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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

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RESPONSE

TO

A SCIENTIFIC AND POLICY REVIEW OF THE FINAL ENVIRONMENTAL STATEMENT FOR THE INITIAL STAGE, GARRISON DIVERSION UNIT (NORTH DAKOTA)

by the

Environmental Impact Assessment Project

of

The Institute of Ecology

NORTH DAKOTA STATE UNIVERSITY
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April 1975

[redacted]
United States. Bureau of Reclamation. Missouri
Response to A scientific and policy review of the final

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PURPOSE

The Institute of Ecology, a private organization funded by the Ford Foundation, has published "A Scientific and Policy Review of the Final Environmental Statement for the Initial Stage, Garrison Diversion Unit." Included in their review are questions, allegations and assumptions related to the function and effects of the project and a recommendation for a moratorium on further development.

This response has been prepared to clarify issues and answer valid questions raised, and to investigate recommendations made by the Institute.

FINDINGS

Examination and research of conclusions drawn in the Environmental Impact Assessment Project (EIAP) Review did not produce justification to support a moratorium on the Garrison Diversion Unit. Furthermore, it was found that principal conclusions drawn and recommendations made in the review are based largely on misconceptions and erroneous assumptions apparently derived from sources other than the FES.

Both beneficial and adverse effects are considered in the Final Environmental Statement (FES) for Garrison Diversion Unit. The statement was prepared as an objective evaluation of impacts anticipated as a result of the project. Input for the FES was obtained from many sources including several Governmental agencies, colleges and universities, private organizations and specialists in fields of irrigation, wildlife, biology, engineering, economics and other sciences. As correctly stated in the EIAP Review,

the FES is final for the principal supply works only. Additional detailed statements which will provide further information will be prepared for sections of the project.

It is important to note that the plan is not static; it is flexible and is being modified as alternatives are considered. It is recognized that the project plan can be improved as more studies are completed and new ideas evaluated. Suggestions offered by landowners and concerned citizens as well as critiques such as the EIAP Review are considered and are often used in formulating the most workable plan meeting the overall objectives for the Garrison Diversion Unit as authorized by law.

SUMMARY

Responses to principal conclusions made in the EIAP Review follow below.

1. "The Garrison Diversion Unit as presented in the FES has no economic justification. Costs of the project outweigh the benefits."

   Response:

   The benefit-cost ratio in the November 1962 report (revised February 1965) is 2.51 to 1. An updating of benefits and costs made earlier this year indicates the current (January 1975) benefit-cost ratio has improved.

2. "Irrigation costs amount to a subsidy of $122,000 per person or $469,771 per farm."

   Response:

   Reviewers apparently attribute the costs of irrigation to only the 650 new farms indicated in the DPR in deriving the expenditure of $469,771 per irrigated farm. Irrigation expenditures per farm will be about $203,000 (1,500 farms) or less than one-half of the amount computed by the reviewers. It is important to note that the total construction cost for irrigation will be returned to the U.S. Treasury from payments by the irrigators and from net power revenues of the Pick-Sloan Missouri Basin Program. While the repayment assistance

from power revenues is significant, it is important to realize that those revenues come from net returns to the Federal investment in power facilities rather than from tax revenues that accumulate to the general fund of the U.S. Treasury.

3. "The project will reduce cropland by 8,148 acres, grassland by 39,172 acres, and trees by 6,276 acres."

   Response:

   The acreages cited will not be lost but will undergo a land use change. Reductions in cropland, grassland and tree acreage will equal the gain in water and marsh areas (49,545) and miscellaneous areas. Increased water and marsh areas will provide excellent fish and wildlife habitat. Productivity of 250,000 irrigated acres will at least triple that of dryland.

4. "Energy consumption per acre for the Garrison Diversion Unit is nearly nine times the national average for irrigation agriculture."

   Response:

   The 905,600 K/Cal per acre figure referred to in the EIAP Review does not represent a national average but is a 20-year old estimate for Nebraska. Data from that period would apply mainly to gravity systems and are not comparable to sprinkler irrigation proposed for Garrison Diversion Unit. The ratio of "nine times" cited in the review was developed by comparing this value to a purported consumption figure of 7,937,000 K/Cal per acre for GDU which includes (1) energy forgone due to water diversion, (2) energy required for construction, as well as (3) energy for project and on-farm pumping; and is multiplied to consider replacement using a fossil fuel conversion process. This is not a true comparison and is grossly misleading.

   Total energy use projected for project and on-farm pumping compares favorably with other existing irrigation projects. Energy forgone due to water diversion from Missouri River cannot be charged against the project since the Pick-Sloan Missouri Basin comprehensive plan included power allocations for irrigation.

5. "Agricultural production could be enhanced on almost 2.4 million acres, if the energy inputs of the project were redirected to the production of fertilizer."

   Response:

   Use of fertilizer for efficient food production is limited by the amount of soil moisture available. For this reason irrigation is of paramount importance for insured increases in food production.

This would also completely ignore the intent of the development of a multipurpose project for the betterment of this region and thus the nation in general as envisioned and authorized by Congress. Lower Basin states specifically received the benefits of flood control and navigation. Upper Basin states were compensated for loss of prime bottom lands taken for reservoirs by irrigation development, municipal and industrial water development, recreation and fish and wildlife developments. Garrison Diversion Unit is a logical and feasible development of these resources.

6. "Studies of water quality impacts for the project are grossly incomplete."

Response:

The Final Environmental Statement adequately covers all general water quality impacts resulting from irrigation. No further substantiating data have been developed which would indicate effects other than those described.

7. "Degradation of water quality by the Garrison Diversion project will be far greater than indicated in the FES."

Response:

On the contrary, since engineering judgments and prognoses are based on the uncertain or worst conditions expected, results are generally conservative. In effect, resulting water quality may very possibly be better than predicted.

The Bureau of Reclamation 1974 model study is one of the most comprehensive water quality studies of this type. Further investigations of return flows and resultant water quality in the Souris River were conducted in 1974 and indicate more favorable results than predicted previously.

8. "Impacts on people have been, and will continue to be, severe. The destruction of family farms, the uprooting of entire families and the concentration of land ownership due to the project are discussed inadequately in the FES."

Response:

Approximately 650 new family farms will be created, thus reducing the existing trend toward landownership concentration. In addition, fair market value and severance damages for land acquired offset economic hardships incurred by landowners.

When relocation of a farm is necessary, the Uniform Relocation Assistance and Land Acquisition Act of 1970 (P.L. 91-646) provides that owners and tenants may be reimbursed for expenses and other losses and damages

incurred. In addition, replacement dwelling costs of up to $15,000 and the cost of moving personal property may be paid.

Reclamation law provides that water will not be delivered to irrigable land in excess of 160 acres held in the beneficial ownership of any single person or in excess of 320 acres held in the beneficial ownership of husband and wife jointly unless the owners thereof have executed valid recordable contracts and agree to the sale of such lands under terms and conditions satisfactory to the Secretary of the Interior.

9. "The FES contains no evidence that a comprehensive vegetation survey was completed in the project area. Vegetation information which is included is vague and incomplete."

Response:

Vegetation data were provided by the Botany Departments at North Dakota State University and the University of North Dakota. Their studies included data developed from over 60 years of botanical research in North Dakota and information resulting from them was used in the FES.

10. "The failure to recognize plant species and vegetation units as the predominant biotic components of complex ecosystems is a basic fault of the FES."

Response:

Bureau studies and evaluations did consider ecosystems and vegetation units. Disturbance of vegetation due to construction was recognized as temporary in nature. Permanent changes in vegetation species as part of biotic communities were also recognized and included in the FES.

11. "Development of the Garrison Diversion Unit will result in a potential loss in annual production of well over 350,000 waterfowl. The combined potential loss in production of waterfowl and other marsh birds will approach a half-million birds per year."

Response:

There is quite a difference of opinion about effects of the Garrison Diversion Unit upon waterfowl and marsh birds in the area of development. U.S. Fish and Wildlife Service analyses of the Project have shown that development of wildlife areas and habitat assoicated with the Unit will result in increased production and an overall increase in waterfowl. Therefore we anticipate an increase, not a decrease, in the annual bird production of the Garrison Diversion Unit area.

12. "When the marginal fisheries benefits of the Garrison Diversion Unit are weighed against the true fisheries costs, it is doubtful that any net fisheries benefits can be attributed to the project."

Response:

Net fishery benefits will result from the project. Fisheries benefits were developed by personnel of the U. S. Fish and Wildlife Service, who have had specialized training and experience in fishery management and making benefit-cost analyses. North Dakota State Game and Fish Department personnel also participated in development of the fisheries plan and have endorsed its fishery potential.

13. "The FES treats recreation inadequately and displays a consistent, obvious bias in favor of recreation benefits of the project and a minimization or neglect of its many recreation liabilities."

Response:

Recreation benefits were derived by National Park Service estimates. Past experience also shows that recreation use and benefits have historically been grossly underestimated on other North Dakota projects. Recreational opportunities will be enhanced or made available in areas where marginal or no recreational facilities exist.

14. "The detailed statement of primary and secondary consequences of the project, as required by the National Environmental Policy Act, is not provided in the FES."

15. "The FES ignores the National Environmental Policy Act process by attempting to trade off the environmental costs of one segment of the project against the claimed economic benefits of the entire project."

16. "In order to comply with the National Environmental Policy Act, the FES must present a balance of the environmental costs of each segment against the isolated economic benefits of that segment, and in summary it must balance total economic benefits against total environmental costs."

Response to 14, 15 and 16:

Requirements of the National Environmental Policy Act have been met by the FES. The final environmental impact statement, pursuant to the National Environmental Policy Act of 1969 (83 Stat. 852, 42 U.S.C. 4321 et seq.), was filed with the Council on Environmental Quality on January 10, 1974. The litigation concerning the sufficiency of this statement in complying with NEPA requirements, entitled The Committee to Save North Dakota, Inc., v. Rogers C. B. Morton et al., Civil No. 1198, United States District Court for the District of North Dakota, was dismissed by the District Court on June 12, 1974. Notice of appeal was filed and the Eighth Circuit Court of Appeals rendered its decision January 15, 1975, upholding the dismissal.

17. "The FES fails to indicate the apparent violations of U. S.-Canadian international law, including the Migratory Bird Treaty Act of 1970 and the Boundary Waters Treaty of 1909, resulting from the adverse environmental impacts of the Garrison Diversion project."

Response:

The United States has repeatedly assured Canada that there will not be any violations of United States-Canadian international treaties. An international task force comprised of U. S. and Canadian representatives has been studying and exchanging information on the matter of Garrison Diversion Unit return flows and effects.

Negotiations are continuing with the Canadian Government to reach a complete understanding of the impacts of Garrison Diversion Unit in North Dakota on the downstream portions of the Souris and Red Rivers. The impacts on the beneficial uses of the Souris River are being reviewed closely. It is the belief of the United States that the potential beneficial uses of the Souris River will be improved.

BACKGROUND

Public Law 89-108, August 5, 1965, provided for the construction of Garrison Diversion Unit and authorized the construction of facilities for the irrigation of 250,000 acres, municipal and industrial water, fish and wildlife conservation and development, recreation, flood control, and other project purposes.

Section 102(2)(c) of the National Environmental Policy Act of 1969 (NEPA) (83 Stat. 852, 42 U.S.C. 4321 et seq.) requires each Federal agency to prepare an environmental impact statement (EIS) " . . . on proposals for legislation and other major Federal actions . . . "

A proposed draft of the environmental impact statement dated January 8, 1971 was sent for comment to interested State and Federal agencies. Comments resulting from that review were incorporated into the draft environmental impact statement filed with the Council on Environmental

Quality on April 23, 1971. It was determined by the Department of Interior that this draft would not meet the requirements of NEPA as set out in the revised standards and format established by Reclamation Instructions issued November 6, 1972.

A revised draft environmental impact statement was sent for comment to interested State and Federal agencies and private individuals on April 10, 1973. In addition, a public hearing was held in Minot, North Dakota on May 21 and 22, 1973. All comments were then incorporated into the revised environmental impact statement.

The Final Environmental Statement (INT FES 74-3) was filed with the Council on Environmental Quality on January 10, 1974.

Civil action (File No. 1198) was filed with U. S. District Court on December 11, 1972 by the Committee to Save North Dakota. The complainants asked for a court order enjoining further work on the Garrison Diversion Unit because of the failure of the United States to comply with the National Environmental Policy Act of 1970, the Fish and Wildlife Coordination Act of 1934, the Environmental Quality Improvement Act of 1970, and the Water Bank Act of 1970.

On February 12, 1973, Judge Bruce Van Sickle denied the complainants' request for a preliminary injunction. On April 2, 1973, the complainants moved the Court of Appeals to remand the case to the District Court or, in the alternative, to issue a preliminary injunction "pending appeal." The order from that court, dated May 18, 1973, denied the appeal and remanded the case to the U. S. District Court.

At the pretrial conference on March 14, 1974, counsel for the plaintiffs informed the court that they were abandoning any claims contained

in the Fish and Wildlife Coordination Act of 1934, the Environmental Quality Improvement Act of 1970, and the Water Bank Act of 1970. The court then found that the Government had satisfied plaintiff's demands for a final environmental statement and thereupon relieved the United States of any and all limitations on construction, including those which were self-imposed.

A Notice of Entry of Memorandum and Order was entered in the court May 14, 1974. This gave the plaintiffs 30 days to file an amended complaint raising any new issues. On June 12, 1974, Judge Bruce Van Sickle signed a Judgment stating that since the plaintiffs had failed to raise any new issues, the case was dismissed.

On June 11, 1974, the plaintiffs filed a Notice of Appeal to the Eighth Circuit Court from the Memorandum and Order Granting a Motion for Summary Judgment entered May 14, 1974. The appeal was heard January 7, 1975 and denied without prejudice January 15, 1975.

The Final Environmental Statement included provision for three additional detailed environmental statements for sections of the project as final designs are prepared. These statements will include more definite data on return flows, fish and wildlife resources, operating plans and construction techniques. Many of the specific questions addressed in the review are among those to be answered by the detailed statements.

RESPONSES

Responses and clarifications to assertions made in the body of the review are presented in this section. Specific material included forms the basis for the summary and findings preceding this section.

Excerpts have been taken from the review, verbatim or condensed, and are presented on the left. Responses follow directly across on the right.

In 1957, BuRec unveiled its new plan to divert water from the Missouri River at Garrison Dam to (1) irrigate 1,007,000 acres of land in central and eastern North Dakota; (2) restore Devils Lake; and (3) provide water for 41 towns. The new plan, renamed the Garrison Diversion Unit, included 8 reservoirs, 6,713 miles of canals, 656 pumping plants, and was estimated to cost $529,000,000. The benefit-cost ratio, according to the Bureau of the Budget, was only 1.03 to 1, and with primary benefits alone it dropped to 0.53 to 1.

Having failed to gain congressional approval, BuRec in 1959 proposed a greatly reduced "initial stage" irrigation plan for 250,000 acres at an estimated cost of $160 million and with a claimed benefit-cost ratio of 1.99 to 1. Elmer Statts, Acting Director of the Bureau of the Budget, pointed out, however, that fish and wildlife benefits had been overestimated and that secondary benefits accounted for over 60 percent of the total benefits. Using only primary benefits, the benefit-cost ratio dropped to 0.76 to 1.

The Report on Garrison Diversion Unit, dated January 1957, proposed development of 1,007,000 acres with first stage construction limited to 407,000 acres. Benefit-cost ratios were computed from common-time (1964) adjusted values of estimated benefits and costs, using 2⅝ percent interest. Bureau of Reclamation method was based on 100 years of useful life, using direct, indirect and public benefits. Bureau of the Budget circular A-47 (later rescinded) prescribed 50-year period which restricted benefit-cost ratio to the first stage.

	BuRec Method	Circular A-47 Method
First stage	1.40	1.03 and 0.53
Full development	1.42	

A comparison of benefits and costs under full development not adjusted to a common-time basis results in a ratio of 1.75 to 1.00 (1957 Report on Garrison Diversion Unit, page vi)

During review of the 1957 report, consideration was given to an initial development which included only 250,000 acres of irrigation and it was agreed that a plan for it should be evaluated. A supplemental report in September 1959 outlined a typical plan for initial development of this magnitude.

On October 1, 1959, the Secretary of the Interior transmitted to the Bureau of the Budget his letter report on initial development of the Garrison Diversion Unit with the proposal that legislative endorsement be sought from the Congress. The Bureau of the Budget gave permission for the Secretary to transmit to the Congress pertinent reports on the unit but withheld approval of the plan for initial development, partly because technical studies basic to the letter report were hurriedly assembled and not completely reliable. Additional studies were requested. On February 3, 1960, the Secretary transmitted to the Congress his letter report to the Bureau of the Budget and the reply of that Agency, the 1957 Report of the Bureau of Reclamation, a companion report by the Bureau of Sport Fisheries and Wildlife, and comments by the State and Federal Agencies concerned. These documents were printed as House Document 325, 86th Congress, 2d Session.

A supplemental report dated November 1962 covering only 250,000 acres and incorporating changes in economic evaluations suggested by the Bureau of the Budget was prepared. During the review of the 1962 report, legislation was passed affecting repayment on recreation and fish and wildlife developments. The 1962 report was revised to reflect

this legislation in February 1965 and submitted to Congress. Public Law 89-108, August 5, 1965, authorized the construction of Garrison Diversion Unit.

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By 1962, BuRec had refined its plan, and although the estimated costs had climbed to $212,000,000, the benefit-cost ratio had risen to 2.51 to 1, based on a 100-year project life. The Initial Stage of the Garrison Diversion Unit received congressional authorization in 1965. Construction of the main pumping plant was begun in 1968 and on the main supply canal in 1970.

The benefit-cost ratio in the November 1962 report (revised February 1965) is 2.51 to 1. A study conducted earlier this year indicated the current (January 1975) benefit-cost ratio to be 2.82 to 1.

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Since the Initial Stage of the Garrison Diversion Unit was authorized in 1965, BuRec estimates costs have increased from $212,000,000 at authorization to $375,710,000. The benefit-cost ratio has dropped to 1.67 to 1. However, in a November 25, 1974 report to Congressman Henry Reuss the Government Accounting Office (GAO) stated that "the authorized ceiling of $394.2 million could be exceeded by about $412 million before the project is completed." This report also stated that in attempting to solve the objections of the Canadian government about the present design, BuRec is studying alternatives to modify the project. However, GAO said "any one of these alternatives could increase the Garrison project's construction cost...but such a development probably was not economically justified because the expected costs probably would exceed the expected benefits." Another recommendation of this report was that BuRec "needs to fully inform the appropriate congressional oversight and appropriation committees of the increases in estimated total Federal obligations which would cause the Garrison project to exceed its authorized ceiling." Approximately $80 million had been expended on construction as of November 1974.

The Project Data Sheet submitted to Congress as part of the Fiscal Year 1976 Budget Justifications shows the total Federal obligations to be $418,592,034, a benefit-cost ratio of 2.82 to 1, and states in part, "... the current estimate is within the appropriation ceiling limitation ..."

Chapter 2 - Economics

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No such excuse can be offered by BuRec for the total absence of professional, systematic economic analysis in the FES on the Initial Stage of the Garrison Diversion Unit. The tools are available and directly relevant; there are numerous model studies from which BuRec could have drawn guidance. In fact, even the recommendations of BuRec's own commissioned report (Design of an environmental evaluation system. Report from Battelle Columbus Laboratories to the U.S. Bureau of Reclamation. 1971.) on this very subject have been ignored in the preparation of the Garrison Diversion Unit FES. Its failure to make use of this readily available literature and ignoring the experiences of hundreds of other water resource projects and studies indicate a flagrant disregard for BuRec's legal obligations under NEPA

The Bureau of Reclamation did not want to use the environmental statement as the document to make a new economic analysis of the Garrison Diversion Unit. An economic study was made to determine the feasibility of the Project and was used to authorize construction of the Unit. The economic impact from this study is presented in the environmental statement. The estimates of costs and benefits anticipated with full development of the 250,000-acre Garrison Diversion Unit were made during project formulation studies which were performed in compliance with Reclamation Laws (Act of June 17, 1902, 32 Stat. 388, and acts amendatory thereof or supplementary thereto). These estimates were included in the Definite Plan Report dated November 1962, revised February 1965, and showed economic justification for approval of the project. The Bureau of Reclamation is not authorized under existing

and a single-minded intent to proceed with the Garrison Diversion project without economic rationality.

At its simplest level, the Garrison Diversion project will cause massive changes in land use patterns within the irrigation area. The FES does not present a summary of these changes in a manner that easily allows the public to grasp the trade-offs implicit in the project. For this reason, review of these land changes are presented here in Tables I and II; they are based on data in the FES. What they indicate, and what BuRec did not indicate, is that the net effect of the Garrison Diversion Unit is to reduce: (1) total cropland by 8,148 acres, (2) grassland by 39,172 acres, and (3) trees by 6,276 acres. The project takes out of production more land than it brings into production! The FES does not provide sufficient quantitative data to indicate to what extent production losses from these areas will be compensated by the proposed irrigation development. Furthermore, since most of the 49,545-acre increase in "water and marsh" will be in deep reservoirs, canals and open water lakes (Tables 2 and 3, I-20, III-9, 27-46) of generally marginal water quality (see Chapters 4 and 8), little compensation in productivity can be expected from these areas.

law to do a reanalysis of the project based on standards which were promulgated after authorization and after construction had been started.

Reviewers listed the negative values as shown in Table II, page 8 of their report and omitted the positive values and arrived at a "net" effect on land change. Losses will occur in cropland, grassland, and tree land uses while an equal number of water and marsh acres will be gained. Reviewers obviously place no productive value on water and marsh acres and miscellaneous acres. The loss of 39,172 acres of grassland and 6,274 acres of trees represents a change of use. Increased water and marsh areas (49,545 acres) will provide excellent fisheries and wildlife habitat. Productivity of the acreage under irrigation will be at least triple that of dryland. Thus, the productivity of 8,148 acres of dryland must be compared with the greatly increased productivity of the 250,000 acres to be irrigated. The increases in productivity of the acreage under irrigation will far outweigh the present productivity.

The loss of cropland and grassland was included in the agricultural losses computation of the benefit-cost analysis for the project. 1/ The Fish and Wildlife Service determined the enhancement value of water and marsh acres and the loss of tree acres in accordance with the criteria available at the time of plan formulation. The statement on marginal water quality in the water and marsh areas is refuted in comments on statements in Chapters 4 and 8.

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For the reasons outlined above it is important not to treat the value of the new crops on the irrigated land as the benefit that is derived from the Garrison Diversion Unit. From this value must be subtracted the value of the dryland crops, beef, wind erosion protection, etc. which would have been produced on these lands without the project.

All of this projected "considerable increase" must be subtracted from the projected benefits of the project as valuable economic activity displaced by the Garrison Diversion Unit.

Agricultural losses were computed and included in the benefit-cost analysis. 2/ Wind erosion protection was also considered in the FES (III-14) - "Sprinkler irrigation will provide additional control by adding moisture to the soil surface and speeding redevelopment of cover."

Benefits per irrigable acres were determined from an increase in farm income, farm expenses, and marketing of the products resulting from irrigation of land. The increase was computed by subtracting farm income, expenses and production of a representative area dry-farmed from comparable farm income, expenses and production from an equal area with irrigation. 3/ Dryland and irrigated yields used in the analysis were based on improved management obtainable about 20 years in the future.

1/ Definite Plan Report, Garrison Diversion Unit, Initial Stage - 250,000 Acres, November 1962, revised February 1965, Appendix K - Economic and Financial Analysis, page K-107.
2/ Ibid.
3/ Ibid., page K-105.

In any typical year, there is not an unlimited demand for agricultural products. Because demand for food products does not increase significantly with rising incomes or relatively lower food prices (low income and price elasticities of demand), nearly the opposite, an "insufficient" demand or "over" supply has usually been the case since the early part of this century, if not before. Any realistic projection would suggest that it will also be true in the future.

Mr. Melvin H. Middents,[4] Division Vice President of Cargill Incorporated, disagrees with this statement. He contends that steadily increasing demand for farm commodities has traditionally been attributed to two major factors--growth in population and increasing per capita income. He says a direct correlation exists between rising consumer affluence and upgraded diets. Growth in per capita income means increased demand for meat, milk and eggs, and consequently increased consumption of grains and oilseeds. Middents indicates that the huge purchases of U.S. wheat and feed grains made by the Soviet Union in each of the last three crop years reflect a commitment made by that government to increase domestic meat consumption substantially.

Several respected authorities have cited recent developments in the world economy which indicate that the present tight world food situation will continue. Dr. Donald Anderson, Professor of Agricultural Economics, North Dakota State University, has stated that available information indicates the current food shortage will continue into the late 1970's.

World population is currently approaching 4 billion people.[5] It is increasing approximately 80 million people each year or about 210,000 people a day. Many demographers estimate that by the year 2000 world population may reach or exceed 7 billion people. The Food and Agriculture Organization (FAO) of the United Nations estimates that based on current population and population trends, the gap between production and need in developing countries will rise within the next 10 to 15 years from the current level of 25 million tons to as much as 85 million tons annually.

In 1972 adverse weather conditions in major grains and oilseeds-producing areas outside the United States reduced foreign production and contributed to strong foreign demand for U.S. farm commodities, causing a major drawdown of our carryover stocks. World grain exports in 1972 increased 24 million tons over the preceding year, and U.S. grain exports increased 30 million tons to make up for the shortfalls of other traditional exporters.

Production in 1973 increased nearly 10 percent worldwide, but demand remained strong as the major developed countries experienced a simultaneous economic boom. Consequently, there was little rebuilding of food stocks that had been depleted in 1972 and little cushion provided for the shortfalls in production that followed in 1974. Total world grains production in 1974 was about 910 million metric tons or about 6 percent less than total production in 1973. End-of-the-year carryover

4/ Melvin H. Middents' presentation, Food--Energy for the World, Fargo Farm Forum, Fargo, North Dakota, February 3, 1975.
5/ Ibid.

of all grains was about 80 million tons--down from 100 million tons in 1973. This is the lowest carryover in decades and only about one-half the 1969 level. Middents also indicated that food supplies may remain tight for a number of years depending on the weather conditions in forthcoming growing seasons. A USDA publication, Agricultural Situation, December 1974, points to the increase in harvested cropland (33 million acres) over the past two years (1973-1974) and indicates that after 1975, any sizable increase in crop acreage will rest on the conversion of permanent pasture and range to crop uses or on the irrigation, drainage, or clearing of the 264 million acres in our land inventory which are not now being cropped, but are suitable for cultivation. Mr. Milo W. Hoisveen[6/] in presenting his comments on the Environmental Impact Statement, Garrison Diversion Unit, stated the following concerning the merits of the irrigation function of the Unit:

> To me, the humanistic environment that will result from this project to a considerable degree is related to the drouth conditions such as we underwent in the 30's. We had one brief reminder when a drouth period occurred in 1961. Few of the present generation remember these catastrophic events. Henceforth, out-of-staters and frustrated politicians often find sympathetic persons who may unwittingly oppose the Garrison Diversion Unit. Since the original efforts were made, countless hours of endeavor to obtain authorization and appropriations for the Garrison Diversion Unit were made by some of our most visionary citizens. It is the efforts of these persons that many in the new generation are being urged to sell down the river. When I say "sell down the river," I mean exactly that, for the water of the Missouri River is much sought after by many downstream users.
>
> Climatologists in their tree-ring studies, have assured us that the course of our weather is cyclical in nature. Thus, drouth periods similar to those of the "thirties" will again return. Similarly, floods the equivalent of the current 200-year Mississippi River will also be repeated. Thus, it should behoove us to prepare to meet and deal with such catastrophies when they recur. Many of us who were exposed to the "drouth of the thirties" and witnessed its adverse effect on the environment as well as demoralizing influence on the millions of underfed Americans, tend to associate drouth with depression. This is not necessarily true for the next drouth could occur during a period of prosperity and result in a period of accentuated inflation.

