Plan of Study:

For the Review of the Operating Plan Contained in *Annex A* of the 1989 International Agreement Between the Government of Canada and the Government of the United States of America

Photo credit: Collage developed from images obtained from the USGS library of photographs following the floods in June 2011.

Prepared for
The International Souris River Board
April 2013
by the
2012 Souris River Basin Task Force

International Joint Commission
Canada and United States

Commission mixte internationale
Canada et États-Unis

June 7, 2013

The Honorable John Kerry
Secretary of State
U.S. Department of State
2201 C St. NW
Washington, DC 20520

The Honorable John Baird
Minister of Foreign Affairs
Foreign Affairs and International Trade
Canada
125 Sussex Dr.
Ottawa, ON, Canada
K1A 0G2

Subject: **Plan of Study: For the Review of the Operating Plan Contained in Annex A of the 1989 International Agreement between the Government of Canada and the Government of the United States of America.**

Dear Secretary Kerry and Minister Baird:

The unprecedented flooding in the Souris River basin in 2011 prompted calls from both sides of the border to review the existing agreement that deals with water supply and flood control in the Souris Basin. The governments subsequently requested that the Commission develop a "Plan of Study" (POS) to identify what needs to be done to address this issue. In particular, the focus should be on evaluating the Operating Plan, but also on identifying potential additional measures to help alleviate flooding in the basin. An integral part of this analysis should be to assess the impacts of climate change in light of the increasing magnitude of floods. The International Joint Commission's International Souris River Board established the Souris River Basin Task Force on February 22, 2012 to develop a POS and provide a range of options for addressing this issue. The Board recently submitted its final report to the Commission. There was a 30 day public consultation period, and the input from stakeholders and the public is captured in the report.

The Task Force identified three funding options based on the scope and level of effort required:

1. Minimum Scope - $1.05M
2. Medium Scope - $1.33M
3. Full Scope - $2.14M

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The advantages and limitations of each option are clearly laid out in the Executive Summary of the POS (**Attachment 1**). As proposed in the POS, the work would take two years to complete and the funding should be equally shared between the two countries. The Task Force, after extensive consultations with International Souris River Board, stakeholders and the public concluded that Option 3 should be pursued, as it provides the most comprehensive assessment. The Commission supports this recommendation and encourages the governments to provide a Reference and commit to this level of funding in a timely manner so that this important work can proceed.

This year's flooding in the basin is again severe, and significant public concern is being voiced on both sides of the border. The work that would be carried out under the POS is viewed by the public and other stakeholders, as well as the Commission and our International Souris River Board, as being important for developing a basin-wide strategy aimed at reducing the impacts of severe floods.

Sincerely,

Lana Pollack
Chair
US Section

Joseph Comuzzi
Chair
Canadian Section

Dereth Glance
Commissioner
U.S. Section

Richard Moy
Commissioner
U.S. Section

Attachment

1. Plan of Study: For the Review of the Operating Plan Contained in Annex A of the 1989 International Agreement between the Government of Canada and the Government of the United States of America.

cc.
Russell Boals, Canadian Co-Chair, International Souris River Board
Todd Sando, US Co-Chair, International Souris River Board

EXECUTIVE SUMMARY

Context

The sharing and management of water across the International Boundary between Canada and the United States has its origin in the Boundary Waters Treaty of 1909 between the two countries. The Treaty also established an International Joint Commission (IJC) to have jurisdiction over the use, obstruction or diversion of these waters. Over the decades, various bi-national boards have been established by the IJC to address the management of the trans-boundary waters of the Souris River basin and its major river, the Souris River which is also known locally as the Mouse River. Currently, the International Souris River Board (ISRB) is responsible for ensuring compliance with flow apportionment and low flow measures adopted by the two countries and for performing an oversight function for flood operations in cooperation with the designated entities identified in the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin, including the terms of Annexes A and B of the Agreement and subsequent Amendments to Annexes A and B in 2000. The Board operates under a 2007 Directive from the IJC and reports to the Commission annually.

Unprecedented flooding in the Souris River basin in 2011 has focused attention on review of the Operating Plan contained in Annex A to the 1989 International Agreement. Interests in the basin, particularly in North Dakota, have asked that additional flood protection measures be evaluated, above and beyond what is currently provided under the International Agreement, and that the Operating Plan contained in Annex A of the Agreement be reviewed. In addition, Article V of the Agreement requires that the Operating Plan be reviewed periodically to maximize the provision of flood control and water supply benefits that can be provided consistent with the terms of the Agreement. In light of these facts, the IJC's ISRB established the 2012 Souris River Basin Task Force at its February 22, 2012 meeting in Bismarck, North Dakota to conduct a review of the Annex A Operating Plan for presentation to the Governments of Canada and the United States. Subsequently, members from Federal, State, Provincial, and local agencies were appointed by the ISRB. The Task Force held its organizational conference call under its Terms of Reference (TOR) from the ISRB on April 20, 2012. The ISRB reported to the IJC and the IJC reported to the Governments on the status of Task Force activities at the IJC Semi-Annual Meeting in October of 2012.

The first requirement of the Task Force TOR is the development of a Plan of Study (POS) to conduct the review. This document describes the detailed POS and studies that are needed to review the existing Annex A Operating Plan for the reservoirs comprising the Souris Basin Project described in the 1989 Agreement in Saskatchewan and North Dakota and to evaluate alternatives to maximize flood control and water supply benefits.

Study Objectives and Scope

The POS described herein provides a course of study that will assist the Task Force in meeting its objectives and mandate in reporting to the Board, as well as the periodic Operating Plan review requirements of Article V of the 1989 Agreement. While the first objective and definition of scope focuses on the needs of reviewing the Annex A Operation Plan, the POS goes considerably beyond the context of the Agreement in order to evaluate a greater latitude of alternatives. These alternatives may include evaluating raising existing dams to increase storage during flooding, more efficient channel alignment and capacity, provision of flood control measures in and around vulnerable communities, etc. The alternatives evaluated will be listed in three distinct modes; first, those that clearly fall within the purview of the current operating rules; secondly, those alternatives that will require modifying the operating rules listed in Annex A without changes to the 1989 Agreement; and finally, the alternatives that would require changes to both the Agreement and the operating rules. This will also assist the IJC and the ISRB in addressing the interests and concerns of stakeholders, in better evaluating the range of operating rules currently within Annex A and in determining as to whether the current rules to regulate the system reservoirs could be improved to better meet the interests of stakeholders. The study tasks described in this document have been designed to examine these issues.

The study area will include the entire Souris River basin to its confluence with the Assiniboine River, and will encompass the key water control reservoirs, Rafferty, Alameda, Boundary and Lake Darling. The study will look at the geographical limits of the basin in the provinces of Saskatchewan and Manitoba and the State of North Dakota.

The primary goal of the studies identified in this POS is to enable the IJC to present recommendations for the consideration of the Governments of Canada and the United States on alternatives to the operating rules contained in Annex A of the 1989 agreement to maximize the provision of flood control and water supply benefits in the Souris River basin. Depending on the direction given to the IJC by the Governments, alternatives to be studied may be confined to operating plan revisions consistent with the terms of the Agreement or may also include alternatives for consideration that go beyond the legal bounds of the existing Agreement. Ultimately, these studies are just the first step in a process to inform governments of possible improvements to the operating rules of Annex A. Implementation of any recommendations requiring changes to Annex A must be jointly agreed upon by the Parties to the Agreement see Annex A, p. A-1 and A-36. The Agreement may be amended by mutual agreement of the Parties. (See Article XIII of the Agreement)

Study Approach

Investigating and evaluating water supply and flood control options requires a good understanding of the water resources. Also needed is knowledge of the hydrological and hydraulic processes of the Souris River basin under the current climate regime and climate change. Computer models will be required to generate water supplies and flows for various water supply and flood control options, and methods will be developed to evaluate the effects that these options will have on resource groups defined in the 1989 Agreement. The study and decision making processes will provide opportunity for public participation in all aspects of the study. The study will employ the most current science, and will engage relevant experts from governments, industries, academic community, First Nations/Native Americans and the public. Efforts will be made to ensure coordination and compatibility with ongoing undertakings of various agencies who are conducting investigations that will complement this effort.

Public Participation

Public participation is a critical element in reviewing the Operating Plan. The formation of a Public Advisory Group is recommended. Public meetings, issuing of newsletters and operation of an internet site are suggested to be part of the public participation process.

Assessing Souris Basin Project Reservoir Operating Rules

The study to improve the outflow regulation of the key system reservoirs includes:

- Review of current rules from the 1989 Agreement and Annexes A and B governing the systemic regulation of outflows, water supply, apportionment and low flow.
- Assessment of how systemic regulation and the operation of the reservoirs affect water levels and flows in the Souris River system.
- Identification of potential updates and improvements to the criteria, requirements, operating rules and outflow limits as well as incorporating operating experience into the Operating Plan.
- Testing of alternative operating rules and their performance under stochastic water supplies and climate change scenarios.

The Affected Resources

To determine whether the water management options to be explored in this study meet contemporary and emerging needs in a sustainable manner, evaluations of their impacts on the various resources of the system are required. The evaluation of water supply and flood control options will focus on resources described in the 1989 Agreement.

Study Organization

A Study Manager reporting to the ISRB is proposed to lead the study and to manage financial, administrative and the day-to-day operations of the study. Under the direction of the Study Manager, the Task Force will establish technical groups to generate water supply, flow and outflow information under the various water management options as well as resource groups to evaluate the impacts of these options on the system's resources. A Public Advisory Group is also proposed to advise the Task Force on issues and concerns as they relate to the resources.

Study Schedule and Cost

The tasks defined in this POS are designed in a modular form with three levels of effort, optimal scope, minimum scope and medium scope with overall study cost depending upon which level of effort is selected. The cost of the study for the various effort levels ranges from just over $1 M dollars for the minimum scope effort to slightly over $2.1 M for the optimal scope effort. The study is planned to span a two-year period from the time authorization is received to proceed. Where possible, the study plans to leverage ongoing and existing work being carried out by other agencies in the basin. Beyond this leveraging, it is assumed that the remaining cost will be split equally between the two governments.

Optimal Scope and Associated Cost

The optimal scope and associated cost is shown in **Table 1**. This level of effort provides a broad review and the necessary elements for an IJC Reference level study and is the best solution given its relatively long shelf life of about 20 years and adaptive nature of the regulation plans that will emanate from its products. Seventeen projects detailed in **Section 5** were carefully designed in a modular approach and feature detailed stochastic and climate change analysis, operation and system modelling, and a facilitated expert workshop. Nonetheless, this level of effort is the most costly alternative with an overall study cost of about $2.1 M.

Table 1 - Overall Costs of the Annex A Operating Plan Review for Optimal Scope

Study Overall Costs Including Technical Studies – Optimal Scope				
No.	**Activity**	**Year 1, $K**	**Year 2, $K**	**Total, $K**
1	Work Group Management	120	215	335
2	Task Force Reviews	45	0	45
3	Data Work Group	80	10	90
4	Hydrology & Hydraulics Work Group	350	120	470
5	Plan Formulation & Evaluation Group	185	500	685
6	Public Advisory Group	40	60	100
7	Communications and Outreach	40	60	100
8	Information Management	40	60	100
9	Peer Review Process	15	35	50
10	Study Coordination	75	85	160
	Total	**990**	**1145**	**2135**

Minimum Scope and Associated Cost

The minimum scope and associated cost is shown in **Table 2**. This level of effort provides a more narrow review with a limited shelf life of less than 10 years allowing only a limited number of alternative operating plans that can be evaluated. The number of projects with this scope is reduced to twelve. This reduction is achieved by eliminating some projects, merging some studies, and reducing the scope of others from among the seventeen projects detailed in **Section 5**. In this scope no optimization modelling, climate change modelling or facilitated expert workshop are considered, although a limited un-facilitated expert workshop is included. Optimization of the Operating Plan at the minimum scope will rely on the trial and error technique of the simulation modelling process. The minimum scope is the least costly alternative with an overall study cost of about $1.0 M.

The advantages and disadvantages of the minimum scope versus the optimal scope are listed immediately following **Table 2**.

Table 2 - Overall Costs of the Annex A Operating Plan Review for Minimum Scope

Study Overall Costs including Technical Studies – Minimum Scope				
No.	**Activity**	**Year 1, $K**	**Year 2, $K**	**Total, $K**
1	Work Group Management	40	70	110
2	Task Force Reviews	25	0	25
3	Data Work Group	50	5	55
4	Hydrology and Hydraulics Work Group	200	40	240
5	Plan Formulation & Evaluation Group	55	200	255
6	Public Advisory Group	25	40	65
7	Communications and Outreach	25	40	65
8	Information Management	25	40	65
9	Peer Review Process	15	30	45
10	Study Coordination	50	70	120
	Total	**510**	**535**	**1045**

Advantages:

1. From a cost consideration standpoint, there is a likelihood funds could be made available from the IJC.
2. The total outlay for each of the two years is just over one-half million dollars to be shared equally by the United States and Canada.
3. The studies are likely concentrated in fewer agencies, enabling quality control and low administration costs.

Disadvantages:

1. The study is limited in scope and will have a short shelf life of less than 10 years and may require rerunning the models.
2. The study will not address the basin response under wet supply sequences for triggers to evaluate contributions from drainage areas that normally do not yield flows during average run-off seasons.
3. The scope of the study is narrow to the point that climate change impacts on regulation are not studied.
4. It will not be known if the study overlooked a better regulation plan based on an optimization approach.
5. Given the reduced budget, only a limited number of alternative plans can be evaluated and may not address the full objective of this exercise of evaluating Annex A of the Agreement.
6. The minimum cost study will limit scoping exercises, workshops and strategy sessions among the key players.
7. The limited budget may not be conducive for agencies that allow participation with full cost recovery.

Medium Scope Effort and Cost

The medium scope and associated cost is shown in **Table 3**. This level of effort provides a middle course for a decent simulation-based modelling study with a medium shelf life of 10 to 15 years, but limited in scope with respect to the number of candidate regulation plans that can be considered. The number of projects in this model is reduced to thirteen. Some of this reduction is achieved by eliminating some projects, merging some studies, and reducing the scope of others from among the seventeen projects detailed in **Section 5**. In this scope no optimization modelling, climate change modelling or facilitated expert workshop is considered (although a limited un-facilitated expert workshop is included). Obtaining an optimized Operating Plan at the medium scope level of effort will rely on the trial and error techniques of system modelling. The medium scope, with an overall study cost of about $1.3 M, is only slightly more costly than the least costly alternative and significantly less costly than the most expensive alternative.

In terms of reviewing the Annex A Operating Plan, the options listed under the medium scope projects are required. The advantages and disadvantages of the medium scope versus the optimal scope are listed immediately following **Table 3**.

Table 3 - Overall Costs of the Annex A Operating Plan Review for Medium Scope

Study Overall Costs including Technical Studies – Medium Scope				
No.	**Activity**	**Year 1, $K**	**Year 2, $K**	**Total, $K**
1	Work Group Management	60	100	160
2	Task Force Reviews	30	0	30
3	Data Work Group	55	10	65
4	Hydrology and Hydraulics Work Group	265	80	345
5	Plan Formulation & Evaluation Group	70	260	330
6	Public Advisory Group	30	50	80
7	Communications and Outreach	30	50	80
8	Information Management	30	50	80
9	Peer Review Process	10	20	30
10	Study Coordination	60	70	130
	Total	**640**	**690**	**1330**

<u>Advantages:</u>

1. From a cost consideration, this is a middle course for decent a simulation- based modelling study.
2. The study will address the basin response under wet supply sequences for triggers to evaluate contributions from drainage areas that normally do not yield flows during average run-off seasons.
3. The total outlay each of the two years is $285K above the minimum scope to be shared equally by the United States and Canada.

4. The studies are likely still to be concentrated in fewer agencies enabling, quality control and low administration costs.

Disadvantages:

1. The study is limited in scope with respect to the number of candidate regulation plans that can be considered, will have a medium shelf life (10 to 15 years), and may require rerunning the models.
2. The scope of the study is narrow to the point that climate change impacts on regulation are not studied.
3. It will not be known if the study overlooked a better regulation plan based on an optimization approach.
4. Given the reduced budget, the number of different regulation plans that can be evaluated will be limited.
5. The medium scope study will still limit scoping exercises, workshops, and strategy sessions among the key players.
6. The limited budget may not be conducive for agencies that allow participation with full cost recovery.

Reductions to Study Overall Costs

Several of the projects identified for each of the scoping models are currently being accomplished by the USACE, St. Paul District for the IJC as part of an IJC effort to assist the work of the Task Force. These efforts will reduce the overall study costs presented in this Plan of Study for each of the scoping models with a reduction of $145K for the optimal scope, $125K for the minimum scope and $140K for the medium scope. Details of these reductions can be found in **Table 10-10** of this Plan of Study.

Public Consultation on the Final Plan of Study

An integral component in the development of Plan of Study for all IJC's projects is the inclusion of public comments. To meet this objective the ISRB planned, designed and conducted a public and stakeholder input process. The public consultation process did not identify any gaps in the proposed scope of work or requirements for additional analysis. No changes are, therefore, necessary in the core chapters 4 to 10. The submissions, however, favoured that the funding level should be considered at the optimum level of $2.14 M to allow for a more thorough analysis.

Recommendations

Based on the three alternatives presented, while the optimal scope plan with all projects is the best solution for its shelf life of about 20 years, adaptive nature of the regulation plans that will emanate from its products, the medium scope solution should be considered as the minimum required to fully test the Operating Plan alternatives. ***The ISRB, taking into consideration the input and requests from the public for a more comprehensive analysis, agreed to recommend the review of the operating plan at the optimum level at a cost of $2.14 M to be shared equally by the US and Canada.***

Regardless of the POS alternative selected, the results of the studies conducted under that POS will be clearly summarized. Based upon the guidance given to the IJC by the Governments, this summary will identify any recommended changes to Annex A (Operating Plan) that are within the terms of the 1989 International Agreement and may also include alternatives for consideration and that would require changes to the existing Agreement. -for which the approval of the Governments of Canada and the United States will be required for implementation.

The Task Force is grateful for the considerable advice and many comments collected from members of the International Souris River Board, the participants at the Charette meeting and at the Technical workshop arranged by North Dakota State Water Commission and other government and academic experts. Their input has helped toward making this document possible.

Respectfully submitted by the Souris River Basin Task Force:

Ed Eaton, U.S. Army Corps of Engineers, St. Paul District (Task Force Co-lead, United States) to December 2012
Scott Jutila, U.S. Army Corps of Engineers, St. Paul District (Task Force Co-lead, United States) from January 2013
Martin Grajczyk, Saskatchewan Water Security Agency (Task Force Co-lead, Canada)
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Syed Moin (Consultant, International Joint Commission)
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AHPS	Advanced Hydrologic Prediction Service
AMC	Antecedent Moisture Conditions
ARIMA	Auto Regressive Integrated Moving Average
ARMA	Auto Regressive Moving Average
BOC	Basis of Comparison
DEM	Digital Elevation Model
EC	Environment Canada
FEMA	Federal Emergency Management Agency
HEC	Hydrologic Engineering Center
HEC-ResPRM	Prescriptive Reservoir Model
HEC-ResSim	Reservoir Simulation Model
HMS	Hydrologic Modeling System
IJC	International Joint Commission
IM	Information Management
ISRB	International Souris River Board
IUGLS	International Upper Great Lakes Study
IWI	International Watersheds Initiative
IWR	Institute for Water Resources
MOU	Memorandum of Understanding
MREFP	Mouse River Enhanced Flood Protection Project
MWS	Manitoba Water Stewardship
NCRFC	North Central River forecast Center
NDDH	North Dakota Department of Health
NDSWC	North Dakota State Water Commission
NGO	Non-Governmental Organization
NWS	U.S. National Weather Service
PAG	Public Advisory Group
POS	Plan of Study
RAS	River Analysis System
RCM	Regional Climate Modelling
SWA	Saskatchewan Watershed Authority
TOR	Terms of Reference
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WSA	Saskatchewan Water Security Agency

1 INTRODUCTION

The sharing and management of water across the International Boundary between Canada and the United States has its origin in the Boundary Waters Treaty of 1909 between the two countries. The Treaty also established an International Joint Commission (IJC) to have jurisdiction over the use, obstruction or diversion of these waters. Over the decades various bi-national boards have been established by the IJC to address the management of the trans-boundary waters of the Souris River basin and its major river, the Souris River which is also known locally as the Mouse River. In more recent times, the IJC combined the ongoing responsibilities of the International Souris River Board of Control and the Souris River responsibilities of the International Souris-Red Rivers Engineering Board into the International Souris River Board (ISRB). The Board operates under a 2007 Directive from the IJC and reports to the Commission annually. The Board is responsible for ensuring compliance with flow apportionment and low flow measures adopted by the two countries and for ensuring that the terms of the 1989 International Agreement for Water Supply and Flood Control in the Souris River Basin, including the terms of Annexes A and B of the Agreement and subsequent Amendments to Annexes A and B in 2000, are met. The terms of the 1989 Agreement including Annexes A and B can be found in **Appendix A** or at http://www.ijc.org/rel/pdf/1989-10-26SourisRiverFloodControlAgreement.pdf, while the 2000 amendments to Annexes A and B can be found in **Appendix B**.

The Souris River originates in Canada, in the Province of Saskatchewan, crosses the International Boundary into the United States and passes through the State of North Dakota, and then again crosses the International Boundary into Canada joining the Assiniboine River in the Province of Manitoba. The river valley is flat and shallow, and the basin's semi-arid prairie landscape has been extensively cultivated. Major reservoirs have been constructed in both Canada and the United States, including Boundary, Rafferty and Alameda Reservoirs in Saskatchewan, and Lake Darling in North Dakota. The basin also includes a number of wildlife refuges and small impoundments along the North Dakota portion of the river.

The unprecedented flooding in the Souris River basin in 2011 has focused attention on review of the Operating Plan contained in Annex A to the 1989 International Agreement for Water Supply and Flood Control in the Souris River Basin between Canada and the United States. Interests in the basin, particularly in North Dakota, have asked that additional flood protection measures be evaluated, above and beyond what is currently provided under the International Agreement. With respect to review of the Operating Plan, the ISRB established the 2012 Souris River Basin Task Force at its February 22, 2012 meeting in Bismarck, North Dakota to conduct the review. Subsequently, members from Federal, State, Provincial, and local agencies were appointed by the ISRB. The Task Force held its organizational conference call under its Terms of Reference (TOR) from the ISRB on April 20, 2012.

The Terms of Reference for the Task Force were finalized by the Board on March 28, 2012. Under the TOR the Task Force was charged to conduct a review of the Operating Plan contained in Annex A for presentation to ISRB and IJC; to evaluate the impacts that changes to the Operating Plan will have to downstream interests; and to facilitate collaboration amongst the various Federal, State, Provincial, and local agencies undertaking actions as the result of the 2011 flood and to provide for public and local government consultation.

Although the review came about as the result of a flood event and the flood control aspect of the Operating Plan has taken center stage, the Operating Plan review will also look at and consider the low flow, apportionment, water quality and aquatic ecosystem health aspects of the Operating Plan for improvement and the impacts to these areas from any recommended changes to the Operating Plan. It must be emphasized that the Souris Basin Project is a multi-purpose project in a semi-arid climate zone. By definition 90 percent of years are less than the 1:10 event flood operation trigger of the 1989 Agreement. This review will also consider in detail how the 1989 Agreement and Souris Basin Project have performed during low flow years.

Subsequently, the Task Force has set about the initial task of its TOR to develop this Plan of Study (POS) to define the process for fulfilling its TOR. This document represents the draft of the POS which will be available for public consultation and comment.

This POS provides background information in **Section 2** on the Souris River basin, key reservoirs in the basin the Souris Basin Project for water supply and flood control, a summary of the 2011 flood hydrology, the 1989 Agreement and the establishment of the Task Force by the ISRB and review of the Operating Plan contained in Annex A. Background information is also provided on work efforts by agencies/others in the basin in response to the 2011 flood.

This POS provides the scope and objectives for the review in **Section 3**. This POS is discussed in terms of studies and activities to be performed and level of detail anticipated, available capacity for accomplishment of needed studies or activities, sources of needed information, work priorities and scheduling, human and financial resources, and stakeholder engagement in Canada and the United States.

Section 4 of this POS identifies a communication plan for the conduct of the review by establishing a separate communications group for handling all the communication efforts, both within the study itself, as well as externally. Communications will be accomplished through a variety of means, including public meetings, workshops, conference presentations, newsletters, email, and the Internet.

The study methodology for accomplishing the TOR is developed in **Section 5** and broadly consists of developing a framework to carry out the analyses of the review, including harmonizing/ reconstructing/coordinating the physical data, hydrology and system hydraulics for accomplishing model studies, projects and review of the operation plan aimed at delivering the objectives and tasks assigned to the Task Force by the ISRB. This work includes a literature review, identification of 2011 flood-related work initiatives being done by others and a gap analysis of this work to supplement the work of the Task Force, hydrological and hydraulic analysis, establishment of a modeling team, impact analysis of Operating Plan changes and reporting. The results of the studies will be summarized clearly identifying any changes that are within the present International Agreement and those that go beyond the present agreement, which will require approval by the Governments of Canada and the United States, prior to any implementation. This POS is a broad “plan of study” to leverage the work being done by others, to identify gaps in that work with respect to needed work identified by the Task Force and to identify and engage those entities best place to fill those gaps.

The organizational structure for accomplishing the work of this POS is given in **Section 6** and includes various work groups to engage in the areas of data and information management, hydrology and hydraulics, operation plan formulation and evaluation, results integration and report production.

