RECLAMATION

Managing Water in the West

Update of Garrison Diversion Unit Principal Supply Works Costs

FINAL - October 2005

U.S. Department of the Interior
Bureau of Reclamation

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INTRODUCTION

Purpose

The purpose of this report is to develop updated cost estimates for construction, operation, maintenance, and replacement (OM&R) of features associated with the Principal Supply Works (PSW), Garrison Diversion Unit (GDU) of the Pick-Sloan Missouri Basin Program. The primary features included in the PSW are the Snake Creek Pumping Plant (SCPP), Lake Audubon, McClusky Canal (McCC) and New Rockford Canal (NRC). The PSW has been under continual operation and maintenance since completion of construction in the early 1990s. However, some major rehabilitation activities or improvements to the PSW have been delayed pending final decisions about how the PSW will ultimately be used. This cost estimate identifies what rehabilitation or construction activities are required to update the current facilities so they can be reliably used in the future.

Costs are being updated because some of the PSW facilities constructed as part of the GDU are being considered for use in three of the Red River Valley Water Supply Project (Red River Valley Project) alternatives. The costs for rehabilitation, enhancement (construction), and OM&R of these facilities will be included in these Red River Valley project alternatives. This report identifies Red River Valley Project related PSW work and other work required to operate the PSW in the future.

Table 1 lists the features of the PSW that have deficiencies, or uncompleted work, that needs to be addressed in order to satisfy operational purposes of the PSW, as well as potential Red River Valley Project water delivery criteria. PSW deficiencies, or uncompleted work, include SCPP intake channel work, major structural rehabilitation projects, adaptation for winter operations, remote monitoring control structures, canal slide repairs, and installation of new canal lining or repair of existing canal lining.

Table 1. Principal Supply Works Rehabilitation Work

PSW Feature	Work Item	Description of Work
SCPP	Construct Snake Creek Intake Channel Extension	Some channel excavation work is required in Lake Sakakawea so the SCPP can draw water at the minimum water operating elevation of 1775.
SCPP	Remove Coffer Dam - Snake Creek Intake Channel	Some of the original coffer dam used to construct SCPP must be removed to operate SCPP at surface water elevation 1775.
SCPP	Major Rehabilitation Work	The pumping plant has some significant structural deficiencies that may need repairs if operations are converted to year-round. This specifically includes the pumping plant concrete deck, bridge pier anchor, and access bridge bearing work.
McCC	Repair McClusky Canal slide	The canal slide at Sta. 1124+00 to 1204+00 needs to be repaired.
McCC	Control Structures (radial gates)	McClusky Canal radial gates presently lack power or monitoring capability using Supervisory Control and Data Acquisition (SCADA).
McCC	Winter Operations - McClusky Canal	Canal control structures need to be modified to assure reliable winter operation.
McCC	McClusky Canal MM 59 Plug Modification (raising)	Flood Frequency analysis of the McClusky Canal indicates that the Mile Marker (MM) 59 plug must be raised to assure that the McClusky Canal does not flow into the Hudson Bay drainage.
McCC	Other Major Structural Improvements	McClusky Canal will require some major structural repair work. (beach belting, coatings, berm drain outlets, repair concrete)
NRC	Install 14 miles of lining New Rockford Canal and drains	Sections of the New Rockford Canal must be lined prior to conveying project water. Protective drains need to be installed to protect the lining.
NRC	Line or Repair 4 miles of lining	Sections of the NRC where the existing lining has failed and need to be repaired or replaced.
NRC	Winter Operations	Canal control structures need to be modified to assure reliable winter operation.
NRC	Control Structure (radial gates)	Canal radial gates presently lack monitoring capability using Supervisory Control and Data Acquisition (SCADA).

Table 2 summarizes the estimated costs for the PSW rehabilitation work listed in Table 1. These values are estimated and discussed in the following sections.

Table 2. PSW Construction and Annual OM&R Cost Summary

PSW Feature	Work Item	Estimated 2005 Costs
SCPP	Option 1 - Lake Sakakawea Inlet Channel (excavating)*	$9,459,000
SCPP	Option 2 - Lake Sakakawea Inlet Channel (dredging)*	$16,070,000**
SCPP	SCPP Major Structural Rehabilitation	$1,829,000
	Total SCPP	**$11,288,000**
McCC	Major McCC Slides – Sta. 1124+00 to 1204+00	$6,204,000***
McCC	McCC Control Structure Updates	$860,000
McCC	Modifications to the McCC MM 59 Plug	$45,000
McCC	McCC Winter Operations	$130,000
McCC	Major Structural Improvements to McCC	$8,453,000
	Total McCC	**$15,692,000**
NRC	NRC New Lining and Drain Installation	$14,000,000
NRC	NRC Existing Lining Repair	$4,500,000
NRC	NRC Winter Operations	$194,000
NRC	NRC Control Structure Updates	$1,335,000
	Total NRC	**$20,029,000**
	Total PSW Construction Costs****	**$47,010,000**
PSW Feature	**Work Item**	**Estimated 2005 Costs**
PSW OM&R	SCPP OM&R	$266,000
PSW OM&R	McCC (Headworks through MM59)	$1,184,000
PSW OM&R	McCC (MM59 to MM74)	$56,000
PSW OM&R	New Rockford Canal	$394,000
PSW OM&R	Fish and Wildlife Mitigation	$509,000
PSW OM&R	Winter Operations	$58,000
PSW OM&R	SCADA (SCPP/McCC/NRC)	$262,000
	Total PSW OM&R	**$2,729,000**

* Includes cofferdam removal
** Not included in the Total PSW Construction Costs
***Calculated using DKAO Force Account
**** Includes only PSW constructed features

Background

Water from Lake Sakakawea is pumped from the SCPP into Lake Audubon. From Lake Audubon, water flows via gravity through the McCC to the Mile Marker (MM) 58 plug. The area between the MM58 plug and the MM59 plug is a wetland pool (Skunk Lake) which serves as an overflow pool. The water level in this pool is managed at a low level by pumping water back upstream over the MM58 plug. The remaining portion of the McCC from the MM59 plug to MM74 is dewatered and not in service. The NRC was constructed to deliver water from the Lonetree Reservoir to the New Rockford area, and down the James River.

Not all of the PSW features are fully operational. The SCPP, Lake Audubon, and McCC have been constructed as planned and are currently in use. Due to environmental concerns, Lonetree Reservoir was never constructed. The NRC was constructed but is currently not in use. The McCC and NRC have been maintained by the Garrison Diversion Conservancy District (Garrison Diversion) under a cooperative agreement with Reclamation. The SCPP is operated and maintained by Reclamation.

Lake Sakakawea Water Elevations

The water surface elevation on Lake Sakakawea is controlled by the U.S. Army Corps of Engineers (Corps) for power generation, flood storage, and navigation. Operating levels of Lake Sakakawea fluctuate between elevation 1775 and elevation 1858.5. Elevation 1775 is considered the top of the inactive capacity, and elevation 1858.5 is considered the maximum pool elevation. Drawings 1 and 2 (Appendix A) show the east end of the lake as it would appear at elevation 1850.

Since 2000, the Great Plains and western United States have been in a record drought cycle. Lake Sakakawea set an all-time record low at elevation 1813.9 in March of 2004. Lake Sakakawea levels dropped below the March 2004 record elevation in September 2004 and are predicted to drop well below the record low throughout the winter of 2004-2005. As of March 2, 2005 the elevation of Lake Sakakawea was 1808.2. Drawings 3 and 4 (Appendix A) show Lake Sakakawea as it would appear at elevation 1810. In the Corps' monthly Main Stem Reservoir and Release Forecast from April 2005, the Corps' "most likely" runoff forecast predicts Lake Sakakawea will be near elevation 1804 at the end of August 2005, as shown in Table 3. The complete reservoir forecast is included in Appendix C, Attachment 1.

Table 3. Corps of Engineers Main Stem Reservoir and Release Forecast (April 1, 2005)

Runoff Simulation	Forecasted Lake Sakakawea Elevation (8/31/2005)
Most Likely	1804.3
Lower-Decile	1800.7
Upper-Decile	1811.9

Water Delivery Requirements

The PSW provides water for municipal, rural and industrial (MR&I) systems, irrigation, fisheries, wildlife, and recreation as authorized under the Dakota Water Resources Act of 2000 and previous Garrison Diversion Unit legislation. For discussions purposes, it is assumed that the PSW will be used to fulfill the above mentioned purposes including managing Lake Audubon water levels, operation of the McCC for fish, wildlife, recreation, and irrigation purposes. Estimates for partial operation of the NRC are also included in this report, but there are no current plans to operate the canal as originally envisioned.

The State of North Dakota and Reclamation have discussed using one of the three intake assemblies at the SCPP for an intake for the Northwest Area Water Supply (NAWS) project. Preliminary data indicate a NAWS intake at the site would require a flow of approximately 40-60 cubic feet per second (cfs). If one pump assembly were to be removed to accommodate an intake for NAWS, the pumping capacity of the SCPP would be reduced by 33% from a maximum flow rate of around 2,050 cfs to 1,370 cfs.

Preliminary Red River Valley Project data indicate flow requirements from the SCPP, through the PSW, and to the Red River Valley, could range from 50 to 450 cfs depending on the alternative selected. Additional SCPP capacity is also required for limited irrigation (McClusky canal-side, Turtle Lake Irrigation District and New Rockford area), wildlife and recreation.

Given the flow requirements listed above, it is possible that the SCPP could deliver water for the project purposes using one high-head pump at 1000 cfs. In order to do so, modifications to the plant and the existing intake channel would be required, and are discussed in the following sections.

SNAKE CREEK PUMPING PLANT

This section discusses construction, operation, maintenance, and replacement of features associated with the SCPP. Engineering details and cost estimates regarding the proposed improvements to the facility, and the needs projected for the Red River Valley Project are included.

SCPP Background

The SCPP is located offshore at the north end, and on the west side of the Snake Creek Embankment, which separates Lake Sakakawea from Lake Audubon (Drawing 1, Appendix A). Constructed in 1975, the plant is located between the towns of Garrison and Coleharbor in central North Dakota.

The plant contains three vertical-shaft pumping units. Each unit is powered by an 8,000-horsepower, 200-rpm synchronous motor. Each pumping unit has two interchangeable pump bowl assemblies that cover the pumping head range of 2 to 76 feet, at a capacity of not less than 685 cfs. The low-head pump bowl assembly is suitable for pumping against 2 to 35 foot heads, while the high-head pump bowl assembly is used for the higher heads from 35 to 76 feet. Water

is supplied to each pump from Lake Sakakawea. After passing through the pumps, water is conveyed to Lake Audubon through three 11-foot inside diameter steel and concrete discharge pipes. Lake Audubon water elevations are held at elevation 1847 from ice-out in the spring through Labor Day, and gradually drawn down in the fall to elevation 1845. Power for the pump motors is provided through a 115 KV transmission line along the Snake Creek Embankment, from the Garrison Dam Power Plant to the pumping plant site.

Lake Sakakawea Intake Channel and Cofferdam Excavation

The east end of Lake Sakakawea represents a dynamic landscape filled with numerous islands and the old Snake Creek bed. Prior to the Corps flooding of the lake, small ponds, the old Snake Creek channel, and an old Highway 83 crossing over the creek between sections 31 and 32 existed. Drawing 4 (Appendix A) shows a general Lake Sakakawea layout with contours at elevation 1810 using topographic information from the U.S. Geological Survey's Riverdale North Quadrangle map.

Conditions for utilizing the PSW for the Red River Valley Project would require the SCPP to be capable of operating at the top of the Lake Sakakawea inactive capacity elevation 1775. Operating at an elevation of 1775 would require a future SCPP intake channel invert constructed to elevation 1766.

The topographic data used to calculate excavation quantities for the intake channel and cofferdam is from two sources. Houston Engineering provided topographic data for the cofferdam area and approximately 1,200 feet of the inlet channel. Garrison Diversion provided the topographic data for the remainder of the inlet channel.

Reclamation has established a proposed alignment for a future inlet channel in Lake Sakakawea (Drawing 5, Appendix A). The proposed alignment runs approximately 15,300 feet and would begin at Sta. 1+00 (invert elevation 1766) and slope at a rate of 0.00012 ft/ft towards Sta. 154+00 (end of original constructed inlet channel). Proposed channel characteristics include a trapezoidal-shaped, 45-foot wide channel bottom, with 2:1 side slopes. Water depth at lake elevation 1775 would vary between 7 and 9 feet in the channel. The channel has a design capacity of approximately 1,100 cfs based on the assumption that one existing 1000 cfs pump and one new 60 cfs pump for NAWS will be used in the SCPP. This channel design assures that the SCPP will be capable of pumping a minimum of 1,100 cfs at or above elevation 1775, which is the bottom of Lake Sakakawea's conservation pool. The volume of material required to be excavated from the proposed channel was calculated to be approximately 1,000,000 cubic yards.

The proposed methods of construction for this channel are hydraulic dredging and conventional excavation. Prior to any dredging work, significant planning is required to determine detailed lake topography data of the dredging location, physical and chemical properties of the soils, potential disposal alternatives, social and environmental concerns, permits, and selection of a suitable dredging method. Possible spoil sites, above the 1850 elevation, are located an average of 1.5 miles away from the planned channel. Using hydraulic dredging to excavate the channel will require a large spoil area with extensive containment system. Typical dredging activity consumes 2,000 gallons of water per cubic yard of material.

In addition to establishing an inlet channel in Lake Sakakawea for operation of the pumping plant at lake elevation 1775, the original inlet channel and cofferdam used to construct the SCPP must be removed (excavated). During construction of the pumping plant, construction specifications required the cofferdam to be removed down to elevation 1780. However, due to problems encountered during construction, the contractor only excavated the cofferdam down to elevation 1814.

Due to extreme drought conditions, Lake Sakakawea fell to its then record low of elevation 1815 in March of 1991. Reclamation removed a portion of the cofferdam in 1991 down to invert elevation 1802 to allow for continued PSW operation. Figure 1 shows the cofferdam and removed portion as they appeared on December 2, 2004 at a Lake Sakakawea elevation of approximately 1810.

Figure 1. Snake Creek Pumping Plant Cofferdam (December 2004)

Drawing 6 (Appendix A) shows the inlet channel layout from a survey performed by Houston Engineering in 2001. The channel invert elevations differ from the design drawing (Drawing 7, Appendix A) due to construction errors, or years of lake siltation. The inlet channel portion from Sta. 6+00 to Sta. 18+38 requires dredging to assure reliable access to Lake Sakakawea to elevation 1775. Proposed channel characteristics include a sloped (-0.00012 ft/ft), trapezoidal-shaped, 45-foot wide channel bottom, 2:1 side slopes, and an invert elevation of 1766.19 at Sta. 6+00. Reclamation calculates approximately 25,000 cubic yards of material need to be excavated between these sections (Drawing 8, Appendix A). The same channel characteristics

could be used to excavate through the cofferdam sections between Sta. 18+38 and 22+68. The volume of material required to be removed through the cofferdam section is approximately 75,000 cubic yards.

Cost estimates to remove the material from the original intake channel and cofferdam total approximately $1,000,000 (Appendix C, Attachment 2). These costs assume difficult excavation conditions and removal of existing cofferdam features that include riprap, steel sheet piling, and other items remaining from the initial construction.

In 2004, Garrison Diversion conducted a water depth survey using sounders and a global positioning unit attached to a motorboat to verify the contour data and proposed inlet channel route. The water depth survey concluded that the existing minimum lake bottom elevation along the proposed intake channel path is near elevation 1785 (See figure 2).

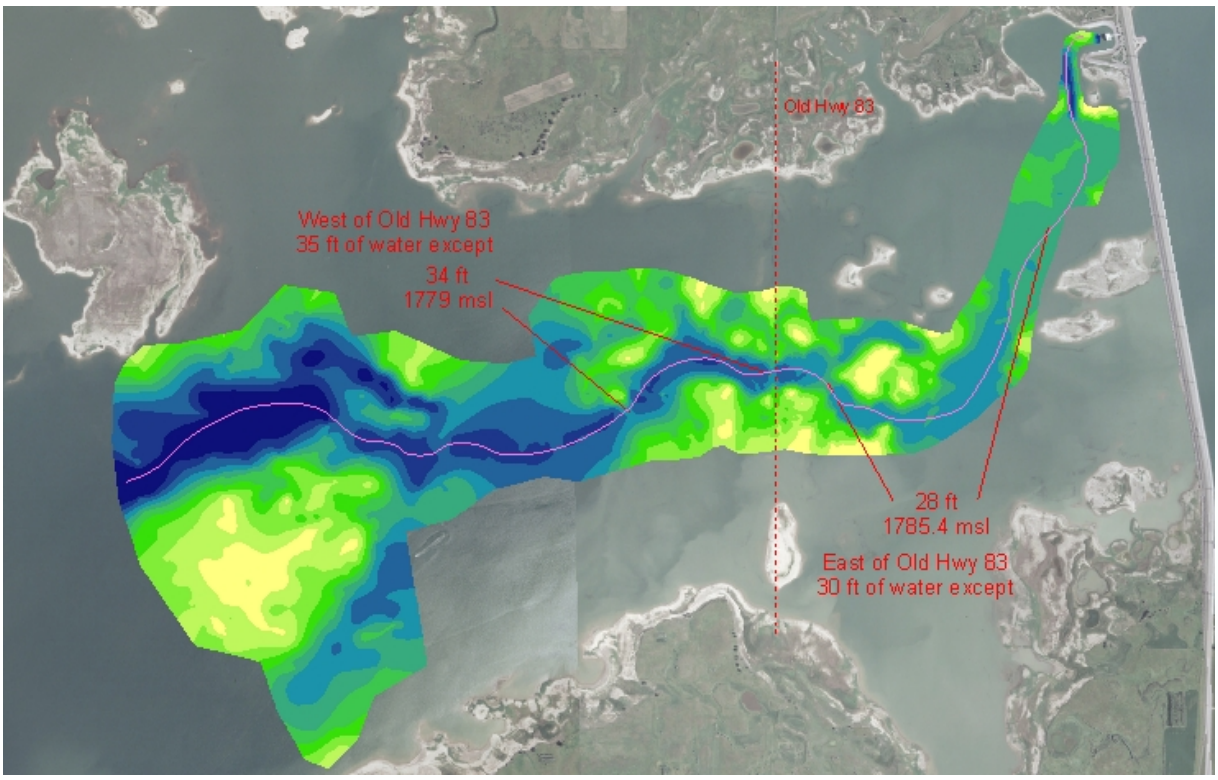


Figure 2. 2004 Snake Creek Water Depth Survey (Sakakawea water elevation approx. 1813).

New topography was created after Garrison Diversion completed the 2004 lake survey. The proposed channel characteristics include a trapezoidal-shaped, 50-foot wide channel bottom, 3:1 side slopes, and an invert elevation of 1766. This would allow 1100 cfs to the pumping plant with a water elevation of 1775. Inlet channel quantities were estimated to be 996,000 cubic yards of material from the pumping plant intake to approximately 4 miles into the lake.

Reclamation in cooperation with Garrison Diversion excavated 42,000 cubic yards from the existing cofferdam in Jan-Feb 2005 to elevation 1790. Further cofferdam excavation to 1780 is

planned as Lake Sakakawea elevation drops throughout 2005. During the winter of 2005-2006, plans are to excavate an additional 21,000 cubic yards.

Two cost estimates for excavating the intake channel have been completed using the new lake contours. One method of estimation includes conventional excavation using scrapers in combination with excavators and haul trucks. This assumes that excavation can be conducted in a dry state, lake elevation 1775-1780. Preliminary cost estimates are included on Sheet 1, Appendix B. Reclamation estimates excavating the intake channel and remaining cofferdam (954,000 cubic yards) costs to be approximately $9,459,000. Supporting cost estimates are detailed in Appendix C, Attachment 2. The second method of estimation involves hydraulic dredging while pumping the channel material to the spoil area. This type of excavation would be recommended if the east end of Lake Sakakawea is under water. Preliminary cost estimates are included on Sheet 2, Appendix B. Reclamation estimates dredging the intake channel and remaining cofferdam (954,000 cu. yds.) costs to be approximately $16,070,000. Supporting cost estimates are detailed in Appendix C, Attachment 2. For this study, the estimated cost of $9,459,000 using conventional excavation is used in the final cost estimate.

SCPP Major Structural Rehabilitation

The SCPP has structural deficiencies that need to be addressed to assure reliable operation of the facility in the future. These deficiencies include the main transfer deck, bridge rocker bearings, pump assemblies, and bridge pier anchor vault.

Transfer Deck

The plant is of the island type with access to the main transfer deck by bridge from the Snake Creek Embankment. The main transfer deck, which also serves as the roof over the motor floor, is composed of a lightweight concrete structural slab supported by structural steel beams and girders. The structural slab has a conventional concrete cover slab to provide a protective wearing surface.

In June of 2001, pieces of the lightweight concrete structural slab failed and fell approximately 45 feet to the control room floor (See Figure 3). Since the failure event, Reclamation has performed several studies on the deck including concrete cores, deck structural analysis, and concrete monitoring. The cause of the concrete deck failure appears to be freeze-thaw and alkali-silica reactions. As a result of these studies, the load bearing capacity of the deck has been reduced by 15%, and the concrete continues to undergo numerous freeze-thaw cycles each season. The transfer deck will require replacement to remedy this situation.

In 2003, Reclamation conducted an appraisal-level cost estimate for replacement of the transfer deck. A copy of the cost estimate is included in Appendix B. The estimate details the costs for complete removal of the cover and structural slabs, as well as construction of a new reinforced concrete structural deck, deck drain piping, and electrical conduits. Based on 2003 Reclamation's Technical Service Center (TSC) billable rates, the estimate totals $1,100,000 (Appendix C, Attachment 3). Indexed to 2005 values using the Corps' Civil Works Construction Cost Index System, the estimated total cost is approximately $1,210,000 (Sheet 3, Appendix B).

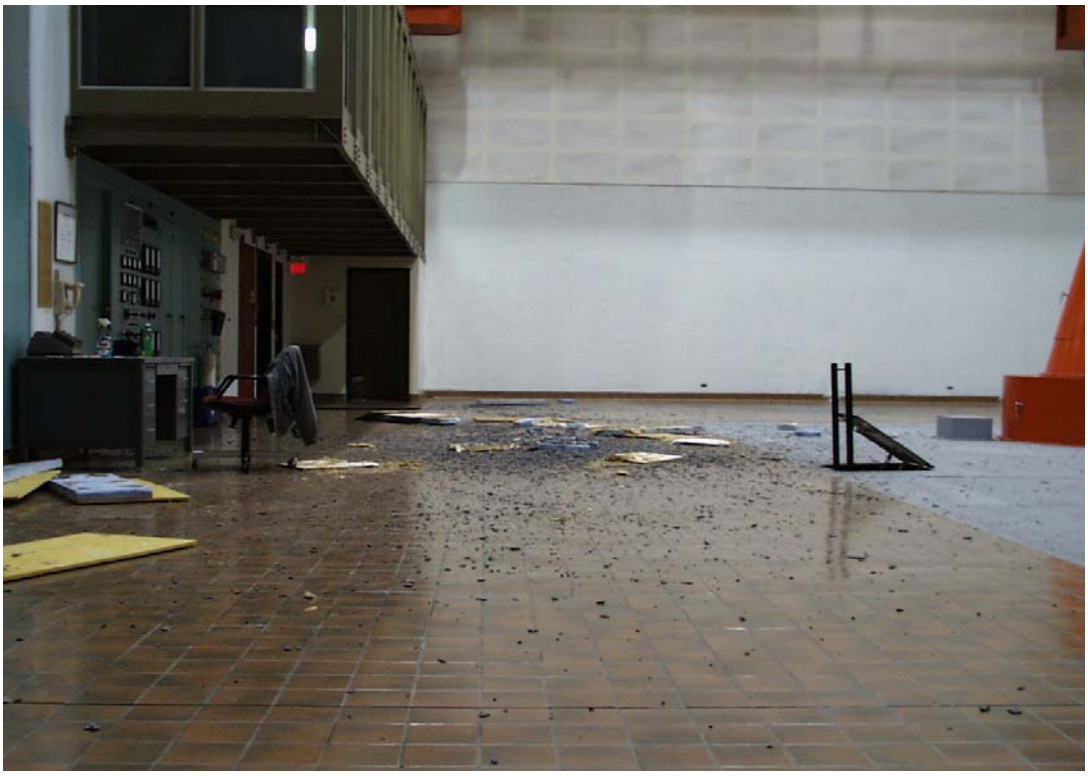


Figure 3. SCPP Transfer Deck Structural Slab Failure (June 2001)

Bridge

The bridge to the pumping plant is fixed against horizontal movement at the pumping plant and at the abutment with fixed bearings. Rocker bearings and an expansion joint were provided at the bridge pier anchor to allow for bridge movements. The bridge rocker bearings have experienced excessive movements since construction and will require repairs. Figure 4 displays the movements of the bearings. Reclamation's Great Plains Regional Office estimated the cost to repair the bridge rocker bearings to be $50,000 (Sheet 3, Appendix B). This task is included in the FY 2005 Dakotas Area Office Work Plan.

Figure 4. SCPP Bridge Rocker Bearings (June 2002)

Pump Bowl Assemblies

The plant pump bowl assemblies required interchanging to the high head bowl in order to pump from Lake Sakakawea below elevation 1812. A service agreement was prepared by the TSC in FY2004 for an estimate of $44,000 to change out one pump bowl assembly. Of that total, $35,000 was for labor. One high-head pump bowl assembly was installed in November of 2004. A second pump bowl assembly is required to serve as an emergency backup. Additional relays will need changing out to accommodate the increase in horsepower requirements associated with the high head bowl. Total costs to change a second assembly are estimated at $44,000 (Sheet 3, Appendix B). A copy of the service agreement is included in Appendix C, Attachment 4.

Pump Unit Alignment

Roger Cline, TSC Mechanical Engineer, noted in his *Unit Alignment and Vibration Testing* travel report from July 16, 2001, that movement of the plant structure has caused the pump shafts to be out of plumb. The direction and the amount the units are out of plumb correspond to plant settlement readings. Each unit requires realignment to assure reliable operation of the facility in the future. Costs to realign two units are estimated at $200,000 (Sheet 3, Appendix B). A copy of the travel report is included in Appendix C, Attachment 5.

SCPP Bridge Pier Anchor Vault Repairs

There is a vault in the bridge pier anchor located below the center of the of the SCPP bridge. The vault provides access to the three steel discharge pipes for the SCPP. The steel pipe coating is severely corroded in some areas and will need to be sandblasted, patched and recoated. Also, the concrete walls and floor of the vault are spalling, collecting mineral deposits, and rusting in several areas. The estimated cost to repair the vault and pipe is $326,000 (Sheet 4, Appendix B).

McCLUSKY CANAL

This section identifies the McCC repairs and improvements required to assure reliable operation of the facilities in the future. This includes the development of construction (repair and enhancements) and OM&R cost estimates for all features associated with the McCC.

McCC Background

The McCC is approximately 74 miles long, has a partial to full clay lining in selected areas, a bottom width of 25 feet, an original design operating water depth of 17 feet, 2:1 side slopes, and an original design capacity of 1,950 cfs with an elevation of 1850 on Lake Audubon. The operating level of Lake Audubon has since been lowered to elevation 1847.0 reducing the maximum capacity down the McClusky Canal to 1,350 cfs. Constructed under eight separate contracts between 1969 and 1978, the major canal structures consist of canal headworks, radial gates, in-line lakes, tunnel, drop chute with radial gate check, baffled apron drop, and several bridges. The first 59 miles of the canal are currently watered-up and in use. The last 16 miles of the canal are de-watered and are not in operation. There are no plans to use McCC between MM59-75; therefore, only the first 59 miles are included in the cost estimates. See Drawing 9 (Appendix A) for McCC location map.

Major McCC Slides – Sta. 1124+00 to 1204+00

The section of the McCC between stations 1124+00 and 1204+00 continues to experience massive slides (See Figure 5). A feasibility study completed by the TSC developed and evaluated alternative remedies for problems associated with slope failures between these stations.

The report, *Canal Modification Feasibility Study for McClusky Canal – Reach 2, Station 1124+00 through 1204+00* (Reclamation 2001a), presented five possible repair alternatives to achieve the desired performance standards of the canal. The preferred alternative was to reduce the slope inclination to 4:1 and construct an open-channel trapezoidal prism with a capacity of 1,000 cfs. This design alternative presented a long-term solution to the slope stability problems which could be implemented safely with proper construction.

The feasibility study estimated the total amount of cut for a 1000 cfs canal prism with 4:1 side slopes to be approximately three million cubic yards. Cost estimates for this alternative totaled $15,250,000, based on 2001 cost values. Indexed to 2005 levels using the Corps' Civil Works Construction Cost Index System, the total cost to perform slide repairs is approximately $16,500,000 (Sheet 5, Appendix B).

In 2004, Reclamation's Dakotas Area Office conducted a separate cost estimate for repairing the major slides. This estimate detailed the costs using a force account between Reclamation and Garrison Diversion. Costs using the force account totaled approximately $6,204,000. This cost estimate is included in the PSW cost summary.

Figure 5. McCC Slides (June 2002)

McCC Control Structure Updates

McCC control structures may require power, remote monitoring, and structural updates to assure reliable operation of the canal in the future. Four of the five control structures on the McCC have power as shown in Table 4. The MM 20 radial gate currently has only single phase power. Three phase power is required to operate the current gate motors. To resolve this, 3-phase power must be brought in or the existing gate motors must be changed out.

Currently, all structures along the canal lack any level of Supervisory Control and Data Acquisition (SCADA) capability. Depending on future operational needs, a SCADA system capable of remote monitoring of canal levels and gate positions may be required. The SCADA system will most likely use radio, satellite, or telephone technology as a communication system between the master control center and remote sites. Indexing the *Estimated Annual OM&R Associated with the Used and Unused Capacity of the Existing GDU Principal Supply Works Features* (Reclamation 1999) cost estimate of $34,000 for SCADA equipment per site to 2005

figures results in an estimate of $39,000 per site. The McCC system would require four SCADA sites, one at the headworks and one at each of the three radial gate structures.

The headworks and radial gate structures on the McCC may also require updates. All control structures have stoplog capabilities for upstream control; however, stoplogs may be needed on the downstream side for maintenance of the radial gates (See figure 6). The three McCC check structures contain 2 radial gates each. This would account for six sets of stoplogs to be installed on the downstream side of the radial gates. Concrete repairs will be required to the structures, as well as coatings to the exposed steel members. The structures may also require modifications for security purposes. Costs to update the McCC power, SCADA, and control structures are estimated at $860,000 (Sheet 6, Appendix B).

Table 4. McCC Control Structure Power

Structure	Location	Power	Distance to Power
Headworks	MM 1	Yes	-
Radial Gate	MM 20 (begin Reach 2)	Single Phase	Approx 1.5 miles to 3-phase
Control Structure	MM 36 (Painted Woods Outlet Channel)	No	Less than 1 mile
Radial Gate	MM 38 (New Johns)	Yes	-
Radial Gate	MM 55 (Hwy 200 Tunnel)	Yes	-

Figure 6. McClusky Canal Radial Gate Structure (June 2002)

Modifications to the McCC MM 59 Plug

The McCC lies in both the Missouri River and Hudson Bay drainage areas. In order to prevent water transfer between the two basins, plugs (earthen embankment) were placed in the McCC at MM58 and MM59. The MM58 plug is an unexcavated plug separating Hoffer and Skunk Lakes. The MM59 plug was built on what is considered the dividing line between the two drainage basins. The current elevation at the top of the MM59 plug is 1847 feet.

Reclamation's TSC performed a flood analysis and canal routing study and documented their results in the *Sykeston Canal Alternative Study: Flood Analysis and Canal Routing* report (Reclamation 1993). The study estimated the probability of Missouri River water crossing into the Hudson Bay drainage during a Probable Maximum Flood (PMF) event. A PMF event results from the most severe combination of hydrologic and meteorologic conditions.

The report concluded that the existing MM59 plug would contain up to a 500-year flood, not a PMF. In order to contain a PMF, the existing MM59 plug will need to be raised to elevation 1860. Approximately 3,000 cubic yards of the adjacent canal spoil pile material could be used to raise the plug at an estimated cost of $45,000 (Sheet 7, Appendix B). Supporting cost estimates are detailed in Sheets 8 and 9 of Appendix C.

McCC Winter Operations

Winter operations of the McCC would be required to provide a continuous water supply to the proposed Red River Project. Flow velocities would be low, so a continuous ice cover is expected to form in the canals, except for control structures. Winter flows through radial gate structures can be accomplished by installing either stoplogs with slide gates to allow flow under the ice, or ice-prevention bubbler systems. Ice-prevention bubbler systems are estimated to cost $20,000 per site based on previous installations. Costs to update the McCC facility for winter operations are estimated at $130,000 (Sheet 8, Appendix B).

Major Structural Improvements to McCC

The McCC has some structural deficiencies that should be repaired to assure long-term reliable operation of the canal system. Deficiencies identified include beach-belting Reach 3, berm drain repairs, headworks structure, and radial gate structures.

The canal prism along Reach 3 is not protected from erosion. Beach-belting of the canal prism throughout the 20 miles of Reach 3 would be required. Due to potentially varying water levels in Reach 3, the beach-belting is planned to be 18ft wide and 1ft thick underlined with a woven geotextile material. Estimated cost for beach belting the 20 miles of Reach 3 is $5,250,000 (Appendix C, Attachment 2).

Failures at the berm drain outlets along the McCC have resulted in significant washouts in places. Significant repairs are required at numerous locations. The McCC headworks structure has significant cracks within the concrete headwall and is in need of repair or replacement. Costs to perform major structural modifications are estimated at $8,453,000 (Sheet 9, Appendix B).

NEW ROCKFORD CANAL

This section identifies the structural improvements required to assure long-term reliable operations of the NRC. Development of construction (repair and enhancement) and OM&R cost estimates for features associated with the NRC are also included. The NRC is not currently considered in any Red River Valley project alternatives, but the rehabilitation costs are estimated to document these potential costs.

NRC Background

The NRC was originally designed as part of the PSW to transport water from the McCC, via Lonetree Reservoir, to the eastern portion of the Garrison Diversion Unit for irrigation, municipal, rural, and industrial water systems, fish and wildlife enhancement, and recreation. The 42-mile-long NRC was constructed between 1983 and 1991, has a flow capacity of 1,600 cfs, with a designed operating water depth of 10.4 feet, side slopes of 2:1 or 2.5:1 (varies with reach and lining material), and a bottom width of 40 to 44 feet. Due to environmental concerns with the proposed Lonetree Reservoir, the NRC was not linked to the McClusky Canal and is not currently in use. See Drawing 9 (Appendix A) for NRC location map and figure 7 showing a typical canal section.

Figure 7. Typical New Rockford Canal Section

NRC New Lining Installation

During construction of the NRC, approximately 14 miles of lining between Sta. 729+00 and 1471+00 was not installed. The lining needs to be installed prior to operation of the canal to limit water losses to a reasonable level. Installation of lining includes excavation, subgrade preparation, geomembrane installation, soil cover placement, and slope protection. The cost of completing the lining through this section is estimated at $14,000,000, or approximately $1,000,000 per mile (Sheet 10, Appendix B). Also needed are 14 miles of protective drains to protect the lining from being ruptured by ground water when the canal is dewatered.

NRC Existing Lining Repair

Since construction of the NRC, slides of the material on the side slopes have caused considerable damage to the canal lining. Approximately 4 ½ miles of the NRC between Sta. 193+38.23 and Sta. 433+91.13 need lining repairs. Costs to perform excavation, subgrade preparation, geomembrane installation, soil cover placement, and slope protection through this section are estimated at $4,500,000 (Sheet 11, Appendix B).

NRC Winter Operations

There are no current plans to use the NRC for the Red River Valley Project, but the estimated costs are documented for future reference. Winter operations of the NRC would be required to provide a continuous water supply to the proposed Red River Valley Project. Flow velocities would be low, so a continuous ice cover is expected to form in the canals, except for control structures. Winter flows through radial gate structures can be accomplished by installing either stoplogs with slide gates to allow flow under the ice or ice-prevention bubbler systems. Costs to update the NRC facility for winter operations are estimated at $194,000 (Sheet 12, Appendix B).

NRC Control Structure Updates

NRC control structures would require remote monitoring, and structural updates to assure reliable operation of the facilities in the future. Table 5 lists all of the control structures on the NRC and shows that all structures have access to power. Currently, all structures along the canal lack SCADA system capability. Depending on future operational needs, a SCADA system capable of remote monitoring of canal levels and gate positions would be required. The SCADA system would most likely use radio, satellite, or telephone technology as a communication system between the master control center and remote sites. Indexing the *Estimated Annual OM&R Associated with the Used and Unused Capacity of the Existing GDU Principal Supply Works Features* (Reclamation 1999) cost estimates of $34,000 for SCADA equipment per site to 2005 figures result in an estimate of $39,000 per site. The NRC system would contain six SCADA sites, and six radial gates structures.

In addition to SCADA requirements, structural modifications may be necessary for both operation and maintenance of the control structures. The six radial gate structures on the NRC would also require repairs. All control structures have stoplog capabilities for upstream control; however, stoplogs may be needed on the downstream side for maintenance of the radial gates. The six NRC check structures contain three radial gates each. This would account for nine sets of stoplogs to be installed on the downstream side. Concrete repairs would be required to the structures, as well as coatings to the exposed steel members. The structures may also require modifications for security purposes. Costs to update the NRC with a SCADA system, and control structures are estimated at $1,335,000 (Sheet 13, Appendix B).

Table 5. NRC Control Structure Power

Structure	Location	Power
Drop/Highway52/Railroad/ Radial Gate	NR1-3 and NR1-4 Sta. 433+91.13	Yes
Drop Structure No. 2	Sta. 1056+10	Yes
Drop Structure/Road Crossing/ Radial Gate	NR1-11 Stat. 1390+54	Yes
Railroad Crossing Siphon	NR2-2A	Yes
Check Structure	Sta. 1825+00	Yes
Check Structure	Sta. 2022+00	Yes

PRINCIPAL SUPPLY WORKS ANNUAL OM&R

This section discusses OM&R costs for the PSW. Cost estimates from the 1999 report *Estimated Annual OM&R Associated with the Used and Unused Capacity of the Existing GDU Principal Supply Works Features* (Reclamation 1999) were used to develop estimated 2005 OM&R costs. A copy of the report is included in Appendix C, Attachment 6.

Day-to-day OM&R of the SCPP is the responsibility of Reclamation's Dakotas Area Office, while day-to-day OM&R of the McCC and NRC are the responsibility of the Garrison Diversion Conservancy District under a cooperative agreement with Reclamation.

Annual OM&R Costs

Table 6 lists the indexed annual OM&R costs at 2005 price levels. The Corps Civil Works Construction Cost Index System (US Army Corps of Engineers 2004) was used as an indexing reference. Cost estimate sheets 14 and 15 in Appendix B were used to compile these values. The 2005 estimated annual OM&R costs of the PSW total approximately $2,729,000. These costs include efforts to provide public safety and security; provide water for wildlife, recreation, and incidental irrigation; maintain water quality; maintain facilities to comply with applicable regulations; and protect the federal investment.