6/ Mr. Milo W. Hoisveen, Consultant to the North Dakota State Water Commission, also served as Chief Engineer, North Dakota State Water Commission, 1954-1973.

It should also be noted that agricultural experts contend that the 32-year period, extending from 1940 to the present time, presented the most ideal conditions for agricultural production since this country was exposed to the plow. Statistics published by the U.S. Department of Agriculture in 1971, indicate that rate of output per unit of input has remained the same since 1963. The cornbelt actually indicates a decline in productivity.

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The FES suggests that "such crops as sugar beets, soybeans, or potatoes will be grown to increase cash-crop income and there will be expanded feed grain and forage production to complement the livestock industry." (III-10) Howe's and Faster's study (1971) of Interbasin Transfers of Water attempted to estimate the displacement effects of irrigation projects which boosted the production of just these crops. Potatoes are a good example of this sort of displacement of cropland in other regions.

Section 5, Public Law 89-108, 89th Congress, H.R. 237, August 1965, clearly excludes use of project water for production of basic crops considered to be in excess of normal supply.

Development of the 250,000 acres of irrigable land after the first year of water delivery is anticipated to take about 26 years. Increased production from irrigation will occur gradually over the development period and will be largely absorbed by the increase in U.S. population which is projected to increase by 90 million from 1970 to 2020 7/ assuming a medium (Series 2) fertility level. Far-sighted resource planners have long realized that increased food production would be necessary to eventually feed not only the United States population, but the world as well. Irrigation is one of the principal tools that can increase production. There are no "surplus" food crops in the world today. References cited in the Review appear to be out-of-tune with today's market conditions.

One might argue that this project is intended to benefit North Dakota and that costs and benefits should be calculated, not on a national basis, but only with respect to North Dakota. As will be shown below, such a regional analysis is legitimate and conveys valuable information. But, if the federal government and the citizens of this country are to make rational decisions about the use of national tax revenues, they must know the full size of the subsidy the nation is granting to North Dakota. Only if the analysis is carried out on a national basis will this be known. Then the decision can be made as to whether the size of the transfer of income from the nation to North Dakota is the size intended by and acceptable to the general public.

The reviewers indicate that the citizens of this country need to know the amount of the subsidy the nation is granting to North Dakota in order to decide whether the size of the transfer of income from the nation to North Dakota is the size intended by and acceptable to the general public. Since the stake that North Dakota has already made in the Pick-Sloan Missouri Basin Program, of which the Garrison Diversion Unit is a part, runs into hundreds of millions of dollars, the national tax revenues employed in construction of the Unit should not be considered a subsidy to the State or region. To fulfill part of the Pick-Sloan Missouri Basin Program, the Federal Government acquired 462,500 acres of land for the Garrison Dam and Reservoir and 106,389 acres for Oahe Dam and Reservoir, totaling about 569,000 acres. This is indeed quite an investment on the part of North Dakota to obtain the Garrison Diversion Unit.

It was obviously long-term gains with which Messrs. Pick and Sloan were concerned when the basic plan for the Missouri River Basin Project

7/ U.S. Bureau of the Census, Current Population Reports, Series P-25, Number 541, February 1975.

was developed. They contemplated a harnessing of flood flows which would save the Lower Basin states and which, at the same time, would provide the resources needed for fuller development of the Upper Basin states. They recognized that the costs of making water available for consumptive use could be substantial, but they considered that irrigation, municipal and industrial development were essential to provide a more balanced and stable economy in the Upper Missouri River Basin. Previous experiences in California and other parts of the West had also convinced them that a multipurpose development would expand the local economy and the tax base, so that state and national revenues would be measurably increased.

The Pick-Sloan promise was not without opposition. Many of the people who fully supported the main stem reservoirs felt it was more economical to keep the water in the river where it could better serve both navigation and power. Points the reviewers make now were made then by the downstream states.

Extended debates and exhaustive hearings on the whole plan for the Missouri River Basin Project then followed, in which the South Dakota delegation and Governor M. Q. Sharpe were principal proponents of a balanced and multipurpose development. To them, such balanced development seemed essential if the Upper Missouri River Basin was to be something more than a hinterland. In those war years it may have also seemed geopolitically important to provide balanced development of that area of the country which could be characterized as the Nation's heartland. In any event, the balanced development of the Missouri River Basin Project was authorized in the 1944 Flood Control Act (58 Stat. 887) and the basic premises for such development were reaffirmed in the Garrison Diversion Unit Authorization Act of August 5, 1965 (79 Stat. 433). As administrators, we in the Bureau of Reclamation have the obligation to proceed with implementation of the cited authorizations.

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This instability in food prices and farm incomes is likely to be exaggerated by our own large supply capacity. U.S. Department of Agriculture figures indicate that although the acreage in this country classified as cropland has remained practically constant for a quarter of a century, the land actually used for crops in 1972 was 14 percent lower than the all-time high of 387 million acres in 1949. This decline of 53 million acres included land idled under federal land retirement programs in the effort to lessen surplus production of food and fiber (Department of Agriculture, 1973).

This paragraph reflects the theory expressed in the third paragraph, page 9, and can be answered with essentially the same comment--after 1975 all idled cropland will have been returned to agricultural production.

In addition to this "retired" cropland, the Soil Conservation Service (SCS) (1967) estimates that cropland could be increased 56 percent (264 million acres) with careful planning and management. Given these two large reserves of currently unused cropland (emphasis added),

The reviewers obviously assumed that all lands suitable for regular cultivation which are presently in uses other than cropland fit into the category of "unused cropland".

the SCS estimates that with favorable farm product and input prices, normal weather and increased use of technology, American farm output could be increased over the next decade by as much as 50-65 percent.

The Soil Conservation Service's National Inventory of Soil and Water Conservation Needs, 1967, indicates that all land in inventory in the 50 states totals 1,438 million acres. Of this total, 631 million acres are suitable for regular cultivation. Of all the land suitable for regular cultivation, 365 million acres are cropland, 117 million acres are pastureland and rangeland, 126 million acres are in forest, and 23 million acres are classed as other land. It is apparent that most of the land in inventory is presently in a productive use and it is not clear how the term "unused cropland" can be applied to any of the land in inventory.

It is not clear what percent of the potential production is based on increased irrigated acreage. The reviewers apparently intended to show that potential production would be accomplished without additional irrigation. This is an impossible task as the historical data, upon which projections were based, include yields from irrigated land as well as dry land. The increase in cropland acreage presented in Table III of the reviewers' report has been shown to be attainable only by drastically reducing the acreage of other land uses. A review of acres harvested, yield, and production of corn grain, soybeans, feed grains, wheat, and cotton for 1971-1974 indicates that projecting substantial production increases (50-65 percent) is extremely risky. In 1974 corn and soybean acreages exceeded those of 1971, but production was less than or equal to that of 1971. Wheat acres harvested in 1974 exceed those of 1971 by 37 percent while production increased only about 12 percent. Production of feed grains in 1974 was only 72 percent of 1971 production.[8/] Only cotton acreage and production increases coincided (about 11 percent) to the extent that a trend could be indicated. Annual yield variations are clearly the inherent uncertainty factor of production projections. Excluding irrigation from future production expansion would multiply the uncertainty of all agricultural output.

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Water has many uses other than irrigated agriculture. The Missouri River Basin's waters currently are used in a broad variety of municipal and industrial ways. If Missouri water is diverted to agriculture and then flows into Canada, it will not be available for these other uses and the value of the goods and services that cannot be produced because of this diversion must be counted as a cost of the project. Potential competing uses that bear consideration here include: (1) hydroelectric power generation, (2) coal gasification and liquification plants, (3) cooling of thermo-electric plants, (4) coal slurry pipelines, (5) downstream municipal and industrial uses, (6) recreation and watershed uses downstream, and (7) future needs as yet unidentified.

The FES assumes that these alternative uses do not exist or that water used for these purposes has zero value. The rising cost of electric

Response to statement found in comments for page 10.

8/ Crop Production, 1973 and 1974 Annual Summaries, Cr Pr 2-1(74) and Cr Pr 2-1(75).

power generation and the increasing industrialization in Wyoming, Montana and North Dakota around the coal deposits make this an impossible assumption to support. Any adequate analysis would have to show either that agriculture was the most highly valued use of the water (an impossible task) or enter into the benefit-cost analysis a figure indicating the lost values which result from the water diversion. As discussed in the review of Energy and Water Resources (Chapter 3), the FES instead ignores the problem, thus exaggerating the net benefits of the project.

The impact of the Garrison Diversion Unit on the natural environment is dealth with in some detail in the following chapters of this review. It must be emphasized here that these environmental damages are also economic losses. The natural environment - air, streams and rivers, marshes, lakes, grasslands and timbered areas - is now providing valuable services. Any reduction in these environmental services, and construction of the environmental capital, is a real economic loss which ought to be entered as such in the benefit-cost analysis.

Techniques to evaluate such losses in quantitative terms have been developed and used for projects as complex as the Garrison Diversion Unit (Cicchetti, 1972; Kurtilla, 1972). NEPA, as interpreted by the courts, requires such an evaluation, but the FES does not provide it (III-3-10). The FES provides only unquantified, unsupported assertions and promises of future studies (I-2, 43, 45) to obtain the very data that are necessary now to evaluate the project before it proceeds further.

Wind erosion is a typical example of an environmental impact which becomes an economic loss. The loss of 39,172 acres of grassland and 6,276 acres of trees (see review Table II) and the switch to more intensive intertilled crops is likely to increase the wind and water erosion hazard on these lands.

If information on increased pesticide use and transfer to surface waters, increased water pollution due to increased livestock production and feeding operations, increased nutrient loads in water from irrigation return flows, etc. is made available prior to further work on the project, options remain open. If work proceeds while the promised studies are carried out, options become more and more

Damages to the natural environment--air, streams and rivers, marshes, lakes, grasslands, and timbered areas--are grossly exaggerated and the beneficial environmental effects are minimized by the reviewers. Generally, environmental damages are nonmonetary effects and cannot be realistically measured through the cost-price structure of the benefit-cost analysis. However, nonmonetary environmental effects are treated as constraints to provide an improved basis for decision-making which is reflected in the design of the project. Environmental aspects such as mitigation of marshes which can be assigned a dollar value are included in the benefit-cost analysis. Mitigation of environmental damages is discussed in Chapter IV of the FES.

As is indicated in previous comments, the Bureau has followed the principles and standards prescribed by reclamation law. Evaluation methods recommended by "individuals" do not supersede these regulations.

Land use change impacts are discussed on page III-9 of the FES. A significant land use change will occur within the irrigated areas as about 50,000 acres of grazing land will be converted to cropland. Some of this land along with land currently cropped will be irrigated as rotation pasture or hayland amounting to 57,000 acres. About 50,000 acres of land normally fallowed will be continually cropped with irrigation. Tree and shrub plantings, grass seedings, maintenance and management of right-of-way areas will assure optimum value for wildlife and public hunting use (page IV-4 of FES) as well as provide wind erosion protection.

Chapter IV of the FES very clearly states:

> The Federal Environmental Pesticide Control Act of 1972 amends the Federal Insecticide, Fungicide and Rodenticide Act. It provides for positive control over the handling and usage of all registered pesticides. (and)

restricted and the precise irreversible damage that NEPA was meant to avoid may become a reality.

Air and water quality standards will be adhered to during construction and operation of the project. Plans have been reviewed for conformance with regulations in Executive Order 11507 - Prevention, Control and abatement of Air and Water Pollution at Federal Facilities. (also)

North Dakota Water Laws and Water Quality Standards for surface water provide for controls to prevent entrance or accidental spillage of solid matter, contaminants, debris and other objectionable pollutants and wastes into streams, flowing or dry watercourse, lakes and underground water sources. These standards were established in compliance with the Water Quality Act of 1965 (P.L. 89234) and subsequent amendments of that law.

The standard tool of analysis used to organize and evaluate economic data related to a public expenditure decision is benefit-cost analysis. The tools of benefit-cost analysis have been developed to their most sophisticated level in the field of water resources. Yet, in the FES one finds no benefit-cost analysis and no references to any.

Reviewers have indicated that no report can include all supporting information. This is particularly true of the Definite Plan Report on the Garrison Diversion Unit (DPR) which includes 12 volumes of appendixes. However, assistance in obtaining copies of the report is available upon request.

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The total absence of a B/C analysis in the FES means that the economic rationality of this $400,000,000 investment is never evaluated for the agencies and the public who are to review the project and decide upon its continuation. As the Legal Analysis (Chapter 10) indicates, NEPA requires a B/C analysis for projects such as the Garrison Diversion Unit and CEQ guidelines require it; in addition, the "Principles and Standards" issued under the Water Resources Planning Act (Water Resources Council, 1971) require it.

Statement is answered by response to page 7 statements.

The elaborate subsidy represented by the Garrison Diversion project should have been clearly indicated and justified in the FES. Subsidies are not necessarily irrational. Economic theory offers several justifications for such support, ranging from outright grants aimed at redistributing income in a more "just" direction to support for economic activities that result in substantial public benefit which normal business exchanges tend to ignore. But that justification must be made explicit and the full amount of the net subsidy must be accurately calculated and shown to be appropriate. None of this is done in the FES.

Statement is answered by response to page 10 statements.

Given the large size of the subsidy - $305,351,000 (counting only irrigation costs) to maintain a farm population of 2,500 individuals (III-11) is $122,000 per person or $469,771 per farm - some justification is necessary. At current interest rates, this amount of money just held in trust for the 2,500 individuals would provide almost $47,000 a year for each farm.

Irrigation of about 160 to 200 acres per farm will affect about 1,300 to 1,500 farms in the 250,000-acre Garrison Diversion Unit. Reviewers apparently attribute the costs of irrigation to only the 650 new farms indicated in thd DPR in deriving the expenditure of $469,771 per irrigated farm. Irrigation expenditures per farm will be about $203,000 (1,500 farms) or less than one-half of the amount computed by the

One must turn to the nearly ten-year-old "Definite Plan Report on the Garrison Diversion Unit" (Bureau of Reclamation, 1965) to obtain any quantitative analysis of the costs and benefits associated with the project. The usefulness of the data in this study is questionable however, especially since the report calculates a B/C ratio of 2.51 while the FES (III-7) indicates the current (undocumented) B/C ratio is 1.67.

The 1965 B/C analysis supporting the Garrison Diversion Unit discounts benefits and costs at 2.875 percent (Bureau of Reclamation, 1965). Professional economists (Seagraves, 1970; Eckstein and Harberger, 1968), the Office of Management and Budget (1972) and the Water Resources Council (1971) all consider this discount rate low by a factor of 3 or 4. Economic theory requires a discount rate well over 10 percent (Seagraves, 1970), and the Water Resources Council (1971) admits that it should be at least 10 percent and legally mandates that at least a 7 percent rate be used.

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BuRec has chosen its time period of analysis of project benefits as 100 years. Although the reservoirs and canals might last that long, the value of the benefits from the project become very doubtful (emphasis added) when projections are made that far in the future. For that reason, economists have long argued that the physical life of the constructions should not be used as the time period of analysis. Instead, a shorter time period, representing the period during which the analyst is reasonably certain the benefits will occur, should be chosen.

This increased economic activity, to the extent it actually takes place, clearly would benefit some of the nonfarm population of North Dakota (and, as pointed out in Chapter 5, it would also harm some segments). But this is a national benefit only to the extent that this nonfarm population would otherwise be unemployed and their potential productivity wasted. To the extent that this increased local economic activity simply induces people to change jobs or migrate into the area or not migrate out to other jobs, only the difference between the productivities of the labor and nonhuman resources in this instance as opposed to the alternative employments can be counted as benefits. It is probable that this difference in productivity in alternative employments would be very small.

reviewers and is an expenditure that will be reimbursed by the irrigators and from power revenues as part of the Pick-Sloan Missouri Basin Program. The annual cost per farm will be about $6,500. Irrigation of 1,500 farms will provide annual benefits of about $13,000 per farm ($20 million total annual benefits from irrigation).

Project data sheets, of which the B/C ratio is a part, have been computed annually since 1965. Project costs have been indexed to current levels while benefits were not. This has caused benefits to lag and has reflected a reduced B/C ratio. Computation of the B/C ratio has been documented in accordance with Bureau procedure. Recent indicators show that the B/C ratio would be about 2.8 to 1 according to current prices.

Section 4(a) of Public Law 89-108 authorizing the Garrison Diversion Unit provided for the interest rate to be used in computing interest during construction and interest on the unpaid balance of interest-bearing costs. The Secretary of the Treasury has certified that the rate as of the beginning of fiscal year 1967, the year construction was initiated on the Garrison Diversion Unit, is 3.225 percent. This interest rate was used when official documents such as project data sheets were submitted for consideration

Environmentalists disagree on the period of time over which the project will serve a useful purpose. The Bureau selected a 100-year period of analysis in compliance with Senate Document No. 97.

This country's unemployment rate is at a relatively high level as compared to that of North Dakota. The United States civilian labor force unemployment rate in July 1974 was 5.3 9/ percent which is considerably higher than North Dakota's unemployment rate (4.3 percent). This difference is the result of a continuing exodus of North Dakota workers competing for jobs in other areas where unemployment is already a serious problem. Retaining the State's population and providing employment will lessen the impact on other areas. This is indeed a beneficial national impact.

9/ U.S. Department of Labor, Employment Security Bureau, North Dakota Employment Trends, August 1974.

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It should be noted that the derivation of the size of the indirect benefits is not documented in BuRec's 1965 economic analysis (Bureau of Reclamation, 1965). The dollar value is a number that is given to be taken on faith. The assumptions behind it and the method of estimation remain hidden.

Derivation of indirect benefits is clearly presented in Appendix K, Economic and Financial Analysis, Definite Plan Report on Garrison Diversion Unit Initial Stage - 250,000 Acres, November 1962, revised February 1965.

In the review of Energy and Water Resources (Chapter 3), it is pointed out that the water proposed for irrigation in the Garrison Diversion Unit is treated in the FES as an unemployed resource which over the next 100 years will have no other valuable uses. This assumption is implicit in the fact that the FES places no dollar value on the water that is being diverted and claims all the improved agricultural output as net benefits. The fallacy of this assumption is clear. The water already is being used to generate hydroelectric power. It could be used in the future for coal gasification, coal liquification, cooling coal-fired thermo-electric generators, mining coal and transporting it in slurry pipelines.

Response provided in comments to page 10 statements.

In this review, only the current hydroelectric value will be considered.

Statement is discussed in comments on Chapter 3.

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The FES points out that in the switch from dryland farming to irrigated farms, "total increased capital investment (sprinkler system, machinery and equipment, livestock and other purchases) could range from $50,000 to $100,000 depending on the size of the farm operation ..." (III-5). However, in the farm budget sheets drawn up to compare dryland farming with the irrigated alternative for the project's benefit-cost analysis (Bureau of Reclamation, 1965), the difference in total farm investment between these two alternatives was considered to be between $6,000 and $12,000, not between $50,000 and $100,000. Clearly, most of the additional investment has been ignored.

Reviewers imply that equipment costs, interest rates, etc. have increased while income to farmers has remained fixed. Such assumptions allow no prospect of succeeding for any farmers regardless of farm size. Farm information publications indicate that present-day farmers can secure financing for sound agricultural investments such as irrigation equipment.

In addition, it is assumed that the opportunity cost of this invested capital is only 4 percent. With prime interest rates at 10 percent, and savings and loan institutions offering 8 percent on five-year saving certificates, this figure is only half of what it should be. If the investment requirements, conservatively stated in the FES, are used and an 8 percent opportunity cost of capital incorporated, total farm investment must be increased 50 to 100 percent. In this situation, the interest payments on this total investment raise farm expenditures so high that only the larger farms have any net income. This also wipes out the difference in net incomes between dryland and irrigated farming for all but the largest two classes of farms (i.e., the 1,200- to 2,000-acre farms; Bureau of Reclamation, 1965). Even for these large farms, however, the difference in net incomes between dryland and irrigation farming is reduced by over 50 percent from that shown in the Bureau of Reclamation's study (1965).

Clearly, either the data used in the FES and that used in the only formal B/C analysis BuRec has carried out (Bureau of Reclamation, 1965) are contradictory, or when accurate assumptions are made the irrigation benefits are nonexistent for all but the largest farms and the benefits for them do not come near covering the costs of the project. Using this approach the benefit-cost ratio is also less than one.

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What the FES attempts to claim is that irrigation will allow these more marginal farms to continue in operation due to the increased profitability of irrigated farming. This is extremely unlikely, however, considering that the FES conservatively estimates that these marginal farms will have to raise and invest $50,000-$100,000 in new equipment, sprinkler systems, stock, etc. (III-5). A failing farm will not be able to afford such an investment and is unlikely to have access to such capital. It is likely to be heavily in debt already. The more probable result will be that the surrounding successful farms will offer an even higher price to obtain the irrigable land and the trend toward consolidation of farms into larger units with a smaller farm-owning rural population will be maintained or accelerated.

Chapter 3 - Energy and Water Resources

Page 21

The FES inadequately deals with the impact of energy resources directly and indirectly to the Garrison Diversion project.

Hydroelectric generation lost with irrigation water has been casually dismissed in one small paragraph of the discussion in the FES (VII-1).

Because irrigated land produces higher yields and greater net returns than dryland, a farmer can increase his net income through irrigation rather than increase his dryland acreage. This will tend to stabilize farm size in the irrigated areas. The "excess land provisions" of the Federal Reclamation Act limit the amount of land that can receive irrigation water from the project to 160 irrigable acres owned by an individual or corporation, and 320 irrigable acres owned by a man and wife. North Dakota's anti-corporation farming laws will also control corporation farming within the State. The Bureau defines marginal farms as farms which are marginal in economic size.

A more detailed analysis of generation losses was not included since irrigation has been an integral part of the multipurpose Pick-Sloan Missouri Basin Program which includes flood control, navigation control, municipal and industrial water development, and hydroelectric production. After extended debates and hearings, this balanced development was authorized by Congress in the Flood Control Act of 1944 and was reaffirmed in the Garrison Diversion Unit Authorization Act of August 5, 1965.

Hydroelectric generation was not the main purpose of the development but was an important item in repayment of costs. The original plan recognized and took into consideration the energy deductions due to water depletions for irrigation, municipal and industrial uses, but it was felt these were essential to provide a more balanced and stable economy in the Upper Missouri River Basin.

A portion of the development cost of power facilities was also allocated to irrigation and this has been reflected in power rates. If the irrigation development was eliminated and costs reallocated, higher power rates would result. Thus, rather than irrigation taking away energy due to its direct use and water depletions, present power users actually are receiving the benefits of low priced power surpluses available until irrigation is developed. Other users have benefited by lower power rates and more power available until irrigation is

Hydroelectric power is presently insufficient to meet projected regional needs so the replacement power source for the annual loss of 576 million kilowatt hours (III-19; VII-1) would probably be coal-fired generation. This would require a power plant with at least 200 megawatt capacity in order to meet the peak demands made during a 120-day growing season.

developed and thus have been able to delay investment costs for additional generation. This was recognized by the following statement in Section 3, page 19 of our environmental statement: "This electrical energy is currently being marketed on an interim basis, pending development of the Garrison Diversion Unit, as planned when the hydroelectric plants were developed."

It is true that hydroelectric power generation, which has remained essentially stable for a number of years, is insufficient to supply projected regional needs. In fact, the present hydro portion of most cooperatives' power supplies is in the range of 50% and getting smaller each year. For some time cooperatives in the area have supplied their additional needs with their own thermal generation and have many other units under construction or planned for the future.

The report infers that the entire cost of a needed 200-MW replacement unit would be chargeable to irrigation. Actually this 200-MW unit would only be needed for the peak use periods during the irrigation season and probably not full time even then. Whenever not needed by irrigation, this power would be marketed elsewhere so that approximately a third of the total power output and a like amount of the cost would be for irrigation.

Another consideration is that the on-farm portion of the pumping power (100 million KWH) is to be furnished by the individual landowner from either private or cooperative supplies and not necessarily direct from hydropower. This power would be required even with ground water irrigation development.

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For the energy input due to irrigation, Pimental (sic) et al. (1973) have used early data on the national average provided from the Nebraska Experiment Station (Epp. 1954). This average value for 1970 is 905,600 kcal/acre-foot of water, and of the individual energy inputs in review Table IV is exceeded only by the energy costs of supply nitrogen. It is evident that irrigation energy costs are considerable, amounting to over 30% of total energy input on certain irrigated land.

In Pimentel's paper, Epp (1954) and Thorfinnson (1955) were used as sources of information. From their work in Nebraska, Pimentel estimated that 905,600 kcal per acre were required to irrigate one acre of corn with one acre-foot of water over one season. Neither the method of irrigation nor the source of water were specified. This figure does not include other energy requirement areas such as labor, machinery, gasoline, nitrogen, phosphorus, potassium, seeds for planting, insecticides, herbicides, drying, electricity, or transportation and appears to represent only that energy necessary to provide water to the corn. It was not presented by Pimentel or any one else, except the reviewers, as a "national average."

The reviewers further utilize Pimentel's work in Table IV with certain significant change and additions. The original and the reviewer's version are presented for comparison. (Emphasis is added.)

Table IV
ENERGY INPUT IN CROP PRODUCTION[a]
(kilocalories per acre)

Input	1945	1970
Labor	12,500	4,900
Machinery	180,000	420,000
Gasoline	593,400	797,000
Nitrogen	58,800	940,800
Phosphorus	10,600	47,100
Potassium	5,200	68,000
Seeds for planting	34,000	63,000
Insecticides	0	11,000
Herbicides	0	11,000
Drying	10,000	120,000
Electricity	32,000	310,000
Transportation	20,000	70,000
Total inputs	955,500	2,862,800
Irrigation, average		905,600
Irrigation, Nebraska[b]		283,000
Irrigation, Garrison Diversion Unit[c]		7,937,000

[a]Taken from Pimental et al. (1973).

[b]Taken from D. E. Lane et al. (1973).

[c]Taken from review Table V.

Pimentel's Table

Table 2. Energy inputs (kilocalories) in corn production.

