PARLBY CREEK - BUFFALO LAKE DEVELOPMENT PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT
VOLUME ONE - SUMMARY REPORT

ENVIRONMENTAL MANAGEMENT ASSOCIATES

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p. 30 rare plants lack of info

p. 32 # of cottages

p. 42 costs of mitigation

p. 43 cost benefits

PARLBY CREEK - BUFFALO LAKE DEVELOPMENT PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT VOLUME ONE - SUMMARY REPORT

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245-1623

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FOREWORD

The Government of Alberta decided in mid August 1989 that an Environmental Impact Assessment (EIA) would be undertaken for the proposed stabilization of water levels in Buffalo Lake. Environment Minister, the Honourable Ralph Klein, announced on November 7th, 1989 that Environmental Management Associates of Calgary had been appointed to conduct the EIA on the lake stabilization component of the Parlby Creek - Buffalo Lake Development Project.

This report is a summary of the EIA of the proposed stabilization of Buffalo Lake. The main document describes the proposed project, the existing environmental and socio-economic conditions, outlines the public involvement program, assesses the impacts of the project, notes data deficiencies and provides conclusions and recommendations. The EIA is based on the data provided by the client; no additional environmental field studies were completed as the existing data were considered sufficient for the purposes of the assessment.

This Environmental Impact Assessment was completed under the direction of Environmental Management Associates with the assistance of a broad cross-section of specialists. The significant input of Alberta Environment staff is acknowledged. The efforts of the general public who provided comments, attended the open house and discussed the project at length with the authors is also acknowledged.

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1.0 INTRODUCTION

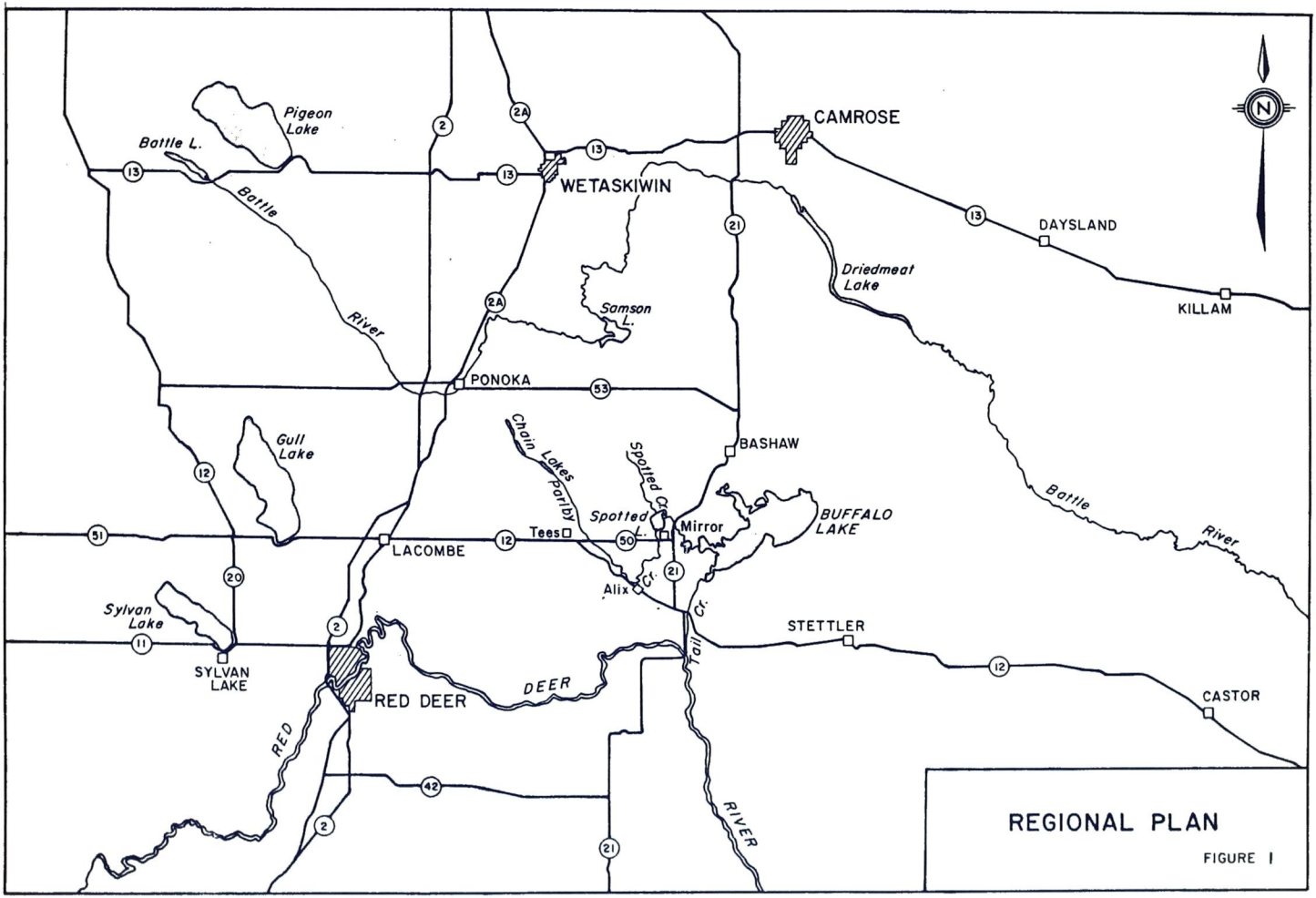
Buffalo Lake is a large, shallow, moderately saline lake located in south-central Alberta, approximately 20 km northwest of Stettler (Figure 1). In November of 1989, Alberta Environment commissioned an independent Environmental Impact Assessment (EIA) on the proposed stabilization of Buffalo Lake, that is, Phase V of the Parlby Creek - Buffalo Lake Development Project. The proposal is to raise the current water level and maintain a higher water level in Buffalo Lake (Figure 2).

The EIA process was initiated by the Water Resources Management Service of Alberta Environment through the preparation of an EIA draft Terms of Reference. These specifications were reviewed for comprehensiveness by the public, the impact assessment consultants and the Environmental Assessment Division of Alberta Environment, and finalized. Subsequently a draft EIA was prepared based on existing data as they were considered sufficient for the purposes of the assessment. The public was invited to review the draft EIA document at an open house in the Buffalo Lake area (Erskine) on 10 March 1990. Comments and suggestions collected during the draft EIA review phase and the public open house were incorporated into the revised version of the EIA for the stabilization of Buffalo Lake.

The EIA, dated 21 November 1990, was submitted to the Environmental Assessment Division of Alberta Environment for an interdepartmental review of the comprehensiveness of the document. The interdepartmental review identified areas where additional information was required. The impact assessment consultants provided responses to the additional information requirements. These responses were also reviewed. Subsequently the EIA was revised to reflect comments raised during the interdepartmental review. The EIA report was then considered to be suitable for review at public hearings.

The final EIA consists of three volumes. Volume One is the summary. Volume Two is the main body of the EIA and reflects comments provided by the public on a draft version and the comments raised during the interdepartmental review. Volume Three contains

the technical appendices related to the water balance, water quality and public consultation components of the EIA.


Pigeon Lake
Battle L.
Battle River
WETASKIWIN
CAMROSE
DAYSLAND
KILLAM
Driedmeat Lake
Samson L.
PONOKA
Gull Lake
Chain Lakes Parlby
Spotted Cr.
BASHAW
Spotted
Mirror
BUFFALO LAKE
Tees
LACOMBE
Alix
Tail Cr.
STETTLER
Sylvan Lake
SYLVAN LAKE
RED DEER
DEER
RED
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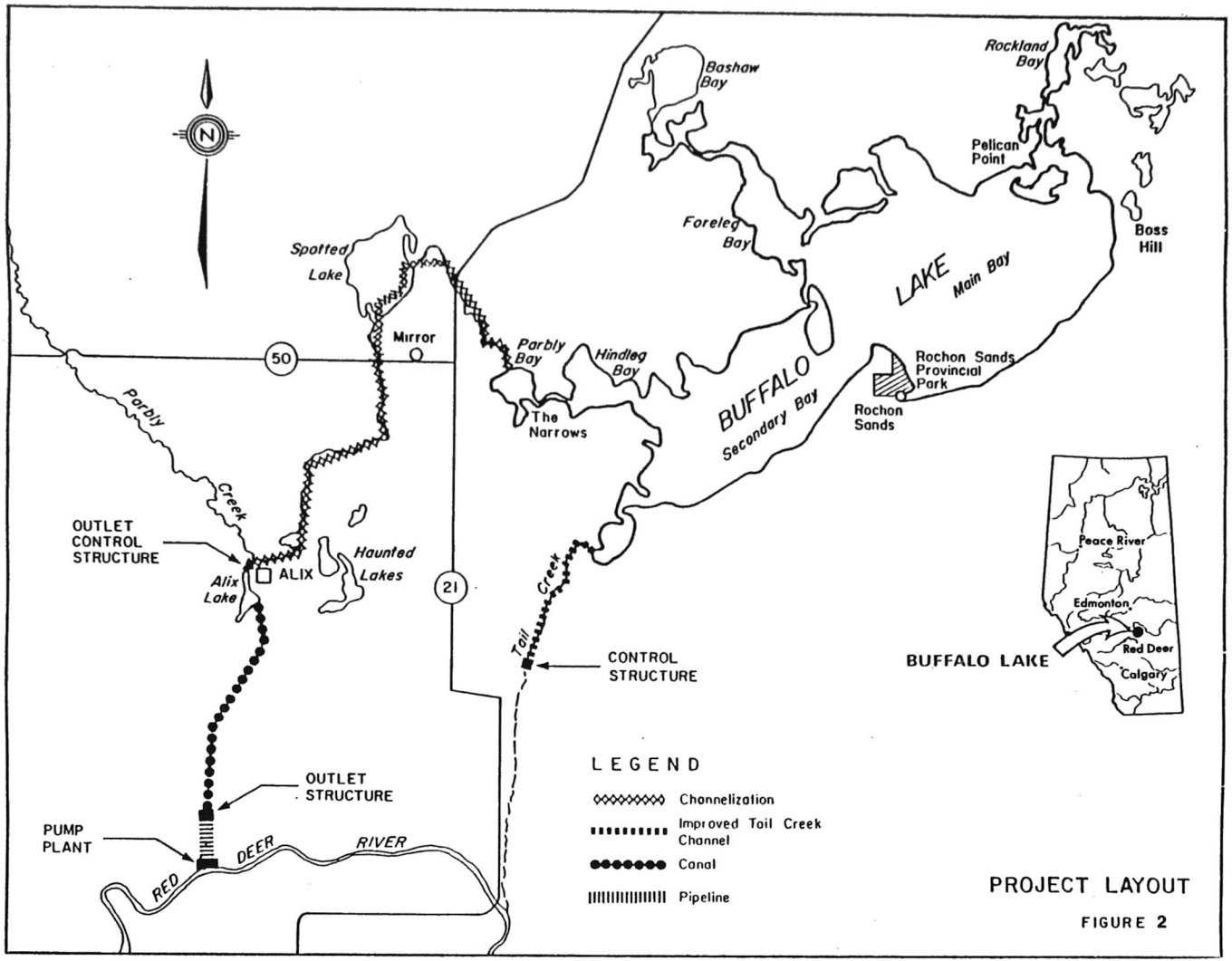
N
REGIONAL PLAN
FIGURE 1



PROJECT LAYOUT

FIGURE 2

2.0 PROJECT DESCRIPTION

The Parlby Creek - Buffalo Lake Development Project is an ongoing water management project started in 1985. Project objectives include agricultural flood control, fish and wildlife habitat enhancement, municipal water supply and stabilization of water levels in Buffalo Lake for recreational purposes.