Table 6. PSW Annual OM&R Costs

Description	1999 Cost Estimate*	Index Factor	Estimated 2005 OM&R Costs
SCPP OM&R	$233,000	1.1401	$266,000
McCC (Headworks through MM59)	$1,053,000	1.1247	$1,184,000
McCC (MM59 to MM74)	$50,000	1.1247	$56,000
New Rockford Canal	$350,000	1.1247	$394,000
Fish and Wildlife Mitigation	$453,000	1.1227	$509,000
Winter Operations	$52,000	1.1247	$58,000
SCADA (SCPP/McCC/NRC)	$233,000	1.1247	$262,000
Total	**$2,424,000**		**$2,729,000**

*As listed in *Estimated Annual OM&R Associated with the Used and Unused Capacity of the Existing GDU Principal Supply Works Features (Reclamation 1999).*

SUMMARY AND CONCLUSIONS

The purpose of this report was to update PSW cost estimates for construction, operation, maintenance, and replacement of PSW features. The focus is on proposed PSW repairs and improvements necessary to assure reliable operation of the PSW in the future. Cost estimates to return the NRC into an operational condition are included in this estimate, but currently there are no plans to use the NRC in any of the alternatives considered in the Red River Valley Water Supply Project Needs and Options Report. Supporting information such as drawings and cost estimates are included. Although some design detail is provided, a design phase would be required prior to contracting for any of the work described.

Costs estimates were compiled of existing known concerns and conditions associated with the PWS. Most cost estimates were calculated with current 2005 price figures. When previous cost estimates were used, cost indexing factors from the *Civil Works Construction Cost Index System* (U.S. Army Corps of Engineers 2004) were used. Unlisted items within the estimates vary from 2% to 15% for earth work and structural components respectively. This is due to the fact earth quantities could be calculated more accurately than structural components.

Costs to improve the SCPP, McCC, and NRC are estimated at approximately $47,000,000. The majority of the costs are to extend and deepen the inlet channel in Lake Sakakawea, repair the major slides on the McCC, and replace and repair linings on the NRC. A savings of $20,000,000 could be achieved if the NRC system is removed from the overall cost estimate. A cost

increase of more than $4,500,000 may be associated with the Lake Sakakawea inlet channel if hydraulic dredging is required to excavate the intake channel.

Based on indexed values to 2005 levels, the total annual OM&R costs of the PSW are estimated at $2,729,000. Table 7 summarizes the PSW construction costs and table 8 summaries the annual OM&R costs.

Table 7. PSW Construction Cost Summary

PSW Feature	Work Item	Estimated 2005 Costs
SCPP	Option 1 - Lake Sakakawea Inlet Channel (excavating)*	$9,459,000
SCPP	Option 2 - Lake Sakakawea Inlet Channel (dredging)*	$16,069,000**
SCPP	SCPP Major Structural Rehabilitation	$1,829,000
	Total SCPP	**$11,288,000**
McCC	Major McCC Slides – Sta. 1124+00 to 1204+00	$6,204,000***
McCC	McCC Control Structure Updates	$860,000
McCC	Modifications to the McCC MM 59 Plug	$45,000
McCC	McCC Winter Operations	$130,000
McCC	Major Structural Improvements to McCC	$8,453,000
	Total McCC	**$15,692,000**
NRC	NRC New Lining Installation	$14,000,000
NRC	NRC Existing Lining Repair	$4,500,000
NRC	NRC Winter Operations	$194,000
NRC	NRC Control Structure Updates	$1,335,000
	Total NRC	**$20,029,000**
	Total PSW Construction Costs	**$47,009,000**

* Includes cofferdam excavation
** Not included in the Total PSW Construction Costs
***Calculated using DKAO Force Account

Table 8. PSW Annual OM&R Cost Summary

Work Item	Estimated 2005 Costs
SCPP OM&R	$266,000
McCC (Headworks through MM59)	$1,184,000
McCC (MM59 to MM74)	$56,000
New Rockford Canal	$394,000
Fish and Wildlife Mitigation	$509,000
Winter Operations	$58,000
SCADA (SCPP/McCC/NRC)	$262,000
Total PSW OM&R	**$2,729,000**

REFERENCES

Bureau of Reclamation, 1993. *Sykeston Canal Alternative Study: Flood Analysis and Canal Routing*, October 20, 1993.

Bureau of Reclamation, 1999. *Estimated Annual OM&R Associated with the Used and Unused Capacity of the Existing GDU Principal Supply Works Features*, March 28, 1999.

Bureau of Reclamation, 2001a. *Canal Modification Feasibility Study for McClusky Canal – Reach 2, Station 1124+00 through 1204+00*, April 25, 2001.

Bureau of Reclamation 2001b. *Snake Creek Pumping Plant Unit Alignment and Vibration Testing Report,* July 16, 2001.

Bureau of Reclamation, 2003. *Snake Creek Pumping Plant Deck Replacement Study, August 2003,* September 5, 2003.

U.S. Army Corps of Engineers, 2004. *Civil Works Construction Cost Index System (CWCCIS),* March 31, 2004.

Appendix A - Drawings

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE OF NORTH DAKOTA
WATER COMMISSION

NORTH DAKOTA
7.5 MINUTE SERIES (TOPOGRAPHIC)

CUSTER MINE STATE GAME MANAGEMENT AREA

DE TROBRIAND STATE GAME MANAGEMENT AREA

TOTTEN TRAIL PARK

DE TROBRIAND STATE GAME MANAGEMENT AREA

SNAKE CREEK PUMPING STATION

Snake Creek Pumping Station

AUDUBON STATE GAME MANAGEMENT AREA

AUDUBON LAKE

LAKE SAKAKAWEA

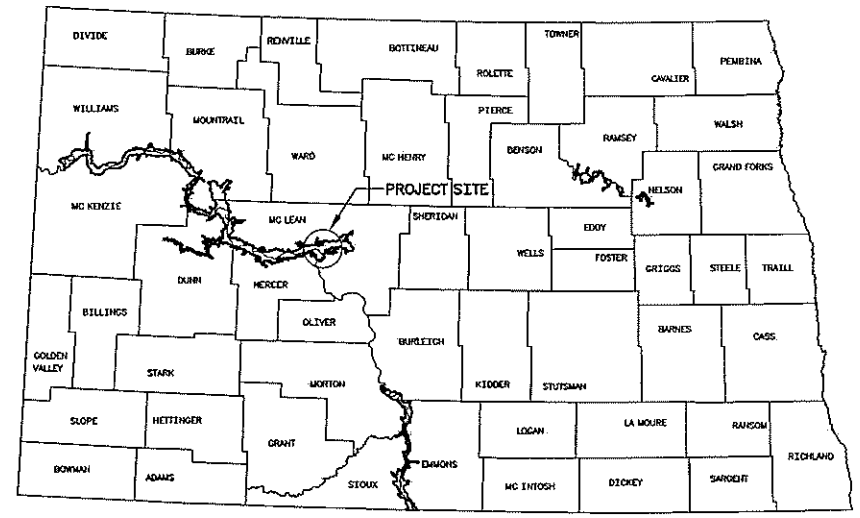
MALLARD ISLAND WOLF CREEK STATE GAME MANAGEMENT AREA

AUDUBON NATIONAL WILDLIFE REFUGE

SNAKE CREEK STATE GAME MANAGEMENT AREA

LOCATION MAP

1760 0 1760 3520 5280
SCALE OF FEET



VICINITY MAP
NO SCALE

LEGEND OF SYMBOLS

- Paved road
- Improved Gravel road
- Unimproved Road
- Trail
- Power line
- Railroad tracks
- Stream
- Barbed wire fence (Existing)
- Canal
- Primary Survey Control
- Base Line Control Point
- Slough

NOTES:

1. *Underwater contours in Lake Sakakawea and Audubon Lake from USGS maps dated 1943, Riverdale North Quadrangle*
2. *Lake Sakakawea water surface elevation 1850.0.*

REV NO	DATE	REVISED TITLE BLOCK
1	4-27-2005 603-JLT	

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK-SLOAN MISSOURI BASIN PROGRAM
GARRISON DIVISION GARRISON DIVERSION UNIT, N.DAK.

SNAKE CREEK PUMPING PLANT
LOCATION MAP AT ELEV. 1850

DESIGNED	D. ALBRIGHT	CHECKED	S. JACOBSON
DRAWN	J.POITRA	TECH. APPR.	Dustin S. Albright, P.E.
APPROVED	Jame L. Todd, P.E.		

CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
ACAD 2000/LDD3 BISMARCK, N. DAK.	SNAKECREEKTOPO.DWG AUGUST 05, 2004	8-05-2004 9:30 AM

769-603-24985

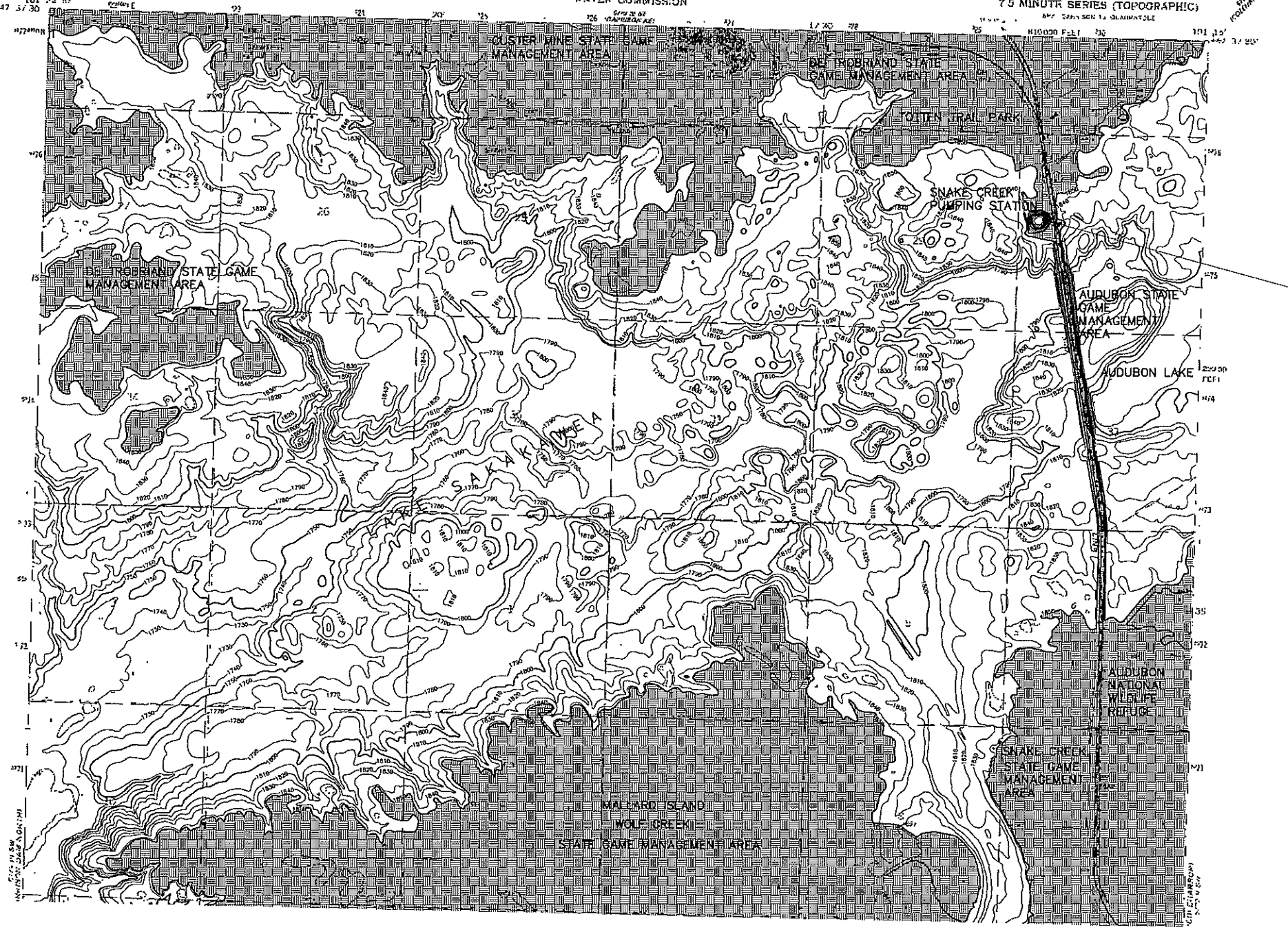
DRAWING 1

(22X34)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

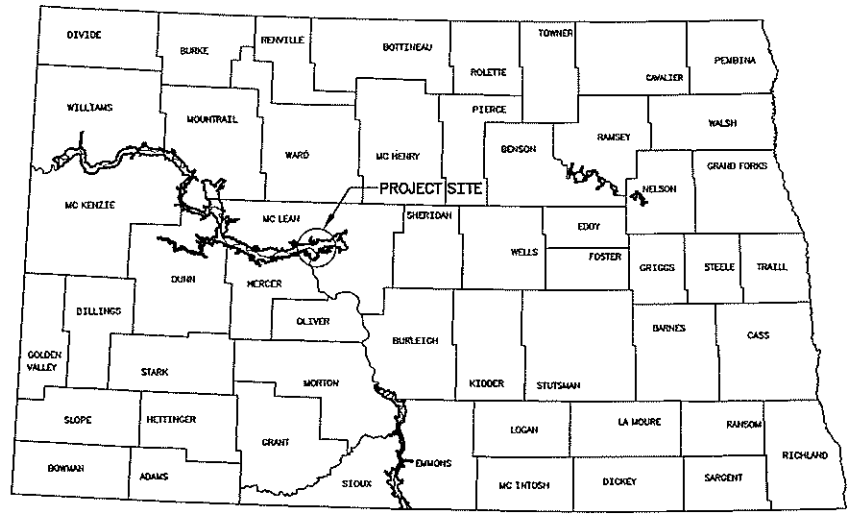
STATE OF NORTH DAKOTA
WATER COMMISSION

NORTH DAKOTA
7.5 MINUTE SERIES (TOPOGRAPHIC)



LOCATION MAP

1700 0 1700 3500 5200
SCALE OF FEET



VICINITY MAP
NO SCALE

Snake Creek Pumping Station

LEGEND OF SYMBOLS

- Paved road
- Improved Gravel road
- Uninproved Road
- Trail
- Power line
- Railroad tracks
- Stream
- Barbed wire fence (Existing)
- Canal
- Primary Survey Control
- Base Line Control Point
- Slough

NOTES:

1. *Underwater contours in Lake Sakakawea and Audubon Lake from USGS maps dated 1943, Riverdale North Quadrangle*
2. *Lake Sakakawea water surface elevation 1850.0.*

REV NO	DATE	REVISED TITLE BLOCK
1	4-27-2005 603-JLT	

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BUREAU OF RECLAMATION

PICK-SLOAN MISSOURI BASIN PROGRAM
GARRISON DIVISION GARRISON DIVERSION UNIT, N.DAK.

SNAKE CREEK PUMPING PLANT
LOCATION MAP AT ELEV. 1850 WITH CONTOURS

DESIGNED	D. ALBRIGHT	CHECKED	S. JACOBSON
DRAWN	J.POITRA	TECH. APPR.	Dustin S. Albright, P.E.
APPROVED	Jame L. Todd, P.E.		

CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
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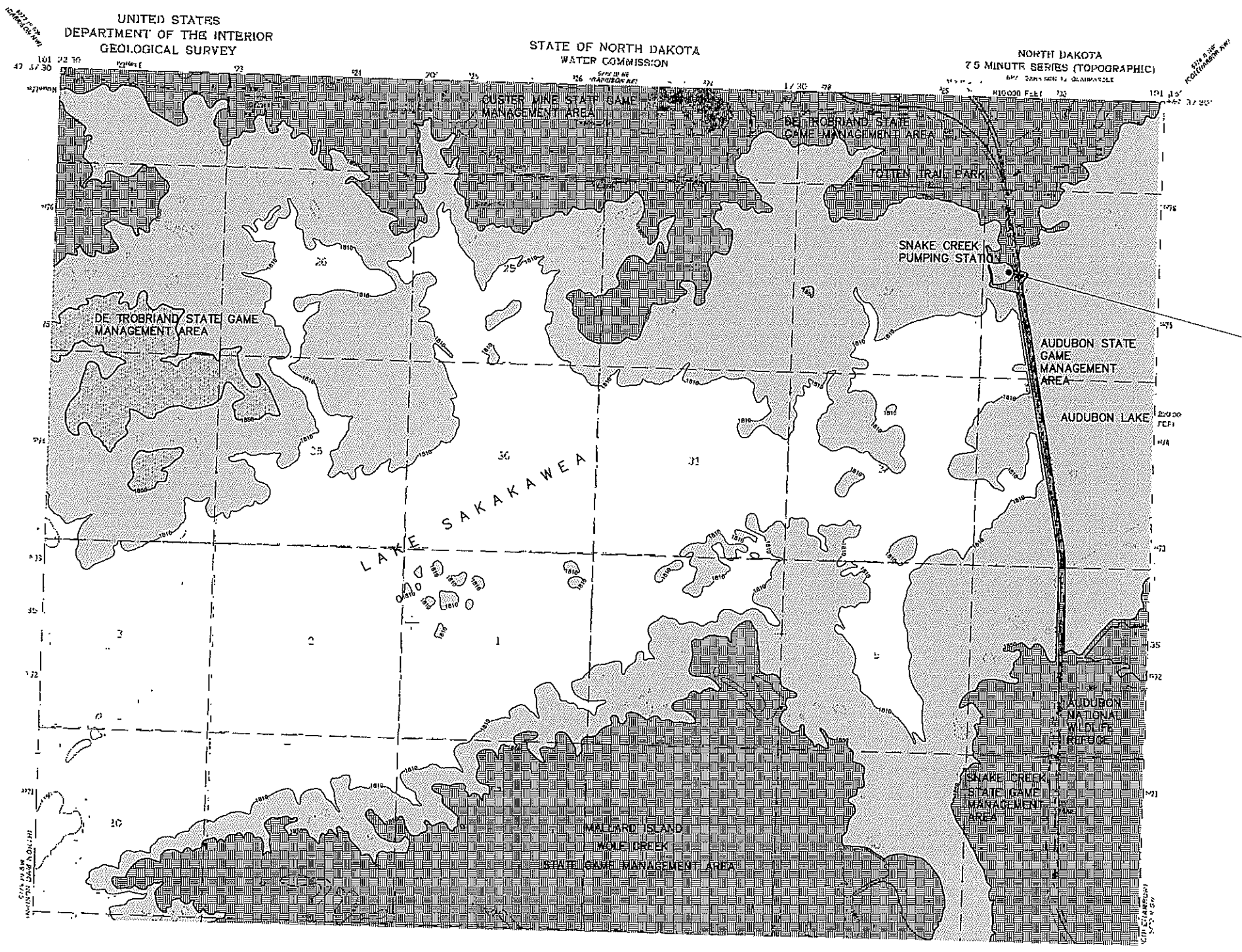
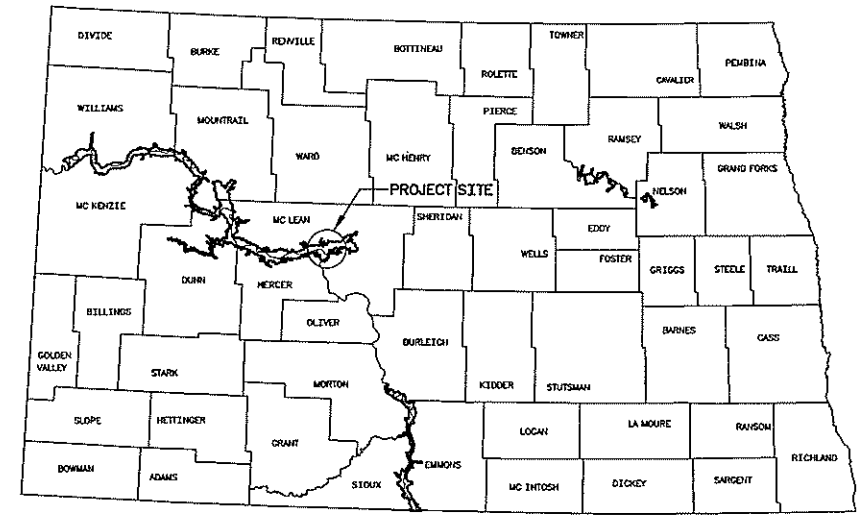
BISMARCK, N. DAK.	AUGUST 05, 2004	769-603-24986

DRAWING 2

(22X34)





VICINITY MAP
NO SCALE

LEGEND OF SYMBOLS

- Paved road
- Improved Gravel road
- Uninproved Road
- Trail
- Power line
- Railroad tracks
- Stream
- Barbed wire fence (Existing)
- Canal
- Primary Survey Control
- Base Line Control Point
- Slough

NOTES:

1. *Underwater contours in Lake Sakakawea and Audubon Lake from USGS maps dated 1943, Riverdale North Quadrangle*
2. *Lake Sakakawea water surface elevation 1810.0.*

LOCATION MAP

1760 0 1760 3520 5280
SCALE OF FEET

REV NO		
1	4-27-2005 683-JLT	REVISED TITLE BLOCK

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
PICK-SLOAN MISSOURI BASIN PROGRAM
GARRISON DIVISION GARRISON DIVERSION UNIT, N.DAK.

SNAKE CREEK PUMPING PLANT
LOCATION MAP AT ELEV. 1810

DESIGNED	D. ALBRIGHT	CHECKED	S. JACOBSON
DRAWN	J.POTTRA	TECH. APPR.	Dustin S. Albright, P.E.
		APPROVED	Jame L. Todd, P.E.

CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
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BISMARCK, N. DAK.	AUGUST 05, 2004	769-603-24987

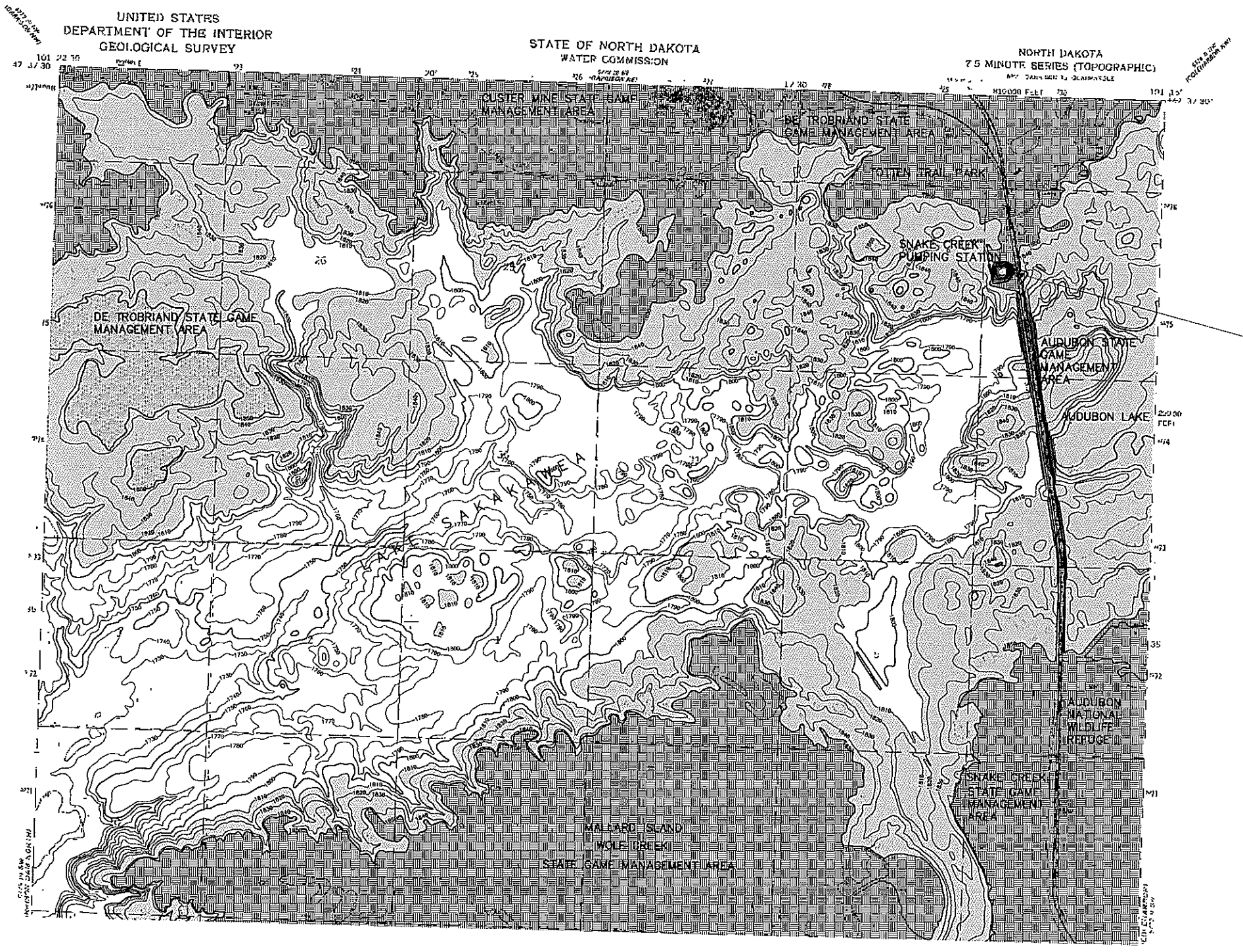
DRAWING 3

(22X34)

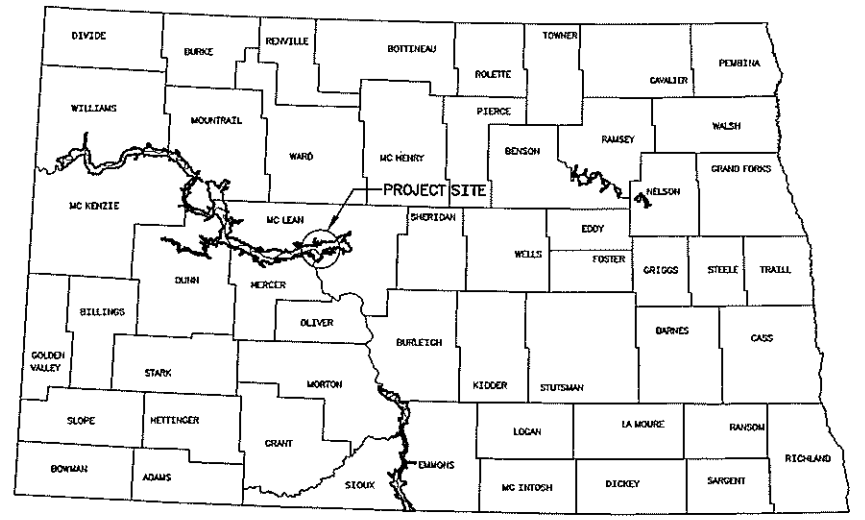
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE OF NORTH DAKOTA
WATER COMMISSION

NORTH DAKOTA
7.5 MINUTE SERIES (TOPOGRAPHIC)



Snake Creek Pumping Station



VICINITY MAP
NO SCALE

LEGEND OF SYMBOLS

- Paved road
- Improved Gravel road
- Uninproved Road
- Trail
- Power line
- Railroad tracks
- Stream
- Barbed wire fence (Existing)
- Canal
- Primary Survey Control
- Base Line Control Point
- Slough

NOTES:

1. *Underwater contours in Lake Sakakawea and Audubon Lake from USGS maps dated 1943, Riverdale North Quadrangle*
2. *Lake Sakakawea water surface elevation 1810.0.*

LOCATION MAP

1760 0 1760 3520 5280
SCALE OF FEET

REVISED	4-27-2005	REVISED TITLE BLOCK
1	663-JLT	

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BUREAU OF RECLAMATION

PICK-SLOAN MISSOURI BASIN PROGRAM
GARRISON DIVISION GARRISON DIVERSION UNIT, N.DAK.

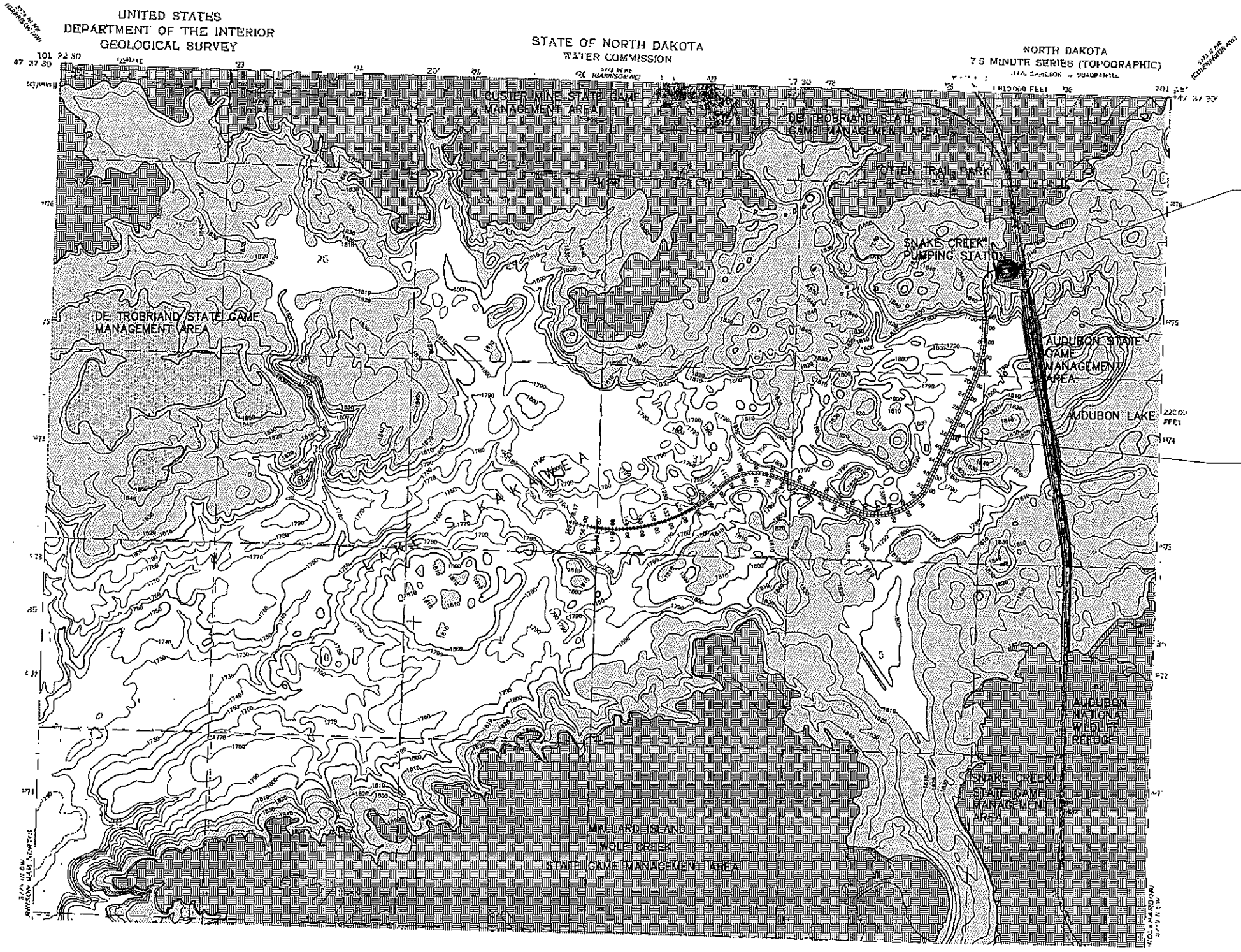
SNAKE CREEK PUMPING PLANT
LOCATION MAP AT ELEV. 1810 WITH CONTOURS

DESIGNED	D. ALBRIGHT	CHECKED	S. JACOBSON
DRAWN	J.POITRA	TECH. APPR.	Dustin S. Albright, P.E.
APPROVED	Jame L. Todd, P.E.		

CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
ACAD 2006/LDD3	SNAKECREEKTOPO.DWG	8-05-2004 9:30 AM
BISMARCK, N. DAK.	AUGUST 05, 2004	769-603-24988

DRAWING 4

(22X34)



NOTES:

1. Underwater contours in Lake Sakakawea and Audubon Lake from USGS maps dated 1943, Riverdale North Quadrangle
2. Lake Sakakawea water surface elevation 1810.0.
3. Proposed alignment invert elevation 1766.0.

REV NO		
1	4-27-2005 603-JLT	REVISED TITLE BLOCK

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PICK-SLOAN MISSOURI BASIN PROGRAM
GARRISON DIVISION GARRISON DIVERSION UNIT, N.DAK.

SNAKE CREEK PUMPING PLANT
PROPOSED SAKAKAWEA INLET CHANNEL ALIGNMENT

DESIGNED	D. ALBRIGHT	CHECKED	S. JACOBSON
DRAWN	J.POITRA	TECH. APPR.	Dustin S. Albright, P.E.
APPROVED	Jame L. Todd, P.E.		

CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
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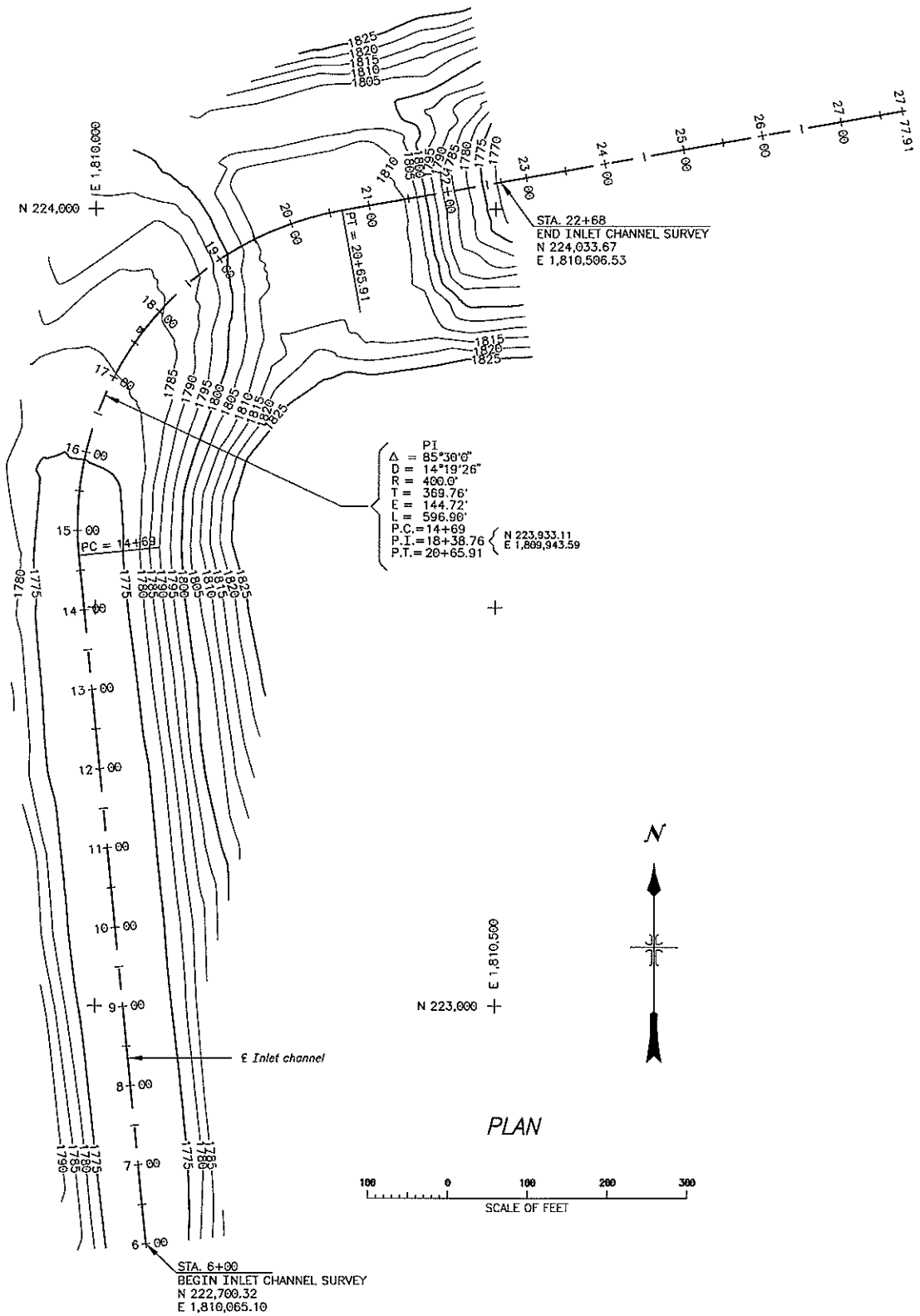
769-603-24989

DRAWING 5

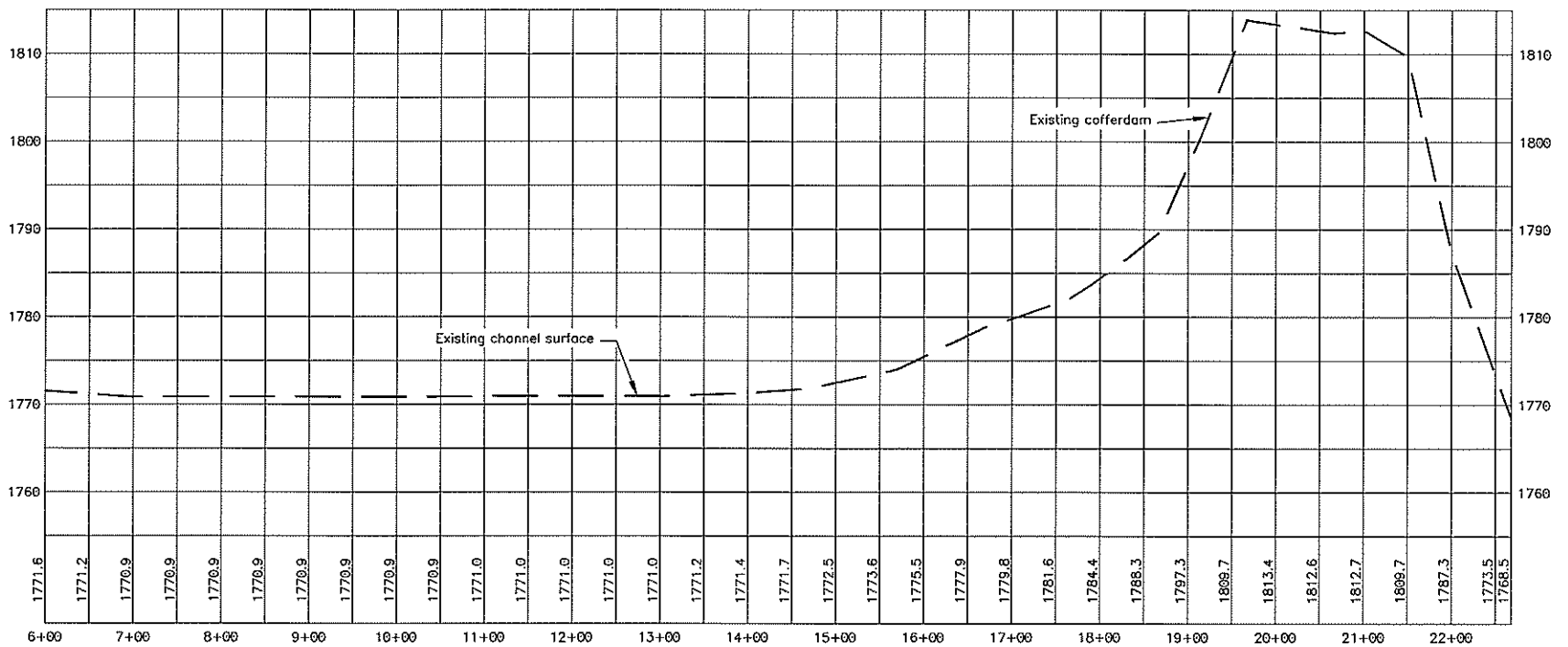
(22X34)

SECTIONS 28 &29, T147N, R82W



PLAN

SCALE OF FEET



PROFILE INLET CHANNEL CENTERLINE

VERTICAL SCALE OF FEET

HORIZONTAL SCALE OF FEET

NOTES:

1. Survey performed March 7–9, 2001 by Houston Engineering.
2. March 8, 2001 top of ice elevation 1827.9 feet.
3. See dwgs. 769–603–23378 through 769–603–23382 for inlet channel cross sections.