Principles for the management of information connected to this POS and its recommended projects, including transparency, preserving artifacts and unrestricted access along with decision mapping can be found in **Section 7**. A peer review process is presented in **Section 8**, while the establishment of a Public Advisory Group is discussed in **Section 9** to work closely with the Task Force and provide valuable input and insights to the progress of Task Force work.

A summary of three budget options for this POS is provided in **Section 10**. These budget options range from a minimum scope level of effort approach to a more extensive optimal scope level of effort approach, with the main differences in cost being associated with the extent to which optimization modeling and climate change water supplies are considered, the number of computer runs for the Stochastic hydrology components and the number of alternative operating plans that can be developed and tested.

This POS is not a compilation of detailed individual study plans for projects identified in this paper. In this context, project descriptions and cost estimates provided by the Task Force in this POS are briefly stated with first order cost estimates. The goal is that these brief project descriptions and first order cost estimates will be sufficient for funding decisions by the IJC and the governments of Canada and the United States. The Task Force expects that researchers/agencies that pursue POS recommended studies to fill gaps in current work will subsequently develop individual detailed study plans proposals and more precise study costs for consideration by the ISRB, the IJC and governments.

2 BACKGROUND

2.1 Basin and Reservoir Information

The Souris River has its headwaters in the Province of Saskatchewan and flows generally in a southeasterly direction past the cities of Weyburn and Estevan, crossing the International Boundary into the State of North Dakota near Sherwood, North Dakota. The river continues its southeasterly course, flowing through the City of Minot and on to the City of Velva, North Dakota, where it reverses course and flows northwesterly to the International Boundary once more and into the Province of Manitoba near the Town of Boissevain, Manitoba. The river then flows north to the Town of Melita and then generally in a northeasterly direction past the Town of Souris and Village of Wawanesa and into the Assiniboine River, a tributary of the Red River of the North. **Figure 2-1** shows the Souris River basin and key tributaries.

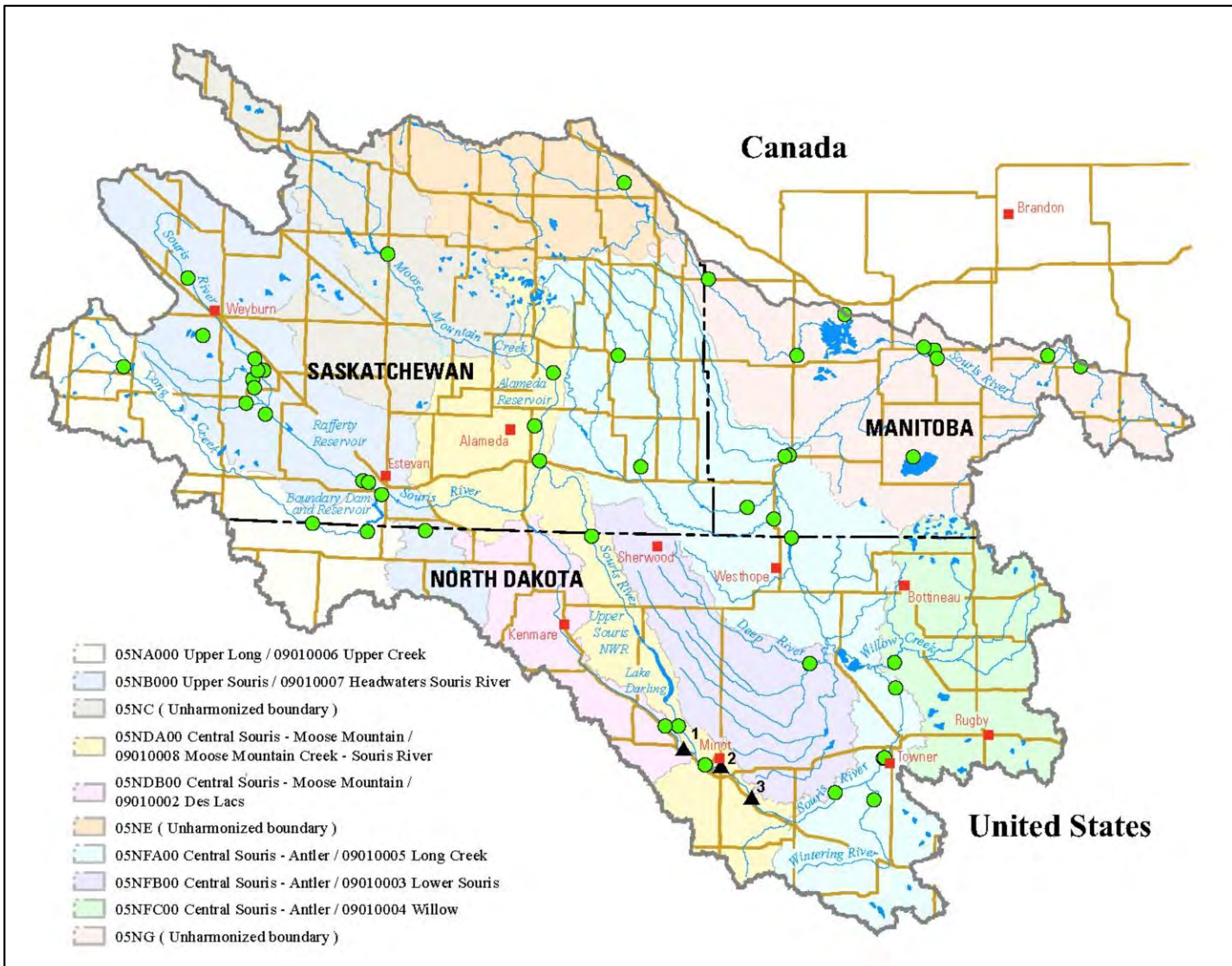

Figure 2-1 Souris River Basin and Key Tributaries

The Souris River valley was formed primarily by glacial melt water, and thus is oversized for the modern river which now meanders at the valley bottom. Flat and shallow, the valley has been extensively cultivated, as the river only spills out of the banks of the modern river and onto the flood plain during flood flows.

Major reservoirs have been constructed in both Canadian and United States portions of the basin, including Boundary, Rafferty and Alameda reservoirs in Saskatchewan, and Lake Darling in North Dakota. Boundary, Rafferty and Alameda reservoirs in Saskatchewan are operated by the Saskatchewan Water Security Agency (WSA) which was known as the Saskatchewan Watershed Authority (SWA) prior to October 1, 2012. Lake Darling is operated by the U.S. Fish and Wildlife Service (USFWS) during non-flood periods and by the U.S. Army Corps of Engineers (USACE) during times of flood threats and/or floods. These major reservoirs are shown in **Figure 2-2**.

Figure 2-2 Major Reservoirs in the Souris River Basin

The basin also includes a number of wildlife refuges and small impoundments along the U.S. portion of the river. The USFWS operates three national wildlife refuges located on the Souris River in North Dakota. The Upper Souris National Wildlife Refuge is located near the Town of Foxholm, North Dakota, upstream of the City of Minot. J. Clark Salyer National Wildlife Refuge is located near the Town of Upham, North Dakota, downstream of the City of Towner. Des Lacs National Wildlife Refuge is located on the Des Lacs River, a tributary of the Souris River, near the City of Kenmare, North Dakota.

All of the major storage impoundments in the Souris River basin in North Dakota are located on the national wildlife refuges and are operated by the USFWS under water right permits issued by the State of North Dakota.

2.2 2011 Flood Hydrology Summary

The 2011 flood in the Souris River basin has proven to be the largest flood of record in the last century and far surpasses any previous recorded floods. As a result, significant damage was experienced throughout the basin, with the water management systems and control structures in the basin severely tested. In addition to extensive flooding along the Souris River, significant flooding also occurred on the Assiniboine River in Manitoba, to which the Souris River is a tributary, entering just downstream of the City of Brandon.

The 2011 flood event in the Souris River Basin set records for peak flows and flow volumes along the entire length of the Souris River. **Tables 2-1 and 2-2** show the top ten annual flow volumes expressed in acre-feet and cubic decametres, respectively, for specified durations at the Sherwood, North Dakota International Crossing. **Table 2-3** shows the top ten peak flows (mean daily) at the Sherwood, North Dakota International Crossing.

Table 2–1 Souris River near Sherwood, 2011 Annual Flow Volumes of Various Durations

April - July Total Volume		Max. 31-Consecutive Day Water Year Volume		Annual Water Year Volume	
Year	ac-ft	Year	ac-ft	Year	ac-ft
2011	1,415,049	2011	718,880	2011	1,641,064
1976	576,621	1976	408,998	1976	637,031
1975	365,892	1979	294,748	1979	381,416
1979	363,558	1975	273,207	1975	379,339
1974	303,715	1969	250,568	1974	307,548
1969	288,476	1974	223,957	1969	297,767
1948	243,038	1948	217,578	1999	269,643
1955	234,456	1943	165,813	1930	261,425
1999	225,350	1982	142,306	2001	251,747
1943	200,581	1955	130,594	1948	249,945

Source: U.S. Army Corps of Engineers, St. Paul District

Table 2–2 Souris River near Sherwood, 2011 Annual Flow Volumes of Various Durations

April - July Total Volume		Max. 31-Consecutive Day Water Year Volume		Annual Water Year Volume	
Year	$dams^3$	Year	$dams^3$	Year	$dams^3$
2011	1,744,755	2011	886,379	2011	2,023,432
1976	710,973	1976	504,294	1976	785,459
1975	442,548	1979	363,424	1979	470,285
1979	448,267	1975	336,864	1975	467,725
1974	374,480	1969	308,950	1974	379,206
1969	355,690	1974	276,139	1969	367,146
1948	299,665	1948	268,273	1999	332,469
1955	289,084	1943	204,447	1930	322,337
1999	277,856	1982	175,463	2001	310,404
1943	247,316	1955	161,022	1948	308,182

Source: U.S. Army Corps of Engineers, St. Paul District

Table 2–3 Souris River near Sherwood, Highest 10 Recorded Peak Mean Daily Flows

Year	Peak Flow (ft^3/s)	Peak Flow (m^3/s)
2011	28,500	800
1976	13,800	390
1979	8,470	240
1948	7,380	210
1975	6,740	190
1975	6,280	180
1943	5,330	150
1955	5,010	140
1982	3,850	110
1956	3,530	100

Source: Saskatchewan Water Security Agency

On a volume basis, the 2011 flood event was 2.5 times greater than the previous flood of record which occurred in 1976. Expressed in another way, the volume of flow in 2011 was greater than the combined volume of flow from the three greatest floods previously recorded, 1976, 1975 and 1979. The 2011 spring peak at Sherwood would have been in the order of 600 m^3/s; however it was attenuated to 100 m^3/s by flood control storage in the Canadian reservoirs. The 2011 summer peak was 800 m^3/s or approximately 16 times larger than the maximum summer peak experienced in the previous recorded history.

The spring snowmelt portion of the 2011 Souris River flood event was an approximate 100-year (1 percent chance) event that equaled the design capacity of the Souris Basin Project. In addition, a series of rainfall runoff events through May and June culminated in mid-June with several days of rainfall that produced a record runoff in the basin that was well beyond the one percent frequency. Prior to 2011 (in recorded history), the 1982 flood event is the only year in which a large magnitude rainfall runoff event occurred after the end of April. However, the series of rainfall events and their magnitudes that occurred through May and June in 2011 is unprecedented.

In 2011, the Souris Basin Project performed well for the 100-year snowmelt runoff for which it was designed. Similarly, it is anticipated that the Project will perform equally well for a 100-year rainfall runoff event. However, the volume (and peak flows) generated by a series of rainfall events through May and June in 2011, culminating in the major rainfall event of June 17-25, far exceeded the one percent probability, exceeding the design capacity of the Project. These rainfall events occurred at a time when all the flood control reservoir impoundments in the basin were already full to capacity from the spring runoff event. The combined probability of the May – June rainfall events and the 100-year snowmelt event makes the 2011 event an extremely rare event. The result was major flooding along the entire reach of the Souris River, including the City of Minot which experienced over $620 million in flood damages.

In contrast to the high volume runoff years shown above in **Tables 2-1 and 2-2**, the annual flow volume at Sherwood is less than 50,000 dam^3 in 50 percent of all years. In 10 percent of all years, the annual flow volume is less than 10,000 dam^3 and approximately every 40 years the flow volume is negligible. The ten lowest runoff volume years of record are given in **Table 2-4**.

Table 2–4 Souris River near Sherwood, ND - Ten Lowest Annual Runoff Volumes

Year	Annual Flow Volume (ac-ft)	Annual Flow Volume (dam^3)
1988	360	450
1937	1,100	1,400
1931	1,400	1,700
1940	1,900	2,300
1961	4,000	4,900
1932	5,900	7,200
1990	5,900	7,200
1945	8,100	10,000
1977	8,700	10,700
1935	8,800	10,900

2.3 Souris Basin Project

Pursuant to the terms of the 1989 International "Agreement between the Government of Canada and the Government of the United States of America for Water Supply and Flood Control in the Souris Basin," flood control along the Souris River is afforded by the operation of several reservoirs in Canada and the United States, collectively known as the "Souris Basin Project". This term refers to the development and operation of the Rafferty and Alameda reservoirs, Boundary Diversion Channel and operation of the existing Boundary reservoir in Saskatchewan and the operation of the existing Lake Darling reservoir in North Dakota for flood control. Rafferty reservoir, Boundary reservoir, and Alameda reservoir are known collectively as the "Canadian reservoirs." The project also includes a number of rural and levee improvements along the Souris River in North Dakota and improvements to other USFWS Service refuge structures in North Dakota. **Figure 2-3** shows a map of the Souris River Basin Project for flood control.

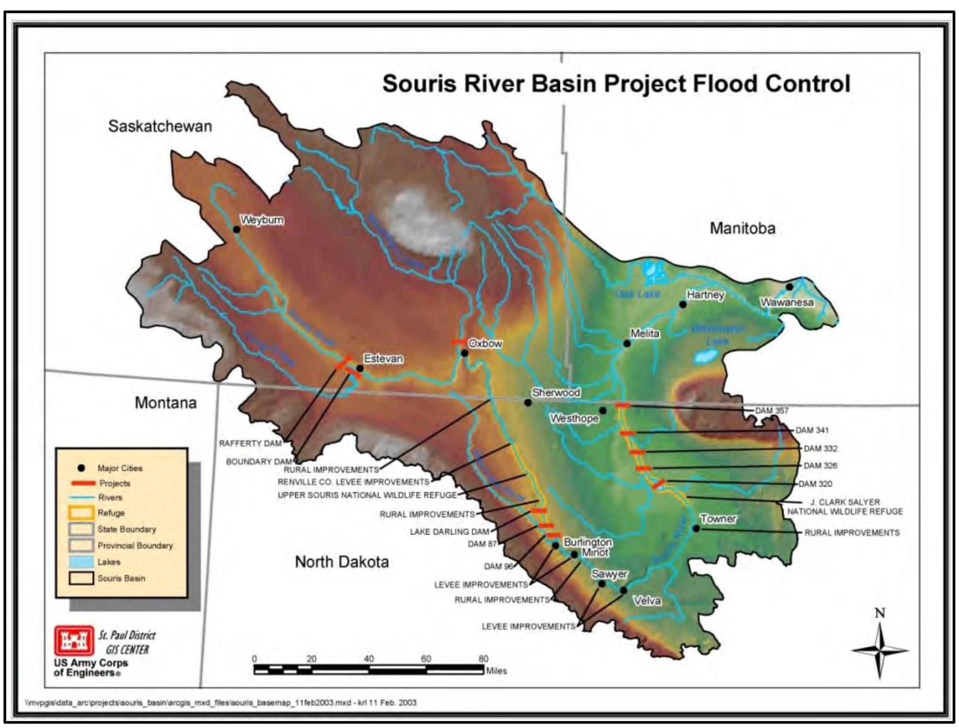

Figure 2-3 Souris River Basin Project for Flood Control

2.4 Designated Entities

Under Article X of the 1989 Agreement, the Government of Canada designates the Government of Saskatchewan as the Canadian entity responsible for construction, operation and maintenance of the improvements mentioned in the Agreement in Canada. The Government of the United States of America designates the Department of the Army as the entity responsible for operating the improvements mentioned in the Agreement in the United States for flood control. The day-to-day flood control responsibilities for the Canadian reservoirs rest with the Saskatchewan Water Security Agency (WSA) and for Lake Darling with the U.S. Army Corps of Engineers (USACE) in the United States.

It is noted here that the flood control responsibilities of the WSA were previously designated to the Saskatchewan Watershed Authority, prior to October 1, 2012, and to Sask Water prior to the Saskatchewan Watershed Authority Act of 2005.

The Government of the United States of America designates the Department of the Interior (and ultimately the USFWS as the entity responsible for operating the improvements mentioned in the Agreement in the United States during non-flood periods. A June 2, 1989 Memorandum of Understanding (MOU) between the USFWS and the USACE formalized and established the procedures, administration, cooperation and coordination between the two agencies for operation of Lake Darling for flood control purposes under the 1989 International Agreement and for identification and remediation of adverse impacts of the Souris Basin Project to fish and wildlife resources, refuge facilities and operations on the Upper Souris River and J. Clark Salyer National Wildlife refuges.

Under Article V of the 1989 Agreement the Parties (through their "designated entities") shall jointly review the Operating Plan contained in Annex A at five-year intervals, or as mutually agreed, in an effort to maximize the provision of flood control and water supply benefits that can be provided consistent with the terms of the Agreement. The Parties shall cooperate and consult, as necessary, with interested states, provinces, and agencies on the review of the Operating Plan and recommend changes in the Operating Plan.

2.5 *Annex A* Operating Plan

Annex A of the 1989 International Agreement outlines an Operating Plan for Rafferty, Alameda, Boundary and Lake Darling reservoirs and defines flood and non-flood operations. Sections of Annex A were modified and/or completely eliminated under the 1989 Interim Measures as Modified and agreed to by the senior levels of government in 2000. In accordance with the Operating Plan for the Canadian reservoirs and Lake Darling, contained in Annex A, Section 4.2, of the 1989 International Agreement, flood control operation of the Souris Basin Project is triggered if a February 1st or subsequent spring runoff estimate shows a reasonable chance (50 percent) of a runoff volume at Sherwood Crossing being equal to or greater than a 10-percent (1 in 10 years) flood, then operations will proceed on the basis of the flood Operating Plan. Flood operation will cease when flood volumes have been discharged and streamflows are at or below 500 cfs at Minot. If a February 1 or subsequent spring runoff estimate shows a reasonable chance (50-percent) of a runoff event less than a 10-percent (1 in 10 years) flood, then operations will proceed on the basis of the non-flood Operating Plan. In addition, under Section 4.3, the operation of the Souris Basin Project will be as per Flood Operations if a February 1st or subsequent spring forecast shows a reasonable chance (50-percent chance) of a 30-day unregulated runoff volume at the Sherwood Crossing equaling or exceeding 175,200 ac-ft (216,110 dam^3), a 10-percent (10-year) flood volume, and/or the local 30-day runoff volume at Sherwood Crossing equaling or exceeding 30,000 ac-ft (37,000 dam^3).

The objectives of the Operating Plan are:

1) Provide 1-percent (100-year) flood protection at Minot, North Dakota,
2) Provide flood protection to urban and rural areas downstream of Rafferty Dam, Alameda Dam and Lake Darling Dam, and
3) Ensure, to the extent possible, that the existing benefits from the supply of water in the Souris River basin and the supply of water to the Souris Basin Project are not compromised.

Under Article V of the Agreement the Parties (the Governments of Canada and the United States, ultimately through their "designated entities") shall jointly review the Operating Plan at five-year intervals, or as mutually agreed, in an effort to maximize the provision of flood control and water supply benefits that can be provided consistent with the terms of the Agreement. Under Section 5.0 of Annex A, reports will be prepared each year on behalf of the United States and Canada by both the WSA and the USFWS describing the operation of the Project. In any year in which flood operations occur, the U.S. Army Corps of Engineers will prepare a post-flood report. This report will then become a part of the USFWS report. This report for the 2011 flood event was submitted by the USACE to the ISRB at its February 22, 2012, meeting in Bismarck, North Dakota.

Under Section 6.0 of Annex A, representatives of the U.S. Army Corps of Engineers, WSA, USFWS and the North Dakota State Engineer will be responsible for monitoring the Operating Plan.

2.6 *Annex B* – Apportionment and Low Flow

A significant requirement of flood operations as specified by the Operation Plan of Annex A is to ensure, to the extent possible, that existing water supply and low flow benefits in the Souris River basin from operation of the Souris Basin Project are not compromised. Annex B of the 1989 Agreement, as subsequently amended in 2000, describes the sharing of apportionment flows across the International Boundary and delivery of low flows. The current POS, in analyzing the full range of flows, needs to evaluate the impact of flood operations to apportionment sharing in subsequent low flow years, including the sharing of evaporation credits, to evaluate minor project diversions and the delivery of low flows, including accounting for channel losses.

2.7 ISRB Oversight Responsibilities for the 2011 Souris River Flood Event

With respect to the 2011 Souris basin flood event, the ISRB has responsibility to perform an oversight function for flood operations in cooperation with the "designated entities" identified in the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin by:

1) ensuring mechanisms are in place for coordination of data exchange, flood forecasts and communications related to flood conditions and operations;
2) determining whether the operations under the 1989 Agreement should proceed based on the Flood Operation or Non-Flood Operation of the Operating Plan, which is Annex A to the 1989 Agreement, using its criteria and informing designated agencies of this determination;
3) reporting to the Commission on any issues related to flood operations and management; and,
4) providing the Commission and the "designated entities" under the 1989 Agreement recommendations on how flood operations and coordination activities could be improved.

2.8 IJC Mandate for the 2011 Souris River Flood Event

With respect to the 2011 Souris basin flood event, the IJC is responsible for fulfillment of its mandate under the 1909 Boundary Waters Treaty to assist the Canadian and United States governments with cross border issues through productive approaches including the International Watersheds Initiative (IWI) using IWI principles that:

1) build a shared understanding of the watershed by harmonizing data and information, developing shared tools, sharing knowledge and expertise, expanding outreach to and cooperation among stakeholders;
2) communicate watershed issues at all levels of government in order to increase awareness;
3) contribute to the resolution of watershed issues by facilitating discussions, participating in development of shared solutions, creating technical tools, fostering development of common ground, brokering resolutions, and bringing unresolved issues to IJC attention; and,
4) administer existing orders and references from the two governments, recognizing that these might need updating.

2.9 ISRB 2012 Souris River Basin Task Force

The 2011 flood in the Souris River basin proved to be the largest flood of record in more than a century and far surpassing any previously recorded flood. Accordingly, the ISRB has called for a review of the Operating Plan contained in Annex A.

With respect to the review, the ISRB established the 2012 Souris River Basin Task Force at its February 22, 2012 meeting in Bismarck, North Dakota. Subsequently, Fourteen Task Force members drawn from Federal, State, Provincial and local agencies including the WSA, USACE, USFWS, U.S. Geological Survey (USGS) of North Dakota, North Dakota State Water Commission (NDSWC), North Dakota Department of Health (NDDH), Manitoba Water Stewardship (MWS) and Environment Canada (EC) were appointed by the ISRB and the Task Force held its organizational conference call on April 20, 2012. The primary focus of the organizational call was development of a POS for the review of Annex A using the March 28, 2012 Final Terms of Reference provided by the ISRB.

The Task Force is aimed at accomplishing a comprehensive review of the Operating Plan, evaluating the impacts that changes to the Operating Plan will have to Saskatchewan and downstream interests, facilitating Federal, State, Provincial, and local interagency collaboration and public and local government consultation, resulting in recommendations for improvements in the Operating Plan to the Governments of the United States and Canada through the ISRB and IJC.

2.10 Interest in Flood Risk Reduction Measures Following the 2011 Flood Event

Following the Souris River Basin flood in 2011, the Souris River Joint Board requested that the North Dakota State Water Commission (NDSWC) conduct a technical investigation to determine the engineering feasibility, associated design features, and cost estimate for a flood risk reduction project to protect against the 2011 flood peak encompassing the entire Souris River loop through North Dakota. The "Mouse River Enhanced Flood Protection Project" (MREFP) (http://www.mouseriverplan.com/) presented in the engineering report on February 28, 2012, at Minot, ND proposed substantial new levee structures/alignments, channel diversion/modifications, non-structural options (buy-outs), and appurtenant features with an estimated cost of $820 million.

On March 2, 2012, the U.S. Army Corps of Engineers (USACE), St. Paul District, met with representatives of the North Dakota Governor's Office and the North Dakota State Water Commission (NDSWC) to further discuss additional flood risk reduction options for potential consideration in the Souris River Basin. Based upon feedback from the NDSWC, the State is interested in evaluating additional options that complement the February 2012 MREFP. Additional options could include changes in the reservoir Operating Plan contained in Annex A (i.e., increased reservoir flood storage and/or target flows) and combinations with levee and channel modifications. USACE, St. Paul District personnel suggested that prior to an additional study being pursued, a "Charette" meeting should be considered to conduct a preliminary evaluation of whether additional opportunities for flood risk reduction had merit in conjunction with the proposed MREFP.

