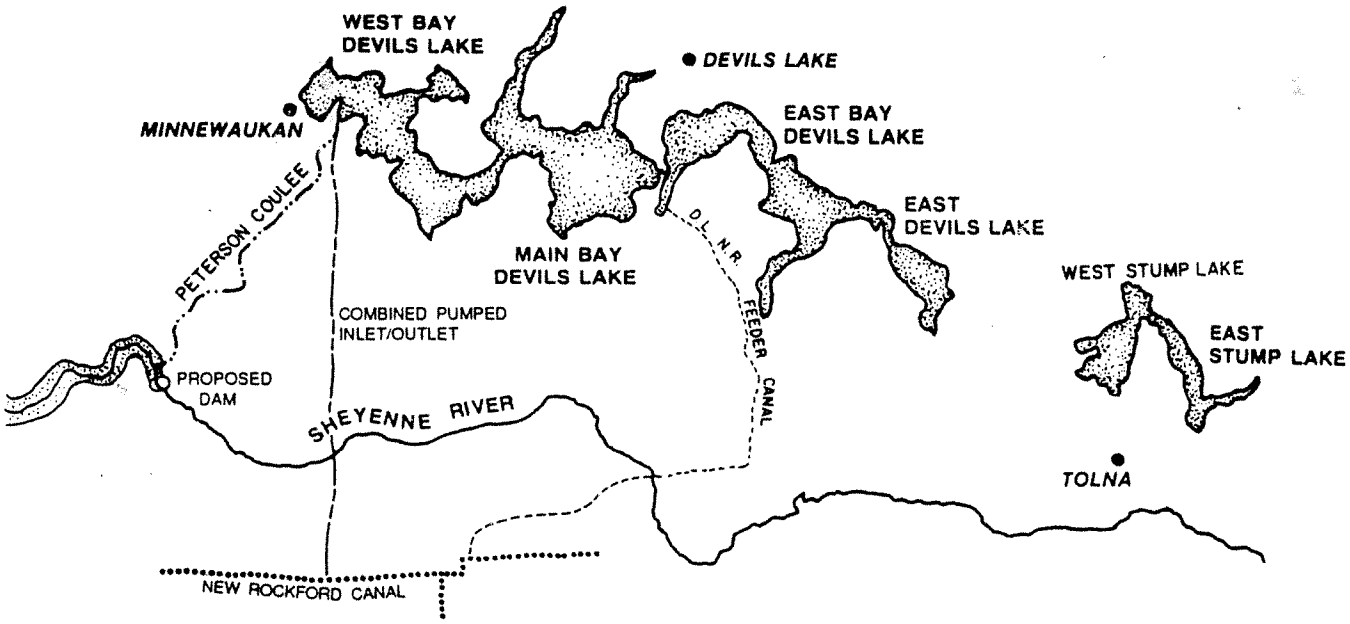
SUMMARY

Devils Lake Stabilization Briefing Report



prepared by
the North Dakota State Water Commission
and State Engineer,
the North Dakota State Game and Fish Department,
Garrison Diversion Conservancy District, and
the North Dakota State Department of Health and Consolidated Laboratories

in cooperation with
the United States Army Corps of Engineers,
the Bureau of Reclamation,
and the United States Geological Survey

April 1990

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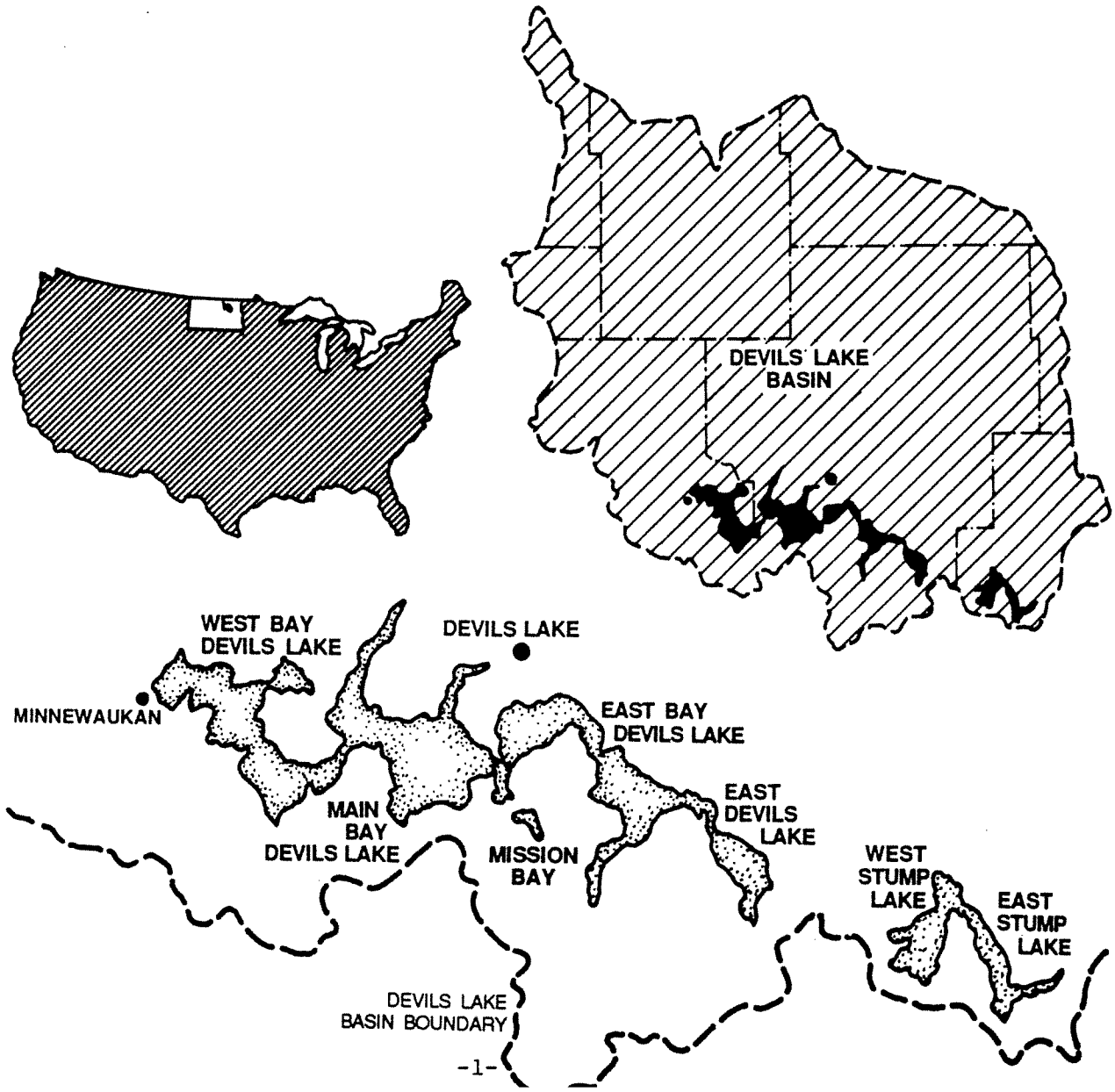
I. INTRODUCTION

