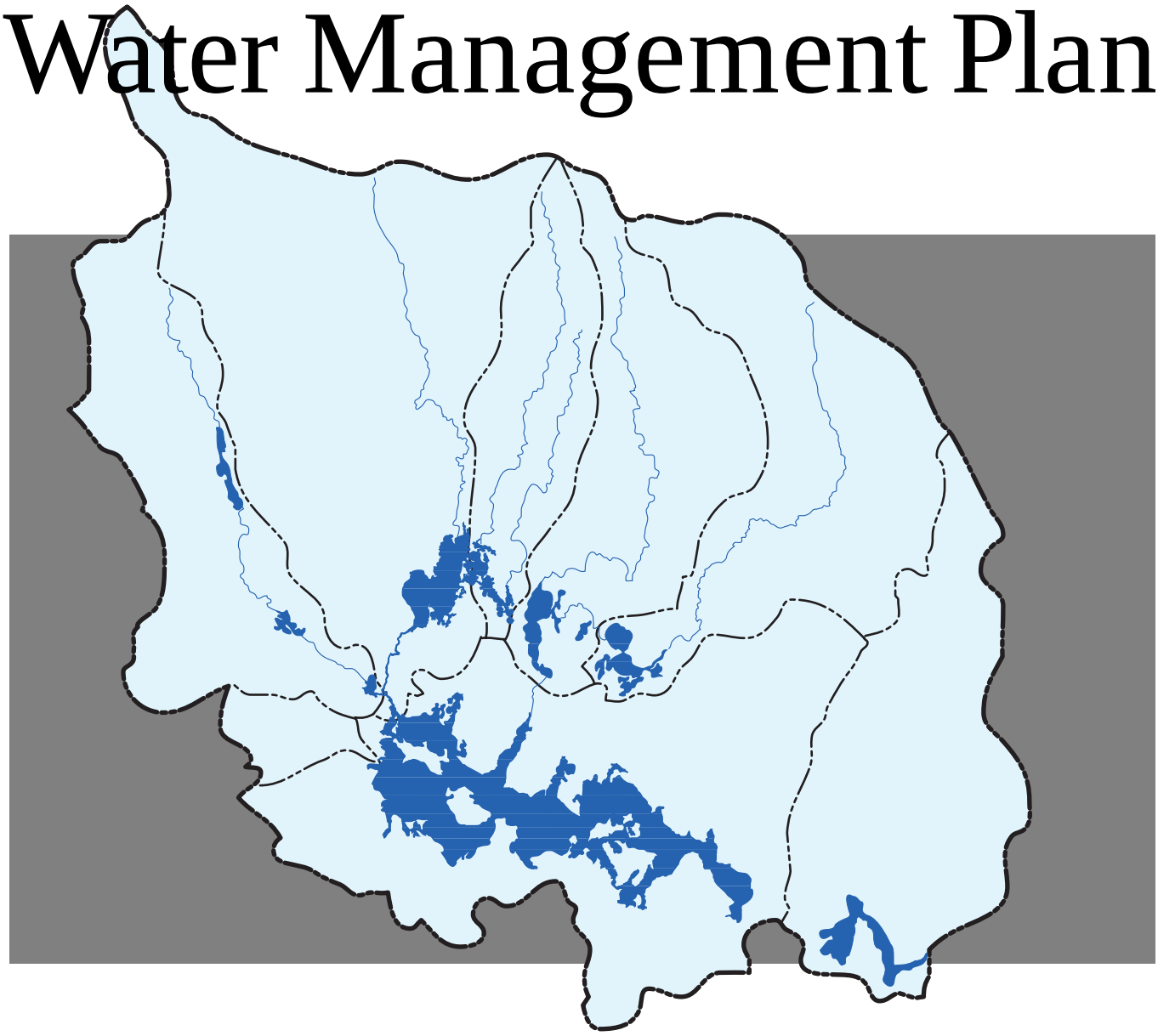
Devils Lake Basin Water Management Plan



PREPARED BY:
Devils Lake Basin Joint Water Resource Board
and the
North Dakota State Water Commission

2002

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Introduction

It was determined by the Devils Lake Basin Joint Water Resource Board in early 2002, that a need existed to update the 1995 plan and to re-evaluate its objectives based on more current and enhanced data. This report supercedes the 1995 Devils Lake Basin Water Management Plan (Devils Lake Basin Task Force and the North Dakota State Water Commission, 1995) that was a product of the Devils Lake Basin Conceptual Water Management Plan (North Dakota State Water Commission, 1991).

One of the primary objectives of the 2002 update of the Devils Lake Basin Water Management Plan was to utilize local citizenry for their experience and expertise, while still employing the expertise of various state, federal, and private agencies in a non-voting, technical support role. The other was to update and adjust the Devils Lake Basin Water Management Plan to more accurately reflect current conditions and needs.

The key to resolving this debate over water management within the Devils Lake Basin is planning at the watershed level, which works at restoring the viability of agriculture, ensuring flood protection for the City of Devils Lake, as well as addressing upper basin flooding, and lastly looking into recreational development for economic diversity.

Mission Statement

It is the goal of the Devils Lake Basin Joint Water Resource Board to develop a comprehensive, coordinated water management plan for the Devils Lake Basin that will protect the economic and biological values of the basin while providing optimum benefits for agriculture, wildlife and fisheries, outdoor recreation, economic development, and its' citizens.

Purpose of the Plan

The purpose of this document is to provide general background on water and land resources, to define water management issues, to update project needs, to state objectives, and to provide strategies designed to manage the Devils Lake Basin in a manner that best meets the needs of all interested parties. Once the Subject Committees and the Devils Lake Basin Joint Water Resource Board have approved the updated basin management plan, the process of implementation of strategies can begin.

Perhaps the most important aspect of this plan is ensuring that all relevant agencies-state, federal, and private organizations, should make a unified effort to achieve the management strategies and objectives of this plan, which will serve as a constant reminder of what actions need to be completed in the basin.

This plan is a working plan, and in that sense will never be completely finished, and will need periodic updates. It uses a loose-leaf format to outline components of the plan so the results of future work can be added with little effort. **Any changes in objectives or strategies must be approved by the Devils Lake Basin Joint Water Resource Board with consultation from the four Subject Committees, and will be reflected in future plan revisions.**

Future Updates

The 2002 update of the Devils Lake Basin Water Management Plan represents the conditions of the Devils Lake Basin at this time. The purpose of the Devils Lake Basin Water Management Plan is to provide a convenient and accessible document that will provide the citizens of the Devils Lake Basin and state, federal, and private agencies with a road map of what has been done, what is being done, and what remains to be done.

While this plan intends to give a long-term vision of water management in the basin, it is the nature of water management issues to change. It is important to continue to make progress towards the basin's long-term water management goals, while still retaining the flexibility necessary to change this plan to best meet short-terms needs.

As a result, the Devils Lake Basin Water Management Plan will be reviewed every three years, or less if necessary, by the Devils Lake Basin Joint Water Resource Board, with the assistance of the Subject Committees and Technical Support Groups. The Subject Committees have also recognized the need to keep their objectives, management issues, strategies and procedures current, and have set timetables for the updating of the respective sections.

Maintaining the Devils Lake Basin Water Management Plan provides long-term guidance, but it is also a document that must be kept current in the overall effort to resolve many of the Devils Lake Basin's water management problems. Many excellent studies have been initiated in the Devils Lake Basin, only to be forgotten or not kept updated. A good example of a study that will need to be continually updated is the Bureau of Reclamation's Road and Railroad Crossing Inventory for the Edmore, Mauvais, and Big Coulee crossings. The responsibility of maintaining this powerful tool for hydrologic modeling has been given to the Devils Lake County Water Resource Boards, and they have agreed to do so. The success of this plan is dependent upon all interests continually working together for the betterment of everyone.

The Three-Pronged Approach

As a result of the extremely high water levels on Devils Lake, and the corresponding land and property damages, the need for a solution to the current water management problems has become apparent. What is needed is a comprehensive, understandable, watershed-level plan to affect true change in the basin, which this document represents. A three-pronged approach, including upper basin water management, infrastructure protection, and an outlet to the Sheyenne River, has been developed to alleviate flooding in the basin.

Upper Basin Water Management

The first aspect of the approach is upper basin water management. The 1995 Devils Lake Basin Water Management Plan concluded that with the proper incentives to landowners, some wetland areas in the upper basin could hold additional waters in high-flow conditions, and this has been done with the North Dakota State Water Commission sponsored Extended Storage Acreage / Available Storage Acreage Programs, the Natural Resource Conservation Service, the North Dakota Natural Resource Trust, and the United States Fish and Wildlife Service National Wildlife Refuge on Lake Alice. Various governmental agencies have, or are planning the development, management, and enhancement of wetland acres for the dual purposes of wildlife habitat and water storage. Currently, nearly 14,000 acres of wetlands have been restored or set aside for the dual purpose of water storage and wildlife habitat, and these agencies estimate that the area of those wetlands could eventually be greater than 27,000 acres if all proposed projects are constructed.

The North Dakota State Water Commission enacted the Available Storage Acreage Program (ASAP) in 1996. This program paid landowners to store water that would have contributed to the flooding around Devils Lake. The program ran from 1996-1999 and stored 8,000-22,000 acre-feet per year at a total cost of $3.5 million. In 2000, the North Dakota State Water Commission changed the program from ASAP to the Extended Storage Acreage Program (ESAP). The revised program is a ten-year water storage program managed by the Devils Lake Basin Joint Water Resource Board. It was thought that a ten-year program would be more cost effective in addressing the long-term nature of the flooding problem. Currently, ESAP is storing 800 acre-feet at a cost of $12,000 per year (Personal communication with James Landenberger, 2002).

There have also been five different studies completed in the Devils Lake Basin, trying to determine the actual storage of wetland depressions. The most accurate and detailed of these studies is the one completed by the United States Army Corps of Engineers in 2001. However, storing surface water alone is not the whole answer.

In addition to changing the quantity of water flowing into Devils Lake, there have also been projects by various agencies that address the quality of water, not only in Devils Lake, but also in the basin as a whole. The United States Geological Survey has produced 22 papers on the hydrogeology of Devils Lake since the last plan was published, addressing subjects ranging from variations in water quality in Devils Lake and upper basin lakes, plankton communities, to reconstructing historical hydrological conditions.

The Devils Lake Basin Joint Water Resource Board in association with the North Dakota Natural Resource Conservation Service is currently working on a restoration demonstration projects on portions of the Starkweather Coulee that will demonstrate the value of different agricultural techniques, such as buffer strips. These types of

projects have the potential to significantly improve the quality of water entering Devils Lake. In addition to actual projects, many of the Technical Support Groups, such as the North Dakota State University Extension Service, and the Natural Resource Conservation Service, have active educational programs in place to increase the sustainability, environmental friendliness, and profit of agricultural land use practices in the upper basin. The various projects, and programs in place in the Devils Lake Basin demonstrate the amount of progress that has been made as a result of the 1995 plan. However, much work remains to be done.

Infrastructure Protection

The second aspect of the three-pronged approach is infrastructure protection. Since 1996, Federal Emergency Management Agency's (FEMA), National Flood Insurance Program (NFIP), through waiving contract rules and adding an endorsement for cyclical lake coverage, has paid a total of 500 claims for the purposes of salvage, relocation, and demolition, and an additional 250 claims for the protection of existing structures, totaling over $28 million dollars.

In May 1999, FEMA contracted for a GPS-based risk assessment inventory of all structures around Devils Lake below 1,465 feet amsl. The inventory used digital aerial photography and LiDAR (Light Detection and Ranging), a topographical remote sensing technology. A total of 890 structures, valued at $76.9 million, were identified, 139 of which are below 1,450 feet amsl. FEMA has completed this detailed risk assessment around Devils Lake. The contractor for the FEMA LiDAR project has been contracted by the state to help provide a data storage site and web-based data access point to be managed by the ND Information and Technology Division.

Since September 1999, the NFIP implemented a closed basin lake flood insurance endorsement replacing the temporary waivers it had been using to handle the continuous lake flooding. As of July 15, 2001, four of nine Devils Lake area NFIP participating communities opted to remain eligible for this closed basin lake flood insurance endorsement. The communities of Benson County, Minnewaukan, Creel Township, and Devils Lake adopted a more stringent floodplain management regulation, which controls development below an elevation of 1,460 feet amsl.

Most of the City of Churchs Ferry was acquired under FEMA's Hazard Mitigation Grant Program (HMPG) at a cost of $3.5 million. Two families remain in the city at an elevation above 1,460 feet amsl. The BTR Cooperative Elevator in Churchs Ferry is relocating five miles west of the city in Benson County through a combination of programs, including the NFIP, HMPG, the Economic Development Administration, the Housing and Urban Development (HUD) program, and local funding. Rural acquisitions in Ramsey and Towner Counties continue, affecting approximately 24 farmsteads.

The North Dakota Department of Transportation has spent over $100 million on improvements and maintenance for roads affected by the rise of Devils Lake. A great deal of work has been completed since 1995, and if waters continue to rise, additional funds will need to be allocated towards road improvements.

Generally, the roads have been raised to an elevation of 1,455 feet amsl, with the base wide enough to eventually go to 1,465 feet amsl and the bridges to 1,465 feet amsl. Currently, the Department of Transportation is refining options to relocate Highway 281 around the Minnewaukan area.

Several areas adjacent to Highways 20 and 57 are not currently flooded by Devils Lake because the roads are acting as dikes. Before the Federal Highway Administration will provide funds for another round of raises, it expects the water to be equalized on both sides of the roads, unless the roads are certified by the U.S. Army Corps of Engineers as protection structures or additional dams are built to protect the roadways or to allow for equalization of the water. The Corps says it is highly unlikely it will certify any of the roads in the Devils Lake area as dikes since they do not meet Corps regulations. The state is considering two solutions to this growing problem. Both options cost about $90 million: one would construct perimeter dikes and interior dams; the other would equalize the water levels and buy out land and homes that would be flooded.

The U.S. Army Corps of Engineers has systematically raised the City of Devils Lake levees. The levees will now protect against lake levels up to elevation 1,450 feet amsl (top of levee at elevation 1,457 feet amsl). The existing dikes can be raised three more feet without additional foundation work, which will protect to a lake elevation of 1,452 to 1,453 feet amsl for an estimated cost of about $7 million. Infrastructure in Minnewaukan was rebuilt in 2000 and planning for structural and non-structural alternatives continues.

The Burlington Northern Santa Fe Railroad has raised its main line rail bed across the Mauvais Coulee near Churchs Ferry to an elevation of 1,456 feet amsl. The $1.5 million cost includes over $400,000 from local and state sources. This raise was completed in November 2001.

Over $1 million has been spent, primarily by FEMA, to relocate pipes and pump stations to keep the Ramsey County rural sewer system operable. Continued loss of customers and added operating costs is making it difficult to maintain the system.

Over the past 10 years, over $400 million dollars have been spent on infrastructure protection in the Devils Lake Basin. If the lake continues to rise, more will undoubtedly be spent.

Outlet to the Sheyenne River

The final aspect to the approach is an outlet from Devils Lake. Any outlet project needs to be carefully planned in order to ensure that water discharged from Devils Lake would meet the water quality standards of the receiving streams. Increased erosion and flooding are additional issues. Many alternatives have been studied. Currently, there are two proposed outlet projects, one being pursued by the State of North Dakota and the other by the United States Army Corps of Engineers.

The United States Army Corps of Engineers is designing a permanent 300-cfs outlet from Pelican Lake to the Sheyenne River. The State of North Dakota is pursuing a temporary phased implementation emergency outlet project out of West Bay to the Sheyenne River. The first phase of the state project is a 100 cfs capacity outlet, with the next phases including the capability of expanding the outlet project to 200 or 300 cfs. The outlet would consist of two pumping stations, 3.3 miles of pipe, and 9.4 miles of open channel. The project will utilize existing United States Army Corps of Engineers EIS studies to assess downstream impacts. The final

design for the entire project has been completed. The final contract for the first components of the projects has been awarded, and work began in October, the schedules calls for it to be in operation in 2004. The entire project is estimated to cost approximately $25 million dollars.