2.10.1 USACE "Charette" Meeting on May 30, 2012 in St. Paul, Minnesota

A "Charette" meeting was hosted by the St. Paul District, USACE, on May 30, 2012 at its District Headquarters in St. Paul to discuss flood risk reduction opportunities within the Souris River basin in the aftermath of the 2011 flood and the proposed Mouse River Enhanced Flood Protection Plan (http://www.mouseriverplan.com/) developed by the State of North Dakota. A "Charette" is a method for organizing concepts and ideas from experts, through a structured meeting, that encourages brainstorming and idea exchange for the intended purpose of identifying viable future courses of action. A Pre-"Charette" conference call was held on May 24th to provide invitees an advance opportunity to review and discuss the USACE modeling work and suggest additional options for consideration at the May 30th "Charette". The "Charette" provided a face-to-face opportunity for presentation/discussion of some limited reservoir and streamflow routing modeling scenarios developed by the USACE for the "Charette". The scenarios looked at the impact to the 2011 flood flows in the Minot area of changing Souris River target flows at Sherwood and Minot as well as increasing the top elevation of the Lake Darling flood control pool.

The list of "Charette" invitees was limited to those agencies with responsibilities identified in the 1989 Agreement: namely the USACE and WSA as "designated entities" for flood control, USFWS and NDSWC as "designated entities" having responsibilities for Operating Plan review.

Manitoba Water Stewardship (MWS) was also included as a courtesy, as the Province of Manitoba receives the downstream effect of any upstream operation plan changes

Subsequent to the May 30th "Charette" meeting and at the request of "Charette" participants, the USACE developed some additional model scenarios for discussion. A web meeting presentation was hosted by the USACE on June 15th for the ISRB and its 2012 Souris River Basin Task Force to inform these entities on the work of the "Charette" and additional model scenarios. The North Dakota delegation and Governor were briefed on the work of the "Charette" on May 13th by the USACE.

The "Charette" was a limited short-term effort aimed at providing a near-term sense of what may be possible for additional flood risk reduction in the North Dakota portions of the Souris Basin in combination with the MREFP and the viability for any future flood risk reduction studies the State may wish to undertake in a U.S. federal study process. The "Charette" study work was accomplished by the USACE with limited time, funding and resources. The models developed by the USACE for the "Charette" and all of their findings are available for use by the Task Force.

3 SCOPE AND OBJECTIVES

3.1 General

On February 22, 2012 the ISRB established the Souris River Basin Task Force, with subsequent appointments to the Task Force from Federal, State, Provincial, and local agencies as appointed by the ISRB. The Task Force received its final TOR, as discussed in the next section, from the ISRB on March 28, 2012 and set about the task of fulfilling its terms of reference. The full original text of the TOR can be found in **Appendix C**.

The TOR defines the objectives of the Task Force and provides details on the scope of the work by defining required tasks to complete the work. The initial key component of these tasks is development of a POS. The POS, with possible later refinements defines the approach and process that the Task Force will use to accomplish its work under its TOR.

3.2 Terms of Reference for the ISRB 2012 Souris River Basin Task Force

The 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin governs the operation of control structures during flood and non-flood events, as specified in Annex A. One outcome of the 2011 flood has been a call for a review of the 1989 Operating Plan.

The ISRB has developed a stepped process to address the concerns raised by the 2011 flood event. The first step, which was to document the 2011 flood event, has been completed by the U.S. Army Corps of Engineers in its 2011 Post-Flood Report for the Souris River Basin. This report was submitted to the ISRB at its February 22, 2012 meeting in Bismarck, North Dakota. The next step is to coordinate and conduct a review of the Operating Plan for Flood Control and Water Supply detailed in the 1989 Agreement. As specified by Article V of the 1989 Agreement, the Parties through their "designated entities" will jointly review the Operating Plan in an effort to maximize the provision of flood control and water supply benefits consistent with the terms of the Agreement.

The "designated entities" are:

1) The Saskatchewan Water Security Agency (WSA) is the designated entity of Canada.
2) The U.S. Army Corps of Engineers (USACE) is the designated entity for the United States during flood operations.
3) The U.S. Fish and Wildlife Service (USFWS) is the designated entity for the United States during non-flood periods.

In addition to the "designated entities", the North Dakota State Engineer is assigned responsibility under the Agreement for monitoring the Operating Plan, and in 2007 the ISRB was given an oversight function by governments for flood operations in cooperation with the "designated entities" identified in the Agreement.

Given the unprecedented flooding in 2011, there is interest in not only documenting the 2011 flood and reviewing Annex A, consistent with the terms of the Agreement, but to examine changes beyond the current Agreement to maximize the provision of flood control and water supply benefits. Based on this interest and the number of initiatives being undertaken by various Federal, State, Provincial, and local agencies, and the requirement for a review of the Operating Plan as per Annex A, the ISRB established the 2012 Souris River Basin Task Force.

The Task Force is led by the Saskatchewan Water Security Agency (WSA) and the U.S. Army Corps of Engineers (USACE) as the "designated entities" for flood control operations under the 1989 Agreement and includes representation from other Federal, State, Provincial, and local agencies as appointed by the ISRB. The Task Force will also make provision for public and local government consultation. The Task Force reports to the Co-chairs of the ISRB.

3.2.1 Objectives:

The objectives of the Task Force are:

1) to conduct a review of the Operating Plan contained in Annex A of the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin for presentation to governments,
2) to evaluate the impacts that changes to the Operating Plan of Annex A will have to downstream interests, and
3) to facilitate collaboration amongst the various Federal, State, Provincial, and Local Agencies undertaking actions as the result of the 2011 flood and to provide for public and local government consultation.

3.2.2 Tasks

The proposed tasks to be accomplished by the Task Force are:

1) Develop a POS and scope of work (SOW) for studies and activities to be conducted to accomplish Task Force objectives, identifying the need for supporting consultants as well as outlining stakeholder engagement in Canada and the United States. The POS and SOW are to:
    a. Articulate all studies and activities to be performed and level of detail anticipated for each study;
    b. Recommend the agencies or organizations capable of conducting aspects of each study or activity, recognizing the need for involvement by a bi-national team;
    c. Identify sources of, or means of obtaining, needed information;
    d. Establish the priority, duration and timing of each study or activity, considering the inclusion of phases to assist in the organizational management of the overall review; and
    e. Estimate the human and financial resources, including expertise, required to conduct each individual study or activity and a summary for the entire review.
2) Conduct a review of post flood reports, watershed plans, proposed and existing flood mitigation efforts, and identify gaps with respect to non-flood and flood issues.
3) Gather information on initiatives being undertaken or proposed by various Federal, State, Provincial, and Local agencies and identify potential gaps or constraints with the intent of supplementing the work of the Task Force and avoiding duplication of effort.

4) Establish an analysis and modelling team to accomplish needed hydrology and hydraulic analysis as identified by the Task Force POS and SOW.
5) Identify constraints and obstacles to changes in the Operating Plan.
6) Evaluate the impact that changes to the Operating Plan contained in Annex A will have to downstream interests.
7) Evaluate the impact that changes to the Operating Plan contained in Annex A will have to water supply benefits and to the delivery of apportionment in low flow years as stated in Annex B, as amended in 2000.
8) Prepare progress reports, an interim draft report, and a final report summarizing flood and non-flood issues and current and proposed water management initiatives within the Souris River basin, identifying possible improvements for non-flood and flood management in the basin as well as possible changes to the Operating Plan as presented in Annex A.

3.3 Some Challenges of the Operating Plan Review

The review of the Annex A Operating Plan carries with it some inherent challenges. The Souris Basin Project performed well for the 100-year snowmelt runoff for which it was designed, and a series of rainfall events that followed. However, the inadequacy of the Project in handling the much less frequent June 2012 rainfall runoff beyond its design capacity and preceded by a 100-year snowmelt runoff event was evident. With regard to water supply challenges, there has not been an extended drought since the project was completed to test how Annex A and Annex B will perform in consecutive low runoff years.

The review of the Annex A Operating Plan could consist of studies aimed at providing recommendations for change to the Operating Plan within the bounds of the existing Project and Agreement. Given this scope, the review will address improvements in the hydrometeorological data collection network, runoff forecasting, communications, terminology, and refinement of the process for periodic Operating Plan reviews.

Alternately, the scope of the review could evaluate opportunities which will involve the re-design of the Souris Basin Project and the Operating Plan considering the impact of added flood control storage at existing reservoirs, possibilities for adding flood control storage on Long Creek and the Des Lacs River, improvements to existing flood protection along the entire length of the Souris River from Estevan, Saskatchewan to Wawanesa, Manitoba. The challenge of this approach is that a number of assumptions will have to be made regarding the configuration of improved downstream protection works that may or may not ever be constructed. In addition, this approach will require studying the flood protection works as a system, optimizing the various combinations of upstream storage and downstream improvements and involve extensive hydrology, hydraulic, design, and economic studies. Nonetheless, reconnaissance level studies using this approach could provide useful recommendations to governments regarding changes to the Operating Plan contained in Annex A. These evaluations will have to be regarded as being outside of the scope of the existing 1989 Agreement.

4. SOURIS RIVER OPERATIONAL PLAN REVIEW COMMUNICATIONS

Ongoing communications during the execution of the reservoir Operating Plan review are extremely important. It is suggested that a separate Communications group be established for handling all the communication efforts, both within the study itself, as well as externally. Communications will be accomplished through a variety of means, including public meetings, workshops, conference presentations, newsletters, email, and the Internet.

Once the study is initiated, a detailed web page needs to be created to provide a means of ongoing public communication. The web page could contain, at a minimum:

- Objectives/Goals of Study,
- Task Force members and Study Manager(s),
- Study Group members,
- Descriptions on ongoing studies,
- Searchable metadata system, describing distributed data that reside on users' systems
- Periodic updates on study progress,
- Individual committee reports on methods and results,
- Any graphics or PowerPoint presentations developed to help explain study objectives/goals and approach,
- An area that allows the public to provide feedback and to add their name, address and email address to a mailing list for notification of public meetings and events,
- Basic educational information on Souris River hydraulics and hydrology and reservoir management factors,
- Electronic newsletter.

Another communication tool to consider is a newsletter in hard copy and electronic form that will be sent to all interested members of the public on a semi-annual or as needed basis. The newsletter will serve to update the public on studies underway, any interim findings or results available, and other current events related to the study. The newsletter will be sent to members of the public, agencies, and groups that participated in the POS consultation as well as names added to the mailing list through the web page. This newsletter will also go to media outlets with news releases highlighting any interesting developments. In addition, conference calls could be used to communicate study progress to interests around the basin.

Public input will be sought on the POS, the shared vision planning approach and finally the final report. The public meetings could be coordinated to coincide with the ISRB's annual meetings in the basin or other related events. In addition to mail outs and internet notices, the team should also use newspapers and radio to publicize public meetings. Presentations for regional conferences are other means of communicating the study goals and early results with the technical community.

The issue of public involvement during the study as well as following completion of the study is necessary. The Communications Group will address a wide range of communication enhancements both, during the POS public comments and during the life of study phases.

It is recommended that the Communications Group also address the issues of public education. Issues to be included will be the basic hydrology of the basin, challenges in operating reservoir water level and release forecasts, climate change, human-induced changes, and design criteria for protection from natural events. Educational opportunities may help to ensure the success of the study by increasing the awareness of the natural system and what influence people really have during extreme events.

The costs for a Communications Group for the study, including salaries and travel, are estimated as follows:

	Year 1	Year 2
Total Cost	$40K	$60K

The total cost for Communications for the study will be about $100K.

5 STUDY METHODOLOGY

5.1 Background

The purpose of this section is to develop a framework to carry out the analyses, studies and projects aimed at delivering the objectives of the Task Force, noted in **Section 3** and reproduced below:

1) to conduct a review of the Operating Plan contained in Annex A of the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin for presentation to governments,
2) to evaluate the impacts that changes to the Operating Plan of Annex A will have to downstream interests, and
3) to facilitate collaboration amongst the various Federal, State, Provincial, and Local Agencies undertaking actions as the result of the 2011 flood and to provide for public and local government consultation.

This section will not address the work that is being carried out by other agencies. However, these projects are listed in the project matrix shown in Table 10-1 and suggestion will be provided if any re-direction is required in their work. Additionally, the linkages with the work of other agencies within the review framework are shown in the POS flowcharts.

On July 26, 2012, in a presentation to the Souris Board members, the Task Force provided a generalized framework by listing activities to address the objectives of the Operating Plan review as shown in **Figure 5-1**. The framework provided two visions of the review; one that was thorough in nature and potentially at an IJC Reference level, and the other a narrow review to provide clarifications and adjustments. The feedback from the Board suggested scoping a more all-inclusive study. Considering the Board's guidance, this POS provides a comprehensive outline for the study using a modular approach. This approach will allow the Board to adopt and approve the path that it deems most appropriate given the time and resources available.

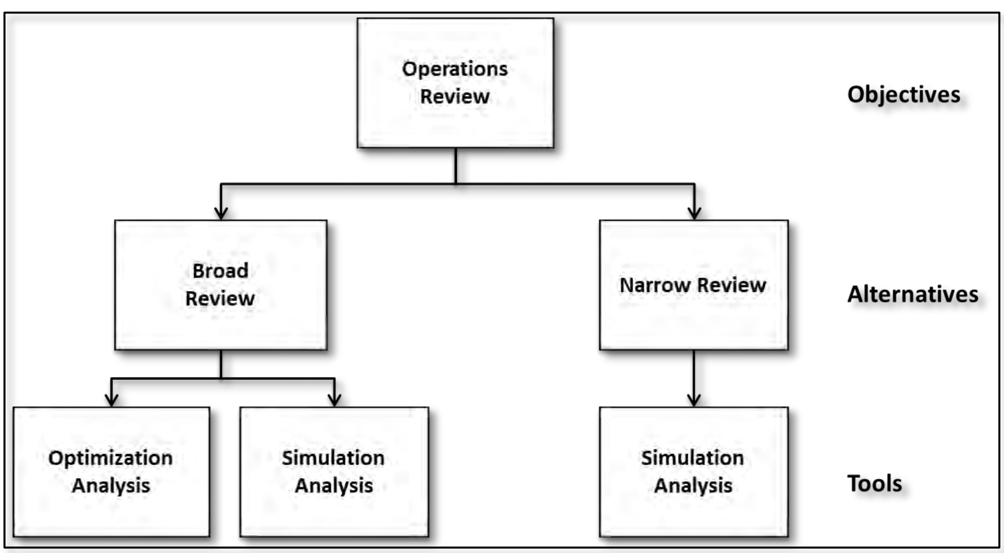

Figure 5-1 Overall Strategy for Reviewing Operating Rules for the Souris Basin Project

5.2 Elements of Operating Plan Review

This section provides information on various elements required to deliver against the Task Force objectives. In the first part, the preliminaries are discussed followed by the necessary activities and studies/projects and associated resource requirements. There are several essential activities that are required prior to any level of evaluation, be it broad-based or narrow in scope. The essential elements are shown in **Figure 5-2**.

Next, the two scopes of the Operating Plan review are presented. Finally, the potential improvements in system operations in the presence of flow forecasting are highlighted.

While the initial and primary objective of the Task Force is to evaluate the Operation Plan as specified in Annex A, and in particular as it relates to flood operations, it is important for the Task Force to evaluate the water supply benefits accrued from the Souris Basin Project and apportionment sharing in low flow years. Flood operations may have impacts to operations in subsequent low flow years. The benefits from flood operations have costs associated with a sharing of evaporation credits; and verification is needed that the accounting of these costs is adequate. Out of necessity a full range of flows need to be evaluated in the project descriptions that follow and in evaluating impacts to management of the 1989 International Agreement.

The objectives of the Task Force are clearly separated into the review of the existing Operating Plan and evaluating the impacts that changes to the Operating Plan will have to Saskatchewan and downstream interests. The results of this study will clearly identify changes that are within the legal bounds of the Agreement versus changes that are outside the legal bounds of the Agreement.

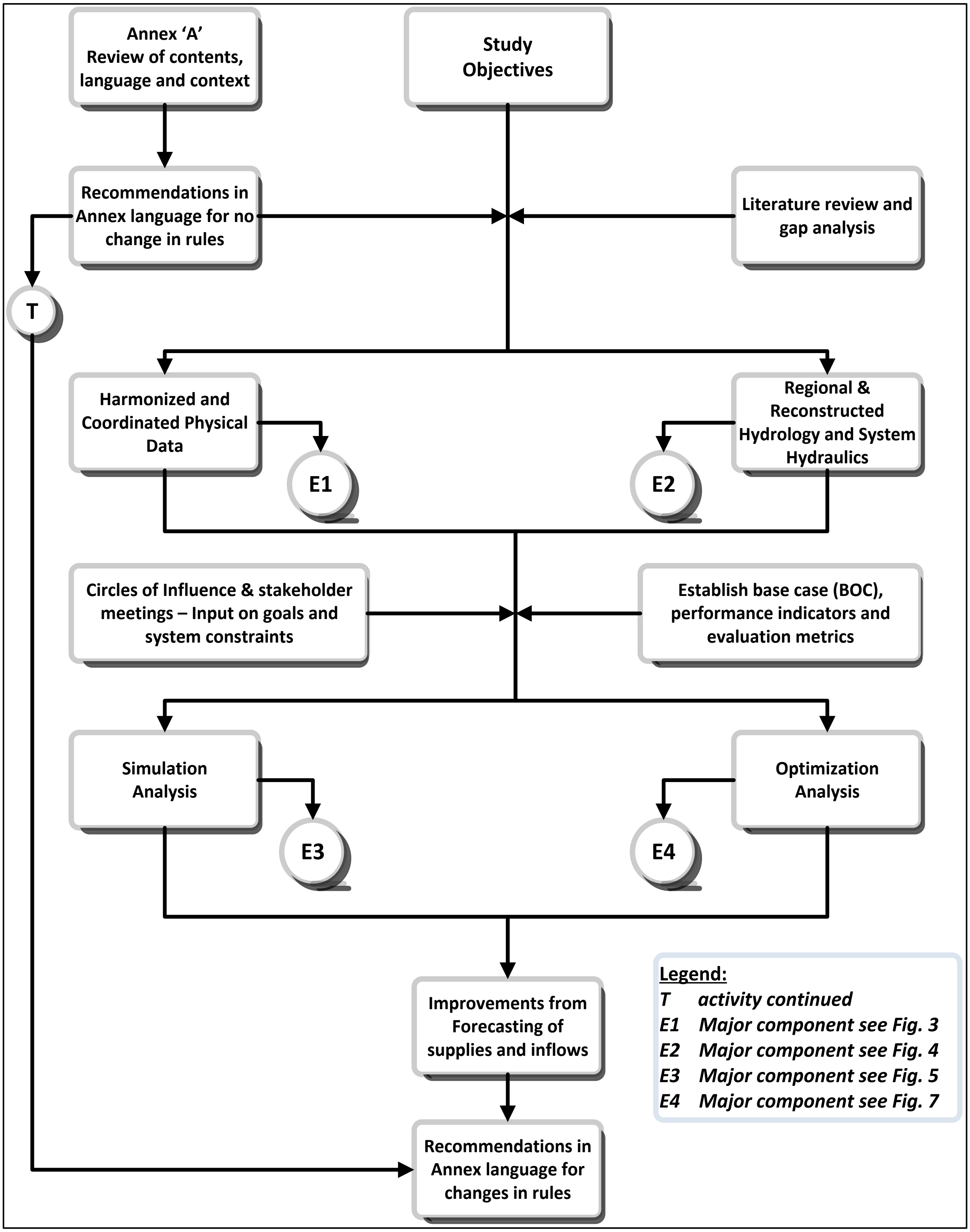

Figure 5-2 Strategic Map of the Logistical Flow of Task Force Activities

5.2.1 Preliminary Assessment

One of the first elements of the work is to review the existing operating rules as captured in the 1989 Agreement and associated Annex A. This will formulate the basis to compare other changes in operating rules that may evolve from this appraisal. Another corollary to this work stems from a sentiment expressed by agencies during conference calls and meetings. The language and wording contained in Annex A were found to be wanting from clarity and ease of interpretation perspectives. Currently some rules appear to have been lifted from computer programming code that may have been developed for reservoir operations. Therefore it is necessary to identify areas where the language and text can be improved for easy understanding and interpretation, even if the study decides against changes to the operating rules in the 1989 Agreement.

Project 1a – Review language of the operating rules from the 1989 Agreement and produce a white paper highlighting key elements, challenges and issues faced from 1989 to the present.
Lead/Agencies – US Army Corps of Engineers, US Fish and Wildlife Service, NDSWC and WSA and Manitoba Water Stewardship
Duration – Two weeks
Cost – Preferably in-house, $10K
Pre-requisite – None
Dependent – Projects 1b and 17

Project 1b – Provide recommendations on areas where changes to the language of the operating rules may be required in the present form, i.e. no changes to the operating rules.
Lead/Agencies – US Army Corps of Engineers, US Fish and Wildlife Service, NDSWC and WSA and Manitoba Water Stewardship or Task Force
Duration – four weeks
Cost – Preferably in-house/Task Force $ 20K
Pre-requisite – Project 1a
Dependent – Projects 1c and 17

A second important preliminary activity, elements of which have been initiated, considers the existing work that supports the Operating Plan review process. These consist of two types of information. The first is already completed studies and reports connected with the Souris River Project prior and subsequent to the implementation of the 1989 Agreement. The second is to list the on-going hydrologic and hydraulic modelling projects following the floods of 2011. A number of initiatives by North Dakota State Water Commission, US Army Corps of Engineers and Federal Emergency Management Agency (FEMA) have addressed the issues raised by the floods in general and flood-related damages in Minot in particular. A listing of these modelling projects is captured in **Appendix D**. Several other documents were also reviewed to help understand the work carried by a number of agencies operating in the basin. A partial listing is provided in **Section 13, References**.

Project 2 – Compile list of Operating plan review related projects. Perform gap analysis to identify and prioritize work that is required in support of the review. Lead/Agencies – US Army Corps of Engineers, US Fish and Wildlife Service, NDSWC and WSA and Manitoba Water Stewardship / Task Force Duration – four weeks Cost – Preferably in-house/Task Force $15K Pre-requisite – Project 1 Dependent – Project 3

5.2.2 Essential Elements

The study should be built on sound footing. This foundation comes from having a good information base and data that will feed the modelling efforts. As noted in **Figure 5-2**, the layer of essential elements has two important tasks. The first activity is delivering a harmonized and coordinated data and information base to be used by all study participants. The second element consists of hydro-technical information consisting of regional and reconstructed hydrology and system hydraulics. It should also be noted that these activities are classified as essential to any approach in developing operating plan review techniques and procedures. The output from this layer of activities becomes the foundation for the analysis.

It is critical to note that the Task Force and ISRB must have the meta-data associated with all information, data, reports, spreadsheets, and databases used in the study. It is therefore recommended that the Task Force consider using the information management (IM) schematics developed for the International Upper Great Lakes Study (IUGLS, 2012). This is discussed in **Section 7.**

5.3 Harmonized and Coordinated Physical Data

In order to pursue Task Force objectives in the review of Operating Plan, a series of assignments needs to be considered at the outset. This overall strategy is presented in **Figure 5-3**.

Within this topic, four broad classes of data are to be harmonized and made available to the user community. These are the physical data of the Souris River basin, bathymetric information of the river system, reservoir elevation-storage-volume-outflow information, and hydro-climatic and hydrometric network information.

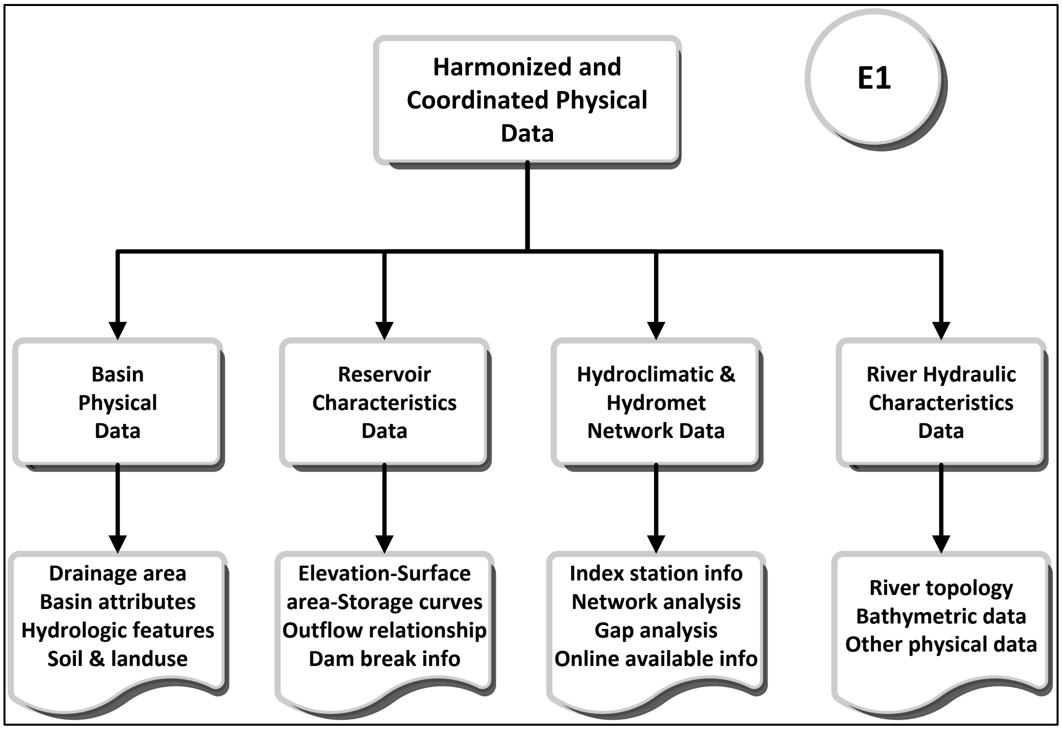

Figure 5-3 Elements of Physical Data Coordination

5.3.1 Physical Data of the Souris River Basin

The basic data used in defining the watershed boundaries under the auspices of the International Watershed Initiative (IWI) have been harmonized. It is understood that the horizontal (x-y) coordinates are in good shape and there is a need to determine if the vertical (z) information could be used as is or requires resolution. Another aspect of the vertical data is to ensure a common datum is used for the Souris River. The vertical information is used for defining the slopes of the overland flows, channel slopes and demark the drainage boundaries for contributing and non-contributing drainage areas. Most of this information is available but requires harmonization and coordination. The likely agencies where these data are located are WSA, NDSWC, USACE and MWS.