Buffalo Lake is a large, shallow, moderately saline lake located in south-central Alberta, approximately 20 km northwest of Stettler (Figure 1). The lake provides significant fish and wildlife habitat and significant recreational opportunities for local residents as well as residents of Calgary and Edmonton. Over time, fluctuations in the lake level have reduced the recreational attractiveness of this waterbody, and have hampered efforts for orderly development of the shoreline.

In response to requests by local residents and recreational users of the lake, Alberta Environment initiated studies in 1978 to assess the feasibility of stabilizing lake levels. Members of the public participated in these discussions and helped to determine a desirable lake level for Buffalo Lake. In 1982, an increase in aquatic plant growth in sections of the lake was predicted, because of an increase in nutrients and decrease in salinity following stabilization, and identified as a potential adverse impact of the proposed project. Completion, in 1984, of the feasibility study led to the conclusion that stabilization of the Buffalo Lake water level would be feasible through the diversion of Red Deer River water via Parlby Creek. However, as a result of other water management commitments and priorities, a decision was made that the stabilization of Buffalo Lake should not proceed at that time.

Recently, renewed public interest in the stabilization of Buffalo Lake has stimulated a re-examination of previous study results and an evaluation of information collected since 1984. After evaluating previous studies and new information in 1989, Alberta Environment concluded that a slight increase in algal biomass would likely result from the proposed lake

stabilization. However, this increased biomass would be comparable to that found in other recreational lakes in Alberta.

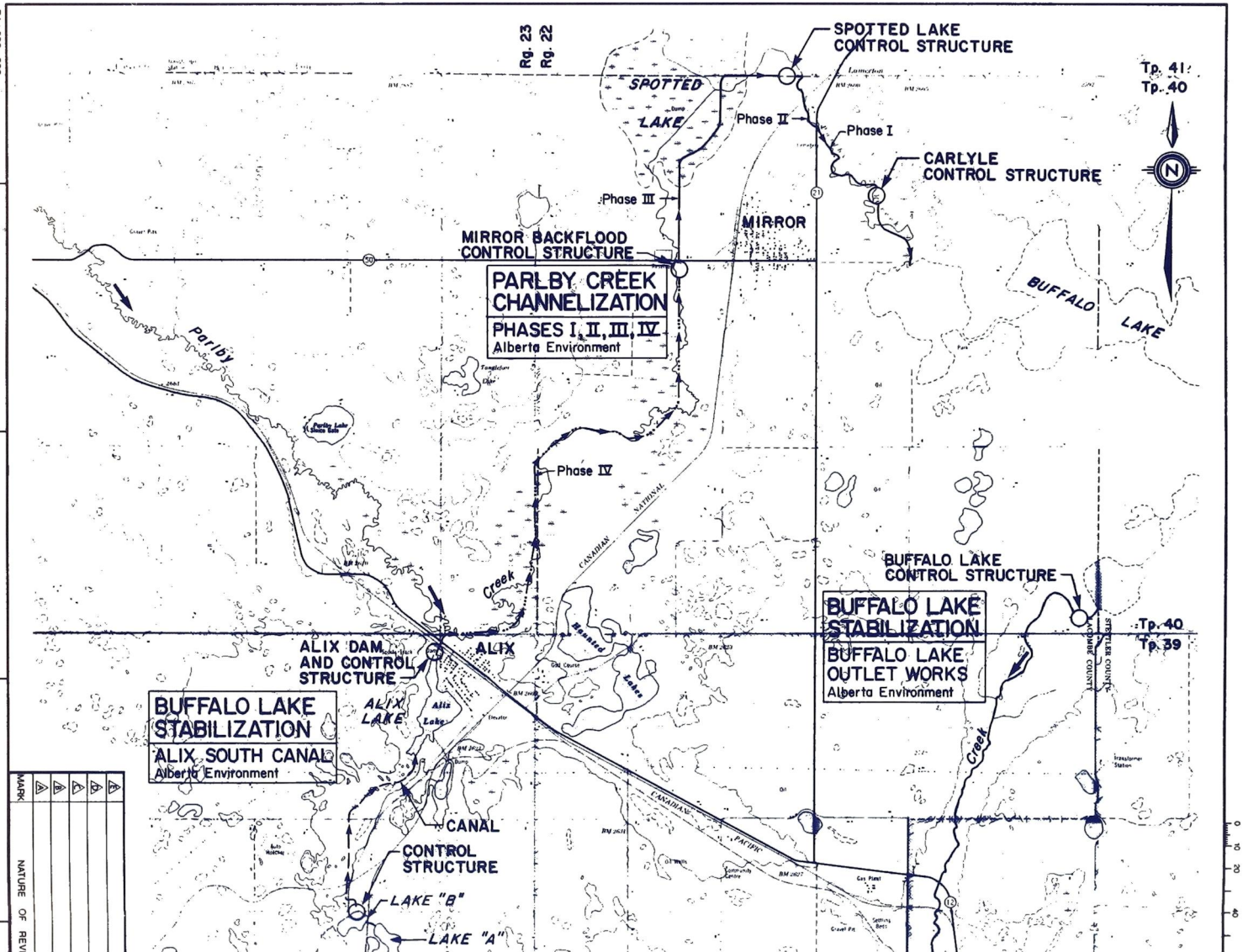
The proposed lake stabilization component of the Parlby Creek - Buffalo Lake Development Project involves raising the current level of the lake and maintaining levels between minimum and maximum elevations of 780.5 and 781.0 m, respectively[1]. The maximum level of 781.0 m is below the natural lake levels that occurred in 1974 and 1975. Water would be pumped from the Red Deer River through a pipeline and canal system to Alix Lake (see Figures 2 & 3). From Alix Lake, diverted water would follow an improved Parlby Creek channel to Buffalo Lake. The maximum pumping rate would be 2.1 m^3/s, occurring during the ice-free months from May to October.

2.1 PARLBY CREEK - BUFFALO LAKE DEVELOPMENT PROJECT WORKS

The Parlby Creek - Buffalo Lake Development Project consists of three main parts: the diversion system from the Red Deer River to Parlby Creek, near the Village of Alix; the channelization of Parlby Creek; and, the lake outlet works on Tail Creek.

The diversion system from the Red Deer River to Parlby Creek is estimated to cost $9.3 million. The major features of this system are illustrated in Figures 2 & 3 and include:

[1]In January 1990, it was determined that due to an error in the elevation of the Water Survey of Canada (WSC) datum, an elevation of 781.0 m is actually 781.17 m. In the EIA, the engineering specifications have been corrected for this 17 cm discrepancy. However, when referring to Buffalo Lake elevations, the old datum has been employed due to its extensive historical use and public familiarity with these elevations.



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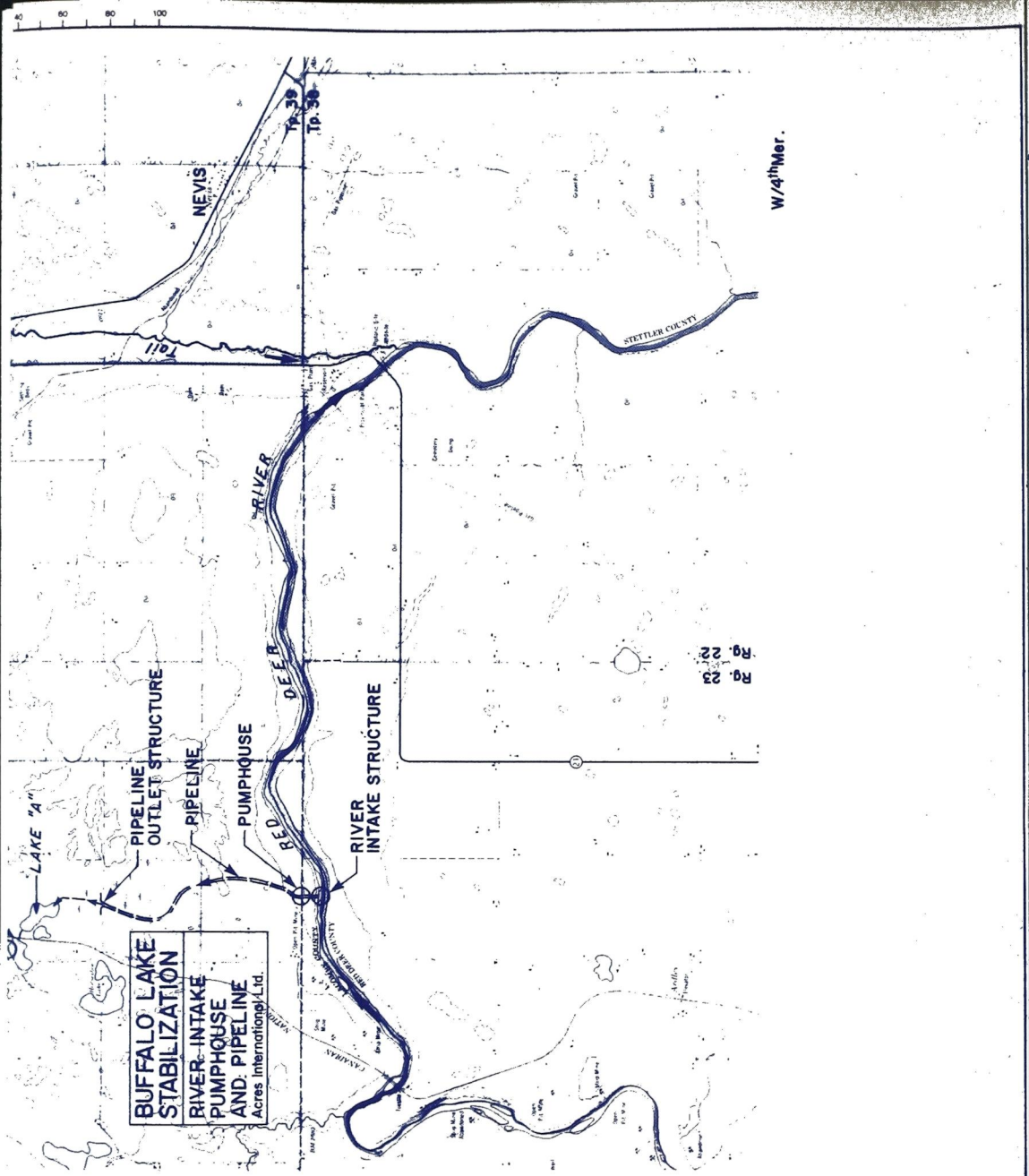


OF	REVISION	DATE	ENG.	DWN.	

