximately 2858 $km^2$ (1103 $mi^2$). The Middle Fork, Flathead River has an average gradient of 4.9 m/km (25.9 ft/mi).

West Glacier is the only town in close proximity to the Middle Fork, Flathead River. The small settlements of Essex and Nyack and a few, widely separated residences and businesses exist along U.S. Highway 2. The vast majority of land in the sub-basin is federally-owned and managed by either Glacier National Park or the Flathead National Forest. The primary socio-economic activity in the sub-basin is timber management.

## 5.2 SOCIO-ECONOMIC ACTIVITIES POTENTIALLY IMPACTED BY CHANGES IN WATER QUALITY AND/OR WATER QUANTITY

### 5.2.1 Recreation

The primary recreational activities in this sub-basin are fishing and whitewater floating. Table 5.1 provides an estimate of river floating on the Middle Fork, Flathead River in 1985.

Table 5.1. Recreational river floating, Middle Fork, Flathead River, 1985.

| Type | Number of Floaters |
|---|---|
| Outfitted | 10 122 |
| Non-Outfitted | 2 040 |
| Total | 12 162 |

Source: J. Ashor, Flathead National Forest, Hungry Horse Ranger District, Montana, personal communication February 1986

5.2.1.1 Fishing. The Middle Fork, Flathead River and some of its larger tributaries serve both as recreational fisheries sites and as important production areas for the cutthroat trout, kokanee salmon and bull trout in the Basin. A large percentage of the kokanee salmon that move up the Flathead River-Mainstem for spawning move into the Middle Fork, Flathead River and some of its tributaries, primarily McDonald Creek in Glacier National Park. Bull trout spawning activity is thought to be nearly evenly distributed between the North and Middle Forks of the Basin (Fredenberg and Graham 1983).

The Middle Fork, Flathead River was not censused as part of the fishing study completed on the North Fork, Flathead River in Montana, Flathead River-Mainstem, and Flathead Lake. Detailed data on fisherman use and harvest for the entire fishing season are not available. A partial creel census was conducted by the Montana Department of Fish, Wildlife and Parks from 1981 September 12 to November 30th, to gather data on the kokanee snag fishery. Kokanee snagging is the major contributor to fishing pressure on the lower Middle Fork, Flathead River (Fredenberg and Graham 1983).

From May 1982 to April 1983, total fisherman use on the Middle Fork, Flathead River was estimated at 7669 fisherman days; 41 percent were resident and 59 percent were non-resident fishermen. Most of this activity was kokanee snagging (Montana Department of Fish, Wildlife and Parks undated). However, approximately 18 percent of the river floaters also fished; compared with approximately 40 percent and 92 percent on the North and South Forks, Flathead River, respectively.

Glacier National Park initiated a comprehensive evaluation of angler use in the Park in 1979. Data have been published for 1979, 1980 and 1981. Voluntary creel census cards and creel census interviews at Park check stations were used to gather data on fishing use and harvest. The interviews indicated that about 10 percent of all Park visitors were fishermen. A total of 119,896 visitors were estimated to have fished in the Park in 1979 and 138,371 in 1980. The census results represent the park fishing season (June 5th to October 15th, yearly). The data are also for all fishing in the Middle Fork drainage within the Park (i.e., the Middle Fork, Flathead River and all tributary streams and lakes).

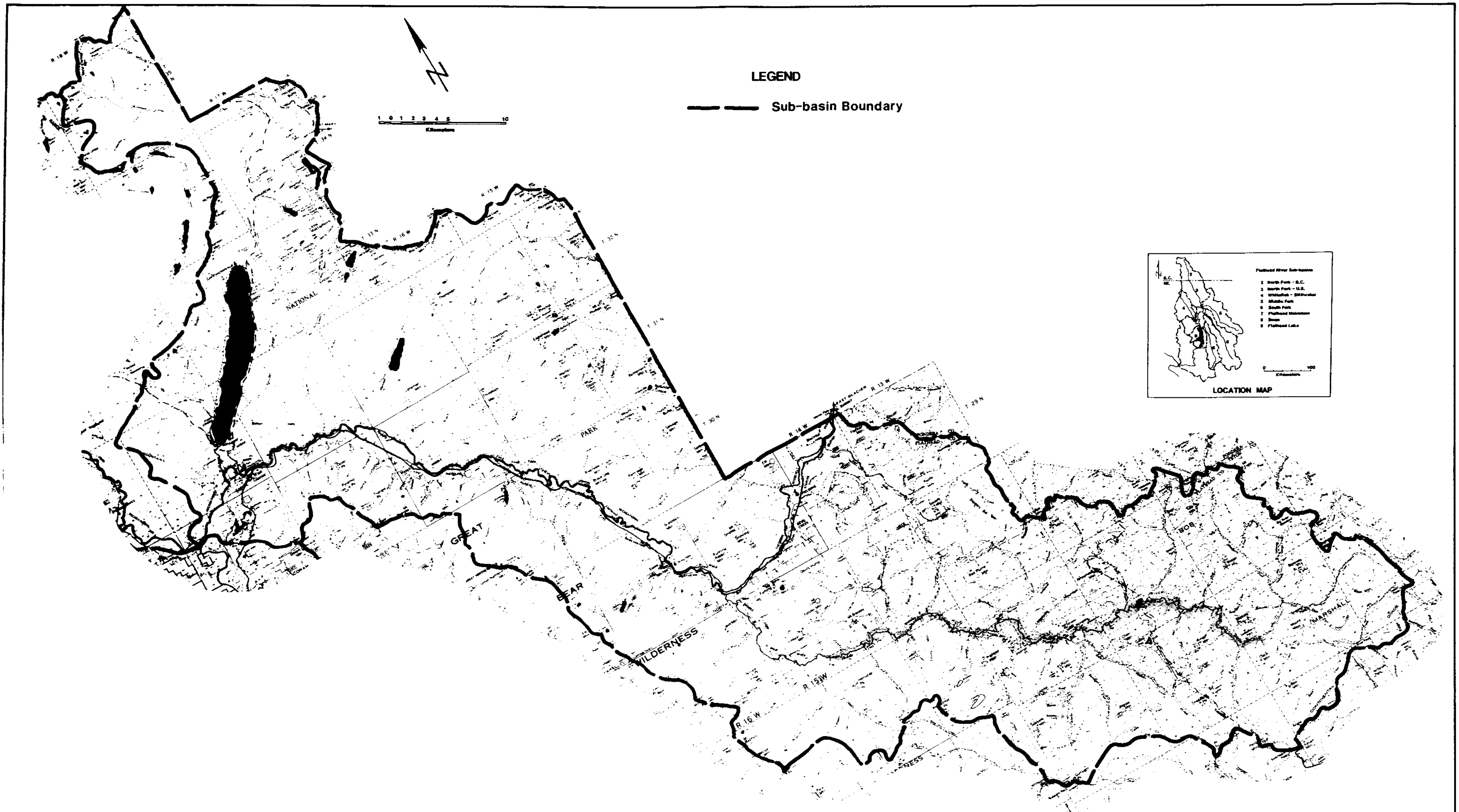



FIGURE 5
MAP OF THE MIDDLE FORK,
FLATHEAD RIVER

Table 5.2 shows the estimated annual fish harvest and species composition of the catch. The remainder of the catch not listed in Table 5.2 (7 percent) was grayling and lake trout. The average annual catch of sportfish, in Glacier National Park, was estimated at 1910 fish. Kokanee snagging is not permitted in the Park.

Table 5.2. Estimated fish harvest for the Glacier National Park portion of the Middle Fork, Flathead River, 1979 to 1981.

| Fish Species | Number of Fish Caught | Catch Rate Fish/Hour | Composition of Catch, Percent |
|---|---|---|---|
| Cutthroat Trout | 1 142 | 0.47 | 59 |
| Bull Trout | 64 | 0.03 | 4 |
| Kokanee | 20 | 0.01 | 1 |
| Whitefish | 36 | 0.01 | 2 |
| Rainbow Trout | 165 | 0.07 | 8 |
| Brook Trout | 375 | 0.15 | 19 |

Source: U.S. Fish and Wildlife Service undated.

During 1979 to 1981, the average annual fishing pressure in Glacier National Park was estimated at 3248 fisherman-hours. The average number of hours fished per day was 3.07 hours. The annual pressure was 1058 angler-days.

The MDFWP investigated the kokanee fishery of the Flathead River-Mainstem and Middle Fork, Flathead River in 1981. Data were collected from September to November. The river kokanee fishery is unique in several respects. Kokanee normally first appear in the lower Flathead River-Mainstem in early September. Spawning occurs between mid-October and mid-December. The adult fish die, and the fry move downstream into Flathead Lake in April and May of the following spring. Kokanee were taken by snagging between September 1st to December 31st. The limit was 35 fish daily, and 70 in possession during this study period. Kokanee were found throughout the Flathead River-Mainstem. A large number moved up the Middle Fork, Flathead River and its tributaries as far as Nyack Flats (Fredenberg and Graham 1982).

The creel census on the Middle Fork, Flathead River was conducted from 1981 September 12 to November 30th. The interviews indicated that very few fishermen were involved in any other type of fishing during this period. About 88 percent of the fishermen were shore fishermen. Twelve percent used boats. Table 5.3 provides information on the origin of these fishermen and associated travel.

Table 5.3. Fishermen origin, Middle Fork, Flathead River, 1981.

| Location | Hours Fished, Percent | Distance from Home, Kilometers | Length of Trip, Hours |
|---|---|---|---|
| County Residents | 61 | 66 (41 miles) | 3.7 |
| In State, excludes County Residents | 19 | 393 (244 miles) | 5.2 |
| Non-residents (Out of State, Foreign) | 20 | 979 (608 miles) | 5.2 |

Source: Fredenberg and Graham 1982.

The average, overall catch rate on the Middle Fork, Flathead River was 1.9 fish per hour. The average angler caught 9.5 kokanee per day. County residents caught 3.2 fish per hour and 12 per day. The total fishing pressure during this period was assumed to be only kokanee snagging. It was estimated at 37,870 fisherman hours. Of this total, 97 percent occurred between the confluence of the North Fork and 21.7 km (13.5 mi) upstream to Harrison Creek (Fredenberg and Graham 1982). Table 5.4 shows the total estimated harvest of kokanee on the Middle Fork during the fall of 1981. It was estimated at 75,117 spawners.

Table 5.4. Estimated kokanee harvest on the Middle Fork, Flathead River, 1981.

| Month | Shore | Boat | Total |
|---|---|---|---|
| September 12 to 30 | 32 376 | 11 926 | 44 302 |
| October | 26 431 | 3 891 | 30 322 |
| November | 493 | 0 | 493 |
| Total | 59 300 | 15 817 | 75 117 |

Source: Fredenberg and Graham 1982.

5.2.2 Preservation

5.2.2.1 Wild and scenic river designation. The Middle Fork, Flathead River was designated as "wild" from its headwaters downstream to Bear Creek and "Recreational" from Bear Creek to its confluence with the North Fork (Figure 5A). See Section 3.2.4 for definitions of wild, scenic, and recreation rivers.

5.2.3 Other Socio-Economic Activities

This sub-basin is not directly downstream from the site of the proposed mine. Any change in water quality and/or water quantity that would be a direct result of the proposed mine cannot directly affect any other socio-economic activities of this sub-basin; therefore, it would not have a direct impact on any other socio-economic activities in this sub-basin.

5.3 SOCIO-ECONOMIC ACTIVITIES THAT POTENTIALLY AFFECT WATER QUALITY AND/OR WATER QUANTITY

5.3.1 Recreation

There are five public campgrounds within this sub-basin. Four are located within Glacier National Park and one is a U.S. Forest Service site. The Forest Service maintains a boating site at Paola Creek on the Middle Fork, Flathead River. The MDFWP maintain a fishing access site on the Middle Fork (Figure 5B). The West Entrance to Glacier National Park is within this sub-basin.

The four developed Glacier National Park sites are located in the Lake McDonald area. These four developed sites had 71,870 Camper Nights in 1985. An additional 2312 Camper Nights were reported for other dispersed Park sites within this sub-basin. The total visitors entering at the West Entrance to Glacier National Park in 1985 were 680,917 (February 1986, Gary Gregory, Glacier National Park Headquarters, Montana, personal communication).

Devil Creek is the Forest Service campground on the Middle Fork. In 1985, 2900 Recreation Visitor Days were reported at this site. The Forest Service also maintains records on recreation use for the Great

Bear Wilderness. The Forest Service reported 22,900 Recreational Visitor Days in 1985 for this wilderness area (U.S. Forest Service 1986). The Forest Service maintains Visitor Days information for the river. In 1985, 20,300 Visitor Days were reported for the river. Table 5.5 lists these latter Visitor Days by activity.

Table 5.5. Forest service estimate of visitor days activities on the Middle Fork, Flathead River, 1985.

| Type of Activity | Visitor Days (Thousands) | Percent |
|---|---|---|
| Canoeing | .4 | 2.0 |
| Other watercraft | 9.2 | 45.3 |
| Swimming and water play | .5 | 2.5 |
| Fishing, cold water | 1.5 | 7.4 |
| Camping, general day | .8 | 3.9 |
| Camping, auto | 1.0 | 4.9 |
| Camping, trailer | 1.1 | 5.4 |
| Camping, tent | .3 | 1.5 |
| Picnicking | .1 | .5 |
| Cross-country skiing, snowshoeing | 3.6 | 17.7 |
| Hunting, big game | 1.0 | 4.9 |
| Hunting, upland birds | .2 | 1.0 |
| Hunting, waterfowl | .2 | 1.0 |
| Nature study, wildlife, birds, fish | .1 | .5 |
| Nature study, hobby, education | .1 | .5 |
| Gathering forest products | .2 | 1.0 |
| Total Visitor Days | 20.3 | 100.0 |

Source: U.S. Forest Service 1986.

There are private recreation facilities at West Glacier and Essex, but the WUC has no detailed information on these sites. The impact of recreational use on water use and quality has not been quantified, but is assumed to be small.

### 5.3.2 Settlement

There are no incorporated communities in this sub-basin. The Glacier National Park Headquarters and employee housing are located at West Glacier. West Glacier and Essex are small unincorporated communities on U.S. Highway 2.

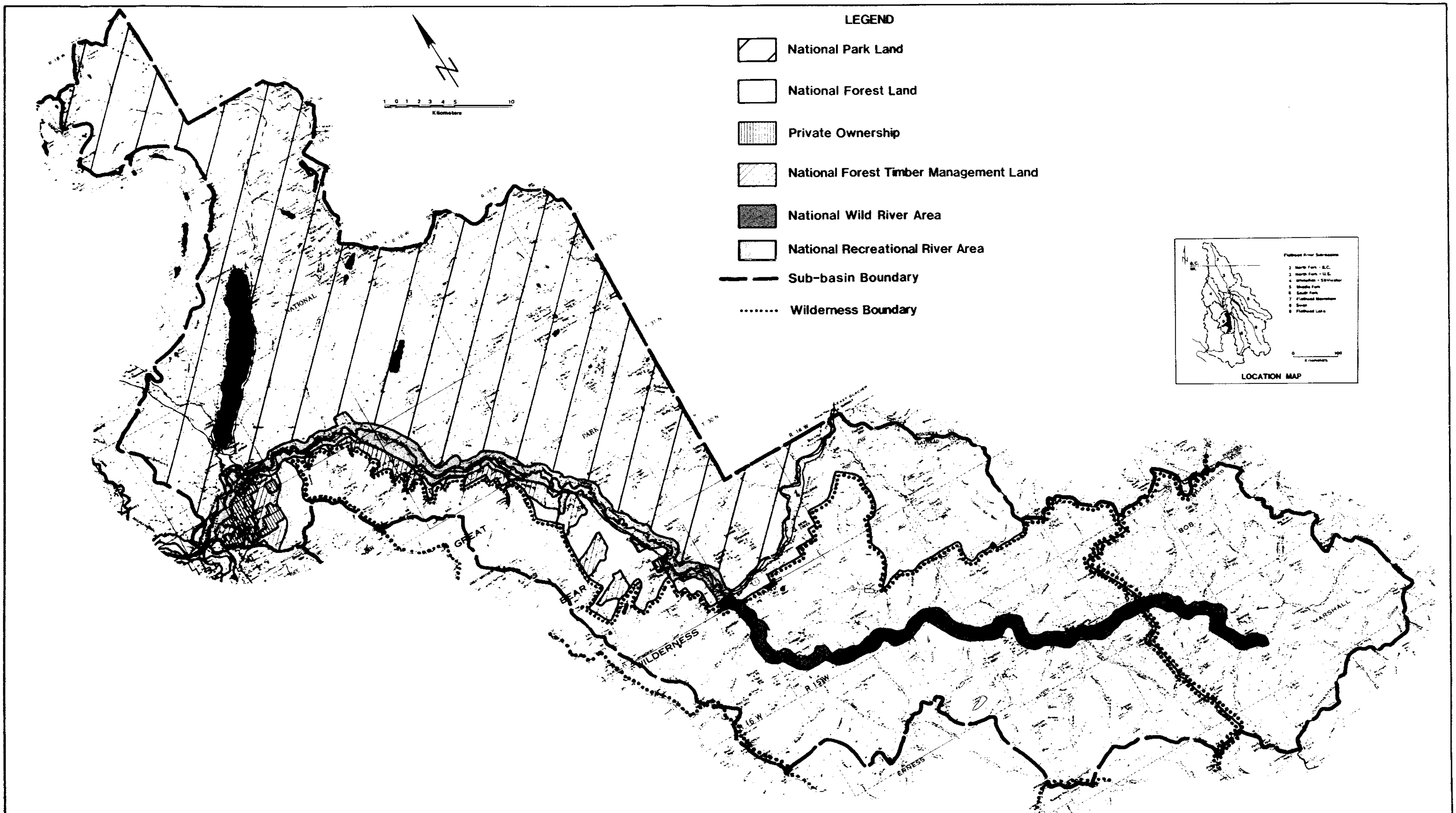



**FIGURE 5A**
**LAND OWNERSHIP AND FOREST ACTIVITIES,**
**MIDDLE FORK, FLATHEAD RIVER**

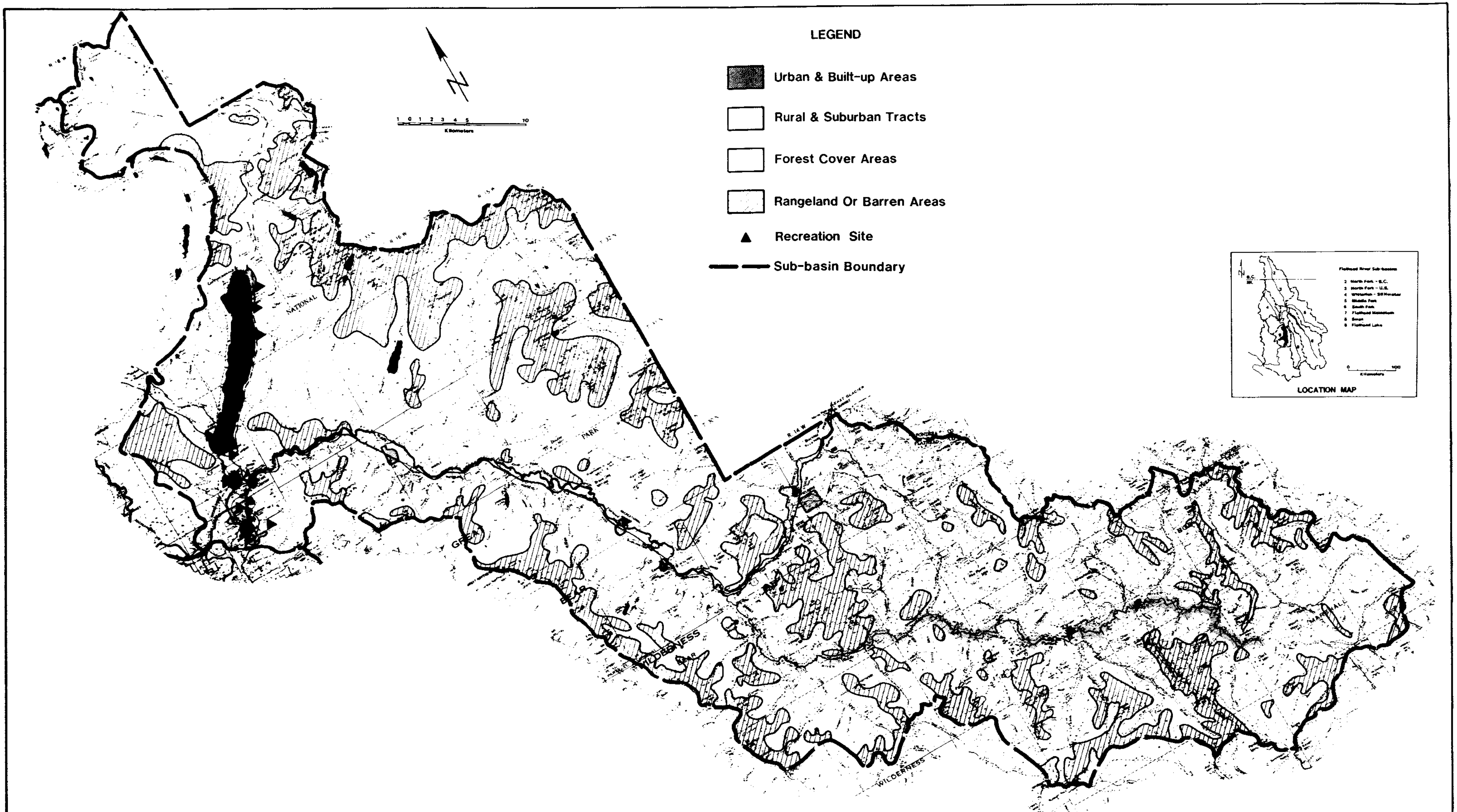



**FIGURE 5B**
**GENERAL LAND USE AND RECREATIONAL SITES, MIDDLE FORK, FLATHEAD RIVER**

The estimated permanent population is 451 people. The projected 1990 population is 496 people (Flathead River Basin Environmental Impact Study 1983, medium scenario, p. 58). There are approximately 454 housing units in the sub-basin (U.S. Census 1980 derived). Of these, 204 units are seasonal. There are 175 people living at Apgar in the summer and 75 people during the winter. The National Park Service operates a sewage treatment system which handles sewage from the Headquarters, Apgar and Lake McDonald Lodge. The sewage system provides secondary treatment and a holding facility. The effluent is spray irrigated on some pasture land. There is no point source discharge into any surface water (February 1986, Gary Gregory, Glacier National Park Headquarters, Montana, personal communication). The remaining homes in the sub-basin are served by individual septic tanks and drainfields. There is no data to indicate the impact of these septic tanks/drainfields.

### 5.3.3 Agriculture

There appears to be little or no agricultural activity in this sub-basin.

### 5.3.4 Forestry

5.3.4.1 Current. The relative intensity and areal distribution of current timber harvest activity is best expressed in terms of the recently completed and ongoing timber sales of the Flathead National Forest. It is the only timber management agency in this sub-basin. The current timber sales and road development data are found on Table 9 in Addendum A and shown on Figure 5A. The data are summarized in Table 5.6.

Table 5.6. Current timber sales and road development in the Middle Fork, Flathead River, 1981 to 1985.

| Forest Manager | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|
| Flathead N.F. | 15 461<br>(15.5 MMBF) | 2 854<br>(7 046 acres) | 21.2<br>(13.2 miles) | 24.5<br>(15.2 miles) |

Source: Flathead National Forest Timber Sales Awarded or in Progress, FY 81 through FY 85, received from Supervisor's Office, Kalispell, Montana 1986 February 21, derived.

5.3.4.2 <u>Committed</u>. Large areas of timbered property are potentially available for harvest, as reflected by the timber sale program plans of the Flathead National Forest. The committed timber harvest activity and road development are found in Table 10, Addendum A, and illustrated in Figure 5. The data are summarized in Table 5.7.

Table 5.7. Committed timber sales and road development in the Middle Fork, Flathead River.

| Forest Manager | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|
| Flathead N.F. | 11 500 (11.5 MMBF) | 277 (685 acres) | 16 (10 miles) | 12.9 (8 miles) |

Source: Flathead National Forest 1985 derived

### 5.3.5 Industry

No industrial activity exists in this sub-basin.

### 5.3.6 Transportation

The major transportation route is U.S. Highway 2 which parallels the Middle Fork, Flathead River. An 18 km (11 mi) stretch of this highway is under reconstruction between Hungry Horse and West Glacier. The project consists of highway widening from two to four lanes. An Environmental Impact Statement was completed in April 1982 by the Montana Department of Highways (MDH) and U.S. Department of Transportation (DOT). The EIS concluded that the non-point source pollution from the project was so small that no adverse impact would be caused to the surface water quality of the Flathead River. Detention facilities are being constructed in areas where stormwater collection systems are used. Measures to reduce water runoff include vegetative buffer strips along water courses, dispersion of stormwater runoff, and erosion and runoff controls during construction (Montana Department of Highways 1982).

The Burlington Northern (BN) Railroad line also runs parallel to the Middle Fork, Flathead River. BN constructed a new railroad trestle across the Middle Fork near Coram in 1986. The new trestle is located directly upstream of an existing trestle, which has been determined to be unsafe. The structure consists of steel monolithic towers which support the decking and track. The bases of five of the towers are located below the high water mark, and the bases of two are located below the low water mark of the river. A construction permit was obtained from the U.S. Army Corps of Engineers (COE) under Section 404 of the Federal Clean Water Act. Another permit was obtained from the Flathead County Conservation District under the Montana Natural Streambed and Land Preservation Act of 1975. Conditions were included in both permits to protect water quality. The construction was monitored on a continuous basis by the Conservation District.

# 6. SOUTH FORK, FLATHEAD RIVER

## 6.1 INTRODUCTION

The South Fork, Flathead River begins in the Bob Marshall Wilderness Area and flows northwest 92 km (57 mi) to Hungry Horse Reservoir (Figure 6). The Reservoir is 65 km (40 mi) long. It is impounded by a 174 m (564 ft) high dam which was completed in 1952. The South Fork, Flathead River has a drainage area of 4422 $km^2$ (1696 $mi^2$). It has an average gradient of 3.9 m/km (20 ft/mi). For purposes of this report, there is an 8 km (15 mi) stretch of the South Fork, Flathead River below the dam which is part of the Flathead-Mainstem sub-basin. It is approximately 49 $km^2$ (19 $mi^2$) in size.

Virtually all of the South Fork drainage sub-basin is owned by the United States Government. It is part of the Flathead National Forest. There are no towns in this sub-basin. The one settlement, Spotted Bear, is a seasonal National Forest Ranger Station.

Water-based recreation in this sub-basin includes stream and reservoir fishing, boating on Hungry Horse Reservoir, and floating on the South Fork, Flathead River from the Spotted Bear Ranger Station to the reservoir. Surveys have shown that approximately 80 to 90 percent of river floaters are fishermen (Fredenberg and Graham 1983). There are several Forest Service campgrounds near or on Hungry Horse Reservoir and near the Spotted Bear Ranger Station.

The only development activity in the South Fork, Flathead River sub-basin is associated with timber harvest (Figure 6A). The seasonal population of the sub-basin is 47 (U.S. Census 1980 derived).

## 6.2 SOCIO-ECONOMIC ACTIVITIES POTENTIALLY IMPACTED BY CHANGES IN WATER QUALITY AND/OR WATER QUANTITY

### 6.2.1 Recreation

6.2.1.1 Fishing. The South Fork, Flathead River sub-basin is an isolated fishery as a result of the obstruction to fish movement created by the Hungry Horse Dam. There is no attempt to artificially facilitate fish passage. Construction of Hungry Horse Dam eliminated the historic bull trout run from Flathead Lake into the South Fork, Flathead River for spawning. It is estimated that construction of the Dam may have reduced bull trout populations in Flathead Lake by as much as one-half (Flathead River Basin Environmental Impact Study 1983). Spawning migrations of bull trout still occur from the Reservoir to the upper South Fork, Flathead River drainage. The Dam has also isolated Flathead Lake from important westslope cutthroat spawning and recruitment in the upstream portion of this sub-basin. The cutthroat trout and bull trout are the predominant game fish species in this sub-basin.

There was no use census conducted on the South Fork, Flathead River as part of the Flathead River Basin fisheries studies. Very little fisherman use and harvest data are available. The MDFWP estimates for the period from 1982 May 1 to 1983 April 30, that fisherman use on the South Fork, Flathead River was 14,543 fisherman-days; 58 percent were resident and 42 percent non-resident fishermen (Montana Department of Fish, Wildlife and Parks undated).

### 6.2.2 Preservation

6.2.2.1 Wild and scenic river designation. The South Fork, Flathead River was designated as "Wild" from its headwaters to the Spotted Bear Ranger Station at the Bob Marshall Wilderness boundary, and "Recreational" from this boundary to the upper end of Hungry Horse Reservoir (Figure 6A). Section 3.2.4.1 describes the Wild and Scenic Rivers Act, Public Law 90-542, 90th Congress, 1968 October 2.

### 6.2.3 Other Socio-Economic Activities

This sub-basin is not directly downstream from the site of the proposed mine. Any changes in water quality and/or water quantity that would be a direct result of the proposed mine cannot directly affect any other socio-economic activities of this sub-basin; therefore, it would not have a direct impact on the other socio-economic activities in this sub-basin.

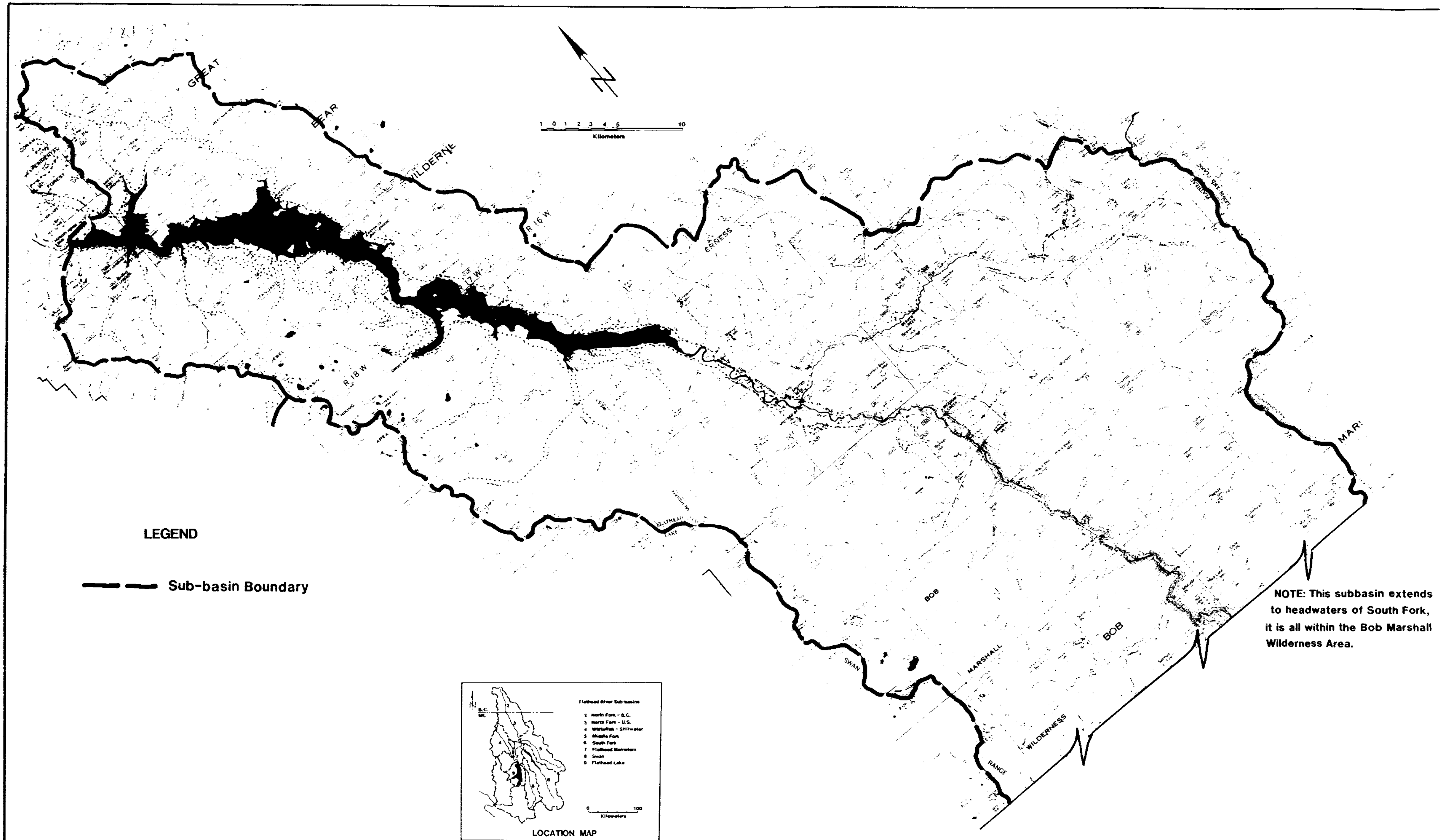



**FIGURE 6**

**MAP OF THE SOUTH FORK, FLATHEAD RIVER**

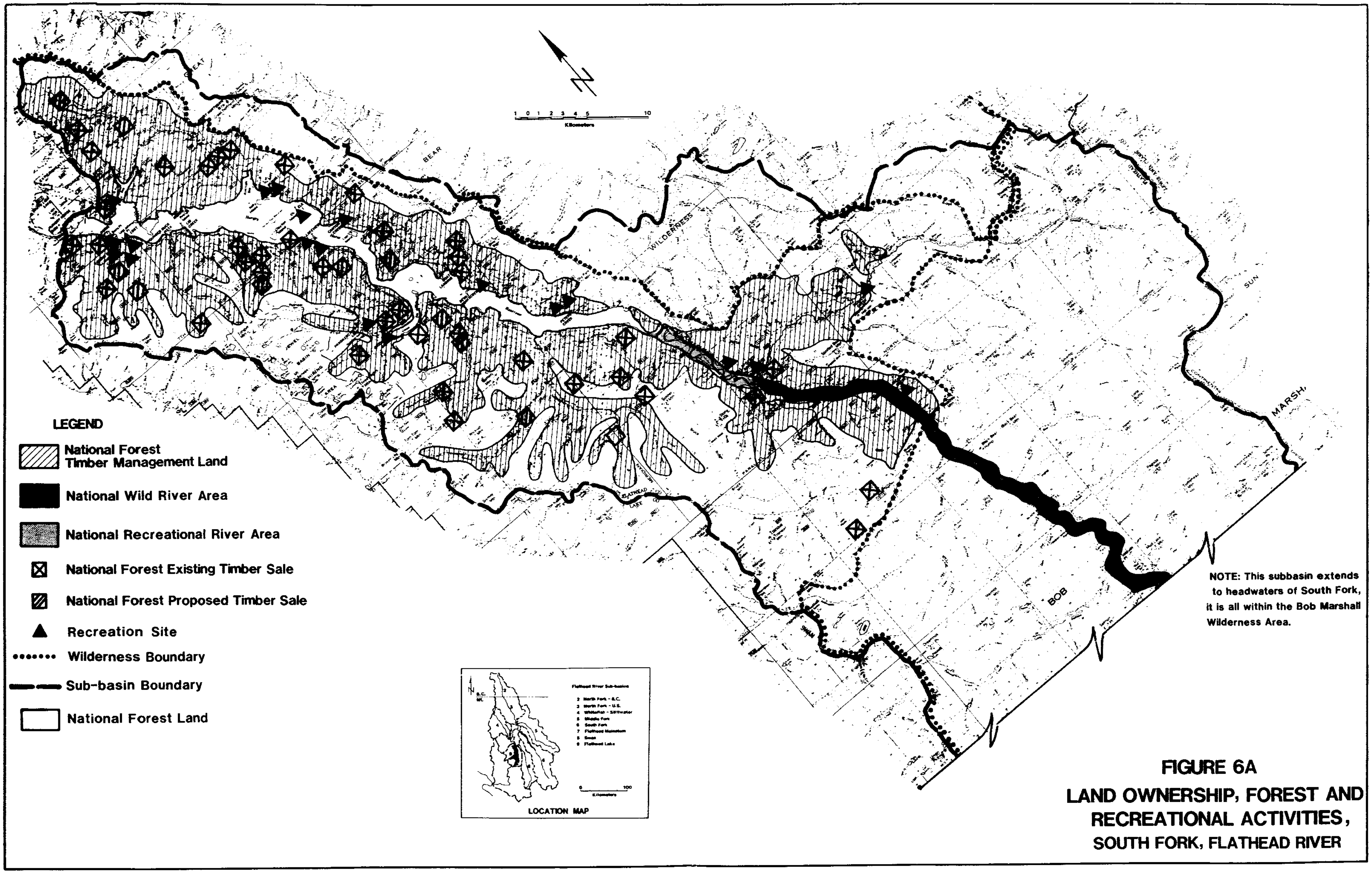



**FIGURE 6A**
**LAND OWNERSHIP, FOREST AND RECREATIONAL ACTIVITIES, SOUTH FORK, FLATHEAD RIVER**

## 6.3 SOCIO-ECONOMIC ACTIVITIES THAT POTENTIALLY AFFECT WATER QUALITY AND/OR WATER QUANTITY

Activities in the upstream South Fork, Flathead River sub-basin have very little affect on the Flathead River-Mainstem and Flathead Lake because of the Hungry Horse Dam barrier. The purpose of this section is to describe activities in this sub-basin.

### 6.3.1 Recreation

All of the land in this sub-basin is managed by the U.S. Forest Service. Recreational activities take place on Hungry Horse Reservoir, the South Fork, Flathead River, Bob Marshall Wilderness, and the Jewel Basin hiking area. There are 10 U.S. Forest Service campgrounds on Hungry Horse Reservoir, and 1 at the confluence of Spotted Bear Creek and the South Fork of the Flathead River (Figure 6A). In 1985, the Forest Service reported 22,300 Recreation Visitor Days at these campgrounds. The Forest Service maintains 35 other developed sites outside of the Bob Marshall Wilderness and in this sub-basin. It reported 27,900 Visitor Days for these sites. These sites included roads, trails, boating activities, and picnic grounds.

The Forest Service also maintains separate records on use of the wilderness areas in this sub-basin. It reported 100,500 Recreation Visitor Days in 1985. In 1985, 40,300 Recreation Visitor Days were reported on the portion of the South Fork protected under the Wild and Scenic River Act. About 14,700 of these Recreation Visitor Days were included in the 100,500 wilderness use Visitor Days. The remaining 25,600 Visitor Days are in addition to the 100,500 Visitor Days reported for the wilderness areas. In 1985, seven commercial outfitters provided river floating services. The number of people that participated on these float trips was estimated to be 1212 (U.S. Forest Service 1986).

### 6.3.2 Settlement

There are no incorporated communities in this sub-basin. The total population is estimated to be 47 people. They reside on a seasonal basis at Forest Service stations, or have leases on forest land (U.S. Census 1980 derived).

6.3.3 Agriculture

There is no agricultural activity in this sub-basin.

6.3.4 Forestry

6.3.4.1 Current. The relative intensity and areal distribution of current timber harvest activity is best expressed in terms of the recently completed and ongoing timber sales of the Flathead National Forest. The current timber sales and road development data are found in Table 11 in Addendum A and shown in Figure 6A. The data are summarized in Table 6.1.

Table 6.1. Current timber sales and road development in the South Fork, Flathead River, 1981 to 1985.

| Forest Manager | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|
| Flathead N.F. | 139 785 (139.8 MMBF) | 43 537 (107 498 acres) | 97.3 (60.5 miles) | 185 (114.8 miles) |

Source: Flathead National Forest timber sales awarded or in progress, FY 81 through FY 85, received from supervisor's office, Kalispell, Montana 1986 February 21, derived.

6.3.4.2 Committed. Large areas of timbered property are potentially available for harvest, as reflected by the timber sale program plans of the Flathead National Forest. The detailed, future timber sale planning by the U.S. Forest Service is for fiscal years 1986 to 1990. The committed timber harvest activity and road development are found in Table 12, Addendum A, and illustrated in Figure 6A. The data are summarized in Table 6.2.

Table 6.2. Committed timber sales and road development in the South Fork, Flathead River.

| Forest Manager | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|
| Flathead N.F. | 108 500 (108.5 MMBF) | 2337 (5771 acres) | 102 (63.3 miles) | 80 (49.7 miles) |

Source: Flathead National Forest 1985 derived.

### 6.3.5 Industry

There is no industrial activity in this sub-basin.

### 6.3.6 Transportation

Dirt and paved roads maintained by the Forest Service run along both sides of Hungry Horse Reservoir. There are no roads in the Bob Marshall Wilderness.

# 7. FLATHEAD RIVER-MAINSTEM

## 7.1 INTRODUCTION

The Flathead River-Mainstem begins at the confluence of the North and Middle Forks of the Flathead River at the southwest boundary of Glacier National Park (Figure 7). It flows southwesterly for 15 km (9 mi) to its confluence with the South Fork near the town of Hungry Horse. For purposes of this IJC study, the Flathead River-Mainstem includes that part of the South Fork between the Mainstem and Hungry Horse Dam. The Flathead River-Mainstem flows through narrow canyons below the mouth of the South Fork for about 8 km (5 mi), until it enters the broad Flathead Valley near the town of Columbia Falls. The river flows south in a meandering pattern to where it enters Flathead Lake, a total of 89 km (52 mi) downstream from the confluence of the Middle and North Forks. The river gradient averages 1.6 m/km (8.4 ft/mi) above Columbia Falls and 0.4 m/km (2.1 ft/mi) from Columbia Falls to the Flathead Lake (Fredenberg and Graham 1983). The sub-basin has an area of 1786 $km^2$ (685 $mi^2$). There are 33,387 people that live in this sub-basin (U.S. Census 1980 derived). This is approximately 57 percent of the population of the entire study area. The largest urban areas in the Basin (Kalispell, Columbia Falls) are located in this sub-basin.

## 7.2 SOCIO-ECONOMIC ACTIVITIES POTENTIALLY IMPACTED BY CHANGES IN WATER QUALITY AND/OR WATER QUANTITY

### 7.2.1 Recreation

There is very little National Forest Land in this sub-basin. Most of the land is privately-owned. The MDFWP maintains many recreation sites. These include Lone Pine State Park, Ashley Lake Recreation area, and six fishing access sites on the Flathead River-Mainstem (Figure 7A). There are also numerous private recreation facilities in the sub-basin.

