

file:
Dist. 36 - Interstate,
Madison River Diversion
Heggen Lake

PRELIMINARY

REPORT OF PROPOSED REGIONAL PROJECT

FOR

CONSERVATION OF NATURAL RESOURCES IN THE AREAS

ADJACENT TO YELLOWSTONE NATIONAL PARK

AREAS LOCATED WITHIN THE STATES OF

MONTANA IDAHO AND WYOMING

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GENERAL STATEMENT

The data presented in this report has been made up largely by a study of surveys and reports gathered from many sources. No actual field work has been attempted other than inspection from time to time of practically all of the areas. The sources of information have been: maps, plans and drawings from various engineering offices, government topographic sheets, soil surveys and engineering reports on various projects, stream gagings by the United States Geological Survey, data furnished by the National Park Service, the Biological Survey and the United States Departments of Interior and Agriculture, and various bulletins and periodicals dealing with the subject. The writer, having lived within the area the greater part of his life, has been able to check roughly the available data which is being used.

LOCATION OF THE PROJECT

MONTANA

THE AREA AFFECTED BY THE PROPOSED PROJECT IN MONTANA

1. The irrigable lands along the entire length of the Yellowstone River from Yankee Jim's Canyon, fourteen miles north of the Yellowstone National Park to the junction of the Yellowstone and Missouri rivers in western North Dakota
2. The irrigable lands along the entire length of the Madison River from Hebgen Reservoir to the town of Three Forks, Montana
3. The irrigable lands along the lower part of the Gallatin River adjacent to Bozeman, Belgrade, Manhattan, and Three Forks, Montana
4. A considerable portion of the irrigable lands along the Missouri River from Three Forks, Montana to Fort Benton, Montana, and principally in the area in the Crow Creek Valley, and the area adjacent to Toston and Townsend, Montana
5. The area which comprises 183 square miles located northeast of Helena, Montana, lying along the Missouri River between 46° 30' and 47° North Latitude, which will include the proposed Gates of the Mountains National Park and Gates of the Mountains National Game Preserve
6. The southern half of Park County, which will comprise the proposed reservoir site, Park Reservation and Migratory Bird Refuge
7. The area adjacent to the Hebgen Reservoir and including the land up to the Montana-Idaho line, to become a Migratory Bird Refuge
8. A portion of Custer National Forest south and west of Red Lodge, Montana, to be made into a Park Reservation

IDAHO

THE AREA AFFECTED BY THE PROPOSED PROJECT IN IDAHO

1. The irrigable lands along the Henry's Fork of the Snake River and the Snake River proper
2. The area around Henry's Lake and including the land up to the Idaho-Montana state line, to be set aside as a Migratory Bird Refuge

WYOMING

THE AREA AFFECTED BY THE PROPOSED PROJECT IN WYOMING

1. The land in the northwest corner of the state lying within the borders of Shoshone National Forest, the proposed area to take in the entire length of the new road from Red Lodge, Montana, to Cooke City, Montana, and to be made into a Park Reservation
2. The land comprising the watershed of the Yellowstone River and lying adjacent to the southeast corner of Yellowstone National Park, to be made into a Park Reservation

PRINCIPAL FEATURES

THE PRINCIPAL FEATURES OF THE PROPOSED PROJECT ARE:

1. Conservation of a large water supply for
 - I. Irrigation
 - II. Power and Electrification
 - III. Flood Control
 - IV. Municipal Water Supply
 - V. Transportation and Navigation
 - VI. Rehabilitation
2. VII. Enlarging the Yellowstone National Park to increase the national recreation area and to preserve wild life
3. VIII. Creation of Gates of the Mountains National Park
4. IX. Enlarging the National areas set aside for migratory bird refuges and game preserves

GENERAL DESCRIPTION OF PRINCIPAL FEATURES

MONTANA

THE GENERAL FEATURES OF THE PROPOSED PROJECT FOR MONTANA

I. IRRIGATION

1. The construction of a dam, reservoir, power house and control works at the four-mile post south of Livingston, Montana on the Yellowstone River
2. The construction of a diversion works, canal and tunnel from the Yellowstone River to the Missouri River Watershed, thru the mountains between Livingston and Bozeman, Montana, and the construction of diversion canals and works in the Gallatin Valley, extending some of these canals thru the Crow Creek area, crossing the Missouri River above Toston, Montana for irrigation in the Toston-Townsend area; also extending the canal into the Prickly Pear Valley adjacent to Helena, Montana
3. Increasing the storage capacity of Hebgen Reservoir by adding to the height of the present dam
4. The construction of a diversion tunnel thru the mountains from Hebgen Reservoir in Montana to Henry's Lake in Idaho
5. The maintenance of a uniform water level in the following rivers sufficient to enable the present irrigation canals to be filled during the low water season without temporary wing dams being built each year
 - a. Yellowstone River
 - b. Gallatin River (Lower End)
 - c. Madison River
 - d. Missouri River