Alberta ENVIRONMENT — DEVELOPMENT AND OPERATIONS DIVISION

SUBMITTED	DESIGNED
DATE	CHECKED
APPROVED	DRAWN C. Ewart
DATE	CHECKED

PARLBY CREEK - BUFFALO LAKE DEVELOPMENT

LOCATION PLAN

SCALE 1:40000	FIGURE 3
DATE FEBUARY, 1990	DWG No. PCBLD-E90-23

- a submerged, wedge-shaped intake structure in the Red Deer River;

- a small river training rockfill weir across the south channel of the Red Deer River to prevent channel shifting;

- a pumphouse located on the north bank of the river with a stilling chamber and sediment trap, a travelling screen and a pump wet well to accommodate two electric drive pumps;

- a 25 kV transmission line to the pumphouse provided by TransAlta Utilities;

- a 0.5 km extension and upgrading of an existing gravel access road which services an existing oil well;

- 1.64 km of 900 mm diameter concrete pressure pipeline to the top of the Red Deer River valley wall and 2.5 km of 900 mm diameter high density polyethylene pipe to an outlet structure stilling basin. A summer-only access road along the portion of the pipeline located in pasture land would be provided;

- approximately 4.5 km of open channel connecting lakes "A", "B" and Alix Lake as shown in Figure 3;

- a gated control structure on the outlet of Lake "B" to maintain lake levels in lakes "A" and "B";

- replacement of the Alix Lake outlet structure with a self-regulating upstream control gate and an emergency overflow weir; and,

- modifications to increase the capacity of the Alix Lake outlet channel and a road crossing located between the CP railroad and Alix Lake.

The channelization of Parlby Creek is being implemented independent of the proposed stabilization of Buffalo Lake and its purpose is to:

- minimize the effects of summer flooding on agricultural lands along the creek;

- provide backflooding of haylands in the flood-prone flats at the Carlyle property, Spotted Lake and upstream of the Village of Mirror; and,

- to improve northern pike spawning habitat along Parlby Creek.

With the improved capacity, Parlby Creek can adequately convey pumped water to stabilize Buffalo Lake.

Implementation of the Parlby Creek Channelization component of the Project by Alberta Environment started in 1985. Design and construction of the works from Buffalo Lake to the Village of Alix have proceeded in a phased manner. To date, Phases I, II and III have been completed at a cost of approximately $2.5 million. Construction on Phase IV was initiated in 1990 and will cost $1.5 million. The major features of this system are as follows (Figure 3):

- Phase I, completed in 1987, consisting of 3.8 km of channelization from Buffalo Lake to Highway No. 21;

- Phase II, completed in 1987, consisting of 1.9 km of channelization from Highway No. 21 to Spotted Lake;

- Phase III, completed in 1988, consisting of 4.1 km of channelization through Spotted Lake to Highway No. 50 near Mirror;

- Phase IV consists of channelization from Highway No. 50 to the Village of Alix, construction of a backflood structure and dyke near Mirror and construction of a wildlife conservation wetland.

The proposed Buffalo Lake outlet works on Tail Creek (Figure 3) are estimated to cost $2.0 million and would consist of:

- a reinforced concrete stoplog-type outlet control structure which would allow levels to rise to a maximum elevation of 781.0 m (WSC pre-January, 1990 datum);

- a mild sloping conveyance channel, up to 2.1 km long, located upstream of the proposed outlet control structure;

- channelization works, for up to 3.5 km downstream of the outlet control structure, designed to convey the 1:100 year return period flood without excessive erosion;

- erosion protection works on the lower 2.5 km of Tail Creek where it cuts into the river valley and joins the Red Deer River; and,

- protection works and/or increased conveyance capacity at culvert crossings to accommodate the discharge outflow of Buffalo Lake and natural runoff to Tail Creek.

The total estimated cost for construction of Phase V - the lake stabilization component of the Project - amounts to $11.3 million. A total of $2.5 million has been expended to date on Phases I through III and an additional $1.5 million will be expended on Phase IV of the Project.

2.2 CONSTRUCTION PROGRAM

A tentative phased implementation plan and schedule allows for construction to start in 1991. The earliest date for commissioning of the diversion system would be in the spring

of 1993. Engineering personnel for the final design and supervisory/inspection are estimated at 50 person-months.

Phase IV construction on Parlby Creek channelization is scheduled for the summer and fall seasons over a two year period. Phase IV construction started in 1990 and will continue through 1991 possibly to 1993. An estimated 115 person-months of effort are required for construction, in addition to approximately 24 person-months for engineering, supervision and inspection personnel.

Construction of the Buffalo Lake outlet structure and the channel improvement works on Tail Creek is tentatively scheduled over a 7.5 month period in 1992. Estimated labour requirements for these works are about 90 person-months plus 20 person-months for engineering and inspection.

2.3 OPERATIONS PLAN

The project owner and operator would be Development and Operations Division of Alberta Environment. Operations advice on the existing Parlby Creek channelization works is currently provided by the Spotted Lake Advisory Committee. Committee members are made up of representatives from the public, Alberta Forestry, Lands and Wildlife, Alberta Agriculture and Alberta Environment.

Operating guidelines for the Buffalo Lake Stabilization component were developed with the recognition that Parlby Creek license priorities would dictate water use for the three backflood operations involved. The Carlyle backflood would have priority up to the limit of its license, followed by Spotted Lake and finally Mirror.

The proposed guidelines assume that water pumped during backflooding would find its way to Buffalo Lake, and no special procedures would be taken to pass the water through the backflood operations. Operating guidelines for the three backflood control structures are

summarized in Tables 1 and 2 for the initial filling period and for long-term conditions, respectively.

Operations for the three project control structures are essentially fixed. These may be summarized as follows:

- Lake "B" Outlet Control - gated control structure to safely pass flows and maintain lake "A" and "B" levels;

- Alix Lake Outlet - self regulating upstream control to maintain level at elevation 790.35 m with an emergency overflow for flood events; and,

- Buffalo Lake Outlet - fixed crest with provision for stoplogs to elevation 781.0 m (WSC pre-January 1990 datum). Depending upon specific flood events, stoplogs may be lowered or raised to reduce upstream or downstream flood impacts.

TABLE 1

Proposed Fill Period Operating Guidelines
(Pumping to be Over Full Summer to Raise Buffalo Lake to Target PSL)

PERIOD	OPERATIONS	MIRROR BACKFLOOD	SPOTTED LAKE BACKFLOOD	CARLYLE BACKFLOOD	REMARKS
Winter - March 15 **ALL CASES**	No Pumping	All bays open	All bays open	All bays open	Normal winter configuration. River forecast centre predicts runoff volume in preparation for operation.
March 15 - May 1 **CASE 1**	May 1 start pumping 2.12 m^3/s from Red Deer River.	All bays open. Pass all flow. Fish ladder closed.	All bays closed. Pass base flow sufficient to supply Carlyle backflood. Fish ladder closed.	All bays closed. Fish ladder closed.	Gates closed dependent on time of runoff. Filling of backflood zones to the height that the available water will go. All fish ladders closed as not sufficient water to operate. Pumping stopped whenever there is a high silt load in the Red Deer River.
CASE 2	May 1 start pumping 2.12 m^3/s from Red Deer River.	All bays closed. Pass base flow sufficient to supply Spotted Lake, Carlyle backflood and fish ladder flow.	All bays closed. Pass base flow sufficient to supply Carlyle backflood and fish ladder flow.	All bays closed. Pass fish ladder flow.	Gates closed dependent on time of runoff. Filling of all backflood zones to target elevations. Fish migration monitored by Fish and Wildlife. Fish ladders operate for one month (or more if required). Pumping may be stopped if a sufficiently heavy storm runoff occurs such that pumping could cause flooding. Pumping will be stopped whenever there is a high silt load in the Red Deer River.
CASE 3	Pass excess runoff through system then operate the same as for Case 2.				
June 1 (Start)	Continue Pumping 2.12 m^3/s	Slowly lower backflood.	Slowly lower backflood.	Slowly lower backflood.	Slowly lower all backfloods to gates wide open. Fish return to Buffalo Lake.
July 1 **ALL CASES**	Continue pumping 2.12 m^3/s	All bays wide open.	All bays wide open.	All bays wide open.	All backflood land now accessible for haying.
October 31 **ALL CASES**	Stop pumping.	All bays wide open.	All bays wide open.	All bays wide open.	Pumping stopped. Normal winter configuration.

NB: Case 1 Refers to years with very low runoff (less than 3000 acre feet).
Case 2 Refers to years with near average runoff.
Case 3 Refers to years with substantially above average runoff.

