1964
~~1954~~

FLOOD DAMAGES

TO

FISH AND WILDLIFE HABITAT

IN

WESTERN MONTANA

Portland, Oregon
August 1964

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INTRODUCTION

A flood occurred on June 8-9, 1964, in northwestern Montana that was larger than any previously recorded for this area. Waters swept down the Flathead, Marias, Teton, Sun, and other rivers, taking many lives, leaving thousands homeless, and causing damages estimated in excess of $50 million. The floods were caused by run-off from rains 2 to 16 inches in depth which fell during a period of 30 hours on above-normal snow packs in Glacier National Park and in the area immediately southward along the Continental Divide.

Damages occurred not only to man and his structures but also to the fish and wildlife resources of the area. Wildlife populations suffered mortalities of individuals, but their basic habitat was not significantly damaged. Fish habitat, on the other hand, underwent drastic changes. Fundamental habitat requirements such as food production areas, spawning and rearing areas, migration routes, depth of pools, and amount of cover, all were changed to varying degrees and in ways detrimental to fish populations.

The areas of damage to fish habitat and fishing covered in this report are confined to: (1) Flathead River basin in the United States downstream including Flathead Lake, which is a part of the Columbia River system and referred to as the West Slope; (2) St. Mary, Waterton, and Belly Rivers in the United States which flow into Canada in the Hudson Bay drainage; and (3) Marias, Teton, Dearborn, and Sun Rivers east of the Continental Divide, which are a part of the Missouri River system and referred to as the East Slope (plate 1). There also were extensive damages to other Federal lands outside of the study area, but these are not included in this report. Flood damage occurred in the largest recreational area of its type in the United States and consists mostly of Federal and Indian lands. It is made up of Glacier National Park (1,013,129 acres), Flathead National Forest (2,335,985 acres), Lewis and Clark National Forest (2,031,918 acres), Blackfeet Indian Reservation (2,300,000 acres) and portions of the Helena and Lolo National Forests. The area of flood damage considered in this report is approximately 8,000,000 acres (plate 2).

The objectives of this report are to provide a description of the flood area, outline flood damages to fish and wildlife resources, describe extent and types of damages and the effects of the flood on fish and wildlife resources, and recommend measures to restore the fish resources by the following progress:

(1) An immediate program of fish habitat restoration and replacement should be undertaken, where damages to fish resources are readily recognizable. There are many instances of bank erosion, mud and gravel deposition, blockage of migration routes, and destruction of pools that should be rectified immediately.

(2) An immediate program of habitat restoration should be undertaken in conjunction with flood-damage repairs of other agencies. As bridges, highways, railroads, irrigation ditches, and access roads are replaced, steps should be taken to insure that fish habitat is not further damaged by proposed construction. Slight modifications of design or construction techniques to restore the affected area for fish should be considered.

(3) A determination should be made of the extent of the changes to the fish population; and

(4) Measures should be undertaken for restoration.

WILDLIFE RESOURCES

Wildlife resources are abundant and include moose, Rocky Mountain elk, grizzly bears, black bears, mule and white-tailed deer, mountain goats, mountain sheep, ring-necked pheasants, blue, ruffed, Franklin's, and sharptail grouse, Hungarian partridge, and various species of waterfowl. A considerable amount of hunting occurs annually, particularly for big-game animals.

Losses to wildlife were confined primarily to the destruction of pheasant, grouse, and waterfowl nests and young pheasants.

FISH RESOURCES

Fish resources of the area under consideration are a part of the vast recreational complex within the northwestern United States. A total of 2,700,000 visitor-days were recorded in 1963 for the Federal and Indian lands within the flood area. It is estimated that an additional 750,000 visitor-days were spent on private areas. Much of the public use is based on recreational fishing by visitors from all over the United States, as well as from foreign countries. Flathead Lake, Duck Lake, and the South Fork of the Flathead River, have attained national prominence for their fine fishing. Hundreds

of back country lakes and streams collectively attract a great number of anglers who like to fish the more remote waters away from all contact with modern civilization.

The Continental Divide separates the fish resources of the flood area into two distinct types. The West Slope river systems are a part of the habitat complex required by migratory fish populations of Flathead Lake. The East Slope has its own resident fish populations for each river system.

West Slope Fishery

Within this drainage is one of the last remaining areas that contain a self-sustaining population of west-slope cutthroat trout. This species, as well as Dolly Varden trout, kokanee salmon (landlocked sockeye), and mountain whitefish, migrate from Flathead Lake to upstream tributaries to spawn. Tag recoveries of Dolly Varden and cutthroat trout indicate that these fishes travel in excess of 100 miles upstream to spawn. Great numbers of kokanee use the river system for spawning as far as 80 miles upstream from the lake. This heavy use of available spawning streams is caused, in part, through recent losses of several important tributary streams by construction of dams. The migratory nature of these fishes creates an interdependence between the lake and its tributaries, requiring management of the entire system as a unit. The upper reaches of the Middle and North Fork Flathead Rivers provide excellent fishing for one or more of these migratory species throughout the angling season. Many trophy fish are caught throughout the area.

Isolated populations of grayling, largemouth bass, and lake, brook, and rainbow trout occur throughout the drainage and also provide excellent fishing.

East Slope Fishery

The stream systems of the East Slope are a part of the Hudson Bay and Missouri River drainages. The fish resources of these two drainages are similar and include cutthroat, brook, rainbow, brown, Dolly Varden, and lake trout, and grayling and whitefish. In addition, northern pike and ling are found in a few of the lower areas. Public access to these streams is excellent, since most of the area is comprised of Federal and Indian lands. Resident anglers fish the waters throughout the year and intensive angling occurs during the summer months by resident and nonresident fishermen. User fees to fish on Indian lands provide a source of income to the Blackfeet Indian Tribe. Spectacular catches of fish are made in the area. Lake trout weighing up to 30 pounds have been caught in St. Mary Lake. Rainbow trout caught from Duck Lake consistently garner high awards in magazine contests. Streams and lakes of remote wilderness sections also have very high aesthetic values.

The fishing waters consist of numerous mountain and foothill lakes as well as a series of streams and rivers that arise along the Continental Divide. The St. Mary, Waterton, and Belly River drainages flow in a northeasterly direction. In the Missouri River drainage the Milk, Marias, Teton, Sun, and Dearborn Rivers and their tributaries flow generally eastward. Each of these systems supports its own resident fish population.

FLOOD DAMAGE TO FISH RESOURCES

The flood affected fish populations in various ways. Young fish of the year probably suffered heavy mortality by being washed out of their small natal streams and carried down to larger unsuitable waters. Other fishes were killed by stranding, injuries from moving objects, and possibly by silt suffocation.

One instance of fish population depletion attributable to the flood was documented by the Montana Department of Fish and Game in a typical flood-damaged stream on the Lolo National Forest west of the study area. Population samples taken by an electric shocker from a 1,000-foot section of Graves Creek after the flood were compared with the number of fishes taken from the same section of stream a year before. The total numbers game fish decreased 85 percent, and one game species was no longer found in this section.