II. POWER AND ELECTRIFICATION

6. The installation of a power house at the dam site and more intensive electrification of the Yellowstone River Valley and adjacent rural districts
7. The use of the present Hebgen Reservoir to supplement the water supply for power purposes along the Missouri River, as well as to store irrigation water for the Madison River Valley and for diversion into Idaho

III. FLOOD CONTROL

8. The control of flood waters in the following rivers with a resulting material decrease in the damage done each year
 - a. Yellowstone River
 - b. Madison River
 - c. Missouri River

IV. MUNICIPAL WATER SUPPLY

9. The improvement of the source of water supply for the cities and towns along the following rivers
 - a. Yellowstone River
 - b. Gallatin River
 - c. Madison River
 - d. Missouri River

V. TRANSPORTATION AND NAVIGATION

10. The removal of the Northern Pacific Railway tracks from Livingston to Gardiner, Montana, and the substitution of motor transportation
11. The construction of a modern highway approximately 20 miles in length for motor travel from Livingston to a point approximately opposite Emigrant, Montana, and above the highway level of the reservoir, the road then to connect with the present highway into Yellowstone National Park
12. The construction of a new tunnel and railroad alignment for the Northern Pacific Railway Company between Livingston and Bozeman, Montana, and the utilization of the old road bed for a motor highway
13. As an alternative for No. 12: The electrification of the Northern Pacific Railway over the "Bozeman Hill", such an alternative possibly proving feasible due to the large power supply generated at the proposed dam
14. The diversion of water from the Yellowstone River to the Missouri River to supplement the water for storage in the Fort Peck Reservoir, which will aid in the navigation possibilities in the lower Missouri River

VI. REHABILITATION

15. The provision of an adequate water supply in the rivers for irrigation, municipal and power uses, which will act as a stabilizing factor in the lives of the inhabitants

VII. ENLARGEMENT OF AREA OF YELLOWSTONE NATIONAL PARK

16. The addition of the area of the present Absarokee National Forest to the Yellowstone National Park as a controlled game reservation and recreational area
17. As an alternative for No. 16: The placing of the entire area from the dam site to Gardiner under federal control, and the removal of the National Park headquarters from Mammoth Hot Springs to Livingston, Montana; the utilization of the present Park headquarters as a recreational center

VIII. GATES OF THE MOUNTAINS NATIONAL PARK

18. The formation of the required area on the Missouri River northeast of Helena, Montana, specifically known as the Gates of the Mountains, into a National Park area

IX. MIGRATORY BIRD REFUGES AND GAME PRESERVES

19. The setting aside of the reservoir site on the Yellowstone as a migratory bird refuge
20. The setting aside of the area around Hebgen Reservoir and the Rock Creek Lakes as a migratory bird refuge
21. The formation of the area lying along the Missouri River northeast of Helena, Montana between 46° 30' and 47° North Latitude, into a national migratory bird refuge and game preserve. (This area is adjacent to the proposed Gates of the Mountains National Park.)

IDAHO

THE GENERAL FEATURES OF THE PROPOSED PROJECT FOR IDAHO

I. IRRIGATION

1. The construction of a diversion tunnel from Hebgen Reservoir in Montana thru the mountains to Henry's Lake in Idaho. (See No. 4, page 4, Montana: Irrigation.)
2. The maintenance of a higher, more uniform water level in the Henry's Lake Fork of Snake River for irrigation purposes
3. Addition to the present stream flow in the Snake River proper for irrigation and for storage in the American Falls Reservoir and other reservoirs along the Snake River

II. MUNICIPAL SUPPLY

4. The improvement of the source of water supply in the Henry's Lake Fork and the Snake River proper

III. MIGRATORY BIRD REFUGE

5. The setting aside of the area surrounding Henry's Lake in Idaho

for a migratory bird refuge. This area is adjacent to the area around Hebgen Reservoir in Montana.