Project 3 – Compile a list of physical data of the Souris River Basin. Perform gap analysis to identify and prioritize work that is required in support of the review.
Lead/Agencies – US Army Corps of Engineers, US Fish and Wildlife Service, NDSWC and WSA and Manitoba Water Stewardship / Task Force
Duration – six weeks
Cost – Preferably in-house/Task Force $20K
Pre-requisite – Project 2
Dependent – Project 6

5.3.2 Reservoir Characteristics Data

An element that requires updating and codifying are the elevation-storage/surface area/outflow relationships for the basin reservoirs. Currently the information is contained in Annex ‘A’ of the

Agreement in hard copy format. These data may also be available in various formats within the agencies. It is, therefore, desirable to harmonize and standardize varying pieces of information to a common electronic format. It will facilitate ease of future use, consistency of information, and readiness for input into further use of data in models like HEC-ResSim and/or HEC-ResPRM.

It may also be desirable to identify and classify all in-stream structures that may influence the hydrograph properties but are not part of Annex 'A'. For these structures similar effort in codifying relationships, like elevation-storage/surface area/outflow, may be required. Efforts may be required to classify structures based on their performances during flood event or in a dry year.

Project 4 – Compile a list of reservoir characteristics data. Perform gap analysis to identify and prioritize work that is required in support of the review.
Lead/Agencies – US Army Corps of Engineers, US Fish and Wildlife Service and WSA, NDSWC / Task Force
Duration – Two months
Cost – Preferably in-house/Task Force $25K
Pre-requisite – None
Dependent – Projects 6, 15 and 16

5.3.3 Hydro-climatic and Hydrometric Network Data

For the Souris River Project it is recommendable that longer lead times and improved accuracy in water generating events for flood forecasting requires increasing observations of atmospheric water - *i.e.,* measuring water before it precipitates on a river basin, for example radar and satellite information, and the quantity of water flowing past a point through streamflow monitoring. It is important that the density and quality of the observation network for hydrometeorological measurements be built according to the needs for water management and forecasting.

Although automation and real-time data communication has gradually increased, sufficient area coverage for minimizing uncertainties associated with spatial averaging of hydrometeorological variables is still a challenge. The lack of sufficient coverage and availability of real-time precipitation data for the Souris Basin Project in the optimal locations may contribute to reduced accuracy in flow and supply forecasting. Therefore, a need to further improve and optimize atmospheric and hydrometeorological observation networks may exist. Longer lead times and improved input accuracy for flow and supply forecasting can be achieved by increasing observations of atmospheric water simultaneously with a better hydrometeorological network. These enhanced observations, tracking, and modelling of weather systems may significantly improve near-term to medium-term supply forecasts with modest improvement in long-term supply forecasts.

From the lessons learned in the Great Lakes studies (2006, 2012), it was found that improved supply forecasting for Lake Ontario showed enhancements in water management of lake regulation. The IUGLS on the other hand showed limited improvements from employing flow forecasting.

Project 5 – Souris River Basin Hydrometeorological Data Network Improvement Project
Lead/Agencies – US Army Corps of Engineers, (in coordination with WSA, NDSWC, MWS, Environment Canada, NWS and USGS)
Duration – One year
Cost – $ 5K for coordination; this $100K study is being conducted by the USACE and the North Dakota Silver Jackets Team and separately funded by the USACE Institute for Water Resources (IWR)
Pre-requisite – None
Dependent – Project 17

5.3.4 River Hydraulic Characteristics Data

The activities associated with this element are similar to those noted for harmonized data. The information needed is the physical in-stream and valley data for the Souris River and its major tributaries. Most of the information for this element may exist with the agencies operating in the Souris River basin.

The data will be used to develop the bathymetry of the channel and off-channel storage, routing characteristics. Other attributes of these data include channel and flood plain roughness, braiding of channel, encroachments and fills, and seasonal distribution of growth in channels. The sources of this information are varied with jurisdiction.

The flood plain data may require Lidar mapping or other Digital Elevation Model (DEM) mapping. These data must be harmonized to a common datum, coordinated, stored and available to the study participants. The data will also require meta-data.

Project 6 – Compile a list of the Souris River Hydraulic Characteristics Data. Perform gap analysis to identify and prioritize work that is required in support of the review
Lead/Agencies – US Army Corps of Engineers, US Fish and Wildlife Service, NDSWC and WSA and Manitoba Water Stewardship / Task Force
Duration – four weeks
Cost – Preferably in-house/Task Force $40K
Pre-requisite – None
Dependent – Projects 12 and 13

5.4 Regional Reconstructed Hydrology and System Hydraulics

The second group of essential elements relates to an understanding of the system's hydrology for use in testing, evaluating, and reviewing existing and alternative regulation plans. A harmonized and coordinated set of hydrologic variables is required.

The activities in this element follow three key branches and can be undertaken in parallel. The activities are stochastic hydrology, deterministic hydrology, and system hydraulics. The overall strategy for the hydrology and hydraulic analysis is shown in **Figure 5-4**.

5.4.1 Stochastic Hydrology

One of the important considerations is to have the hydrology of the basin reconstructed to provide a frame of reference when considering supply sequences for the Operating Plan review. In order to meet this objective, a comprehensive map is shown as **Figure 5-4** as preparatory to the review of the Operating Plan. Within the scope of stochastic hydrology, two main themes are required for testing operating plans: historic time series (flow) reconstruction and alternative hydrology. Historic time series (flow) reconstruction consists of establishing the state-of-nature water supplies and flows at key locations in the basins and outlets of key Souris River tributaries. This supply sequence will then become the basis of evaluation for the current operating rules and alternative plan formulations. The second is to consider alternate hydrology sequences.

Historic Time Series (Flow) Reconstruction

In addition to establishment of a base case or basis of comparison (BOC), there are three main types of data that need to be considered. The first set consists of naturalizing the flows from reservoir outflows; the second set addresses generating flows for ungauged watersheds; and, finally the third set looks at filling missing data for gauged basins.

Given that the flow sequences in the Souris River are influenced by major regulation structures, the first activity will be on naturalizing the flows. This activity has an additional challenge of generating natural flow sequences with a pair of reservoirs in series – Rafferty and Lake Darling as well as Alameda and Lake Darling. After reviewing the operations and rules for the smaller control structures managed by the USFWS, a decision to naturalize the flows or deem the degree of regulation as nominal and ignore the regulation effect is required.

The second major task is the generation of flow at locations deemed and identified as important and at the outlet of major tributaries that are either ungauged or that gauges are located far upstream to negate the use of a simple area-ratio technique. Accepted and practical methods that are available to synthesize continuous flows at ungauged locations will be used to generate flow sequences.

There are occasions when a gauged site has gaps in the data as the result of non-functional gauges. The missing data will be filled using acceptable methods like regression or area-ratio methods.

Proper parametric and non-parametric tests will be used to ensure that statistical properties and flow series correlations are preserved.

Project 7 – Regional and Reconstructed Hydrology of the Souris River in Support of the Review of Operating Plan Lead/Agencies – Task Force, US Army Corps of Engineers, NDSWC, USGS Duration – Six months Cost – $ 100K Pre-requisite – Project 3 Dependent – Project 8

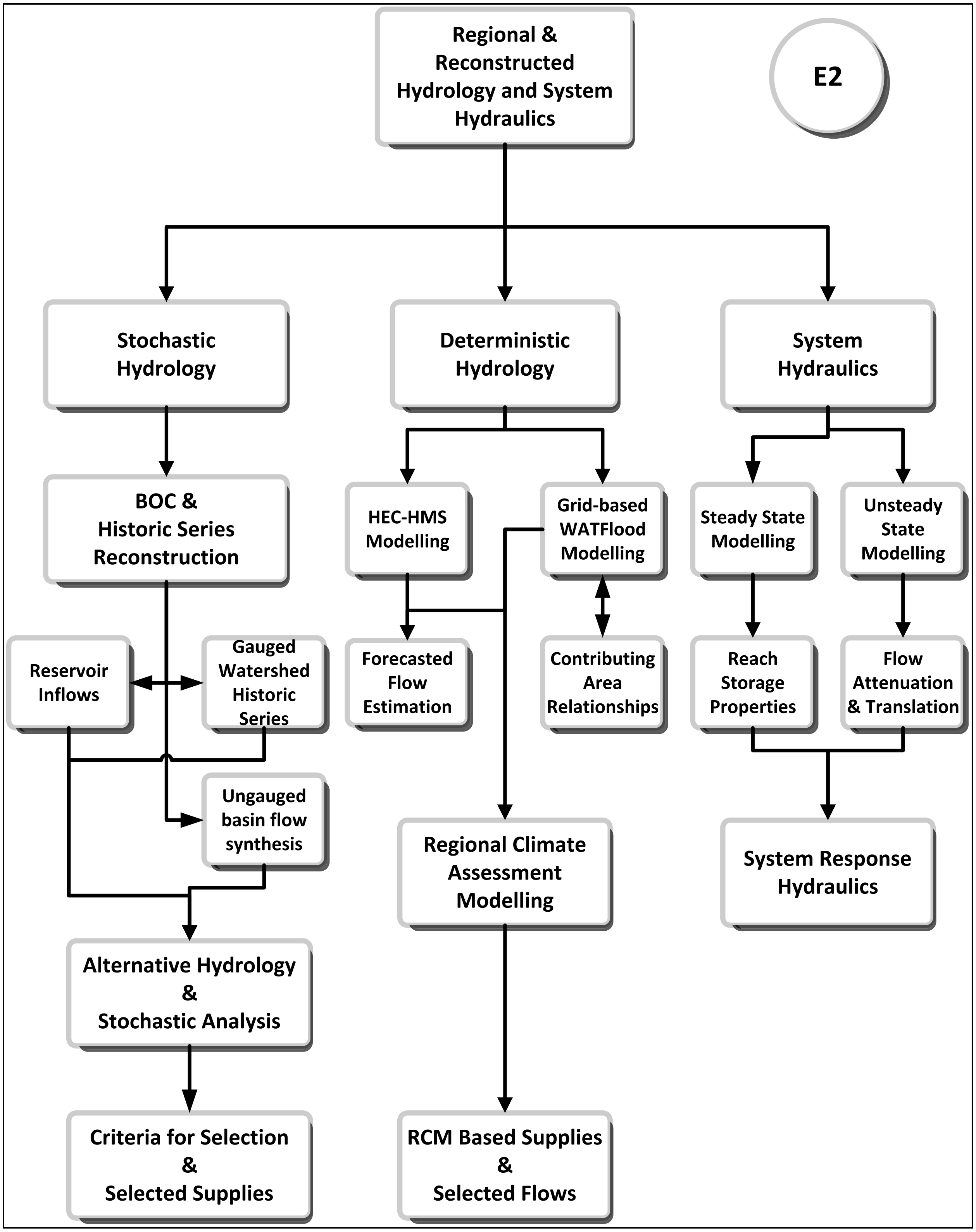

Figure 5-4 Activities under Regional & Reconstructed Hydrology and System Hydraulics

Alternate Hydrology

Stochastic simulation of hydrological variables is routinely used to assist in evaluating alternative designs and operation rules, particularly where the historical record is relatively short or the risk of project structural failure is relatively high. The performance of a given regulation plan can be estimated by simulating the behaviour of a water resources system using sequences of inputs that are long enough to contain a large number of potential hydrological scenarios that could occur in the future, including rare and potentially catastrophic events.

It should be acknowledged for a system like the Souris River there have been challenges from high flows and floods that are well known from the historic records. There have been six or seven floods where the system was put into the flood mode with significant damages occurring, particularly in 1969, 1976, 1979 and 2011 in the North Dakota communities. There is another type of challenge for the Souris River when the basin is experiencing drought conditions or during low flow periods of insufficient water to satisfy international apportionment, the needs of senior water rights holders and other riparian water users. For this reason, the POS is including stochastic hydrology to provide the backdrop for testing the alternative plans not only for wetter than normal sequence but for dry sequences as well. These requirements will be elaborated more fully, when the statement of work is developed for the simulation analysis and modelling.

To obtain a greater understanding of the long-term variability of the past, whose variations might be extended into the future, stochastic models need to be developed for plan formulation purposes. When the stochastic series is produced, a wide range of plausible sequences of water supplies not seen in the relatively brief historical record will be realized.

The naturalized flow sequences that are synthesized in the previous step are but one finite set of possibilities from an infinite population of hydrology. Nature could have easily produced an alternative flow sequence quite different than the historical sequences observed to date. Under these alternative flow sequences, reservoir operations could have been trivial or severely tested depending upon the sequence of events. To test the reservoir operations for robustness, it is essential to test the operation with alternate flows. Similarly, when an alternate candidate regulation plan is proposed, its robustness should be demonstrable over a variety of hydrological sequences. Hence the need for studies that can generate hydrological supplies using stochastic techniques that will preserve the essential statistical properties of the historical flow sequences.

A stochastic model should be developed with the historical supply record (1930 – 2010) of the contemporary water supplies. This computational scheme should include the use of an Auto Regressive Moving Average (ARMA) or an Auto Regressive Integrated Moving Average (ARIMA) Model at the annual or seasonal level and a temporal annual or seasonal or monthly or quarter-monthly disaggregation scheme. If other more practical and statistically acceptable methods are available, these could be used as well.

The sample statistics of the supplies and the corresponding routed levels and outflows should be compared with observed characteristics which will verify that the generated supplies, as well as the routed levels and outflows series, reproduce the characteristics of the historical series.

Project 8 – Develop 10,000 or 50,000 years of stochastic water supplies for the three sets of data series for the state of nature flows in the Souris River basin using ARMA or ARIMA models or equivalent methodology Lead/Agencies – Task Force or Study Coordinator Duration – Four to six months Cost – Estimated at $100K Pre-requisite – Project 7 Dependent – Projects 15 and 16

5.4.2 Deterministic Hydrology

Analysis of hydrological processes in the Souris River system would employ deterministic modelling approaches. In this deterministic method, the hydrological parameters are based on physical relations of the various components of the hydrological cycle and their interaction with the system of reservoirs, channels, etc. The deterministic approaches do not consider randomness, so that a given input of precipitation always produces the same output in water supplies to the reservoirs. This is a simplification of the natural process.

The second major branch in the hydrology and hydraulics framework is the deterministic modelling of the hydrological cycle. In the past, hydrological modelling of the Souris River has been sporadic by not using consistent methods or preserving the water balance in the system beyond event based modelling or for parts of the system for flow forecasting. In these cases the objectives are limited to the job at hand. It is desirable to ensure a fully thought-out process of the needs and scope of modelling required in support of the Operating Plan review but also to have other added benefits to the users of the system. An evaluation may be required once the studies are underway whether to have planning and assessment models different from an operational model.

In this section modelling efforts in support of the two areas of flow forecasting and climate change modelling are described along with the list of projects and associated costs.

One major issue raised during discussions was the challenge of estimating contributing area to flows. For the average basin yield years, part of the watershed will not contribute due to the topography and the size of depression storage. In other years, depending on the Antecedent Moisture Conditions (AMC) and the amount of precipitation, some or all of the drainage will contribute, as was witnessed in 2001 and again in June 2011 when the entire basin was supplying. It is, therefore, desirable to have a hydrological model that is capable of dynamically assessing the status of moisture and ensure proper water-balance computations are carried out.

The Task Force will consider the performance of different approaches. HEC-HMS is a widely used model in the U.S. and its grid-based options could be employed. The Advanced Hydrologic Prediction Service (AHPS) is an operational tool employed by the North Central River forecast Center (NCRFC) of the U.S. National Weather Service (NWS) located in Chanhassen, MN to routinely forecast flows in the Souris basin. AHPS uses the soil moisture accounting routines of the Sacramento Soil Moisture Accounting model in its calculations. These will be tested to determine if the models can dynamically adjust the contributing area based on AMC and precipitation volume and intensity. Discussions will be required with the Hydrologic Engineering

Center in Davis, CA, the developer of the HEC-HMS program, and the NCRFC in Chanhassen before employing a technique.

The second tool, WATFlood (2005) has been used extensively in Canada and applied on the International Upper Great Lakes Study (2012), a bi-national effort. WATFlood is a grid based model and its capabilities to address the above noted objective will be evaluated at the first step. Once a model is selected, it will be operated to establish the relationships among the key hydro-climatological and basin physical variables to develop the thresholds of flow and contributing areas and their relationships.

Project 9 – Establish thresholds among hydro-climatological, basin physical and contributing drainage area by selecting an appropriate model and its application for this task
Lead/Agencies – Task Force or Study Coordinator
Duration – Three months
Cost – Estimated at $60K
Pre-requisite – Projects 3, 4, 5 and 6
Dependent – Projects 10 and 11

Flow Forecasting

The second objective is the capability of the model to be used in predicting the water supplies to the system reservoirs using information from AHPS scenarios. These scenarios in turn could be employed in reservoir operations in a predictive sense using a risk management concept.

Flow forecasting plays an important role in managing water resources systems. This is especially the case for Souris Basin Project reservoirs, because streamflows are the major inputs into the reservoirs. Obtaining high-quality streamflow forecasts and making efficient use of these forecasts make it possible to obtain maximum benefit from the short-term near future water supplies. The quality of water supply forecasting could be quantified in terms of lead time and accuracy. The usual definition of the lead time in flow forecasting is the time interval between the issuing of the forecast and the occurrence of the forecasted flow event. Additionally, the accuracy of flow forecasting can similarly be defined as the difference between the forecasted and the actual realization.

The use of a streamflow forecast for real-time reservoir operation is challenged by forecast uncertainty and limited forecast horizon. The effects of the two factors are complicating since increasing the forecast horizon usually provides more information for decision making in a longer time framework but with increasing uncertainty, which offsets the information gain from a longer forecast horizon. The Task Force will assess what is an effective forecast horizon with a given forecast, which balances the effects of the forecast horizon and forecast uncertainty and provides the maximum information for reservoir operation and decision making.

It is intuitive that better–quality water supply forecasting yields higher benefit for reservoir management, such as, sustainable water supplies and lower flood damages. If water supply forecasts with longer lead times are available, these will allow more efficient reservoir operations over extended time horizons. This in turn will lead to a better balance between the near-term benefits and the potential of future benefits, increasing the total benefit.

The work in this part of study will be determined by the outcome of the initial modelling effort in Project 9. Project 9 will decide the best model for use in water supply forecasting. The selected model will have gone through the usual steps of model calibration and verification and be available for flow simulation given the AMC and precipitation forcing.

For the operators to have confidence in the model, it is imperative that the studies employ indices to measure the accuracy of flow forecasting. There are several of these like Nash-Sutcliffe coefficient, relative mean absolute error or relative accumulated difference between computed and observed discharge, whichever test is employed, a rationale will be provided.

Project 10 – Develop tools and procedure for predicting forecasted water supply – establish degrees of confidence for various lead times
Lead/Agencies – Task Force or Study Coordinator
Duration – Six months
Cost – Estimated at $50K
Pre-requisite – Project 9
Dependent – Projects 16 and 17

Climate Change

Regional-scale climate projections provide the first step in assessing the potential impacts of climate change on a broad range of human and natural systems. In most cases, however, additional impact modeling and analysis is essential to translate the climate projections into information that can be directly used by regional agencies, business leaders, and stakeholders to inform policy and decision making. This often includes modeling of regional hydrology and its inter-relationships with agriculture, ecosystems, water, and energy.

Another reason to have a practical and operational hydrological model of the Souris River basin is for its use in investigating impacts from future climate change and variability. For assessing the vulnerability of the operating rules of the reservoirs to the extremes of climate change, it is proposed to use the existing climate change modelling results for the region. One climate change impact study was commissioned by the Manitoba Conservation, Climate Change Branch with a final report by Stantec (2011). The Manitoba study was for the Assiniboine River – of which the Souris River is a tributary. The study produced climate change flows and related hydro-climatological variables. The analysis was based on the Regional Climate Modelling (RCM). The results were, however, reported only at the outlet of the Souris River where it joins the Assiniboine River. The Manitoba study employed Mike-SHE model to generate the hydrological changes for a gridded system of the regional climate model.

If there are other climate change studies at a regional scale, these will be brought forward to assess the results to a common understanding. Additionally, when there are other techniques of evaluating climate change impacts, these methods will be assessed for further considerations and mapping against stochastic modelling results for testing trial plan robustness.

The Task Force will employ the selected hydrological modelling tools from Project 9 for the time horizons selected for climate projections. As most of the climate change projections are reported for either 2050 or 2100, it may be preferable to use a planning horizon of 2050 for computing climate change water supplies.

Project 11 – Develop climate change water supplies at key locations in the Souris River basin using results from Stantec or other Task Force supplied specifications
Lead/Agencies – Task Force or Study Coordinator
Duration – Six months
Cost – Estimated at $100K
Pre-requisite – Project 9
Dependent – Projects 15 and 16

5.4.3 System Hydraulics

The third major branch in the hydrology and hydraulics element of work is the understanding of the hydraulic characteristics. This will also require studying channel responses in affecting the hydrograph properties between upstream and downstream locations of the key Souris River reaches. A considerable amount of work in this part of the study will be leveraged against the projects initiated by several agencies already responding to the flood of 2011. These include the review of floodplain management issues by FEMA and the project work funded by the North Dakota State Water Commission and associated with the Mouse River Enhanced Flood Protection Project encompassing the entire Souris River loop through North Dakota. Another source of useful information may come from the studies the USACE is conducting in various reaches of the Souris River. Some of the leveraged work may require some computer runs from the work of others to allow results to feed into the regulation component of the review.

During the management of the 2011 flood, the response of the Souris River below the Souris Basin Project reservoirs was difficult to assess in view of the topographic features in the valley and due to the presence of other auxiliary features/structures. The agencies managing the flow release had a difficult time in attaining 1989 Agreement target flows at Sherwood and Minot. It is, therefore, important to develop tools and methodologies to more accurately determine the flow timing and attenuation characteristics of the river response to flow changes under different conditions. The work under this branch will require the development and understanding of the river response to operational flow changes below the reservoirs at the downstream key locations. This will require setting up transient hydraulic models that will feature not only the valley system below the reservoirs, but also any in-stream features like weirs, parallel dykes, etc.
The work in this branch will look at two distinct areas of hydraulic modelling in the steady and unsteady states.

Steady State Modelling

Steady state hydraulic models for the selected reaches of the Souris River will be used for the purposes of establishing reach-based hydraulic properties of stage or depth versus surface area and storage characteristics. Agencies in the Souris River basin have collected data suitable for hydraulic modelling with the HEC-RAS model and may have data in its earlier version of HEC-2. These data can be used in a straight forward manner to produce the hydraulic properties that can be used to route an upstream flow using an appropriate storage routing method. With the Province of Manitoba opting for the Mike-11 model as a choice for one-dimensional flow routing, the information can easily be re-formulated through a data mapping/input process for use with HEC-RAS. For the Souris River the lower reaches are located in Manitoba where this data exchange/mapping is required.

There are two approaches that can be used in investigating the changes to hydrograph properties like attenuation and translation. The first method is to simply employ the steady state hydraulic model and use the information for hydrologic routing of index hydrographs. The second method, described in the next section, requires the using of steady state channel data with index hydrograph in an unsteady state. The outflow hydrograph readily displays transformed properties. The results are next inserted into the Operating Plan evaluation.

Project 12 – Reservoir flow release attenuation and translation in support of the review of Operating Plan in the Souris River Project using storage routing options
Lead/Agencies – Task Force or Study Coordinator
Duration – Six weeks
Cost – Estimated at $25K
Pre-requisite – Project 6
Dependent – Projects 15 and 16

Unsteady State Modelling

For the critical reaches where data and information already exist for the unsteady modelling carried out by others, new model runs could be made directly after verifying the model setup. If it is deemed necessary, the steady state models extracted earlier could be employed in making the runs with selected index hydrographs to compute reach based travel time and attenuation that is achieved from valley storage considerations. The Task Force will determine and select the index hydrographs for routing purposes along with identifying the critical reaches in the Souris River system where such information is desirable.

Project 13 – Reservoir flow release attenuation and translation in support of the review of Operating Plan in the Souris River Project using unsteady state modelling
Lead/Agencies – Task Force or Study Coordinator
Duration – Six months
Cost – Estimated at $35K
Pre-requisite – Project 6
Dependent – Projects 15 and 16

5.5 Operating Plan Review

The core of the work and the central focus of the Operating Plan review are captured in this section. The current operations are based on the 1989 Agreement and the essential elements are captured in Annex ‘A’. The purpose of this section is to explore what tools are available to carry out a structured approach in meeting the intents of the Task Force, ISRB and 1989 Agreement, while satisfying the needs of the original stakeholders identified in the Agreement and the emerging stressors on the system. Some of the stakeholders may be at cross-purposes with other users and may require compromises and in some cases conflict resolution.

In this section two approaches in water resources management, in the presence of reservoirs in parallel and tandem, are presented for this Plan of Study. The methods have been applied in other jurisdictions so no new research is proposed here. There are two categories of computer tools available for use in conflict resolution in reservoir management. These are generally classified as *simulation* or *optimization*.