TABLE 2

Proposed (Long-Term) Operating Guidelines

PERIOD	OPERATIONS	MIRROR BACKFLOOD	SPOTTED LAKE BACKFLOOD	CARLYLE BACKFLOOD	REMARKS
Winter - March 15 ALL CASES	No Pumping	All bays open	All bays open	All bays open	Normal winter configuration. River forecast centre predicts runoff volume in preparation for operation.
March 15 - May 1 CASE 1	May 1 start pumping up to 2.12 m^3/s from Red Deer River.	All bays open. Pass all flow. Fish ladder closed.	All bays closed. Pass base flow sufficient to supply Carlyle backflood. Fish ladder closed.	All bays closed. Fish ladder closed.	Gates closed dependent on time of runoff. Filling of backflood zones to the height that the available water will go. All fish ladders closed as not sufficient water to operate. Pumping stopped whenever there is a high silt load in the Red Deer River.
CASE 2	May 1 start pumping up to 2.12 m^3/s from Red Deer River.	All bays closed. Pass base flow sufficient to supply Spotted Lake, Carlyle backflood and fish ladder flow.	All bays closed. Pass base flow sufficient to supply Carlyle backflood and fish ladder flow.	All bays closed. Pass fish ladder flow.	Gates closed dependent on time of runoff. Filling of all backflood zones to target elevations. Fish migration monitored by Fish and Wildlife. Fish ladders operate for one month (or more if required). Pumping may be stopped if a sufficiently heavy storm runoff occurs such that pumping could cause flooding. Pumping will be stopped whenever there is a high silt load in the Red Deer River.
CASE 3	Pass excess runoff through system then operate the same as for Case 2.				
June 1 (start)	Continue Pumping up to 2.12 m^3/s	Slowly lower backflood.	Slowly low backflood.	Slowly lower backflood.	Slowly lower all backfloods to gates wide open. Fish return to Buffalo Lake.
June 15 ALL CASES	Stop Pumping.	All bays wide open.	All bays wide open.	All bays wide open.	Pumping stopped for the year if lake has reached target FSL.
July 1 ALL CASES	No pumping.	All bays wide open.	All bays wide open.	All bays wide open.	All backflood land now accessible for haying. This is the normal configuration until next spring. Pumping may resume if Buffalo Lake level recedes 0.15 m below FSL.

NB: Case 1 Refers to years with very low runoff (less than 3000 acre feet).
Case 2 Refers to years with near average runoff.
Case 3 Refers to years with substantially above average runoff.
Once FSL level if reached, typical annual pumping to maintain Buffalo Lake will be about 1.5 months/year.

Pumping from the Red Deer River at the maximum rate of 2.1 m^3/s would be restricted to the May 1 to October 31 period on an as-needed basis. For assessment purposes, three scenarios were modelled with pumping starting and ending according to pre-set lake levels as follows:

Scenario	Lake Elevation (m)	
	Start of Pumping	End of Pumping
1	780.50	780.65
2	780.60	780.75
3	780.70	780.85

Actual pump operating criteria would depend upon a combination of the level of Buffalo Lake, the flow in Parlby Creek, and the flow and water quality in the Red Deer River.

From a water quantity perspective Scenario 2 is the preferred option. In this scenario the lake level does not fall below 780.5 m during the modelling period (1968-1988 historical conditions) and outflows were significantly lower than in Scenario 3. Water levels fell below 780.5 m under Scenario 1.

The estimated average annual operation and maintenance cost for the Buffalo Lake Stabilization component is $186,000 and for the Parlby Creek Channelization component is $78,000, based on pumps operating under Scenario 2 conditions. It is estimated that pump operation and maintenance costs would be about $7,000 per year less under Scenario 1 and $13,000 per year more under Scenario 3 conditions. This range does not account for changes in maintenance requirements as a result of flow changes in Parlby and Tail creeks. Maintenance costs on Tail Creek are expected to increase as a result of an increase in the frequency and volume of spill under Scenario 3 conditions.

3.0 ENVIRONMENTAL IMPACT ASSESSMENT

Although all five phases of the Parlby Creek - Buffalo Lake Development Project are described in this report, the scope of the EIA is limited to Phase V, that is, the Buffalo Lake Stabilization component. The following components were identified, by an issue scoping process, as primary environmental issues: water quality, surface water, fisheries and wildlife. Secondary issues included soils and terrain, terrestrial vegetation and groundwater. The specific concerns, existing conditions, potential impacts and proposed mitigation for each of these environmental issues are presented in the following text.

3.1 WATER QUALITY

3.1.1 Specific Concerns

The major water quality concerns raised during the issue scoping process include: the effects of water withdrawal on the Red Deer River; the influence wastewater discharges into the Red Deer River will have on the quality of water diverted to Buffalo Lake; the potential impacts on Alix and Spotted lakes; the dilution effect of salinity in Buffalo Lake; changes to phosphorus loading; the effects of water freshening and phosphorus budget alterations on aquatic plant and algal growth; aquatic plant and algal growth impairment of water uses; and, the downstream impacts to Red Deer River if occasional spilling from Buffalo Lake occurs.

3.1.2 Existing Conditions

The main discharges to the Red Deer River, upstream of the proposed diversion point for the Buffalo Lake Stabilization component, include municipal discharge from the City of Red Deer, industrial discharges from Electric Furnace Products Company Ltd. (Union Carbide), the Alberta Gas Ethylene Company Ltd. and Cominco Fertilizers.

The salinity of Buffalo Lake is increasing and currently appears to inhibit algal growth and macrophyte distribution. Blue-green algae are common in Buffalo Lake but are limited by phosphorous availability to well below the levels present in other area lakes. However, the presence of blue-green algae may impair water uses. Phosphorus concentrations in the Red Deer River are higher than those in Buffalo Lake. Based on computer simulations for the water balance of Buffalo Lake, no outflow has occurred from the lake since 1967.

3.1.3 Potential Impacts

Critical water quality limits for the Red Deer River are currently unavailable. An instream flow needs study is currently underway that could specify such limits. However, the Buffalo Lake Stabilization component will reduce the long-term mean discharge in the Red Deer River by less than 3% during filling. Out of the remaining 18 years of the water balance simulation, pumping is only required in 5 years for a total of 16 months. Thus, no significant impacts on the quality of Red Deer River water are anticipated.

The sewage treatment plant for the City of Red Deer is operating well below licence limits. The plant is operating at 60 to 70% of its maximum capacity and no expansion is expected for approximately 10 years. Upgrading of the treatment system will occur, as required, when the capacity is expanded or if a problem for downstream users is identified. Additional requirements for treatment will likely include phosphorus control, disinfection and possibly nitrogen control. The discharges of the three main industries are well within their licence limits and are generally less than 4% of the Red Deer River loads under minimum instream flows. The effluent quality of these industrial treatment systems will be significantly improved by new methods and technologies when plant capacities expand.

Spills from upstream municipal and industrial sources could negatively affect water quality in the Red Deer River, Alix Lake, Parlby Creek and Buffalo Lake.

No significant impacts are expected along the conveyance route because the water quality from the Red Deer River is comparable to the water quality of Alix Lake.

Stabilization of Buffalo Lake will cause some freshening of Buffalo Lake (15 to 20% decrease in salinity) during the initial period of pumping. Once the design lake level is achieved, however, further dilution will not occur and Buffalo Lake will again become saline.

Pumping of Red Deer River water would increase the total mass loading of phosphorus to Buffalo Lake. However, this would only have a minor effect on Buffalo Lake. Under Scenario 3 (high pumping scenario), pumping would contribute only 2% of the annual phosphorus budget to Buffalo Lake.

The reduction of salinity and slight increase in phosphorus may cause a slight increase in the Buffalo Lake algal biomass. However, the predicted levels, corrected for reduced salinity and increased phosphorus, are well within the natural variability of algal biomass for Buffalo Lake.

The reduction of salinity in Buffalo Lake may partially relieve the inhibitory effects of salinity on aquatic macrophytes. Stabilizing lake levels at between 780.5 and 781.0 m would expand the current littoral zone (zone where macrophytes grow) and create new habitat for growth. However, natural fluctuations in water levels, although attenuated with pumping, would limit the degree and extent of colonization of this littoral area.

The ratio of nitrogen to phosphorus in Buffalo Lake would not be altered by pumping and thus, no major shift in the composition of the algal community is expected. As the overall distribution of macrophytes and the biomass of algae is not expected to change significantly, no impairment of water use is anticipated.

Lowering the Tail Creek outlet and raising Buffalo Lake levels would increase the frequency and amount of spill down Tail Creek. Outflows under the modelling conditions would

have occurred in 3% of the months under Scenarios 1 and 2 and in 6% of the months under Scenario 3. This compares to zero outflows from 1968-1988 under the existing conditions. Based on modelling results, outflow would reduce the total phosphorus concentrations by 2 to 6% in the Red Deer River and increase conductance by 1 to 21%. These predicted changes are not considered major impacts on the water quality of the Red Deer River.

3.1.4 Proposed Mitigation

If the instream flow needs study for the Red Deer River identifies critical limits for water quality, the operator of the Buffalo Lake Stabilization component will conform to any limits placed on diversion.

Spills of municipal and industrial effluents must be reported to the Directors of Pollution Control Division and/or Standards and Approvals within 24 hours of their occurrence. To minimize potential negative impacts, communication of this information to the operator of the Buffalo Lake Stabilization component would result in reduction or termination of pumping.

The impacts of the stabilization of Buffalo Lake on water quality issues were not deemed to be significant. Therefore, no mitigation measures are proposed. However, a monitoring program will be initiated to verify predictions regarding changes of salinity, phosphorus, algal biomass or macrophyte distribution in Buffalo Lake. If monitoring results indicate negative impacts are occurring due to project implementation, mitigation measures (related to lake levels, pumping frequency and timing) will be carried out.