Input	1945	1950	1954	1959	1964	1970
Labor *	12,500	9,800	9,300	7,600	6,000	4,900
Machinery †	180,000	250,000	300,000	350,000	420,000	420,000
Gasoline ‡	543,400	615,800	688,300	724,500	760,700	797,000
Nitrogen §	58,800	126,000	226,800	344,400	487,200	940,800
Phosphorus ‖	10,600	15,200	18,200	24,300	27,400	47,100
Potassium ¶	5,200	10,500	50,400	60,400	68,000	68,000
Seeds for planting #	34,000	40,000	18,900	36,500	30,400	63,000
Irrigation †	19,000	23,000	27,000	31,000	34,000	34,000
Insecticides **	0	1,100	3,300	7,700	11,000	11,000
Herbicides ††	0	600	1,100	2,800	4,200	11,000
Drying †	10,000	30,000	60,000	100,000	120,000	120,000
Electricity †	32,000	54,000	100,000	140,000	203,000	310,000
Transportation †	20,000	30,000	45,000	60,000	70,000	70,000
Total inputs	925,500	1,206,400	1,548,300	1,889,200	2,241,900	2,896,800
Corn yield (output) ‡‡	3,427,200	3,830,400	4,132,800	5,443,200	6,854,400	8,164,800
Kcal return/input kcal	3.70	3.18	2.67	2.88	3.06	2.82

* It is assumed that a farm laborer consumes 21,770 kcal per week and works a 40-hour week. For 1970: (9 hours/40 hours) X 21,770 kcal = 4,900 kcal. † See Table 1. ‡ Gasoline, 1 gallon = 36,225 kcal (77). § Nitrogen, 1 pound = 8,400 kcal, including production and processing (78). ‖ Phosphorus, 1 pound = 1,520 kcal, including mining and processing (79). ¶ Potassium, 1 pound = 1,050 kcal, including mining and processing (79). # Corn seed, 1 pound = 1,800 kcal (33). This energy input was doubled because of the effort employed in producing hybrid seed corn. ** Insecticides, 1 pound = 11,000 kcal including production and processing (similar to herbicide: see ††). †† Herbicides, 1 pound = 11,000 kcal including production and processing (31). ‡‡ Each pound of corn was assumed to contain 1,800 kcal (33) and a bushel of corn was considered to be 56 pounds.

It should be noted that Table IV serves no useful purpose in the narrative and the only significant portion of it is the additions made by the reviewers entitled "Irrigation, Average" and "Irrigation, Garrison Diversion Unit." The purported "National Average" figure is compared with the "Irrigation, Garrison Diversion Unit" figure. The derivation of this "Irrigation, Garrison Diversion Unit" figure (contained in Table V) is not valid. Specific comment on this table and its conclusions are contained in another response.

In summary a comparison of the energy requirements for irrigation in North Dakota with those of a Nebraska corn crop in 1954 or 1955 is highly questionable.

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Table V - Energy Budgets on Garrison Diversion Project

Lost hydro generation should not be charged against Garrison Diversion Unit because, as previously discussed, irrigation has been an integral part of the authorization of the Pick-Sloan Missouri Basin Program and a portion of the development costs of power generation have been allocated and will be reimbursed by irrigation development.

Direct pumping energy should not be increased to equivalent fossil fuel generation energy with 30 percent efficiency because of authorizing legislation for the Pick-Sloan Missouri Basin Program and the Garrison Diversion Unit which reserves hydro generation energy for the project.

Making the above corrections to the table would indicate total energy inputs of 540 x 10^3 Kcal/A, not 7,937 x 10^3 as the table shows.

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Certain of the obvious practical alternatives which have escaped scrutiny or even casual observation in the FES are directly related to the efficient allocation of scarce energy resources. In this

Existing development of irrigation in North Dakota has consistently shown a very profitable response to investment of resources and all investigations leading to the authorization of the Garrison Diversion

regard, two major questions have not been addressed in the FES in response to Section 102(c) of NEPA:

(1) Is the intensive input of energy in the Garrison Diversion Unit better allocated to land capable of delivering a more productive return elsewhere?

(2) Would the input of federal capital into this region be more productive to the national good if otherwise directed?

The relative energy efficiency of the Garrison Diversion project is evident in the comparison of its energy input per acre of the national average value of 905,000 kcal given by Pimental et al. (1973). Column 6 of review Table V shows the Garrison project inputs to approximate 8,000,000 kcal/acre annually. Thus the energy input for the Garrison Diversion Unit is nearly 9 times the national average for irrigation.

Unit have indicated a favorable return from the commitment of resources.

Considering the importance of agricultural production to our national economy, the world food situation and the currently alarming trend of loss of agricultural land to urban subdivision and industrial development, it appears that development of sound irrigation projects is consistent with national goals. It should be recognized that land resources suitable for development of irrigation are not as extensive as may be generally believed. The combination of many favorable factors for development of irrigation on the Garrison Diversion Unit suggests this project is a wise development of resources. Some of the factors are: (1) the land resources, (2) the water supply, (3) economic delivery of the water supply to irrigable land, (4) associated multipurpose benefits to the region--recreation development, fishery and wildlife enhancement, municipal water supplies, domestic water supplies, and stabilizing influence on the economy. The project has had wide support from residents of the region who have been interested in development of resources.

Electric energy for operation of the Garrison Diversion Unit is projected to be as follows:

	Kwh/yr.	Kwh/acre-yr.	Kcal/yr.	Kcal/Acre-yr.
Pumping Plants	57,000,000	228	49,000,000,000	196,000
On-Farm Pumping	100,000,000	400	86,000,000,000	344,000
TOTALS	157,000,000	628	135,000,000,000	540,000

Electric energy use for the Garrison Diversion Unit would be expected to be higher than the national average for irrigation because of the large amount of gravity diversion and surface irrigation in the national average. No pumping is required for much of the irrigation in the United States.

Comparing the use of electric energy on the Garrison Diversion Unit of 540,000 Kcal/acre with average energy inputs for growing corn in the United States (Table IV, page 22) indicates that machinery at 420,000, gasoline at 797,000, nitrogen at 940,800, drying at 120,000 and electricity at 310,000 Kcal/acre are comparable inputs. Thus electricity for pumping irrigation water is not a disproportionate input compared to the total inputs for growing corn of 2,862,800 Kcal/acre shown in Table IV. Also, electric energy use of 540,000 Kcal/acre on the Garrison Diversion Unit for pumping does not appear disproportionally large compared to the Nebraska average total irrigation inputs of 905,000 Kcal/acre shown.

More recent data described by Lane et al. (1973) show that an efficient sprinkler system using well water sources of average lifts for that state would require 329 kwh/A/yr using electricity as the power source. This is equivalent to 283,000 kcal/A.

By contrast, if we consider only the electric power to be used for pumping and that lost to hydrogeneration in the Garrison Diversion Unit, it adds up to 576 million kwh (III-19; VII-1). This equates to 2,304 kwh/A.

The energy output side of the Garrison Diversion project energy budget will be represented by the increase in efficiency of solar energy captured by crops under irrigation. This can be expressed as yield of dry matter per acre, although digestible dry matter may be more appropriate. The increment of agricultural productivity which might be anticipated from irrigation in the Garrison Diversion Conservancy District is difficult to evaluate despite the optimistic figures presented from North Dakota Agricultural Experiment Station data on experimental plots (Carrington Irrigation Station, 1969-73). Obviously, such high quality practices under optimum conditions are not representative of real field conditions in the district.

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Data available from the U.S. Department of Commerce (1969) indicate the per acre yield for principal crops in each state with and without irrigation. Review Table VI reports these results for North Dakota and for the average of 17 western states. It is evident that existing irrigation programs in North Dakota produce incremental yields which are less than the 17 western state average in all cases reported except clover and timothy hay. The major crops anticipated for the lands of the Garrison Diversion Unit, such as corn, barley, sugar beets and alfalfa, show incremental yields ranging from about equal in the case of alfalfa to less than half in the case of corn grain and barley. Such data show the limitations imposed by immutable factors such as climate.

The option to consider in meeting the increased demand for agricultural crops with more energy-efficient alternatives than the proposed irrigation program are the classic ones of using more land and/or more fertilizer. Retired acreage is sizeable and available in North Dakota,

The comparison of a sprinkler irrigation system which has electric energy use of 329 kwh/acre/year (283,000 Kcal/acre/year) to on-farm pumping for the Garrison Diversion Unit of 400 kwh/acre/year (344,000 Kcal/acre/year) is a valid comparison. Various types of sprinkler systems require different design pressures which would account for the difference in these calculations of annual energy use.

As previously discussed, direct pumping energy of 628 kwh/acre/year is the only energy that can be appropriately considered. It must also be noted that extensive ground water irrigation is not possible or practical. This subject is treated in Chapter VIII of the FES.

Private irrigators with comparable irrigation systems are receiving comparable yields to the Carrington Irrigation Farm exist at many locations in North Dakota. Irrigators are reporting outstanding yields and outstanding increases over dryland crop yields.

Data on some outstanding crop yields by private irrigators is contained in the 1974 Annual Report of Irrigation Scheduling of Mechanized Sprinkler Systems in North Dakota by the Department of Agricultural Engineering, North Dakota State University. Irrigators in the LaMoure-Oakes area received average corn yields from 91 to 113 bushels per acre and best yields in individual field from 97 to 122 bushels per acre. In the same area, a large potato grower averaged 300 bushels per acre.

The reviewers note that certain crops will not give the increase in yield response from irrigation that is projected for the entire 17 western states. Referring to Table VI, page 25, comparable response is indicated for alfalfa, corn silage, and clover and timothy, but that corn for grain, other grains and sugar beets would have a lesser response. Because of the marginal rainfall in North Dakota and particularly the variation during the growing season, far greater response will be noted during dry years and in certain years, which represents the difference between almost total crop failures and full production.

Data from the Carrington Irrigation Branch Station shows appreciably higher yields for the years 1971 through 1974 for barley, approximately 70 bushels per acre (versus 51.1 in Table VI), and spring wheat, approximately 50 to 60 bushels per acre (versus 32.0 in Table VI). In the Oakes area during 1974, corn grain yields under irrigation averaged 80.5 with yields as high as 101.1 bushels per acre. See previous comment.

The reviewers' comment that "Retired acreage is sizeable and available in North Dakota ..." is no longer true in 1974 and 1975. Recent price stimulants have served to cause most retired acreage to be placed in production.

and while fertilizer treatment is energy intensive, it is much less so than the proposed Garrison Diversion Unit. Data for such decision-making are partly available in a report from the North Dakota Agricultural Experiment Station (Martin and Bergan, 1968).

The alternative of using fertilizer on dryland to increase production as more energy-efficient than irrigation development would be true only to a point where the law of diminishing returns applies. Extensive use of fertilizer is probably presently employed to the extent in large segments of American agriculture that further increase in fertilizer use would be less than an energy-efficient way to increase yields. Use of fertilizer is limited by available water for efficient assimilation of nutrients.

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The impact of increasing agricultural exports on land use in the U.S. is under continuing study at the Center for Agricultural and Rural Development at Iowa State University. Preliminary analyses are underway on a model which uses prices higher than those set in the 1973 Agriculture and Consumer Protection Act. One scenario involves the impact on land use under conditions where present exports are doubled and prices are twice those set in the 1973 Act. Even under these conditions, from the national point of view the Missouri Basin irrigation water remains consistently below marginal value of other irrigation regions. This model also indicates that the national value of the marginal products of irrigation water is roughly one-half the cost of the power used and lost in delivering water to the Garrison Diversion Unit.

Economic studies by the Bureau of Reclamation have consistently indicated favorable benefit-cost ratios for the Garrison Diversion Unit. Recent work has indicated a higher ratio than at the time of project authorization.

The Bureau of Reclamation keeps extensive cost and benefits records of all its operating projects in the 17 western states. These records form a basis of comparison between projects. This experience is used in evaluating new projects such as the Garrison Diversion Unit.

In summary, it is evident that even under the most optimistic condition of demand and prices the costs of irrigation in the Garrison Diversion Unit plan far exceed the returns. It appears that to continue this extremely inefficient project will saddle the U.S. taxpayer with a perpetual subsidy and a constant drain on energy resources.

Bureau of Reclamation investigations indicate that benefits to be expected far exceed costs of the project. The comparison with energy use on other Bureau of Reclamation projects is also favorable. Refer to Chapter 2 responses pertaining to economics for benefits versus costs relationship.

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In summary, the fiscal and energy resources required for the proposed Garrison Diversion Unit would increase food production more efficiently if they were devoted to improvement of agriculture in underdeveloped countries.

The alternatives of a fertilizer industry from coal resources to provide fertilizer for undeveloped countries might amount to a United States Government subsidy of the industry because of the undeveloped countries inability to pay for the fertilizer. The Garrison Diversion Unit will reimburse the United States for the reimbursable portion of costs.

This matter should be reviewed in the light of the original intent of the Pick-Sloan Missouri Basin Program. The original intent was development of resources in the national interest. Lower Basin States specifically received the benefits of flood control and navigation. Upper Basin States were compensated for loss of prime bottom lands taken for reservoirs by the irrigation developments, municipal and industrial developments, recreation, fishery and wildlife developments. A balanced development of resources was planned that would contribute to the nation's economic strengths as well as enhancement of the

Specifically, the FES does not address the water withdrawals of the Garrison Diversion project as they affect decision making in the upper Missouri River Basin relating to the coal resource, which is also placing large demands on the water in the basin. Potential development of these resources under the Northern Great Plains Resources Program (NGPRP) (1974) intimately involves BuRec.

environment. The Garrison Diversion Unit is a logical development of these resources. Development of coal resources can also proceed using the abundant water resources available in the Upper Missouri Basin.

For the Northern Great Plains Resources Program study, the Bureau of Reclamation assumed the work on streamflow forecases, water supply operation studies, reservoir costs, storage potentials, aqueduct routing and water conveyance costs. The Bureau of Reclamation found that enough water is available to meet all projected water needs in the Upper Missouri Basin above Sioux City, Iowa, and in addition, at least 3 million acre-feet would be allocated to the derivation of energy from coal conversion processes.

Chapter 4 - Water Quality

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The nature and extent of soil and water quality deterioration clearly depend on the specific local conditions where irrigation is to be practiced. Before any new major irrigation project is undertaken, a thorough study of the potentially detrimental effects should be carried out.

On a national average, each ton of vegetative growth transpires some 100 tons of water (Penman, 1970). BuRec has established that Missouri River irrigation water will contain 540 milligrams per liter (mg/l) of minerals (Bureau of Reclamation, 1974). This means that for each ton of crops produced, more than 100 pounds of salt will be left in the soil or will have to be carried off by excess irrigation water. Of the total water supplied by irrigation, usually as much as 65 percent may be used consumptively (evaporated and transpired). The remaining 35 percent, if drained properly, would have to carry this excess salinity (a three-fold increase) in order to balance the evapo-transpiration losses alone.

Penman's article does not include any figures proporting to be national averages.

These calculations ignore precipitation contributions entirely. For example, in the LaMoure-Oakes Area we expect about 17 inches of precipitation. Of this amount, approximately 5 inches will be lost to deep percolation. Irrigation is expected to supply approximately 10.5 inches, of which 1.6 inches are lost to deep percolation. Rainfall TDS levels are generally 10-15 mg/l. This means that water available for flushing salts (deep percolation) is composed of 1.6 parts of irrigation water with a TDS of about 540 mg/l and 5.0 parts precipitation with a TDS of about 15 mg/l.

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Additional salts frequently are picked up from the land because of greater use of fertilizers and the continuing mineralization that occurs as a result of weathering of rock.

Rock weathering is normally a process of thousands and tens of thousands of years. With a planned project life of 100 years, little, if any, mineralization from this source can be expected.

BuRec has provided quantitative predictions of concentrations of total dissolved solids (TDS) in Garrison Diversion Unit return flows only for those entering the Souris River (III-21). These predictions were obtained through the use of a complicated computer model which, theoretically, starts with the irrigation water, applies it to the crops to be grown and to the soil profile, considers the effects of soil chemistry and cropping on its quality, and finally mixes the projected values with historical TDS levels in the receiving waters,

TDS (total dissolved solids) includes all the most commonly analyzed constituents which determine water quality from a mineralogical standpoint.

in this case, the Souris River. The computer model, which considers only TDS and nitrate levels in return flows and these only for the Souris River, is not included in the FES but was described in an earlier report (Bureau of Reclamation, 1972). The results of that computer modeling of TDS levels in the Souris River are, however, included in the FES and estimate average TDS levels in return flows to range from 2,260 mg/l during the initial soil leaching period to 1,520 mg/l when soil salts reach equilibrium with those in the flushing water 20 years later (III-21). The resultant TDS concentration in the Souris River, after equilibrium is achieved, is predicted to average 1,320 mg/l, although it is noted that selection of soils with minimum salt content could lower this figure to 1,030 mg/l (III-21).

Since the release of the FES, BuRec has apparently realized that the expected Souris River TDS levels in excess of 1,000 mg/l probably would not be satisfactory to the Canadian government. Therefore, BuRec eliminated some of the previously selected irrigable lands which contain highly saline soils and substituted other lands with more favorable characteristics in its computer model. This time, BuRec came out with projected average TDS figures on the order of 885 mg/l for the Souris River - after soil-water equilibrium is reached, a staged irrigation development is included and canal seepage and operational wastes are incorporated (Bureau of Reclamation, 1974).

In summary, then:

(1) Computer studies of water quality impacts of the Garrison Diversion Unit have been completed only for the Souris River, which receives the return flows from 46.4 percent of the project's 250,000 irrigated acres.

(2) The computer modeling study for Souris River water quality considered only TDS and nitrate levels in return flows.

(3) TDS estimates presented in the FES for other drainage basins were derived without the use of the computer model.

BuRec's use of this computer model may well be a first step in the right direction, representing an attempt to utilize state-of-the-art predictive methodologies to quantify environmental impacts. It is critical to realize, however, that dangers are involved in interpreting the results of a computer study such as this one.

(1) The output of the model (TDS concentrations in the Souris River) will only be as good as the worst input data. Many possible sources of error or incomplete information exist in the input data which were used, including soil chemistry analyses, river flow data, cropping patterns, etc.

This fact does not negate the validity of the results. The reviewers repeat this criticism a number of times on succeeding pages but do not explain its significance.

Additional model studies are underway with results to be included in detailed environmental statements.

This is not a danger, merely a limitation of an engineering tool. This statement does bring up a very strong point on the positive side. By the very nature of a data collection program necessary in providing input to any study, the questionable or uncertain areas are most heavily investigated. This means that in the soils data, land of unquestionable high quality, i.e. productivity potential, salinity, drainability, etc. is not subject to as close a scrutiny as the lower quality land. Therefore, the input is weighted heavily toward the conservative side because this is the source of the majority of the data. In effect, the program has a tendency to indicate the very worst to be expected.

This is true of any method of prediction. Investigations are conducted in a very thorough manner for all irrigation areas included in the Unit.

(2) The use of a model like this is dependent upon making a number of significant assumptions - "real world" data just are not available for some of the activities which need to be factored into the calculations. Some critical assumptions which are questionable include: a high degree of irrigation efficiency practices by individual farmers, 100 percent use of sprinkler irrigation systems, and, perhaps most importantly, that water seeping from canals and laterals (never reaching the fields) will not pick up salts as it finds its way to the receiving waters.

Sprinkler irrigation makes possible a high degree of irrigation efficiency. Sprinkler irrigation efficiencies as high as 62.5% based on totally random sampling were attained on a project having neither a water scheduling program nor any particular incentive for the farmer to conserve water (Use of Water on Federal Irrigation Projects, USBR, 1973). With the GDU planned water scheduling program and some incentive to maximize operating efficiency, higher irrigation efficiencies can reasonably be expected.

As stated in the FES, the delivery systems are being designed for sprinkler irrigation. This means that the water delivery to each farm will be made at a convenient location. This would only coincidentally fall on the highest point of the unit. It also means that the volume of delivery will be too low to sustain gravity irrigation. In addition, field size, leveling, and other economic factors effectively rule out gravity irrigation.

The use of lining in open canals will reduce seepage losses to a minor level. It is felt that these losses will have minor effects on the return flow. Since seepage losses from canals will have lower TDS concentrations than return flows, effects will be on the positive side.

(3) Some of the information used in the model was obtained from experience with return flows in other parts of the country (e.g., the Grand Valley of Colorado). Since soil and climate conditions in these areas are vastly different from those found in North Dakota (Follett, et al., 1970) the validity of their use is open to question.

This does not negate the validity of the input used. There is no question that the soils and climate of North Dakota may be different; however, constituents of the soil (sand, silt, clay), regardless of parentage and geologic history, have basically identical characteristics in regard to certain parameters. In these cases it is not unreasonable to utilize information derived from other areas.

(4) BuRec has collected the data and run the model in the computer, resulting in ONE NUMBER, ostensibly representing the final prediction for TDS in the Souris River! It would have been much more meaningful to vary some of the input data (which most certainly will vary in the "real world"), and then recalculate conditions to develop the probable range of TDS values. Judging from experience with other water quality models, it is likely that the results as presented by BuRec for the Souris River are accurate only within 20 percent (Environmental Protection Agency, personal communication). Thus, it is as likely that TDS levels in the Souris River still will exceed 1,000 mg/l as it is that they will average 885 mg/l as BuRec claims. But BuRec's reports fail to acknowledge that such deviations or ranges are possible, much less probable.

The ONE NUMBER objected to represents an average figure, as is quite clearly pointed out in Table 9.

This figure is not contained in the FES. With regard to this statement, it might be pointed out that the figure could as easily lie somewhere in the 700 mg/l area if we utilize the quoted (EPA) 20% accuracy factor.

A general description of the model, along with references to BuRec studies which describe how it works, should have been provided. In addition, BuRec should have listed the assumptions which were applied to the model.

Here and twice previously on page 33 under Methodologies, the reviewers complain that a description was not included in the FES. As is also pointed out by the reviewers on page 33, a description of the model is contained in an earlier report. One description, as widely disseminated as this one seems to be, would appear to be adequate for most purposes.

The FES fails completely to discuss in a meaningful fashion the impacts on the Souris River ecosystem resulting from even the predicted increased TDS levels. After utilizing this complicated model, BuRec simply stopped with its single, fixed figure of expected TDS concentrations. A better method of presenting these data would have involved the use of graphs to show how the TDS (and individual ion) concentrations will vary over the year on a month-by-month basis. Then, these increases and how they compare with historical levels and accepted standards should have been presented and analyzed, and their anticipated environmental impacts described and evaluated.

The suggested presentation has the capability to be extremely complex and possibly could do more to confuse rather than clarify the issue.

As previously noted, the computer model which was applied to the Souris River was not applied to either the Red River of the North or the James River drainages. Even though Garrison Diversion project irrigation is expected to begin first in the Oakes Section, portions of which are drained by the Red (via the Wild Rice) and James Rivers (I-18), BuRec apparently believes that the Canadian government first must be satisfied concerning impacts on the Souris River (III-80; IV-33; VIII-34-39; IX-10) before U.S. citizens can be shown how the project will affect their waters. Ironically, the Red River, which receives return flows via the Sheyenne (I-14) and Wild Rice (I-18) Rivers, also enters Manitoba. However, since most of the diplomatic correspondence on the project to date between Canada and the U.S. has discussed only the Souris River, BuRec apparently is assuming that the effects on the project on the Red River either are "insignificant" or will be dealt with in later negotiations.

Return flow impacts will have greater impact on the Souris River than on any other water receiving return flows, hence the emphasis on this area. The purpose of the FES is, in part, to inform the U.S. citizens of the impacts which are anticipated from the Garrison Diversion.

As stated in the FES (III-22), return flows will increase the average annual discharge of the Red River of the North about 2% at the Canadian-U.S. border. G. J. Brunskill, writing for Volume II produced by the Natural Resources Institute of the University of Manitoba, states on page D6, "It is likely that the diversion of the above stated amounts of irrigation waters in North Dakota to the Souris and Red Rivers would have an undetectable effect ..."

The FES implies that substantial benefits will accrue under the project from the "freshening" of saline lakes and wetlands (I - 14-15, 31; II - 73-74; III - 39-41, 61; Figure 44; VIII - 29-32). However, the only mention of adverse impacts of this "freshening" on receiving waters is a statement that "the quality of other streams and lakes may be somewhat degraded by sediment and salts from return flows and by the brackish outflows from saline lakes, other than the Devils Lake Chain, during the initial period required to freshen them" (III-17). Other than noting that "storage of flush water in East Stump Lake would initially result in a freshening of the lake, but eventually the salt content would increase above present levels" (III-40), the FES does not even identify the "other streams and lakes" that will be degraded, let alone present quantitative data on this degradation and its impact on aquatic ecosystems.

Streams and lakes receiving project water are identified in Chapter I of the FES. Detailed environmental statements for separable project areas will contain explicit descriptions of the receiving bodies, degradation impacts, etc.

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The FES indicates that 80 areas, 400 feet by 30 feet, will be riprapped on the James River (I-16), but this severely underestimates the areas which will be subject to erosion (see Chapter 8). While this riprapping presumably will result in some physical stabilization of some 6 miles (one side) of stream banks, it will also result in significant losses of valuable riparian vegetation. The proposed riprapping is

Streambank stabilization measures on the James River will not result in significant losses of valuable riparian vegetation. In fact, just the opposite is true. Without such bank protection, many valuable trees and other vegetation that line the river will be lost. A recent boat trip down the James by Bureau representatives not only confirms this, but also indicates that where riprap has been placed, the river has

necessitated by the increased stream flows produced by the Garrison Diversion project causing increased erosion of banks. While some mitigating measures have been mentioned in the FES (III-42), the impacts of such "bank protection" must be carefully considered.

ceased to attack the bank, saving valuable trees and land. In many instances, river sediment has subsequently been deposited between the rocks and riparian grasses have reestablished themselves. Most areas designated for riprapping are areas of active erosion and presently have no vegetation from the water surface to near the top of the bank. In central LaMoure County, the river is choked by the debris of trees and other vegetation which has fallen into the river where the banks are being eroded. It should also be noted that "400 feet by 30 feet" are average figures.

Such activities as "snagging" and riprapping (III-42) affect light penetration, moisture in bank soils, flow regimes, water quality, and ultimately the entire biota of the stream (Haynes, 1972).

Snagging and clearing will involve only the removal of dead trees and other debris from the river channel and those trees which are in eminent danger of falling into the river.

The FES mentions that "total channelization in the entire Garrison Diversion Unit will be about 80 miles involving about 1,900 acres of right-of-way" in the Souris Basin and the Wild Rice River (I-21), but no meaningful discussion of environmental impacts of this channelization is provided (III - 47-48). Similarly, the FES alludes to the "deepening" (III-48) of 44 miles of existing man-made drains in the Upper Wild Rice Watershed (II-44), but it fails completely to discuss the environmental impacts, including those related to water quality, associated with the "deepening" of the drain and the resultant drainage of the vast wetland complex located in this area (see Chapter 7).

Information on III-48 refers to deepening approximately 5 miles of the Upper Wild Rice River. This is in an area where the river has little or no developed channel. As a result, any large flow of water such as that from a 5-year frequency storm spreads over meadow and farmland as it moves eastward. Page II-44 contains information about the man-made drains in the East Oakes Area. Of the 44 miles, 20.3 miles are within the project area, 14.8 miles lie south of the project area, and 8.9 miles serve as an outlet for the entire area to the Wild Rice River. The outlet portion of this drain, built some 40 years ago, has filled in considerably and now functions only during periods of high flows. This drain will be restored to serve its original purpose.

Increased sediment loads in rivers draining the project area will cause increased turbidity in the water and increased deposition of silt along river bottoms.

In actuality, there will be little increased sediment load in the project rivers. In the Wild Rice River area, the exceedingly low slopes (.0001) and resulting low water velocities and tractive forces eliminate significant sediment transport.

Municipalities drawing water from these rivers will be forced to expand their water treatment capacities and face increased water treatment costs. Turbidity criteria for various industrial water supplies may affect existing industrial users or restrict future industrial development.