WYOMING

THE GENERAL FEATURES OF THE PROPOSED PROJECT FOR WYOMING

I. ENLARGEMENT OF AREA OF YELLOWSTONE NATIONAL PARK

1. The setting aside as a part of Yellowstone National Park, as a controlled game preserve, those parts of Custer National Forest in Montana, and Shoshone National Forest in Wyoming, that will include the newly constructed Red Lodge-Cooke City Highway, and also the area included in the Yellowstone River Watershed southeast of the Park

DETAILED DESCRIPTION OF FEATURES

MONTANA

I. IRRIGATION

1. Dam, reservoir, power house and controlling works

After making a study of the U. S. Geological Survey records on the area and making estimates therefrom, we have the following:

Height of dam	330 feet
Length of dam at top	2,150 feet
Concrete in dam	1,600,000 cubic yards
Storage capacity	3,080,000 acre feet
Length of lake	22 miles
Width at greatest point	4 miles
Area flooded	23,000 acres

The average annual flow of the Yellowstone River at Livingston, Montana, since 1898 is estimated from the U. S. Geological Survey records to be 3,080,000 acre feet annually. From subsequent tables, it will be seen that this water supply will prove ample for the needs of the project.

2. Diversion to Missouri River Watershed

The diversion of water into the Missouri River Watershed to supplement the supply therein would necessitate the construction of a canal approximately seven miles long, and a tunnel approximately eleven miles long, with a capacity of 3,000 second feet.

The purpose of this diversion is to supply water on the Missouri River Watershed for irrigation and power, and to supplement the supply furnished for irrigation in the Madison River Valley and in the Snake River Watershed in Idaho by the present Hebgen Reservoir which is now in use by the Montana Power Company.

3. The Hebgen Reservoir

The run-off area for the Madison River at Hebgen Dam is 911 square miles and the average yearly discharge is 819,000 acre feet. The present Hebgen Dam is 87.5 feet above the original channel, and the present storage capacity is 346,000 acre feet. By increasing the height of the dam 25 feet, the storage capacity may be increased 819,000 acre feet. With this capacity, the project will be able to accomplish the releases of water as outlined in other parts of this report.

4. Diversion to Snake River Watershed

For diversion to the Idaho side into the Snake River drainage basin, a gravity flow tunnel approximately six miles long and with a diameter of about 16 feet will be required. This tunnel will discharge 500,000 acre feet into Henry's Lake during a 125-day period.

The reason for this diversion is to supplement the water supply for the land along the Snake River in Idaho.

5. Irrigation

(a) Yellowstone River Area

(Note: In general the irrigation problems along the Gallatin, Madison, Missouri, Henry's Fork, and Snake rivers are similar to those along the Yellowstone.)

The valley lands of the Yellowstone have partially been reclaimed by gravity canals and by pumping from the river. The use of gravity canals directly from the river is the most economical method of supplying irrigation water to the land. However, during the period of irrigation - June, July, August, and September - the water level in the Yellowstone becomes so low at times that the canals cease to function.

The amount of land covered by gravity diversions on the Yellowstone is at present about 400,000 acres, with a potential acreage of 600,000. During the irrigation season from July 15th to September 1st, the water in the Yellowstone reaches such low stages that the headworks of many of the canals are too high above the water level to take the water from the river. To overcome this, the irrigation companies construct at a cost of many thousands of dollars, temporary diversion dams. These dams are of such a type that they are swept away in the next spring floods. This yearly cost is prohibitive and the temporary dams do not do much to solve the problem. The water level in many of the past years became so low that even such temporary measures were unsuccessful.

It is estimated by operators of these various canal companies that a supplemental supply of 45 days duration, from July 15th on, would solve the problem. From the records of discharge at Intake, Montana, the flow in the stream gradually decreases from about July 15th, until well past the irrigation season, which ends about September 1st. As the natural flow of the stream decreases, supplemental water from the proposed reservoir would be released and the level of the water in the river could be maintained within reasonable limits.