Lone Pine State Park is located just south of Kalispell. In 1981, 16,900 people visited the Park. Ashley Lake had 5400 visitors in 1984. Table 7.1 shows the visitor use at the six fishing access sites.

Table 7.1. Number of visitors at fishing access sites on the Flathead River-Mainstem, 1985.

| Access Site | Visitors |
|---|---|
| Teakettle | 17 200 |
| Kokanee Bend | 2 500 |
| Pressentine Bar | 9 000 |
| Old Steel Bridge | 28 400 |
| Kiwanis Lane | 34 000 |
| Sportsman's Bridge | 13 500 |
| Total Use | 104 600 |

Source: Montana Department of Fish, Wildlife and Parks 1985.

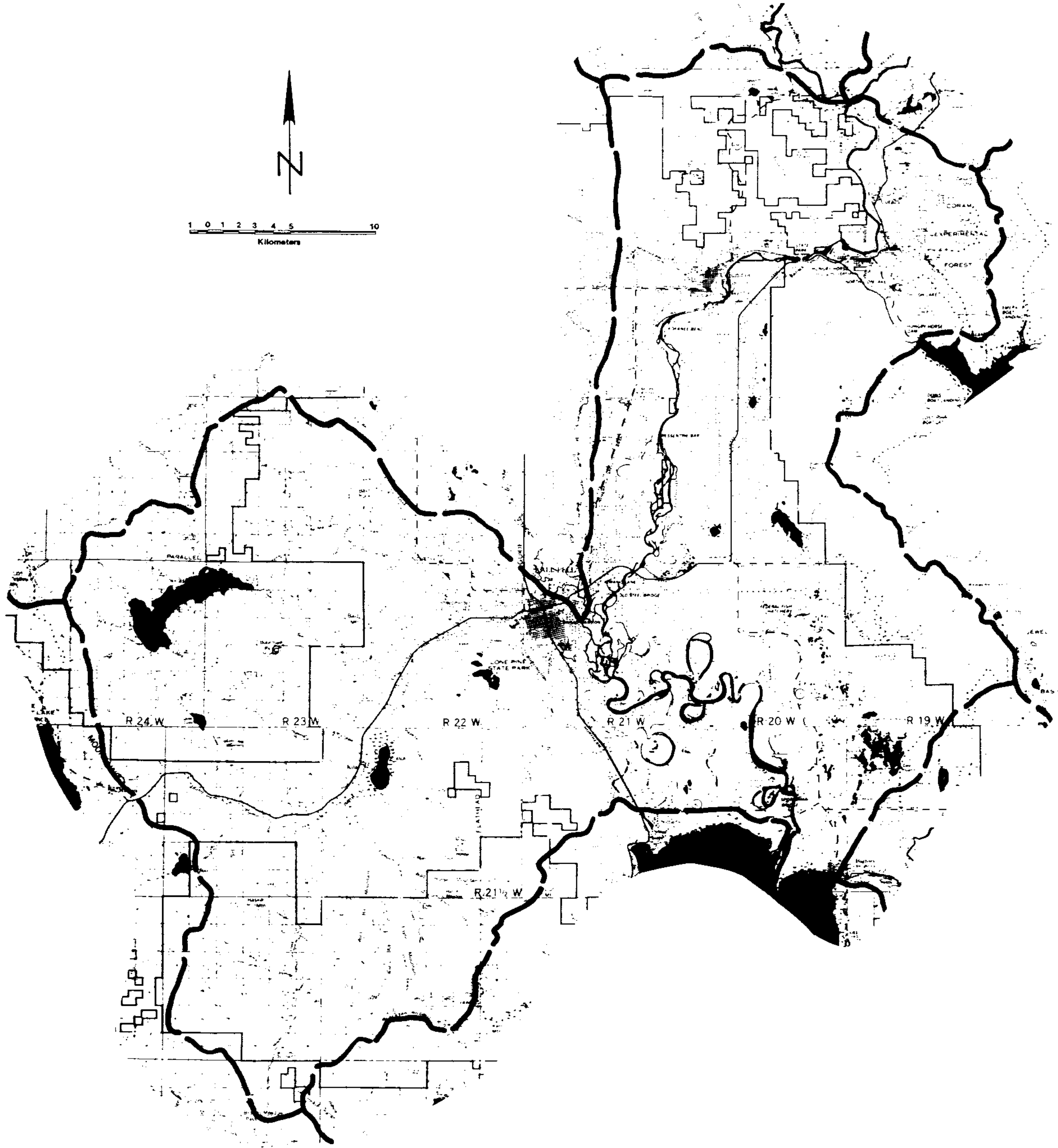
There are 12 private campgrounds in the sub-basin. They are licensed by the MDHES. These campgrounds provide 568 recreational vehicle spaces.

7.2.1.1 Fishing. A detailed census of fishermen was conducted on the Flathead River-Mainstem from 1981 May 16 to November 30th by the MDFWP as part of a five-year baseline inventory of the resources of the Flathead River Basin (Fredenberg and Graham 1983). It is the source of the following information about fishing.

This study divided the Flathead River-Mainstem into four segments. This permits a more meaningful presentation of the fishing data. These Flathead River-Mainstem segments were defined as follows:

- MS1 - Flathead Lake to confluence with the Stillwater River, 36.0 km (22.4 mi)
- MS2 - Mouth of Stillwater River to Pressentine River fishing access site on the Mainstem, 19.0 km (11.8 mi)
- MS3 - Pressentine River to the town of Columbia Falls, 10.6 km (6.6 mi)
- MS4 - Columbia Falls to the North/Middle Forks confluence, 23.3 km (14.5 mi)

Bull trout, westslope cutthroat trout and kokanee are the most important game fish in the river, but rainbow trout and whitefish are also found in significant numbers. The census and harvest data must be



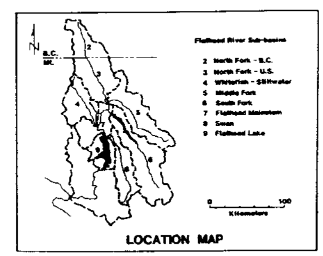




**FIGURE 7**

**MAP OF THE FLATHEAD RIVER - MAINSTEM**

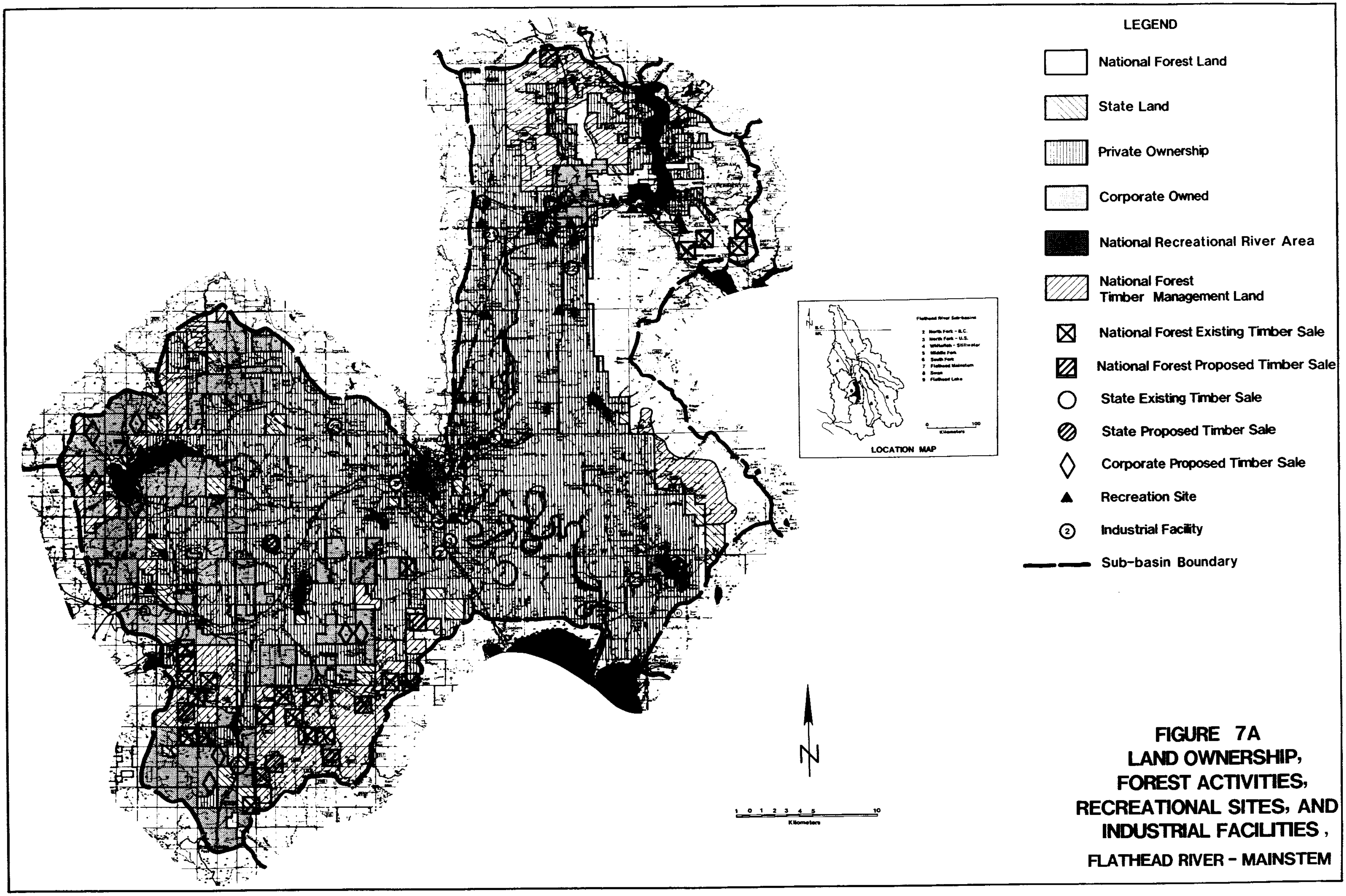



FIGURE 7A
LAND OWNERSHIP,
FOREST ACTIVITIES,
RECREATIONAL SITES, AND
INDUSTRIAL FACILITIES,
FLATHEAD RIVER - MAINSTEM

interpreted using the State established possession limits that were in effect during the study.

1. Trout (cutthroat and rainbow) - 4.5 kg (10 lbs) and 1 fish or 10 fish, whichever is reached first.
2. Bull trout - one fish which must be at least 46 cm (18 in) in length.
3. Kokanee - 35 fish daily and 70 in possession.
4. Whitefish - 30 daily and 60 in possession.

The trout limit has been reduced to five fish in possession for stream fishing, but it was not changed for lakes.

The Flathead River-Mainstem creel census included the entire 199-day open stream fishing season. Data were collected using a combination of aerial counts from fixed wing aircraft and concurrent on-the-ground interviews. The census indicated that shore fishermen represent 76 percent of hours fished and boat fishermen represented 24 percent of the hours fished. Table 7.2 shows the monthly distribution of fishermen by river segment on the Flathead River-Mainstem (non-snagging fishermen only).

Table 7.2. Distribution of fishermen along the Flathead River-Mainstem, 1981.

| | River Segments (Fisherman Hours) | | | | |
|---|---|---|---|---|---|
| Month | MSI | MS2 | MS3 | MS4 | Total |
| May | 296.9 | 745.6 | 256.2 | 14.5 | 1 313.2 |
| June | 153.6 | 928.7 | 164.4 | 23.0 | 1 269.7 |
| July | 0 | 372.5 | 276.0 | 56.3 | 704.8 |
| August | 97.0 | 360.8 | 109.0 | 42.0 | 608.8 |
| September | 269.5 | 114.0 | 14.0 | 0 | 397.5 |
| October | 109.0 | 39.0 | 30.0 | 4.0 | 182.0 |
| November | 128.5 | 61.5 | 0 | 0 | 190.0 |
| Total | 1054.5 (23%) | 2622.1 (56%) | 849.6 (18%) | 139.8 (3%) | 4 666.0 (100%) |

Source: Fredenberg and Graham 1983.

From September to November, snagging is a legal method for catching kokanee during their spawning migration in the River. The declining number of fisherman hours during this period of the year (Table 7.2) is offset by a large increase in kokanee snaggers. Table 7.3 shows the origin of the fishermen. Table 7.4 shows the average distance people travelled from their homes. Table 7.5 shows the catch rates and species composition (excluding kokanee snagging) and Table 7.6 shows the proportion of the catch that was kept. It varied considerably by species, possibly influenced by the possession limits.

Table 7.3. Origin of fishermen on the Flathead River-Mainstem, 1981.

| Home | Percent Distribution (Percent of Total Hours) |
|---|---|
| Flathead County residents | 85 |
| Other Montana residents | 5 |
| Non-residents (Out-of-state, Foreign Country) | 10 |

Table 7.4. Average distance traveled by fishermen, Flathead River-Mainstem, 1981.

| Home | Distance (Average) |
|---|---|
| County residents | 21 kilometers (13 miles) |
| Other Montanans | 341 kilometers (212 miles) |
| Non-residents | 1110 kilometers (690 miles) |

Table 7.5. Fish species catch composition and catch rate, Flathead River-Mainstem, 1981.

| Fish Species | Catch Rate (Fish/Hour) | Composition (Percent) |
|---|---|---|
| Cutthroat Trout | 0.18 | 52 |
| Kokanee | 0.50 | 27 |
| Bull Trout | 0.05 | 14 |
| Whitefish | 0.02 | 5 |
| Rainbow Trout | -- | 2 |

Table 7.6. Fish harvest percentage, Flathead River-Mainstem, 1981.

| Fish Species | Catch Kept (Percent) |
|---|---|
| Cutthroat Trout | 56 |
| Kokanee | 100 |
| Bull Trout | 47 |
| Whitefish | 77 |
| Rainbow Trout | 91 |

Source: Tables 7.3 to 7.6; Fredenberg and Graham 1983.

The MDFWP carried out an investigation of the kokanee fishery of the Flathead River-Mainstem and the Middle Fork in 1981. Census data was collected during the period September 1 to November 30 (kokanee season) (Fredenberg and Graham 1982).

The river kokanee fishery is unique in several respects. Kokanee normally first appear in the lower Flathead River-Mainstem in early September to begin their spawning migration. Spawning occurs between mid-October and mid-December. The adult fish die. The fry move downstream to Flathead Lake in April and May of the following spring. Kokanee were caught by snagging from September 1st to December 31st. Catch limit was 35 fish daily and 70 in possession. Kokanee are found throughout the Flathead River-Mainstem and in the South Fork upstream to Hungry Horse Dam. A major percentage of the kokanee migrate up the Middle Fork and its tributaries.

A partial kokanee fishing creel census was conducted on the four segments of the Flathead River-Mainstem from 1981 September 1 to November 30. Kokanee were caught by non-snag fishermen during September in segment MS1. As the fish matured, however, snagging became the only method of taking this fish. Snag fishermen made up 63 percent of the total fisherman-hours observed on the Flathead River-Mainstem during September, and 67 percent during October. Table 7.7 shows the origins of these fishermen (Fredenberg and Graham 1982).

Table 7.7. Origin of fishermen, 1981 September 1 to November 30, Flathead River-Mainstem.

| Home | Hours Fished (Percent) | Distance Traveled From Home |
|---|---|---|
| County Resident | 76 | 66 kilometers ( 41 miles) |
| Out of County Residents | 17 | 393 kilometers (244 miles) |
| Non-residents (Out-of-state Foreign Country) | 7 | 979 kilometers (608 miles) |

Source: Fredenberg and Graham 1982.

The average overall catch rate on the Flathead River-Mainstem was 2.0 fish per hour. The average angler caught 6.1 kokanee per day. County residents, however, caught 2.4 fish per hour and 7.3 per day. Table 7.8 shows the kokanee fishing pressure and harvest information for 1975, 1981 and 1982 (Fraley, McMullin and Graham In Draft).

Table 7.8. Kokanee fishing pressure and harvest information, Flathead River-Mainstem.

| | 1975 | 1981 | 1982 |
|---|---|---|---|
| Catch rate (kokanee/hour) | 2.0 | 2.0 | 0.45 |
| Fishing pressure (angler-hours) | 69 276 | 56 602[a] | 25 630 |
| Hours per completed trip | 3.6 | 3.2 | 3.3 |
| Fishing Pressure (angler-days) | 19 223 | 17 688[a] | 7 767 |
| Kokanee harvest | 150 000 | 77 000 | 12 402 |

[a]Pressure from September and October.

Source: Fraley, McMullin and Graham In Draft.

Over the past years, fishing use and harvest levels have declined significantly. Although not clearly understood, catch rates in 1982 were about one-fourth the previous levels. In 1982, the MDFWP changed the fishing limits and length of the fishing season. The total fishing pressure during the 1981 fishing season on the Flathead

River-Mainstem was estimated at 115,727 hours. Table 7.9 shows fishing pressure broken down by river segment.

Table 7.9. Total fishing pressure, Flathead River-Mainstem, 1981.

| | Segment | | | | |
|---|---|---|---|---|---|
| | MS1 | MS2 | MS3 | MS4 | Total |
| Fisherman hours | 15,240 | 53,917 | 23,239 | 23,331 | 115,727 |
| Percent of total | 13 | 47 | 20 | 20 | 100 |

Source: Fredenberg and Graham 1983.

These estimates include both conventional and snag fishermen. The average length of a completed trip was 3.2 hours. This yields an estimated total pressure of 35,940 man-days. The total estimated game fish harvest (including fish taken by snagging) on the Flathead River-Mainstem during 1981 for all anglers was 89,273 fish. Table 7.10 shows the composition of the catch. Table 7.11 provides a comparison of estimated fishing pressure and harvest for five fishing seasons and Table 7.12 shows the fishing use and percent of total harvest of the predominant sportfish species for 1981. That year appears to be representative.

Table 7.10. Total estimated fish harvest, Flathead River-Mainstem, 1981.

| Fish Species | Total Estimated Harvest | Percent |
|---|---|---|
| Kokanee | 76 830 | 86 |
| Cutthroat Trout | 8 557 | 10 |
| Bull Trout | 1 827 | 2 |
| Whitefish | 1 582 | 2 |
| Rainbow | 477 | 0.5 |

Source: Fredenberg and Graham 1983.

While the kokanee harvest in 1981 was about 42 times that of the bull trout (76,830 vs 1827), the angler-days for kokanee were only four times that of the bull trout. This suggests that the relative

Table 7.11. Estimated fishing pressure, Flathead River-Mainstem, 1968 to 1982.

| Year | Fisherman Days | Fish Species (Number of Fish) Kokanee | Cutthroat | Bull Trout |
|---|---|---|---|---|
| 1968 | 34 703 | - | - | - |
| 1975 | 40 716 | 149 644 | 10 463 | 2 398 |
| 1976 | 30 315 | - | - | - |
| 1981 | 35 940 | 76 830 | 8 557 | 1 827 |
| 1982 | 29 640[a] | 12 400 | No Data | |
| Average | 34 262 | | | |

[a]Montana Department of Fish, Wildlife and Parks undated.

Source: Fredenberg and Graham 1983.

Table 7.12. Major fish species fishing pressure, Flathead River-Mainstem 1981.

| Fish Species | Fishing Use (Angler-Days) | Percent of Total Harvest |
|---|---|---|
| Kokanee | 48 000 | 86 |
| Cutthroat Trout | 14 856 | 10 |
| Bull Trout | 11 411 | 2 |

Source: Table 7.9 to 7.12, Fredenberg and Graham 1983.

importance of sportfish species is not always simply represented by the numbers of fish harvested or the catch rate.

7.2.2 Settlement

Land ownership is shown on Figure 7A. Land use is shown on Figure 7B. The estimated sub-basin population is 33,387 people (U.S. Census 1980 derived). This is 57 percent of the population in the entire study area. The projected 1990 population is 36,693 (Flathead River Basin Environmental Impact Study 1983, medium scenario, p. 58). There is a total of about 13,590 housing units. Of these, 447 are seasonal.

The incorporated communities of Kalispell and Columbia Falls are within this sub-basin; Kalispell had a population of 10,648 in 1980,

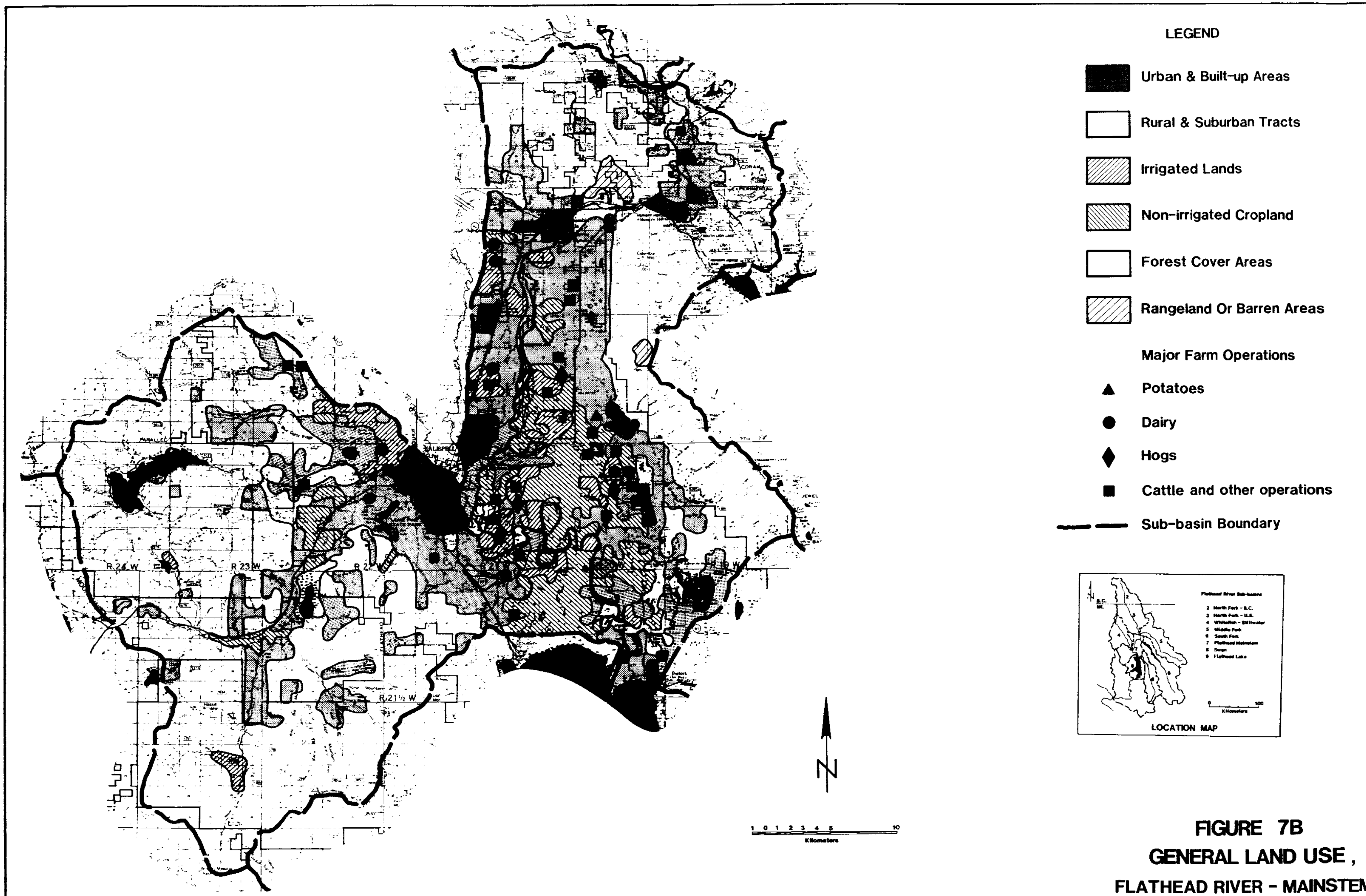



**FIGURE 7B**
**GENERAL LAND USE,**
**FLATHEAD RIVER - MAINSTEM**

and Columbia Falls had a population of 3112. Several small unincorporated communities are located in this sub-basin. These are: Coram, Martin City, Hungry Horse, Evergreen, and Creston. Kalispell is a regional trade centre in northwest Montana. There is a very high level of commercial development in this sub-basin as compared to the other sub-basins in the study area.

Table 7.13 shows the water use permits issued on the Flathead River-Mainstem. A total of 197 water permits are filed with the DNRC (Figure 7C). Fish, wildlife, and recreational uses are nonconsumptive water uses.

Columbia Falls and Kalispell have municipal water systems. The Cedar Creek Reservoir provides 90 to 97 percent of the yearly supply of water for Columbia Falls. The reservoir is fed by the watershed for Cedar Creek. It is located 1.2 km (2 mi) north and east of the city.

Table 7.13. Water use permits issued, Flathead River-Mainstem.

| Use | Number | Volume (acre feet/year) |
|---|---|---|
| Irrigation and stock watering | 149 | 19,112 |
| Domestic | 30 | 57 |
| Commercial/Industrial | 4 | 692 |
| Fish/Wildlife/ Recreation (instream) | 14 | 5,392,020 |
| | 197 | 5,411,881 |

Source: Montana Department of Natural Resources and Conservation 1986.

Two wells, located on the north east side of Columbia Falls, provide the remaining water supply. These wells are 10.7 m (35 ft) deep. One well provides 25.2 L/s (400 gal/min) and the other well provides 63 L/s (1000 gal/min). The system serves 3100 people. The city uses a total of 1.76 billion L (466 million gal) of water per year. The water supply for Kalispell is provide by four wells. Two wells are located immediately north of the City. One of these wells is a deep artesian well near the Stillwater River. It provides 37.8 L/s (600 gal/min). The other well is a 600 m (1968 ft) well on Buffalo Hill. The yield is unknown. A third well is located in the center of the city. It is 367 m (1204 ft) deep, and provides 76 L/s (1200 gal/min). The fourth well is located at the south end of the City. It is 433 m (1420 ft) deep, and provides 101 L/s (1600 gal/min). The water system serves approximately 12,000 people. Kalispell uses approximately 2.83 billion L (750 million gal) of water per year. Three other settlements have community water systems: Martin City, Hungry Horse, and Evergreen. Martin City is served by four wells located adjacent to the town. The wells are 51 to 96 m (167 to 282 ft) deep and all provide approximately 2 L/s (30 gal/min). The system serves 200 people. The Hungry Horse system serves 1000 people. The water is provided by a single well with a 378,000 L (100,000 gal) storage tank. The well is located near the confluence of the South and Middle Forks, Flathead River. It is 46 m (150 ft) deep and yields 38 L/s (600 gal/min). The Evergreen water system serves 4000 people. Water is provided by two wells. The wells are located near the confluence of the Whitefish and Stillwater Rivers. They are 117 and 157 m (344 and 515 ft) deep, and both yield approximately 76 L/s (1200 gal/min). Three new wells are being developed north of Evergreen near the Stillwater River (October 1985, J. Melstad, Water Quality Bureau, Montana Department of Health and Environmental Sciences, personal communication).

### 7.2.3 Agriculture

The majority of agricultural activity in Flathead County occurs in this sub-basin. The location of major farm operations of greater than 65 ha (160 acres) is shown on Figure 7B. The 1982 Agricultural Census indicated there were 914 farms in the county. The farms had an average size of 127 ha (312 acres). The total cropland was 44,000 ha (108,000 acres). This was a decrease of 9 percent from the 1978 cropland area. The total land in irrigation in 1982 was 13,555 ha (33,350 acres), a decrease of 14 percent from 1978. Table 7.14 lists the major products, area cultivated, and yields.

There are 149 water use permits issued for irrigation on the Flathead River-Mainstem. These permits consume a total of 23,565,000 $m^3$ (19,112 acre-ft) per year.

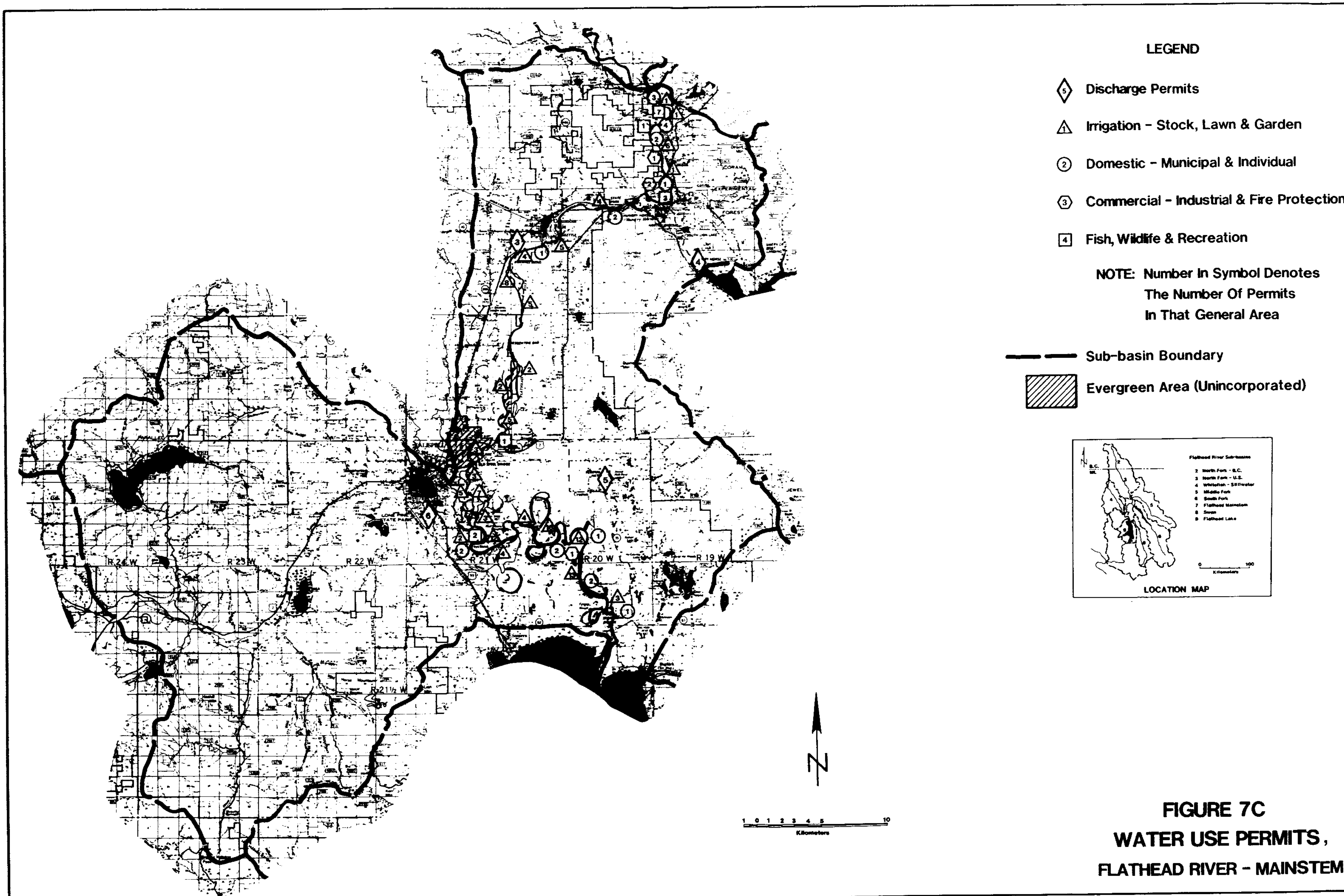



**FIGURE 7C**
**WATER USE PERMITS,**
**FLATHEAD RIVER - MAINSTEM**

Table 7.14. Agricultural activity, Flathead River-Mainstem, 1982 to 1983.

| Product | Acres | Yield |
|---|---|---|
| Cattle | 26 507 | Not Available |
| Barley | 22 514 | 42.5 hw/ac |
| Dairy | 6 400 | 2 mil pds/mo |
| Christmas trees | 7 000 | 750 000 trees |
| Seed potatoes | 900 | 275 hw/ac |
| Hogs | Not Available | 16 300 head |
| Wheat | 7 389 | 50 bu/ac |

Source: Flathead County Conservation District, Preservation of Agricultural Lands in Flathead County, Montana February 1985.

There are no known constituents in the existing waters in the Flathead River-Mainstem which adversely affect agriculture. It would require significant reductions in water quantity to adversely affect irrigation (October 1985, Cathy Jones, Resource Specialist, Flathead County Conservation District, personal communication).

## 7.3 SOCIO-ECONOMIC ACTIVITIES THAT POTENTIALLY AFFECT WATER QUALITY AND/OR WATER QUANTITY

### 7.3.1 Recreation

Section 7.2.1 describes the level of recreation use. The adverse impact of this recreation use on water quality and quantity has not been studied quantitatively.

### 7.3.2 Settlement

This sub-basin contains the largest population in the study area. Point and non-point source contamination to the Flathead River system has been attributed to residential and commercial development. Kalispell and Columbia Falls have sewage treatment plants which discharge into the river system (Figure 7C). The Kalispell plant serves 10,648 people, and the Columbia Falls plant serves 3112. There is also a small wastewater treatment plant at Hungry Horse Dam which is operated by the Bureau of Reclamation. The MDHES is requiring both cities and the Hungry Horse facility to upgrade their sewage treatment plants to remove phosphorus. Engineering analysis is presently being done at the Kalispell plant to explore various options to meet the discharge limits. The current compliance schedule indicates advanced wastewater treatment will be completed by 1988. The Hungry Horse Dam facility has been upgraded to achieve the new phosphorus discharge limits. The estimated capital cost of the upgraded Kalispell plant is $1.46 million, of which $1.045 million is attributed to the advance phosphorus wastewater treatment. Columbia Falls already has acceptable secondary treatment. The estimated cost for the advanced wastewater treatment is $390,000. EPA grants are available to pay 75 to 85 percent of these costs, provided the local communities pay the remaining share. Local shares must be approved through a vote on bond issues, and approval cannot be assumed.

Approximately 19,627 people live in small communities or on rural tracts. Figure 7D shows population density. These people occupy 7647 homes. All of them are assumed to be served by individual septic tanks and drainfields. Very little information is available on the potential effect of these systems on the water quality.

The densely populated Evergreen area has been studied by the MDHES. This area is north and east of Kalispell. It has approximately 1800 residents (Figure 7D). The area is characterized by very porous soils and shallow ground water. The MDHES is concerned that sewage disposal is contaminating the ground water. This ground water is hydrologically connected to the Flathead River-Mainstem and, ultimately, Flathead Lake. The MDHES has recommended that the area be connected to sewers. The collected effluent would be treated in lagoons and spray-irrigated. The Evergreen Water District has held two votes to provide local financing, but in both cases the issue failed. The MDHES is currently reassessing the problem and is considering sanitary restrictions prohibiting new land divisions in the Evergreen area (February 1986, Steve Pilcher, Water Quality Bureau, Montana Department of Health and Environmental Sciences, personal communication).

Division of land has occurred throughout the sub-basin. The parcel density in rural areas is shown on Figure 7E. Between 1977 and 1981, 8814 ha (21,800 acres) were divided into 7942 parcels in Flathead County. This was the greatest number of land divisions in any of the 56

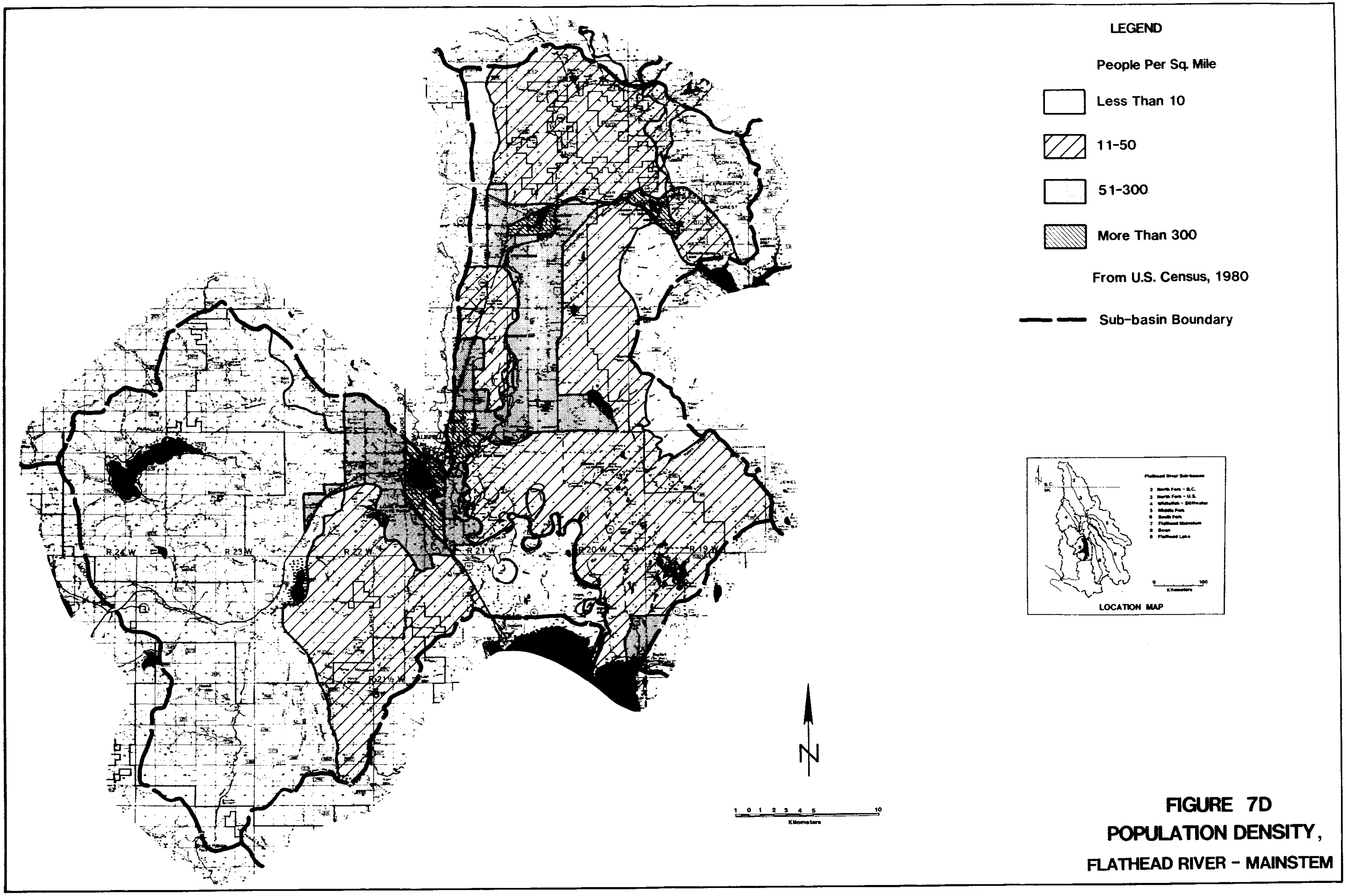



**FIGURE 7D**
**POPULATION DENSITY,**
**FLATHEAD RIVER - MAINSTEM**

counties in Montana. Between 1973 and 1980, an additional 17,980 ha (44,000 acres) were divided into 1609 parcels which were greater than 8 ha (20 acres) in size. The vast majority of the Basin's subdivision activity occurred in this sub-basin. Since 1982, subdivision activity has slowed. Construction has not begun on a great number of parcels that were created before 1982. Although studies have not been undertaken, the potential cumulative effect of rural residential development may adversely impact water quality (Montana Environmental Quality Council 1983).

### 7.3.3 Agriculture

Agricultural activities in this sub-basin are listed on Table 7.14. Most of the irrigation in the sub-basin is sprinkler irrigation. There are little surface return flows. The Flathead Drainage 208 project established a sampling station on Ashley Creek in the Spring of 1976. Sampling continued until March 1977. That sampling concluded that the major impact on Ashley Creek comes from activities associated with Kalispell. Very little adverse impact was caused by agriculture. The Flathead Drainage 208 Project completed an Agriculture and Water Quality Report in 1978 which includes an Appendix of Agricultural Best Management Practices. The Flathead County Conservation District is working with local farmers to implement these practices. The District is focusing primarily on stream protection rules and controlling soil erosion (October 1985, Cathy Jones, Resource Specialist, Flathead County Conservation District, personal communication).

### 7.3.4 Forestry

7.3.4.1 Current. The relative intensity and areal distribution of current timber harvest activity is best expressed in terms of the recently completed and ongoing timber sales of the major land managing entities in the sub-basin. In the Flathead River-Mainstem sub-basin, they are the Flathead National Forest, Montana state forests, and Plum Creek Timber Company. The current timber sales and road development data are found on Tables 13 to 14 in Addendum A and shown on Figure 7A. The data are summarized in Table 7.15.

Table 7.15. Current timber sales and road development, Flathead River-Mainstem, 1981 to 1985.

| Forest Manager | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|
| Flathead N.F. | 94 146 | 7 396 | 178 | 92 |
| State Forest lands | 24 044 | * | 4.8 | * |
| Plum Creek Co. | * | * | * | * |
| Totals | 118 190 (118.2 MMBF) | 7 396 (18 261 acres) | 182.8 (113.9 acres) | 92 (57.1 miles) |

*Data not available

Source: MDSL, Northwestern Land Office, Kalispell, Montana, Montana State Forest Timber Sale Data Table, Ongoing Program, February 1986, and Flathead National Forest Timber Sales Awarded or in Progress, FY 81 through FY 85, received from Supervisor's Office, Kalispell, Montana 1986 February 21, derived.

7.3.4.2 Committed. Large areas of timbered property are potentially available for harvest, as reflected by the timber sale program plans of the major forest managers in the sub-basin. The detailed, future timber sale planning by these organizations varies from three to five years hence. The committed timber harvest activity and road development are found in Tables 15 to 17, Addendum A, and illustrated in Figure 7A. The data are summarized in Table 7.16.

### 7.3.5 Industry

The largest single industrial plant in the study area is the Aluminum Plant at Columbia Falls. In 1984, 629 people were employed at the plant which occupies about 70 ha (170 acres). The plant has a MDHES permit to discharge to the ground adjacent to the Flathead River-Mainstem. The MDHES is presently renegotiating discharge constituent limits with the owners of the plant.

