ISLE LAKE/LAC STE. ANNE
REGULATION FEASIBILITY STUDY
SUMMARY REPORT

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SUMMARY REPORT

Prepared By

PLANNING DIVISION

ALBERTA ENVIRONMENT

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Alberta

ENVIRONMENT

Planning Division

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P. G. Melnychuk, P. Eng.
Assistant Deputy Minister
Environmental Engineering
Support Services

Sir:

I am pleased to submit herewith *Isle Lake/Lac Ste. Anne Regulation Feasibility Study: A Summary Report.* This report is a condensation of the much larger and more detailed report *Isle Lake/Lac Ste. Anne Regulation Feasibility Study.*

This study, which was initiated internally in late 1978 as follow-up to recommendations in the 1977 "Interim Report - Sturgeon River Basin Study", addresses the hydrotechnical, social preference and cost factors associated with potential regulation of Isle Lake and Lac Ste. Anne.

Recognizing that water levels of Isle Lake and Lac Ste. Anne are interrelated, alternatives were formulated to encompass both lakes as a set rather than studying them on an individual basis. Seven alternative regulation sets were analysed, using a water balance simulation model developed for the 15 year period 1963-77.

Lac Ste. Anne

Study results indicate that the natural historic fluctuation of 1.5 m on Lac Ste. Anne could at best be reduced to 1.0 m through regulation. The target level range was 0.5 m. There is no apparent concensus of private citizens and local officials as to how, or if, Lac Ste. Anne should be regulated. Cost of major regulation works, including an operational outlet structure and channelization would approach $500,000. These works could qualify for about 72% Provincial funding.

Isle Lake

The historic fluctuation of 1.7 m on Isle Lake could be regulated within 0.8 m. The target level range was 0.6 m. Cost of major regulation works, including an operational outlet structure, channelization and the replacement of a bridge would be about $600,000. No portion of these works would qualify for Government funding.

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Downstream Effects

Major regulation of Lac Ste. Anne would have a significant downstream effect, primarily on amplifying extreme high and low water levels at Big Lake. In high runoff years, it is calculated that increased outflows from Lac Ste. Anne would increase natural flood levels in Big Lake by up to 0.3 m, thus affecting up to 1,000 acres of privately owned land. In drier periods, regulation of Lac Ste. Anne to retain water would reduce natural inflows to Big Lake and suppress water levels.

The specific areas which would be affected on Big Lake would change from year to year, depending on initial levels of Big Lake. About 4,500 acres of the total 7,500 acres within the Big Lake flood zone are privately owned.

The primary recommendation is that Alberta Environment not participate in major regulation works for Lac Ste. Anne or Isle Lake. The ongoing program of weed and obstruction removal in outlet channels should continue, with local input.

Respectfully yours,

C. L. Primus

C. L. Primus
Director
Planning Division

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BACKGROUND

Historically Isle Lake levels have fluctuated through a mean monthly range of about 1.7 m from elevation 729.0 to elevation 730.7. Lac Ste. Anne levels are known to have fluctuated through a range of about 1.5 m from elevation 722.1 to elevation 723.6. High water levels have caused flooding to cottages and inundated beach areas at both lakes while low levels hamper boating and are thought to have caused freezing of whitefish spawn at Lac Ste. Anne which supports a commercial fishery. As a result of the numerous complaints from lake shore residents Alberta Environment undertook a study with the following objectives:

1. to define lake level regulation ranges for Isle Lake and Lac Ste. Anne that would best accomodate the multiple interests and uses of shoreline municipalities, private landowners, and public recreation, environmental and downstream values;
2. to formulate a range of water level regulation alternatives for both lakes, defining the form and cost of necessary lake regulation works;
3. to test the technical feasibility of achieving each alternative, using hydrotechnical modelling techniques; and
4. to make water level management recommendations for both lakes.

Water quality is not addressed in this study. However, none of the regulation alternatives considered would have a significant effect on water quality parameters in either lake.

The general location of these two lakes is shown in Figure 1 and their location in the Sturgeon River Basin in Figure 2.

LAKE LEVEL PREFERENCES

The "Interim Report - Sturgeon River Basin Study" published by the Planning Division of Alberta Environment in 1977, recommended that Isle Lake would best be regulated through a 0.6 m range from elevation 730.0 in summer to elevation 729.4 in winter and Lac Ste. Anne through a 0.5 m range from elevation 723.2 in summer to elevation 722.7 in winter. These recommendations were made from a wide range of water use considerations.