REV NO		
1	4-27-2005 603-JLT	REVISED TITLE BLOCK

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PICK–SLOAN MISSOURI BASIN PROGRAM
GARRISON DIVISION GARRISON DIVERSION UNIT, N.DAK.

SNAKE CREEK PUMPING PLANT

INLET CHANNEL SURVEY PLAN AND PROFILE

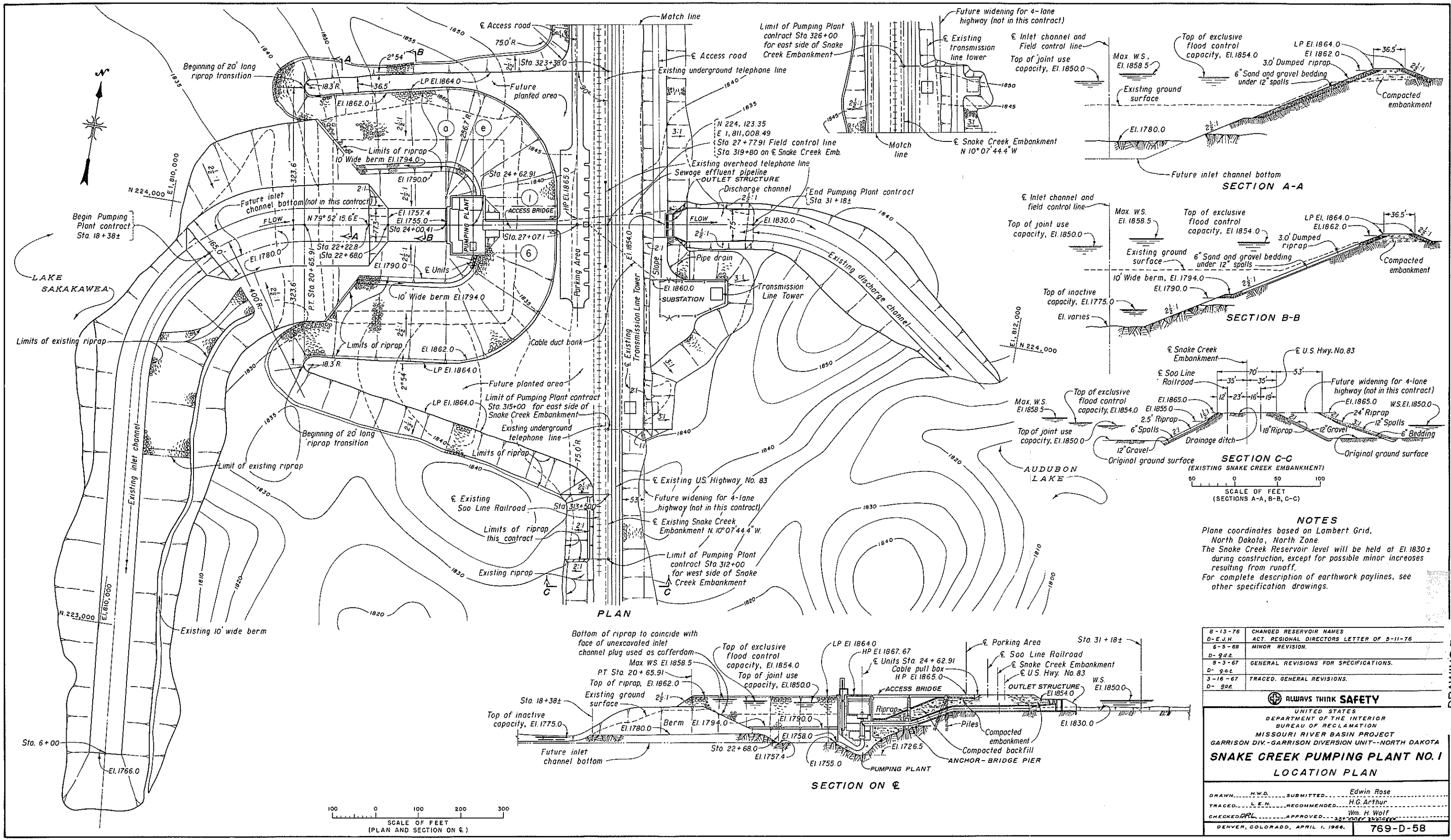
DESIGNED	D. ALBRIGHT	CHECKED	S. JACOBSON
DRAWN	D. ALBRIGHT	TECH. APPR.	Dustin S. Albright, P.E.
APPROVED	Jame L. Todd, P.E.		

CADD SYSTEM: ACAD 2000/LDD2 BISMARCK, N. DAK.	CADD FILENAME: INLET_TOPO.DWG MARCH 10, 2005	DATE AND TIME PLOTTED: 04-18-2005 9:00 AM

769–603–23377

DRAWING 6

(22X34)



NOTES

Plane coordinates based on Lambert Grid, North Dakota, North Zone.
The Snake Creek Reservoir level will be held at El. 1830± during construction, except for possible minor increases resulting from runoff.
For complete description of earthwork paylines, see other specification drawings.

8-13-76 D-E.J.H.	CHANGED RESERVOIR NAMES ACT. REGIONAL DIRECTORS LETTER OF 5-11-76
6-5-68 D-g.a.t.	MINOR REVISION.
8-3-67 D- g.a.t.	GENERAL REVISIONS FOR SPECIFICATIONS.
3-16-67 D- g.a.t.	TRACED. GENERAL REVISIONS.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MISSOURI RIVER BASIN PROJECT
GARRISON DIV.-GARRISON DIVERSION UNIT--NORTH DAKOTA

SNAKE CREEK PUMPING PLANT NO. 1

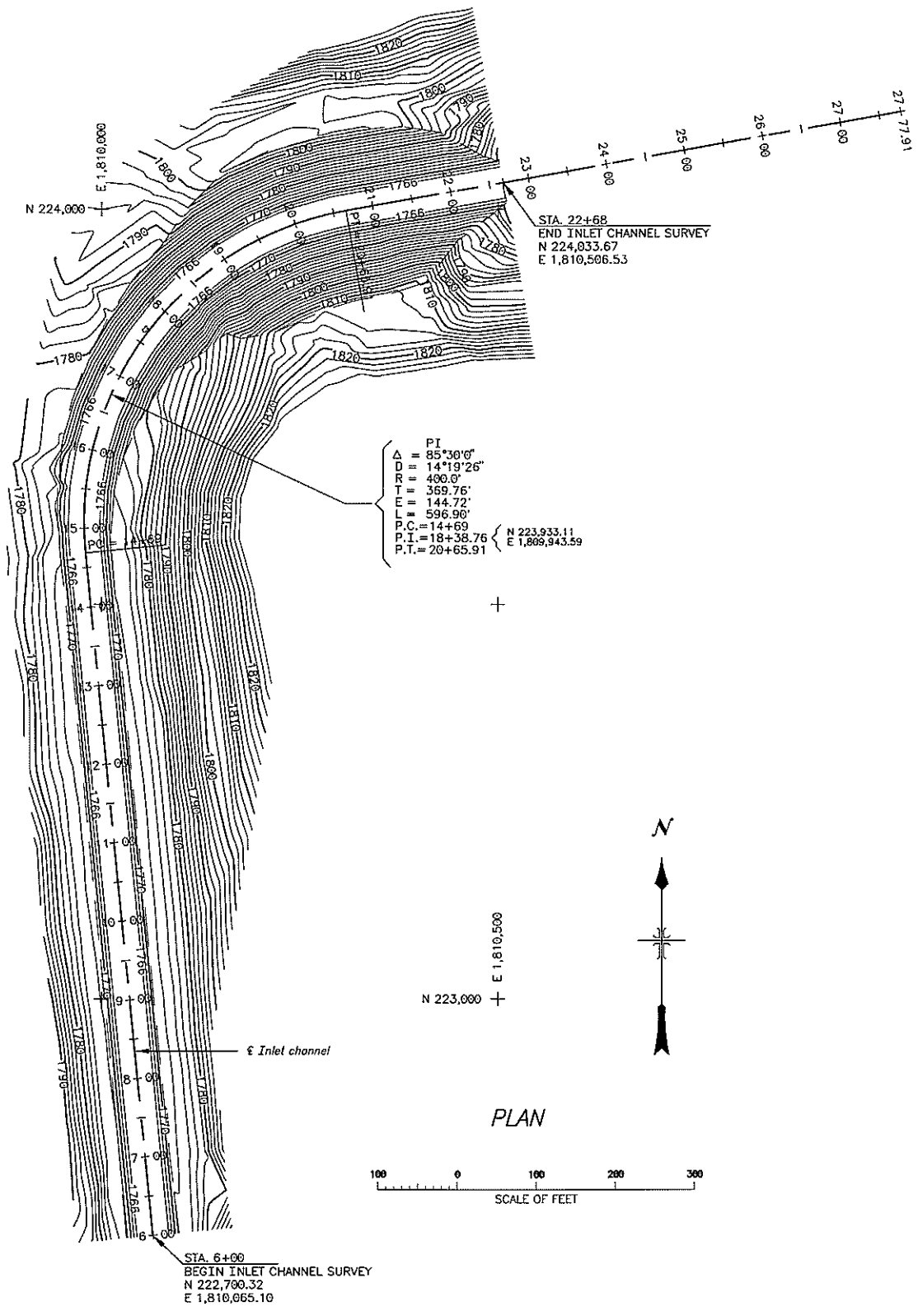
LOCATION PLAN

DRAWN H.W.O. SUBMITTED Edwin Rose
TRACED L.E.N. RECOMMENDED H.G. Arthur
CHECKED DRL APPROVED Wm. H. Wolf
Assistant Commissioner and Chief Engineer

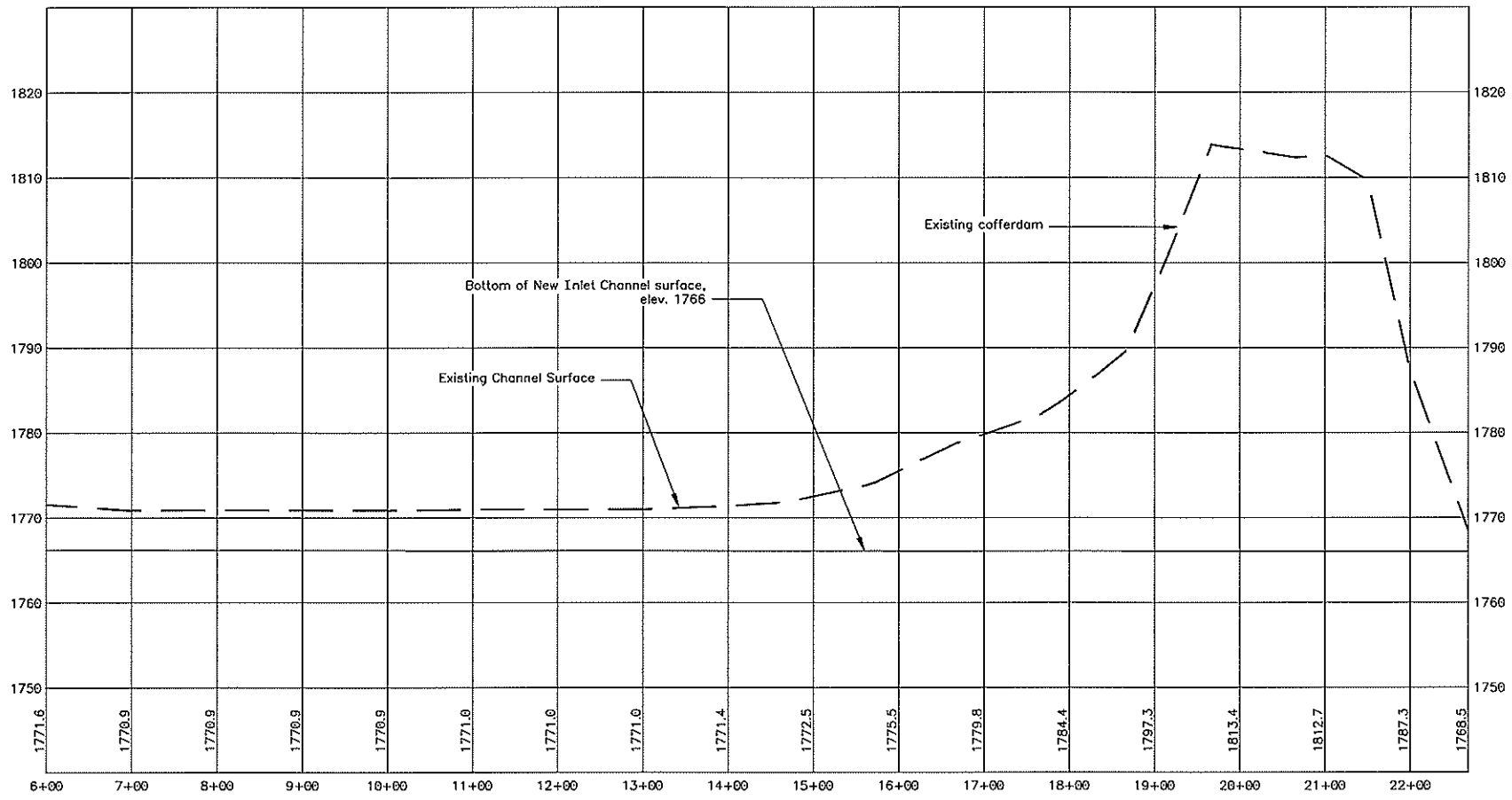
DENVER, COLORADO, APRIL 1, 1966. 769-D-58

DRAWING 7

SECTIONS 28 &29, T147N, R82W



PLAN



PROFILE INLET CHANNEL CENTERLINE

10 0 10 20 30
VERTICAL SCALE OF FEET

100 0 100 200 300
HORIZONTAL SCALE OF FEET

NOTES:

1. Survey performed March 7–9, 2001 by Houston Engineering.
2. March 8, 2001 top of ice elevation 1827.9 feet.
3. See dwgs. 769–603–23378 through 769–603–23382 for inlet channel cross sections.

REV NO		
1	4-27-2005 603-JLT	REVISED TITLE BLOCK

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
PICK–SLOAN MISSOURI BASIN PROGRAM
GARRISON DIVISION GARRISON DIVERSION UNIT, N.DAK.

SNAKE CREEK PUMPING PLANT

NEW PROPOSED INLET CHANNEL
PLAN AND PROFILE

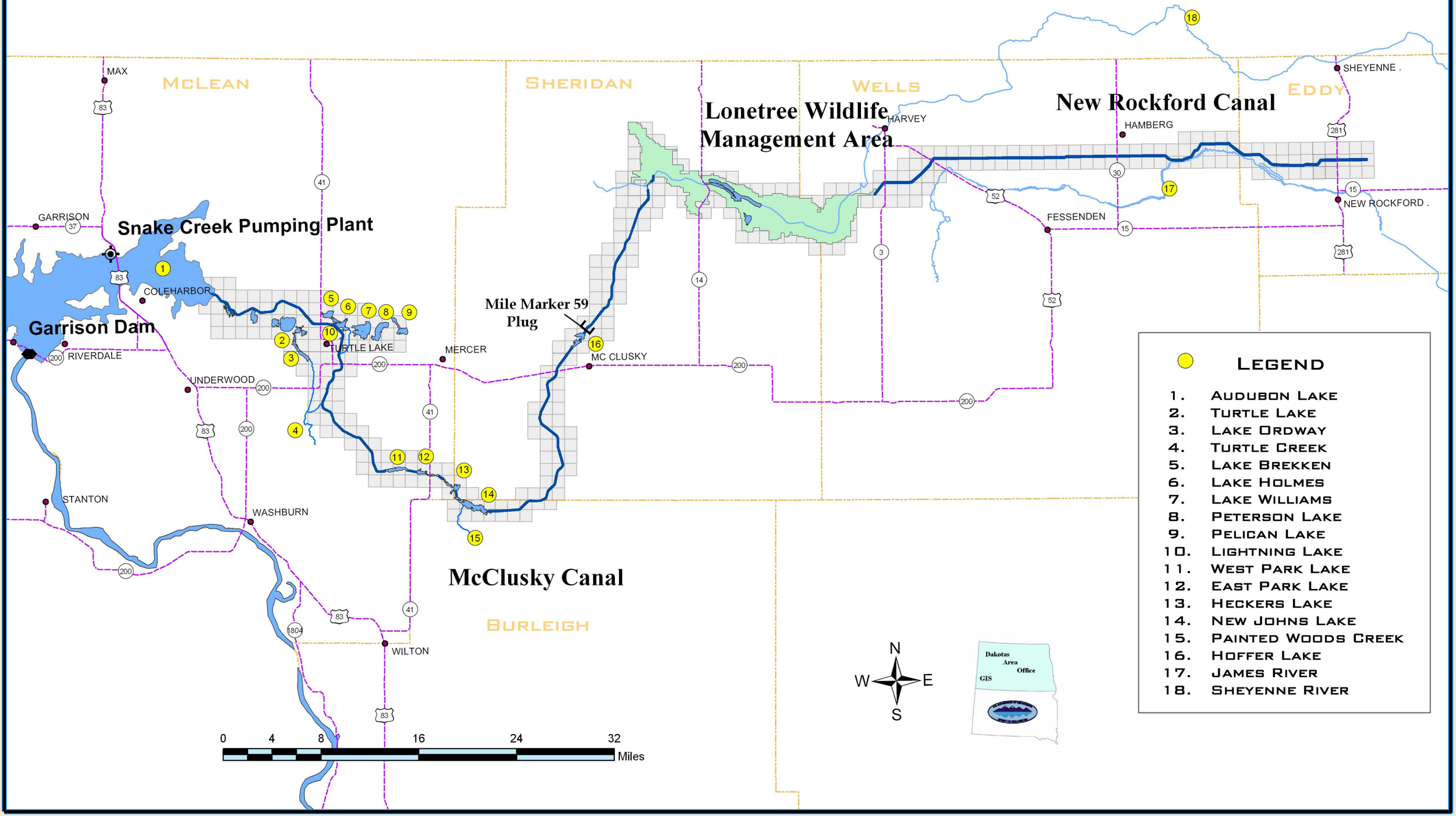
DESIGNED	D. ALBRIGHT	CHECKED	S. JACOBSON
DRAWN	D. ALBRIGHT	TECH. APPR.	Dustin S. Albright, P.E.
APPROVED	Jame L. Todd, P.E.		

CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
ACAD 2000/LDD2	INLET_TOPO.DWG	3-10-2005 9:00 AM
BISMARCK, N. DAK.	MARCH 10, 2005	769–603–24990

DRAWING 8

(22X34)

GARRISON DIVERSION UNIT
PRINCIPAL SUPPLY WORKS



DRAWING 9

Appendix B - Cost Estimates

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE	OFFICE	DAKOTAS AREA OFFICE
CONSTRUCTION OF SNAKE CREEK PUMPING PLANT	DIVISION	**GARRISON DIVISION**
INTAKE CHANNEL (Conventional Excavation)	UNIT	**GARRISON DIVERSION UNIT**

PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Clearing and Grubbing	100	ACRE	1050.00	105,000.00
2	Access Road Embankment	44,000	CY	4.00	176,000.00
3	Excavate Channel	954,000	CY	4.50	4,293,000.00
4	Water, Dust Abatement	100	MGAL	15.00	1,500.00
5	Remove Access Road Embankment	44,000	CY	4.50	198,000.00
6	Top Soil Stripping	242,000	CY	2.00	484,000.00
7	Spoil Area Prep	100	ACRE	5000.00	500,000.00
8	Placing Topsoil	242,000	CY	2.00	484,000.00
9	Seeding	100	ACRE	800.00	80,000.00
10	Site Cleanup and Restoration	1		1.50%	94,822.50
	Subtotal 1				6,416,322.50
	Mobilization and preparatory work (5% of unit costs)				320,816.13
	Unlisted Items (2%)				134,742.77
	Contingencies (15%)				1,010,570.79
	Total Field Cost				7,882,452.19
	USBR Engineering and Construction Management (20%)				1,576,490.44
	(topographic lake surveys, soil sampling, design, environmental)				
SUBTOTAL - INTAKE CHANNEL EXTENSION					$9,458,942.63
TOTAL ESTIMATE				$9,458,943	$9,458,942.63

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
Nathan D. Kraft	S. Jacobson	Nathan D. Kraft	S. Jacobson
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
16-Feb-04		16-Feb-04	2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE	OFFICE	DAKOTAS AREA OFFICE
CONSTRUCTION OF SNAKE CREEK PUMPING PLANT	DIVISION	**GARRISON DIVISION**
INTAKE CHANNEL (Hydraulic Dredge)	UNIT	**GARRISON DIVERSION UNIT**

PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Clearing and Grubbing	100	ACRE	1050.00	105,000.00
2	Hydraulic Dredge Channel	954,000	CY	9.00	8,586,000.00
3	Top Soil Stripping	242,000	CY	2.00	484,000.00
4	Spoil Area Prep	100	ACRE	10000.00	1,000,000.00
5	Placing Topsoil	242,000	CY	2.00	484,000.00
6	Seeding	100	ACRE	800.00	80,000.00
7	Site Cleanup and Restoration	1		1.50%	161,085.00
	Subtotal 1				10,900,085.00
	Mobilization and preparatory work (5% of unit costs)				545,004.25
	Unlisted Items (2%)				228,901.79
	Contingencies (15%)				1,716,763.39
	Total Field Cost				13,390,754.42
	USBR Engineering and Construction Management (20%)				2,678,150.88
	(topographic lake surveys, soil sampling, design, environmental)				
	Provided for information only.				

SUBTOTAL - INTAKE CHANNEL EXTENSION		$16,068,905.31
TOTAL ESTIMATE	$16,068,905	$16,068,905.31

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
Nathan D. Kraft	S. Jacobson	Nathan D. Kraft	S. Jacobson
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
16-Feb-05		16-Feb-05	2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE	OFFICE	DAKOTAS AREA OFFICE
MAJOR REHABILITATION WORK AT SNAKE CREEK	DIVISION	**GARRISON DIVISION**
PUMPING PLANT	UNIT	**GARRISON DIVERSION UNIT**

PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Transfer Deck Replacement	1	LS	LUMP SUM	$1,209,890
	Indexed as Pumping Plant from $1,100,000 4Q2001(475.09) to 2Q2005 (522.5)				
	Index Factor: 522.5/475.09 = 1.0998				
	Note: See "Supporting Info." section in Appendix B for a copy of the TSC estimate				
	Subtotal 1				1,209,889.98
	Total Field Cost				1,209,889.98
	Others:				
1	Bridge Rocker Bearing Repairs	1	LS	LUMP SUM	$50,000
2	Pump Bowl Changeout (1 changed in Dec 2004)	1	EACH	$44,000	$44,000
3	Pump Unit Alignment(assuming NAWS in pump unit 1)	2	EACH	$100,000	$200,000
4	Bridge Pier Anchor Vault Repairs	1	LS	$325,600	$325,600
SUBTOTAL - SCPP MAJOR REHAB					$1,829,489.98
TOTAL ESTIMATE				$1,829,490	$1,829,489.98

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
S. Jacobson/Dustin S. Albright, PE		Dustin S. Albright, PE	
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
18-Apr-05		18-Apr-05	2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE		OFFICE	DAKOTAS AREA OFFICE
BRIDGE PIER ANCHOR VAULT WORK AT SNAKE CREEK PUMPING PLANT		DIVISION	**GARRISON DIVISION**
		UNIT	**GARRISON DIVERSION UNIT**

PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Sandblast, patch and coat three 11 ft. diam. Pipes	730	sf	20.00	$14,600
2	Patch, repair concrete and seal joints	1	ls	$30,000	$30,000
3	Dampproofing vault	6,000	sf	$10	$60,000
4	Excavation/backfill	1,000	cy	$15	$15,000
5	Dewatering	1	ls	$50,000	$50,000
6	Fill vault with concrete	312	cy	$500	$156,000
SUBTOTAL - SCPP BRIDGE PIER ANCHOR VAULT					$325,600.00
TOTAL ESTIMATE				$325,600	$325,600.00

QUANTITIES		PRICE	
BY S. Jacobson	CHECKED	BY S. Jacobson	CHECKED
DATE PREPARED 14-Apr-05	APPROVED	DATE 14-Apr-05	PRICE LEVEL 2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE		OFFICE	DAKOTAS AREA OFFICE		
REPAIR OF MAJOR SLIDES ON McCLUSKY CANAL		DIVISION	**GARRISON DIVISION**		
STA 1124+00 TO STA. 1204+00		UNIT	**GARRISON DIVERSION UNIT**		
PAY ITEM	**DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
1	McClusky Canal Slide Repair, Stations 1124+00 to 1204+00	3,000,000	CY	1.88	5,640,000
	Using Force Account				
	(See Appendix C for Detailed Force Account Estimate)				
	Total Field Cost				5,640,000.00
	USBR Engineering and Construction Management (10%)				564,000.00
	Total Field Cost				6,204,000.00
	Note: See TSC's report "Canal Modification Feasability Study for McClusky Canal - Reach 2				
	Station 1124+00 through 1204+00," April 25, 2001 for cost estimate information.				
	Provided for information only.				
	McClusky Canal Slide Repair, Stations 1124+00 to 1204+00	3,000,000	CY	5.49	16,463,880
	Indexed as Channels and Canals from $15,250,000				
	3Q2001 (537.32) to 2Q2005 (580.09)				
	Index Factor: 580.09/527.32 = 1.0796				
SUBTOTAL - McCC MAJOR SLIDE REPAIRS					$6,204,000
TOTAL ESTIMATE				$6,204,000	$6,204,000

QUANTITIES		PRICE	
BY Dustin S. Albright, PE	CHECKED	BY Dustin S. Albright, PE	CHECKED
DATE PREPARED 1-Dec-04	APPROVED	DATE 1-Dec-04	PRICE LEVEL 2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE		OFFICE	DAKOTAS AREA OFFICE		
UPDATES TO McCLUSKY CANAL CONTROL STRUCTURES		DIVISION	**GARRISON DIVISION**		
Headworks to MM59		UNIT	**GARRISON DIVERSION UNIT**		
PAY ITEM	**DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
1	Power Updates to Headworks	1	EACH	30000.00	30,000.00
2	Power Updates to Radial Gates	3	EACH	25000.00	75,000.00
3	Supervisory Control and Data Acquisition (SCADA) System:				
	Master Control Center (GDCD-HDW), computer, software	1	LS	LUMP SUM	40,000.00
	Control Center (Field Offices), computer, software, misc.	1	LS	LUMP SUM	40,000.00
	Additional Centers (USBR, RRV), computer, software, misc.	1	LS	LUMP SUM	40,000.00
	Remote Terminal Units (for control at McCC sites)	4	EACH	39000.00	156,000.00
4	Radial Gate Updates (Downstream Stoplogs)	6	EACH	25000.00	150,000.00
	Subtotal 1				531,000.00
	Mobilization and preparatory work (5% of unit costs)				26,550.00
	Unlisted Items (15%)				79,650.00
	Contingencies (15%)				79,650.00
	Total Field Cost				716,850.00
	USBR Engineering and Construction Management (20%)				143,370.00
SUBTOTAL - McCC CONTROL STRUCTURE UPDATES					$860,220.00
TOTAL ESTIMATE				$860,220	$860,220.00

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
Dustin S. Albright, PE		Dustin S. Albright, PE	
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
1-Dec-04		1-Dec-04	2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE		OFFICE	DAKOTAS AREA OFFICE		
MODIFICATIONS TO THE MM59 PLUG AT McCLUSKY CANAL		DIVISION	**GARRISON DIVISION**		
		UNIT	**GARRISON DIVERSION UNIT**		
PAY ITEM	**DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
1	Raise Existing MM59 Plug, Earthfill, dike	3,000	CY	7.47	22,410.00
	(Use approximately 3,000 cubic yards from adjacent				
	canal spoil piles)				
2	TOPSOIL STRIPPING	1,000	CY	2.00	2,000.00
3	PLACING TOPSOIL	1,000	CY	2.00	2,000.00
4	SEEDING	5	ACRE	800.00	4,000.00
5	SITE CLEAN UP AND RESTORATION			2%	60.00
	Subtotal 1				30,470.00
	Mobilization and preparatory work (5% of unit costs)				1,523.50
	Unlisted Items (2%)				639.87
	Contingencies (15%)				4,799.03
	Total Field Cost				37,432.40
	USBR Engineering and Construction Management (20%)				7,486.48
SUBTOTAL - McCC MP59 PLUG MODIFICATIONS					$44,918.87
TOTAL ESTIMATE				$44,919	$44,918.87

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
Nathan D. Kraft	S. Jacobson	Nathan D. Kraft	S. Jacobson
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
23-Feb-05		23-Feb-05	2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE		OFFICE	DAKOTAS AREA OFFICE		
McCLUSKY CANAL WINTER OPERATIONS		DIVISION	**GARRISON DIVISION**		
Headworks to MM59		UNIT	**GARRISON DIVERSION UNIT**		
PAY ITEM	**DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
1	Ice Prevention Bubbler Systems at Headworks	1	EACH	20000.00	20,000.00
2	Ice Prevention Bubbler Systems at Radial Gates	3	EACH	20000.00	60,000.00
	Subtotal 1				80,000.00
	Mobilization and preparatory work (5% of unit costs)				4,000.00
	Unlisted Items (15%)				12,000.00
	Contingencies (15%)				12,000.00
	Total Field Cost				108,000.00
	USBR Engineering and Construction Management (20%)				21,600.00
SUBTOTAL - McCC WINTER OPERATIONS					$129,600.00
TOTAL ESTIMATE				$129,600	$129,600.00

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
Dustin S. Albright, PE		Dustin S. Albright, PE	
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
1-Dec-04		1-Dec-04	2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE	OFFICE	DAKOTAS AREA OFFICE
McCLUSKY CANAL MAJOR STRUCTURAL IMPROVEMENTS	DIVISION	**GARRISON DIVISION**
Headworks to MM59	UNIT	**GARRISON DIVERSION UNIT**

PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Beachbelting, Reach 3	20	MILE	262199.07	5,243,981.40
2	Coatings at Three Radial Gate Structures	3	EACH	10000.00	30,000.00
3	Repairs to Numerous Berm Drain Outlets	1	LS	LUMP SUM	250,000.00
4	Concrete Repair at Headworks Structure	1	LS	LUMP SUM	250,000.00
	Subtotal 1				5,773,981.40
	Mobilization and preparatory work (5% of unit costs)				288,699.07
	Unlisted Items (2%)				115,479.63
	Contingencies (15%)				866,097.21
	Total Field Cost				7,044,257.31
	USBR Engineering and Construction Management (20%)				1,408,851.46
SUBTOTAL - McCC STRUCTURAL IMPROVEMENTS					$8,453,108.77
TOTAL ESTIMATE				$8,453,109	$8,453,108.77

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
Nathan D. Kraft	S. Jacobson	Nathan D. Kraft	S. Jacobson
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
23-Feb-05		23-Feb-05	2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE	OFFICE	DAKOTAS AREA OFFICE
NEW ROCKFORD CANAL NEW LINING INSTALLATION	DIVISION	GARRISON DIVISION
	UNIT	GARRISON DIVERSION UNIT

PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	NRC New Lining Installation, Begin Reach B (Sta. 729+00) to	1	LS	LUMP SUM	14,000,000.00
	End Reach B (Sta. 1471+00)				
	(Excavation, subgrade preparation, geomembrane installation,				
	soil cover placement, and slope protection)				
	Note: Estimate based on O&M's recommendation of $1,000,000/mile				
SUBTOTAL - NRC NEW LINING INSTALLATION					$14,000,000.00
TOTAL ESTIMATE				$14,000,000	$14,000,000.00

QUANTITIES		PRICE	
BY Dustin S. Albright, PE	CHECKED	BY Dustin S. Albright, PE	CHECKED
DATE PREPARED 1-Dec-04	APPROVED	DATE 1-Dec-04	PRICE LEVEL 2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE	OFFICE	DAKOTAS AREA OFFICE
NEW ROCKFORD CANAL EXISTING LINING REPAIR	DIVISION	GARRISON DIVISION
	UNIT	GARRISON DIVERSION UNIT

PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	NRC Lining Repair, Sta. 193+38.23 to Sta. 433+91.13	1	LS	LUMP SUM	4,500,000.00
	(Excavation, subgrade preparation, geomembrane installation,				
	soil cover placement, and slope protection)				
	Note: Estimate based on O&M's recommendation of $1,000,000/mile				
SUBTOTAL - NRC EXISTING LINING REPAIRS					$4,500,000.00
TOTAL ESTIMATE				$4,500,000	$4,500,000.00

QUANTITIES		PRICE	
BY Dustin S. Albright, PE	CHECKED	BY Dustin S. Albright, PE	CHECKED
DATE PREPARED 1-Dec-04	APPROVED	DATE 1-Dec-04	PRICE LEVEL 2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE	OFFICE	DAKOTAS AREA OFFICE
NEW ROCKFORD CANAL WINTER OPERATIONS	DIVISION	GARRISON DIVISION
	UNIT	GARRISON DIVERSION UNIT

PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Ice Precention Bubbler Systems at Radial Gate Structures	6	EACH	20000.00	120,000.00
	Subtotal 1				120,000.00
	Mobilization and preparatory work (5% of unit costs)				6,000.00
	Unlisted Items (15%)				18,000.00
	Contingencies (15%)				18,000.00
	Total Field Cost				162,000.00
	USBR Engineering and Construction Management (20%)				32,400.00
SUBTOTAL - NRC WINTER OPERATIONS					$194,400.00
TOTAL ESTIMATE				$194,400	$194,400.00

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
Dustin S. Albright, PE		Dustin S. Albright, PE	
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
1-Dec-04		1-Dec-04	2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE	OFFICE	DAKOTAS AREA OFFICE
UPDATES TO NEW ROCKFORD CANAL CONTROL STRUCTURES	DIVISION	**GARRISON DIVISION**
	UNIT	**GARRISON DIVERSION UNIT**

PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Power Updates to Radial Gate Structures	6	EACH	10000.00	60,000.00
2	Supervisory Control and Data Acquisition (SCADA) System:				
	Control Center (Field Offices), computer, software, misc.	1	LS	LUMP SUM	40,000.00
	Additional Centers (USBR, RRV), computer, software, misc.	1	LS	LUMP SUM	40,000.00
	Remote Terminal Units (for control at NRC sites)	6	EACH	39000.00	234,000.00
3	Radial Gate Updates (Downstream Stoplogs)	18	EACH	25,000.00	450,000.00
	Subtotal 1				824,000.00
	Mobilization and preparatory work (5% of unit costs)				41,200.00
	Unlisted Items (15%)				123,600.00
	Contingencies (15%)				123,600.00
	Total Field Cost				1,112,400.00
	USBR Engineering and Construction Management (20%)				222,480.00
SUBTOTAL - McCC CONTROL STRUCTURE UPDATES					$1,334,880.00
TOTAL ESTIMATE				$1,334,880	$1,334,880.00

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
Dustin S. Albright, PE		Dustin S. Albright, PE	
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
1-Dec-04		1-Dec-04	2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE	OFFICE	DAKOTAS AREA OFFICE
ANNUAL PRINCIPAL SUPPLY WORKS OM&R	DIVISION	**GARRISON DIVISION**
	UNIT	**GARRISON DIVERSION UNIT**

PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Snake Creek Pumping Plant	1	LS	LUMP SUM	265,643
	Indexed as Pumping Plant from $233,000				
	2Q1999 (458.29) to 2Q2005 (522.50)				
	Index Factor: 522.50/458.29 = 1.1401				
2	McClusky Canal (Headworks through MP59)	1	LS	LUMP SUM	1,184,309
	Indexed as Channels and Canals from $1,053,000				
	2Q1999 (515.79) to 2Q2005 (580.09)				
	Index Factor: 580.09/515.79 = 1.1247				
3	McClusky Canal (MP59 through MP74)	1	LS	LUMP SUM	56,235
	Indexed as Channels and Canals from $50,000				
	2Q1999 (515.79) to 2Q2005 (580.09)				
	Index Factor: 580.09/515.79 = 1.1247				
4	New Rockford Canal	1	LS	LUMP SUM	393,645
	Indexed as Channels and Canals from $350,000				
	2Q1999 (515.79) to 2Q2005 (580.09)				
	Index Factor: 580.09/515.79 = 1.1247				
5	Fish and Wildlife Mitigation	1	LS	LUMP SUM	508,583
	Indexed as Fish & Wildlife Facilities from $453,000				
	2Q1999 (480.31) to 2Q2005 (539.26)				
	Index Factor: 580.09/515.79 = 1.1227				
	Subtotal 1				2,408,416

SUBTOTAL - PSW OM&R	$2,408,416
TOTAL OM&R ESTIMATE (SEE SHEET 14)	

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
Dustin S. Albright, PE		Dustin S. Albright, PE	
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
1-Dec-04		1-Dec-04	2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE		OFFICE	DAKOTAS AREA OFFICE		
ANNUAL PRINCIPAL SUPPLY WORKS OM&R (CONT.)		DIVISION	GARRISON DIVISION		
		UNIT	GARRISON DIVERSION UNIT		
PAY ITEM	**DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
6	Winter Operations (McCC/NRC)	1	LS	LUMP SUM	58,484
	Indexed as Channels and Canals from $52,000				
	2Q1999 (515.79) to 2Q2005 (580.09)				
	Index Factor: 580.09/515.79 = 1.1247				
7	SCADA (SCPP/McCC/NRC)	1	LS	LUMP SUM	262,055
	Indexed as Channels and Canals from $233,000				
	2Q1999 (515.79) to 2Q2005 (580.09)				
	Index Factor: 580.09/515.79 = 1.1247				
	Subtotal 2 (Sheet 14)				320,540
	Subtotal 1 (Sheet 13)				2,408,416
	Subtotal 2 (Sheet 14)				320,540
	Total Annual OM&R Costs				2,728,955
SUBTOTAL - PSW Annual OM&R					2,728,955
TOTAL ESTIMATE				$2,728,955	2,728,955

