STATE WATER CONSERVATION COMMISSION
Minutes of Meeting
Held in Office of State Water Commission on
December 14, 1956.

A regular meeting of the North Dakota State Water Conservation Commission was called to order on December 14, 1956, at the State Water Conservation Commission office in Bismarck, North Dakota, to consider routine business matters. The following were present:

MEMBERS OF THE STATE WATER CONSERVATION COMMISSION

Governor Norman Brunsdale, Chairman
Curtis Olson, Vice Chairman, Member from Valley City
A. M. Christensen, Member from Minot
Earle F. Tucker, Member from Bismarck
Math Dahl, Commissioner of Agriculture and Labor, Member from Bismarck
Einar Dahl, Member from Watford City
Oscar Lunseth, Member from Grand Forks
Fred Fredrickson, Planning Coordinator, Washington, D. C.
Milo W. Hoisveen, Secretary and Chief Engineer, State Engineer
Vernon Cooper, Assistant Secretary
Iver Acker, Special Assistant Attorney General

OTHERS PRESENT AT THE MEETING

Governor-elect John Davis, McClusky
Mr. Walter Burk, Williston
Honorable Milton R. Young, United States Senator
Bruce Johnson, Bureau of Reclamation

The meeting was called to order at 1:45 p.m. o'clock by Vice Chairman Curtis Olson with Commissioners A. M. Christensen, Earle F. Tucker, Math Dahl, Einar Dahl, Oscar Lunseth, Planning Coordinator Fred Fredrickson and Secretary Milo W. Hoisveen present.

It was moved by Commissioner Math Dahl, and seconded by Commissioner Einar Dahl, that the Minutes of the meeting held on November 7, 1956, be approved and filed in the office of the State Water Conservation Commission. All Commissioners voted aye and said motion carried.

Commissioner Christensen moved that the Financial Statement for November, 1956, be approved and filed in the office of the State Water Conservation Commission, which motion was seconded by Commissioner Tucker. All members voted aye and said motion carried.

Mr. Iver Acker reported that a Petition has been received and filed from the Upper Souris River Water Conservation and Flood Control District requesting exclusion from the district. Mr. Acker stated that two hearings were held and that the district was properly organized. Litigation followed and the proceedings were dismissed. Mr. Acker stated that there is no provision in the law for dissolving a water conservation and flood control district. The boundaries of a district can be modified but a district cannot be dissolved. It was felt that the dissatisfaction was due largely to the three mill levy which had been assessed by the County Board and had this been one-half mill, this situation might not have come up.

It was further reported by Mr. Acker that a similar Petition has been received from the Oak Creek Water Conservation District in which they also request exclusion. As

in the Upper Souris River District, the complaint is due largely to the excessive mill levy.

It was moved by Commissioner Math Dahl that inasmuch as Mr. Acker, Special Assistant Attorney General for the State Water Commission, has advised that the Commission has no jurisdiction in matters of this kind and cannot dissolve a district, that the Petitions of the Upper Souris River District and the Oak Creek District for exclusion be tabled. Commissioner Christensen seconded said motion. All members voted aye and said motion carried.

Vice Chairman Olson read a letter from Mr. Raymond W. Johnson, County Auditor of Bottineau County, requesting that the Commission establish a water conservation and flood control district along Willow Creek, which is in the southern part of Bottineau County. The Petition and Resolution passed by the Bottineau Board of County Commissioners is on file. Commissioner Tucker moved that the Chief Engineer be authorized to conduct a hearing within the proposed district to determine public opinion relative to the establishment of the Willow Creek Water Conservation and Flood Control District. The motion was seconded by Commissioner Math Dahl. All members voted aye and said motion carried.

Mayor Walter Burk of Williston entered the meeting and appeared on behalf of former landowners in the Lewis and Clark area. The land in question is land which has been purchased by the government for the Garrison Reservoir. The former landowners desire to rent the land back on a leasing agreement. The rental rate charged by the government is $8.00 an acre and a lease is given for only one year. Mr. Burk stated that he felt the rental rate was excessive in view of the fact that the lessees would still be required to pay the cost of operating the project and the water charges for the acres irrigated. He requested that the Commission assist them in obtaining a more reasonable rental approximating $5.00 an irrigable acre and a five year lease. The Lewis and Clark Highway #85 problem was also mentioned by Mayor Burk. He stated that the Corps of Engineers is going to raise the highway nine feet and this will destroy the three siphons under the highway, which in turn will cause the land east of the highway to become dry land. It was agreed among the Commissioners that they would cooperate as much as possible but recommended that Mayor Burk contact Senator Young relative to these matters, as it was felt that he was in a better position to assist him in obtaining beneficial legislation.

Secretary Hoisveen reported that three hearings have been held in Walsh County to determine the sentiments of the people over the entire county relative to the formation of a water conservation and flood control district. In view of the fact that a large majority of the people have voted in favor of the district at these meetings, he recommended that a district be formed in Walsh County. Commissioner Tucker, therefore, moved the adoption of the following Resolution, which motion was seconded by Commissioner Christensen. All members voted aye and the following Resolution was unanimously adopted:

RESOLUTION GRANTING PETITION OF WALSH COUNTY, NORTH DAKOTA, REQUESTING CREATION OF A WATER CONSERVATION AND FLOOD CONTROL DISTRICT EMBRACING WITHIN ITS BOUNDARIES THE ENTIRE COUNTY.

WHEREAS, Walsh County, North Dakota, acting by and through its Board of County Commissioners, did on the 20th day of July, 1956, file with the State Water

Conservation Commission a petition requesting the establishment of a water conservation and flood control district embracing within its boundaries all of Walsh County; and

WHEREAS, the petition of Walsh County was accompanied by a certified copy of a resolution adopted by the Board of County Commissioners thereof, authorizing and directing the filing of such petition; and

WHEREAS, the report of the Chief Engineer of this Commission, based on his investigation of periodical flooding of farm lands in the various watershed areas within the county, and information given at public hearings held in the Farmers Room in the County Court House in the City of Grafton on the 21st day of August, in the Opera House in Adams on September 7th, and the City Hall in Park River on November 20th, 1956, after due notice thereof, discloses that valuable farm lands in various watershed areas of the County have been periodically damaged by the flooding of streams therein, and also because of inadequate drainage of surface waters produced by melting snows in the spring of each year and heavy rainfall throughout the growing season.

NOW, THEREFORE, BE IT RESOLVED by the State Water Conservation Commission in meeting assembled on this 14th day of December, 1956, that the petition of Walsh County, North Dakota, requesting the establishment of a water conservation and flood control district comprising all of the County, be and the same is hereby approved, and that the Chairman and Secretary of the Commission are directed to execute its Order establishing such water conservation and flood control district, the boundaries whereof shall be commensurate with the territorial limits of the County, and designating said district as Walsh County Water Conservation and Flood Control District.

Commissioner Earle Tucker stated that he and Secretary Hoisveen have checked into the A. C. Harke land matter and that very shortly they hoped to conclude the same in a satisfactory manner to all.

Secretary Hoisveen stated that he had received a Resolution adopted by the Board of County Commissioners of Benson County relative to using Mauvais Coulee for draining and diverting the waters of Lake Irvine, Lake Alice and Twin Lakes. After the receipt of this Resolution, a hearing was held in conjunction with the Benson and Ramsey County Commissioners and interested landowners on November 29, 1956, and a much better understanding of the problems now exists. It is anticipated that a water conservation and flood control district will be formed in the lower reaches of Mauvais Coulee, which will provide the residents in the lower area a legal entity to facilitate the drainage problem.

Commissioner Einar Dahl referred to the Cartwright Irrigation Project, stating that the Bureau of Reclamation has been working on the same for 15 years and has spent approximately $93,000 in preparing a cost estimate for construction purposes. It was his thought that possibly this could be reduced to smaller areas and come under the Small Irrigation Projects Act and the cost would be cut down considerably. Mr. Dahl mentioned that a meeting was held with the district board at which he, Mr. Hoisveen and Mr. Ziegler were present. The district is much interested in obtaining an active irrigation project. Commissioner Einar Dahl moved that Secretary Hoisveen be authorized to conduct a survey and estimate the cost of the project. Said motion was seconded by Commissioner Tucker. All members voted aye and said motion carried.

Mr. Fred Fredrickson stated that Mr. Acker is revising the water conservation and flood control district laws and various other amendments to the water laws are being discussed. The proposed legislation and amendments will be presented to the Commission at their January meeting.

Governor-elect Davis, Fred Fredrickson and Bruce Johnson entered the meeting.

The proposed budget for 1957-1959 was discussed by Commission members. The present budget allows $402,000 for the Commission, the new budget calls for $494,000 and the amount allowed by the Budget Board is $394,000. It was felt that this large of a cut was not justified in view of the growing popularity of the water program and the constant demand for dam repair and the additional work that will be required in organizing irrigation districts in view of the Garrison Diversion Project. The Federal Government left approximately $20,000 worth of dams to be maintained and repaired. These dams were built in the 1930 period and considerable deterioration is now occurring as many dams were constructed from inferior materials. With the proposed budget reduced for maintenance of dams, it will be impossible to keep up with the demand that is now being manifested throughout the State. Secretary Hoisveen stated that this past summer the Commission worked on 17 dams and that the construction crews were still out in the field working on repairs. He also stated that considerable more work has and will be done in conjunction with the Corps of Engineers, such as the Bowman-Haley project, Mauvais Coulee and Pembina Dam and the Scranton Flood Protective Works. If any one of these should become a reality, the State would be repaid many times for the money expended by the Commission. The Marmarth and Scranton projects are practically assured. It was moved by Commissioner Math Dahl and seconded by Commissioner Earle Tucker that Secretary Hoisveen be authorized to make every effort to get the budget request as originally submitted restored by the State Legislature. All members voted aye and said motion carried.

Governor Brunsdale entered the meeting.

Secretary Hoisveen introduced Mr. H. A. Parker, Consultant for the Garrison Diversion Conservancy District, Mr. Parker has been employed by the Conservancy District to review the Bureau of Reclamation's estimate on O & M costs for the Garrison Diversion Project. A detailed copy of his report was presented to each of the Commissioners, a copy of which is attached hereto. The report is set up in two parts, general description of the project and the items that go into making up the general O & M costs. Three separate estimates were made to show the anticipated costs under varying stage development plans as follows:

1. For the ultimate Garrison Unit area of 1,007,120 acres.
2. For stage development of 406,620 acres.
3. For stage development of 105,000 acres.

The annual O & M cost for the ultimate project of 1,007,120 acres is estimated by the Bureau of Reclamation at $5,496,130. The estimate of Mr. Parker's report is $4,935,911, or a reduction of $560,219. Per acre costs are $5.46 and $4.90 respectively.

The annual O & M cost for the stage development of 406,620 acres is estimated by the Bureau at $2,171,985. The estimate in this report is $1,961,429, or a reduction of $210,556. Per acre costs are $5.34 and $4.82 respectively.

The annual O & M cost for the stage development of 105,000 acres is $508,408 or $4.85 per acre. The relatively low cost for this stage is accounted for by reduced canal and drain cleaning in the early years which offsets the higher per acre costs of the principal supply works.

Mr. Parker further stated that if the O & M of the Garrison Reservoir is determined to be an obligation of the District, the estimated O & M should be raised 25¢ for each irrigable acre. He also believed that the Bureau's estimate of the number of miles of drains required appeared excessive and stated that any reduction would reduce the O & M costs proportionately. It was Mr. Parker's recommendation that further studies be had of the cost of a tunnel to replace part of the McClusky canal. Mr. Parker recommended that a tunnel expert familiar with tunnel construction costs be employed to make a cost estimate of the proposed tunnel. All of the estimates in this report have been based on the Bureau's wage scale at the 1956 level. In conclusion Mr. Parker stated that he felt that the per acre costs for either of the three stages of development appears to be within the ability of the water users to pay, with some assistance from the Conservancy District in the early years.