A. Description of the Study Area

The Devils Lake Basin, located in northeastern North Dakota, is a closed or noncontributing subbasin in the drainage of the Red River of the North, see Figure 1 for location. Devils Lake encompasses approximately 3,800 square miles. Of the total drainage area, about 1,300 square miles are noncontributing. Runoff is trapped within the basin by the topography. Devils Lake is the ultimate collecting point for a majority of the basin's surface runoff. The amount of runoff which reaches Devils Lake in any particular year is determined by a complicated set of circumstances involving general climatic factors, soil moisture conditions, and the availability of surface water storage in wetlands and the Chain of Lakes located north of Devils Lake.

Figure 1



B. Problem Statement

The drought which has afflicted a large portion of the Northern Great Plains during the past three years has caused significant declines in water levels of lakes and reservoirs throughout the region. Devils Lake has receded from an elevation of 1428.9 msl in 1987 to 1424.7 msl in early 1990. The volume lost between these two elevations is approximately 225,000 acre-feet. Since Devils Lake is replenished almost entirely by spring runoff, the lack of significant snowmelt and the forecast of below median spring rains suggest the water level may continue to drop through 1990.

Continued declines in Devils Lake water levels poses a very serious threat to this highly valued natural resource. Devils Lake has, in recent years, become a nationally acclaimed sport fishery and it contributes substantially to North Dakota's water based recreational opportunities.

A creel census of the 1988 summer sport fishery and 1988-89 winter ice fishery conducted by the ND Game and Fish Department, reported almost 938,000 angler hours were spent fishing on Devils Lake. Using this creel census data, it was estimated that anglers spent $27.4 million to fish on Devils Lake during the 1988-89 fishing season. Using the multiplier for recreation and tourism contained in the Input/Output Economic Model developed at North Dakota State University, the gross business volume generated by fishermen in the region exceeds $90 million. This level of business activity supports almost 1,400 jobs. Recreation on Devils Lake has become a growing and extremely valuable resource to the state's economy.

Should water levels continue to fall at the rate experienced since July of 1987, Devils Lake could fall to elevation 1422 sometime in 1990. At this level, large areas of the lake become very susceptible to loss of sport fish due to anoxic conditions. The most significant losses will most likely occur first in the eastern portions of the lake basin where TDS concentrations exceed 10,000 parts per million (PPM). As water levels continue to decline, fishkills will likely progress further west.

If the lake suffers a severe fish kill, it could take many years, under favorable conditions, to restore a quality fishery in Devils Lake. Restoration would be complicated by the fact that Devils Lake currently provides from 85 to 90 percent of the walleye and northern pike eggs needed to maintain North Dakota's statewide fish stocking program. Although a large percentage of the statewide walleye and northern pike eggs are taken from Devils Lake, the loss of this egg source would not mean that stocking of these species would discontinue in North Dakota. Other areas are available for a source of walleye eggs, but not with the ease or in the quantities available at Devils Lake. Procurement of northern pike would prove to be more difficult.

There is currently not a good reliable source of northern pike eggs other than Devils Lake.

While the current water level conditions are drought related, it is recognized that flood control is also a long-term problem. The fluctuation from low to high water levels is cyclic and the overall longer term objective is to stabilize both types of fluctuations. Thus, many of the project features were designed to address both low lake levels and flood control. Combining project features for both purposes results in economic efficiency.