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
Dustin S. Albright, PE		Dustin S. Albright, PE	
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
1-Dec-04		1-Dec-04	2005

Principal Supply Works Rehabilitation and Construction Costs

Task Number	Work Item	Principal Supply Works Feature	Original Cost Estimate	Year of Original Cost Estimate	Indexing Factor (through 2005)	Indexed Construction Cost (2005)
Engineering 1-1	Construct Snake Creek Intake Channel Extension (conventional excavation)	SCPP	$9,458,943	2005	1	$9,458,943
Engineering 1-2	Construct Snake Creek Intake Channel Extension (hydraulic dredge)	SCPP	$16,068,905	2005	1	$16,068,905
Engineering 1-3	Other Major Rehabilitation Work – SCPP	SCPP	$1,829,490	2005	1	$1,829,490
						$11,288,433
Engineering 1-4	Repair McClusky Canal (McCC) Slide - Sta. 1124+00 to 1204+00 (1,000 cfs Option)	McCC	$6,204,000	2001	1	$6,204,000
Engineering 1-5	Control Structure (radial gates) Power and SCADA connections	McCC	$860,220	2005	1	$860,220
Engineering 1-6	Winter Operations - McClusky Canal	McCC	$129,600	2005	1	$129,600
Engineering 1-7	McClusky Canal MM 59 Plug Modification (raising)	McCC	$44,919	2005	1	$44,919
Engineering 1-8	Other Major Structural Improvements	McCC	$8,453,109	2005	1	$8,453,109
						$15,691,848
Engineering 1-9	Install 14 miles of Lining New Rockford Canal (NRC)	NRC	$14,000,000	2005	1	$14,000,000
Engineering 1-10	Line or Repair 4 miles of Lining - New Rockford Canal	NRC	$4,500,000	2005	1	$4,500,000
Engineering 1-11	Winter Operations – NRC	NRC	$194,400	2005	1	$194,400
Engineering 1-12	Control Structure (radial gates) Power and SCADA connections	NRC	$1,334,880	2005	1	$1,334,880
						$20,029,280
Totals						**$47,009,560**
Engineering 1-13	OM&R costs for SCPP, McCC to MM 59, McCC after MM 59, and the NRC	SCPP, McCC, NRC	$2,728,955	2005	1	$2,728,955

Appendix C – Supporting Information

Appendix C – Attachment 1

Main Stem Reservoir & Release Forecast – Monthly Study

April 1, 2005 Basic Simulation
SR-FTT, Shorten Navigation Seas
Elevations & Storages are for D
Avg Discharge & Energy are Mont
Date of Study: Apr 1, 2005

	31-Mar-05	30-Apr	2005 31-May	30-Jun	31-Jul	31-Aug	3
FORT PECK -------							
ELEV FTMSL	2198.5	2198.6	2198.2	2197.9	2194.4	2193.3	2
DISCH KCFS	4.5	5.0	5.5	5.5	8.0	8.0	
GARRISON --------							
ELEV FTMSL	1808.7	1807.7	1806.0	1806.6	1804.3	1804.3	1
DISCH KCFS	12.1	15.5	19.0	15.5	15.5	15.5	
OAHE ------------							
ELEV FTMSL	1574.4	1574.8	1575.0	1574.5	1570.7	1567.3	1
DISCH KCFS	19.2	17.9	21.5	21.2	26.8	24.1	
BIG BEND --------							
ELEV FTMSL	1421.1	1420.0	1420.0	1420.0	1420.0	1420.0	1
DISCH KCFS	17.9	19.0	21.5	21.2	26.7	23.8	
FORT RANDALL ----							
ELEV FTMSL	1355.2	1355.2	1355.2	1355.2	1355.2	1353.1	1
DISCH KCFS	13.3	20.4	23.3	23.2	27.1	26.6	
GAVINS POINT ----							
ELEV FTMSL	1206.5	1206.0	1206.0	1206.0	1206.0	1206.5	1
DISCH KCFS	14.7	22.5	25.5	25.5	28.3	28.0	
SYSTEM ----------							
STORAGE 1000 AF	35576	35392	35004	35002	33304	32384	
ENERGY GWh	5406	538	647	597	728	686	
PEAK POWER MW		2004	1998	1998	1964	1948	

April 1, 2005 Lower Basic Simul
SR-FTT, Shorten Navigation Seas

	31-Mar-05	30-Apr	2005 31-May	30-Jun	31-Jul	31-Aug	3
FORT PECK -------							
ELEV FTMSL	2198.5	2197.5	2195.9	2194.1	2190.2	2188.0	2
DISCH KCFS	4.5	5.0	5.5	5.5	8.0	8.0	
GARRISON --------							
ELEV FTMSL	1808.7	1806.2	1804.6	1803.8	1801.1	1800.7	1
DISCH KCFS	12.1	18.0	15.0	15.0	15.0	14.5	
OAHE ------------							
ELEV FTMSL	1574.4	1574.6	1572.5	1570.4	1565.4	1564.1	1
DISCH KCFS	19.2	19.2	23.3	23.2	28.0	16.2	
BIG BEND --------							
ELEV FTMSL	1421.1	1420.0	1420.0	1420.0	1420.0	1420.0	1
DISCH KCFS	17.9	20.3	23.3	23.2	27.9	15.8	
FORT RANDALL ----							

ELEV FTMSL	1355.2	1355.2	1355.2	1355.2	1355.2	1346.3	1
DISCH KCFS	13.3	21.2	24.3	24.3	27.9	27.0	
GAVINS POINT ----							
ELEV FTMSL	1206.5	1206.0	1206.0	1206.0	1206.0	1206.5	1
DISCH KCFS	14.7	22.5	25.5	25.5	28.3	28.0	
SYSTEM ----------							
STORAGE 1000 AF	35576	34871	33919	33089	31138	29889	
ENERGY GWh	5440	574	641	615	731	581	
PEAK POWER MW		1996	1977	1960	1919	1907	

April 1, 2005 Upper Basic Simul
SR-FTT, Shorten Navigation Seas

	31-Mar-05	30-Apr	2005 31-May	30-Jun	31-Jul	31-Aug	3
FORT PECK -------							
ELEV FTMSL	2198.5	2198.7	2198.5	2198.9	2197.1	2197.5	2
DISCH KCFS	4.5	5.0	5.5	7.0	7.0	6.5	
GARRISON --------							
ELEV FTMSL	1808.7	1808.9	1809.7	1813.8	1811.9	1811.9	1
DISCH KCFS	12.1	15.5	16.5	17.0	17.0	17.0	
OAHE ----------							
ELEV FTMSL	1574.4	1575.8	1576.3	1578.1	1576.5	1574.4	1
DISCH KCFS	19.2	16.6	19.7	18.3	22.9	22.6	
BIG BEND --------							
ELEV FTMSL	1421.1	1420.0	1420.0	1420.0	1420.0	1420.0	1
DISCH KCFS	17.9	17.6	19.7	18.3	22.8	22.4	
FORT RANDALL ----							
ELEV FTMSL	1355.2	1355.2	1355.2	1355.2	1355.2	1353.1	1
DISCH KCFS	13.3	19.6	22.2	21.6	23.6	25.5	
GAVINS POINT ----							
ELEV FTMSL	1206.5	1206.0	1206.0	1206.0	1206.0	1206.5	1
DISCH KCFS	14.7	22.5	25.5	25.5	25.6	27.2	
SYSTEM ----------							
STORAGE 1000 AF	35576	35849	36105	37447	36431	35907	
ENERGY GWh	5368	520	605	586	672	676	
PEAK POWER MW		2014	2019	2044	2026	2019	

Appendix C – Attachment 2

Cost Estimate Supporting Data

Sheets 1-2: Removal of Coffer Dam Estimates

Sheets 3-7: SCPP Intake Channel Extension Estimates

Sheets 8-9: McCC Raising MM59 Plug

Sheet 10: McCC Beach Belting

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE		OFFICE	DAKOTAS AREA OFFICE		
CONSTRUCTION OF SNAKE CREEK PUMPING PLANT		DIVISION	GARRISON DIVISION		
INTAKE CHANNEL EXTENSION (USGS Quad Data)		UNIT	GARRISON DIVERSION UNIT		
PAY ITEM	**DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
1	Clearing and Grubbing	1	LS	LUMP SUM	25,000.00
2	Access Road Construction	1	LS	LUMP SUM	100,000.00
3	Riprap	1	LS	LUMP SUM	50,000.00
4	Water, Dust Abatement	1	LS	LUMP SUM	30,000.00
5	Hydraulic Dredging and disposal, intake channel	1,000,000	CY	9.00	9,000,000.00
7	Site cleanup and restoration	1	LS	LUMP SUM	100,000.00
8	Road maintenance and repairs	1	LS	LUMP SUM	100,000.00
	Subtotal 1				9,405,000.00
	Mobilization and preparatory work (5% of unit costs)				470,250.00
	Unlisted Items (15%)				1,410,750.00
	Contingencies (20%)				1,881,000.00
	Total Field Cost				13,167,000.00
	USBR Engineering and Construction Management (30%)				3,950,100.00
	(topographic lake surveys, soil sampling, design, environmental)				
SUBTOTAL - INTAKE CHANNEL EXTENSION					$17,117,100.00
TOTAL ESTIMATE				$17,117,100	$17,117,100.00

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
Dustin S. Albright, PE		Dustin S. Albright, PE	
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
1-Dec-04		1-Dec-04	2005

PRINCIPAL SUPPLY WORKS CONSTRUCTION, OPERATION, MAINTENANCE, AND REPLACEMENT COST ANALYSIS

FEASABILITY LEVEL COST ESTIMATE

FEATURE		OFFICE	DAKOTAS AREA OFFICE		
REMOVAL OF COFFERDAM AT SNAKE CREEK		DIVISION	**GARRISON DIVISION**		
PUMPING PLANT (Houston Engr. Data)		UNIT	**GARRISON DIVERSION UNIT**		
PAY ITEM	**DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
1	Clearing and Grubbing	1	LS	10,000.00	5,000.00
2	Access Road Construction	1	LS	25,000.00	25,000.00
3	Riprap	1	LS	25,000.00	25,000.00
4	Water, Dust Abatement	1	LS	10,000.00	10,000.00
6	Excavation, Cofferdam	75,000	CY	3.50	262,500.00
7	Hydraulic Dredging, Intake Channel	17,000	CY	9.00	153,000.00
10	Site Cleanup and Restoration	1	LS	20,000.00	25,000.00
	Subtotal 1				505,500.00
	Mobilization and preparatory work (5% of unit costs)				25,275.00
	Unlisted Items (15%)				75,825.00
	Contingencies (20%)				101,100.00
	Total Field Cost				707,700.00
	USBR Engineering and Construction Management (30%)				212,310.00
SUBTOTAL - COFFERDAM REMOVAL					$920,010.00
TOTAL ESTIMATE				$920,010	$920,010.00

QUANTITIES		PRICE	
BY	CHECKED	BY	CHECKED
Dustin S. Albright, PE		Dustin S. Albright, PE	
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
1-Dec-04		1-Dec-04	2005

CONSTRUCTION COST ESTIMATE

BY: N.D.K.	DATE PREPARED: February 16, 2005	GENERAL CONTRACTOR
PKG. NO.	PROJECT: SCPP INTAKE CHANNEL EXTENSION (GDCD Data)	SHEET 3
WORK ITEM:	ENGINEERS ESTIMATE: Conventional Excavation	OF 10

EQUIPMENT

Work Item		QUANTITY	UNIT	UNIT PRICE	AMOUNT
MOBILIZATION & PREPARATORY WORK ENGINEERS ESTIMATE				5%	$320,816.13
CLEARING AND GRUBBING		100	ACRE	$1,050.00	$105,000.00
SITE CLEAN UP AND RESTORATION				1.50%	$94,822.50
ACCESS ROAD EMBANKMENT		44000	CY	$4.00	$176,000.00
WATER, DUST ABATEMENT		100	MGAL	$15.00	$1,500.00
EXCAVATE CHANNEL		954000	CY	$4.50	$4,293,000.00
REMOVE ACCESS ROAD EMBANKMENT		44000	CY	$4.50	$198,000.00
TOPSOIL STRIPPING		242000	CY	$2.00	$484,000.00
SPOIL AREA PREP		100	ACRE	$5,000.00	$500,000.00
PLACING TOPSOIL		242000	CY	$2.00	$484,000.00
SEEDING		100	ACRE	$800.00	$80,000.00
			TOTAL		**$6,737,138.63**
	UNLISTED ITEMS			2%	$134,742.77
	CONTINGENCIES			15%	$1,010,570.79
			TOTAL		**$7,882,452.19**
	USBR ENGINEERING AND CONSTRUCTION MANAGEMENT			20%	$1,576,490.44
			GRAND TOTAL		**$9,458,942.63**

CONSTRUCTION COST ESTIMATE

BY: N.D.K.	DATE PREPARED: Febuary 16, 2005	GENERAL CONTRACTOR
PKG. NO.	PROJECT: SCPP INTAKE CHANNEL EXTENSION (GDCD Data)	SHEET 4
WORK ITEM:	**Intake Channel Excavation (Excavator)**	OF 10

EQUIPMENT

QUAN.	DESCRIPTION	HOURS	RATE	AMOUNT
				$0.00
1	Grader (blade)	1490	$39.88	$59,421.20
				$0.00
1	2 ton mechanics truck	1490	$16.91	$25,195.90
				$0.00
1	3/4 ton pickup truck	1490	$10.60	$15,794.00
				$0.00
4	excavators (3cy)	1490	$87.01	$518,579.60
				$0.00
16	6x6 Haul trucks (23cy)	1490	$78.06	$1,860,950.40
				$0.00
1	Dozer 300 hp	1490	$92.07	$137,184.30
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
	EQUIP SUBTOTAL			**$2,617,125.40**

LABOR

QUAN.	TRADE	HOURS	RATE	AMOUNT
	plus 35%			$0.00
1	Grader op	1490	$26.00	$38,740.00
				$0.00
1	Mechanic	1490	$24.00	$35,760.00
				$0.00
1	Foreman	1490	$25.00	$37,250.00
				$0.00
4	excavator	1490	$16.27	$96,969.20
				$0.00
16	Haul trucks	1490	$20.24	$482,521.60
				$0.00
6	Laborer	1490	$13.45	$120,243.00
				$0.00
1	dozer	1490	$24.40	$36,356.00
				$0.00
				$0.00
	LABOR SUBTOTAL			**$847,839.80**

MATERIALS

DESCRIPTION	UNIT	QUAN.	PRICE	AMOUNT
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
MATERIAL SUBTOTAL				**$0.00**

SALES TAX	5.00%	$0.00
MATERIAL SUBTOTAL		**$0.00**
EQUIPMENT SUBTOTAL		$2,617,125.40
LABOR SUBTOTAL		$847,839.80
SUBTOTAL COST		**$3,464,965.20**

SUBTOTAL		**$3,464,965.20**			
OVERHEAD	@ 15.00%	$519,744.78			
PROFIT	@ 10.00%	$346,496.52			
BOND	@ 1.00%	$34,649.65	**UNIT** CY	**# OF UNIT**	954000
TOTAL COST =		**$4,365,856.15**	**COST PER UNIT =**		**$ 4.58**

		CONSTRUCTION COST ESTIMATE				
BY: N.D.K.	DATE PREPARED: February 16, 2005				GENERAL CONTRACTOR	
PKG. NO.	PROJECT: SCPP INTAKE CHANNEL EXTENSION (GDCD Data)				SHEET	5
WORK ITEM:	**Intake Channel Excavation (Scraper)**				OF	10
	EQUIPMENT					
QUAN.	**DESCRIPTION**			**HOURS**	**RATE**	**AMOUNT**
						$0.00
1	Grader (blade)			1472	$39.88	$58,703.36
						$0.00
1	2 ton mechanics truck			1472	$16.91	$24,891.52
						$0.00
1	3/4 ton pickup truck			1472	$10.60	$15,603.20
						$0.00
3	Dozers 300 hp			1472	$92.07	$406,581.12
						$0.00
12	Scrapers 21 cu. yds			1472	$117.89	$2,082,408.96
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
			EQUIP	**SUBTOTAL**		**$2,588,188.16**
	LABOR					
QUAN.	**TRADE**			**HOURS**	**RATE**	**AMOUNT**
						$0.00
1	Grader op			1472	$26.00	$38,272.00
						$0.00
1	Mechanic			1472	$24.00	$35,328.00
						$0.00
1	Foreman			1472	$25.00	$36,800.00
						$0.00
3	Dozer ops			1472	$24.40	$107,750.40
						$0.00
12	scraper ops			1472	$24.45	$431,884.80
						$0.00
6	Laborer(+35%)			1472	$13.45	$118,790.40
						$0.00
						$0.00
						$0.00
						$0.00
			LABOR	**SUBTOTAL**		**$768,825.60**
	MATERIALS					
	DESCRIPTION		**UNIT**	**QUAN.**	**PRICE**	**AMOUNT**
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
			MATERIAL	**SUBTOTAL**		**$0.00**
				SALES TAX	5.00%	$0.00
			MATERIAL	**SUBTOTAL**		**$0.00**
			EQUIPMENT	**SUBTOTAL**		$2,588,188.16
			LABOR	**SUBTOTAL**		$768,825.60
			SUBTOTAL	**COST**		**$3,357,013.76**
SUBTOTAL		**$3,357,013.76**				
OVERHEAD @	15.00%	$503,552.06				
PROFIT @	10.00%	$335,701.38				
BOND @	1.00%	$33,570.14	**UNIT**	CY	**# OF UNITS**	954000
TOTAL COST =		**$4,229,837.34**	**COST PER UNIT =**			**$ 4.43**

CONSTRUCTION COST ESTIMATE

BY: N.D.K.	DATE PREPARED: February 16, 2005	GENERAL CONTRACTOR
PKG. NO.	PROJECT: SCPP INTAKE CHANNEL EXTENSION (GDCD Data)	SHEET 6
WORK ITEM:	ENGINEERS ESTIMATE (HYDRAULIC DREDGE)	OF 10

EQUIPMENT

Work Item	QUANTITY	UNIT	UNIT PRICE	AMOUNT
MOBILIZATION & PREPARATORY WORK ENGINEERS ESTIMATE			5%	$545,004.25
CLEARING AND GRUBBING	100	ACRE	$1,050.00	$105,000.00
SITE CLEAN UP AND RESTORATION			1.50%	$161,085.00
DREDGE CHANNEL	954000	CY	$9.00	$8,586,000.00
TOPSOIL STRIPPING	242000	CY	$2.00	$484,000.00
SPOIL AREA PREP	100	ACRE	$10,000.00	$1,000,000.00
PLACING TOPSOIL	242000	CY	$2.00	$484,000.00
SEEDING	100	ACRE	$800.00	$80,000.00
		TOTAL		**$11,445,089.25**
UNLISTED ITEMS			2%	$228,901.79
CONTINGENCIES			15%	$1,716,763.39
		TOTAL		**$13,390,754.42**
USBR ENGINEERING AND CONSTRUCTION MANAGEMENT			20%	$2,678,150.88
		GRAND TOTAL		**$16,068,905.31**

		CONSTRUCTION COST ESTIMATE				
BY: N.D.K.	DATE PREPARED: February 16, 2005				**GENERAL CONTRACTOR**	
PKG. NO.	PROJECT: SCPP INTAKE CHANNEL EXTENSION (GDCD Data)				**SHEET**	7
WORK ITEM:	**Intake Channel Excavation (Hyraulic Dredge)**				**OF**	10
	EQUIPMENT					
QUAN.	**DESCRIPTION**			**HOURS**	**RATE**	**AMOUNT**
						$0.00
1	Grader (blade)			16591	$39.88	$661,649.08
						$0.00
1	2 ton mechanics truck			16591	$16.91	$280,553.81
						$0.00
1	3/4 ton pickup truck			16591	$10.60	$175,864.60
						$0.00
1	Dozers 300 hp			16591	$92.07	$1,527,533.37
						$0.00
1	DREDGE (2000 gal/cy ex)			16591	$161.00	$2,671,151.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
			EQUIP	**SUBTOTAL**		**$5,316,751.86**
	LABOR					
QUAN.	**TRADE**			**HOURS**	**RATE**	**AMOUNT**
						$0.00
1	Grader op			16591	$26.00	$431,366.00
						$0.00
1	Mechanic			16591	$24.00	$398,184.00
						$0.00
1	Foreman			16591	$25.00	$414,775.00
						$0.00
1	Dozer ops			16591	$24.40	$404,820.40
						$0.00
1	DREDGE			16591	$24.45	$405,649.95
						$0.00
3	Laborer(+35%)			16591	$13.45	$669,446.85
						$0.00
						$0.00
						$0.00
						$0.00
			LABOR	**SUBTOTAL**		**$2,724,242.20**
	MATERIALS					
	DESCRIPTION		**UNIT**	**QUAN.**	**PRICE**	**AMOUNT**
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
			MATERIAL	**SUBTOTAL**		**$0.00**
				SALES TAX	5.00%	$0.00
			MATERIAL	**SUBTOTAL**		**$0.00**
			EQUIPMENT	**SUBTOTAL**		$5,316,751.86
			LABOR	**SUBTOTAL**		$2,724,242.20
			SUBTOTAL	**COST**		**$8,040,994.06**
SUBTOTAL		**$8,040,994.06**				
OVERHEAD @	15.00%	$1,206,149.11				
PROFIT @	10.00%	$804,099.41				
BOND @	1.00%	$80,409.94	**UNIT**	CY	**# OF UNITS**	954000
TOTAL COST =		**$10,131,652.52**	**COST PER UNIT =**			**$ 10.62**

CONSTRUCTION COST ESTIMATE

BY: N.D.K.	DATE PREPARED: February 16, 2005	GENERAL CONTRACTOR
PKG. NO.	PROJECT: McCC MM59 plug raising	SHEET 8
WORK ITEM:	ENGINEERS ESTIMATE Raising MM59 Plug	OF 10

EQUIPMENT

Work Item		QUANTITY	UNIT	UNIT PRICE	AMOUNT
MOBILIZATION & PREPARATORY WORK ENGINEERS ESTIMATE				5%	$1,523.50
EXCAVATE AND FILL		3000	CY	$7.47	$22,410.00
TOPSOIL STRIPPING		1000	CY	$2.00	$2,000.00
PLACING TOPSOIL		1000	CY	$2.00	$2,000.00
SEEDING		5	ACRE	$800.00	$4,000.00
SITE CLEAN UP AND RESTORATION				1.50%	$60.00
			TOTAL		**$31,993.50**
	UNLISTED ITEMS			2%	$639.87
	CONTINGENCIES			15%	$4,799.03
			TOTAL		**$37,432.40**
	USBR ENGINEERING AND CONSTRUCTION MANAGEMENT			20%	$7,486.48
			GRAND TOTAL		**$44,918.87**

CONSTRUCTION COST ESTIMATE

BY: N.D.K.	DATE PREPARED: February 23, 2005	GENERAL CONTRACTOR
PKG. NO.	PROJECT: McCC MM 59 Plug Raising	SHEET 9
WORK ITEM:	**Raising MM 59 plug**	OF 10

EQUIPMENT

QUAN.	DESCRIPTION	HOURS	RATE	AMOUNT
				$0.00
1	CAT 140-H Grader (blade)	40	$39.88	$1,595.20
				$0.00
1	2 ton mechanics truck	40	$16.91	$676.40
				$0.00
1	3/4 ton pickup truck	40	$10.60	$424.00
				$0.00
1	CAT D-8R Dozer 300 hp	40	$92.07	$3,682.80
				$0.00
1	CAT 627G Scraper 21 cu. yds	40	$117.89	$4,715.60
				$0.00
1	Cat CP-433C vibatory roller	40	$22.14	$885.60
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
	EQUIP SUBTOTAL			**$11,979.60**

LABOR

QUAN.	TRADE	HOURS	RATE	AMOUNT
				$0.00
1	Grader op	40	$26.00	$1,040.00
				$0.00
1	Mechanic	40	$24.00	$960.00
				$0.00
1	Foreman	40	$25.00	$1,000.00
				$0.00
1	Dozer ops	40	$24.40	$976.00
				$0.00
1	scraper ops	40	$24.45	$978.00
				$0.00
1	Roller operator	40	$21.33	$853.20
				$0.00
				$0.00
				$0.00
				$0.00
	LABOR SUBTOTAL			**$5,807.20**

MATERIALS

DESCRIPTION	UNIT	QUAN.	PRICE	AMOUNT
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
MATERIAL SUBTOTAL				**$0.00**
SALES TAX			5.00%	$0.00
MATERIAL SUBTOTAL				**$0.00**
EQUIPMENT SUBTOTAL				$11,979.60
LABOR SUBTOTAL				$5,807.20
SUBTOTAL COST				**$17,786.80**

SUBTOTAL		**$17,786.80**
OVERHEAD @	15.00%	$2,668.02
PROFIT @	10.00%	$1,778.68
BOND @	1.00%	$177.87
TOTAL COST =		**$22,411.37**

UNIT	CY	**# OF UNITS**	3000
COST PER UNIT =		**$**	**7.47**

CONSTRUCTION COST ESTIMATE

BY: N.D.K.	DATE PREPARED: Feb 23, 2005	GENERAL CONTRACTOR
PKG. NO.	PROJECT: MCC Beach Belting Reach 3	SHEET 10
WORK ITEM:	**Beach Belting Reach 3 (20 miles)**	OF 10

EQUIPMENT

QUAN.	DESCRIPTION	HOURS	RATE	AMOUNT
				$0.00
				$0.00
				$0.00
2	Loader	2000	$52.45	$209,800.00
				$0.00
1	3/4 ton pickup truck	2000	$10.60	$21,200.00
				$0.00
1	excavator	2000	$87.01	$174,020.00
				$0.00
5	Tandem dump truck	2500	$26.00	$325,000.00
				$0.00
1	2 ton mechanic truck	2500	$16.91	$42,275.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
		EQUIP SUBTOTAL		**$772,295.00**

LABOR

QUAN.	TRADE	HOURS	RATE	AMOUNT
				$0.00
1	Excavator (basic wages + 35% labor burden)	2000	$16.75	$33,500.00
				$0.00
2	Loader	2000	$20.50	$82,000.00
				$0.00
1	Foreman	2500	$24.30	$60,750.00
				$0.00
1	mechanic	2500	$24.00	$60,000.00
				$0.00
5	Truck driver	2500	$20.25	$253,125.00
				$0.00
4	Laborer	2000	$17.55	$140,400.00
				$0.00
				$0.00
				$0.00
				$0.00
		LABOR SUBTOTAL		**$629,775.00**

MATERIALS

DESCRIPTION	UNIT	QUAN.	PRICE	AMOUNT
				$0.00
Filter Fabric	SY	94000	$1.00	**$94,000.00**
Beach Belting	CY	140800	$18.00	**$2,534,400.00**
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
	MATERIAL SUBTOTAL			**$2,628,400.00**
	SALES TAX		5.00%	$131,420.00
	MATERIAL SUBTOTAL			**$2,759,820.00**
	EQUIPMENT SUBTOTAL			$772,295.00
	LABOR SUBTOTAL			$629,775.00
	SUBTOTAL COST			**$4,161,890.00**

SUBTOTAL		**$4,161,890.00**
OVERHEAD @	15.00%	$624,283.50
PROFIT @	10.00%	$416,189.00
BOND @	1.00%	$41,618.90
TOTAL COST =		**$5,243,981.40**

UNIT	MILE	**# OF UNITS**	20
COST PER UNIT =			**$ 262,199.07**

Appendix C – Attachment 3

Snake Creek Pumping Plant
Transfer Deck Replacement Cost Estimate

United States Department of the Interior

BUREAU OF RECLAMATION
PO Box 25007
Denver, Colorado 80225-0007

IN REPLY REFER TO:
D-8120
PRJ-8.00

SEP 05 2003

MEMORANDUM

To: Area Manager, Dakotas Area Office
Attention: DK-200 (Albright) (ACT)

From: Thomas C. Fisher
Manager, Structural and Architectural Group

Subject: Snake Creek Pumping Plant Deck Replacement Study, August 2003

Attached is the appraisal level construction cost estimate for the Snake Creek Pumping Plant deck replacement prepared by the Technical Service Center (TSC) according to the service agreement dated, June 11, 2003. The construction cost estimate includes all work associated with the complete removal of the transfer deck cover slab as shown on drawing 769-D-123 and the lightweight concrete structural slab located below the cover slab. The cost estimate also includes a new reinforced concrete structural deck (no cover slab) and the replacement of the embedded deck drain piping and electrical conduits.

The TSC's design cost estimate for final design of the deck replacement is $111,000 and is based on fiscal year 2003 billable rates. The work to be produced during this final design includes final design drawings, specification paragraphs, and final construction costs estimates. The design of the new reinforced concrete deck slab will be based on the loading criteria shown on the existing Structural Design Data sheet (Drawing 769-D-73).

Attachment

cc: DK-400 (Freitag), DK-400 (Volk)
(w/att to each)

OFFICIAL FILE COPY
RECEIVED
SEP - 8 2003

REPLY: YES		NO
INFO. COPY TO:		
DATE	INITIAL	TO
9/8	DEA	ALBRIGHT
Copy to		Volk
" 9/		FREITAG
		JACOBSON
		TODD
CLASSIFICATION		
PROJECT		
CONTROL NO.		
FOLDER I.D.		

CODE: D-8170

ESTIMATE WORKSHEET

FEATURE: 11-Aug-03

Snake Creek Pumping Plant
Transfer Deck Cover Slab Replacement - El. 1867.67

Revision 1 - Based on Additional Field Data
and Better Known Site Specific Conditions

PROJECT:
Missouri River Basin Project
(Pumping Plant located between Minot and Bismark ND)

REGION:
Great Plains
WOID: 6B282

FILE:
D:\lotus\WORK FILES\GP\Snake River\Feas\[PP Deck Replace Rev 1.xls]Sheet 1

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Furnish, erect and remove weather tight debris decking		1	LS	$250,000.00	$250,000.00
		(Deck is located above motor and motor control rooms					
		and is approx. 5050 sq. ft. of area w/44' ceiling height)					
		Assume temporary metal pan decking supported via heavy					
		duty shoring/structural members to withstand possible falling					
		concrete deck debris during decking removal activities.					
		Provide additional protection for existing powerplant					
		features from construction debris.					
	2	Perimeter sawcutting existing reinforced concrete slab		310	LF	$50.00	$15,500.00
		Cut 1' thick Lightweight concrete and 6" thick normal weight					
		concrete for 1'-6" total - assume reinforcement both faces.					
	3	Remove/dispose of existing top layer of concrete slab		100	CY	$240.00	$24,000.00
		Normal weight concrete: (6" cover slab reinf w/#5@6 ew)					
		Assume intermediate sawcutting and jackhammering.					
	4	Remove/dispose of existing bottom layer of concrete slab		200	CY	$345.00	$69,000.00
		Light weight concrete:					
		(1' thick reinf w/#6@12 and #8@12 each face, deck					
		must have underneath support system during removal					
		in case deck debris does fall through so that the motors					
		and control room floor and equipment are protected.					
		Pay Item 1 provides this safety support mechanism.)					
		Assume intermediate sawcutting into large concrete					
		sections. Then furnish and insert lifting lugs into the					
		large concrete sections for removal via crane.					
		Assume lots of hand labor work to get final removal.					
		The above activity includes remove and dispose of					
		existing roof/deck drain piping that is embedded in					
		the light wt concrete 1' thick slab. Drain pipe quantity:					
		(260 ft. of 4" dia. iron pipe, 5 ft. of 6" dia. iron pipe					
		and 8 - 4" deck drains to be removed)					
		Also, per Dustin Albright, about 200 ft of 2" dia conduit					
		with electrical wiring will need to be removed.					
		Subtotal (Sheet 1)					$358,500.00

QUANTITIES		PRICES	
BY: B.K. Goplen, D-8120	CHECKED:	BY: Dan Donaldson	CHECKED: ✓ 8/14/03
DATE PREPARED: 11-Aug-03	APPROVED:	DATE: 11-Aug-03	PRICE LEVEL: Appraisal

CODE: D-8170

ESTIMATE WORKSHEET

FEATURE: 11-Aug-03

Snake Creek Pumping Plant
Transfer Deck Cover Slab Replacement - El. 1867.67

Revision 1 - Based on Additional Field Data
and Better Known Site Specific Conditions

PROJECT:
Missouri River Basin Project
(Pumping Plant located between Minot and Bismark ND)

REGION:
Great Plains WOID: 6B282

FILE:
D:\lotus\WORK FILES\GP\Snake River\Feas\[PP Deck Replace Rev 1.xls]Sheet 1

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	5	Furnish and install roof/deck drain piping and conduit		1	LS	$43,000.00	$43,000.00
		Piping and conduit to be embedded within new concrete deck.					
		(match deck drainage system and conduit removed per Pay Item 4)					
	6	Furnish and install #8 epoxy anchor dowels		620	EA	$70.00	$43,400.00
		Assume Hilti-HIT type anchors, 18" embedment.					
	7	Concrete for new deck slab		300	CY	$400.00	$120,000.00
		Assume ready-mix concrete purchased and trucked					
		to the site. Assume large CJ formed and poured					
		sections. Furnish and handle cementitious materials					
		(85 tons) included in the ready-mix 4000 psi concrete cost.					
		Quote - Minot Ready Mix 701-852-2151, 50 mi one-way haul					
	8	Furnish and place reinforcing bars in slab		56,000	LBS	$1.00	$56,000.00
	9	Furnish and install structural steel		3,000	LBS	$8.00	$24,000.00
		Miscellaneous support steel installed underneath the					
		new concrete slab deck.					
	10	Furnish and install miscellaneous metalwork		1,300	LBS	$10.00	$13,000.00
		New metalwork framing for the existing hatch cover.					
	11	Remove and re-install existing lighting		1	LS	$65,000.00	$65,000.00
		(approx. 21 luminaires and 460 lin. ft. of conduit)					
		Assume existing conduit and wiring is demolished					
		and replaced with new materials. Assume the existing					
		luminaires can be removed and reinstalled. For breakage					
		considerations during removal, assume 15% (+/-) of					
		the luminaires will need to be replaced with new ones.					
		Subtotal (Sheet 2)					$364,400.00
		Subtotals from all sheets					$722,900.00
		Mobilization (+/- 5%)					$36,000.00
		Grand Subtotal (Subtotals from all sheets + Mobilization)					$758,900.00
		Unlisted Items (+/- 15%)					$111,100.00
		Contract Cost					$870,000.00
		Contingencies (+/- 25%)					$230,000.00
		Field Cost					$1,100,000.00

QUANTITIES		PRICES	
BY: B.K. Goplen, D-8120	CHECKED:	BY: Dan Donaldson	CHECKED: ✓ 8/14/03
DATE PREPARED: 11-Aug-03	APPROVED:	DATE: 11-Aug-03	PRICE LEVEL: Appraisal

Appendix C – Attachment 4

Snake Creek Pumping Plant High head Pump Bowl Installation

STATEMENT OF WORK

INSTALLATION ASSISTANCE

SNAKE CREEK PUMPING PLANT
MISSOURI RIVER BASIN PROJECT
NORTH DAKOTA

I. GENERAL

The Bureau of Reclamation (Reclamation) Technical Service Center (TSC) shall provide technical assistance with the removal of the low head pump and installation of the high head pump at Snake Creek Pumping Plant, Garrison Diversion Unit, North Dakota. The pumping plant is designed in a manner such that two pump bowls are used to cover the full range of expected pumping heads. The current low reservoir elevations have made it necessary to install the high head pump bowl assembly to meet water demands. The assistance will be to provide technical oversight during the removal, installation, alignment and startup of the pump bowls. The current schedule for the work will be to start in August 2004 and complete the installation in December 2004. Current job time estimates are that the projects should take 6 to 8 weeks to complete.

II. SCOPE OF WORK

Task 1. Coordinating initial pump bowl disassembly and reassembly; time estimates; need for pump bowl change; and writing service agreement (est. 4 sd). Work performed in FY04.

Task 2. - Providing technical information for the planning of the removal of the low head pump bowl assembly and replacing it with the high head pump bowl assembly (est. 4 sd).

Task 3. - Assistance in the disassembly of the currently installed low head pump bowl assembly (est. 10 sd).

Task 4. - Assist in the inspection and preparation of the high head pump bowl assembly for installation and the installation of high head pump bowl (est. 10 sd).

Task 5. - Assist in the final installation (est.5 sd), alignment (est. 5 sd) and startup (est. 5 sd) of the high head pump unit.

III. BUDGET TO COMPLETE WORK

Reclamation's TSC estimates the cost to complete the appraisal designs described within this document is $ 44,144.00.

IV. SCHEDULE

Estimated Start date	August 2004
Project Complete	December 2004

END STATEMENT OF WORK

United States Department of Interior
Bureau of Reclamation
Technical Service Center

SERVICE AGREEMENT SUMMARY FORM

Job Name: Snake Creek High Head Pump Bowl Installation			Date Submitted: September 1, 2004	
JCN:			WOID:	
TSC Team Leader:	Client Group or Region: Great Plains Region		Client Office: Dakotas Area Office	
Client Liaison: Barb Schuelke D-8010 (303) 445-3607	Client Contact: Tom Volk DK-400 (701) 337-5756			
Complete Service Agreement or Client Approval Obtained?			YES	NO
Resource Availability Confirmed by Group Manager(s)?			YES	NO
			X	
Schedule	Target Dates		Other Milestones (Concept, award, etc.)	
Start:	October 2004			
Complete:	December 2004			

FY2004/FY 2005 Budget Group	Staffdays SL1	Staffdays SL2	Staffdays SL3	SD Total	Non-labor ($)
Mechanical Equipment Group (D-8410)		26		$19,136.00	$5,000.00
Hydraulic Equipment Group (D-8420)			7	$ 5,992.00	
Hydraulic Research & Tech Services (D-8450)			10	$ 9,520.00	$3,700.00
TSC Client Liaison (D-8010)		.5	.5	$ 796.00	
Staffday Totals:		25	14		
FY2004/FY2005 Labor and Non-labor Costs:				$ 35,444.00	$ 8,700.00
				Total Budget:	$ 44,144.00

Description and Scope of Work: Refer to attached Statement of Work.		
Notes (Notation of peer review, etc.):		
Additional Information Attached (Service agreement, letter, fax, telephone memo, copy of email, etc.)?	YES: X	NO

Signatures below indicate concurrence with this Service Agreement:

John Shisler, D-8410, Team Leader — Date

Tom Volk, DK-400 — Date

September 1, 2004

Appendix C – Attachment 5

Snake Creek Pumping Plant
Unit Alignment & Vibration Testing Travel Report

BUREAU OF RECLAMATION
Technical Service Center
Denver, Colorado

TRAVEL REPORT

Code: D-8450
PRJ-19.00

Date: July 16, 2001

To: Bert Milano, Manager
Hydroelectric Research and Technical Services Group

From: Roger Cline, Mechanical Engineer

Subject: Unit Alignment and Vibration Testing, Snake Creek Pumping Plant

1. Travel period: June 11-14, 2001.

2. Places or offices visited: Snake Creek Pumping Plant.

3. Purpose of trip: To take vibration and shaft alignment readings on all three units.

4. Synopsis of trip: During annual maintenance on unit 1 in 1998, the bearing clearances of the lower pump guide bearing were found to be in excess of twice the design clearance. The upper pump bearing clearances were high as well, so a check of the unit alignment was done prior to readjusting the guide bearing segments. When the alignment was checked, the shaft was found to be out of plumb by more than 0.200 inch. An alignment check of the other two units found that they were also out of plumb by more than 0.200 inch. All of the units were out of plumb generally in the same direction, indicating that the pumping plant building was shifting. The units were so far out of plumb it would have required moving the motor stators to plumb the shaft. As there were no heating problems with the bearings, and the units operate very infrequently, it was decided not to realign the units and to check the alignment and vibration levels periodically. The clearances of the pump bearings of all three pumps were adjusted after the alignment check.