Senator Young and his secretaries, Messrs. Sylvester and Bullis, entered the meeting.

Mr. Bruce Johnson was requested to report to the Commission on the status of the definite plan report for the Garrison Diversion Conservancy District. Mr. Johnson stated that because of certain difficulties encountered in determining the allocation of benefits for the project to the various beneficiaries, it appeared that the definite plan report would be delayed from four to six weeks. He stated that their immediate problem was that of allocating the costs of restoring Devils Lake between the Fish and Wildlife, recreation and project repayable costs. This item could amount to approximately $40,000,000. He pointed out that a method of allocating project benefits for a lake restoration, such as is contemplated at Devils Lake, had not been set forth in directives for the procedures for allocating project benefits. In view of this fact the economists charged with the responsibility for making the benefit cost allocations would be required to establish their own method and procedure. It was in connection with this procedure that the delay resulted. Mr. Johnson also stated that there possibly could be other matters that would come up in the near future that could delay the project report still more. He said that he did not believe there was any possibility of getting the report out as originally scheduled. However, in order to avoid delays through some future problem, such as this, it would be desirable if the local proponents of the project and Senator Young would make known their wishes that the project report should be completed as soon as possible.

Secretary Hoisveen stated that he had received a request from the Ohio Oil Company for reports containing water supply information pertinent to western North Dakota. Mr. Hoopman, Superintendent, was most appreciative of the information received and desires to meet with Mr. Hoisveen to discuss details of water supply in areas under consideration.

Secretary Hoisveen reported that meetings were held with interested parties at Dickinson and Williston on December 10th relative to designating the topographic work to be accomplished by the U. S. Geological Survey and the State Water Commission in the immediate vicinity of those towns. At Dickinson President Stranik, Senator Amos Freed, Mr. Johnson and several members of the Chamber of Commerce attended the meeting. The Dickinson group designated two quadrangle surveys to be made in the immediate vicinity of Dickinson and a third quadrangle

sheet to be taken Southeast of Dickinson, along the Heart River. The contention being that the third sheet would be of value for locating industry in view of its proximity to the Heart River. The people in attendance were enthusiastic over the recognition that the Commission had given them in authorizing topography to be taken in that area.

Those in attendance at Williston were Mayor Walter Burk, Senator-elect Wenstrom, Representative Poling, County Commissioner Chairman Farland, Harry Polk, the City Engineer, the County Agent and the Secretary of the Chamber of Commerce. It was explained to this group the value of topography in locating industry. As was the case in Dickinson, a quadrangle sheet showing the survey which had been made in the vicinity of Mandan and Bismarck was used as a sample. Two quadrangles were selected in the immediate vicinity of Williston and one to the Northeast of Williston. This group expressed a keen interest in having irrigation projects established in the Little Muddy area in view of the loss of the Lewis and Clark project which will be impaired by the Garrison Reservoir. This was given as the reason they desired to have topography taken Northeast of town along the Little Muddy River. Those present expressed appreciation of the consideration given them by the Water Commission in having topography taken in and about their city.

Secretary Hoisveen presented a report of the State Examiner covering the period September 1, 1955, to October 31, 1956. It was moved by Commissioner Math Dahl and seconded by Commissioner Christensen that said report be acknowledged and filed in the office of the State Water Conservation Commission. All members voted aye and said motion carried.

It was moved by Commissioner Earle Tucker and seconded by Commissioner Oscar Lunseth that Secretary Hoisveen be authorized to proceed in assisting with the organization of the Oakes Irrigation District. All members voted aye and said motion carried.

Commissioner Christensen moved that $1,000 be paid to the Missouri Souris Projects Association for services rendered, which motion was seconded by Commissioner Math Dahl. Upon roll call all members voted aye and said motion carried.

It was reported by Secretary Hoisveen that the Golden Lake Restoration Project is nearing completion. The dam is completed and as soon as water becomes available, plans will be made to divert the same into the Golden Lake area. Satisfaction of the project was expressed by all Commissioners.

The following water rights were considered:

#645. L. E. Lilyquist, Lisbon, requests the right to divert 50 acre feet of water from wells in Section 26-134-54 to irrigate 97.5 acres of land. Commissioner Tucker moved that said request be granted, which motion was seconded by Commissioner Lunseth. Motion carried.

#662. Ray Schnell, Dickinson, requests the right to divert 250 acre feet of water from Cedar Creek in Section 29-130-92 to irrigate 125 acres of land. Commissioner Einar Dahl moved that he be granted the right to divert 23 acre feet of water to irrigate 15.6 acres of land. Commissioner Lunseth seconded said motion. Motion carried.

#685. Montana Dakota Utilities, Old Mandan Plant, requests the right to divert 161 acre feet of water from wells for industrial and municipal use. Commissioner Tucker moved that this application be placed in the pending file and the water right to be granted when the company places said well in use.

#686. Montana Dakota Utilities, Heskett Station, requests the right to divert 161 acre feet of water from wells for industrial and municipal use. It was moved by Commissioner Tucker and seconded by Commissioner Christensen that they be granted the right to divert 161 acre feet of water, .22 c.f.s. Motion carried.

#547. Ronald Wagner, Englevale, requests the right to divert 600 acre feet of water from wells to irrigate 480 acres of land. Commissioner Christensen moved that said water right permit be granted in the amount of 400 acre feet of water to irrigate 320 acres of land. Commissioner Tucker seconded said motion. Motion carried.

#548. Orrin R. Streich, Englevale, requests the right to divert 200 acre feet of water from wells to irrigate 154 acres of land. Commissioner Tucker moved that Mr. Streich be granted the right to divert 193 acre feet of water to irrigate 154 acres of land. Commissioner Christensen seconded said motion. Motion carried.

#549. August J. Wagner, Erglevale, requests the right to divert 375 acre feet of water from wells to irrigate 300 acres of land. Upon recommendation of Secretary Hoisveen, action on this water right will be delayed until the same has been checked by a representative of this office.

It was reported that representatives of the lower Heart River Water Conservation and Flood Control District had shown a desire to have two segments of the protective works in the vicinity of Mandan constructed at an early date. It is believed that the construction of these segments would possibly alleviate the flooding in the #1 segment. This would be accomplished by channel straightening on the western edge of Mandan and through the southern part of the city. A dike with a large flood plain would then be constructed as a single segment below Mandan. The flood plain would also eliminate the meandering condition that occurs in the Heart River below Mandan which causes ice jams and the flooding of the highway and commercial site between Mandan and the Memorial Bridge. Secretary Hoisveen was instructed to contact the Corps of Engineers and the Water Conservation and Flood Control District officials relative to this proposal. The raising of the new bridge on U. S. Highway #10 immediately west of Mandan would not be required if this proposal works out satisfactorily.

The meeting adjourned at 4:30 o'clock p.m.

Respectfully submitted,

Attest:

Norman Brunsdale
Governor

Milo W Hoisveen
Secretary

THIS REPORT IS NOT FOR

RELEASE UNTIL ANNOUNCED BY THE

GARRISON DIVERSION CONSERVANCY DISTRICT

Maps Not Attached

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REVIEW OF OPERATION, MAINTENANCE AND REPLACEMENT ESTIMATES FOR THE GARRISON DIVERSION UNIT OF THE MISSOURI RIVER BASIN PROJECT

By H. A. Parker, Consultant
December, 1956

This review is in response to the desire of the Garrison Diversion Conservancy District Board of Directors for an independent appraisal of the estimated costs prepared by the Bureau of Reclamation that will be incurred in the operation and maintenance of the Garrison Diversion Unit under various stages of development. The study has followed, as nearly as practicable, the outline set up by the District which is quoted in full below:

Purpose

"The Bureau of Reclamation has advanced in their investigations of the Garrison Diversion project to the point where the cost of water to the potential irrigators can be determined fairly accurately. It is desirable insofar as the prospective irrigators, the Conservancy District and the Bureau of Reclamation are concerned that the data compiled and estimates made by the Bureau therefrom be reviewed by an independent consultant representing the Conservancy District to determine if these estimates accurately reflect the O, M & R costs. The Bureau of Reclamation figure for repayment component and the Conservancy District's consultant's estimate of O, M & R will serve as the basis for forecasting the cost of water to the potential irrigators."

Scope of Work

"An item by item review of the Bureau's estimate of average O, M & R costs; including proposed O & M organization, equipment requirements and costs, wage rates, replacement factors, development schedules, etc. The consultant will have sufficient latitude in his review to make specific recommendations to the District as to methods, practices and design that may reduce O, M & R costs and improve operations of the project."

Material Available

"A rather detailed year by year estimate of O, M & R costs which have been prepared during the fall of 1956 by the Bureau of Reclamation and reviewed by the Denver and Billings O & M staffs of that agency. This estimate is based on forecasted organization but also makes use of certain estimating factors applied to miles of drains and ditches, etc."

Reports Required

"An independent evaluation of the adequacy of the Bureau estimate and a conclusion as to the likely present day cost of operating the system of several stages of development."

STAGE DEVELOPMENT

A separate estimate is included for each of three different stages of development.

1. For the ultimate project area of 1,007,120 acres.
2. For stage development of 406,620 acres.
3. For stage development of 105,000 acres.

This should not be construed to have any relation to the rate of development which depends on landowner acceptance of irrigation, the formation of irrigation districts, size of appropriations for construction work and other factors which cannot be resolved at this time. The three estimates have been made to indicate the situation the irrigators and the

Conservancy District would be in, with respect to costs, at various points along the line toward complete development.

DATA AVAILABLE

The Bureau has prepared a very detailed estimate of cost for all features of both the ultimate project and the 406,620 acre stage. The data included the irrigable area within each area; the miles of canals, laterals, and drains, the estimated periods at which these would need cleaning and the machine time required to do it; schedules of supervisory, operation and maintenance employees with rates of pay and, for maintenance employees, the number of hours to be employed each year; the type and number of pieces of equipment required with the hours each would be used and the cost of operating them; lists of materials and supplies; electrical energy for the pumping plants and maintenance of the power facilities to serve them. The completeness of this data was of great value in making the review and shortened the time required by several weeks.

Material for the 105,000 acre stage was less complete and a considerable amount of original estimating was required.

The basic data from which the estimates are derived is not entirely complete. All canals and laterals in excess of 50 c.f.s. were actually located on the ground and preliminary design of the major structures made. For the smaller laterals and for the drainage system, the mileage was obtained by applying to the entire area the data found in certain typical sample areas where the laterals and drains were worked out in detail. About eight percent of the project is included in the sample areas so there is a possibility that the total estimate may be somewhat in error. In general, it is felt that the estimate may be somewhat higher than will actually be required when the system is built. This is particularly true of the drainage system.

DIVISIONS WITHIN PROJECT

The Bureau has proposed and the estimates include four operating divisions designated as the Central, Souris, Oakes and Coleharbor. The Coleharbor division is relatively small and, although separated by a considerable distance, could be combined with the central division. There are no unusual features of difficult operating conditions in the Coleharbor area and its 39,820 acres are well within the amount to be handled by one watermaster.

If this combination is made, no additional supervisory personnel would be required in the central division headquarters and that now set up in the Coleharbor division could be dispensed with. The latter is estimated to cost $36,600 per year or $.92 per acre. The Coleharbor division has the highest cost per acre of any of the divisions and this reduction would bring its cost more nearly in line with the others. The change is strongly recommended.