Increased sediment loads and related increased turbidity levels are not expected to be of this magnitude. There are few, if any, municipalities in North Dakota and very possibly none in either South Dakota or Minnesota which would be affected by levels suggested by the reviewers.

Recreational use and esthetic appeal of streams can be seriously affected by high turbidity levels. The treatment in the FES of the impacts on these values associated with increased turbidity is totally inadequate.

The very low level of increased and total turbidity will not have significant adverse impacts on the recreational use and aesthetic appeal of streams. Recreational use and aesthetic appeal will be enhanced due to stabilized flows during the normal low or no-flow period.

According to the FES, during construction, recreation and esthetics "could be temporarily or intermittently affected" (III-25). However, little analysis of these impacts is included to justify such a statement. Similarly, the impacts on aquatic life resulting from increased sediment loads have been completely ignored in the FES except for the statement, again relating only to the construction period, that "tempo rv elimination of the micro flora and fauna in the affected

Dilution of surface return flows by project water minimizes any increases in turbidity. In fact, existing natural turbidity may be greatly diminished rather than increased.

area is likely" (III-25). There is no evaluation of impacts on other aquatic life or impacts of increased turbidity resulting from project operation and maintenance.

In fact, no evidence is offered to support the statement, again pertaining only to the construction period, that "turbidity will be controlled within the requirements of State and Federal water quality and pollution standards with minimum effect on sedimentation in downstream lakes or impoundments or fish and wildlife" (IV-18). Specific standards, how they will be maintained, and the provisions for financing and carrying out their enforcement should be included in the FES.

State and Federal water quality and pollution standards have been published and widely disseminated.

BuRec's nutrient data indicate that irrigation return flows could increase the annual nutrient load of the Souris by 50 percent (Bureau of Reclamation, 1974). As in the case of salinity, however, total annual load increases of nutrients and other parameters, as well as increases in the initially observed concentrations, must be considered for all waters receiving irrigation return flows. Data presented for the Souris River (Bureau of Reclamation, 1974) raise several concerns for water quality in other rivers affected by the project.

Examination of the reference also indicates that "results of the above studies and analyses show that the nutrient concentrations of Souris River streamflow (primarily nitrates) will not be significantly affected by the addition of Garrison Diversion Unit return flows."

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Claims have been made by BuRec that algae and denitrification will remove nutrients in the Souris and Assiniboine Rivers while enroute to Lake Winnipeg (Bureau of Reclamation, 1974). Such claims are made without including evidence pertaining to the self-purification potential of these streams. BuRec has also stated that no further study of nutrients on the Souris River is anticipated (Bureau of Reclamation, 1974). However, conclusions regarding the effects of nutrients and the amount of nutrients reaching downstream waters should be made only after conclusive evidence has been presented and evaluated.

The Bureau of Reclamation is presently making a study of nitrates in return flows and will have some results available in the near future. However, W. H. Garman reports, "results of the United States' most conclusive agricultural nitrogen study to date have recently been published by the Department of Agriculture for the Upper Rio Grande River Valley. During the past 30 years, when use of fertilizers increased 35 to 100-fold in the Rincon, Mesilla and El Paso Valleys, there was no increase in the nitrate content of the river waters. Analyses of Midwest streams tend to confirm that their nitrate level has not increased in recent years even though use of nitrogen fertilizers and other livestock feeding have more than doubled." (W. H. Garman, "Agriculture and the Environment," Crops and Soils Magazine, August-September 1973. Emphasis added)

No consideration apparently has been given to the effect that increased salinity and other parameters will have on each river's ability to degrade and/or eliminate nutrients. The interdependence of all parameters must be fully appreciated, for, as the Federal Water Pollution Control Administration (FWPCA) (1969) has observed, "Increases in nitrates and phosphates produce plant materials which in turn reduce the light penetration and, upon senescence and decay, utilize oxygen in the water resulting in a subdued light environment that is basically anaerobic in nature." The FES has identified existing algae problems in Lake Ashtabula (Badhill Dam) on the Sheyenne River (II-17) and in Jamestown Reservoir (IV-32). In light of the FWPCA's statement, it is reasonable to assume that increased nutrients will have a significant adverse effect on water quality in the James River, the Sheyenne River and, potentially, the Red River.

Reference is made in the FES to the fact that release of nutrients to various water bodies will be minimal and will consist mostly of nitrates with but small additions of phosphorus (III-70; IV - 25-27, 32). This conclusion is questionable in light of the present condition of the Jamestown Reservoir with its algal blooms (IV-32) and the condition of Lake Ashtabula with its high nutrient content and abundance of algae (II-17). BuRec implied that overland runoff from fields is the only way in which phosphorus can reach a river or lake, and it stresses that little of this will happen with sprinkler irrigation (III-70; IV - 25-27, 32).

"Plant growth in the open lake waters appears to be controlled by turbidity and light penetration, and not nutrients which are present in excess amounts" (G. J. Brunskill, Rates of Supply of Nitrogen and Phosphorous to Lake Winnipeg etc., Volume 2, Natural Resources Institute of the University of Manitoba). In addition, "An amount of .3 mg/l of nitrogen in water or half the amount normally contained in ordinary rainfall, will support the growth of algae. Less than 0.01 mg/l of phosphorous in a lake is sufficient to support an algae bloom" (Irrigation Return Flows to the Souris River and Canada, USBR, 1974, p. 32). Based on these points, an increase in nutrients does not insure an increase in algae blooms.

However, significant surface runoff can occur during spring melt before soils thaw and subsurface drains become functional.

It is questionable that any significant quantity of phosphorous is available to the snowmelt waters from frozen soil. Additionally, a larger percentage of the snowmelt runoff collects in potholes and depressions than runs off directly to a watercourse. "Micro relief consisting of numerous small depressions tends to collect surface water and percolate it to the underground aquifer system. This situation will prevail after development since there will be no land leveling associated with sprinkler irrigation" (FES, Appendix B, page 55).

Further wastes will be produced by those in the area who are supported by the project - the people who live there, the cattle which will be fed there (III-4) and the agricultural product processing operations that are expected to develop around the project (III-5). Ultimately, the crops are converted to food, either for human use or for livestock, and wastes ensue. The traditional disposal of wastes has been and probably will continue for some time to be the nearest water body. This will be true for industrial wastes generated in connection with the project.

Page 51 of Appendix B to the FES states, "State Health Department standards concerning sanitary wastes from recreation facilities and wastes from feedlots and crop processing facilities are adequate to guard against pollution of streams and ground water from these potential sources. It is not possible at this time to quantitatively evaluate water quality impacts due to such developments as additional feedlots and crop processing facilities that may result from economic growth due to the project. It is assumed, however, that any point discharges will have to meet Federal and State standards."

Page 81 of Appendix B to the FES states, "The Garrison Diversion Unit is projected to be able to support one packing plant. It is not known how many other agricultural processing facilities would be built as a result of the project; however, it must be assumed that any new plant would have to comply with State and Federal water quality standards."

In addition, cultivation will result in significant transport of nutrients by rain and dustfall.

Page 55 of Appendix B to the FES states, "The actual amount and severity of wind and water erosion may not be as great under sprinkler irrigation as at the present time because of the reduction in the amount of summerfallowing, the addition of topsoil moisture, and general increased vegetation due to irrigation." The same is repeated on page III-14 of the FES.

BuRec's suggestion that all irrigation under the Garrison Diversion project will be done by sprinkler systems (I-5; III-5; IV - 11, 20, 31, 32) is open to question. Although the project is being designed for use with sprinkler systems (I-5), sprinkler irrigation has much higher

A switch to gravity irrigation will hardly be practical or result in a lesser energy requirement. In addition to land leveling, pumping will be required to transfer the water from the delivery point on each unit to the highest point, as it is unlikely that these points will coincide.

electrical and petroleum requirements than does gravity irrigation, and over the next few years, if the energy situation continues as it has, those practices requiring less energy will surely be used to a greater extent. Therefore, overland flow of nutrients may become a more significant factor than indicated in the FES and must be evaluated.

As previously mentioned, deliveries will not be of sufficient volume to employ gravity irrigation.

The introduction of carp to new areas could have a significant impact since carp can contribute great amounts of phosphorus to water bodies through their feeding activities (Lamarra, personal communication). The mechanism involves digestion of sediment followed by excretion of large amounts of ammonia nitrogen and phosphate-phosphorus, both readily available for algal growth. Presumably, a significant fraction of the phosphorus and nitrogen adsorbed to colloidal substances could also be released at the same time.

Carp, by their particular feeding method, root up submerged vegetation and in this process stir up bottom sediments which may be ingested. Nutrient material on the soil colloids will tend to remain on the soil colloids even as they pass through the fish gut. If the fish had need of phosphorous for bone development, for example, then there is a possibility that the fish's body would extract those nutrients. This leads one to believe that nutrient material attached (bonded) to the soil colloids would be reduced in excretia and hence, not available for further fertilization of water. If the nutrient material (phosphorous) was not used by the fish's body, it would be retained on the soil colloid. Probably the only source of nutrient material, from carp, would be by ingestion of organic matter (plant and/or animal). In this manner, nutrient material would be released for reuse by aquatic plants.

In any event, a realistic-sized carp population can cause heavy blooms of algae. BuRec's proposal to prevent the spread of such fish as carp (IV - 11-13) is probably not completely practical (see Chapters 7 and 8).

Carp, by their feeding activity, tend to stir up bottom sediments which causes increased turbidity. Turbidity precluded indepth penetration of sunlight which is a prerequisite of algal growth. Therefore, a "realistic-sized" carp population can be expected to reduce, rather than cause, algal blooms. Also, positive steps to prevent the spread fish are being taken. Studies on this subject are continuing by the Bureau in conjunction with the University of North Dakota.

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One of the most significant deficiencies in BuRec's consideration of nutrient pollution resulting from the project is its failure to recognize the very significant contribution of natural wetlands to water purification and their very substantial contribution to water pollution when drained.

This has not been the case. Water discharging from the Oakes pilot drain is of better quality than the city water supplied by Oakes to its residents. Also, page 79 of Appendix B states, "Any nutrient contamination which might occur because of wetland drainage would have a one-time impact. Most wetland drainage will occur by subsurface drainage."

The FES indicates that 26,950 acres of existing wetlands will be drained and 28,662 acres of existing wetlands will be "improved" by the project (III-56), but the FES does not describe the potential impacts on water quality resulting from the release of nutrients contained in organic debris and bottom sediments when these wetland basins are drained. For example, deepening (III-48) of the 44 miles of existing man-made drains (II-44) in the Upper Wild Rice Watershed will destroy a vast, 8,000-acre wetland complex (see Chapter 7). Not only will this eliminate an extensive existing biological filtering system from the Wild Rice River Watershed, but it will result in the direct discharge into the Wild Rice River (and ultimately the Red River and Lake Winnipeg) of a tremendous load of nutrients that has accumulated in these wetlands.

The Environmental Protection Agency (EPA), in its comments on the Garrison Diversion project DES, had pointed out to BuRec that wetland impacts of the Garrison Diversion Unit would include:

(1) Wetland drainage will allow water rich in nutrients, dissolved solids, and sediment to flow in project features ...
(2) Supplemental water flows to some wetlands, provided by project works, will essentially eliminate the natural water purification benefits of these wetlands ... (Appendix B-57).

Insecticide and herbicide information in the FES (III-69; IV - 24-25) inadequately considers effects on aquatic life.

The pesticide information presented by BuRec is superficially descriptive (III-70; IV - 24-25) and not oriented to total ecosystem impacts. While concentrations of pesticides in water might be minimal, no attempt has been made to determine if the combined, or synergistic, effects of various pollutants will be significantly harmful to aquatic life. The Federal Water Pollution Control Administration (1969) has stated that synergistic effects or interactions "should be an extremely important part of any study of irrigation return flow effects on fish and wildlife. This is perhaps why in situ bioassay techniques have been about the only techniques effectively employed in the measurement of effects of irrigation return flows on aquatic organisms." However, BuRec does not anticipate further study in this area (Bureau of Reclamation, 1974).

The cited pages of the FES clearly indicate that there will be no effects on aquatic life due to insecticides and herbicides. Page 54, Appendix B, also states, "No cumulative effects of pesticides and nutrients on the aquatic ecosystems of the project area are expected based on recent studies."

We have contracted with North Dakota State University for a study on the behavior and movements of pesticides and nutrients from irrigated agriculture in the Sheyenne, Red, and Souris River Basins. We would agree that in situ bioassay techniques are probably the most effective in determining the effects of irrigation return flows on aquatic organisms; however, this presupposes the existence of such return flows. We feel that we cannot wait until actual irrigation is underway and that studies such as our nitrate study and the ongoing NDSU study provide us with the best possible predictions available. We have also contracted with the University of North Dakota for a study of the effects of the project on algae in Devils Lake. This study employs both laboratory and in situ bioassay techniques.

This does not negate the validity of the input used.

It should be noted that BuRec has derived conclusions from pesticide studies which have been completed in other parts of the country, such as the Columbia River Basin (Bureau of Reclamation, 1974). Extrapolating the results of studies in areas ecologically vastly different from North Dakota may lead to invalid conclusions.

Whether irrigation return flows come from surface runoff or have returned to the system via the soil profile, the water can be expected to undergo a variety of quality changes resulting from a variety of exposure conditions. Trace elements carried by irrigation waters or leached from soils into irrigation return flows may be of concern to subsequent water users. The FES has not provided information on trace element concentrations of applied irrigation waters, levels of trace elements in soils, or projected concentrations in irrigation return flows. No monthly breakdown is provided for return flows or seepage and operational losses which would accrue to rivers as a result of the Garrison Diversion Unit. The Souris River study (Bureau of Reclamation,

Trace elements received minimal attention until 1973. Until that time, no agency or organization had regarded trace elements important in irrigation development. Consequently, comparatively little data is available, even today, on trace element concentrations in these areas. It is doubtful that trace elements will be a significant factor in return flows.

1974) contains only a few brief comments on historic trace element levels in the river.

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A high degree of efficiency in the management of the total irrigation system of the Garrison Diversion Unit is critical both to the success of crop production and in minimizing pollutant concentrations in return flows (IV-32). In fact, with the exception perhaps of land classification practices, irrigation management is the most important part of the system in terms of water quality. If little or no control is exerted over irrigation management practices, water quality will suffer and the expected increases in pollutant loads presented in the FES (III - 17-23) will be exceeded.

Problems which could diminish the level of efficiency include the following:

(1) A small team of irrigation advisers will be employed by BuRec and the Garrison Diversion Conservancy District (IV-20). The educational responsibilities of these advisers are enormous. Schedules for water applications will be drawn up with the farmer, and he will be told how much water to apply, for how long and when. Fertilizer applications also will be scheduled for the greatest efficiency. But the logistics of this education program and the probability that not all farmers in the irrigation areas will adhere to the schedules, coupled with the unpredictability of natural precipitation, raise serious questions regarding the level of efficiency that actually will be realized. Certainly, the level of management skill required to minimize pollutant discharges will seriously tax the small, family farm operation.

An irrigation scheduling program is designed to assist the farmer in irrigation applications. He is under no obligation to follow the suggestions; however, considerable economic incentive exists to follow the program.

(2) Provisions of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), which call for permits to be obtained before pollutants are discharged to receiving waters, will be applied to drain effluents from the project (Appendix B-52). To meet FWPCA standards, farmers will have to use sophisticated equipment to help them schedule water and fertilizer applications, and to monitor the quality of their return flows. Tremendous expense will be involved, and it will have to be paid for by the irrigation districts, and ultimately the individual farmers. This could seriously affect the economic viability of the entire project.

Sophisticated equipment would be nice, but hardly necessary.

(3) Lack of enforcement personnel in BuRec and the Garrison Diversion Conservancy District, as well as the cumbersome legal steps that would have to be taken under the provisions of the FEPCA, will make it very difficult, if not impossible, to enforce FWPCA. The result will be that water quality will deteriorate far beyond those predictions presented in the FES.

Establishment of "Water Police" has not been necessary on any other Reclamation project.

The reviewers have presented a great calvacade of "may, perhaps, could, possibly," etc. and have arrived at "will." This is hardly compatable with the scientific method. Our predictions are based on the best

available evidence and have utilized the expertise of a great number of extremely competent people.

Public health and certain bacterial aspects of water quality have not been considered fully in the FES. The Federal Water Pollution Control Administration (1969) has identified the growing need for additional information regarding viral and other pathogenic organisms which may be associated with irrigation return flows. Nematodes and plant pathogens may be carried by some irrigation return flows and while direct runoff is probably the source, confirmation is lacking. Bacterial problems on the James River (II-13) and on the Red River (II-17) have been identified in the FES, but BuRec has yet to address the effects of the Garrison Diversion Unit on such existing problems. While increased flow might, in certain respects, dilute and somewhat diminish such problems, it may also accelerate the spread of disease and parasitic problems over a very wide geographic area. Furthermore, existing bacterial problems on these rivers are severe and additional bacterial loads should not be permitted.

While it is possible that surface return flows could be a source of bacterial contamination, there is no evidence to suggest that subsurface return flows from sprinkler irrigation as will be employed on the project would be such a source. In fact, a "living earth filter" averaging some six or seven feet should prove beneficial in this regard. The North Dakota State Health Department supports the project because of the effects that return flows will have on North Dakota streams.

Municipal water supplies for several towns in Minnesota will be affected by changes in water quality of the Red River. Moorhead and Oslo, which draw water from the Red River, will be affected directly. Dilworth, Halstad, Shelly, Hendrum, Bygland and Climax, which draw water from wells near the Red River, may be affected through the mixing of ground water with river water. The primary industrial user of the Red River in Minnesota is the American Crystal Sugar plant at Moorhead, Minnesota. Its process water treatment system would be extremely sensitive to changes in water quality. In addition, numerous irrigation projects in Minnesota draw water from the Red River. The impacts of the Garrison Diversion project on these water users have not been addressed in the FES, nor have water users of the Red River in North Dakota and of the James River in South Dakota been considered.

Page III-22 of the FES indicates that water quality changes in the Red River due to return flows will be minimal. Average annual flows will be increased by less than 5 percent. Thus TDS levels will hardly be affected by this small proportion of water. With a projected average annual TDS level of about 400 mg/l, it would be difficult to imagine how the ground water, in mixing with irrigation return flows, could increase in TDS levels.

Water quality impacts on the James River are generally beneficial. Return flows from project irrigation will accrue to the river, increasing present TDS levels (about 350 to 500 mg/l) by about 10 percent. The return flows will dilute pollutants and nutrients, increase dissolved oxygen levels and maintain a live stream during most periods of the year. This will lead to the establishment of a larger, more stable population of game fish species and a more diverse invertebrate population. The permanent flow would also benefit furbearers and other aquatic life (III-20 and -21, FES)

Water quality impacts on the Souris River are generally the same as listed above with TDS levels increasing to about 885 mg/l. Public health and drinking water supplies will not be degraded any significant amount.

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BuRec's proposed "restoration" of the Devils Lake Chain (I - 14-15) to water quality conditions suitable for the development of potential fishery (III-50) and recreation (III-67) resources represents an ambitious proposal - the commitment of 8.5 percent of the annual 871,000 acre-feet water allocation associated with the Garrison Diversion

This is the crux of the whole problem and the proposed restoration will alleviate these conditions.

Detailed description and analysis included in the FES in the sections which pertain to the various aspects.

project (I-15; III-39). Further, the water quality conditions in Devils Lake, both past and present, have not always been conducive to the development of a viable fishery and recreation resource (II-37; III-40). However, as is true of other sections of the FES, a detailed description and analysis of this restoration and its impacts is lacking.

Even though the proposed restoration is identified as one of the major features of the Garrison Diversion Unit (III - 39-41, 50; VIII - 29-32), Chapter I (Description of the Proposal) of the FES contains only a one-page description of the Devils Lake restoration plans, including the associated fish and wildlife development areas (I - 14-15). Not discussed in this important section are such items as: present use and ownership of the lands to be inundated, if any; control structures necessary to maintain the lake at reasonable levels; operation of the features; and a description of exactly how the "four step impoundments" (I-15) will work. Nowhere is there a limnological description of the lakes in the Chain. Also lacking is a discussion of biota, geologic history, current uses, wildlife and fishery resources and the relationship of this water system to the groundwaters in the area. When one considers the magnitude of the proposed restoration, the implied benefits accruing to the entire Garrison Diversion project from this restoration (II - 74-75; III - 39-41, 50), and its potential impact on the entire watershed and the state, this description becomes critical. Briefly, some of the area which should be discussed in more detail follow.

Irrigation of agricultural lands is the major feature of the Garrison Diversion Unit. Devils Lake restoration is one of the major recreational features.

Limnology - For all lakes of the Chain: temperature; circulation patterns; stratification and seasonal behavior; length; depth; area; volume; extent and development of the shoreline; and water level fluctuations. Even though some water level data are provided (Figure 24; II-74; III-40), they are sparse and fragmented.

Nearly all the information on limnology can be found on pages III-36, III-40, II-75 and on Figure 25.

Water Quality - Study results, with meaningful interpretations demonstrating the response of the lake to changes in the quality of inflow waters. These data are necessary to determine how the Devils Lake Chain will respond to the vastly different quality of expected inflow waters (I-15; III - 39-40). The FES should consider how the chemical and biological systems of the lake respond in high water conditions when surface runoff in the basin is highest and salt and nutrient loads are diluted, and what happens to the lake when the sewage lagoon for the City of Devils Lake is discharged. Further, since the unique hydrologic characteristics of the closed basin call for the Devils Lake Chain to be a "sump" or repository for all surface runoff in the basin (II-36), the FES should address such points as: quality of inflow water to the basin; existing pollution sources; plans for water quality management in the basin; and the behavior of chemical substances in the lake (e.g., nutrients) in relation to the physical and chemical properties of the system.

Refer to EPA Negative Declaration, Project Number C 380287, E. I. Appraisal - City of Devils Lake, North Dakota. It is assumed that any discharges of this nature would have to meet Federal and State standards.

Biota - The current trophic state of lakes in the Chain, the indicator organisms present which suggest eutrophication which could

On page III-40 of the FES the following can be found: "Representative data on biological factors are not available. Data from research

be a problem, nutrients for the growth of nuisance algae, other factors limiting algae growth now, and potential impact on algae blooms. BuRec should consider data which are now being collected for Devils Lake under EPA's National Eutrophication Survey.

recently completed or in progress will be available for the Central North Dakota Section detailed statement."

Data being gathered at the present time could hardly have been incorporated in the FES.

The 2-1/2 page description of the environmental impacts of the proposed restoration (III - 39-41), as noted above, should have included a discussion of the expected impacts of the project on the lake system. In addition, the possibility of flooding and the relationship of the restoration to the proposed Starkweather Watershed Project (II-81), or the similar Channel "A" development by the North Dakota Water Commission, should have been discussed. Since inflow waters will contain some irrigation return flows (I-14), the impacts of these polluted waters on the proposed restoration should have been discussed.

Channel "A" is not a similar project. It is essential to the Starkweather project as the only outlet channel. As of November 1973, the Starkweather project was officially abandoned by the SCS. It appears that, without some Federal funding, the project will not be built. No discussion is needed in the FES.

The use of the term "polluted" conjures up a vastly different picture than would actually exist. Page III-37 of the FES states that irrigation return flows will be conveyed to East Devils Lake. Page III-40 shows the future stabilized TDS levels in East Devils Lake.

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The implementation of alternatives being discussed to mitigate effects on Canada and the Souris River (VIII - 34-39) discussed in Volume II of this review (Boyd, 1975) could affect the proposed restoration of the Devils Lake Chain. Details should be provided concerning how these alternatives could change plans for supplying water to the system. For example, alternatives mentioned in the FES (III - 37, 39) suggest that irrigation return flows from the Souris Section and the Warwick-McVille Area may be diverted into the Devils Lake Basin. However, the impacts of these alternatives are not adequately analyzed.

The cited pages (VIII-34 thru -39) do exactly this.

The cited pages do not mention alternatives and do not suggest that irrigation return flows from the Souris Section may be diverted into the Devils Lake Basin.

Throughout the sections of the FES dealing with the proposed restoration of the Devils Lake Chain (I - 14-15; III - 39-41, 50; VIII - 29-32), the discussion proceeds under the assumption that the main body of Devils Lake and the East Bay will be freshened enough to support fish populations (III - 39-41, 50; VIII - 29-32). Yet, no objective data to support such an assumption are provided.

Information provided on pages III-40 and -41 directly contradict this.

What has not been put into perspective by BuRec is the relationship of the proposal to natural conditions in the basin. It is important to note that the water level data presented in the FES (II - 37, 74; Figure 25; III-40) are not current - the latest data are for 1972. If the water levels are above the already-high 1972 levels when restoration is slated to begin, there are two resultant possibilities: (1) water will be diverted into the Chain anyway, with the resultant flooding, or (2) water delivery will be delayed until the natural lake level might once again be low enough to justify restoration, a situation which is impossible to place on a time schedule. This latter action would also provide an equal delay in the realization of project benefits which already have been ascribed by BuRec.

This is incorrect. Data from July 1973 can be found on page II-36 and on Figure 25.

As proposed in the restoration plans, East Stump Lake will act as a sump for waters flushed from the rest of the chain. On page II-74 of the FES, "Stump Lake has not enjoyed a rising lake elevation such as has occurred at Devils Lake ..." Delivery of water to Devils Lake will not result in flooding.

This is hardly likely. The benefits to be derived from stable water surface elevations and accompanying recreational development, including a self-sustaining fishery, outweigh the benefits of any delay.

As discussed in greater detail in the review of recreation (Chapter 9) aspects of the project, virtually the entire Devils Lake Chain has been deeded to BuRec (the U.S. Government) by the Garrison Diversion Conservancy District as repayment for specific recreation and fish and wildlife development costs (I-15, 33-34; III-8, 39). Thus, the responsibility for management of the Chain, currently and under the proposed restoration, belongs to BuRec and should have been discussed in the FES.

Article No. 20(a) of Contract No. 14-06-600-8948 between the United States and the Garrison Diversion Conservancy District states: "Upon the Contracting Officer's announcement of the completion of any recreation area, C-District shall thereafter, by separate agreement with the United States, assume, or, by separate agreement among the United States, C-District, and an R&FWL contractor, arrange for the assumption of the operation, maintenance and replacement responsibility and the costs thereof for such area."

Serious water quality problems already occur in Devils Lake, and in July 1974, coliform counts exceeded public health standards in some portions of the Chain. The City of Devils Lake operates a municipal sewage lagoon and the second cell discharges (April and November in 1974) via a ditch into Creel Bay of Devils Lake. While BuRec is responsible for maintaining water quality in the Devils Lake Chain, the FES fails to indicate what, if any, provisions BuRec has developed for regulating the discharge of municipal and domestic sewage and other pollutants into the Chain.

The Bureau of Reclamation does not have this responsibility. Discharge of municipal and domestic sewage and other pollutants into the Chain would be subject to EPA and State regulations.

BuRec's proposal to "restore" Devils Lake to the 1423 feet elevation (I-14; III-40) appears to represent the maximum level feasible with the developments that already have occurred (based on this assumption) around the lake. However, as already noted, the lake has been naturally restored to approximately this level in recent years. Thus, the threat of flooding precludes further freshening by dilution, and the elimination of the Stump Lake Outlet Canal (I-14) precludes effective freshening by flushing of the Chain. Therefore, even under BuRec restoration management, Devils Lake will not be substantially improved beyond its present condition.

The table on page III-40 directly contradicts this statement.