C. Purpose and Scope

This briefing report was prepared to compare a variety of alternative actions considered to have differing degrees of potential in preventing the loss of the highly valued fishery and recreation opportunities currently provided by Devils Lake. A list of those agencies that participated in this effort is provided later in this report.

Due to the emergency nature of the problem, the briefing report was completed in the short time-span of four weeks. Much of the information needed in the analysis of alternatives was readily available from previous studies of water problems affecting Devils Lake and its watershed. The Devils Lake Basin is one of the most highly studied areas in North Dakota, due to its long history of either too much or too little water. New information, including preliminary designs and cost estimates, was generated where necessary.

The briefing report was developed to provide decision-makers with a basic understanding of the problems facing the people of the Devils Lake region and of the alternatives available to resolve those problems. Alternatives have been separated into those which can be implemented quickly and at minimal cost to provide immediate albeit short-term relief and those that involve major construction projects, but will provide long-term relief. A long-term solution must include the means to stabilize the water level of Devils Lake.

Stabilizing water levels in Devils Lake means limiting fluctuations in water levels to a range such as between 1424 and 1433 mean sea level (msl). Keeping water levels above 1424 msl will require importation of Missouri River water to supplement runoff from the watershed. Building an inlet for Missouri River water may ultimately require an outlet to be provided to prevent flooding during climatic wet cycles. The process of inlet/outlet needs to be expanded to explain why and perhaps how it can be sequentially developed.

D. Organizations Involved

The following entities participated in the development of this study report:

State of North Dakota:

Department of Health and Consolidated Laboratories
Game and Fish Department
State Water Commission
State Engineer
Garrison Diversion Conservancy District

Federal Agencies:

Bureau of Reclamation
U.S. Army Corps of Engineers, St. Paul District
U.S. Geological Survey

II. SHORT-TERM ALTERNATIVES

The dramatic decline in Devils Lake water levels, caused by the ongoing drought, has created an immediate need to develop and implement a plan to protect the lake's highly valued recreation resources. Due to the complexity of the environmental and political issues, and the time needed to construct structural measures to divert Missouri River water, it is necessary to address other options that may help sustain the lake. The main report includes an evaluation of several alternatives using surface and ground water sources in or near to the Devils Lake Basin. Surface water sources were determined to be inadequate during drought periods. Ground water sources were determined to be of insufficient quantities to significantly contribute to the level of Devils Lake without jeopardizing existing water users.

Without a viable source of water within the Devils Lake basin, another option would be to isolate portions of Devils Lake. Due to the large surface area of Devils Lake, and the high evaporative losses, several options in this alternative deal with isolating portions of Devils Lake to maintain a smaller surface area. The purpose of this approach is to prevent the inflow from being dispersed throughout the lake. For example, if an inflow of 30,000 acre-feet would occur in Main Bay and West Bay at the present lake elevation of 1424.7, it would amount to a 1.0-foot rise in the Main Bay, rather than only 0.6-foot rise if allowed to spread over the entire lake.

The preferred option for isolating portions of the lake is to construct a weir at Highway 20 at elevation 1424 msl. The cost of a sheet pile control structure on Highway 20 was estimated to be $170,000. Blocking the flow at Highway 20 will obviously be beneficial only if inflow occurs.

If Devils Lake continues to receive no inflow and the lake continues to drop, it may necessitate sacrificing East Bay and East Devils Lake by pumping the water that remains in these bays, back into Main Bay. This option prioritizes the fisheries in West and Main Bays over those in East Bay and East Devils Lake. Actual pumping of East Bay water into Main Bay should not be initiated until fish populations in Main Bay are threatened by conditions conducive to a severe fishkill. By this time, it is believed that water levels in East Bay will have deteriorated to the point where it is no longer capable of maintaining a quality sport fishery. The remaining water volume in East Bay would then be best utilized in an attempt to save Main Bay.

While the east portions of the lake may be temporarily lost with this short-term alternative, the recovery time, as far as restorable fish populations are concerned, would be relatively short if this allowed viable populations to be preserved in the main lake. Main lake fish populations would quickly reoccupy and

repopulate East Bay and East Devils Lake much faster than the 5-7 years it would take if the entire lake were to kill.

This option, over a period of several years, may increase TDS levels in Main Bay to the point where natural reproduction of sport fish is severely restricted. Main Bay would then become primarily dependent on stocking for maintenance of its fishery. While options in this alternative may not create the most desirable situation, it should nonetheless, retain a sport fishery in Main Bay.

III. DIVERSION ALTERNATIVES (LONG-TERM)

A. Introduction

This report considers three major scenarios designed to add supplemental water to Devils Lake. They are: 1) diverting Sheyenne River water from a point southwest of Devils Lake, 2) diverting untreated Missouri River water, and 3) diverting treated Missouri River water. Missouri River water would be delivered to Devils Lake, in part, by features of the Garrison Diversion Unit Project.

B. Sheyenne River Water Diversion Scenario

This alternative involves the construction of a dam on the Sheyenne River near the intersection of the Peterson Coulee. From this point, water would move through a channel or pipeline northeast to the West Bay of Devils Lake. This is a new proposal evaluated for this report. It was determined this proposal would not be pursued because of insufficient water in the Sheyenne River.