REPLACEMENT

Throughout the Bureau estimates a replacement item for pumping plants and power facilities has been included in the costs. The principle is sound but so far as known to the writer no irrigation district is actually accumulating a replacement fund. Most contracts with the government require the district to build up a fund, usually equal to one year's normal operation and maintenance costs, to finance any unusual expense such as major washouts and the like which could not be foreseen when making up the annual assessment roll. This is to the district's advantage, particularly after it assumes its own pperation, and is generally acceptable to the districts.

The legality of including replacement costs in annual operation and maintenance assessments has been explored and the conclusion reached is

that North Dakota law does not permit making assessments for the purpose of building up such a fund.

The useful life of machinery or other requipment depends to a large extent on the degree of maintenance which is expended on it. The automobile is an example of this with which everyone is familiar. In the absence of authority to make replacement assessments, it is of the utmost importance that the annual maintenance program be adequate to keep the property in first class operating condition. Therefore, the replacement cost items throughout the Bureau estimates have been deleted and a more or less arbitrary percentage of the annual replacement cost added to the normal maintenance items. This is generally 25 percent except for some of the major installations where it is less.

The effect of this when applied to the ultimate project is as follows:

Replacement items deleted	$262,475
Maintenance items added	49,998
Decrease in annual costs	$212,477
per acre	$.212

OPERATION AND MAINTENANCE ORGANIZATION

In order to minimize operating costs and assure coordinated control of water, a centralized operating agency, referred to in this report as the Central Control Agency, is proposed to supervise the entire system. The irrigated areas in the Unit will be broken into Operating Divisions, each of which will be operated under the direct supervision of a division superintendent, with an irrigation district or group of districts composing the Operating Division.

Each Division is subdivided into watermaster districts containing 50,000 acres, more or less, with the watermaster supervising the ditchriders, who will handle the water deliveries to about 5,000 acres each, also the equipment operators, truck drivers and maintenance men necessary to keep the particular district in repair. This is the type of organization

that has proven effective in the larger operating projects and is recommended here.

The Central Control Agency organization and that for a typical large division office, with proposed rates of pay are as follows:

Central Control Agency

Project Manager	GS-15*	$12,420
Assistant Project Manager	GS-14	10,965
Hydraulic Engineer	GS-13	9,635
Administrative Assistant	GS-12	8,215
Clerks (3)	GS-5	4,075
Steno-Typist	GS-4	3,670

* Civil Service Classification Grades

Division Office

Division Superintendent	GS-14	$10,965
Chief Clerk	GS-11	7,035
Cost Accountant	GS-9	5,845
Operation & Maintenance Supt	GS-13	9,635
Hydraulic Engineer	GS-12	8,215
Hydrographer	GS-9	6,115
Maintenance Civil Engineer	GS-12	8,215
Mechanical Engineer	GS-12	8,215
Clerks (4)	GS-5	4,075
Steno-Typist	GS-3	3,430

The salaries listed above are those for the middle point within each grade. For new employees, the starting salary is the lowest step within the grade. It should be understood that the number of positions and the salaries are those contemplated when the irrigated area is approaching its maximum. For the earlier stages, when the responsibility is less, an appropriate reduction in both number of employees and salary rates can be expected.

The numbers of watermasters, ditchriders, etc. will be found in the discussion of each canal area in the appendix.

WAGE RATES

Bureau of Reclamation wage rates are used in this estimate at the 1956 level. The following are rates for all classes of employees not

listed in the section on Operation and Maintenance Organization.

Classified Employees

		Per annum
Watermaster	GS-9	$5,845
Ditchrider	GS-4	3,670
Patrolman	GS-3	3,430

Hourly Employees

	Per hour
Unskilled labor	$1.50
Truck Driver (medium duty)	1.50
Truck Driver (heavy duty)	1.75
Maintenance Foreman	2.50
Electrician	2.38
Communication Technician (radio)	2.38
Pump Mechanic	2.38
Equipment Operator	2.30
Oiler	1.75
Shop Foreman	2.50
Mechanic	2.30
Machinist and Welder	2.50

A comparison of wage scales from other agencies in North Dakota with those used in this estimate is shown in the following table:

COMPARISON OF WAGE RATES IN NORTH DAKOTA

Classification	Used this estimate	N.Dak. Averages from Employment Bureau	Stutsman County	Lower Yellow-stone Project
Unskilled labor	1.50	1.25-1.40	1.10-1.30	1.10
Truck Driver (Medium Duty)	1.50	1.25	1.25	
Equipment Operator	2.30	2.00	1.60-1.70	2.00
Mechanics	2.30	2.00		

The comparisons are obviously incomplete but where local rates are available they run from eleven to twelve percent lower. As long as the government operates the project or any part thereof, it must conform to the federal wage schedules. The evidence does point out however, that some savings should be realized if an irrigation district assumes its own operation and maintenance as early as it is able to do so.

No one can tell with certainty whether the 1956 wage scale will be applicable ten, twenty or thirty years from now. Some economists predict that it will drop but in making a long range estimate such as this it is not considered safe to count on any reduction. The costs arrived at by using the 1956 level may be slightly high. If this proves to be true, the advantage will be in favor of the districts.

EQUIPMENT REQUIREMENTS AND COSTS

The estimates include the cost of operating all equipment but do not provide for the purchase of any of it. This is because it is the policy of the government to purchase, from construction funds, the equipment required initially. The rates per hour or mile, as the case may be, charged for the use of the equipment contain a depreciation factor which is intended to cover the cost of the purchase of a new machine when the one in use is worn out. It is also the practice of the government to turn over to the irrigation district without additional charge all of its equipment used in the operation and maintenance of the district whenever such district assumes its own operation and maintenance.

The following table shows the rates used in the estimate for various types of equipment and, for the major items, is based on the Associated General Contractors schedule, taking into account where necessary the nature of the work on which it is to be used. Rates for automobiles, pickups, and trucks are based on actual operating costs in the Projects Office.

EQUIPMENT OPERATION RATES

Type of Equipment	Operating Cost
Automobile	$ .07 per mile
Pickup truck	.07 per mile
Heavy trucks to 3 ton	.20 per mile
Heavy duty truck & lowboy trailer	.70 per mile
Crawler tractor & dozer 130 h.p.	6.00 per hour
Crawler tractor & dozer 70 h.p.	5.50 per hour

Crawler tractor and dozer 40 h.p.	$5.00 per hour
Crawler tractor, loader, backhoe 30 h.p.	3.00 per hour
Scraper 4 to 6 cy	2.00 per hour
Dragline 3/4 cy	4.25 per hour
Dragline 1½ cy	6.50 per hour
Dragline 2½ cy	8.00 per hour
Gradal	5.00 per hour
Truck Mounted Crane	5.00 per hour
Peerless Dredger	7.00 per hour
Motor Grader	4.00 per hour
Weed Sprayer or Burner	.50 per hour
Farm Tractor and mower	2.00 per hour
Hydraulic Ditcher	2.00 per hour
Brisco Sloper	1.00 per hour

The rates include all costs associated with the equipment except operating labor costs. The latter is covered in the personnel estimates.

REPAIR SHOPS

The Bureau contemplates a well-equipped repair shop at each division headquarters where major repairs to pumps, motors, gates and maintenance equipment can be performed. It will also have minor repair facilities at each watermaster headquarters where such jobs as servicing cars and trucks, minor repairs and service to tractors, etc. can be done.

It is felt that a considerable saving can be realized by adding more facilities in the watermaster shops than are now planned. The most compelling reason for this view is that great distances from some areas to the division headquarters. With a truck and lowboy trailer costing seventy cents a mile to operate, a lot of expense is incurred just to transport a piece of equipment to the shop. All equipment is subject to occasional breakdown and if it can be repaired close by, much lost time and expense is avoided.

CLEANING CANALS, LATERALS AND DRAINS

The maintenance costs included in the estimates for cleaning canals, laterals and drains are based on the following assumptions:

	Complete Cleaning
Large main canals	20 years
Other canals & laterals over 10 foot base	10 years
Laterals 6 to 9 foot base	5 years
Laterals under 6 foot base	3 years
Drains, sub-surface	8 years
Drains, surface	10 years

RADIO COMMUNICATION

A radio network interconnecting the Central Office, Division Offices, Watermaster offices and a certain number of mobile units is proposed to handle most of the necessary communications. This method has proven to be very effective in a large irrigation system since it permits immediate contact with the person nearest to a break or other emergency at any point on the system. It meets the needs better than exclusive telephone service and, considering the widely dispersed areas with resultant high toll charges, it should be somewhat less costly to operate. The estimates include an annual O & M cost of $100 per set. Of this, $80 is included in the personnel estimates to cover the cost of technicians and repairmen and $20 for materials and supplies.

DRAINS

The drainage system for the Garrison Unit is the most extensive of any heretofore encountered on any project. It consists of a network of deep drains to relieve high ground water conditions, surface drains to remove water from existing depressions and to provide outlets for waste irrigation water originating on the individual farms. Many miles of natural channels are to be improved to serve as outlets for the constructed drains.

The situation is best illustrated by the fact that over 9,200 miles of all types of drains are proposed which is one mile for every 110 acres of the ultimate project. The annual maintenance cost varies considerably in the several areas and, excepting the LaMoure area where drainage costs

are low, ranges from $.45 to $1.45 per acre. The weighted average is $.98 per acre. This represents a very sizable portion of the total O & M cost.

It is not within the scope of this study to determine whether or not all of these drains will be required or built. Therefore, no alternative seemed possible other than to accpet the system as proposed and estimate the cost accordingly. It can, however, be stated with confidence that no more than one-half of the projected mileage will ever be built and the reduction of around $.50 per acre in O & M costs would materially help the districts.

BUREAU METHODS, PRACTICES AND DESIGNS

The following remarks are intended mainly for Bureau consideration although some of them will have a bearing on O & M costs. No criticism of the criteria established for the construction of the various features should be inferred.

McClusky Canal

It is conceivable that a slide may completely block this canal. If not discovered for several hours, the water could back up to an elevation that would endanger the New Home Reservoir dikes and the banks of the canal between New Home and the Snake Creek pumping plant. It is suggested that more than normal freeboard be built into these features.

McClusky Tunnel

Both the high cost of the McClusky Canal and the probability of excessive maintenance costs point to the desirability of a tunnel to replace it. It is therefore suggested that, before final decision is reached, the estimates be re-examined on the basis of two parallel tunnels, the first to have a capacity of about one-half the ultimate requirement. By the time the second tunnel is needed, a much more

accurate estimate of the actual number of acres in the ultimate project should be available and the second tunnel designed to meet the need. It is felt that this proposal is important enough to justify the services of the best tunnel authority available.

Over-Capacity in Structures

There are times, such as during an unusual hot period, that the timely delivery of a little extra water or a lesser degree of rotation may make the difference between a good crop and a mediocre one. Structures such as road culverts, siphons, and the like are usually the bottlenecks that prevent any increase in flow above the design capacity. By encroaching slightly on the freeboards, the lateral capacity can safely be increased if the structures are large enough. It is recommended that structures of a type that limit the flow be increased in capacity by about ten percent. This entails a relatively small increase in construction costs and greatly improves the service that can be rendered to the water users.

Measuring Devices

The Bureau criteria calls for parshall flumes at the head of each main canal, constant head orfices at the head of each lateral and precast concrete turnouts with measuring wells for farm deliveries. The Cipolletti weir has been found the most satisfactory type of measuring device and its use is recommended wherever sufficient head is available.