Table 1. Population Samples, Graves Creek

Species	No. Fishes Taken Aug. 4, 1963	No. Fishes Taken Aug. 5, 1964
Whitefish	90	21
Rainbow trout	79	1
Cutthroat	27	9
Dolly Varden trout	16	0
Total	212	31

The most serious damage was the change of basic habitat conditions. The heavy damage to fishing streams and lakes which occurred could seriously impair fish production for many years. Flood flows carried boulders, trees, gravel, silt and detritus which ground up or suffocated the bottom organisms that provide fishes with basic sustenance. Sand and silt covered up riffle areas and impaired future productivity of the area. Spawning beds were covered by fine silt in some areas and by boulders and debris in others. Trees and protective vegetation

were stripped from many miles of streambank. Streams carrying heavy silt and gravel loads lost their momentum and dropped this material in the channel and then fanned out over the bottomlands, changing stream courses. Pools were filled, eliminating much of the cover necessary for fish life. Silt, gravel, and debris were deposited in areas near the mouths of streams, forming impassable barriers to trout and kokanee salmon that must migrate up these streams to spawn. In addition, erosion may have made it possible for rough fish species to invade waters inhabited by desirable resident species. Flood flows also eliminated many oxbows and sections of formerly productive streams, resulting in increased water velocities.

Damage to lakes is serious, though not as obviously dramatic as that occurring in the streams. Since siltation affects water clarity, it is detrimental to basic fishfood production within a lake. Light penetration is necessary to production and sustenance of many aquatic fishfood organisms. Siltation also affects spawning beds for lake-spawning fishes.

Flathead Lake received tons of debris and colloidal materials, which reduced the light penetration in the water and inhibited the production of plankton. Since this is the basic food for kokanee, this species undoubtedly will be affected.

In other lakes, the inflow of muddy and debris-laden water may have decreased the oxygen in deep waters, affecting the habits and movements of resident species. The concentration of fishes in certain areas has resulted in abnormal losses to predation. The destruction of irrigation facilities has caused landowners to pump water from one large natural lake, thereby threatening elimination of the fish population.

Flood waters also destroyed access to many of the good fishing areas by eliminating trails and roads. Emergency measures which have been taken by agencies to restore these facilities have resulted in further local damage to fish habitat. Plans now being developed for reconstruction of permanent facilities could result in additional damage to fish resources unless proper planning and coordination take place.

TECHNICAL FISHERY ASSISTANCE PROGRAM

It is recommended that fishery biologists of this Bureau cooperate with the various Federal and State agencies in order to reduce construction damage to stream habitat when facilities lost or damaged by the flood are replaced. Plans for these facilities would be

studied and measures recommended to construction agencies for minimizing damages to stream habitat. Reduction of damage could be effected by: (1) confining bulldozer crossings to a minimum, (2) keeping equipment out of streams during spawning and migration, (3) constructing culverts and bridges to allow for fish passage, (4) keeping cement out of lakes and streams, (5) keeping fill and spoil out of fishing waters, (6) placing of rip-rap to protect pools and spawning areas, and (7) by providing for fish protective facilities in irrigation canals. Routing of roads and trails should be done so as to replace destroyed access areas to fishing. Other measures would become apparent with further study.

Personnel costs of this program have been estimated at $30,000 annually for three years.

FISH HABITAT RESTORATION PROGRAM

A program of immediate stream habitat restoration is recommended to restore these streams, as nearly as possible, to their former biotic productivity and aesthetic desirability. This program should consist of:

1. Stabilization of streambanks by use of vegetative planting, rip-rap, anchored-logs, boulders, and rock-filled-wire cribs (Gabion structures).

2. Installation of flow-concentrating structures designed to use the force of water to dig out pools and remove silt.

3. Construction of small rock or log dams designed to provide pools above and below the recommended structures.

4. Diversion of side flows into the main stream channel.

5. Manipulations of channels to reduce velocities and restore the length of fishing waters by restoring streams into meander patterns.

6. Elimination of log jams, debris, and gravel deposits that block spawning migrations.

In addition to stream restoration, the above facilities will be of considerable aid in preventing turbidity during future high runoff periods when constructed on streams tributary to lakes. Preliminary surveys of the damaged lakes must be made before habitat restoration measures can be determined.

The extent of flood damages is described below for Glacier National Park, the several National Forests, and the Blackfeet Indian Reservation:

Glacier National Park

Damage to fish habitat in Glacier National Park was extensive and occurred on both sides of the Continental Divide. There were 335 miles of fish habitat damaged, which comprises 75 percent of all fishable streams in the Park. Habitat destruction is evident in all stream courses originating in the zones of heavy precipitation (plate 2). Miles of streams damaged within the Park for the three major basins are as follows: Missouri River, 55; Hudson Bay, 90; and Columbia River, 190. Streams on the boundary of the Park are included in the discussion of Flathead National Forest below.

Most lakes in the Park were affected to some degree by the abnormal inflow. Back country lakes at high elevations were not damaged, however, the lower lakes received the heavy silt and gravel loads of their tributaries. The extent of damages to lakes by basins are as follows: Missouri River, 430 acres; Hudson Bay, 5,000 acres; and Columbia River, 13,000 acres. It will be necessary to conduct fishery surveys to determine extent of damage and possible restoration measures.

The immediate fishery program in the Park should be centered around technical assistance in the restoration of use facilities. In order to prevent further losses and to protect the fish resources, restoration of fish habitat should be planned in conjunction with reconstruction of roads, bridges, and trails. This is in keeping with the Park policy of retaining natural phenomena features for visitors. The restoration program should be coordinated with the Park plan of stream protection. Immediate surveys should be instigated to investigate damages to lakes in order to determine needed restoration.

Flathead National Forest

Flood damage to fish habitat is evident in the North, Middle, and South Fork systems of the Flathead River with the most severe damage occurring on the Middle Fork and its tributaries. The Middle Fork originates in the area where the heaviest rainfall of the storm occurred. Streams of the South and North Fork systems were damaged to a lesser extent. Although stream habitat damage in the Flathead National Forest portions of the Flathead River basin is very extensive, practicable restoration is limited to about 200 miles of the main forks and their tributaries. Immediate restoration measures should be undertaken.

Hungry Horse Reservoir and Flathead Lake received tremendous silt loads, as well as debris from flood waters. Fishery surveys are needed to determine extent of damage and possible restoration measures. Hungry Horse Reservoir has discharged silt-laden waters into the river system since the flood. The effect on the spawning run of migrating kokanee salmon that will occur in the fall of 1964 should be determined. Lake habitat influenced by flood damage is about 150,000 acres.

Helena National Forest

Flood damages were restricted to 25 miles of stream habitat on the Lincoln Ranger District of the Helena National Forest. These streams are a part of the Columbia River basin.

Lolo National Forest

Flood damages were restricted to 24 miles of stream habitat on the Seeley Lake Ranger District, which also is a part of the Columbia River basin.

Lewis and Clark National Forest

Flood damages occurred to 129 miles on both small and large streams within this Forest, which is located within the Missouri River basin. Lakes were not affected as seriously, although they received a considerable amount of sediment.

The upper tributaries to Sun River are famous trout fishing streams, and many of these are located in the Bob Marshall Wilderness Area. These were heavily damaged by scouring, gravel deposition, and loss of bank cover.

Principal types of stream habitat restoration needed include channel manipulation and bank stabilization. In many places silt should be removed from spawning beds by flow-concentrating devices. Preliminary surveys are needed to determine the extent of the badly damaged areas and where restoration can be accomplished most advantageously. Immediate restoration will be concentrated on structures that restore known areas of damage.