Simulation models demonstrate what will happen if specified decisions are made or how the system will behave for a given set of trial operating rules. This is a repetitive process with objectives coded in the trial plans and incrementally adjusted to achieve the goals and meet the system constraints.

Optimization models determine what decisions should be made to achieve specified objectives of maximizing benefits and/or minimizing costs to the system. The objectives are achieved while addressing the constraints holistically basin wide.

The challenge with using optimization models has been captured by Labadie (1998) and reproduced below:

- many reservoir system operators have lacked confidence in models which purport to replace their judgement and prescribe solution strategies;
- computer hardware and software limitations in the past have often required simplifications and approximations that operators are unwilling to accept;
- optimization models are often more mathematically and numerically challenging to comprehend than simulation models;
- many optimization models are not conducive to incorporation of risk and uncertainty;
- the enormous range and varieties of optimization methods create confusion as to which to select for a particular application; and,
- several optimization methods, such as dynamic programming, often require customized program development when generalized software packages are unavailable.

Many of these hindrances to use of optimization models in reservoir system management are being overcome. This is due primarily to the ascendancy of the concept of decision support systems and dramatic advances in the power and affordability of desktop computing, both in hardware and software.

One of the purposes here is to place the tools in front of system operators and managers, governing bodies like the IJC and the ISRB for them to choose one or both techniques. It is emphasized here that the minimum required for the purposes of the Plan of Study is the simulation, iterative modelling approach. Also, it is to be noted that the use of the optimization technique will require extra modelling, but will establish a system-wide picture on sharing resources and in conflict resolution. While what will be proposed in this section will not guarantee a truly optimal solution, it will nevertheless be near optimal with shared vision planning elements embedded in the process.

5.5.1 Preliminaries

This section is common to both simulation and optimization modelling sections. A number of preliminary activities are required to assist in the evaluation process. This will include establishing the basis of comparison of reservoir regulations, a listing of important performance indicators and the metrics used for evaluating these.

It is important for the study to engage all interests mentioned in the 1989 Agreement and the evolving interests over time. For example, the water supply element, if looked at in isolation, conveys that the element is for municipal water supply. The statement on water supply as it pertains to Canada is stated in the Agreement as:

> *"Water supply in Canada" means the use of reservoir storage in Canada for the purposes of: cooling water for electric generating plants, irrigation, domestic use, municipal and industrial use, agricultural use, recreation, conservation, flood protection in Canada, or such other uses as the Government of Canada shall designate. (Article I, Clause 1. r)*

Based on similar definitions in the Agreement and Annex A, the study will consider inclusion of these elements when developing the objectives of alternate regulation plans and designing system constraints. As the study has limited resources and little time to collect data for parameters noted above, the study calls for using surrogate information where requirements, for the ecosystem for example, will be re-casted in terms of flows and water levels. For testing whether alternate plans are meeting these objectives, a statistical test will be devised. These considerations are further discussed in this section.

It is important for this review to address not only regulation challenges during high flow periods, but also recognize the very ephemeral nature of the Souris River where there have been many periods of low flow. This POS addresses this by generating stochastic flows that will allow the plan formulators and evaluators to focus on water supply sequences that are not only wet, but also dry and very dry. The hydrologic sequences will also include supplies that go from dry to wet and wet to dry over short time periods. All these activities will test the system on its vulnerabilities and ability to recuperate during these stress events.

There are three separate requirements that need to come from a workshop of stakeholder agencies, environmental NGOs and through discussions at the “Circles of Influence” and within the framework of “Shared Vision Planning”. Prior to initiating this part of the project, an expert workshop will be arranged to solicit stakeholder’s interest. This workshop will allow expert input from key stakeholders, groups that can bring resources and influence to bear upon getting changes if required and input from experts outside of government agencies.

A facilitator will keep the workshop focussed with a report on performance indicators and evaluation metrics. In order to evaluate changes in reservoir operations emanating from multi-interest water management objectives, three phases of work will be required. These key features are required for each of the identified reservoirs, river reaches and key locations identified in earlier components.

1) Each stakeholder group should provide their goals and objectives clearly;

2) The stated goal must be written in terms of specific reservoir operation parameters (a function of storage, release, or flow) or other flow/stage variable for the river; and,
3) The analyst must create a mathematical statement or evaluation metric of each objective at the target locations. These key mathematical statements allow simulation and optimization models to evaluate and compare alternative reservoir operating rules according to their performance.

The information generated at this stage is also useful in establishing constraints and penalty functions for each of the stakeholders. These data could be combined to produce an integrated, non-monetary, index based penalty function for the optimization model.

Project 14 – Design a facilitated expert workshop to develop project goals and objectives, performance indicators and penalty functions at key basin locations and associated evaluation metrics
Lead/Agencies – Task Force or Study Coordinator
Duration – Two months
Cost – Estimated at $60K
Pre-requisite – Projects 1 and 2a
Dependent – Projects 15 and 16

5.5.2 Simulation Analysis and Modelling

In the simulation modelling approach, an optimized solution is obtained through an iterative process of trial regulation plans for all the reservoirs in the system. The overall flow of work is captured in **Figure 5-5**. The outcome of the workshop described above provides the backdrop to the work, initially, in a five-step candidate plan selection.

Develop Trial Operational Plans – Step 1

The Plan Formulation is based on respecting the legal and system constraints outlined in the 1989 Agreement. Any plan that does not meet the legal constraints will be rejected. Using input from various stakeholders, a number of trial proposals with variations in timing or scope of the operational plans need to be formulated. At this stage flow and evolving storage requirements of other stakeholders not identified explicitly in the Agreement could be considered. All assumptions and requirements should be documented in a spreadsheet to verify the limits and practicality at later stages.

Evaluate Trial Plans– Step 2

Using the reconstructed historical water supplies (Project 7), the trial plan is used to develop flow releases and routed through the system. Using the information generated at the stakeholder workshop (Project 14) for performance indicators at key locations, the identified metrics are evaluated based on the computed flow releases. A number of different statistical parameters could be used to highlight the performance of the trial plans.

Tabulate Metrics – Step 3

The metrics (Project 15) will come from a list developed at the workshop, vetted and approved by the Task Force. This will also allow an objective comparison of different trial plans. Some examples of metrics could be as varied as water level ranges in different reservoirs (could be different on an agreed criteria for flood and non-flood seasons), flow (or elevation) limits placed in communities from a flooding perspective, water supply requirements, consideration of water levels in USFWS reservoirs, limits on diversion flows at Boundary reservoir, etc. Additionally, some performance indicators may not readily lend themselves to explicit numbers; these need to be translated into metrics that can be compared objectively.

The metrics chosen are compared in a tabular form to ensure the performance of the trial plan when compared against other plans.

Compare Metrics – Step 4

At this step the performance of the trial plan is compared against the BOC based on the current operating rules for the reconstructed historical water supply sequence. If the trial plan performs better than the current operations, it is classified as a candidate plan for further consideration.

Reject or Fine-tune the Trial Plan – Step 5

The trial plan could fail against either the metrics or perform poorly when compared to the current operations. In this scenario the plan could either be rejected outright or the operating rules of the trial plan could be tweaked for another round of iteration of the five steps described in this section.

It is strongly suggested that the plan formulators keep a tally of such tweaks and adjustments by re-numbering or renaming the plans suitably for tracing the plan evolution.

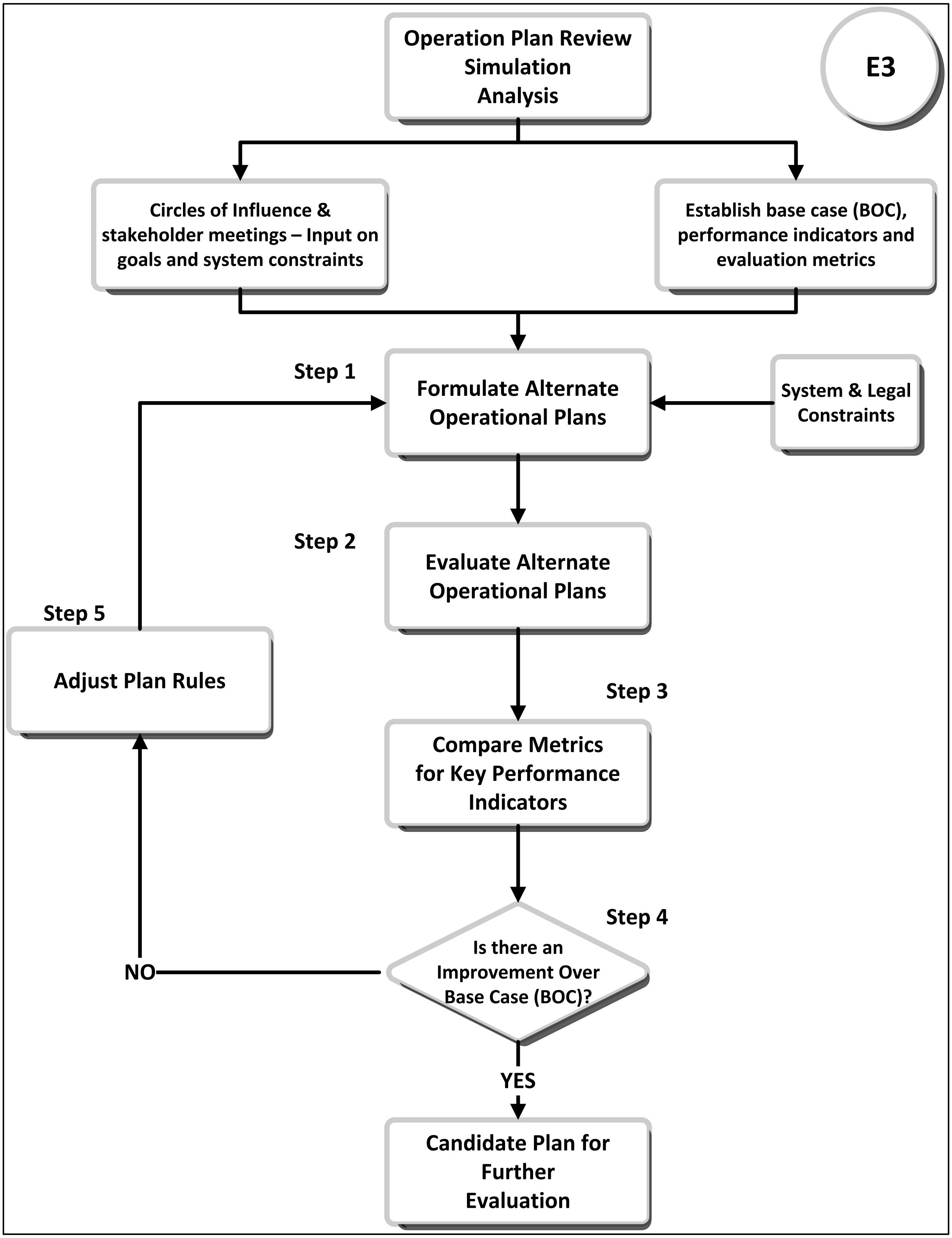

Figure 5-5 Operation Plan Review Steps for the Simulation Analysis Approach

5.5.3 Compare Candidate Plans and Aggregate Rules

The candidate plans that pass the evaluation criteria in the previous step were tested against the reconstructed historical supplies. To screen and further evaluate the candidate plans, they need to demonstrate robustness and resilience against a variety of water supply sequences from the stochastic analysis and climate change scenarios. The sequence of events for this phase of work is shown in the flow chart, **Figure 5-6**.

A set of parameters will test the properties of the candidate plan. By considering all the geographical zones impacted by the regulation plan, consideration should be given to plans that manage to deliver improvements in key sectors in economic, environmental and hydrological areas. Besides delivering key metrics, the plans may include maintaining reservoir water levels within constraints, better all-round economic benefits, more predictability in flow changes, more natural flows and simpler rules and coding. The Task Force may also add other features as well.

If the candidate plans fail the robustness test by failing under stochastic or climate change water supplies, all the candidate plans may be aggregated to develop an integrated candidate plan. While better than the current plan, it will not be optimal, but will handle most situations.

Project 15 – Develop simulation modelling tools using HEC-ResSim or equivalent as the core - screen alternatives to meet study objectives including improvements from water supply forecasting Lead/Agencies – Task Force or Study Coordinator Duration – Two months Cost – Estimated at $300K Pre-requisite – Projects 6, 9, 10, 11, 13 and 14 Dependent – Project 17

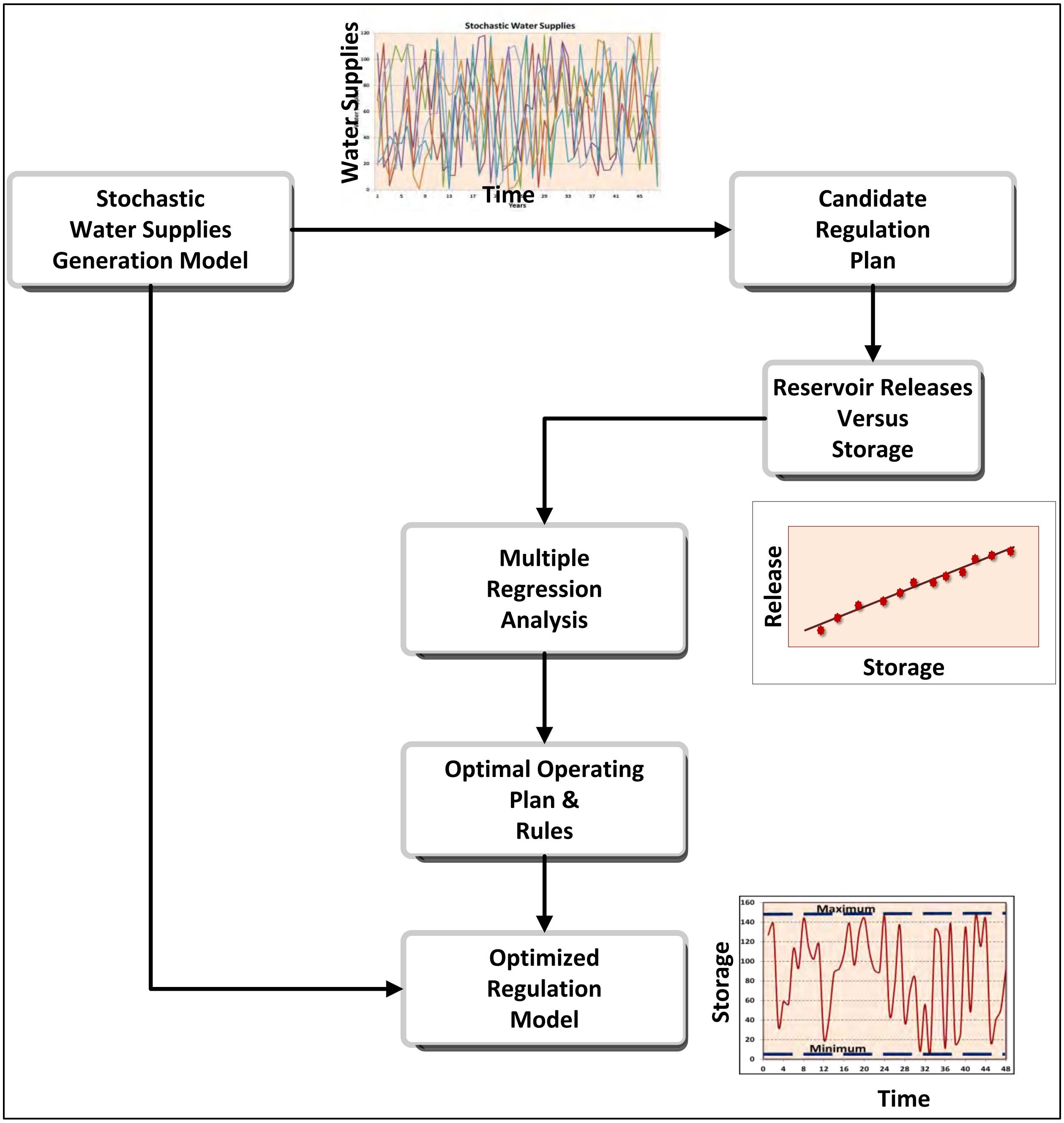

Figure 5-6 Evaluation and Aggregation of Candidate Plans (Adapted from Labadie, 1998)

5.5.4 Optimization Analysis and Modelling

The challenge of determining *optimal* reservoir operation plans is historically difficult and uncertain, both from a theoretical perspective and practicality considerations. Several distinct approaches have been developed and proposed, but none has proved to be generally applicable, portable and rigorous. One of these approaches, being suggested for the Plan of Study is to employ deterministic optimization techniques for the Souris Basin Project using a long record of reconstructed historical, synthetic and climate change system inflows, followed by the development of reservoir operating rules which most closely mimic the time-series of optimal decisions produced by the optimization model. When a long streamflow record is used, this approach can be called *implicit stochastic optimization.* These approaches have been applied to several studies in the last 20 to 25 years. Two earlier applications of the implicit stochastic optimizations were in the Great Lakes system (IJC Water Levels Reference Study 1993) and Developing Operation Plans from HEC Optimization Reservoir Model Results for the Missouri River System (US Army Corps of Engineers, Hydrologic Engineering Center, 1992) and the Columbia River Study (US Army Corps of Engineers, Hydrologic Engineering Center, 1995).

In this approach, the optimization model considers the objectives of either minimizing costs or maximizing the benefits to the system. The physical and hydrological constraints obtained through the workshop can be converted into penalty functions for keeping the overall reservoirs and connecting reaches in a comfort zone holistically.

In this POS, the proposed modelling strategy offers a systematic and holistic method to develop, screen, and evaluate all reservoir operational alternatives to help resolve conflicts over water resources in the Souris River basin. The method takes advantage of an implicit optimization model for screening and a deterministic simulation model for testing and refining alternatives. Typically, optimization models require numerical representation of values for all water uses. Traditionally, most of these quantitative value functions have been formed using standard economic analysis. Economic analysis, however, is not always feasible for all water uses. Therefore, a systematic method that produces relative or value functions is proposed. This method provides an approximate yet an objective representation of advocacy groups' preferences toward specific modes of reservoir operation. These functions are also referred to as *Interest Satisfaction Curves*. These approximate value functions allow the analyst to benefit from the optimization model's screening capability to make the detailed simulation study more efficient.

The steps required for the implicit stochastic optimization are shown in **Figure 5-7**. These will be briefly described. It should be noted that this approach only comes up with an optimization tool that will provide an intelligent step towards an objective regulation plan that still has to be evaluated in the simulation framework described in **Section 5.5.2**.

Similar to the simulation modelling, the goals and metrics will be re-casted in a Linear Programming framework as objectives and penalty functions. Using the reconstructed historical and a selection of stochastic and climate change supplies, optimal releases for the design periods will yield different optimal solutions. For each of these optimal releases, operating rules can be developed by carrying out regression analysis for storage and releases. This step will yield an operating plan for each of the supply sequences. Finally, the results from all the supply sequences can be aggregated to yield an integrated regulation plan. This regulation plan, while not optimal for any of the supply sequences, will be robust, as many different supplies from both wet and dry scenarios will have been used in developing the plans. Each of the regulation plans will be subject to the five-step evaluation process of **Section 5.5.2**. Once plans have been shortlisted down to the best three or four candidate plans, the improvements coming from water supply forecasting should be investigated.

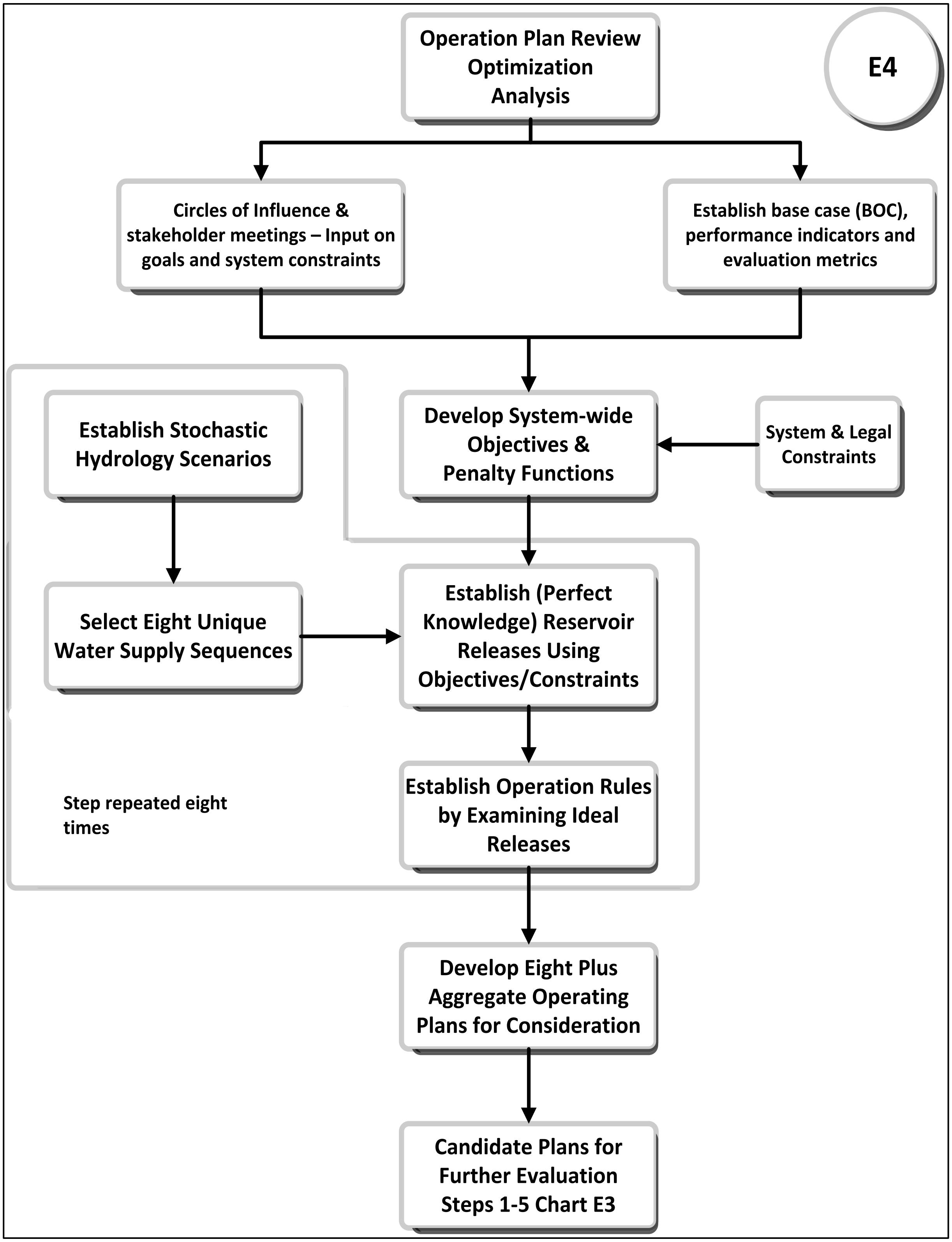

Figure 5-7 Optimization Modelling Based Candidate Plan Selection

Project 16 – Develop optimization modelling tools using HEC-ResPRM or equivalent as the core - screen alternatives to meet study objectives including improvements from water supply forecasting
Lead/Agencies – Task Force or Study Coordinator
Duration – Two months
Cost – Estimated at $250K
Pre-requisite – Projects 6, 9, 10, 11, 13 and 14
Dependent – Project 17

Project 17 – Quantify improvements in system operations by including water supply forecasts for the shortlisted candidate regulation plans
Lead/Agencies – Task Force or Study Coordinator
Duration – Two months
Cost – Estimated at $75K
Pre-requisite – Projects 10, 15 and 16
Dependent – None

5.5.5 Plan Selection Process

In the previous sections it was demonstrated how a candidate plan is developed respecting the legal and system constraints and evaluated through either the optimization or simulation modelling approaches. In this section, the process to short list the recommended plans and to conduct the assessment is described. The high level picture is captured in **Figure 5-2**.

The selection of candidate regulation plans was described in **Sections 5.5.3 and 5.5.4**. The potential exists for several candidate plans that pass the basic criteria of respecting all elements of the 1989 Agreement, while adjusting the operating rules and associated parameters contained in Annex A. It will be desirable to reduce the number of candidate regulation plans to two or three best alternatives. To identify the best alternatives, a two-level screening procedure is proposed, which will assist the Task Force and ISRB in recommending changes.

The two-stage process is shown in **Figure 5-8**. The first set of criteria will test the hydrological robustness of the selected candidate regulation plans by ensuring that the basic objectives contained in the 1989 Agreement are honoured. The selected candidate regulation plans should address the system and legal constraints and provide improved system performance, given historical flows and flow sequences and considering stochastic and climate change scenarios.

Performance screening criteria will be developed for the final assessment of the selected candidate regulation plans. These criteria will be developed by the Task Force with guidance from the Board, stakeholder agencies, and Public Advisory Group. The candidate regulation plans that pass the hydrological screening are assessed considering the performance criteria. Since most criteria can be linked to the flow, water level, duration of flow above or below a threshold, the initial hydrological screening will be critical. An initial set of performance criteria may include features of availability of water for water supply, fish and wildlife, effluent management, and level of flood protection.