Operation and Maintenance Roads

The criteria provides for all weather roads to the major structures such as pumping plants, dams, wasteways, etc. It is considered important that these be extended to include all canal bank roads over which the ditchrider must travel in his daily rounds. Driving on a canal bank is somewhat hazardous at best and a muddy road is positively dangerous.

Furthermore, the speed with which the ditchrider can get over his beat influences the number of acres he can serve with the consequent reduction in O & M cost.

It is noted that most operating roads are to be on the canal banks. This is the best place because (1) the ditchrider should be in position to watch for weed jams and other hazards in the canal and (2) all maintenance work is now mechanized which requires the machine to work from the top of the bank. Savings in O & M costs by reason of good roads on the canal banks fully justify considerable extra construction expense to provide them.

Concurrent Construction of Laterals and Drains

Whenever it is sure that a certain drain will be needed, it has been found advantageous to include its construction with the lateral construction contract. Favorable bids are received for overhaul on a mile-cubic yard basis which often permits the utilization of excavated material from the drain being used to construct lateral banks. This does away with many unsightly borrow pits which are sources of weeds and use up valuable agricultural land.

Road Crossing Contracts

It has been found advantageous to enter into blanket road crossing agreements with the several counties and, in some cases, railroads. This type of contract simplifies the work of the Bureau in that a separate agreement does not have to be made for each individual crossing but, more important, defines once and for all the responsibility of the counties for future maintenance.

SUMMARY AND CONCLUSIONS

The annual O & M cost for the ultimate project of 1,007,120 acres is estimated by the Bureau at $5,496,130. The estimate in this report is $4,935,911 or a reduction of $560,219. Per acre costs are $5.46 and $4.90 respectively.

Reductions are as follows:

Garrison Reservoir O & M	$251,780
Replacement items (net)	212,477
McClusky Canal slide removal	70,570
Miscellaneous	25,392
Total	$560,219

The annual O & M cost for the stage development of 406,620 acres is estimated by the Bureau at $2,171,985. The estimate in this report is $1,961,429 or a reduction of $210,556. Per acre costs are $5.34 and $4.82 respectively.

The annual O & M cost for the stage development of 105,000 acres is $508,408 or $4.85 per acre. The relatively low cost for this stage is accounted for by reduced canal and drain cleaning in the early years which offsets the higher per acre costs of the principal supply works.

If O & M of the Garrison Reservoir is determined to be an obligation of the District, all per acre estimates in this report should be increased by twenty-five cents.

Further studies of the cost of a tunnel to replace part of the McClusky canal is recommended.

The Bureau estimate of the miles of drains required appears excessive. Any reduction will reduce the O & M costs proportionately.

Three operating divisions instead of the four now proposed will

reduce the Coleharbor area cost by $.92 per acre and the total project cost by three cents.

The per acre costs for either of the three stages of development appear to be within the ability of the water users to pay with some assistance from the Conservancy District in the early years.

A P P E N D I X

This appendix contains the summary and detailed cost estimate for each feature comprising:

1. The ultimate project of 1,007,120 acres
2. The stage development of 406,620 acres
3. The stage development of 105,000 acres

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For 1,007,120 Acre Project

For 406,620 Acre Project

Garrison Diversion Unit
O & M Summary
Ultimate Project, 1,007,120 Acres

	Central Division	Sourie Division	Oakes Division	Colcharbor Divison	Project Totals
Irrigable Area	$ 362,480	$ 484,620	$120,200	$ 39,820	$1,007,120
Principal Supply Works	154,657	206,770	51,285	12,185	424,897
Distribution Works	1,301,796	1,906,623	470,985	210,010	3,889,414
Administration	220,694	270,684	90,855	39,367	621,600
Total Cost	$1,677,147	$2,384,077	$613,125	$261,562	$4,935,911
Cost Per Acre	$4.66	$4.92	$5.10	$6.57	$4.90
Bureau Estimate	$5.12	$5.48	$5.76	$7.30	$5.46

This estimate excludes an item that may or may not be chargeable to the districts. The Army Engineers have proposed a charge equivalent to twenty-five cents per acre as the Bureau's share of operation and maintenance of the Garrison Reservoir. If this is finally determined to be a proper charge, all estimates should be increased by twenty-five cents per acre.

DETAILED ESTIMATES

Snake Creek Pumping Plant

	By Army Engineers and Bureau of Reclamation	By Consultant
O & M	$ 15,500	$ 25,500
Replacement	104,400	-------
Energy	282,677	282,677
Total	$402,577	$ 308,177
	Cost Per Acre	$0.31

Present plan is for operation of the Snake Creek pumping plant by the Army Engineers. The installation of telemetering equipment makes it possible for the operators in the Garrison Dam power plant to also operate the pumping plant by remote control, thus doing away with the necessity of a duplicate staff of operators to run the pumps.

This plan also solves the problem of seasonal employment of the pump

operators since it is improbable that they would possess the necessary skills or be permitted by union regulations to participate extensively in the non-irrigation season maintenance program. Furthermore, machinists, welders and similar crafts would always be available from the power plant on short notice when required, all of which makes a large saving over the cost of independent operation of the pumping plant.

As discussed in the foregoing report under the heading "Replacement" all items of replacement cost have been deleted from the estimates and an appropriate amount added to the annual maintenance item, designed to keep the equipment in first class condition, and thus prolong its useful life. The Snake Creek pumping plant replacement estimate of $104,400 has been deleted and $10,000 additional maintenance added making a net annual reduction of $94,400.

The cost of energy is based on lifting 1,920,000 acre feet of water through heads ranging from 0 to 75 feet requiring an estimated 89,650,000 kilowatt hours of electrical energy each year. This amount, under the applicable Missouri River Basin rate schedule for pumping loads accounts for the energy estimate of $282,677. This amount will doubtless vary somewhat from year to year depending on how excessive or deficient rainfall influences the demand for irrigation water and on the fluctuation of water surface in the Garrison Reservoir.

McClusky Canal

	By Bureau	By Consultant
Personnel	$77,580	$ 51,658
Equipment	72,550	31,690
Materials & Supplies	16,850	16,850
Administration & General	8,790	5,002
Total	$175,770	$105,200
	Cost per acre	$0.10

Maintenance of the McClusky Canal which is 72 miles long with cuts ranging up to 100 feet presents one of the most indeterminate problems of any feature of the Garrison Unit. The combination of deep cuts and, in many places, unstable material and high groundwater table indicates almost

certain slides, some of which may be of considerable magnitude and persist over a number of years.

The proposed plan of construction of this canal is to first build a channel with a bottom width of 20 feet with a capacity of 2,900 c.f.s. to serve approximately 400,000 acres. When additional lands require more capacity, which conceivably might be as much as 20 years, the canal would be enlarged to a bottom width of 84 to 88 feet with capacities ranging from 7,200 to 8,200 c.f.s.

The Bureau OM estimate provides for complete rehabilitation of the canal by removal of slides as they occur in addition to the normal operation and maintenance. It has been the accepted policy of the Bureau to consider whatever work is necessary to produce a system in good working order as part of the construction cost of the project. It is evident that the conditions along the McClusky canal are such that it cannot be considered complete until it has reached a state of equilibrium.

Recommendation is therefore made that the contract between the Bureau and the District contain a provision that the Bureau will remove slides as they may occur until the canal becomes reasonably stable and the cost incurred be charged to the construction cost of the Unit. If a definite time limit for this arrangement is insisted on, it is suggested that it be for the duration of the development period for the first irrigation district to receive water.

It can be expected that most of the slides will occur during the first few years of operation while the ground water table adjacent to the canal is being lowered and that when enlargement becomes necessary, the slopes should be fairly stable. It is unfortunate both for the Bureau and the District that a tunnel to replace this canal cannot be economically justified. It is suggested that before final decision is reached, the estimates be re-examined on the basis of two parallel tunnels, the first to

have a capacity one half the ultimate capacity. By the time the second tunnel is required a much more accurate estimate of the actual number of acres in the ultimate project should be available and the second tunnel designed to meet this requirement.

Assuming that the agreement with the Bureau above recommended becomes effective, the maintenance cost estimate is subject to substantial reduction. The equipment estimate includes a 2½ c.y. dragline which is necessary for slide removal and could well be retained for periodic cleaning in future years. It is estimated that none of this would be required during the period the Bureau assumes slide removal as a part of construction. To provide for the lone-term operation, this machine has been included in the revised estimate on the basis of 960 hours annual operation. Elimination of the costs of personnel, equipment and general administration, associated with other than normal maintenance, results in the following reduction from the Bureau estimate:

Personnel	$25,922
Equipment	40,860
Adm. & General	3,788
Total	$70,570

Lonetree Dam and Reservoir
Wintering Dam and Seepage Pumping Plant

	By Bureau	By Consultant
Personnel	$ 6,221	$ 6,221
Equipment	1,000	1,000
Materials & Supplies	1,486	1,486
Energy	645	645
Power Facilities OM	3,101	1,620
Administration & General	647	548
Total	$13,100	$11,520
	Cost per acre	$0.01

Personnel requirements for this feature consist of a small portion of the time of the watermaster and clerk assigned to the McClusky canal; one

full time damtender and a part time laborer. Presumably the damtender would be stationed at the Lonetree dam and would operate the headgates at both this and the Jamestown dike. He could make periodic inspections of the Wintering dam until such time as the Velva canal is in operation when it would be desirable for the patrolman on that canal to handle its headgates.

The estimate for this feature appears adequate except that the replacement item for electrical facilities listed at $1,981 has been eliminated and an item of $500 added to Power Facilities OM. The reduction in the estimate by reason of this change is $1,580.

Central Division Office

	By Bureau	By Consultant
Personnel	$157,175	$150,140
Equipment	30,000	30,000
Administration & General	15,875	15,360
Total	$203,000	$195,500
Per acre	$.56	$.54

The Central Division office is the headquarters for areas aggregating 362,480 acres. It is headed by a division superintendant assisted by various specialists in the field of project management including accounting, property management, OM supervisor, hydraulic engineer, hydrographer, electrical and communications personnel and civil maintenance engineer whose duties cover their repsective fields in the entire division.

A central shop will be located at the office equipped to handle major repairs on all types of machinery and equipment used in the Division. The personnel estimate includes the mechanics and other craft workmen required to perform the work.

No provision is made for a mechanical engineer in the organization and in view of the large number of pumps and similar equipment, one is recommended. An electrical superintendent and two electricians also a

communication superintendent and two communication technicians are included. It is recommended that both of the superintendent positions be eliminated. These changes will result in a reduction of personnel costs as follows:

Deduct	1 electrical superintendent	$ 8,215
	1 communication superintendent	7,035
		15,250
Add	1 mechanical engineer	8,215
	Net reduction	$ 7,035

Central Division, McClusky Area

	By Bureau	By Consultant
Personnel	$26,133	Same
Equipment	11,195	
Materials & Supplies	5,070	
Administration & General	2,700	
Energy	92	
Power Facilities OM	424	
Replacement	none	
Total	$45,614	
Per acre	$4.23	

The McClusky canal area contains 10,790 irrigable acres scattered in small blocks along both sides of the canal, some to be served by pumping, and a more concentrated area adjacent to the Lonetree reservoir. There are no unusual OM problems but the land is rough and the soils have low permeability which results in an above normal amount of required drainage and a corresponding high drain maintenance cost. The estimated drainage requirement for this area includes 114 miles of deep, surface and tile drains involving an annual maintenance cost of $1.33 per acre compared to the normal cost of $.25 per acre on many existing projects.