In addition to water quality concerns, the need also exists to closely monitor the effects of increased flows on the Sheyenne River to minimize disruption of that system. Average seasonal flows in the Sheyenne River have been 62.4 cfs, although during the course of the year, flows are higher, as evidenced by the river's 600 cfs channel capacity. Both the State of North Dakota and the United States Army Corps of Engineers are looking at adding up to 300 cfs, so downstream communities must be considered. However, the potential danger that a 6,000 cfs natural overflow poses to lives, property, and water quality in Valley City, Lisbon, Fargo and Grand Forks, necessitates alleviating the flooding threat as quickly as possible (United States Army Corps of Engineers Draft Environmental Impact Statement, 2002).

The "Fourth Prong"

While this plan demonstrates that there has been a great deal of progress made by all groups on the water problems of the Devils Lake Basin, an area that has often been overlooked, is economic revitalization and recovery, the so-called "fourth prong." While the first three prongs focus on physical solutions to water management problems, the economy of the Devils Lake Basin, while less physically tangible, is no less important.

Some progress has been made in this area, with the Economic Development Subject Committee outlining objectives and strategies in this area. The majority of the work on economic recovery and revitalization has been done at the local level, though a report prepared in 2000 by CEO Praxis for the City of Devils Lake and the Mayor's Business Committee, and an economic summit held in Devils Lake in 2000 with over 20 state and federal agencies represented demonstrates progress in this area.

However, economic revitalization and recovery efforts are often limited by a lack of funding and technical expertise. The small number of programs in this area highlights the need for local citizens, state, federal, and private agencies to focus more of their energy in the future on this vital area. Solving the water management problems of the Devils Lake Basin is not only vitally important to the economic future the communities and residents of the basin, but has important impacts on the economic viability of the entire State of North Dakota.

Background of Devils Lake Basin Water Management

In 1992, The United States Army Corps of Engineers developed a reconnaissance report concerning comprehensive planning in the Devils Lake Basin and the water level of Devils Lake. The North Dakota State Water Commission and the Devils Lake Basin Joint Water Resource Board at the urging of the local interests, worked with the United States Army Corps of Engineers on the completion of a federal feasibility study looking for ways to manage the basin's water and Devils Lake water levels.

Reviews of the Conceptual Plan generated the ideas incorporated into a report published 1995. Comments received from reviews of that report were used to develop specific recommendations and implementation strategies that are included in this new comprehensive, basin-wide water management action plan.

The State Engineer appointed the Devils Lake Basin Task Force in that earlier process. It was their mission to work with the Devils Lake Basin Joint Water Resource Board and the public to produce a final plan that addressed the basin's water quantity and water quality issues, while promoting peace and harmony among the various interests in the basin.

The Devils Lake Basin Task Force developed the 1995 report as an action plan to manage the Devils Lake Basin. There are four main interests within this report: agriculture, wildlife and fisheries, recreation, and economic development. Each interest developed its own objectives to pursue the common goal, which was stated in the mission statement.

In 1995, the Devils Lake Basin Water Management Plan was completed, drawing upon the combined efforts of private citizens, and local interests, utilizing the technical expertise of various state and federal agencies.

Stage I of the feasibility study emphasized quantifying flood risks around Devils Lake. Stage II of the study followed to define projects and programs needed to stabilize the water level of Devils Lake.

The 1995 Devils Lake Basin Water Management Plan was important to the feasibility study process because it addressed the management needs of the entire basin. A management plan is essential to gain federal approval of any project designed to alleviate the flooding situation currently affecting the Devils Lake Basin.

The 1995 report was a revolutionary attempt to look at the entire basin in respect to its issues and resources and to clearly define the contemporary water management needs that existed in the Devils Lake Basin. It was an interim step to clearly define the actions that must take place in order to resolve water issues in the basin. The Devils Lake Basin Task Force determined that all concepts and proposals contained in the report would require continued discussion and refinement. Cooperative efforts would be made through the Devils Lake Basin Joint Water Resource Board to resolve identified problems.

Devils Lake Basin Joint Water Resource Board

In June of 1979, six county water resource districts (Benson, Cavalier, Nelson, Pierce, Ramsey and Towner) joined together under the joint powers agreement granted by the North Dakota Century Code 61-16.1-11. This organization was formed to replace the Devils Lake Basin Advisory Committee. In March of 1980 Rolette and Walsh Counties joined with the six original counties. And finally, in October of 1997, the Devils Lake Basin Joint Resource Board reorganized with a new joint powers agreement and added Eddy County as a member, bringing the total number of member counties to nine (Figure 1).

The Directors of the Devils Lake Basin Joint Water Resource Board are comprised of one water resource district representative selected by each member county. In January of each year the Board reorganizes electing a Chairman and Vice Chairman from the county representatives.

The Devils Lake Basin Joint Water Resource Board's mandate is "that a Joint Board is necessary for a coordinated and cooperative approach to water management in the Devils Lake Basin…it was recognized by the water resource districts of the Devils Lake Basin that one entity representing the entire Devils Lake Basin would better represent the area concerning planning and implementation of a complete water management plan for the basin, and that one entity could better represent the entire Devils lake Basin in dealings with the federal, state and other local governments." (Devils Lake Basin Joint Water Resource Board By-Laws, June 1997).

Devils Lake Basin Joint Water Resource Board of Directors (As of 2002)

Carl Duchscher, Benson County
Larry Gellner, Cavalier County
Pete Becherl, Eddy County
Ben Varnson, Nelson County
Duane Hawk, Pierce County
Gordon Cowan, Ramsey County
Ronald Heinz, Rolette County
Dale Anderson, Towner County
Bob Shirek, Walsh County

Subject Committee Representatives

The 36 Subject Committee Representatives were appointed by the Devils Lake Basin Joint Water Resource Board for the 2002 update of the Devils Lake Basin Water Management Plan. Qualified representatives were appointed by each of their respective counties that comprise the Devils Lake Basin and the Spirit Lake Nation. The idea behind this updated version of the Devils Lake Basin Water Management Plan was to have a plan that was even more representative of the interests of the citizens of the basin than was the 1995 plan. As a result, the majority of the Subject Committee Representatives were private citizens who had an active interest and expertise in one of the four subject areas: agriculture, recreation, wildlife and fisheries, or economic development. These hard-working citizens devoted many long hours of their time for the betterment of the Devils Lake Basin.

Subject Committee Representatives

BENSON COUNTY
Agriculture- Jason Lee
Wildlife & Fisheries- Barry Cox
Recreation- David Johnson
Economic Development-
Bruce Terpening

CAVALIER COUNTY
Agriculture- Richard Flanders
Wildlife & Fisheries-
Harold Nowatzki
Recreation- Ray Rollness
Economic Development-
Carol Goodman

EDDY COUNTY
Agriculture- William Starke
Wildlife & Fisheries-
Travis Peterson
Recreation- Clayton Quam
Economic Development-
Jim Eversvik

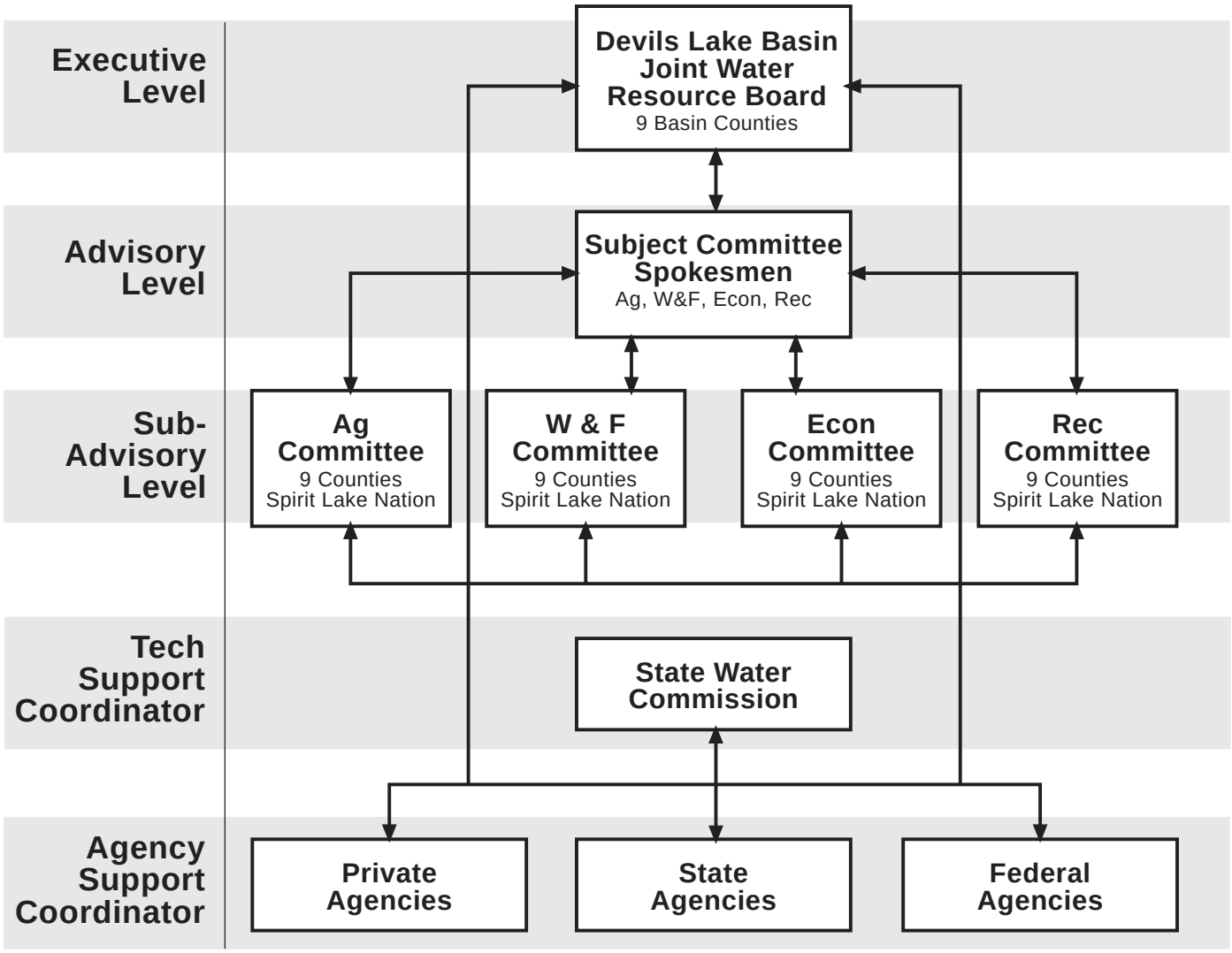


FIGURE 1: Organizational flow chart for the 2002 update of the Devils Lake Basin Water Management Plan. Note that the Devils Lake Basin Joint Water Resource Board coordinates all activities in this process.

NELSON COUNTY
Agriculture- David Thompson
Wildlife & Fisheries- Dale Varnson
Recreation- Larry Johnson
Economic Development- Denise Hendrickson

PIERCE COUNTY
Agriculture- Robert Fritel
Wildlife & Fisheries- Kermit Peters
Recreation- Dondi Sobolik
Economic Development- Gerry Jacobson

RAMSEY COUNTY
Agriculture- Dan Webster
Wildlife & Fisheries- Kyle Blanchfield
Recreation- Barb Britsch
Economic Development- Jim Dahlen

ROLETTE COUNTY
Agriculture- Dan Boe
Wildlife & Fisheries- Lee Lewis
Recreation- Scott Mitchell
Economic Development- Justin Andirst

TOWNER COUNTY
Agriculture- Dale Anderson
Wildlife & Fisheries- Richard Lord
Recreation- John Elsperger
Economic Development- Joanne Rodenbiker

WALSH COUNTY
Agriculture- Jeff Moen
Wildlife & Fisheries- Dale Zahradka
Recreation- Cory Kouba
Economic Development- Mike Hodny

The Spirit Lake Nation Tribal Council was invited to appoint four representatives to serve on the Subject Committees, but declined to do so.

Technical Support Agencies

The Technical Support Agencies were invited to participate in the planning process, because the Devils Lake Basin Joint Water Resource Board felt that these particular groups had the technical expertise necessary. Each of the agencies appointed representatives to work closely with the Subject Committees. The Technical Support Agency Representatives acted in only an advisory role, and as such, had no voting rights, being present primarily as a resource and a sounding board for ideas developed the Subject Committees.

Technical Support Agency Representatives

Garrison Diversion Conservancy District
Jerry Schaack, District Engineer

Lake Region Anglers Association
Ed Dosch

Natural Resource Conservation Service
Jack Russell, Assistant State Conservationist

North Dakota Department of Health
Environmental Health Section, Water Quality Special Projects
Mike Sauer

North Dakota Forest Service
Tom Berg, Staff Forester

North Dakota Game and Fish Department
Terry Steinwand, Chief, Fisheries Division

North Dakota Natural Resources Trust
Sharon Clancy

North Dakota Parks and Recreation Department
Dick Horner, Manager, Devils Lake Parks

Lake Region Sportsman's Club
Bill Byram

North Dakota State University Extension Service
Terry Gregoire, Area Extension Specialist / Cropping Systems

North Dakota State Water Commission
Lee Klapprodt, Director, Planning & Education

North Dakota State Water Commission
James Landenberger, Water Resources Engineer

U.S. Army Corps of Engineers
Dave Loss

U.S. Fish and Wildlife Service
Roger Hollevoet, District Director

U.S. Geological Survey
Gregg Wiche, District Chief

Subject Committee Recommendations

Agriculture

OBJECTIVES:
1. Ensure that the rights of property owners are protected.
2. Increase both the economic and environmental benefits of agriculture through the implementation of better land and water management practices.
3. Provide flood protection for private and public lands sufficient to protect against a specific flood event.
4. Develop specific plans and goals, for the Devils Lake Basin Joint Water Resource Board and the sub-basin advisory boards, in order to promote better conservation management practices.
5. Identify local, state and federal regulations that can help or hinder implementation of the Devils Lake Basin Water Management Plan.
6. Increase farm income through increased commodities production using better water management practices.

Objective 1: Ensure that the rights of property owners are protected.

Management issues, strategies and procedures:

1. Analyze all Devils Lake Basin Water Management Plan activities, in order to determine if private property owners' rights are being protected.

2. Consideration of the needs of agriculture to be taken into account for township and/or county zoning regulations.

Objective 2: Increase both the economic and environmental benefits of agriculture through the implementation of better land and water management practices.

Management issues, strategies and procedures:

1. Develop mechanisms to address the problem of basin soils that are considered to be saline. (NDSU Ext. bulletin #SF10-87)

2. Continue the research of techniques used to identify the various water management practices affects on salt movement and accumulation.

3. Use the "Devils Lake Flood Land Analysis Study" (North Central Planning Council, June 2002) to help explore compensation alternatives for inundated agricultural acres around Devils Lake.

4. Use the "Upper Basin Water Utilization Study" (Bartlett & West Engineers, Aug. 2002) to pursue the potential of agricultural irrigation in the upper basin.

5. Continue to work with local, state and federal officials on the economic impact of flooding in the Devils Lake Basin in the agricultural sector, using information contained in "A Blueprint for Economic Recovery and Revitalization" (Mayor's Business Committee, City of Devils Lake, October, 2000) and other studies.

6. Ensure that the Devils Lake Operating Plan Committee takes into account private lands and production losses when setting lake operating levels.