Hungry Horse Dam on the South Fork of the Flathead River is located in this sub-basin. The 174 m-high (571 ft) dam impounds Hungry Horse Reservoir. It generates 1000 megawatt hours per year. Its peak

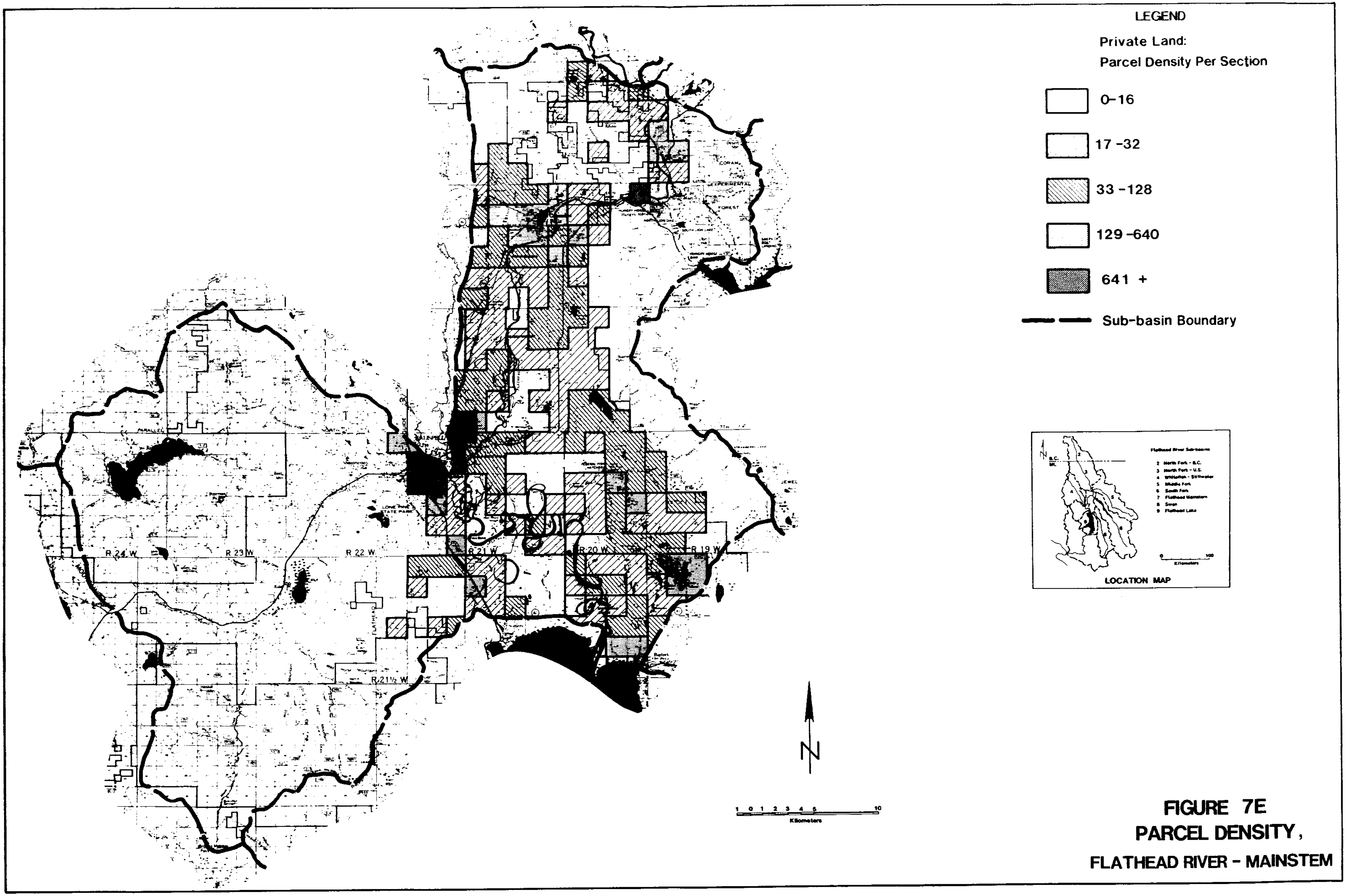



FIGURE 7E
PARCEL DENSITY,
FLATHEAD RIVER - MAINSTEM

Table 7.16. Committed timber sales and road development, Flathead River-Mainstem.

| Forest Manager | Year | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|---|
| Flathead N.F. | 1986-90 | 24 000 | 520 | 20.9 | 7.6 |
| State Forest lands | 1987-92 | 3 500 | 393 | 8.9 | * |
| Plum Creek Co. | 1986-88 | 92 500 | 3 037 | * | * |
| Totals | | 120 000 (120 MMBF) | 3 950 (9 755 acres) | 29.8 (18.6 miles) | 7.6 (4.7 miles) |

*Data not available

Source: Flathead National Forest, Forest Plan, December 1985; MDSL, Northwestern Land Office, Kalispell, Montana, Montana State Forest, Timber Sale Data Table, Planned/Committed Program, 1986 March 14; and Plum Creek Timber Company, Timber Sales Data Table, November 1985, derived.

capacity is 328 megawatts. It blocks any fish migration between the Flathead River-Mainstem and the South Fork, Flathead River.

The MDFWP has recommended minimum flows for operation of this dam in an effort to improve the river spawning of the Flathead Basin's kokanee population, and to provide a stable environment for other game fishes and invertebrates in those river stretches. These flows return the river hydrograph to a pattern much closer to the natural one. The Bureau of Reclamation, which operates the Dam, has agreed to meeting the recommended flows.

Hungry Horse Dam flow regulation may significantly affect water quality in the Flathead River-Mainstem and Flathead Lake. Hungry Horse Dam water releases are now timed to coincide with MDFWP recommendations. These discharges may still contribute to Flathead Lake's nutrient load. A combination of temperature, volume and timing of dam releases in conjunction with other events, such as precipitation and/or central sewage collection discharges may cause dramatic increases in lake toxic algae blooms. The lack of co-ordination between Kerr Dam (Flathead Lake sub-basin) and Hungry Horse Dam releases may have the same effect. The

University of Montana Biological Station at Yellow Bay (Flathead Lake) is studying these impacts on the trophic status of Flathead Lake. Table 7.17 shows other industrial sites in this sub-basin.

Table 7.17. Industrial sites, Flathead River-Mainstem.

| Site Name | Figure 7A Key | Type | Size Hectares | (Acres) |
|---|---|---|---|---|
| [a]Aluminum Plant | 18 | Aluminum | | |
| Stoltze Land & Lumber | 15 | Lumber Mill | 33 | 80 |
| Plum Creek Lumber | 16 | Lumber Mill | 53 | 130 |
| Superior Lumber | 17 | Lumber mill | 41 | 100 |
| [a]B&F Excavating | 19 | Gravel pit | 4 | 10 |
| Beaver Wood Products | 20 | Wood Pole plant | 2 | 5 |
| Hamilton Sand & Gravel | 21 | Gravel pit | 16 | 40 |
| Weaver Sand & Gravel | 22 | Gravel pit | 2 | 5 |
| Kalispell Feed & Grain | 2 | Grain elevators | 6 | 15 |
| JBM Inc. | 3 | Metal fabrication | 2 | 5 |
| S & S Mfg. | 4 | Metal fabrication | 2 | 5 |
| Montana Forest Products | 5 | Lumber mill | 16 | 40 |
| [a]American Asphalt | 7 | Gravel pit, Asphalt plant | 8 | 20 |
| Industrial Wood Products | 24 | Saw mill | 8 | 20 |
| Big Fork Ready Mix | 23 | Gravel pit | 16 | 40 |

[a]Adjacent to the Flathead River-Mainstem

Source: Tom Jens, Flathead Regional Development Office, personal communication, February 1986.

### 7.3.6 Transportation

The major roads are U.S. Highways 93 and 2. Part of U.S. Highway 2 from Hungry Horse to West Glacier is currently being reconstructed. This is discussed in Section 5.3.6 (Middle Fork, Flathead River).

# 8. SWAN RIVER/SWAN LAKE

## 8.1 INTRODUCTION

The Swan River flows in a northerly direction from its headwaters in the Mission and Swan Mountains. It enters and leaves Swan Lake 23 km (14 mi) upstream from its confluence with Flathead Lake at the town of Bigfork (Figure 8). The Swan River drains 1959 $km^2$ (751 $mi^2$). It has an average gradient of 4.5 m/km (4 ft/mi). There are numerous high mountain and valley lakes in the drainage. Swan Lake is the largest lake in this sub-basin. It has a surface area of 1085 ha (2680 acres). The second and third largest lakes are Lindberg Lake, 294 ha (735 acres), and Holland Lake, 165 ha (413 acres). Both are located near the headwaters of this sub-basin.

Most of the sub-basin is composed of National Forest, State Forest and large corporate forest lands. Smaller private holdings total about 9300 ha (23,000 acres) and occupy the relatively flat valley bottom. Agricultural use is limited to a small amount of livestock raising on the private holdings. Development activity in the sub-basin is primarily timber harvesting (see Section 8.2.4) on the Federal, State and corporate forests. Recreational homesites are being built around the three larger lakes and selected locations along the river valley. Although there are no incorporated towns in the Swan drainage, there are several small settlements. The permanent population of this sub-basin is 1784 (U.S. Census 1980 derived).

## 8.2 SOCIO-ECONOMIC ACTIVITIES POTENTIALLY IMPACTED BY CHANGES IN WATER QUALITY AND/OR WATER QUANTITY

### 8.2.1 Recreation

The primary recreational activities in this sub-basin are fishing and boating (both river and lake). There is a high gradient stretch of the Swan River between Swan Lake and Flathead Lake which is very popular for whitewater floating. Several campgrounds are located in this sub-basin primarily around the three larger lakes.

8.2.1.1 Fishing. A 2-1/2 year study was conducted in the Swan River drainage by the MDFWP. The study results were reported by Leathe and Enk (1985) and are the primary data source for the following discussion. The study showed the following distribution of game fish species in the Swan sub-basin.

1. Swan River tributaries - brook trout, westslope cutthroat, and bull trout.
2. Swan River upstream of Swan Lake - brook trout and rainbow trout predominant. There are fewer numbers of bull trout and cutthroat.
3. Swan Lake - kokanee salmon, northern pike, and native bull trout. Rainbow, cutthroat and brook trout were also present.

The westslope cutthroat and bull trout are native species and are designated "species of special concern" by the MDFWP.

A creel census was conducted by the MDFWP to gather fisherman use, preference and harvest days for the Swan River, Swan Lake, and Swan River tributary streams. Most of the emphasis was on the lake and river sport fisheries. The census covered the 1983 May 21 to 1984 May 18 time period. The Swan Lake fishing season is year-round. The fishing season for the Swan River is May 21st to November 30th. Table 8.1 shows fishing use for the Swan River, Swan Lake and Swan River tributary streams during the study period.

Table 8.1. Fishing activity, Swan River/Swan Lake, 1983 to 1984.

| | Total Estimated Fisherman Use (Hours) | Average Length of Completed Trip (Hours) | Fisherman Days |
|---|---|---|---|
| Swan Lake | 21 734 | 3.17 | 7 093 |
| River | 16 508 | 2.76 | 5 981 |
| Tributaries | 9 850 | 3.04 | 3 240 |
| TOTAL | 48 092 | 2.99 (avg.) | 16 314 |

Source: Leathe and Enk 1985.

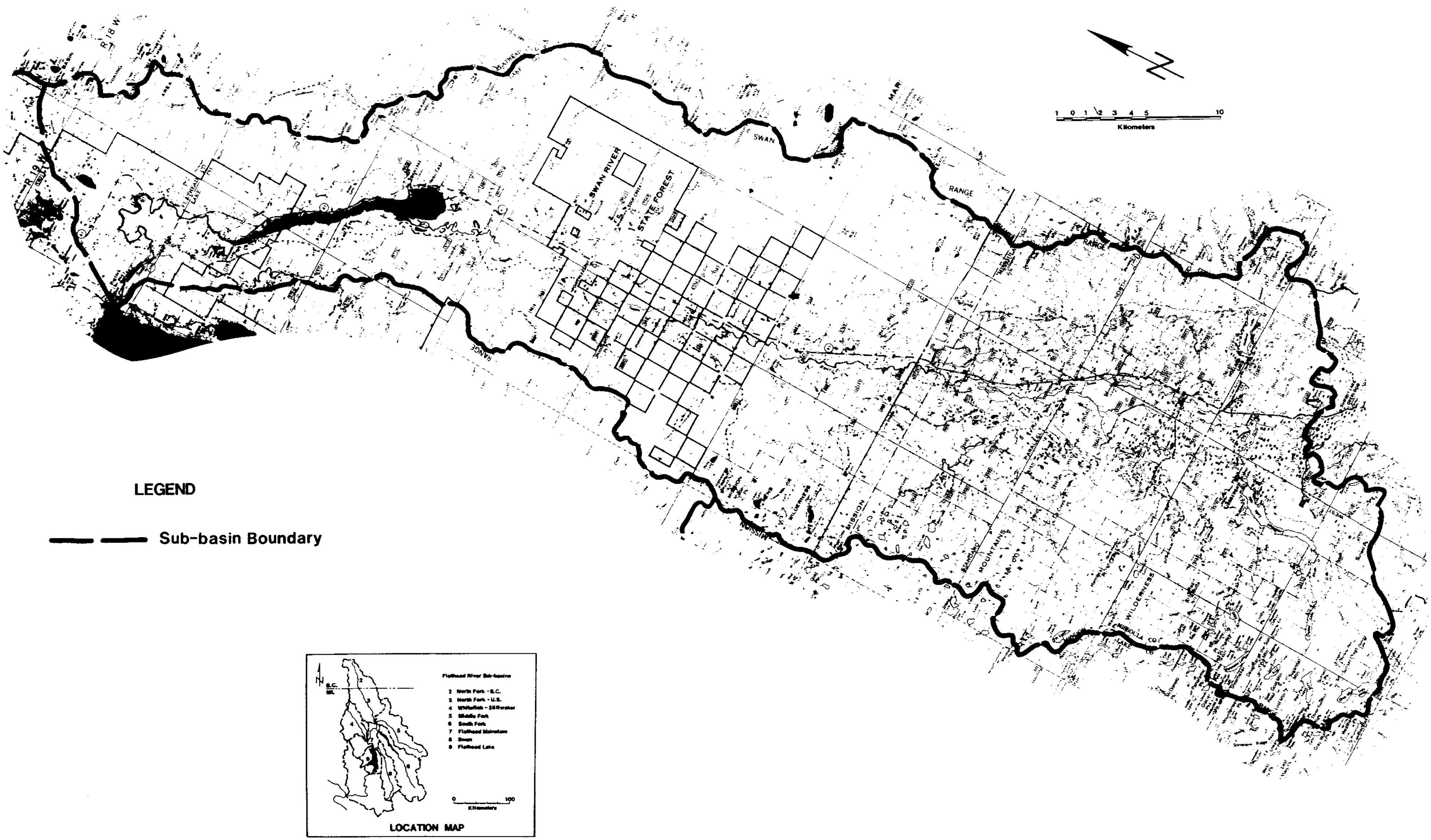



**FIGURE 8**

**MAP OF SWAN RIVER/SWAN LAKE**

Fishing occurs throughout the year. The peak use period is June through August. Ice fishing also occurred on Swan Lake from December to February. Table 8.2 shows the origin of the fishermen.

Table 8.2. Origin of fishermen, Swan River/Swan Lake Sub-basin 1983.

| | Fishing Locations | | | |
|---|---|---|---|---|
| Origin | Lake | River | Tributaries | |
| Local counties (Lake, Flathead, etc) | 69% | 71% | 86% | |
| Other Montana Counties | 11% | 6% | 2% | 2% |
| Out-of-State and Canada | 20% | 23% | 12% | 12% |

Source: Leathe and Enk 1985.

The total estimated, annual sportfish harvest based on data collected during the study period (1983 fishing season) was 32,536 fish. Table 8.3 shows the composition of species. The catch rate, measured in fish caught per hour of angler effort, suggests the level of effort that anglers are willing to expend to catch particular species of fish and the availability or catchability of that species. Table 8.4 shows the catch rate for fish species. This study also stated that "different sport fish have different values to anglers." Table 8.5 shows that fish harvest levels do not necessarily reflect the relative effort that anglers are willing to invest in pursuing a species.

The small 3.6 m (12 ft) diversion dam on the Swan River, located immediately above Flathead Lake, is a barrier to fish migration between Flathead Lake and the Swan sub-basin. A fish ladder was constructed in 1959 to allow migratory westslope cutthroat, bull trout and kokanee salmon to move from Flathead Lake into the Swan River drainage. Only a limited amount of passage, however, is actually occurring. Migration between Flathead Lake and the Swan River is considered important by the MDFWP for maintenance of species diversity.

Table 8.3. Swan River/Swan Lake Fish Harvest, 1983.

| Fish Species | Lake | River | Tributaries |
|---|---|---|---|
| Kokanee | 14 430 (85%) | - | - |
| Northern Pike | 1 238 (7%) | - | - |
| Bull Trout | 739 (4%) | 564 (11%) | 296 (3%) |
| Brook Trout | - | 2399 (48%) | 9 653 (91%) |
| Rainbow Trout | 284 (2%) | 1765 (36%) | 394 (4%) |
| Cutthroat | 238 (1%) | 240 (5%) | 296 (3%) |
| Totals | 16 929 | 4968 | 10 639 |

Source: Leathe and Enk 1985.

Table 8.4. Catch rate for fish species, Swan River/Swan Lake 1983.

| | Fish/Hour | | | |
|---|---|---|---|---|
| Species | Lake | River | Tributaries | Average |
| Kokanee | 1.68 | - | - | 1.68 |
| Northern Pike0.21 | - | - | 0.21 | |
| Bull Trout | 0.26 | 0.06 | 0.07 | 0.13 |
| Brook Trout | - | 0.33 | 1.53 | 0.93 |
| Rainbow | - | 0.27 | 0.05 | 0.16 |
| Cutthroat | - | 0.05 | 0.07 | 0.06 |

Source: Leathe and Enk 1985.

Table 8.5. Angler days for fish species, Swan River/Swan Lake, 1983.

| | Estimated Harvest | |
|---|---|---|
| Species | Number of Fish | Angler Use (days) |
| Kokanee | 14 430 | 2 873 |
| Bull Trout | 1.599 | 4 114 |
| Brook Trout | 12 052 | 4 334 |

Source: Leathe and Enk 1985.

### 8.2.2 Other Socio-Economic Activities

This sub-basin is not directly downstream from the site of the proposed mine. Any change in water quality and/or water quantity that would be a direct result of the proposed mine cannot directly affect the other socio-economic activities of this sub-basin; therefore, it would not have a direct impact on other socio-economic activities in this sub-basin.

## 8.3 SOCIO-ECONOMIC ACTIVITIES THAT POTENTIALLY AFFECT WATER QUALITY AND/OR WATER QUANTITY

### 8.3.1 Recreation

There are two U.S. Forest Service Campgrounds in this sub-basin. They are located at Swan Lake and Holland Lake (Figure 8A). There are two private campgrounds at Swan Lake. There is also a private resort at Holland Lake which is located on National Forest land. A total of 84,400 Visitor Days were reported in this sub-basin in 1985. The Forest Service maintains a total of 11 developed sites in this sub-basin. These sites include the two campgrounds, trails, roads, boating activities, swimming, picnic grounds, and a ranger station. In 1985, the total reported recreational use on these sites was 32,900 Visitor Days. The U.S. Forest Service also maintains records on nine dispersed areas. It reported 51,500 Recreational Visitor Days for these areas. Table 8.6 identifies the Recreation Visitor Days by activity. The managed season (principally summer) for the 11 developed sites ranged from 69 to 184 days. Actual use of the developed sites ranged from 4 to 41 percent of Theoretical Seasonal Capacity (U.S. Forest Service 1986).

The private resort at Holland Lake reported 2800 Recreation Visitor Days in 1985. The two private campgrounds at Swan Lake contain a total of 24 recreational vehicle spaces. The resort and private campgrounds are licensed by the MDHES. They are inspected once a year for compliance with health regulations.

The recreational use impacts on water quantity and quality are assumed to be minimal.

Table 8.6. U.S. Forest Service recreation visitor days, Swan River/Swan Lake, 1985.

| Type of Activity | Visitor Days (Thousands) | Percent |
|---|---|---|
| Viewing scenery | .1 | .1 |
| Automobile travel | 14.4 | 16.3 |
| Motorcycle and scooter travel | 1.1 | 1.2 |
| Ice and snow craft travel | 1.1 | 1.2 |
| Boat, powered | 1.6 | 1.8 |
| Hiking and walking | 4.2 | 4.8 |
| Bicycle | .1 | .1 |
| Horseback | 3.3 | 3.7 |
| Canoeing | .9 | 1.0 |
| Other watercraft | .2 | .2 |
| Swimming and water play | 1.5 | 1.7 |
| Fishing, cold water | 9.0 | 10.2 |
| Camping, general day | 8.8 | 10.0 |
| Camping, auto | 5.9 | 6.7 |
| Camping, trailer | 5.5 | 6.2 |
| Camping, tent | 7.0 | 7.9 |
| Picnicking | .9 | 1.0 |
| Resort & comm. pub. serv., general | 1.4 | 1.6 |
| Resort lodging | 1.2 | 1.4 |
| Recreation cabin use | 5.6 | 6.3 |
| Cross-country skiing, snowshoeing | .4 | .5 |
| Hunting, big game | 9.9 | 11.2 |
| Hunting, upland birds | 1.8 | 2.0 |
| Hunting, waterfowl | .3 | .3 |
| Gathering forest products | 1.3 | 1.5 |
| Viewing interpretive exhibits | .1 | .1 |
| General information | .8 | .9 |
| Total Visitor Days | 84.4 | 100.0 |

Source: U.S. Forest Service 1986.

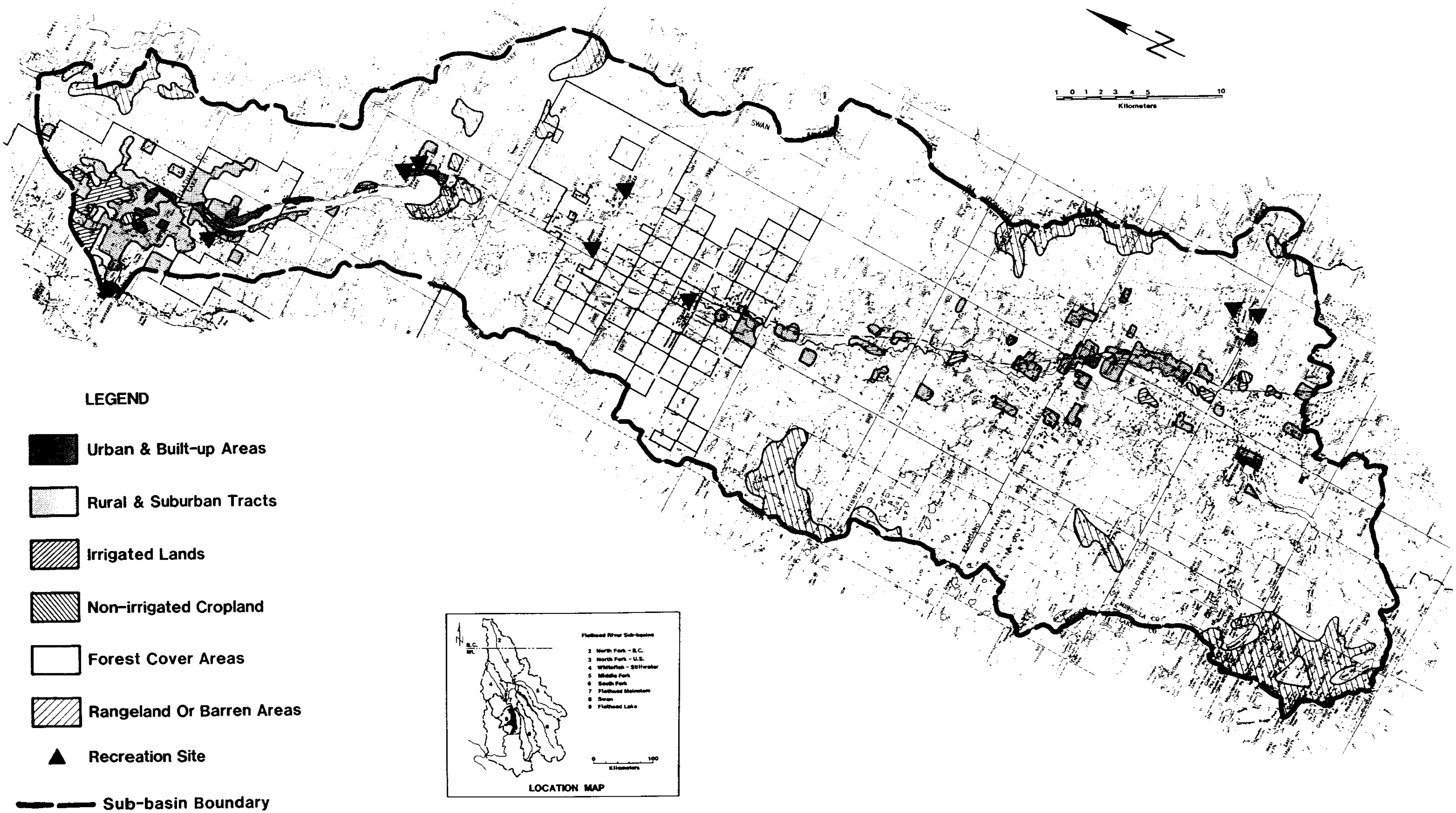



**FIGURE 8A**
**GENERAL LAND USE AND RECREATIONAL SITES,**
**SWAN RIVER/SWAN LAKE**

8.3.2 Settlement

Land ownership is shown on Figure 8B. General land use is shown on Figure 8A. The vast majority is National or State Forest lands, and private corporate forest holdings. There are no incorporated communities. The small unincorporated settlements of Swan Lake, Ferndale, Salmon Prairie, and Condon are located in this sub-basin.

The estimated population is 1784 people (U.S. Census 1980 derived). The 1990 projected population is 2046 people (Flathead River Basin Environmental Impact Study 1983, medium scenario, p. 58). There are a total of 993 housing units. Of these, 312 units are seasonal. All of the homes are on individual septic tanks and drainfields. There are no data to indicate the potential adverse impact of these septic systems/drainfields on water quality, but it is assumed to be small.

8.3.3 Agriculture

Very little agricultural activity takes place in this sub-basin. There are a few cattle and hay operations in the upper Swan drainage around Salmon Prairie. The adverse impact on water quality and quantity is thought to be insignificant.

8.3.4 Forestry

8.3.4.1 Current. The relative intensity and areal distribution of current timber harvest activity is best expressed in terms of the recently completed and ongoing timber sales of the major land managing entities in the sub-basin. In the Swan River/Swan Lake sub-basin, they are the Flathead National Forest, Swan State Forest, and corporate forest land. Information is not available for corporate forest land. Information on the current timber sales and road development data are noted in Tables 18 and 19 in Addendum A, and shown on Figure 8B. The data are summarized in Table 8.7.

8.3.4.2 Committed. Large areas of timbered property are potentially available for harvest, as reflected by the timber sale program plans of the major forest managers in the sub-basin. The detailed, future timber

Table 8.7. Current timber sales and road development, Swan River/Swan Lake, 1981 to 1985.

| Forest Manager | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|
| Flathead N.F. | 105 153 | 11 594 | 157.5 | 113.8 |
| State Forest Lands | 21 237 | * | 5.5 | * |
| Totals | 126 390 (126.4 MMBF) | 11 594 (28 627 acres) | 163 (101.3 miles) | 113.8 (70.7 miles) |

*Data not available

Source: Flathead National Forest, Timber Sales Awarded or in Progress, FY 81 through FY 85, provided by Supervisor's Office, Kalispell, Montana, 1986 February 21; MDSL, Northwest Land Office, Kalispell, Montana, State Forest, Timber Sale Data Table, Ongoing Program, provided February 1986.

sale planning by these organizations varies from three to five years hence. Information on committed timber harvest activity and road development are noted in Tables 20 and 21, Addendum A, and illustrated in Figure 8B. The data are summarized in Table 8.8.

Table 8.8. Committed timber sales and road development, Swan River/Swan Lake.

| Forest Manager | Year | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|---|
| Flathead N.F. | 1986-90 | 67 000 | 1150 | 83 | 55 |
| State Forest lands | 1987-92 | 53 100 | 1224 | 70 | Data not available |
| Totals | | 120 100 (120 MMBF) | 2374 (5862 acres) | 153 (95.3 miles) | 55 (34.4 miles) |

Source: Flathead National Forest, Forest Plan, December 1985; MDSL, Northwestern Office, Kalispell, Montana, State Forest, Timber Sale Data Table, Planned/Committed Program, provided 1986 March 14.

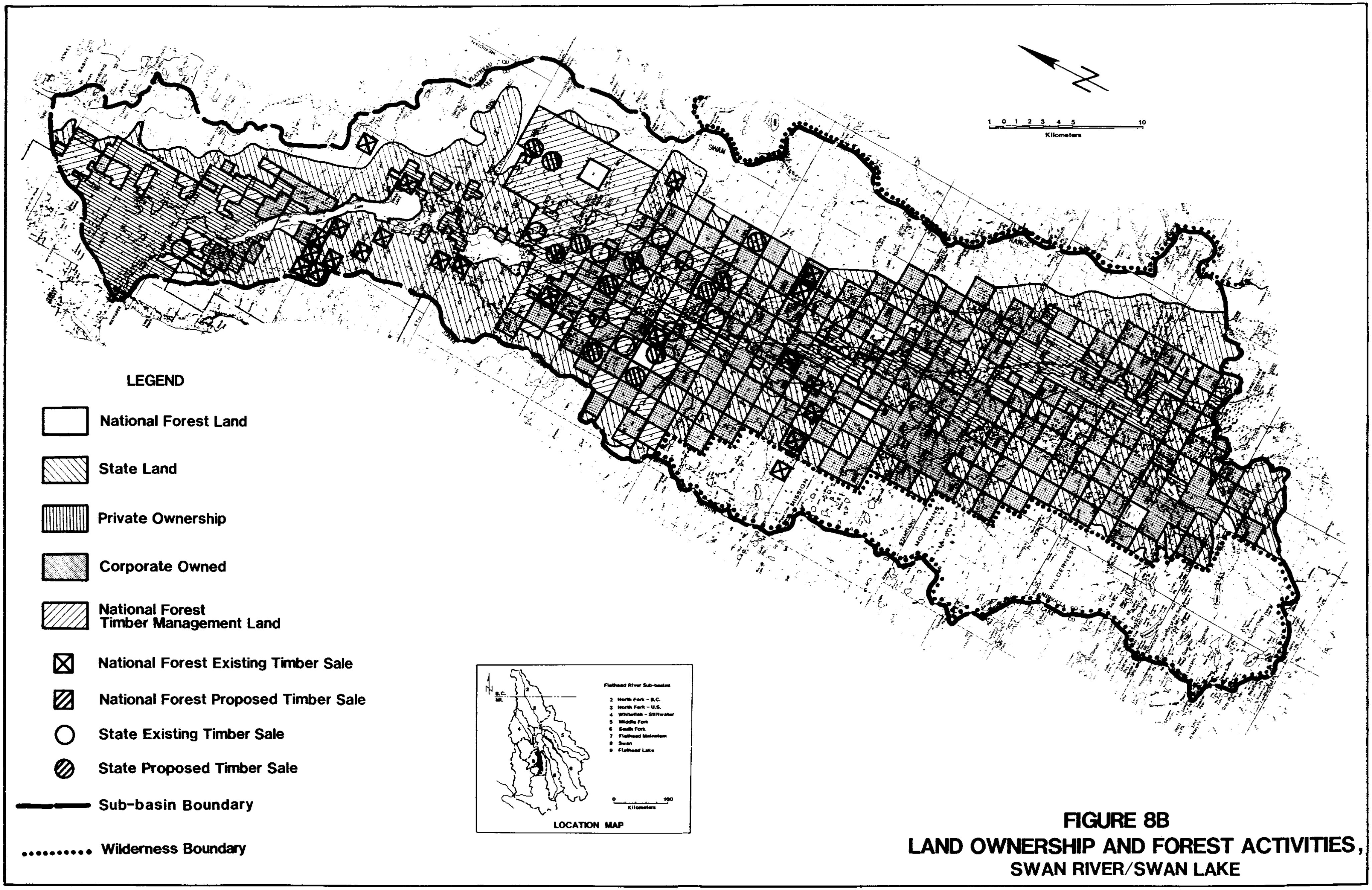



**FIGURE 8B**
**LAND OWNERSHIP AND FOREST ACTIVITIES, SWAN RIVER/SWAN LAKE**

8.3.5 Industry

Little industrial activity exists in the sub-basin. Bigfork Dam, located on the Swan River less than one mile from Flathead Lake, has a small hydroelectric facility. The Dam is owned and operated by Pacific Power and Light (PPL). It produces four megawatts of power which are distributed locally.

8.3.6 Transportation

The main highway is State Highway 83 which parallels the Swan River and east shore of Swan Lake. No new construction is planned for this Highway. There is no evidence that the existing highway adversely impacts water quality.

# 9. FLATHEAD LAKE

## 9.1 INTRODUCTION

This sub-basin is defined as the entire Lake and all small streams (excluding the Flathead and Swan Rivers) flowing directly into the Lake (Figure 9). The northern sub-basin boundary is where the Flathead River-Mainstem enters Flathead Lake. The southern sub-basin boundary is Kerr Dam which is located on the Flathead River 6.4 km (4 mi) downstream from Flathead Lake. The Swan River downstream of the Bigfork Dam is also in this sub-basin. The area of this sub-basin is approximately 1435 $km^2$ (550 $mi^2$).

Flathead Lake has a mean depth of 32.5 m (107 ft) and a maximum depth of 113 m (370 ft). The upper 3 m (10 ft) of lake level is regulated by Kerr Dam. The lake drainage area is approximately 18,379 $km^2$ (7100 $mi^2$), much of which is underlain by nutrient-poor precambrian sedimentary rock. Over 30 percent of the drainage area is designated wilderness land and Glacier National Park (Graham and Fredenberg 1983).

There are many communities located on Flathead Lake. Relatively heavy concentrations of year-round and seasonal homesites and recreational facilities are also found around the Lake. Commercial activity surrounding the Lake includes cherry orchards, campgrounds and RV parks, boat marinas, and a railroad tie treatment site. The estimated population of the sub-basin is 9706 people (U.S. Census 1980 derived).

## 9.2 SOCIO-ECONOMIC ACTIVITIES POTENTIALLY IMPACTED BY CHANGES IN WATER QUALITY AND/OR WATER QUANTITY

### 9.2.1 Recreation

Flathead Lake is a major recreational attraction in Montana and is considered to have regional and national recreational significance. The major recreational activities on the lake are fishing, boating, water skiing, swimming, and sightseeing.

There are seven State Recreation Areas (SRA) and two State Parks (SP) around the Lake. Lake Mary Ronan is located approximately 10 km (6 mi) west of Dayton. There is one State recreation area and three private campgrounds at this Lake. The sites administered by the State of Montana are listed in Table 9.1. Analysis of the receipts indicated that 53 percent of the users were from outside the State of Montana (Montana Department of Fish, Wildlife and Parks 1985).

Table 9.1. Visitation at State of Montana - administered recreation areas, Flathead Lake, 1985.

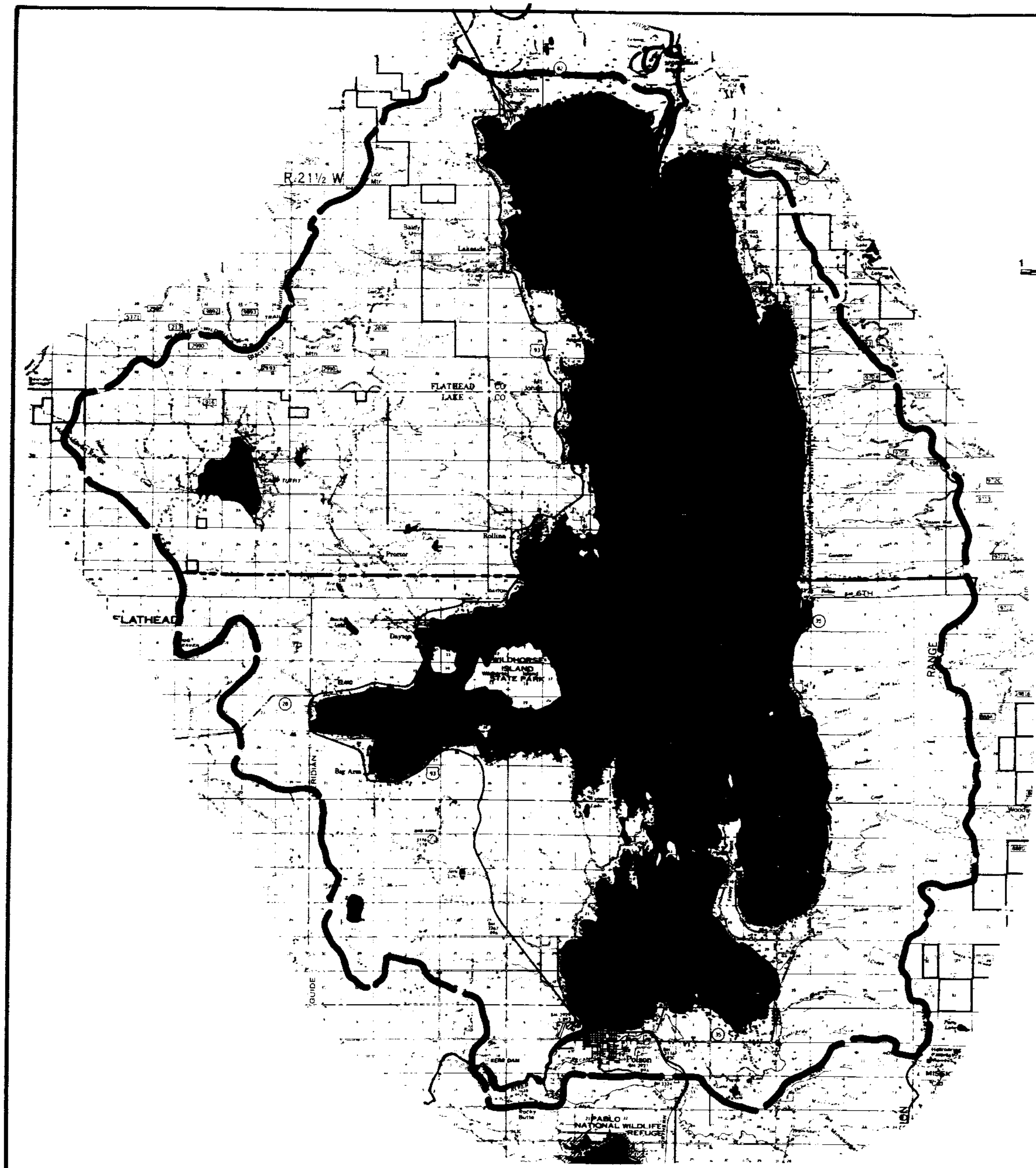
| Site | Number of Visits |
|---|---|
| Wayfarer SRA | 59 200 |
| Woods Bay SRA | 9 100 |
| Yellow Bay SRA | 31 800 |
| Finley Point SRA | 23 500 |
| Walstad SRA | 7 400 |
| Big Arm SRA | 27 900 |
| Elmo SRA | 16 400 |
| West Shore SP | 32 400 |
| Wild Horse Island SP | 4 700 |
| Total Visitors - Flathead Lake | 212 400 |
| Lambeth (Lake Mary Ronan) | 18 400 |

Source: Montana Department of Fish, Wildlife and Parks 1985.

There are 20 private campgrounds around Flathead Lake. They are licensed by the MDHES. They provide approximately 500 camping spaces. The three private campgrounds at Lake Mary Ronan provide an additional 70 camping spaces.

The MDFWP conducted aerial counts of boating activity on Flathead Lake between June and September 1985. This survey counted 9447 boats on the Lake. Approximately 5677 (60 percent) were fishing boats; 2499 (26.5 percent) were non-fishing boats; and 1271 (13.5 percent) were sailboats. (February 1986, L. Hanzel, Montana Department of Fish, Wildlife and Parks, Region 1, Kalispell, Montana, personal communication).

9.2.1.1 Fishing. A detailed census of water-related recreation use was conducted by the MDFWP from 1981 May 16 to 1982 May 14. It provided



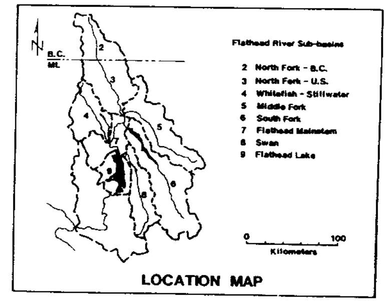




**FIGURE 9**
**MAP OF FLATHEAD LAKE**

information on the fishing activity and gamefish harvest, and is the primary source of the following data (Graham and Fredenberg 1983).

Fishing appears to be the major recreational activity on the Lake. There are seven species of gamefish. They are the westslope cutthroat trout, bull trout, mountain whitefish, pygmy whitefish, kokanee salmon, lake trout, and lake whitefish. The first four fish are natives; the latter three fish are introduced species. The gamefish harvest on Flathead Lake was influenced by the statutory possession limits in effect at the time of the MDFWP study. They were:

1. Trout - 4.5 kg (10 lbs) and 1 fish or 10 fish, whichever is reached first. One daily limit in possession.
2. Bull Trout - As above except, the fish must be at least 46 cm (18 in) in total length to be kept.
3. Kokanee - 35 fish daily and 70 in possession.
4. Whitefish - 30 fish daily and 60 in possession.
5. Kokanee - Lakeshore snagging.

Table 9.2 shows the species composition of the Flathead Lake catch. During the study period, anglers spent a total of 605,160 hours on 168,792 trips to harvest and estimated 536,870 fish. Boat fishermen took 92 percent of the catch and accounted for 93 percent of the use.

Table 9.2. Fish species catch composition, Flathead Lake, 1981 to 1982.

| Fish Species | Catch Percent |
|---|---|
| Kokanee | 92 |
| Perch (considered non-game) | 4 |
| Trophy-size Lake and Bull Trout | 2 |
| Cutthroat Trout | 1 |

Source: Graham and Fredenberg 1983.