Operations will be handled by a part time watermaster and clerk, the balance of their time being charged to other areas. Three ditchriders are provided which is higher than the average for an area of this size but is justified by the scattered tracts a considerable distance apart. Other

personnel includes the equipment operators, truck drivers, etc. required to maintain the laterals and drains. The estimate for the McClusky canal includes partolmen. It seems possible to assign a portion of this work to one of the ditchriders and eliminate one patrolman position.

No change in the estimate for this canal area is considered necessary.

Central Division, Sykeston Area

	By Bureau	By Consultant
Personnel	$ 81,680	$ 81,680
Equipment	50,265	50,265
Materials and Supplies	15,285	15,460
Administration and General	8,150	8,150
Energy	1,949	1,949
Power OM	5,023	5,491
Replacement	2,572	-----
Total	$164,924	$162,995
Per acre	$4.56	$4.40

The Sykeston area contains 37,000 irrigable acres widely scattered in the valleys of the James and Pipeston Rivers. The lands are rather rough and contain soils with lower than average permeabilities, both of which tend to increase OM costs because of high drain maintenance and relift pumping. Two major pumping plants and thirty-two relifts will serve the area. The drain maintenance cost for 465 miles of drains in this area is $50,322 or $1.36 per acre.

Personnel requirements are one watermaster (part time) and one clerk (part time), eight ditchriders, one patrolman during the irrigation season, and the equipment operators necessary to maintain the canals, laterals and drains.

Replacement cost for the two major pumping plants are $702 and for the power facilities $1,872. Additional OM of $175 and $468 are being added to materials and supplies and power OM respectivley and the replacement cost eliminated. This will result in a reduction in the estimate as follows:

Pumping plant replacement	$ 702
Power facilities replacement	1,872
	$2,574
Additional OM	645
Net Reduction	$1,929

No change is suggested in the other items making up the OM cost for the Sykeston area.

Central Division, Harvey Pumping Area

	By Bureau	By Consultant
Personnel	$19,994	$19,994
Equipment	10,088	10,088
Materials and Supplies	4,080	4,328
Administration & General	2,180	2,180
Energy	1,438	1,438
Power Facilities OM	2,540	2,972
Replacements	2,719	-----
Total	$43,039	$41,000
Per acre	$4.17	$3.98

The Harvey Pumping area contains 10,310 irrigable acres adjacent to the east end of Lonetree Reservoir. It will be served by the Harvey Pumping Plant with a 17 foot lift taking water directly from Lonetree Reservoir. Rough topography and soils of low permeability cause high drain and distribution system costs. Thirty-three relift plants are proposed to serve the area.

Personnel includes one watermaster (part time), one clerk (part time), two ditchriders and the equipment operators necessary to maintain the system. The drainage system consists of 98 miles of deep and surface drains on which the estimated maintenance is $9,898 or $.96 per acre.

Replacement costs for the Harvey Pumping Plant are $989 and for power facilities $1,730. Amounts of $248 and $32 are being added to the items of materials and supplies and power facilities OM respectively, and the replacement item eliminated. This will result in a reduction of the estimate

as follows:

Harvey Pumping Plant replacement	$ 989
Power facilities replacement	1,730
	$2,719
Additional OM	680
Net reduction	$2,039

No change is suggested in the other items making up the OM cost for the Harvey Pumping area.

Central Division, Berlin Pumping Area

	By Bureau	By Consultant
Personnel	$25,218	$25,218
Equipment	12,859	12,859
Materials & Supplies	5,750	6,430
Administration & General	2,455	2,455
Energy	7,359	7,359
Power Facilities OM	1,355	1,355
Replacement	2,720	-----
Total	$ 57,716	$55,676
Per Acre	$4.53	$4.36

The Berlin Pumping area contains 12,740 irrigable acres located along the north shore of Lonetree Reservoir. It is served by the Berlin Pumping Plant with a lift of 84 feet. Thirteen relift pumping plants are required. Topography is rough and soils low in permeability requiring an abnormal amount of constructed drains. The drainage system includes 132 miles of drains which is one mile for each 97 acres with an estimated maintenance cost of $1.32 per acre.

Personnel includes one watermaster (part time), one clerk (part time), three ditchriders and the required number of maintenance men to keep up the system.

Replacement cost for the main pumping plant is $2,720. An amount of $680 is being added to the materials and supplies item and the replacement

eliminated. This results in a reduction as follows:

Berlin Pumping Plant Replacement	$2,720
Additional OM	680
Net reduction	$2,040

No change is suggested in the other items making up the OM costs for the Berlin Pumping area.

Central Division, Harvey-Maddock Area

	By Bureau	By Consultant
Personnel	$140,063	$140,063
Equipment	89,890	89,890
Materials & Supplies	25,285	25,764
Administration & General	13,485	13,485
Energy	3,802	3,802
Power Facilities OM	7,485	8,878
Replacement	5,573	-----
Total	$285,583	$281,882
Per acre	$3.31	$3.27

The Harvey-Maddock area contains 86,260 irrigable acres served by the Devils Lake canal. The lands are in two blocks of about 40,000 acres each lying on each side of the north fork of the Sheyenne River. In general, the topography consists of long slopes and will require a slightly less mileage of constructed drains per acre to supplement the many deeply incised natural drainage channels. The estimated OM drain cost is, however, $1.15 per acre. Five major pumping plants and forty relifts will be required.

The personnel requirements include two watermasters, two watermaster clerks, seventeen ditchriders, two part time patrolmen and the equipment operators, truck drivers and laborers necessary to maintain the system.

Replacement cost for the five main pumping plants has been estimated at $1,915 and $3,658 for the power facilities making a total of $5,573. Additional OM of $479 is being added to materials and supplies and $1,393 to power facilities and the replacement item eliminated. This results in

a decrease as follows:

Replacement	$5,573
Additional OM	1,872
Net reduction	$3,701

No change is suggested in the other items making up the OM cost for the Harvey-Maddock area.

Central Division, New Rockford Area

	By Bureau	By Consultant
Personnel	$107,929	$107,929
Equipment	62,108	62,108
Materials & Supplies	25,260	25,401
Administration & General	13,470	13,470
Energy	1,667	1,667
Power Facilities OM	5,076	5,300
Replacement	1,456	-----
Total	$216,966	$215,875
Per acre	$3.23	$3.21

The New Rockford area contains 67,190 irrigable acres lying in the James and Sheyenne River valleys and extending from Lonetree Reservoir on the west to a point just north of Jamestown Reservoir on the east. Lands are generally level, the most of which are easily drained. Irrigable lands are checkerboarded throughout extenisve areas resulting in smaller than normal ditchrider areas. There are two major pumping plants and thirty-two relifts in the area. Drain mileage is estimated at 406 miles and the OM cost at about $.45 per acre.

Personnel requirement includes the equivalent of 1.4 watermasters and watermaster clerks, 14 ditchriders and equipment operators, truck drivers and laborers necessary to maintain the system.

Replacement costs for the two major pumping plants are estimated at $563 and for power facilities at $893 or a total of $1,456. Additional OM of $141 is being added to materials and supplies and $224 to power facilities and the replacement item eliminated. This results in a decrease as follows:

Replacement	$1,456
Additional OM	365
Net reduction	$1,091

No change is suggested in the other items making up the OM cost for the New Rockford area.

Central Division, Warwick-McVille Area

	By Bureau	By Consultant
Personnel	$ 72,479	$ 72,479
Equipment	42,268	42,268
Materials & Supplies	16,510	17,002
Administration & General	8,800	8,800
Energy	5,238	5,238
Power Facilities OM	6,675	7,120
Replacement	3,750	-----
Total	$155,720	$152,907
Per acre	$3.76	$3.70

The Warwick-McVille area contains 41,380 irrigable acres in the upper Sheyenne River valley served by the Warwick canal, a branch of the New Rockford Canal. The topography and soils of this area are such that sub-surface drainage will be effective without any unusual problems. Drains are estimated at 319 miles and the drain OM cost at $.56 per acre. Two major and twenty-two relift pumping plants are proposed.

Personnel requirement includes one watermaster, one watermaster clerk, nine ditchriders, one part time patrolman and the equipment operators, truck drivers, and laborers necessary to perform the maintenance work.

Replacement items include $1,970 for the two major pumping plants and $1,780 for power facilities, a total of $3,750. Additional OM of $492 is being included in materials and supplies and $445 in power facilities and the replacement item eliminated. The reduction in the cost estimate by reason of these changes is as follows:

Replacement	$3,750
Additional OM	937
Net reduction	$2,813

No change is suggested in the other items making up the OM cost for the Warwick-McVille area.

Central Division, Baldhill Area

	By Bureau	By Consultant
Personnel	$168,740	$168,740
Equipment	91,440	91,440
Materials & Supplies	36,940	37,169
Administration & General	19,700	19,700
Energy	4,434	4,434
Power Facilities OM	23,776	24,364
Replacement	3,262	------
Total	$348,292	$345,847
Per acre	$3.60	$3.57

The Baldhill area contains 96,810 irrigable acres located in the Baldhill Creek valley and served by the Baldhill and Cooperstown canals which are extensions of the New Rockford system. Topography and soils are good over the majority of the area with tighter soils and less favorable topography in the southern portion. The drain estimate includes 655 miles of drains on which the OM cost is $.68 per acre. Three major and twenty-nine minor pumping plants are proposed to serve the area.

Personnel for the Baldhill area includes 2 watermasters, 2 watermaster clerks, 1 part time patrolman, 20 ditchriders and the required number of equipment operators, truck drivers and laborers required to maintain the system.

Replacement items are $916 for the three major pumping plants and $2,346 for power facilities, a total of $3,262. Additional OM of $229 has been added to materials and supplies and $588 to power facilities and the replacement items eliminated. The reduction in the estimate by reason of these changes is as follows:

Replacement	$3,262
Additional OM	817
Net reduction	$2,445

No change is suggested in the other items making up the OM estimate for the Baldhill area.

Souris Division Office

	By Bureau	By Consultant
Personnel	$188,880	$181,835
Equipment	36,000	36,000
Administrative & General	19,160	19,165
Total	$244,000	$237,000

The Souris Division comprises 484,620 irrigable acres of which 5,000 are contained in the Velva area mostly in scattered blocks along both sides of the Velva canal, the Souris Loop area of 327,670 acres and the East Souris area of 151,950 acres.

The Souris Division will function as a unit under the direction of a Division Superintendnet, assisted by various specialists in the field of project management. Key personnel, as proposed by the Bureau, in addition to the division superintendent include a chief clerk, cost accountant, property warehouse man, OM superintendent, hydraulic engineer, hydrographer, electrical superintendent, communication superintendent, and maintenance civil engineer. Supporting personnel includes clerks, electricians, cummunication technicians and the mechanics required to operate the Division's central machine shop.

As indicated in the Central Division organization, it is believed a mechanical engineer should be added to the staff because of the large number of pump installations. It is likewise felt that the position of the electrical superintendent and communication superintendent can be dispensed with. With these changes, the organization appears to be adequate but not overstaffed.

The suggested changes result in a decrease as follows:

Delete	1 electrical superintendent	$ 8,215
	1 communciation superintendent	7,035
		$15,250
Add	1 mechanical engineer	8,215
	Net reduction	$ 7,045

Souris Division, Velva, Souris Loop and East Souris Areas

	By Bureau	By Consultant
Personnel	$816,550	$812,880
Equipment	484,312	484,312
Materials & Supplies	155,275	172,035
Administration & General	81,822	81,822
Energy	322,774	322,774
Power Facilities OM	30,085	32,800
Replacement	77,904	-------
Total	$1,968,722	$1,906,623
Per acre	$4.06	$3.94

The above summary includes the entire Souris Division contain 484,620 irrigable acres. Each of the three areas of which it is made up will be considered separately in the following discussion.