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In a case where public funds are to be used for large-scale irrigation works that could effect major changes in the water supply picture of a large geographical region, it would seem appropriate that the potential pollution problems be studied and evaluated thoroughly before the project is undertaken. However, it is clear that the water quality studies that have been carried out for the Garrison Diversion Unit are far from complete. No reliable data are provided on water quality parameters for the Sheyenne, Wild Rice, Red or James Rivers. The absence of such information precludes any meaningful evaluation of water quality impacts of the project on these rivers.

This information is provided on pages II-12, -15, -17 and -18. Detailed environmental statements are being prepared to provide information on further studies for the respective sections.

As summarized by Eikleberry (1974), the factors essential to the determination of whether a soil is suitable for sustained irrigation include: (1) soil type and texture; (2) soil slope or topography; (3) chemical content, especially salt content; (4) soil permeability, or its capacity to conduct water, (5) soil drainability; (6) depth of water table under varying circumstances; and (7) subsoil structure,

The information by Eikleberry (1974) is from the affidavit of Robert Eikleberry, April 9, 1974 - United Family Farmers Inc., a South Dakota corporation, et al., plaintiffs, vs Rogers C.B. Morton, individually and as Secretary of the Department of the Interior, et al., defendants. When reviewing Mr. Eikleberry's affidavit, Mr. John Maletic, Chief, Water Quality Office, E&R Center, states, "In fact, although osmotic

especially effects of water movement in soils with either platy or columnar structure. As Eikleberry (1974) further explains:

> Water located in the upper soil horizons also tends to move upward through the process of osmosis toward the plant root zone and downward through the force of gravity and processes of osmosis - again carrying its salt load in both directions. Salts, especially those high in sodium, are deleterious to plant growth. On those midwestern glacial prairie soils which will support plant growth, the salts have been leached during the last several years into soil horizons below plant root zones of native prairie grasses. If there remains in the upper and active percolation zones of any soil a substantial salt concentration, there is always a serious danger of this salt being drawn upward (sometimes rapidly) into the plant root zone where it will limit or completely destroy plant growth. The introduction of irrigation water is by its very nature artificial and contrary to the established patterns of nature. It may dramatically reverse traditional patterns established over the ages.

This prescribed analysis might pose no problem if the area proposed for irrigation were to contain only a few types of soils. But the Garrison Diversion Unit is planned to irrigate 250,000 acres located in 10 North Dakota counties. A line from the northwest to the southeast through the project area is 200 miles long. Within that area are found at least six basic geological formations (II - 8-9). Within each such formation are many subcategories of soil types (II - 25-43). Moreover, the soil types are not found in easily locatable blocks (III-13). They are distributed in irregular patterns resulting from successive glacial and alluvial forces and modified by subsequent climatic factors. The best soils can, and often do, lie adjacent to soils that are not irrigable. Thus, the manner in which the land to be impacted will respond to Missouri River water is a remarkably complex question.

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The reviewer who knows the importance of soils and drainage to irrigation of already existing farmland thus asks whether the discussion in the FES is adequate. Is there enough information to insure that the prescribed balancing of environmental and economic benefits and costs can occur? Quite clearly, it is impractical and undesirable for BuRec to include all of its research findings on soil irrigability in the FES. However, BuRec should capsulate the information and state conclusions. In this case, BuRec has clearly "touched base." Whether it has complied with NEPA requires a discussion with soil scientists and drainage engineers. It appears, however, given the importance of forces are responsible for a limited amount of water movement in soils, capillary forces and gravity are far more important" and "In fact, recent findings by the U.S. Salinity Laboratory indicate that high salt concentrations in the lower portion of the root zone do not damage the crop so long as a portion of the root zone is exposed to less saline water."

The United States Department of Agriculture has identified some 245 soil series within the State of North Dakota. In the various project areas of the Garrison Diversion Irrigation Unit, there are fewer than 20 soil series which represent 95 percent of the land area. Although the Middle Souris and Oakes Project Areas are separated by nearly 200 miles, the same group of soil series occurs within both areas. The soil similarity of the two areas is related to the nearly identical parent material and very similar climatic conditions. The irrigable lands in the Middle Souris Project Area consist of predominantly sandy soils on the glacial outwash, beach and deltaic deposits associated with glacial Lake Souris, while the irrigable lands of the Oakes Area are located on similar outwash, beach and deltaic deposits of glacial Lake Dakota. The soils in both project areas have udic soil moisture regimes and have mean annual soil temperatures of less than 47° F.

We have referred to lands suitable for irrigation and described characteristics of soils, but have not mentioned soil type which is a subdivision of the soil series based on the texture of the surface soil. Thus, Hecla loamy fine sand is the name of a soil type within the Hecla series. Soil irrigability will be discussed more in depth when the additional detailed sections of the environmental statement are prepared.

In order for land to be classified as irrigable it must satisfy all requirements of the soils scientists plus those of the drainage engineers. These requirements generally consist of a soil that will be productive and has subsoil characteristics that will allow excess water to drain out naturally or be moved by artificial subsurface drains. Other factors considered are topography and surface drainage.

the issue to this project, that the FES inadequately discusses soil irrigability. The adequacy of the FES in describing other primary consequences of the Garrison Diversion Unit is the principal subject of other sections of this review.

Chapter 5 - Impacts On People

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Virtually no attention is paid in the FES to the relation of the Garrison Diversion Unit emergent values in the American Population with respect to water resources development. Yet, large-scale construction projects, such as flood control reservoirs, irrigation projects, interbasin transfers of water and channelization projects, have increasingly drawn serious questioning and opposition from citizens. In this regard, the National Water Commission (1973) recently has called for a thorough reappraisal of existing water policies (see Chapter 3). Specific recommendations of the Commission include: (1) assignment of higher priority to nonengineering solutions to water problems in the United States, (2) termination of federal subsidies on water projects, and (3) an end to federally sponsored irrigation projects . Background studies prepared for the Commission suggest that there is little justification at this time for further expansion or irrigated land in the United States for food production and that other emergent demands for water exist that should be given higher priorities than irrigation (National Water Commission, 1973). Unfortunately, these and other nationally oriented issues are ignored by BuRec in the FES.

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Important also to the growing public criticism of water resource projects is that costs frequently are understated and proposed benefits are inflated. This contention has been supported in a recent post-hoc analysis (Haverman, 1972) of actual performance records on a sampling of water projects. A recent analysis of a large water project in Oregon (Smith, et al., 1971) points up one undesirable consequence of such a distortion of benefits and costs: substantial public investments in services and facilities may be made anticipating population growth that never occurs. Another adverse consequence of such distortions, of course, is that undesirable projects may be endorsed and actively supported by the population out of inaccurate expectations for their future. Robinson (1966) has suggested that this may be the case for the Garrison Diversion project.

As directed by Congress, the primary objective of the Garrison Diversion Unit is increased food production through irrigation. Recent developments in the world food picture, and the growing necessity of massive food exports to the American economy, mandate that increased food production be a long-term and very basic goal of this nation. Thus, in this instance, Garrison Diversion Unit is very much attuned to the "public interest".

Further, if we accept as a goal that the wisest use of water is to not only produce food for people but to make the project area more economically viable for the people in it, Garrison Diversion Unit meets that requirement.

While much of this nation suffers from overconcentration of population, which results in a degraded quality of life, much of our rural lands languish in social and economic stagnation. An oft-proposed solution to both situations is to increase economic opportunity in the rural area; studies have shown urban dwellers in significant numbers say they will opt for small town or country living if jobs in those areas are available. Garrison Diversion Units threats no areas with population growth of "boom" proportions. It does, however, offer substantial prospect for modest population growth throughout the project area; such growth can promise to give much more in social and cultural (as well as economic) enhancement to communities which have for years been in a state of atrophy-historically the case with water development-than may possibly be lost through such growth impact.

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Other than noting the approximate number of farmers to be relocated, and the fact that their "costs" will be mitigated by BuRec (IV - 3), the FES says little about the potential social and psychological problems that may be produced by their forced residential moves. There is scientific evidence (Kantor, 1964; Gans, 1968) that forced residential relocation can be disruptive of the physical and mental well-being of individuals. It can, under certain circumstances, produce what psychiatrists call a "grief syndrome" characterized by extreme nervousness, chronic depression and physical disorders (Fried, 1963). This syndrome is especially prevalent among persons whose personal characteristics (e.g., old age, low income, limited education) and/or previous life experiences (e.g., constricted social worlds) are such as to complicate their ready adaptation to new residential, employment, and social situations. Forced migration also can reduce or sever established social ties with local family, kin and friends which, in some communities, comprise important sources of life-satisfaction and personal security.

Not all consequences of forced migration need, however, be negative. Such mobility may serve to open up for some new intellectual vistas, provide new valued experiences, lead to improved economic status, facilitate retirement plans, and the like. What is important is that both the positive and negative effects of forced migration be indentified, as thoroughly as possible, in the FES in evaluating the desirability of the proposed water development project. Human impacts represent very real benefits and costs of such projects, although in some cases they may not be readily amenable to financial assessment.

Landowners are fully advised of benefits under the law at the time of land acquisition. It should be noted that social effects can be positive or negative and that they are intangible. Bureau experience has been favorable in relocation of farm families. It is clear that land acquisition usually has no psychological effect on landowners as they normally relocate within the local community. Since such effects vary with individual characteristics and personalities, they are difficult if not impossible to discribe or quantify in an environmental statement.

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The FES similarly neglects to consider the likely social impacts of the Garrison Diversion project on persons who will lose some land, but who are not being forced to move. This impact occurs principally where canals cross farms and separate contiguous landholdings (e.g., pastures cut off from wells and farmsteads). The number of such partial impacts appears to be substantial, considering the fact that

Consideration is given to economic viability of affected farm units. If a unit is made, uneconomical, the entire unit will be purchased if the landowner so desires.

A payment for severance is included in the total purchase price. The value of severance is the dimunition in value of the remaining parcel of land which reflects added burdens in operating the parcel.

about 5,000 parcels of land are to be acquired in project development (V -1). In examining the personal and social impacts of the Garrison Diversion Unit on this category of people, attention should be paid to the following:

(1) The number of acres to be lost to the project, arrayed by total farm size. Consideration should be given to how these land losses will affect the future economic viability of different sized units.

(2) The physical availability in travel time of severed parts of established farm units. A determination could be made of the added financial and energy costs of continuing to farm land separated by canals from core units.

(3) The extent to which altered transportation networks will affect the established kin-friendship interaction and connumity trade patterns of these farm families. It may be that the project, while aiding the growth of some communities, will threaten the survival of others as open-country trading patterns are altered by closed roads (Table 2).

(4) The types of changes the canals and other project features will bring in the perceived asthetic quality of the physical environment. What types of values do residents hold toward the rolling prairie and farm lands, and to what extent will these appreciative-asthetic values be lost or impaired by project features, such as canals, pumping plants and sprinkler equipment?

While the FES makes note of the possibility of adverse social impacts of the project for farm families (V - 1), no attempt is made to document the nature or nagnitude of these impacts objectively.

Page 47

Information should be presented in the FES on the attitudes of these farmers toward the desirability of converting from dryland to irrigation agriculture. Also, their financial resources and managerial skills should be assessed, especially since sizable financial investments and manpower skills will be required in their making successful transitions to irrigation farming (III - 5, 10). The severe adverse economic impact on small, family farm operations of increased capital investments necessitated by irrigation is potentially significant (see Chapter 2).

Relocation of roads and location of canal crossings are based on established traffic patterns, school bus and mail routes and in consultation with the County Commissioners. and township supervisors. It has been determined that no community will suffer due to altered traffic patterns.

Canal waste banks are designed to blend into the rolling topography of the land. All structures and features are designed with aesthetics as an important consideration. Aesthetic values again are an individual matter dependant upon personalities. Any attempt to describe and quantify these values in a published document would be difficult if not impossible.

A significant growth of private irrigation development in recent years demonstrates farmers desire for irrigation to stabilize farm operations. Effects described in (1), (2) and (3) are presently in existence to a great extent. Irrigation development will slow and perhaps reverse this trend. Landowners are allowed 10 years to dispose of excess irrigable land. Whether such sales are made to family members or others does not alter the fact that additional farm units are established.

Complicating a determination of the likely social impacts from the Garrison Diversion project is the fact that BuRec historically and consistently has been derelict in enforcing legal limits on the amount of acreage that individual families can place under project irrigation (Taylor, 1971). Unless acreage limitations are enforced for the Garrison Diversion project, increased concentration of land ownership and economic power, rather than the desired growth in the number of family farms, can result. A concentration of land ownership likely will bring, in turn, such things as: (1) a growth in the proportion of salaried farm employees (as versus owner-operators), (2) an expansion of the migratory farm labor force in the area, and (3) and expansion of the existing trade areas as a result of farmers seeking out better markets for their products. (See Chapter 10).

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Virtually no attention is paid in the FES to potential social costs of the project for local communities. Yet, contrary to the FES scenario (III - 10; VI - 2), an increased concentration of land ownership in the agricultural sector and a commensurate reduction in farm units holds potentially severe adverse economic and social consequences for local communities. Small towns are bypassed as the larger farm operators seek out better markets for their products. Commitments of citizens to civic affairs are reduced as a more transient labor force appears. Not all segments of a community necessarily benefit from economic growth; the aged and the small businessmen can be economically harmed by such expansion.

Reviewers indicate trends which presently exist; but, will not be i introduced by irrigation development. This trend will continue unless new economic conditions stimulate the small towns, small farms, etc. Irrigation will serve to slow these trends. The net impact will be beneficial to the area.

Chapter 6 - Vegetation

Page 50

Not only does the FES cover only the initial 250,000 acres of the total 1,007,000 acre Unit (I - 1,46-47), but it defers detailed assessment on the four major irrigation areas within the 250,000 acre Initial Stage, the LaMoure, Oakes, Central North Dakota and Souris Sections (I - 2). A water resource project the size of the Garrison Diversion project must be assessed in regional terms. Impacts, both direct and indirect, can be expected to extend beyond the areas immediately surrounding project features (reservoirs, canals and irrigated lands).

The FES is an overall environmental impact statement and the cumulative assessement of impacts is based on what is known today and the best possible projections into the future. This statement covers the cumulative impacts of development of the initial stage of the project because this is the portion authorized by Congress for construction. Impacts pertaining to specific areas will be discussed in greater detail in later Environmental Statements for the LaMoure-Oakes Section, Central North Dakota Section, and the Souris Section. Areas immediately surrounding project features have been included for consideration by the FES.

The FES does not indicate that BuRec completed a comprehensive survey of existing vegetation units during the planning phase of the project. Initial assessment should have included a search of the literature for pertinent floristic and vegetational studies done in the area of the proposed project. Only two references in the bibliography (IX - 20-23) focus on vegetation. Such past studies would be helpful in documenting environmental changes that have occurred since the study was completed and how the vegetation has been altered as a result. Ecosystems are dynamic entities. BuRec must understand how they change under natural conditions, if it is to anticipate their responses to the man-made conditions resulting from the Garrison Diversion project.

The vegetation data provided on pages II-9, 10, 11, resulted from personal communication with members of the staff of the Botany Depts. at North Dakota State University and the University of North Dakota. Their data sources included over 60 years of botanical research in North Dakota. These studies were quite comprehensive and information resulting from them was used in the FES. Specific information for each of the proposed irrigation areas is being developed and will be included in detailed environmental impact statements for these areas.

A thorough understanding of the structure and dynamics of the affected vegetation units will provide not only a tool for planning project features so as to minimize undue damage to vegetation, soils and wildlife, but also a set of baseline data against which future impacts can be measured.

Page 51

The FES is replete with unsupported and undocumented statements and conclusions. Without reference to supportive data or clear authority, it is impossible to assess the validity or credibility of these comments. Statements such as "Research has shown..." (III - 61) and "No adverse impact is expected..." (III - 62) should be accompanied by detailed data or reference citations. More precise statements also are often undocumented:

No specific support or documentation is needed for statements regarding general information that has been established by researchers over a long period of time.

Description of the expected impacts on vegetation resulting from increases in the salinity and turbidity of effluent streams is inadequate.

The increase in the salinity levels of the Sheyenne River... should not have adverse effects upon flood plain forests... The river in the past has exceeded predicted Garrison Diversion Unit salinity levels many times and for relatively extended periods of time with no harm to vegetation cover, and there is no evidence to suggest such effects from irrigation in the area (III - 14).

The FES further fails to answer the additional questions implied by this statement.

Vegetation along effluent streams such as the Cheyenne will not be adversely effected since the river has historically exceeded predicted postproject flow salinity levels many times and for relatively long periods. Since no adverse change can be predicted, and actually beneficial conditions from elimination of very high salinity periods are likely, the Bureau of Reclamation takes the position that effects on vegetation will be minor and generally beneficial.

Concerning the expected increase in dissolved solids in the Souris River, the FES notes that:

An increase in average dissolved solids levels and a decrease in peak concentration could result in the replacement of some less salt-tolerant vegetative species by more salt tolerant species (V - 6).

The FES recognizes a possible change in vegetation due to higher salinity levels in the marsh area. This matter will be investigated further and a more detailed discussion will appear in the detailed environmental assessment of the Souris Section.

Page 52

The FES provides no detailed description of the vegetation likely to be affected by 80 miles of stream channelization in the Middle Souris area and on the Wild Rice River (III - 48) and by deepening (III - 48) the 44 miles of existing man-made drains in the Upper Wild Rice Watershed (II - 44). The FES notes that "trees, bushes, and grass will be disturbed" (III - 47). However, the FES does not describe what species are involved, how extensive will be the disturbance," how extensive will the impact be on water table levels, or whether channelization and deepening of drains will encourage local farmers to increase private drainage efforts.

The FES recognizes the disturbance of grass, brush, and trees in the channelization of creeks in the Souris Area and in the upper reaches of the Wild Rice River. After the channelization the excavated material will be dressed and seeded and will revegetate to native grasses.

The FES itself discloses (Appendix B - 57) that 15,550 acres of wetlands will be drained "within the irrigable acreas" and that "all wetland losses associated with the irrigable areas are of water table origin..." Moreover, the FES does not indicate how many more acres of wetlands will be drained by the lowering of groundwater

Detailed nvironmental statements will provide further data for canals in each particular section.

The economic analysis of the Garrison Diversion Unit takes into account the value of sub-irrigation which might be lost by project

levels in nonirrigable areas, as has already occurred in the area of the McClusky Canal. BuRec's revised Supplemental Report (1965) points out that "the extensive drainage system of the Garrison Diversion Unit will benefit nonirrigable land adjacent to the irrigable areas." This report, based on a gravity irrigation system, claimed "subsurface drainage benefits from an estimated 45,657 acres ..." The FES claims $541,000 annual drainage benefits for the current sprinkler irrigation project (III - 4). Apparently, the loss of natural subirrigation was not subtracted as a project cost.

drainage.

Some trees and shrubs will be destroyed at the site of the construction activities. Construction of canals will require the removal of some natural wooded areas as well as the removal of some farm shelter belts. Lonetree Reservoir will inundate trees and shrubs within the pool area (III - 25).

The FES recognizes that trees and shrubs will be lost by construction of canals, laterals, drains, and reservoirs. In project formulation, in project design, and in selection of canal, lateral, or drain alignments the Bureau of Reclamation does consider alternatives that eliminates destruction of trees, shelterbelts, or farmsteads. All factors are considered - severance, relocation of persons, monetary costs, asthetic consideration, and local desires and interests.

The FES does not identify what species will be destroyed, how extensive the destruction will be, or what vegetation types are involved.

Areas required for disposal of excess material are evaluated along with the potential borrow areas to minimize possible adverse environmental impacts (III - 24).

The FES does not indicate what guidelines are used to evluate these areas, or how they were developed. What priority does BuRec assign to environmental protection as compared to ease and expense of material extraction or disposal?

The FES states that "there will be no impact on endangered vegetation because none have been so designated in the project area" (III - 15). Special effort should be made to identify any vegetation type, species or individual plants that should be protected because of their rarity, unusual geographic distribution (peripheral distributions, endemics, relics, etc.), size or historical value. Eighteen species listed in the FES (II - 10) could qualify for protection as a result of their rarity in North Dakota. The FES should evaluate what impact the project will have on these species.

The very reason the FEIS states that there will be no impact on endangered vegetation (P. III-15) is because a special effort was made to determine if rare species indeed existed. An annotated list of species of vascular plants of North Dakota was prepared by members of the staff of the Department of Botany at North Dakota State University. The species listed as rare in North Dakota were so listed because they did not occur as frequently in North Dakota as they did in other parts of their range in the United States. No species which occur in the State have been determined to be so rare as to require protection (Personal communication with Dr. Harold Goetz and D. Wm. Barker).

Page 53

In its description of "Short- and Long-Term Environmental Uses" BuRec implies that the negative impacts from the project will be largely short-term and the positive impacts will be both more plentiful and long-term (VI - 1). However, loss of many acres of prime marshland, increases in salinity and turbidity of effluent streams and modifications of regional water table levels will undoubtedly result in long-term negative impacts on natural ecosystems in the areas. Indeed, responses of ecosystems to environmental mocifications often involve a lag period of extended duration. Thus, these negative responses may not be recognizable for several years or even decades.

The FES fails to provide the detailed information and objective analysis necessary to weigh the claimed economic benefits of the Garrison Diversion Unit against its actual and potential costs in ecosystem disruption as required by NEPA.

The Bureau of Reclamation does consider ecosystems and by its extensive investigations and consultations with other agencies does its best to objectively evaluate project costs and benefits.

Chapter 7 - Wildlife

Page 54

Wetland losses for the original 1,007,000 and acre project (House Document No. 325, 86th Congress, 2nd Session) were estimated by using 10 sample areas of irrigable and nonirrigable land selected by BuRec in 1953. According to the Supplement to the Final Environmental Statement (Bureau of Reclamation, 1974), "The Bureau of Sport Fisheries and Wildlife utilized three sample areas to estimate wetland losses under the assumption that the density, distribution, and proportional composition of wetland types in the sample areas were similar to those in the entire block areas under consideration."

BuRec's 10 sample areas were selected on the basis of soil irrigability, topography, geology, and the difficulties of providing adequate farm outlets for excess surface water (Bureau of Reclamation, 1974). They were not selected for purposes of making an accurate inventory of wetlands. Also, unless carefully stratified for wetland density, distribution, and type, an accurate statistical estimate of the wetland resource is not possible. Smith, et al. (1964) noted that, "by no means do potholes occur in neat patterns or regular numbers. Sometimes you can count 100 of them in a square mile but only 10 in another section a few miles away." Therefore, the FES inventory method is faulty.

Wetland losses were estimated by the U.S. Fish and Wildlife Service and furnished to the Bureau of Reclamation. A discussion of the methods used by the Fish and Wildlife Service to estimate the wetland losses was included in the Supplement to the Final Environmental Impact Statement (III.10.c.(3) - pages 10-13). Wetland losses are being reviewed for detailed environmental statements for each irrigation service area as stated on page 2 of the responses to comments in the Supplement.

Page 55

However, the FES fails to describe the total impact associated with channelizing 5 miles of the Wild Rice River and deepening (III - 48 the 44 miles (II - 44) of the existing man-made drains in the Upper Wild Rice Watershed.

Work planned for improving 5 miles of the upper Wild Rice River is in an area where there is no developed channel. Consequently, large flows such as could result from a 5-year frequency flood or larger spread out and inundate farms and land.

Existing drains in the East Oakes Area are described in II.B.9.c.(2), page II-44. Of the 44 miles of existing drains, 20.3 miles are within the project area, 14.8 miles are south of the project area, and 8.9 miles serve the entire area. Only 29.2 miles of these drains are affected and will be brought to original grade, not deepened.

The FES stated, "Deepening of the existing drain in this area will result in disturbance primarily of grassland" (III - 48). However, deepening of the drain will result in the destruction of over 8,000 acres of wetlands and will eliminate a significant wetland complex. The FES states that the area was drained some 40 years ago to prevent it from becoming a lake. This disguises the existence of the vast wetland complex extending some 35 miles through Sargent and Ransom Counties. The shallow drain constructed at that time did lower water levels in the marsh complex, but many of the original values still remain and excellent potential exists for restoring the wetlands to their former productivity. It will be difficult to mitigate this loss elsewhere.

Moreover, drainage of these marshes will eliminate vital production habitat for diving ducks and many other species of migratory birds. One of the last breeding populations of greater prairie chickens in North Dakota occurs in the vicinity of Big Slough in habitat that will be eliminated with development of the East Oakes Irrigation District. The FES also fails to indicate that Bruns, Big (Crete Game Management Area) and Meszaros Sloughs provide critical wintering habitat for ring-necked pheasants and white-tailed deer in areas where alternate habitat is already scarce and will be further reduced with development of the Garrison Diversion Unit.

The inadequacy of the FES in assessing impacts on wetlands is demonstrated by its restricting discussion to wildlife areas to be developed while virtually ignoring those to be destroyed or degraded. In "Description of the Environment," national wildlife refuges and state-owned game management areas within the project area are listed (II - 46-50) and 17 pages (II - 57-73) are devoted to brief descriptions of the 34 major wildlife development areas, but no mention is made of, nor description of the environment provided for, the 26,950 acres of wetlands to be drained. Similarly, in "Environmental Impacts of the Project," discussion is limited almost exclusively to the claimed or implied benefits to wildlife refuges and development areas (III - 52-55, 57-64), with only three paragraphs (III - 56) briefly mentioning the gross acreage of wetlands to be drained. No effort has been made in the Supplement FES (Bureau of Reclamation, 1974) to rectify these deficiencies.

Table 10, following page III-56, lists a total of 4220 acres of wetlands to be lost due to irrigation development. On Table 11 of the FES it shows 8271 acres of water and marsh to be developed for wildlife. The "8000 acre" figure is not stated in the FES.

In the description of the environment of page II-50, first paragraph, it is stated, "These areas provide habitat for upland game and deer." On page II-53 it is stated, "The larger wetlands are essential for deer in areas where trees are scarce." This certainly points out the critical value of wetlands for wildlife habitat. On page II-55, a further statement is included, "Pheasants were once common, but in recent years they have become sparse except where populations have been maintained in the Oakes Area," and further in the third paragraph on page II-55, "Both deer and upland game birds are closely associated with the larger marshes and riverine habitat." The LaMoure and Oakes Section EIS will include more detailed data regarding these areas.

Seventeen pages is not a brief description. Wetlands were adequately described by types on pages II - 52-55. In addition, the number of acres of each wetland type is included in Table 10 (following page III-56), "Estimates of Wetlands to be Lost."

Page 56

Elsewhere the FES states that the Taayer Game Management Area, which is located at the west side of Kraft Slough, merely "is 80 acres of wetlands in the Taayer Reservoir area" (II - 49), and that "some loss of wildlife may occur during filling of the reservoir" (III - 46).

These cursory descriptions of high quality wetland and its inundation by 26 feet of water in Taayer Reservoir provide an inadequate description of the biological characteristics inherent in the area or of the severe adverse environmental impacts of the proposed reservoir.

The FES describes physical features at Taayer Reservoir and of the existing Kraft Slough in I-17 and -18 and in Figures 6 and 7. Land use at Kraft Slough is described in II-42. Impacts on the area are outlines in III-45; impacts on the wildlife (a general discussion of all wetland areas) are discussed in III-48 thru -63 plus page 8 of Table A-3; and birds and specific fish impacts are discussed on III-50 and -51. The description presented by T.I.E. appears to be information collected during 1974, after the FES was published, which indicates that such information was not available from the U. S. Fish and Wildlife Service for inclusion in the FES.