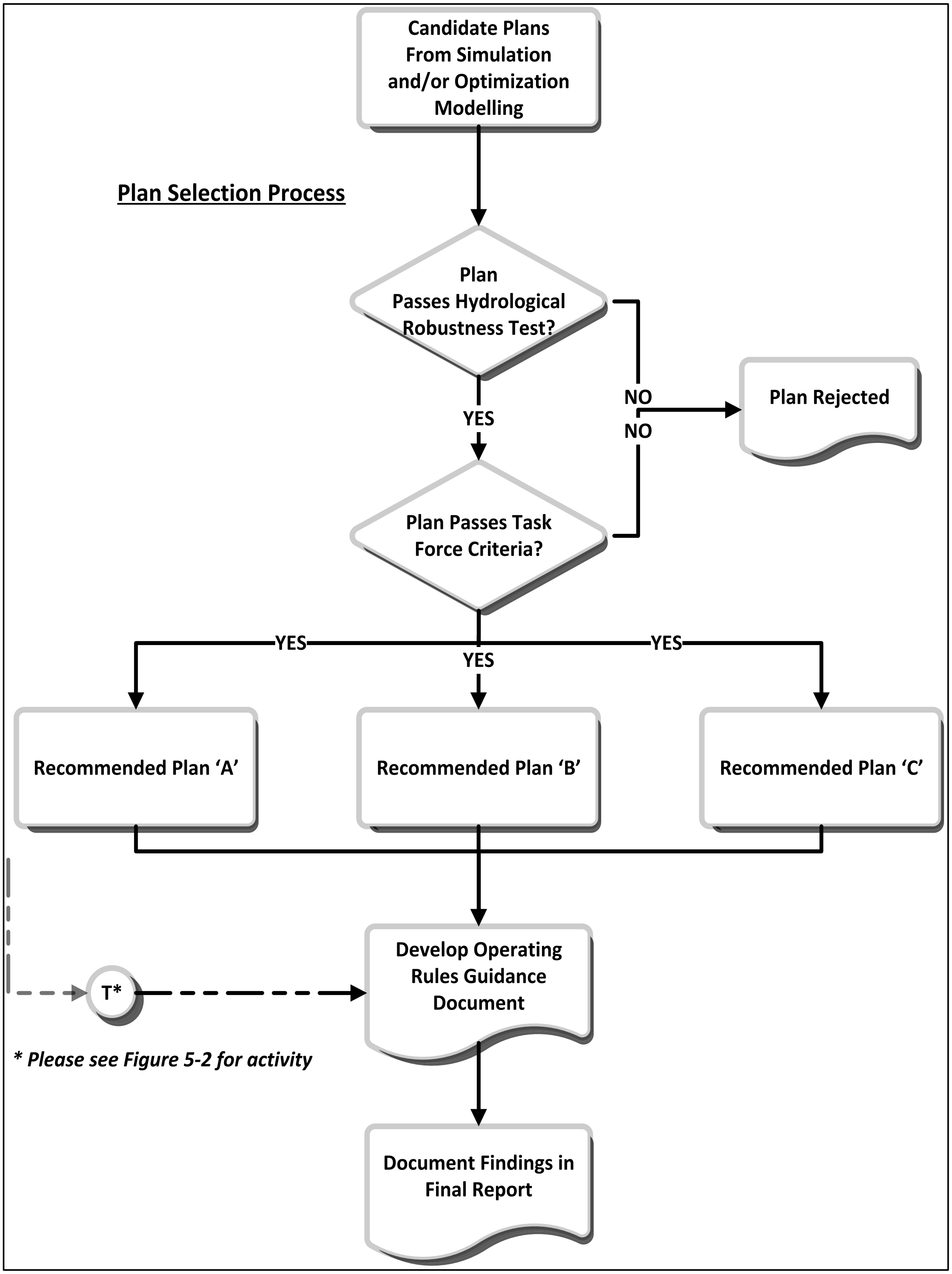

Figure 5-8 Plan Selection Procedure

Once a regulation plan or a short list of plans is agreed to, operating rules for the selected plan(s) will be developed and codified. This activity will complement the work that was initiated as part of Project 1b described in **Section 5.2.2**. The operating rules need to be written in such a way that they are simple to follow, leaving little ambiguity for the operators.

Project 1c: Develop operating rules to reflect the recommended alternative regulation plan.
Lead/Agencies – Task Force and Study Coordinator
Duration – Four weeks
Cost – Preferably in-house/Task Force $ 20K (included in Project 1b)
Pre-requisite – Projects 1a and 1b
Dependent – None

6 STUDY ORGANIZATION

The study will be led by the ISRB through the Task Force. The Board will be responsible for the direction of all work, the provision of guidance as required, the approval of all communications and reports, and the submission of the final report to the IJC. The Task Force will be responsible for the assessment of all results, the weighing of the alternatives, the preparation of the final report with conclusions and recommendations. The ISRB will issue a final report to the IJC and the IJC will provide the report to the governments of the U.S. and Canada. The governments will need to agree to any recommended changes to reservoir operations. Until such time as the governments agree to changes to the 1989 Agreement, the existing Operating Plan at Appendix A of the 1989 Agreement will remain in effect.

Study Manager(s) will be used to supervise the study activities on a day-to-day basis. The study work may be undertaken by governmental agencies involved in the Souris River basin, and some tasks may be contracted out to other agencies or groups.

Regardless of how the various components of the study are carried out, all review and evaluation of existing work, and all final assessment of new work, will be conducted by independent, impartial persons with the appropriate skills and knowledge.

6.1 Organizational Structure

The organizational structure is shown in **Figure 6-1**. The inter-relationships of the different proposed bodies will be better defined once the Plan of Study is approved. The IJC may choose to have a different organizational arrangement for the Operating Plan review. Each of the structural components in the organizational structure below the Task Force is briefly described.

For a study of this magnitude and complexity, it is desirable to have a coordination structure reporting to the Task Force. In the same vein the coordination of all the studies and projects in support of the Operating Plan review need to be serviced by a Study Manager. Again, the IJC most likely will define the number of managers suitable for the study, given the bi-national nature of the review. The Study Manager and Task Force with guidance from the ISRB and IJC will recommend how the work be spread over agencies, countries as well as the temporal arrangement.

For each of the three technical work groups, it may be desirable to draw the leads from the Task Force membership, one each from the U.S. and Canada. The Study Manager working with the co-leads will coordinate work of the projects within each of the three work groups. Besides the co-leads, the technical work groups may draw memberships from supporting agencies and other principal investigators.

Most of the projects described in **Section 5** are to be carried out by a number of work groups which are described in this and the following sub-sections. As noted in the organizational structure, the integration of work, weighting of the information and report production will be carried out by the full Task Force or an appointed sub-group.

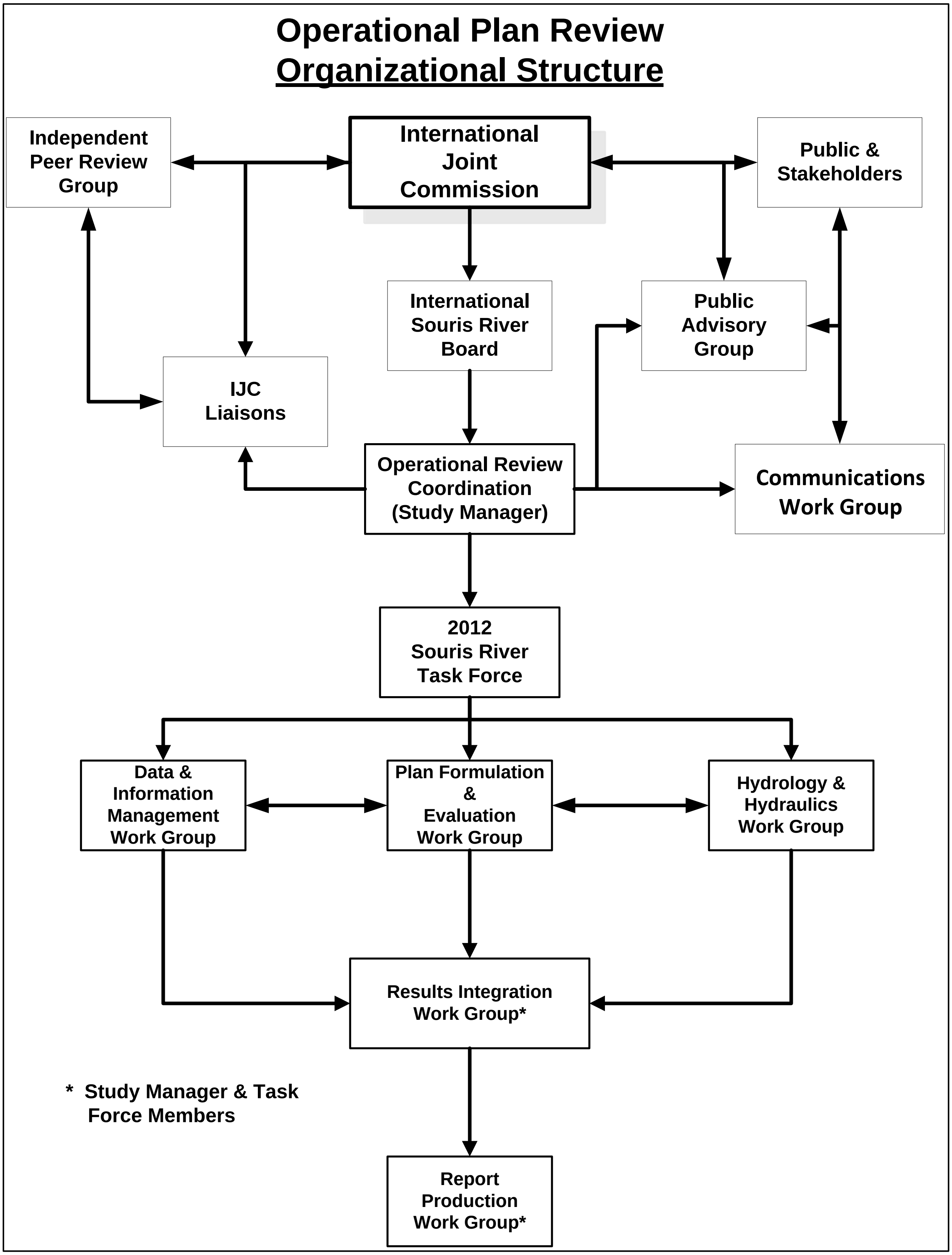

Figure 6-1 Operational Review Organization

6.1.1 Data and Information Management Work Group

This work group like all other work groups will have the co-leads appointed by the Task Force with a dual mandate of providing quality assurance, the basis of analysis of data to the other study participants and for establishing the framework of developing information management instruments.

In addition to analyzing existing data, the work group will gather new data from a gap analysis for including bathymetry, if required, water level and flow data in support of projects outlined in **Section 5**. This information is essential to calibrate and verify a variety of mathematical and simulation models that will be used to study hydrological processes as well as hydraulic and hydrologic flow characteristics under different climate regimes.

The second major activity for this group will be to develop protocols for managing data, information and reports during the life of study and beyond. As part of this work, the group will develop a framework for tracking the Task Force / ISRB decisions and connect the information stream from data, models, results, conclusions and findings.

No.	Activity	Year 1	Year 2	Total
1	Projects for Data Management	$ 40K	$ 10K	$ 50K
2	Projects for Decision Mapping	-	$ 50K	$ 50K
3	Work Group Management	$ 30K	$ 25K	$ 55K
	Total	**$ 70K**	**$ 85K**	**$ 155K**

6.1.2 Hydrology and Hydraulics Work Group

This work group is responsible for providing the basic hydrology information and time series of water supplies at key points, developing hydrological stochastic supplies, developing procedures and estimates of forecasted water supplies and an estimate of reliable lead times. The group's other main activity is to rationalize and use climate change information applicable to the Souris River basin. The group, at the early stages of the study, will develop an understanding of climate change scenarios by hosting an expert workshop.

The second major activity is to develop procedures to understand the response of the river to various stimuli. This will help understand the response of reservoir releases at points downstream in terms of attenuation and translation of the peaks.

No.	Activity	Year 1	Year 2	Total
1	Projects for Hydrology and Hydraulics	$ 350K	$ 120K	$ 470K
2	Work Group Management	$ 30K	$ 20K	$ 50K
	Total	**$ 380K**	**$ 140K**	**$ 520K**

6.1.3 Operational Plan Formulation and Evaluation Work Group

The key aspect of this work group is to generate a range of alternative regulation plans that are intended to improve, if possible, benefits to the users over the current Operating Plan for the Souris Basin Project. Using information produced by the first two work groups, the PFEG work group is responsible for reviewing and testing alternative operating plans. The group will direct the activities for all aspects of developing objective functions as well as conducting and directing activities in support of simulation and optimization modelling to test and evaluate alternative regulation plans for the system reservoirs.

Prior to beginning any analysis, a workshop, circle of influence meetings or a series of public consultation sessions will be required to properly frame the objectives to address as many view points as possible. An early identification of the stakeholder interest could be gleaned from the first round of consultations as part of the POS public input.

No.	Activity	Year 1	Year 2	Total
1	Workshop & Meetings for Alternative Plans	$ 40K	-	$ 40K
2	Projects for simulation Modelling	$ 125K	$ 310K	$ 435K
3	Projects for optimization Modelling	$ 60K	$ 190K	$ 250K
4	Work Group Management	$ 20K	$50K	$ 70K
	Total	**$245K**	**$ 550K**	**$ 795K**

6.1.4 Results Integration Work Group

This work group is required for providing objective based results from the various projects in formulating and evaluating results for the further consideration of the ISRB and IJC. In the process of evaluating alternative regulation plans for the system reservoirs, there is always the potential that several plans may appear worthy of further consideration. The Task Force will closely monitor the evaluation process and be responsible for the development of objective criteria to assess optimal alternatives. For this purpose, there may be a need for a decision making workshop to further refine the selection process.

This group will consist of members appointed by the Task Force in consultation with the ISRB and assisted by the Study Manager.

No.	Activity	Year 1	Year 2	Total
1	Workshop & Decision Practice for Alternative Plans	-	$ 25K	$ 25K
2	White Paper on Plan Selection	-	$ 10K	$ 10K
3	Work Group Management	-	$ 10K	$10K
	Total	**-**	**$ 45K**	**$ 45K**

6.1.5 Report Production Work Group

One of the lessons learned from recent IJC studies is to have a small core team for final report writing purposes, assisted by an external expert technical editor. This work group will consist of a small number of Task Force or Study Board members along with the technical editor supported by the Study Manager. The work of this work group will start in the second year upon the completion of several projects and studies. Preferably, study planning should allow a six-month time line for the writing of the final report.

No.	Activity	Year 1	Year 2	Total
1	Contract for Technical Editor	-	$ 50K	$ 50K
2	Work Group Management	-	$ 25K	$ 25K
	Total	**-**	**$ 75K**	**$ 75K**

6.2 Recommended Agencies or Organizations to Conduct Studies or Activities

The Plan of Study proposes a study organization consisting of a Study Manager supported by the Task Force, as well as panels of advisors and technical/resource groups responsible for studies. While experts in government agencies are expected to be appointed to the study organization, private citizens, companies and industries, and the academic community who have good knowledge of Souris River water management issues and experience in multi-disciplinary studies should be considered.

If the study is under the auspices and funding of the IJC, all study participants will serve in their personal and professional capacity and not represent their employer, company or institution.

The listings in **Sections 6.2.1 through 6.2.7** are an initial identification of possible study participants, and are not meant to be all inclusive. There are many agencies and individuals that may provide input and expertise to the Operating Plan review components, such as local governments, universities and non-governmental organizations.

On joining the study organization, the study participant should be advised of the time commitments to be spent on the study, including travel to attend meetings.

Experts from the following organizations could assist the study.

6.2.1 Task Force and Study Management

Initial appointments to the Task Force were made earlier for the POS. The ISRB may need to re-visit this at the initiation of the study. If the study is escalated to an IJC Reference level, the study management appointments could be made by the International Joint Commission.

6.2.2 Communications

This group will have individuals who are well versed in the public affairs and public communications.

United States:
U. S. Army Corps of Engineers
North Dakota State Water Commission
Canada:
Environment Canada
Saskatchewan Water Security Agency
Manitoba Conservation and Water Stewardship
International:
International Joint Commission

6.2.3 Public Advisory Group

This group will have individuals who are knowledgeable of water management issues in the Souris River. Their responsibilities will include advising the ISRB, Task Force, Study Manager and work groups on issues of concern, advising on any technical issues or assumptions of the study, and acting as liaison between the Task Force and their constituents. The IJC or ISRB will consult with the local constituents to identify with the potential participants.

6.2.4 Data and Information Management

This group will be responsible for developing an information strategy for the Task Force, and its implementation. The group will also operate and maintain the Task Force web site to facilitate data exchange among the work groups, and to communicate with the public. The study may draw expertise for this work from the USACE, NDSWC, Environment Canada and SWA. With experiences from the Great Lakes studies, the IJC could also provide guidance in this area.

6.2.5 Independent Technical Review

Experts will be invited during the course of the study to provide review and comment on the science used in the study. The initial review will be to assess the science and engineering strategies proposed in the study. The second review will be of a selected number of sub-products that the peer review group may choose from the study. The final review by the external peer reviewers will be of the draft final report to ensure consistency in analysis from strategy to findings. It should be noted that the peer review process is independent of the Task Force activities and arranged and managed by the IJC. The Task Force and Study Manager will be expected to provide support and all documentation required for the review.

6.2.6 Hydrology and Hydraulics Work Group

This work group will provide the Task Force and other work group with information on flow regimes for the Souris River Operating Plan review. The work of this group is instrumental for testing, developing and implementing procedures and schedules for the synthesis of study results. The membership and expertise could be drawn from:

United States:
U.S. Army Corps of Engineers
U.S. Geological Survey
U. S. Fish & Wildlife Service
National Weather Service, Bismarck ND and Chanhassen, MN
FEMA (Denver Office)
North Dakota State Water Commission
North Dakota Geological Survey
Canada:
Environment Canada
Saskatchewan Water Security Agency
Manitoba Conservation and Water Stewardship

International:
Universities

6.2.7 Plan Formulation and Evaluation Group

The Plan Formulation and Evaluation Group is responsible for formulating alternative plans, evaluating in accordance with method and level of detail approved by the Board, various regulation options and providing information essential for decision making. As the core of the work is carried out by this group, it is essential that timely submission of work progress reports and the final report in suitable formats for use by the Task Force be made. The group will also be responsible for providing timely information to support for the study board web site to inform the public on the study progress.

Listed below are the potential sources for expertise when making up this study group.

United States:
U.S. Army Corps of Engineers
U. S. Fish and Wildlife Service
FEMA (Denver Office)
National Weather Service, Bismarck ND and Chanhassen, MN
North Dakota State Water Commission
North Dakota Game and Fish Department
North Dakota Department of Health
Canada:
Environment Canada
Saskatchewan Water Security Agency
Saskatchewan Ministry of Environment
Manitoba Conservation and Water Stewardship
International:
Public Works/Municipality Representatives
Universities
Non-Governmental Organizations

7 INFORMATION MANAGEMENT AND DECISION SCHEMATICS

An information management framework is a key element to ensure the transparency of the study progress and process, and to protect the investments made by the ISRB, IJC, both governments and participating agencies. From lessons learned during the recent Great Lakes studies, the information management (IM) requirement must be considered at the start of the study.

A vision statement for this study, which needs to be endorsed by the IJC, may read

"The IJC encourages unrestricted access to data. Data collected by the Task Force will be made available on line once it has been approved for distribution. Most of the data collected by the Task Force will be readily available to the general public by the completion of the Study. However, some limited data will be protected and not be distributed, such as in cases of proprietary information or national security sensitivities".

The three main elements of IM are transparency, preserving artefacts, and unrestricted access.

- **Transparency** - The IJC, ISRB and the Task Force have a strong desire to show others what actions were taken in determining the choice of an alternative operating plan.
- **Preserving Artefacts** - The IJC, ISRB and the Task Force must preserve the study assets that were used in determining the choice of an alternative operating plan so future generations can understand the motivation behind those choices
- **Unrestricted access** - The IJC encourages unrestricted access to data. Data collected by the Task Force will be made available once it has been approved.. Availability will include both direct human interfaces and machine interfaces.

The second key aspect of IM is to provide future users of the study, stakeholders and water managers insight into the decision making process. In most studies this understanding is lost once the mandate of the study ends. To preserve the rationale, all underlying knowledge and experience should be captured. This decision mapping should be factored in the process at the time of developing strategies for the study.

One example of such mapping is shown in **Figure 7-1**. In this graphic a decision, for example recommending an adaptive regulation plan for the Souris Basin Project is connected to the key findings on which this recommendation/decision is made. The key findings emanating for the study conclusions are supported by several modelling results using a variety of source data. Similar connectivity diagrams are needed for other findings and recommendations.

The costs for Information Management and Decision Mapping for the Operational Review are estimated as follows:

	Year 1	Year 2
Total Cost	$40K	$60K

The total cost for the study Information Management Group will be about $100K.

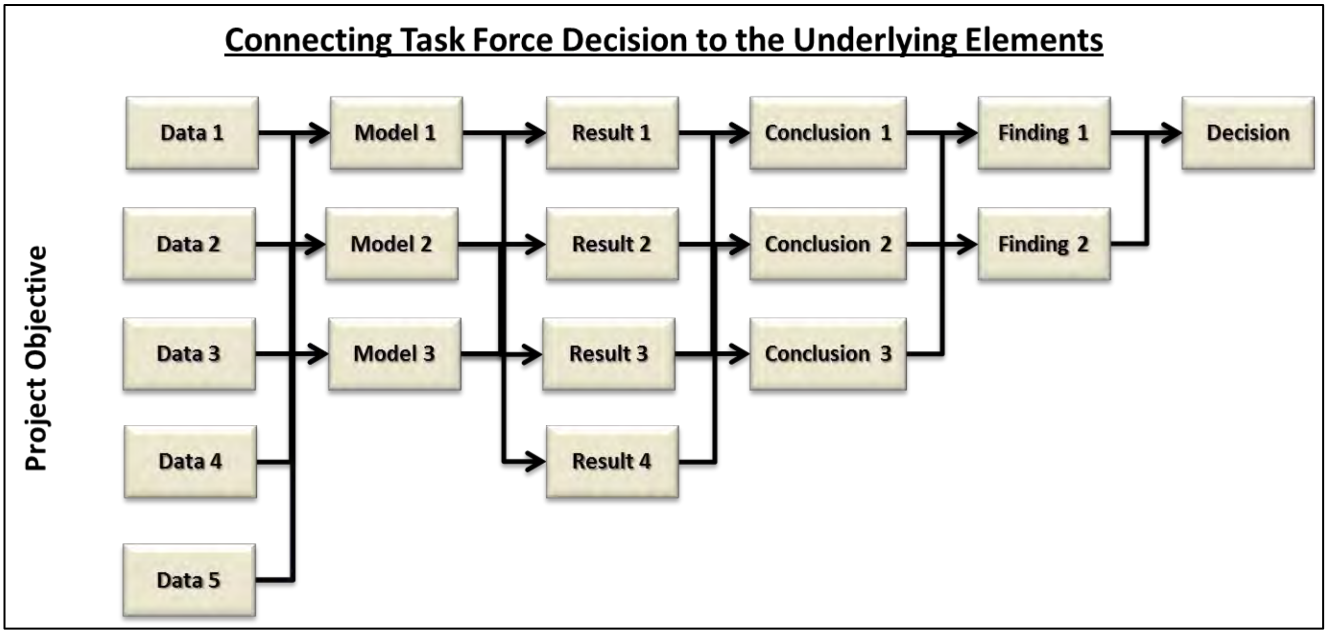

Figure 7-1 Decision Mapping Schematic

8 PEER REVIEW PROCESS

The IJC has been interested in a more targeted and coherent layer of Independent Peer Review (IPR) that is outside the study activities and is focused on any issues which may not be receiving appropriate technical review.

As well, there may be issues that are raised by the Independent Peer Review Process which require a degree of "scientific refereeing", particularly when there is a substantive scientific debate on unresolved issues, for example, on the interpretation of climate change scenarios and their application to operational water management. Overall, the independent peer review function is structured in such a manner that the IJC itself will manage the review process, and the peer reviewers will report directly to the IJC.

Traditionally, independent peer review, as practiced by the U.S. National Research Council (NRC) or the Council of Canadian Academies (CCA) is structured in such a way as to provide an independent, one-time final assessment of a particular project or study, with limited feedback and interaction with study team members. This model was used in the Lake Ontario Study.

Based on the lessons learned from Lake Ontario experience, the International Upper Great Lakes Study (IUGLS) chose a different peer review model. IUGLS, an 'operational study', required real-time feedback from experts so that mid-course corrections could be made on a series of technical issues and choices. The IUGLS required both an independent peer review and an advisory function.

The IJC may select the peer review panels, seeking advice from professional institutions such as the AWRA, ASCE, CSCE and CWRA. The overarching charge shall be to evaluate the ***appropriateness*** and ***sufficiency*** of the studies and models used to inform decisions related to regulation plan options. The following should be considered:

- The science and technical studies, as represented in the reports and model documentation provided shall be reviewed using an Independent Peer Review process in terms of the degree to which:
    - the models and reports are sufficient and appropriate to evaluate the various regulation plan options and impacts of changes in water levels and flows;
    - the studies reflect reasonable and acceptable scientific methods, assumptions and supported findings;
    - the models sufficiently and appropriately integrate and display the key information needed for a comprehensive evaluation and understanding of the tradeoffs for selecting among the candidate plans, as well as properly explicating the degrees of uncertainty in the analyses.
- The review shall be limited to critical evaluation and decision components of the topics listed that relate directly to the regulation plan options.
- Panels of Experts for each task should be composed of approximately equal numbers of U.S. and Canadian citizens to reflect the bi-national equality of work undertaken by the IJC.