Souris Divison, Velva Canal Area

	By Bureau	By Consultant
Personnel	$11,683	$8,013
Equipment	6,680	6,680
Materials & Supplies	2,535	2,535
Administration & General	852	852
Total	$21,750	$18,080
Per acre	$4.35	$3.62

The Velva canal area consists of 5,000 acres of irrigable land in scattered blocks along both sides of the Velva canal. Low lift pumping from the canal will be necessary to serve some of the lands. Topography is godd but soil permeabilities are generally low resulting in an extensive drainage system and high drain maintenance costs. Anticipated drains total 43 miles and the estimated annual maintenance cost is $.87 per acre.

Personnel requirements are 1 watermaster, 1 watermaster clerk (10% of their time in this area), 2 ditchriders and the necessary number of maintenance employees. Two ditchriders seem excessive for the area irrigated although it is recognized that the tracts are far apart. It is suggested that one of the three patrolmen assigned to the Velva canal help out as necessary and eliminate one ditchrider position. This will result in a redcution in the estimate of $3,670.

Souris Division, Souris Loop Area

	By Bureau	By Consultant
Personnel	$530,657	Same
Equipment	325,842	
Materials & Supplies	101,000	
Administrative & General	55,370	
Energy	3,578	
Power Facilities OM	13,187	
Replacement	none	
Total	$1,029,634	
Per acre	$3.15	

The Souris Loop area of 327,670 irrigable acres is situated in the eastern half of the Souris River loop and extends northward to the Canadian boundary. Lands are largely part of a glacial lake plain, with smooth surface and gentle slopes making them easy to reach with a simple distribution system. The area is served by the Velva canal. Over 2,800 miles of drains are proposed with an estimated annual maintenance cost of $1.02 per acre.

Personnel includes 7 watermasters, 7 watermaster clerks, 66 ditchriders, 3 patrolmen during the irrigation season and equipment operators, truck dirvers, etc. as required. The watermaster and ditchrider requirements are, as in the case of most areas, based on the assumption that each watermaster will supervise about 50,000 acres and each ditchrider will serve 5,000 acres. There are no major pumping plants but 149 minor relift plants are proposed.

The detailed estimates of OM costs to be incurred strictly follow the criteria set up for personnel and equipment. No changes are suggested other than the comments heretofore made applying to all areas.

Souris Division, East Souris Area

	By Bureau	By Consultant
Personnel	$274,210	$274,210
Equipment	151,790	151,790
Materials & Supplies	51,740	68,500
Administration & General	25,600	25,600
Energy	319,196	319,196
Power Facilities OM	16,898	19,613
Replacement	77,904	-------
Total	$917,338	$858,909
Per acre	$6.03	$5.65

The East Souris area contains 151,950 irrigable acres stretching along the east side of the Souris River from the Canadian boundary southerly almost to the point where the Velva canal crosses the Souris River on its way north to serve the Souris Loop area. Westhope dam will be constructed on the Souris River near the Canadian border to prevent return flows escaping into Canada. Westhope pumping plant will lift water some 90 feet from back of this dam into the East Souris canal. The water supply for the East Souris area will, therefore, depend on return flows accumulating in the Souris River augmented by water spilled into the river directly from the Velva canal. The Berwick pumping plant will be located near the southern end of the East Souris canal to serve the southern end of the

area and make possible the diversion of excess water into the Sheyenne River basin. There are 15 major and 113 minor relift pumping plants proposed for the area. Over 1,799 miles of drains are proposed with an estimated annual OM cost of $1.24 per acre.

The higher than average OM cost for the East Souris area as a whole might suggest its elimination from the project. However, some circumstances for which this area is not wholly responsible must be considered. It order not to lose the return flow from this and the Souris Loop area to Canada, it is necessary to take it back southward and the East Souris canal is the only practical way to do it. Perhaps some value could be assigned to this recaptured water and a credit allowed to the East Souris area for taking care of it.

Personnel requirements are 3 watermasters, 3 watermaster clerks, 30 ditchriders, 8 pump operators, 2 patrolmen during the operating season and the equipment operators etc. required to maintain the system. No change in the number of people required to operate and maintain the system as now proposed is suggested.

Due to the large number of pumping plants and the transmission lines to serve them, replacement costs are high in this area. The estimate for pumping plant replacement is $67,045 and for power facilities $10,859, a total of $77,904. In lieu of these items additional OM of $16,760 has been added to materials and supplies and $2,715 to power facilities. These changes result in a decrease as follows:

Replacement costs	$77,904
Additional OM	19,475
Net reduction	$58,429

Oakes Division Office

	By Bureau	By Consultant
Personnel	$67,215	$64,705
Equipment	11,100	11,100
Administrative & General	6,695	6,695
Total	$85,010	$82,500

The Oakes Division contains 120,200 irrigable acres lying in the valleys of the James and Wild Rice Rivers and will function as a unit under the direction of a Division Superintendent assisted by various specialists. Key personnel proposed by the Bureau in addition to the superintendent include a chief clerk, property warehouseman, OM superintendent, an electrician, a communication technician, and a hydraulic (civil) engineer. Other personnel include clerks and the mechanics necessary to operate the Division's central machine shop.

The Bureau estimate provides for paying the same salaries to the Division Superintendent and the OM superintendent as are paid in the much larger Central and Souris Divisions. It is felt that one grade lower for each of these positions can be justified. These changes result in decreases as follows:

Division Superintendent, GS-14 to GS-13	$1,330
OM Superintendent, GS-12 to GS-11	1,180
Total reduction	$2,510

The Division hardly justifies the full time employment of a mechanical engineer so this position has not been added to the organization. The engineer assigned to the Central Division could serve occasionally as needed.

Oakes Division, LaMoure Area

	By Bureau	By Consultant
Personnel	$21,043	$21,043
Equipment	8,533	8,533
Materials & Supplies	4,310	5,354
Administration & General	2,950	2,950
Energy	7,974	7,974
Power Facilities OM	5,675	7,364
Replacement	10,930	------
Total	$61,415	$53,218
Per acre	$5.03	$4.36

The LaMoure area contains 12,200 irrigable acres in small blocks scattered along the James River between Jamestown and Oakes. The land will be served by 13 pumping plants along the James River, having lifts from 27 to 85 feet. Five relift plants are proposed. Ditchriders will be required to travel considerable distances consequently the area served by each ditchrider will be about 1,000 acres less than the average. Drainage is not an important item. There are no deep drains and the 60 miles of surface and tile drains are estimated to have an annual OM cost of $.07 per acre.

Personnel consists of 1 watermaster and 1 watermaster clerk (each being used one-fifth of his time in this area), 3 ditchriders and part time equipment operators, etc. as required for the maintenance work. No changes are suggested in the organization.

Replacement of $4,174 for pumps and $6,756 for power facilities are included in the estimate. In lieu of these $1,044 additional OM has been added to materials and supplies and $1,689 to power facilities resulting in a decrease as follows:

Replacement	$10,930
Added OM	2,733
Net reduction	$ 8,197

Oakes Division, Oakes Area

	By Bureau	By Consultant
Personnel	$185,045	$185,045
Equipment	98,211	98,211
Materials & Supplies	41,470	44,992
Administration & General	20,280	20,280
Energy	41,652	41,652
Power Facilities OM	25,265	27,587
Replacement	23,404	------
Total	$435,327	$417,767
Per acre	$4.03	$3.88

The Oakes area contains 108,000 irrigable acres lying in the valleys of the James and Wild Rice Rivers, about 50,000 of which are in South

Dakota. Water will be delivered to the area by pumping from the James River through the Oakes pumping plant into the Oakes canal. From the Oakes canal water will be pumped into the Taayer reservoir to provide additional storage and control. Ten major pumping plants and 98 minor relift plants are proposed. Drains are estimated at 945 miles with an annual OM cost of $.86 per acre.

Personnel includes 2 watermasters and 2 watermaster clerks (part of time changed to LaMoure area), 22 ditchriders, 12 pump operators during the irrigation season and the equipment operators, etc., required to maintain the system. No changes in the organization are suggested.

Replacement cost on pumping plants is estimated at $14,107 and $9,296 on power facilities. Additional OM of $3,522 has been added to materials and supplies and $2,322 to power facilities in lieu of the replacement items. This results in a decrease in the estimate as follows:

Replacement	$23,403
Added OM	5,844
Net reduction	$17,559

Coleharbor Division Office

	By Bureau	By Consultant
Personnel	$26,725	Same
Equipment	6,320	
Administrative & General	3,555	
Total	$36,600	

The Coleharbor Division contains 39,820 irrigable acres adjacent to the south shore of the Snake Creek reservoir and will function as a unit under the direction of a Division Superintendent assisted by a chief clerk, a clerk-steno, electrician, radio repairman and a shop foreman. Salaries have been fixed in accordance with the lesser responsibilities by reason of the small area. No change is suggested in the estimate. However,

recommendation is made that this area be added to the Central Division and the Coleharbor Division office eliminated.

Coleharbor Division, Coleharbor Area

	By Bureau	By Consultant
Personnel	$79,610	$79,610
Equipment	44,670	44,670
Materials & Supplies	16,672	20,022
Administrative & General	7,435	7,435
Energy	44,335	44,335
Power Facilities OM	11,838	13,938
Replacement	21,803	------
Total	$226,363	$210,010
Per acre	$5.68	$5.28

The Coleharbor area of 39,820 irrigable acres will be served by a pumping plant with 115 foot lift taking water directly from Snake Creek reservoir. Because of its isolated position in respect to other irrigable areas, it does not share in any of the principal supply works except Snake Creek pumping plant. Topographic deficiencies and soils with low permeabilities necessitate a large number of drains and as a result the drain maintenance cost is the highest for any area in the Garrison Unit. It is estimated that 547 miles of drain will be required with an annual OM cost of $1.45 per acre. There will be 5 major pumping plants and 32 minor relift plants.

Personnel requirements are estimated to be 1 watermaster, 1 watermaster clerk, 3 pump operators during the irrigation season, 8 ditchriders and the equipment operators, etc., necessary to maintain the system.

Replacement costs are estimated at $13,398 for the pumping plants and $8,405 for the power facilities. Additional OM of $3,350 is being added to materials and supplies and $2,100 to power facilities in lieu of the replacement charge.

This results in a decrease in the estimated cost as follows:

Replacement	$21,803
Added OM	5,450
Net reduction	$16,353

Devils Lake Restoration

A part of the multi-purpose Garrison Diversion Unit proposes to divert fresh water into Devils Lake. A feeder canal with a capacity of 400 c.f.s. leading northward from the Devils Lake canal will deliver water to the lake near Minnewaukan. An additional feeder canal will be constructed between Devils and Stump lakes and an outlet canal from Stump lake to convey water back to the Sheyenne River.

In estimating OM costs for the Devils Lake restoration plan, Snake Creek pumping cost for the actual diversions into Devils Lake were included along with the estimated OM cost of the feeder and outlet canals. A share of the costs of joint facilities such as the McClusky canal, Lonetree reservoir and Devils Lake canal were not included.

Estimated costs are:

Snake Creek Pumping energy	$13,848
Devils Lake feeder canal	3,510
Stump Lake feeder canal	5,000
Stump Lake outlet canal	1,068
Total	$23,426

Since the cost of operation and maintenance of this feature is not chargeable to the irrigation water users it has not been taken into the estimates.