The Lac Ste. Anne Shore Association, representing the various municipalities on the lake, met with the Minister of Environment in July, 1979 to request that Lac Ste. Anne be stabilized at elevation 722.7. The Association was mainly concerned with the exposure of beach areas.

At a meeting of the Edmonton Regional Planning Commission Lac Ste. Anne Lake Management Plan Review Committee held in mid September, 1979, the question of lake levels was raised. The mayor of Sunset Point indicated that there was no agreement in his summer village as to preferred regulation levels, but there seemed to be a tendency toward the long term mean. The summer villages of West Cove and Castle Island were against regulation of Lac Ste. Anne, but the summer village of Yellowstone favoured lowering the lake. The Alexis Indian Band, which was not represented at the meeting, was indicated as not favouring regulation.

About 50% of the respondents to a questionnaire developed by the ERPC indicated yes to water level concerns; however, there was disagreement as to what the most important concerns are. Alberta Beach residents perceive water level problems somewhat differently than over summer village residents.

There is no apparent concensus as to whether or not Lac Ste. Anne should be regulated or, if so, how it should be regulated.

CONSTRAINTS TO LAKE LEVEL REGULATION

Ideally a regulated lake would be maintained at a chosen water level with little or no fluctuation. To achieve this, runoff into the lake must always offset or be greater than evaporation loss. When runoff exceeds evaporation, sufficient discharge capacity must be available to pass the excess through the lake without a rise in the water surface. In practice these conditions are seldom, if ever met. There are periods of drought when evaporation losses exceed inflow and the lake level falls below the regulation level. Conversely there are periods of flood when inflow exceeds the discharge capacity at the outlet and the lake level rises.

The degree to which a lake can be regulated is also influenced by the discharge capacity that can be provided. This capacity may be affected by economic considerations or more commonly by the limitations on discharge that downstream considerations impose, while the ratio of inflow to evaporation is determined by climatic conditions.

In the case of Isle Lake and Lac Ste. Anne much of the inflow is from spring runoff. A relatively high discharge capacity would be required at that time to prevent the lakes from rising too high. Sufficient inflow must be kept in storage to offset evaporation and prevent the lake levels from falling below the minimum desired elevations. While this may be achieved in average and wet years, optimum lake levels may not be maintained in dry years.

The effects of lake level regulation on downstream channel flow need to be taken into account. During a flood, the peak discharge into the downstream reaches may be greater than would occur under unregulated conditions because the flood must be moved more quickly through the lake to prevent a significant rise in water level. During drought conditions the downstream

discharge would be less than would occur normally because the runoff must be stored to compensate for evaporation loss. This would cause flows to be more eratic and would amplify water level fluctuations downstream where flooding may be aggravated and problems associated with low water levels intensified.

REGULATION ALTERNATIVES

Regulation of Isle Lake and Lac Ste. Anne could be achieved by means of an adjustable weir constructed at the outlet of each lake. In order to maintain outlet control at the weir the channel downstream of each lake outlet would have to be lowered for a distance of about 4,000 m to 5,000 m. A water balance computer model was developed to analyse the effect of the regulation alternatives on water levels in Isle Lake and Lac Ste. Anne using a fifteen year simulation period (1963-77).

It is not appropriate to consider specific regulation alternatives for either lake in isolation of the other lake or the downstream flow regime. Therefore, alternatives were formulated to describe each of six combination possibilities encompassing both lakes. Alternatives I through VI, describing describing various regulation/non-regulation cases on Isle Lake and Lac Ste. Anne, are defined in the following table.

	LAC STE. ANNE UNREGULATED	LAC STE. ANNE REGULATED (between 722.7 and 723.2 m)	LAC STE. ANNE REGULATED (at 722.7 m)
ISLE LAKE UNREGULATED	Alternative I	Alternative II	Alternative III
ISLE LAKE REGULATED (between 722.7 and 723.2 m)	Alternative IV	Alternative V	Alternative VI

The outlet channels of both lakes become increasingly impeded over the summer period by weed growth, debris, and construction of beaver dams. These obstructions, combined with the relatively shallow bed slope of the channels, decrease the amount of outflow which can occur from the lakes, particularly during low lake levels. A seventh alternative (VII) examines the effect on lake levels of maintaining outlet channels free of weeds and obstructions on an annual basis from spring runoff to fall freeze-up.