3.2 SURFACE WATER

3.2.1 Specific Concerns

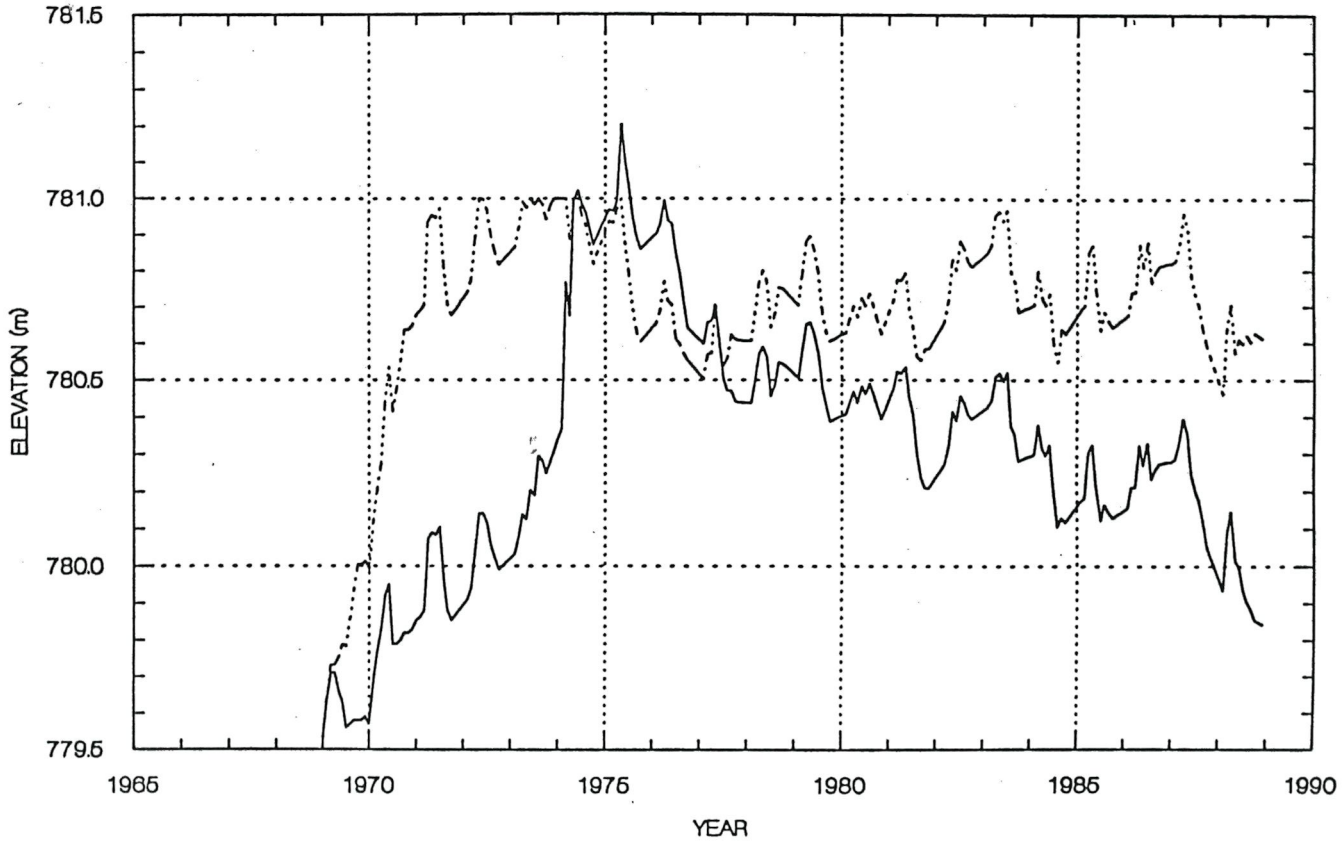
The main issues regarding surface water, raised during the issue scoping process, include: water withdrawal from, and reduced flow in, the Red Deer River; increased flow through Parlby Creek; higher water levels in Buffalo Lake; and, increased frequency of outflow from Buffalo Lake to Tail Creek.

3.2.2 Existing Conditions

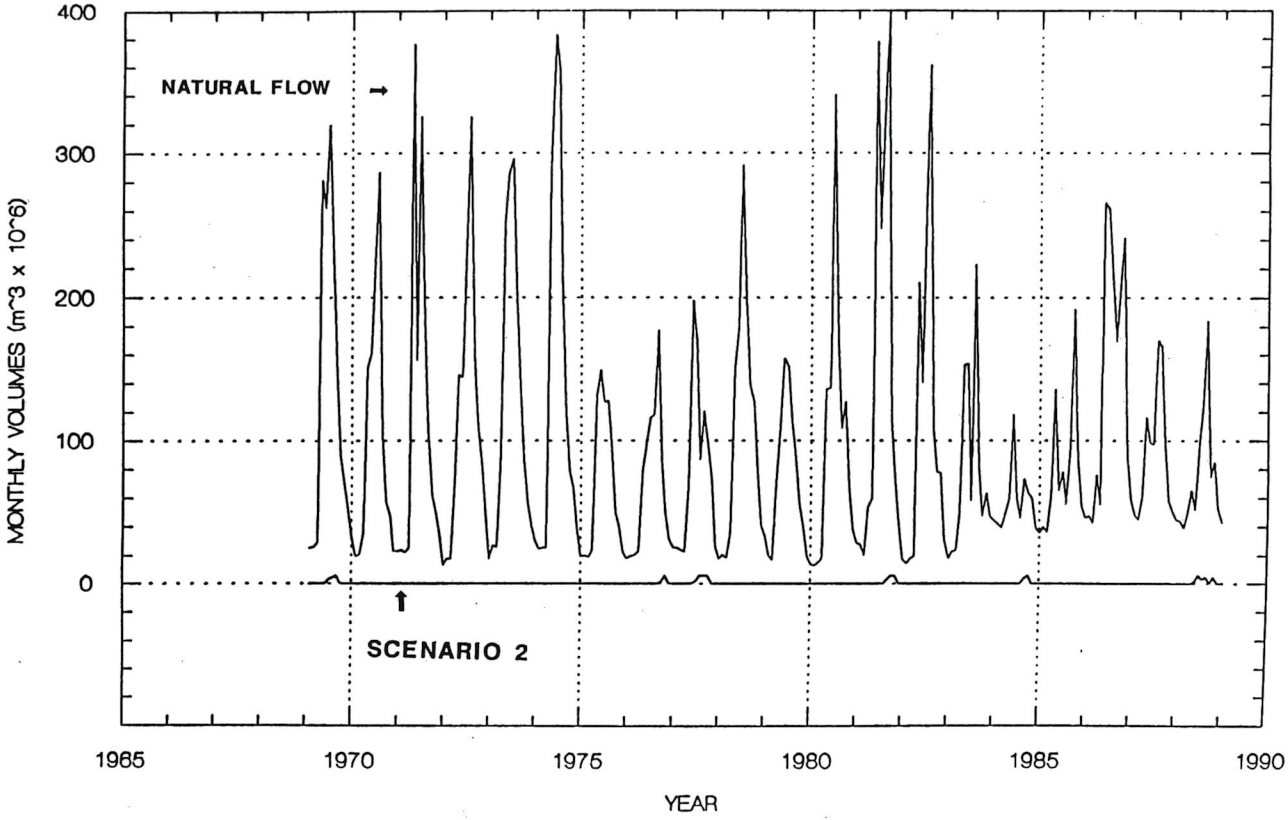
Discharge of the Red Deer River at the City of Red Deer is presented in Figure 4. The interim minimum instream flow for the Red Deer River is 300 cfs (8.5 m^3/s). The Red Deer River is part of the South Saskatchewan River basin. The interprovincial Master Agreement on Apportionment specifies the water quantity that needs to be passed on to Saskatchewan for the entire South Saskatchewan River basin. Streamflow in Parlby Creek is typically zero from November to February, with flows peaking from late March to early May as a result of snowmelt runoff and spring rains. Parlby Creek flows are very low in the summer, responding primarily to rainstorms. Water levels for Buffalo Lake are presented in Figure 4. No streamflow records are available for Tail Creek. However, the water balance simulation for Buffalo Lake determined zero outflow from 1969 to 1988.

3.2.3 Potential Impacts

Discharge of the Red Deer River would be reduced less than 3% of the long-term mean flow assuming continuous withdrawal during the May to October period. Based on the water balance simulation, pumping would be required only 16 months during the 18 years after initial filling (Figure 5).



BUFFALO LAKE
EXISTING VS REGULATED WATER LEVELS
FIGURE 4



RED DEER RIVER AT RED DEER
NATURAL MONTHLY FLOW VOLUMES
VS SCENARIO 2 BUFFALO LAKE WITHDRAWALS
FIGURE 5

The Red Deer River, even under low flow conditions, is capable of satisfying all existing license demands, the interim minimum instream flow and the water withdrawal requirements for the Buffalo Lake Stabilization component.

Obligations for water quantity in the South Saskatchewan River Basin, under the interprovincial Apportionment Agreement, are assessed through computer modelling. A recent scenario run includes continuous water withdrawal for the Buffalo Lake Stabilization component. Results show that the obligations under the Apportionment Agreement have been met every year of the 63-year simulation period.

The Buffalo Lake Stabilization component may result in increased streamflows through Parlby Creek. Potential negative impacts related to this altered streamflow include erosion, slope instability, flow restrictions due to weed growth and beaver activity and seepage losses in built-up channel sections. Beneficial impacts include improved stabilization of water levels in Alix Lake, an improved water supply for the Village of Mirror and improved access along the channel.

On average, Buffalo Lake water levels would be higher as the result of lake stabilization (Figure 4). These higher water levels may cause some flooding of existing beaches but they will remain within the historical water level range. The Buffalo Lake Stabilization component will virtually eliminate flooding above 781.0 m. Available information suggests that recreational facilities are generally located above 781.0 m and would not be impacted by the project.

The lowering of the Tail Creek outlet and raising of the water level in Buffalo Lake would increase the frequency of spill down Tail Creek. Increased spillage could cause creek bank erosion and slope instability.

3.2.4 Proposed Mitigation

To mitigate any significant impacts of the proposed project on discharge in the Red Deer River, withdrawal will be reduced or curtailed when the actual river flow, at the point of diversion, cannot meet the interim minimum instream flow needs and all existing upstream and downstream licensed withdrawals. Necessary adjustments to this policy will be made when a new minimum instream flow is determined.

Measures to alleviate the concerns regarding impacts to Parlby Creek include:

- proper follow-up maintenance until a protective vegetative cover develops;
- riprap and gravel lining for sections above and below structures and through transitions where higher flow will occur;
- maintenance of the channel; and,
- polyethylene lining in areas of coarse sands and gravels.

To alleviate erosion and slope stability concerns in Tail Creek, channel protection works are proposed. Monitoring during and after water releases is proposed to identify potential impact areas. Where necessary, further protection measures will be provided.

3.3 FISHERIES

3.3.1 Specific Concerns

The main fisheries issues raised during the issue scoping process include: water withdrawal from the Red Deer River; the operating regime on Parlby and Tail creeks; and, potential water quality changes in Buffalo Lake.