7. Investigate possible funding sources for various water management practices through funds available in the 2002 and future farm bills.

Objective 3: Provide flood protection for private and public lands to protect against a specific flood event.

Management issues, strategies and procedures:

1. Continue to promote upper basin water storage.

2. Continue to develop management practices for water storage and handling in the

basin to minimize crop losses (i.e., Grand Harbor Watershed Management Project).

3. Develop procedures that address those issues that arise from the use of private and public lands to alleviate flooding.

4. Develop a generic channel maintenance program with adequate funding for sub-basins using NDCC 61-16.1-09.1 authorization.

5. Continue to investigate the concept of a Devils Lake Basin Trust Fund.

6. Encourage sub-basin advisory boards to assist in the development of plans to manage various size rain events in order to minimize local losses and to help manage water flows for the benefit of downstream entities.

Objective 4: Develop specific plans and goals, for the Devils Lake Basin Joint Water Resource Board and the sub-basin advisory boards, in order to promote better conservation management practices.

Management issues, strategies and procedures:

1. Continue to monitor tillage practices and to encourage reduced tillage operations.

2. Encourage the Devils Lake Basin Joint Water Resource Board and sub-basin advisory boards to work with NRCS "Local Work Groups" (NRCS, SCDs, County FSA, and County Extension Agents) with the goal of securing funding for specific projects and programs.

3. Use both NRCS and other agency programs developed through the 2002 and future farm bills to help fund those conservation practices enacted by individual farmers.

4. Encouragement of the sub-basin advisory boards by the Devils Lake Basin Joint Water Resource Board, in the development of demonstration projects tailored to individual watersheds in the basin, thereby creating interest by individual farmers in better management practices.

5. Encourage the Devils Lake Basin Joint Water Resource Board to work with sub-basin advisory boards, in order to develop two or more demonstration filter strip sites in each sub-basin, with goal of grassing all major coulees in the basin by 2008.

Objective 5: Identify local, state and federal regulations that can help or hinder implementation of the Devils Lake Basin Water Management Plan.

Management issues, strategies and procedures:

1. Provide adequate input from both the agricultural community and affected property owners, in order to establish a lake level that provides for continued production or compensates property owners.

2. Develop mechanisms whereby payment-in-lieu-of-taxes that are made on land in the basin, are equal to the full amount of property taxes that were paid prior to a public or non-profit gaining ownership of that land.

3. Conduct research on the purchase of private lands by any sovereign nation, in order to ensure the amount paid to local taxing authorities remains the same.

4. Provide better education on the value of wetlands to basin residents including current regulations and/or voluntary wetland agreements.

5. Ensure that the local community has input into any future wetland regulations that would impact the basin.

6. Balance the needs of agricultural producers with the goals of regulatory agencies for the protection of wildlife and fisheries.

7. Investigate the development of a basin-wide "wetlands bank" for use in mitigating acres of wetlands being altered by either private or public entities.

Objective 6: Increase farm income through increased commodities production using better water management practices.

Economic Development

OBJECTIVES:
1. Capitalize on the economic resources of the Devils Lake Basin regardless of water levels.
2. Create a basin-wide economic development effort utilizing existing basin economic development organizations.

Objective 1: Capitalize on the economic resources of the Devils Lake Basin regardless of water levels.

Management issues, strategies and procedures:

1. Adjust marketing efforts, from a business development standpoint, based upon the opportunities available at various lake levels.

2. Increase economic development opportunities through improved water management (including fee hunting, public access hunting, utilizing local lodging and restaurant tax where possible and continuing to promote educational programs on available economic opportunities).

3. Increase the agriculture sector's net return through improved water management in the basin.

4. Continue to pursue irrigation potential in the basin by providing assistance to participating producers in order to make the program economically enticing.

5. Encourage the development of non-traditional income producers (bed & breakfasts, bird watching, rural vacation packages).

6. Utilize the expertise and information available from NDSU Research and Extension Centers, that serve the basin, to develop value added opportunities in agriculture.

7. Ensure that the basin-wide community's infrastructure capabilities are adequate to support increased economic development activities and ensure a quality of place for current and future residents of the basin (including, but not limited to: adequate roads, including future maintenance needs; adequate airport, airline and charter services; motel and resort facilities; medical and educational facilities and services; community and rural utilities).

8. Support the Devils Lake Basin Water Management Plan's Recreation Committee recommendations on increasing tourism related activities throughout the basin.

9. Encourage cooperation and communication between basin economic development groups and resident recreational interests.

Objective 2: Create a basin-wide economic development effort utilizing existing basin economic development organizations.

Management issues, strategies and procedures:

1. Promote increased communication and cooperation between basin economic development groups.

2. Develop a closer working relationship with other jurisdictions (similar to Devils Lake Region which includes Ramsey, Towner, Cavalier Counties and City of Rolla) throughout the basin.

3. Hold annual meetings of the representatives of all basin economic development organizations to set priorities in the implementation of plans and projects. This process should be initiated and coordinated by the Devils Lake Basin Joint Water Resource Board.

4. Continue to encourage cooperative ventures and projects; including, but not limited to: labor market studies, regional and national trade shows and ND Department of Commerce programs.

Recreation

OBJECTIVES:
1. Stabilize Devils Lake to enhance recreation opportunities in the Devils Lake Basin.
2. Develop recreational opportunities in and around Devils Lake.
3. Develop recreational opportunities in the Devils Lake Basin.

OBJECTIVE 1: Stabilize Devils Lake to enhance recreation opportunities in the Devils Lake Basin.

Management issues, strategies and procedures:

1. Establish an outlet for the stabilization of Devils Lake.
2. Establish a variance level for Devils Lake to enhance recreational development.
3. Encourage basin-wide establishment of 'water rights' for basin waters and also with emphasis on the waters of the Sheyenne River (upstream).

OBJECTIVE 2. Develop recreational opportunities in and around Devils Lake.

Management issues, strategies and procedures:

1. Increase overnight camping facilities around Devils Lake.
2. Investigate the feasibility of creating a "Recreation District" around Devils Lake.
3. Maintain and expand all–season lake access and parking.
4. Ensure area parks have adequate swimming, camping and picnicking facilities with adequate road access for all types of vehicles.
5. Maintain and expand public boat launching facilities with adequate parking, fish cleaning stations, rest rooms and docking.
6. Continue to expand marina facilities with slip space availability and investigate other boat storage facilities.
7. Use Internet to promote Devils Lake.
8. Stock Devils Lake with desirable species as needed.
9. Increase the promotion of and access to hunting and fishing on Devils Lake, including shoreline fishing opportunities.
10. Promote "customer satisfaction and service" through programs developed by Lake Region State College, Chambers of Commerce and other similar organizations.
11. Increase the year round angler numbers.
12. Investigate possible feasibility study of a convention/conference center located on the lake, with or without a hotel attached, including potential uses. Study to include funding sources for construction and O&M.

OBJECTIVE 3. Develop recreational opportunities in the Devils Lake Basin.

Management issues, strategies and procedures:

1. Create incentive opportunities to expand hunting access in the basin.
2. Continue efforts to educate general public about courtesies relating to hunting in the basin.
3. Promote landowner's perception of waterfowl as an "asset" rather than a "liability".
4. Increase non-consumptive wildlife recreation in the basin through the use of promotion, education, increased viewing sites, other marketing efforts and infrastructure investment.
5. Promote expansion of agricultural 'tourism' with local farmers including crop tours, farm and ranch vacation packages including suitable marketing materials.
6. Secure support for expanded recreational opportunities in the basin by providing economic benefit information to State Legislators, farm

organizations, financial institutions and other involved parties.

7. Develop an inventory of recreational opportunities in the basin including: golf, community celebrations, bike trails, snowmobile trails, cross country skiing areas, museums, historical sites, bird watching opportunities and other recreational activities.

8. Work to develop 'basin-' wide recreation information brochure working with all interested parties including: Chambers of Commerce, Tourist & Convention Bureaus, Economic Development groups, RECs and others.

9. Use Internet to promote Devils Lake Basin.

10. Stock area lakes with desirable species as needed.

11. Increase the promotion of and access to hunting and fishing in the Devils Lake Basin, including shoreline fishing opportunities.

12. Coordinate Devils Lake Basin Recreation plan with the State Recreation plan and other agency plans as it is revised and updated.

13. Coordinate information and studies done by state agencies to determine economic benefits to basin recreation programs.

14. Encourage state agencies to cooperate with basin recreation organizations in the promotion of international tourism.

15. Hold annual meetings of the representatives of all basin recreation promotional organizations to set priorities and discuss plans and projects. These meetings should be initiated and coordinated by the Devils Lake Basin Joint Water Resource Board.

16. Work with state, federal, and private agencies to increase awareness of, and develop educational materials on the risks of biota transfer.

Wildlife and Fisheries

OBJECTIVES:

1. Enhance grassland, woodland and wetland acreages for the betterment of wildlife and fisheries production in the Devils Lake Basin.

2. Manage water quality for the benefit of Devils Lake Basin fisheries and wildlife.

3. Encourage continuation and intensification of agricultural conservation practices that are beneficial to agriculture, wildlife and fisheries in the Devils Lake Basin.

4. Implement programs that encourage increased youth participation in hunting, fishing and outdoor recreation.

5. Improve communication between agricultural and outdoor interest groups.

Objective 1: Enhance grassland, woodland and wetland acreages for the betterment of wildlife and fisheries production in the Devils Lake Basin.

Management issues, strategies and procedures:

1. Estimate, on a regular basis, the acreage of quality habitat available.

2. Continue to explore and develop methods that will enhance the quality of existing habitat (i.e., PLOTS program and WaterBank).

3. Ensure that private and public rights are respected.

4. Determine the impact of water levels, in the Devils Lake Basin, on wildlife and fisheries habitat.

5. Ensure public input on issues regarding wetland retention.

6. Fund existing voluntary programs and create new incentives to improve the quality and diversity of habitat on private lands.

7. Maintain existing programs designed to monitor and test established enhancement methods.

8. Manage federal, state, non-profit and private lands to improve production of wildlife and fisheries.

9. Continue to stock fish in viable lakes within the Devils Lake Basin through the ND Game and Fish Department.

10. Restore flooded wooded acres within the Devils Lake Basin.

Objective 2: Manage water quality for the benefit of Devils Lake Basin fisheries and wildlife.

Management issues, strategies and procedures:

1. Maintain a basin-wide water quality monitoring program.

2. Identify land management practices that degrade water quality.

3. Identify practices that improve water quality.

4. Continue to develop and implement programs that inform the community of the importance of water quality initiatives and continue developing strategies to implement water quality practices.

5. Work with state, federal, and private agencies to increase awareness of, and develop educational materials on the risks of biota transfer.

Objective 3: Encourage continuation and intensification of agricultural conservation practices that are beneficial to agriculture, wildlife and fisheries in the Devils Lake Basin.

Management issues, strategies and procedures:

1. Continue to expand on the implementation of high residue tillage, nutrient management, erosion control, livestock waste management and other sound agricultural management practices.

2. Identify funding sources, which will provide greater incentives for conservation practices.

Objective 4: Implement programs that encourage increased youth participation in hunting, fishing and outdoor recreation.

Management issues, strategies and procedures:

1. Identify methods designed to increase interest in hunting, fishing and outdoor recreation.

2. Maintain youth educational and safety programs.

3. Encourage creation and expansion of programs that are intended to facilitate youth hunting and fishing.

Objective 5: Improve communication between agricultural and outdoor interest groups.

Management issues, strategies and procedures:

1. Establish basin-wide, landowner and outdoor interest organizations.

2. Identify reasons for conflict.

3. Address methods designed to resolve conflicts through increased communication.

4. Educate community residents and visitors about the respect and courtesies required for good landowner and outdoor interest organization relations.

Results and Developments Since the 1995 Plan

There has been a great deal of work done by many different state, federal, and private agencies since the 1995 plan was completed. Projects have focused on water storage, water quality, habitat restoration, wildlife enhancement and restoration, infrastructure protection, and the extensive background work required for the construction of the proposed emergency outlets. As a result, the Devils Lake Basin is perhaps the most exhaustively studied region in North Dakota.

The following section details some of the major projects and dollars spent studying the Devils Lake Basin, and potential repercussions of the proposed Devils Lake emergency outlet. Beyond what is listed here, each of these organizations along with many others, have devoted innumerable man-hours of study and research in the Devils Lake Basin.

Bureau of Reclamation

The Bureau of Reclamation, part of the United States Department of the Interior, has a mission statement of "...to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public." In line with these goals, the Bureau of Reclamation has recently completed a "Road and Railroad Crossing Inventory" for the Edmore, Mauvais, and Big Coulee crossings. The Bureau of Reclamation will be adding the St. Joe and Calio Coulees in the future. This project is important, as it will greatly enhance the ability of agencies and individuals to design more accurate hydrological models of the Devils Lake Basin. The Bureau of Reclamation has also done a wetlands inventory and drained wetlands water storage capacity estimation for the St. Joe-Calio Coulee sub-basin of the Devils Lake Basin.

Devils Lake Basin Joint Water Resource Board

The Devils Lake Basin Joint Water Resource Board has been extremely active in water management issues since the 1995 Devils Lake Basin Water Management Plan was originally published. Since the 1995 plan was published, the Devils Lake Basin Joint Water Resource Board has worked extensively with various state, federal, and private agencies on a multitude of projects, both large and small.

The Devils Lake Basin Joint Water Resource Board has been involved in myriad types of projects and studies, including: water quality, water storage, flood management, wetland inventories, the State Water Plan, sedimentation studies for several points along the south side of Devils Lake, water control structure maintenance and improvements, and treatment options for Devils Lake.

The Devils Lake Basin Joint Water Resource Board has also been involved in cooperative projects designed to restore wetland, forested, mixed-grass, and tall-grass prairie habitat, sending informational mailings to residents of the basin and downstream interests, land restoration for wildlife habitat, and environmentally friendly agricultural practices. The Devils Lake Basin Joint Water Resource Board also maintains a position specifically designed to inform the public and promote Devils Lake Basin interests.

As of 2002, the Devils Lake Basin Joint Water Resource Board and the North Dakota State Water Commission have also been actively pursuing a reconnaissance water utilization study in the Devils Lake Basin with Bartlett & West Engineers. In addition to having the potential to increase the yield of crops within the basin, irrigation would generate large indirect economic impacts for local communities and the state. Water utilization in the upper basin would have the added benefit of lowering the water

level on Devils Lake, by taking irrigation water from upper basin lakes, constructed reservoirs, or even Devils Lake itself. The Devils Lake Basin Joint Water Resource Board has been encouraged by the initial reports provided, and is currently pursuing the development of eight test sites to verify the benefits of the project.

Garrison Diversion Conservancy District

On December 22, 1944, Congress authorized the Flood Control Act, later named the Pick-Sloan Missouri Basin Program. The act called for the construction of a massive series of main stem dams, power plants and other water control and management systems to manage the waters of the Missouri River for flood control, navigation, irrigation and hydroelectric power. It was out of this program that Garrison Diversion Conservancy District was born.

While the Garrison Diversion Project as originally envisioned, is no longer a viable option, the Garrison Diversion Conservancy District has played an active role in water development in the Devils Lake Basin, having spent nearly $700,000 on recreational developments, and nearly $7,400,000 on MR&I developments since 1990.

Natural Resource Conservation Service

The Natural Resources Conservation Service provides leadership in a partnership effort to help people conserve, maintain, and improve our natural resources and environment. The Natural Resource Conservation Service maintains offices in the nine basin counties. The Natural Resource Conservation Service provides conservation planning assistance to producers in the Devils Lake Basin. It does this by meeting with landowners to explain and discuss the various conservation treatments and programs available, in order to counteract the negative economic and natural resource impacts that have been caused by years of flooding.