The fishing data were gathered using a partial creel census. People were interviewed, and cars were counted using a pre-determined schedule. The average distance traveled from home for all fishermen is

178 km (111 mi). The average time each day spent fishing (a completed trip) was 3.8 hours. The mean party size was two anglers. Table 9.3 shows the origins of the fishing parties interviewed.

Table 9.3. Origins of the fishermen, Flathead Lake, 1981 to 1982.

| Homes | Percent |
|---|---|
| Residents of Flathead or Lake County | 61 |
| Other Montana residents | 20 |
| Out-of-state, Foreign | 19 |

Source: Graham and Fredenberg 1983.

Nearly 90 percent of the total fishermen interviewed were using boats. A large proportion of fishermen interviewed during December, January and February were ice fishing (7, 44, 53 percent, respectively). The boat fishing was divided into "kokanee boats", "bull/lake trout boats" and "other or combination". Chart 9A shows the monthly distribution of fishing boat types during the study period (Graham and Fredenberg 1983).

The average catch rate for gamefish and perch was 1.1 fish per hour. Fishing pressure varied seasonally for fish species indicating the species-specific nature of fishing methods, seasonal availability of fish (success), weather, size of fish, and local fishing tradition. Table 9.4 shows the year-round catch rates and species composition of this catch on Flathead Lake. The three whitefish species catch was very small. The highest catch rate for kokanee occurred in the southeast quarter of Flathead Lake (1.6 fish/hour). That catch rate was twice the rate for any other part of the Lake largely as the result of ice fishing in Skidoo Bay.

Table 9.5 shows that the proportion of the catch that was kept varied considerably by species, possibly influenced by the possession limits and fisherman's objective (i.e., sport and food vs. trophy/sport fishing).

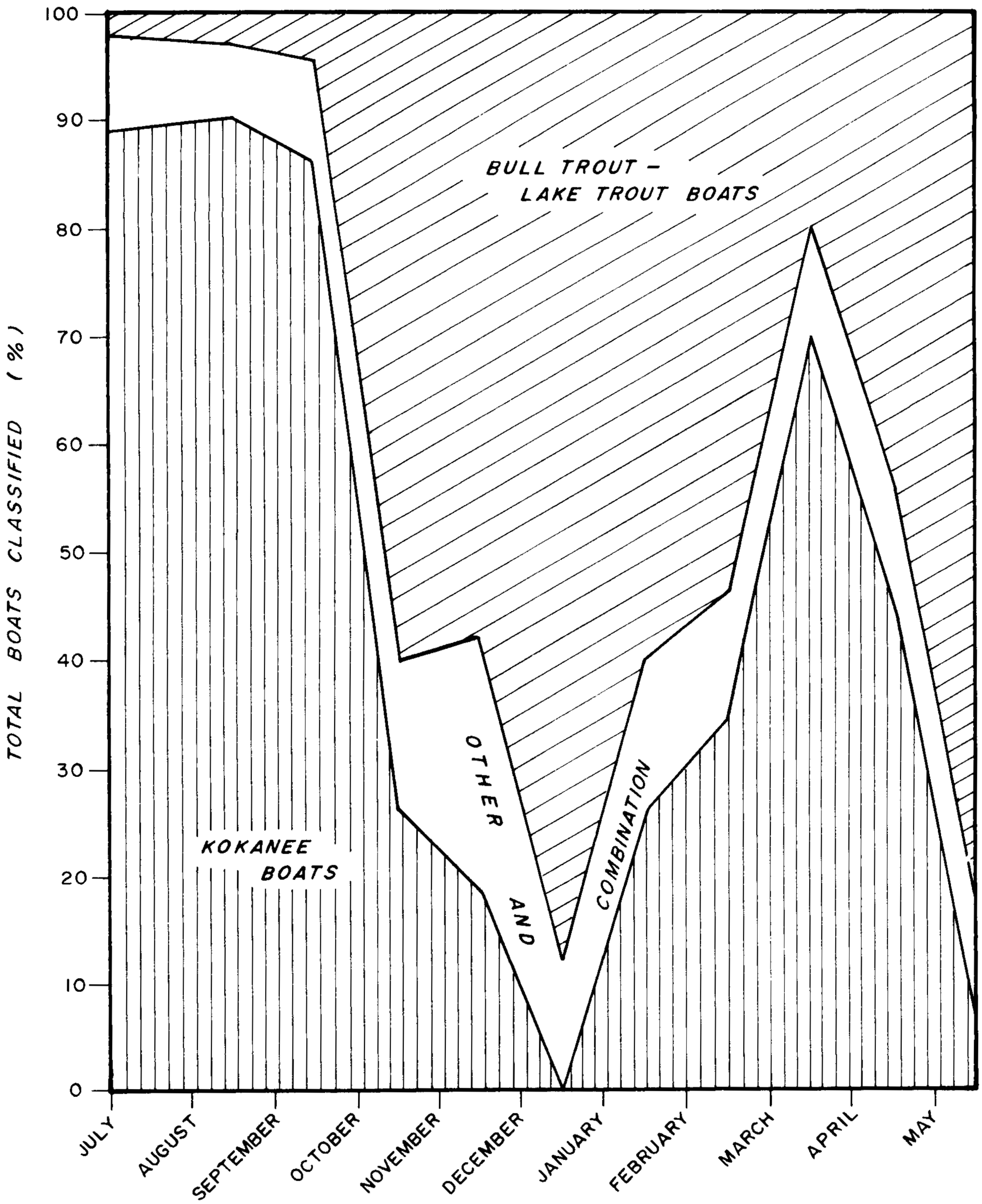



CHART 9A Monthly distribution of types of fishing boats, Flathead Lake - July 1, 1981 to May 14, 1982.

Source
Graham and Fredenberg , 1983

Table 9.4. Fish species composition and catch rate, Flathead Lake, 1981 to 1982.

| Species | Catch Rate (Fish/Hour) | Composition (percent) |
|---|---|---|
| Kokanee | 0.97 | 89 |
| Bull Trout | 0.02 | 2 |
| Lake Trout | 0.02 | 2 |
| Cutthroat Trout | 0.01 | 1 |
| Yellow Perch | 0.07 | 6 |

Source: Graham and Fredenberg 1983.

Table 9.5. Fish catch kept by fishermen, Flathead Lake, 1981 to 1982.

| Fish Species | Fish Kept Percent |
|---|---|
| Kokanee | 100 |
| Bull Trout | 48 |
| Lake Trout | 69 |
| Cutthroat Trout | 99 |
| Yellow Perch | 92 |

Source: Graham and Fredenberg 1983.

The total Flathead Lake fishing pressure during the May 1981 to May 1982 study period was estimated at 605,160 hours, or 168,792 fisherman days. This is equivalent to 365 fisherman days per square kilometer of lake surface area. Chart 9B shows the monthly distribution of fishing pressure by boat and shore fisherman. The highest monthly pressure (31 percent) occurred in August. For comparison, the total fishing pressure estimate for the 1982-83 period is 103,888 fisherman days (Montana Department of Fish, Wildlife and Parks, Computer Printout, provided by Hanzel, February 1986). Table 9.6 shows the total estimated harvest of gamefish (including perch) on the Lake. It was estimated to be 536,870.

An estimate of the annual value of the Flathead Lake fishery can be made from the fisherman use (angler-days) during the 1981-82 study period. The relative importance or value of the predominant sportfish

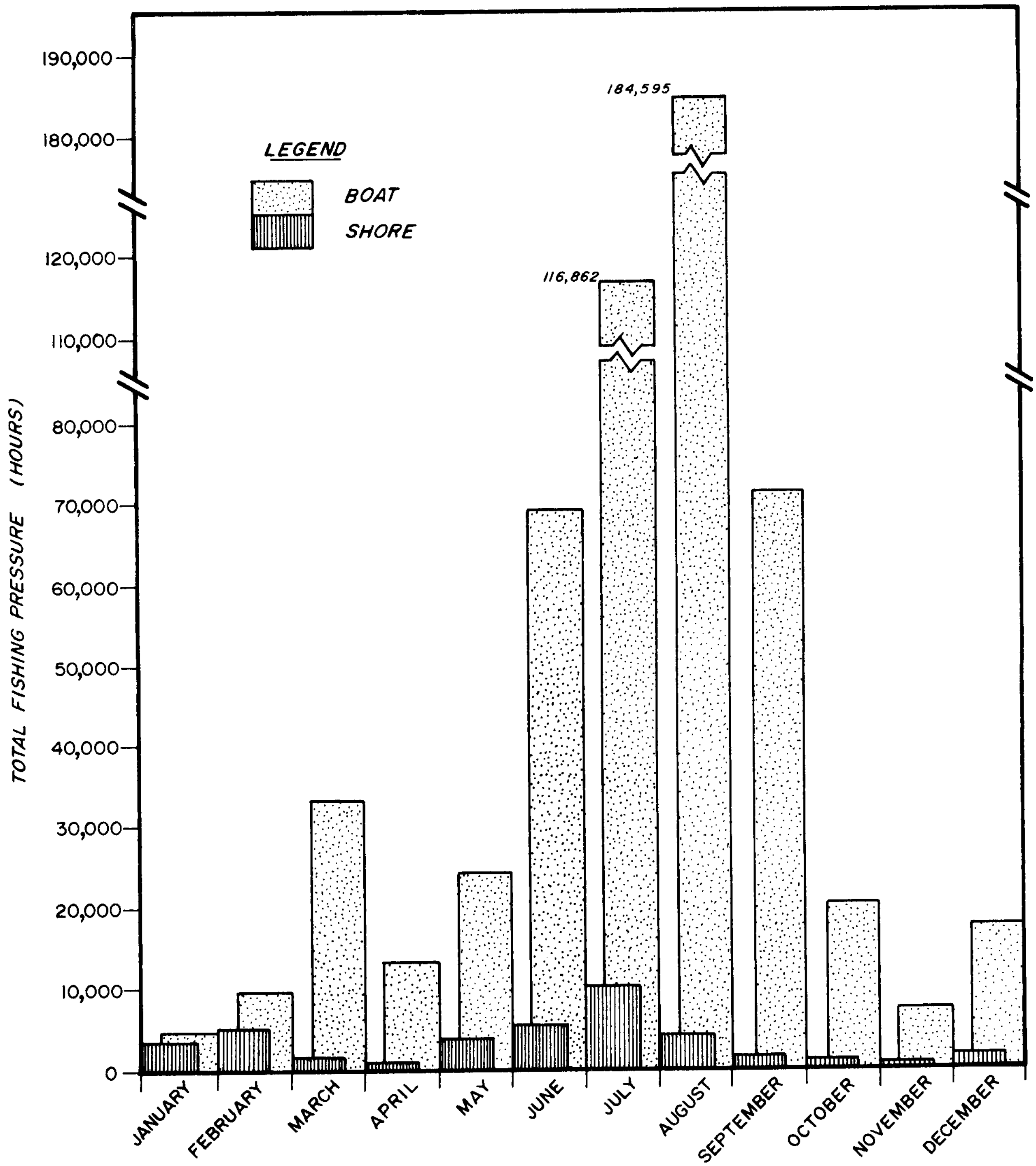



CHART 9B Monthly distribution of boat fishermen and shore fishermen, Flathead Lake - May 16, 1981 to May 14, 1982.

Source
Graham and Fredenberg, 1983

species may be expressed by estimating fishing pressure for each fish species. Table 9.7 shows this angler days fishing pressure. Although the kokanee harvest was about 80 times that of the bull trout or lake trout, the kokanee fishing angler days were less than twice that for the two trophy species.

Table 9.6. Estimated gamefish harvest, Flathead Lake, 1981 to 1982.

| Fish Species | Number Harvested | Total Harvest (Percent) |
|---|---|---|
| Kokanee | 495 910 | 92 |
| Bull Trout | 5 452 | 1 |
| Lake Trout | 6 947 | 1 |
| Cutthroat Trout | 6 910 | 1 |
| Yellow Perch | 20 903 | 4 |

Source: Graham and Fredenberg 1983.

Table 9.7. Angler days fishing pressure, Flathead Lake, 1981 to 1982.

| Fish Species | Angler Days | Total Harvest (Percent) |
|---|---|---|
| Kokanee | 142 000 | 92 |
| Bull Trout | 75 700 | 1 |
| Lake Trout | 96 500 | 1 |

Source: Graham and Fredenberg 1983.

### 9.2.2 Settlement

The only incorporated community in this sub-basin is Polson. It is located on the south shore of Flathead Lake. Several unincorporated communities are located around Flathead Lake including Bigfork, Somers, Lakeside, Woods Bay, Rollins, Dayton, Elmo, Big Arm, Finely Point, and Yellow Bay. Land use is shown on Figure 9A and Land Ownership on Figure 9B.

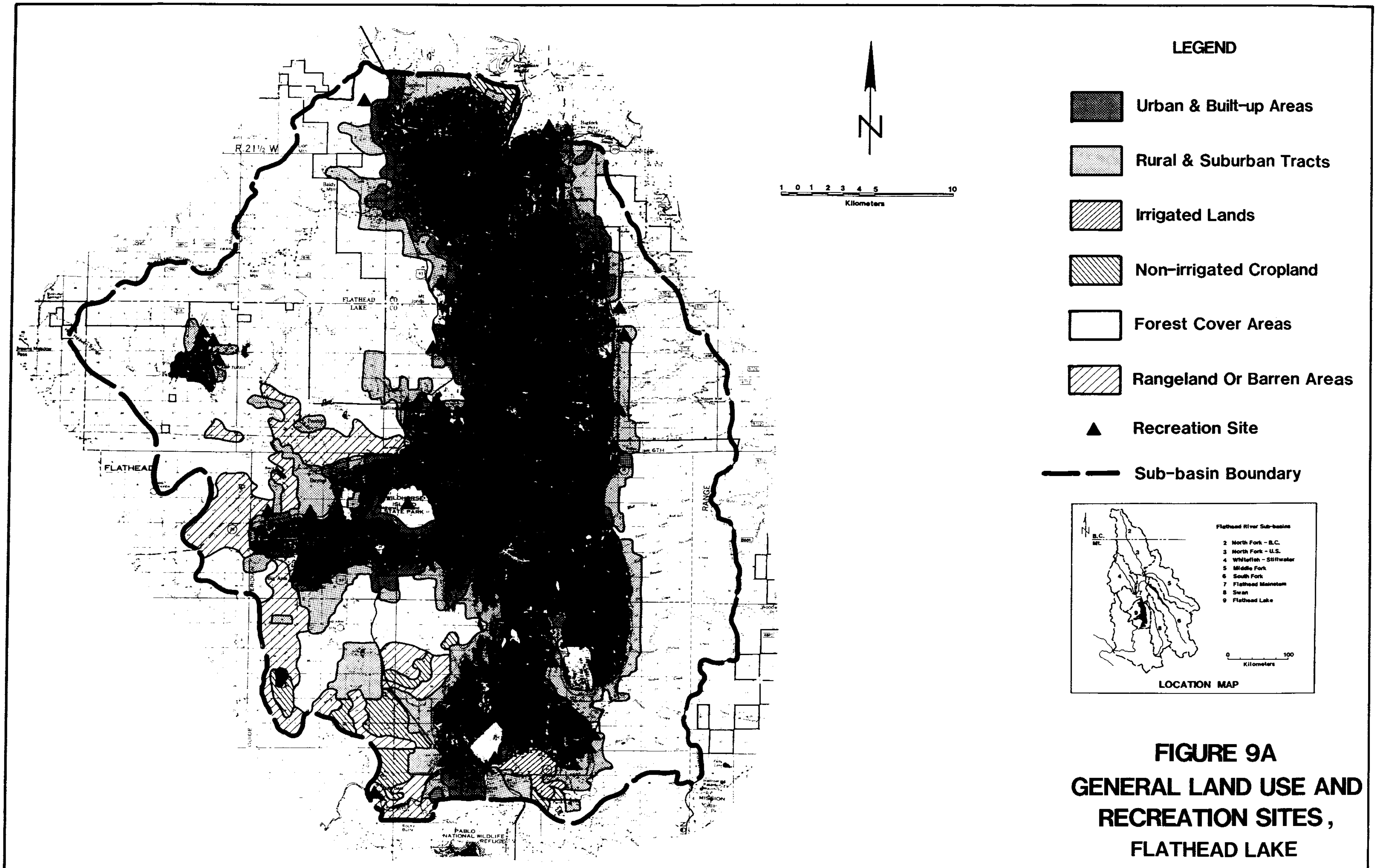
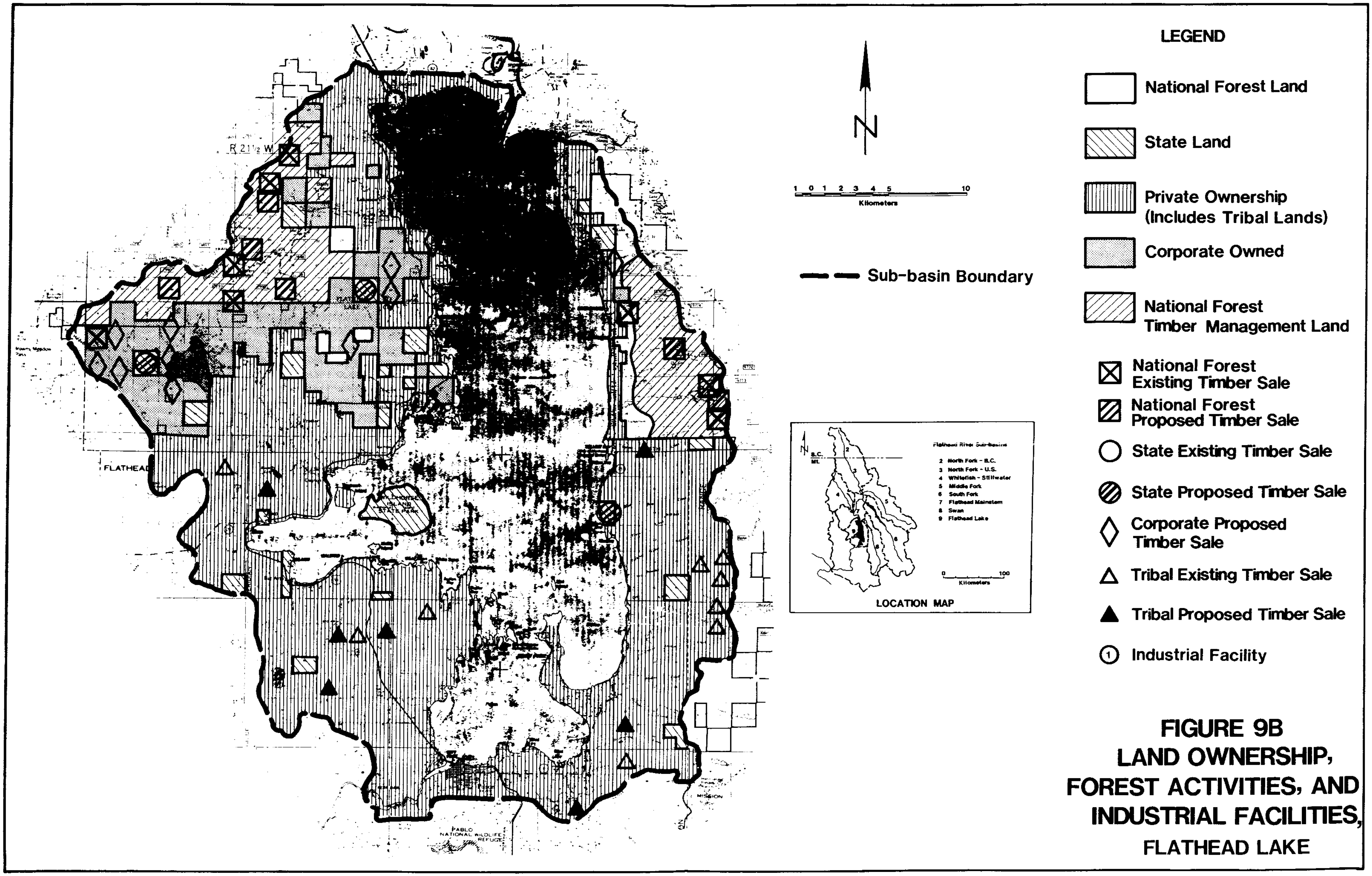



**FIGURE 9A**
**GENERAL LAND USE AND RECREATION SITES, FLATHEAD LAKE**




# FIGURE 9B
## LAND OWNERSHIP, FOREST ACTIVITIES, AND INDUSTRIAL FACILITIES, FLATHEAD LAKE

The total population in this sub-basin is estimated to be 9706 people (U.S. Census 1980 derived). The projected 1990 population is 11,133 people (Flathead River Basin Environmental Impact Study 1983, medium scenario, p. 58). There are approximately 6222 housing units in this sub-basin. About 24 percent (1474) are estimated to be seasonal homes. Polson had a 1980 population of 2798. Most of the remaining population lives in rural homesites surrounding the shoreline of Flathead Lake.

This sub-basin includes portions of Flathead and Lake counties. The Confederated Salish and Kootenai Tribes own the bed and banks of the south half of Flathead Lake. The Lake has approximately 298 km (180 mi) of shoreline. Approximately 200 km (120 mi) of this shoreline is within Lake County. The Lake County Land Services Department conducted a lakeshore inventory in 1983. The survey indicated that there were about 2000 private parcels in Lake County which border Flathead Lake. Of the lakefront owners, 34 percent were county residents, 45 percent were Montana residents living outside of Lake County, and 21 percent were out-of-state residents (January 1986, Nancy Thormahlan, Lake County Planning Department, personal communication). A total of 1716 licensed water use permits have been filed with the MDNRC (Figure 9C). Table 9.8 lists these water use permits.

Table 9.8. Licensed water use permits, Flathead Lake.

| Type of Water Use | Number |
|---|---|
| Irrigation (includes lawn, orchard and garden) | 430 |
| Domestic | 1232 |
| Commercial/Industrial/Fire Protection | 35 |
| Fish/Wildlife/Recreation (Non-consumptive, e.g., Fish Hatchery) | 19 |
| Total | 1716 |

Source: Montana Department of Natural Resources and Conservation 1986.

Many people use Flathead Lake as their domestic water supply. This water is usually not treated. Deterioration of surface water quality may lead to a health risk because use of surface water is not presently regulated by state and local governmental agencies. Flathead Lake is used as a water source because ground water near the lake is difficult and expensive to reach. On the east shore of Flathead Lake, domestic wells are usually 121 to 181 m (400 to 600 ft) deep. On the west shore, wells are generally 61 to 181 m (200 to 600 ft) deep (March 1986, Paddy Trusler, Lake County Health Department, personal communication).

Lakefront and lakeview property are the most expensive residential real estate in this sub-basin. Lakefront tracts currently sell for $400 to $1000 a front foot. Diminished water quality may adversely affect amenity values associated with living next to the lake, and reduce real estate values (March 1986, J. Sorensen, Lake County Planning Department, personal communication).

There are four community water systems in this sub-basin. The Polson municipal water system serves approximately 5000 people. Water is provided by a surface water reservoir in the Mission Mountains (Hellroaring watershed) and three wells. The wells are located in the City. One well is 159 m (525 ft) deep, one is 45 m (150 ft) deep and one is 61 m (200 ft) deep. One well yields 6.3 L/s (100 gal/min), and the other two yield 32 L/s (500 gal/min). The City uses approximately 1.7 million $m^3$ (450 million gal) of water per year.

Bigfork and Lakeside also have community water systems. The Bigfork water system serves approximately 1250 people. It consists of two infiltration galleries which collect water from the Swan River near the town. Bigfork uses about 568,000 $m^3$ (150 million gal) of water per year. The Lakeside water system serves 500 people. The system consists of two wells. One well is 56 m (186 ft) deep and the other well is 52 m (172 ft) deep. The yields are 4.8 and 3.7 L/s (76 and 58 gal/min), respectively. The wells are located at the south end of Lakeside. The community of Somers obtains water from Flathead Lake.

### 9.2.3 Agriculture

There are approximately 16,000 ha (40,000 acres) of farmland in this sub-basin. That is approximately 18 percent of the land area (Figure 9A). None of the farmland is classified as prime farmland by the

U.S. Soil Conservation Service (SCS). Approximately 4000 ha (10,000 acres) of land classified as good agricultural land is located west of Polson between U.S. Highway 93 and the Flathead River. An additional 1600 ha (4000 acres) of good agricultural land is located in the Proctor Valley west of Dayton. The remaining land (10,400 ha or 26,000 acres) is identified as rangeland. It is dispersed along the west shore back from the Lake. The east shore of Flathead Lake is characterized by numerous orchards, mostly cherry trees. There are approximately 500 ha (1200 acres) in orchards on the east side of the Lake.

### 9.2.4 Preservation

The south half of Flathead Lake is part of the Flathead Indian Reservation. The Confederated Salish and Kootenai Tribes regulate any structures or construction activity that occurs below the high water line on the south half of Flathead Lake under their Shoreline Protection Ordinance. The preamble to that ordinance states:

"Section 1. The Tribal Council of the Confederated Salish and Kootenai Tribes of the Flathead Reservation, Montana, finds and declares that --

(a) title to the bed and banks below high water mark of all navigable waters on the Flathead Indian Reservation is held by the United States in trust for the Confederated Salish and Kootenai Tribes, and such waters and their shorelines are among the most valuable and fragile of the natural resources of the Reservation and are high in scenic and resource value;

(b) increasing population and even greater utilization of unrestricted construction on the other activities along these shorelines are causing much of the value of the shorelines to become permanently lost and the shorelines to become permanently and irreparably dispoiled, and there therefore exists an immediate need to regulate such activities and manage the shorelines so as to preserve and protect them and, to the greatest extent possible, restore them to their original condition; and

(c) under the Treaty of Hell Gate of 1855 July 16, 12 Stat. 975, the Confederated Salish and Kootenai Tribes hold the exclusive right to fish in the waters within the Reservation, and the aforementioned activities along the shorelines of such waters are causing significant harm to the ecology of the waters and are destroying the shores as a habitat for plants, fish and other animal life and thereby are interfering with the Tribes' fishing rights, and for this reason also there exists an immediate need to regulate such activities and manage the shorelines so as to protect and preserve the plant, fish and other animal life in said waters and the general ecology of the shoreline."

## 9.3 SOCIO-ECONOMIC ACTIVITIES THAT POTENTIALLY AFFECT WATER QUALITY AND/OR WATER QUANTITY

### 9.3.1 Introduction

Research has suggested that the trophic status of Flathead Lake is changing due to an increase in the amount of phosphorus entering the Lake. In April 1984, the MDHES prepared a "Strategy for Limiting Phosphorus in Flathead Lake". The strategy outlined a six-point plan to reduce phosphorus inputs to the Lake:

1. Impose a 1.0 mg/L phosphorus limit on all state permitted effluents in the Basin. Table 9.9 shows the estimated benefits of implementing this phosphorus limit (see below);
2. Develop wastewater management plans for unsewered communities in the Basin;
3. Recommend legislation to allow the sale of only low or phosphorus-free laundry detergents;
4. Strengthen the control of non-point sources of phosphorus;
5. Require subdividers to evaluate the phosphorus-absorption capacity of soils where drainfields would be sited near surface water; and
6. Expand and refine the phosphorus monitoring program in the Basin.

### 9.3.2 Recreation

Recreation use is described in Section 9.2.1. The impact of recreation use on water quality and quantity has not been quantified.

### 9.3.3 Settlement

9.3.3.1 Sewage treatment plants. Point and non-point contamination of surface waters has been caused by residential and commercial development. There are three community sewer systems which have licensed point discharges. These are Bigfork, Yellow Bay, and Polson (Figure 9C).

The Bigfork sewage treatment plant serves 710 households. The MDHES is requiring that plant to be upgraded to remove phosphorus. At this time, the design of the facility is nearly complete. The advanced wastewater treatment plant is expected to be operational in 1987. The cost of the project is $2.5 million. The portion of the upgrade attributed to advanced wastewater treatment is $220,000. The sewage treatment plant at Yellow Bay (University of Montana Biological Station) is currently meeting the State-imposed phosphorus limitation of 1.0 mg/L total phosphorus. The sewage treatment plant at Polson serves 1300 households. It discharges into the Flathead River south of Flathead Lake but upstream of Kerr Dam. As a result, this effluent discharge is not considered to influence Flathead Lake. The MDHES has not required improved phosphorus limitations for this facility.

The community of Lakeside is located in Flathead County on the west shore of Flathead Lake. It has a population of approximately 1500 residents. Wastewater treatment from individual systems in this community has been found to be inadequate due to excessive soil permeability, shallow bedrock, seasonal shallow groundwater, and steep slopes. The residents have formed the Lakeside County Sewer District. They are planning to construct a sewage treatment plant to collect and treat sewage so that individual septic systems can be discontinued. Current plans are to dispose of the treated sewage by spray irrigation. If implemented, there will be no discharge into surface waters. This central system is currently scheduled to be operational in 1987. The estimated cost of the facility is $4.9 million (January 1986, Steve Pilcher, Water Quality Bureau, Montana Department of Health and Environmental Sciences, personal communication).

Table 9.9 shows the respective phosphorus contributions from each sewage treatment plant and estimated benefits of implementing the

Table 9.9. Total phosphorus loading to Flathead Lake from point source municipalities in Flathead Basin Study.

| Town | Year 1983 Phosphorus | | | Year 2000 Phosphorus | | | |
|---|---|---|---|---|---|---|---|
| | Flow[a] (MGD) | mg/l | Metric Tons Per Year | Flow[a] (MGD) | mg/l | Without P Removal Metric Tons Per Year | With P Removal Metric Tons Per Year |
| Kalispell | 1.30 | 4.7 | 8.4 | 2.88 | 6.0 | 23.8 | 4.0 |
| Whitefish | 0.70 | 6.0 | 5.8 | 1.2 | 6.0 | 9.9 | 1.7 |
| Columbia Falls | 0.30 | 9.5 | 3.9 | 0.55 | 7.0 | 5.3 | 0.8 |
| Bigfork | 0.20 | 9.9 | 2.7 | 0.38 | 7.0 | 2.7 | 0.5 |
| Total | 2.50 | | 20.8 | 5.01 | | 41.7 | 7.0 |

[a] Million gallons per day.

Source: Strategy for Limiting Phosphorus in Flathead Lake, Montana Department of Health and Environmental Sciences, Water Quality Bureau 1984 April 27.

1.0 mg/L phosphorus limit. Table 9.10 shows the sources of biologically available phosphorus in the Flathead River Basin upstream of the Flathead Lake outlet. The total phosphorus from sewage treatment plants is essentially biologically available phosphorus.

Table 9.10. Sources of biologically available phosphorus in the Flathead River Basin upstream of the Flathead Lake outlet, 1985.

| Source | Amount (Metric Tons) |
|---|---|
| Flathead River | 58.4 |
| Airshed | 30.0 |
| Sewage Treatment Plants | 20.5 |
| Swan River | 7.8 |
| Stillwater River | 6.1 |
| Shoreline | 2.1 |
| Total | 124.9 |

Source: J. Stanford, University of Montana Biological Station, Yellow Bay (Flathead Lake), Montana, personal communication, March 1986.

9.3.3.2 Rural development. Approximately 5200 people live in small communities or on rural tracts. Figure 9D shows population density in the sub-basin. These people occupy 2738 homes. There is an additional 1474 seasonal homes (U.S. Census 1980 derived). All of these dwellings are assumed to be served by individual septic tanks and drainfields. Very little information is currently available on the potential effect of these systems on the water resources in the Basin. The University of Montana Biological Station at Yellow Bay is currently conducting a sewage leachate study around Flathead Lake to detect failing sewer systems.

Land subdivision has occurred throughout the sub-basin, particularly on or near the Lake. The parcel density in rural areas is shown on Figure 9E. In the Lake County portion of the sub-basin, 36 subdivisions were approved since 1973. This created 676 lots on 768 ha (1920 acres). During the same time frame, 2900 ha (7250 acres) were divided into 900 tracts using exemptions from the state subdivision law. In the last three years, subdivision development has slowed. A substantial number of the parcels that have been created by subdivision have not been built on. The potential cumulative effect of rural residential development may have an adverse impact on water quality, but it has not been studied (January 1986, Nancy Thormahlan, Lake County Planning Department, personal communication).

MDHES has implemented a policy which requires subdividers of land to evaluate the phosphorus absorption capacity of soils for new developments proposed with septic tank drainfield systems. The subdivision must demonstrate that no phosphorus will contaminate an adjacent water body within a period of 50 years.

9.3.3.3 Detergent initiative. It is estimated that 4 to 10 percent of the biologically available phosphorus entering Flathead Lake may come from phosphorus-bearing detergents. A 1 to 5 percent decrease in phosphorus input annually may be enough to prevent future problem algae growth "blooms" (October 1985, J. Stanford, University of Montana Biological Station, Yellow Bay (Flathead Lake), Montana, personal communication).

The 1985 Montana Legislative session passed HB711. That bill gives Montana counties with natural lakes the option of adopting rules that would prohibit the sale of cleaning products containing phosphorus. Agricultural (fertilizer) activities, hospitals, nursing homes and commercial and industrial operations were exempted by the bill as was the use of hand soaps, other personal care items and dishwasher detergents. Before adoption, a county must demonstrate that other complementary phosphorus removal efforts (e.g., upgraded sewage treatment plants, setbacks from the lake, etc.) are being implemented. Counties can restrict only the sale of phosphorus products. The use of phosphorus products will not be penalized. If a store in a "ban" county offers a phosphorus detergent for sale, the county must notify the store of its violation. If the store has not taken the product off its shelves within 30 days after notification, the store is subject to a misdemeanor penalty. Lake and Flathead County Commissioners adopted ordinances to prohibit the sale of cleaning products containing phosphorus, effective 1987 January 1.

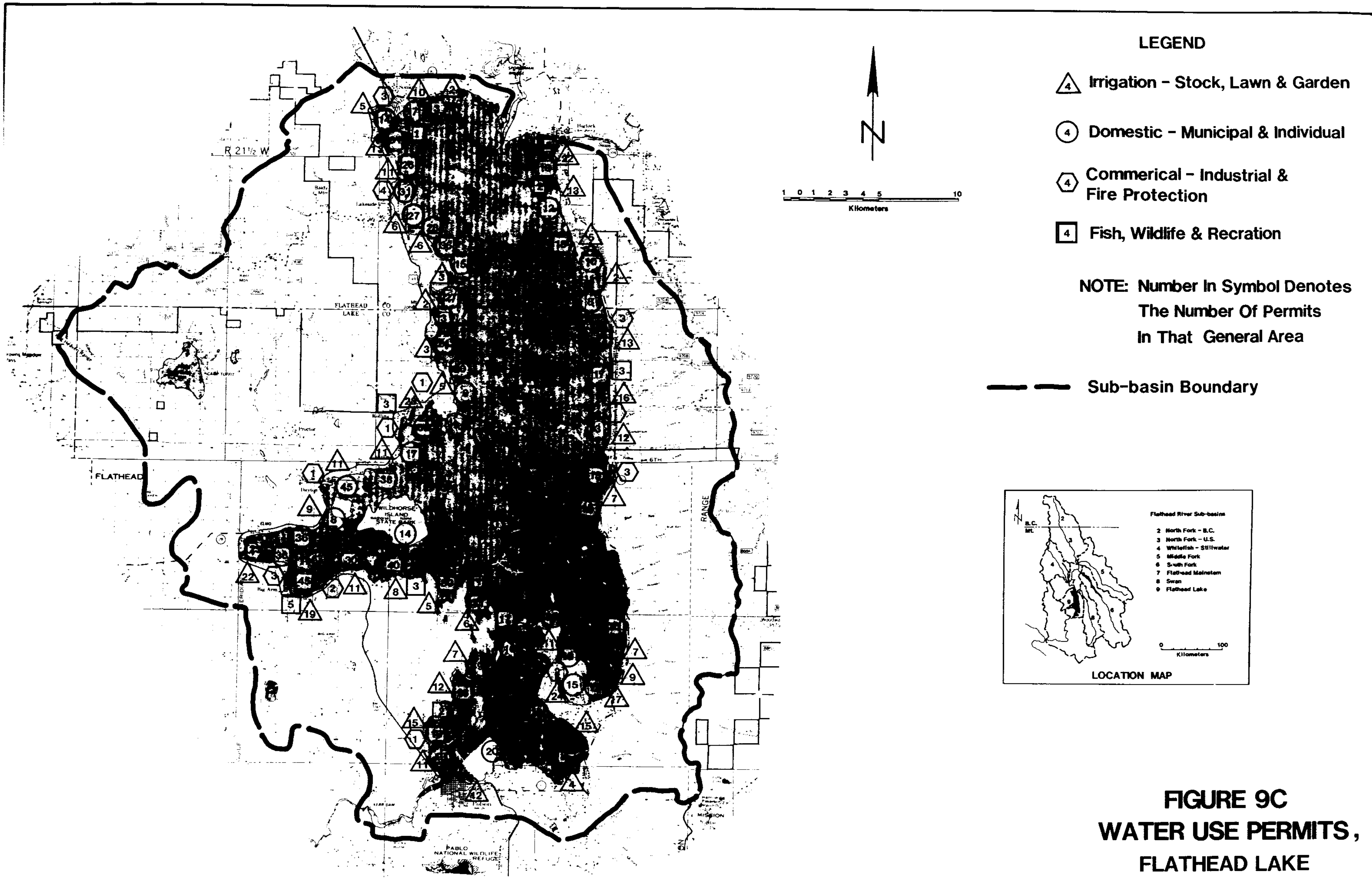



**FIGURE 9C**
**WATER USE PERMITS, FLATHEAD LAKE**

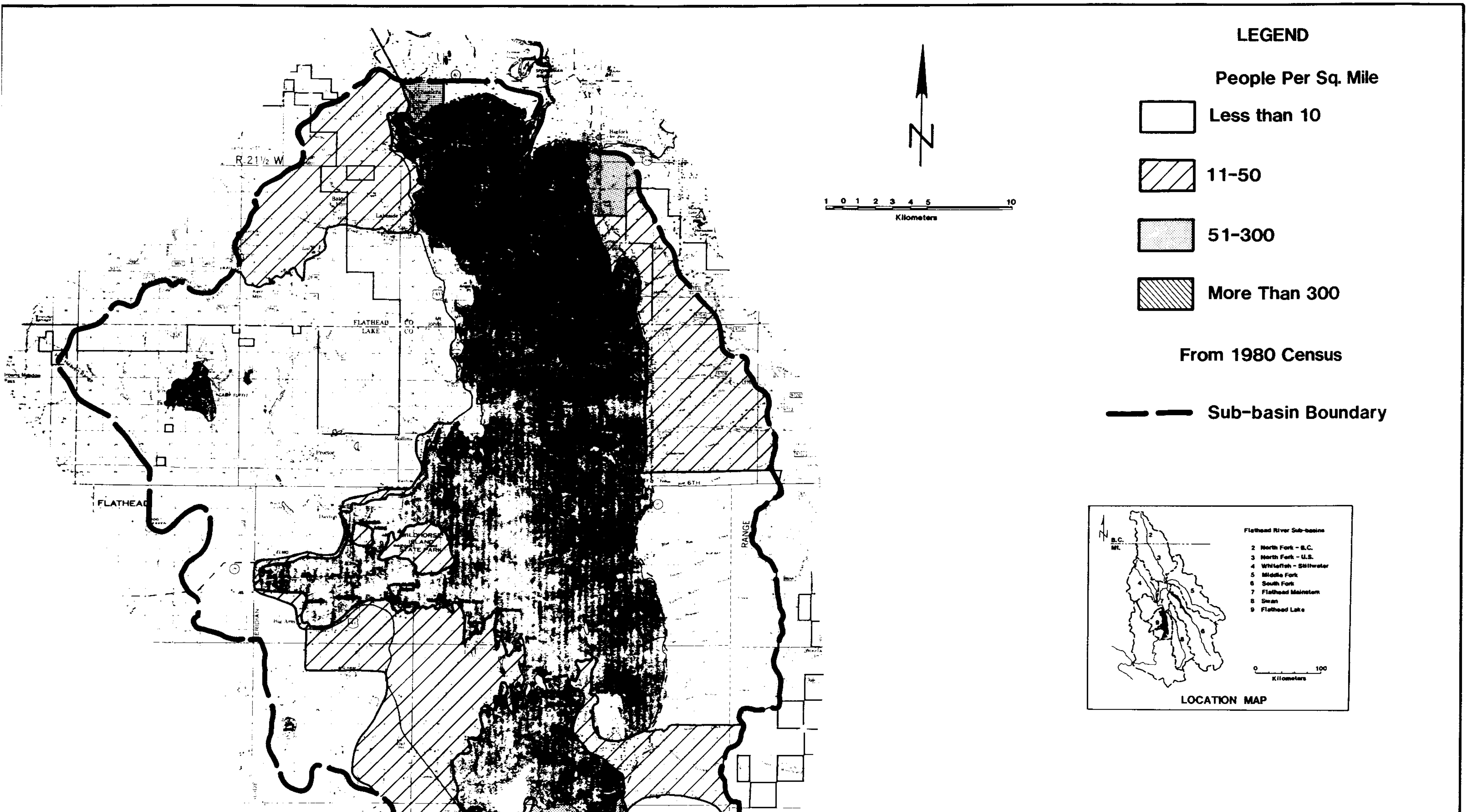



**FIGURE 9D**
**POPULATION DENSITY,**
**FLATHEAD LAKE**

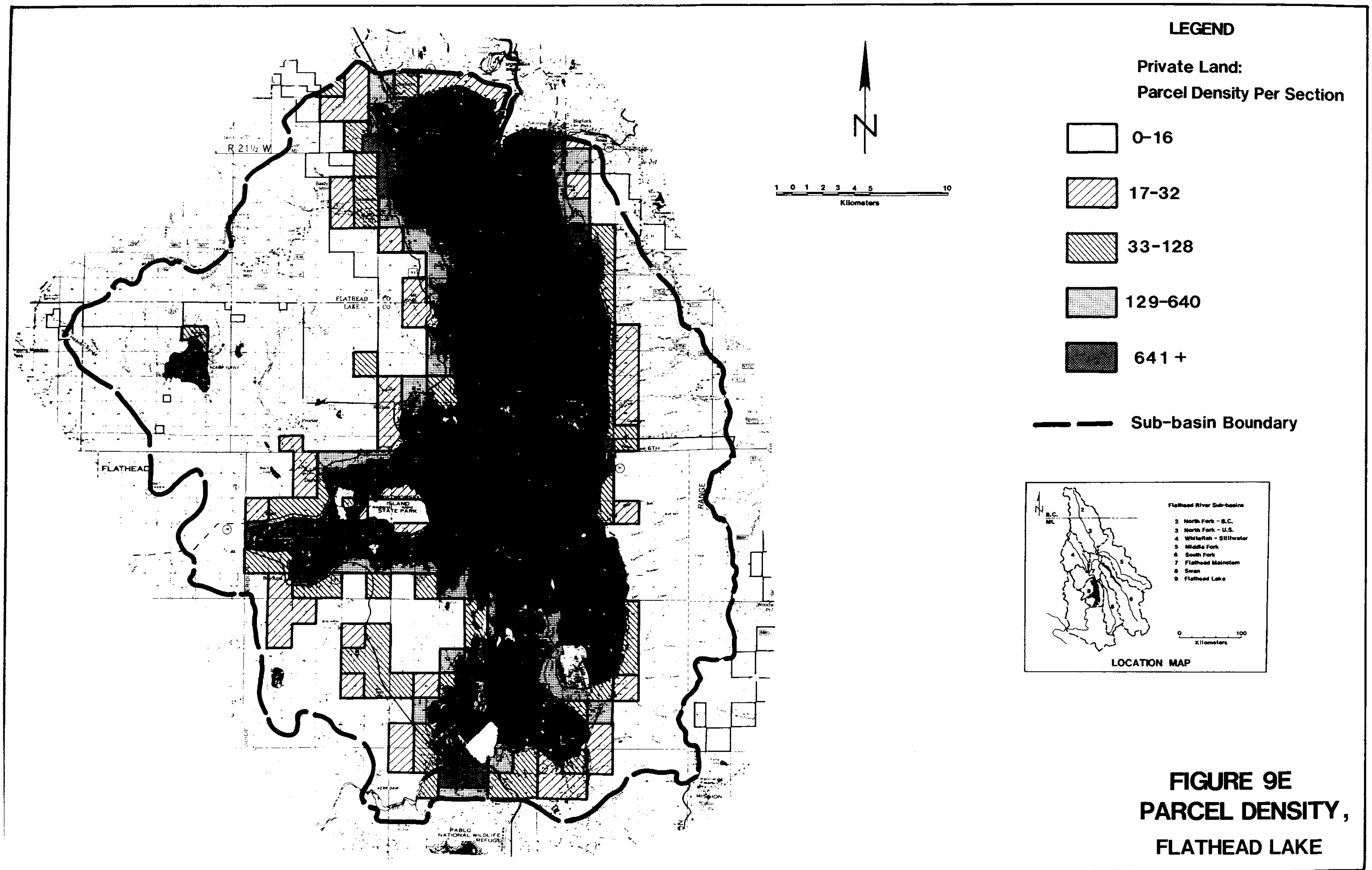



**FIGURE 9E**
**PARCEL DENSITY,**
**FLATHEAD LAKE**

9.3.4 Agriculture

Agricultural activity is also described in Section 9.2.3. There is very little cropland and relatively little irrigation in this sub-basin.