3.3.2 Existing Conditions

Fisheries information for the Red Deer River is limited and pertains to the period prior to the operation of the Dickson Dam in 1983. Tail Creek and two small lakes along the conveyance system do not provide fisheries habitat. Parlby Creek is mainly used as spawning habitat for northern pike. Northern pike and white suckers were found during a summer survey near the Alix Creek confluence. The current population of northern pike in Buffalo Lake is likely below that which the lake is capable of supporting, and certainly below the population levels which have historically occurred in the lake. Currently, high alkalinity and pH limit habitat suitability and productivity of northern pike in Buffalo Lake.

3.3.3 Potential Impacts

Based on post-impoundment discharge characteristics, and the existing instream flow needs information, the withdrawal of 2.1 m^3/s of water from the Red Deer River, during the open-water season, is not likely to result in negative impacts to the aquatic environment. Therefore, if all identified mitigation measures were incorporated into the design and construction of the intake system, construction and operation of the intake structure on the Red Deer River could be realized, with only minor, short-term negative impacts to the aquatic resource. This impact prediction also applies, if appropriate timing windows and construction procedures are adopted, to any instream construction activities on the lower reach of Tail Creek.

Silt loads in water pumped from the Red Deer River could settle on eggs and smother developing embryos in Parlby Creek. The operation of control structures and fishways to allow backflooding and enhance pike spawning has been negotiated through the Spotted Lake Advisory Committee. Regulation of flows to maximize pike spawning habitat could result in an increase of northern pike in Buffalo Lake.

The alkalinity in Buffalo Lake would be reduced by raising the water level. Over a 10 to 15 year period, alkalinity would return to existing conditions. Thus, improvement in

quality of fisheries habitat in Buffalo Lake would occur during the initial 10 to 15 year period following stabilization.

3.3.4 Proposed Mitigation

To minimize the potential negative impacts of construction of the intake structure in the Red Deer River, appropriate timing windows and instream construction activities will be used.

The pumping plan includes a component to stop pumping when there is a high suspended sediment concentration in the Red Deer River. This will be critical to successful recruitment from northern pike spawning areas in Parlby Creek.

The operation of the Spotted Lake control structure will allow backflooding to 1 June of each year to enhance the northern pike spawning run. The operational directions would be achieved through the Spotted Lake Advisory Committee.

Alberta Environment will initiate and fund a northern pike migration study on Spotted Lake to evaluate Spotted Lake fisheries viability, starting spring 1991.

Alberta Environment will keep, as an option, the possibility of acquiring private land or reallocating existing crown land in the Spotted Lake backflood area to enhance pike spawning opportunities.

3.4 WILDLIFE

3.4.1 Specific Concerns

As identified during the issue scoping process, the main issues regarding wildlife relate to habitat for waterfowl, colonial-nesting birds, shorebirds, furbearers, ungulates and other wildlife along Parlby Creek, Buffalo Lake and Tail Creek.

3.4.2 Existing Conditions

The project area lies within an important implementation area for the North American Waterfowl Management Plan (NAWMP). This program is designed to help restore continental populations of waterfowl. The potential exists for expenditures of over $10 million in an area surrounding and including Buffalo Lake. The area around Buffalo Lake and the conveyance system constitutes important breeding, moulting and staging waterfowl habitat. Colonial-nesting birds have been observed on Buffalo and Spotted lakes and numerous shorebirds visit the proposed project area. Of particular interest is the presence of nesting Piping Plovers (considered an "endangered species" in Canada). Little information exists for other bird species.

The most common furbearers in the area are coyote, beaver and muskrat. Both mule and white-tail deer are present in the area, which is considered a key wintering habitat for these ungulates.

3.4.3 Potential Impacts

The project will have some positive benefits for wildlife, such as a stable water regime in Parlby Creek and improved habitat conditions, but it may affect wildlife utilization of wetlands along the conveyance channel and Tail Creek. Provision of permanent waterbodies

within the backflood areas along Parlby Creek would have significant positive implications for waterfowl production.

Some reduction in existing island habitat for colonial-nesting birds and shorebird nesting and foraging habitat can be expected in Buffalo Lake as a result of the lake stabilization.

At a desired maximum water elevation of 781.0 m, one Piping Plover nest site on the shore of Buffalo Lake would be inundated and therefore lost. Several nests on Rockland Bay may also be affected.

Higher water levels in Buffalo Lake and along the conveyance channel could sustain populations of muskrat, which could in turn support other predators such as mink. Conversely, channelization along the conveyance channel and Tail Creek would eliminate preferred riparian habitat used by furbearers.

Beyond the removal of riparian habitat along the channelized portion of Parlby Creek, little ungulate habitat would be adversely affected by raising and stabilizing the water levels of Buffalo Lake.

Given the lack of existing information concerning other wildlife species, impacts on these species and their habitats cannot be reasonably predicted.

3.4.4 Proposed Mitigation

The mitigation for impacts to waterfowl resulting from the proposed Buffalo Lake Stabilization component would include such steps as:

- routing of the conveyance channel around wetlands;

- input by wildlife officers, through the Spotted Lake Advisory Committee, into the operating plan for backflood operations;

- construction of dykes across bays in Buffalo Lake to allow separate management; and,

- construction of artificial islands to provide nesting and loafing sites in Buffalo Lake.

Stabilization-related impacts on colonial nesting birds and shorebirds would be mitigated though the construction of artificial islands and nesting structures in Buffalo Lake.

Alberta Forestry, Lands and Wildlife, Fish and Wildlife Division, plans to inventory and plot the exact location of Piping Plover nests along Rockland Bay and the north-east wetlands in 1991. Alberta Environment will then carry out the more detailed elevational survey work required to assess impacts of the stabilization of Buffalo Lake on Piping Plovers. Potential mitigation strategies will be developed with input from the Fish and Wildlife Division and could entail removing culverts between Buffalo Lake and Rockland Bay or retro-fitting those culverts with a control structure.

3.5 ADDITIONAL ENVIRONMENTAL CONCERNS

3.5.1 Soils and Terrain

Impacts of lake stabilization on soils and terrain are expected to be short-term. During construction of the conveyance system, the disturbance and compaction of soils could cause increase runoff and erosion. Additionally, increased flow through the conveyance system may cause erosion of the channel bank. Soil and channel bank erosion would ultimately result in increased sedimentation in the lakes along the conveyance system, including Buffalo Lake. With proper mitigation, such as the re-establishment of a vegetation cover along channel banks

and upland sites, the erosion potential will be returned to a condition similar to the natural prechannelization stage.

3.5.2 Terrestrial Vegetation

Impacts on the terrestrial vegetation of the area are expected as a result of disturbance to, and removal of, native vegetation during construction of the conveyance system. Furthermore, the stabilization of Buffalo Lake water levels may result in altered vegetation patterns in the affected area, to an extent that is currently unknown.

Three rare plant species occur on the shores of Buffalo Lake. In addition, eight regionally or provincially uncommon plant species exist within the Buffalo Lake study area. Some loss of these rare plants may occur as a result of inundation of the current shoreline. However, there is a lack of information regarding the locations of these plants in relation to either the construction of the conveyance system or the change in hydrologic regime of Buffalo Lake.

3.5.3 Groundwater

Groundwater flow pattern analysis indicates that increasing the level of Buffalo Lake would not have a significant effect on groundwater conditions within the study area. Water added to Buffalo Lake would not be lost by downward seepage and lateral seepage loss into adjacent, shallow, unsaturated geologic materials would cease once the shallow groundwater flow regime had equilibrated with the increase in lake level. The rise in water table associated with the adjacent, shallow geologic materials would be equal or less than the rise in lake level. Backflood conditions could improve in the Spotted Lake and Parlby Creek area over the short-term rather than resulting in degradation (salinization) of groundwater.

4.0 HISTORICAL RESOURCES

Previous archaeological investigations in the Buffalo Lake area and immediate environs have resulted in the recording of numerous historical resource sites. These consist of a variety of prehistoric sites including campsites, isolated finds, occupation sites, lithic scatters, butchering sites, bison bone deposits, a buffalo pound and a chipping station. Historic period sites include homesteads, the Tail Creek Metis Settlement, the Buffalo Lake Metis Site, an unidentified fort and a burial ground containing three to four graves. Some of the sites documented are of regional and/or provincial significance.

An Historical Resources Impact Assessment (HRIA) has not been completed for the canal/pipeline corridor south of Alix, in the Buffalo Lake area or along Tail Creek. Alberta Culture will require an HRIA prior to construction and is in the process of preparing a terms of reference for the HRIA. Given the historical resource sites known to exist in the area, and the fact that areas adjacent to watercourses and waterbodies have the highest potential for archaeological sites in southern Alberta, the likelihood of recording additional sites is high. Once the sites have been inventoried and assessed, recommendations for mitigation can be made.

5.0 SOCIO-ECONOMIC IMPACTS

This section considers project related impacts on population, economy, resource and land use, and services and infrastructure in the region surrounding Buffalo Lake. This assessment is based on a review of existing data sources which has been supplemented, where possible, through interviews with residents and representatives of the area.

5.1 RECREATION AND TOURISM

Recreation and tourism represents the dominant economic sector in those regions that would be affected by the stabilization of Buffalo Lake. Several local people and recently developed tourism plans in the study area support the Buffalo Lake Stabilization component as a means of securing and enhancing tourism opportunities in the region.

At the current time, there are 3 provincial park facilities with 170 sites, 1 country campsite (90 sites) and 1 private campground facility (175 sites) situated on Buffalo Lake. All have day-use areas, ranging from highly developed beach and marina settings to more informal picnic sites. In addition to camping and day-use facilities, 6 cottage subdivisions are located around Buffalo Lake. A total of about 784 lots, 480 of which have been developed, are contained in these subdivisions.

Camping activities at all provincial park facilities have shown a steady decline since 1982. This decrease is partly due to the decline in lake levels and perceived changes in water quality, but increased camping fees have also been a major factor. Based on average daily occupancy, these camping facilities appear to be substantially under-utilized. On the other hand, the utilization of private camping facilities in the area has increased dramatically in the last few years. This is due primarily to intensive marketing strategies by facility owners.

Changes in the extent of day use of provincial parks facilities during the last eight years are unclear, due to a lack of consistent data. However, it is believed that potential

increases in visits attributable to recent upgrading of facilities at Rochon Sands Provincial Parks have been offset by a continued decline in lake levels and weed accumulation on beaches, plus problems with "swimmers' itch". The vast majority of these day users (72 percent) were residents of the local and regional market areas.