A continuous record of the lake levels for these two lakes during the study period 1963-77 is not available, thus mean monthly lake levels during this period were simulated using the computer model to fill the gap in the historic record, see Figure 5. Figure 6 is the unregulated base case. The effect of each regulation alternative on both lakes is shown in Figures 7 to 12.

Alternative I is the natural case and examines both lakes in their unregulated condition. Alternative II attempts to regulate Lac Ste. Anne towards the objective of the "Interim Report - Sturgeon River Basin Study", which recommended a fluctuation range of 0.5 m. Alternative III was designed to satisfy the objective of the Lac Ste. Anne Shore Association and attempts to stabilize the lake at elevation 722.7. Alternative IV attempts to regulate Isle Lake through a 0.6 m range to meet the objective of the Sturgeon River Basin Study Interim Report. The effect on unregulated Lac Ste. Anne was also considered. Alternatives V and VI examine the effect that regulation of Isle Lake according to the Sturgeon River Basin Study Interim Report would have on Lac Ste. Anne when regulated as in Alternative II and III. Alternative VII looks at the extent to which all or any of the objectives can be satisfied by maintaining the channel downstream of both lakes in a weed-free and obstruction-free condition on a year-round basis. Each of the alternatives is assessed relative to the stated objectives and the natural

conditions (Alternative I), in terms of lake level response during the 15 year study period from 1963-1977.

Isle Lake

Regulation according to alternative IV, V or VI would maintain the natural mean level of Isle Lake but reduce lake level fluctuations by more than 50% during the study period. This means that peak levels would be lower and of shorter duration and the lake would not fall as low during periods of drought as when unregulated.

Alternative IV in which Isle Lake only would be regulated would somewhat amplify high and low levels on Lac Ste. Anne. Alternative VII which provides for annual channel maintenance would allow faster outflow and hence maintain the lake at a lower mean level than at present. Lake level fluctuations will also be somewhat reduced. Peak levels would be reduced and low levels will fall even lower which may be undesirable in drought years.

Lac Ste. Anne

Alternatives II and V seek to regulate Lac Ste. Anne towards the recommendations of the "Interim Report - Sturgeon River Basin Study." These alternatives would maintain Lac Ste. Anne at a higher mean level than at present and reduce the lake level fluctuations to about 1.0 m over the study period. The duration and height of peak levels would also be reduced but the lake levels would not fall as low during drought as without regulation. There would probably be a negative impact on beach exposure.

Alternatives III and VI would regulate Lac Ste. Anne towards the objectives of the Shore Association. These alternatives would maintain Lac Ste. Anne at a lower mean level than at present and about 0.4 m lower than would alternatives II and V. Lake level fluctuation would be reduced to

about 1.0 m over the study period and lake levels would be within 0.1 m of the target level during 50% of the summer months. The height and duration of peak events would be substantially reduced; however, lake levels during dry periods would be even lower than without regulation. There changes would reduce cottage and property flooding and increase beach exposure.

The effects of alternative VII, annual channel maintenance would be the same as for Isle Lake. Selective channel maintenance undertaken when the hydrologic conditions warrant could be beneficial to both lakes. It would not be desirable to improve outlet channel efficiency through weed clearing in dry periods such as 1968-70.

Downstream Effects

With the exception of alternatives IV and VII which should have no impact, all the alternatives would induce higher than natural water levels on Big Lake during flood and lower than natural levels during drier months of the year. That is, the fluctuation range of Big Lake would tend to increase, as would the amount of patented land flooded.

If the maximum mean monthly outflow from Lac Ste. Anne during the 15 year study period were limited to about 14.2 m^3/s, the average downstream bankful flow capacity of Villeneuve, then during four years (1965, 1971, 1974, 1977) Big Lake levels would be in the order of 0.3 m higher than would occur without regulation. The additional amount of patented land flooded would be in the order of 1,000 acres, depending on the initial lake level at that time.

When levels at Lac Ste. Anne are at or below weir crest elevation, there is no outflow. Consequently, during 7 of the 15 years, Big Lake would be about 0.2 m to 0.3 m lower than under natural conditions. There would also be a corresponding reduction in outflow from Big Lake with probable water quality consequences.