Blackfeet Indian Reservation

Fish habitat and populations were severely affected by the flood. Trout streams immediately downstream adjoining Glacier National Park received the brunt of the flows from higher elevations. All the streams on the Reservation were altered; bottoms of streams were scoured; streambeds destroyed; and silt and debris deposited in the stream channels and adjacent flood plains. Over 90 percent of the trout stream habitat on the Reservation was severely damaged.

Lower St. Mary Lake received large quantities of silt that have remained in suspension. This may prove damaging to lake whitefish and lake trout eggs this fall. Commercial take of whitefish provides revenue for the Blackfeet Tribe. The size of Lower Two Medicine Lake on the Two Medicine River was increased in 1915 to provide irrigation storage. The dam providing this storage washed out adding to the destruction in the flood plain below. The Bureau of Indian Affairs plans to rebuild this dam, possibly at a lower site downstream near the confluence of the South and West Forks of the Two Medicine River. Chemical treatment of the remaining lake and the streams between Trick Falls and Two Medicine Falls should be undertaken to remove

nongame fishes. The loss of this reservoir necessitated replacement of irrigation water from Mission Lake. Water is now being pumped to supply the irrigated lands, which is adversely affecting the fishery in Mission Lake. This fishery may be lost during the winter of 1984-1985 if the drawdown is severe.

Personnel costs of the Fish Habitat Restoration Program have been estimated at $60,000 annually for three years.

Table 2. Summary of Estimated Costs of Fish Habitat Restoration Program

Area	Size (Acres)	Stream Drainage (Miles)	Lake Drainage (Acres)	Est. Cost Restoration
Hudson Bay				
G.N.P. 1/	328,073	60	5,000	-
B.I.R.	125,000	25	1,200	$ 35,000
Missouri River				
G.N.P.	72,320	55	430	20,000
L.&C.N.F.	2,031,818	129	-	129,000
B.I.R.	2,125,000	264	1,550	278,500
Columbia River				
G.N.P.	614,736	190	13,100	40,000
F.H.F.	2,383,365	200	25,000	200,000
H.N.F.	934,509	25	-	25,000
L.N.F.	405,351	24	-	24,000
F.L.	125,000	-	125,000	-
Construction Costs				741,500
Personnel Costs for Three Years 2/				180,000
Total Cost of Program				$921,500

1/ Abbreviations: G.N.P. (Glacier National Park); B.I.R. (Blackfeet Indian Reservation); L.&C.N.F. (Lewis & Clark National Forest); F.N.F. (Flathead National Forest); H.N.F. (Helena National Forest); L.N.F. (Lolo National Forest); F.L. (Flathead Lake).

2/ Personnel costs would include salaries, travel, etc. for Bureau of Sport Fisheries and Wildlife.

INVESTIGATION OF FACTORS LIMITING NATURAL FISH PRODUCTION

Detrimental changes to the fish habitat cannot be ascertained without detailed knowledge of ecological factors that influence fish populations throughout their lifetime. A program should be initiated that will determine long-range effects of the flood on the basic fish resources, and will provide a basis for ultimate restoration measures. This will involve fish population studies of all species and the effect that various factors have on these resources.

Many of the fishes in the flood area require several years to reach sexual maturity and influences due to changed conditions will not be evident until that time. Since kokanee salmon is one of the main species involved and its life cycle requires four years, this length of time will be needed to measure the influence on only one generation.

Detailed information must be obtained to determine whether or not fish reproduction is adequate. Trout and salmon are very specific in spawning requirements, and spawning areas are known to have been drastically changed by the flood. Future fish populations are dependent on the replacement of adult fish. Moreover, in areas where reproduction is inadequate, restoration of natural habitat or stocking will be required.

One important consideration is the effects of the flood upon the migration patterns of fishes. Physical obstructions will affect fish migrations due to damages caused by the flood.

Other changes have no doubt affected downstream migrations of young fishes. Such changes must be determined in order to evaluate needed improvements to spawning streams.

Detailed information must be obtained to determine if adequate streamside vegetation, resting pools and riffles will be available. Determination should be made of the possible increased vulnerability of fishes to predation, in view of the changed habitat. Adequate habitat is essential for the protection of fishes throughout their life span. Changes in management regulations may be needed in order to provide protection for fishes.

Most of the above program might be obtained by coordinated efforts of the land management agencies in their programs of watershed protection.

The fishes that have inhabited these watersheds are primarily cold-water species. These fish are specific in their selection of water

temperatures and it will require several years before influence of the flood on water temperatures can be determined. This program should investigate temperature changes attributable to destruction of streamside vegetation. Restoration of streambank vegetation may be desirable. Water temperature is vital to the hatching time of eggs, spawning migrations, and food production. It also affects the invasion of habitat by nongame species. Provision for long-range observations should be made on the effects of silt deposits. Streambed studies should be made to determine fishfood production. Colloidal silt in lakes and silt deposits in streams interfere with food production and subsequent fish growth resulting in lack of replacement of catchable fishes.

Removal of silt from streambed areas will not only aid stream habitat restoration but also alleviate silt problems of lakes. Measures for removing silt should be determined in the above program.

Cost of this program has been estimated at $20,000 annually for four years.

CONCLUSION

Construction cost of the Fish Habitat Restoration Program has been estimated at $741,500.

Estimated annual costs of personnel services by the Bureau of Sport Fisheries and Wildlife for concurrent programs are as follows: Technical Fishery Assistance Program, $30,000; Fish Habitat Restoration Program, $50,000; and Investigation of Factors Limiting Natural Fish Production, $20,000. Thus, the total estimated personnel costs for the first three years would be $330,000 and for the fourth year $20,000, making a total cost of $350,000.

The total cost of construction and personnel services for four years would amount to $1,091,500.

Table 3. Estimated Costs of Program by Fiscal Years

Program	Fiscal Years 1965	1966	1967	1968	Total
Fishery Technical Assistance	$ 30,000	$ 30,000	$ 30,000		$ 90,000
Fish Habitat Restoration					
Construction	141,500	300,000	300,000		741,500
Personnel	50,000	50,000	50,000		150,000
Fishery Investigations	20,000	20,000	20,000	$20,000	80,000
Total	$251,500	$410,000	$410,000	$20,000	$1,091,500

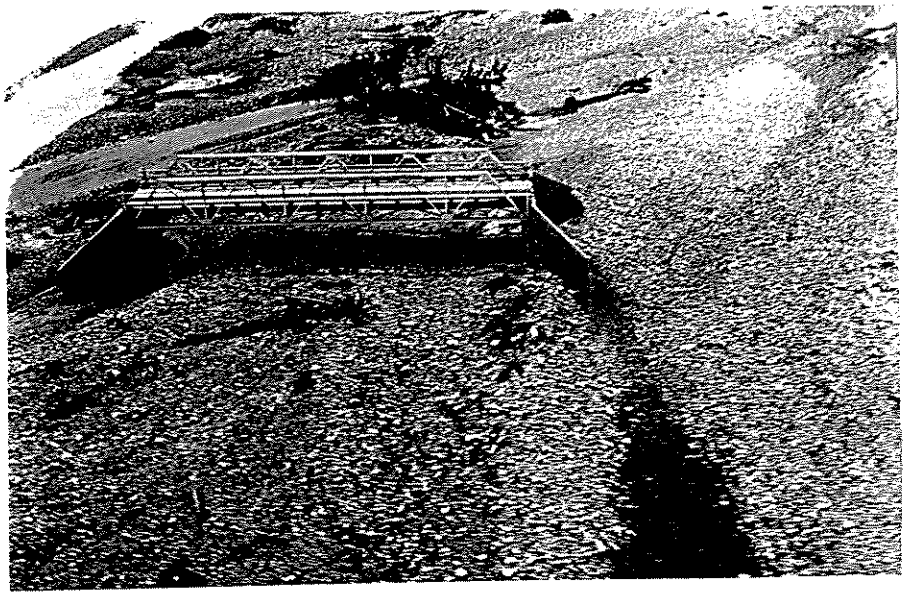


Figure 1. Changes in stream channel of Teton River, Lewis & Clark National Forest (Photo courtesy of Lewis & Clark National Forest).