The most significant agricultural impact on water quality is associated with livestock grazing close to surface waters. Dayton Bay on the west shore has been found to have high fecal coliform counts. These counts are believed to be caused by extensive grazing near the creek flowing into the bay. No studies have actually documented the source of these high values.

9.3.5 Forestry

9.3.5.1 Current. The relative intensity and areal distribution of current timber harvest activity is best expressed in terms of the recently completed and ongoing timber sales of the major land managing entities in the sub-basin. In the Flathead Lake sub-basin, those entities are the Flathead National Forest, Montana State Forests, Flathead Indian Reservation and corporate forest land. Information is not available for corporate forest land. The current timber sales and road development data are found on Tables 22 to 24 in Addendum A and shown on Figure 9B. The data are summarized in Table 9.11.

9.3.5.2 Committed. Large areas of timbered property are potentially available for harvest, as reflected by the timber sale program plans of the major forest managers in the sub-basin. The detailed, future timber sale planning by these organizations varies from three to five years hence. The committed timber harvest activity and road development are found in Tables 25 to 28, Addendum A, and illustrated in Figure 9B. The data are summarized in Table 9.12.

9.3.6 Industry

The Burlington Northern tie treatment plant is located in the town of Somers on Flathead Lake, 24 km (15 mi) south of Kalispell. For more than 40 years, process water containing creosote was discharged into

Table 9.11. Current timber sales and road development, Flathead Lake, 1981 to 1985.

| Forest Manager | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|
| Flathead N.F. | 57 573 | 5 377 | 148 | 68 |
| State Forest lands | 3 000 | * | * | * |
| Indian Res. | 9 462 | 3 047 acres | 71 miles | 0 |
| Totals | 70 035 (70.0 MMBF) | 8 424 (20 800 acres) | 218 (135.7 miles) | 68 (42.1 miles) |

*Data not available

Source: Bureau of Indian Affairs, Flathead Reservation, Pablo, Montana, Timber Sale Data Table, Ongoing and Committed Program, 1985 November 25; Flathead National Forest, Flathead National Forest Timber Sales Awarded or in Progress, FY 81 through FY 85, Supervisor's Office, Kalispell, Montana, 1986 February 21; and, MDSL, Northwestern Land Office, Kalispell, Montana, State Forest, Timber Sale Data Table, Ongoing Program, received February 1986.

Table 9.12. Committed timber sales and road development, Flathead Lake.

| Forest Manager | Year | Timber Sales Volume (MBF) | Timber Sales Area (Hectares) | Road Development Construction (Kilometers) | Road Development Reconstruction (Kilometers) |
|---|---|---|---|---|---|
| Flathead N.F. | 1986-90 | 57 000 | 1 449 | 68 | 18.7 |
| State Forest lands | 1987-92 | 4 350 | 676 | 13.7 | * |
| Indian Res. | 1986-88 | 29 000 | 81 | 64 | * |
| Plum Creek Co. | 1986-88 | 40 700 | 1 336 | * | * |
| Totals | | 131 000 (86.0 MMBF) | 3 543 (8 747 acres) | 145.6 (90.5 miles) | 18.7 (11.6 miles) |

*Data not available

Source: Bureau of Indian Affairs, Flathead Reservation, Pablo, Montana, Timber Sale Data Table, Ongoing and Committed Program, 1985 November 25; Flathead National Forest, Flathead National Forest Plan, December 1985; MDSL, Northwestern Land Office, Kalispell, Montana, State Forest Timber Sale Data Table, Planned/Committed Program, received 1986 March 14; and Plum Creek Timber Company, Timber Sales Data Table, "Sale Plans 1986, 1987, 1988," November 1985.

a holding pond. Overflow from the pond was channeled into a pond adjacent to Flathead Lake. After 1971, BN built lagoons to collect the process water and no longer used the holding pond. In 1984, BN curtailed the use of the lagoons in favour of a closed-loop system that recycles process water back through the treatment process.

Lagoons are currently being cleaned by BN under the supervision of the Montana Solid and Hazardous Waste Management Bureau, MDHES. The site has been added to the EPA's National Priorities List (NPL) of Superfund hazardous waste sites. EPA has assumed responsibility to oversee BN's cleanup.

The Kerr Dam hydroelectric plant is located on the Flathead River downstream from Flathead Lake, 8 km (5 mi) south of Polson (Figure 9B). The Dam is operated by Montana Power Company (MPC) on land leased from the Confederated Salish and Kootenai Tribes. Kerr Dam is 61 m (201 ft) high. It generates an average of 125 megawatts of electricity during a normal water year. Peak generation capacity is 180 megawatts.

### 9.3.7 Transportation

The main roads are U.S. Highway 93 on the west shore and State Highway 35 on the east shore of Flathead Lake. Much of U.S. Highway 93 between Elmo and Lakeside is scheduled for reconstruction by the MDOH.

# 10. RELATIONSHIPS BETWEEN WATER QUANTITY AND CURRENT AND/OR COMMITTED SOCIO-ECONOMIC ACTIVITIES IN THE FLATHEAD RIVER BASIN

## 10.1 INTRODUCTION

The objective of this chapter is to briefly review the relationships between several socio-economic activities in the Flathead River Basin and the quantity of water available in the study area. Discussion is limited to three designated sub-basins: North Fork, Flathead River in British Columbia; North Fork, Flathead River in Montana; and Flathead River-Mainstem (Figure 1). Those sub-basins which drain into the Flathead-Mainstem, but which cannot be impacted by the proposed coal mine, have not been assessed. As requested by the Board, only existing data were used in the review.

Prior to a discussion of forest management in each sub-basin, a brief summary of the general effects of this activity on runoff is presented (activities associated with forestry, such as construction can have a large effect on runoff). Chamberlin (1982) indicates that harvesting effects can be roughly grouped into three major categories that form the basis for most runoff analyses.

1. Influences on snow distribution and melt rates. As forest openings cause snow to be trapped in them, the soil is wetter and hence the melt water comes out faster resulting in higher and earlier peak flows.
2. Influences on interception, evapotranspiration and soil storage. The elimination (by tree-cutting) of substantial amounts of leaves, stems and roots reduces interception of rain or snow and transpiration from the soil which results in higher soil-water contents and runoff in cleared areas.
3. Influences on soil structure affecting infiltration and water transmission rates. Disturbance to soil structure will usually cause some reduction in water runoff times, some increase in peak flows and a possible decrease in ground-water levels.

Resource managers often become concerned about flow regime changes as the land area recently harvested in a given basin approaches 25 percent (1986, Chamberlin, Fisheries Branch, Ministry of Environment and Parks, Victoria, B.C., personal communication), although specific basin properties and harvesting practices may vary this rule of thumb. "Recent" in the hydrologic recovery context refers to the period of time required for a regenerating cut area to regain the properties of the surrounding forest with respect to evapotranspiration, snow accumulation and melt. Depending on region and forest type, it may vary from 5 to over 50 years (Hibbert 1967).

Forest management can affect not only the quantity of water in a stream channel, and obviously the quality of water, but also can impact the physical properties of the channel directly by accelerating in-channel erosion processes, by introducing or removing large organic debris, by removing riparian vegetation and by accelerating erosion and mass-movement processes.

The percent of land area in each sub-basin potentially impacted by timber harvesting activities is shown in Table 10.1. Information presented in this table has been compiled from earlier sections of this report (Chapters 2 to 9). Discussion is limited to only recent timber harvesting activity; but decades of timber removal have occurred resulting in various stages of forest regeneration which complicates the analysis of harvesting on water yield. All sub-basins have been included for comparison purposes although discussion is limited to the three designated sub-basins previously mentioned in the introduction.

## 10.2 DISCUSSION

### 10.2.1 North Fork, Flathead River in British Columbia

Fisheries resources in this sub-basin have been addressed in earlier sections of this report. This portion of the study area supports approximately 25 percent of the bull trout spawning in the North Fork of the Flathead River drainage (i.e., British Columbia and Montana North Fork designated sub-basins). Little information exists regarding fisheries/ water quantity problems in Howell Creek (important as a bull trout spawning area), but it experiences low flows in the late summer/early winter period (Water Quality and Quantity Committee Report provides information with respect to the seasonal flow regime of Howell Creek). Withdrawal of

Table 10.1. Timber harvesting in the Flathead River Basin (through 1990).

| Sub-Basin | Drainage Area (Hectares) | Timber Sales (Hectares)[a] | | Percent Area of Sub-Basin Potentially Affected by Timber Harvesting | |
|---|---|---|---|---|---|
| | | Current | Committed | Current | Committed & Current |
| North Fork, Flathead River in British Columbia | 165 501[b] | 5 710[a,b] | 1905[a,b] | 3.5[a] | 4.6[a] |
| North Fork, Flathead River in Montana | 262 626 | 6 433 | 1804 | 2.4 | 3.1 |
| Whitefish River/Stillwater River | 208 236 | 21 760 | 6672 | 10.4 | 13.7 |
| Middle Fork, Flathead River | 285 677 | 2 854 | 277 | 1.0 | 1.1 |
| South Fork, Flathead River | 434 343 | 43 537 | 2337 | 10.0 | 10.6 |
| Flathead River-Mainstem | 177 415 | 7 396 | 3950 | 4.2 | 6.4 |
| Swan River/Swan Lake | 194 509 | 11 594 | 2374 | 6.0 | 7.2 |
| Flathead Lake | 142 450 | 8 424 | 3543 | 5.9 | 8.4 |

[a]Totals likely do not include areas of road access.

[b]Summary of data presented in Chapters 2 to 9 of this report.

water in this sub-basin is insignificant due to the sparse population base.

Current and committed timber harvesting accounts for only 3.5 to 4.6 percent (Table 10.1) of the land area in the North Fork, Flathead River in British Columbia. This is unlikely to cause any significant impact to flows in the Flathead River. It should be noted, however, that these figures refer to the sub-basin as a whole. If the area harvested is confined to only a few watersheds within the sub-basin, then serious localized impacts could occur.

### 10.2.2 North Fork, Flathead River in Montana

Aquatic recreation activities (fishing, floating, etc.) in this sub-basin require that sufficient water be available to preserve these water uses. Tables 10.2 and 10.3 (Biological Resources Committee 1987) illustrate the flows required to sustain the fish populations (final claim column) now legally reserved for instream uses, and the more preferable flow (flow recommendation) to optimize production.

The minor amount of water withdrawn under domestic water use permit is not believed to significantly impact water quantity in this sub-basin. Total population was estimated at 136 (1980 census) and irrigation requirements are very low.

Current and committed timber sales in the sub-basin account for only 3.1 percent of the land area. It is believed that changes in water quantity resulting from this relatively minor area of forest harvesting would be insignificant.

### 10.2.3 Flathead River-Mainstem

Fisheries use is very high in this sub-basin. A large number of kokanee spawn in this section - 16,279 spawners or 28 percent of the Flathead drainage spawning population in 1983 (Biological Resources Committee 1987). Juveniles of the species use the river (especially the margins) for rearing and adult fish of various species reside in this section.

Chart 10A illustrates the changes in the flow regime that have occurred in the Flathead River at a monitoring location downstream from the confluence with the South Fork prior to and after September 1951,

Table 10.2. Median flows, monthly flow recommendations, and the original filing and final claimed instream flows by the Montana Department of Fish, Wildlife and Parks for the North Fork of the Flathead River from Bowman Creek to the International Boundary[a].

| Time Period | Flow Recommendation ($m^3/s$)[b] | Original Filing ($m^3/s$)[c] | Final Claim ($m^3/s$)[d] | Median Flow ($m^3/s$)[e] |
|---|---|---|---|---|
| January | 21.2 | 17.7 | 17.7 | 18.3 |
| February | 21.2 | 17.7 | 17.7 | 18.8 |
| March | 21.2 | 17.7 | 17.7 | 20.3 |
| April 1 to 15 | 21.2 | 42.4 | 21.2 | 42.4 |
| April 16 to 30 | 31.1 | 42.4 | 31.1 | 97.0 |
| May 1 to 15 | 89.7 | 42.4 | 42.4 | 206.7 |
| May 16 to 31 | 154.6[f] | 42.4 | 42.4 | 328.9 |
| June 1 to 15 | 153.9 | 42.4 | 42.4 | 341.6 |
| June 16 to 30 | 101.0 | 42.4 | 42.4 | 231.8 |
| July 1 to 15 | 61.5 | 42.4 | 42.4 | 156.2 |
| July 16 to 31 | 36.2 | 42.4 | 36.2 | 83.0 |
| August | 21.2 | 42.4 | 21.2 | 47.8 |
| September | 21.2 | 42.4 | 21.2 | 29.4 |
| October | 21.2 | 17.7 | 17.7 | 28.2 |
| November | 21.2 | 17.7 | 17.7 | 26.7 |
| December | 21.2 | 17.7 | 17.7 | 21.7 |

[a] Adapted from Montana Department of Fish, Wildlife and Parks 1982.
[b] Derived from the wetted perimeter method and the dominant discharge concept.
[c] Flows as originally filed by MDFWP in 1970 December 22.
[d] Chosen as the lowest of the recommended or original filing flows by MDFWP.
[e] Derived for the 39-year period of record (1941 to 1979) for the USGS gauge station on the North Fork near Columbia Falls.
[f] A flow of 511.3 $m^3/s$ (approximate bankful discharge) should be maintained for 24 hours during this period.

Source: Biological Resources Committee 1987

Table 10.3. Median flows, monthly flow recommendations, and the original filing and final claimed instream flows by the Montana Department of Fish, Wildlife and Parks for the North Fork of the Flathead River from the confluence of the Middle Fork to Bowman Creek[a].

| Time Period | Flow Recommendation ($m^3/s$)[b] | Original Filing ($m^3/s$)[c] | Final Claim ($m^3/s$)[d] | Median Flow ($m^3/s$)[e] |
|---|---|---|---|---|
| January | 39.6 | 28.0 | 28.0 | 18.3 |
| February | 39.6 | 28.0 | 28.0 | 18.8 |
| March | 39.6 | 28.0 | 28.0 | 20.3 |
| April 1 to 15 | 39.6 | 74.3 | 39.6 | 42.4 |
| April 16 to 30 | 50.0 | 74.3 | 50.0 | 97.0 |
| May 1 to 15 | 134.2 | 74.3 | 74.3 | 206.2 |
| May 16 to 31 | 227.1[f] | 74.3 | 74.3 | 328.9 |
| June 1 to 15 | 226.4 | 74.3 | 74.3 | 341.6 |
| June 16 to 30 | 154.6 | 74.3 | 74.3 | 231.8 |
| July 1 to 15 | 98.5 | 74.3 | 74.3 | 156.2 |
| July 16 to 31 | 57.8 | 74.3 | 57.8 | 83.0 |
| August | 39.6 | 74.3 | 39.6 | 47.8 |
| September | 39.6 | 74.3 | 39.6 | 29.4 |
| October | 39.6 | 28.0 | 39.6 | 28.2 |
| November | 39.6 | 28.0 | 39.6 | 26.7 |
| December | 39.6 | 28.0 | 39.6 | 21.7 |

[a] Adapted from Montana Department of Fish, Wildlife and Parks 1982.
[b] Derived from the wetted perimeter method and the dominant discharge concept.
[c] Flows as originally filed by MDFWP in 1970 December 22.
[d] Chosen as the lowest of the recommended or original filing flows by MDFWP.
[e] Derived for the 39-year period of record (1941 to 1979) for the USGS gauge station on the North Fork near Columbia Falls.
[f] A flow of 511.3 $m^3/s$ (approximate bankful discharge) should be maintained for 24 hours during this period.

Source: Biological Resources Committee 1987

the date of closure of the coffer dam used in the construction of the Hungry Horse Dam. Chart 10A also indicates the percent of time (occurrences) that flows were less than 99.1 $m^3/s$ (approximately 3500 cfs) for the period of record from 1922 to the present, split into pre- and post-September 1951. Table 10.4 presents the actual number of occurrences when flows were less than 99.1 $m^3/s$. For example, during the month of September, of the 720 daily flows recorded prior to September 1951 (24 years), 674 (93.6 percent) were less than 99.1 $m^3/s$ (data used were taken directly from the U.S. Geological Survey [USGS] computer file). Since the dam has been in operation (September 1951), this has decreased to 41.4 percent. The figure of 99.1 $m^3/s$ was chosen because this flow is currently used in fisheries low flow studies (discussed later in this section). Indications from Chart 10A are that the Hungry Horse Dam has markedly improved the flow regime during the low-flow months.

In order to protect the kokanee spawning population, attempts were made to ensure that sufficient water was available to the fish during low flow periods of the year (August 1986, J. Vashro, Montana Department of Fish, Wildlife and Parks, Kalispell, Montana, personal communication). Minimum flows of 99.1 to 127.4 $m^3/s$ (4500 cfs) from October 15th through December 15th, and a minimum flow of 99.1 $m^3/s$ from December 15th through April 30th have been secured through the North-West Power Planning Council through 1987 to ensure successful spawning, egg development and fry emergence in the Flathead River downstream from the South Fork (Biological Resources Committee 1987). Flow data collected by the USGS at Station No. 12363000 on the Flathead River at Columbia Falls showed that during the period 1982 October 16 to 1985 September 30, daily flows (with one exception) have been greater than the 99.1 $m^3/s$. The established minimum flows should help alleviate fisheries problems related to low flow. Flows as low as 22.6 $m^3/s$ (800 cfs) had been recorded at this USGS station in the past. The period 1982 to 1987 is being used as a monitoring phase to study the value of this minimum. It is likely that soon after this study is completed, final recommendations regarding minimum flows will be made (August 1986, J. Fraley, Montana Department of Fish, Wildlife and Parks,

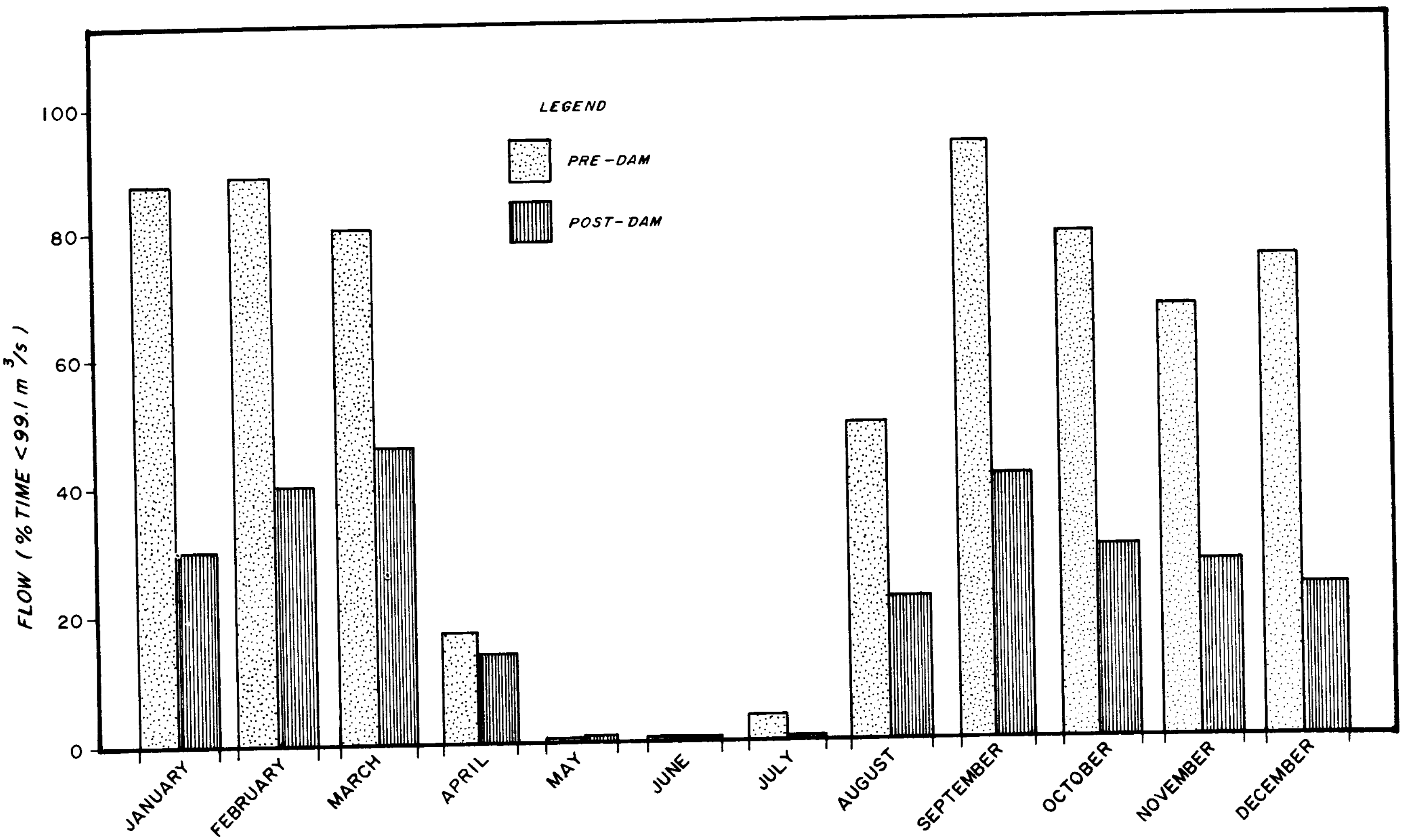



CHART 10A Low flow occurrences in the Flathead River downstream from South Fork confluence.

Source
U.S. Geological Survey

Table 10.4. Low flow occurrences in the Flathead River downstream from the South Fork confluence, pre- and post-September 1951.

| Month | Total # Daily Measurements | | # Occurrences < 99.1 $m^3/s$ | | Percent Occurrences < 99.1 $m^3/s$ | |
|---|---|---|---|---|---|---|
| January | 713[a] | 1054[b] | 632[a] | 318[b] | 88.6[a] | 30.2[b] |
| February | 649 | 961 | 577 | 393 | 88.9 | 40.9 |
| March | 713 | 1054 | 578 | 482 | 81.1 | 45.7 |
| April | 690 | 1020 | 117 | 149 | 17.0 | 14.6 |
| May | 744 | 1054 | 0 | 2 | 0.0 | 0.2 |
| June | 750 | 1020 | 0 | 0 | 0.0 | 0.0 |
| July | 806 | 1054 | 34 | 1 | 4.2 | 0.1 |
| August | 806 | 1054 | 406 | 238 | 50.4 | 22.6 |
| September | 720 | 1050 | 674 | 435 | 93.6 | 41.4 |
| October | 713 | 1054 | 570 | 320 | 79.9 | 30.4 |
| November | 690 | 1020 | 469 | 286 | 68.0 | 28.0 |
| December | 713 | 1054 | 536 | 249 | 75.2 | 23.6 |

[a] Column refers to pre-September 1951 data.

[b] Column refers to post-September 1951 data.

Source: U.S. Geological Survey Data.

Kalispell, Montana, personal communication). A delicate "balancing act" may be required, especially in a drought year, in releasing sufficient water from the Hungry Horse Dam to meet fisheries requirements in the study area while still maintaining adequate reservoir levels for other uses.

Juvenile fish using river margins can be stranded by rapidly increasing or decreasing flows in the Flathead River-Mainstem as a result of sudden changes in discharges from the dam, especially during low flow periods. Egg survival would also suffer by dewatering some margin areas. Numerous examples of rapid flow changes from one day to the next are apparent from the USGS flow data, and studies on the effects of these changes on fish populations are continuing (Clancey and Fraley 1986).

Day-to-day changes in water temperature (USGS data) can occur with the rapid flow alterations; the significance to fish has not been documented in the study area. Water temperature is important in initiating spawning behaviour. It may prove detrimental to the fish population should "false starts" occur, as a result of temperature fluctuations, before nature intended. The reservoir water would normally be warmer in winter than the stream temperature. A rapid release from the dam might increase the stream temperature downstream in the Flathead River and adversely affect fish.

A significant number of water use permits have been issued in this section of the Flathead River, but indications to date are that no problems have occurred with lack of water for irrigation purposes (August 1986, J. Vashro, Montana Department of Fish, Wildlife and Parks, Kalispell, Montana, personal communication). It is also understood that instream flows have been secured to ensure the protection of fishery flow requirements from future consumptive uses (August, 1986, J. Fraley, Montana Department of Fish, Wildlife and Parks, Kalispell, Montana, personal communication). The amount of water withdrawn for domestic use is unlikely to significantly affect flow in the Flathead River-Mainstem.

Table 10.1 indicates that timber harvesting could impact as much as 6.4 percent of the land area in this sub-basin over the next four to six years. Even though this is twice as much as could potentially exist in the North Fork, Flathead River in Montana sub-basin it is still unlikely to significantly affect flows in the Flathead River-Mainstem sub-basin.

## 10.3 SUMMARY

Under present conditions, water quantity appears adequate for the water uses currently occurring in the three designated sub-basins. Fisheries concerns, especially under low-flow conditions, appear to have been reduced with the securing of claims for instream uses in the North Fork, Flathead River in Montana and the 99.1 $m^3/s$ flow from October to April in the Flathead River-Mainstem. It is likely that current minimum flows will only sustain existing fish populations. Increased and more stable, flows at certain times of the year may be required to optimize fisheries production.

Timber harvesting can affect water quantity at local sites but normally in the order of 25 percent of a watershed must be recently clear-cut for flow alterations to become apparent. None of the three designated sub-basins reviewed come anywhere close to approaching this figure. The other designated sub-basins in the Basin are all well below this 25 percent figure. The South Fork, Flathead River and the Whitefish River/Stillwater River designated sub-basins contain the highest percentages of potentially committed harvested land area, 10.6 and 13.7 percent, respectively. It should be realized, however, that this is a continuum, i.e., that decades of timber harvesting have occurred and it would be an extremely difficult task to analyze the cumulative effects of cutting and reforestation.

# 11. SUITABILITY OF EXISTING WATER QUALITY FOR THE CURRENT AND/OR COMMITTED SOCIO-ECONOMIC ACTIVITIES OF THE FLATHEAD RIVER BASIN.

## 11.1 INTRODUCTION

The objective of this chapter is to evaluate existing water quality in terms of generalized water uses in selected designated sub-basins. No attempt is made to distinguish between characteristics which are natural and those which are due to man-made perturbations. All water uses have been grouped into the five following categories:

1. Drinking and food processing
2. Aquatic life
3. Livestock watering
4. Irrigation
5. Recreation and aesthetics

Criteria designed to protect these water uses were selected to enable assessment of water quality. Only water quality data presented in the Water Quality and Quantity Committee Data Report (1986) were reviewed. The analysis was restricted to the two sub-basins whose water quality may be subject to influences from the proposed Sage Creek Coal Limited mine; the North Fork, Flathead River in Montana (refer to Chapter 3) and the Flathead River-Mainstem (refer to Chapter 7).

Each water quality characteristic for which baseline data were available in the WQQC (1986) was reviewed if a criterion could be found and if the characteristic had significant potential impact on water use. Criteria were selected from the most appropriate sources preferably the Water Quality Sub-Committee Report, U.S. Environmental Protection Agency, United States Safe Drinking Water Act and the Montana Water Quality Act. Only if these sources did not provide a criterion were other sources selected. Criteria based on changes relative to background water quality could not be used because it was "background" that was being assessed. The selection of the criteria in Table 11.1 does not represent endorsement for this or any other application. These criteria were employed only as an aid to screen out water quality characteristics which potentially impact water uses and which require more detailed evaluation. Evaluation of these water quality characterisitcs was attempted here, although, due to various limitations (discussed in each section), the interpretation was sometimes inconclusive.

## 11.2 WATER QUALITY SCREENING

Data for 34 water quality characteristics were screened using the criteria in Table 11.1. Twenty-five of the characteristics met the criteria. The remaining nine are discussed further.

With the exception of fecal coliform, the criteria used for drinking and food processing were intended for finished water (i.e., after treatment). It is assumed that simple water treatment systems likely to be employed in this region will not significantly alter most variables with the exception of bacteria and turbidity (including suspended sediment). Therefore, these criteria are applied to raw waters in this analysis.

Many of the metal criteria for aquatic life vary depending on water hardness, with criteria becoming less stringent as hardness increases. Background hardness varies from 67 to 170 mg/L (as $CaCO_3$), depending on season and location. To simplify the analysis, hardness was assumed to be 100 mg/L (as $CaCO_3$) when selecting criteria.

Both the total and the dissolved fractions of all metals were screened. However, a metal criterion was not considered to have been exceeded unless the dissolved fraction exceeded the criterion. This procedure was considered necessary due to the presence of significant concentrations of suspended sediment which can account for large quantities of biologically unavailable metals measured by total analysis.

The following are variables which did not meet the criteria, and are discussed further:

1. Aluminum
2. Cadmium
3. Chromium
4. Lead
5. Suspended Sediment
6. Stress Index
7. Turbidity
8. Oxygen
9. Total inorganic nitrogen

## 11.3 ALUMINUM

Dissolved aluminum exceeds the 0.05 mg/L drinking water criterion. This is a very stringent criterion and is commonly exceeded

Table 11.1. Selected criteria and references (criteria in mg/L or as indicated, references in brackets).

| | Drinking and Food Processing | | Aquatic Life | | Livestock Watering | | Irrigation | | Recreation and Aesthetics | |
|---|---|---|---|---|---|---|---|---|---|---|
| Periphyton | N/A | | 100 mg/m[c] | (11) | N/A | | N/A | | 50 mg/m[c] | (11) |
| Fecal coliform[a] | 50 org/100 mL | (12) | N/A | | 50 org/100 mL | (12) | 50 org/100 mL | (12) | 50 org/100 mL | (12) |
| Fecal coliform[b] | 200 org/100 mL | (12) | | | 200 org/100 mL | (12) | 200 org/100 mL | (12) | 200 org/100 mL | (12) |
| Colour | 15 C.U. | (17) | N/A | | N/A | | N/A | | 15.0 | ( 7) |
| Turbidity | 5 NTU | ( 1) | N/A | | N/A | | N/A | | 50 NTU | (20) |
| Suspended Sediment | N/A | | 25.0 | (14) | N/A | | N/A | | N/A | |
| Stress Index | N/A | | < 6 | (13) | N/A | | N/A | | N/A | |
| Hardness | 200 | ( 1) | N/A | | N/A | | N/A | | N/A | |
| pH (lab and field) | 6.5 to 8.5 | (17) | 6.5 to 8.5 | (13) | N/A | | 4.5 to 9 | ( 4) | 6.5 to 8.3 | ( 4) |
| Oxygen | N/A | | 9.0 | (13) | N/A | | N/A | | N/A | |
| Sulphate | 250 | (17) | N/A | | N/A | | N/A | | N/A | |
| Ortho Phosphorus | N/A | | N/A | | N/A | | N/A | | N/A | |
| Total Phosphorus | N/A | | N/A | | N/A | | N/A | | N/A | |
| Ammonia-N | 0.5 | ( 4) | Variable | (15) | N/A | | N/A | | N/A | |
| Nitrite-N | 1.0 | ( 4) | 0.012 | (13) | 10 | (21) | N/A | | 1.0 | (21) |
| Nitrate-N | 10.0 | (16) | 40 | (21) | 100 | (21) | N/A | | 10 | (21) |
| Total inorganic Nitrogen | N/A | | 0.04 | (13) | N/A | | N/A | | 0.04 | (13) |
| Aluminum | 0.05 | (19) | 0.15 | (18) | 5.0 | ( 4) | 5.0 | ( 4) | 0.10 | ( 5) |
| Arsenic | 0.05 | (16) | 0.19 | (15) | 0.2 | ( 4) | 0.1 | ( 2) | N/A | |
| Barium | 1.0 | (16) | N/A | | N/A | | N/A | | N/A | |
| Cadmium | 0.01 | (16) | 0.001 | (17) | 0.05 | ( 4) | 0.01 | ( 4) | 0.01 | ( 6) |
| Chromium | 0.05 | (16) | 0.01 | (15) | 1.0 | ( 4) | 0.10 | ( 4) | N/A | |
| Cobalt | N/A | | 0.05 | ( 4) | 1.0 | ( 4) | 0.05 | ( 4) | N/A | |
| Copper | 1.0 | (17) | 0.01 | (15) | 0.5 | ( 4) | 0.2 | ( 4) | 0.5 | ( 6) |
| Iron | 0.3 | (17) | 0.3 | ( 3) | N/A | | 5.0 | ( 4) | N/A | |
| Lead | 0.05 | (17) | 0.003 | (15) | 0.5 | ( 4) | 5.0 | ( 4) | 0.05 | ( 6) |
| Magnesium | 100 | (16) | N/A | | N/A | | N/A | | N/A | |
| Manganese | 0.05 | (17) | 0.1 | ( 3) | N/A | | 0.2 | ( 4) | N/A | |
| Mercury | 0.002 | (16) | 0.12 µg/L | (15) | 0.01 | ( 4) | N/A | | N/A | |
| Molybdenum | 0.25 | (09) | 1.0 | ( 4) | N/A | | 0.01 | ( 4) | N/A | |
| Nickel | 0.2 | ( 6) | 0.025 | ( 6) | N/A | | 0.2 | ( 4) | 0.2 | ( 6) |
| Selenium | 0.01 | (17) | 0.001 | ( 8) | 0.05 | ( 4) | 0.02 | ( 4) | 0.05 | ( 6) |
| Silver | 0.05 | (16) | 0.0001 | ( 6) | N/A | | N/A | | N/A | |
| Sodium | 20.0 | ( 1) | N/A | | N/A | | N/A | | N/A | |
| Zinc | 5.0 | (17) | 0.05 | ( 6) | 25.0 | ( 4) | 1.0 | ( 6) | 5.0 | ( 6) |

[a]North Fork (upstream of the confluence with Middle Fork).
[b]Mainstem Flathead River (between Middle Fork and Flathead Lake).
[c]Criteria varies according to temperature and pH.
N/A - Not applicable or not available.

Source:
1. Health and Welfare Canada 1978
2. U.S. Environmental Protection Agency 1976
3. American Fisheries Society 1979
4. National Academy of Sciences 1972
5. D.H. Cullen and P.E. Belliveau 1982
6. Environment Canada (Series of reports 1979 to 1983)
7. Department of Environment, Inland Waters Branch 1972
8. International Joint Commission 1982
9. L. Swain 1985
10. Health and Welfare Canada 1978
11. R.N. Nordin 1985
12. Montana Water Quality Act
13. Water Quality Criteria Sub-Committee 1987
14. European Inland Fisheries Advisory Commission 1964
15. U.S. Environmental Protection Agency 1986(a)
16. U.S. Environmental Protection Agency 1970
17. U.S. Environmental Protection Agency 1979
18. U.S. Environmental Protection Agency 1986(b)
19. American Water Works Association 1986
20. Health and Welfare Canada 1983
21. Nordin, R.N. L.W. Pommen 1986

even in unpolluted waters. Approximately 14 percent of samples containing detectable aluminum exceeded this criterion with a maximum value of 0.174 mg/L. Little is known about aluminum toxicity to humans; aluminum intake may be associated with Alzheimer's disease and is harmful at very low levels to patients receiving artifical kidney dialysis treatment. For general drinking water purposes a criterion of 0.2 mg/L may be more realistic; this criterion is not exceeded.

The aquatic life criterion of 0.15 mg/L is exceeded for dissolved aluminum in 2 out of 122 samples. This is not considered significant due to the low frequency of occurrence.

Based on existing water uses, present aluminum concentrations should not affect any water uses with the exception of being unsuitable for use in artificial kidney dialysis.

## 11.4 CADMIUM

Dissolved cadmium concentrations exceed the 0.001 mg/L aquatic life criterion frequently. Dissolved cadmium ranged from <0.0001 mg/L to 0.009 mg/L. Of 133 analyses, 82 percent were below detection. Almost all of the remaining detectable values exceeded the criterion.

There does not appear to be any geographical trend for exceeding the aquatic life criterion. The criterion is exceeded at all sites where data is available including the data site at the International Boundary, and at the two sites near Columbia Falls. The impact on aquatic life and consumers of fish resulting from these cadmium levels cannot be assessed within the scope of this review.

## 11.5 CHROMIUM

Dissolved chromium ranges from 0.0001 to 0.03 mg/L. Unfortunately, the detection limit of 0.02 mg/L used for a large portion of the analyses exceeded the aquatic life criterion of 0.01 mg/L. About 11 percent of the 106 measurements contained detectable chromium, only the maximum value of 0.03 mg/L exceeded the criterion. The remainder of the detectable values were 0.01 mg/L or less.

Although there is uncertainty as to the actual chromium concentration due to the detection limitations, it appears unlikely that chromium exceeds the aquatic life criterion to any significant extent.

## 11.6 LEAD

The aquatic life criterion of 0.003 mg/L has been exceeded frequently. Dissolved lead ranged from <0.0005 mg/L to a maximum of 0.024 mg/L. The detection limits were generally 0.001 mg/L and 0.002 mg/L, with 52 percent of all values being below detection. Of the remaining detectable lead concentrations, 28 percent exceeded the aquatic life criterion. There does not appear to be any geographical trend as the criterion was frequently exceeded at the International Boundary and at the two sites near Columbia Falls.

The 0.003 mg/L criterion proposed by EPA is intended to represent the maximum acceptable four-day mean value. EPA also proposes a 0.08 mg/L criterion as a one-hour mean. Sampling frequency was not adequate to determine how long these high lead concentrations persisted. The highest value recorded was 0.024 mg/L; well below the higher criterion.

## 11.7 SUSPENDED SEDIMENT

Suspended sediment and turbidity are highly correlated measurements. Suspended sediment is a direct measurement of the mass of particulate matter (mainly inorganic sediment) in suspension. Turbidity is a measure of the light scattering property of water, which largely results from the presence of particulate matter. Turbidity is an approximation of apparent water clarity and is, therefore, useful for assessment of the suitability of water for recreational, aesthetic and drinking uses (refer to Section 11.9). Suspended sediment measurements are, however, generally preferable for water quality assessment in terms of aquatic life uses.

The Water Quality Criteria Sub-Committee has developed criteria to facilitate assessment of the impact of further increases in suspended sediment on aquatic life. These criteria are variable depending on background levels and cannot be used to evaluate existing suspended sediment levels. To enable the assessment of existing water quality, the frequently used fixed criterion of 25 mg/L suspended sediment was selected.

The 25 mg/L suspended sediment criterion has been exceeded frequently in the North Fork, Flathead River in Montana and Flathead

River-Mainstem. The criterion is consistently exceeded by a large margin during the April, May, and June freshet period. The mean monthly values for the period of record during freshet range from 20 mg/L to 250 mg/L. Maximum monthly values during freshet range from about 100 to 1600 mg/L.

Values above the criterion have been reported in all months of the year. The mean monthly values for the period of record during the non-freshet months does not exceed 15 mg/L. Maximum monthly values during non-freshet months varies from about 10 to 300 mg/L.

The high suspended sediment concentrations which occur throughout the North Fork, Flathead River in Montana and Flathead River-Mainstem, particularly during non-freshet months, is less than ideal for aquatic life, and represents a stress factor to fish.