COSTS

Project Costs

Estimated capital and annual maintenance costs for each alternative are based on unit costs in 1979. Engineering costs have not been included. Regulation of Isle Lake would cost about $600,000 and regulation of Lac Ste. Anne about $480,000. Annual maintenance would be about $7,500 and $10,000 respectively. In the case of Isle Lake a bridge on Highway 634 would have to be replaced at a cost of approximately $125,000. This sum has been included in the project cost. Alternative VII is the least costly and involves maintenance only.

Cost-Sharing

Alberta Environment may provide financial assistance to a local authority(s) for lake management projects which enhance recreational opportunities for the general public. The extent of this opportunity enhancement is determined by calculating the proportions of the lake shore that is made up of publicly owned shorelands, suitable for recreational use and providing suitable public access to the lake.

To meet these criteria a particular parcel of public shoreland must:

1) be larger than 10 acres in area,

2) provide an average of 700 ft. behind each foot of the shoreline of the parcel,

3) be potentially or readily accessible to the general public,

4) not be currently in use for purposes that would conflict with recreational use,

5) be bounded on at least one side by the waters of the lake.

If the miles of public shoreline that meet these criteria exceed

25% of the total shoreline of the lake then Alberta Environment may completely fund the project. If the miles of public shoreline make up less than 25% of the total shoreline the Alberta Government may provide assistance up to a maximum of 75% of the costs according to a sliding scale.

When these criteria are applied to the shorelands of Lac Ste. Anne the project could qualify for about 72% Provincial funding.

CONCLUSIONS

The following conclusions regarding the technical feasibility of regulating Isle Lake and/or Lac Ste. Anne according to lake level objectives recommended for each lake in the 1977 "Interim Report - Sturgeon River Basin Study", or, alternatively, regulating Lac Ste. Anne at level 722.7 m as recommended in 1979 by the Lac Ste. Anne Shore Association, are based on the following assmptions:

i) The use of mean monthly lake levels on Isle Lake and Lac Ste. Anne yields sufficient accuracy for lake regulation planning and recommendations.

ii) Simulated mean monthly lake levels from 1963 to 1977 reasonably approximate levels that actually occurred over this 15 year period.

iii) The ranges and sequences of lake level fluctuations experienced between 1963 and 1977 reasonably describe lake level fluctuation patterns that can be expected to occur in the future. For instance, 1974 represents a major spring runoff event; 1965 and 1971 represent major summer runoff events. The three years from 1968 to 1970 represent an extended dry period with no significant spring or summer runoff.

1. Isle Lake could be regulated with a high degree of success to conform with level target objectives expressed in the 1977 "Interim Report - Sturgeon River Basin Study."

2. Annual maintenance of the outlet channel from Isle Lake free of weeds and obstructions would be a highly unsuccessful technique for regulating Isle Lake within the target level range of 729.4 m and 730.0 m. However, channel clearing during wetter than average years would marginally reduce peak levels and duration of the high runoff events.

3. Regulation of Lac Ste. Anne according to target level objectives outlined in the 1977 "Interim Report - Sturgeon River Basin Study" would only achieve a marginal success.

4. Regulation of Lac Ste. Anne according to the Lac Ste. Anne Shore Association summer target level objective of 722.7 m would only achieve a marginal success.

5. Annual maintenance of the outlet channel from Lac Ste. Anne to free it of weeds and obstructions would, relative to unregulated alternative I, achieve a small net positive effect toward the objective of the Lac Ste. Anne Shore Association and would have a small net negative effect with respect to Lac Ste. Anne target levels expressed in the 1977 "Interim Report - Sturgeon River Basin Study."

6. It is important to note that the two separate target level objectives analysed for Lac Ste. Anne are not compatible with each other, being about 0.4 m apart. Schemes that would partially satisfy one would be counter-productive to the other.

7. There is no apparent concensus as to whether or not Lac Ste. Anne should be regulated or, if so, how it should be regulated.

8. The estimated cost of regulating Isle Lake is about $600,000 (1979).

9. The estimated cost of regulating Lac Ste. Anne is about $480,000 (1979).

10. Isle Lake would not qualify for Provincial cost-sharing. Lac Ste. Anne would qualify for about 72% provincial and 28% local cost-sharing.

RECOMMENDATIONS

Lac Ste. Anne

1. It is recommended that the provincial government not participate in major regulation schemes involving outlet control works and downstream channelization at Lac Ste. Anne.