Garrison Diversion Unit
O & M Summary
Stage Development 406,620 Acres

	Central Division	Souris Division	Project Totals
Irrigable Area	$ 249,180	$157,440	$ 406,620
Principal Supply Works	155,795	98,437	254,232
Distribution Works	848,493	596,629	1,445,122
Administration	155,000	107,075	262,075
Total Cost	$1,159,288	$802,141	$1,961,429
Cost Per acre	$4.65	$5.09	$4.82
Bureau Estimate	$5.12	$5.69	$5.34

This estimate excludes an item that may or may not be chargeable to the districts. The Army Engineers have proposed a charge equivalent to twenty-five cents per acre as the Bureau's share of operation and maintenance of the Garrison Reservoir. If this is finally determined to be a proper charge, all estimates should be increased by twenty-five cents per acre.

DETAILED ESTIMATES

Snake Creek Pumping Plant

	By Army Engineers and Bureau of Reclamation	By Consultant
O & M	$ 15,500	$ 14,500
Replacement	34,800	-------
Energy	133,531	133,531
Total	$183,831	$148,031
	Cost per acre	$0.36

For this stage development the Snake Creek pumping plant would be built for the ultimate project but only two of the six pumping units installed. The Bureau estimate contemplates the same OM cost as would be

incurred in the ultimate project. It is felt that the cost should be somewhat less and has been revised by using one-third of the OM estimate plus $6,000. The latter amount has been added because it will take nearly as much operator time to run two pumps as it would six. The discussion relative to operation of the plant by the Army Engineers and the treatment of replacement costs contained in the ultimate project estimate apply to this partial installation. Therefore OM has been increased by $3,333 (1/3 of the $10,000 added in the ultimate plan) and the replacement item eliminated. These changes will reduce the estimate as follows:

Replacement		$34,800
Reduced OM	$4,333	
Added OM	3,333	1,000
Net reduction		$35,800

McClusky Canal

	By Bureau	By Consultant
Personnel	$49,457	$46,493
Equipment	51,280	28,521
Materials & Supplies	11,950	15,165
Administration & General	5,930	4,502
Total	$118,617	$ 94,681
Cost per acre		$0.23

The proposed plan of construction under this stage development is to build the canal with a bottom width of 20 feet with a capacity of 2,900 c.f.s. The remarks made under the ultimate plan concerning Bureau responsibility for removal of slides apply also to this stage. In fact, more serious slides may be expected during the first few years than when the canal is enlarged because the high ground water table which is the major cause of sliding will have been lowered and the slopes more or less stabilized.

It is not evident that normal OM costs will be materially different for either size of canal. Operating personnel will be the same. The area

of the slopes on which seeding or other protection is required will not change. Normal cleaning of the canal section will probably be somewhat reduced and the smaller size of some of the structures may cost less to maintain.

It is felt that Bureau estimate for this stage does not allow enough for slide removal but, if this is accepted as Bureau responsibility, the deficiency does not affect the normal OM cost. In the Consultant's estimate of cost for the ultimate canal, a rather thorough analysis of the normal OM cost was made. For the estimate under this stage, an across the board reduction of 10% from that for the ultimate section has been assumed. This is shown in the following:

Normal OM Costs For

	Ultimate Section	Stage Section	Difference
Personnel	$ 51,658	$46,493	$ 5,165
Equipment	31,690	28,521	3,169
Materials & Supplies	16,850	15,165	1,685
Administration & General	5,002	4,502	500
Total	$105,200	$94,681	$10,519
Net reduction from Bureau estimate for all items			$23,936

Lonetree Dam and Reservoir
Wintering Dam and Pumping Plant

The OM costs for this feature are the same in each estimate since exactly the same facilities are required in either case.

A summary of the estimate is as follows:

	By Bureau	By Consultant
Personnel	$ 6,221	$6,221
Equipment	1,000	1,000
Materials & Supplies	1,486	1,486
Energy	645	645
Power Facilities OM	3,101	1,620
Administration & General	647	548
Total	$13,100	$11,520
Net reduction		$ 1,580
Cost Per Acre		$.03

Stage Development, Project Office and Central Division Office

	By Bureau	By Consultant
Personnel	$123,845	Same
Equipment	18,770	
Administrative & General	12,385	
Total	$155,000	
Cost per acre	$0.38	

For the stage development of 406,620 irrigable acres, two instead of four divisions are proposed. These are the Central and Souris Divisions. In the interest of economy the Project Office and the Central Division office are combined and the above estimate includes the key personnel in both. The estimate differs from that under the ultimate development plan in that the time of the Project Manager and certain others whose duties extend to both Divisions is proportioned between the Divisions. The Central Division Superintendent and his staff, including the mechanics, etc required to operate a central shop are included.

No provision is made in the Bureau estimate for a mechanical engineer. This position has been added and, for the reasons stated in the report on ultimate development, the positions of electrical superintendent and communication superintendent eliminated. These changes offset each other and make no appreciable change in the estimate.

Central Division, New Rockford Area

	By Bureau	By Consultant
Personnel	$107,929	$107,929
Equipment	62,108	62,108
Materials & Supplies	25,260	25,401
Administration & General	13,470	13,470
Energy	1,667	1,667
Power Facilities OM	5,076	5,300
Replacement	1,456	-----
Total	$216,966	$215,875
Per acre	$3.23	$3.21

The New Rockford area containing 67,190 irrigable acres is identical to the ultimate plan and the remarks covering this area apply to this stage development.

The estimated reduction in the estimate amounts to $1,091.

Central Division, Harvey-Maddock Area

	By Bureau	By Consultant
Personnel	$127,600	$127,600
Equipment	81,637	81,637
Materials & Supplies	23,000	23,000
Administration & General	12,300	12,300
Energy	1,875	1,875
Power Facilities OM	5,135	5,517
Replacement	1,528	------
Total	$253,075	$251,929
Per acre	$3.22	$3.20

The Harvey-Maddock area contains 78,570 irrigable acres proposed for development under this stage compared with 86,260 acres in the ultimate plan. The Legried and Hagel pumping areas are deferred. Additional OM of $382 has been added to power facilities OM and the replacement item eliminated making a net reduction of $1,146.

Central Division, Baldhill Area

	By Bureau	By Consultant
Personnel	$159,000	$159,000
Equipment	86,100	86,100
Materials & Supplies	34,744	34,973
Administration & General	18,600	18,600
Energy	4,434	4,434
Power Facilities OM	23,776	24,364
Replacement	3,262	------
Total	$329,916	$327,471
Per acre	$3.62	$3.59

The Baldhill area contains 91,220 irrigable acres under this stage development compared with the ultimate area of 96,810 acres. The lands to be served by Lateral 39.6 are deferred. Replacement items are $916 for pumping plants and $2,346 for power facilities. Additional OM of $229 has been added to materials and supplies and $588 to power facilities. The reduction in the estimate by reason of these changes is as follows:

Replacement	$3,262
Additional OM	817
Net reduction	$2,445

Central Division, LaMoure Area

	By Bureau	By Consultant
Personnel	$21,043	$21,043
Equipment	8,533	8,533
Materials & Supplies	4,310	5,354
Administration & General	2,950	2,950
Energy	7,974	7,974
Power Facilities OM	5,675	7,364
Replacement	10,930	-----
Total	$61,415	$53,218
Per acre	$5.03	$4.36

The LaMoure area of 12,200 acres is identical with the ultimate plan. The area will be administered by the Central Division office until such time as additional areas in the vicinity of Oakes are developed.

Replacement of $4,174 for pumps and $6,756 for power facilities are included in the estimate. In lieu of these, $1,044 additional OM has been added to materials and supplies and $1,689 to power facilities resulting in a decrease as follows:

Replacement	$10,930
Added OM	2,733
Net reduction	$ 8,197

Stage Development, Souris Division Office

	By Bureau	By Consultant
Personnel	$87,875	$80,950
Equipment	16,760	16,760
Administration & General	9,365	9,365
Total	$114,000	$107,075

Under stage development, the Souris Division contains 157,440 irrigable acres of which 114,890 are in the Souris area and 42,550 in the East Souris area.

The Souris Division will function as a unit under the direction of a Division Superintendent, assisted by various specialists in the field of project management. No mechanical engineer is provided and, in this case, none is considered necessary since the one assigned to the project office can perform the necessary work. The part time positions of electrical superintendent and communication superintendent can be dispensed with. This makes a decrease in the estimate as follows:

Delete electrical superintendent	$4,110
Communication superintendent	2,815
Total reduction	$6,925

Stage Development, Souris Division, Souris Loop Area

	By Bureau	By Consultant
Personnel	$178,762	Same
Equipment	102,252	
Materials & Supplies	35,400	
Administration & General	16,650	
Energy	192	
Power Facilities OM	522	
Replacement	0	
Total	$333,778	
Per acre	$2.91	

The Souris Loop area under this stage development contains 114,890 acres situated in the southwestern quarter of the total ultimate area.

Personnel includes 2 watermasters and 2 watermaster clerks, 23 ditchriders, 2 partolmen during the irrigation season and the equipment operators, etc. necessary to maintain the system. There are no major pumping plants and 14 minor relift plants.

The criteria established in the ultimate project estimates have been applied to maintaining canals, laterals, and drains in this area. No changes in the estimate are suggested.

Stage Development, Souris Division, East Souris Area

	By Bureau	By Consultant
Personnel	$ 74,325	$ 74,325
Equipment	43,826	43,826
Materials & Supplies	19,000	25,369
Administration & General	7,120	7,120
Energy	106,545	106,545
Power Facilities OM	5,314	5,666
Replacement	26,884	--------
Total	$283,014	$262,851
Per acre	$6.65	$6.20

The East Souris area under stage development contains 42,550 irrigable acres in the Willow City vicinity. It will require construction of the Westhope dam and pumping plant but only enough pumping units will be installed initially to serve the reduced area.

Personnel are 1 watermaster, 1 watermaster clerk, 9 ditchriders and equipment operators etc. required to maintain the system. The cost for this area is very high but as explained in the report on the ultimate section, its development is almost necessary to utilize water that would otherwise be lost to Canada.

Estimated replacement costs are $25,474 for the pumping plants and $1,410 for power facilities. Additional OM of $6,369 has been added to materials and supplies and $352 to power facilities in lieu of the replacement items. These changes reduce the estimate as follows:

Replacement	$26,884
Added OM	6,721
Net reduction	$20,163

OPERATION AND MAINTENANCE ESTIMATE FOR INITIAL DEVELOPMENT OF 105,000 ACRES

Summary
Stage Development, 105,000 Acres

Irrigable Area	105,000 Acres
Principal Supply Works	$ 83,520
Distribution Works	348,888
Administration	76,000
Total	$508,408
Per acre	$4.85

Tis estimate excludes an item that may or may not be chargeable to the districts. The Army Engineers have proposed a charge equivalent to twenty-five cents per acre as the Bureau's share of operation and maintenance of the Garrison Reservoir. If this is finally determined to be a proper charge, the estimate should be increased by twenty-five cents per acre.

The estimates for both the 406,000 acre stage and the ultimate development of 1,007,000 acres are based on the costs that may be expected when the total number of acres in each case are under irrigation. It is impossible at this time to accurately forecast the rate of development that will be attained. It seems safe to assume that it will be at least 20 years before the 406,000 acres are all under irrigation and possibly 50 years before the ultimate project is completed. By that time the project lands should have reached a mature state of development and the production and economy of the entire area improved to the point where the irrigation districts are able to assume the full operation and maintenance costs.