Alignment readings were taken to compare to the 1998 readings, and vibration readings were taken to compare to readings taken in 1996. A Ludeca laser alignment system was used to take the alignment readings. Proximity probes were temporarily mounted at the lower motor bearing and the upper pump bearing locations. Vibration data were recorded using an IOTech data acquisition system. Pertinent alignment and vibration data are attached.

Prior to the unit alignment and vibration tests, settlement points on the pumping plant building were checked by Area Office personnel. These readings along with the previous year's readings are attached.

5. Results:

The vibration levels measured were the same or lower than those readings taken in 1996 on all units. The lower readings are probably a result of resetting the pump bearing segment clearances. The peak-to-peak vibration on unit 1 remained nearly the same at the motor bearing at approximately 9 mils. The vibration at the pump bearing was reduced from12 mils to approximately 10 mils. The vibration on unit 2 at the motor bearing was reduced from nearly

9 mils to 6 mils, and the vibration at the pump bearing was reduced from 8 mils to approximately 5 mils. The vibration levels on unit 3 were very nearly the same as in 1996. The maximum vibration magnitude on the motor bearing was approximately 6 mils and 7 mils on the pump bearing.

The alignment readings showed some improvement over the 1998 readings. In 1998, all of the units were out of plumb at least 0.200 inch, with unit 3 nearly 0.300 inch out of plumb. The readings taken during this trip showed units 1 and 2 to be out of plumb 0.185 inch, and unit 3 to be out of plumb 0.200 inch. Again this was probably a result of resetting the pump guide bearing clearances. The units all are out of plumb to the north and east. The direction and the amount the units are out of plumb correspond with the settlement readings. The settlement readings actually indicate that the entire pumping plant building is rising, with the northeast corner rising the most and the southwest corner rising the least. This would cause the bottom of the pumping units to lean to the northeast. The average out of plumb of the units is 0.156 mil/inch to the north and 0.251 mil/inch to the east. The settlement readings show that the plant is leaning 0.291 mil/inch to the north and 0.292 mil/inch to the east.

6. Conclusions:

The movement of the pumping plant building at this time does not appear to be having a detrimental effect on the operation of the units. Since the units do not appear to be in distress and are operated very infrequently, the work to realign the units would not be worthwhile, although if the building continues to move, alignment of the units may be required in the future.

7. Recommendations:

   a. Continue to monitor the plant settlement points and bearing temperatures when the units are running. If there is a significant movement indicated by the settlement point measurements, or if any of the bearing temperatures rise significantly, schedule more vibration measurements of the units.

8. Client feedback received: None.

9. Action correspondence initiated or required: None.

Attachments

cc: Regional Director, Billings MT, Attention: GP-2000 (Wedeward)
Area Manager, Dakotas Area Office, Bismarck ND, Attention: DK-400 (Freitag, Albright), DK-410 (Sabot)
(w/attachments to each)

SIGNATURES AND SURNAMES FOR:

Travel to: Snake Creek Pumping Plant

Dates of Travel: June11-14, 2001

Name and Code of Traveler: Roger Cline, D-8450

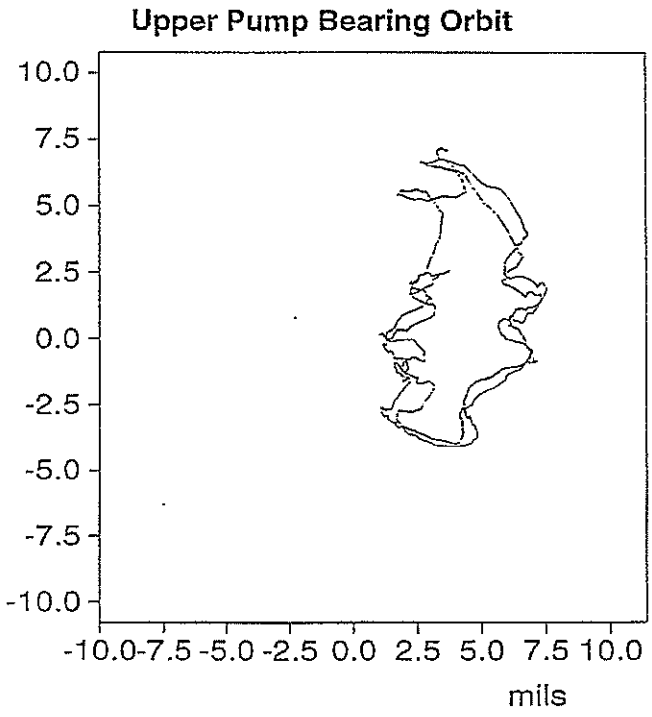
Traveler	Date	Traveler	Date
[signature]	7/17/01		

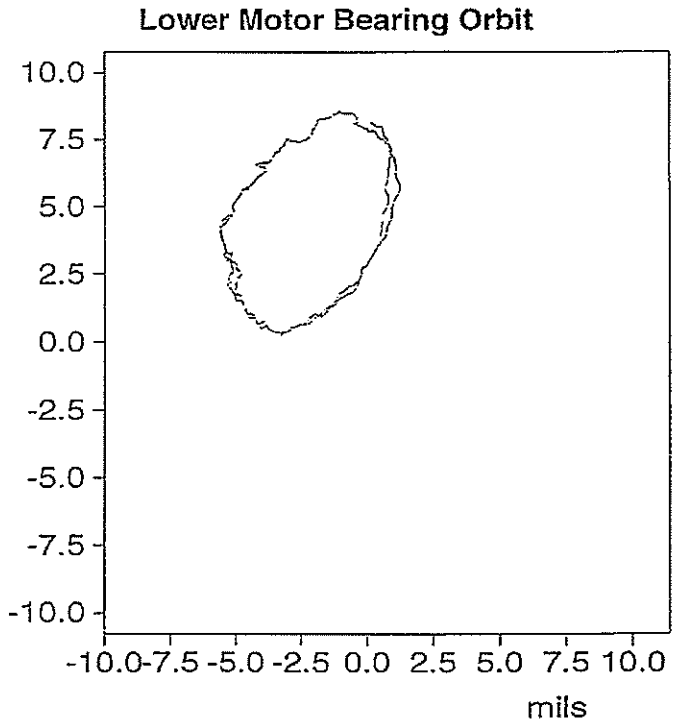
Noted and Dated By:

[signature] 7/17/01
Peer Reviewer Date

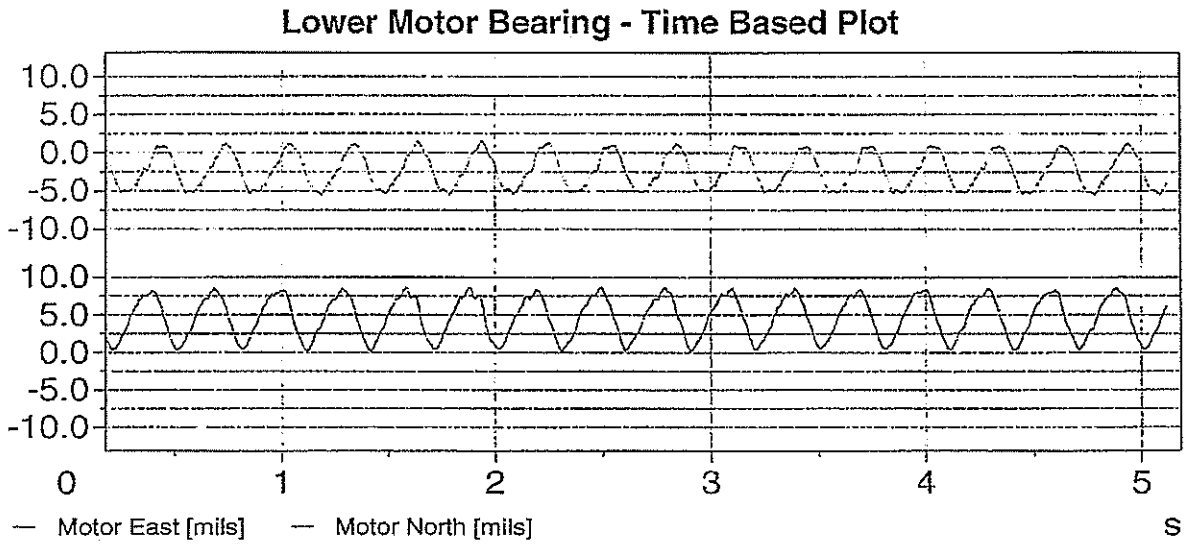
[signature] 7/18/01
Manager, Hydroelectric Research and Technical Services Group Date

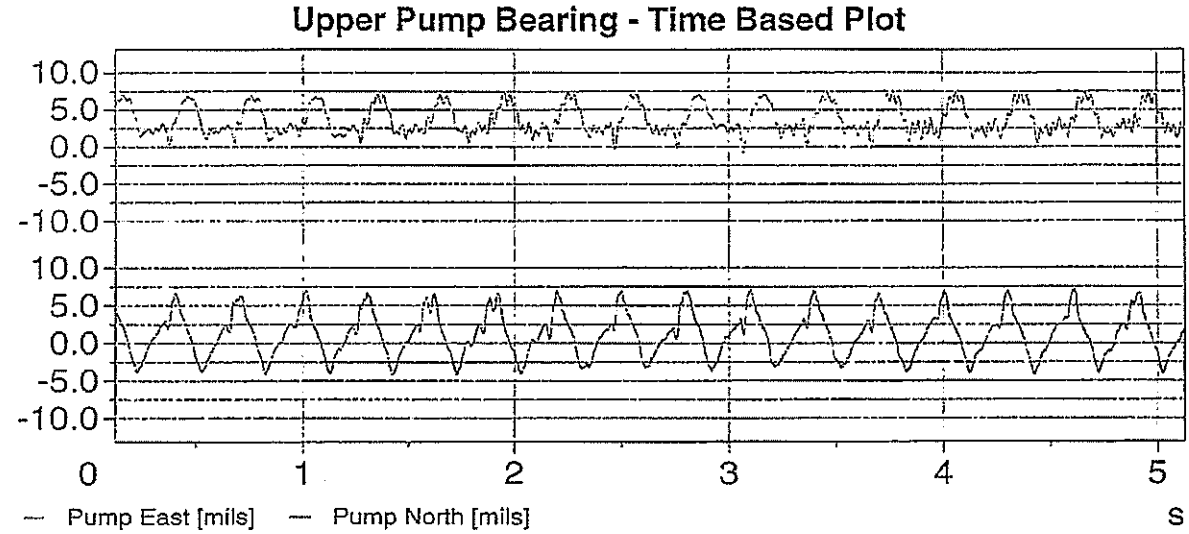
Snake Creek Unit 1





Snake Creek Unit 1





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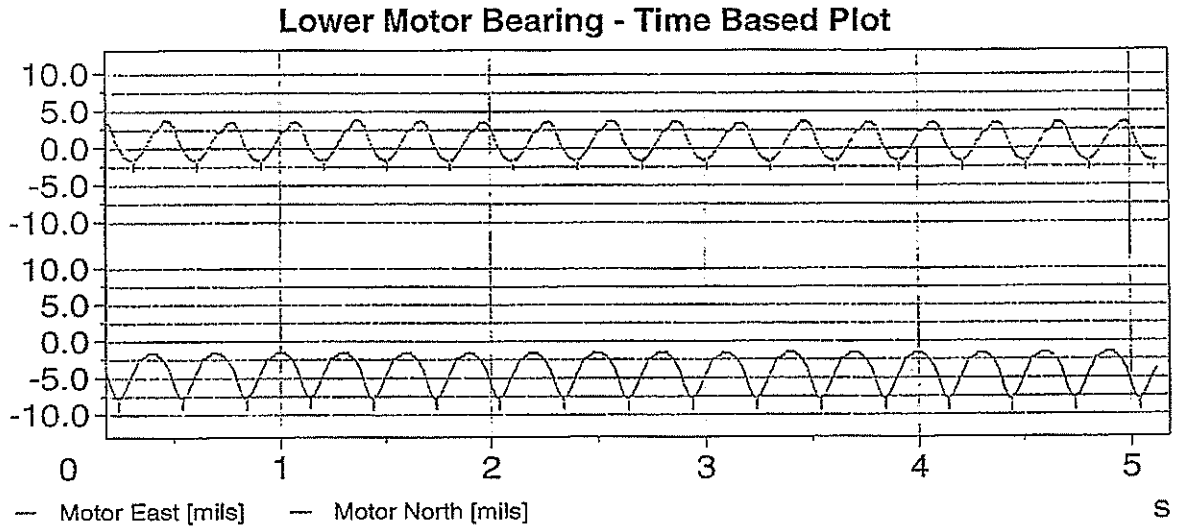
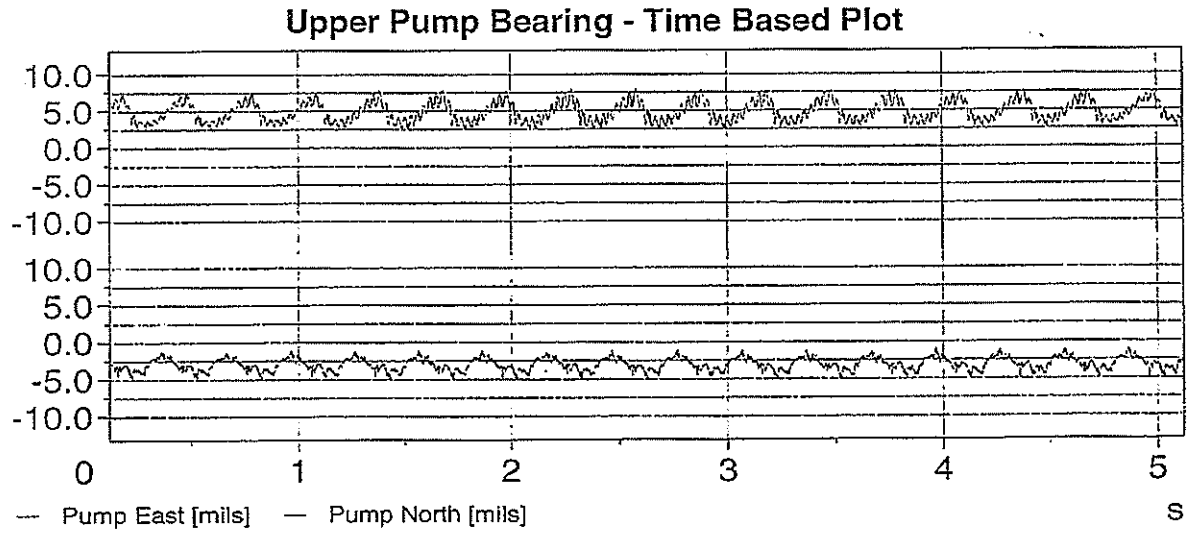
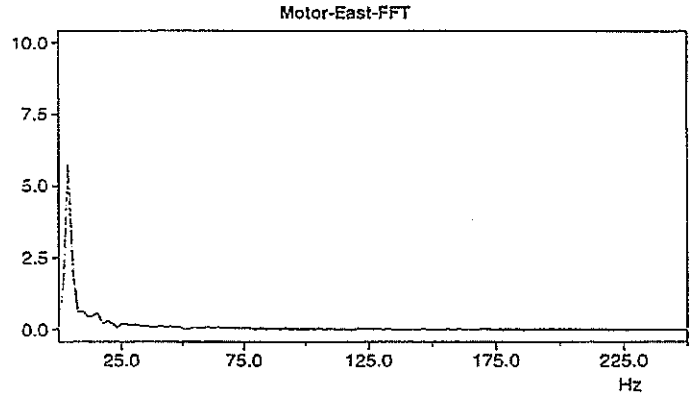
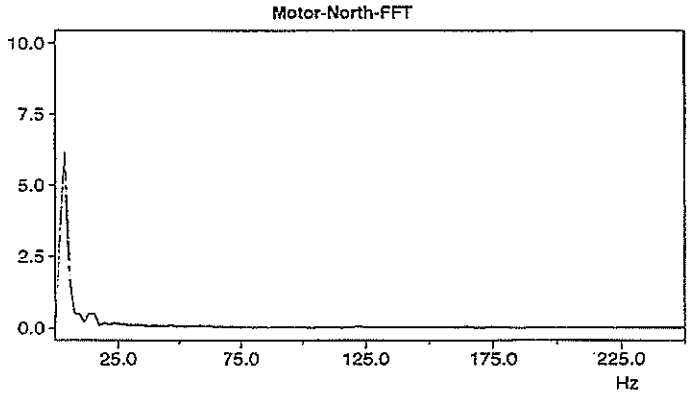
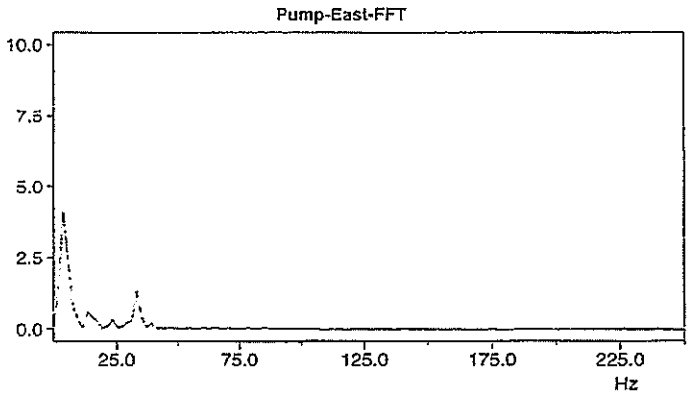