- When an item has been referred for peer review, a fairly quick turnaround time is required. Normally, it is expected that the peer review will be conducted within two to four weeks, depending on the nature and scope of the review requested.

The costs for the Peer Review process for the study are estimated as follows:

	Year 1	Year 2
Total Cost	$15K	$35K

The total cost for completing the peer review process of the study will be about $50K.

9 PUBLIC ADVISORY GROUP

A Public Advisory Group (PAG) is a critical element in reviewing the regulation of reservoir outflows and potentially recommending criteria and alternative regulation plans. This group differs from the Communications Group discussed earlier in that the PAG will act as more of an avenue for public input to the study, rather than study presentations to the public.

It is critical that the public involvement process begins early and continues throughout the study. The PAG should be established at the study initiation and should meet twice a year, as a minimum. PAG members will be appointed by the IJC or the ISRB. This PAG model is depending upon whether IJC, based on consultations with the governments, issues a Reference or the ISRB undertakes the study as part of its responsibilities. The members of PAG will be selected from key local institutions to adequately represent the broad interests in the basin. Equal representation from Canada and the United States will be considered. It should be noted that PAG members are volunteers, with only their travel paid to be determined on a case-by-case basis. The expectations of time commitments should be clearly communicated to potential members at the start of the study.

In addition to obtaining views and opinions from the public, it is equally important that the public and interested parties are informed of the Operating Plan of Annex A and its effects on upstream levels and downstream flows. The public information program will seek Task Force assistance in conveying technical aspects of the study.

To achieve this understanding, it is recommended that the major user groups and a select number of the public be involved directly in the study. The PAG should be an advisory arm of the Task Force. The POS recommends that the PAG be assembled to ensure that the interests and issues of major affected groups and parties are represented in a formal way during the study. The PAG will have members that will act as liaisons to each of the Task Force committees, and thereby have significant knowledge of the direction of the study and the work of the various committees. Given its unique role, PAG will be a forum for evaluating and ground-truthing the direction of the work. Through the PAG, the public will help meet the goals and objectives of the study, provide input to the development of evaluation criteria, identify possible scenarios and options, and provide advice and guidance to other critical components of the study.

The PAG will include members representing a variety of interests, with representatives chosen through their affiliation. These could include city officials, floodplain managers, ecosystems, fisheries, municipal and industrial water users, and others as appropriate.

Members of the PAG are expected to assist with other public involvement efforts using their own local contacts. This will help facilitate communication to all interested parties and the general public. Many of these interests have competing recommendations for water flow changes. The success of the study will be dependent in part on conveying the issues regarding competing uses of the waters to the public and furthering the understanding that most proposed solutions that benefit one resource will have some negative consequences for others.

The costs for a Public Advisory Group for the study are estimated as follows:

	Year 1	Year 2
Total Cost	$40K	$60K

The total cost for the study Public Advisory Group will be about $100K.

10 FINANCIAL SUMMARY AND STUDY BUDGET

10.1 Introduction

In this section the information presented in **Sections 4 through 9** all have cost items that are summarized. For the purposes of this POS, the costing activities and projects need to be refined, as these are first order estimates in most cases drawing from other similar undertakings by IJC and the Task Force.

An optimal scoping model is presented along with two alternatives representing a range of effort and cost from about $2.1 M for the optimal model containing the elements necessary for an IJC Reference level study down to a minimum model costing about $1.0 M, but providing a more narrow review with a limited shelf life allowing only a limited number of alternative operating plans that can be evaluated.

It is proposed to complete the Operating Plan review in two calendar years following the receipt of the directive from the IJC.

Regardless of the scoping level of effort selected, the results of the Operating Plan alternatives analysis will be summarized clearly identifying any changes that are within the present International Agreement and those that go beyond the present agreement which will require approval and agreement by the Governments of Canada and the United States for implementation.

10.2 Optimal Scope Model

Information is presented in three parts for the optimal scope. The core scientific and engineering studies are presented in **Table 10-1**, the non-study coordination and management activities are listed in **Table 10-2** and a consolidated table of all costs for the Operating Plan review is presented in **Table 10-3** for the optimal scope model.

This level of effort provides a broad review and the necessary elements for an IJC Reference level study and is the best solution for its long shelf life and adaptive nature of the regulation plans that will emanate from its products. Seventeen projects detailed in **Section 5** were carefully designed in a modular approach and feature detailed stochastic and climate change analysis, simulation and optimization modeling, and a facilitated expert workshop. Nonetheless, this level of effort is the most costly alternative with an overall study cost of about $2.1 M

Table 10–1 Summary of Scientific and Engineering Studies and Projects – Optimal Scope

List of Projects for Operating Plan Review - Optimal Scope						
Project Number	**Description**	**Group**	**Duration**	**Estimate, $K**	**Pre-requisite**	**Dependent**
1a	Review language of the operating rules from the 1989 Agreement and produce a white paper highlighting key elements, challenges and issues faced during 2001 and 2011 floods.	**Task Force (TF)**	Two weeks	**10**	None	Projects 1b, 1c & 17
1b	Provide recommendations on areas where changes to the language of the operating rules may be required in the present form, i.e. no changes to the operating rules.		Four weeks	**20**	Project 1a	Projects 1c & 17
2	Compile list of Operating plan review related projects. Perform gap analysis to identify and prioritize work that is required in support of the review.		Four weeks	**15**	Project 1	Project 3
3	Compile a list of physical data of the Souris River Basin. Perform gap analysis to identify and prioritize work that is required	**Data Work Group**	Six weeks	**20**	Project 2	Project 6
4	Compile a list of reservoir characteristics data. Perform gap analysis to identify and prioritize work that is required in support of the review.		Two months	**25**	None	Projects 12, 13, 15 & 16
5	Souris River Basin Hydrometeorological Data Network Improvement Project (Coordination)		One year	**5**	None	Projects 9, 10 & 17
6	Compile a list of the Souris River Hydraulic Characteristics Data. Perform gap analysis to identify and prioritize work that is required in support of the review		Four weeks	**40**	None	Projects 12 & 13
7	Regional and Reconstructed Hydrology of the Souris River in Support of the Review of Operating Plan	**Hydrology & Hydraulics Work Group**	Six months	**100**	Project 3	Project 8, 15 &16
8	Develop 10,000 or 50,000 years of stochastic water supplies for the three sets of data series for the state of nature flows in the Souris River basin using ARMA or ARIMA models or equivalent methodology		Six months	**100**	Project 7	Project 15 & 16
9	Establish thresholds among hydro-climatological, basin physical and contributing drainage area by selecting an appropriate model and its application for this task		Three months	**60**	Projects 3, 4, 5 & 6	Projects 10 & 11
10	Develop tools and procedure for predicting forecasted water supply - establish degrees of confidence for various lead times		Six months	**50**	Project 9	Projects 16 & 17
11	Develop climate change water supplies at key locations in the Souris River basin using results from Stantec or other Task Force supplied specifications		Six months	**100**	Project 9	Projects 15 & 16
12	Reservoir flow release attenuation and translation in support of the review of Operating Plan in the Souris River Project using storage routing options		Six weeks	**25**	Project 6	Projects 15 & 16

13	Reservoir flow release attenuation and translation in support of the review of Operating Plan in the Souris River Project using unsteady state modelling		Six months	35	Project 6	Projects 15 & 16
14	Design a facilitated expert workshop to develop project goals and objectives, performance indicators and penalty functions at key basin locations and associated evaluation metrics	**Plan Formulation & Evaluation Work Group**	Two months	60	Projects 1 & 2a	Projects 15 & 16
15	Develop simulation modelling tools using HEC-ResSim or equivalent as the core & screen alternatives to meet study objectives including improvements from water supply forecasting		Ten months	300	Projects 6, 9, 10, 11, 13 & 14	Project 17
16	Develop optimization modelling tools using HEC-ResPRM or equivalent as the core& screen alternatives to meet study objectives including improvements from water supply forecasting		Ten months	250	Projects 6, 9, 10, 11, 13 & 14	Project 17
17	Quantify improvements in system operations by including water supply forecasts for the shortlisted candidate regulation plans		Two months	75	Projects 10, 15 & 16	Project 1c
1c	Provide recommendations on areas where changes to the language of the operating rules may be required for the alternate form, i.e. with changes to the operating rules or new regulation plan	**TF**	Six weeks (cost included in Project 1b)	0	Projects 17, 1a & 1b	None
	Total			**1290**		

Table 10–2 Study Coordination and Management Costs – Optimal Scope

Study Management Costs – Optimal Scope				
No.	**Activity**	**Year 1 ($K)**	**Year 2 ($K)**	**Total ($K)**
1	Work Group Management	120	215	335
2	Public Advisory Group	40	60	100
3	Communications and Outreach	40	60	100
4	Information Management	40	60	100
5	Peer Review Process	15	35	50
6	Study Coordination	75	85	160
	Total	**330**	**515**	**845**

Table 10–3 Overall Costs of the Annex A Operating Plan Review – Optimal Scope

Study Overall Costs Including Technical Studies – Optimal Scope				
No.	**Activity**	**Year 1, $K**	**Year 2, $K**	**Total, $K**
1	Work Group Management	120	215	335
2	Task Force Reviews	45	0	45
3	Data Work Group	80	10	90
4	Hydrology & Hydraulics Work Group	350	120	470
5	Plan Formulation & Evaluation Group	185	500	685
6	Public Advisory Group	40	60	100
7	Communications and Outreach	40	60	100
8	Information Management	40	60	100
9	Peer Review Process	15	35	50
10	Study Coordination	75	85	160
	Total	**990**	**1145**	**2135**

10.3 Alternate Budget and Costing Models

In **Section 10-1**, detailed costs estimates were provided for the planned two-year study horizon for the optimal scope level of effort. These costs and associated projects were based on a broad review and the necessary elements for an IJC's Reference level study. The designed approach encompasses all features that will help IJC and the ISRB for many years to manage water resources in the Souris River project. An additional advantage of the elements noted in **Section 5** is that the study and techniques will have a shelf life of about 20 years.

The Task Force was careful in designing the seventeen projects detailed in **Section 5** in a modular approach. It is relatively simple to limit the Operating Plan review study to various scoping levels of effort by considering projects pertinent to each level. For the purposes of providing alternative models for consideration by the ISRB and IJC, two alternatives are proposed below. The first alternative is to consider the minimum scope study for the Operating

Plan review. The second alternative will require an enhanced hydrology to provide slightly more robust testing of alternative regulation plans for a medium scope level of effort. The advantages and drawbacks are noted for each alternative. **Tables 10-4 to 10-6** capture the essentials for the minimum scope and **Tables 10-7 to 10-9** detail the medium scope. For details on individual projects, please refer to the descriptions in **Section 5**.

10.3.1 Minimum Scope Model

The number of projects in this model is reduced to twelve. This reduction is achieved by eliminating some projects, merging some studies, and reducing the scope of others. In this model no optimization modelling and climate change modelling are considered. To obtain the optimum operating plan, the reliance will be on the trial and error technique of the simulation modelling process.

Similar to the optimal scope study, the information in this section is presented in two parts. First, the core scientific and engineering studies are presented in **Table 10-4**. Second, the non-study coordination and management activities are listed in **Table 10-5**.

Finally, a consolidated table of all costs for the Operating Plan review is presented in **Table 10-6** and re-produced in the Executive Summary Section. It is proposed to complete the Operating Plan review in two years following the receipt of the directive from the IJC.

Table 10–4 Summary of Scientific and Engineering Studies and Projects – Minimum Scope

List of Projects for Operating Plan Review - Minimum Scope						
Project Number	**Description**	**Group**	**Duration**	**Estimate, $K**	**Pre-requisite**	**Dependent**
1	Review language of the operating rules from the 1989 Agreement and provide recommendations on areas where changes to the language may be required (following consideration of changes to the plan)	**Task Force**	Two weeks	**15**	None	Projects 2 & 17
2	Compile list of Operating plan review related projects. Perform gap analysis to identify and prioritize work that is required in support of the review.	**Task Force**	Four weeks	**10**	Project 1	Project 3
3	Compile a list of physical and reservoir characteristics data of the Souris River Basin. Perform gap analysis to identify and prioritize work that is required in support of the review.	**Data Work Group**	Two months	**30**	Project 2	Project 6
5	Souris River Basin Hydrometeorological Data Network Improvement Project (Coordination)	**Data Work Group**	One year	**5**	None	Project 10
6	Compile a list of the Souris River Hydraulic Characteristics Data. Perform gap analysis to identify and prioritize work that is required in support of the review	**Data Work Group**	Four weeks	**20**	None	Project 12
7	Regional and Reconstructed Hydrology of the Souris River in Support of the Review of Operating Plan	**Hydrology & Hydraulics Work Group**	Six months	**100**	Project 3	Project 8
8	Develop 10,000 or 50,000 years of stochastic water supplies for the three sets of data series for the state of nature flows in the Souris River basin using ARMA or ARIMA models or equivalent methodology	**Hydrology & Hydraulics Work Group**	Six months	**60**	Project 7	Project
10	Develop tools and procedure for predicting forecasted water supply - establish degrees of confidence for various lead times	**Hydrology & Hydraulics Work Group**	Six months	**50**	Project 9	Projects 16 & 17
12	Reservoir flow release attenuation and translation in support of the review of Operating Plan in the Souris River Project	**Hydrology & Hydraulics Work Group**	Six weeks	**30**	Project 6	Projects 15 & 16
14	Design an expert workshop to develop project goals and objectives, performance indicators and penalty functions at key basin locations and associated evaluation metrics	**Plan Formulation & Evaluation Work Group**	Two months	**15**	Projects 1 & 2	Projects 15 & 16
15	Develop simulation modelling tools using HEC-ResSim or equivalent as the core & screen alternatives to meet study objectives including improvements from water supply forecasting	**Plan Formulation & Evaluation Work Group**	Ten months	**200**	Projects 6, 10 & 14	Project 17
17	Quantify improvements in system operations by including water supply forecasts for the shortlisted candidate regulation plans	**Plan Formulation & Evaluation Work Group**	Two months	**40**	Projects 10, 15	None
	Total			**575**		

Table 10–5 Study Coordination and Management Costs - Minimum Scope

Study Management Costs - Minimum Scope				
No.	**Activity**	**Year 1, $K**	**Year 2, $K**	**Total, $K**
1	Work Group Management	40	70	110
2	Public Advisory Group	25	40	65
3	Communications and Outreach	25	40	65
4	Information Management	25	40	65
5	Peer Review Process	15	30	45
6	Study Coordination	50	70	120
	Total	**180**	**290**	**470**

Table 10–6 Overall Costs of the Annex A Operating Plan Review - Minimum Scope

Study Overall Costs including Technical Studies – Minimum Scope				
No.	**Activity**	**Year 1, $K**	**Year 2, $K**	**Total, $K**
1	Work Group Management	40	70	110
2	Task Force Reviews	25	0	25
3	Data Work Group	50	5	55
4	Hydrology and Hydraulics Work Group	200	40	240
5	Plan Formulation & Evaluation Group	55	200	255
6	Public Advisory Group	25	40	65
7	Communications and Outreach	25	40	65
8	Information Management	25	40	65
9	Peer Review Process	15	30	45
10	Study Coordination	50	70	120
	Total	**510**	**535**	**1045**

<u>Advantages:</u>

1. From a cost consideration, there is a likelihood funds could be made available from the IJC through the ISRB.
2. The total outlay for each of the two years is just over one-half million dollars to be shared equally by the U.S. and Canada.
3. The studies are likely concentrated in fewer agencies, enabling quality control and low administration costs.

<u>Disadvantages:</u>

1. The study is limited in scope and will have a short shelf life and may require rerunning the models.
2. The study will not address the basin response under wet supply sequences for triggers to evaluate contributions from non-effective drainage areas.

3. The scope of the study is narrow to the point that climate change impacts on regulation are not studied.
4. It will not be known if the study missed out on a better regulation scheme that could have resulted from optimization modelling.
5. Given the reduced budget, only a limited number of alternative plans can be evaluated.
6. The minimum cost study will limit scoping exercises, workshops and strategy sessions among the key players.
7. The limited budget may not be conducive for agencies that allow participation with full cost recovery.

10.3.2 Medium Scope Model

The number of projects in this model is reduced to thirteen. Some of this reduction is achieved by eliminating some projects, merging some studies, and reducing the scope of others. In this framework no optimization modelling and climate change hydrology are considered. To obtain the optimum Operating Plan, the reliance will be on the trial and error technique of the simulation modelling.

Similar to the optimal scope study, the information in this section is presented in two parts. First, the core scientific and engineering studies are presented in **Table 10-7**. Second, the non-study coordination and management activities are listed in **Table 10-8**.

Finally, a consolidated table of all costs for the Operating Plan review is presented in **Table 10-9** It is proposed to complete the Operating Plan review in two years following the receipt of the directive from the IJC.

Table 10–7 Summary of Scientific and Engineering Studies and Projects – Medium Scope

List of Projects for Operational Review - Medium Scope						
Project Number	**Description**	**Group**	**Duration**	**Estimate, $K**	**Pre-requisite**	**Dependent**
1	Review language of the operating rules from the 1989 Agreement and provide recommendations on areas where changes to the language may be required	**Task Force**	Two weeks	**20**	None	Projects 2 & 17
2	Compile list of Operating plan review related projects. Perform gap analysis to identify and prioritize work that is required in support of the review.	**Task Force**	four weeks	**10**	Project 1	Project 3
3	Compile a list of physical and reservoir characteristics data of the Souris River Basin. Perform gap analysis to identify and prioritize work that is required in support of the review.	**Data Work Group**	Two months	**30**	Project 2	Project 6
5	Souris River Basin Hydrometeorological Data Network Improvement Project (Coordination)	**Data Work Group**	One year	**5**	None	Project 10
6	Compile a list of the Souris River Hydraulic Characteristics Data. Perform gap analysis to identify and prioritize work that is required	**Data Work Group**	Four weeks	**30**	None	Project 12
7	Regional and Reconstructed Hydrology of the Souris River in Support of the Review of Operating Plan	**Hydrology & Hydraulics Work Group**	Six months	**100**	Project 3	Project 8
8	Develop 10,000 or 50,000 years of stochastic water supplies for the three sets of data series for the state of nature flows in the Souris River basin using ARMA or ARIMA models or equivalent methodology	**Hydrology & Hydraulics Work Group**	Six months	**100**	Project 7	Project
9	Establish thresholds among hydro-climatological, basin physical and contributing drainage area by selecting an appropriate model and its application for this task	**Hydrology & Hydraulics Work Group**	Three months	**45**	Projects 3, 5 & 6	Project 10
10	Develop tools and procedure for predicting forecasted water supply - establish degrees of confidence for various lead times	**Hydrology & Hydraulics Work Group**	Six months	**50**	Project 9	Projects 16 & 17
12	Reservoir flow release attenuation and translation in support of the review of Operating Plan in the Souris River Project	**Hydrology & Hydraulics Work Group**	Six weeks	**50**	Project 6	Projects 15 & 16
14	Design an expert workshop to develop project goals and objectives, performance indicators and penalty functions at key basin locations and associated evaluation metrics	**Plan Formulation & Evaluation Work Group**	Two months	**20**	Projects 1 & 2a	Projects 15 & 16
15	Develop simulation modelling tools using HEC-ResSim or equivalent as the core & screen alternatives to meet study objectives including improvements from water supply forecasting	**Plan Formulation & Evaluation Work Group**	Ten months	**250**	Projects 6, 9, 10, 11 & 14	Project 17
17	Quantify improvements in system operations by including water supply forecasts for the shortlisted candidate regulation plans	**Plan Formulation & Evaluation Work Group**	Two months	**60**	Projects 10, 15 & 16	None
	Total			**770**		

Table 10–8 Study Coordination and Management Costs - Medium Scope

Study Management Costs - Medium Scope				
No.	**Activity**	**Year 1, $K**	**Year 2, $K**	**Total, $K**
1	Work Group Management	60	100	160
2	Public Advisory Group	30	50	80
3	Communications and Outreach	30	50	80
4	Information Management	30	50	80
5	Peer Review Process	10	20	30
6	Study Coordination	60	70	130
	Total	**220**	**340**	**560**

Table 10–9 Overall Costs of the Annex A Operating Plan Review - Medium Scope

Study Overall Costs including Technical Studies – Medium Scope				
No.	**Activity**	**Year 1, $K**	**Year 2, $K**	**Total, $K**
1	Work Group Management	60	100	160
2	Task Force Reviews	30	0	30
3	Data Work Group	55	10	65
4	Hydrology and Hydraulics Work Group	265	80	345
5	Plan Formulation & Evaluation Group	70	260	330
6	Public Advisory Group	30	50	80
7	Communications and Outreach	30	50	80
8	Information Management	30	50	80
9	Peer Review Process	10	20	30
10	Study Coordination	60	70	130
	Total	**640**	**690**	**1330**

Advantages:

1. From a cost consideration, this is a middle course for a decent simulation based modelling study.
2. The study will address the basin response under wet supply sequence for triggers to evaluate contributions from non-effective drainage areas.
3. The total outlay each of the two years is just under $285K above the minimal model to be shared equally by the U.S. and Canada.
4. The studies are likely still to be concentrated in fewer agencies enabling quality control and low administration costs.

Disadvantages:

1. The study is limited in scope with respect to the number of candidate regulation plans that can be considered, will have a medium shelf life (10 to 15 years), and may require rerunning the models.
2. The scope of the study is narrow to the point that climate change impacts on regulation are not studied.
3. It will not be known if the study overlooked a better regulation plan based on an optimization approach.
4. Given the reduced budget, only a limited to fair number of regulation plans can be evaluated.
5. The medium cost study will still limit scoping exercises, workshops, and strategy sessions among the key players.
6. The limited budget may not be conducive for agencies that allow participation with full cost recovery.

10.4 Reductions to Study Overall Costs

Several of the projects identified for each of the scoping models are currently being accomplished by the USACE, St. Paul District for the IJC as part of an IJC effort to assist the work of the Task Force. These efforts will reduce the overall study costs presented in this POS for each of the scoping models. These reductions and the projects to which they apply are shown in **Table 10-10**.

Table 10–10 Reductions in POS Scoping Model Costs by Project from Existing Work Efforts

Project	Reductions in Scoping Model Costs		
	Optimal Scope	Minimum Scope	Medium Scope
1/1a/1b/1c	$30K	$15K	$20K
2	$10K	$10K	$10K
4	$15K	Eliminated	Eliminated
7	$100K	$100K	$100K
Totals	**$145K**	**$125K**	**$140K**

10.5 Recommendations

Based on the three alternatives presented, while the optimal scope plan with all projects is the best solution for its shelf life, adaptive nature of the regulation plans that will emanate from its products, the medium scope solution should be considered as the minimum required to fully test the Operating Plan alternatives.

11 PUBLIC CONSULTATION ON THE FINAL PLAN OF STUDY

An integral component in the development of Plan of Study for all IJC's projects is the inclusion of public comments. To meet this objective the ISRB planned, designed and conducted a public and stakeholder input process. After consultations with Saskatchewan, Manitoba, and North Dakota, the ISRB agreed on a public meeting in Minot, ND, the area heavily impacted by the 2011 flood. The public meeting was supplemented with an agency/stakeholder webinar and a final public webinar to enable broader public participation.

Notice of the meeting and webinars were provided to media outlets by the Commission's Communication staff. The public consultation details were also posted on the Board's website. As well the draft POS and the PowerPoint presentation developed for the public briefings were made available on the Board's website.

The public consultation schedule was as follows:

1. Agency/Stakeholder Webinar on Thursday, March 14, 2013 at 1030 CDT.
2. Public Meeting on Wednesday, March 20, 2013 at the Grand International Hotel, Minot, ND at 1430 CDT.
3. Public Webinar on Tuesday, March 26, 2013 at 1900 CDT.

A brief report on each of the consultations and a summary of public comments follows.

11.1 Agency/Stakeholder Webinar

This session provided agencies and stakeholders an advance preview of the POS, a forum for discussion and comments, and advance notice of opportunities for these agencies to support the work of the study. Twenty participants and the POS development team were on the call. The participants represented most of the key resource-based agencies in the US and Canada at the federal, provincial, state, and local levels. No major concerns were raised at the webinar regarding the POS and public engagement process.

11.2 Minot Public Meeting

The public meeting in Minot was well attended with about fifty members of the public in the audience. This meeting was well advertised in the local media with an afternoon time slot to allow participants from Canada and other parts of the watershed to travel to Minot. Two local TV stations covered and reported on the meeting with interviews with the State Governor, Jack Dalrymple and Mayor of the City of Minot, Curt Zimbleman. A number of public comments were received in response to ISRB's presentation. The general sentiment was for the governments to do something to avoid such extensive flooding in the future. Mayor Zimbleman, who submitted a brief to the ISRB, requested that the ISRB support the optimum option in light of the City's current design of the flood mitigation works at over $800 M. There were also media representatives who produced two stories in the local newspapers, Minot Daily News and the Leader-Post. A section of the participants at the meeting is shown in Figure 11-1.

Figure 11-1 Public Meeting on Wednesday, March 20, 2013 at the Grand International Hotel, Minot, ND

11.3 Public Webinar

The webinar was not particularly well attended with only 18 external participants and media. A number of webinar participants joined only through conference call and had no access to the slides being presented. For this reason very few questions directly related to the scope of the study were asked. There were technical challenges with the slide show.