The most critical period with which the water users and the Conservancy District are faced is when relatively few acres are available to share the cost. Certain parts of the irrigation system, particularly the principal supply works, are not susceptible of a reduction in OM costs

proportionate to the number of acres being irrigated.

In order to present a realistic picture of the conditions that will be faced in the first few years, an estimate has been prepared based on the development of approximately 105,000 acres. The initial areas used for estimating purposes have been selected, with the advice of Bureau and Conservancy District officials, as shown in the list below. These particular areas are subject to modification depending on the interest in irrigation that develops locally, the feasibility of building irrigation works to serve them and other factors not possible to determine at this time.

Suggested Areas for Initial 105,000 Acres

1.	Harvey-Maddock area west of the North Fork of the Sheyenne River and the Esmond area	30,000 acres
2.	Warwick-McVille area	30,000
3.	Oakes area north of state line	35,000
4.	LaMoure area	10,000
	Total	105,000 acres

In preparing this estimate, an attempt has been made to include only those items of OM cost that must, of necessity, be incurred during the time it takes to develop these areas. For instance, at the various pumping plants only a sufficient pump capacity will be installed and operated to serve the acres being developed. The McClusky canal will have been built to a capacity capable of serving the 406,000 acre project so less thorough cleaning will be required to maintain the capacity for 105,000 acres.

Many of the proposed drains will not have been built and some of those that are required will not need to be cleaned during the early period. And finally, the project supervisory staff will contain employees

in somewhat lower pay grades than are justified under the added responsibility of a larger project.

Following are the estimated OM costs for the irrigation works necessary to provide water for 105,000 acres and the supervisory personnel to administer them. As in the estimate for the larger project, all replacement costs have been excluded and an appropriate increase made in the normal maintenance items to offset them. (See discussion of replacement costs under "Replacement", in the portion of this report preceeding the appendix.)

The estimates have been prepared in part by the Bureau and in part from independent studies by the Consultant.

Project Headquarters Office

Personnel	$62,065
Equipment	9,700
Supplies (shop)	600
Administration & General	3,635
	$76,000

One project headquarters office will supervise the work in all of the areas. All accounting, preparation of water bills and similar work will be done there. The office will have overall control of the water supply for each area and be responsible for its measurement. A reasonably well equipped machine shop will handle all major repairs on maintenance equipment, pumps, and other items that cannot be done locally with the facilities in each watermaster district. Only a skeleton organization is proposed in the shop since it is expected that ditchriders and other field men will be available to help out during the non-irrigation season.

This estimate contemplates the requirement when irrigation of the 105,000 acres is nearly all accomplished. Obviously, in the first few years the staff will be somewhat smaller. Following is the project office staff and pay rates used in this estimate:

Project Manager	GS-13	$9,635
Chief Clerk	GS-9	5,845
Clerks (2)	GS-5	8,150
Clerk-Stenographer	GS-3	3,430
Hydrographer (Civil Engineer)	GS-9	6,115
Electrician - 2080 hours @ $2.38		4,950
Communication Technician - 2080 hrs. @ $2.38		4,950
Maintenance Foreman - 2080 hrs. @ $2.50		5,200
Shop Foreman - 2080 hrs. @ $2.50		5,200
Heavy Duty Mechanic - 2080 hrs. $2.38		4,950
Truck Driver - 2080 hrs. @ $1.75		3,640
		$62,065

Principal Supply Works, Snake Creek Pumping Plant

O & M	$ 7,250
Energy	29,750
Total	$37,000

The OM estimate is based on the operation of one pump for about three months each year. The amount used is computed by using one-sixth of the OM estimate for the ultimate project plus $3,000. The latter amount is added because it will require nearly as much operator time to run one pump as it would six but taking into account the fact that under this stage development, the pump will be operated a shorter period. The energy cost is directly proportional, on an acreage basis, to that required for the ultimate project.

Principal Supply Works, McClusky Canal

Personnel	$18,255
Equipment	8,320
Materials and Supplies	6,770
Administration and General	1,655
Total	$35,000

The estimate is based on the assumption that the Bureau removed whatever slides occur during the years required to place the first 105,000 acres under irrigation. Operating personnel is estimated on the basis that the canal will be operated about three months each year. Consideration has also been given to the fact that the canal will never

be called on to carry more than one-half its capacity so that cleaning need not be so thorough as would otherwise be required. This has the effect of reducing the maintenance cost materially.

Principal Supply Works, Lonetree Dam and Reservoir
Wintering Dam and Pumping Plant

Personnel	$ 6,221
Equipment	1,000
Materials and Supplies	1,486
Energy	645
Power Facilities OM	1,620
Administration and General	548
Total	$11,520

The OM costs for this feature are the same for this stage development as for all others since the same facilities are required in each case.

Harvey-Maddock Area, 30,000 Acres

Personnel	$52,927
Equipment	16,970
Materials and Supplies	8,000
Energy	2,200
Power Facilities OM	5,206
Administration & General	4,267
Total	$89,570
Per acre	$2.98

The Harvey-Maddock area used in this estimate is that contained between the Soo railroad running through Harvey and the North Fork of the Sheyenne River plus the land in the vicinity of Esmond. About 40 miles of the Devils Lake canal will be required to supply water to the area and to reach the Legreid pumping plant, from which the Esmond tract is served.

The system includes the Selz, Hazel, and Legreid major pumping plants and 17 minor relifts. The distribution system is estimated to cover 36,000 acres in order to be sure of 30,000 net irrigable acres. This will require approximately 165 miles of laterals.

No extensive cleaning of the Devils Lake canal is contemplated since

the canal will be 2½ times the capacity required to this area. Only limited drain cleaning is included because most drains will not have been built long enough to require it.

Personnel includes 1 watermaster, 1 watermaster clerk, 6 ditchriders, 1 patrolman (6 months), 1 maintenance foreman, 2 equipment operators (8 months each), and 4 truck driver-laborers for 8 months per year.

Warwick-McVille Area, 30,000 Acres

Personnel	$56,478
Equipment	20,730
Materials and Supplies	8,100
Energy	4,220
Power Facilities OM	7,375
Administration & General	4,847
Total	$101,750
Per acre	$3.39

The Warwick-McVille area used in this estimate is essentially the same as in the ultimate area but contemplates irrigating only 30,000 acres of the total 41,380 acres. Facilities to supply the water consist of the Hamburg Diversion Dam, 17.9 miles of the New Rockford canal, 9.2 miles of Lateral N.R. 17.8, 65 miles of the Warwick canal and about 221 miles of laterals. The lateral system is estimated for 36,000 acres in order to insure a net of 30,000. No extensive cleaning of the New Rockford canal and Lateral N.R. 17.8 is planned because they will be built with much larger capacity than required for the 30,000 acres now contemplated. The Warwick canal will require minor cleaning as will some of the laterals and drains. The additional mileage of both the Warwick canal and lateral system, the greater energy requirement, and more power facilities account for the higher OM costs for this area than that for the same number of acres in the Harvey-Maddock area.

Personnel cost used in the estimate includes 1 watermaster, 1 watermaster clerk, 6 ditchriders, 1 maintenance foreman, 3 equipment

operators (8 months each), and 5 truck driver-laborers for 8 months each.

LaMoure Area, 10,000 Acres

Personnel	$16,830
Equipment	6,110
Materials & Supplies	3,000
Energy	6,500
Power Facilities OM	6,440
Administration & General	1,920
Total	$40,800
Per acre	$4.08

The initial development in the LaMoure area contemplates irrigation of 10,000 acres of the 12,200 total. The area extends for a distance of over 40 miles along the James River and 11 of the ultimate 13 pumping plants are included in the estimate. Since the area contains several non-contiguous tracts, none of the laterals will be large so cleaning will not be costly. The drainage system consists only of surface drains.

Personnel requirement is estimated to be 1 watermaster and 1 watermaster clerk, each spending about 1/5 of their time here, 2 ditchriders, and part time service by 1 maintenance foreman, 1 equipment operator and 2 truck driver-laborors. It is realized that two ditchriders will have unusually long rides and it is suggested that the damtender at Jamestown Dam might do some of the work in the northern end of the area.

This area is particularly well suited for turning the OM responsibility over to the irrigation district soon after it is in operation. There are no complicated canals or structures and the small, isolated tracts lend themselves well to cooperative operation and maintenance.

Oakes Area, 30,000 Acres

Personnel	$53,754
Equipment	20,730
Materials & Supplies	12,952
Energy	14,550
Power Facilities OM	9,222
Administration & General	5,560
Total	$116,768

The Oakes area used in this estimate includes 30,000 acres contained within the 52,000 on the North Dakota side of the state line. It has been assumed that all facilities except the pumping unit and sub-station capacity will be built, as far as required to serve the 30,000 acres, to the full ultimate capacity. This will reduce maintenance costs in the early years because, with the excess capacity, cleaning will not be required in the larger canals to any great extent. Only sufficient pump capacity will be installed to meet the requirement of the reduced area and energy costs are computed accordingly.

Personnel includes 1 watermaster and 1 watermaster clerk, each spending 4/5 of their time in this area, 6 ditchriders and part time service by 1 maintenance foreman, 3 equipment operators, and 5 truck driver-laborers.

Administrative and General Expenses Items

Throughout the estimates an item appears titled "Administration and General". This averages about five per cent of the total cost and since it comprises a significant amount, the following Table I is included to show the items of which it is made up, exclusive of supervisory personnel. It should not be inferred that costs will be incurred under every item but more will be required if and when the district assumes responsibility for any part of the irrigation plant than when it remains under Bureau responsibility. For example, the government does not carry insurance nor do employees come under social security.

TABLE I
ADMINISTRATIVE AND GENERAL EXPENSE
FOR OPERATION AND MAINTENANCE

Engineers misc. surveys, records, and supplies
Directors fees
Attorney retainer
Audit fees
Office supplies
Postage
Maps
Office utilities
Telephone and telegraph
Maintenance of office machines
Box rent
Maintenance, office building and grounds
Travel
Surety bond premiums
Employees liability insurance
Automobile insurance
River pump insurance
House insurance
Office building insurance
Damage claims and damage suit costs
Advertising
Donations
Election expense
First aid supplies
Sundry fees and expense
Miscellaneous office expense
Dues and subscriptions
Social Security

Distribution of Costs - Other Projects

In order to see how the distribution of costs for the principal items making up the Garrison Diversion Unit OM estimate compare with other projects and to make sure that none of the items are seriously out of line, Table II is submitted. This shows the weighted average in per cent of total cost, excluding pumping power, for a list of thirteen selected projects.

TABLE II
O & M COSTS
(Excluding Pumping Power)

Project or Unit	Personnel	Equipment	Materials and Supplies	Adm. & General Expenses
Boise Board of Control	57.5	20.1	12.3	10.1
Central Valley Project	70.6	16.9	6.1	6.4
Gering-Ft. Laramie Irrig. Dist.	68.4			
Pathfinder Irri. District	64.9			
Salt River Water Users' Assn.	51.3	14.0	13.7	21.0
Yuma County Water Users' Assn.	58.0	20.0	9.0	13.0
Buffalo Rapids Project	48.5	8.2	25.6	17.7
Arch Hurley Conservancy District	66.6	9.4	12.8	11.2
Taber Irri. Dist., Alberta, Canada	57.2	21.4	12.2	9.2
Mercedes District	66.5		26.2	7.3
Harlingan District	51.2		39.9	8.9
El Jardin District	61.1		30.2	8.7
La Feria District	55.8		38.2	6.0
Averages	59.8			10.9
Weighted Average	60	19	13	8
Garrison Diversion Unit (estimate)	58.8	29.6	11.7	6.4