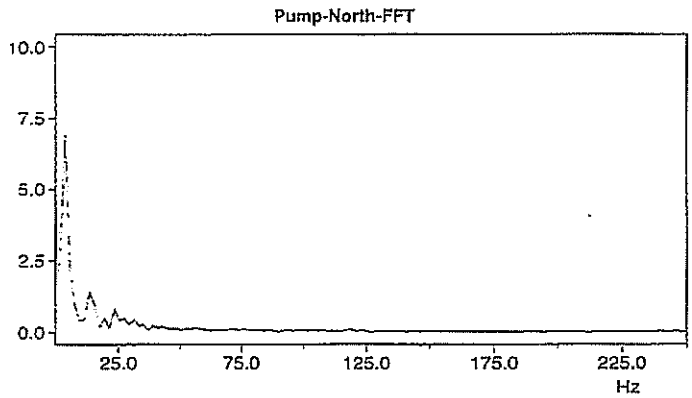


Snake Creek Unit 1

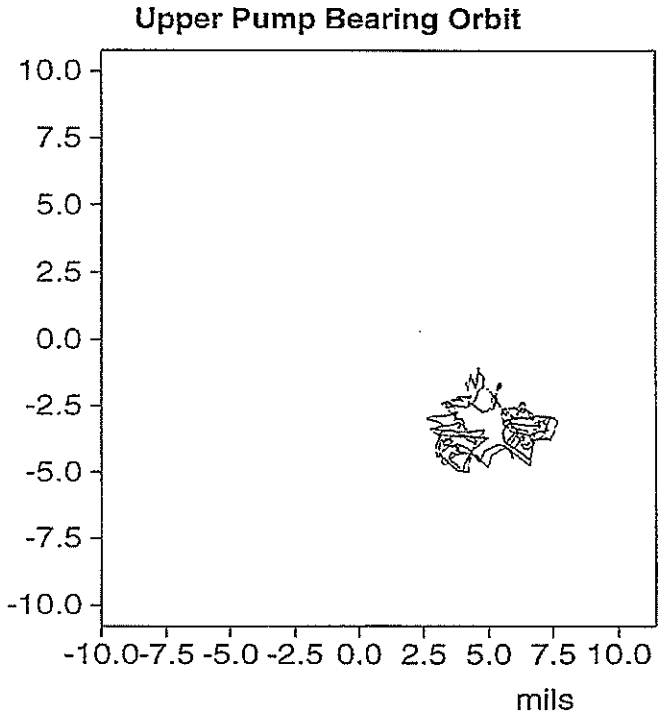


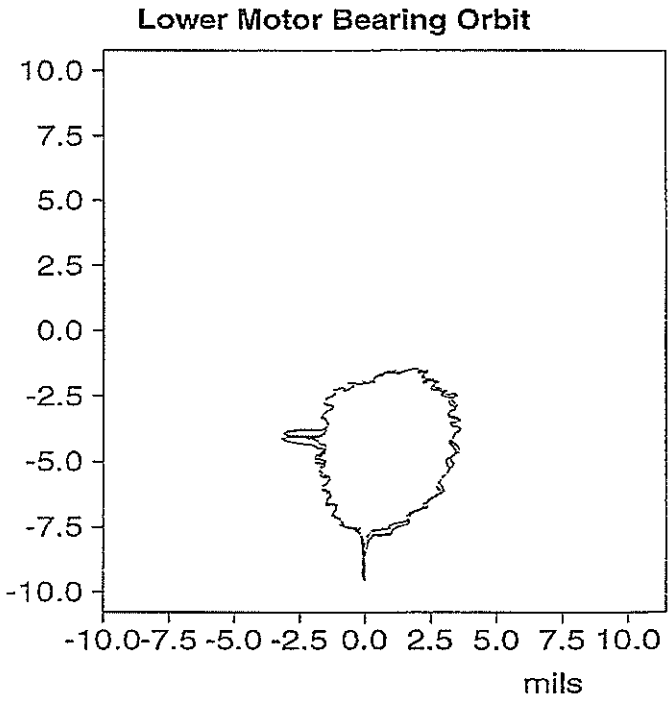




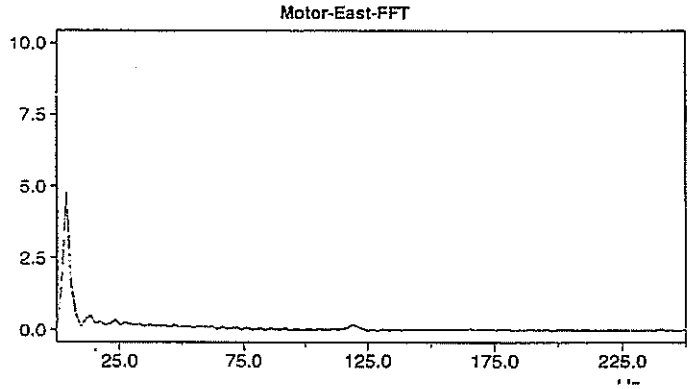


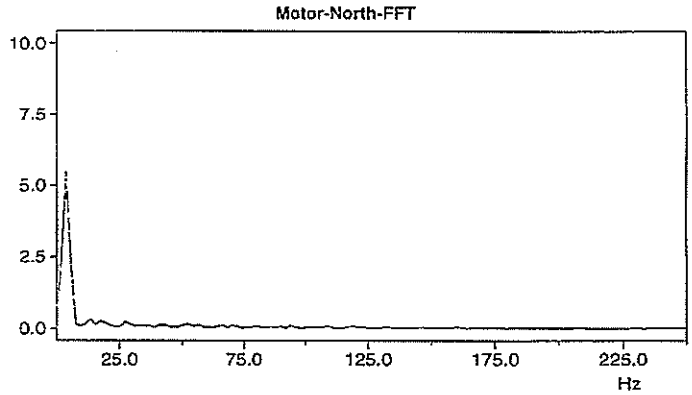
Snake Creek Unit 2

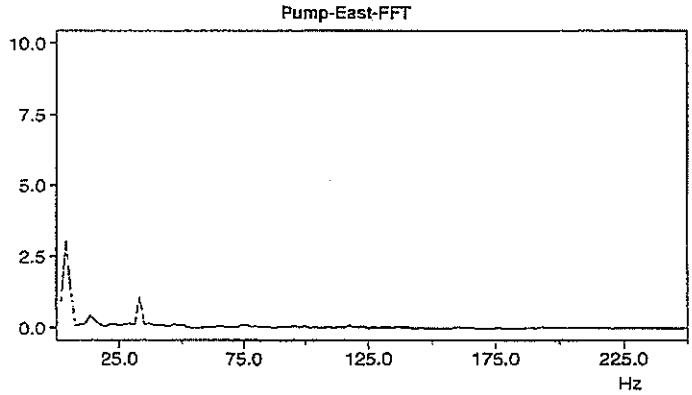


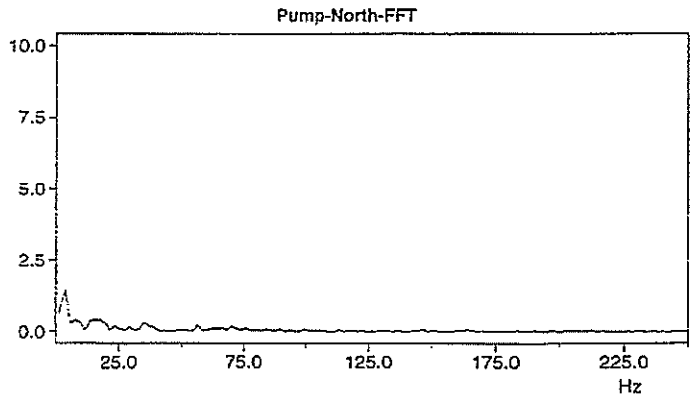


Snake Creek Unit 2

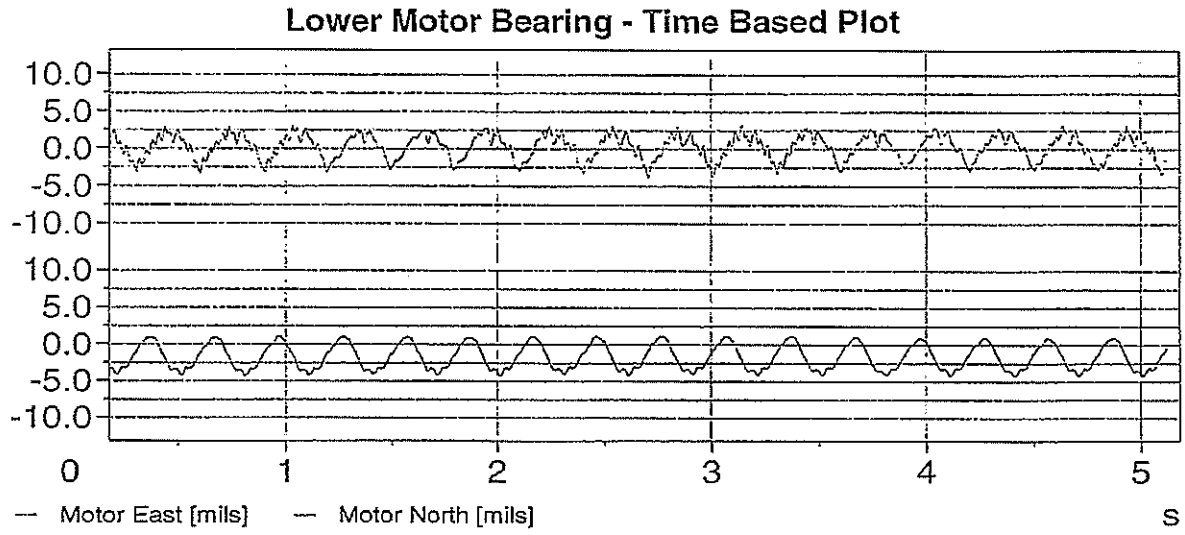


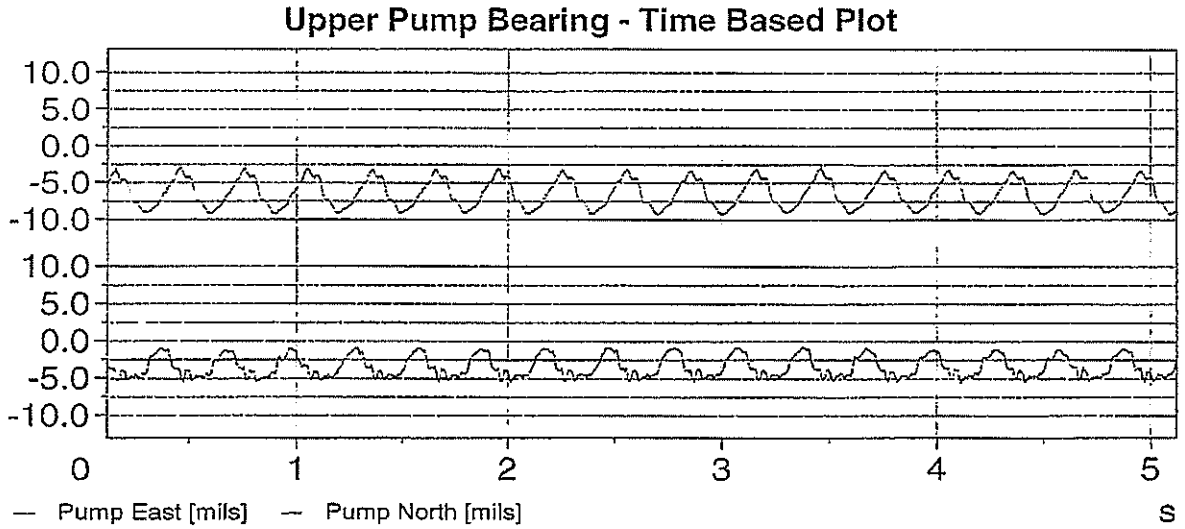




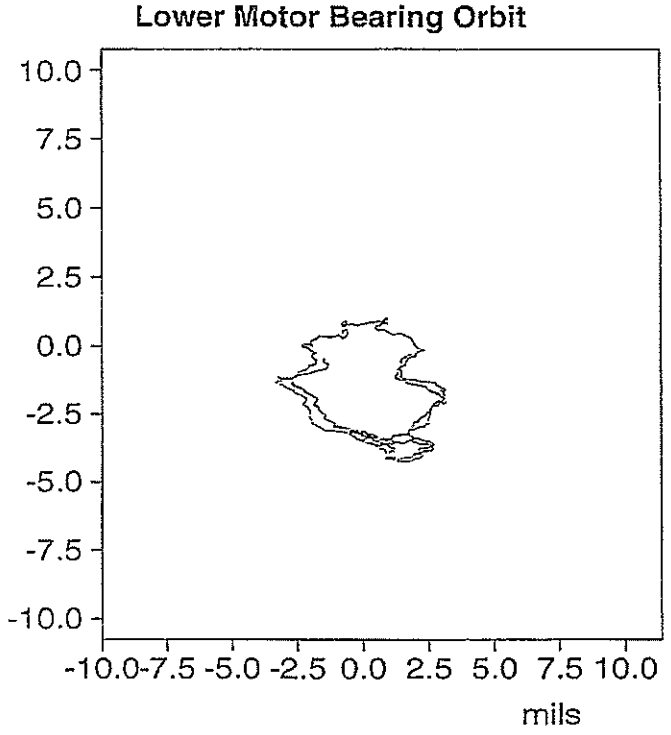


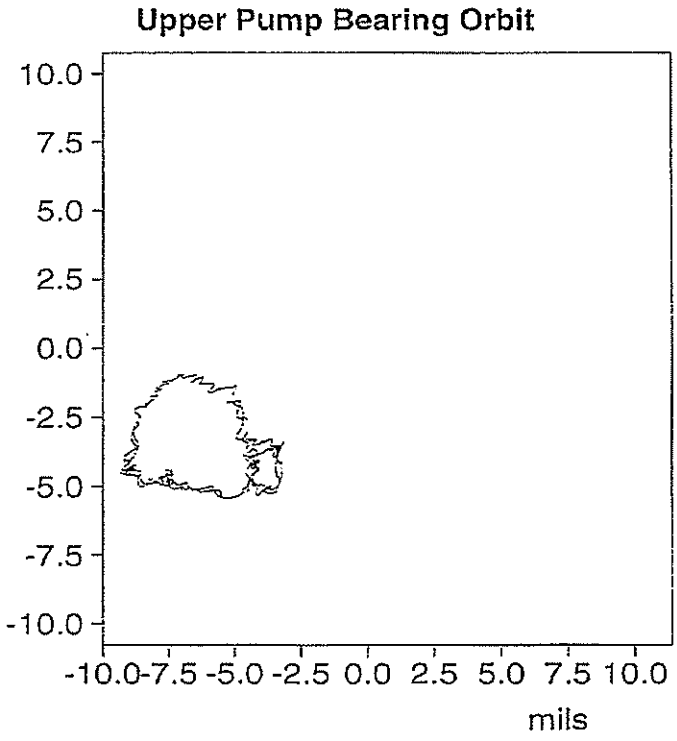
Snake Creek Unit 3



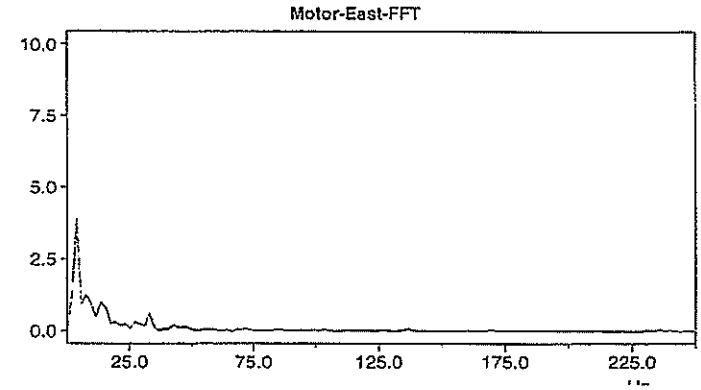


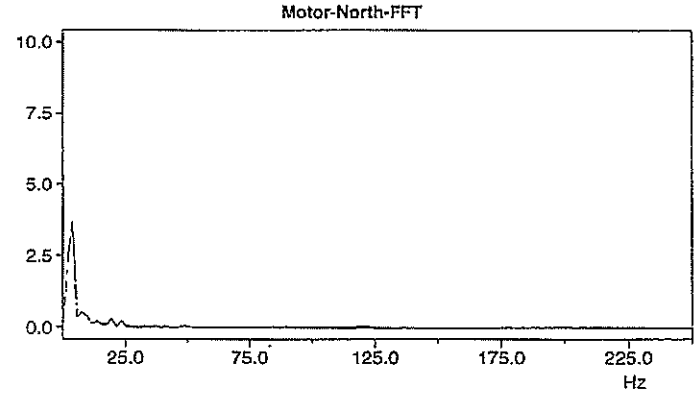
Snake Creek Unit 3

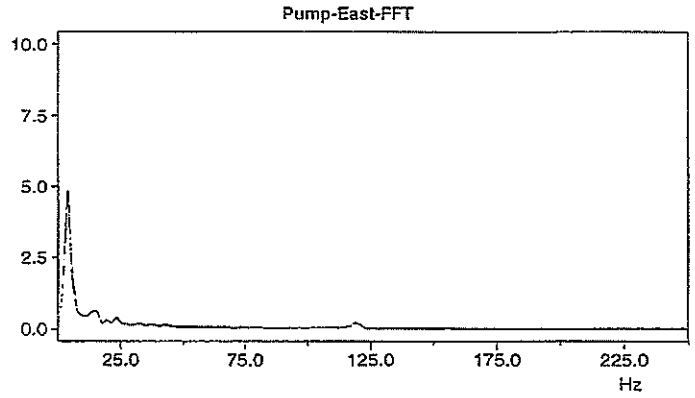


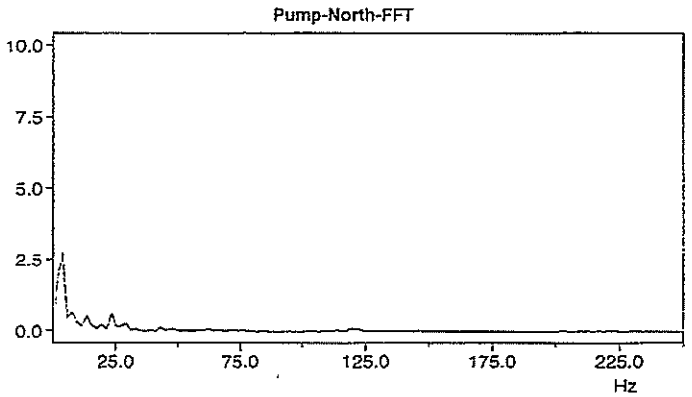


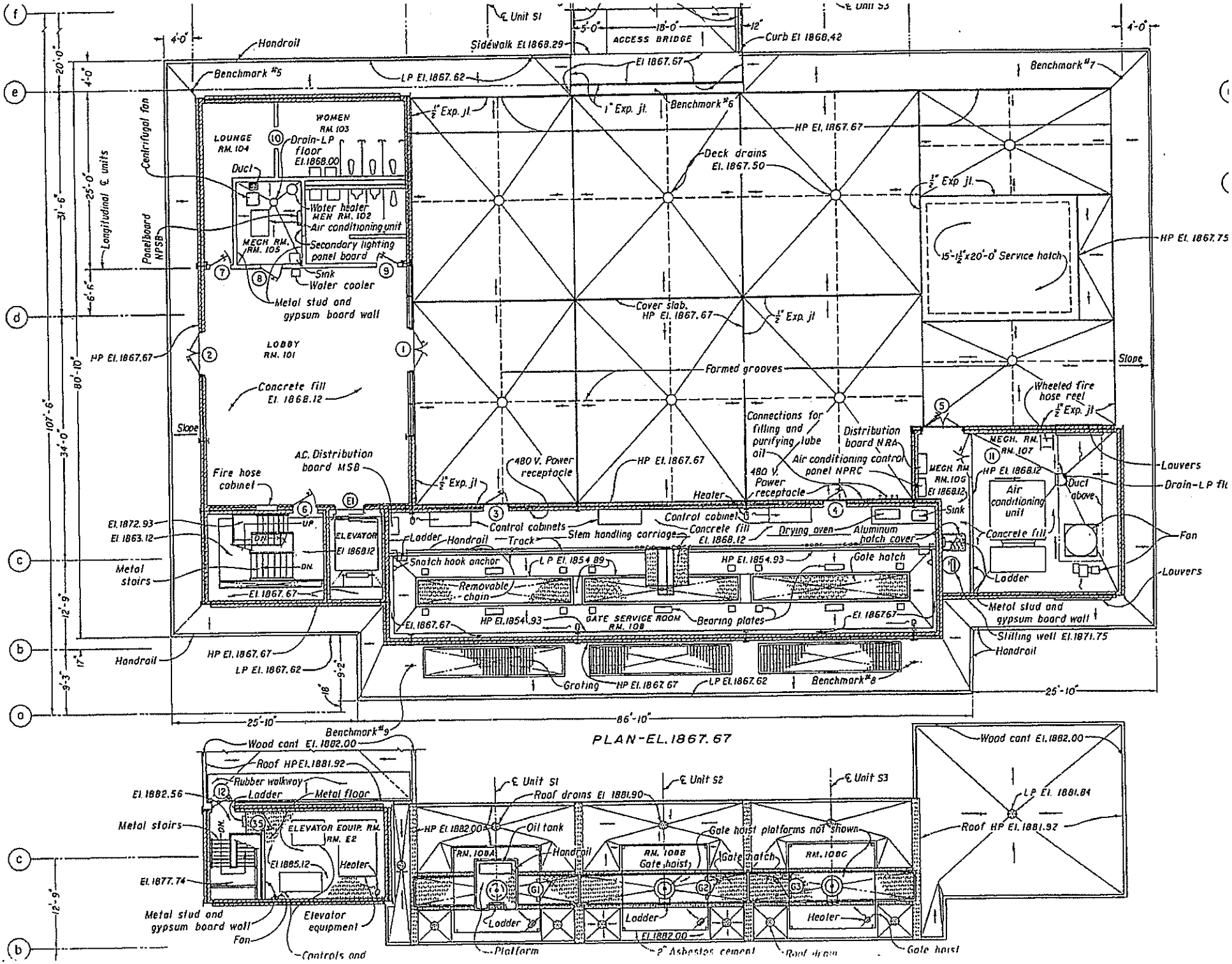
Snake Creek Unit 3

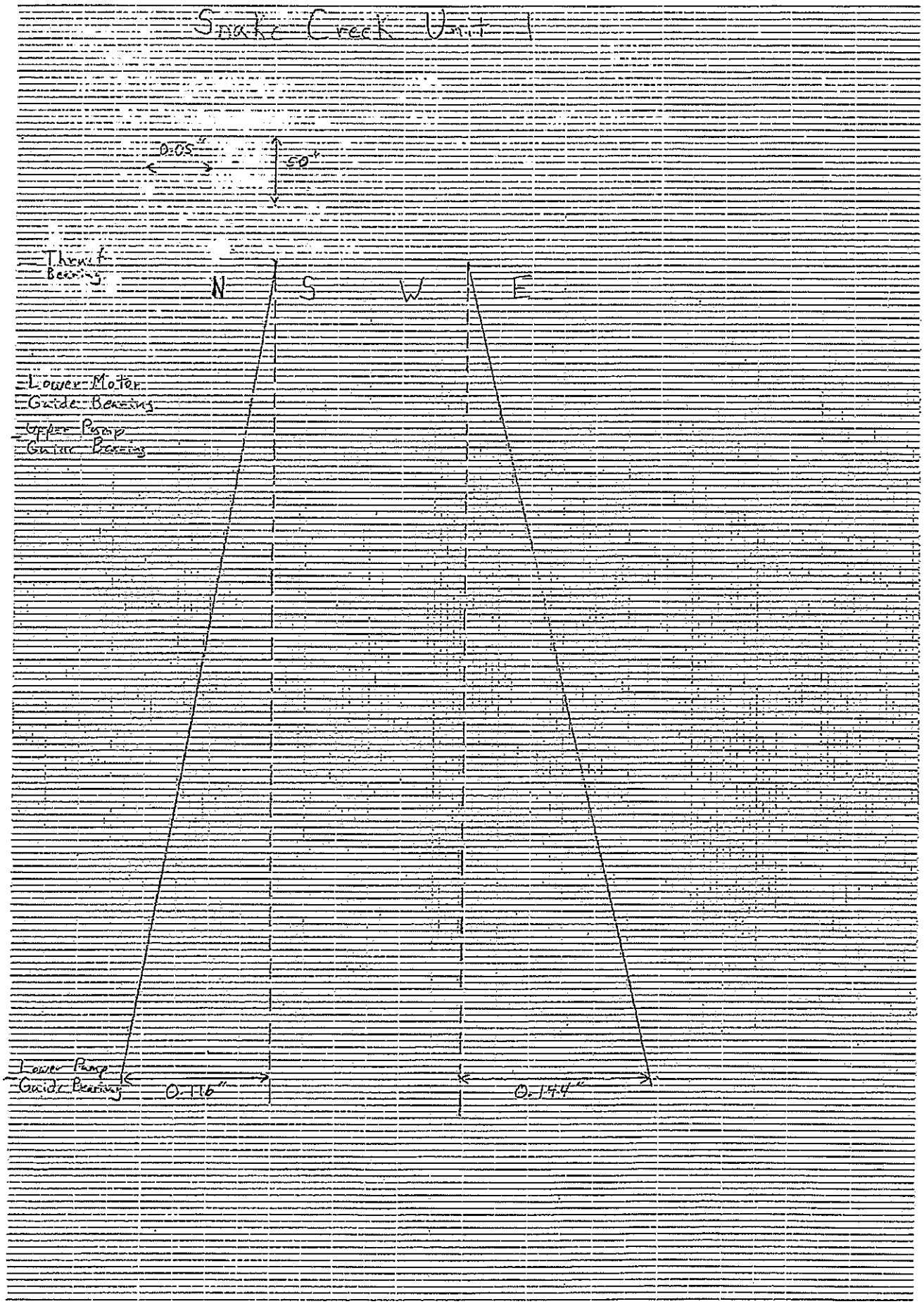




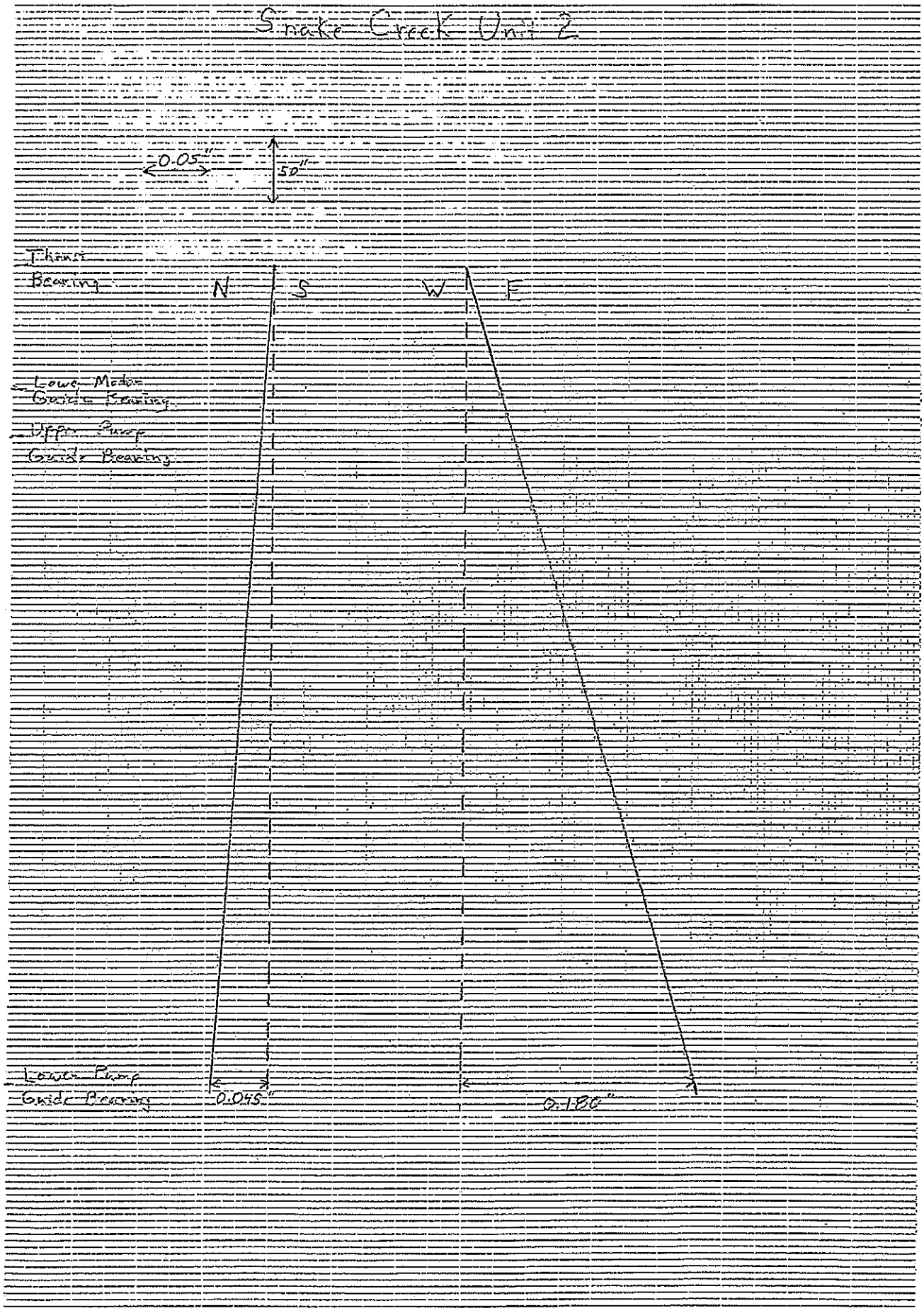


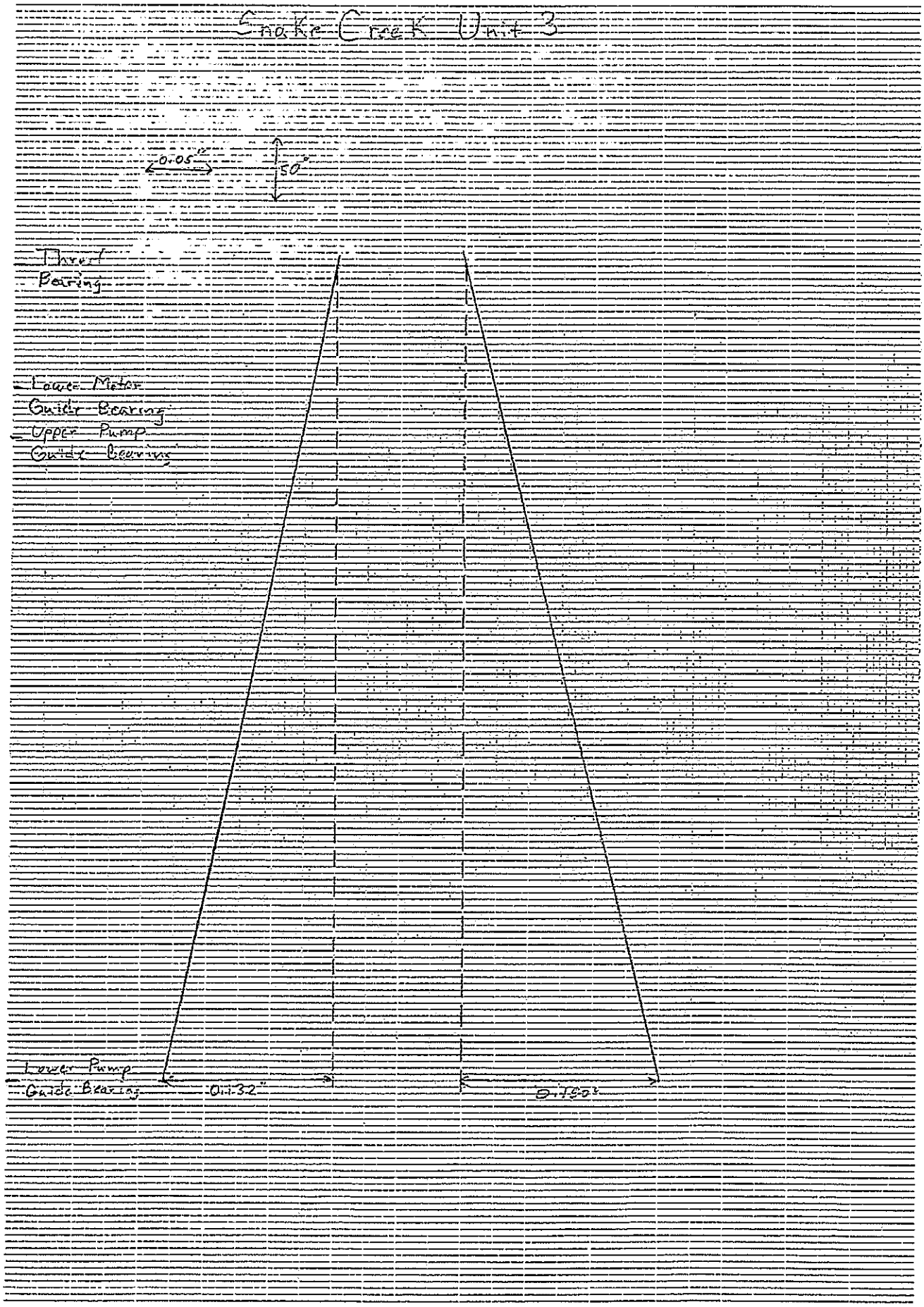



PLAN-EL. 1867.67
Handrail
Benchmark #5
LP El. 1867.62
Sidewalk El 1868.29
℄ Unit S1
ACCESS BRIDGE
Curb El 1868.42
El 1867.67
Benchmark #7
Benchmark #6
½" Exp. jt.
1" Exp. jt.
HP El. 1867.67
Deck drains El. 1867.50
WOMEN RM. 103
LOUNGE RM. 104
Drain-LP floor El. 1868.00
Duct
Centrifugal fan
Longitudinal ℄ units
Panelboard NPSB
Water heater MEN RM. 102
Air conditioning unit
MECH. RM. RM. 105
Secondary lighting panel board
Sink
Water cooler
Metal stud and gypsum board wall
LOBBY RM. 101
Concrete fill El. 1868.12
Slope
Cover slab, HP El. 1867.67
Formed grooves
15'-1½"x20'-0" Service hatch
HP El. 1867.75
Wheeled fire hose reel
Connections for filling and purifying lube oil
Distribution board NRA
Air conditioning control panel NPRC
480 V. Power receptacle
Heater
Control cabinet
Control cabinets
Stem handling carriage
Concrete fill El. 1868.12
Drying oven
Aluminum hatch cover
Sink
MECH. RM. RM. 107
MECH. RM. RM. 106 El 1868.12
HP El. 1868.12
Air conditioning unit
Duct above
Concrete fill
Ladder
Louvers
Drain-LP fl
Fan
Louvers
Metal stud and gypsum board wall
Slilling well El. 1871.75
Handrail
Fire hose cabinet
A.C. Distribution board MSB
El. 1872.93
El. 1863.12
ELEVATOR
El 1868.12
UP
DN
Metal stairs
El. 1867.67
Ladder
Handrail
Track
Snatch hook anchor
LP El. 1854.89
HP El. 1854.93
Gate hatch
Removable chain
GATE SERVICE ROOM RM. 108
Bearing plates
El. 1867.67
Grating
LP El. 1867.62
Benchmark #8
Benchmark #9
25'-10"
86'-10"
Wood cant El. 1882.00
Roof HP El. 1881.92
Rubber walkway
Ladder
Metal floor
El. 1882.56
Metal stairs
ELEVATOR EQUIP. RM. RM. E2
El. 1885.12
Heater
El. 1877.74
Metal stud and gypsum board wall
Fan
Elevator equipment
Controls and
℄ Unit S1
℄ Unit S2
℄ Unit S3
Roof drains El. 1881.90
HP El. 1882.00
Oil tank
Gate hoist platforms not shown
RM. 108A
Handrail
RM. 108B Gate hoist
Gate hatch
RM. 108C
Ladder
Heater
El. 1882.00
Platform
2" Asbestos cement
Roof drain
Gate hoist
LP El. 1881.84
Roof HP El. 1881.92


Snake Creek Unit 1
0.05"
50"
Thrust Bearing
N
S
W
E
Lower Motor Guide Bearing
Upper Pump Guide Bearing
Lower Pump Guide Bearing
0.176"
0.144"

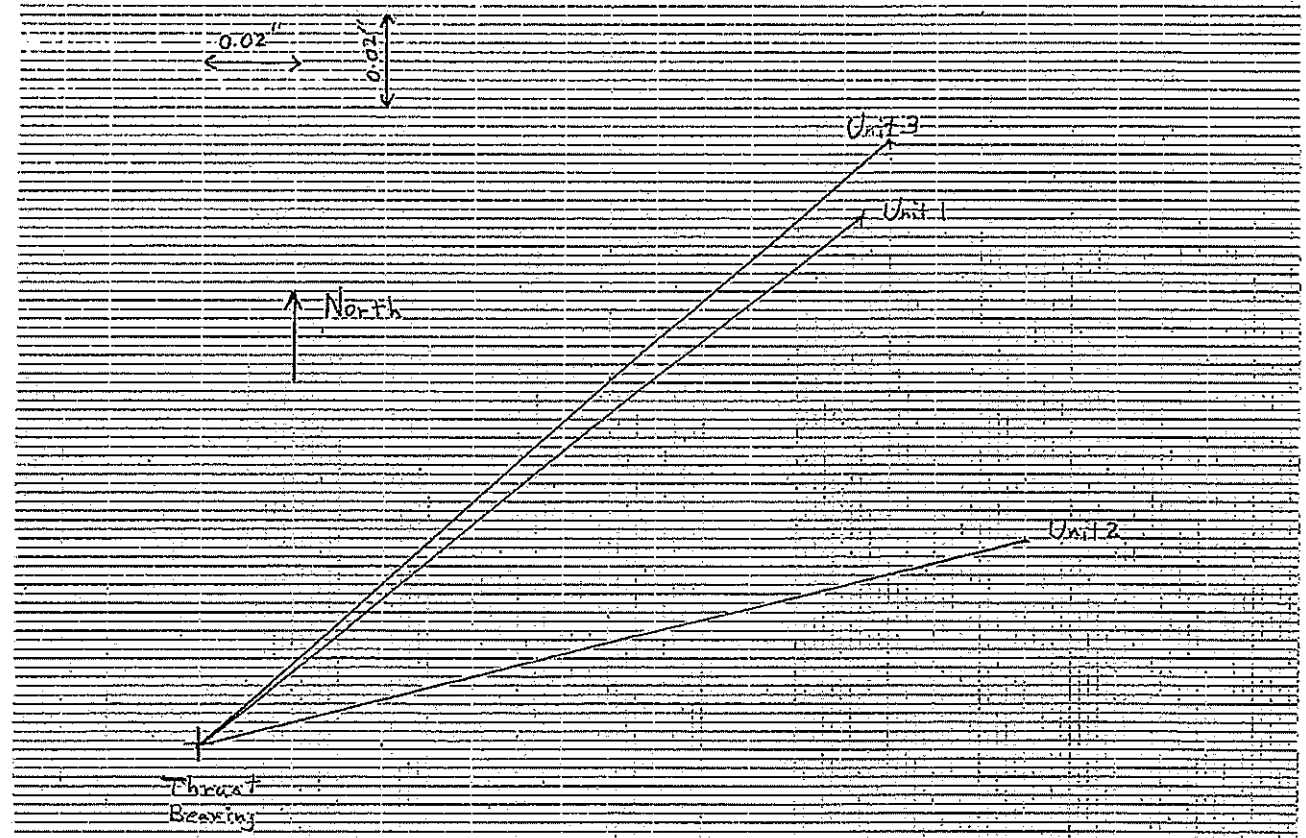
Snake Creek Unit 2




Smoke Creek Unit 3
0.05"
50"
Thrust Bearing
Lower Motor Guide Bearing
Upper Pump Guide bearing
Lower Pump Guide Bearing
0.132"
0.132"

Snake Creek Pumping Plant
6/01

Plan View Showing Relation of Pump Centerlines to Motor



PLUMBNESS REPORT

22:23:3 PLUMB.EXE VERS 1.5, COPYRIGHT 1990, LUDECA, INC. 7/10/2001
Data file path C:\MYDOCU~1\SC1.DAT

Snake Creek
unit1on 6/12/01
Data file Date: 05/10/2001 06:10:37

Lens Constant = 14.96 in.
Laser to Mirror = 10.00 in.
Effective length = 24.96 in.

RAW DATA:

		mils	Std Dev
12:00	X:	177.8	0.40
	Y:	81.5	0.40
3:00	X:	193.6	0.10
	Y:	78.1	0.30
6:00	X:	192.3	0.20
	Y:	70.3	0.20
9:00	X:	186.4	0.10
	Y:	69.7	0.20

X data suspect. Confirm readings. Residual: (X0+X6) - (X3+X9) = -9.8
Y data suspect. Confirm readings. Residual: (Y0+Y6) - (Y3+Y9) = 4.0

RESULTS:

Plane	Actual	Targets	Tolerances	
12:00-6:00	-0.185	0.00	0.000	Mils/inch
3:00-9:00	-0.229	0.00	0.000	Mils/inch

Adjustment Name	Dist. in.	12 or 6 mils		MOVES 3 or 9 mils	
Thrust Bearing	0.0	0.0	->12	0.0	-> 3
Lower Motor	-95.0	17.6	-> 6	21.7	-> 9
Upper Pump	-132.0	24.4	-> 6	30.2	-> 9
Lower Pump	-630.0	116.5	-> 6	144.2	-> 9

Pad Corrections, Clockwise from TOP

#	Degrees	Correction
1	0.0	0.4
2	90.0	0.0
3	180.0	4.1
4	270.0	4.6

PLUMBNESS REPORT

22:27:35 PLUMB.EXE VERS 1.5, COPYRIGHT 1990, LUDECA, INC. 7/10/2001
Data file path C:\MYDOCU~1\SC2.DAT

Snake Creek
Unit 2 6/13/01
Data file Date: 05/10/2001 23:33:33

Lens Constant = 14.96 in.
Laser to Mirror = 10.00 in.
Effective length = 24.96 in.

RAW DATA:

		mils	Std Dev
12:00	X:	-142.5	0.30
	Y:	-46.5	0.20
3:00	X:	-131.6	0.20
	Y:	-36.9	0.20
6:00	X:	-126.5	0.20
	Y:	-47.9	0.10
9:00	X:	-137.5	0.10
	Y:	-49.6	0.20

Y data suspect. Confirm readings. Residual: (Y0+Y6) - (Y3+Y9) = -7.9

RESULTS:

Plane	Actual	Targets	Tolerances	
12:00-6:00	-0.073	0.00	0.000	Mils/inch
3:00-9:00	-0.286	0.00	0.000	Mils/inch

Adjustment Name	Dist. in.	12 or 6 MOVES mils		3 or 9 MOVES mils	
Thrust Bearing	0.0	0.0	->12	0.0	-> 3
Lower Motor	-95.0	6.9	-> 6	27.2	-> 9
Upper Pump	-132.0	9.6	-> 6	37.8	-> 9
Lower Pump	-630.0	45.8	-> 6	180.3	-> 9

Pad Corrections, Clockwise from TOP

#	Degrees	Correction
1	0.0	2.1
2	90.0	0.0
3	180.0	3.6
4	270.0	5.7

PLUMBNESS REPORT

22:31:46 PLUMB.EXE VERS 1.5, COPYRIGHT 1990, LUDECA, INC. 7/10/2001
Data file path C:\MYDOCU~1\SC3.DAT

Snake Creek
Unit 3 6/13/01
Data file Date: 05/11/2001 01:11:35

Lens Constant = 14.96 in.
Laser to Mirror = 10.00 in.
Effective length = 24.96 in.

RAW DATA:

		mils	Std Dev
12:00	X:	148.6	0.20
	Y:	-48.8	0.20
3:00	X:	161.7	0.10
	Y:	-44.1	0.30
6:00	X:	155.2	0.20
	Y:	-54.0	0.10
9:00	X:	145.9	0.20
	Y:	-61.4	0.20

X data suspect. Confirm readings. Residual: (X0+X6) - (X3+X9) = -3.9
Y data suspect. Confirm readings. Residual: (Y0+Y6) - (Y3+Y9) = 2.6

RESULTS:

Plane	Actual	Targets	Tolerances	
12:00-6:00	-0.210	0.00	0.000	Mils/inch
3:00-9:00	-0.239	0.00	0.000	Mils/inch

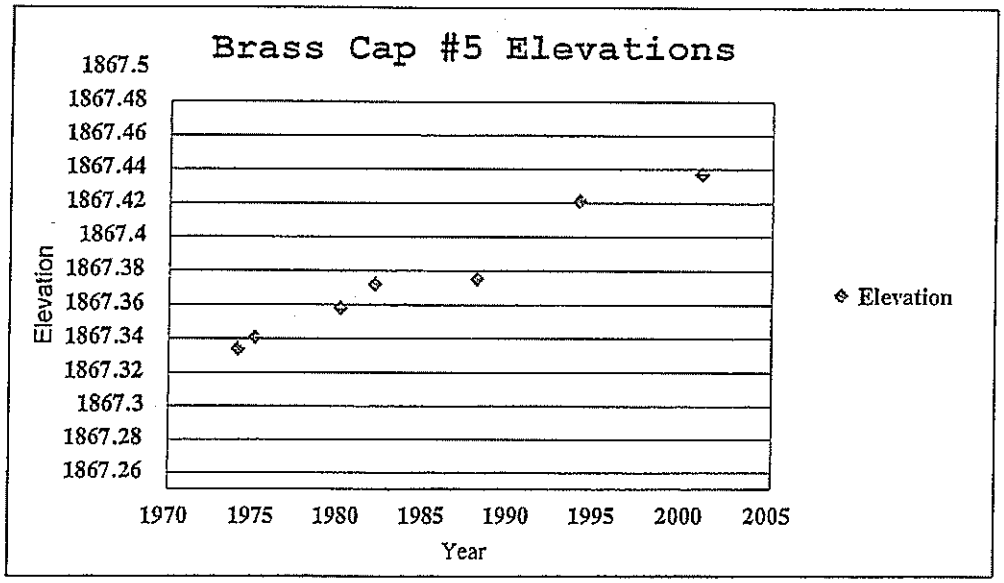
Adjustment Name	Dist. in.	12 or 6 MOVES mils		3 or 9 MOVES mils	
Thrust Bearing	0.0	0.0	->12	0.0	-> 3
Lower Motor	-95.0	20.0	-> 6	22.7	-> 9
Upper Pump	-132.0	27.7	-> 6	31.6	-> 9
Lower Pump	-630.0	132.4	-> 6	150.6	-> 9

Pad Corrections, Clockwise from TOP

#	Degrees	Correction
1	0.0	0.3
2	90.0	0.0
3	180.0	4.5
4	270.0	4.8

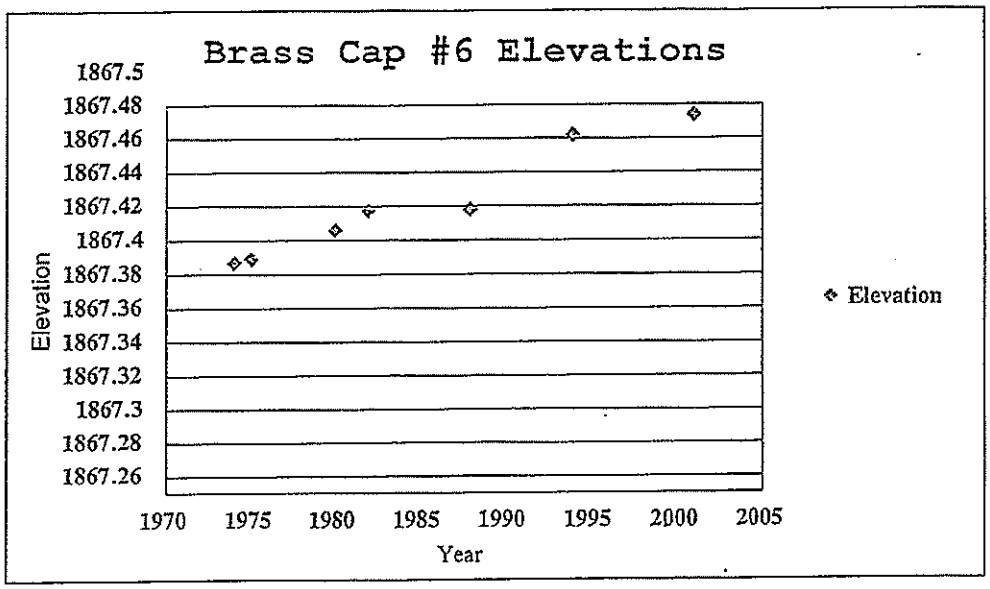
SNAKE CREEK PUMPING PLANT
SETTLEMENT POINTS
BRASS CAP #5

Year	Elevation	Movement (Year-Year)	Movement (Base-End)
1974	1867.334	(Base line)	0.103
1975	1867.341	0.007	
1980	1867.358	0.017	
1982	1867.372	0.014	
1988	1867.375	0.003	
1994	1867.421	0.046	
2001	1867.437	0.016	



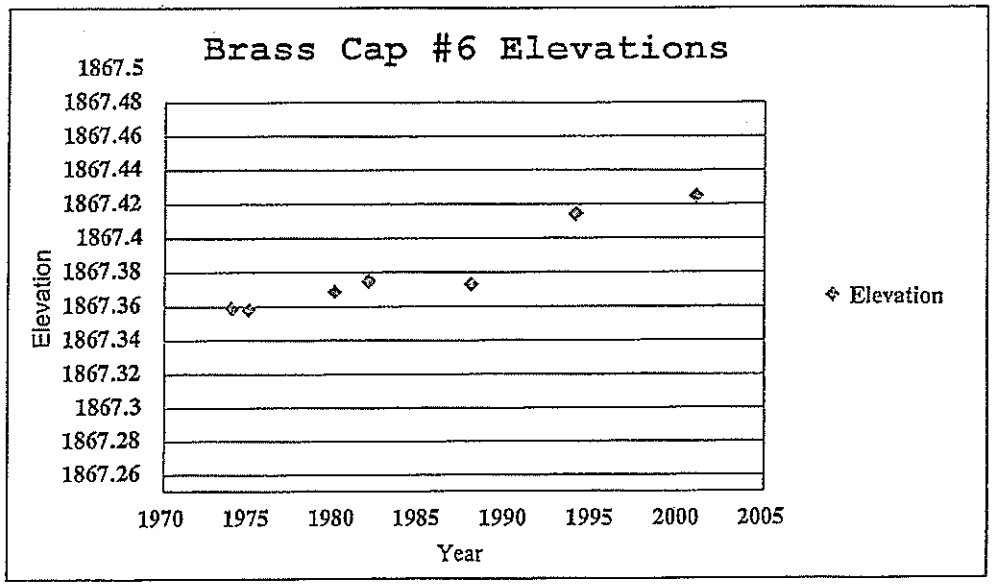
SNAKE CREEK PUMPING PLANT
SETTLEMENT POINTS
BRASS CAP #6

Year	Elevation	Movement (Year-Year)	Movement (Base-End)
1974	1867.387	(Base line)	0.087
1975	1867.389	0.002	
1980	1867.406	0.017	
1982	1867.417	0.011	
1988	1867.418	0.001	
1994	1867.462	0.044	
2001	1867.474	0.012	



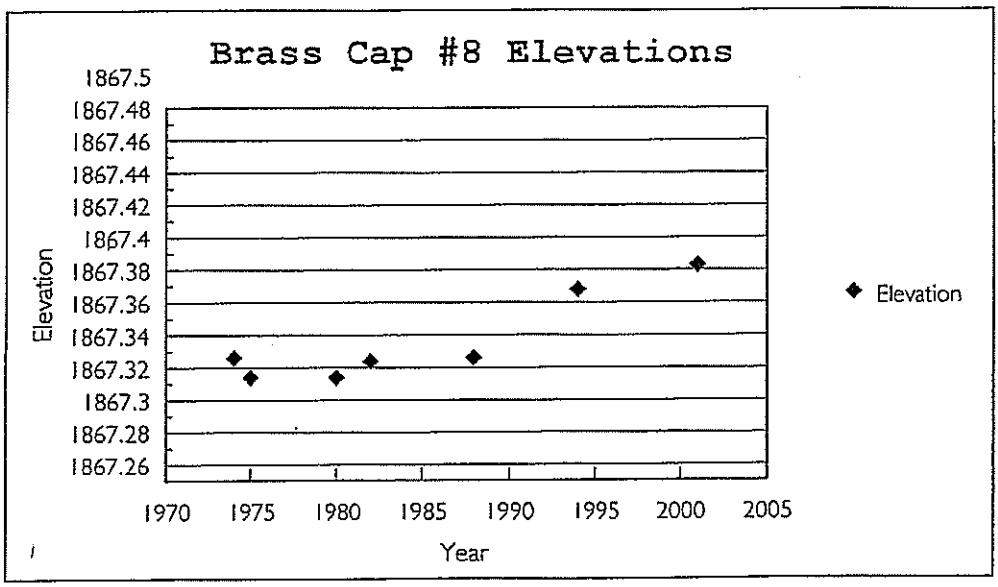
SNAKE CREEK PUMPING PLANT
SETTLEMENT POINTS
BRASS CAP #7

Year	Elevation	Movement (Year-Year)	Movement (Base-End)
1974	1867.359	(Base line)	0.066
1975	1867.358	-0.001	
1980	1867.369	0.011	
1982	1867.375	0.006	
1988	1867.373	-0.002	
1994	1867.414	0.041	
2001	1867.425	0.011	



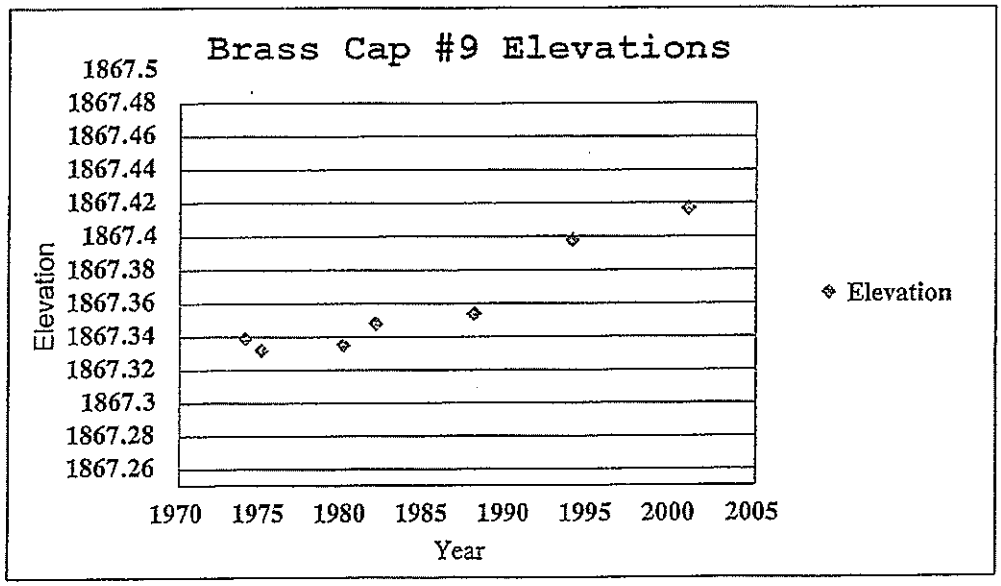
SNAKE CREEK PUMPING PLANT
SETTLEMENT POINTS
BRASS CAP #8

Year	Elevation	Movement (Year-Year)	Movement (Base-End)
1974	1867.326	(Base line)	0.057
1975	1867.314	-0.012	
1980	1867.314	0	
1982	1867.324	0.01	
1988	1867.326	0.002	
1994	1867.368	0.042	
2001	1867.383	0.015	



SNAKE CREEK PUMPING PLANT
SETTLEMENT POINTS
BRASS CAP #9

Year	Elevation	Movement (Year-Year)	Movement (Base-End)
1974	1867.339	(Base line)	0.078
1975	1867.332	-0.007	
1980	1867.335	0.003	
1982	1867.348	0.013	
1988	1867.354	0.006	
1994	1867.398	0.044	
2001	1867.417	0.019	



Appendix C – Attachment 6

GDU Principal Supply Works Estimated Annual OM&R Associated With the Used and Unused Capacity Draft Report, 1999

Draft - March 28, 1999

Garrison Diversion Unit - Principal Supply Works
Estimated Annual OM&R Associated with the Used and Unused Capacity

Conclusions and Recommendations

The Garrison Diversion Unit (GDU) was originally authorized in 1965. Snake Creek Pumping Plant, McClusky and New Rockford Canals, and mitigation and other features were constructed to meet the demands of this authorization, including the irrigation of approximately 250,000 acres. The Garrison Diversion Unit Reformulation Act of 1986 reduced the irrigation to about 85,360 acres through the principal supply works and an additional 28,000 acres in locations other than the Hudson Bay, James River, or Devils Lake drainage basins. The State of North Dakota is currently proposing legislation that would further reduce the irrigation from the Principal Supply Works to about 25,000 acres. Due to these changes, the previously constructed facilities will only be operated at a fraction of their full capacity.

The reduced water needs related to reformulation and revisions of the Garrison Diversion Project, cause the existing facilities to be more expensive to operate than if new facilities were specifically designed for the proposed Dakota Water Resource Act (DWRA). Therefore, this report was prepared to describe four alternatives for computing the percentage of costs associated with the used capacity of existing GDU facilities. The "used capacity" percentages could be used to determine the State of North Dakota's portion of OM&R costs of existing GDU facilities. The balance of these OM&R costs would remain the responsibility of the Federal government.

Current OM&R costs of the existing GDU principal supply works facilities have been estimated at about $2.1 million. These costs include efforts to provide public safety and site security, provide water to wildlife development and recreation areas, maintain water quality, maintain facilities in compliance with local regulations and to protect the federal investment. Providing water as detailed in the Dakota Water Resources Act only increases the OM&R costs slightly from the current "non-operational" status.

Alternative 1 computes the OM&R "used capacity" percentage of 71.62% by comparing the costs of a hypothetical canal system designed specifically for the Dakota Water Resources Act irrigation and MR&I to those of the existing facilities. This alternative is based on the justifiable logic that if canals and pumping plants were built specifically for the reduced capacities, the beneficiary would pay for these OM&R costs.

Alternatives 2 computes the OM&R "used capacity" percentage of 35.95% by dividing the M&I and irrigation capacities in the DWRA by the existing capacity. Alternative 3 is similar to alternative 2, except only the DWRA M&I capacity is used. The "used capacity" percentage in alternative 3 is 17.07%. However, these two alternatives cannot be justified based on actual or estimated O&M costs. OM&R costs are not directly proportional to the capacity of a pumping plant or canal. In fact, the increase in OM&R cost is only a fraction of the increase in capacity.

This is due to larger fixed costs not directly associated with capacity and has been documented in several studies (see appendix C).

Alternative 4 computes the OM&R "used capacity" percentage of 87.48% by comparing the increased cost of using the existing principal supply works facilities to those of a Bismarck to Fargo pipeline designed for DWRA M&I needs only. This alternative has justifiable logic similar to alternative 1. If a new pipeline system was built specifically for the reduced capacities, the beneficiary would pay for these OM&R costs. This "used capacity" percentage provides that the state would pay at least the same cost if it used the existing facilities for M&I needs. A major component of the costs computed in this alternative are power costs. This percentage was based on a M&I water delivery to the Red River Valley of 66,360 acre-feet/year (100 cfs, 22 hr/day, 365 days/yr). This "used capacity" percentage would drop to 44.64% if Red River Valley deliveries were only 30,000 acre-feet/year.