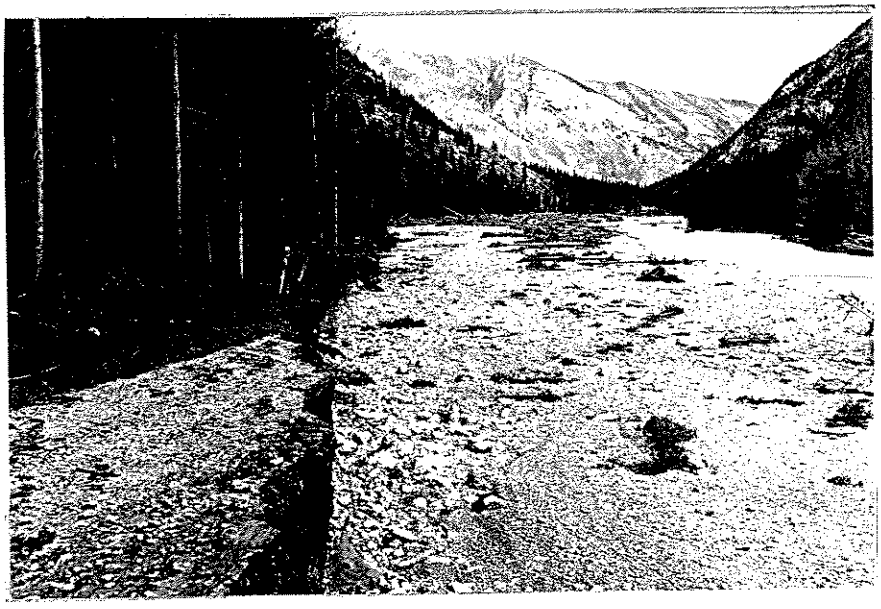


Figure 2. Destruction of streambank cover along Teton River, Lewis & Clark National Forest (Photo courtesy Lewis & Clark National Forest).

Figure 3. Typical log jam caused by flood along Straight Creek, Lewis & Clark National Forest (Photo courtesy of Lewis & Clark National Forest).

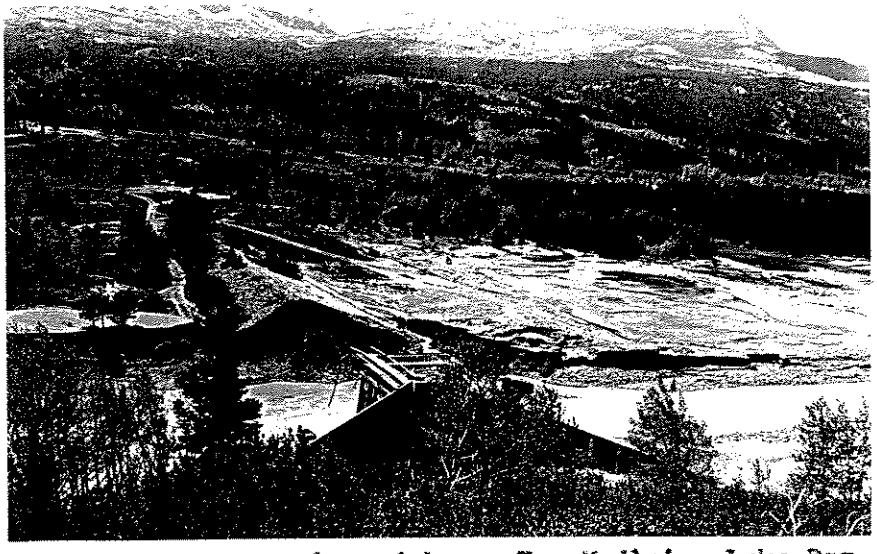


Figure 4. Destruction of Lower Two Medicine Lake Dam on Two Medicine River of Blackfeet Indian Reservation (Photo courtesy of Glacier National Park).

Figure 5. View of Two Medicine River downstream from bridge near Trick Falls prior to flood (May 1964) in Glacier National Park.

Figure 6. View of same area after flood on August 5, 1964.

Figure 7. Water flowing over old Belton Bridge on June 8, 1964, Middle Fork Flathead River, Glacier National Park (Photo courtesy of Glacier National Park).

Figure 8. Destruction of U.S. Highway 2 along Middle Fork Flathead River on Flathead National Forest (Photo courtesy U.S. Forest Service).

Figure 9. Silt and gravel deposition in stream channel Flathead National Forest (Photo courtesy Montana Department of Fish and Game.)

Figure 10. View of South Fork White River above Needle Fall, July 10, 1964, Flathead National Forest (Photo courtesy Montana Department of Fish and Game.)