   Alternatives II or III would not achieve sufficient regulation to justify the expense and the negative downstream effect (primarily at Big Lake). In addition, alternative III regulation could have a negative effect on low lake levels at Lac Ste. Anne.

2. The remnants of the abandoned weir at the outlet of Lac Ste. Anne should remain in place, as it does not control high water levels (downstream channel does) and removal of the sill may aggravate low lake level conditions.

3. Some weed and obstruction removal in the Lac Ste. Anne outlet channel would have a positive influence on beaches, and cottage flooding under certain conditions. However, ongoing channel maintenance, as demonstrated by analysis of alternative VII, may force low lake levels to drop even lower. The ongoing program to maintain the outlet channel free of weeds, debris, beaver dams, etc. should be continued, but only on a selective basis dependent on seasonal lake levels, hydrologic conditions, etc. The maintenance guidelines should be jointly agreed to by the Department and local authorities.

4. It is recommended that Alberta Environment follow-up specific suggestions which arose from local input to the study for such things as marking navigation hazzards, creating openings in the government boat launch pier at Alberta Beach to relieve local water stagnation, etc.

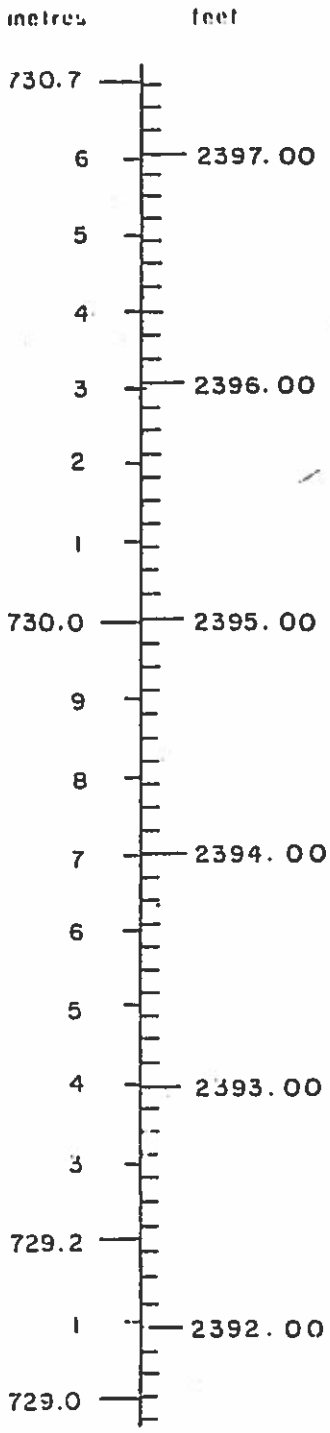
This should be integrated with the ongoing (ERPC) lake management planning process.

Isle Lake

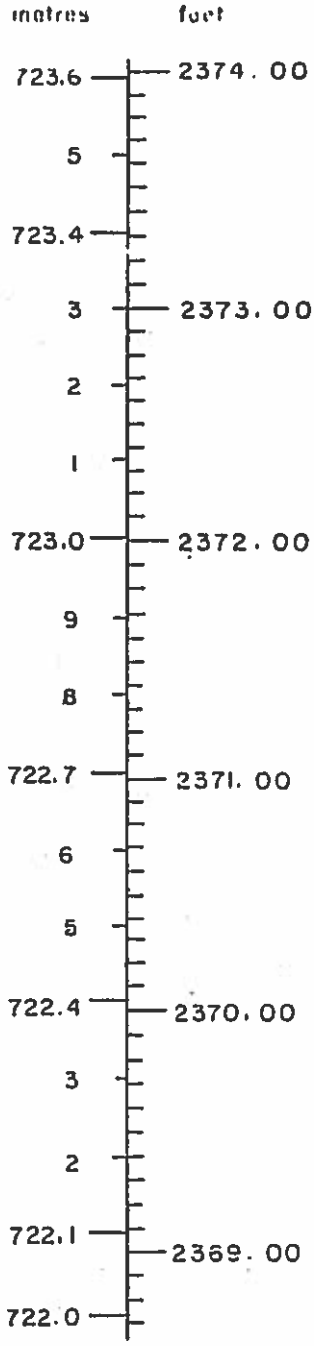
5. From a technical standpoint, it appears feasible to regulate Isle Lake to satisfy to a high degree the target level objectives outlined in the 1977 "Interim Report - Sturgeon River Basin Study." However, with Lac Ste. Anne not regulated, regulation of Isle Lake would somewhat amplify water level problems on Lac Ste. Anne. Further, Isle Lake regulation could have a negative influence at Lac Ste. Anne by amplifying water level fluctuation.