The Natural Resource Conservation Service has several programs that they administer, including the Federal Water Bank Program, which provides 3,700 acres of land for floodwater storage in the Devils Lake Basin. There are still interested landowners, and it is hoped that the next Federal budget will make more funding available for the 8,250 acres waiting to be enrolled. The Emergency Watershed Protection (EWP) program has enrolled 2,777 acres for the purpose of watershed protection. Another program, the Environmental Quality Incentive Program (EQIP), has contracts on 193,530 acres in the Devils Lake Basin.

In addition to these programs, the Natural Resource Conservation Service is active in educating landowners about the benefits of different types of agricultural practices, with the Sustainable Agriculture and Research Education grant. The Natural Resource Conservation Service is also currently involved in association with the Devils Lake Basin Joint Water Resource Board, looking at conservation and management techniques along the Starkweather Coulee and Morrison outlet.

North Dakota Department of Health

The North Dakota Department of Health is committed to the protection and enhancement of the natural environment. The North Dakota Department of Health has completed a study examining the chemical, physical and biological parameters of Devils Lake. This study looked at how water quality changes in the lake over time, and what affects that those roads that bisect the lake have on water quality. In addition, the North Dakota Department of Health also does periodic water quality testing on the Devils Lake chain

of lakes, conducting a complete water quality analysis at six sites, four to six times annually. The North Dakota Department of Health also does 319 non-point water pollution source BMPs (Best Management Practice) in the upper basin. The North Dakota Department of Health was involved in a major project in 1991-1992 designed to reduce nutrient loading by the City of Devils Lake, where a water treatment plant was constructed on a cost-share basis with the city. This innovative project captured municipal waste, and treated it using an aquatic plant known as lemna. This treatment system resulted in a reduction of phosphorous input into Devils Lake by 20 percent to 33 percent, and drastic reductions in nitrogen and ammonia as well. This project had the added benefit of providing nutrient-rich topsoil to be used for agriculture.

North Dakota Department of Transportation

The North Dakota Department of Transportation has a mission statement of providing a transportation system that safely moves people and goods. North Dakota Department of Transportation has spent over $100,000,000 on improvements and maintenance for roads affected by the rise of Devils Lake. Generally, the roads have been raised to an elevation of 1455 feet amsl, with the base wide enough to eventually go to 1465 feet amsl and the bridges to 1465 feet amsl. A great deal of work has been completed since 1995, and if waters continue to rise, additional funds will need to be allocated towards road improvements.

North Dakota Forest Service

The North Dakota Forest Service administers forestry programs statewide. Technical assistance relating to the management of private forest lands, state forest lands, urban and community forests, tree planting, and wildlife fire protection is provided by the North Dakota Forest Service. The North Dakota Forest Service also owns and manages approximately 13,278 acres of state forested lands. The North Dakota Forest Service has done numerous surveys of Devils Lake to determine the amounted of acres of forest inundated since 1995.

North Dakota Game and Fish Department

The North Dakota Game and Fish Department has and continues to do a great deal of work in the Devils Lake Basin. The North Dakota Game and Fish Department maintains an active sports fishery on Devils Lake, and since 1995 they have stocked over 3,657,000 fish at a cost of approximately $64,000. This agency also plays an active role in providing and maintaining angler facilities such as boat ramps, and parking lots, spending over $800,000 so far. The North Dakota Game and Fish Department is also active in the development of land devoted to wildlife production, through programs such as the Private Land Initiative, which has raised over $660,000 since 1995 for the counties in the basin, and is still expanding the program. The North Dakota Game and Fish Department has also funded work done through the Agriculture Department in the basin, in regards to the State Waterbank Program, totaling over $890,000 so far.

North Dakota Natural Resources Trust

The North Dakota Natural Resources Trust was established as part of the Garrison Diversion Unit Reformulation Act of 1986. The purpose of the North Dakota Natural Resource Trust is to preserve, enhance, restore and manage wetlands, grasslands and riparian areas and associated wildlife habitat in the State of North Dakota. The North Dakota Natural Resource Trust has done a lot of work in terms of wildlife and fisheries

habitat, and also for sustainable agriculture. The North Dakota Natural Resource Trust has also developed a demonstration program, the Grand Harbor Watershed Management Project, which has taken nearly a half-mile of land in the Devils Lake Basin, and developed and maintained it with the goals of meeting the needs of all interests; agriculture, wildlife enthusiasts, sportsmen, and the various levels of government.

In total, the North Dakota Natural Resource Trust has restored over 18,000 acres of land in the Devils Lake Basin for various types of habitat, including 4,086 acres of wetlands, 10,608 acres of uplands, and 3,937 acres of conservation tillage. The North Dakota Natural Resource Trust is working with over 300 producers, and has spent over $1,391,000 on these projects.

North Dakota Parks and Recreation Department

The North Dakota Parks and Recreation Department is involved with maintenance and enhancement of the three state park facilities in the basin; Graham's Island, Shelvers Grove, and Black Tiger Bay. Parks in the Devils Lake Basin have been plagued by access issues, as water continued to rise. Despite these challenges, North Dakota Parks and Recreation District has worked to relocate recreational structures to keep ahead of rising water. Because of their work, park access in the basin has been reduced by the current wet cycle, but not eliminated. The North Dakota Parks and Recreation District has spent $570,000 in the maintenance of their facilities due to the lake rise.

North Dakota State University Extension Service

The North Dakota State University Extension Service exists to serve the people of North Dakota. The Cooperative Extension System was established in 1914 to address through education the critical needs of the public in the areas of agriculture, family and youth. The work of the North Dakota State University Extension Service continues to be extremely important to producers, families, community leaders and young people. Extension maintains a unique relationship among federal, state and county constituents. Local input into programs, combined with support and funding from state and federal partners, enables the Extension Service to truly meet the needs of people.

The North Dakota State University Extension Service is active in disseminating knowledge about sustainable land use practices in North Dakota. While the North Dakota State University Extension Service does not break down their projects to the basin level, their efforts have been integral in increasing the amount of land that is used for conservation tillage, and encouraging alternative crops that are more suited to the current conditions in the basin.

North Dakota State Water Commission

The North Dakota State Water Commission's mission is to assist in the implementation of the three-pronged approach to solving the flooding problem on Devils Lake. The North Dakota State Water Commission has comprehensive water management in North Dakota as its primary goal.

The North Dakota State Water Commission has spent $3,500,000 on both the ASAP and ESAP programs in the Devils Lake Basin, which paid landowners in the upper basin to store excess water on their land. The ASAP program stored 8,000-22,000 acre-feet per year. In 2000, the North Dakota State Water Commission changed the program from ASAP to the Extended Storage Acreage

Program (ESAP). The revised program is a ten-year water storage program managed by the Devils Lake Basin Joint Water Resource Board. It was thought that a 10-year program would be more cost effective in addressing the long-term nature of the flooding problem. Currently, ESAP is storing 800 acre-feet at a cost of $12,000 per year.

The North Dakota State Water Commission has also co-funded a Bartlett & West Engineering study with the Devils Lake Basin Joint Water Resource Board into the feasibility of irrigation as a means of lowering lake levels, and enhancing crop production in the Devils Lake Basin. The North Dakota State Water Commission has also played an integral role in assisting and coordinating efforts with the Devils Lake Basin Joint Water Resource Board to develop and update the Devils Lake Basin Water Management Plan and other water management projects. The North Dakota State Water Commission, in association the Devils Lake Basin Joint Water Resource Board, also funds a full-time engineering position.

The State of North Dakota is pursuing a phased implementation outlet project limited by water quality and quantity constraints from West Bay on Devils Lake to the Sheyenne River. The first phase of the project would pump up to 100 cubic feet per second, with the potential for expansion to 200 or 300 cfs later. The outlet would consist of two pumping stations, 3.3 miles of pipe, and 9.4 miles of open channel. The project will utilize existing U.S. Army Corps of Engineers EIS studies to assess downstream impacts. The final design for the entire project has been completed. The final contract for the first components of the projects has been awarded, and work is expected to begin in October of 2002. The initial cost estimate for the construction of the 100 cfs outlet is approximately $25 million, with an annual operation and management cost of approximately $500,000.

United States Army Corps of Engineers

The United States Army Corps of Engineers, St. Paul District, serves the citizens of the Devils Lake Basin in the areas of environmental enhancement, navigation, flood damage reduction, wetland regulation, recreation sites and disaster response. The Corps of Engineers has spent millions of dollars studying the feasibility of and impacts from the Devils Lake emergency outlet. In pursuance of that goal, the Corps of Engineers has completed or funded studies on water quality, upper basin water storage, water management, flood management, wetland inventories, sedimentation, outlet alternatives, biological inventories, cultural impacts and demographics, economic feasibility of various project options, hydrology, soils, public surveys, mitigation, Geographic Information Systems (GIS) analysis of the basin, and planning.

Since 1998, approximately $44 million has been spent by the Corps of Engineers, the State of North Dakota and the City of Devils Lake to raise the dike system protecting the City of Devils Lake. The dike currently has a top elevation of 1,457 feet amsl, and is approximately 7.83 miles in length. The dike protects the City up to lake elevations of 1,450 feet amsl. The dike begins on the west side of Devils Lake near the airport, goes around the south end, and comes out by Highway 2, near the Mertens Lake View Dairy. With Devils Lake getting closer to the current protection level of the dike, the Corps of Engineers, and the City are pursuing funding to raise the dike three feet, to elevation 1,460 amsl. This would protect the City of Devils Lake up lake levels of 1,452 feet amsl. The last dike was constructed to allow this three-foot raise without changing the base of the dike. If Devils Lake reaches an elevation of 1,448 feet amsl at freeze-up, the Corps of Engineers will begin construction to raise the dike.

In addition to that lengthy list, the Corps of Engineers has also been involved in assisting in the development of North Dakota's State Water Plan, appointing a full-time position to work with downstream interests, has initiated land acquisition for potential outlet construction. As a result of the multitudes of studies that the Corps of Engineers has commissioned, the Devils Lake Basin is perhaps the most thoroughly examined geographic area in the world. The Corps of Engineers has also played a vital role in driving the development of an outlet plan, and will certainly continue to do so in the future.

United States Fish and Wildlife Service

The United States Fish and Wildlife Service is part of the Department of the Interior. The United States Fish and Wildlife Service is responsible for carrying out federal laws and programs that conserve fish and wildlife and their habitats. The United States Fish and Wildlife Service has major responsibilities for migratory birds, endangered species, some marine mammals, and freshwater and anadromous fish.

In the Devils Lake Basin, the United States Fish and Wildlife Service manages the National Wildlife Refuge System including easement and fee title tracts, and administers the Federal Aid in Sport Fish and Wildlife Programs. An important facility is the Sully Hill National Game Preserve, which is part of the National Wildlife Refuge System. Sully Hill receives 38-43,000 visitors annually. Flooding is causing severe damage at the Preserve. Sully Hill was closed until July 4, 2002 so that the United States Fish and Wildlife Service could repair the dike and road due to high water and severe winds. The high water was the result of State Highway 57 being plugged, which resulted in the washing out of the access road. Due to rising water levels the United States Fish and Wildlife Service has submitted a 5-year plan to relocate many of the facilities at Sully Hill.

In addition to managing Sully Hill, the United States Fish and Wildlife Service actively acquires land through fee title and easement, and manages wetlands for the dual purposes of water storage and wildlife / waterfowl production, including the Lake Alice Refuge. In total, the United States Fish and Wildlife Service has 21 projects completed within the Devils Lake Basin, totaling 6,268 acres in area, with potential to store 9,130 acre-feet of water, and has 22 additional projects planned that would total 5,086 acres in area, with 9,713 acre-feet in storage, which would bring the total to 11,354 acres, with 18,843 acre-feet in storage. The United States Fish and Wildlife Service has also done work on a bird watching trail in the Devils Lake Basin.

United States Geological Survey

The United States Geological Survey serves the nation by providing reliable scientific information to describe and understand the earth, minimize loss of life and property from natural disasters, manage water, biological, energy, and mineral resources, and to enhance and protect our quality of life. The United States Geological Survey has played a vital role in the study of various hydrogeological aspects of the Devils Lake Basin. In all, the United States Geological Survey has completed nearly 50 studies, or papers, on the hydrogeology of the Devils Lake Basin, 22 since 1995, and their work is vital in keeping decision-makers informed with the best, most up-to-date information. The United States Geological Survey also is involved in stream gauging, and water quality monitoring in the basin.

Devils Lake Basin Background

Even before European settlement began in the region, Devils Lake represented a geographic focal point. The availability of water, food, and game on the shores of the lake supported the American Indians (Spirit Lake Nation and other tribes) and was a magnet to early European settlers. As additional land opened for settlement through various acts of Congress and as transportation improved, rural communities began to emerge. The land was gradually converted from prairie and wetlands to farmland.

The relatively flat topography, dramatic swings in climate; abundance of prairie potholes, and conversion of land has led to a variety of water management conflicts over the years. More recently, the most serious concerns have related to the flooding of agricultural lands and public infrastructure, the preservation of wetlands and other wildlife habitats, water quality and the viability of the Devils Lake fishery, along with the recreation industry it supports.

Many aspects of the geography, land use, water quantity, water quality, and social issues of the Devils Lake Basin are unique to the area. Knowing the background of the basin will help to focus the Devils Lake Basin Water Management Plan towards those needs that are the most imperative.

Water Use

Contentious water issues have plagued the Devils Lake Basin since the area was settled in the late 1890s. Excess water creates problems when it inundates properties from which economic returns are expected. These problems are compounded if natural flows have been altered.

Alteration of flows started before the advent of power machinery, as we know it today. Testimony in the court report of 1957, the Upper Lakes Farmers versus the United States, details an attempted channel clean out using hand shovels and later horse drawn equipment. As agriculture obtained more sophisticated equipment, the movement of excess waters off the land was accelerated.

The lake region community desires to stabilize Devils Lake water levels to maintain or improve the local economy, and the local economy is highly dependent on water-based recreational activities. The lake region community desires to sustain the recreational resources of Devils Lake, especially as a fishery. The Spirit Lake Nation wants to also maintain or enhance certain qualities of Devils Lake for spiritual reasons. Recreational interests want to implement important watershed management conservation measures, which will also improve the upper basin for recreational purposes, along with flood mitigation features, and also want the water that enters Devils Lake to be as clean as possible.

Agricultural interests want to channel as much water as possible into Devils Lake, if it means taking it off croplands. Water sports enthusiasts and lakeshore residents want a stable water level. The fishing community wants a water level and quality that will sustain their fishery. Many agriculturalists reason that with the advent of soil tillage, the amount of wetlands was increased. They adamantly oppose strict regulations that stop certain management activities on their lands such as consolidation of wetlands. Alternately, many wetland conservationists are strongly in support of any actions that prevent or restrict such practices.

The presence of the United States Fish and Wildlife Service refuge, in conjunction with upstream drainage, on and around Lake Alice, has resulted in some conflict in the upper lakes area. The objectives of agricultural interests and the objectives of the United States Fish and Wildlife Service are different and some conflict has been the result.

The United States Fish and Wildlife Service and the agricul-

ture interests in the chain of lakes area are unhappy about the amount of uncontrolled waters entering their area. The United States Fish and Wildlife Service is not able to carry out their mission because of unpredictable water levels. Agricultural land is continually being inundated by water that does not drain off quickly enough.

Those interested in maintaining the values of wetlands want to retain, or slow the movement of water in the basin for the production of wildlife. Wetland scientists have demonstrated that wetlands recharge ground water, provide wildlife food sources and habitat, provide some degree of downstream flood control, improve water quality, decrease erosion, provide for scientific study and education needs, increase recreation, and provide economic diversity.