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Although BuRec's FES claims a wetland loss of 26,950 acres (Types I, III, IV and V), the FES fails to identify the number of areas lost (Table 10). The acreage to be lost is under sprinkler irrigation. In the DES (Bureau of Reclamation, 1973), Table 10 gives a wetland loss under the original gravity irrigation Proposal of 39,533 acres in 11,197 individual wetland basins. This table in the DES shows a slightly different wetland acreage loss of 26,311 acres for sprinkler irrigation, but fails to list the number of wetland basins included in this loss. The number of wetland basins to be drained under a sprinkler irrigation system is not shown in either the DES or the FES, although such information is of vital importance in evaluating impacts on wildlife resources. A simple ratio analysis would indicate that a loss of some 7,000 wetland basins could be involved in the project as presently proposed.

The change from a gravity system to a sprinkler system included a reduction in wetland basins. The Fish and Wildlife Service did not have time to re-evaluate the number of wetland basins under the sprinkler plan.

Both the DES and the FES fail to adequately discuss the importance of the wetland complex (number and type) to waterfowl production, in spite of the fact that the purpose of the wildlife development areas is the replacement of waterfowl production habitat lost due to the Garrison Diversion Unit. The FES also fails to disclose the methods used to determine the extent and kind of mitigation.

The Supplement to the FES discusses the importance of wetland complexes at length (III.E.10.c.(3).

The equivalent ratio formula permits wide scale reduction of wetland habitat diversity. For example using this formula, a wetland complex containing 12.31 acres of Type I, 2.44 acres of Type III, 1.0 acre of Type IV, and 1.7 acres of Type V could be drained by the Garrison

At the time of the BSFW study the existing knowledge and BSFW policy sanctioned the methods used for determining mitigation.

Diversion project and the lost waterfowl production replaced by developing a 4.0 acre Type IV wetland. No wetland-waterfowl production data exist that will support this conclusion.

Disregard for the wetland complex can be seen in the narrative for the development areas (I - 22-32; Table 5, FES; and Table 3, Supplement FES). The 34 major development areas listed identify 125 marshes and 15 impoundments containing 48,812 acres and 3,070 acres, respectively. The average size of the marshes would be 391 acres while that of the impoundments would be 204 acres. Since the Type IV Equivalent Ratio Formula was the basis for these proposed developments, it is assumed that most of the areas will contain wetlands closely resembling Type IV wetlands, Assuming the loss of 7,000 wetland basins under a sprinkler system, it must then be concluded that wetland complexes will be replaced with about 140 wetlands averaging over several hundred acres in size and predominantly of a single wetland type. Such a development plan resembles the BSFW's approach to waterfowl management in the 1930's and 1940's which was redirected in the 1960's due to and based on accumlated knowledge of the value of the wetland complex.

Approximately 27 "minor areas" are proposed, averaging 142 acres in size. Since these areas also will have a "dependable" water supply, they will no doubt be of a single wetland type. The deficiencies associated with the "major areas" are present here as well.

The discussion of the development areas in the BSFW's (1974) recent reevaluation states, The need for reevaluation is exemplified among the initial areas proposed for development. Along the principal Supply Works are proposed eight major areas and four small areas involving 8,662 existing wetland acres. After development there will be 11,397 wetland acres (Table 1). Although Table 1 does show that 2,735 acres of upland habitats will be inundated, it fails to show that 122 individual wetland basins containing 670 wetland acres will also be inundated. The actual result will be a decrease in wetland distribution and diversity - an essential requirement for waterfowl production.

Thus, not only will the Garrison Diversion Unit destroy wetland complexes, the development areas as well will eliminate them.

The Fish and Wildlife development plan was approved by BSFW in November, 1962, and previously concurred with by the North Dakota Game and Fish Dept. (Oct. 8, 1962) and the South Dakota Department of Game, Fish, and Parks (Oct. 9, 1962). The Plan represented management policies and objectives at least of that period.

According to the BSFW report Fish and Wildlife Resources in Relation to Garrison Diversion Unit, Initial Stage, Nov. 14, 1962, there were 27 small areas in the Oakes area and the Warwick-McVille area, totaling 496 acres of water and marsh and 1739 acres of land. These small areas averaged 18.37 acred of water and 64.4 acres of land. In addition there were numerous other small areas in the principal supply works vicinity, New Rockford Canal vicinity, New Rockford Area, Souris Section and Karlsruhe areas which totaled 2340 acres of water and 4400 acres of land. This shows that the 27 minor areas will average much smaller than "142 acres" in size.

The dependable water supply proposed to be available to these areas, again, is subject to the management needs of these areas.

Any reevaluations made by the FWS since the release of the FES does not present grounds for criticism of the FES.

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The FES shows in precise figures (I - 22-32; Table 5) the total area and the exact acreage of water and marsh for each of the proposed 34 major fish and wildlife development areas, but, although every one of these already is a wetland area, the FES mentions the existing water and marsh acreage for only nine of the development areas, totaling 4,149 acres (II - 57-73). Since the land classification criteria are not specified, it is impossible to evaluate objectively the current status of the 56,175 acres of water and marsh to be developed under the mitigation program.

The significance of the deficiency becomes apparent when the Devils Lake West Bay fish and wildlife development area is considered. This is the largest single fish and wildlife development area proposed for the project, with 16,147 acres of water and marsh and 17,813 acres of upland habitat planned (I - 29; Table 1). But nowhere in the FES is it possible to determine the existing wetland area of West Bay: it is not mentioned in the "Description of the Environment" for West Bay (II - 67): It is obscured among gross acreage figures for the Central North Dakota Section and Devils Lake in Table 8A. And it is omitted from the table on page III - 40 which shows both 1970 and projected stabilized water surface acreages for all pools of Devils Lake except West Bay, for which only the projected stabilized acreage is given.

Although it is not possible to determine from the FES what portion of the 28,662 acres of existing wetlands to be developed is in West Bay, BuRec's Supplement FES (Bureau of Reclamation, 1974) does indicate that 5,224 acres of water and marsh (as well as 18,884 acres of "pasture") currently exist in West Bay. This conflicts, however, with the disclosure in the FES that "22,000 acres included in fish and wildlife development areas" are meandered lake bottom of the Devils Lake chain (III - 8). Since Spring Lake, the only other mitigation area at Devils Lake, will total only 970 acres (I -29), it appears that as much as 21,000 acres in the West Bay development within the meander line of the lake should be considered existing wetland.

The 56,175 acres of wetland habitat proposed for development under the Garrison Diversion Unit include a substantial acreage of wetlands already in public ownership, but which will be transferred from one

Land use, before and after development is given for all Fish and Wildlife areas in Table 3 in the Supplement to the FES.

West Bay - Devils Lake - has been alternately wet and dry since the 1870's. Generally speaking the lake has been drying for years hence the water area is being reduced. That is why more land is under cultivation around the area. Accurate definition of wetland and dryland is difficult.

Only 5,224 acres of the 22,000 acreas is water and marsh. Land within the meander line of the lake is being farmed and could hardly be considered wetland.

This is a legal, standard procedure which is used to meet cost sharing obligation as set forth by law (Public Law 89-72, Fed. Water Pj 4. Rec. Act, July 9, 1965, (79 Stat. 213), Sec 2 B1). If this

public agency to another to meet cost-sharing obligations and reduce costs of fish and wildlife aspects of the project. For example, approximately 21,000 acres of the state-owned, meandered lands forming the bottom of Devils Lake were transferred, cost free, from the Bank of North Dakota to the Garrison Diversion Conservancy District by the North Dakota Legislature. These lands are to be deeded to the U. S. Government to form the West Bay Wildlife Area as part of the Garrison Diversion Conservancy District's cost-sharing responsibility for the project. This method has already been used to write off $3,885,000, or 94 percent, of the Conservancy District's repayment obligation for recreation and fish and wildlife developments by deeding 62,370 acres of formerly state-owned, meandered lands of Devils Lake to the federal govenment.

wasn't done, BuRec sould have to purchase the land. The procedure was used to write off 100% of the repayment obligations in addition to providing credit for future developments to be added to the plan.

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The use of meandered lake bottom lands to meet mitigation requirements weakened claims that wetland losses are being adequately compensated. However, Jamestown Reservoir, a deep-water storage reservoir on the James River (Figure 14) is also being considered as part of the 56,175 acres of wetland habitat to be developed under the project (Appendix B - 218). Use of publicly owned lakes and reservoirs as mitigation for destruction of highly productive, shallow prairie wetlands, such as Kraft Slough (Dill Slough, Figure 6), is inadequate.

Jamestown Reservoir is not part of the 56,175 acres and was placed in Appendix B-218 by mistake. The areas included in this acreage are accurately described in the BSFW Summary Report of Fish and Wildlife Resources, Nov. 14, 1962, pp 6-9.

Another potential impediment to adequate mitigation of wetland losses emerged at the October 1974 quarterly meeting of the Garrison Diversion Conservancy District Board of Directors. The Board recommended that the Bureau of Reclamation consider canals, canal right-of-way and recreation areas as fish and wildlife mitigation areas. Adoption of such a policy would end acquisition of wildlife habitat which already is far behind other aspects of project development. A partial list of project features that would fall under the heading of canals, canal right-of-way and recreation areas shows that such a plan would permit the 146,530 acre mitigation package to be met with virtually no further acquisition of wildlife habitat.

No action has been taken on this recommendation to date. Such action would require the approval of the Secretary of the Interior and is not likely. The Bureau of Reclamation has no intention of including any such areas in mitigation except those previously approved.

The FES briefly discusses the benefits of alternate drying and flooding of wetlands. The statement is made (II - 52) that "waterfowl food production and organic decompositions are both dependent on these cyclic fluctuations." Due to this value, the Prairie Pothole Region produces from 50 to 70 percent of the continental waterfowl although this region contains only 10 percent of the available production habitat. Beyond this admission that such fluctuations are essential in natural waterfowl habitat, continous reference is made to the benefits of supplying a dependable water supply to existing wetlands.

A description of water level management is given on pages I-24 thru -27. The authorized wildlife area management plan, developed by the Fish and Wildlife Service designated large areas with shallow average depths as being the most desirable condition for multiple wildlife use and maximum benefit. At the time this plan was developed, it was considered to be the best management procedure. The Bureau of Reclamation is dependent on its sister agency, the Fish and Wildlife Service, for guidance in Wildlife matters. Thus, the plan presented in the FES was the authorized and accepted plan for the Garrison Diversion Unit. Interestingly, the development plan for areas to receive a dependable supply of water called for water management controls which could allow manipulation of water levels. This means that water could be supplied as needed, rather than continously.

Much of the new marsh acreage credited to the Garrison Diversion Unit obviously is obtained by expanding the surface acreage of existing wetlands - many of them already optimum relative to waterfowl production. At least 22 development areas can be identified in the narrative as existing marshes to be supplied with a "dependable" water supply. These benefits are not valid (Johnsgard, 1956).

Benefits are also claimed for freshening existing saline marshes. It appears that at least 11 development areas contain saline wetlands that are to receive "good quality" water. This kind of development disregards the value of saline marshes for many forms of wildlife. The North Dakota Chapter of the Wildlife Society, in its comments on the DES (Appendix B - 195-196), stated,

The impact of the project in this area could also have been more accurately assessed if it were mentioned that Lake Williams (a saline wetland) contains one of the five nesting colonies of the California gull (Larus californicus) in North Dakota and is the site of the only known Caspian tern (Hydroprogne caspia) nesting in the state. This chain of lakes also serves as the largest known staging area for fall migrant lesser sandhill cranes (Grus canadensis-canadensis) in North America.

BuRec, in responding to the North Dakota Chapter of the Wildlife Society's comments on saline areas, said (Appendix B - 195),"...BSFW will determine if and to what extent saline lakes will be freshened". At the time the development areas were being designed, BSFW concluded that "freshening" saline areas was a benefit. The basis for this conclusion was not discussed in the FES. In regard to Lake Williams, the BSFW's (1964) report on the Principal Supply Works stated, "Lake Williams is one of the areas proposed for development. A vast alkaline flat in years of low runoff, it will become a good, fresh-water lake and marsh after development." This statement has been reversed in the BSFW's (1974) reevaluation.

As previously mentioned, the BSFW's criterion of "wetlands of various types" was apparently abandoned in the proposal for development areas under the Garrison Diversion Unit. Unless BuRec accepts the BSFW's reevaluation, the creation of fresh-water wetlands at the expense of important saline wetlands will be a project loss.

The Bureau of Reclamation depends upon the U.S. Fish and Wildlife Service for guidance in wildlife matters. The Bureau accepted FWS's recommendations and these became part of the authorized plan. Any reevaluations made by FWS since release of the FES will require further consideration by the Bureau and are not a sound basis for criticizing the FES.

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The original proposal for wildlife development areas failed to fulfill BSFW's legal commitments to other migratory species associated with saline wetlands. Under the provisions of the "Convention between the United States and Great Britain for the Protection of Migratory Birds," signed in Washington, D.C. on August 16, 1916 and ratified by the Senate and the President, and a similar Convention with Mexico in 1936, this nation has responsibilities for many species of migratory birds.

In the report of Cooperating Agencies, February 1957, BSFW describes habitat requirements for, and effects of the GDU on, migratory species associated with saline wetlands (pp. 22, 26, 30 and 33). This concern is again definitely stated in the Detailed Report on the Principal Supply Works, Garrison Diversion Unit, December 1963, pp. 32-42.

No treaties will be violated with development of the project.

The FES recognizes (III-51) that "waterfowl habitat of North Dakota that does not now support populations of carp could be degraded if these fish become established in them and are not controlled," and it concedes (III-51) that "access to wildlife development areas will be through direct turnouts from canals." But, except for noting that carp consume aquatic plants and increase turbidity through rooting, the FES fails to consider seriously the severe adverse ecosystem impacts from the introduction of rough fish on wetlands and waterfowl production. Instead the FES turns its discussion to "a model study for a proposed fish screen for the McClusky Canal" (IV-11) which, if properly operated and maintained, "would eliminate the introduction of all rough fish from project supply features and would eliminate related adverse impacts to fisheries and wildlife areas" (IV-12).

A discussion of the impacts of fish introduction is contained in the FES on pages III-49 thru -52. The subject is adequately covered for an overall project FES. Impacts of this type are frequently problematical and quantification cannot be given. The FES discussed direct and indirect effects of rough fish introduction to waterfowl habitat (III-51). Rough fish introductions to shallow wetlands can be controlled as described on III-58. What the reviewers fail to consider is that there would have to be a large population of rough fish reintroduced in each wetland each year, since the shallow wetlands will winterkill annually. A population of rough fish would need to be permanently established to "destroy" the vegetation in a wetland. They simply couldn't root up or eat that much vegetation in one season.

The FES noted that, at least "the reduction of the number of fish entering these areas would reduce the management effort that would be required to control them once they had entered the system" (IV-12). However, after considering reduction of water levels to promote winterkill, seining and poisoning, the FES concludes (IV-12) that "these methods would be extremely expensive if applied to the larger reservoirs in the system and in some cases not practical." Finally, BuRec dismisses the entire issue by saying (III-51) "much of the waterfowl habitat of North Dakota is characterized by shallow water which will not support fish over the winter period." This statement overlooks the fact that it is not the winter period that is of concern for waterfowl production in North Dakota.

Subsequently, these fish would be winterkilled due to the shallow water depth. Another factor involved is the possibility of summerkill of fish due to oxygen depletion in shallow areas. This can occur when algae die off and dissolved oxygen levels are reduced below the amount required for fish. The FES is correct in stating (III-51) that much of the waterfowl habitat in North Dakota is characterized by shallow water which will not support fish over the winter period.

Even if the McClusky Canal fish screen were 100 percent effective in preventing the movement of rough fish from the Missouri River, it would not "eliminate the introduction of all rough fish from project supply features" since introductions from the James River via the James River Feeder Canal and the Oakes Canal and, with augmented flows from the project, possibly from the Souris River, would assure the eventual establishment of these fish in virtually all areas receiving project water. Regardless of the original source, once established in Devils

The fact that the Bureau of Reclamation has developed the McClusky Canal fish screening device resulting from the hydraulic model study (described on IV-11) shows serious consideration for the potential impacts on the aquatic ecosystem. Further measures to prevent fish movement from the James River into the James River Feeder Canal and Oakes Canal are being incorporated into the design of those facilities. Other measures to prevent fish transfer or uncontrolled movement are being studied and will be implemented as needed. As for fish introduction from other

Lake and the major reservoirs, rough fish would spread along water conveyances to rapidly recolonize wetlands and other shallow waters each spring, making control economically prohibitive if not technically infeasible.

Finally, the FES fails to consider that it is not only rough fish that may adversely affect waterfowl production on prairie wetlands, sport fish and minnows may compete for invertebrate food supplies important to nesting waterfowl and growing ducklings (Swanson and Nelson, 1971), and some game fish, such as northern pike, may prey directly on ducklings. Not only will fish enter water conveyances from the Devils Lake, Lake Brekken-Lake Holmes and the James River fisheries, but they will be stocked directly into Lonetree (III-49) and Taayer (III-50) Reservoirs, the principal water supply reservoirs for the project. Yet, BuRec dismisses its responsibility to evaluate the potential environmental impacts of introducing fish into 56,175 acres of prairie wetlands by casually noting (III-51) that "quantitative data is lacking on the associated effects on waterfowl."

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The FES is deficient also in its discussion of the impact on wetlands that will receive irrigation return flows. This is particularly true of existing wetlands now considered as fresh wetlands. Continuous reference is made to the advantage of having a dependable water supply. The Supplement to the FES (Bureau of Reclamation, 1974) states, "Project water service to fish and wildlife management areas will include the availability of over 115,000 acre-feet of Missouri River water annually including water for West Bay-Devils Lake. Up to about 50,000 acre-feet of irrigation return flow is also included in the dry year water service ..." Of the development areas, 21 are to be supplied entirely with Missouri River water. The remainder will receive all or some portion of their water from irrigation return flows.

The addition of saline irrigation return flow water can be expected to have an effect on existing wetlands. First, these return flows can be expected to decrease plant species diversity. Injury to seeds and retardation of growth have been noted for cattail (Typha latifolia) and bulrush (Scirpus acutus and S. paludosus) as the concentration of salts increases (Kaushik, 1963). Second, altering water levels, nutrient budgets and salinity may destabilize wetland ecosystems, thus predisposing them to outbreaks of waterfowl and shorebird botulism.

sources, the FES states (III-52) the BSFW's management plans include measures for mitigating or controlling rough fish introduction and reproduction as they relate to project waterways (IV.E.3.a). This means that plans were being considered for fish control measures at the time the FES was published.

The same effects of winterkill and fish movement control would apply to game fish as well as rough fish. These effects have been stated above. The type of game fish to be stocked in project waters would be determined by the North Dakota Fish and Game Department and the U.S. Fish and Wildlife Service.

The FES makes frequent reference to the advantages of having a dependable water supply. This is meant to convey the logical conclusion that water would be available, as needed, and the wetlands, especially those under intensive management, could receive water when the need arose (III-56).

The Institute of Ecology report states that "return flows can be expected to decrease species diversity, "yet they go on to point out effects of increased concentrations of salts on cattails and bulrush (Scirpus acutus and S. palundosus) species which are not adversely affected by increased salinity at anticipated GDU return flow levels.

Regarding the expected salinity of return flows, the FES says "... small amounts of mineral salts (less than 1,000 mg/l) have little or no effect on fish, aquatic plants, and wildlife" (III-18). However, during the 20-year leaching period, total dissolved solids (TDS) concentrations of 2,000 to 2,500 mg/l may be expected in the resulting return flows (III-17). Even after this 20-year period, the FES predicts maximum TDS levels of 1,500 mg/l in return flows. Thus, the FES fails to discuss this relationship in terms of what the expected TDS of the return flows will be and the use of this water for wetland development areas. The effects on wetland ecosystems of other ecosystems of other irrigation return flow constituents, such as nutrients and pesticides, are not considered in the FES, nor is any information on these impacts presented in the Supplement FES (Bureau of Reclamation, 1974).

Effects of nutrients and pesticides on water supplies for wildlife development areas are the subject of ongoing studies.

As stated in the Institute critique, there will be no effects on aquatic life due to pesticides. On page 54 of Appendix B, the FES states, "No cumulative effects of pesticides and nutrients on the aquatic ecosystem of the project area are expected based on recent studies (see Herbicide Contamination of Surface Runoff Waters, EPA, June 1973)." This information has been covered in the water quality section.

In addition, the FES fails to discuss the impact on natural wetlands from receiving Missouri River water directly from supply canals and laterals. Missouri River water is expected to have a TDS level of about 500 mg/l. Using this water to "freshen" the saline marshes already has been discussed as an adverse impact. However, the FES does not consider the expected impact on existing fresh water wetlands that will receive Missouri River water. Their salinity in relation to Missouri River water should be discussed.

The effect of using Missouri River water to freshen saline marshes has been discussed (III-55 thru -61).

Nine national wildlife refuges are located within the project area (II-46) and eight of these (Audubon, J. Clark Salyer, Arrowwood, Sheyenne Lake, Stump Lake, Tewaukon, Dakota Lake and Sand Lake) will be directly affected by the project (III - 52-53). Except for noting that the Sheyenne Lake National Wildlife Refuge "will be inundated by Lonetree Reservoir" (III-52) and that "increased average dissolved solids may have an adverse effect on some vegetation ..." at the J. Clark Salyer National Wildlife Refuge (III-53), the FES foresees no adverse impacts on these important wildlife areas. The two pages (III - 52-54) devoted to discussion of the environmental impacts of the project on national wildlife refuges fail, however, to provide even the most cursory consideration of the potential adverse impacts of increasing water levels, flows and velocities; increasing salinity and other pollutant concentrations; and introducing rough fish. It fails to recognize that the effect on national wildlife refuges will be similar to that on natural wetlands: reduced value for wildlife.

The FES, in discussing the national wildlife refuges and state game management areas on pages II - 46-48, III - 52-54 and in the Supplement to the FES on page III-9, has provided much more than a mere cursory consideration for impacts to these areas. In Appendix B, Comments on the Draft Environmental Statement, pp. 1-17, and again in the Supplement to the FES, pp. 1-16, narrative is presented which clearly shows BuRec's good intentions and continuing studies to evaluate effects of the project on wildlife refuges and game management areas. Detailed environmental statements for sections of the project will provide additional information regarding refuges and game management areas.

Even assuming the validity of the BuRec wetlands analysis, which is disputed in this review, significant adverse impacts on waterfowl and other major birds will still result.

Eleven species of ducks nesting in North Dakota would be adversely affected to varying degrees by wetland elimination and degradation. To estimate the impact on these species, the highest annual breeding pair density (1967-69) can be used.

Production would be lost from more than 69,000 breeding pairs as a result of eliminating 26,950 acres of wetlands (III-56). Mallards, blue-winged teal, gadwalls and pintails would account for approximately 80 percent of the loss. Additional waterfowl production losses would result on 56, 175 acres of wetlands (28,662 acres of existing wetlands plus 27,513 acres to be created (III-56), principally by increasing depth of existing wetlands) proposed for wildlife mitigation and enhancement. This would result from fish introductions, increased pesticide loads, water quality degradation, inundation of emergent vegetation increasing unproductive open water areas, water level stabilization, and destruction of small wetland complexes, among other factors. Production from another 73,600 waterfowl pairs would be reduced on 28,662 acres of existing wetlands to be developed, without substantial compensation from the 27,513 acres of new open water to be created.

Thus, the potential impact of the Garrison Diversion Unit would be the elimination of production habitat for 143,000 nesting duck pairs by either destruction or degradation of wetland habitat. This would include a complete loss of production from approximately 20,000 mallard pairs, 1,500 redhead pairs, and over 300 canvasback pairs, as well as lowered production from an additional 20,000 pairs of mallards, 1,600 pairs of redheads and more than 300 pairs of canvasbacks.

Assuming 50 percent nesting success (including renesting) and five young per brood, the Garrison Diversion Unit would, depending upon the severity of wetland degradation, result in a potential loss of over 350,000 waterfowl, including as many as 100,000 mallards, 7,700 redheads and over 1,600 canvasbacks.

Prairie wetlands are critical to many marsh birds other than ducks. Over 30 species of these birds commonly nest in North Dakota wetlands within the Garrison Diversion Unit area. On the average, these species reach a density of about 100 breeding pairs per 100 wetland acres. Approximately 26,950 breeding pairs of these species would be lost,

These conclusions are grossly exaggerated assuming total degradation of wetlands and maximum losses. The discussion is based on the use of breeding pairs of waterfowl at what is apparently the highest annual breeding pair density recorded.

Elimination of 26,950 acres of wetlands (Table 10, III-56) would result in an annual loss of 14,000 to 41,000 ducklings. North Dakota duckling production varies from 0.5 to 1.5 ducklings per wetland acre on wetlands with water (H. Kantrud, USFWS - Northern Prairie Wildlife Research Center, March 1975, personal communication). The report also assumes a loss from 28,662 acres of existing wetlands to be developed. This is untrue. Even if 28,662 acres of existing wetlands were degraded, these wetlands would not be eliminated and therefore would maintain value to wildlife.

Mallards, teal, and pintails are primarily ground nesting species (1971, Puddle Ducks, U.S. Fish and Wildlife Service pamphlet, Washington, D.C., 15 pages). The degradation of wetlands would not restrict these species' ability to reproduce.

According to EIAP Review, marsh birds are estimated to be at an average density of 100 breeding pairs per 100 acres of wetlands. At this rate there would be 26,950 breeding pairs directly affected by draining 26,950 acres of wetlands. With a nesting success of 50% these birds could produce 107,800 young, but only if it is assumed that a maximum of four young per pair were raised to flight. Degradation, not elimination, of 28,662 acres of wetlands would not affect 28,662 breeding pairs to the extent of no young raised. It is doubtful if these non-waterfowl species would be affected at all since the wetlands would still be present. In addition, the 27,513 acres of new water and marsh would definitely contribute to the production of birds since these new areas would be used in place of those eliminated. There is no valid reason to conclude that birds would not utilize these new areas for propagation. The 28,662 acres of wetlands degraded plus the 27,513 acres of new water and marsh total 56,175 acres. If only half of these acres were productive they would more than compensate for losses of marsh bird production on the drained wetlands.

The combined total loss in production of waterforl and other marsh birds is conjectural. From the foregoing discussion it is apparent that losses could not approach a half-million birds per year.

therefore, as the result of wetland drainage. Also, degradation of 28,662 acres of existing wetlands would reduce production habitat for another 28,662 pairs, with negligible compensation from 27,513 acres of new open water to be created. Assuming a 50 percent nesting success with four young raised to flight stage, the Garrison Diversion Unit would result in a potential loss of over 220,000 birds to the fall populations of these other marsh bird species.

The combined potential loss in production of waterfowl and other marsh birds would, therefore, approach a half-million birds per year.

The Garrison Diversion Unit can be expected to have far-reaching effects on the region's fishery resources. Agencies concerned with water development projects frequently have heralded the impounding of natural waters as a means of providing a fishery where none previously existed. The high initial fish production of newly-created reservoirs has led to overly optimistic predictions of the fishery benefits of reservoirs. Fish production in reservoirs inevitably declines after a few years so that fishery benefits ascribed to reservoirs that have been projected into the future and included in the benefit-cost analyses for those projects are not justified.