In terms of the number of cottagers and the extent to which cottage facilities are used, cottaging activities have been steadily increasing around Buffalo Lake since 1981. Most of the increase in demand appears tied to economic growth in Calgary with city residents accounting for many of the new cottages developed. According to a 1981 survey, the majority of cottagers (55 percent) were residents of the local and regional market areas while 22 percent were from Calgary and 10 percent from Edmonton. These people typically spent four or more weeks at the cottage each year.

In the absence of lake stabilization, the trends observed over the last decade for camping, day-use activities and cottaging can generally be expected to continue. The greatest potential for increased utilization of the lake is expected to be cottaging since the general economic climate for Calgary, which has been an important source of demand for lots and cottages, is expected to remain healthy and stable. Camping activities at private campgrounds can also be expected to increase, primarily due to the promotional efforts of the owners. At public recreational facilities, participation in day-use activities is anticipated to remain constant over the next decade since increases in the number of households will affect the general trend toward decreased participation in water-based recreational activities. The recent downward trend in camping at provincial park facilities is expected to continue since the popularity of camping is declining due to factors such as an aging population and changing work and leisure patterns.

With the stabilization of Buffalo Lake, the quality of the recreational experience can be expected to improve. As a consequence, cottaging activities at Buffalo Lake would benefit substantially. With stabilization, it is expected that the marketability of cottage lots would improve, even though this may not lead to an increase in the price of lots. As recreational

quality improves, another benefit of stabilization is that cottagers would derive more enjoyment from Buffalo Lake and would probably make more use of their cottages each year.

For day-use activities, lake stabilization can be expected to enhance recreational quality, leading to increases in the amount of recreational activity that occur at Buffalo Lake. With lake stabilization, conditions for boating are expected to improve yet the amount of available beach area would decrease significantly (for example, at Rochon Sands Provincial Park). The major limiting factor for day-use activities is expected to be a continuation of the declining provincial participation rates for water-based recreational activities.

Camping at the provincial park facilities on Buffalo Lake is not expected to change very much as a result of lake stabilization, due to the general decline in household participation in camping throughout the province. However, there would probably be less variation in camping activity from year-to-year. For private facilities, the amount of camping activity at Buffalo Lake may increase after lake stabilization. However, most of this increase would probably be a result of increased promotional activities by private operators who are able to capitalize on the benefits that lake stabilization will have on recreational quality.

Local communities have expressed an interest in the enhancement of Alix Lake for recreational purposes through the introduction of Red Deer River water into the system. Plans for expansion of recreational facilities on the lake are underway and the viability of this venture would be improved by any actions leading to improved water quality and quantity at Alix Lake. Stabilization of Alix Lake using Red Deer River water would result in considerable cost savings to the Village of Alix which currently pumps water out of Parlby Creek in order to maintain water levels in Alix Lake.

5.2 AGRICULTURE

Agriculture is a dominant economic activity in the Buffalo Lake region, particularly in the vicinity of Parlby Creek. The pipeline corridor, access road, channel structure, pumphouse facilities and outlet works could result in some losses of agricultural lands. Compensation for any such losses would be available subject to current government policies. Crop production and quality is expected to improve through backflooding. The frequency of backflooding may increase with increased flow in Parlby Creek due to the Buffalo Lake Stabilization component. With reduced risk of flood damages and enhanced production, there may be diversification of farm activities plus expansion of related service industries.

Stabilization of Buffalo Lake would also affect the quantity of agricultural lands as there may be some loss of crown lands currently leased for pasture along the lakeshore. To date there have been no discussions with potentially affected leaseholders. Consideration will be given to compensation where the higher water levels associated with the Buffalo Lake Stabilization component affect long term lease holders. The stabilization of lake levels would, however, make farming operations more predictable with respect to flooding conditions and pasture boundaries. This would enable permanent fencing to be erected to control cattle on the lake shore.

5.3 POPULATION, LABOUR FORCE, EMPLOYMENT OPPORTUNITIES

The proposed lake stabilization component is not expected to cause significant population increases in the project area once the facilities are in place. During the construction season a temporary increase in population would occur as construction workforce is in the area. Some portion of the workforce are expected to be from the local area. Due to the proximity of Buffalo Lake to Stettler and Red Deer it is likely that most non-local construction personnel would not choose to stay in the smaller communities of Alix and Mirror.

Project construction has the potential to create employment and increase regional incomes in two ways. First, the construction phase can provide short-term job opportunities to qualified local residents. Second, project construction activities would likely result in the purchase of some goods and services from local businesses. The magnitude of these benefits would depend upon the extent to which the contractors support the use of local labour and suppliers. When the capability is available, untendered or force account work would be done with local firms located as close to Buffalo Lake as possible.

5.4 SERVICES AND INFRASTRUCTURE

The Parlby Creek - Buffalo Lake Development Project would provide the Village of Mirror with more flexibility in timing for municipal water supply withdrawals and a more assured water supply. It may be necessary to install an auxiliary pump with a capacity of 0.15 m^3/s, or run the larger pumps for short periods of time in order to guarantee an adequate supply in all years since pumping for lake stabilization would not be required in some years.

For the Village of Alix, the diversion of Red Deer River water into Alix Lake will not benefit the municipal water supply. The village currently relies on groundwater and would have to install costly water treatment facilities to utilize a surface water supply. However, as previously described (Section 5.1), the village would no longer have to incur pumping costs to supplement Alix Lake.

A modest increase in cottage development (in the order of 6% per year) is anticipated over the next few years. There are enough lots and undeveloped land to meet this level of cottage demand for the next 10 to 20 years. Without a substantial increase in the size of the summer villages and subdivisions, as well as a significant increase in year-round residents at these properties, central sewage collection and treatment would be far too costly for the individual property owner.

Some increases in traffic on primary highways and secondary roads around Buffalo Lake can be expected as a result of lake stabilization and associated recreational use. These increases should not be significant, however, and all roads are considered to be in good conditions. Currently no plans exist to improve these roads.

Without anticipated long-term increases in permanent employment or population in the region, impacts on community services and infrastructure are not anticipated as a result of the Buffalo Lake Stabilization component.

5.5 INDUCED SOCIAL AND ECONOMIC IMPACTS

Buffalo Lake Stabilization may generate some additional, induced impacts on social and economic conditions in the region. With the added farm stability and agricultural productivity, some expansion of the service sector may occur. Similarly, as the extent of recreation and tourism is expected to increase with lake stabilization, some diversification and expansion of the recreation/tourism facilities may also occur, creating new opportunities for employment for local and regional residents.

6.0 PUBLIC PARTICIPATION

Following the Alberta Government decision in mid August 1989 to undertake a formal EIA, the public participation program commenced in September 1989 with an issue scoping exercise. Details of the approach, list of interviewees, the interview guide and all issues identified by the public are presented in the Public Consultation Data Report contained in Volume Three. A summary of the issue scoping is provided in Volume Two. Each question raised by the public in the issue scoping was divided into areas of scientific responsibility and was referred to the lead scientist for inclusion in the draft EIA. This approach resulted in these public concerns being integrated into the appropriate areas of the draft EIA.

During the September 1989 to February 1990 time period, letters of interest were received, occasional meetings with special interest groups were conducted and telephone conversations were held. Copies of all letters and telephone calls received are presented in Volume Three. All comments received during this period were forwarded to the appropriate scientist for consideration in the draft EIA.

On March 10, 1990, an open house was held at Erskine with approximately 140 people in attendance. The draft EIA summary document was available to the public for review and comment before the open house. In addition, the complete draft EIA document was available in Alix, Rochon Sands, Stettler, Mirror, Bashaw, Calgary and Edmonton for perusal.

Comments received in response to the open house prompted a number of changes to the EIA document. These included the following:

a) a cost-benefit analysis was prepared;

b) the recreation assessment was revised;

c) the description of the effects of providing water to Alix and Mirror was expanded to include more discussion on water quantity and quality;

d) a separate data deficiency section was added to the report;

e) conclusions and recommendations for each discipline had initially been presented in the Environmental Impact section and the report was expanded to include a section summarizing the main conclusions and recommendations;

f) the water quality section was expanded to explain more completely the predicted impacts on water quality and review how and why these predictions are different from previous studies; and,

g) the section describing potential impacts on wildlife, particularly waterfowl and shorebirds was expanded.

The following time line documents the public participation program implemented for the EIA:

September 1989:	Issue Scoping was undertaken as described above, in Volumes Two and Three.
September 1989-March 1990 :	Telephone interviews and personal visits were conducted (Volume Three).
December 1989:	Public Notice of the EIA placed in 17 newspapers. A copy of the Public Notice is in Volume Three.

February 1990:	Newsletter Issue No. 1 was produced and 1377 copies were mailed to area residents and to residents in Calgary, Edmonton and outside the province. One hundred or more newsletters were sent to each of the following communities: Alix, Calgary, Edmonton, Mirror and Stettler. A newsletter distribution list is provided in Volume Three.
	Draft Summary EIA available to all interested parties.
	Public Notice of Open House placed in 17 newspapers. A copy of the public notice is in Volume Three.
March 1990 :	Newsletter Issue No. 2 was produced and 1430 copies were mailed.
March 7, 1990:	The complete draft EIA document was available in Alix, Rochon Sands, Stettler, Mirror, Bashaw, Calgary, Edmonton.
March 10, 1990:	Open House - Attendance list and Open House Comment Sheets are provided in Volume Three.

The public consultation program for Buffalo Lake stabilization was designed to provide maximum input. Public issues were solicited at the very beginning of the EIA process through the issue scoping. Additional contacts were made with local experts, communities, regional districts and interest groups. The public process culminated with the Open House and the comments received on the draft EIA. The final EIA addressed all of the issues that were raised by the public.

It is evident from the review of all material submitted by the public that there is a great deal of support by local residents for the Buffalo Lake Stabilization component. In general, the response was also positive towards the draft EIA and the manner in which it was

conducted, although there were some concerns about the recreation component in the draft EIA document. Finally, it is notable that there are some residents in the area that oppose the project.

7.0 BENEFIT - COST

In response to concerns raised by the public, a benefit-cost analysis of the Buffalo Lake Stabilization component was undertaken. This analysis examined the economic efficiency of stabilizing Buffalo Lake accounting perspective and also reviewed the distribution of benefits and costs within Alberta.

What about the costs of mitigation? Are these included?