The approximate manner of release would be as follows:

YELLOWSTONE RIVER STORAGE

Release of Water for Period of Minimum Flow

During Irrigation Season

<u>July 15 to September 1</u>	<u>Second Feet</u> <u>To Maintain</u> <u>Maximum Flow</u>	<u>Total Acre Feet</u>
<u>47 Day Period</u>		
July 15 to 20	2,000	20,000
" 20 to 25	6,000	60,000
" 25 to 31	6,000	72,000
Aug. 1 to 5	10,000	100,000
" 5 to 10	10,000	100,000
" 10 to 15	14,000	140,000
" 15 to 20	14,000	140,000
" 20 to 25	18,000	180,000
" 25 to 31	18,000	216,000
Total - 47 days		1,028,000 Acre Feet

Storage Table for the Reservoir

<u>Elevation in Feet</u> <u>Above Sea Level</u>	<u>Flooded</u> <u>Area Acres</u>	<u>Acre</u> <u>Feet</u>	<u>Total</u> <u>Acre Feet</u>
4530			
4600	2,840	99,400	99,400
4630	5,034	117,600	217,000
4700	9,820	633,000	850,000
4780	15,404	1,008,960	1,858,960
4800	16,800	322,040	2,181,000
4850	23,100	977,500	3,178,500

In considering the water requirements or distribution from the above table, the year is divided into four parts:

- | | |
|---|----------|
| 1. Supplemental Irrigation Season - period of minimum flow, from July 15th to September 1st | 47 days |
| 2. Full Irrigation Season - May 1st to September 1st (i.e., for Crow Creek Valley) | 120 days |
| 3. Navigation Season on the Lower Missouri - March 20th to November 15th | |
| Total - 244 days less 47-day supplemental irrigation season | 197 days |
| Or - 244 days less 120-day irrigation season | 124 days |
| 4. Remainder of year to maintain flow for domestic supply, stock and stream life | 121 days |

The distribution from the proposed reservoir on the Yellowstone will be approximately as follows:

Estimated annual storage - - - - -	3,080,000 acre feet
Dead Storage in reservoir below contour 4630 - - - -	<u>217,000 acre feet</u>
Available Storage - - - -	2,863,000 acre feet

The average annual releases from the reservoir will be approximately as follows:

5. 47-day Supplemental Yellowstone Valley for Irrigation - Average Flow 10,900 second feet	1,028,000 acre feet
6. 197-day Navigation Supply, Lower Missouri via Yellowstone - Average Flow 1,500 second feet	591,000 acre feet
7. 121-day Power Supply at Dam Site - Average Flow 1,000 second feet	242,000 acre feet
8. 120-day Diversion to Missouri River Full Irrigation Supply - Average Flow 3,000 second feet	<u>720,000 acre feet</u>
Total Average Annual Release - - - -	2,581,000 acre feet

From the above it is seen that only by storage above Livingston can there be any real solution to the problem. The site of the reservoir is the only feasible one for capacity, from the standpoint of service to the greatest number of canals (since over 60% of the land now irrigated lies above the confluence of the Big Horn River with the Yellowstone), and also with respect to diversion to the Upper Missouri River Watershed.

It is important to note that, unless this storage project is built, due to the development of irrigation systems on many of the lesser side streams, the summer flow percentage will be greatly lessened. There is no way by which to arrive at the volume of water that will be necessary to meet these requirements, but it will almost certainly be sufficient to lessen the supply to the Yellowstone when it is most needed.

(b) Gallatin River (Lower End)

The irrigable lands adjacent to Bozeman, Montana, which are irrigated by water by diversion from the Gallatin River, would be greatly benefited by the diversion from the Yellowstone. Prior water rights farther up the Gallatin River and its tributaries leave nothing for the farmer lower down except "run back" during the dry season.

Approximately 114,800 acres can thus be supplied with the above supplemental water before it reaches the Missouri River at Three Forks, Montana. (See paragraph "(d) Missouri River" which follows.)

(c) Madison River

There are approximately 30,000 acres of irrigable land needing supplemental water along the Madison River, and the problem of diversion is much the same as along the Yellowstone; that is, the maintaining of a uniform water level. By increasing the storage of Hebgen Reservoir (see No. 3, Montana - Irrigation, page 8), this need of water can be supplied. The distribution of water from the Hebgen Reservoir is approximately as follows:

	<u>Acres</u>	<u>Feet</u>
Present Capacity - Hebgen Reservoir		346,000
Proposed Capacity - Hebgen Reservoir		819,000
47-day Supplemental Supply Madison Valley for Irrigation - Average Flow 2,000 second feet	188,000	
197-day Navigation Supply Lower Missouri - Average Flow 200 second feet	78,000	
121-day Domestic Supply, Stock and Stream Life - Average Flow 100 second feet	24,200	
125-day Diversion to Henry's Lake in Idaho - Average Flow 2,000 second feet	<u>500,000</u>	
Hebgen Reservoir - Total Average Annual Release	790,200	
		<u>790,200</u>
Average Annual Surplus		18,800