C. Missouri River Water Diversion Scenarios

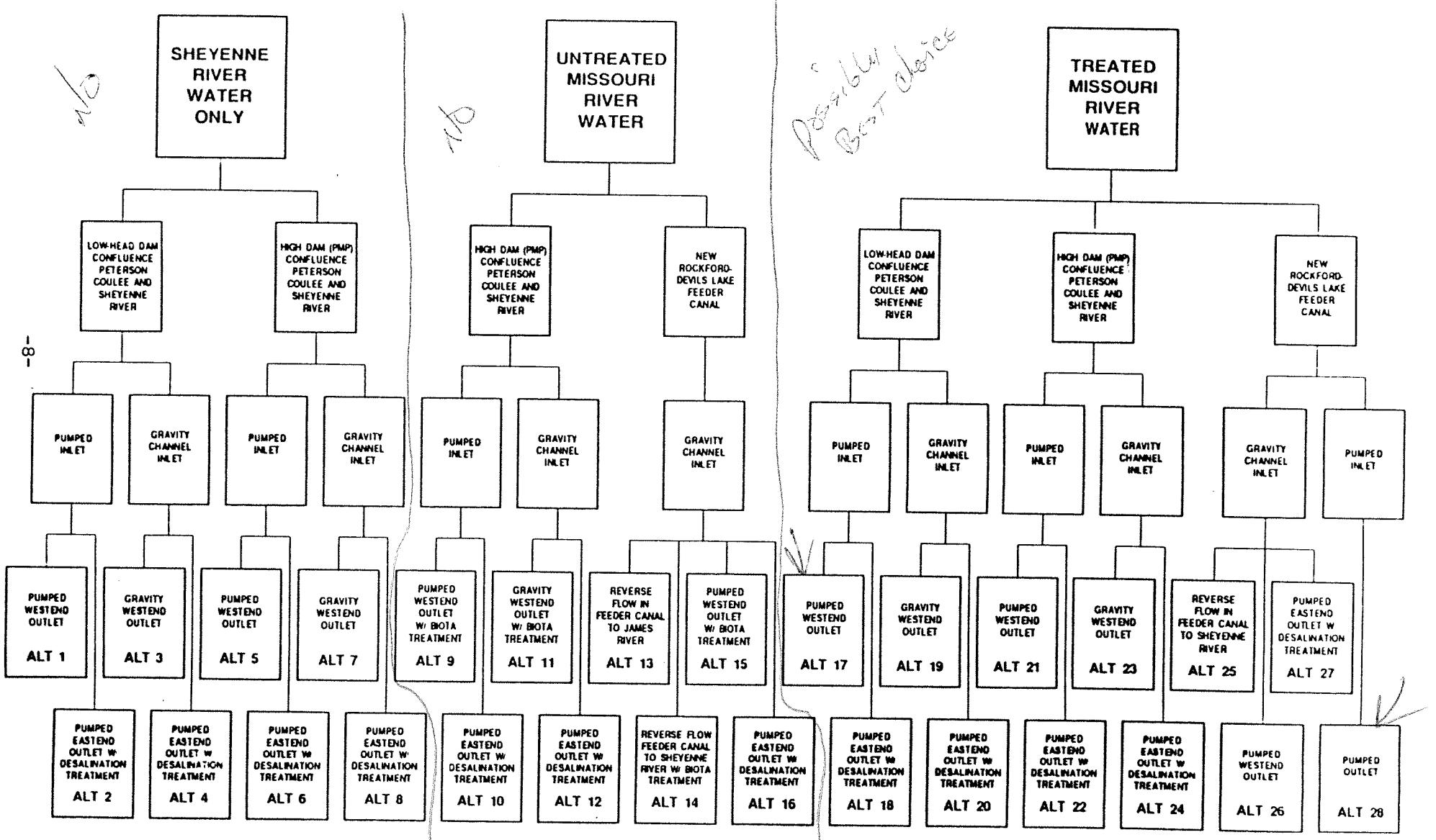
The quality of water delivered to Devils Lake will depend on whether the water is treated or untreated. The timing of water delivered to Devils Lake will depend on completion of consultations with Canada and appropriation of funds to allow completion of NEPA compliance (EIS) and completion of construction of a connecting link between McClusky Canal and New Rockford Canal.