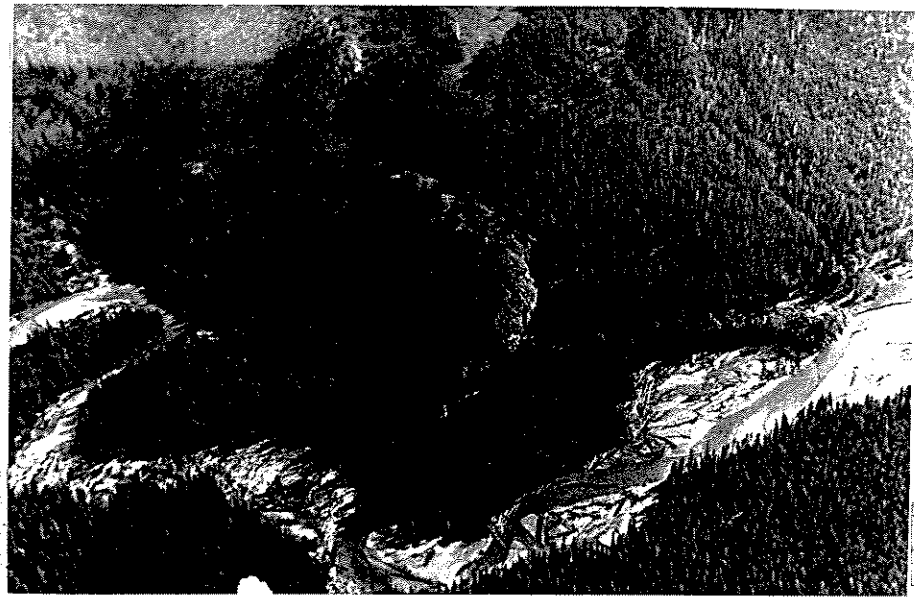
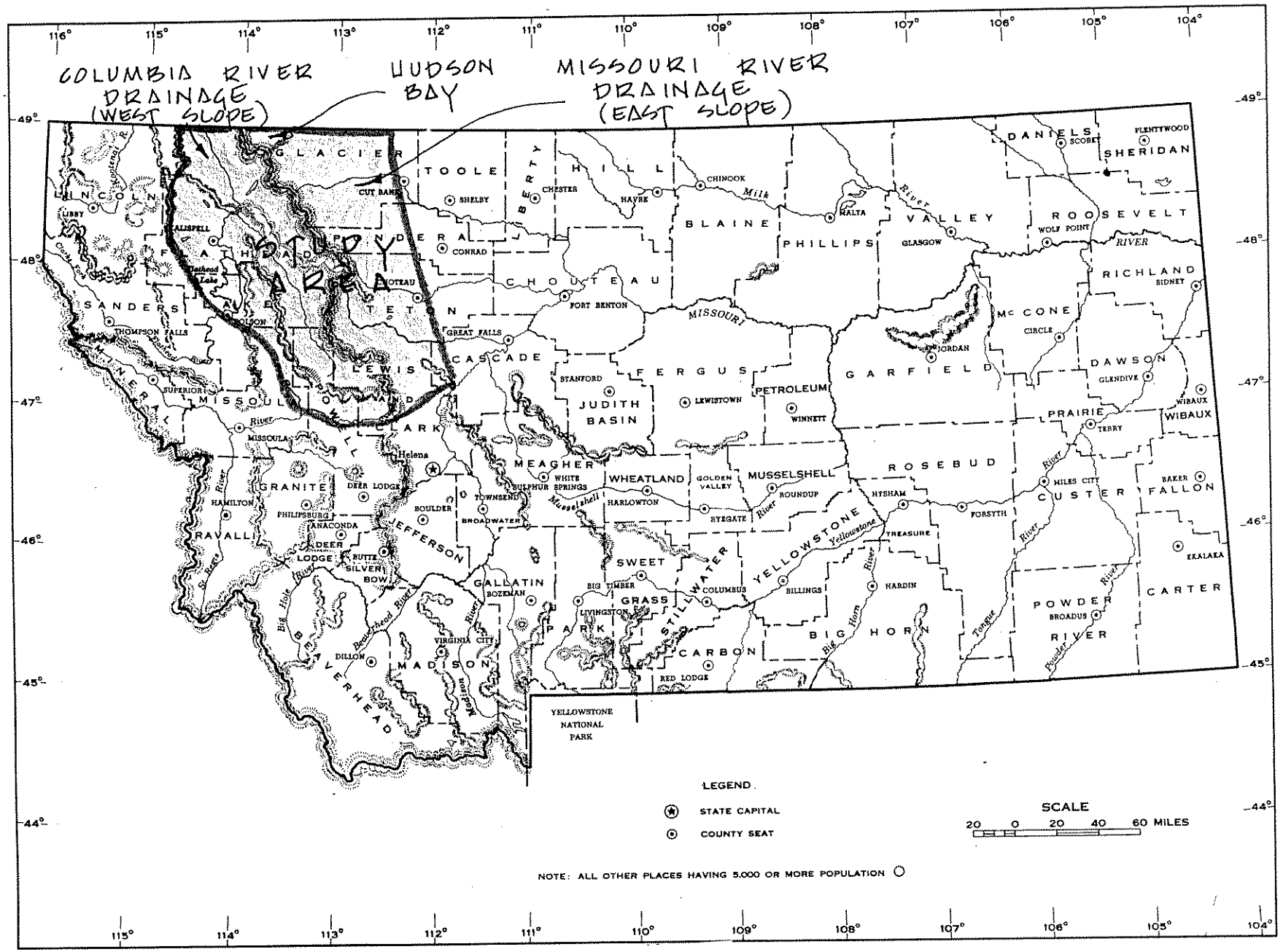


Figure 11. View of destruction along Middle Fork Flathead River in Bob Marshall Wilderness Area of Flathead National Forest (Photo courtesy of Montana Department of Fish and Game.)



MONTANA

PLATE 1

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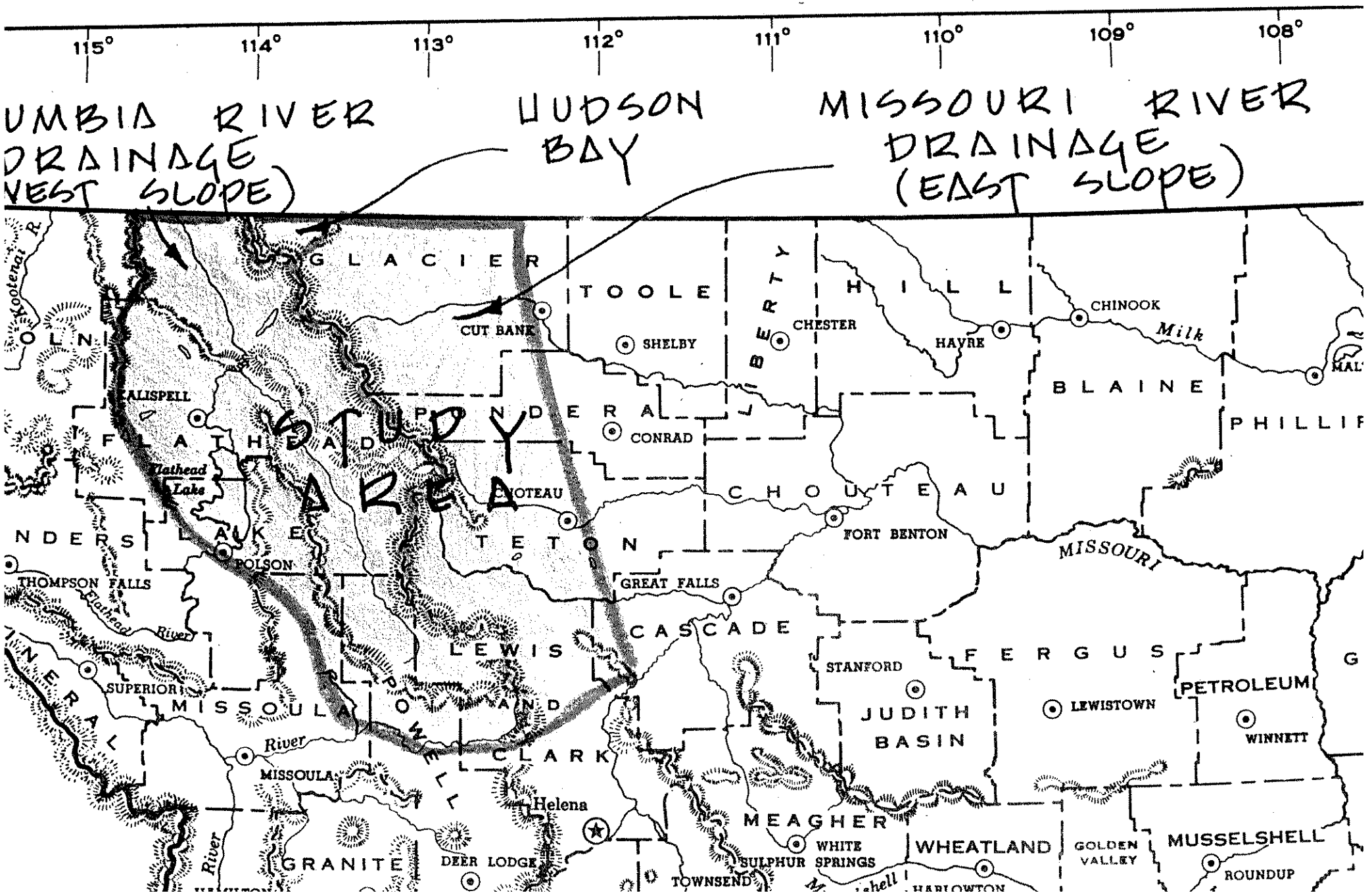
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FORT BENTON
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TETON
POLSON
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GREAT FALLS
CASCADE
LEWIS
CLARK
FERGUS
STANFORD
PETROLEUM
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MISSOULA
JUDITH
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SULPHUR SPRINGS
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VALLEY
MUSSELSHELL
ROUNDUP
GRANITE
DEER LODGE
TOWNSEND