Devils Lake is of great spiritual significance to the Spirit Lake Nation. Peter Belgarde, former Chairman of the Spirit Lake Nation says, "The waters of Devils Lake serve as a symbol of hope for the people of the Sioux Tribe. Devils Lake is a prominent fixture of the Devils Lake Sioux past. There is healing power at certain parts of the lake. Herbs, roots, leaves, and barks have medicinal powers." Belgarde continues, "I believe there is a connection between the spiritual presence of Devils Lake and my people."

The wide variety of goals of these diverse interests in the Devils Lake Basin highlights the need for a comprehensive water management plan. In order to begin resolving some of these dilemmas, it is important that these groups set aside their differences, and begin to work for the betterment of the basin.

Land Use

Agriculture, natural resources, and recreation are the three primary components of the land use in the Devils Lake Basin (Table 1). The challenges facing the people of the basin are diverse and complex, both scientifically and politically. Within the Devils Lake Basin, there are three primary goals for land use. These include: 1) Agriculture; 2) Conservation, Wildlife, and Fisheries; 3) Alternative Uses and Benefits.

Agricultural use of the landscape is the best-suited use on most of the soils and is important for economic prosperity in the basin. Wildlife production and habitat development are land uses that the Devils Lake Basin is well suited for, due to a combination of factors. Alternative uses and benefits refer to practices such as urban development, floodwater storage, and tourism.

TABLE 1
Land Use in the Devils Lake Basin in 2000. Data was extrapolated from Landsat Satellite Imagery.

LAND COVER PERCENTAGE	CROPS	PASTURE/RANGE CRP/NON-AG	FOREST	WATER	URBAN	FALLOW/IDLE CROPLAND	OTHER
Benson Co. (Basin)	51.3	24.3	2.3	14.8	0.4	6.9	0
Cavalier Co. (Basin)	65.6	23.6	0	0	1.2	9.6	0
Eddy Co. (Basin)	27.3	50.8	0.1	9.3	0.4	12.1	0
Nelson Co. (Basin)	49.4	29.8	0	3.7	0.8	16.4	0
Pierce Co. (Basin)	74.1	11.2	0.2	9.6	0.5	4.3	0.1
Ramsey Co. (Basin)	52.7	23.5	0	7.7	2.3	13.8	0
Rolette Co. (Basin)	72.9	14.4	2.8	5.3	0.8	3.5	0.3
Towner Co. (Basin)	77.4	11.3	0.2	3.4	0.4	7.3	0
Walsh Co. (Basin)	38.0	29.1	0	0.1	1.3	31.5	0
Devils Lake Basin Total	**59.1**	**21.3**	**0.7**	**7.0**	**1.2**	**10.8**	**0**

Agriculture

As Europeans began to settle the region, native mixed grass and tall grass prairie were plowed, and wetlands were drained. In 2000, cropland accounted for approximately 59 percent and rangeland, CRP and hay land accounted for an additional 21 percent of the basin's land cover. Cropland is currently the most important economic activity in the Devils Lake Basin.

Economic pressures, new or revised state and federal laws and programs, weather problems, demographic shifts, and other factors, have changed the face of agriculture in North Dakota. In the Devils Lake Basin, much like the rest of the state, the number of farming operations is down and remaining farm sizes are up. In 1997, those counties that comprised the Devils Lake Basin had a total of 4,755 farms, with 5,518,615 acres in farms, and the average size of a farm was 1,170 acres, or nearly two square miles (NASS Website, 2002).

There were over 709,058.5 acres enrolled in the Conservation Reserve Program (CRP), in those counties that comprise the Devils Lake Basin, as of the 24th sign-up in 2002. This number is up dramatically from the 25,361 acres of CRP that were enrolled in the basin counties in 1991. The current number of active CRP contracts within the counties that comprise the Devils Lake Basin is 7,520, with an average rental rate of $35.47 / acre. (FSA Website, 2002) (Table 2).

TABLE 2
Active CRP contracts for counties in the Devils Lake Basin (2002).

COUNTY	NUMBER OF CONTRACTS	NUMBER OF ACRES ENROLLED	AVERAGE RENTAL RATE
Benson	686	53,115.6	$31.34
Cavalier	654	50,973.5	$42.76
Eddy	568	72,067.5	$33.28
Nelson	1,121	125,757.5	$35.55
Pierce	943	80,953.1	$32.07
Ramsey	651	74,651.6	$35.27
Rolette	731	72,052.9	$31.61
Towner	610	66,615.2	$33.11
Walsh	1,556	112,871.6	$44.26
Devils Lake Basin Total	**7,520**	**709,058.5**	**$35.47**

Conservation, Wildlife, and Fisheries

The Devils Lake Basin lies in the drift prairie region, and is characterized by numerous shallow potholes. This prairie pothole region of the United States is of significant importance to waterfowl populations. The Devils Lake Basin is located in the center of the United States Fish and Wildlife Service Devils Lake Wetland Management District. This complex of lands includes the Lake Alice National Wildlife Refuge, Sully's Hill National Game Preserve, and thousands of acres of waterfowl production areas (in public and private ownership). It is estimated that 20 percent of the 2001 waterfowl production in North Dakota took place in the eight counties that comprise the United States Fish and Wildlife Service Devils Lake Wetland Management District. In addition to waterfowl, the basin also provides habitat for deer, furbearers, sandhill cranes, upland game, and many non-game species of wildlife (Personal Communication with Roger Hollevoet, 2002).

The Devils Lake Basin landscape, being very rich in natural resources, hosts a multitude of wetlands, woodlands, and grasslands that provide necessary habitat for many species of wildlife.

The wetlands of the basin are located directly in the Central Flyway and are some of the nations best waterfowl and other migratory bird staging, nesting, and production areas.

The Devils Lake area also represents one of the three most important remaining areas of natural woodlands in North Dakota. The woodlands along the south shore, the Lakewood area on Creel Bay, the Sullys Hill National Game Preserve, on the Spirit Lake Nation Reservation and at Graham's Island State Park are unique in North Dakota, due to a scarcity of natural woodlands. Woodlands are important as wildlife habitat, for wildlife-oriented recreation, and for aesthetics as well. An aerial survey conducted by the North Dakota Forest Service estimated that there were 3,876 acres of forest impacted by the rise of Devils Lake to 1,446 amsl (Personal Communication with Bob Harsel, 2002).

The grassland acres of the basin occurring on public land and on private lands, composed of rangeland, hay land, and CRP, are critical to many migratory and resident game and non-game species for nesting and feeding sites.

Alternative Uses and Benefits

The Devils Lake Basin offers diverse, high quality, outdoor recreation opportunities. The attractiveness and natural diversity of the area has led to the development of recreation as an important contributor to the economy of both the region and the state.

Demand for recreation was identified in the 1991-1995 Outdoor Recreation Plan (1990). Walking, bicycling, gardening, hiking, open water fishing, camping, jogging, boating/water skiing, horseback riding, and beach swimming were the top ten activities on the basis of per capita days of participation.

Baltezore and Leitch (1990) estimated that wildlife-related recreation (fishing, hunting, trapping, and nature observation) in North Dakota totaled over 700,000 days of participation in 1990 and were projected to increase by 20 percent by the year 2000. Mean daily expenditures and participation levels are the starting points in estimating the economic value of recreation. Mean daily expenditures ranged from $63 for small upland game to $173 for resident dear hunting (gun); angler mean daily expenditures ranged from $129 for ice fishing to $213 for open water fishing (Baltezore and Leitch 1992). In 1996, user days for only the parks in the Garrison Diversion Unit totaled over 500,000 (Leitch et al, 1996).

Other outdoor recreation such as boating, skiing, swimming, canoeing, camping, picnicking, and sight-seeing exceeded one million user days of participation in 1990 and is expected to experience similar growth by the year 2000. In 1998, a study of park users found that the four highest uses were sightseeing, camping, picnicking, and boating with percentages of 64.0, 36.5, 23.0, and 20.8 percent respectively (Personal Communication with Donna Schouweiler, 2002). These numbers reflect a change in recreational usages in North Dakota, with sightseeing, seeming to be gaining in importance as opposed to anglers, with some sightseers coming specifically to view the flooding situation.

Devils Lake also supports a nationally recognized sport fishery. The lake has been host to many fishing tournaments, including the nationally known events such as the Cabela's Tournament, the Pro Walleye Tour circuit, and the Wal-Mart "RCL" Tournament. Schwinden and Leitch (1984) documented that expenditures by all anglers during the 1983-84 fishing season were $14 million, which resulted in $33 million of gross business volume for the Devils Lake regional economy. Angler activity reached 156,000 angler days in the summer and 116,000 angler days in the winter (Brooks and Schlueter 1993). According to the North Dakota Game and Fish Department, the direct income from the sport fishery in 1988-89 was $27,403,462. According to a 1996 survey, in terms of total resident and non-resident expenditures (including licenses), annually generated nearly $594 million in North Dakota (Lewis et al., 1998). Dokken (1999) estimated that anglers spend greater than $1 million in Devils Lake annually. Ice angling is also popular on Devils Lake, but the majority of this group came from out of state, with nearly 70 percent coming from either Wisconsin or Minnesota (Schroeder, 2002). On Stump Lake, ice fishing accounted for over 6,000 angler days and 2,600 angler trips (Brooks and Hiltner, 2002).

The 1991-1995 Outdoor Recreation Plan (North Dakota Parks and Recreation, 1990) states the Devils Lake community has tremendous growth potential due to its strategic location and its cultural / historical and recreational assets. Most important of these visitor attractions is Devils Lake itself, a recreational resource throughout the year. The Fort Totten State Historic Site, the cultural values of the Spirit Lake Nation, Sully's Hill National Game Preserve, Camp Grafton, and Lake Alice National Wildlife Refuge are additional examples of important local attractions.

The potential to utilize the environment as a resource in terms of economy, has not yet been fully realized. As stated in some sources, North Dakota is the least visited state in the country, however it has enormous natural resource economic opportunities. In North Dakota, resident and non-resident hunters and anglers generated more than 1.6 billion dollars in total business in 1996, and supported more than 21,000 jobs. (Personal Communication with Roger Hollevoet, 2002; Lewis et al., 1998).

Waterfowl Production Area's preserve wetlands and other wildlife habitat. These lands, administered by the United States Fish and Wildlife Service, became part of the National Wildlife Refuge System in 1966. Nearly 95 percent of Waterfowl Production Area's are located in the Prairie Pothole Region; and the Devils Lake Basin is in the heart of the Prairie Pothole Region. These areas provide virtually thousands of acres of habitat that not only increase the tourism draw for hunters and outdoor enthusiasts, but they are also sites for flood storage and water quality improvements (Personal Communication with Roger Hollevoet, 2002).

Despite rising water levels in the lake, the Devils Lake area could be developed as a flagship of visitor destinations in North Dakota, the "Detroit Lakes of North Dakota." The key to the community's success is a concerted, collaborative effort by local landowners, elected officials, farm groups, the business community, the Spirit Lake Nation, assisted by state and federal agencies.

Geography

The Devils Lake Basin is located in northeastern North Dakota and covers a total of about 3,814 square miles (2,440,960 acres), containing all or portions of nine counties, a small portion of the Turtle Mountain Chippewa Reservation, and a large portion of the Spirit Lake Sioux Reservation (Figure 2).

The basin is a typically non-contributing portion of the Red River of the North's drainage area, but under prolonged conditions of precipitation exceeding evapotranspiration, or extreme precipitation events, it becomes seasonally contributing (North Dakota State Water Commission Memorandum, 1994).

There are nine sub-basins within the Devils Lake Basin (Figure 3). Most of the sub-basins are connected via natural coulees. The Edmore, Starkweather, St. Joe, and Calio Coulees originate in southern Cavalier County and flow in a south-southwesterly direction. Mauvais Coulee originates along the southern flanks of the Turtle Mountains 300 to 400 feet above the elevation of Devils Lake and enters Big Coulee at Lake Irvine. Big Coulee flows from Lake Irvine into Devils Lake's West Bay. Little Coulee serves about 421 square miles on the west side of the basin and joins Big Coulee approximately five miles south of the now defunct town of Churches Ferry.

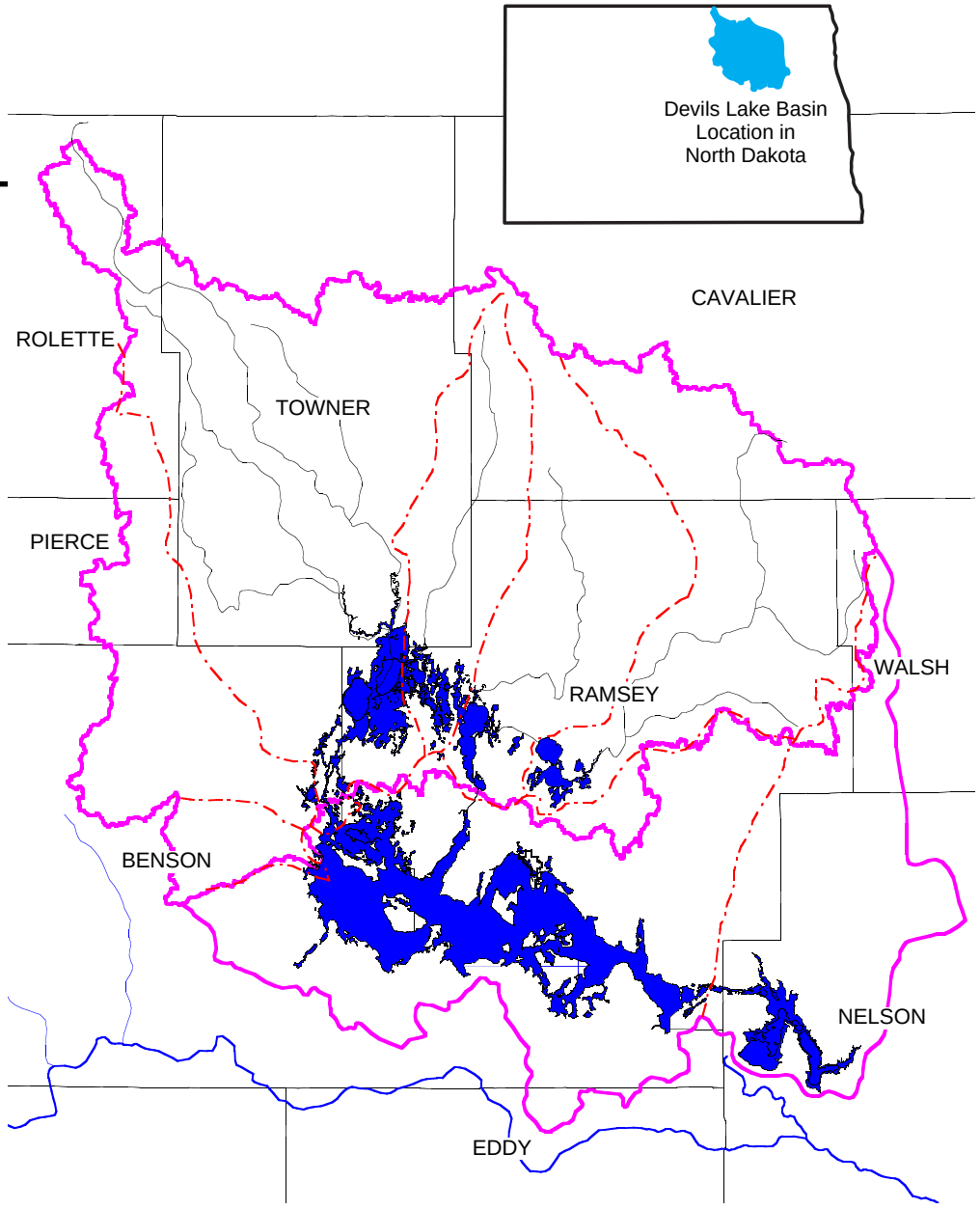


FIGURE 2
Counties of the Devils Lake Basin

Physiographically, the basin lies within the Central Lowlands Province, an area of glacial drift and lacustrine plains formed by the continental ice sheets during the latter part of the Wisconsinan glaciation in the Pleistocene Epoch. The