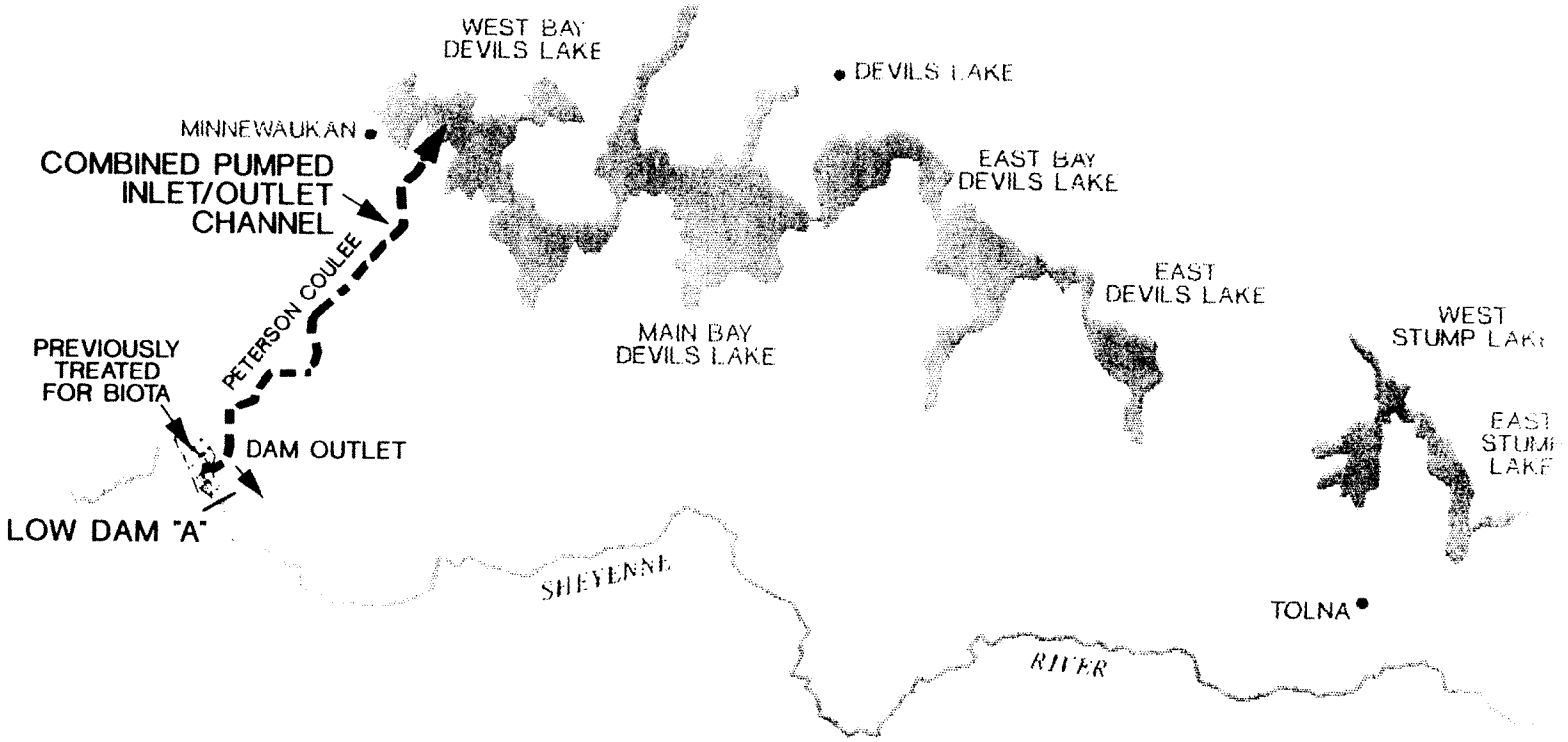
It is extremely important to note that the state of North Dakota has made a commitment to Canada that no water will be released to the Sheyenne River or any stream in the Hudson Bay watershed that contains biota which is objectionable to Canada. It is understood that none of the methods prepared have been approved as being adequate treatment for biota by the Canadian Government. As a result, the assumptions used in developing the alternative comparisons in this report have not been approved by Canada.

D. Alternative Diversion Plans

These plans incorporate different sets of project features that, when linked together, are capable of getting supplemental water into Devils Lake. The following diagram was developed to identify the project features included in each of the 28 alternative plans. A brief analysis of each plan is included in the main report. This summary report includes information on only the three most feasible alternatives as determined by the state agencies involved.

Devils Lake Stabilization Alternatives





TREATED MISSOURI RIVER WATER
LOW DAM AT PETERSON COULEE
PUMPED INLET TO DEVILS LAKE
COMBINED PUMPED OUTLET

ALTERNATIVE 17

Alternative 17 - Treated Missouri River Water
Low Head Dam
Pool EL 1436 MSL (Pumping Pool)
at Peterson Coulee (Location A)
Pumped Inlet to Devils Lake
Pumped Outlet

Water Treatment For Biota	$ 28,100,000
Dam	
Right-of-Way	450,000
Highway and Bridge Relocations	20,000
Low Head Dam	1,500,000
Inlet	
Pumped Inlet Channel to Devils Lake With Gravity Through Lakes	16,700,000
Outlet	
Pumped Outlet	18,000,000
TOTAL	$ 64,770,000
Annual Operation and Maintenance Costs	$ 3,700,000

Narrative:

This alternative proposes to divert treated Missouri River water into the West Bay of Devils Lake. Water would be delivered down the New Rockford Canal for five miles to a biota treatment plant within the James basin. The biota treatment plant would also deliver water to the Sheyenne River for use by the communities along the Red River (Fargo, Grand Forks, etc.) during a seven-month period. Treated water for both Devils Lake and downstream communities will be diverted into the Sheyenne River. The treated water would be captured at the proposed low-head dam located 17 miles southwest of Devils Lake near the confluence of Peterson Coulee and the Sheyenne River. The dam would be approximately 12 feet high, 100 feet in length, and would have a crest elevation of 1436 msl. The pool created by the structure would have a capacity of 3000 acre-feet and a surface area of 673 acres.

The water stored in the low-head dam and the inflow entering the dam could then be transferred to Devils Lake by a pumping plant and pipeline. The pumping plant and the pipeline would have a design capacity of 200 cfs. The inlet would be designed to lift water 110 feet up Peterson Coulee to Stony Lake. From

this point, the water would enter West Bay by gravity via Long Lake and Round Lake.