The quantifiable costs of the project included the capital and operating costs associated with the diversion, pipeline, canal and outlet structures. Over the 30-year life of the project, these costs had a present value of $13.1 million based on a discount rate of 5 percent. Other project costs that could not be readily quantified included the incremental costs of pumping water to meet municipal demands and the foregone benefits that could result from using this water for other purposes, but those are perceived to be quite small.

The primary benefits of lake stabilization will be improvements in the recreational capacity of Buffalo Lake and water supplies for the villages of Alix and Mirror. To deal with the uncertainty of estimating these benefits over the life of the project, various scenarios were evaluated and the results of the base case scenario are presented in Table 3.

In terms of recreational benefits, this table shows that most of the quantifiable project benefits ($9.6 million or 87 percent) would accrue to existing and future cottage owners. Benefits to people using public and private camping and day-use facilities would total only about $412,000 and this reflects the base case assumption that no additional public day-use facilities are developed at Buffalo Lake.

Two types of water supply benefits have been examined. For the Village of Alix, the cost of pumping to stabilize Alix Lake would no longer be required and this would result in cost savings of about $0.1 million over the life of the project. For the Village of Mirror, increased flows through Parlby Creek would provide a more assured water supply and would

Subsidy

Cost per cottage

480 existing cottages

$20,045 /cottage

784 lots

$12,273 /~~cottage~~ lot

an average lot value of

Cost Benefit analysis uses

$15,000

TABLE 3 BASE CASE NET BENEFITS (1990 $, P.V.)	
Benefits:	
1. Camping Benefits	$ 64,470
2. Day-use Benefits	347,390
3. Cottage Development Benefits	9,622,000
4. Cost Savings - Village of Alix	65,500
5. Municipal Water Supply - Mirror	1,000,000
Total Present Value Benefits	$11,099,360
Costs:	
1. Capital Costs	$10,655,000
2. Operating Costs	2,505,000
Total Present Value Costs	$13,160,000
Net Benefits	($2,060,640)
Benefit - Cost Ratio	0.84

eliminate the need to find some alternative water supply source which might cost, based on experience elsewhere, as much as $1.0 million.

Other project benefits include a short-term improvement in sport fisheries, but it is assumed that these benefits have been incorporated into the analysis of project impacts on recreation. There is also some potential for improved water supply for people residing along the conveyance route but this potential is known to be very small. These withdrawals will require application and approval under the Water Resources Act.

A comparison of quantifiable benefits and costs indicates that, in present value terms, the Buffalo Lake Stabilization component would produce total net benefits of -$2.1 million or -$126,000 per year over the 30-year life of the project. This represents a benefit/cost ratio of 0.84. As this analysis did not include various other benefits and costs that could not be quantified in dollar terms, this benefit/cost ratio provides only a partial assessment of the socio-economic value of lake stabilization.

Similar benefit-cost comparisons were conducted using a variety of other assumptions and scenarios. For example, one scenario assumed that the private sector would develop camping facilities required to accommodate most of the potential future demand. This would require expenditures having a present value of about $1.23 million, would generate additional recreational benefits of $1.64 million and would increase the benefit/cost ratio of the project to 0.89. On the other hand, a more pessimistic assumption about benefits to cottagers would decrease the benefit/cost ratio to only 0.58. And, while there is considerable uncertainty about the size of the potential benefits of improvements in the potential benefits of improvements in the municipal water supply for the Village of Mirror, the analysis indicates that these benefits would have to be about three times greater (about $3.1 million in total) for benefits to exceed costs.

This analysis is based on a proposed in-service date of 1992 with benefits occurring in that same year.

8.0 EIA TERMS OF REFERENCE

8.1 INTRODUCTION

Alberta Environment has commissioned an independent consultant group to conduct a comprehensive Environmental Impact Assessment (EIA) of the effects of Buffalo Lake stabilization component on Buffalo Lake and Parlby and Tail creeks. The study will review existing information to advise the public on the extent and significance of the project's environmental impacts, both positive and negative, on the area. The EIA will also identify mitigation measures that may be applied to offset any negative impacts, and identify data gaps that limit the study team's ability to assess impacts with a high degree of confidence.

The environmental assessment will include a description of the environmental resources of the project area and an assessment of potential effects of the lake stabilization project. Social and economic benefits are to be included as components of the EIA.

Public consultation is to play a significant role in the project. The aim is to have the public initially identify their ideas, issues and concerns and to review the Terms of Reference for the study. Public review and comments on a draft copy of the impact assessment will also be important.

8.2 GENERAL INFORMATION

The EIA will address all of the environmental components identified in the project-specific Table of Contents (Appendix 1). Existing data will be used in the preparation of environmental baseline for each component. Assessment of potential and residual impacts will be based on scientific review, modelling and the professional judgement of the scientists involved in this study. Mitigative measures will be proposed to minimize or avoid any adverse effects. Public input will be solicited throughout the assessment process.

8.3 SPECIFIC TERMS OF REFERENCE

A number of specific issues were identified as being of concern as a result of preliminary data review and the initial public input. These issues have been incorporated into the specific Terms of Reference for the Buffalo Lake Stabilization component EIA, which are as follows:

8.3.1 Water Quality

a) Review available data and reports pertaining to water quality in the Red Deer River in the vicinity of the proposed diversion, in Parlby Creek and in Buffalo Lake.

b) Describe the present water quality conditions in Buffalo Lake, emphasizing salinity, phosphorus and algal biomass and the factors affecting these parameters. A detailed phosphorus budget, including internal loading for pre and post-diversion conditions, should be included.

c) Predict the effects of the addition of Red Deer River water, emphasizing phosphorus, salinity and algal biomass on Buffalo Lake water quality.

d) Analyze the significance of any possible water quality impact in terms of recreational use, fish and wildlife uses and aesthetic considerations.

e) Recommend mitigation strategies to ameliorate any predicted negative effects on lake water quality.

f) Comment on possible effects on Red Deer River water quality resulting from the withdrawal, implications of occasional spilling of Buffalo Lake water to the Red

Deer River via Tail Creek, and the downstream water quality effects of construction and initial flushing of water to the Red Deer River.

g) Address potential water quality impacts resulting from all components of the stabilization project. The roles of Alix and Spotted lakes in the proposed diversion require close scrutiny.

h) Assess the influence of the Dickson Dam and present and future municipal wastewater discharges on water to be withdrawn from the Red Deer River.

8.3.2 Aquatic Plants

a) Describe the composition and distribution of aquatic plant communities in Buffalo Lake.

b) Assess likely changes to littoral vegetation as a result of the stabilization project.

c) Assess the implications of any changes in aquatic plant communities to recreational use, fish and wildlife utilization and aesthetics.

d) Recommend strategies to mitigate any negative effects which may result from changes to the aquatic plant community following lake stabilization.

8.3.3 Fish

a) Describe the species composition and relative abundance of fish populations in the Buffalo Lake - Parlby Creek system.

b) Assess the quality of fish habitat and its limitations and identify critical areas for fish, e.g., overwintering areas, spawning areas, migration routes.

c) Assess the value and utilization of the fishery resource in the Buffalo Lake - Parlby Creek system.

d) Describe the impacts of the stabilization project on invertebrate populations in Buffalo Lake.

e) Describe the likely effects of the stabilization project on fish habitat and populations. The use of Spotted Lake to transport water during the spring may present a problem in allowing spawning pike to reach the lake. Information is required on the effects of: (i) water diversion on the operation of the fishways in the channel; and, (ii) increased water flows on the spawning pike.

8.3.4 Wildlife

a) Assess wildlife utilization of Buffalo Lake and the areas traversed by the diversion route.

b) Describe existing habitat quality and its limitations for waterfowl, colonial nesting birds and aquatic furbearers.

c) Assess the regional importance of the wildlife resources of the project area.

d) Describe the likely effects of the project on wildlife habitat and populations.

e) Recommend mitigation strategies to ameliorate any possible negative effects on wildlife habitats and populations.

8.3.5 Historical Resources

a) It is recognized that Alberta Culture and Multiculturalism will be in close contact with Water Resources Management Services regarding requirements under the Historical Resources Act. The Historical Resources section of the EIA should provide a synopsis of the results of the Historical Resources Impact Assessment.

b) Describe the location and values of historical resources for the entire project (ie., pipeline and canal from Red Deer River to Alix Lake; channelization of Parlby Creek from Alix Lake to Buffalo Lake; increasing surface area of Buffalo Lake; channelization of Tail Creek and outlet control structure from Buffalo Lake). Historical resources issues associated with the expected full supply level of Buffalo Lake will require close examination.

c) Recommend mitigation strategies for ameliorating any adverse effect of the project on historical resources.

This hasn't been done

8.3.6 Geology and Soils

a) Describe the bedrock and surficial geology along the pipeline and canal route.

b) Describe the structural stability of soils, erosion potential and any existing erosional problems along the pipeline and canal route.

c) If any geotechnical concerns are identified, suggest how they can be ameliorated.

8.3.7 Recreation and Tourism

a) Identify existing recreation sites (formal and informal) and the extent of recreational use of Buffalo Lake as it relates to historic lake levels.

b) Describe the opportunities that will occur for recreation and tourism as a result of the Buffalo Lake Stabilization component.

c) Recommend mitigation strategies to ameliorate possible adverse effects of the project on Buffalo Lake's recreation and tourism potential.

8.3.8 Socio-Economic

a) The economic evaluation and social assessment undertaken in 1982 should be updated to reflect the present situation.

b) Collect data on the existing social and economic situation in the project area, for example, community demographics, length of occupancy during the year, community groups, businesses distribution of population, nearest centres.

c) Predict impacts on the existing situation if the project is implemented (examples of impacts might be changes in nature of population, land use, nature of community groups, traffic patterns and volume, real estate values, businesses).

d) Describe the construction period impacts, if any.

8.3.9 Public Consultation

a) Identify affected and interested parties (landowners, cottage owners, local municipalities, etc.) in the Buffalo Lake area and along the diversion route.

b) Review past public consultation programs on the project with a view to continuity in the community.

c) Ensure that a variety of means to involve people are used so that those in the community seeking different levels of participation are accommodated.

d) Hold meetings in the local area to present EIA draft Terms of Reference, draft EIA and to solicit comments from the public. Use other means of informing publics and gamering responses as deemed appropriate. Report to the project proponent on public response to the EIA draft Terms of Reference and the draft EIA.

e) Document the issues that are raised throughout the public consultation process, along with the measures that have been or will be undertaken to address the concerns.