(d) Missouri River

The same difficulties with respect to irrigation systems exist along the Missouri River as along the Yellowstone. In this project, it is proposed to maintain to some extent the flow in the Missouri River basin for supplemental irrigation. It is also proposed to irrigate under a system of canals to be constructed, the land in the following table:

Table of Irrigable Lands - Upper Missouri River Basin

<u>Location of Area</u>	<u>Total Acres</u> <u>Under</u> <u>Proposed Canal</u>	<u>Acres</u> <u>Irrigable</u>	<u>Acres</u> <u>Amount</u>
South of East Gallatin River	98,000	60%	58,800
Lower Madison	28,000	50%	14,000
Willow Creek to Three Forks	40,000	50%	20,000
North of East Gallatin River	38,000	60%	22,800
Three Forks Bench Missouri River	22,000	50%	11,000
Crow Creek-Radersburg	100,000	70%	70,000
Toston-Townsend East Side	140,000	60%	84,000
Winston-Beaver Creek	48,000	30%	14,400
Helena-Prickly Pear Valley	180,000	40%	72,000
Total -	694,000		367,000

It is proposed to divert from the Yellowstone 1,008,000 acre feet for this irrigation. (See item No. 8 in the table on page 10.)

II. POWER AND ELECTRIFICATION

6. Power and Electrification of Rural Areas

With an adequate supply of water for irrigation, the areas will be in a better position to support rural electrification. The opportunities for power generation on the proposed Yellowstone dam will be confined to a minimum head of 100 feet and a minimum release of 1,000 second feet for the 121-day period, with the output rated at 10,000 H. P. The potential annual average power output is estimated at over 200,000,000 K. W. H. by taking advantage of the 47 and 197-day periods when quantities of water are released under varying heads. The minimum release of 1,000 second feet for the 121-day period is in excess of the minimum flow in the Yellowstone at Livingston.

7. Montana Power Company - Hebgen Reservoir

The Montana Power Company has at the present time in Hebgen Reservoir a storage capacity of 346,000 acre feet. This is used mainly as a supplemental and standby supply for the power station at Hauser Lake Dam on the Missouri River near Helena.

From the tables of diversions in this report, it is shown that 1,008,000 acre feet can be diverted into the Missouri from the Yellowstone, and of this, approximately 75% can be used for power generation at Hauser Lake Dam and stations lower down the Missouri River.

The release for the Madison Valley from Hebgen Reservoir is 197,000 acre feet. The total is 819,000 acre feet, almost three times more than the present capacity of Hebgen Reservoir. This amount of water together with a capacity of 3,000 second feet from the Yellowstone should prove of greater benefit to the power company.

III. FLOOD CONTROL

8. Flood Control

(a) Yellowstone River

Conversely with supplementing the supply during periods of minimum flow, the storage reservoir will retard and level off flood flows during high water in the early spring; also, by raising the dam height at Hebgen Reservoir, it will aid in this same respect the control of floods on the Madison and Missouri rivers.

The safe limit of discharge of the Yellowstone River at Livingston is 20,000 second feet and at Intake, Montana, 43,000 second feet. The maximum recorded discharge of the Yellowstone at Corwin Hot Springs in Yankee Jim's Canyon occurred June 17 and 18, 1918, reaching 26,500 second feet. In case of repetition, the proposed reservoir could release the safe maximum flow of 20,000 second feet in the Yellowstone River and store the balance. This balance, 6,500 second feet, for a two-day period as above, would amount to 26,000 acre feet, and would raise the level of the reservoir approximately one foot at maximum pool level.

The estimated damage caused by the 1918 flood along the Yellowstone River is set at \$5,000,000. From \$800,000 to \$1,000,000 of this was suffered by the Northern Pacific Railway. The yearly damage varies from \$100,000 to \$500,000, all of which will be materially reduced by the storage of water in the upper Yellowstone.

(b) Madison River

The early spring floods along the Madison River could be entirely controlled by the additional storage at Hebgen Reservoir, and would allow for the permanence of wing dam and diversion dam structures by the various canal companies.

(c) Missouri River

The repetition of the disastrous flood which occurred June 7, 1908, could be partially avoided by the enlarged capacity in the Hebgen Reservoir. The sudden rise in temperature, melting the snows that year, caused a flood of 107,000 second feet capacity in the Missouri below Hauser Lake. With the added capacity of Hebgen Reservoir, the above flood would have been greatly reduced, decreasing the extent of the flood damages.