If Devils Lake were to reach elevation 1430 msl, water would be pumped to the Sheyenne River through the West End outlet. The West End pumped outlet would lift the water through Round Lake, Long Lake, Stony Lake, and by gravity down Peterson Coulee to the Sheyenne River. The West End pumped outlet is described in the Corps of Engineers' outlet study.

Advantages:

1. Moderate initial cost.

2. Sheyenne River water could supplement GDU water.

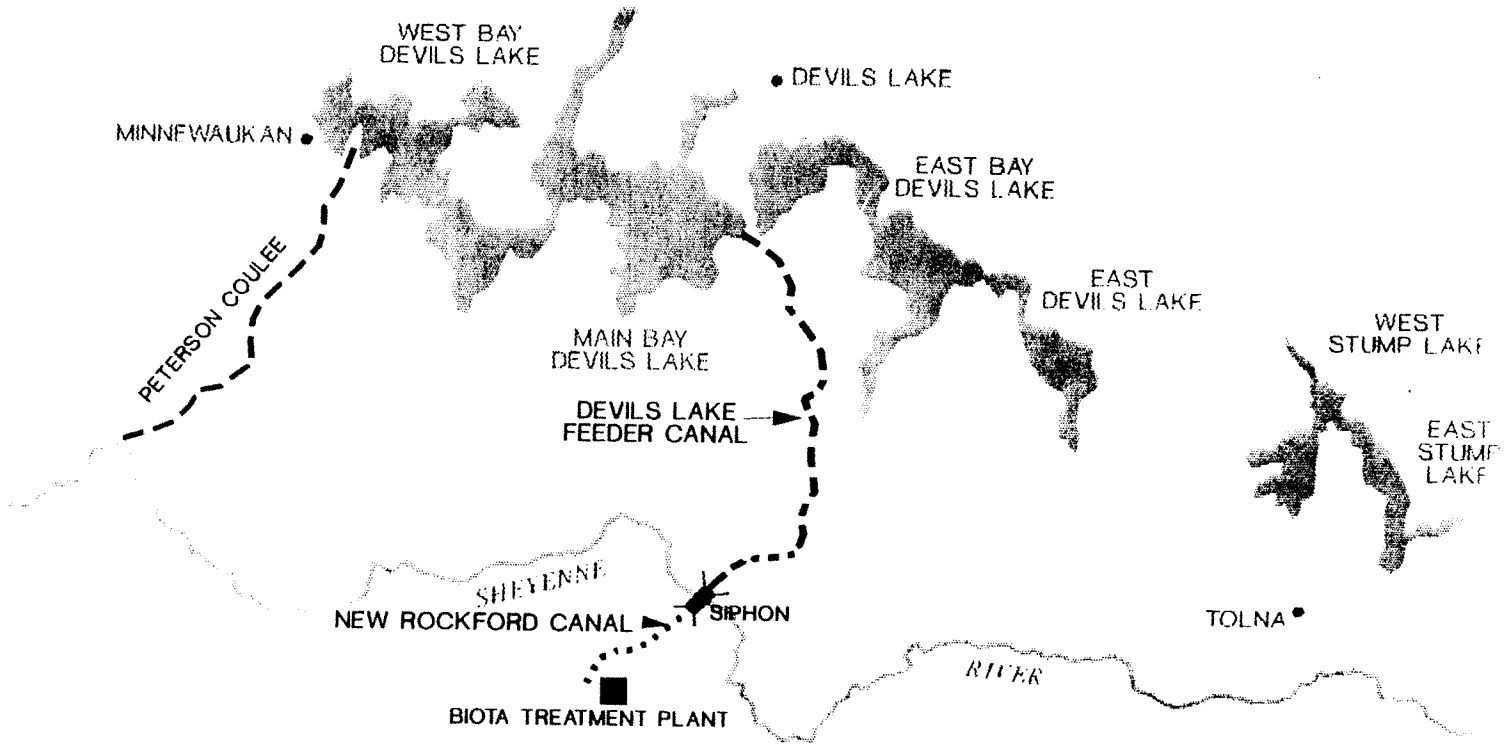
3. A West Bay inlet would enhance the potential for natural reproduction of the desirable sport fish population.

Disadvantages:

1. Uses the Sheyenne River for the conveyance of both Devils Lake and downstream M&I water.

2. Somewhat higher treatment costs due to channel losses in the Sheyenne River during dry years.

3. Inlet and outlet pumping costs.



TREATED MISSOURI RIVER WATER
PETERSON COULEE OUTLET
ALTERNATIVE 26

Alternative 26 - Treated Missouri River Water
Devils Lake Feeder Canal
Pumped Outlet From West End
Devils Lake to Sheyenne River

Water Treatment - Biota	$ 28,100,000
Inlet	
Devils Lake Feeder Canal (Including all Costs)	25,700,000
Outlet (Return Flows to Sheyenne River)	
Peterson Coulee Pumped Outlet	18,000,000
TOTAL	$ 71,800,000
Annual Operation and Maintenance Costs	$ 3,555,000

Narrative:

Alternative 26 will have a 200 cfs biota treatment plant located on Reach 3 of the New Rockford Canal in Section 10, 149-65. The plant would be located in the James River basin and the effluent from the plant would be returned to the James River. The water would be delivered to Devils Lake during the winter months. The system would have the capacity to deliver approximately 70,000 acre-feet annually to Devils Lake. The biota treatment plant would also deliver water to the Sheyenne River for use by the communities along the Red River (Fargo, Grand Forks, etc.) during a seven-month period. The water would be delivered to Devils Lake via the Devils Lake Feeder Canal. The Devils Lake Feeder Canal, as used in this report, includes the Warwick and the Devils Lake Feeder Canal, both features of the original 250,000 acre Garrison Diversion Unit project. The combination 400 cfs canal is 26 miles long and starts at a point on the New Rockford Canal. Water would be transported under the Sheyenne River using a siphon. The water is delivered from the Devils Lake Feeder Canal to Mission Bay (Section 15, 152-64) of Devils Lake. The Devils Lake Feeder Canal will cross a number of small lakes which will be retained by the use of canal check structures.