## 11.8 STRESS INDEX (S.I.)

The stress index is calculated as the natural logarithm of the product of suspended sediment (mg/L) and the duration of exposure (hours). Values below 6 represent minimal stress, values between 6 and 12 represent sublethal stress and values between 12 and 18 are usually lethal. S.I. values during freshet at the International Boundary and near Columbia Falls were estimated to be between 11 and 12.

Application of the S.I. to existing water quality data suggest that suspended sediment levels associated with freshet conditions represent a significant natural stress. Existing fish production may, therefore, be lower than it would under more ideal circumstances and/or only fish species (or races) which are tolerant of persistently high levels of suspended sediment can succeed.

## 11.9 TURBIDITY

As a result of spring freshet and winter storm events, both the drinking water and recreation/aesthetics criteria for turbidity are exceeded frequently. The drinking water criterion used is 5 NTU's and the recreation/aesthetic criterion used is 50 NTU's. During freshet, turbidity values up to 200 NTU's have been recorded at the International Boundary. Further downstream, near the inflow to Flathead Lake at Holt, turbidity up to 615 NTU's have been recorded. Mean turbidity during these periods generally varies from 10 to 50 NTU's throughout the North Fork, Flathead River in Montana and Flathead River-Mainstem.

The 5 NTU's criterion for drinking water is intended to apply to finished water and can apply to raw water if no treatment is used. Community water supply systems routinely treat raw water containing up to 25 NTU's and achieve the 5 NTU's criterion. Individual home treatment systems, however, cannot produce water containing less than 5 NTU's given the turbidity which occurs naturally in the North Fork, Flathead River in Montana and Flathead River-Mainstem. Therefore, existing turbidity represents a major limitation on the use of the Flathead River for drinking water uses.

The 50 NTU's criterion selected for recreation/aesthetic uses is mainly intended to define acceptable water clarity for safe and enjoyable bathing and swimming. It is assumed that boating, floating, fishing, viewing and other water-related activities will also be negatively impacted by turbidity values in excess of 50 NTU's. The highest turbidity values occur during freshet and winter storms; values exceeding the criterion can persist for several consecutive days and presumably weeks. Turbidity values greater than 50 NTU's have been recorded during March, April May, June, August and December. This suggests that the criterion can potentially be exceeded during any month of the year. The recreational and aesthetic values of the North Fork, Flathead River in Montana and Flathead-Mainstem are presently limited by this turbidity on a seasonal basis.

## 11.10 OXYGEN

Dissolved oxygen concentrations in the water column less than the aquatic life criterion of 9.0 mg/L have been recorded during July and August at the International Boundary and at Columbia Falls. The minimum recorded value was 8.4 mg/L. The 9.0 mg/L criterion is intended to apply as a seven-day mean; for shorter periods 8.0 mg/L is considered acceptable. Sampling frequency is inadequate to determine how long these low values persisted.

Cutthroat alevins are in the stream gravel in July and are extremely sensitive to low oxygen during this period. Intragravel oxygen concentrations may be about 3 mg/L lower than the overlying water.

Existing oxygen concentrations may, therefore, occasionally represent a stress factor, limiting the fecundity of cutthroat trout in the North Fork, Flathead River in Montana and Flathead River-Mainstem.

## 11.11 TOTAL INORGANIC NITROGEN (TIN)

Total inorganic nitrogen is defined here as the sum of nitrate, nitrite and ammonia. The 0.04 mg/L criterion for the protection of aquatic life, and recreation and aesthetics, is frequently exceeded at all sites in the North Fork and Flathead River-Mainstem. The individual concentrations of nitrate and ammonia also exceed this criterion. The 40 mg/L criterion for nitrate in Table 11.1 is intended to protect aquatic life against direct toxic effects. This criterion is not exceeded.

The 0.04 mg/L criterion represents an approximation of the minimum TIN concentration required to support the maximum growth rate of periphyton in the absence of other growth limiting factors. Excessive periphyton growth can interfere with fish spawning and can have a negative impact on recreation and aesthetic values. Periphyton biomass is regulated by the seasonal dynamics of TIN, phosphorus and several other physical factors such as turbidity, flow rate and the scouring action of sediment movement. Interpretation of the significance of TIN cannot be made in isolation of these factors.

The very limited periphyton biomass data found in the WQQC Data Report does indicate that existing biomass levels in the North Fork and Flathead River-Mainstem are well below the biomass criterion for aquatic life, recreation and aesthetics, therefore, the exceedance of the TIN criterion has little significance to existing water uses. These high nitrogen levels do however need to be considered in predicting the impact of further increases in nitrogen resulting from proposed mining activities.

## 11.12 SUMMARY

Thirty-four water quality characteristics and constituents from the North Fork, Flathead River in Montana and the Flathead River-Mainstem sub-basins were screened using general criteria used by various agencies. The existing water quality met the requirements of all known general categories of water use with the exception of four metals, suspended sediment, turbidity, oxygen, total inorganic nitrogen and the Stress Index. The exceedance of the cadmium and lead criteria may be significant to aquatic life and consumers of fish whereas the exceedance of the aluminum and chromium criteria are unlikely to be significant. Suspended sediment and turbidity levels exceeded the selected criteria during the freshet period by a large margin. These criteria are also occasionally exceeded during the remainder of the year. High Stress Index values also suggest conditions that are less than ideal for fish during freshet. Recreational, aesthetic, drinking and aquatic life uses are limited by existing suspended sediment and turbidity levels in the North Fork, Flathead River in Montana and the Flathead River-Mainstem mainly during April, May and June. Occasional dissolved oxygen levels below the criterion also may be stressful particularly to cutthroat trout. The exceedance of the total inorganic nitrogen criterion is not significant to any water uses in view of the very low levels of periphyton growth in the North Fork, Flathead River in Montana and the Flathead River-Mainstem designated sub-basins.

# 12. EFFECTS OF THE PROPOSED CABIN CREEK COAL MINE ON WATER RELATED ACTIVITIES IN THE FLATHEAD RIVER BASIN SOUTH OF THE INTERNATIONAL BOUNDARY.

## 12.1 INTRODUCTION

The Water Uses Committee (WUC) Phase I work identified extensive water-based activities within the Basin that could be sensitive to changes in water quality, water quantity and fisheries. If the proposed Cabin Creek coal mine development were to occur, changes in water quality, water quantity and/or fisheries could occur. Such changes could affect current and/or committed socio-economic activities south of the International Boundary and result in an economic impact on the State of Montana. The purpose of this chapter is to evaluate the impact of potential changes in water quality, water quantity and fisheries on current and/or committed socio-economic activities south of the International Boundary.

## 12.2 EVALUATION OF POTENTIAL IMPACTS ON SOCIO-ECONOMIC ACTIVITIES

The Flathead River International Study Board directed the WUC to complete a number of assignments. One specific assignment was stipulated as follows:

> "Based on information provided by the Water Quality and Quantity Committee, the Biological Resources Committee, and the Mine Development Committee, and also assessments and information developed by the Water Uses Committee, carry out an analysis of the effects resulting from construction, operation, and reclamation of the proposed Cabin Creek Coal Mine on water-related activities in the Flathead River Basin south of the International Boundary" (Flathead River International Study Board 1985).

The WUC Phase I studies (Chapters 2 to 9) identified a number of water-related socio-economic activities in the Basin that could potentially be affected by the proposed mining activities. If such activities were to alter the Basin's water quality, water quantity and/or fisheries and these alterations could be quantified, then studies could be undertaken to evaluate the impact of the changes on the current and/or committed socio-economic activities in the Basin south of the International Boundary. Furthermore, Sutherland (1982) identified a "preservation value" (non-user value) associated with the waters of specific portions of the Basin that could also be affected if the water quality and/or water quantity were to change. These studies would be expensive and time consuming requiring the use of "state of the art" methods for economic analysis.

In its' final report, the Water Quality and Quantity Committee (WQQC) identified potential changes in water quality and quantity variables at the proposed mine site and at the International Boundary (Water Quality and Quantity Committee 1987). Table 12.1 summarizes the WUC's interpretation of these potential changes for both the optimum and adverse mining scenarios. Furthermore, the Biological Resources Committee (BRC) also predicted changes in biological resources at the proposed mine site, at the international boundary and at Flathead Lake (Biological

Table 12.1. Anticipated changes in water quality and quantity variables as a result of optimal and adverse mine development scenarios, in the vicinity of the proposed Cabin Creek coal mine and at the International Boundary.[a]

| | Location[b] | | | |
|---|---|---|---|---|
| | Mine Site | | International Boundary | |
| Variable | Optimal | Adverse[c] | Optimal | Adverse |
| Hydrologic Changes | X | X | 0 | 0 |
| Suspended Sediment | X | X | X | X |
| Turbidity | X | X | X | X |
| Deposited Sediment | X | X | ? | ? |
| Nutrients | X | X | X | X |
| Toxic Compounds of N | X | X | ? | ? |
| Trace Metals | ? | ? | ? | ? |

X = some degree of anticipated change
0 = no anticipated change
? = insufficient information from which to draw conclusions

[a] This summary of anticipated changes is based on a review of the Water Quality and Quantity Committee Report (1987).

[b] The WQQC did not forecast changes south of the International Boundary.

[c] The WQQC defined "adverse" as two times the Mine Development Committee adverse levels for suspended sediment, turbidity and nutrients.

Resources Committee 1987). Table 12.2 summarizes the WUC's interpretation of these potential changes for both the optimum and adverse mining scenarios. The BRC also considered an "extreme event"

Table 12.2. Anticipated changes to biological resources as a result of optimal and adverse mine development scenarios, in the vicinity of the proposed Cabin Creek coal mine, at the International Boundary and at Flathead Lake.[a,b]

| | Location | | | | | |
|---|---|---|---|---|---|---|
| | Mine Site | | Int'l Boundary | | Flathead Lake[c] | |
| Biological Resources | Optimal | Adverse[d] | Optimal | Adverse | Optimal | Adverse |
| Algae | X | X | ? | ? | 0 | 0 |
| Macroinvertebrates | X | X | X | X | 0 | 0 |
| Fish[e] | | | | | | |
| - Bull Trout | X | X | X | X | X | X |
| - Cutthroat Trout | X | X | X | X | X | X |
| - Other Species | X | X | X | X | 0 | 0 |
| Riparian/Wildlife | X | X | 0 | 0 | 0 | 0 |

X = some degree of anticipated change
0 = no anticipated change
? = insufficient information from which to draw conclusions

[a] This summary of anticipated changes is based on a review of the Biological Resources Committee Report (1987).

[b] For consequences of an "extreme event" scenario as described by the BRC, refer to section 5.2.3 of the BRC report.

[c] Indirect effects due to migratory species of fish.

[d] For definition of "adverse" see Biological Resources Committee Report (1987).

[e] The BRC reports effects on the fishery resource resulting from changes in the following variables: physical habitat, deposited sediment, suspended sediment, nutrients, toxic nitrogen compounds, dissolved oxygen, and temperature.

mining scenario which was defined as an event involving a sudden release of large amounts of inert sediment such as the failure of a waste dump or sedimentation pond (Biological Resources Committee 1987). However, the

WUC has not attempted to interpret the potential changes on the biological resources and subsequently on the socio-economic activities associated with an "extreme event" because of the subjectivity of the analysis of the BRC.

Based on the summary information in Tables 12.1 and 12.2, the WUC attempted to assess the potential for impacts as a result of the proposed coal mine on existing and/or committed socio-economic activities at the mine site, at the International Boundary and downstream to Flathead Lake. Table 12.3 provides a summary of this assessment. It is apparent that the proposed mine, in varying degrees, in both the optimal and adverse mining scenarios, could have an impact on socio-economic activities at and/or downstream of the proposed mine site. However, except for technical information associated with the bull trout, the unquantifiable nature of the remaining available information makes it

Table 12.3. Proposed Cabin Creek coal mine development and its potential for impacts on socio-economic activities in the vicinities of: North Fork, Flathead River in British Columbia; North Fork, Flathead River in Montana; Flathead River - Mainstem; and, Flathead Lake.

| | Location | | | |
|---|---|---|---|---|
| Activity | North Fork B.C. | North Fork Montana | Mainstem | Flathead Lake |
| Recreation (Non-fishing) | X | ? | ? | ? |
| Fishing | | | | |
| - Bull Trout | X | X | X | X |
| - Cutthroat Trout | X | X | X | X |
| Settlement | N/A | 0 | 0 | 0 |
| Agriculture | N/A | 0 | 0 | 0 |
| Preservation | | | | |
| - Wild and Scenic River | N/A | X | N/A | N/A |
| - Glacier National Park | N/A | X | N/A | N/A |
| - Biosphere Reserve | N/A | X | N/A | N/A |
| - World Heritage Site[a] | N/A | ? | N/A | N/A |

X = some degree of anticipated impact
0 = no anticipated impact
? = insufficient information to forecast impact
N/A = not applicable

[a] Nomination only at time of writing.

impossible to determine the degree of potential economic impact that could result from changes in socio-economic activities south of the International Boundary. Therefore, the following section is restricted to estimating the potential loss in economic value to the State of Montana resulting from the proposed coal mine's potential impact on bull trout.

## 12.3 POTENTIAL ECONOMIC IMPACT ON THE STATE OF MONTANA DUE TO TOTAL LOSS OF THE BULL TROUT POPULATION OF HOWELL AND CABIN CREEKS

### 12.3.1 Introduction

As a result of work completed by the WQQC and the BRC, it was concluded that if the proposed Cabin Creek coal mine development were to proceed, the bull trout populations of Howell and Cabin Creeks (Figure 2B) would be eliminated (Biological Resources Committee 1987). As such, the WUC reviewed other studies that examined both the economic value of sport fishing activities and the sensitivity of fishing and the associated economic value to changes in fish populations. There was not sufficient time, human or financial resources to complete a proper on-site study. However, utilizing available information on the Basin's bull trout populations and bull trout angling, the results from other relevant socio-economic studies were applied to these available data to estimate the annual economic value of bull trout fishing to the State of Montana and the potential direct loss in value as a result of the complete loss of the Howell and Cabin Creeks' bull trout populations.

The economic value associated with bull trout fishing is comprised of both user and non-user (intrinsic) values. Empirical studies indicate that to rely solely on user values would understate the total economic value associated with the loss of a portion of the bull trout fishing (Fisher and Raucher 1984). However, because non-user values are difficult to define precisely and their estimation more elusive, the WUC felt it could not use the method described in the preceding paragraph to determine non-user values. Therefore, no attempt is made to include an estimate of non-user value as part of the total economic value associated with a loss of a portion of the bull trout population.

The following analysis has some severe limitations. Nevertheless, working within the limitations, a "ballpark" estimate is made on the sensitivity of anglers to reductions in the bull trout population and the resulting loss in economic value ("user" value) to the State of Montana.

12.3.1.1 Study Area

The WUC divided the Basin into eight designated sub-basins to assist in the identification of socio-economic activities and the spatial display of the information (Figure 1). However, for the purpose of this project, only four designated sub-basins make up the study area: North Fork, Flathead River in British Columbia; North Fork, Flathead River in Montana; Flathead River-Mainstem; and Flathead Lake. The portion of the Flathead River Basin bull trout population that spawns in Howell and Cabin Creeks and matures in Flathead Lake is the target of this study. Therefore, the value of sport fishing in the State of Montana that can be attributed to this specific component of the bull trout population can only be generated within these designated sub-basins. Furthermore, when determining what portion the Howell and Cabin Creeks' bull trout population is of the total population, only the bull trout populations of these four designated sub-basins are aggregated to form the total population. The bull trout sport fishing activity in the four remaining sub-basins, which are part of the overall study area, and the bull trout populations in these sub-basins are not included as part of this analysis.

12.3.1.2 Study Outline. This study is assembled in six sections. This introductory section has dealt with background and objective, study area and organization of the project. The next section provides a brief overview of the concepts of economic value and willingness to pay. Section 12.3.3 looks at techniques for estimating willingness to pay and concentrates on three methods felt to be most relevant to aspects of this study. Section 12.3.4 and 12.3.5 outlines the study design and provides a review of results from other relevant studies, available data and study procedure. The study analysis, results, and limited conclusions are presented in the final section.

12.3.2 Concept of Economic Value

The measurement of economic value for non-market goods and services is both complex and evolving. Before examining various measurement techniques, the concept of economic value must be clearly defined. In this section a brief overview is provided on the concept of economic value in both a market and non-market exchange of goods and services.

12.3.2.1 Definition. Criteria for measuring economic value are tied to the fundamental principles underlying economics itself. Generally, economic principles focus on the alternatives available to society as a whole. Two basic conditions in economics must be met in order for a good or service to have economic value.

1. A good or service must be scarce; this scarcity forces choices among alternatives and choosing alternatives creates tradeoffs (i.e., one thing of value must be given up to obtain another of value).
2. A good or service must provide individual consumers with some level of satisfaction (utility); a measure of the level of satisfaction is reflected by an individual's willingness to pay.

In economics, utility is the measure of an individual's well-being, or satisfaction. In theory, Figure 12A shows the utility an individual consumer might derive from a specific fishing experience at a specific site, as well as the reduction in utility that might occur as a result of a reduction in the quality of that fishing experience. Figure 12A illustrates the hypothetical change in utility or satisfaction resulting from a reduction in bull trout that injures the quality of the fishing experience at a specific site. Before a decrease in the bull trout population, an individual might make 10 visits to this specific site and have a total utility of $TU_a$. However, with the reduced bull trout population, if the individual continues to make 10 visits to this specific site, his total utility will be reduced (e.g., his fishing success per visit has been reduced); his total utility curve reflecting his well-being or satisfaction shifts downward, and his associated utility

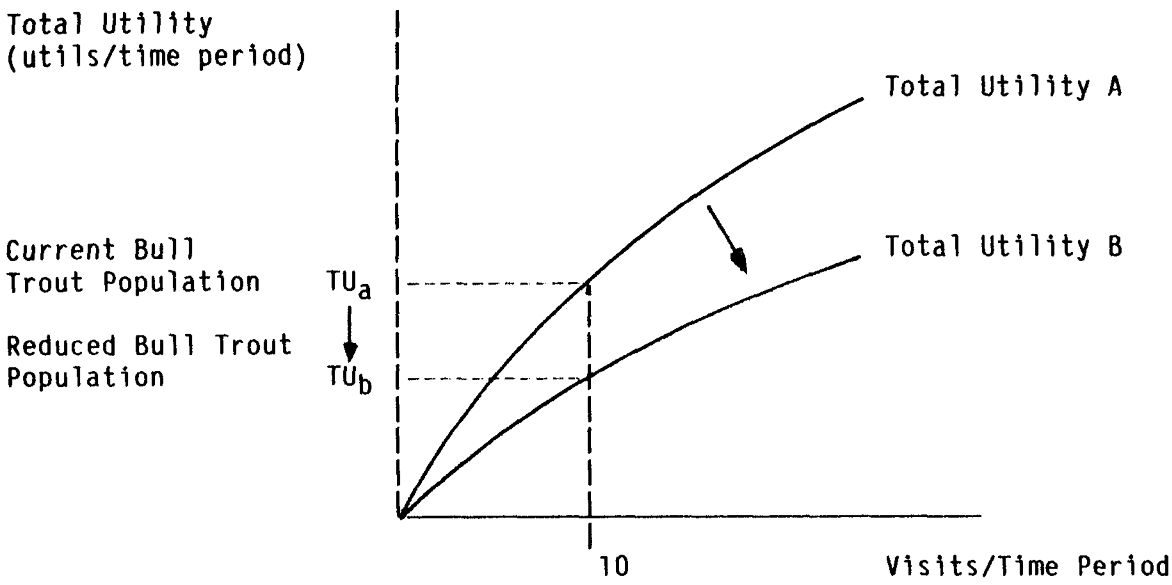



Figure 12A. Reduction in utility from injury to a specific fishing site.

is reduced to $TU_b$. Thus the value of the reduced bull trout population is the reduction in utility from $TU_a$ to $TU_b$ (in Figure 12A) due to the reduced level of satisfaction (utility) derived from each visit to the specific site. If, for a given time period, utility functions for the specific fishing experience for all individuals were to be evaluated in the preceding manner, and their change in utility aggregated, then the total loss in value or utility would be obtained.

The question that remains to be answered is: How is utility measured? In the preceding example, utility is assumed to be measured in "utils" (Figure 12A). In reality, however, there is no way of finding out what these "utils" are and how much they would change with the reduction in the bull trout population. However, the utility change can be viewed as a measure of the change in satisfaction due to the injury to a fishing site. Economic valuation simply aims at approximating the utility change. The ideal measure (aggregate change in utility) will show the linkages between the reduction in the quality of the resource (reduced bull trout population at a specific fishing site), the effects on an individual (fewer fishing visits), and the value of the effects (lost utility).

12.3.2.2 Market Versus Non-Market Exchange. Economics uses money as the scale for approximating changes in utility. As a scale of value, money may not be totally ideal, but nevertheless it does have certain desirable properties for obtaining empirical estimates of changes in utility. In economics, it has been argued for over half a century that money imposes a form of rationalism that makes economic life easier to study and that money is a means of systematizing and rationalizing behaviour (Marshall 1920; Mitchell 1969). Money imposes certain measurement rules and benchmarks on values. In other words, within a certain range of their preferences, people are familiar with the process of expressing how much they value something by determining its monetary equivalent.

Within a market system, the price paid by a consumer for a good or service to a business as revenue also represents the maximum value or utility the consumer receives from the last unit consumed. While the price is the cost to the consumer, it is revenue to the firm. If the last unit consumed were worth more than the price (had greater utility or value), the consumer would continue to buy additional units until the added satisfaction from one more unit had fallen to exactly equal its price. Therefore, the price paid or gross revenue to the firm accounts for only the utility or value of the last unit sold to each consumer and ignores the value received by consumers over and above the price paid on the first units consumed. This gain in utility on the first units represents net economic value or "consumer surplus" of those units (see Section 12.3.2.3). This economic value is not captured by firms who charge uniform prices and hence consumer surplus is not part of the gross revenue received by the firms.

A further, and equally important, problem exists with the preceding measure of value in that it ignores both economic benefits and costs of goods or services not exchanged in markets. As a rule in most of Canada and western United States, the majority of recreational fishing is on public lands and is not a "pay-as-you-fish" fishery. Therefore, if fishing at a particular site for a particular fish species is eliminated, or reduced in quality, because of the development of a coal mine, the loss in utility or economic value to the anglers is not reflected as foregone revenues since no firm is "selling the right to fish". The loss in economic value of sport fishing from the altering of a specific fishing site is not fully accounted for in any market since, other than specific items purchased, the service does not pass through a market.

12.3.2.3 Willingness to Pay - Concept of Consumer Surplus. A consumer's willingness to pay for a good or service, whether market or non-market, is a measure of its economic value (U.S. Water Resources Council 1979, 1983). Furthermore, the measure of value is the net willingness to pay over and above actual expenditures. Willingness to pay over and above actual expenditures is a measure of what that resource use contributes to economic development or economic efficiency. For example, the actual expenditures or wages paid reflect costs incurred to gain the opportunity to fish bull trout at the specific site, not the actual benefits obtained from the experience. Net willingness to pay benefits measured as "consumer surplus" quantify, in dollar terms, the additional satisfaction received by consumers when they spend their money on their first choice good or service (e.g., bull trout fishing on the Flathead River/Lake system) rather than their next best alternative.

Using an empirical concept in economics known as an individual demand function, consumer surplus can be calculated and used as a measure for utility-based valuation. Shown in Figure 12B, the demand function describes any good or service, F, and the maximum quantity of F a consumer would be willing to purchase at each price at a given point in time. The downward sloping curve indicates that consumers are willing to purchase more of F as the price falls. At any given point in time it must be assumed that all other factors that might influence consumer demand, such as income, price of related goods and services, and tastes or preferences, do not change. The demand function also shows how much people will pay for an additional unit; that is, it shows the marginal value of a particular level of F. In Figure 12B, $OP_a$ is the marginal value a consumer attaches to the $Q_f$ unit of F. With a demand function, be it one that reflects market transactions or one that is derived to reflect non-market transactions, we have a systematic way of measuring consumers values.

If the market process establishes a price at $P_a$ (or the non-market cost of having the opportunity to consume desired units of

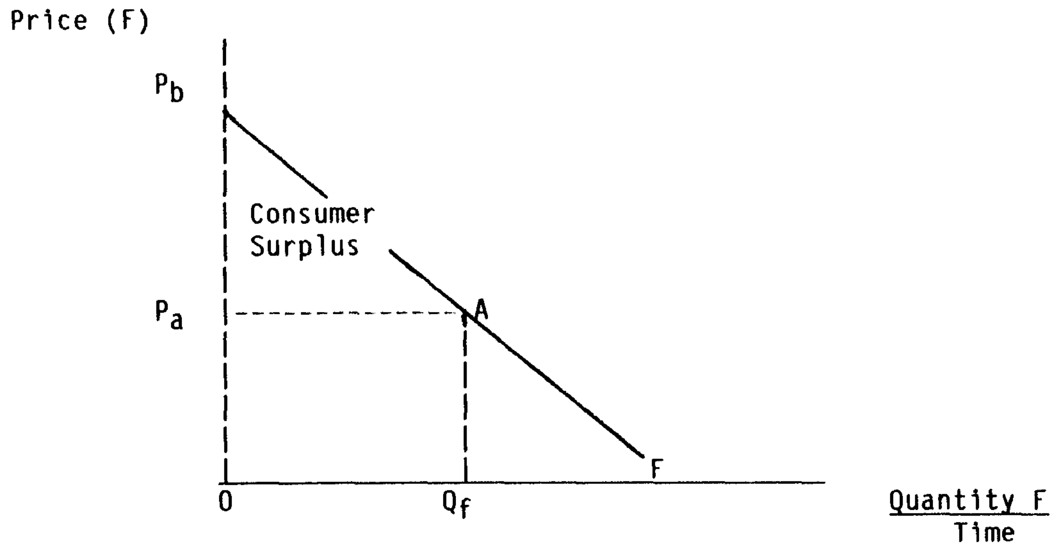



Figure 12B. The demand function and consumer surplus.

F), the consumer will consume $Q_f$ units of F and make an expenditure equal to $P_aAQ_fO$. Since the area under the demand curve measures the individual consumer's maximum willingness to pay for each unit of consumption, the total willingness to pay for $Q_f$ is the entire area; total expenditures plus the triangle $P_aP_bA$. The difference between what an individual actually pays and the amount he/she is willing to pay is the consumer surplus, or the dollar measure of satisfaction (utility) an individual receives from consuming a good or service, less what he pays for it (or less what he pays to capture the opportunity to consume it).

Consumer surplus, then, can be used as an economic measure for both market and non-market goods and services quantified in terms of net willingness to pay. As a dollar measure of individual well being (and therefore, economic value), consumer surplus is not perfect, but most studies are finding it to be a reliable estimate.

### 12.3.3 Methods for Determining Net Willingness to Pay for Outdoor Recreation (Fishing)

A variety of techniques have been developed to estimate the net willingness to pay for outdoor recreation and reported in various journals and government publications. Knetsch and Davis (1966), Smith and Kavanaugh (1969), Dwyer, Kelly and Bowes (1977), Daubert and Young (1981), Mendelsohn and Brown (1983), Walsh (1986) and the U.S. Water Resources Council (1979, 1983) all recommend the Travel Cost Method (TCM), a modification of the TCM, the Hedonic Travel Cost Method (HTCM), and the Contingent Valuation Method (CVM) as conceptually correct techniques for measuring the net economic value (consumer surplus or net willingness to pay) of outdoor recreation (fishing). In this section a brief overview is provided on each method and its applicability to this study. A majority of this information is summarized from an overview, prepared by ECO Northwest (1984), discussing analytical techniques used to estimate net willingness to pay for outdoor recreation.

12.3.3.1 Travel Cost Method. One of the most popular approaches used to describe demand for an outdoor recreation experience, the travel cost method (TCM) has been used to estimate recreational benefits in a wide variety of applications (see Dwyer, Kelly and Bowes 1977). Basically, the TCM statistically estimates a demand equation using number of visits as a measure of quantity and recreationists' travel cost as a measure of price. The logic underlying the travel cost method is simple. Recreationists at a particular site pay an "implicit" price for using the site's services through their travel costs associated with visiting the site. Since recreationists visit the site from diverse origins, their "travel behaviour", in an aggregated sense, can be used to analyze the demand for the site's services. That is, all else being equal, a person will continue to travel to the site until the marginal value of the "last" trip is exactly equal to his/her travel expenses.

Note the emphasis on the "last" trip called the "marginal trip". What about the value of the previous trips called the "inframarginal" trips? Economic analysis shows that inframarginal trips are generally worth more than the marginal trip. For almost all consumptive goods or services, people value an extra unit less and less, the more of the good or service they have. Thus, a bull trout angler's tenth trip to a particular site is not worth as much as the first trip.

The critical issue in determining the economic value of a site for a specific use is estimating how much more than the marginal trip the inframarginal trips are worth. The net value of a site (net willingness to pay) is the difference (consumer surplus) between the benefits it provides (area under the demand curve) and what users pay to get those benefits. What users pay is travel cost, which are assumed to be independent of the number of trips made (i.e., a user's cost of marginal and inframarginal trips are equal). Therefore, for every inframarginal trip, users of a recreation site get benefits that are greater than the travel costs. The sum of these benefits to all users of the site is the net value of the site (consumer surplus).

To measure the value of the inframarginal trips, the TCM infers their value by observing the number of trips made to the recreation site by people who live different distances from the site. Users living different distances from the site face different prices (travel costs) for the use of the site. Assuming that people are otherwise alike (an heroic assumption), then the different number of trips people take result solely from the different prices (distances) they face.

Figure 12C is a hypothetical travel cost demand function that denotes the number of trips users of a specific recreation site will take based on their distance from the site. If, for example, recreationists residing 300 km (186 mi) from the site visit the site once per year, the first trip (in this case, their marginal trip) is worth $72 (300 x 2 x 0.12 - assuming a travel cost of $0.12 per kilometer). If recreationists 250 km (155 mi) go to the site twice, the second trip (their marginal trip) is worth $60. And finally, if recreationists take a third trip when they reside 200 km (124 mi) away, their third trip (marginal trip) is worth $48.

Using the TCM, the value of any specific recreation site to a user is the amount he/she is willing to pay above the travel cost for each trip. In the preceding example, if the recreation site was eliminated, recreationists living 300 km (186 mi) would lose one trip they value at $72, but they would save $72 of travel expenses. Therefore, the net loss in economic value to each consumer is zero. However, recreationists living 200 km (124 mi) away would lose three trips. The first trip they would value at $72, the second at $60 and the third at $48 for a total value of $180. On the other hand, they would

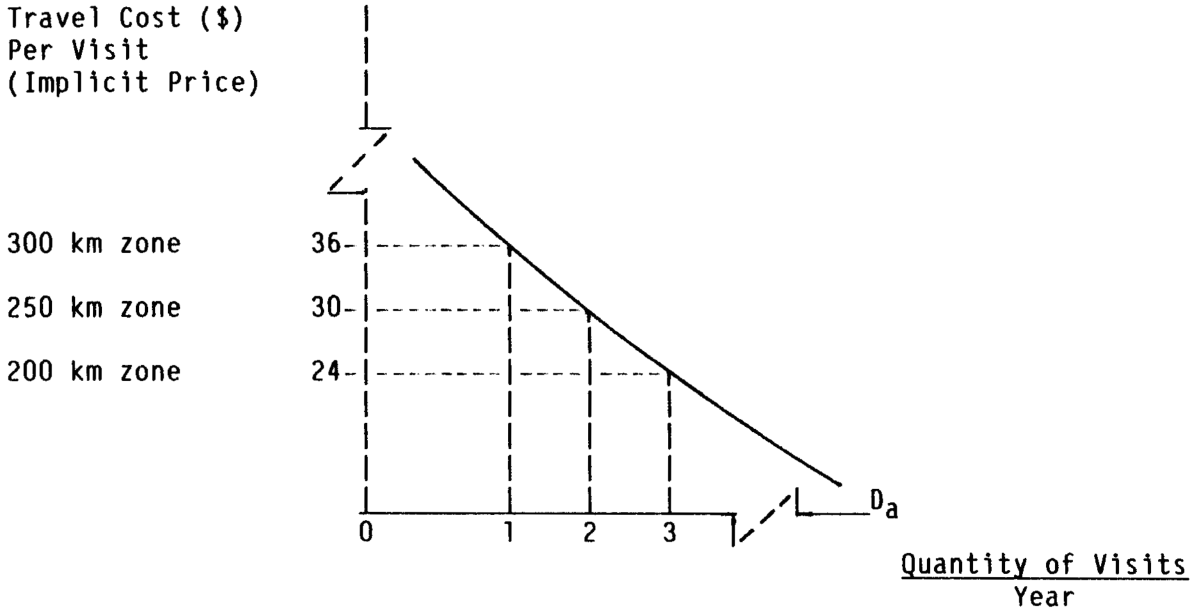



Figure 12C. Travel cost demand function for a specific recreation site.

save travel costs for the three trips ($48 x 3) totalling $144. The net loss in economic value would be $36. Therefore, $36 is what the recreationists 200 km (124 mi) away would pay for the privilege of maintaining the recreation site. This net value is the consumer surplus of trips to the site; it is an appropriate measure of the economic value of a site for a specific use. The sum of the consumer surplus for all recreationists using the site gives an estimate of the net value of the site.

Using the TCM to estimate the value of a recreation site has several problems, mainly associated with its basic assumption. First, using the TCM to determine the value of inframarginal trips, it must be assumed that all users of the site are similar. Secondly, a problem can arise from the assumption that travel costs are incurred solely to arrive and return from a specific site. No allowance is made for multi-purpose trips or visits to another site. Thirdly, it is extremely difficult to achieve a consistent measure of travel cost per kilometer for each recreationist. Each recreationist will likely include different elements in their calculation of travel costs.

A fourth problem with the TCM, and one of greater interest to this study, is that it can only measure the all-or-nothing value of a specific recreation site. If, for example, the TCM was used to estimate the total economic value of the recreation activities of the three designated sub-basins (North Fork, Flathead River in Montana, Flathead River-Mainstem, and Flathead Lake), this aggregate value would certainly approximate the upper bound of the value that would be lost as a result of a reduced bull trout population. However, these three sub-basins, even with the reduced bull trout population, would continue to provide the majority of their recreational service. Therefore, the total value of all recreational services, computed by the TCM, would grossly overestimate the loss of recreational value that would be a direct result of the reduced bull trout population.

The TCM is basically used to determine the economic value of a specific recreation site, not a change in the site. However, a variation of the TCM, the Hedonic Travel Cost Method (HTCM) has been designed to evaluate specific aspects of a recreational site, such as fish populations.

12.3.3.2 Hedonic Travel Cost Method. A number of variations of the travel cost method have been developed to improve on its ability to determine the value of specific characteristics of a recreational experience (Burt and Brewer 1971; Vaughan and Russell 1982). One such development, the Hedonic Travel Cost Method (HTCM) combines the hedonic procedure (examining interrelationships) with the traditional TCM (Brown and Mendelsohn 1984). Recreation sites are viewed as a mix of homogeneous characteristics (each physical site has a mix of scenic quality; type of water bodies; type, number and size of fish; site congestion; etc.). For each recreation trip the price or cost of purchasing a "specific mix" for a trip is the marginal travel cost from the origin to the site. By evaluating the variety of purchases of a group of recreationists from a single origin, the marginal expenditures necessary to purchase additional units of each characteristic can be estimated. Having established "prices" for the various recreation characteristics, the demand for each can be estimated by comparing origin residence zones which have varying access to recreation sites.

The initial step in the HTCM is to estimate the price recreationists must pay to obtain more of each characteristic. Having performed this initial step for each residential zone (300 km [186 mi], 250 km [155 mi], etc.), the price each recreationist faces for each characteristic can be calculated. With these "prices" the demand for a specific characteristic, such as fish density (bull trout population), can be estimated. That is, by comparing the behaviour of anglers from different residential zones, one can estimate how anglers value access to a specific recreation site with a known fish population. After all, enhancement (more bull trout) or degradation (less bull trout) of a specific site only changes how far the angler must travel to obtain a site of the desired quality.

Having established a hypothetical demand function (Figure 12C) for a specific recreation (fishing) site with a known quality for a specific characteristic (bull trout population), the HTCM can be used to evaluate the sensitivity of demand to a loss in quality of the recreation site (reduction in bull trout population). By observing changes in demand for the site by recreationists from the various residential zones, an estimate in the reduction in consumer surplus (economic value) can be made. Figure 12D denotes a shift in the hypothetical travel cost demand function ($D_a \rightarrow D_b$) that reflects recreationist reaction to the reduced quality of the recreation site (lower bull trout population). Note that as a result of the reduced bull trout population, there is a reduction in the number of visits to the recreation site by individuals from each residential zone. In this simple example, assuming the same travel costs as in Figure 12C, if this recreation site were now eliminated, the recreationist living 200 km (124 mi) away would now only lose two trips. Now, however, the first trip is only worth $60 and the second trip $48 for a total value of $108. The travel cost saved would be $96 (2 x $48) with the net loss in economic values now being only $12. Therefore, $24 ($36 - $12) is the amount of consumer surplus (economic value) that has been lost from a recreationist living 200 km (124 mi) away as a direct result of the reduced bull trout population. Again, the sum of the <u>reduced</u> consumer surplus for all recreationists (anglers) using the site gives an estimate of the total <u>loss</u> in net value from the site.

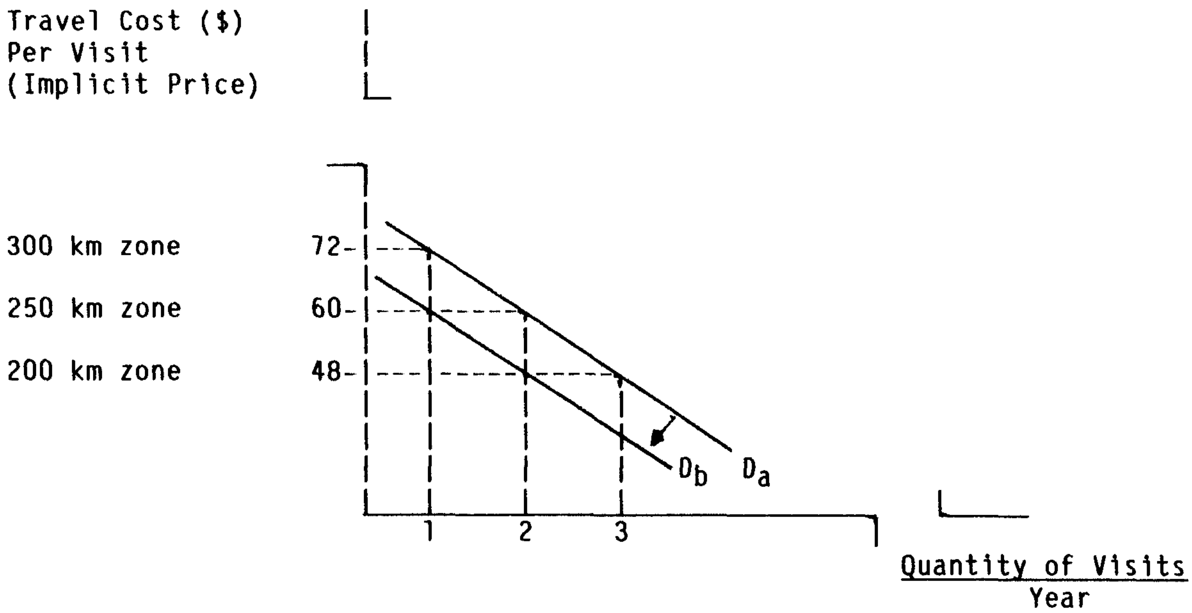



Figure 12D. Travel cost demand function for a lower quality specific recreation site.

The advantage of the HTCM is that it can be used to focus on specific characteristics of a recreation site. However, the disadvantage of this approach is that it requires substantial data on residential origins, user behaviour and site characteristics. Such data are generally unavailable and specific surveys must be undertaken to collect them, an expensive and time consuming exercise.

12.3.3.3 <u>Contingent Valuation Method</u>. Unlike the TCM and the HTCM, the Contingent Valuation Method (CVM) does not depend on observed user behaviour. Instead, the CVM uses recreationists' response to a simulated market (Knetsch & Davis 1966; Schulze, d'Arge and Brookshire 1981). The value of desired characteristics of a service (bull trout fishing) can be revealed by how recreationists respond to a set of hypothetical questions. By constructing the correct set of questions, the interviewer tries to get the recreationist to reveal the true values of the service (bull trout fishing).

For example, a questionnaire is developed which describes this hypothetical market in which the angler currently pays for the right to fish bull trout at a specific site (say an entrance fee or a fishing licence). Now, in order to maintain the particular fishing experience (quality bull trout fishing), the anglers are asked if they would pay some specific amount in addition to their current costs. If the anglers state they would pay the stated amount, the amount is increased until an amount is reached that the anglers indicate they are no longer willing to pay to maintain the quality bull trout fishing. For each recreationist, the difference between their current expenditures per fishing experience and the amount of their willingness to pay ("bid") can be used to calculate their net willingness to pay (consumer surplus) to maintain the bull trout fishery at its current level.

Although the CVM seems the most straightforward of the methods described, it is the most difficult to apply. The difficulties lie in designing the questionnaire and in eliminating the potential biases in the administration of the questionnaire. However, correctly designed and administered, the analysis of CVM results is quite straightforward.

Although this study only reviews three techniques, it should be noted that a considerable number of other techniques not mentioned in this exercise also suffer from the preceding problems.

### 12.3.4 Study Design - Review of Relevant Studies

One of the preceding techniques, or some combination of the three, could have been used to assess the economic impact in the State of Montana associated with the potential loss of a portion of the bull trout population in the Flathead River Basin. The total economic value to society (Montana) of the potential fish loss would have been the sum of what all individual users (recreationists) would have been willing to pay to prevent such a loss. Unable to undertake such a study, the WUC utilized the results from studies completed on similar situations and, in combination with bull trout population data and creel census information, estimates of economic values (user values) were made.

In this section, a brief summary review is provided on the results of four relevant studies and how these results will be used with data from the Basin to determine the value of a specific portion of the bull trout fishery.