Based on these alternatives, it appears that it would be appropriate for the state to pay at least 44% of the OM&R of the existing principal supply works when initial deliveries are made for the MR&I component of DWRA. This percentage should be increased as MR&I water demands increase and as deliveries are made for irrigation or other project purposes. A percentage of 71% would be appropriate as demands at Snake Creek Pumping Plant reach about 737 cfs (the capacity used in this study for DWRA MR&I and irrigation demands).

03-18-99 DRAFT

Draft Report

ESTIMATED ANNUAL OM&R

ASSOCIATED WITH THE USED AND UNUSED CAPACITY

OF

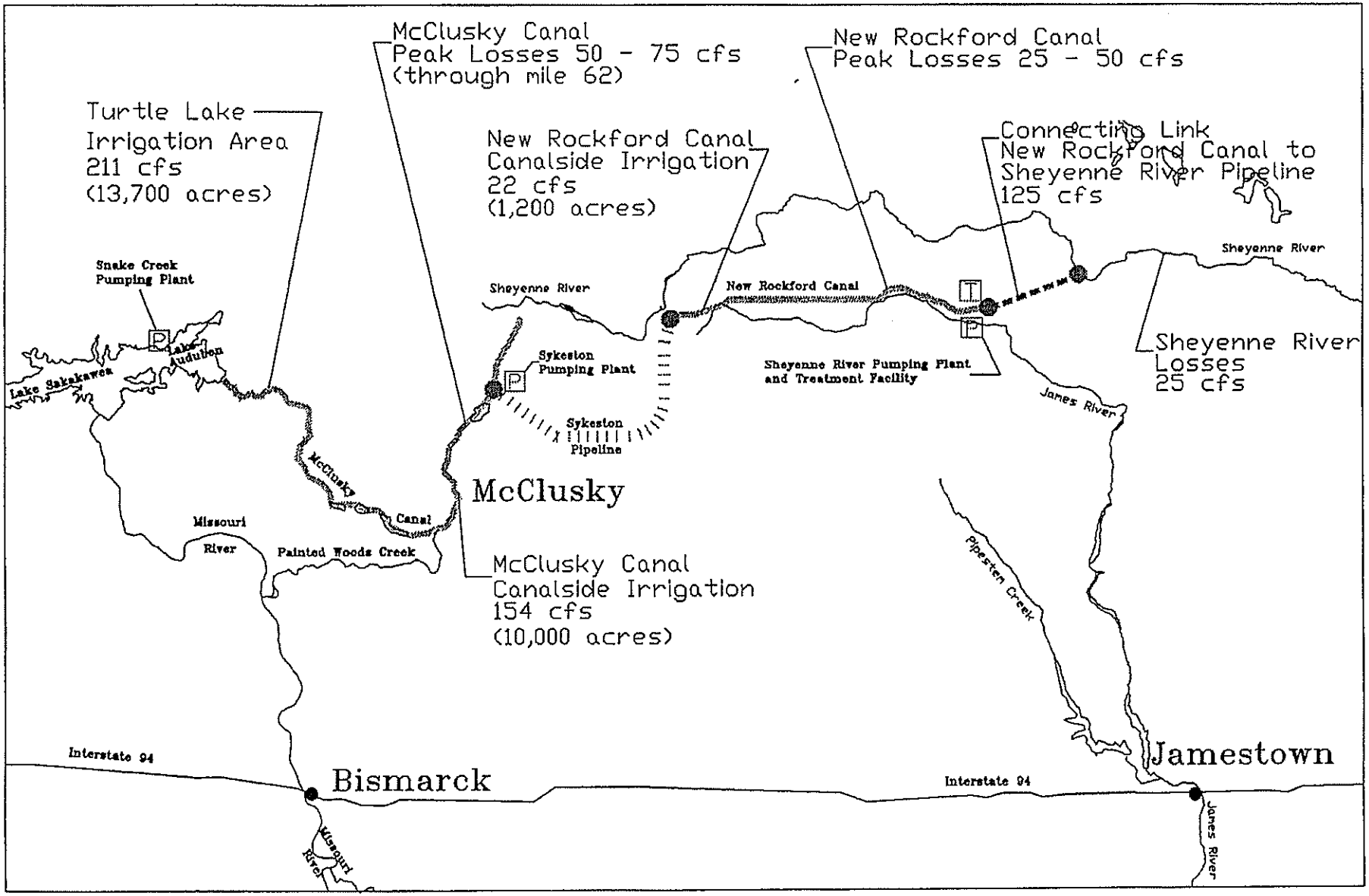
EXISTING GARRISON DIVERSION UNIT

PRINCIPAL SUPPLY WORKS FEATURES

United States Department of the Interior
Bureau of Reclamation
March, 1999

Draft Dakota Water Resources Act of 1997
Use Capacity

March 1999



ESTIMATED ANNUAL OM&R
ASSOCIATED WITH THE USED AND UNUSED CAPACITY
OF EXISTING GARRISON DIVERSION UNIT
PRINCIPAL SUPPLY WORKS FEATURES

TABLE OF CONTENTS

ESTIMATED ANNUAL OM&R
ASSOCIATED WITH THE USED AND UNUSED CAPACITY
OF EXISTING GARRISON DIVERSION UNIT
PRINCIPAL SUPPLY WORKS FEATURES

1. PURPOSE

The purpose of this report is to document estimated annual OM&R costs associated with the used and unused capacity of existing Garrison Diversion Unit (GDU) principal supply works features which have been constructed to-date. Information in this document has been prepared to respond to draft Dakota Water Resources Act of 1997 legislation being developed. Wording in the June 19, 1998 Draft of the legislation reads as follows:

> "SEC. 1.""(f) In implementing the provisions of this Act, the Secretary is directed to estimate the actual construction costs of the existing facilities, including mitigation, and annual OM&R associated with the used and unused capacity of the existing features. An appropriate repayment contract shall be negotiated based on the prorated share of the currently used capacity to the total capacity. The remaining reimbursable costs shall be deferred until such time as the remaining capacity is put in service. The Secretary shall be responsible for the cost of operation and maintenance of the proportionate share attributable to the capacity of the facilities, including mitigation, which remains unused."

2. BACKGROUND

The GDU Project was originally authorized in 1965 as part of the Pick-Sloan Missouri Basin Program. The project was amended by the Garrison Reformulation Act of 1986 to address concerns of Canada, reduce environmental impacts, and to meet contemporary needs of the State of North Dakota. The State of North Dakota is preparing legislation for Congress to further amend the GDU Project to implement the recommendations of the GDU Commission Final Report (dated December 20, 1984), to construct a revised "multi-purpose federally-assisted water resource development project providing for the development of irrigation, municipal, rural and industrial water, enhanced fish and wildlife habitat, and other natural resource conservation and development, recreation, flood control, augmented stream flows, ground water recharge, and other project purposes". The proposed legislation is referred to as the "Dakotas Water Resource Act of 1997.

At the request of the North Dakota Congressional Delegation, the Bureau of Reclamation conducted an analysis to compare costs of alternative conveyance systems to supply Missouri River water to the Fargo, North Dakota/Red River Area. Four alternatives of providing 100 cubic feet per second (cfs) to Fargo and the Red River were evaluated. Discussion and costs of the alternatives are documented in *"Garrison Diversion Unit - Cost Comparison Analysis - Bureau of Reclamation - March 1997"*.

3. SCOPE AND LIMITATIONS OF REPORT

This study is limited to estimating annual OM&R costs associated with the used and unused capacity of existing Garrison Diversion Unit (GDU) principal supply works features which have been constructed to-date. Principal supply works features constructed to-date and evaluated in this report include the: 2050 cfs Snake Creek Pumping Plant, 1950 cfs McClusky Canal, and 1600 cfs New Rockford Canal. Fish and wildlife mitigation costs associated with the above-mentioned supply works features are included in the evaluation.

The proposed Dakota Water Resources Act legislation provides limited specific information on the location and extent of the "multi-purpose federally-assisted water resource development project providing for the development of irrigation, municipal, rural and industrial water, enhanced fish and wildlife habitat, and other natural resource conservation and development, recreation, flood control, augmented stream flows, ground water recharge, and other project purposes". The legislation does specify the service area and acreage of irrigation to be authorized.

For this report, the used capacity of constructed supply works features is based on irrigation service areas and acreage specified in the draft legislation and on MR&I water Alternative No. 4 discussed in the *"Garrison Diversion Unit - Cost Comparison Analysis - Bureau of Reclamation - March 1997"* document. The alternative, referred to as the "Connecting Link" alternative, provides Missouri River water to the Fargo/Red River area via the McClusky Canal, Sykeston Pipeline, and the New Rockford Canal joined to the Sheyenne River through a pipeline. The Sykeston Pipeline (Missouri Coteau Route) has an intake located near McClusky Canal Mile 62 or in the vicinity of the McClusky Canal Mile 59 plug. Flows are pumped through the Sykeston Pipeline to a discharge point at the beginning of the New Rockford Canal.

4. DESCRIPTION OF PRINCIPAL SUPPLY WORKS OM&R ESTIMATE OPTIONS

The following OM&R estimate options were made to evaluate the used capacity of existing Garrison Diversion Unit supply works features and are discussed in this report:

Option No. 1: Estimated OM&R costs of operating the existing constructed 2050 cfs capacity Snake Creek Pumping Plant, 1950 cfs capacity McClusky Canal, and 1600 cfs capacity New Rockford Canal at reduced capacities to meet DWRA specific irrigation and MR&I water requirements.

Option No. 2: Estimated OM&R assuming the Snake Creek Pumping Plant, McClusky Canal, and New Rockford Canal were designed and constructed at a reduced capacity to meet DWRA requirements.

Option No. 3: Estimated OM&R costs of operating the existing constructed 2050 cfs capacity Snake Creek Pumping Plant, 1950 cfs capacity McClusky Canal, and 1600 cfs capacity New Rockford Canal at reduced capacities to meet DWRA MR&I water requirements only.

5. DESCRIPTION OF USED CAPACITY PRORATED SHARE OF OM&R COST ALTERNATIVES

The following alternatives were considered to assess the used capacity prorated share of OM&R costs of existing Garrison Diversion Unit principal supply works features:

Alternative 1: Existing features used capacity based on the ratio of the Option No. 2 estimated OM&R cost (of the existing principal supply works features, if designed and constructed with a capacity for DWRA irrigation and MR&I water demands) vs. the Option No. 1 estimated OM&R cost (of the existing principal supply works features utilizing the existing capacity principal supply works facilities for DWRA irrigation and MR&I water demands).

Alternative 2: Existing features used capacity based on the ratio of the Option No. 1 required principal supply works capacity in cfs for DWRA irrigation and MR&I water demands vs. the designed and constructed existing principal supply works features water capacity in cfs.

Alternative 3: Existing features used capacity based on the ratio of the Option No. 3 required principal supply works capacity in cfs for DWRA MR&I water demands vs. the designed and constructed existing principal supply works features water capacity in cfs.

Alternative 4: Existing features used capacity based on the OM&R cost differential of providing MR&I water to the Fargo, ND/Red River area under the "Bismarck - Fargo" alternative vs. the "Connecting Link" MR&I alternative utilizing the existing principal supply works features for DWRA MR&I water demands.

6. SUMMARY OF ESTIMATED ANNUAL OM&R COSTS AND CAPACITIES USED IN PRORATED OM&R SHARE ALTERNATIVES

Estimated annual OM&R costs of the options considered are summarized in Table 1 and are discussed in Section 8 of this report.

Used capacity prorated share of principal supply works OM&R cost alternatives are summarized in Table 3.

Table 1.

SUMMARY OF PRINCIPAL SUPPLY WORKS ESTIMATED ANNUAL OM&R COSTS			
PRINCIPAL SUPPLY WORKS PROJECT FEATURE/ITEM	OPTION NO. 1 (Utilizing existing capacity principal supply works facilities for DWRA irrigation and MR&I water demands)	OPTION NO. 2 (Principal supply works facilities sized for DWRA irrigation and MR&I water demands)	OPTION NO. 3 (Utilizing existing capacity principal supply works facilities for DWRA MR&I water demands only)
1. EXISTING FEATURES/ITEMS WITH USED AND UNUSED CAPACITY			
a. Snake Creek Pumping Plant (including energy and power transmission)	$233,000	$183,000	$227,000
b. McClusky Canal (through Mile 62)	$1,053,000	$789,000	$1,053,000
c. New Rockford Canal	$350,000	$175,000	$350,000
d. McClusky Canal Abandoned Reaches (Mile 62 - 74)	$50,000	0	$50,000
e. Fish and Wildlife Mitigation McClusky and New Rockford Canals	$223,000	$201,000	$223,000
f. Fish and Wildlife Mitigation Lake Audubon	$230,000	$184,000	$230,000
TOTAL ITEM 1. (FEATURES/ITEMS WITH UNUSED CAPACITY)	$2,139,000	$1,532,000	$2,133,000
2. PROPOSED NEW FEATURES/ITEMS			
a. Winter Operations For MR&I Releases (McClusky-New Rockford Canals)	Not applicable to prorated share of OM&R cost alternatives considered in this report		$52,000
b. Supervisory Control and Data Acquisition (SCADA) System (SCPP/McClusky Canal/Sykeston Pumping Plant & Pipeline/New Rockford Canal/Sheyenne River Pipeline)			$233,000
c. "Connecting Link" pumping plants/Sykeston Pipeline/Sheyenne River Pipeline (W/O SCADA AND NON-REIMBURSABLE WATER TREATMENT)			$4,376,000
TOTAL ITEM 2. (FEATURES/ITEMS WITHOUT UNUSED CAPACITY)			$4,661,000

Table 2.

SUMMARY - CAPACITIES AND OM&R COSTS USED IN PRORATED OM&R SHARE ALTERNATIVES			
PRINCIPAL SUPPLY WORKS PROJECT FEATURE/ITEM	TOTAL CAPACITY (CFS)	ESTIMATED USED CAPACITY (CFS)	ESTIMATED OM&R COST ($)
1. EXISTING FEATURES/ITEMS WITH USED AND UNUSED CAPACITY			
Option No. 1 (Utilizing the existing capacity principal supply works facilities for DWRA irrigation and MR&I water demands)	1600 New Rockford 1950 McClusky 2050 SCPP	197 New Rockford 637 McClusky 737 SCPP	$2,139,000
Option No. 2 (Principal supply works facilities sized for DWRA irrigation and MR&I water demands)	172 New Rockford 587 McClusky 687 SCPP	172 New Rockford 587 McClusky 687 SCPP	$1,532,000
Option No. 3 (Utilizing the existing capacity principal supply works facilities for DWRA MR&I water demands only)	1600 New Rockford 1950 McClusky 2050 SCPP	175 New Rockford 260 McClusky 350 SCPP	$2,133,000
2. PROPOSED NEW FEATURES/ITEMS			
"Connecting Link" Alternative Proposed Features/Items, SCADA, and Canal Winter Operations (MR&I water demands only) (WITHOUT NON-REIMBURSABLE WATER TREATMENT)	125-175	125-175	$4,661,000 *
"Bismarck-Fargo" Alternative MR&I Water Supply (WITHOUT NON-REIMBURSABLE WATER TREATMENT)	100	100	$6,527,000 *

* Based on the OM&R estimate presented in *"Garrison Diversion Unit - Cost Comparison Analysis - Bureau of Reclamation - March 1997"*, with costs indexed to January 1999. Costs shown do not include non-reimbursable water treatment costs and 20 percent for unlisted items associated with water treatment. Costs shown are for delivering 66,360 acre-feet (100 cfs, 22 hours/day, 365 days/year) annually to the Fargo/Red River area. Pumping plant power costs in the 1997 comparison analysis for the "Connecting Link" alternative have been reduced to reflect New Rockford Canal annual seepage losses of 3530 ac-ft in lieu of 33,190 ac-ft annual losses used in the analysis.

Table 3.

SUMMARY ALTERNATIVE USED CAPACITY PRORATED SHARE OF PRINCIPAL SUPPLY WORKS OM&R COSTS/PERCENTAGES	
PRORATED OM&R SHARE ALTERNATIVE	EXISTING FEATURES USED CAPACITY PRORATED SHARE CALCULATION
Alternative 1: Existing features used capacity based on the ratio of the Option No. 2 estimated OM&R cost (of the existing principal supply works features, if designed and constructed with a capacity for DWRA irrigation and MR&I water demands) vs. the Option No. 1 estimated OM&R cost (of the existing principal supply works features utilizing the existing capacity principal supply works facilities for DWRA irrigation and MR&I water demands).	Used Capacity = $1,532,000 / $2,139,000 = 71.62 %. 0.7162 X $2,139,000 = $1,532,000
Alternative 2: Existing features used capacity based on the ratio of the Option No. 1 required principal supply works capacity in cfs for DWRA irrigation and MR&I water demands vs. the designed and constructed existing principal supply works features water capacity in cfs.	Used Capacity = 737 cfs SCPP / 2050 cfs SCPP = 35.95 %. 0.3595 X $2,139,000 = $768,970
Alternative 3: Existing features used capacity based on the ratio of the Option No. 3 required principal supply works capacity in cfs for DWRA MR&I water demands only vs. the designed and constructed existing principal supply works features water capacity in cfs.	Used Capacity = 350 cfs SCPP / 2050 cfs SCPP = 17.07 %. 0.1707 X $2,139,000 = $365,130
Alternative 4: Existing features used capacity based on the OM&R cost differential of providing MR&I water to the Fargo, ND/Red River area under the "Bismarck - Fargo" alternative vs. the "Connecting Link" MR&I alternative utilizing the existing principal supply works features for DWRA MR&I water demands only. Note: Costs do not include non-reimbursable water treatment costs)	Used Capacity = "Bismarck-Fargo" MR&I OM&R minus "Connecting Link" MR&I OM&R. $6,527,000 - $4,661,000 = $1,866,000 $1,866,000/$2,133,000 = 87.48 % *

* The "Bismarck - Fargo" MR&I and "Connecting Link" alternative OM&R costs would be reduced by approximately $1,952,000 and $1,038,000, respectively if an average of only 30,000 acre-feet annually is delivered to the Fargo/Red River area. The majority of the OM&R cost reductions are due to reduced pumping power. The pumping power costs are based upon a 40 mill per kilowatt-hour rate for power with wheeling, as used in *"Garrison Diversion Unit - Cost Comparison Analysis - Bureau of Reclamation - March 1997"*. The existing features used capacity would then be 44.63%. ($4,575,000 - $3,623,000 = $952,000; $952,000/$2,133,000 = 44.63%)

7. SUPPLY WORKS SYSTEM WATER DEMANDS

MR&I Water Demand

MR&I water demands from the GDU principal supply works considered in this OM&R estimate are limited to a release of 125 cfs from the New Rockford Canal via a pipeline into the Sheyenne River to deliver 100 cfs to the Fargo, North Dakota/Red River area. The peak delivery rate and quantities are based on Alternative No. 4 (Connecting Link) information presented in the *"Garrison Diversion Unit - Cost Comparison Analysis - Bureau of Reclamation - March 1997"* report.

No other MR&I water demands from the GDU principal supply works are identified in the draft Dakota Water Resources Act of 1997 legislation.

Irrigation Demand

Irrigation water demands from the GDU principal supply works specified in the Dakota Water Resources Act of 1997 draft legislation and considered in this OM&R estimate consist of demands to irrigate the following service areas: Turtle Lake (13,700 acres), McClusky Canal (10,000 acres), and the New Rockford Canal Service Area (1,200 acres).

Irrigation distribution system peak demands are estimated based on criteria developed in 1980 for the Garrison Diversion Unit. Criteria for the Central Section, which includes the New Rockford Area, is:

Irrigated Area in Acres (Ac)	Material capacity in CFS
0 - 2000	Ac/56
2000 - 5000	35.7 + ((Ac-2000)/72.8)
over 5000	Ac/65

Annual irrigation diversions are based on an average application of 18 inches of water.

System Losses

System seepage, evaporation, and operational losses from the McClusky Canal and New Rockford Canal for Option No. 1, utilizing the existing 2050 cfs capacity Snake Creek Pumping Plant, 1950 cfs McClusky Canal, and 1600 cfs New Rockford Canal, were obtained from previous studies. Peak losses from the 73.6-mile long McClusky Canal have in the past been estimated to be 145 cfs. Initial estimates of losses from New Rockford Canal Reaches 1 and 2 (42.6 miles) have been estimated to be as high as 75 cfs. These New Rockford Canal losses were comparable to those estimated for the McClusky Canal. However, unlike the McClusky Canal, portions of the New Rockford Canal have been membrane-lined and designed with seepage collection systems which are estimated to reduce the losses by up to 50 percent. Peak losses from the New Rockford Canal for this OM&R estimate are estimated to be 50 cfs, which is the loss used in the *"Garrison Diversion Unit - Cost Comparison Analysis - Bureau of Reclamation - March 1997"* report. Peak losses from the McClusky Canal up to Mile 62 are estimated to be 75 cfs.

McClusky Canal and New Rockford Canal losses for Options No. 1 and No. 3 of this report are based on an average annual seepage loss of 70 acre-feet per year-mile and an evaporation loss of 14 acre-feet per year-mile. The annual loss rates are taken from "*A Special Study by the State of North Dakota to Evaluate All Reasonable Alternatives for Connecting the McClusky and New Rockford Canals - March 1, 1993*", Page 5-6, Section 5.1.3. Losses for Option No. 2 are based on an average annual loss of 35 acre-feet per year-mile and an evaporation loss of 7 acre-feet per year-mile

Reservoir losses are based on a net evaporation of 18 inches per year.

Summary of System Water Demands

A summary of system water demands for Option No. 1 is presented in Table 4.

Table 4.

OPTION NO. 1
PROJECT WATER DEMANDS USED IN OM&R COST ESTIMATE
(Utilizing the existing 2050 cfs capacity Snake Creek Pumping Plant, 1950 cfs McClusky Canal, and 1600 cfs New Rockford Canal for DWRA irrigation and MR&I water demands)

Feature/Item	Peak Daily Demand (cfs)		Annual Demand (acre-feet)
New Canal - Sheyenne River Pipeline Connecting Link	125		82950 *
New Rockford Canal Canalside Irrigation (1200 acres)	22		1800
New Rockford Canal Losses	50		3530 ** (***)
New Rockford Canal DWRA Capacity		197	
Sykeston Pipeline Losses	0		
McClusky Canal Losses (through Mile 62)	75		5210 **
McClusky Canal Canalside Irrigation (10,000 acres)	154		15000
Turtle Lake Irrigation Area (13,700 acres)	211		20550
McClusky Canal DWRA Capacity		637	
Audubon Lake Losses	100		27000
Snake Creek Pumping Plant DWRA Capacity		737	
TOTAL SYSTEM DEMAND FOR OM&R ESTIMATE	737 cfs		156,040

* Based on 125 cfs, 22 hours/day, 365 days/year.
** Based on 70 ac-ft/mile seepage and 14 ac-ft/mile evaporation.
*** A loss of 33,190 acre-feet (116,140 - 82,950) is presented for Alternative No. 4, the "Connecting Link" alternative, in the "GDU - Cost Comparison Analysis - Bureau of Reclamation - March 1997" report.

System demands for Option No. 2, with Snake Creek Pumping Plant, McClusky Canal, and New Rockford Canal designed and constructed to meet DWRA requirements, would be similar to Option No. 1 with the exception that canal losses from a reduced-size McClusky Canal and New Rockford Canal would be slightly less. A design for resized McClusky and New Rockford Canals has not been conducted. For purposes of this study, peak losses from the McClusky Canal have been reduced from 100 cfs to 75 cfs and peak losses from the New Rockford Canal have been reduced from 50 cfs to 25 cfs for option No. 2. Annual losses from the New Rockford Canal have been reduced by 50 percent from 70 ac-ft/mile seepage and 14 ac-ft/mile evaporation to 35 ac-ft/mile seepage and 7 ac-ft/mile evaporation, respectively.

A summary of system water demands for Option No. 2 is presented in Table 5.

Table 5.

OPTION NO. 2
PROJECT WATER DEMANDS USED IN OM&R COST ESTIMATE
(With Snake Creek Pumping Plant, McClusky Canal, and New Rockford Canal designed and constructed at a reduced capacity to meet DWRA irrigation and MR&I requirements)

Feature/Item	Peak Daily Demand (cfs)		Annual Demand (acre-feet)
New Canal - Sheyenne River Pipeline Connecting Link	125		82950 *
New Rockford Canal Canalside Irrigation (1200 acres)	22		1800
New Rockford Canal Losses	25		1770 ** (***)
New Rockford Canal DWRA Capacity		172	
Sykeston Pipeline Losses	0		
McClusky Canal Losses (through Mile 62)	50		5210 ****
McClusky Canal Canalside Irrigation (10,000 acres)	154		15000
Turtle Lake Irrigation Area (13,700 acres)	211		20550
McClusky Canal DWRA Capacity		587	
Audubon Lake Losses	100		27000
Snake Creek Pumping Plant DWRA Capacity		687	
TOTAL SYSTEM DEMAND FOR OM&R ESTIMATE	687 cfs		154,280

* Based on 125 cfs, 22 hours/day, 365 days/year.
** Based on 35 ac-ft/mile seepage and 7 ac-ft/mile evaporation.
*** A loss of 33,190 acre-feet (116,140 - 82,950) is presented for Alternative No. 4, the "Connecting Link" alternative, in the *"GDU - Cost Comparison Analysis - Bureau of Reclamation - March 1997"* report.
**** Based on 70 ac-ft/mile seepage and 14 ac-ft/mile evaporation.

A summary of system water demands for Option No. 3 is presented in Table 6.

Table 6.

OPTION NO. 3
PROJECT WATER DEMANDS USED IN OM&R COST ESTIMATE
(Utilizing the existing 2050 cfs capacity Snake Creek Pumping Plant, 1950 cfs McClusky Canal, and 1600 cfs New Rockford Canal for DWRA MR&I water demands)

Feature/Item	Peak Daily Demand (cfs)		Annual Demand (acre-feet)
New Canal - Sheyenne River Pipeline Connecting Link	125		82950 *
New Rockford Canal Canalside Irrigation (1200 acres)	0		0
New Rockford Canal Losses	50		3530 ** (***)
New Rockford Canal DWRA Capacity		175	
Sykeston Pipeline Losses	0		
McClusky Canal Losses (through Mile 62)	75		5210 **
McClusky Canal Canalside Irrigation (10,000 acres)	0		0
Turtle Lake Irrigation Area (13,700 acres)	0		0
McClusky Canal DWRA Capacity		250	
Audubon Lake Losses	100		27000
Snake Creek Pumping Plant DWRA Capacity		350	
TOTAL SYSTEM DEMAND FOR OM&R ESTIMATE	350 cfs		118,690

* Based on 125 cfs, 22 hours/day, 365 days/year.
** Based on 70 ac-ft/mile seepage and 14 ac-ft/mile evaporation.
*** A loss of 33,190 acre-feet (116,140 - 82,950) is presented for Alternative No. 4, the "Connecting Link" alternative, in the "GDU - Cost Comparison Analysis - Bureau of Reclamation - March 1997" report.

8. OM&R ESTIMATE SUPPORTING DATA

General

Annual OM&R cost estimates under the three (3) options were evaluated for the following features/items to arrive at a relative cost difference between the options:

- Existing Project Principal Supply Works Features/OM&R Items

  (1) Snake Creek Pumping Plant.

  (2) McClusky Canal from Audubon Lake through Mile 62, which is the location of the Sykeston Pumping Plant and beginning of the Sykeston Pipeline.

  (3) McClusky Canal abandoned reaches (mile 62 - 73.6).

  (4) New Rockford Canal.

  (5) Fish and wildlife mitigation.

- Proposed New Principal Supply Works Features/OM&R Items

  (1) Supervisory Control and Data Acquisition (SCADA) System.

  (2) Winter operations of SCPP, McClusky Canal, and New Rockford Canal for MR&I water releases.

The OM&R costs are summarized in Table [illegible].

Operation and Maintenance Organization

Operation and maintenance of the principal supply works system (Snake Creek Pumping Plant, McClusky Canal, Sykeston Pumping Plant, Sykeston Pipeline, New Rockford Canal, Sheyenne Pumping Plant, Sheyenne MR&I Water Treatment Plant, and Sheyenne River Pipeline) would be administered by the Garrison Diversion Conservancy District (District) headquartered at Carrington, North Dakota. District staff assigned to the Snake Creek Pumping Plant, the Western Operating Division located at McClusky, North Dakota, and the Central Operating Division located at New Rockford, North Dakota, would conduct onsite O&M activities in conjunction with O&M of the entire principal supply works.

Operation and Maintenance Estimating Criteria

Reclamation criteria provide two acceptable methods for developing irrigation facility OM&R cost estimates: the comparable project method and the organizational method. A comparable project OM&R cost estimate is derived from similar irrigation projects in which conditions are comparable to those expected on the project under study. An organizational OM&R cost estimate is developed based on personnel costs using the following percentages:

	Percent of total cost
Personnel	60
Equipment	19
Supplies	13
Administration	8
	100

The above formula does not include pumping plant OM&R or other special/ extraordinary maintenance items.

Data used in preparing OM&R estimates for this report consist primarily of: comparisons to actual costs of operating and maintaining existing GDU features in recent years, a GDU OM&R estimate prepared by the Bureau of Reclamation in 1987 which was summarized in a document entitled *"Summary, Annual OM&R Estimate, Garrison Diversion Unit, Reformulated Plan, July 1987"*, and several proposed Sykeston Canal studies/reports.

Snake Creek Pumping Plant OM&R

The actual Snake Creek Pumping Plant annual OM&R cost in recent years has been approximately $200,000 without Bureau of Reclamation administrative overhead and approximately $15,000 for pumping energy costs.

For Option No. 1, the estimated Snake Creek Pumping Plant annual OM&R is $233,000. The cost includes $212,000 OM&R without energy (based on actual cost of operating and maintaining the pumping plant in recent years with an adjustment for increased pumping costs) and $21,000 for station service and pumping energy with wheeling charges for pumping 156,040 acre-feet annually.

OM&R costs for Options No. 2 and No. 3 have been estimated based in part on the methods outlined in *"Pumping Plant Operations and Maintenance Costs, United States Department of the Interior, by John M. Eyer, May 1965"* with consideration given for actual experienced costs of operating and maintaining the existing pumping plant. For Option No. 2, the estimated annual OM&R of a 687 cfs pumping plant is $183,000, including $20,000 for station service and pumping energy for pumping 154,280 acre-feet annually. For Option No. 3 the estimated annual OM&R of the existing 2050 cfs pumping plant is $227,000, including $17,000 for station service and pumping energy for pumping 118,690 acre-feet annually. (Refer to APPENDIX "A" supporting material)

Electrical energy costs for both options are based on a 4.0 mill per kilowatt-hour rate for Pick-Sloan Missouri River Basin power. The 4.0 mill rate is the current rate charged to Reclamation by Western Area Power Administration. It is questionable whether Pick-Sloan Missouri River Basin irrigation power at a rate of 2 1/2 mills per kilowatt-hour can be provided to the pumping plant after the GDU Conservancy takes over O&M if the plant is used to meet Dakota Water Resources Act MR&I demands only. Electrical power is provided directly to the pumping plant substation from a Western Area Power Administration power transmission line.

Annual replacement and extraordinary maintenance costs are based on the estimated construction cost times 0.001. Estimated pumping plant construction

costs were obtained from construction cost curves included in a report entitled "*Cost Estimates For Reduced Capacity Snake Creek Pumping Plant, McClusky Canal, Sykeston Canal, New Rockford Canal and James River Feeder Canal, Garrison Diversion Unit, May 1990*". The cost curves for Garrison Diversion Unit features with unused capacity were prepared by the Bureau of Reclamation in 1990. (Refer to Exhibit II for the construction cost curves) The replacement and extraordinary maintenance sinking fund factor of 0.001 was obtained from "Replacements, Units - Service Lives - Factors, USBR, August, 1981" for pumping plants at an interest rate of 6-7 percent.

McClusky Canal and New Rockford Canal OM&R

McClusky Canal OM&R - The 1987 annual OM&R cost for the McClusky Canal and Sykeston Canal, without supervisory control and automation replacements, was estimated to be approximately $661,000 with approximately $154,000 chargeable to then-proposed Sykeston Canal. The remaining amount chargeable to the McClusky Canal was $507,000 or about $6,890 per mile at 1987 costs. Indexing to 1999 costs, the estimated annual OM&R cost for normal/typical McClusky Canal operation and maintenance activities is $750,000 or $10,200 per mile ($6890/mi x 1.48 = $10,200/mi).

New Rockford Canal OM&R - The 1987 annual OM&R cost for the proposed 55.8 mile New Rockford Canal, James River Feeder Canal, and Upper James River was estimated to be $397,000. Approximately 82 percent of the costs or $326,000 are associated with the 55.8 mile New Rockford Canal. Estimated 1987 costs assigned to the 42.6 miles of completed New Rockford Canal are about 249,000. Indexing to 1999 costs, the estimated annual OM&R cost for normal/typical New Rockford Canal operation and maintenance activities is about $368,000 or $8,640 per mile.

Combined estimated McClusky Canal and New Rockford Canal OM&R at January, 1999 costs equals $750,000 + $368,000 = $1,118,000.

As a comparison, the annual cost for the District to operate and maintain the completed McClusky and New Rockford Canals at an acceptable level in recent years has been approximately $1.8 million. Approximately $1,450,000 ($19,700/mile) is required for the 73.6 mile McClusky Canal and $350,000 ($8,210/mile) is required for the 42.6 miles of completed New Rockford Canal. About $200,000 of the $1,450,000 required for operation and maintenance of the McClusky Canal is being spent on "deferred construction" type maintenance activities such as canal prism riprapping and V-ditch drain installation along the O&M roads. It is expected that some extra-ordinary maintenance activities will continue in future years.

For Options No. 1 and No. 3, it is estimated that OM&R costs of operating the existing constructed McClusky Canal and New Rockford Canal at reduced capacities would be basically the same as operating the canals at the existing constructed capacity. OM&R costs used in this estimate are based on a long-term annual OM&R cost of $1,250,000 ($16,980/mile) to operate and maintain the 73.6 mile long McClusky Canal and approximately $350,000 ($8,210/mile) to operate and maintain the 42.6 mile long New Rockford Canal. The annual cost for OM&R of the McClusky Canal through mile 62, at $16,980/mile, is $1,053,000.

For Option No. 2, assuming the McClusky and New Rockford Canals were designed and constructed at a reduced capacity for the DWRA, it is estimated that the OM&R cost of a 587 cfs McClusky Canal would be approximately 75 percent of the OM&R cost of the canal as constructed. The OM&R cost of a 172 cfs New Rockford Canal is estimated to be approximately 50 percent of the OM&R cost of the canal as constructed. The estimates are based on the following:

> Construction cost curves for Garrison Diversion Unit features with unused capacity were prepared by the Bureau of Reclamation in 1990 and are included in a report entitled "*Cost Estimates For Reduced Capacity Snake Creek Pumping Plant, McClusky Canal, Sykeston Canal, New Rockford Canal and James River Feeder Canal, Garrison Diversion Unit, May 1990*". It is estimated that the total cost to construct all reaches of the McClusky Canal at 587 cfs would be approximately 80 percent of the cost to construct the canal at 1950 cfs. The total cost to construct Reaches 1 and 2 of the New Rockford Canal at 172 cfs would be approximately 65 percent of the cost to construct the canal at 1600 cfs. The percentage is typically highest in reaches of canal with deep cut sections and lowest in balanced cut-fill sections of the canal. (Refer to APPENDIX "B" for the construction cost curves)

> Conveyance feature curves for estimated O&M costs per mile of various irrigation conveyance features was prepared by the Denver Office of the Bureau of Reclamation in 1984. The information is provided on the attached drawing "*Conveyance Feature Envelope Curves for Estimated O&M costs Per Mile, E&RC-D-430-03-84*". Projecting the curve for typical unlined or earth-lined Canals (less than ideal conditions) to 1950 cfs, it is estimated that the O&M cost of a 587 cfs canal is approximately 72 percent of the O&M cost of a 1950 cfs canal. The O&M cost of a typical 172 cfs canal is approximately 45 percent of the O&M cost of a typical 1600 cfs canal. (Refer to APPENDIX "C" for the drawing "*Conveyance Feature Envelope Curves for Estimated O&M costs Per Mile, E&RC-D-430-03-84*")

> Operational surveillance for a reduced capacity principal supply works canal would not be reduced significantly.

For Option No. 2, McClusky Canal (62-mile) and New Rockford Canal (42.6 mile) OM&R costs used in this estimate $789,800 ($16,980/mile x 0.75 = $12,740/mile) and $175,000 ($8,210/mile x 0.50 = $4,100/mile) respectively.

McClusky Canal Abandoned Reaches

For Options No. 1 and No. 3, abandoned reaches of the McClusky Canal downstream of the Missouri Coteau alignment Sykeston Pumping Plant (Mile 59 or 62) would be maintained at a minimum level. O&M activities would include noxious weed control within the right-of-way, fence maintenance, minimal road maintenance, erosion control under the bridges, etc. Assume OM&R cost per mile on the McClusky Canal abandoned reaches to be approximately $4,000/mile or $50,000 for the 12 plus miles. The $4,000/mile cost is about 50 percent of the OM&R cost per mile for desirable maintenance of the New Rockford Canal.

Fish and Wildlife Mitigation - McClusky and New Rockford Canals

Approximately 9,000 acres of fish and wildlife mitigation lands were required to mitigate for the impacts of constructing the existing McClusky Canal and New Rockford Canal. The wetland mitigation requirement is about 3,200 acres and the grassland/woodland mitigation requirement is about 5,800 acres. To meet the wetland mitigation requirement, a surplus of upland acres needed to be purchased/acquired. An average of three acres of uplands was acquired for each wetland acre. Therefore, about 12,800 acres of wildlife mitigation land was acquired to mitigate for construction of the McClusky and New Rockford Canals. Annual O&M costs (including overhead) for fish and wildlife mitigation lands are currently about $17.45 per acre. The current annual mitigation OM&R cost is estimated to be $223,360.

For Options No. 1 and No. 3, fish and wildlife mitigation acreage associated with the impacts of constructing the McClusky Canal and New Rockford Canal is similar to the existing mitigation requirement. Impacts associated with constructing the canal, including the McClusky Canal reach from about mile 62 through 73.6 which would be abandoned under Options No. 1 and No. 3, exist whether the canal is operated at full capacity, operated at a reduced capacity, or abandoned and not operated. The annual mitigation OM&R cost is estimated to be $223,360.

For Option No. 2, the wildlife mitigation requirement for the McClusky and New Rockford Canals would likely not be reduced significantly, except that no mitigation would be required for the lower reach of the existing McClusky Canal from mile 62 through 73.6 since it would not be constructed under Option No. 2. Most wetland loses were the result of a canal being constructed through them. A smaller canal on the same alignment would result in similar loses. The smaller right-of-way would reduce the upland mitigation requirement and may reduce some wetland acreage lost or adversely affected by construction within the existing canal right-of-way. The degree of this reduction cannot be determined without information on the reduced size of the right-of-way and possibly re-analyzing the GIS database. However, since the acquisition of mitigation land was largely based on the wetland mitigation requirements, reductions of upland impacts may not substantially reduce quantity of lands needed for mitigation or the OM&R costs associated with these lands. Comparing the mitigation requirement based on a per mile of constructed canal, the mitigation requirement for McClusky and New Rockford canals For Option No. 2 would be $201,060. ((62.0 + 42.6)/(73.6 + 42.6)x $223,360 = $201,060).