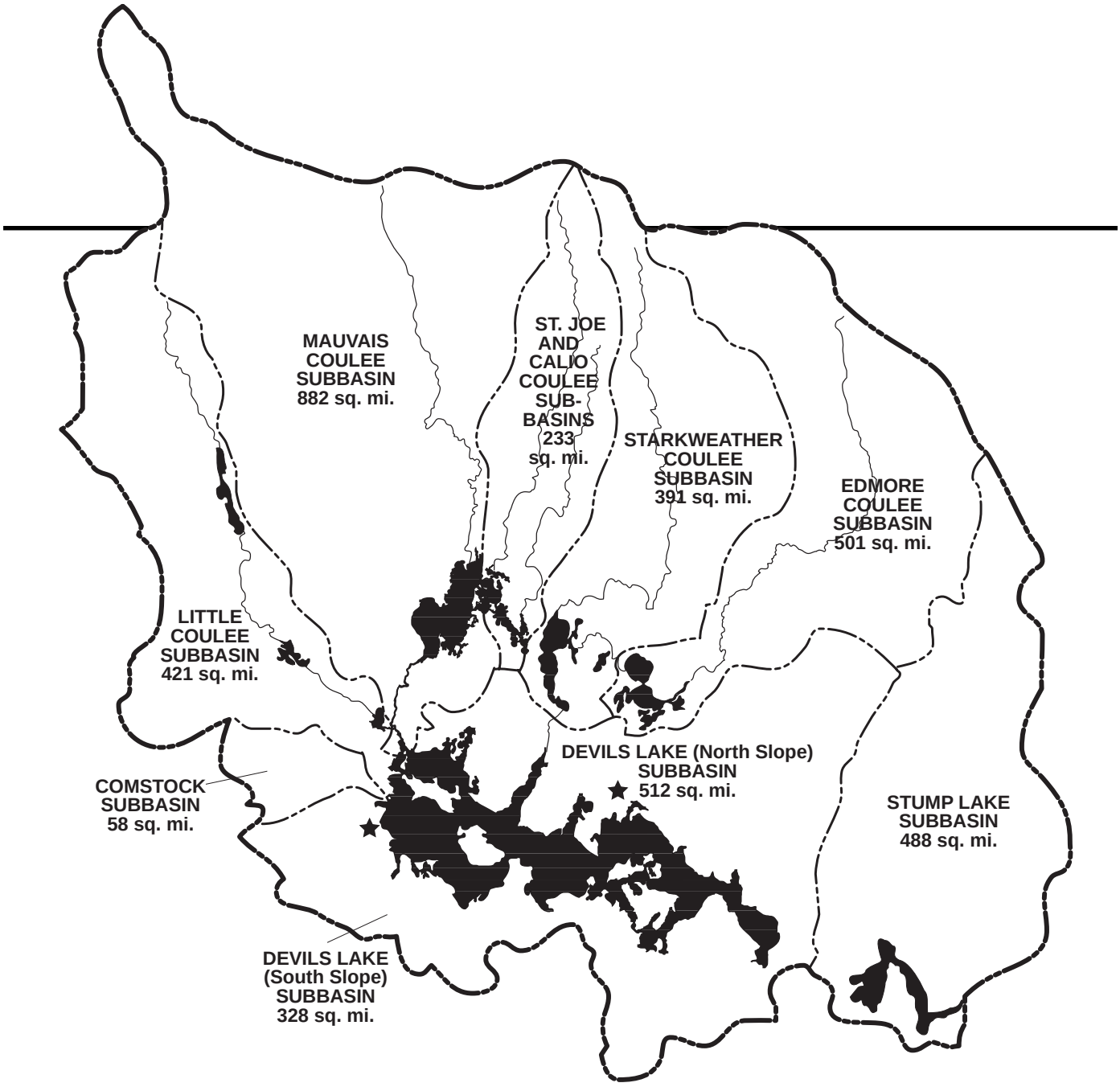


FIGURE 3
Sub-basins of the Devils Lake Basin

glacial drift ranges from a few feet to over 300 feet in thickness.

Topography in the region is glacial in origin; low hills and flat lands are typical. Many depressions, wetlands, and small lakes occurring in the basin are connected via poorly defined drainage systems. During prolonged wet cycles or extreme precipitation events, these areas can overflow and contribute water to Devils Lake, and under extended wet cycles may actually flow to the Red River Basin.

The Devils Lake Basin has had several documented actual or potential points at which water naturally flows to the Red River Basin under extreme precipitation events (North Dakota State Water Commission Memorandum, 1994) (Figure 4).

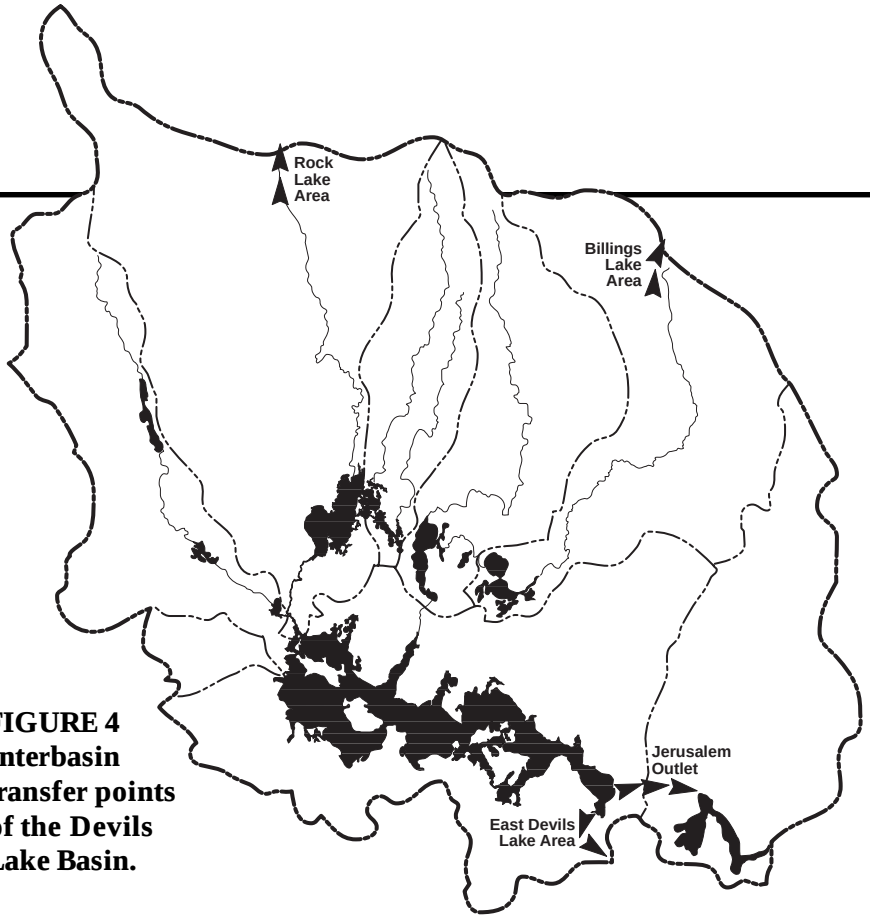


FIGURE 4
Interbasin transfer points of the Devils Lake Basin.

The basin provides a diverse landscape, which appeals to many different types of natural resource users. An analysis of land use and cover, using Landsat satellite imagery from 2000, shows the approximate acreages for the following land cover types; 59 percent cropland, 21 percent pasture / range / CRP / Non-Ag, 0.65 percent woodland, 7 percent water, 11 percent fallow / idle cropland, 1 percent urban, and less than 1 percent other. The thousands of acres of rich agriculture lands are dotted with hundreds of wetlands that attract the attentions of those interested in wetland values (NDSU Extension Landsat Data, 2000) (Table 1).

Upper Basin Lakes

A multitude of studies confirm that the chain of lakes (Figure 5) are an important factor affecting the flow of water into Devils Lake. The chain of lakes upstream of Devils Lake can act as storage and evaporation basins that ultimately affect flows throughout the system. These effects are evident in water volume and, under certain circumstances, can be a factor in improving the quality of water that enters Devils Lake.

The arrival of the United States Fish and Wildlife Service in 1936 added a new factor to water movement. The evolution, of those interested in production of wildlife and its associated values and an awareness of the importance of water quality, further added to the complexity of the issue.

Prior to 1979, runoff from the basin tributaries flowed into the interconnected chain of lakes and discharged through Big Coulee (Lower Mauvais) into Devils Lake. During the period from 1993 to the present, conditions of high precipitation, coupled with a low rate of evapotranspiration have led to increased overland water flow through the various coulees that ultimately feed into Devils Lake.

Channel A, which connects Dry Lake to Six Mile Bay (Devils Lake), began operation in 1979 as a flood control project protecting agricultural lands and the transportation system. The construction of Channel A and a levee across the natural outlet of Dry Lake, divided the drainage pattern of the basin into two sub-basins. Now, except for unusually large runoff events, runoff flowing through Sweetwater, Morrison, and Dry Lakes discharges down Channel A directly into Devils Lake, as opposed to flowing through Chain Lake, Lake Alice, Lake Irvine, and Big Coulee first. Runoff from the remainder of the watershed discharges along the natural watercourse down Big Coulee (Lower Mauvais) into Devils Lake.

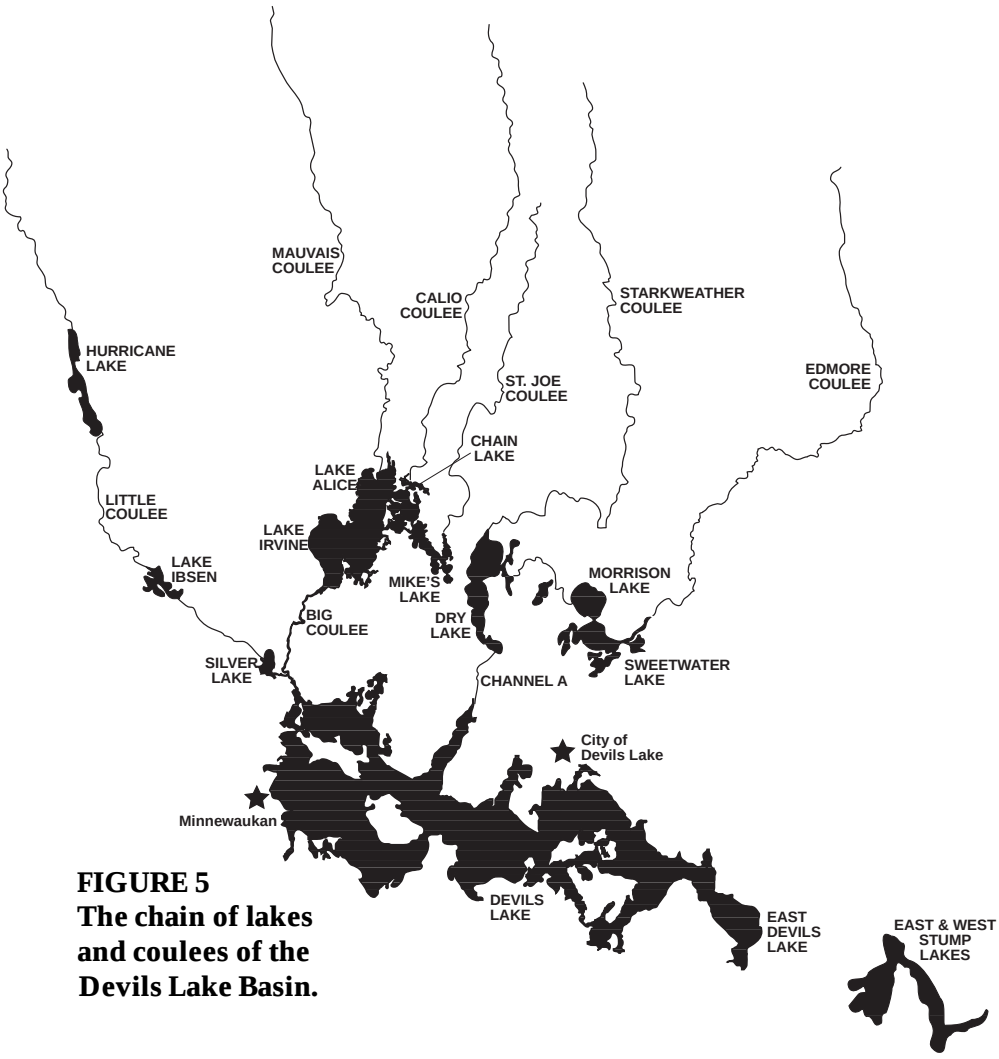


FIGURE 5
The chain of lakes and coulees of the Devils Lake Basin.

The upper basin lakes are meandered lakes. The meander lines were established by the original United States government survey in the early 1880s. Surveyors, using "metes and bounds," determined where the property lines around lakes were drawn. This was necessary in the determination of a settler's total of 160 acres of land for homestead rights. The survey reflects conditions at that time. Meander lines are not an indication of a "normal" lake level, nor do they imply that land beyond that line will not be flooded periodically.

Historically, lake levels have been controlled by runoff conditions and the natural overflow elevation. The natural overflow elevation is the level at which the lake overflowed prior to tampering by man. This elevation may change over time due to erosion and sedimentation. Lowering a lake below its natural overflow elevation would require a drain permit. The State Engineer and the County Water Resource Districts jointly administer the drain permitting process. In the case of a meandered lake, the State Engineer would make the final decision on an application to drain.

The Devils Lake Basin Joint Water Resource Board manages the outlet controls at Sweetwater-Morrison Lake, and Dry Lake is managed by an agreement between Ramsey County, Cavalier County, Water Resource Districts, and the North Dakota State Water Commission. The North Dakota State Water Commission has granted the United States Fish and Wildlife Service a permit to hold Lake Alice at 1,443 feet above mean sea level (amsl). The United States Fish and Wildlife Service has developed a water management plan for the Lake Alice National Wildlife Refuge. This plan consists of 11 managed pools that total over 7,700 acres and storing 9,883 acre-feet of managed water. To date, the United States Fish and Wildlife Service has completed several of the Lake Alice wetland development projects, totaling almost 4,400 acres and storing 3,394 acre-feet of water. Completing the remainder of these projects would provide valuable water storage, water management, wildlife habitat and recreation potential (Personal communication with Roger Hollevoet, 2002).

Mike's Lake has a control structure, but it is beneath the current elevation of the lake. The other upper basin lakes, Chain, and Irvine, do not have specific operating plans at this time.