12.3.4.1 "Valuing a fishing day: an application of a systematic varying parameter model." W.J. Vaughan and C.S. Russell (1982). This study estimated the willingness to pay for a day of freshwater recreational fishing by type of fish sought: coldwater gamefish (trout) and warmwater fish (catfish). The authors estimated a varying-parameter travel cost model (a variation of the HTCM) using cross-sectional data on fee-fishing sites. Their model attempted to account for the influence of site characteristics, such as fish species available, on the demand function for fishing days.

The central hypothesis of the study was that anglers value some species more highly than others. Thus, one could expect that the major species class of a fishery (recreation site) would be an important site attribute and would influence demand (net willingness to pay). The study showed that anglers would be willing to pay $19.49 (1979 dollars) for a trout fishing day versus $12.48 (1979 dollars) for a catfish fishing day.

The method used for this study represents a simple, straightforward way of incorporating site characteristics into a modified travel cost framework. Its application permits the valuation of changes in recreation site attributes, such as proportional changes in fish species at a specific site. Thus, if the Flathead River Basin's fish population mix were to change (i.e., decrease in bull trout), this method could be used to determine the resulting economic loss (loss in consumer surplus) to the Basin. Furthermore, Vaughan and Russell (1982) were able to show that recreationists (anglers) are sensitive to fish species and are willing to pay a higher price (i.e., travel further, etc.) for different fishing experiences (trout versus catfish). Would a component of anglers be willing to pay an even higher price for a bull trout fishing experience?

12.3.4.2 "The value and characteristics of freshwater angling in British Columbia." R. Reid (1986). This survey of anglers holding a freshwater fishing licence in 1981 provided British Columbia with up-to-date information about the value and characteristics of freshwater fishing in the province. Although a mail survey was used to obtain information from both resident and non-resident anglers, different methods were used to determine the economic value of resident and non-resident angling.

For resident anglers, the value of fishing was determined by asking anglers the maximum amount they would be willing to pay for a fishing day over and above their actual expenditures. The amounts expressed by anglers was thought of as an implicit price for angling. The resulting estimates of the anglers' net willingness to pay summed across all the 1981 resident anglers denoted the net economic value of resident freshwater fishing to the Province of British Columbia. It was estimated that in 1981, over 300,000 active resident anglers in British Columbia generated over 5.6 million angler days and placed a net economic value (net willingness to pay) on their recreation fishing activities of over $113 million (1981 dollars). Therefore, resident anglers were willing to pay approximately $20.10 (1981 dollars) for each day of angling over and above their actual expenditures.

For non-resident anglers, the study again was interested in determining the economic value of the fishing activity to the province of British Columbia. However, since non-residents' use value is not captured by the province, a different method for measuring the economic value was used. The economic value for British Columbia that was generated by non-resident anglers was measured through the gross expenditures they made on fishing trips in the province. The net economic value was determined by removing the cost of goods and services necessary for providing the non-resident fishing days. It was estimated that in 1981, over 100,000 non-resident anglers generated over 800,000 angler days and contributed approximately $25.4 million (1981 dollars) in economic value to the Province of British Columbia. Therefore, a non-resident angler day contributed an average of approximately $31.20 (1981 dollars) net economic value to the province.

The method used in this survey to determine the net economic value that non-resident anglers contribute to the Province of British

Columbia could be readily used for the Flathead River Basin. With some minor modification, the net economic value could be determined for non-resident angling for different species of fish. The method used for resident anglers was a modified version of the Contingent Valuation Method (CVM). With some further modification, the questionnaire could be used to distinguish the net willingness to pay for angling days of varying qualities (e.g., high quality fishing such as bull trout in the Flathead River Basin).

12.3.4.3 "Economic valuation of potential losses of fish populations in the Swan River." ECO Northwest (1984). The purpose of this study was to provide information and analysis necessary to answer economic questions associated with the potential fish loss resulting from the proposed micro-hydroelectric development on tributaries of the Swan River, a sub-basin of the Flathead River Basin (Figure 1). The study utilized three techniques that were felt to most likely answer the questions about the economic value of the potential loss of fish. They were the Travel Cost Method, the Contingent Valuation Method, and the Hedonic Travel Cost Method.

Results using the Travel Cost Method placed the net economic value of the recreational fishery of the Swan River basin at $788,000 (1984 dollars). It was estimated that, for the 1983-84 fishing season, the basin generated approximately 16,300 angler days. Average angler day values were estimated to be between $21 and $76 (1984 dollars). Furthermore, when the total net economic value of the fishery was divided by the number of angler days, the average value of an angler day was estimated to be approximately $48.30 (1984 dollars).

Having established the value of an angler day, the study utilized both the Contingent Valuation and the Hedonic Travel Cost Methods to determine angler response and resulting loss in economic value due to a potential 25 percent loss in fish population as a result of the proposed micro-hydroelectric development. Responses to the contingent valuation questions indicated that anglers were willing to pay between $13 and $76 (1984 dollars) annually to prevent a 25 percent loss in fish population. When all the anglers' willingness to pay values (consumer surplus) were summed, the total annual willingness to pay value was estimated to be $331,300 (1984 dollars). Again, using a variation of the Contingent Valuation Method, anglers reported being willing to drive 85 to 204 one-way kilometers (53 to 127 mi) to get to an area of equal angling quality to the Swan River basin. This translated into a total annual willingness to pay value (willingness to drive) of $249,600 (1984 dollars). Finally, results using the Hedonic Travel Cost analysis revealed a lower value of a 25 percent fish loss ($122,500 - 1984 dollars).

Table 12.4 denotes the aggregate valuation of a 25 percent fish loss using the three different estimation techniques. Furthermore, when the potential loss in value due to the 25 percent decline in fish population is compared to the initial net economic value of the Swan River Basin recreational fisheries ($788,000), indexes of fish loss to value loss can be estimated. These indexes could be useful when examining the value of potential fish losses in the Flathead River Basin.

The study concluded that although the Hedonic Travel Cost. analysis resulted in lower total values, it was still considered to be the most useful technique for addressing relative values of site characteristics. However, the analysis concluded that bull trout were found to be significantly more valuable than "trout" to anglers in the Basin. Anglers were willing to pay an estimated $450 (1984 dollars) per party-visit to fish for bull trout ($135 per angler day) compared to only $30 (1984 dollars) for "trout" ($18 per angler day). Although there was an extremely large variance associated with these estimates, the relative values would indicate that the "value" of an angler day for bull trout should be considerably greater than for "trout". This conclusion will be important when estimating the value of a bull trout angler day in the Flathead River Basin (see Section 12.3.6).

12.3.4.4 "Quantifying the economic effects of hydroelectric developments on recreational fisheries: a case study of Idaho." J. Loomis, D. Donnelly and C. Sorg (1985). The purpose of this study was to simulate the possible impacts of a small hydroelectric dam on the Henry's Fork River in Idaho and to show the economic values lost with: (1) a

Table 12.4. Aggregate valuation (1984 dollars per year) of a hypothetical 25 percent fish loss in the Swan River Basin using three estimation techniques.

| | Willingness To Pay | Willingness To Drive | Hedonic Travel Cost |
|---|---|---|---|
| Loss in Economic Value | $331 300 | $249 600 | $122 500 |
| Percentage Loss of Economic Value | 42% | 32% | 16% |

Source: ECO Northwest 1984

reduction of the number of fish caught of current size; (2) a 50 percent reduction in the size of fish caught; and, (3) total loss of the recreational fishery. Although the three cases demonstrate interesting results and capabilities to attach an economic value to these losses, for our purpose only the results of case (1) will be discussed.

Although the authors used both the CVM and a modified HTCM for the complete study, only the HTCM was used to determine the economic value lost as a result of a potential reduction in the fish population. The authors assumed a direct correlation between fish populations and fish catch.

In 1983, the University of Idaho conducted both a mail and telephone survey. A random sample of licenced anglers were asked to provide information on their 1982 angling activities. Anglers were phoned to obtain responses on their angling activities and a simulated fishing market was described to them. Results of the analysis using the HTCM indicated that for the Henry's Fork River, there would be 76,700 fishing trips with a net economic value (consumer surplus) of $2.86 million (1985 dollars). This translated to approximately $37.34 (1985 dollars) per trip of 2.2 days in length. In other words, Henry's Fork

River accommodates approximately 168,740 angler days per year and each angler day has a net economic value of $16.97 (1985 dollars).

The analysis next approximated the effect of a reduction in fish population (and hence fish catch). The simulation analysis showed that a 50 percent reduction in fish population caused an annual reduction of approximately $920,000 (1985 dollars) in economic value and 24,742 fewer trips (54,432 angler days). If the loss of fish population was increased to 75 percent, the annual loss in economic value would be $1.36 million (1985 dollars) and 36,362 fewer trips (79,996 angler days).

Table 12.5 summarizes the expected number of angler days and associated net economic value for Henry's Fork River based on projected changes in fish populations. Clearly, the method of analysis used to generate these results for the Henry's Fork River could be readily used for the Flathead River Basin when examining the question of a potential reduction in fish populations resulting from the proposed coal mine.

Table 12.5. Changes in fish populations of Henry's Fork River - impact on recreational fishing and associated economic value (1985 dollars).

| Fish Population (Percent) | Net Economic Value (000,000$) | Total Angler Days | Percent Change |
|---|---|---|---|
| 100 | $2.86 | 168 740 | |
| 50 | $1.94 | 114 308 | -32% |
| 25 | $1.50 | 88 744 | -48% |

Source: Loomis, Donnelly and Sorg 1985

### 12.3.5 Study Design - Reduction of Bull Trout Population of Flathead River Basin

The preceding studies provided a variety of measures of the net economic value of an angler day and the sensitivity of the economic values to changing conditions of a recreation experience such as reductions in fish populations. Any one of the methods or a combination of them could be used to measure the net economic impact to the State of Montana associated with the potential loss of a portion of the bull trout population. Instead, results from the preceding studies will be used with the Basin data and estimates made of economic values.

An assumption is made that the expressions of economic value by anglers in the preceding studies can be applied to the bull trout angling experience for the designated sub-basins. Available data on the Basin's bull trout population and its distribution throughout the Basin is used to determine what portion of the population originates from the North Fork, Flathead River in the British Columbia designated sub-basin and, more specifically, from Howell and Cabin Creeks. Available data on fishing activities for bull trout in the Basin is available from a creel census. Using the data on bull trout and angling activities in conjunction with angling activities from the preceding studies, information on sensitivity to changes in bull trout populations are compiled. Furthermore, information on angler days for bull trout in the Basin is used with the value of angler days from the preceding studies to determine a range of aggregated net economic value contributed to the State of Montana from bull trout fishing. Finally, utilizing the computed aggregated net economic values and the sensitivity of angler-use to changing fish populations, net economic values are calculated that denote a range for the potential economic loss to the State of Montana.

The limitations of the preceding analysis should be apparent. The assumptions that are made to complete the analysis in Section 12.3.6 can only be verified by undertaking a complete on-site study using the methods previously mentioned. Nevertheless, the range of estimates of loss in net economic value that could occur as a result of a reduction in the bull trout population are reliable within the study limitations.

### 12.3.6 Estimated Economic Value of Bull Trout Angling in Designated Study Area: Loss in Value due to Potential Decline in Bull Trout Population

Recreational fishing is a major socio-economic activity in the Flathead River Basin. Kokanee, westslope cutthroat trout, bull trout, lake trout and mountain whitefish are the species most sought by the recreational angler. In this section an estimate is made of the annual number of bull trout angler days, the population of bull trout, and its distribution between the British Columbia and Montana portions of the designated study area. Utilizing this base data (creel census and bull trout population) in conjunction with information from other relevant studies (economic value of an angler day and sensitivity of anglers to changing fish populations), an estimate is made on the direct loss in "user" value to the State of Montana as a result of the total loss of the Howell and Cabin Creek bull trout populations.

12.3.6.1 Census of Bull Trout Angling. A census of recreation fishing was conducted on Flathead Lake from May 16, 1981 through May 14, 1982 (Graham and Fredenberg 1983) and on the Flathead River-Mainstem from Flathead Lake upstream to its confluence with the North Fork from 1981 May 16 to 1981 November 30 and on the North Fork, Flathead River in Montana from 1981 May 16 to 1981 September 7 (Fredenberg and Graham 1983). In addition, beginning in 1979, Glacier National Park initiated an evaluation of angler use in the Park (U.S. Fish and Wildlife Service undated [a] and [b]). This angling information was for fishing in the North Fork, Flathead River in Montana designated sub-basin inside the Park. It is included as part of the overall census total since little, if any, duplication is assumed because of limitations imposed by physical access, licence requirements and data collection methods. Census information was analyzed to estimate the use and harvest of gamefish and the basic characteristics of the angling population. Table 12.6 denotes the aggregate number of angler days estimated in the preceding censuses. The estimate of angler days was for all types of fish species. However, sufficient information was collected on anglers' fishing effort for different types of fish species that an estimate on the annual bull trout angler days could be made.

The census on the Flathead River and Lake determined the number of bull trout caught in each designated sub-basin during the census period and the success rate per bull trout angler day. During the census period, 5452 bull trout were caught on Flathead Lake, 1827 on the Flathead River-Mainstem, 404 on the North Fork, Flathead River in Montana, and 254 on the Glacier National Park portion of the North Fork,

Table 12.6. Estimate of total number of angler days: May 16, 1981 to May 14, 1982.

| Designated Sub-Basin | Number of Angler Days |
|---|---|
| Flathead Lake | 168 792 |
| Flathead River-Mainstem | 35 940 |
| North Fork, Flathead River in Montana | 9 485 |
| - Glacier National Park | 1 421[a] |
| Total | 215 638 |

[a]Angling in Glacier National Park averaged 1421 angling days per year during 1979 to 1981, a three-year census period.

Source: Fredenberg and Graham (1983)
Graham and Fredenberg (1983)
U.S. Fish and Wildlife Service (undated [a] and [b])

Flathead River in Montana (mean annual harvest). The census also determined both an average catch rate per angler hour and the average number of angler hours per bull trout angler day in the various designated sub-basins. Using the preceding information, Table 12.7 provides an estimate of the bull trout catch rate per angler day. Using this information, Table 12.8 denotes the number of bull trout angler days estimated for the census period. For the purpose of this study, it is assumed that the three designated sub-basins annually support approximately 97,220 bull trout angler days.

12.3.6.2 Economic Value of the Bull Trout Fishery to the State of Montana. In Section 12.3.4, a brief summary review was made of four studies that determined the value of an angler day. In each of these studies an attempt was made to explain the basis for determining the value of an angler day. Two of the studies were able to conclude that type of fish species sought influenced the amount an angler would be

Table 12.7. Estimate of catch rate of bull trout per angler day in the three designated sub-basins.

| Designated Sub-Basin | Catch Rate Per Hour | Average Number of Hours Per Angler Day | Catch Rate Per Angler Day |
|---|---|---|---|
| Flathead Lake | 0.02 | 3.6 | 0.072 |
| Flathead River-Mainstem | 0.05 | 3.2 | 0.160 |
| North Fork, Flathead River | | | |
| in Montana | 0.02 | 2.3 | 0.046 |
| - Glacier National Park | 0.07 | 2.8 | 0.196 |

Source: Fredenberg and Graham (1983)
Graham and Fredenberg (1983)
U.S. Fish and Wildlife Service (undated [a] and [b])

Table 12.8. Estimate of annual number of bull trout angler days in the three designated sub-basins.

| Designated Sub-Basin | Number of bull trout Caught | Catch Rate of bull trout Per Angler Day | Number of bull trout Angler Days |
|---|---|---|---|
| Flathead Lake | 5452 | 0.072 | 75 722 |
| Flathead River-Mainstem | 1827 | 0.160 | 11 419 |
| North Fork, Flathead River | | | |
| in Montana | 404 | 0.046 | 8 783 |
| - Glacier National Park | 254 | 0.196 | 1 296 |
| Total | | | 97 220 |

Source: Fredenberg and Graham (1983)
Graham and Fredenberg (1983)
U.S. Fish and Wildlife Service (undated [a] and [b])

willing to pay for an angler day (Vaughan and Russell 1982; ECO Northwest 1984). Table 12.9 denotes a range of values for angler days based on the results of studies reviewed in Section 12.3.4. (All values are in United States dollars except for the R. Reid (1986) values which are in Canadian dollars). Without completing an actual on-site study, it is extremely difficult, if not impossible, to determine the economic value of a bull trout angler day for the Flathead River Basin. However, for the purpose of this study, the WUC concluded that the bull trout fishery should be considered a high quality fishery and would command a higher "willingness to pay" value. In reviewing the values denoted in Table 12.9, the WUC could not accept using $143.00 (1986 dollars) as the value of a bull trout angler day because of the large amount of variance associated with this estimated value. Instead, the next highest value, $51.15 (1986 dollars), was used as the value of a bull trout angler day. Table 12.10 denotes the estimated economic value contributed by bull trout anglers in each of the three sub-basins to the State of Montana on an annual basis. In total, it is estimated that bull trout angling in the three designated sub-basins has an annual economic value of approximately $5 million (1986 dollars).

Table 12.9. Estimates of the value of an angler day (1986 Dollars).

| Study | Value of Angler Day (Current $) | Value of Angler Day (1986 $) |
|---|---|---|
| R. Reid 1986 | 20.10 (1983 $) | 22.56 |
| | 31.20 (1983 $) | 35.02 |
| J. Loomis et al. 1985 | 16.97 (1985 $) | 17.36 |
| ECO Northwest 1984 | 18.00 (1984 $) | 19.06 |
| | 48.30 (1984 $) | 51.15 |
| | 135.00 (1984 $) | 143.00 |
| Vaughan and Russell 1982 | 12.48 (1979 $) | 18.71 |
| | 19.49 (1979 $) | 29.22 |

12.3.6.3 Distribution of Bull Trout Population. In order to attempt to determine the economic impact associated with the potential total loss of the bull trout population of Howell and Cabin Creeks, information was

Table 12.10. Estimated annual value of bull trout angling in the three designated sub-basins.

| Designated Sub-Basin | Estimated Angler Days | Value of Angler Days (1986 $) |
|---|---|---|
| Flathead Lake | 75 722 | 3 873 180 |
| Flathead River-Mainstem | 11 419 | 584 082 |
| North Fork, Flathead River | | |
| in Montana | 8 783 | 449 250 |
| - Glacier National Park | 1 296 | 66 290 |
| Total | | $4 972 802 |

obtained on estimates of the bull trout population in various portions of the Basin. The estimates for the bull trout population in the North Fork, Flathead River in British Columbia designated sub-basin were then compared with the overall population to determine what portion of the total population of bull trout originated from this sub-basin and, more importantly, what portion of the overall population originated from Howell and Cabin Creeks.

Table 12.11 outlines the distribution of bull trout redds (spawning sites) in three designated sub-basins (Biological Resources Committee 1987). When comparing the distribution of redds (and therefore the distribution of the bull trout population), approximately 16 percent of the bull trout population spawn in the British Columbia portion of the Basin. Furthermore, about 60 percent of all spawners in British Columbia spawn in Howell and Cabin Creeks. Therefore, approximately 9.36 percent of the bull trout of this entire population spawn in Howell and Cabin Creeks[1].

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[1] A small population of bull trout are known to spawn in the Swan River/ Swan Lake, Flathead River-Mainstem and Whitefish River/Stillwater River designated sub-basins. These populations would contribute to the angling for bull trout on Flathead Lake. Therefore, the 9.36 percent of the relevant bull trout population attributed to Howell and Cabin Creeks could be high.

Table 12.11. Distribution of bull trout population in three designated sub-basins.

| Stream | Number of Years of Data | Mean ($\bar{X}$) No. of Redds | | Mean ($\bar{X}$) No. of Spawners[a] | |
|---|---|---|---|---|---|
| North Fork, Flathead River in British Columbia | | | | | |
| Howell | 3 | 74 | | 316 | |
| Cabin | 2 | 2 | | 9 | |
| Couldrey | 3 | 19 | | 81 | |
| Sage | 2 | 5 | | 21 | |
| Kishinena | 3 | 17 | | 73 | |
| Mainstem (B.C.) | 1 | 10 | | 43 | |
| Total in British Columbia | | | 127 | | 542 |
| North Fork, Flathead River in Montana | 3 | 378 | | 1614 | |
| Middle Fork, Flathead River in Montana | 3 | 308 | | 1316 | |
| Total in Montana | | | 686 | | 2930 |
| Overall Total | | | 813 | | 3472 |

[a] 3.2 Spawners/redd and 75 percent redd location rate.

Source: Biological Resources Committee 1987

12.3.6.4 <u>Estimate of Loss in Economic Value Due to Potential Loss of Howell and Cabin Creeks' Bull Trout Population</u>. The final question that now remains to be answered is what is the potential loss in economic ("user") value that the State of Montana could experience with the 9.36 percent loss in bull trout population? In other words, if the population of bull trout were to decrease by 9.36 percent, what percentage of bull trout angler days would be lost and what would be the resulting loss in economic value.

The sensitivity of angler days to reductions in fish population was reviewed in Section 12.3.4. Based on findings by ECO Northwest (1984) and Loomis et al. (1985), and using the preceding information compiled on bull trout angler days and their economic value to the State of Montana, an estimate of the potential loss in economic value is made. The ECO Northwest (1984) study determined the economic value that would be lost as a result of a 25 percent loss in fish population using three estimation techniques (Table 12.4). Using the same correlation between loss in fish population and resulting loss in economic value, estimates are made on the potential loss in economic value to the State of Montana. Table 12.12 denotes the potential percentage loss in economic value using the three techniques. Based on the estimate of the total economic value of bull trout angling in the study area (Table 12.10), estimates of the potential loss of economic value due to a reduction in the bull trout population are denoted in Table 12.13. Using the preceding method, the annual potential loss in economic value to the State of Montana is approximately $300,000 to $800,000 (1986 dollars).

Table 12.12. Potential percentage loss in economic value due to a 9.36 percent loss in bull trout population.

| Percent Loss in Fish Population | Willingness To Pay | Willingness To Drive | Hedonic Travel Cost |
|---|---|---|---|
| 25%<br>ECO Northwest 1984 | 42% | 32% | 16% |
| 9.36%<br>(Table 12.11) | 16% | 12% | 6% |

Table 12.13. Estimated annual loss in economic value of bull trout angling due to 9.36 percent loss in bull trout population (1986 Dollars): Simulation using ECO Northwest (1984) results.

| Designated Sub-Basin | Value of Angler Days | Loss in Economic Value: Willingness To Pay | Loss in Economic Value: Willingness To Drive | Loss in Economic Value: Hedonic Travel Cost |
|---|---|---|---|---|
| Flathead Lake | 3 873 180 | 619 709 | 464 782 | 232 391 |
| Flathead River - Mainstem | 584 082 | 93 453 | 70 090 | 35 045 |
| North Fork, Flathead River in Montana | 449 250 | 71 880 | 53 910 | 26 955 |
| - Glacier National Park | 66 290 | 10 606 | 7 955 | 3 977 |
| Total | $4 972 802 | $795 648 | $596 736 | $298 368 |

Using the same sensitivity analysis as was used by Loomis, Donnelly and Sorg, 1985 provides a similar measure of potential loss in economic value due to a reduction in angler days. Table 12.5 denotes the sensitivity of anglers to changing fish population in the Henry's Fork River. When the same trend analysis is applied to a potential 9.36 percent loss in the Flathead River Basin bull trout population, an estimated 6 percent loss in angler days is projected (Table 12.14). On that basis, the potential annual loss in economic value to the State of Montana (Table 12.15) would be approximately $300,000 (1986 dollars).

Table 12.14 Potential percentage loss in angler days due to a 9.36 percent loss in bull trout population.

| | Percent Loss in Fish Population | Percent Loss in Angler Days |
|---|---|---|
| Loomis et al. 1985 | 75.00% | 48.00% |
| | 50.00% | 32.00% |
| This Study (Table 12.11) | 9.36% | 6.00% |

Table 12.15 Estimated annual loss in economic value of bull trout angling due to 9.36 percent loss in bull trout population (1986 dollars): Simulation using Loomis et al. (1985) results.

| Designated Sub-Basin | Value of Angler Days | Loss in Economic Value |
|---|---|---|
| Flathead Lake | 3 873 180 | 232 391 |
| Flathead River-Mainstem | 584 082 | 35 045 |
| North Fork, Flathead River in Montana | 449 250 | 26 955 |
| - Glacier National Park | 66 290 | 3 977 |
| Total | $4 972 802 | $298 368 |

12.3.6.5 Conclusion. This exercise has attempted to determine an estimate of economic loss to the State of Montana as a result of the complete loss of the Howell and Cabin Creeks' bull trout population due to the potential Cabin Creek coal mine development in British Columbia. Recent information from creel censuses indicated that the three relevant designated sub-basins annually supported approximately 97,220 bull trout angler days. Information from relevant studies provided a range in the value of an angler day in 1986 dollars ($17.36 to $143.00). Because the bull trout fishery is considered a high quality fishery and because the ECO Northwest (1984) study determined that anglers were "willing to pay" considerably more for bull trout fishing compared to other types of fishing, the WUC used the higher value of $51.15 (1986 dollars) for a bull trout angler day. Therefore, bull trout angling in the three designated sub-basins was estimated to have an annual economic value of approximately $5 million (1986 dollars).

Recent studies of the bull trout population estimated that approximately 9.36 percent of the relevant population originated from Howell and Cabin Creeks (Biological Resources Committee 1987). Using the sensitivity of angler days to changing fish populations denoted from other studies (ECO Northwest 1984; Loomis et al. 1985), the 9.36 percent decline in bull trout population was estimated to result in an annual potential loss in economic value to the State of Montana of approximately $300,000 to $800,000 (1986 dollars). Using the same sensitivity trend analysis as Loomis et al. (1985) indicated an annual potential loss of approximately $300,000 (1986 dollars) and using the sensitivity analysis of the Hedonic Travel Cost Method portion of the ECO Northwest (1984) study indicated an annual potential loss of approximately $300,000 (1986 dollars).

As emphasized throughout, the preceding analysis has some severe limitations. However, working within the study limitations, the range of estimated values of between $300,000 and $800,000 (1986 dollars) does provide an indication of the sensitivity of anglers to the potential reduction in the bull trout population and the resulting loss in economic value ("user" value) to the State of Montana.

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# 14. ADDENDUM A

Current and Projected Timber
Harvesting in the Designated Sub-basin
of the Flathead River Basin

Table 1. Summary of past and future logging in the North Fork, Flathead River in British Columbia (1980 to 1990).

| Drainage | Year | Acres | Hectares[1] |
|---|---|---|---|
| Couldrey Creek | 1980 | 160.83 | 65.09 |
| | 1982-83 | 797.33 | 322.67 |
| | 1983 | 508.55 | 205.81 |
| | 1984 | 1136.24 | 459.82 |
| Calder Creek | 1980 | 544.93 | 220.53 |
| | 1984 | 55.86 | 22.61 |
| Small unnamed tributary between Couldrey and Calder Creeks | 1980 | 25.11 | 10.16 |
| Sage Creek | 1980 | 700.22 | 283.37 |
| | 1981 | 69.28 | 28.04 |
| | 1982 | 783.51 | 317.08 |
| | 1983 | 1021.83 | 413.52 |
| | 1987 | 540.88 | 218.89 |
| | 1988 | 24.47 | 9.90 |
| Elder Creek | 1980 | 445.14 | 180.14 |
| Kishinena Creek | 1980 | 2743.82 | 1110.40 |
| | 1982-83 | 179.03 | 72.45 |
| | 1983 | 457.72 | 185.23 |
| | 1987 | 262.29 | 106.15 |
| Dally Hill Creek | 1980 | 91.41 | 36.99 |
| Commerce Creek | 1982 | 99.04 | 40.08 |
| | 1983 | 268.94 | 108.84 |
| | 1984 | 45.47 | 18.40 |
| Cabin Creek | 1982 | 296.88 | 120.14 |
| | 1982-83 | 327.23 | 132.43 |
| | 1983 | 97.73 | 39.55 |
| | 1984 | 466.85 | 188.93 |
| | 1985 | 655.90 | 265.44 |
| | 1986 | 234.35 | 94.84 |
| | 1988 | 143.78 | 58.19 |
| | 1989 | 402.01 | 162.69 |
| Howell Creek | 1984 | 474.44 | 192.00 |
| | 1985 | 746.22 | 301.99 |
| | 1986 | 241.63 | 97.79 |

Continued

Table 1. Concluded.

| Drainage | Year | Acres | Hectares[1] |
|---|---|---|---|
| Howell Creek (cont'd) | 1988 | 110.68 | 44.79 |
| | 1989 | 398.68 | 161.34 |
| | 1990 | 90.05 | 36.44 |
| Harvey Creek | 1986 | 139.71 | 56.54 |
| | 1987 | 233.07 | 94.32 |
| | 1988 | 104.22 | 42.18 |
| | 1989 | 21.88 | 8.85 |
| | 1990 | 443.75 | 179.58 |
| Shepp Creek | 1980 | 143.63 | 58.13 |
| | 1988 | 255.83 | 103.53 |
| | 1990 | 356.29 | 144.19 |
| Unnamed tributary between Packhorse and St. Eloi Creeks in west bank | 1988 | 204.56 | 82.78 |
| Pincher Creek | 1981 | 158.67 | 64.21 |
| | 1989 | 65.37 | 26.45 |
| McLatchie Creek | 1980 | 115.04 | 46.56 |
| | 1984 | 74.13 | 30.00 |
| Flathead drainage between Howell and Commerce Creeks | 1980 | 54.68 | 22.13 |
| | 1982 | 102.79 | 41.60 |
| Flathead drainage west of Commerce Creek | 1983 | 63.79 | 25.82 |
| Flathead drainage between Pollack and Pincher Creeks | 1981 | 73.97 | 29.93 |
| | 1987 | 432.44 | 175.00 |
| Flathead drainage in vicinity of McLatchie Creek | 1981 | 197.92 | 80.10 |
| Total logged | 1980-85 | 14,110.00 | 5710.18 |
| Total to be logged | 1986-90 | 4705.94 | 1904.45 |

1 Areas determined by digitization from 1:50,000 scale timber supply maps prepared by Don Embury, Cranbrook Forest District, B.C. Ministry of Forests.

Table 2. Current timber harvest activity in the North Fork Flathead River sub-basin.

Flathead National Forest

Land Manager/Owner

| Location SRT | Timber Sales: Volume (MBF) | Timber Sales: Area (acres) | Road Development (Miles): Construction | Road Development (Miles): Reconstruction |
|---|---|---|---|---|
| 1. T33N, R20W | 6 700 | 1 636 | 9.1 | 5.8 |
| *2. T32 + 33N | 256 | 130 | 0 | 0 |
| 3. T37N, R23+24W | 4 860 | 335 | 0 | 7.6 |
| 4. Sec. 15, 22; T37N, R23W | 2 060 | 300 | 0 | 8.7 |
| 5. T34N, R22W, T34N, R23W | 1 840 | 680 | 0 | 0 |
| 6. T33N, R20W, T33N, R21W | 584 | 600 | 0 | 0 |
| 7. T34N, R22W | 580 | 54 | 0 | 0 |
| 8. T33N, R20W, T33N, R21W | 784 | 345 | 0 | 0 |
| 9. T34N, R22W | 14 850 | 1 026 | 6.3 | 22.9 |
| 10. T36BN, R22+23W | 7 070 | 1 262 | 0 | 0 |
| 11. T32N, R20W | 702 | 736 | 0 | 0 |
| 12. T36N, R22+23W | 1 444 | 713 | 0 | 0 |
| 13. T33N, R21W | 1 480 | 731 | 0 | 3.3 |
| 14. T35N, R22W | 1 171 | 714 | 0 | 8.3 |
| 15. T36N, R22N | 159 | 711 | 0 | 0 |
| 16. T32N, R20W | 8 530 | 736 | 5.0 | 16.5 |
| 17. T29N, R25W | 132 | 832 | 0 | 0 |
| 18. T34N, R22W | 2 050 | 1 103 | 0 | 0 |
| 19. T33+34N; R22W | 1 430 | 411 | 0 | 0 |
| 20. T33N, R21W | 1 216 | 312 | 0 | 0 |
| 21. T35N; R22+23W | 9 950 | 1 545 | 8.6 | 17.0 |
| 22. T34N, R22W; T34N R21W, T35N, R22W | 1 860 | 525 | 0 | 0 |
| 23. T32N, R21W | 1 390 | 746 | .4 | 3.2 |
| TOTALS | 71,098 | 16,183 | 29.4 | 93.3 |

*Complete location description not available.

Table 3. Planned/committed timber harvest activity in the North Fork Flathead River sub-basin.

Flathead National Forest

Land Manager/Owner

| Year | Location SRT | Timber Sales: Volume (MBF) | Timber Sales: Area (acres) | Road Development (Miles): Construction | Road Development (Miles): Reconstruction |
|---|---|---|---|---|---|
| 86 | 1. Sec. 14-16, 22-25 T33N, R22W Sec. 28-33; T33N, R21W | 5 300 | 422 | 0 | 0 |
| 86 | 2. Small Sales | 2 000 | * | * | * |
| 87 | 3. Sec. 20-24 T36N, R23W | 3 500 | 240 | 3.8 | |
| 87 | 4. Sec. 20-25 T34N, R22W | 6 800 | 405 | 5.9 | |
| 87 | 5. Sec. 14, 15, 23, 24 T33N, R22W | 2 800 | 186 | | 1.9 |
| *87 | 6. Sec. 26, 27, 34, 35 | 2 800 | 169 | 2.3 | |
| 87 | 7. Sec. 25-27, 36; T36N R23W, Sec. 30-32; T36N, R22W | 8 700 | 400 | 6.4 | 1.0 |
| 87 | 8. Small Sales | 2 000 | * | * | * |
| 88 | 9. Sec. 16-19; T34N, R22W | 1 900 | 84 | .6 | |
| 88 | 10. Sec. 14-16, 22-24 T34N, R22W | 2 500 | 117 | .6 | 1.0 |
| 88 | 11. Sec. 22-28, 33, 34 T33N, R21W Sec. 19, 30; T33N, R20W | 2 900 | 220 | 1.4 | |
| 88 | 12. Sec. 12-14; T32N, R22W Sec. 8, 17; T32N, R21W | 6 400 | 322 | 5.0 | 1.0 |
| 88 | 13. Small Sales | 2 000 | * | * | * |

Continued

Table 3. Concluded.

Flathead National Forest

Land Manager/Owner

| Year | Location SRT | Timber Sales: Volume (MBF) | Timber Sales: Area (acres) | Road Development (Miles): Construction | Road Development (Miles): Reconstruction |
|---|---|---|---|---|---|
| 89 | 14. Sec. 17-30, 30 T33N, R21W | 2 100 | 150 | 4.8 | .5 |
| 89 | 15. Sec. 28-30, 32, 33 T33N, R20W | 2 700 | 230 | 1.9 | |
| 89 | 16. Sec. 29-34, T32N, R20W Sec. 3-9, 16, 17; T31N R20W | 9 600 | 690 | 9.1 | 1.0 |
| 89 | 17. Small Sales | 2 000 | * | * | * |
| 90 | 18. Sec. 25, 26, 34-36 T33N, R22W Sec. 31, T33N, R21W Sec. 1-3, T34N, R22W | 5 400 | 317 | 2.9 | 2.0 |
| 90 | 19. Sec. 7-9, 15-18, 20, 21 28, 29; T32N, R20W | 7 200 | 502 | 3.2 | |
| 90 | 20. Small Sales | 2 000 | * | * | * |
| TOTALS | | 80,600 | 4454 | 47.9 | 8.4 |

*Data not available.

Table 4. Current timber harvest activity in the Whitefish/Stillwater Rivers sub-basin.

Flathead National Forest

Land Manager/Owner

| Location SRT | Timber Sales: Volume (MBF) | Timber Sales: Area (acres) | Road Development (Miles): Construction | Road Development (Miles): Reconstruction |
|---|---|---|---|---|
| 1. T32N, R24W | 13,050 | 950 | 11.9 | 2.6 |
| 2. T31N, R24+25W | 10,790 | 750 | 9.1 | 4.0 |
| 3. T29N+T30N, R25W | 10,940 | 700 | 15.1 | 0 |
| 4. T29+30N, R24W | 9 850 | 2 000 | 20.3 | 4.4 |
| 5. T31N, R24W | 3 050 | 327 | 2.2 | 4.3 |
| 6. T30+31N, R25W | 4 170 | 168 | 3.0 | 6.9 |
| 7. T30N, R23+24W | 12,570 | 750 | 15.3 | 9.1 |
| 8. T31N, R25+26W | 18,230 | 1 000 | 12.3 | 16.9 |
| 9. T29N, R25W | 9 020 | 690 | 0 | 0 |
| 10. T29N, R25W | 16,080 | 1 400 | 0 | 0 |
| 11. T30N, R25W | 1 520 | 77 | 0 | 0 |
| 12. T29+30N, R24W | 21,250 | 1 500 | 17.9 | 24.2 |
| 13. T30N, R25W | 18,300 | 1 760 | 5.1 | 8.5 |
| 14. T30N, R25+26W | 12,180 | 1 500 | 8.4 | 14.3 |
| 15. T29+30N, R25W | 24,240 | 5 760 | 10.1 | 5.6 |
| 16. T30+31N, R24+25W | 17,560 | 3 809 | 10.1 | 22.4 |
| 17. T29N, R25W | 8 250 | 1 751 | 0 | 0 |
| 18. T31N, R25W | 1 820 | 1 636 | 1.1 | 0 |
| 19. T29+30N, R24+25W | 6 800 | 3 240 | 10.1 | 7.5 |
| 20. T30+31N, R24W | 6 750 | 2 250 | 4.2 | 6.8 |
| 21. T32N, R24+25W | 10,100 | 1 600 | 12.9 | 22.9 |
| 22. T32N, R24W | 2 490 | 946 | 2.5 | 3.3 |
| 23. T29N, R24+25W | 3,700 | 500 | 3.5 | 0 |
| 24. T32N, R24+25W | 566 | 610 | 0 | 0 |
| 25. T30N, R25+26W | 428 | 1 725 | 0 | 0 |
| 26. T28+29N, R24+25W | 6 830 | 1 250 | 7.8 | 4.4 |
| 27. T31N, R23W | 7 080 | 612 | 7.8 | 1.7 |
| 28. T31N, R24W | 414 | 70 | 0 | 0 |
| 29. T29N, R25W | 1 640 | 209 | .5 | 0 |
| 30. T30N, R24W | 219 | 26 | 0 | 0 |
| 31. T36N, R22+23W | 380 | 16 | 0 | 0 |
| 32. T30N, R24W | 1 039 | 243 | 0 | 0 |
| 33. T26N, R22W | 398 | 106 | 0 | 0 |
| 34. T30N, R24+25W | 4 420 | 826 | 3.0 | 2.7 |

Continued

Table 4. Concluded.

Flathead National Forest

Land Manager/Owner

| Location SRT | Timber Sales: Volume (MBF) | Timber Sales: Area (acres) | Road Development (Miles): Construction | Road Development (Miles): Reconstruction |
|---|---|---|---|---|
| 35. T30N, R24W | 145 | 819 | 0 | 0 |
| 36. T31N, R25, 26W | 376 | 809 | 0 | 0 |
| 37. T30N, R25W | 222 | 816 | 0 | 0 |
| 38. T30N, R23+24W | 8 100 | 818 | 8.4 | 5.3 |
| 39. T29N, R24W | 5 770 | 823 | 3.9 | 0 |
| 40. T28N, R25W | 1 301 | 640 | 0 | 0 |
| 41. T31N, R24W | 4 440 | 811 | 5.2 | 4.9 |
| 42. T29N, R25W | 346 | 815 | 0 | 0 |
| 43. T29N, R25W | 538 | 829 | 0 | 0 |
| 44. T30N, R24W | 612 | 816 | 0 | 0 |
| 45. T30N, R24W | 301 | 825 | 0 | 0 |
| 46. T29+30N, R24+25W | 6 100 | 824 | 0 | 0 |
| 47. T30N, R24W | 326 | 320 | .1 | 0 |
| 48. T29+30N, R24W | 3 370 | 560 | 4.8 | 3.7 |
| 49. T31+32N, R25+26W | 5 990 | 808 | 1.4 | 16.4 |
| 50. T31N, R24+25W | 15,140 | 812 | 7.0 | 15.8 |
| 51. T30+31N, R25W | 632 | 816 | 0 | 0 |
| TOTALS | 319,833 | 53,718 | 225 | 218.6 |

Table 5. Current timber harvest activity in the Whitefish/Stillwater Rivers sub-basin.

Montana State Forest

Land Manager/Owner

| | Timber Sales | | Road Development (Miles) | |
|---|---|---|---|---|
| Location SRT | Volume (MBF) | Area* (acres) | Construction | *Reconstruction |
| 1. Sec. 11, 12, 14, 15, 23, 25, 26, 27, 36, T34N, R24W | 3 800 | | * | |
| 2. Sec. 16, T33N, R26W | 1 000 | | * | |
| 3. Sec. 23, 24, 25, T33N R24W | 1 400 | | * | |
| 4. Sec. 8, 17, 20, 27, 28 34, T32N, R23W | 2 000 | | * | |
| 5. Sec. 30, 31, T34N, R23W | 1 200 | | * | |
| 6. Sec. 16, 22, T33N, R26W Sec. 30, T33N, R23W | 1 638 | | * | |
| 7. Sec. 23, 24, 25 T33N, R24W | 1 200 | | * | |
| 8. Sec. 30-32, T33N, R22W | 3 834 | | * | |
| 9. Sec. 6, T30N, R22W | 6 030 | | * | |
| 10. Sec. 20, 21, 27, 28, 34 T32N, R23W | 3 400 | | * | |
| 11. Sec. 11, 12, T33N, R24W | 7 890 | | * | |
| 12. Sec. 18-20, T33N, R23W | 6 016 | | * | |
| 13. Sec. 36, T36N, R26W | 7 000 | | .4 | |
| 14. Sec. 28-32, T34N, R21W | 4 800 | | 3.1 | |
| 15. Sec. 13, 23, 24, T33N R26W | 2 500 | | 2.5 | |
| 16. Sec. 17, 18, T31N, R22W | 7 000 | | .25 | |
| TOTALS | 60,708 | | 6.25 | |

*Data not available

Table 6. Planned/committed timber harvest activity in the Whitefish/Stillwater Rivers sub-basin.