F-F-32

STATE OF MONTANA

DEPARTMENT OF FISH AND GAME

HELENA, MONTANA

Office Memorandum

TO : MEMO TO FILE

DATE: August 18, 1964

FROM : ART WHITNEY

SUBJECT: Flood damage report by Bureau of Sport Fisheries and Wildlife

Walt Allen left a copy of the subject report in this office on August 13, 1964. This was reviewed by Holton and Whitney and discussed by Whitney in Staff meeting on August 14. Basically it is a good report. It represents considerable effort and dramatically expresses the need for habitat rehabilitation. A few suggestions are penciled in the margins of the carbon copy and were discussed by Holton on a conference call with Pillow, Robbins and Parkhurst on August 17. They agreed to the changes.

The end result of this report will likely be the assignment of a Forest Service team (consisting of a watershed hydrologist and a fishery biologist) to survey the damaged areas in detail and make specific recommendations for corrective measures. This received the Director's verbal approval in staff.

The Fish and Wildlife Service has spent considerable additional time editing this report in Portland and have now worked up the long-range research plan as well. It is understood that this will basically be the same as a portion of Phenicie's old CBIAC research program. It was their intent to have someone fly to Helena with the completed report to go over it. We advised them that we did not feel this would be necessary since our Director has already been appraised of the basic concepts involved and had approved them.

George Halton

Prepared by BSF+W
(allen & Pillan)
Aug 13, 1964

INTRODUCTION

On June 8-9, 1964, a flood occurred in northwestern Montana that was larger than any previously recorded for this area. Waters swept down the Flathead, Marias, Teton, Sun and other rivers, causing over fifty million dollars damage, taking many lives and leaving thousands homeless. The floods were caused by run-off from rains of from 3 to 16 inches in depth which fell on above-normal snow packs in Glacier National Park and the continental divide immediately southward.

Damages occurred not only to man and his structures, but to the fish and wildlife resources of the area. Wildlife populations suffered mortalities of individuals, but their basic habitat was not significantly damaged. Fish habitat on the other hand, underwent drastic changes. Fundamental habitat requirements of food production areas, spawning and rearing areas, migration routes, depth of pools, and amount of cover, all were changed to varying degrees, and in ways detrimental to fish populations.

OBJECTIVES

The objectives of this report are threefold:

1. To point out the need of an immediate program of habitat restoration and replacement where damage to fishery resources is readily recognizable. There are many instances of bank erosion, mud and gravel deposition, blockage of migration routes and destruction of pools that should be rectified immediately.

2. To initiate an immediate program of habitat restoration in conjunction with flood damage repairs of other agencies, as bridges, highways, railroads, irrigation ditches, access roads etc. are replaced, many things can be done to insure that fish habitat is not further damaged by this construction. Also slight modifications of design, or in construction techniques, often

restore the affected area for fish.

3. To show the need for a determination of the extent of the changes to the fish population itself, and to devise measures to restore it to its former abundance.

FLOOD AREA

For the purpose of this report, the area of damage to the fishery resources will be confined to the following areas:

1. The Flathead River system in the United States downstream to and including Flathead Lake. This is part of the Columbia River system.

2. The St. Mary, Waterton and Belly River drainages in the United States which flow into Canada. This a part of the Hudson Bay drainage.

3. The upper tributaries of the Marias, Teton, Dearborne and Sun Rivers east of the continental divide and west of a line drawn from Cutbank to Craig Montana. These are part of the Missouri river system.

The area of flood damage is located in the largest recreational area of its type in the United States and consists mostly of Federal and Indian lands. It is made up of Glacier National Park (1,013,129 acres), Flathead National Forest (2,335,565 acres), Lewis and Clark National Forest (2,031,618 acres), Blackfeet Indian Reservation (2,500,000 acres) and portions of the Helena and Lolo National Forests. Flathead lake consists of 125,000 acres of navigable water and some of the shoreline is publicly owned. There is a small amount of private land along the Flathead River between the Lake and the National Forest.

THE WILDLIFE RESOURCE

Wildlife resources in this area are abundant and varied. Big game species are moose, Rocky Mountain elk, grizzly bear, black bear, mule deer, whitetail deer, mountain goat and mountain sheep. The Elk, black bear, and deer pop-

ulations are large and provide a considerable amount of hunting. Upland game species consist of ringneck pheasants in the valleys and three species of grouse in the mountains. Waterfowl are moderately abundant around the lakes and lowlands.

Losses to wildlife because of the flood were confined mostly to the upland game bird population ~~when many pheasant~~ with broods and nests ~~were drowned.~~ flooded out. Resident waterfowl also suffered in the same manner, but big game losses were light.

Effects of flood damage to wildlife habitat has been considered, but significant ecological changes to the land are not predicted.

THE FISHERY RESOURCE

The fishery resource of the area under consideration is a part of the vast recreational complex within the northwestern United States. In 1963, a total of 2,700,000 visitor days were recorded for the Federal and Indian areas and it is estimated that an additional 750,000 days were spent on private areas. Much of this public use is based on recreational fishing which attracts visitors from all over the United States, as well as from foreign countries. Flathead Lake, Duck Lake and the South Fork of the Flathead River, have obtained national prominence for their fine fishing. Collectively, the hundreds of back country lakes and streams attract a great number of anglers who like to fish the more remote waters away from all contact with civilization. This area is considered to have a great potential for providing fishing opportunities for the rapidly expanding use of the recreation-minded public.

West Slope Fishery

Within this drainage is one of the last remaining areas that contain a self-sustaining population of west-slope cutthroat trout. This endangered species, as well as Dolly Varden trout, kokanee salmon (landlocked sockeye),

and mountain whitefish, migrate from Flathead Lake to upstream tributaries to spawn. Tag recoveries of Dolly Varden and cutthroat trout indicate spawning runs in excess of 100 miles upstream. Great numbers of kokanee salmon utilize the river system for spawning as far as eighty miles above the lake. This heavy use of available spawning streams is caused, in part, by recent losses of several important tributary streams to mans activities. The migratory nature of these fishes creates an interdependence between the lake and its tributaries, requiring management of the entire system as a unit. The upper reaches of the Middle and North Fork Flathead Rivers provide excellent fishing for one or more of these migratory species throughout the angling season. Many trophy fish are caught throughout the system.

Isolated populations of grayling, largemouth bass, and lake, brook and rainbow trouts occur throughout the drainage, and provide excellent fishing to anglers willing to seek them out.