Devils Lake

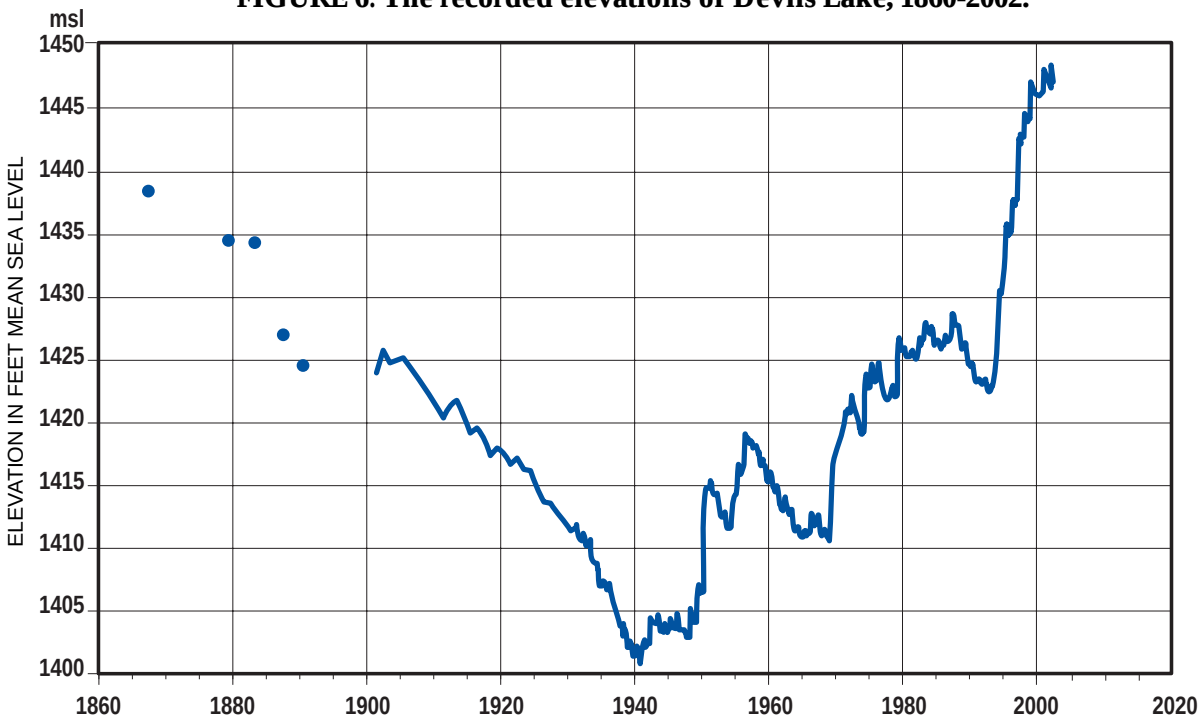
The most prominent feature of the basin is Devils Lake, the largest natural lake in North Dakota. Devils Lake is located in the southern portion of the basin and collects runoff water from 86 percent of the contributing portions of the basin. The remaining 14 percent of the basin flows into Stump Lake, located in the southeast portion of the basin.

Devils Lake is a shallow, saline, hypereutrophic lake under extended dry conditions, but under the current extended wet cycle, is relatively deep, sub-saline, and eutrophic. Water levels have varied widely over time, dependant largely upon long-term hydrologic / climatic conditions. Data from many study initiatives over the last 100 years do not reach definitive conclusions about why the level of Devils Lake varies so dramatically.

Warren Upham (1895) estimated that Devils Lake was at elevation 1,441 feet amsl in 1830. According to studies by Bluemle (1991), Devils Lake's water level overtopped its natural outlet (approximately 1,459 feet amsl), to the Sheyenne River, at least twice in the last 1,800 years.

The lowest recorded elevation is 1,400.9 feet amsl, at which time the lake covered about 10.2 square miles (North Dakota State Engineer 1944). The lake climbed to a level of 1,438 feet amsl, an elevation that was reached in 1867 (Bluemle 1991) and reached a maximum recorded level of 1,448 in August of 2001 (United States Geological Survey 2001). The five water levels available from 1867 to 1901 were made at or near the dock of the Minnie H and authenticated by the United States Geological Survey (Wiche et at. 1986). The water elevation of Devils Lake was 1,446.8 feet amsl as of the completion of this plan in 2002. A recent ten-year wet cycle has resulted in Devils Lake rising 25 feet since 1993. Recorded history has shown the elevation of Devils Lake to be quite variable, with extremes from overflowing into Stump Lake to being almost completely dry (Figure 6, 7).

FIGURE 6: The recorded elevations of Devils Lake, 1860-2002.



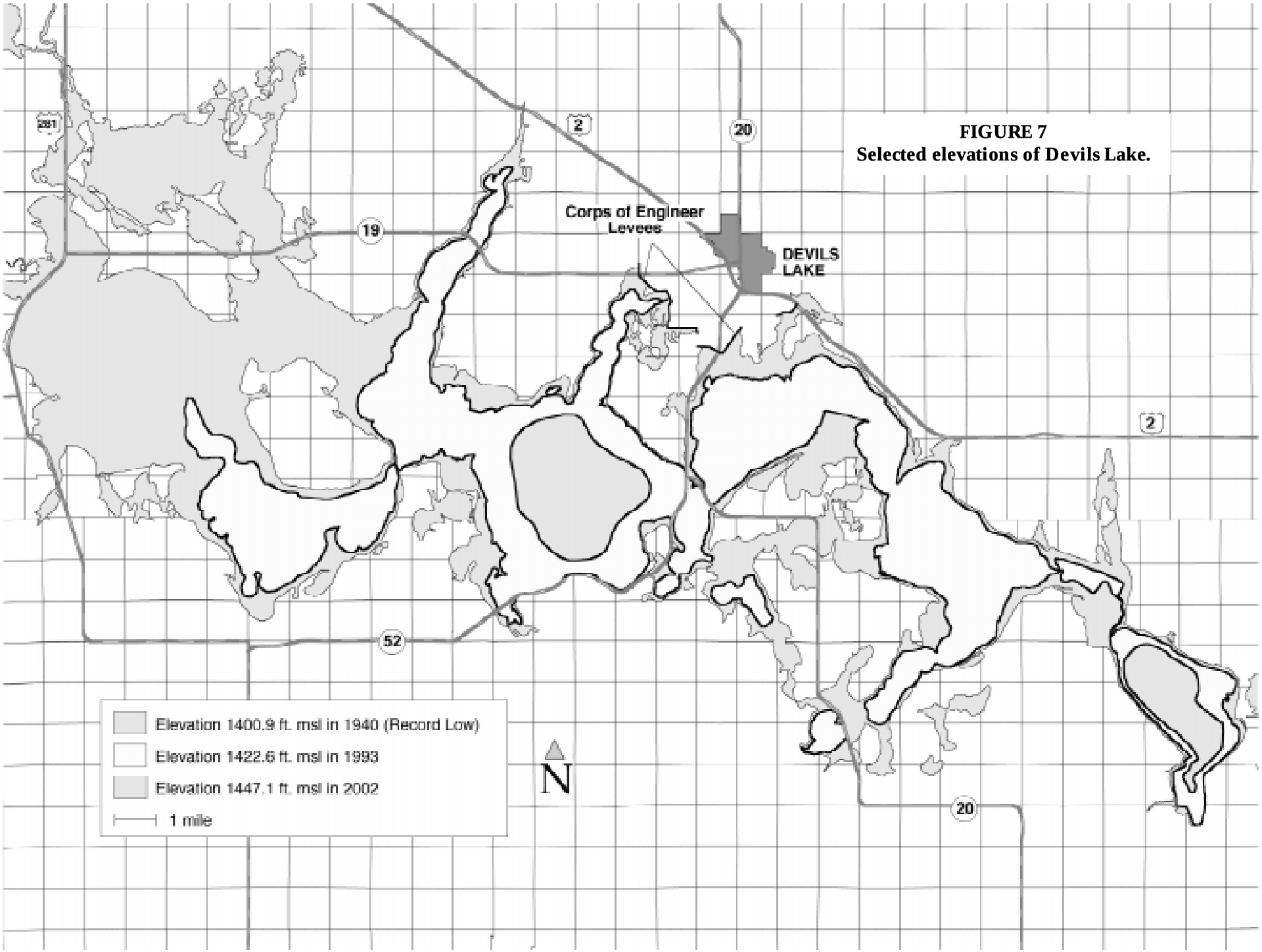


FIGURE 7
Selected elevations of Devils Lake.

Water Quantity

Many contentious issues surround water quantity and water management in the basin. Many landowners desire to drain wetlands and move water, especially from their cropland, to increase their economic returns through increased crop production on soils that can be very productive when dry, and especially to make it easier to utilize large farm machinery.

A total of 1,785 square miles of contributing area enters the upper basin lakes (Table 3). The Natural Resource Conservation Service lists approximately 307,000 acres of wetlands and about 4 million cropland acres (a 1:14 ratio of wetlands to croplands) in the counties associated with the Devils Lake Basin.

As the quantity of water in the Devils Lake Basin has increased, so too has the area of waterbodies. A study commissioned by the Devils Lake Basin Joint Water Resource Board, and completed by North Central Planning, estimates that the area of deeded land lost to the rise of Devils Lake since 1993 to a lake level of 1,450 feet amsl with an area of approximately 81,000 acres. Of those acreages, 38,736 acres were cropland/CRP, 34,934 acres were pasture/hay, 672 acres were developed residential, 446 acres were farmstead, 294 acres were parks/refuge, and 5,833 were classified as "other" (Anderson, 2002).

There have been numerous studies conducted by various agencies into the amount of storage in the upper Devils Lake basin, sometimes with widely varying numbers. The most recently completed was an extensive study completed in 2001, commissioned by the United States Army Corps of Engineers, and conducted by West Consultants Inc. The scope of the study was to develop a physically based hydrologic model to simulate the hydrologic functions of identified depressions. This included an estimate of pre- and post-drainage wetland storage in the Devils Lake Basin.

Wetland storage in the study was determined utilizing a combination of digital elevation models (DEM), aerial photos, National Wetlands Inventory (NWI) data, flow direction data, and digital quad maps. Wetlands were split into two categories, possibly intact and possibly drained. Researchers found that there were approximately 202,990 acres of possibly intact wetlands, with approximately 481,604 acre-feet of storage, and 92,429 acres of possibly drained wetlands with approximately 132,729 acre-feet of storage. However, when running 10 different climate sequences based on United States

TABLE 3
Drainage Areas of Devils Lake Subbasins

SUBBASIN	CONTRIBUTING	NONCONTRIBUTING SQUARE MILES	TOTAL
Edmore Coulee	389	112	501
Starkweather Coulee	291	100	391
St. Joe Coulee	91		91
Calio Coulee	142		142
Mauvais Coulee	872	10	882
Little Coulee	263	158	421
Comstock	58		58
Devils Lake (north slope)	512		512
Devils Lake (south slope)	328		328
Stump Lake	488		488

SOURCE: U.S. Geological Survey Report 86-4320

Geological Survey hydrologic models, and incorporating both wet and dry years, the average annual runoff reduction was only 23,841 acre-feet. That amount of storage would only lower Devils Lake at its current elevation, by approximately two inches annually (Doeing and Forman, 2001; Personal Communication with James Landenberger, 2002).

The damages to property in Devils Lake Basin as a result of the current high water have reached $400 million dollars to date, with the natural overflow level into the Sheyenne River being projected at approximately 1,459 feet amsl. In November 1994, the Devils Lake Basin Joint Water Resource Board established the flood stage level of Devils Lake at elevation 1,427.5 feet amsl, approximately 32 feet lower than the natural outlet elevation, and the flood stage level has been achieved for over nine years. A flood reaching the natural outlet elevation would affect over 200 miles of transportation system, over 240 miles of infrastructure system (i.e., water and sewer lines), about 900 permanent structures, and over 65,000 acres of land, to say nothing of the damage that could potentially be caused downstream by an overflow into the Sheyenne River. A balanced water management approach is necessary to address all of these issues.

Upper Basin Lakes

Flooding is a common occurrence in the upper basin lakes (Sweetwater, Morrison, Dry, Mikes, Chain, Alice, and Irvine). Flooding in this area occurs when runoff waters from the 1,785 square miles of the watershed (about 60 percent of the area contributing to Devils Lake) flow into an area with relatively level topography. These well-developed upper basin drainage systems leading into the chain of lakes carry water more quickly than the system can effectively manage. Large amounts of water moving into this very flat area typically cause overland flows. Management of these lakes may be accomplished to help diminish flooding both around the lakes and downstream. In addition to the management of existing lakes, various wetland development projects have been identified in a water management plan for Lake Alice National Wildlife Refuge mentioned previously in this report.

The upper basin lakes stand at the confluence of several coulee systems; this fact combined with the flat topography of the area has long caused flooding for many of the landowners in the area. The opening of Channel A, a flood control channel constructed from Dry Lake directly to Devils Lake, diminished the upper watershed problem. Sweetwater-Morrison Lake and Dry Lake waters were then able to flow into Devils Lake, thereby reducing the flooding pressures on Mike's Lake, Chain Lake, Lake Alice, and Lake Irvine.

Despite these flood control measures in the upper basin lakes, the high level of Devils Lake itself, combined with continued high flows from the Edmore, Starkweather, Mauvais, Calio, and St. Joe Coulees have all but negated any positive effects realized from the construction of Channel A, due to the fact that water levels have connected Devils Lake to the upper basin lakes. High water levels have also made management of the upper basin lakes very difficult if not impossible. The result of flooding on Devils Lake has been the continued inundation of lands surrounding the upper basin lakes.

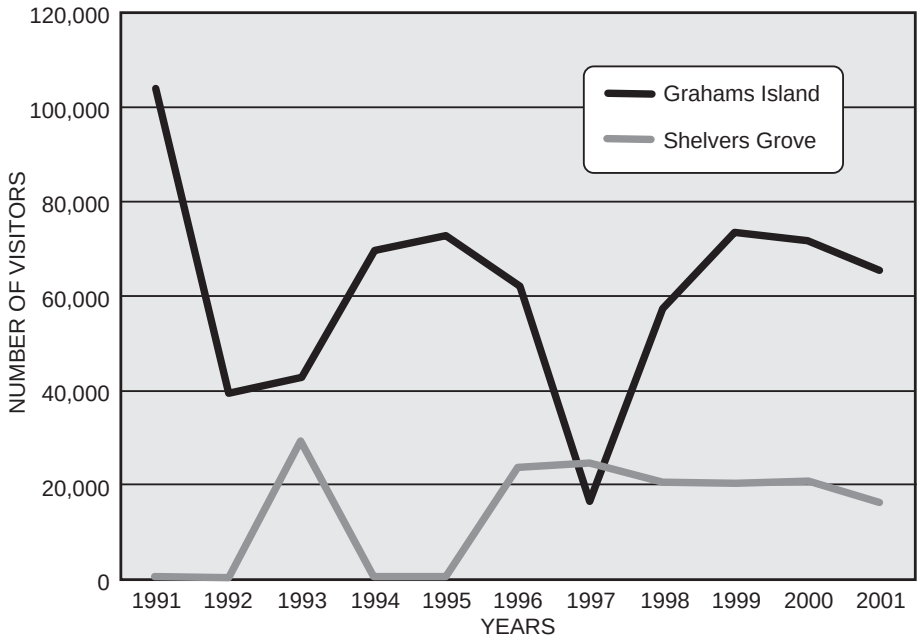


FIGURE 8
Trends in visitation to Devils Lake Basin parks over time. Note the sudden decline in visitation in 1992-1994 and 1997. This is due to the loss of access to park facilities because of rising lake levels.

Devils Lake

There are three sources for water in Devils Lake, precipitation falling on the lake, runoff from the basin, and ground water. Prior to 1993, in the majority of years on record, the largest percentage of water contribution to Devils Lake came from precipitation falling on the lake, but since 1993 the largest percentage contribution has come from upper basin inflow. A simple explanation of evapotranspiration to precipitation ratios is difficult to obtain, due to the drastic changes in lake area (Personal Communication with Gregg Wiche, 2002). Ground water inflow is only a small percentage of total inflow, but is relatively constant at about 3,000 acre-feet per year.

Evapotranspiration is the only important mechanism that removes water from Devils Lake, excepting natural overflow during extended wet cycles. The average annual evaporation loss for the Devils Lake Basin is 21 inches (United States Army Corps of Engineers Draft EIS, 2002). The average annual precipitation at Devils Lake is 18 inches. The average yearly inflow in the 63 years prior to the release of the 1995 plan was 32,859 acre-feet. In recent years however, weather has been anything but average.

The average annual inflow over the last nine years has been approximately 300,000 acre-feet. The average annual net storage gain has varied from 70,000 acre-feet for 1969-1983 to as little as 4,530 acre-feet for 1931-1940. Also, over the last nine years the average net volume gain for Devils Lake has been over 200,000 acre-feet annually.