If Devils Lake were to reach elevation 1430 msl, the water would be pumped to the Sheyenne River through the West End outlet. The West End pumped outlet lifts the water through the Chain of Lakes, south of the Minnewaukan Flats (West Bay) and by gravity down Peterson Coulee to the Sheyenne River. The West End pumped outlet is described in the Corps of Engineers outlet study. No treatment of the outlet water is required because the inflow water was treated to remove objectionable biota. Also,

during period of high water in Devils Lake (stages greater than elevation 1430), the water quality in West Bay should meet water quality standards for the Sheyenne River.

Advantages:

1. Gravity inflow.

2. Does not use the upper Sheyenne River for conveyance of water to Devils Lake.

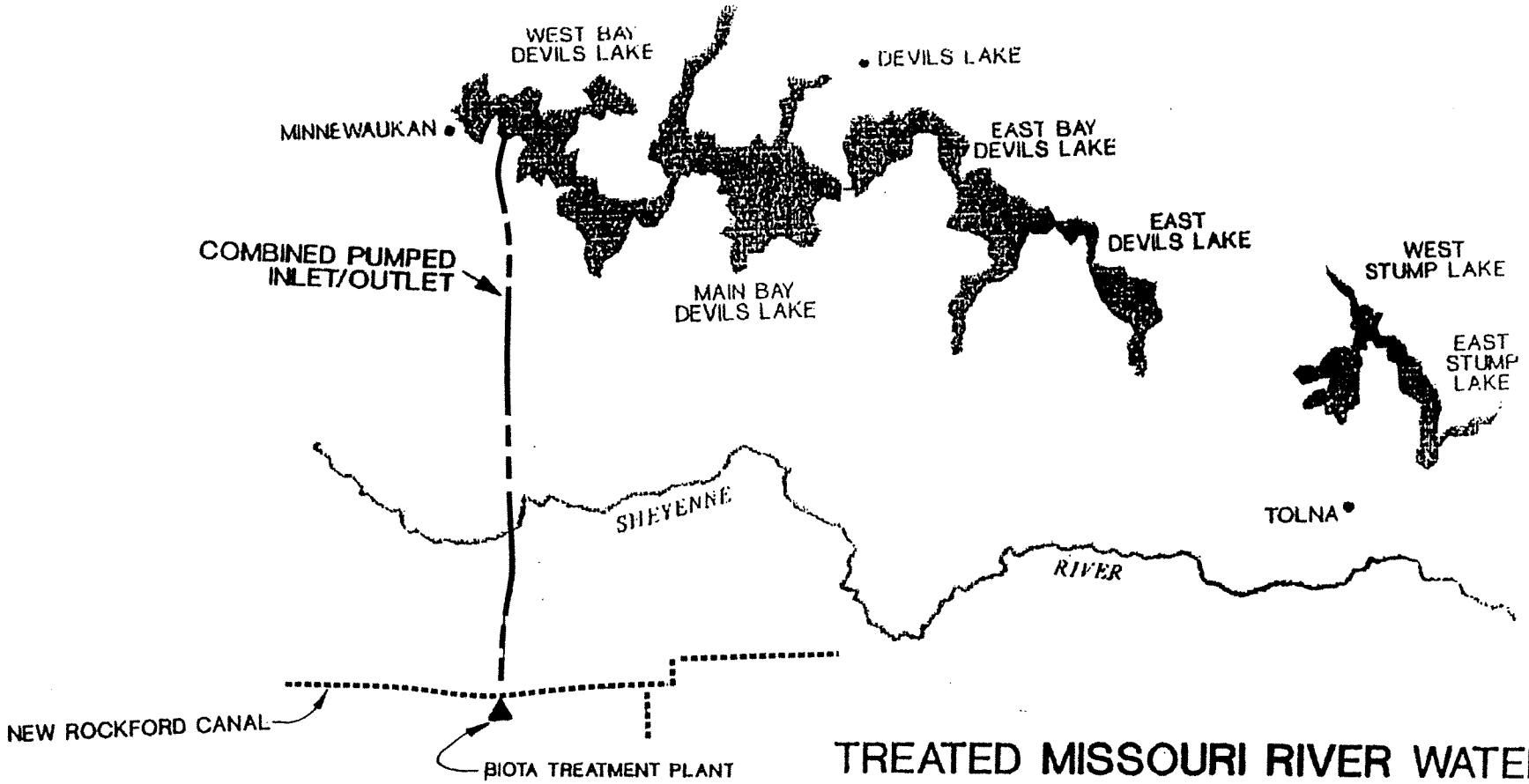
Disadvantages:

1. Pumped outlet.

2. Somewhat higher treatment costs due to seepage losses in the Devils Lake Feeder Canal.

3. Increased environmental consequences which may delay the project.

4. Increased mitigation requirements because of separate inlet and outlet routes.



TREATED MISSOURI RIVER WATER

COMBINED PUMPED INLET/OUTLET

ALTERNATIVE 28

Alternative 28 - New Rockford - Devils Lake Pipeline Treated Water

Biota Treatment Plant	$ 23,300,000
Inlet	
Pipeline (22 mile -72 inch)	48,600,000
Outlet	
Pump Back Through the Pipeline (Cost Added to Inlet Pipeline)	4,255,000
TOTAL	$ 76,155,000
Annual Operation and Maintenance Costs	$ 3,860,000

Narrative:

Alternative 28 is designed to deliver 200 cfs (70,000 acre-feet) of treated Missouri River water to Devils Lake via a pipeline. The biota treatment plant would be located on the New Rockford Canal in the James River basin. The pipeline to Devils Lake would begin at the biota treatment plant and cross the Sheyenne River. A turn-out and energy dissipator would be constructed at the Sheyenne River crossing so water could be delivered to the Sheyenne River for the cities of Fargo and Grand Forks. The same pipeline would serve as an outlet to the Sheyenne River. The 22-mile pipeline would be a 72-inch diameter pipe with two pumping plants. This alternative is a new concept and, as a result, the route, facility locations, and costs are very preliminary.

Advantages:

1. Closed system will minimize the loss of treated water.
2. Minimal environmental impacts.
3. Minimum loss of land.
4. Does not use the Sheyenne River for the conveyance of water to Devils Lake.
5. A West Bay inlet would enhance the potential for natural reproduction of the desirable sport fish population.

Disadvantages:

1. Inlet and outlet pumping costs.
2. Higher initial investment than Alternatives 17 and 26.

IV. CONCLUSIONS

This report provides preliminary information on several alternatives for stabilizing water levels in Devils Lake. This information should be adequate for use by local groups and various governmental authorities in selecting short-term and long-term plans for further consideration. It is anticipated that selected plans will be studied in greater detail to verify feasibility, desirability and acceptability.

1. The only logical water source is the Missouri River using the Garrison Diversion Unit project. The Sheyenne River and Devils Lake basin water supplies are inadequate during a drought period. Ground water is also inadequate in quantity and large withdrawals from area aquifers would jeopardize existing users.

2. It was the general consensus that an inlet and outlet from Devils Lake should be considered together. Clearly, Devils Lake needs supplemental supply at the present time, but if history repeats itself, an outlet will also be needed to prevent flooding in the future.

3. There are numerous local, state, federal, and international considerations concerning Missouri River diversion alternatives. Many of the decisions related to these considerations must be made at the federal and international level.

4. Short-term alternatives (non-diversion) should be considered for implementation at an appropriate time. One alternative considered should be blocking the Highway 20 bridge and the possible pumping of water from East Bay into the Main Bay of Devils Lake. Although this would, in all likelihood, result in the loss of the fishery in East Bay and East Devils Lake, it could enhance the survival potential of the fishery in Main Bay. Specifically, a sheet pile structure would be installed in front of the Highway 20 bridge to elevation 1424 msl. Portable pumps could possibly be borrowed from the Corps of Engineers for use in pumping water from East Bay to Main Bay.

5. Changing the level of Devils Lake raises at least two legal issues. The first issue relates to the state's authority to change the level of Devils Lake and the necessity of compensating landowners who are affected by this change. The second issue relates to whether the change in the lake level would affect ownership interests in and around the lake bed. Both of these issues need to be more thoroughly researched and considered before the level of Devils Lake is artificially controlled.

6. Water diverted into Devils Lake should be treated to eliminate the possibility of the introduction of undesirable fish species. Due to Canadian concerns regarding possible environmental consequences, untreated water delivery may actually delay implementation of any diversion project for Devils Lake.

7. Completion of the NEPA (EIS) compliance will require at least three years. As a result and the time needed for design and construction, it is not likely that water can be diverted into Devils Lake within the next five years.

8. An operating plan will be required regardless of the diversion alternative selected. In order to make a selective comparison of alternative costs to minimize the inlet-outlet transfer of water, and therefore O&M costs, the following plan is suggested for consideration and refinement.

Devils Lake Elevation	Pumping Activity	High/Low Lake Level*
1430 and Above	Outlet Pumping to Begin	Peak - 1432.7 msl
1426-1430	No Pumping	
1426 and Below	Inlet Pumping	Low - 1423.9 msl

*Assumes a 200 cfs maximum pumping capacity for 210 days.

Although this operating plan results in a 60-year maximum fluctuation from 1423.9 to 1432.7 or 8.8 feet, the lake would usually fluctuate between 1425 and 1430 msl. While there may be some advantage to a more stable lake level, several feet of fluctuation promotes fish production and minimizes annual pumping costs.

9. The main report contains information on 28 different diversion alternatives. In concluding the report, it was deemed appropriate to narrow the alternatives. As a result, the four state agencies involved selected three alternatives that appear to be the most feasible (Alternatives 17, 26 and 28). The state agencies also designated Alternative 28 as the preferred choice at this time.

10. Cost estimates contained in this report are total costs to construct and operate the alternatives. These costs are conservative and contain components and operating