East Slope Fishery

The stream systems of the East Slope are a part of the Hudson Bay and Missouri River drainages. The fishery resources of these basins are similar with cutthroat, brook, rainbow, brown, Dolly Varden and Lake trouts, grayling and whitefish present. In addition, northern pike and ling are found in restricted lower areas. Public access to this resource is excellent, with most of the area Federal and Indian lands. Resident anglers utilize the waters throughout the year and intensive use occurs during the summer months by resident as well as non-resident fisherman. User fees based on fishery management of tribal waters provide a source of income to the Blackfeet Indian Tribe. Much of the fishery resource is of a spectacular nature, lake trout weighing up to 50 pounds have been caught in St. Marys Lake. Rainbow trout caught from Duck Lake consistantly garner high awards in magazine contests.

Streams and lakes of remote wilderness sections have very high aesthetic values and are utilized by many tourists.

The fishing water consists of numerous mountain and foothill lakes as well as a series of streams and rivers that arise along the continental divide. The St. Mary, Waterton and Belly drainages flow in a northeasterly direction. In the Missouri drainage the Milk, Marias, Teton, Sun and Dearborn Rivers and their tributaries flow generally eastward in a parallel manner. Each of these systems have their own resident fish populations.

FLOOD DAMAGE TO FISHERY RESOURCES

The flood affected fish populations in various ways. Young fish of the 1964 year class of spring spawning species undoubtedly suffered heavy mortality by being washed out of their small natal streams and carried down to larger waters unsuitable to them. Other fish, especially the smaller ones, were killed by silt suffocation, stranding, or by injuries from moving objects.

One instance of fish population depletion attributable to the flood was documented by the Montana Fish and Game Department in a stream on the Lolo National Forest where damage is typical of the flood area. Population samples taken by an electric shocker from a 1,000 foot section of Graves Creek after the flood, were compared with the number of fish taken from the same section of stream a year before. The total numbers of fish decreased 86%, but game fish decreased 93% and two game species were completely eliminated.

Population Samples, Graves Creek

	Number of Fish August 4, 1963	August 5, 1964
Whitefish	90	21
Rainbow trout	79	9
Cutthroat	27	0
Dolly Varden trout	16	0
Total	212	30

The most serious damage, however, was the change of basic habitat conditions. Heavy damage to fishing streams and lakes occurred to a degree

which could seriously impair fish production for years to come. Flood flows carried boulders, trees, gravel, silt and detritus to grind up or suffocate the bottom organisms that provide fish with basic sustenance. Sand and silt covered up riffle areas to smother these same organisms and impair future productivity of the area. Spawning beds were covered by fine silt in some areas, by boulders and debris in others. Trees and protective vegetation were stripped from many miles of streambank. Streams carrying heavy silt and gravel loads lost their momentum and dropped their loads in the channel, and then fanned out over the bottomland. Pools and holes were filled eliminating much of the cover necessary for fish life. Silt, gravel and debris were deposited in areas near the mouths of streams forming impassable barriers to species of trout and salmon that must migrate up these streams to spawn. On the other hand, erosion has destroyed certain barriers which may allow rough fish species to invade waters now inhabited by desirable resident species.

Flood flows cut through and eliminated stream meanders. This will increase water velocities and eliminate many sections of formerly productive streams.

Damage to lakes is serious, though not as dramatic as what has taken place in the streams. Siltation, as it affects water clarity, is a detrimental factor upon basic food production within a lake. Another possible affect of siltation would be covering of spawning beds for lake-spawning species such as lake trout.

Flathead Lake has received tons of debris including colloidol silt, greatly reducing the light penetration in the water, and inhibiting the production of plankton. Since this is the food for kokanee salmon, that species will undoubtedly be affected. Fishing success for kokanee has been poor since the flood.

In other lakes, the inflow of muddy water has decreased the oxygen in deep waters of the lake affecting the habits and movements of resident species. This has resulted in abnormal losses to predation and heavy fishing pressure possibly to the point of depleting the resource.

In one case, the destruction of irrigation facilities has caused landowners to pump water from a natural lake threatening it with complete drawdown and elimination of the fish population.

Flood waters did tremendous damage to trails, highways, and railroads which destroyed access to many of the good fishing areas. Emergency measures have been taken by local agencies to restore these facilities, which has resulted in further local damage to the fish habitat. Permanent plans for reconstructing facilities are now being developed and could result in additional damage to fisheries unless proper planning and coordination takes place.

HABITAT RESTORATION PROGRAM

General - A program of immediate stream habitat restoration is recommended to return these streams, as nearly as possible, to their former productivity of fish and aquatic organisms, and to their original desirability by anglers. This program will consist of:

1. Stream bank stabilization by use of, vegetative planting, rip rap, anchored logs, boulders, and rock filled wire cribs.

2. Flow - concentrating structures designed to use the force of the water to dig out pools and holes and to remove silt.

3. Creation of pools by construction of small rock or log dams designed to create a pool above and below the structure.

4. Structures that will divert side flows into the main stream channel.

5. Channel manipulation to reduce velocities and increase the length of fishing water by diverting streams into meander patterns.

6. Removal of log jams, debris and gravel deposits that block spawning migrations.

In addition to stream restoration the above facilities will be of considerable aid in improving water clarity and preventing turbidity during future high runoff when constructed on streams that are tributary to lakes. Preliminary surveys of the damaged lakes must be made before habitat restoration measures are apparent. This would primarily be directed toward removal of barriers between the lake and its spawning streams, though other rectification measures may become apparent.

Other preliminary surveys must be made immediately in order to determine waters where the 1964 year class of naturally-spawned fish should be replaced by hatchery fish.

TECHNICAL ASSISTANCE PROGRAM

It is recommended that fishery biologists of this Bureau work with the various Federal and State agencies in order to prevent further damage to stream habitat as a result of replacement of facilities lost or damaged by the flood. Plans for these facilities would be studied and recommendations advanced to constructing agencies for minimizing stream habitat damage by construction activities. Examples of ways to limit damage in this manner are: confining bulldozer crossings to a minimum, keeping them out of streams during spawning and migration, constructing of culverts and bridges to allow for fish passage, keeping raw cement out of lakes and streams, keeping fill and spoil out of fishing water, placing of rip rap to protect pools or spawning areas, and designing of irrigation facilities to protect fisher. Also routing of roads and trails can be done so as to replace destroyed access to fishing areas.

This program should be instigated immediately on all Federal areas that were damaged, since much of the planning and construction of facility replacement is already under way.

Glacier National Park

Damage to fishery habitat in Glacier National Park occurred on both sides of the Continental Divide. Damage was widespread throughout the Park, with habitat destruction evident in all stream courses whose headwaters originated in the heavy precipitation zones. The following is a summary of stream damage in the three major basins within the Park. Boundary streams will be included in the Flathead National Forest.

	Miles of Stream Damaged
Flathead River Drainage	190
Missouri River Drainage	55
Hudson Bay Drainage	90
Total	335

There was a total of 335 miles of fishery habitat damaged in Glacier National Park. This is about 75% of all fishable streams in the Park.

Most lakes in the Park were affected to some degree by the abnormal inflow. Back country lakes at high elevations were not damaged, however, the lower lakes received the heavy silt and gravel loads of their tributaries. Many of them will need fishery management surveys to determine extent of damage and possible restoration measures.