6. Under the cost-sharing policy, the provincial government would not contribute towards major regulation works for Isle Lake under present land ownership.

7. It is recommended that findings regarding the potential pros and cons of regulating Isle Lake be discussed with the municipalities and people involved through the (ERPC) lake management planning program for Isle Lake.

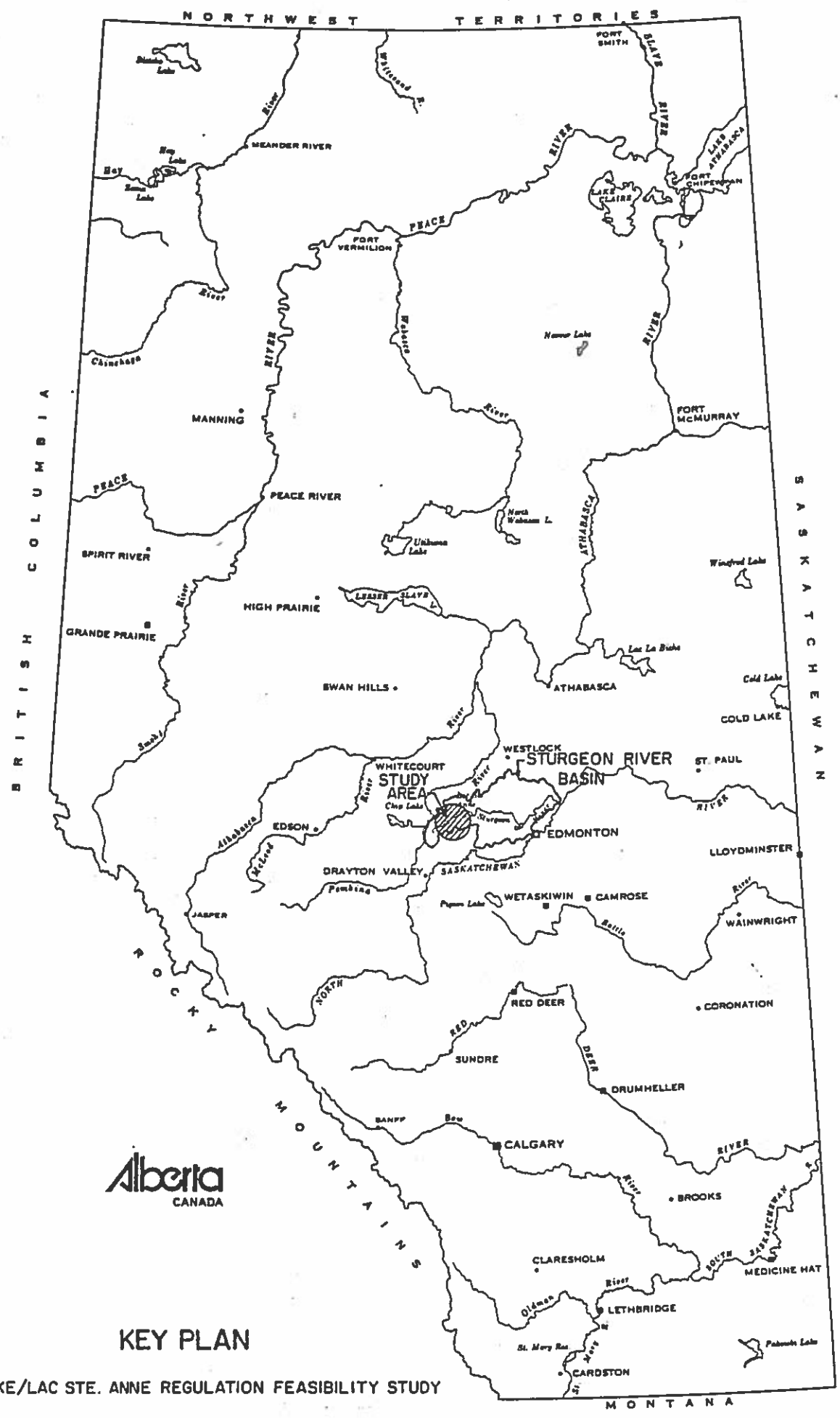


Isle Lake



Lac Ste. Anne

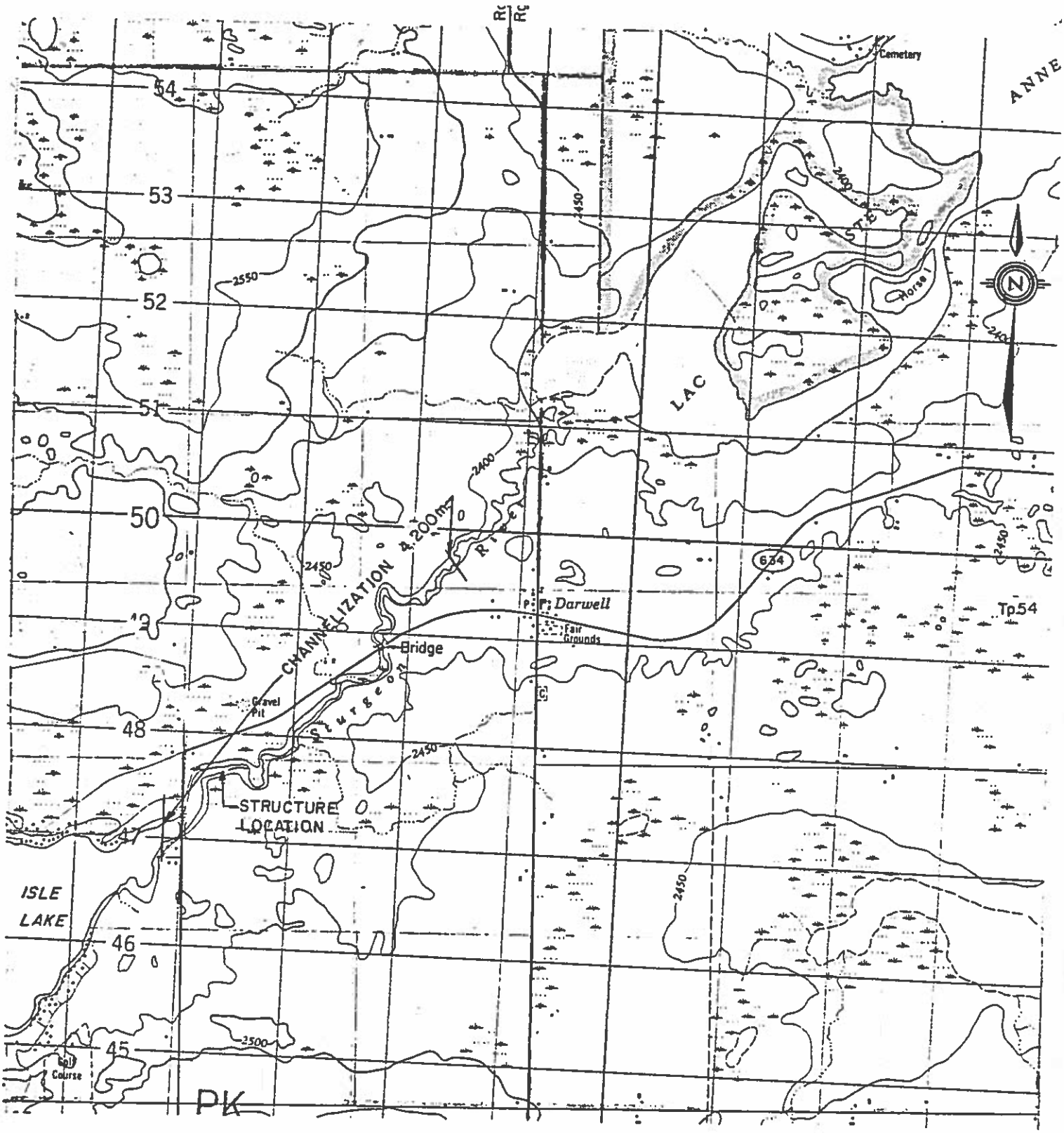
METRIC - IMPERIAL CONVERSION DIAGRAM



KEY PLAN

ISLE LAKE/LAC STE. ANNE REGULATION FEASIBILITY STUDY