IV. MUNICIPAL WATER SUPPLY

9. Water Supply and Sanitation

Along the (a) Yellowstone, (b) Madison, (c) Missouri, (d) Gallatin, (e) Snake rivers.

The increasing demand for water by growing communities and the recurrence of periods of drought creates the problem of furnishing adequate supplies of water for domestic and industrial uses, and the use of streams for carrying away municipal sewage and industrial wastes presents a serious problem in the field of sanitation and public health.

The water supply for towns along the Yellowstone, Madison, Gallatin, Missouri, and Snake rivers would be of uniform quality and improved considerably by storage in reservoirs. During the period of minimum flow in the summer months, pollution of the streams is not uncommon, and purification, usually by chemical treatment, is used. The quality of water is greatly benefited by storage, and an opportunity for coagulation, precipitation, bleaching, death of disease germs and subsidence of silt and clay is afforded.

Since the reservoirs will have storage greatly in excess of needs, this supply of water will only be incidental to the project as a whole, and it will eliminate some of the excessive pumping costs that are paid by the various towns, as well as the installation of temporary pumping apparatus during periods of minimum flow.

V. TRANSPORTATION AND NAVIGATION

10. Northern Pacific Railway

This line runs from Livingston to Gardiner, paralleling the river for a distance of 54 miles. The increased use of motor transport, the short duration of tourist travel during the summer months, the excess grade to be overcome, and other important reasons, may cause this branch line to be taken up, and a motor bus system installed similar to the present system in the Park. It is estimated that about 26 miles of the present Yellowstone Park Branch of the Northern Pacific Railway will be flooded by the proposed reservoir.

11. Highway - Livingston to Gardiner

The new proposed highway, to replace that part flooded by the reservoir, will join the present road about twelve (12) miles south of Livingston. This highway will carry a grade to reach the top of the dam and then continue along the edge of maximum water level of the reservoir.

12. Railroad and Highway Changes

The most difficult obstacle to be met by transportation systems, both railroad and highway, is the Bozeman Pass, lying in the range of mountains between Bozeman and Livingston. The highest point is twelve miles west of Livingston and is crossed by the highway at an elevation of 6,100 feet, and by a tunnel for the railroad at an elevation of 5,564 feet. It is proposed that the Northern Pacific Railway Company work in conjunction with this project in making a new tunnel in order to eliminate a very steep grade in their main line. This grade starts at Livingston, and on an average of 1.8% to 2% runs up to the present tunnel, a distance of 12 miles, thence down again to Bozeman.

With the new tunnel, approximately at an elevation of 4,650, this grade would be reduced to 0.6% for a length of seven miles on both sides of the Bozeman Hill. The greater ease in construction for the combination rail and water tunnels will decrease in proportion the cost of the work.

The present railroad alignment could be used for a motor highway, the present railroad tunnel eliminating the "Bozeman Hill", that portion of the road which winds over the apex of the hill. This will also lessen the travel risks during the winter months, when, due to ice and snow, motor travel proves very hazardous.

13. Alternative for No. 12

Since electrical power will be generated so close to this part of the Northern Pacific Railway, it is suggested that the railway company investigate the possibilities of electrification over the "Bozeman Hill" on their present trackage.

14. Aid to Navigation on the Lower Missouri (In Conjunction with the Fort Peck Dam)

It is estimated that from 40% to 60% of the water used during the 47-day irrigation season mentioned heretofore, will be "return flow" back into the streams.

Practically all of the release during the 197-day navigation period will be used by the lower Missouri. This water will aid in maintaining a minimum flow of 30,000 cubic feet per second at Yankton, South Dakota during the navigation season from March 20th to November 15th.

The following table gives approximately the amount of this flow during the navigation season, which may be put to beneficial use for that purpose.

<u>Period (Days)</u>	<u>Source</u>	<u>Second Feet Average</u>	<u>Percent Return Flow</u>	<u>Amount Second Feet</u>	<u>Estimated Acre Feet Return Flow</u>
47	Yellowstone	10,900	80%	8,720	819,680
168	"(To Missouri Basin)	3,000	75%	2,250	756,000
47	Hebgen Reservoir	2,000	60%	1,200	112,800
197	Yellowstone	1,200	100%	1,200	472,800
197	Hebgen Reservoir	200	100%	200	<u>78,800</u>
Total Flow - Missouri River Navigation Season					2,240,080
Average Flow in Second Feet to Missouri River During Navigation Season					5,700

When the mean annual discharge of the Missouri River at the Fort Peck Dam is given at 8,253,000 acre feet, it will be seen that the above amounts to more than 25% of this average annual flow of the Missouri.