Flathead National Forest

Land Manager/Owner

| Year | Location SRT | Timber Sales Volume (MBF) | Timber Sales Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction |
|---|---|---|---|---|---|
| 86 | 1. Sec. 16, 17, 20, 29 T29N, R25W | 9 600 | 491 | 1.0 | 0 |
| 86 | 2. Sec. 10, 15, 16, 21 28, T29N, R25W | 6 900 | 325 | | |
| 86 | 3. Sec. 19; T30N, R25W Sec. 24, 25, T30N R26W | 4 300 | 240 | 2.0 | 0 |
| 86 | 4. Sec. 1, 2, 11, 12 T29N, R25W | 4 500 | 250 | | |
| 86 | 5. Small Sales | 4 700 | * | * | * |
| 87 | 6. Sec. 6-8, 18; T30N R25W, Sec. 12-14, 23; T30N, R26W | 6 100 | 340 | 1.0 | 0 |
| 87 | 7. Sec. 32-34, T30N, R25W Sec. 3-9, T29N, R25W | 15,000 | 840 | 1.0 | 0 |
| 87 | 8. Small Sales | 8 900 | * | * | * |
| 88 | 9. Sec. 14-16, 22-26; T29N, R25W | 10,500 | 600 | 2.5 | * |
| 88 | 10. Sec. 24, 25, 23, 26 35; T30N, R25W | 5 000 | 300 | | |
| 88 | 11. Sec. 17, 20, 21, 22 27, T31N, R24W | 5 000 | 300 | 2.0 | 0 |
| 88 | 12. Small Sales | 9 500 | * | * | * |

Continued

Table 6. Concluded.

| | | Flathead National Forest | | | |
|---|---|---|---|---|---|
| | | Land Manager/Owner | | | |
| | | Timber Sales | | Road Development (Miles) | |
| Year | Location SRT | Volume (MBF) | Area (acres) | Construction | Reconstruction |
| 89 | 13. Sec. 4-9, 16, T29N R24W, Sec. 28, 32 33, T30N, R24W | 6 000 | 350 | 1.0 | 0 |
| 89 | 14. Sec. 7, 18, T32N R24W, Sec. 12, 13 T32N, R25W | 4 500 | 300 | 4.0 | 0 |
| 89 | 15. Sec. 9, 15, 16, 21-23 26, 27; T32N, R25W | 7 500 | 450 | 4.5 | 0 |
| 89 | 16. Sec. 9, 16, 17, T31N R24W | 5 000 | 350 | 2.5 | 0 |
| 89 | 17. Sec. 3, 10 11; T31N, R24W | 700 | 65 | | 0 |
| 89 | 18. Small Sales | 6 300 | * | * | * |
| 90 | 19. Sec. 34-36; T32N R26W, Sec. 1, 23, 10-15, 23, 24, T31N, R26N, Sec. 7, T31N, R25W | 13,000 | 900 | 8.0 | 0 |
| 90 | 20. Sec. 14, 15, 21-23 T31N, R25W | 7 500 | 750 | 6.0 | 0 |
| 90 | 21. Small Sales | 9 500 | * | * | * |
| TOTALS | | 150,000 | 6851 | 35.5 | 0 |

*Data not available

Table 7. Planned/committed timber harvest activity in the Whitefish/Stillwater Rivers sub-basin.

Montana State Forest

Land Manager/Owner

| Year | Location SRT | Timber Sales Volume (MBF) | Timber Sales Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction[1] |
|---|---|---|---|---|---|
| 87 | Sec. 16 T30N, R24W | 30 | 160 | 0 | |
| 87 | Sec. 36 T30N, R24W | 80 | 325 | 0 | |
| 87 | Sec. 16 T36N, R26W | 80 | 240 | 1.2 | |
| 87 | Sec. 21, 22, 23, T33N R23W | 3 400 | 148 | 2.1 | |
| 87 | Sec. 5, T32N, R23W Sec. 32, 33, T33N, R23W | 1 200 | 300 | 0.8 | |
| 87 | Sec. 1, 14, 24, T31N, R24W | 2 800 | 470 | 2.6 | |
| 87 | Sec. 7, 8, T31N, R22W | 800 | 211 | 1.5 | |
| 88 | Sec. 16, T35N, R26W Sec. 36, T36N, R27W | 900 | 281 | 0.5 | |
| 88 | Sec. 30-32, T36N, R24W | 600 | 300 | 0.5 | |
| 88 | Sec. 21, 28, 33, T33N R23W | 1 300 | 335 | 1.2 | |
| 88 | Sec. 16 T34N, R26W | 2 700 | 450 | 2.8 | |
| 88 | Sec. 16 T36N, R22W | 1 800 | 360 | 0.8 | |
| 88 | Sec. 14, 15, T34N, R21W | 1 500 | 100 | 0.7 | |
| 89 | Sec. 29, 30, T33N, R23W | 1 800 | 428 | 0.3 | |
| 89 | Sec. 36, T35N, R26W | 400 | 160 | 0.0 | |
| 89 | Sec. 2, 3, 10, 11, T33N R23W | 2 600 | 110 | 1.6 | |
| 89 | Sec. 8, 17, 20, T32N R23W | 2 800 | 538 | 3.4 | |
| 89 | Sec. 6, 7, T32N, R23W | 800 | 143 | 0.2 | |
| 90 | Sec. 31-33, T32N, R23W | 1 000 | 263 | 0.4 | |
| 90 | Sec. 18, 19, T32N, R23W | 800 | 266 | 0.3 | |
| 90 | Sec. 19, 20, T31N, R22W | 800 | 250 | 0.2 | |
| 90 | Sec. 31, 32, T33N, R23W Sec. 36, T33N, R24W | 1 800 | 375 | 0.9 | |
| 90 | Sec. 25, 36, T33N, R26W | 2 500 | 640 | 0.5 | |
| 90 | Sec. 16, 17, 21, T33N R23W | 2 100 | 117 | 1.1 | |
| 91 | Sec. 33, 34, T33N, R26W | 1 200 | 320 | 0.8 | |
| 91 | Sec. 36, T36N, R28W | 2 000 | 196 | 1.8 | |

Continued

Table 7. Concluded.

Montana State Forest

Land Manager/Owner

| Year | Location SRT | Timber Sales: Volume (MBF) | Timber Sales: Area (acres) | Road Development (Miles): Construction | Road Development (Miles): Reconstruction[1] |
|---|---|---|---|---|---|
| 91 | Sec. 10, 14, 15, T33N R24W | 900 | 272 | 0.2 | |
| 91 | Sec. 3, 10, 14, 15, T33N R23W | 2 500 | 111 | 1.1 | |
| 91 | Sec. 18, 19, 20, T33N, R23W Sec. 13, T33N, R24W | 2 400 | 154 | 2.5 | |
| 92 | Sec. 16, T29N, R23W | 1 500 | 400 | 2.0 | |
| 92 | Sec. 19, 29, 30, T34N, R21W | 1 500 | * | * | |
| 92 | Sec. 7, 18, 19, T32N, R22W | 1 500 | * | * | |
| 92 | Sec. 25, T33N, R24W Sec. 30, T33N, R23W | 1 600 | * | * | |
| 92 | Sec. 16, T37N, R28W | 800 | * | * | |
| 92 | Sec. 17-19, T33N, R23W Sec. 20, 21, T33N, R23W | 2 800 | * | * | |
| 92 | Sec. 6, 7, T31N, R22W | 800 | * | * | |
| TOTALS | | 54,090 | 8423 | 32 | |

[1] Construction/reconstruction not differentiated in the data.

*Data not available.

Table 8. Planned/committed timber harvest activity in the Whitefish/Stillwater Rivers sub-basin.

Plum Creek Timber Company

Land Manager/Owner

| Year | Location SRT | Timber Sales[1] Volume (MBF) | Timber Sales[1] Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction |
|---|---|---|---|---|---|
| 86 | Sec. 25, T28N, R25W<br>Sec. 29, T28N, R24W | 3 700 | 300 | * | * |
| 86 | Sec. 25, 26, 36; T33N R23W | 3 700 | 300 | * | * |
| 87 | Sec. 9, T32N, R23W | 3 700 | 300 | * | * |
| 87 | Sec. 3, T32N, R23W | 3 700 | 300 | * | * |
| TOTALS | | 14,800 | 1200 | | |

[1] Average Volume and area of all sales.
*Data Not Available.

Table 9. Current timber harvest activity in the Middle Fork Flathead River Sub-basin.

Flathead National Forest

Land Manager/Owner

| Location SRT | Timber Sales Volume (MBF) | Timber Sales Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction |
|---|---|---|---|---|
| 1. T30 + 31 + 32N, R19W | 3 490 | 620 | 4.3 | .5 |
| 2. T31N, R17W | 431 | 6372 | 0 | 0 |
| 3. T28 + 29N, R13 + 14W | 11,540 | 54 | 8.9 | 14.7 |
| TOTALS | 15,461 | 7046 | 13.2 | 15.2 |

Table 10. Planned/committed timber harvest activity in the Middle Fork Flathead River Sub-basin.

Flathead National Forest

Land Manager/Owner

| | | Timber Sales | | Road Development (Miles) | |
|---|---|---|---|---|---|
| Year | Location SRT | Volume (MBF) | Area (acres) | Construction | Reconstruction |
| 88 | 1. Sec. 32-35; T29N, R13W Sec. 2-11, 16-18; T28N R13W | 7 500 | 400 | 4.0 | 6.0 |
| 90 | 2. Sec. 7, 16-21, 29-31; T29N, R13W, Sec. 13, 36, T29N, R14W | 4 000 | 285 | 6.0 | 2.0 |
| TOTALS | | 11,500 | 685 | 10.0 | 8.0 |

Table 11. Current timber harvest activity in the South Fork, Flathead River sub-basin.

Flathead National Forest

Land Manager/Owner

| Location SRT | Timber Sales Volume (MBF) | Timber Sales Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction |
|---|---|---|---|---|
| 1. T29N, R18W | 12,830 | 1 400 | 6.0 | .3 |
| 2. T25N, R15W | 7 600 | 3 440 | 11.8 | 0 |
| 3. T27N, R17W | 2 870 | 500 | 1.3 | .6 |
| 4. T29+30N, R17+18W | 3 070 | 1 300 | 0 | 2.6 |
| 5. T24N, R14+15W | 4 920 | 500 | 1.7 | 0 |
| 6. T30N, R19W | 2 750 | 500 | 1.2 | 9.7 |
| 7. T28N, R17+18W | 3 600 | 900 | 3.0 | 7.7 |
| 8. T26N, R167W | 6 380 | 2 880 | 1.5 | 15.1 |
| 9. T26+27N, R17W | 7 210 | 1 000 | .7 | 13.1 |
| 10. T24N, R14W | 2 350 | 1 200 | .7 | 0 |
| 11. T24N, R15W | 1 990 | 320 | 3.0 | 0 |
| 12. T27+28N, R17W | 8 350 | 900 | 4.3 | 4.1 |
| 13. T26N, R16W | 1 830 | 1 200 | 0 | 0 |
| 14. T30N, R18W | 91 | 44 | 0 | 0 |
| 15. T27N, R17W | 900 | 71 | 0 | 0 |
| 16. T28+29N, R18W | 1 420 | 78 | 0 | .1 |
| 17. T29N, R17W | 2 045 | 292 | 0 | 0 |
| 18. T30N, R18+19W | 4 490 | 1 475 | 0 | 0 |
| 19. T27N, R17W, T30N, R25W | 1 880 | 400 | 0 | 0 |
| 20. T28+29BN, R18+19W | 9 770 | 5 055 | 0 | 0 |
| 21. R19N, T29N | 1 105 | 53 | 0 | 0 |
| 22. T29N, R18W | 161 | 6 083 | 0 | 0 |
| 23. T30N, R19W | 1 560 | 6 051 | 0 | 2.8 |
| 24. T27N, R18W | 9 880 | 6 110 | 1.8 | 7.9 |
| 25. T27+28N, R17W | 1 330 | 6 332 | 0 | 0 |
| 26. T28N, R17+16W | 1 120 | 6 321 | .3 | 0 |
| 27. T30N, R18W | 1 760 | 626 | 1.5 | 0 |
| 28. T28+29N, R17W | 6 470 | 630 | 5.3 | 9.9 |
| 29. T29+30N, R17+18W | 4 850 | 6 252 | 3.4 | 0 |
| 30. T25N, R15W | 2 270 | 417 | 0 | 0 |
| 31. T26N, R16W | 408 | 443 | 0 | 0 |
| 32. T30N, R18+19W | 501 | 6 202 | 0 | 0 |
| 33. T27+30N, R17+19W | 5 590 | 6 143 | .4 | 31.6 |
| 34. T27+28N, R17W | 130 | 6 092 | 0 | 0 |

Continued

Table 11. Concluded.

| | Flathead National Forest | | | |
|---|---|---|---|---|
| | Land Manager/Owner | | | |
| | Timber Sales | | Road Development (Miles) | |
| Location SRT | Volume (MBF) | Area (acres) | Construction | Reconstruction |
| 35. T30N, R19W | 437 | 71 | 0 | 0 |
| 36. T30+31N; R18W | 4 550 | 4 480 | 9.3 | 1.3 |
| 37. T26N; R16+17W | 1 110 | 2 200 | 0 | 0 |
| 38. T25+26N, R16+17W | 3 320 | 444 | .8 | 5.1 |
| 39. R17+18W, T29+30N | 370 | 6 252 | 0 | 0 |
| 40. T28N, R17W | 365 | 6 313 | 0 | 0 |
| 41. T29N, R18W | 153 | 6 082 | 0 | 0 |
| 42. T26+27N, R16+17W | 6 000 | 446 | 2.5 | 2.9 |
| TOTALS | 139,786 | 107,498 | 60.5 | 114.8 |

Table 12. Planned/committed timber harvest activity in the South Fork Flathead River sub-basin.

Flathead National Forest

Land Manager/Owner

| Year | | Location SRT | Timber Sales Volume (MBF) | Timber Sales Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction |
|---|---|---|---|---|---|---|
| 86 | 1. | Sec. 36; T30N, R19W Sec. 1, 2, 9, 10-12 14, 16, 17; T29N, R19W | 7 500 | 320 | 3.0 | 8.0 |
| 86 | 2. | Sec. 1, 11-15, T29N R19W | 4 000 | 200 | 3.5 | 6.0 |
| | 3. | Sec. 26, 31, 34-36 T26N, R15W, Sec. 1-12 T25N, R14W | 7 900 | 440 | 12.1 | 10.7 |
| 86 | 4. | Small Sales | 4 600 | * | * | * |
| 86 | 5. | Sec. 2, 3, 9, 15-21 30; T26N, R17W, Sec. 13, T26N, R18W Sec. 15-17, 20-23, 27 28, 31-35; T27N, R17W | 18,000 | 660 | 11.5 | 6.0 |
| 87 | 6. | Sec. 6, 7, 17, 18; T27N R16W, Sec. 1; 27N R17W, Sec. 10, 11, 13-15 23-26, 36, T28N, R17W | 5 000 | 320 | 7.0 | 3.0 |
| 87 | 7. | Small Sales | 1 000 | * | * | * |
| 88 | 8. | Sec. 33, 34, T31N R18W; Sec. 2-4, 8-17 20-23, T30N, R18W | 6 800 | 467 | 7.0 | 1.5 |
| 88 | 9. | Sec. 15-17, 21, 22 26-28, 35, 36, T25N R15W | 8 000 | 710 | | |

Continued

Table 12. Continued.

Flathead National Forest

Land Manager/Owner

| Year | Location SRT | Timber Sales Volume (MBF) | Timber Sales Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction |
|---|---|---|---|---|---|
| 88 | 10. Small Sales | 1 700 | * | * | * |
| 89 | 11. Sec. 26, 35, 36 T30N, R19W, Sec. 2, T29N, R19W, Sec. 17, 23, 26, T29N, R18W, Sec. 3, 5, 6, 10, 25 T27N, R17W, Sec. 29; T28N, R17W | 4 000 | 464 | | 1.0 |
| 89 | 12. Sec. 7, 8, 17-20 T28N, R17W, Sec. 13, 14, 23, 24, T28N, R18W | 3 500 | 175 | 2.5 | 1.0 |
| 89 | 13. Sec. 17, 18, 20, 21 27-29, 33, 34, T31N R18W, Sec. 3, 4, T30N R18W | 6 700 | 305 | | |
| 89 | 14. Sec. 1, 12, T26N, R17W Sec. 5-8, 16-18, T26N R16W | 6 400 | 490 | 6.2 | 5.0 |
| 89 | 15. Small Sales | 3 400 | * | * | * |
| 90 | 16. Sec. 3, 4, 8-10 15-22, 28, T27N, R17W | 2 500 | 190 | 1.5 | |
| 90 | 17. Sec. 26, 34, 36, T29N R18W, Sec. 2-5, 8-10 T28N, R18W | 2 000 | 145 | 1.5 | 1.0 |
| 90 | 18. Sec. 33, T29N, R17W Sec. 5, 9, 16, 21, 26-28, 35, T28N, R17W Sec. 2, 12, 13, T27N R17W, Sec. 7, 18; T27N, R16W | 3 200 | 290 | | |

Continued

Table 12. Concluded.

| | | Plum Creek Timber Company (Land Manager/Owner) | | | |
|---|---|---|---|---|---|
| | | Timber Sales | | Road Development (Miles) | |
| Year | Location SRT | Volume (MBF) | Area (acres) | Construction | Reconstruction |
| 90 | 19. Sec. 21-23, T25N, R14W | 3 200 | 160 | 2.5 | 2.5 |
| | 20. Sec. 13, 24, 25, T24N R15W, Sec. 19, 30 T24N, R14W | 3 000 | 300 | 3.0 | 2.0 |
| 90 | 21. Sec. 22, 23, 27, 28 33, T26N, R17W | 1 500 | 135 | 2.0 | 2.0 |
| 90 | 22. Small Sales | 4 600 | * | * | * |
| TOTALS | | 108,500 | 5771 | 63.3 | 49.7 |

*Data not available.

Table 13. Current timber harvest activity in the mainstem Flathead River sub-basin.

Flathead National Forest

Land Manager/Owner

| Location SRT | Timber Sales: Volume (MBF) | Timber Sales: Area (acres) | Road Development (Miles): Construction | Road Development (Miles): Reconstruction |
|---|---|---|---|---|
| 1. T26+27N, R21+21-1/2W | 8 710 | 1 080 | 21.6 | 0 |
| 2. T26N, R22W | 8 970 | 1 660 | 17.5 | 6.1 |
| 3. T26N, R22W | 4 650 | 1 120 | 9.2 | 2.6 |
| 4. T27N, R23W | 2 090 | 700 | 3.2 | 0 |
| 5. T25+26N, R21+22W | 6 310 | 2 470 | 14.2 | 1.0 |
| 6. T26+27N, R23W | 2 904 | 650 | 2.9 | 0 |
| 7. T29N, R24W | 3 750 | 960 | 6.1 | .4 |
| 8. T27N, R21+22W | 3 240 | 1 055 | 4.5 | 0 |
| 9. T26N, R22W | 616 | 460 | 0 | 0 |
| 10. T30N, R23W | 117 | 266 | 0 | 0 |
| 11. T26N, R21+22W | 16,090 | 4 180 | 19.4 | 19.7 |
| 12. T26N, R23W | 1 666 | 108 | 0 | 0 |
| 13. T29+30N, R23W | 4 410 | 818 | 5.4 | 5.8 |
| 14. T26N, R22W | 3 635 | 105 | 1.4 | 0 |
| 15. T31+32N, R20W | 4 680 | 747 | 3.3 | 13.9 |
| 16. T26N, R22W | 465 | 105 | 0 | 0 |
| 17. T26N, R18W | 4 280 | 1 020 | 0 | 0 |
| 18. T26N, R22W | 5 850 | 106 | .7 | .1 |
| 19. T26N, R22W | 5 670 | 105 | 1.5 | 7.5 |
| 20. T28N, R25W | 1 123 | 66 | 0 | 0 |
| 21. T26N, R23W | 4 920 | 480 | 0 | 0 |
| TOTALS | 94,146 | 18,261 | 110.9 | 57.1 |

Table 14. Current timber harvest activity in the mainstem Flathead River sub-basin.

Montana State Forest

Land Manager/Owner

| Location SRT | Timber Sales Volume (MBF) | Timber Sales Area* (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction[1] |
|---|---|---|---|---|
| 1. Sec. 16, 24, 26, 34 T26N, R23W | 10,500 | | * | |
| 2. Sec. 36, T28N, R24W | 7 840 | | * | |
| 3. Sec. 22, T28N, R24W | | | | |
| 4. Sec. 35, T27N, R19W | 2 454 | | * | |
| 5. Sec. 16, T26N, R25W | 2 000 | | 0 | |
| 6. Sec. 36, T25N, R25W | 1 250 | | 3.0 | |
| TOTALS | 24,044 | | 3 | |

[1] Construction/reconstruction not differentiated in the data.

*Data not available.

Table 15. Planned/committed timber harvest activity in the mainstem Flathead River sub-basin.

Flathead National Forest

Land Manager/Owner

| Year | Location SRT | Timber Sales Volume (MBF) | Timber Sales Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction |
|---|---|---|---|---|---|
| 86 | 1. Sec. 2-4, 8, 10, T26N, R23W; Sec. 26, 27, 33-35, T27N, R23W | 6 000 | 360 | 5.0 | 1.3 |
| 86 | 2. Sec. 6, 7, T26N, R21W Sec. 1, 2, 12; T26N R22W | 5 000 | 350 | 5.6 | 1.4 |
| 88 | 3. Sec. 2-4, 10, 11, 14 15, 22, 23, 26, 27 T26N, R22W | 5 000 | 410 | 2.0 | 0 |
| 88 | 4. Small Sales | 6 000 | * | * | * |
| 87 | 5. Sec. 4, 6, T26N, R23W Sec. 27, 28, 33, T27N R23W | 2 000 | 165 | .5 | 2.0 |
| TOTALS | | 24,000 | 1285 | 13.1 | 4.7 |

Table 16. Planned/committed timber harvest activity in the mainstem Flathead River sub-basin.

| | | Montana State Forest | | | |
|---|---|---|---|---|---|
| | | Land Manager/Owner | | | |
| | | Timber Sales | | Road Development (Miles) | |
| Year | Location SRT | Volume (MBF) | Area (acres) | Construction | Reconstruction[1] |
| 87 | Sec. 5, T27N, R19W | 500 | 100 | 0.5 | |
| 88 | Sec. 36, T29N,R23W | 500 | 150 | 1.0 | |
| 90 | Sec. 16, T27N, R22W | 500 | 160 | 0.5 | |
| 90 | Sec. 36, T28N, R23W | 500 | 160 | 0.5 | |
| 92 | Sec. 16, T28N, R23W | 1500 | 400 | 3.0 | |
| TOTALS | | 3500 | 970 | 5.5 | |

[1] Construction/reconstruction not differentiated in the data.

Table 17. Planned/committed timber harvest activity in the mainstem Flathead River sub-basin.

Plum Creek Timber Company

Land Manager/Owner

| Year | Location SRT | Timber Sales[1] Volume (MBF) | Area (acres) | Road Development (Miles) Construction | Reconstruction |
|---|---|---|---|---|---|
| 86 | S22, 23; T26N, R23W | 3 700 | 300 | * | * |
| 86 | S11, T28N, R24W | 3 700 | 300 | * | * |
| 86 | S32, 33, T26N, R24W | 3 700 | 300 | * | * |
| 86 | S1, T28N, R25W, S31 T29N, R24W | 3 700 | 300 | * | * |
| 86 | S34, 35, T26N, R24W | 3 700 | 300 | * | * |
| 86 | S33, T29N, R24W, S3, 4 T28N, R24W | 3 700 | 300 | * | * |
| 86 | S23, 24, 25; T27N, R22W | 3 700 | 300 | * | * |
| 86 | S31, T27N, R24W | 3 700 | 300 | * | * |
| 86 | S11, 13; T26N, R23W | 3 700 | 300 | * | * |
| 86 | S23, T28N, R24W | 3 700 | 300 | * | * |
| 86 | S15, 17; T2, 8N: R24W | 3 700 | 300 | * | * |
| 87 | S19, 20: T27N; R24W | 3 700 | 300 | * | * |
| 87 | S23, 24, 25; T27N, R22W | 3 700 | 300 | * | * |
| 87 | S17, 18, 19, 20, 30; T26N, R24W | 3 700 | 300 | * | * |
| 87 | S19, T26N, R24W | 3 700 | 300 | * | * |

Continued

Table 17. Concluded.

Plum Creek Timber Company

Land Manager/Owner

| Year | Location SRT | Timber Sales[1] Volume (MBF) | Area (acres) | Road Development (Miles) Construction | Reconstruction |
|---|---|---|---|---|---|
| 87 | S20, 21, 28; T26N, R24W | 3 700 | 300 | * | * |
| 87 | S18, T26N, R24W | 3 700 | 300 | * | * |
| 87 | S34, T27N, R24W | 3 700 | 300 | * | * |
| 87 | S14, 15; T26N, R24W | 3 700 | 300 | * | * |
| 88 | S10, T26N, R24W | 3 700 | 300 | * | * |
| 88 | S17, 20, T26N, R24W | 3 700 | 300 | * | * |
| 88 | S35, T29N, R24W | 3 700 | 300 | * | * |
| 88 | S7, T26N, R23W | 3 700 | 300 | * | * |
| 88 | S34, T26N, R24W | 3 700 | 300 | * | * |
| 88 | S27, 34, T26N, R23W | 3 700 | 300 | * | * |
| TOTALS | | 92,500 | 7500 | | |

[1] Average volume and area of all sales.

*Data not available.

Table 18. Current timber harvest activity in the Swan River/Swan Lake sub-basin.

Flathead National Forest

Land Manager/Owner

| Location SRT | Timber Sales Volume (MBF) | Timber Sales Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction |
|---|---|---|---|---|
| 1. T19N, R16W | 2 510 | 240 | 1.4 | 0 |
| 2. T25N, R18+19W | 8 100 | 750 | 3.3 | 0 |
| 3. Sec. 20, T22N, R17W | 2 790 | 600 | 0 | 0 |
| 4. T25+26N, R18+19W | 2 910 | 740 | 5.4 | 0 |
| 5. T20N, R16W | 5 850 | 1 420 | 3.9 | .6 |
| 6. T21N, R16W | 2 490 | 650 | 2.6 | 0 |
| 7. T22N, R17W | 2 560 | 1 500 | 3.0 | 2.1 |
| 8. T25N, R18W | 4 230 | 760 | 3.2 | 3.8 |
| 9. T18+19N, R17W | 6 040 | 1 020 | 11.6 | 1.1 |
| 10. T24N, R18W | 205 | 79 | 0 | 0 |
| 11. T21N, R16W | 1 560 | 1 560 | 0 | .9 |
| 12. T23N, R18W | 288 | 300 | 0 | 0 |
| 13. Sec. 16+17, T25N, R18W | 464 | 120 | 0 | 0 |
| 14. T25N, R18W | 471 | 520 | 0 | 0 |
| 15. T22N, R17W | 335 | 600 | 0 | 0 |
| 16. T19+20N, R16W | 2 750 | 221 | 5.3 | .8 |
| 17. T21N, R16W | 395 | 214 | .8 | 0 |
| 18. T19N, R19W, T19N, R17W | 563 | 220 | 1.7 | 1.3 |
| 19. T21+22N, R18W | 2 279 | 205 | 2.0 | 0 |
| 20. T22N, R17W | 276 | 202 | 0 | 0 |
| 21. T21+22N, R18W | 2 279 | 205 | 2.0 | 0 |
| 22. T21N, R16W | 5 435 | 211 | 9.0 | 9.6 |
| 23. T23N, R16+17W | 5 750 | 137 | 6.0 | 5.3 |
| 24. T17W, Sec. 22+32 | 1 230 | 6 132 | 0 | .01 |
| 25. T25N, R19W | 632 | 123 | 0 | 0 |
| 26. T25N, R19W | 295 | 120 | 0 | 0 |
| 27. T25N, R18W | 2 390 | 319 | .9 | 0 |
| 28. T20N, R16W | 154 | 221 | 0 | 0 |
| 29. T25+26N, R18+19W | 2 340 | 120 | 0 | 0 |
| 30. T21N, R18W | 726 | 280 | 0 | 0 |
| 31. T25N+T26N, R19W | 967 | 900 | 0 | 0 |
| 32. T25+26N; R18W | 5 030 | 1 840 | 8.2 | 4.2 |
| 33. T29+20N, R17W | 4 820 | 1 650 | 6.5 | 14.1 |
| 34. T20+21N, R17+18W | 9 712 | 3 880 | 12.3 | 14.5 |
| 35. T21+22N, R17+18W | 14,700 | 208 | 8.8 | 12.4 |
| 36. T26N, R23W | 485 | 108 | 0 | 0 |
| 37. T25N, R19+18W | 402 | 124 | 0 | 0 |
| 38. T24N, R18W | 740 | 128 | 0 | 0 |
| TOTALS | 105,153 | 28,627 | 97.90 | 70.71 |

Table 19. Current timber harvest activity in the Swan River/Swan Lake sub-basin.

Montana State Forest

Land Manager/Owner

| Location SRT | Timber Sales: Volume (MBF) | Timber Sales: Area (acres) | Road Development (Miles): Construction | Road Development (Miles): Reconstruction[1] |
|---|---|---|---|---|
| 1. Sec. 8, 18, T23N, R17W | 1 500 | * | * | |
| 2. Sec. 18, 30, T23N, R17W | 2 000 | * | * | |
| 3. Sec. 14, T23N, R18W | 1 000 | * | * | |
| 4. Sec. 6, T23N, R17W<br>Sec. 32, T24N, R17W | 4 000 | * | * | |
| 5. Sec. 2, 12, T23N, R18W<br>Sec. 34, T24N, R18W | 4 167 | * | * | |
| 6. Sec. 22, T23N, R17W | 120 | * | * | |
| 7. Sec. 17, 18, W1/2 23<br>T24N, R17W | 5 000 | * | 2.39 | |
| 8. Sec. E1/2 30, 32, T23N<br>R17W | 3 000 | * | 1.0 | |
| 9. Sec. 10, T23N, R17W | 450 | * | 0 | |
| TOTALS | 21,237 | | 3.39 | |

[1] Construction/reconstruction not differentiated in the data.

*Data not available.

Table 20. Planned/committed timber harvest activity in the Swan River/ Swan Lake sub-basin.

Montana State Forest

Land Manager/Owner

| Year | Location SRT | Timber Sales Volume (MBF) | Timber Sales Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction |
|---|---|---|---|---|---|
| 86 | 1. Sec. 3, 4, 9, 10, 15 16, 17, 20, 28, 29 33, T24N, R18W | 13,000 | 485 | 7.5 | 12.0 |
| 86 | 2. Small Sales | 6 000 | * | * | * |
| 89 | 3. Sec. 6, 18, T21N, R17W Sec. 12, T21N, R18W Sec. 18, 30, T22N, R17W Sec. 2, 4, 10, 12, 26; T22N, R18W | 13,000 | 820 | 14.7 | 4.4 |
| 89 | 4. Sec. 30, T22N, R16W Sec. 2, 12, 24, T22N R17W | 6 000 | 350 | 12.0 | 15.0 |
| 89 | 5. Small Sales | 6 000 | * | * | * |
| 90 | 6. Sec. 8, 16, 20, T19N R17W, Sec. 4, 8, T20N R17W, Sec. 12, T20N R18W, Sec. 16, 22, 28 T21N, R17W, Sec. 36 T21N, R18W | 9 000 | 510 | 6.0 | 0 |
| 90 | 7. Sec. 12, T27N, R19W Sec. 7, 8, 9, 10, 15 17, 18, 35, T28N, R19W | 2 000 | 160 | 3.0 | 1.0 |
| 90 | 8. Sec. 4-8, T24N, R17W Sec. 22, 27-36, T25N R17W | 6 000 | 515 | 8.5 | 2.0 |
| 90 | 9. Small Sales | 6 000 | * | * | * |
| TOTALS | | 67,000 | 2840 | 51.7 | 34.4 |

*Data not available.

Table 21. Planned/committed timber harvest activity in the Swan River/ Swan Lake sub-basin.

Montana State Forest
Land Manager/Owner

| Year | Location SRT | Timber Sales Volume (MBF) | Timber Sales Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction[1] |
|---|---|---|---|---|---|
| 87 | Sec. 6, T23N, R17W | 2 400 | 120 | 1.0 | |
| 87 | Sec. 19, 30, T24N, R17W | 2 600 | 180 | 2.0 | |
| 87 | Sec. 9, 15, T24N, R17W | 400 | 256 | 4.0 | |
| 88 | Sec. 20, 28, T23N, R17W | 3 600 | 240 | 3.0 | |
| 88 | Sec. 36, T31N, R17W | 2 000 | 100 | 1.5 | |
| 88 | Sec. 22, 27, T24N, R17W | 3 400 | 170 | 3.0 | |
| 89 | Sec. 28, 33, T24N, R17W | 4 000 | 200 | 1.5 | |
| 89 | Sec. 22, 24, 26, T23N R18W | 4 200 | 208 | 8.0 | |
| 89 | Sec. 29, T24W, R17W | 1 300 | 64 | 0.7 | |
| 90 | Sec. 16, 22, T23N, R17W | 3 900 | 192 | 1.0 | |
| 90 | Sec. 26, 34, 36, T23N R17W | 5 800 | 290 | 4.0 | |
| 91 | Sec. 2, 3, 10, 11, T24N R17W | 4 200 | 210 | 3.5 | |
| 91 | Sec. 4, 8, T23N, R17W | 3 800 | 188 | 0.7 | |
| 91 | Sec. 10, T23N, R18W | 2 000 | 100 | 0.5 | |
| 92 | Sec. 2, 12, T23N, R17W | 3 700 | 184 | 3.2 | |
| 92 | Sec. 28, T24N, R18W | 1 300 | 64 | 1.0 | |
| 92 | Sec. 28, 32, T23N, R18W | 4 500 | 256 | 5.0 | |
| TOTALS | | 53,100 | 3022 | 43.6 | |

[1]Construction/reconstruction not differentiated in the data.

Table 22. Current timber harvest activity in the Flathead Lake sub-basin.

Flathead National Forest

Land Manager/Owner

| Location SRT | Timber Sales Volume (MBF) | Timber Sales Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction |
|---|---|---|---|---|
| 1. T26N, R22W | 7 420 | 1 200 | 10.31 | 5.1 |
| 2. T25N, R18W | 8 620 | 970 | 9.8 | 10.4 |
| 3. T26N, R21W | 6 170 | 1 400 | 11.3 | 2.2 |
| 4. Sec. 28, T27N, R23W | 3 610 | 1 090 | 6.2 | 1.8 |
| 5. T25+26N, R22+23W | 11,460 | 4 330 | 21.4 | 16.2 |
| 6. T26+27N, R21S | 11,560 | 3 500 | 24.1 | 0 |
| 7. T25N, R22W | 2 333 | 112 | 2.3 | 0 |
| 8. T25N, R18W | 6 400 | 675 | 6.3 | 6.4 |
| TOTALS | 57,573 | 13,277 | 91.71 | 42.1 |

Table 23. Current timber harvest activity in the Flathead Lake sub-basin.

Montana State Forest

Land Manager/Owner

| Location SRT | Timber Sales Volume (MBF) | Timber Sales Area (acres) | Road Development (Miles) Construction | Road Development (Miles) Reconstruction |
|---|---|---|---|---|
| 1. Sec. 3, 4, 9, 10, 16 T26N, R19W | 3000 | * | * | * |
| TOTAL | 3000 | | | |

*Data not available.

Table 24. Current timber harvest activity in the Flathead Lake sub-basin.

Flathead Indian Reservation

Land Manager/Owner

| Location SRT | Timber Sales: Volume (MBF) | Timber Sales: Area (acres) | Road Development (Miles): Construction | Road Development (Miles): Reconstruction |
|---|---|---|---|---|
| Sec. 5, 8, R21W, T23N | 549 | 400 | 3 | * |
| Sec. 5, 19, 20, 29-32 R19W, T23N | 1738 | 2965 | 16 | * |
| Sec. 29, 20, R19W, T23N | 265 | 205 | 2 | * |
| Sec. 17, 18, R19W, T23N | 342 | 215 | 1 | * |
| Sec. 10, 3, R20W, T22N | 350 | 133 | 5 | * |
| Sec. 1-3, 10, 9, R22W, T24N | 1411 | 440 | 3 | * |
| Sec. 30, 31, 25, 36, R19W T23N | 2221 | 1260 | 2 | * |
| Sec. 5-8, 18, 31, R19W T23N | 1890 | 1595 | 11 | * |
| Sec. 11, R21W, T23N | 696 | 310 | 2 | * |
| TOTALS | 9462 | 7523 | 45 | |

*Data not available.

Table 25. Planned/committed timber harvest activity in the Flathead Lake sub-basin.

Flathead National Forest

Land Manager/Owner

| Year | Location SRT | Timber Sales: Volume (MBF) | Timber Sales: Area (acres) | Road Development (Miles): Construction | Road Development (Miles): Reconstruction |
|---|---|---|---|---|---|
| 87 | Sec. 19-22, 26-30, 32, 33 T26N, R21W, Sec. 13, 14, 23, 24; T26N, R22W | 8 000 | 900 | 11.4 | 2.4 |
| 87 | Sec. 30-33, T26N, R21W; Sec. 25-28, 32-36, T26N, R22W, Sec. 3, 4; T25N, R22W | 8 000 | 500 | 3.9 | 8.8 |
| 87 | Sec. 10-15, 21-24, T25N R19W | 6 000 | 425 | 6.3 | |
| 87 | Small Sales | 6 000 | * | * | * |
| 88 | Sec. 2-5, 8, 16, 17; T26N R21W, Sec. 32; T27N, R21W | 5 000 | 350 | 5.4 | 0.4 |
| 88 | Sec. 2, 3, 10-14, 23-27 34-36, T25N, R19W Sec. 26-28, 33-35; T26N, R19W | 14,000 | 990 | 15.0 | 0 |
| 89 | Sec. 17, 20, 29, 32-36 T26N, R22W | 5 000 | 275 | 0 | 0 |
| 90 | Sec. 8, 19, 20, 29, 30 T26N, R22W | 2 000 | 115 | 0 | 0 |
| 90 | Sec. 18-20, 30, T27N, R21W Sec. 25, 26; T27N, R21 1/2W Sec. 12; T27N, R22W | 3 000 | 240 | 0 | 0 |
| TOTALS | | 57,000 | 3795 | 42 | 11.6 |

*Data not available.

Table 26. Planned/committed timber harvest activity in the Flathead Lake sub-basin.

Montana State Forest

Land Manager/Owner

| | | Timber Sales | | Road Development (Miles) | |
|---|---|---|---|---|---|
| Year | Location SRT | Volume (MBF) | Area (acres) | Construction | Reconstruction |
| 87 | Sec. 16, T25N, R21W | 1000 | 250 | 2.5 | * |
| 87 | Sec. 16, T25N, R22W | 600 | 368 | 0.5 | * |
| 87 | Sec. 26, T25N, R22W | 1000 | 500 | 2.5 | * |
| 89 | Sec. 16, T24W, R19W | 250 | 50 | 1.0 | * |
| 91 | Sec. 36, T26N, R21W | 1500 | 500 | 2.0 | * |
| TOTALS | | 4350 | 1668 | 8.5 | |

*Construction/reconstruction not distinguished in the data.

Table 27. Planned/committed timber harvest activity in the Flathead Lake sub-basin.

Flathead Indian Reservation

Land Manager/Owner

| Year | Location SRT | Timber Sales: Volume (MBF) | Timber Sales: Area (acres) | Road Development (Miles): Construction | Road Development (Miles): Reconstruction |
|---|---|---|---|---|---|
| 86 | 1. Sec. 2, 26, 23, R19W T22N, Sec. 3-5, 9, 10 35, 34, 26, 27, 23, R20W, T22N | 8 500 | | 40 | * |
| 86 | 2. Sec. 32, 29, 17, 8; R20W, T21N | 1 500 | 200 | * | * |
| 87 | 3. Sec. 28, 21, 22; R21W T22N, Sec. 15, 9-11, 1-3, 34-36, 26, 27, R21W, T23N | 4 000 | * | * | * |
| 88 | 4. Sec. 7, 6, R20W, T24N Sec. 5, 8, R21W, T24N | 2 000 | * | * | * |
| 88 | 5. Sec. 23, 24; R19W, T23N Sec. 18, 7, 6, 1, 2, 11-14, 5, 8, R19W T24N, Sec. 21, 22; R20W T23N, Sec. 15, 16, 8-10 3, R20W, T24N | 13,000 | * | * | * |
| 88 | 6. Sec. 17, 4-6, 7-9, 31 32, 11, 12, 1, 2; R21W T23N, Sec. 9, 10, 3, 4 33, R20W, T23N | * | * | * | * |
| TOTALS | | 29,000+ | 200+ | 40+ | |

*Data not available.

Table 28. Planned/committed timber harvest activity in the Flathead Lake sub-basin.

Plum Creek Timber Company

Land Manager/Owner

| | | Timber Sales[1] | | Road Development (Miles) | |
|---|---|---|---|---|---|
| Year | Location SRT | Volume (MBF) | Area (acres) | Construction | Reconstruction |
| 86 | S29, T26N, R19W | 3 700 | 300 | * | * |
| 86 | S5, 7, 8; T25N; R22W | 3 700 | 300 | * | * |
| 86 | S21, 22, 23; T25N, R22W | 3 700 | 300 | * | * |
| 86 | S17, 20; T25N, R22W | 3 700 | 300 | * | * |
| 86 | S15, T25N, R22W | 3 700 | 300 | * | * |
| 86 | S3, 10, T25N, R22W | 3 700 | 300 | * | * |
| 86 | S11, 12, 14; T25N; R21W | 3 700 | 300 | * | * |
| 87 | S30, T26N, R20W | 3 700 | 300 | * | * |
| 87 | S21, T25N, R20W | 3 700 | 300 | * | * |
| 88 | S18, 19; T25N, R22W | 3 700 | 300 | * | * |
| 88 | S31, T26N, R20W<br>S25, T26N, R21W | 3700 | 300 | * | * |
| TOTALS | | 40,700 | 3300 | | |

[1]Average volume and area of all sales.

*Data not available.