In addition, the increased us of fertilizers on irrigated land further degrades water quality and hastens the demise of newly created reservoirs associated with such projects.

The introduction of new species of aquatic organisms into areas where they do not presently exist is a feature of the Garrison Diversion Unit (III - 50) that has far-reaching and unpredictable ramifications. History is replete with accounts of the devastating effects on native flora and fauna of the introduction of exotic organisms (Laycock, 1966). Therefore, a sound understanding of local ecosystems should be developed and incorporated into the planning phase of projects such as the Garrison Diversion Unit. Until this is done, it is very difficult to accurately predict the floristic and faunistic effects of these projects.

Lake Sakakawea is the reservoir created by the impoundment of the Missouri River behind Garrison Dam, which was constructed by the Army Corps of Engineers and completed in 1953 (II - 11). This reservoir, according to the FES, removes all the turbidity from the Missouri River water (III - 18).

No data are provided in the FES concerning the existing fishery in Lake Sakakawea. However, Ellis (1941) stated that summer stagnation in reservoirs will be more serious if heavy silt loads are brought into the reservoirs.

Since siltation is a major problem in North Dakota reservoirs, this could result in lethal conditions for fish, especially with the heavy withdrawals from Lake Sakakawea expected "under ultimate Missouri River water resource development" (I - 5).

Fertilizers, in general, may or may not degrade water quality as a result of irrigation. Phosphorus is usually tied up on the soil colloids and not transported unless by erosion. Nitrates are transported by leaching in the soil, but again, the quantity applied would determine how much material was transported to cause a subsequent effect, or no effect, on water quality.

Irrigation return flows placed in newly created reservoirs will be mixed and diluted to prevent problems with water quality and degradation.

Such planning objectives have been incorporated into the project. Specialized studies have been and are currently underway. As of December 20, 1973, eleven major Bureau-sponsored research contracts are in effect on the project for studies as varied as evaluation of irrigation practices, ground and surface water quality, algal growth potential, fisheries, and pesticide and nutrient movements in irrigated agriculture.

The FES is misquoted. The statement on page III-18 states, "...removes nearly all..."

Although no species list was provided for Lake Sakakawea, a listing (Appendix A, Table A-1) was presented for Lake Audubon which receives its water (and fish) from Lake Sakakawea.

The use life of Lake Sakakawea was recently estimated by the U.S. Army Corps of Engineers to be approximately 600 years. This was a significant upward revision from the original 100-year life expectancy. Sedimentation and ultimate resource development were major factors considered for this change.

It is claimed that because of the silt trapping properties of Lake Sakakawea and the project design, turbidity added to waters by the Garrison Diversion Unit's operation will be minimal (III - 18). However, Eakin (1936) studied reservoirs in the southeastern and southwestern portions of the U.S. and concluded that siltation was a problem related to soil erosion. Although the supply canals will be designed on a gradient (III - 18), this alone will not reduce soil erosion. Furthermore, if the canals are inadequately vegetated at any time, canal siltation will occur, resulting ultimately in reservoir siltation. In fact, the extensive erosion and slumping of banks that already have occurred on completed sections of the McClusky Canal, along with the canal and drain cleaning schedule outlined in the FES (III - 73-74), indicate that siltation will be a major factor in the operation of the Garrison Diversion Unit.

Confusion exists in this paragraph on the part of the reviewers as to the correct use of the terms "turbidity" and "siltation". They are not the same thing and should not be so used.

The supply canals will be designed on a low gradient. Water velocity through the canal will be about 2 feet per second, a rate slow enough that fine sand particles will not be transported. The canal will be lined with an impervious clay material which will not degrade at this low velocity. The canal passes through a series of lakes which will act as settling basins for sediments which may enter the canal water. Vegetative cover on the canal banks, when established, will eliminate soil erosion from this source. A major portion of the "slumping" of banks occurred during early construction. These resulted from water seeps in unfinished portions of the canal. These areas contained steep sloped pilot channels used for dewatering and had not been excavated to final grade. Persistent water seeps were anticipated and control measures are being applied to contain future slumping.

Lake Audubon is not an example of a saline lake that was freshened and deepened, so it cannot be used as supporting evidence for the claim that the fisheries in other bodies of water would benefit from freshening and deepening, as is attempted in the caption for Figure 44.

The caption was not intended to support the fact that as a result of developing the Garrison Diversion Unit some saline lakes will be freshened and deepened for fishery purposes. The caption and picture were intended to portray a productive fishery in Audubon Lake.

Lake Audubon will be deepened under project operation and it is claimed that the resulting habitat changes will be neutral for marsh birds and waterfowl (III - 52). However, saline lakes that are freshened and deepened for fishery purposes will be harmed or destroyed as waterfowl and shorebird habitat (see review of Wildlife, Chapter 7).

Audubon Lake is not a saline lake. However, the freshening of saline lakes could cause plant and invertebrate changes, but the lakes would not be "harmed" or "destroyed" for use by waterfowl. Shoreline vegetation would develop, as would an invertebrate population.

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It is claimed that the fishery at Jamestown Reservoir will benefit from the Garrison Diversion project (III - 49). Algae blooms, a result of nutrient flow into the reservoir, are common and it is claimed that the introduction of project water will alleviate the algae problem (III - 30). However, even a small amount of nutrient accrual to a reservoir may be detrimental and, as Ellis (1941) has stated, at the height of summer stagnation (stratification) the water in reservoirs can be brought to lethal levels for fish by the addition of even small quantities of nutrients.

Introduction of project water will not permit nutrient accrual in Jamestown Reservoir because there will be increased flows and a continuous discharge during the irrigation season. Summer stagnation will not occur.

In fact, the North Dakota Game and Fish Department (1974) reports, "we have noted a general decline in the sport fishery of this (Jamestown) reservoir the past few years. Growth rates have slowed, and rough fish such as carp and buffalo are increasing." Thus, the inevitable decline already has begun, and the statement in the FES, regarding fisheries to be established under the project, that "effectiveness will be similar to the substantial fishery impact at Jamestown Reservoir" (III - 49) becomes prophetic.

The fishery of Jamestown Reservoir has declined for several years because of several reasons resulting in an "out-of-balance" fish population dominated by rough species. These same rough species will be excluded from Lonetree Reservoir by the McClusky Canal fish screen.

The present state of Lake Ashtabula, a 20-year-old reservoir on the Sheyenne River, may be indicative of what can be expected of newly formed reservoirs in the Garrison Diversion Unit 20 years from now.

Other reservoirs of approximately the same age as Lake Ashtabula, including Lake Tschida, Edward Arthur Patterson Lake, and Jamestown Reservoir, are not in the same condition.

Peterka (1970, unpublished data) stated that Lake Ashtabula supported a "pea soup" bloom of blue-green algae that results from excessive plant nutrients in the river water that enters the reservoir. Runoff from farmland, feed lots and domestic sewage are the main sources of nutrients (Peterka, 1970, unpublished data). This algal production of Lake Ashtabula was equal to or in excess of that in Lake Erie, popular example of a lake "dying" due to excess nutrients. These algal blooms make the lake unsuitable for swimmers and unpleasant for boaters and fishermen much of the summer. Irrigation return flows from the New Rockford and Warwick-McVille Irrigation Areas will accrue to the Sheyenne River above Lake Ashtabula (I - 13-14). The additional nutrients and sediments contained in these return flows (or resulting from the increased stream flows) will contribute to the eutrophication of this reservoir and accelerate the decline of its fishery.

Published water quality data for the Sheyenne River at Cooperstown, North Dakota (USGS 1972) show high nutrient loadings already present. Irrigation return flows will contain additional nutrients. However, because the flow will also be increased, the nutrient concentrations (mg/l) are not expected to increase.

It is claimed the Lonetree Reservoir will contribute to the approximately 22,000 acres of water that will be developed for fishing under the Garrison Diversion Unit (III - 50). However, the surface of Lonetree Reservoir will fluctuate from 20,300 acres when filled to 8,700 acres when withdrawals are made for irrigation (I - 9) so it is difficult to assess just what portion of the 22,000 acres of new fishing water is ascribed to Lonetree Reservoir.

Page I-9 of the FES discusses water level fluctuations of Lonetree Reservoir. As stated there, "Annual fluctuations will vary from less than one foot during the initial years of operation to an annual average of about 15 feet after about 20 years where the full 250,000 acre area is being irrigated."

Lonetree Dam will be located on the Sheyenne River (I - 10) and, as discussed above, Lake Ashtabula, another Sheyenne River impoundment, already is becoming seriously degraded for fishing and other recreation. It is likely that the same fate awaits Lonetree Reservoir.

Lonetree Reservoir will not be fed by the Sheyenne River, but by McClusky Canal. The fate of Lonetree Reservoir water quality cannot be predicted on the basis of Sheyenne River water quality.

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A lack of shallow lateral areas around the margin of the reservoir for fish spawning and rearing will be caused by the periodic drawdown to supply water for irrigation. Lonetree and Taayer Reservoirs will undergo fluctuations of 15-20 and 20-26.5 feet, respectively (I - 9, 17).

Gradual drawdown will occur after most species which can reproduce in the reservoir have spawned. The reservoir is tentatively scheduled to be primarily a walleye and salmonid fishery. Fluctuations in Lonetree Reservoir have been discussed in a preceeding comment.

The FES states that the fluctuations of Jamestown Reservoir will be kept to a minimum, although no substantiating data are provided (III - 30).

Table 3 of the FES describes water level elevations in Jamestown Reservoir. Specific data were not presented because this was an initial stage FES, not a specific EIS.

Most warm-water fish such as pike depend on the shallow littoral areas for spawning (Scott and Crossman, 1973; Kimsey, 1957) and pike spawning is greatly influenced by water levels (Jenkins, 1970). Scott and Crossman (1973) state that mortalities of young pike and pike eggs resulting from stranding by the lowering levels is very

At the time of year when northern pike spawn (just at ice-out time), the reservoir water levels will be up and not being used for irrigation.

high (99 percent). In addition, the littoral zones of lakes usually are very important in the production of the forage fish that predatory game fish, such as pike or walleye (Stizostedion vitreum), utilize as food. Fluctuating water levels result in very unstable and sterile littoral zones (Kimsey, 1957). Thus pike reproduction is not likely to be successful in Lonetree Reservoir or other project reservoirs where drastic fluctuations in water levels occur.

A related factor is that the large number of fish developing during the initial period of high food production consume food organisms at a greater rate than the food supply can sustain (Ellis, 1941). Consequently, a rapid reduction in game fish numbers can be expected in these reservoirs if the food supply suddenly is decreased as a result of an unproductive littoral zone.

Amply productive littoral zone should exist under operation detailed on page I-9.

Loss of nutrients in reservoir discharges:

In lakes, nutrients resulting from organic decompostion accumulate on the bottom. During summer stratification of deep reservoirs, 80 feet in the case of Lonetree Reservoir (I - 9), these nutrients are unavailable to the epilimnetic (surface) organisms (Neel, 1967) upon which predatory fish such as pike depend. When water is drawn from Lonetree Reservoir (also Jamestown and Taayer) during summer stratification to supply irrigation needs, the store of nutrients in the reservoir will be quickly depleted, resulting in a reduced future fish population. In fact, Lonetree Reservoir will fluctuate between 60 and 80 feet in depth and from 8,700 to 20,300 acres in area (I - 9), resulting in a high percentage of turnover of water. This loss of nutrient-rich bottom waters is almost exclusively peculiar to reservoirs (Neel, 1967), and while the loss of nutrients may retard eutrophication of the reservoirs, it does so at the expense of contributing to downstream pollution. Furthermore the loss of these bottom nutrients may not reduce algal blooms which are dependent principally on nutrients in the surface layer.

This paragraph is extremely contradictory. Nutrients accumulate in the bottom sediments. Pike are carniverous and do not feed on just any surface organisms. The statement implys that pike feed on invertebrates and plankton, some of which make use of nutrient material. Pike become carniverous almost immediately after the mouth becomes functional.

Reduction of the future fish population based on depleted nutrients is based on an erroneous assumption.

Algal blooms depend on surface nutrients, not nutrients from the "nutrient-rich bottom waters." Bottom sediments are not scheduled for release. Since reservoir nutrients throughout the reservoir will be depleted, as contended by the reviewers, there should be a retarding effect on algal blooms.

The FES states that the loss of phosphorus and nitrate to the reservoirs will be minimal (IV - 20), although no substantiating data are provided.

Studies and the results of same are discussed on pages IV-26 and -27.

The water quality of reservoirs during midsummer stratification can easily be brought to dangerous levels for fish by the addition of small quantities of municipal sewage (Ellis, 1941) or agricultural fertilizers.

The reviewers previously pointed out in the paragraph on "Loss of nutrients in reservoir discharges" that summer stratification will not occur. In addition municipal and industrial discharges are expected to conform to State and Federal standards.

It is doubtful that the claims of minimal nutrient loss to the reservoirs from the surrounding watershed (III - 70; IV - 25-27, 32) can be substantiated in view of Verduin's (1967) conclusion that phosphorus levels in waters of the U.S. have increased rapidly, partly due to agricultural runoff. In fact, Peterka (1970, unpublished

The term minimal is relative. However, it was used in relation to irrigation practices, not the existing contamination of the Sheyenne River and its subsequent effects on Lake Ashtabula.

data) described Lake Ashtabula as an "overfertilized" lake that has "four times more nitrogen and ten times more phosphorus than is needed to produce algal blooms." Thus, the term "minimal" is a relative one. If the amounts of phosphorus and nitrates that now accrue to Lake Ashtabula without irrigation return flows are "minimal," then it is apparent that even "minimal" phosphorus and nitrate loss to a reservoir (IV - 26, 32) is very detrimental.

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The FES claims that "sedimentation will be minimal in Taayer Reservoir with no long-term effect on the life of the reservoir" (I - 17). Again, however, no data are presented to substantiate such a claim. Water for Taayer Reservoir will be diverted from the James River via the 11.3-mile-long Oakes Canal (II - 41-42). Sedimentation in the reservoir is likely to be substantial from several sources, such as bank erosion within the reservoir resulting from water level fluctations of 20 to 26.5 feet (I - 17); wind-blown sediment (II - 7); and sediment carried in suspension in the James River, which may be increased by water velocity and channel modifications (III - 41-43; I - 15-16).

Taayer Reservoir is landlocked as shown by the description (I-17). Inflows are regulated. Water level fluctuations will not be violent actions which break down shoreline areas. Wind-blown sediment will contribute to lake bottom accumulations, but this source will be minimized by increased vegetation in the irrigated area. Channel modifications are intended to reduce sedimentation. Low gradient and resultant low velocities are not conducive to sediment transport in this area.

The violent fluctuations of Taayer Reservoir and increased flows of the James River undoubtedly will increase erosion and the problem of phosphate loading of the water may be serious. Also, the growth of vegetation on areas exposed during the summer drawdown will remove nutrients from bottom sediments and these nutrients will then be released as these areas are reflooded and the vegetation decays.

Fluctuations of water levels will not be violent. Vegetative growth will aid in holding shorelines. Phosphate loading will be more in relation to and tied up with bottom material.

If present water levels in Devils Lake are maintained naturally from runoff, which has been increasing since the early 1960's (II - 74), no benefits would accrue from the introduction of project water (Fish and Wildlife Service, 1974). However, projected total dissolved solids (TDS) levels for Devils Lake (1,450 parts per million, ppm) and East Bay Devils Lake (3,050 ppm) after restoration (III - 40) may still exceed the concentrations tolerated for reproduction by important game fish such as pike (1,300-1,600 ppm), walleye (800-1,000 ppm) and perch (800-1,000 ppm) (III - 40; Fish and Wildlife Service, 1974).

Northern pike are not now or are they expected to spawn in Devils Lake proper. Spawning occurs and will continue to occur in the shallow areas of West Bay Devils Lake, Mauvais Coulee and upstream in Silver Lake. There is no indication that spawning success will be low.

Perch are not recognized as a game fish in North Dakota.

Also, since pike reproduction will not be adequate to maintain a fishery in Lonetree Reservoir, yet additional hatchery stocking will be required there.

This is based on a previous erroneous assumption in the discussion of reservoir fluctuations.

The hatching and rearing of pike is a very expensive proposition and the survival of pike fry is very low, about 2-5 percent because of cannibalism (Bardach, et al., 1972). If annual stocking of salmonids were carried out in Lonetree Reservoir, present hatchery facilities in North Dakota could not support such a request (Fish and Wildlife Service, 1974) - and trout culture is relatively easy. Therefore, it is difficult to visualize how present hatchery facilities in North

Hatchery facilities will not be required for northern pike. Previous discussion on Devils Lake fisheries support this statement.

Dakota would be adequate for the much more difficult task of pike culture required to sustain a "thriving" fish population in Devils Lake. In fact, it is probable that the available hatchery stocks would have to be at least doubled to meet the annual stocking requirements of the proposed fisheries developments under the Garrison Diversion project. The FES does not indicate that the cost of developing these facilities has been included in the benefit-cost analysis of the project.

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Buffalo Lake suffered a severe winter kill of fish in 1973 and the anticipated increase in depth planned under the Garrison Diversion project is not sufficient to prevent winterkill from occurring. Present designs preclude natural restocking (Fish and Wildlife Service, 1974).

All the lakes mentioned are included in the U.S. Fish and Wildlife Service's reevaluation of fish and wildlife areas as related to the Garrison Diversion Unit.

Winterkill of fish is likely to occur in Stink Lake since Velva Canal water will not be available during the winter, a critical period for fish in any shallow body of water in North Dakota (Fish and Wildlife Service, 1974). As already pointed out, present hatchery facilities preclude increased stocking of pike.

Nead Lake should be deep enough to support a year-round fishery and reproducing fish populations under the project (Fish and Wildlife Service, 1974). Fisheries benefits will accrue to this area as a result of the project.

The FES proposes to develop the fishery potential of Lake Jaunita (I - 29). However, a depth of 15 feet (I - 29) is insufficient to prevent the winterkill of fish, as Rounsefell and Everhart (1953) have stated that winterkill occurs frequently in the small, shallow lakes of the Northern states. In addition, winterkills occur in the prairie pothole lakes of Manitoba and Saskatchewan, many of which are deeper than 15 feet and have excellent conditions for fish growth. Lake Juanita has questionable fishery potential and, as the Fish and Wildlife Service (1974) has already noted, the selection of marginal waters to provide fishery benefits is a questionable practice since North Dakota possesses more than adequate numbers of marginal fishery water as present.

The Fish and Wildlife Service (1974) states that enlarging and deepening Lake Brekken-Lake Homes should provide a sustainable fishery. However, contrary to the claim that "the area will have adequate depth to sustain a permanent fish population" (I - 24), the future depth of the lakes, 20 feet (III - 66), may not be sufficient to prevent fish kills in exceptionally harsh winters such as have occurred in recent years. In marginal lakes such as these, even a slight increase in algal growth, resulting from a rise in nutrient input, would increase the biological oxygen demand under the ice, thus further stressing the fish during the critical winter period.

The U.S. Fish and Wildlife Service's reevaluation study has taken this area under close scrutiny and continues to support the development of the fishery.

No mention is made in the FES of the type of fishery that can be expected in Lake Brekken-Lake Holmes, but presumably pike are planned for this development as well. In the FES discussion of this fish development area, as in the others, no mention is made of any type of forage fish that the pike can utilize or of the cost of the additional hatchery facilities demanded by such a development.

Fisheries planning in Brekken and Holmes is the responsibility of local authorities subject to approval of the North Dakota State Game and Fish Department.

In 1955 Brush Lake "was stocked with walleyes, northern pike, and bass. Annual stocking of northern pike and walleyes has continued," according to the FES (II - 58). No mention is made of the success of the stocking and the resulting fishery, however. Nowhere does the FES describe specifically what is planned for Brush Lake, other than to say that it is the only lake in the area that has a recent history of "fishing opportunity" (II - 58). Yet Brush Lake is included as a development area.

Brush Lake was included as a development area subject to Fish and Wildlife Service's determination of whether or not the lake would be freshened.

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Missouri River fisheries data are totally lacking from the FES. Garrison Dam has been in existence for 18 years (I - 2) and a discussion of its effects on the Missouri River should have been included in the "Description of the Environment."

This is not true. Fisheries data are referred to in the description of the environment (II-45 and II-46), in the discussion of impacts (III-27), and in the discussion of fish impacts (III-50 thru -52).

No mention is made in the FES of the water quality (other than TDS, II - 12), fish life or wildlife habitat of the Missouri River before and after the Garrison Dam was constructed. These data would have had predictive value in assessing the environmental impacts of the Garrison Diversion Unit.

On the contrary, page (II-12) contains a discussion of water quality in the Missouri River after stabilization of return flows. The discussion includes such chemical parameters as calcium, magnesium, sodium, sulfate, bicarbonate, and chloride. Historical water quality data developed by the U.S. Geological Survey were utilized for predicting and assessing the impacts on water quality. These data are so voluminous as to prohibit inclusion in the FES.

The FES states that "a completely dry [Souris] river channel was experienced for more than 40 percent of the time for an entire decade" (II - 85). This statement is used by BuRec as a justification for increasing Souris River flows by discarding irrigation return flows into it (III - 21). However, this justification is based on data from the 1930's when the worst drought on the prairies was in effect (II - 85). In addition, while a low flow of only 100 acre-feet in 1937 was recorded where the Souris River leaves the U.S. at Westhope, North Dakota, the flows at Sherwood, North Dakota, where the Souris enters the U.S., were 1,130 acre-feet (Bureau of Reclamation, 1974). While there was zero flow at Westhope for 49 months in the period from 1931 to 1940 (II - 85), no data are shown for the Sherwood station. An inspection of the index map (Map No. 769-603-5700) at the beginning of the FES reveals the existence of Lake Darling, a man-made impoundment on the Souris River between Sherwood and Westhope, North Dakota. This reservoir may have been part of the reason for the low flows at Westhope during that period of time.

U.S. Geological Survey records show that the Souris River at Westhope, North Dakota, had little or no flow during 38 months of 1941-1950, 6 months of 1959, and 6 months during 1962-1965. In addition, flows at Sherwood, North Dakota, were lower (average - 106 c.f.s.) than flows at Westhope, North Dakota (average - 185 c.f.s.) during the period 1930-1960. U.S. Geological Survey records also show that Lake Darling was first filled to spillway level in April 1943.

No mention is made in the FES of the possible effects of the Garrison Diversion Unit on the fishery of the Souris River. In fact, the only mention of the existing Souris River fishery is the species list Appendix A which indicates only "Existing," "Introduced" or "Possible Introduction."

A discussion of the impact on the Souris River fishery is included in III-50 and -51.

One probable effect, however, is that, with "stabilization" of flows under the project (III - 21-22), carp and other rough fish from the Red River and the Assiniboine River will become established in the Souris River and invade the project area near the Lonetree Reservoir and the main supply canals.

These undesirable fishes are present in the Assiniboine River now. There is no reason to believe that these species will not become established in the Souris River prior to irrigation development. Measures are being included in project facilities to prevent fish transfers.

The Bureau of Reclamation (1974) claims that nitrate and phosphorus accruals to the Souris River will not be detrimental to the river or to Manitoba. However, nutrient accruals to the Souris River may be significant due to runoff from fertilized agricultural land and from livestock feeding operations, as well as from the discharge of wastes from agricultural processing plants which are anticipated to develop in association with the project (III - 5).

In the report "Irrigation Return Flows to the Souris River and Canada," the Bureau of Reclamation states that irrigation return flows will increase the total nutrient loading of the Souris River by 50 percent (page 36). On page 29 the report states that streamflow will also be increased more than 50 percent. This means that the total concentration of nutrients in the Souris River will not be increased.

The FES states that mitigation procedures for the streams of the Souris and East Oakes areas include development of up to 45 cut-off oxbows for fish and wildlife (IV - 11). This statement is not supported by data. If they are not deep enough the fish will, in all likelihood, winterkill. Carp might survive in these oxbows, but they are of little value.

At the time the FES was written, planning had not been completed as to how these areas would be developed. Development would have to be primarily wildlife-oriented.

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No substantiating data are provided in the FES for the claim that "the stabilization of water flow in the James River" will result in "a larger more stable population of game fish" and " a more diverse invertebrate population" (III - 20). These are not only vague and misleading generalizations, but stabilization of the water flow will result in less diverse invertebrate populations by decreasing the variety of habitats available for invertebrate colonization. No species of fish or invertebrates are mentioned, except in the fish species list in Appendix A. Unless the invertebrates are of use to game fish as food (directly or indirectly), it is difficult to see how the fishery, and therefore the people, would benefit from this type of James River management.

Stablized flows will allow water to be supplied to areas which in the past have been dry during summer months. This will allow more spawning and could increase game fish populations. Invertebrates, not usually found in this area due to no water in the summer months, will become part of the biota after stabilized flows, thus making a more diverse invertebrate population.

The FES contends that "the conveyance of project water from the James River Feeder Canal to the Oakes Pumping Plant by the river will dilute pollutants and nutrients in the river, increase dissolved oxygen in the water and maintain a live stream during most periods of the year" (emphasis added) (III - 20). However, this clearly implies that the river will be "dead" some portions of the year, this bringing into serious question the claimed benefits of project water.

The statement by the FES is justified. Use of the word "live" is intended to mean flowing, i.e., a flowing stream as opposed to a no-flow condition.

The FES admits that "snagging may reduce or modify fish and wildlife carrying capacity" (III - 43). In addition, "stream-flow velocity could increase due to snag removal" (III - 43). But the environmental impacts of channel modification are seriously underestimated in the FES. Cutting across oxbows (VIII - 15), riprapping banks (III - 42) and snag removal (III - 43) will have deleterious effects on aquatic organisms. The statement that, "Riprap material will provide a hard substrate now generally lacking on which small aquatic life can develop" (III - 43) is vague. Riprapping the banks necessitates the removal of overhanging bank vegetation that fish depend upon for shelter and as a source of insects that fall into the stream.

The existing substrate in areas to be riprapped is not stable. The intend of of the statement on riprap was meant to convey the fact that a stable substrate, having an exceptionally greater surface area for attachement, would in all probability allow more aquatic invertebrate production. In addition, riprapping of severely-eroded streambanks would not remove overhanging vegetation since there would be only eroded banks prior to repairs.

Presumably the increase in James River flows resulting from the addition of irrigation water and snag removal is what will necessitate bank protection. Figure 5 in the FES indicates that the reaches requiring bank protection include only 4 of some 15 bends shown. Two of the unprotected bends are directly adjacent to farmsteads; the cutoff oxbows indicate the historic instability of the channel. Clearly, either the amount of bank protection must be greatly increased over that indicated in the FES or the amount of erosion will be sharply magnified.

Field Studies were made on the James River to determine which areas were most in need of bank protection. In addition, hydraulic studies of the James River indicated which areas had erosion potential. On this basis, 80 locations which average 400 feet long and 30 feet wide will require bank protection (Page I-16 of the FES).

The FES contains little discussion of the effects of the Garrison Diversion Unit on the Sheyenne River (III - 22) even though irrigation return flows from both the New Rockford and Warwick-McVille (partially) Irrigation Areas accrue to this river (I -14). The FES claims that water quality is usually good in Lake Ashtabula (II - 17), but, as already has been shown, Lake Ashtabula has very poor water quality and a poor fishery. The same fate may await Lonetree Reservoir, another Sheyenne River impoundment.