It is also seen that the bulk of this water comes during the 47-day period, such period being at the time when all the rivers are at their minimum flow. This part of the project, the aid to navigation, is one of the benefits derived, and, from the magnitude, it becomes an important factor.

VI. REHABILITATION

15. Rehabilitation of Areas

Water conservation is a national responsibility, and water is the first and most important of our national resources. Without an adequate supply of water, entire communities can be affected, as is easily shown by the drought of last year (1934). Without an adequate water supply it is doubtful whether great areas can survive a recurrence of similar droughts. With the assurance of uniform crop productions each year, the agricultural areas outlined in this report will become more permanent in character.

With a better chance for electrification of the rural communities, the standard of living of many people will be affected. The rehabilitation of many farmers affected by drought conditions, and the withdrawal of many areas where living is but a mere existence, can be in a measure made possible for many by this project.

The support of this project would lead to substantial gains in the nation's wealth and in the broader distribution of human welfare, a policy at which our national government aims.

VII. ENLARGEMENT OF AREA OF YELLOWSTONE NATIONAL PARK

16. In keeping with the present national plan to set aside popular recreational areas, none offer such an ideal location as those areas shown on the drawings. Those areas, besides having characteristics ideal for national parks and recreational grounds, are also ideally situated to help solve the problem of conservation of wild life.

Since the areas affected are part of the project, and in order to accomplish at this time something that will ultimately come, it is now proposed to set aside for the enlargement of Yellowstone Park the following areas, 95% of which are in National Forest areas. These areas are described as follows:

TABLE OF AREAS - YELLOWSTONE PARK ENLARGEMENT

Area north of the Park in Montana	607 square miles
Area in Montana east of the Park and south of Red Lodge	338 " "
Area in Wyoming east of the Park	679 " "
Area in Wyoming south of the Park	331 " "
	<hr/>
Total	1,955 square miles
Present area of Yellowstone Park	<u>3,500 square miles</u>
Grand Total	5,455 square miles

17. Alternative for No. 16

The entire area from the dam site south to the Yellowstone Park boundary is to be a national park area. (The State of Montana, however, is to have control over the water stored annually in the reservoir.) After weighing carefully the recreational and wild game possibilities against the commercial possibilities of such an area, the advantages will most certainly be in the former's favor.

VIII. GATES OF THE MOUNTAINS NATIONAL PARK

18. "Gates of the Rocky Mountains" is the name given in 1805 by Captain Meriwether Lewis of the Lewis and Clark Expedition to a small stretch of the Missouri River, which, due to the singular appearance of the surrounding areas is one of scenic beauty. This area is about 19 miles northeast of Helena, Montana, and is comprised of about 15 square miles.

It is proposed that this area, being a part of this entire project, and having the natural characteristics necessary to make it suitable for recreation, become a national park area, and bear the name of "Gates of the Mountains National Park".

IX. MIGRATORY BIRD REFUGES AND GAME PRESERVES

19. It is proposed to set aside the reservoir site on the Yellowstone as a migratory bird refuge.

20. It is proposed to set aside the area adjacent to and surrounding the Hebgen Reservoir as a migratory water fowl refuge. This area would in-

clude the following lakes in Montana along Rock Creek: Lower Red Rock, Upper Red Rock, Elk, Hidden, Cliff, Wade and Swan lakes. In Idaho the area would include Henry's Lake. Such small areas as are now set aside and would come within the scope of this project would be absorbed.

21. It is proposed to set aside the area lying along the Missouri River northeast of Helena, Montana between 46 30' and 47 North Latitude, as a national migratory bird refuge and game preserve. This area is adjacent to the proposed Gates of the Mountains National Park.

The various rivers named in this report are so situated that they are used by countless fowl as a flyway each fall. From a study of maps showing mountain ranges, these areas prove to be natural refuges before the flights pass over into lower altitudes on the Idaho side. The fact that they are adjacent to Yellowstone Park and to the proposed Gates of the Mountains National Park will be an added incentive for the creation of these bird sanctuaries. During the season of 1934 it became apparent that the nation's supply of ducks and geese will need areas at low altitudes where they may be allowed to increase, and where they may be allowed to find unmolested feeding grounds on their flights. It is to be noted that the areas proposed offer the only natural flyway in a belt approximately 600 miles wide, and are located in line with present bird sanctuaries. The following table indicates the amounts of these proposed areas:

TABLE OF AREAS FOR MIGRATORY BIRD REFUGES AND GAME PRESERVES

Adjacent to Yellowstone Park

Montana - Reservoir Site, Yellowstone River- - - - -	70 square miles
Hebgen Reservoir - Rock Creek Lakes - - - - -	496 " "
Idaho - Henry's Lake Area - - - - -	120 " "
Total - - - - -	686 square miles

Adjacent to the Proposed

Gates of the Mountains National Park

Montana - Area containing Lakes Sewall, Helena, Hauser, and Holter - - - - -	130 square miles
Grand Total - - - - -	816 square miles

IDAHO

I. IRRIGATION

1. The construction of a gravity flow tunnel from the Madison River watershed through the mountains to the Snake River watershed is proposed. This tunnel will divert 500,000 acre feet of water which may be used along the Henry's Fork of the Snake River and the Snake River proper.

2. The maintenance of a higher water level in the Henry's Fork of the Snake River during the period of low flow will materially aid the small canal diversions to the land. The problem is similar to that along the Yellowstone River.
3. There are approximately 600,000 acres of land adjacent to the rivers mentioned and under the American Falls Reclamation project. The American Falls Reservoir with a storage of 1,700,000 acre feet and other diversions and storage works will be considerably augmented by this addition of 500,000 acre feet.

II. MUNICIPAL SUPPLY

4. The general improvement of domestic water supply will be accomplished from the rivers as the flow is kept uniform during the dry season.

III. MIGRATORY BIRD REFUGE

5. It is proposed to set aside the area of Henry's Lake and the adjacent land up to the Idaho-Montana State Line. This area, in conjunction with that in Montana around Hebgen Reservoir, will greatly aid in preserving the wild water fowl.

WYOMING

I. ENLARGEMENT OF YELLOWSTONE NATIONAL PARK

1. A new entrance to Yellowstone Park will be formally opened during the summer of 1935. This entrance is a new road built from Red Lodge to Cooke City, Montana, and thence into the Park. The main portion of the road rises from 6,000 feet elevation a few miles from Red Lodge to 11,000 feet above sea level. This part of the highway for over 60 miles winds through some of the most rugged mountainous scenery. The entire area abounds in small lakes and streams, the character of the country in general being very similar to Yellowstone Park. On account of this, and since it borders on the Park, it is proposed to set aside a considerable portion of the National Forest areas in Montana and Wyoming for a part of the Park. The area south of the Park and located within the Yellowstone River drainage basin offers the same general characteristics and is included in the proposed areas.

TABLE OF IRRIGABLE AREAS

AREA	WATER	TOTAL ACRES	IRRIGABLE %	AMOUNT	ACRE FEET REQUIRED	ACRE FEET DELIVERED	% OF LOSS IN CANALS	DIVERSION ACRE FEET
I.	Supplemental Supply - South of East Gallatin River	98,000	60%	58,800	1.5	88,200	40%	123,480
II.	Supplemental Supply - Lower Madison	28,000	50%	14,000	1.5	21,000	40%	29,400
III.	Supplemental Supply - Willow Creek	40,000	50%	20,000	1.5	30,000	40%	42,000
IV.	Supplemental Supply - North of East Gallatin River	38,000	60%	22,800	1.5	34,200	40%	47,880
V.	Full Supply - Three Forks Bench - Missouri River	22,000	50%	11,000	2.0	22,000	40%	30,800
VI.	Full Supply - Crow Creek - Radersburg District	100,000	70%	70,000	2.5	175,000	40%	245,000
VII.	Supplemental Supply - Toston - Townsend	140,000	40%	56,000	2.0	112,000	40%	156,800
VIII.	Supplemental Supply - Winston - Beaver Creek	48,000	30%	14,400	2.0	28,800	40%	40,320
IX.	Supplemental Supply Helena - Prickly Pear Valley	180,000	40%	72,000	2.0	144,000	40%	201,600
TOTALS		694,000		329,000		655,200		917,280
A.	Supplemental Supply -Madison Valley - Hebgen Reservoir	50,000		30,000	1.5	45,000	20%	54,000
B.	Supplemental Supply -Yellow- stone Valley	600,000		400,000	1.5	600,000	20%	720,000
C.	Supplemental Supply -Idaho Diversion from Hebgen Reservoir	600,000		200,000		500,000		500,000
TOTALS		1,250,000		630,000		1,145,000		1,395,000
GRAND TOTALS		1,944,000		959,000		1,800,200		2,191,280