Water levels of Devils Lake have fluctuated between the outlet elevation of about 1,459 feet amsl, to the lake being nearly dry at about 1,398 feet amsl. Research suggests that lake levels have reached those extremes several times since glaciation. Besides climatic variability affecting the inflow to Devils Lake, the chain of lakes upstream of Devils Lake retains runoff and acts as an evaporation basin.

Damage from the rise of Devils Lake has also affected the state maintained park facilities on or near the lake. It is estimated that $570,000 has been spent on restoring the three main parks on the lake, with an additional $7,500,000 required to raise roads if the lake reaches 1,450.5 feet amsl. Attendance has been affected as well, as can be seen in Figure 8, where attendance plummeted with the rise in water levels, as access was lost until the park facilities were raised as well (Personal communication with Dick Horner, 2002).

Local parks have been affected similarly to state parks. Minnewaukan, now on the shore of Devils Lake, has had to relocate the Humphrey Memorial Park to elevation 1,460 feet

amsl, after the tennis court and swimming pool were wrecked by rising ground water (Personal Communication with Mike Connor, 2002).

As the water has risen, forested areas along Devils Lake have been inundated. Since the last basin plan was published in 1995, 3,876 acres of forested land have been impacted at the 1,446 feet amsl elevation of Devils Lake (Harsel, 2002).

Water Quality

Explorer Joseph Nicollet recorded in 1839 that the water in Devils Lake was too salty to drink. Because Devils Lake is a basin that is only connected to the Red River Basin under extended wet conditions, which allows a natural uncontrolled flow to the Sheyenne River, the nutrient load of the lake is constantly increasing.

The United States Army Corps of Engineers Reconnaissance Report (1992, p. 35) states:

"The Devils Lake watershed has probably always been fertile and provided large quantities of nutrients to Devils Lake, as the result of natural processes. However, human activities, in both urban and agricultural areas of the watershed, very likely have severely accelerated the runoff of excess nutrients that eventually enter the lake and accelerate problems there. It is often quite difficult to reduce nutrient inputs from natural sources, but in many cases it is quite possible and economical to reduce the human contributions. This means that there may be an opportunity to decrease the hypereutrophic conditions in the lake to conditions closer to pre-European settlement conditions. However, even with the best current technology, the lake would naturally be eutrophic."

There has been some progress in this area, with various water quality studies and projects; including a Section 319 water quality monitoring study completed by the Devils Lake Basin Joint Water Resource Board in 2001. It is difficult to quantify the amount of nutrients entering into Devils Lake from each source in any given year, although the City of Devils Lake has instituted a new and innovative sewage treatment program utilizing lemna, a wetland plant that has reduced the phosphorous load from that source by 20 percent to 33 percent. New agricultural production methods are also being pursued to reduce the volume and velocity of runoff from the lands, thus improving the quality of the water entering watercourses. However, even with the annual variability in nutrient runoff, it is possible for scientists to estimate a long-term average annual loading of nutrients to a lake. It is recommended that a nutrient budget and an estimate of annual nutrient loading be done for Devils Lake in the future (Personal communication with Mike Sauer, 2002).

The Devils Lake Basin Joint Water Resource Board, the North Dakota State Water Commission, and the United States Geological Survey are cooperating to compile all available United States Geological Survey data concerning the basin into report form and as of the completion of this report, nearly 50 separate studies have been published. The new summary report will be used as a basis for determining sources and amounts of various loads to the lakes in the basin.

Since the beginning of the wet cycle in 1993, water quality in Devils Lake has dramatically improved, with decreases in total dissolved solids (TDS) and total dissolved sulfates corresponding to the rise in water levels (Elstad, 2002).

Upper Basin Lakes

Besides the loss in crop production, many farmers believe that standing water in wetlands may contribute to salinity problems on nearby farmland, contribute to soil compaction problems on adjoining supersaturated farmland, and harbor noxious weeds.

Managing these conditions increases production costs. While some disagree on the roles that wetlands play in soil salinization, and compaction, this does little to change the firmly held beliefs of many farmers.

The Edmore, Starkweather, St. Joe, Calio and Mauvais Coulees' watersheds drain through the upper basin lakes (Sweetwater-Morrison Lake, Dry Lake, Mikes Lake, Chain Lake, Lake Alice and Lake Irvine). The impact of these lakes on the quality of runoff entering Devils Lake continues to be studied.

An assessment made by the North Dakota Department of Health concluded that detaining runoff water in these lakes for a period of time would allow nutrient carrying sediments to settle out and/or nutrients to be tied up by vegetation in the lakes. These lakes, through proper management, may be an important part of cleaning the water before it enters Devils Lake. A detailed management plan for their operation is necessary. The wetland basins upstream are also important for nutrient uptake.

The Natural Resource Conservation Service is also currently involved with the Devils Lake Basin Joint Water Resource Board, in looking at conservation and management techniques along the Starkweather Coulee.

Devils Lake

Devils Lake is currently a relatively deep, sub-saline (variable amounts of soluble salts), eutrophic (rich in nutrients, minerals, and organisms) lake characterized by large fluctuations in water level and in concentrations of chemical constituents and nutrients, which can have profound effects on the biology of the lake.

There is a concern held by many that all the salt from the many water softeners used in the City of Devils Lake may be contributing to the degradation of the water. The numbers of livestock that have direct access to the lake may also be a source of contamination.

The North Dakota Department of Health states that periodic fish kills impair the lake. Swimming, boating, and aesthetic enjoyment of the lake are reduced when algal blooms occur.

The United States Geological Survey states in a fact sheet, that Devils Lake naturally overflows into Stump Lake at an elevation of 1,446.5 feet amsl, and has done so at least twice in the last several thousand years (United States Geological Survey, 2000). Evapotranspiration is the main way water completely leaves the system when the basin is experiencing a "normal precipitation cycle;" the constituents brought in with the runoff are left behind. The lower the water level drops, the higher the concentration of total dissolved solids (TDS).

In 1989, eight water-quality sampling sites were monitored for TDS concentrations. The samples varied from 2,500 parts per million (PPM) at the Minnewaukan Flats in May, to 10,700 PPM at East Devils Lake in February. Over ten years after that study was completed, the increases in the volume of Devils Lake correspond with increases in water quality, with a TDS at the West Bay near the Minnewaukan Flats of 1,140 PPM, and 5,450 PPM for East Devils Lake, a drop of nearly 50 percent (Sando, S.K., 1992; United States Geological Survey Fact Sheet, 2000).

Generally, highest TDS concentrations occur during the winter months, the lowest in the spring, and increase in the lake going from west to east.

The variations in TDS from west to east exist because most runoff water enters the system on the west end via Mauvais Coulee and Channel A. Water from Channel A, as measured by the United States Geological Survey from October 1987 through November 1993, had dissolved solid levels ranging from 2,170 to 310 PPM, with a mean of 835 PPM. Water from Mauvais Coulee measured during the same period had dissolved solid levels ranging from 1250 to 208 PPM, with a mean of 560 PPM.

Water quality is the most important factor affecting the Devils Lake sport fishery. Although salinity of the water seriously impacts fish reproduction, the larger concern is with excessive nutrients. Excess nutrients stimulate rapid growth of algae and plant life and increase the probability of anoxic conditions. Both winter and summer fish kills have resulted prior to the major runoff events that have occurred since 1993.

At elevations greater than 1,422 feet amsl, conditions in Devils Lake will probably result in a major fish kill. A 1990 stabilization report (Sando 1990) and a 1992 reconnaissance study (United States Army Corps of Engineers, 1992) analyzed ways to preserve the fishery and provide flood control for property surrounding the lake.

During a two-year period from September 1988 through October 1990, Steven K. Sando, United States Geological Survey, conducted a detailed analysis of the water quality of Devils Lake (Sando 1992). The study took place with the lake at a relatively high level (1,425.7 feet amsl in 1989 and 1,424.3 feet amsl in 1990). The purposes of the study were to determine the nutrient budget of the lake, to provide a general description of water-quality and plankton relations in the lake, and to provide information to aid in evaluating lake-management proposals. The study period was relatively dry in the basin and is probably indicative of years of low runoff.

S.K. Sando (1992) found the estimated mass of total nitrogen in Devils Lake during the two-year study period ranged from a high of 3,300 tons on August 15, 1989 to a low of 1,100 tons on September 12, 1990. External sources of nitrogen were minor concerning changes in the nitrogen mass between sampling periods. Precipitation was the greatest external source of nitrogen, but generally accounted for less than 10 percent of increases in nitrogen mass between sampling periods. It seems apparent from nitrogen mass calculations that, during the study period, internal processes caused much of the annual variation in nitrogen mass in the Devils Lake system. Those processes include resuspension of organic matter, diffusion of dissolved inorganic nitrogen from the sediments into the water, and sedimentation of particulate organic matter from the water into the sediments. Fixation of atmospheric nitrogen by heterocystous blue-green algae probably also contributes to summer increases in nitrogen mass.

Estimates of phosphorus in Devils Lake ranged from 278 tons on August 15, 1989 to 54.1 tons on October 25, 1990. Discharge of storm water and treated sewage from the City of Devils Lake was the greatest external source of phosphorus during the study period but generally accounted for less than 5 percent of increases in phosphorus mass between sampling periods. External sources of phosphorus were minor concerning changes in phosphorus mass between sampling periods. Since the 1989 study was completed, water treatment methods practiced by the City of Devils Lake have drastically reduced the phosphorous that the city releases into Devils Lake (Personal communication with Mike Sauer, 2002).

Sando (1992) made a special assessment of the effects of fish harvest and migratory waterfowl waste on nutrient levels in Devils Lake. Using estimated fish harvest figures provided by the North Dakota Game and Fish Department and assuming fish contain 2.5 percent nitrogen and 0.2 percent phosphorus, the total masses of nutrients removed from Devils Lake during 1989 and 1990 were relatively very small. It is unlikely that fish harvest plays an important role in the lake's nutrient balance.

The second consideration concerned migratory waterfowl. According to this research, the effect of migratory waterfowl waste on the Devils Lake's nutrient balance is not large. Also, the nutrient contribution by waterfowl occurs during the time of the year when nutrient masses in the lake typically decline. Nutrients supplied to Devils Lake by waterfowl do, however, contribute to the nutrients that accumulate in the sediments.

Nutrient budgets indicate that internal loading and sedimentation processes generally account for variability of masses of nutrients in Devils Lake (at least in years of minimal inflow from the watershed). The North Dakota Department of Health continues to sample water quality in Devils Lake four to six times per year, and to work on programs reducing nutrient loading in the lake (Personal communication with Mike Sauer, 2002).

The North Dakota Department of Health has also completed a study examining the chemical, physical, and biological parameters of Devils Lake. This study looked at how water quality changes in the lake over time. In addition, the North Dakota Department of Health also does periodic water quality testing on the Devils Lake chain of lakes. The North Dakota Department of Health conducts a complete water quality analysis at seven sites, four to six times annually.

The North Dakota Department of Health also does Section 319 non-point source water pollution Best Management Practices (BMP) in the upper basin. The North Dakota Department of Health was involved in a major project designed to reduce nutrient loading by the City of Devils Lake. This innovative project captured municipal waste, and treated it using an aquatic plant known as lemna. This treatment system resulted in a reduction of phosphorus input into Devils Lake by up to 80 percent, with drastic reductions in nitrogen and ammonia as well. This project had the added benefit of providing nutrient-rich fertilizer to be used for agriculture.

Appendix

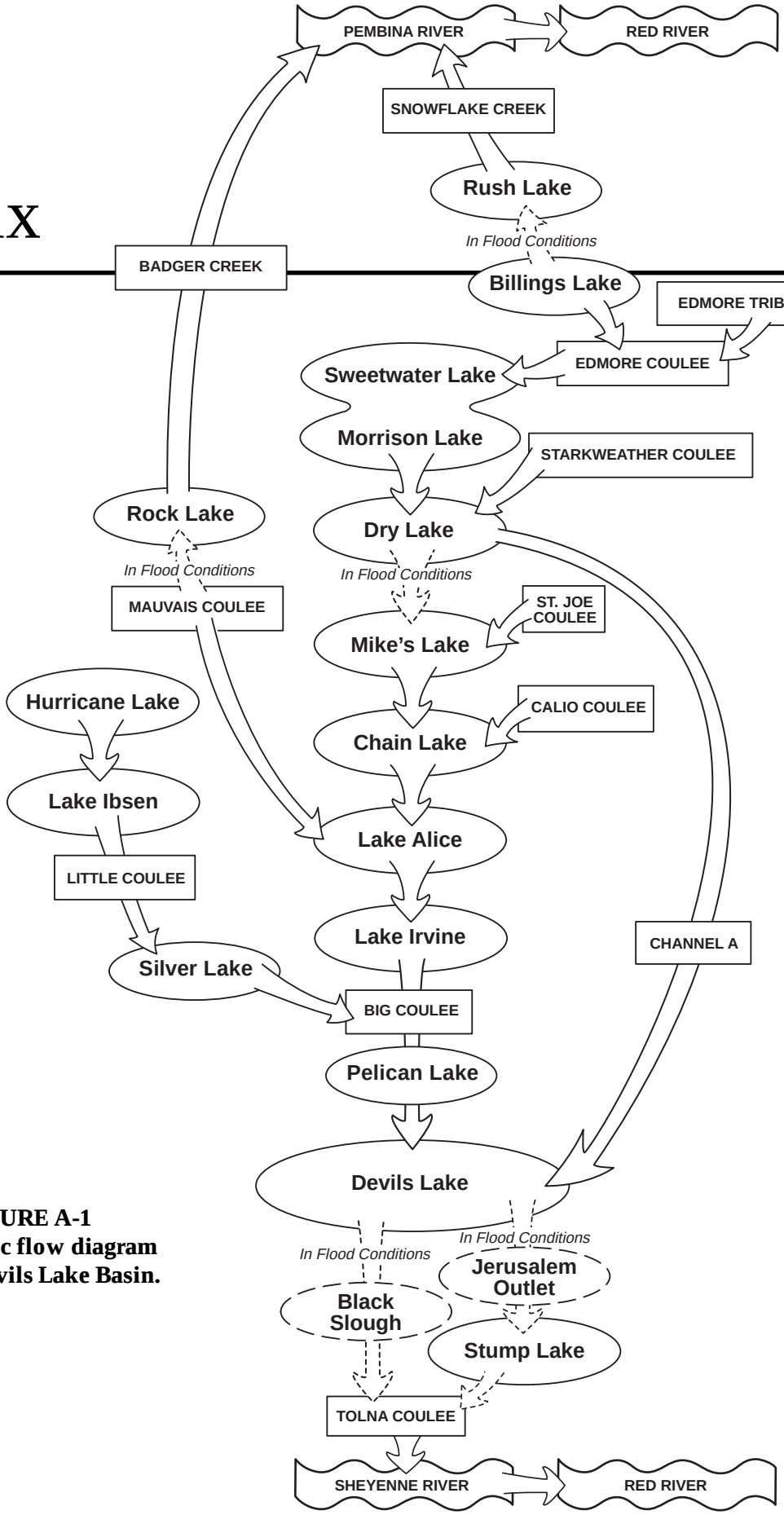


FIGURE A-1
Hydrologic flow diagram for the Devils Lake Basin.

Contact Information

Michael Connor, Manager,
Devils Lake Basin Joint Water Resource Board
524 4th Ave. #27
Devils Lake, ND 58301
(701) 662-7076
Fax: (701) 662-7096
E-mail: dlbjb@stellarnet.com

Lee Klapprodt, Director,
Planning and Education Division,
North Dakota State Water Commission
900 E Boulevard Ave, Dept 770
Bismarck, ND 58505
(701) 328-4970
Fax: (701) 328-3747
E-mail: lklap@swc.state.nd.us

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