Detailed discussion will be contained in the Detailed EIS for the Central Section. The statement in the FES on page II-17 reads, "water quality conditions are usually good in the reservoir except for algae blooms, moss and occasional periods when coliform counts have been high." As previously stated, the fate of Lonetree Reservoir water quality cannot be predicted on the basis of Sheyenne River water quality.

Very few data are presented in the FES concerning the effect of the Garrison Diversion project on the Wild Rice River, other than to state that it will receive 17,000 acre-feet of irrigation return flows from the East Oakes Irrigation Area (I - 18). Since the Wild Rice River will receive irrigation return flows, studies must be carried out to determine nutrient loading of the river and its effects on existing and potential fish life.

On page 91 of Appendix B in the response to EPA's comment regarding effects of the project on the Wild Rice River, there is even further evidence of studies having been conducted to determine effects. The following is a direct quotation from page 91:

> In Arthur D. Little, Inc.'s appraisal of the downstream effects of the Wild Rice Creek Watershed Project they state that, "Channel length and gradient are moderate, suggesting no unusual velocity increases that would add to flood peaks materially, particularly with control exercised by storage." They further state, "There are no measureable adverse downstream water quality effects." The effect of irrigation return flows on total dissolved solids in the Wild Rice River is indicated in the statement. (See III.C.8.h).
>
> In their Biological Evaluation of Wild Rice Creek Watershed Project, the Academy of Natural Sciences concludes, "This project has had no significant effect upon the aquatic biota which was practically non-existent to begin with due to the intermittent nature of the stream.

A substantial recreational and bait fishery exists in the Red River at Lockport, Manitoba, 13 miles north of Winnipeg. In addition, the estuary of the Red River, on southern Lake Winnipeg, provides extensive angling, commercial fishing, hunting and trapping opportunities.

Since the Red River will be a receptacle for irrigation waste water via the Wild Rice River (I - 18) and the Sheyenne River (I - 14), studies should be carried out to determine what changes in water quality can be expected in the Red River and how these would jeopardize existing and potential uses of the river.

As stated in the FES (III-22), return flows will increase the average annual discharge of the Red River of the North about 2% at the Canadian-U.S. border. G.J. Brunskill, writing for Volume II produced by the Natural Resources Institute of the University of Manitoba, states on page D6, "It is likely that the diversion of the above stated amounts of irrigation waters in North Dakota to the Souris and Red Rivers would have an undetectable effect..."

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According to the FES, the fish screen on the McClusky Canal "is expected to be 100 percent effective in removing all fish and eggs from the canal flows entering Lonetree Reservoir" (IV - 12). The 100 percent success figure is based on optimum operating conditions, but severe weather and mechanical or structural breakdown can reduce this efficiency (Fish and Wildlife Service, 1974). Virtually the total flow of the McClusky Canal (an average of 871,000 acre-feet annually, I - 4) must pass through this screen, and if even a minimal amount of debris or algae clogs the screen, screening efficiency will be reduced. The water in the McClusky Canal will be clear as a result of storage in Lake Sakakawea (III - 18), although turbidity is likely to increase as the water flows through the canal. Clear water supports greater plant growth because of increased light penetration (Hynes, 1969). In spring and summer, during the height of photosynthetic activity, oxygen will be produced by the plants, causing plant material to become suspended in the water and carried downstream, thus clogging the fish screen and reducing its screening efficiency.

The self-cleaning fish screen was developing as a result of construction and intensive study of a sectional hydraulic model. The model was a full-scale representation of portions of the structure. Severe testing was incorporated in the study duplicating numerous conditions which may be encountered in the field. The self-cleaning properties of the screen were considered satisfactory by the U.S. Fish and Wildlife Service, Bureau of Reclamation, and North Dakota Game and Fish Department.

The FES maintains that even if rough fish do escape screening, the reduced numbers being allowed to enter the new water areas will require less management effort to control them (IV - 12). However, the few rough fish that do escape screening will be in an essentially utopian environment: abundant food and no competition. The population increase will be rapid and much management effort would be necessary to alleviate the problem. Fetterolf (1957) observed that rough fish production in reservoirs is much later than that of game fish and if rough fish populations are established in a reservoir, the addition of game fishes through stocking has little effect if both types of fish compete for food. Rough fish usually occupy a lower trophic level (herbivore) than do game fishes (carnivore), which accounts for the expected high rough fish production.

The paragraph at the bottom of page IV-12 of the FES lists management techniques which could be employed in fisheries management for rough fish control.

Even if the fish screen in the McClusky Canal were 100 percent efficient in preventing the movement of rough fish from the Missouri River into Lonetree Reservoir, it would not "eliminate the introduction of all rough fish from project supply features," as claimed (IV - 12). Intro-

The possibility of utilizing screening devices in other areas of the project was considered. The first paragraph of page IV-13 indicates that this method or similar methods had been and were being considered for use. Introductions from the James River via the feeder canal will be controlled

ductions still can be expected to occur from the James River via the James River Feeder Canal and the Oakes Canal and, with "stabilized" flows, from the Souris River. Once the main water supply system is invaded by rough fish from any source, colonization of Devils Lake and the upper Sheyenne River, including Lake Ashtabula, with attendant adverse impacts on existing fisheries, will occur rapidly.

In order to evaluated the net impact of the Garrison Diversion Unit on fisheries resources, it is necessary to weigh the actual benefits to be realized against the real costs of the developments themselves, of the increased hatchery capacities required to maintain these fisheries and of the introduction of rough fish into existing fisheries where they do not now occur. When the marginal fisheries benefits of the Garrison Diversion Unit are weighed against its very substantial fisheries costs, it is difficult to envision the realization of any net fisheries benefits.

as discussed in the Supplement to the FES page 14 (III.E.10.g) and page 19 (IV.E.3.a).

Fisheries benefits were developed for the Garrison Diversion Unit project by competent, knowledgeable people who have specialized training and experience in benefit-cost analyses. Their conclusions and recommendations for this project during its development were sound and based on the best available techniques and methods at that time. Benefit-cost figures were provided to the Bureau of Reclamation by the U.S. Fish and Wildlife Service (formerly Bureau of Sport Fisheries and Wildlife).

Chapter 9 - Recreation

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The FES states that the 11 recreation areas expected to be developed under the Garrison Diversion Unit will provide an "opportunity for over 1,100,000 visitor days of recreation" annually (III - 65). However, what is needed in the FES is a thorough analysis of recreation use actually expected under the project, together with detailed documentation of how such predictions were made.

The estimate of recreation use in the FES is an estimate of use that is actually expected. It has been the Bureau of Reclamation's experience on other projects that recreation use and benefits have usually been under-estimated. These estimates of recreation in the FES could be conservative.

Documentation should be provided in the FES on how recreation use figures were predicted, on current rates of participation of residents of the area as well as that of nonresident tourists, and how these rates and patterns of participation are expected to change as a result of the project.

The Bureau of Reclamation has had much experience in Central and Western United States in providing outdoor recreation facilities in rural and remote areas. It has not been obvious that rural residents do not participate in outdoor recreation to the extent that urban residents do. Visitation records of recreation areas in predominantly rural areas seem to indicate substantial local use. Participation in specific recreation activities varies according to the type of area, facilities provided, climate, and population of the immediate area. It has been Bureau of Reclamation's policy to develop recreation facilities according to local demand.

The "additional needs by 1985" for recreation (II - 73) are misleading since these "needs" are those projected for the entire state of North Dakota, not just the project area. But, in fact, the Garrison Diversion project will provide more recreation area and facilities than even these figures indicate will be needed; e.g., hunting: 170,000 acres will be provided by the project (III - 65) vs. 123,620 acres "additional need" in the state by 1985 (II - 73). Again, it appears the project will provide more "opportunity" for recreation than will be actually needed. The FES should discuss how this relates to recreational benefits computed in the benefit-cost (B/C) calculations for the project. In addition, the FES should address the question of what recreation opportunities the residents of the area want.

Observations of visitation of existing recreation areas in North Dakota indicate both resident and non-resident use, which varies according to location and type of area. Expected visitation of recreation areas to be developed in the Garrison Diversion Unit includes a substantial percentage of visitation by persons living outside of the immediate project area.

The FES should describe how recreation use in the project area is presently being defined and measured by BuRec. This is important in that planning is going forward from data currently being collected and presented; e.g., Devils Lake-Stump Lake had 530,000 visitor-days and Jamestown Reservoir had 562,000 visitor-days of use in 1972 (II - 75-76). Studies by many outdoor recreation researchers have found substantial overestimation of actual use in similar instances, particularly at state and local recreation areas (Lucas, 1963; et al., 1971).

Estimates of recreation uses in the project area at Jamestown Reservoir and in the Devils-Stump Lake Area is substantiated by visitation counts, hunting and fishing license records, and by sample visitation counts by local observers.

Related to this matter is the lack of comparability of the use figures presented. Use is reported in the FES as "visitors" (III - 66), "visitor-days" (III - 7, 65, 67), and as "activity days" (III - 67). By standard definition of the Bureau of Outdoor Recreation, a visitor-

As a measure of recreation use and for comparability of recreation areas the visitor-day has been adapted as a standard unit. On the other hand, total visitation can be a more meaningful measure of recreation use of a specific area and it is used in this context in the FES.

day is 12 visitor-hours of recreation time at a site. From the FES, it is impossible to determine how much use actually takes place at recreation sites in the area. This must be clarified prior to planning of recreation developments, which should be based on present participation and related future needs.

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Many residents of the project area currently travel to Minnesota lakes, the Missouri River and other reservoirs for water-oriented outdoor recreation. Bismarck, Minot and Williston residents have numerous river and reservoir sites for water recreation within 30 minutes driving time; Grand Forks, Fargo, Wahpeton and Grafton residents can reach hundreds of Minnesota lakes in one to two hours; Jamestown residents use Jamestown and Pipestem Reservoirs; Valley City residents use nearby Lake Ashtabula; and Devils Lake residents have the existing Devils Lake chain. There is no evidence these people would change their patterns and use facilities to be developed as part of the Garrison Diversion project. Recreation facilities and developments of the project may not be adequate substitutes in terms of quality for areas now used, including the more distant Minnesota lakes. Furthermore, to whatever extent recreation developments of the Garrison Diversion Unit attract visitors who otherwise would use existing developments at such areas as Pipestem, Baldhill and Garrison Dams, this reduction in recreation benefits of other projects must be considered a cost of the Garrison Diversion project to prevent double-counting of benefits. These issues are not addressed to the FES and are extremely important aspects of the economic justification of the project discussed below.

Experience with outdoor recreation and visitation at Bureau of Reclamation reservoirs indicate that the size of the reservoir is an important factor in certain activities such as fishing, boating, water skiing, and swimming. Lonetree, Jamestown and Taayer Reservoirs will have excellent quality of water because of continuous recharge and will be impoundments of a size that will be particularly attractive for water sports. It is expected that they will be popular recreation areas and in fact compete for some out-of-state visitation. It is also expected that these reservoirs will furnish superior recreation opportunities for some activities than existing at other areas, and will compete in this respect. Because of the growing demand for outdoor recreation and because of an expected population growth due to coal development and other economic growth, it is not likely that other recreation areas will be under-utilized or that recreation benefits will be double-counted.

The FES states that 170,000 acres of private land to be acquired for the project will be "opended" to hunting (III - 65). Apparently, however, nearly all of this area has been open to hunting in the past. Therefore, little or no benefit should be ascribed to the Garrison Diversion project for hunting opportunities on these 170,000 acres. This would have a major impact on the portions of the benefit-cost analysis of the project attributed to fish and wildlife values.

The statement in the FES that 170,000 acres of private land to be acquired for project purposes will be made available to the public for hunting is valid. In private ownership this is not open to the public. Hunting on private lands is possible only with the owner's permission and in most instances is restricted or prohibited by the owner. Therefore, benefits attributed to the project from hunting opportunities on this acreage are valid.

The expected visitor-use level at Lonetree Reservoir is 150,000 "visitors" per year, according to the FES (III - 66). If we assume two-thirds of the annual use takes place in summer (a period of about 100 days), use must average 1,000 "visitors" per day all summer and nearly 200 "visitors" per day the entire rest of the year. The surface level of the reservoir will fluctuate an average of 15 feet per year, and up to 20 feet with "full development," and the surface area of water will vary from 8,700 to 20,300 acres (I - 9). As a result, extensive and very unsightly exposed bottom mud flats will be created much of the year. Furthermore, the FES is contradictory concerning this exposed bottom area: subtraction of the

Bureau of Reclamation defends the estimate of visitor-use at Lonetree Reservoir on the basis of the reservoirs size (20,300 acres), a long shoreline length, initial development of two major day-use areas, possible future development of six additional recreation sites, two damsites, and numerous fisherman-access sites. Comparison with visitation experienced at other Bureau of Reclamation reservoirs in this state indicates that the estimate is realistic and probably conservative.

above figures indicates a possible exposed area of 11,600 acres; however the FES states that "...as much as 9,000 acres..." of bottom could be exposed at Lonetree Reservoir (III - 28; V - 2).

At Lonetree Reservoir dust suppression measures would be undertaken by operation and maintenance forces similar to measures employed at other Bureau of Reclamation reservoirs. These measures are taken when and if required, and could consist of tillage of exposed areas, planting of exposed areas to annual grains, diking and ponding of certain areas. Since prolonged inundation destroys trees and almost all vegetation, an annual program of dust suppression would be employed if needed.

At Lonetre Reservoir, wind erosion of exposed beaches could be a problem and will be controlled by soil ridging, ridging and seeding cover crops, diking and ponding, erection of wind barriers such as trees and snow-fencing, and mulching (IV - 11). Several problems are inherent in such management. The FES does not identify what effect these measures will have on esthetic values of the reservoir, how they will affect recreational usefulness and desirability of the reservoir, who will perform these mitigating functions and at what cost, whether these costs have been included in the benefit-cost analysis, and what species of trees can be "erected" on such areas and would withstand periodic flooding. Vegetation maintenance under these conditions has not been found possible elsewhere.

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Environmental impacts of the project on existing recreation on the Souris, Sheyenne, Wild Rice, Red, and James Rivers have been considered. Beneficial impacts to recreation along the Souris, Sheyenne, James and Red Rivers will be realized because of the increased stream flows, particularly during low flow stages. Augmentation of stream flows in these rivers is possible from outlet works in Lonetree, and Jamestown Dams, and from the Velva Canal. Off-peak flows from wasteways in the East Oakes Area Distribution System will augment stream flows in and dilute drain flows into the Wild Rice River.

The FES neglects to document how much recreation of what types now takes place on the Souris, Sheyenne, Wild Rice, Red, James and other rivers that will be affected by the project, or how much use will be affected by increased dissolved solids and changes in volumes and patterns of flow in these rivers. It is well known that these rivers provide many excellent recreation opportunities at present. However, no unavoidable adverse effects on recreation are mentioned in the FES (V - 1-7).

The Bureau of Reclamation takes the position that water-based recreation within or in proximity to the project area is far from adequate and that recreation benefits of the project are fully justified. Over use of existing recreation facilities at Bureau of Reclamation reservoirs within North Dakota requires continued expansion and visitation surveys have indicated a greatly expanding demand.

A parallel question, relevant to much of the above, concerns the present availability of water-based recreation within or in close proximity to the project area. This is mentioned briefly in a few areas of the FES, but is not adequately discussed (II - 73-77). The FES should consider how much area and what facilities are now available, where they are, how far from residents of the area, how heavily they are used, who uses them - residents, tourists, and whether the facilities and capacities of existing lakes and reservoirs can be increased to meet current and future needs without development of the project. In fact, water for recreation in or near the project area currently includes: the Souris, Missouri, James, Sheyenne, Wild Rice, Red, Turtle, Maple, Pembina, Cannonball and Little Missouri Rivers, Devils, Jaunita, George, Isabel, Golden, Mitigoshe, Spiritwood, Green and Beaver Lakes; Sakakawea, Oahe, Tschida, Darling, Jamestown, Pipestem, Ashtula, Sweet Briar, Crown Butte, Nelson and Sykeston Reservoirs; and thousands of smaller lakes, sloughs and wetlands.

The North Country Scenic Trail would uuse recreation features and facilities of the Garrison Diversion Unit from Devils-Stump Lake to Snake Creek Pumping Plant which would enhance development of the trail. The Bureau of Reclamation has been in communication with the Bureau of Outdoor

Considerations in the FES for the North Country Scenic Trail, which bisects the Garrison Diversion Unit area, occupy only three paragraphs (II - 81) and are clearly inadequate. No mention is made of how the project will affect development and use of the Trail, or what measures

will be taken to protect or enhance it. Any impairment of use or required mitigation should be included as a project cost.

Related to the question of recreation participation, it is noted under Future Environment without the Project (II - 86-87) that population will continue to decline, with "a total outmigration of about 4,500 people" over the next 30 years. However, in the same section, the FES states that "demands for outdoor recreation facilities and areas are going to continue to increase along with population..." (emphasis added).

The diversion of 871,000 acre-feet of water per year for the Garrison Diversion Unit (I - 4) will affect the recreational values of Lake Sakakawea. Since any impairment of recreation values at Lake Sakakawea and downstream Missouri River reservoirs resulting from the diversion of 8 to 9 percent of the river's flow (III - 18) must be considered as costs of the Garrison Diversion project, such choices have major impact on recreation benefits ascribed to the project and are of critical importance in the B/C analysis.

The FES should consider what recreational use is now made of these streams, what its value is and how it will be impaired by the proposed modifications.

Recreation in regard to project construction.

Reference to a decline in population (Chapter II, P.86) without project development means a decline in farm population with an attendant decline in population in rural communities in the immediate project area. Reference to the demand for outdoor recreation facilities increasing as population increases is valid because the State's population will probably increase even though farm population may decrease slightly.

The diversion of up to 871,000 acre-feet annually will have a minor effect on recreation at Lake Sakakawea. Diversions for irrigation will be highest during the summer season when Lake Sakakawea is normally at it's highest elevation from spring runoff. Consequently, the drawdown due to the diversion will be minimal during the height of the recreation season.

The James River will be enhanced for recreation use by increased flows. Presently recreation use is curtailed during periods of low flow and enhanced when releases are made from Jamestown Reservoir. This beneficial impact has been observed for twenty years since Jamestown Dam was completed. Increased flows will also enhance recreation opportunities in the Wild Rice River.

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However, small communities, counties, etc. may not be able to assume financial responsibility for development, operation and maintenance of the recreation facilities envisioned as producing 1,100,000 visitor-days recreation use annually. For example, the City Park of Turtle Lake (population, 712) may not develop and operate the 800 acre lake-750 acre land Lake Brekken-Lake Holmes Recreation Development (I - 34). The FES assumes it can and will, and that substantial benefits will accrue as a result to help justify the project. However, if the Turtle Lake City Park Board cannot sustain such an undertaking, a large portion of the recreation benefits being projected as partial justification for the project will never be realized.

Taayer Reservoir will have 440 acres of recreation land and will be developed for picnicking, camping, boat lauching and sightseeing (I - 36). However, the drawdown plans (I - 17) and photograph (Figure 7) indicate a highly questionable environment for recreation - particularly for boat launching and sightseeing. Kraft Slough (Dill's Slough) will be destroyed in creating Taayer Reservoir (II - 77). As discussed in the review of wildlife impacts of the project (Chapter 7), this wetland area now supplies outstanding hunting and nonconsumptive

Administering agencies will not be required to fund initial construction of recreation facilities as this is an obligation of the Conservancy District. They will be required to fund operation and maintenance expenses. They can use proceeds from concession leases, and user fees to pay part of the operation and maintenance costs. At other recreation areas in the State administering agencies find themselves able to fund operation and maintenance expenses but find it difficult to cost-share capital improvements. Turtle Lake Park Board is enthusiastic about development, operation, and maintenance of Brekken-Holmes Recreation Area.

Recreation areas at Taayer Reservoir will be located to take advantage of the steepest shorelines, which will be affected least by reservoir fluctuation. The FES recognized unavoidable adverse effects in connection with the construction of reservoirs. Loss of hunting in Dill Slough by the construction of Taayer Reservoir is recognized to be an unavoidable adverse effect.

recreation opportunities. These values should be analyzed and described in the FES as a project cost, as well as an "Irreversible and Irretrievable Commitment of Resources."

Regarding the recreation component of the B/C analysis, the FES fails to indicate how the $639,000 annual recreation benefits and the $1,018,000 fishing and hunting benefits were determined (III - 7). The FES states that the "Garrison Diversion Conservancy District will assume the specific recreation repayment obligation of 50 percent of the specific recreation costs" by transferring 83,000 acres of publicly owned, meandered lake bed to the federal government as payment (I - 33-34). In an October 1, 1974, correspondence, North Dakota Governor Arthur Link indicated that 94 percent of the total reimbursable costs of $3,885,000 for recreation and fish and wildlife developments already has been written off simply by transferring title of 62,000 acres of publicly owned, meandered lands of the bottom of Devils Lake to the federal government. However, only 2,400 acres "will be available for recreation development" (I - 35) and 970 acres are scheduled for fish and wildlife development (I - 29) in this entire portion of the Devils Lake chain. These reimbursable costs amount to not 50 percent, but less than 10 percent of the more than $39,000,000 total recreation ($13,050,000 - Bureau of Reclamation, 1965) and fish and wildlife ($25,750,000 nonreimbursable portion - Table 1) development costs. BuRec should conduct a reanalysis of the economic aspects of recreation development under the Garrison Diversion Unit, especially the cost reimbursement procedures and amounts.

There may be adverse effects on businesses presently serving recreationists at locations that will be adversely affected by losing visitor-use to Garrison Diversion project recreation developments. If so, these should be studied, described in the FES, and included as project costs.

The FES does not state that the substantial hunting opportunities to be destroyed by the project (III - 56) were deducted as a project cost. There is no indication in the FES that any costs were attributed to losses of wetlands, fish and wildlife habitat, or any associated recreational use of these areas. That these losses will be extensive is shown in the reviews of wildlife and fisheries impacts of the project, yet they apparently were not deducted from recreation benefits created by the project.

It is stated that "increased boating activity on reservoirs and lakes increases the possibility of water pollution from gasoline, oil and other materials" (III - 66), and "private recreational developments will create minor additional impacts on the environment due to sewage disposal,.." (III - 66). The FES fails to consider costs of this pollution and its control in the economic analysis of the project.

Fish and Wildlife benefits of $1,018,000 were estimated by the Fish and Wildlife Service and recreation benefits of $639,000 were estimated by the National Park Service. Estimates of benefits are based on experience in this area and in comparable areas in other parts of the country. They represent the best estimate that can be made by agencies with expertise in the field.

Joint costs of the unit allocated to fish and wildlife and recreation will be nonreimbursable. Repayment of reimbursable fish and wildlife and recreation costs will be made in accordance with principles recommended by Federal Reclamation laws, modified by the policy proposed by the Administration on February 19, 1965 for treatment of cost allocation to recreation and fish and wildlife enhancement and subsequently introduced as S1229 and H.R.5269, 89th Congress, First Session. This policy is that not more than one-half of the separable recreation costs and costs associated with areas for fish and wildlife enhancement which are appropriate for management by non-federal public entities would be reimbursable.

In Devils Lake Basin, West Bay, Devils Lake, will provide a 33,960 acre game management area. In addition Spring Lake will provide a 970 acre area. Recreation facilities will be developed initially on 1,750 acres at Devils Lake and on 400 acres at Stump Lake. After restoration, the entire water area will be available for water-oriented recreation.

Because of the expanding demand for recreation, the Bureau of Reclamation does not think that there will be substantial under-utilization of recreation facilities in other areas or of diminished income to concessionaires or businesses dependent on those areas.

Fish and Wildlife costs and benefits were determined by the U.S. Fish and Wildlife Service using their current criteria. This determined mitigation for areas lost due to project development. Lost habitat was fully mitigated, therefore, no reduction in recreation benefits was necessary.

Private recreation development around reservoirs and lakes will be regulated by local zoning regulations and sewage system regulations. Adverse impacts from sewage disposal systems will be minimized by enforcement of these regulations.

Chapter 10 - Legal Analysis

Pages 80 - 86

Statements challenging the adequacy of the Final Environmental Statement with respect to (1) Indirect Impacts, (2) Benefit-Cost Analysis and (3) Segmentation of the Project.

The Final Environmental Impact Statement, pursuant to the National Environmental Policy Act of 1969 (83 Stat. 852, 42 U.S.C. 4321 et seq.), on Garrison Diversion Unit was filed with the Council on Environmental Quality of January 10, 1974. The litigation concerning the sufficiency of this statement in complying with NEPA requirements; entitled The Committee to Save North Dakota, Inc., v. Rogers C.B. Morton et al., Civil No. 1198, United States District Court for the District of North Dakota, was dismissed by the District Court June 12, 1974. Notice of appeal was filed and the Eighth Circuit Court of Appeals rendered its decision January 15, 1975, upholding the dismissal.

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In planning the Garrison Diversion project, economic benefits were claimed for the creation of municipal and industrial water supplies (Bureau of Reclamation, 1965). Water will be made available at main canals, but municipal and industrial users will have to finance and construct the necessary delivery facilities from the canals to the points of use.

Feasibility studies for municipal and industrial water supplies to 14 communities considered as potential users are underway. An appraisal investigation was completed in 1972. Upon completion of studies and plan formulation, detailed environmental statements will be prepared assessing impacts.

A related matter, of course, is the potential environmental impacts of municipal and industrial storage reservoirs and the associated impacts of municipal and industrial water use. However, the evaluation of these impacts will be deferred to supplemental environmental statements (I - 45). As already discussed, these secondary impacts must be considered in the FES for the Garrison Diversion Unit.

The Federal Water Pollution Control Act Amendments of 1972 (FWPCA) require a uniform national schedule of effluent controls through the National Pollutant Discharge Elimination System (NPDES). This system will regulate the discharge of pollutants by all point sources through a permit system established by the federal Environmental Protection Agency (EPA) and the states. The permits will place specific limits on effluents and specify schedules of compliance, and a violation of the permit will be a violation of the Act. New sources will be subject to special standards to be promulgated by EPA.

All water pollution standards, Federal and State will be conformed to by the Project. See Chapter 4 for water quality.

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The use, diversion and regulation of the waters along the United States-Canada border are governed by The Boundary Waters Treaty of 1909 (Treaty with Great Britain Relating to Boundary Waters between the United States and Canada, Jan. 11, 1909, 36 Stat. 2448, T.S. No. 548).

It is the intent of the Bureau of Reclamation to adhere to the Boundary Waters Treaty with Canada. An international task force comprised of U.S. and Canadian representatives have been studying and exchanging information on the matter of Garrison Diversion Unit return flows and effects.

Negotiations are continuing with the Canadian Government to reach a complete understanding of the impacts of the Garrison Diversion Unit in North Dakota on the downstream portions of the Souris and Red Rivers. Two particular aspects of the Unit are being closely reviewed; the adverse impact of increased dissolved solids in return flow that will accrue to the Souris and Red Rivers and the beneficial impact of the net increase in the water supply in the rivers--increased minimum flow in summer and reduced fluctuation in dissolved solids.

If Canada is not willing to accept the return flows in the Souris River or the Red River, alternative measures described in Chapter VIII of the Final Environmental Impact Statement for the Garrison Diversion Unit (INT-FES 73-3) will be considered.

GPO 859 - 861