	Acres of Lakes Damaged
Flathead River Drainage	13,100 acres
Missouri River Drainage	430 "
Hudson Bay Drainage	5,000 "
Total	18,530

The immediate restoration program in the Park will be centered around technical assistance in the restoration of use facilities. In order to prevent further losses and to protect the fishery, restoration of fish habitat is planned in conjunction with rehabilitation of roads, bridges and trails. This is in keeping with Park policy of retaining natural phenomenon

features for park visitors. The restoration program would be coordinated with the park program of stream protection.

Immediate surveys should be instigated to investigate damages to lakes to determine needed rehabilitation measures.

FLATHEAD NATIONAL FOREST

Flood damage to fish habitat is evident in the North, Middle and South Fork systems of the Flathead River with the most severe damage ocurring on the Middle Fork and its tributaries. The Middle Fork originates in the area where the heaviest rainfall of the storm fell. Streams of the South and North Fork systems were damaged but to a lesser extent than the Middle Fork system. Although stream habitat damage in the Flathead National Forest portions of the Flathead River basin is very extensive, practicable restoration is limited to about 200 miles of the main Forks and their tributaries. Immediate rehabilitation measures on tributary streams should be undertaken.

Hungry Horse Reservoir and Flathead Lake received tremendous silt loads, as well as debris from flood waters. Fishery management surveys are needed to determine extent of damage and possible restoration measures. Hungry Horse Reservoir has discharged silt laden waters into the river system since the flood. The effect of this change on the spawning run of migrating kokanee salmon that will occur in the fall of 1964 should be determined.

Lake habitat influenced by flood damage is about 150,000 acres.

Helena National Forest

Flood damages were restricted to 25 miles of stream habitat on the Lincoln Ranger District of the Helena National Forest. These streams are a part of the Columbia River basin.

Lolo National Forest

The Seeley Lake Ranger District of the Lolo National Forest had flood damages to 24 miles of fish habitat. These streams are a part of the Columbia River basin.

Blackfeet Indian Reservation

Fishery habitat and fish populations were severely affected by the flood. The trout streams immediately down stream adjoining Glacier National Park received the brunt of the flows from the higher area. All the streams on the blackfeet Reservation were altered, bottoms of streams were scoured, stream beds destroyed and silt and debris deposited in the stream channel and the adjacent flood plains. Over 90% of the trout stream habitat on the Reservation was severely damaged.

	Miles Damaged
Hudson Bay Drainage	25
Missouri River Drainage	264

A total of 289 miles of trout stream habitat was damaged. Twenty-five miles of this is in the Hudson Bay drainage and the remainder in the Missouri drainage. Lower St. Mary received huge quantities of silt that remain in suspension to the present time. This may prove damaging to this Falls spawn of the lake Whitefish and lake Trout. The former provides a source of revenue for the Blackfeet Tribe. Lower Two Medicine Lake on the Two Medicine River was irrigation storage reservoir built in 1915. The structure washed out, adding to the flood and destruction in the flood plain below. This irrigation project is to be rebuilt, possible at a lower site below the confluence of the South and West Forks of the Two Medicine River. Prior to completion of this project, chemical treatment of the streams between Trick Falls and Two Medicine Falls should be done to remove undesirable fishes.

The loss of the reservoir necessitated replacement of irrigation water from Mission Lake. Water is now being pumped to supply the irrigated lands. This is affecting the fishery in Mission Lake. This fishery may be lost during the winter of 1964-1965 if the drawdown is severe.

LEWIS AND CLARK NATIONAL FOREST

The waters of the Lewis and Clark National Forest are a part of the Missouri River drainage. Both large and small streams on the Forest suffered damage from the exceptionally high runoff. Lakes were not affected as seriously, although they received a considerable amount of sediment.

Upper tributaries to the Sun River are famous trout fishing streams. Many of these are located in the Bob Marshall Wilderness Area. These were heavily damaged by scouring gravel deposition and loss of bank cover.

Principal types of stream habitat restoration needed are channel manipulating and bank stabilizing. In many places silt should be removed from spawning beds by flow-concentrating devices. Preliminary surveys are needed to determine the extent of the badly damaged areas and where restoration can be accomplished most advantageously. Immediate rehabilitation will be concentrated on structures that restore known areas of damage.

MONTANA Flood Area

Comments + Suggestions thru by visit of Helena

LONG RANGE PROGRAM to Determine Restoration Measures

1. Habitat Requirement
   a. Shade
   b. Pools
   c. Cover

2. Migration Studies
   a. weir counts
   b. barrier studies
   c. pattern changes

3. Spawning Ground Surveys
   a. affects of silt
   b. Extent
   c. Egg + fry survival
   d.

4. Food Study
   a. affects of silt
   b. quantity + quality of productive areas
   c.

5. Temperature Study

a. effect on fish

b. effect on food

c. change in species composition

6. Your Class Study (Flood related)

a. population of your classes

F+ & Wldlife

UNITED STATES GOVERNMENT

Memorandum

AIRMAIL

JUL 2 2 1964

TO : Regional Director, Portland, Oregon

DATE:

FROM : Assistant Director - Technical Services
Assistant Director - Sport Fisheries

SUBJECT: Western Montana flood damage investigations

This is to request that you detail a team of two or more men to conduct an on-site investigation and prepare a report by August 21 on the extent of flood damage and needed rehabilitation of the North and Middle Forks of the Flathead River and tributaries from the standpoint of fish and wildlife habitat and resources. We suggest that your Divisions of River Basin Studies and Fishery Management Services collaborate on the investigations and report.

Dr. Willis King and I recently made a reconnaissance of these flood-damaged streams and I have reviewed the memorandum of July 18 from J. Norvell Brown. Dr. King concurs that an investigation of damage should be undertaken promptly.

The report should be of sufficient scope and detail to recommend specific rehabilitation measures, by area, and it should estimate requirements for funds, manpower, and time to complete. It should also indicate what agencies would be expected to do the work and when. The Montana Fish and Game Department should be apprised of the investigation. You should, of course, consider any coordination that may be appropriate, especially since emergency fund requests will probably require State action or concurrence.

Any work found to be needed for restoration of the fishery should be scheduled so as not to interfere with the spawning runs of fish. This might indicate a delay of a part or all of the work until sometime next spring to avoid damage to fall migration runs and your report should clarify this aspect of the problem.

The study should, at least, assess the following:

1. Problems and solutions re damage to fisheries created by the flood,

2. Problems and solutions re damage to fisheries created by flood damage rectification (i.e., road and culvert reconstruction, bank stabilization, channel restoration, and the like),

3. Opportunities for coordination with the Forest Service and National Park Service on channel and bank stabilization and other stream reconstruction,

4. Opportunities for channel rectification and clearing independent of the National Park Service and Forest Service but in coordination with the Montana Department of Fish and Game,

5. Need for restocking depleted waters,

6. Need and feasibility of bank replanting and gravel restoration, and

7. Need for fisherman-access restoration.

This list is not intended to be all-inclusive but is suggestive of the type of information desired. If remedial work is found to be needed, the report should be sufficiently persuasive and detailed to be used as a justification statement in support of necessary emergency reconstruction funds to carry out the recommendations.

Please let us have your plans to conduct the study as soon as possible. It is our thought that Messrs. Otis Robbins, Jr. and Walter Allen or Mark Morton could be appropriately detailed to this task. It would be anticipated that engineering and other services available to you would be utilized as appropriate in preparing maps, engineering estimates, etcetera. If you have any questions, please telephone or teletype us in the interest of saving time.

James T. McBroom

R. E. Johnson

R. E. Johnson