Fish and Wildlife Mitigation - Lake Audubon

A comprehensive mitigation plan is being completed by the Bureau of Reclamation, in cooperation with the Fish and Wildlife Service and the North Dakota Game and Fish Department, to document the mitigation for impacts to Audubon National Wildlife Refuge and the Audubon Wildlife Management Area associated with raising the operating level of Lake Audubon to meet GDU project demands. Preliminary estimates of the annual OM&R costs for this mitigation were developed in 1996. Annual OM&R in 1996 was estimated to be about $161,000 for Audubon National Wildlife Refuge and about $56,500 for Audubon Wildlife Management Area for a total annual OM&R cost of about

$217,500. These cost estimates are being refined based on actual construction costs of mitigation features and estimated requirements for staffing, equipment, and supplies.

For Options No. 1 and No. 3, it is expected that the annual mitigation OM&R would be similar to the 1996 estimate of $217,500 indexed to 1999 costs of about $230,000. Lowering the operating level of Lake Audubon is not feasible being the McClusky Canal beachbelting zone is constructed for a specific canal operating level range.

For Option No. 2, the operating level of Lake Audubon could likely be lowered approximately two feet due to a reduced flow capacity of the McClusky Canal. This would presumably result in decreased impacts, although additional analyses, including estimates of ultimate erosion, would be necessary to accurately quantify the impacts and required mitigation at a lower lake operating level. Assuming mitigation requirements were reduced by 20 percent, estimated annual OM&R for Lake Audubon mitigation would be about $184,000.

Supervisory Control and Data Acquisition (SCADA) System

A computer-based supervisory control and data acquisition (SCADA) system will be required to monitor and control the complete principal supply works system from the Snake Creek Pumping Plant through the MR&I outlet into the Sheyenne River. The major components of the SCADA system will likely be a master station, supervisory control unit, remote terminal units (RTU), programmable logic controller (PLC), data collection equipment, and a communication system. The communication system would transmit data between the PLC, RTU and the master station. The communication system would be some combination of radio, microwave, and metallic or fiber optic cables.

SCADA system construction costs and OM&R costs were provided in the *"Cost Comparison Analysis - Garrison Diversion Unit - Bureau of Reclamation - March 1997"* study report, which compared costs of alternative conveyance systems to supply Missouri River water to the Fargo, North Dakota/Red River Area. The estimated cost, at 1997 prices, to construct a monitoring and telemetry system for the proposed "Connecting Link" features (Sykeston and Sheyenne River pumping plants, pipelines, and water treatment) system was $1,500,000. Annual OM&R was estimated to be $178,100. The estimate did not include a redundant communication system to ensure backup communication capability in case of primary system failure. Replacements were based on a 10-year life for monitoring and telemetry equipment and a capital repayment (loan repayment) at 3 1/4 percent interest. Indexing to 1999 costs, the annual replacement cost is $189,000.

Approximately eleven (11) monitoring stations, in addition to the monitoring stations utilized for the MR&I features, will be required at the Snake Creek Pumping Plant and at water control structures along the McClusky and New Rockford canals for monitoring the entire principal supply works system. At an estimated cost of about $34,000 per site, the cost to install the additional monitoring stations is $374,000. Again, using a 10-year life and a 3.25 percent interest rate, the annual replacement cost of SCADA equipment at the 11 monitoring stations is approximately $44,000.

Replacement costs can/could be reduced by at least 25 percent (based on a 10-year life and 3.25% interest rate) and by about 50 percent (based on a 10-year life and 7 percent interest rate) if replacement funds can be reserved/saved in advance instead of borrowing money and making capital repayments with interest.

As a comparison, the cost to furnish and install a SCADA system for the entire principal supply works system was estimated in 1987 to be $1,758,000. Annual replacement costs were estimated to be $236,000 using a 7 percent interest rate for capital repayment. The estimated service life of microwave and programmable master supervisory control equipment was 10 years and the estimated service life of buildings, towers, antennas, and miscellaneous equipment of a microwave system was 30 years.

The reduction in the estimated construction cost, considering inflation, is primarily due to technology advances in the computer industry. Comparing the proposed "Connecting Link" SCADA system cost to a SCADA system installed during 1998 in southeastern North Dakota, it may be possible to furnish and install a SCADA system for the entire principal supply works for the estimated costs included for the "Connecting Link" features.

For this report, annual SCADA system replacement costs for the entire principal supply works are estimated to be $233,000. The cost includes replacements, as provided in the *"Cost Comparison Analysis - Garrison Diversion Unit - Bureau of Reclamation - March 1997"* study report for the "Connecting Link" features indexed to a 1999 cost of $189,000 and the replacement cost of the required additional monitoring stations at the Snake Creek Pumping Plant and along the McClusky and New Rockford canals of approximately $44,000.

The estimates do not include a redundant communication system to ensure backup communication capability in case of primary system failure. As with the 1997 report, this scenario assumes operation and maintenance of the telemetry system will be conducted by supply works system operators and that O&M costs are included in the canal O&M cost.

SCADA system OM&R costs associated with the McClusky Canal/Sykeston Pipeline/New Rockford Canal/Sheyenne River Pipeline system are essentially the same for Options No. 1, No. 2, and No. 3.

Winter Operations For MR&I Releases

Winter operations of the principal supply works system from the Snake Creek Pumping Plant through the New Rockford Canal will be required to provide an MR&I release to the Sheyenne River throughout the year. Since flow velocities will be well under 2 feet per second, a smooth continuous ice cover will form in the canals, except at structures. However, potential ice accumulations would be a concern at drop structures and pumping plants. Flow through radial gate structures will be accomplished by fully opening the radial gate and installing stoplogs containing slide gates at the bottom to allow flow under the ice. Slide gates at drop structures would contain heat cables to prevent freezing or ice accumulations. Ice prevention systems consisting of air bubblers or small circulation pumps would be installed in the pumping plants.

These methods have successfully kept trashracks and pump intakes ice-free in similar plants.

The SCADA system would continue to monitor canal levels and structure operations in the winter. Heating of the telemetry control room and equipment would be required.

OM&R costs would be considerably higher if the full MR&I release down the McClusky and New Rockford Canals is absolutely required 365 days per year and the canals cannot be dewatered for maintenance. Diking of the canal section to be repaired and pumping MR&I flows around the diked-off section would then be required.

The Sykeston and Sheyenne River pumping plants will also have additional personnel and operation costs associated with winter operation. Winter operation costs of the pumping plants and pipelines are included in the OM&R costs of the features presented in the *"Garrison Diversion Unit - Cost Comparison Analysis - Bureau of Reclamation - March 1997"* report.

For Options No. 1 and No. 3, additional costs associated with winter operation of the McClusky and New Rockford canals are estimated to be approximately $52,000 based on the following:

Additional Surveillance (less labor)

➢ Vehicle Costs
Additional 2 routine inspections per week for 5 months = 40 inspections
300 miles per inspection x 40 inspections x $0.35/mile = $4,200

➢ All-Terrain Vehicle Costs
12 sites x 20 inspections/site = 240 inspections
240 inspections x 1 hr/inspection x $10.00/hr ATV cost = $2,400

Additional SCADA System Costs (less labor)

➢ Heating of SCADA Telemetry Control Room and Equipment
Assume 5 kw/site operating 75 percent of the time for 5 months.
5 kw x (5 mo. x 30 days/mo. x 24 hr/day) x).75 = 13,500 kwh/site
13,500 kwh/site x 12 sites x $0.07/kwh = $11,340/yr., Say $11,300

➢ Miscellaneous SCADA OM&R
Assume the service life of the RTU's and depth sensors decrease by 10 percent.
Implies the additional replacement cost is approximately $4,000/year.

Additional Erosion of the Canal Prism Due To Fluctuating Ice Levels

➢ Beachbelt/Membrane Lining Cover

Personnel Assume at least 0.5 additional staff-years annually	
0.5 staff-years @ $30,000/yr =	$15,000
Personnel benefits @ 27.5 percent =	$ 4,100
	$19,100

Equipment Use @ 32% of personnel =	6,100
Materials @ 22% of personnel =	4,200
	$29,400 Say $30,000

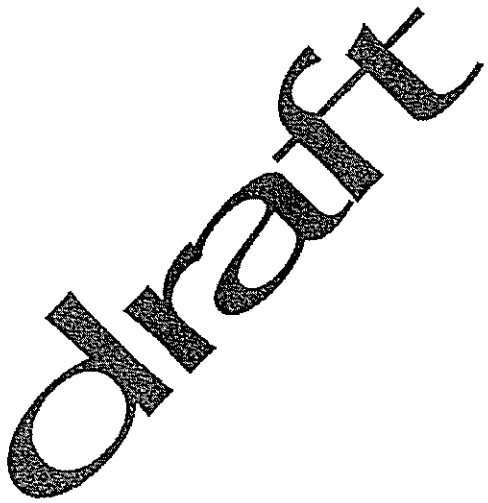
For Option No. 2, the additional costs associated with winter operation of the McClusky and New Rockford canals would be only slightly less than Option No. 1 and No. 3 being the McClusky Canal would be shorter by about 12 miles (mile 62 - 73.6). Use an additional cost of $46,000 based on miles of canal being monitored and maintained.

APPENDIX "A"

Snake Creek Pumping Plant Annual Operation and Maintenance Cost Estimate

For

Dakota Water Resources Act of 1997 OM&R cost allocations
based on used and unused capacity (3-2-99)



03-02-99 Draft

Snake Creek Pumping Plant Annual Operation & Maintenance

For Dakota Water Resources Act of 1997 OM&R cost allocations based on used and unused capacity .

OPTION 1: OM&R if the existing 2050 cfs pumping plant is operated to meet DWRA specific requirements.
OPTION 2: OM&R if the pumping plant were constructed at a capacity to meet DWRA specific requirements.
OPTION 3: OM&R if the existing 2050 cfs pumping plant is operated to meet DWRA MR&I requirements.
NOTE: Cells with blue figures and shading are the data input cells.

	Option 1	Option 2	Option 3
H design (ft))	75	75	75
Q (cfs) =	2,050	687	2,050
G (ac-ft/yr) =	156,040	154,280	118,690
T (wks/yr) =	52	52	52
Wo ($/hr) =	22.95	22.95	22.95
I =	5.61	5.61	5.61

A. OPERATION AND MAINTENANCE WITHOUT ENERGY AND LABOR (does not include the intake canal or conduit, discharge conduit, and substation costs)

The following pumping plant operation and maintenance costs are based on equations provided in "Pumping Plant Operation and Maintenance Costs - May, 1965 - United States Department of the Interior, Bureau of Reclamation".

Co = Operation cost ($)
Cm = Maintenance cost ($)
C1 = Labor cost ($)
C2 = Other costs, i.e. supplies, transportation, etc. ($)
W = Operator hourly wage rate ($)

T = Length of operating season (weeks)
H = design head (ft)
Q = Discharge (cfs)
G = Annual water pumped (acre-feet)
I = Price Level Ratio (Jan. 1999 = 5.61)
(Based on a 1962 price level of 1.00)

Note: The wage rate is based on an operator salary of $18.00/hr x 1.275 for benefits = $22.95/hr w/o administrative overhead.

Operation Costs
Attended plant 450 - 15,000 hp
(Average daily attendance of 16 hours or more)

Co = 7.0 x Q^.04 x H^.13 x T x I

Co1 = $4,856.15
Co2 = $4,648.37
Co3 = $4,856.15

Maintenance Costs
Plants up to 15000 hp

Cm =1.7 x Q^.11 x H^.41 x G^.43 x I
(without replacements)

Cm1 = $22,160.08
Cm2 = $19,553.53
Cm3 = $19,700.53

B. REPLACEMENTS / EXTRAORDINARY MAINTENANCE (Pumping plant, intake, discharge conduit, substation)

From "Replacements, Unit - Service Lives - Factors, USBR, August , 1981",, the composite sinking fund deposit factor for all major pumping plant accounts (except dams, reservoirs, and waterways) at 7% interest is approximately 0.001.

	Option 1	Option 2	Option 3
Pumping plant construction cost =	60,000,000	42,000,000	60,000,000

R = Construction cost x 0.001

Option 1: Replacements (R1) = $60,000.00
Option 2: Replacements (R2) = $42,000.00
Option 3: Replacements (R3) = $60,000.00

C. LABOR

	Option 1	Option 2	Option 3
Staff-Years =	2.0	1.5	2.0
Wo ($/hr) =	22.95	22.95	22.95

L = Staff-years x Wo x 2080
(without administrative overhead)

Option 1: Operator/Mechanic Salaries with Benefits (L1) = $95,472.00
Option 2: Operator/Mechanic Salaries with Benefits (L2) = $71,604.00
Option 3: Operator/Mechanic Salaries with Benefits (L3) = $95,472.00

D. MISCELLANEOUS (Yard maintenance, vehicle expenses, equipment, etc.)

Option 1	Option 2	Option 3
30,000	25,000	30,000

Option 1: Miscellaneous (Misc1) = $30,000.00
Option 2: Miscellaneous (Misc2) = $25,000.00
Option 3: Miscellaneous (Misc3) = $30,000.00

Snake Creek Pumping Plant Annual Operation & Maintenance (Cont.)

E. POWER

Using 4.0 mils/kw-hr currently paid by the Bureau of Reclamation for Pick-Sloan Missouri Basin irrigation power.

Option 1

Q (cfs) =	2,050	HP(max) =	21,839		
Havg (ft) =	20	KW (max) =	16,265		
Hmax (ft) =	75	KW (avg) =	4,337		
G (ac-ft/yr) =	156,040	Kwh/yr =	3,994,624		
Eff =	0.8				
Power Rate	0.004			Option 1: Pumping Power Cost =	$15,978.50
				Option 1: Station Service Power Cost =	$5,000.00

Option 2

Q (cfs) =	687	HP(max) =	7,319		
Havg (ft) =	20	KW (max) =	5,451		
Hmax (ft) =	75	KW (avg) =	1,454		
G (ac-ft/yr) =	154,280	Kwh/yr =	3,949,568		
Eff =	0.8				
Power Rate	0.004			Option 2: Pumping Power Cost =	$15,798.27
				Option 2: Station Service Power Cost =	$4,000.00

Option 3

Q (cfs) =	2,050	HP(max) =	21,839		
Havg (ft) =	20	KW (max) =	16,265		
Hmax (ft) =	75	KW (avg) =	4,337		
G (ac-ft/yr) =	118,690	Kwh/yr =	3,038,464		
Eff =	0.8				
Power Rate	0.004			Option 3: Pumping Power Cost =	$12,153.86
				Option 3: Station Service Power Cost =	$5,000.00

TOTAL SCPP OM&R

	Option 1	Option 2	Option 3
SCPP OM&R (LESS POWER) =	$212,488	$162,806	$210,029
POWER =	$20,978	$19,798	$17,154
TOTAL SCPP OM&R =	$233,467	$182,604	$227,183

L:\123\GDU-OM&R\DWRA-97\SCPPOM&R.WK4

APPENDIX "B"

Portions of

"Cost Estimates For Reduced Capacity Snake Creek Pumping Plant, McClusky Canal, Sykeston Canal, New Rockford Canal and James River Feeder Canal - Garrison Diversion Unit - Pick Sloan Missouri Basin Program"

Prepared by Bureau of Reclamation - May 1990

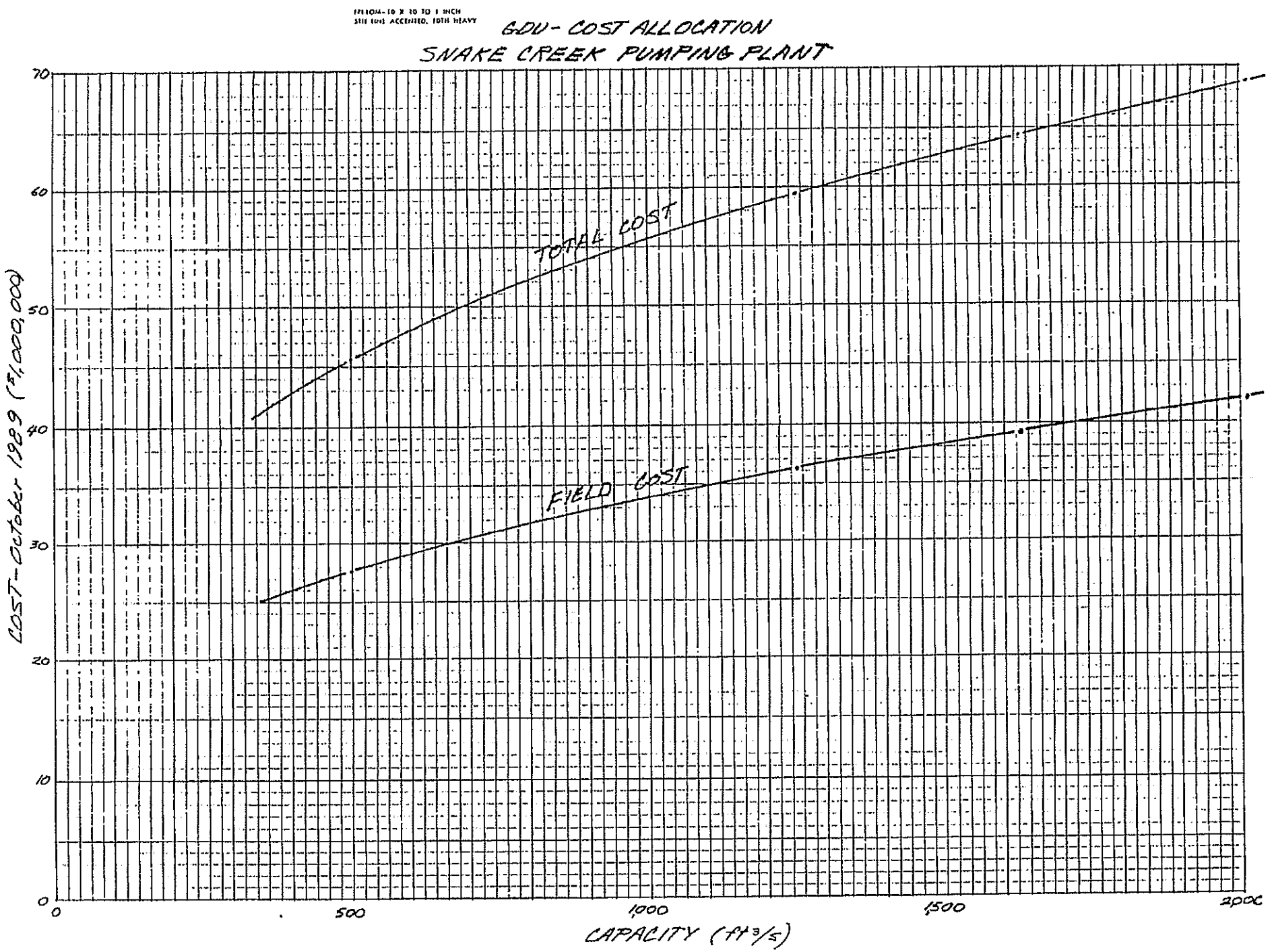

GDU - COST ALLOCATION
SNAKE CREEK PUMPING PLANT
TOTAL COST
FIELD COST
COST - October 1989 ($1,000,000)
CAPACITY (ft³/s)
0
10
20
30
40
50
60
70
0
500
1,000
1,500
2,000

figure 1

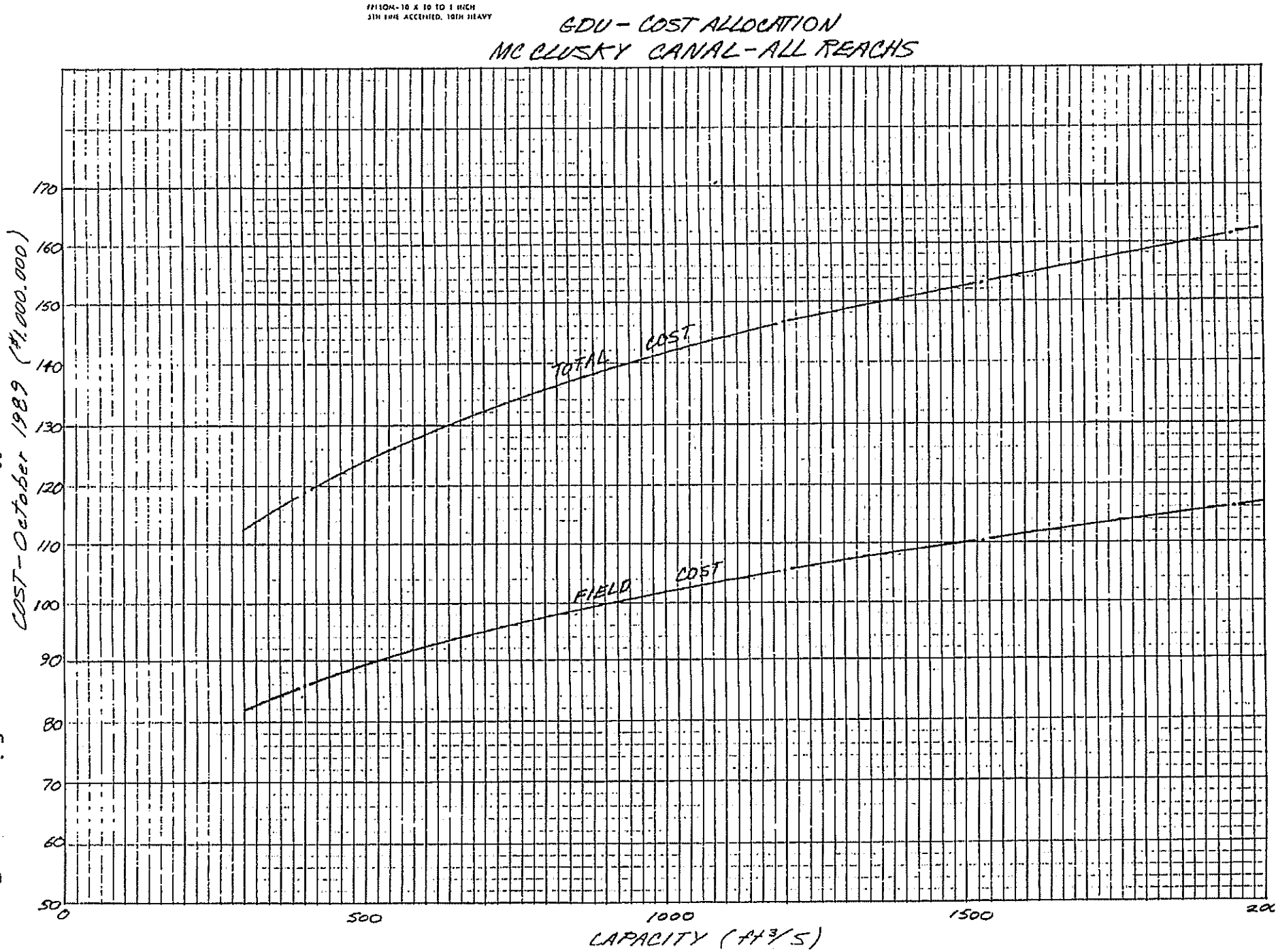

GDU - COST ALLOCATION
MC CLUSKY CANAL - ALL REACHS
TOTAL COST
FIELD COST
COST - October 1989 ($1,000,000)
CAPACITY (M3/S)
170
160
150
140
130
120
110
100
90
80
70
60
50
0
500
1000
1500
2000

figure 2

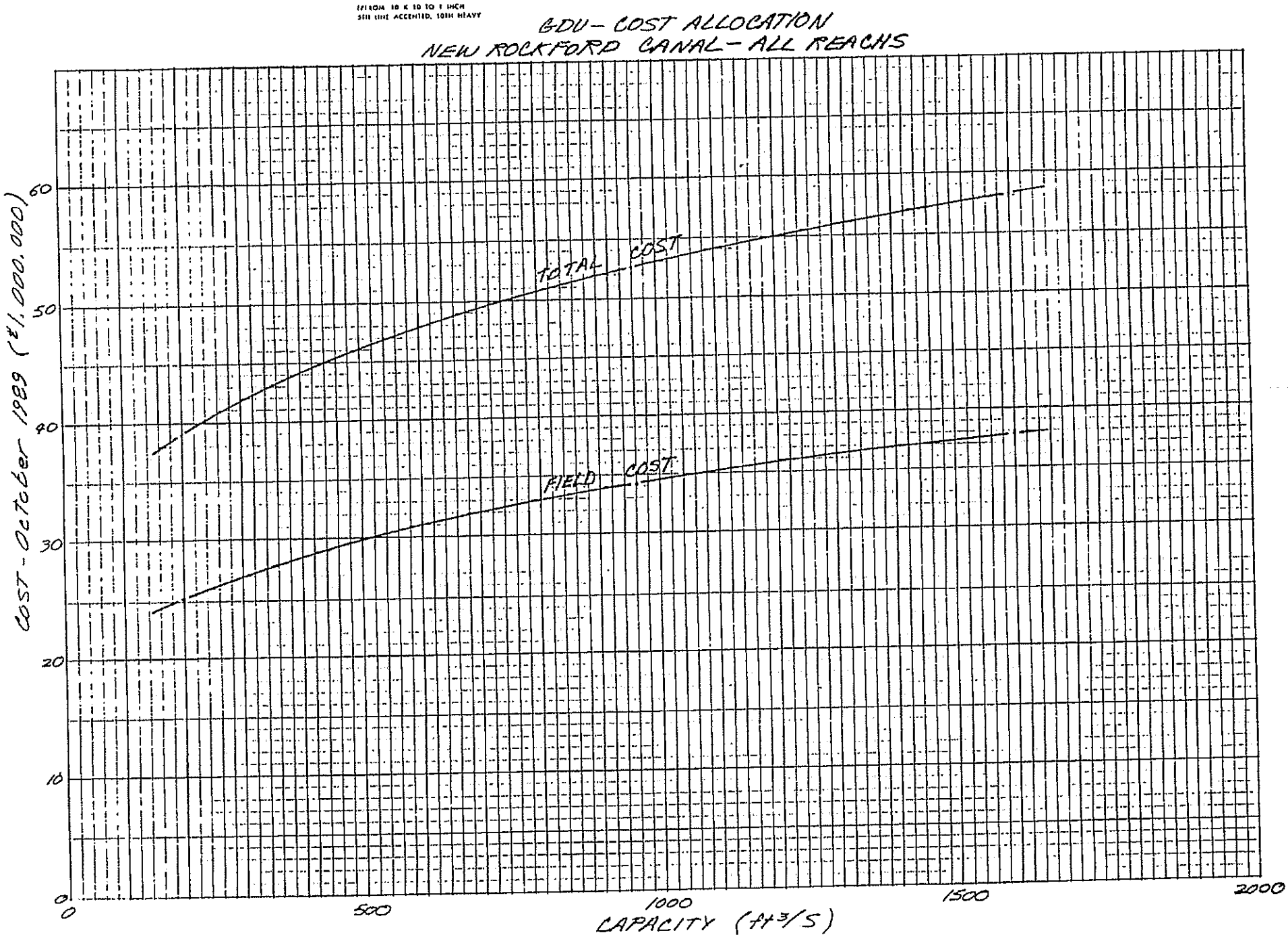

GDU - COST ALLOCATION
NEW ROCKFORD CANAL - ALL REACHS
TOTAL COST
FIELD COST
COST - October 1989 ($1,000,000)
CAPACITY (ft^3/s)
0
10
20
30
40
50
60
500
1000
1500
2000

figure 4

APPENDIX "C"

Drawing

"Conveyance Feature Envelope Curves for Estimated O&M Costs Per Mile, E&RC-D-430-03-84"

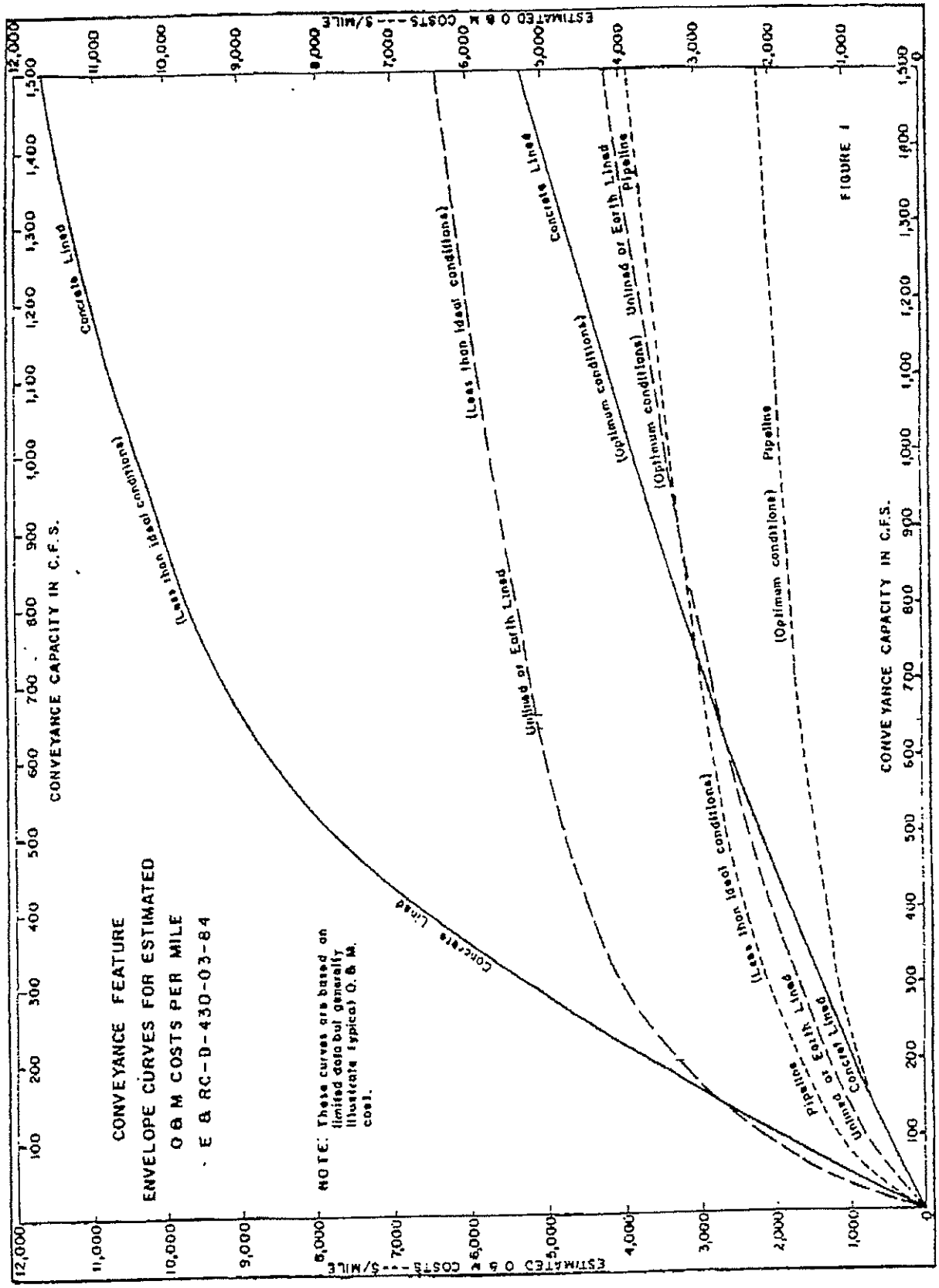

CONVEYANCE FEATURE
ENVELOPE CURVES FOR ESTIMATED
O & M COSTS PER MILE
E & RC-D-430-03-84
NOTE: These curves are based on limited data but generally illustrate typical O. & M. cost.
CONVEYANCE CAPACITY IN C.F.S.
ESTIMATED O & M COSTS - $/MILE
Concrete Lined
(Less than ideal conditions)
Unlined or Earth Lined
(Optimum conditions)
Pipeline
FIGURE 1

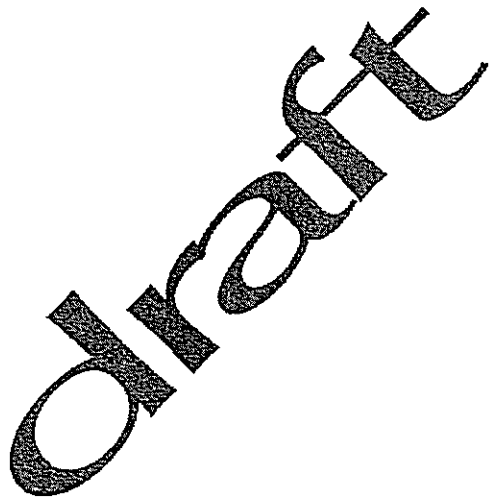
FIGURE 1

APPENDIX "D"

"Connecting Link" and "Bismarck-Fargo, ND" OM&R Analysis

portions of

"Garrison Diversion Unit - Cost Comparison Analysis
Bureau of Reclamation - March 1997"



BUREAU OF RECLAMATION
DAKOTAS AREA OFFICE
ENGINEERING & CONSTRUCTION DIVISION

COST COMPARISON
GARRISON DIVERSION UNIT

March 1997

GDU OM&R Analysis

Reconnaissance Level Cost Comparison Estimate 4/01/97

SHEET 1 OF 1

FEATURE	OFFICE	DAKOTAS AREA OFFICE				
Alternative 1: 100cfs pipeline from Bismarck to Fargo, ND.	DIVISION	GARRISON DIVISION				
	UNIT	GARRISON DIVERSION				

ITEM	DESCRIPTION	LIFE	OPERATION	MAINTENANCE	POWER	ANNUAL REPLACEMENT	TOTAL ANNUAL OM&R COST
1	Mobilization and preparatory work (5% of unit costs)						
2	Furnish and Install 60" concrete lined steel pipe - including earthwo	50+	Covered in Pump Plant O&M	Covered in Pump Plant O&M	N/A	$121,468.86	$121,468.86
	ROW, Field, and Indirect Costs.						
3	Intake & Main Pumping Plant (Head = 462')	35-50	$5,720.00	$339,195.00	$1,683,600.00	$180,964.72	$2,209,479.72
4	Booster Station #1 (Head = 397')	35-50	$5,375.00	$161,915.00	$1,446,700.00	$99,707.77	$1,713,697.77
5	Booster Station #2 (Head = 88')	35-50	$2,895.00	$111,100.00	$320,700.00	$44,416.39	$479,111.39
6	Blowoff Assemblies (EST. 2/mi.)	50+	$0.00	$0.00	N/A	$0.00	$0.00
7	Air Vacuum/Pressure Relief Valves (2/mi)	50+	$0.00	$0.00	N/A	$0.00	$0.00
8	Surge Protection Chambers (1/pump plant or booster station)	50+	$0.00	$0.00	N/A	$0.00	$0.00
9	Jacking 66"x 75' Casing	N/A	$0.00	$0.00	N/A	$0.00	$0.00
10	Overhead Electrical supply to each pump/booster station & WTP	45	$0.00	$0.00	N/A	$102,242.64	$102,242.64
	(EST. 20mi/per location)						
11	Cathodic Protection	20				$326,837.33	$326,837.33
12	Monitoring and Telemetry System	10-15	10yr on Central Processors and Man-Machine Interface - 15yr on RTU's			$178,096.65	$178,096.65
13	Water Treatment Plant (ozinization only) -ND SWC, 100 cfs		$20,050.00	$107,600.00	$151,959.00	$255,786.28	$535,395.28
	SUBTOTAL						$5,666,329.64
	Unlisted items 20% +/-						$1,133,265.93
TOTAL ESTIMATE							Rounded $6,800,000.00

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GDU OM&R Analysis

Reconnaissance Level Cost Comparison Estimate 4/01/97

SHEET 1 OF 1

FEATURE	OFFICE DAKOTAS AREA OFFICE					
Alternative 4: Connecting Link	DIVISIOGARRISON DIVISION					
	UNIT GARRISON DIVERSION					
ITEM	DESCRIPTION	LIFE-	OPERATION	MAINTENANCE	POWER	ANNUAL REPLACEMENT	TOTAL ANNUAL OM&R COST
1	Mobilization and preparatory work (5% of unit costs)						
2a	Furnish and Install 60" concrete lined steel pipe - including earthwor	50+	Covered in Pump Plant O&M	Covered in Pump Plant O&M	N/A	$7,423.10	$7,423.10
	ROW, Field, and Indirect Costs.						
2b	72"	50+	Covered in Pump Plant O&M	Covered in Pump Plant O&M	N/A	$35,100.66	$35,100.66
3a	Intake & Main Pumping Plant (Head = 50') @125cfs	35-50	$2,595.00	$97,540.00	$227,800.00	$114,737.26	$442,672.26
3b	Intake & Main Pumping Plant (Head = 462') @ 175cfs	35-50	$7,740.00	$172,940.00	$2,946,300.00	$251,713.25	$3,378,693.25
4	Blowoff Assemblies (EST. 2/mi.)	50+	$0.00	$0.00	N/A	$0.00	$0.00
5	Air Vacuum/Pressure Relief Valves (2/mi)	50+	$0.00	$0.00	N/A	$0.00	$0.00
6	Surge Protection Chambers (1/pump plant or booster station)	50+	$0.00	$0.00	N/A	$0.00	$0.00
7	Jacking 66"x 75' Casing	N/A	$0.00	$0.00	N/A	$0.00	$0.00
8	Overhead Electrical supply to each pump/booster station & WTP	45	$0.00	$0.00	N/A	$68,161.76	$68,161.76
	(EST. 20mi/per location)						
9	Cathodic Protection	20				$83,525.10	$83,525.10
10	Monitoring and Telemetry System	10-15	10yr on Central Processors and	Man-Machine Interface - 15yr	on RTUs	$178,096.65	$178,096.65
11	Water Treatment Plant (ozinization only) -ND SWC, 125 cfs		$24,400.00	$131,000.00	$189,350.00	$106,855.94	$451,605.94
	SUBTOTAL						$4,645,278.72
	Unlisted items 20%						$929,055.74
TOTAL ESTIMATE							Rounded $5,574,000.00

filename: e-fcost.wk4

APPENDIX "E"

Southwest Pipeline Project Water Costs

SOUTHWEST PIPELINE PROJECT (SWPP) WATER COSTS

The information below was received from Jeffrey Mattern of the North Dakota State Water Commission on Thursday February 10, 1999 regarding SWPP expenses charged to water consumers per 1000 gallons of treated water.

Rate charged to **Contract Users** such as cities and towns, per 1000 gallons.

capital repayment	$0.79
transmission REM	$0.35
O&M	$0.88
treatment	$0.56
transmission reserve	$0.05
TOTAL	$2.63

Rate charge to **Rural Users** (per thousand gallons)

transmission REM	$0.35
transmission O&M	$0.88
treatment	$0.56
transmission reserve	$0.05
distribution REM	$0.10
distribution reserve	$0.10
distribution O&M	$1.01
Total	$3.05

Rural Monthly Minimum

capital repayment	$23.96
distribution O&M	$0.04
2000 gallons	$6.10
meter fee	$5.00
TOTAL	$35.10

Note:
REM means Replacement Extraordinary Maintenance.