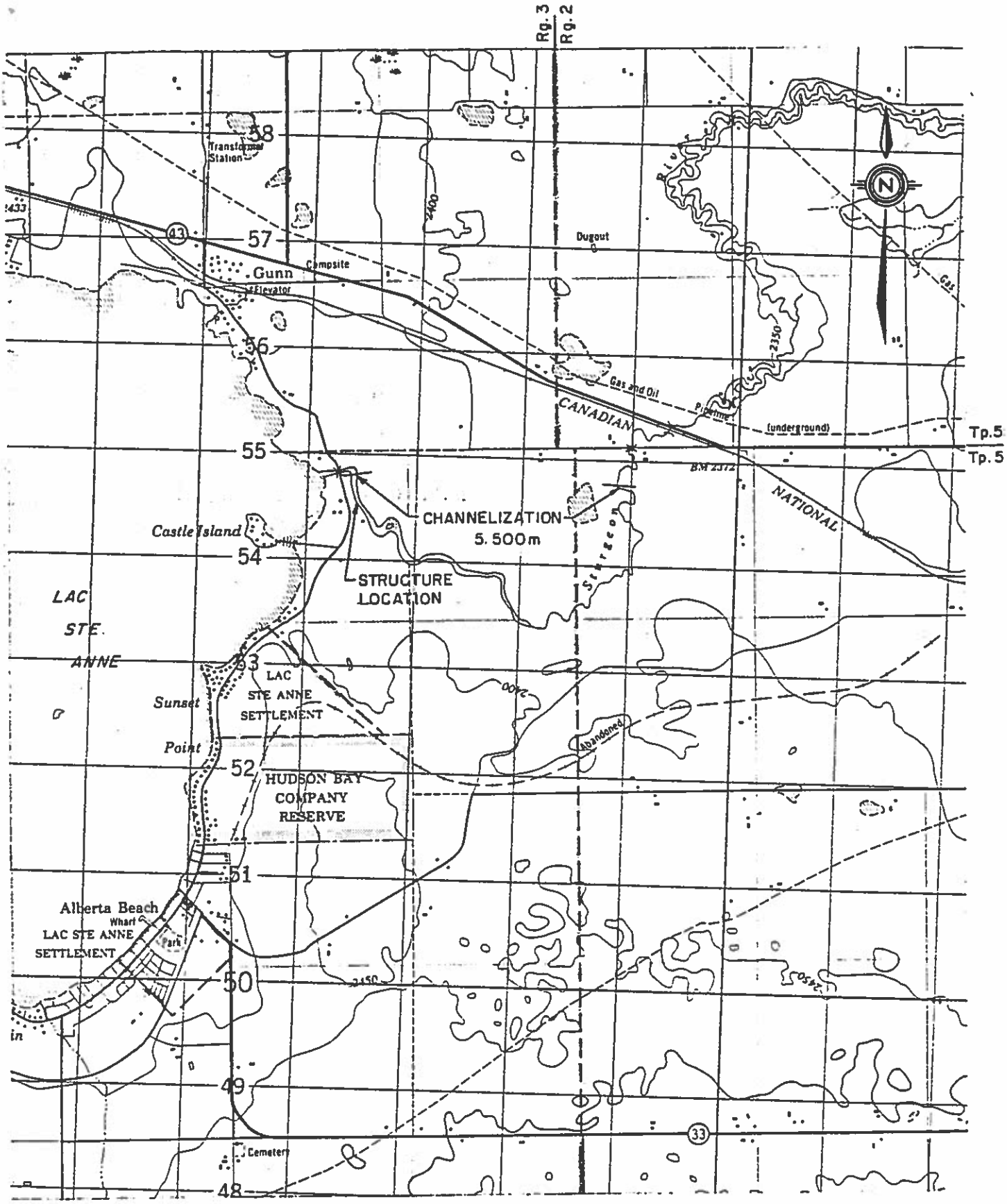
FIGURE 1



ISLE LAKE/LAC STE. ANNE REGULATION FEASIBILITY STUDY

ISLE LAKE POTENTIAL STRUCTURE AND CHANNELIZATION LOCATION

FIGURE 3



ISLE LAKE/LAC STE. ANNE REGULATION FEASIBILITY STUDY

LAC STE. ANNE POTENTIAL STRUCTURE AND CHANNELIZATION LOCATION

FIGURE 4