11.4 Public Comments

A total of 24 comments were received: public officials (3), general public (17) and video and paper reports (4) were extracted from the media websites. The public comments were received by handing written comments to the ISRB's Secretariat at the public meeting, through e-mail, and general mail. Three public comments were received via the Board's website. Most of the comments were from Towner, ND and emphasized the protection and economic value of farmland. The general feeling in Minot was to the need to provide greater protection against flood damages. There were some suggestions on alternative flood mitigation measures.

A summary of public input is presented in Table 11-1. A full listing of all the comments received is available and is shown in Appendix E.

11.5 Summary of Public Input

The public consultation process did not identify any gaps in the proposed scope of work or requirements for additional analysis. No changes are, therefore, necessary in the core chapters 4 to 10. The submissions, however, favoured that the funding level should be considered at the optimum level of $2.14 M to allow for a more thorough analysis.

Table 11-1 Summary of Public Input

No.	Name	E-mail	Date
	Public Officials		
1	Governor Jack Dalrymple	-	March 14, 2103
2	Senator John Hoeven	-	March 15, 2103
3	Mayor Curt Zimbleman	-	March 14, 2103
	Public Comments		
1	Fred Hurt, Minot, ND	bigboot@srt.com	March 10, 2103
2	Jim Olson, Minot, ND	701-852-4968	March 14, 2103
3	Jim Kraft, Minot, ND	ckraftnd@minot.com	March 15, 2103
4	Vern Kongslie, Towner, ND	kong234@srt.com	March 31, 2103
5	Orlin Oium, Towner, ND	Handwritten note	April 02, 2103
6	Marvin Block, Towner, ND	701-537-5413	April 02, 2103
7	Leland Goodman, Willow City, ND	701-366-4765	April 03, 2103
8	Bonnie Feist, Velva, ND	cbfeist@srt.com	April 06, 2103
9	Cliff Hanretty, Towner, ND	-	April 06, 2103
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11	Ryan Taylor, Towner, ND	ryan.m.taylor7@gmail.com	April 08, 2103
12	David Ashley, Velva, ND	davidashley@srt.com	April 08, 2103
13	Paul Engeldinger, Burlington, ND	via website	April 08, 2103
14	Pat Ryan, Minot ND	via website	April 08, 2103
15	Chris Nelson, Towner, ND	Elliot@srt.com	April 05, 2013
16	Lynn Kongslie, Towner, ND	kongslieranch@srt.com	April 05, 2013
17	Tom Miller, Towner, ND	701-537-5674	April 10, 2013
	Media Reports		
1	KXNews TV	-	March 20, 2013
2	Julie Leonardi	KQCD News	March 20, 2013
3	Jill Schramm	jschramm@minotdailynews.com	March 21, 2013
4	Emma Graney	egraney@leaderpost.com	March 15, 2103

12 MEMBERSHIP - 2012 INTERNATIONAL SOURIS RIVER BASIN TASK FORCE

Canadian Section

Martin Grajczyk, P.Eng. (Co-chair), Saskatchewan Water Security Agency (WSA), Regina, SK
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Steve Topping, Manitoba Water Stewardship (MWS), Winnipeg, MB
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Edward Eaton,P.E., Co-chair, U.S. Army Corps of Engineers (USACE), St. Paul District.
Elizabeth Nelsen,P.E., U.S. Army Corps of Engineers (USACE), St. Paul District.
Kari Hauck, P.E., U.S. Army Corps of Engineers (USACE), St. Paul District.
Megan Estep, U.S. Fish & Wildlife Service (USFWS), Denver, CO
Tom Pabian (Backup Member) U.S. Fish & Wildlife Service (USFWS), ND
Frank Durbian (Backup Member) U.S. Fish & Wildlife Service (USFWS), ND
Steve Robinson, U.S. Geological Survey (USGS) of North Dakota, Bismarck, ND
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Bob White, North Dakota State Water Commission (NDSWC), Bismarck, ND
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13 ACKNOWLEDGEMENTS

The Task Force wishes to thank the ISRB members, individuals and organizations for their timely and indispensable assistance in making this Plan of Study possible. Timely leadership in coordinating work activities, comments and input into this document by North Dakota State Water Commission and Saskatchewan Water Security Agency are acknowledged and appreciated.

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APPENDIX A – 1989 AGREEMENT FOR WATER SUPPLY AND FLOOD CONTROL IN THE SOURIS RIVER BASIN

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Mr. [redacted] Bruce Heide
U.S. Army Engineer District - St. Paul
[redacted]
180 East Kellogg Boulevard
St. Paul, Minnesota MN 55101-1479
U.S.A.

AGREEMENT

BETWEEN

THE GOVERNMENT OF CANADA

AND

THE GOVERNMENT OF THE UNITED STATES OF AMERICA

FOR WATER SUPPLY AND FLOOD CONTROL

IN THE SOURIS RIVER BASIN

October 26, 1989

Canadian Embassy — Ambassade du Canada

501 Pennsylvania Avenue, N.W.
Washington, D.C. 20001

October 26, 1989

Mr. Robert W. Page
Assistant Secretary of the
Army for Civil Works
The Pentagon
Room 2E570
Washington, D.C.
20310-0103

Dear Mr. Page,

I wish to express formally my Government's satisfaction with the signature today of the Agreement Between the United States of America and Canada for Water Supply and Flood Control in the Souris River Basin. We believe that the Accord will help to satisfy the needs of Basin residents for flood control and assured water supply, as well as encourage closer co-operation among the various interested jurisdictions in dealing with matters of common concern.

Canada and the United States share a mutual objective of ensuring that Souris waters are used fairly and wisely. We look forward to continuing to work with you in pursuit of this goal.

Yours sincerely,

Michael Kergin
Minister

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, DC 20310-0103

26 OCT 1989

Mr. Michael Kergin
Minister
Embassy of Canada
501 Pennsylvania Avenue, N. W.
Washington, D. C. 20001

Dear Mr. Kergin:

On behalf of the Government of the United States of America, I wish to respond to your letter of today's date respecting the Agreement Between the United States of America and Canada for Water Supply and Flood Control in the Souris River Basin. We share your view that the Agreement will contribute to meeting the needs of American and Canadian residents of the Souris Basin and foster closer cooperation among the jurisdictions of both countries in dealing with matters of common concern. That the waters of the Basin are used wisely and fairly is indeed in the best interests of both our nations. We would be pleased to continue our joint endeavors toward this shared objective.

Yours sincerely,

for Robert W. Page, Deputy
Assistant Secretary of the Army
(Civil Works)

AGREEMENT
BETWEEN
THE GOVERNMENT OF CANADA
AND
THE GOVERNMENT OF THE UNITED STATES OF AMERICA
FOR WATER SUPPLY AND FLOOD CONTROL
IN THE SOURIS RIVER BASIN

The Government of Canada and the Government of the United States of America, hereinafter referred to as "the Parties;"

DESIRING to provide for development of the Souris River Basin to increase the general welfare of the people of the United States and Canada;

NOTING that significant benefits will accrue to the Parties by construction, operation, and maintenance of reservoir projects in the Souris River Basin in Canada for the purposes of flood control in the United States of America and for water supply in Canada;

FURTHER NOTING that the Government of the United States of America and the Government of Canada are parties to the Treaty between the Government of the United States of America and the Government of the United Kingdom Concerning Boundary Waters and Questions Arising Along the Boundary between the United States of America and Canada, signed on January 11, 1909, hereinafter referred to as the "Boundary Waters Treaty", and to the Convention Between the Government of the United States of America and the Government of the United Kingdom for the Protection of Migratory Birds in the United States of America and Canada, signed on August 16, 1916, hereinafter referred to as the "Migratory Birds Convention", and desire in connection with the development contemplated in this Agreement to fulfill their rights and obligations under these instruments, and any agreements or orders which implement them;

INTENDING that the Souris River Basin be developed for flood control benefits in the United States of America and water supply benefits in Canada in a manner that is consistent with the Boundary Waters Treaty and the Migratory Birds Convention;

NOW, THEREFORE, hereby agree to the following plan for development of the Souris River Basin:

ARTICLE I

1. In this Agreement, the term:

   a. "Alameda Dam" means the dam which will be constructed on Moose Mountain Creek in the Province of Saskatchewan approximately four kilometers upstream from its confluence with the Souris River;

   b. "Boundary Dam" means an existing dam located on Long Creek approximately seven kilometers in a southwesterly direction from the City of Estevan in the Province of Saskatchewan;

   c. "Boundary Diversion Channel" means a channel that will be constructed in the Province of Saskatchewan with a maximum capacity of 60 cubic meters per second (2,100 cubic feet per second) to allow the conveyance of water from the Boundary reservoir to the impoundment behind Rafferty Dam;

   d. "Boundary Reservoir" means the impoundment of water behind Boundary Dam;

   e. "construction costs" means expenditures made by Canada for construction of Rafferty Dam and Alameda Dam and reservoirs. Such costs shall include expenditures for engineering, design, construction, land acquisition, and operation and maintenance prior to completion of construction;

   f. "flood control storage" means the volume below the maximum allowable water level in a reservoir to store flood event runoff;

   g. "improvement" means a dam, reservoir or related facility to which this Agreement applies;

   h. "Lake Darling Dam" means an existing structure which is part of the Upper Souris National Wildlife Refuge located on the Souris River approximately 25 kilometers in a northwesterly direction from the city of Minot in the State of North Dakota;

   i. "maintenance curtailment" means an interruption or curtailment of operations under the Operating Plan which is necessary for purposes of repairs, replacements, installation of equipment, performance of other maintenance work, investigations, or inspections;

j. "Operating Plan" means the plan of operation which is attached to this Agreement as Annex A and which is an integral part of this Agreement, for certain dams, reservoirs, and related works on the Souris River;

k. "Rafferty Dam" means the dam which is under construction at a location on the Souris River approximately six kilometers upstream in a northwesterly direction from the City of Estevan in the Province of Saskatchewan;

l. "Reservoir Regulation Manual" means a document which is used as a guide in the day-to-day operation of a reservoir by the agency responsible for the operation of the reservoir. The manual shall contain a description of the project and its history, and discuss watershed characteristics, data collection and communication networks, hydrologic forecasts, the water control plan, and water control management;

m. "substantially destroyed" means when the cost of repairs or rehabilitation to an improvement to rectify damages to that improvement would exceed 50 percent of the replacement value of the improvement at the time the damage is sustained;

n. "uncontrollable force" means any force or cause beyond the control of the party affected, including, but not limited to, war, riot, civil disturbance, sabotage, earthquake, catastrophic storm event, and restraint by court order, which by exercise of due care and foresight, such party could not reasonably have been expected to avoid;

o. "useful life" means the time remaining until an improvement is permanently retired from service because it no longer effectively serves its intended purpose, as defined in this Agreement and the Operating Plan, notwithstanding good maintenance, or because it is substantially destroyed by uncontrollable force;

p. "water quality monitoring" means the collection, analysis and interpretation of water quality conditions, whether obtained through systematic surveys or special studies;

q. "water quality objective" means a concentration level, other measure, or narrative goal which is intended to support the designated uses of water at a specific site; and

r. "water supply in Canada" means the use of reservoir storage in Canada for the purposes of: cooling water for electric generating plants, irrigation, domestic use, municipal and industrial use, agricultural use, recreation, conservation, flood protection in Canada, or such other uses as the Government of Canada shall designate.

2. Both the United States of America system of measurement and the Système international (metric system) are equally valid where used in this Agreement. The conversion table in the Operating Plan shall be used to convert values in one measurement system to values in the other measurement system.

3. The terms defined in this Agreement shall have the same meaning when used in the Operating Plan.

ARTICLE II

1. The Government of Canada shall expeditiously provide the Government of the United States of America with a minimum of 466,000 cubic decameters (377,800 acre-feet) of flood storage by:

   a. Completing construction of Rafferty Dam and including in that improvement a minimum of 327,100 cubic decameters (265,200 acre-feet) of flood control storage; and

   b. Constructing Alameda Dam and including in that improvement a minimum of 138,900 cubic decameters (112,600 acre-feet) of flood control storage.

2. The Government of Canada shall design and construct Rafferty Dam and Alameda Dam in accordance with accepted engineering standards. Before the Government of the United States of America shall make any payment pursuant to Article IV of this Agreement, the Government of Canada shall ensure, to the satisfaction of the Government of the United States of America, that Rafferty Dam and Alameda Dam will be designed to have a 100-year project life, and will be capable of operation in accordance with the Operating Plan.

ARTICLE III

1. The Government of Canada shall operate and maintain Rafferty Dam and Alameda Dam at no cost to the Government of the United States of America, except for those costs referred to in Article IV of the Agreement, in accordance with the Operating Plan or in accordance with any subsequent mutually agreed upon change to the Operating Plan for the term of this Agreement. Operation and maintenance of Rafferty Dam and Alameda Dam in accordance with the Operating Plan shall commence immediately upon completion of construction of each dam.

2. The Government of Canada shall operate and maintain the Boundary Reservoir at no cost to the Government of the United States of America in accordance with the Operating Plan or in accordance with any subsequent mutually agreed upon change to the Operating Plan for the remainder of the useful life of the Boundary Reservoir. Operation and maintenance of the Boundary Reservoir in accordance with the Operating Plan shall commence immediately upon entry into force of this Agreement.

3. The Government of Canada shall operate the Boundary Diversion Channel and any future water resources development or flood control projects constructed after entry into force of this Agreement for the term of this Agreement at no cost to the Government of the United States of America in a manner which will not adversely affect the stream flow in the Souris River so as to reduce the flood control benefits provided by the Rafferty Dam and Alameda Dam and the Operating Plan;

4. The Government of the United States of America shall operate and maintain the improvements located in the United States for the remainder of their useful life at no cost to the Government of Canada and in accordance with the Operating Plan or any subsequent mutually agreed upon change to the Operating Plan.

5. The Parties shall notify one another of any maintenance curtailment that is proposed at any project addressed in the Operating Plan and the probable duration thereof, and take such action as is appropriate to minimize the effects of such maintenance curtailments on operations under the Operating Plan, to include providing one year's notice of such maintenance curtailments when possible.

ARTICLE IV

1. The Government of the United States of America shall pay the Government of Canada $26.7 million (United States currency, based on October 1985 price levels) for the flood control storage provided at Rafferty Dam.

2. The Government of the United States of America shall pay the Government of Canada an additional $14.4 million (United States currency, based on October 1985 price levels) for the flood control storage provided at Alameda Dam.

3. The amount of the contributions specified in Paragraphs 1 and 2 were determined by an allocation of construction costs based on the proportionate use of the Rafferty Dam and Alameda Dam for flood control in the United States of America and water supply in Canada. Such contributions shall be subject to adjustment for cost changes by the United States of America pursuant to Section 902(2) of Public Law 99-662 and shall fluctuate to reflect changes in the rate of exchange for currency between the United States of America and Canada that occurred between October 1985 and the time such contributions are made.

4. At the end of each calendar month, the Government of Canada shall issue a progress billing to the Government of the United States of America for its share of project construction costs, which shall be determined by an allocation of joint construction costs to flood control and water supply purposes. The Government of the United States of America shall review such billing and, if not disputed, make payment of the amount billed within thirty days of receipt of the bill for the amount due. If the Government of the United States of America disputes any billing or portion of such billing, it shall specify its reasons for disputing the billing and pay any undisputed amount. Disputed billings or disputed portions of billings shall be discussed by the Parties. Disputes concerning amounts billed that are not resolved by discussion may be settled in accordance with Article XII.

5. Records shall be established and maintained to permit identification of the exact nature and amounts of costs of the Rafferty Dam and Alameda Dam. The records established and maintained pursuant to this paragraph shall be subject to audit at the request of the Government of the United States of America at any reasonable time during the construction of the dams and for five years thereafter, following reasonable notice to the Government of Canada.

6. The Government of Canada shall furnish quarterly status reports to the Government of the United States of America on the progress of construction on the Rafferty Dam and Alameda Dam, the total amount of funds expended on the dams at the time of the report, and the anticipated costs to be billed to the United States for the remainder of the United States of America Government fiscal year, which ends on September 30, and for each following United States of America Government fiscal year.

ARTICLE V

1. The Parties shall cooperate and consult on the matters addressed in this Agreement. The Parties shall exchange such information as is appropriate to ensure timely and beneficial fulfillment of obligations under this Agreement.

2. The Parties shall prepare the Reservoir Regulation Manuals required by the Operating Plan. In preparing such Manuals, the Parties shall consult with interested states and provinces.

3. The Parties shall jointly review the Operating Plan at five-year intervals, or as mutually agreed, in an effort to maximize the provision of flood control and water supply benefits that can be provided consistent with the terms of this Agreement. The Parties shall cooperate and consult, as necessary, with interested states, provinces, and agencies on the review of the Operating Plan and recommended changes in the Operating Plan.

4. Subject to the consent of the Government of Canada, officials of the Government of the United States of America may enter on lands in Saskatchewan acquired for construction of Rafferty, Alameda, and Boundary Dams for the purpose of inspection to ensure that such improvements are being constructed, operated, and maintained in accordance with the terms of this Agreement.

5. The Parties shall consult with interested states and provinces upon request, as appropriate, and so far as is practicable, concerning the supply of water throughout the Souris River Basin.

ARTICLE VI

1. The Parties shall ensure that all activities pursued under the terms of this Agreement are consistent with applicable provisions of the Boundary Waters Treaty, particularly those of Article IV, paragraph two.

2. The Parties shall establish a Joint Water Quality Monitoring Program ("the Program") in the relevant portions of the Souris River Basin.

3. The Parties shall establish, within six months of the entry into force of this Agreement, a Bilateral Water Quality Monitoring Group ("the Group"). The Group shall be composed of six members, three appointed by each Party, and be co-chaired by a Canadian and a United States of America member. Each Party may also identify advisors to the Group to assist its respective members.

4. The initial United States of America members of the Group shall include a representative of each of the United States Environmental Protection Agency, the North Dakota Department of Health and Consolidated Laboratories, and the United States Geological Survey. A representative of the United States Fish and Wildlife Service, the United States Department of the Army, and the North Dakota State Engineer shall serve as the initial advisors to the United States of America members of the Group.

5. The initial Canadian members of the Group shall include a representative of each of the Government of Canada, the Government of Saskatchewan, and the Government of Manitoba.

6. The Group shall:

   a. develop recommendations for the Parties on the Program and on water quality objectives;

   b. on a regular basis, exchange data provided by the Program;

   c. collate, interpret, and analyze the data provided by the Program;

   d. review the Program and the water quality objectives at least every five years and recommend to the Parties, as appropriate, any modifications to improve the Program and the water quality objectives; and

   e. prepare an annual report to be submitted to the Parties containing:

      i. a summary of the principal activities of the Group during the year;

      ii. a summary of the principal activities affecting water quality in the Souris River Basin during the year;

      iii. a summary of the collated, interpreted, and analyzed data provided by the Program;

      iv. a summary of the water quality of the Souris River at the two locations at which it crosses the International Boundary between Canada and the United States;

      v. a section summarizing any definitive changes in the monitored parameters and the possible causes of such changes;

      vi. a section discussing whether the water quality objectives as established pursuant to Paragraph 7 have been attained;

      vii. a section summarizing other significant water quality changes and the possible causes of such changes; and

      viii. recommendations on new water quality objectives or on how existing water quality objectives can be met, including suggestions on water quality as it relates to water quantity during periods of low flow, in the event that the annual report indicates that the water quality objectives have not been attained as a result of activities pursued under this Agreement.

7. The Parties shall, by April 1, 1991, establish water quality objectives for the Souris River at the Saskatchewan/North Dakota boundary and at the North Dakota/Manitoba boundary.

8. The Parties shall make reasonable efforts, consistent with then existing legal authorities, to implement the recommendations of the Group and, where reasonably practicable, to improve water quality in the Souris River Basin.

9. If the annual report of the Group indicates that the water quality objectives are not being attained, the Parties shall commence consultations to determine how the water quality objectives can be met, revised or otherwise addressed. Such consultations shall include participation by interested states, provinces, and agencies.

ARTICLE VII

The Parties agree that paragraph 1 of the 1959 Interim Measures, which were approved by the Government of the United States of America and the Government of Canada, shall be modified as shown in Annex B attached hereto.

ARTICLE VIII

1. Should operation of any improvement result in flood damages in either the United States of America or Canada in excess of the flood damages that would have occurred had the improvement not been in operation, the Parties shall, upon the request of either Party, commence consultations on how such flood damages can be avoided in the future and what mitigation and compensatory measures may be appropriate, including possible changes to the Operating Plan. Such consultations shall include participation by interested states, provinces and agencies.

2. Notwithstanding Article XI, paragraph 2, nothing in this Article shall preclude either Party from asserting any rights it may have against the other Party for flood damages resulting from the actions of the other Party.

ARTICLE IX

All obligations of the Government of the United States of America to be carried out under the terms of this Agreement shall be subject to the laws and regulations of the United States of America. All obligations of the Government of Canada to be carried out under the terms of this Agreement shall be subject to the laws and regulations of Canada.

ARTICLE X

1. The Government of Canada designates the Government of Saskatchewan as the Canadian entity responsible for the construction, operation, and maintenance of the improvements mentioned in this Agreement and located in Canada. Such entity shall issue the progress billings and receive the payments referred to in Article IV.

2. The Government of the United States of America designates the Department of the Army as the entity responsible for receiving billings and making the payments for flood control storage referred to in Article IV and for operating the improvements mentioned in this Agreement and located in the United States of America in accordance with the Operating Plan during periods of flood. The Government of the United States of America designates the Department of the Interior as the entity responsible for operating the improvements mentioned in this Agreement and located in the United States of America in accordance with the Operating Plan during non-flood periods.

ARTICLE XI

1. The Parties shall be liable to each other and, shall make appropriate compensation to each other with respect to any act, failure to act, omission or delay amounting to a breach of this Agreement. For the purposes of this Agreement, any act, failure to act, omission or delay occurring by reason of uncontrollable force shall not constitute a breach of this Agreement.

2. The Parties do not intend to create in this Agreement any private right of action. Except as provided by Paragraph 1 of the Article, neither Party shall be liable to the other or to any person in respect of any injury, damage, or loss occurring in the territory of the other caused by an act, failure to act, omission or delay under this Agreement whether the injury, damage, or loss results from negligence or otherwise.

3. Neither Party shall have any obligation under this Agreement to rebuild or further operate or maintain any improvement to be constructed under this Agreement that is destroyed by uncontrollable force.

4. Neither Party shall have any obligation under this Agreement to take any act to extend the life of any improvement mentioned in this Agreement beyond its normal useful life.

ARTICLE XII

1. The Parties shall seek to resolve any dispute concerning the interpretation or application of this Agreement through consultations undertaken in good faith. As part of this consultation process, the Parties may refer any dispute concerning the interpretation or application of this Agreement to the International Joint Commission for advice and recommendations if mutually agreed. In making such a referral, the Parties shall request that the International Joint Commission provide its advice and recommendations within 90 days of the referral.

2. Any dispute concerning the interpretation or application of this Agreement which cannot be resolved through good faith consultations shall, upon the request of either Party, be referred to a neutral tribunal for review and examination and issuance of advice and recommendations. The tribunal shall consist of two members appointed by the Government of Canada, two members appointed by the Government of the United States of America, and a member jointly appointed by the Parties, who shall be chairman of the tribunal.

3. The Parties shall give prompt and sympathetic consideration to the advice and recommendations of the International Joint Commission and the tribunal.

4. The expenses of the International Joint Commission and the tribunal shall be shared equally by the Parties.

5. These procedures may be supplemented or modified by mutual agreement of the Parties.

ARTICLE XIII

1. This Agreement shall enter into force upon signature.

2. This Agreement may be amended by mutual agreement of the Parties.

3. This Agreement shall remain in force for a period of one hundred years or until the Parties agree that the useful life of the Rafferty and Alameda Dams has ended, whichever is first to occur.

4. If either Party fails to receive appropriations or other revenues in amounts sufficient to meet anticipated obligations under this Agreement, that Party shall so notify the other Party. Ninety calendar days after providing such notice, either Party may elect to terminate this Agreement or to defer future performance under this Agreement. Termination or deferral of future performance shall not affect existing obligations of the Parties under this Agreement or relieve the Parties of liability for any obligation previously incurred. In the event that either Party terminates or suspends future performance under this Agreement pursuant to this provision, the Government of the United States of America and the Government of Canada shall make appropriate adjustments in the Operating Plan to maximize the flood control and water supply benefits that can be obtained in the United States of America and Canada from the construction accomplished at the time of termination or suspension.

IN WITNESS WHEREOF the undersigned, duly authorized by their respective Government, have signed this Agreement.

DONE at Washington DC in duplicate, this 26th day of October, 1989 in the English and French languages, each text being equally authentic.

For Canada:

For the United States of America:

ANNEX A

OPERATING PLAN

FOR

RAFFERTY, ALAMEDA, BOUNDARY, AND LAKE DARLING RESERVOIRS

OPERATING PLAN FOR
RAFFERTY, ALAMEDA, BOUNDARY, AND LAKE DARLING RESERVOIRS

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INTRODUCTION

Purpose: This Operating Plan was developed pursuant to the Agreement between the Government of the United States of America and the Government of Canada for water supply and flood control in the Souris River Basin (hereinafter referred to as "the subject Agreement.")

It provides for operation of the Souris Basin Project and sets forth a framework for completing project specific Reservoir Regulation Manuals.

Scope: The Operating Plan is limited to the operation of the Souris Basin Project in the Souris River Basin in Saskatchewan, Canada, and North Dakota, United States of America, in accordance with the subject Agreement.

Objectives: The objectives of the Operating Plan are:

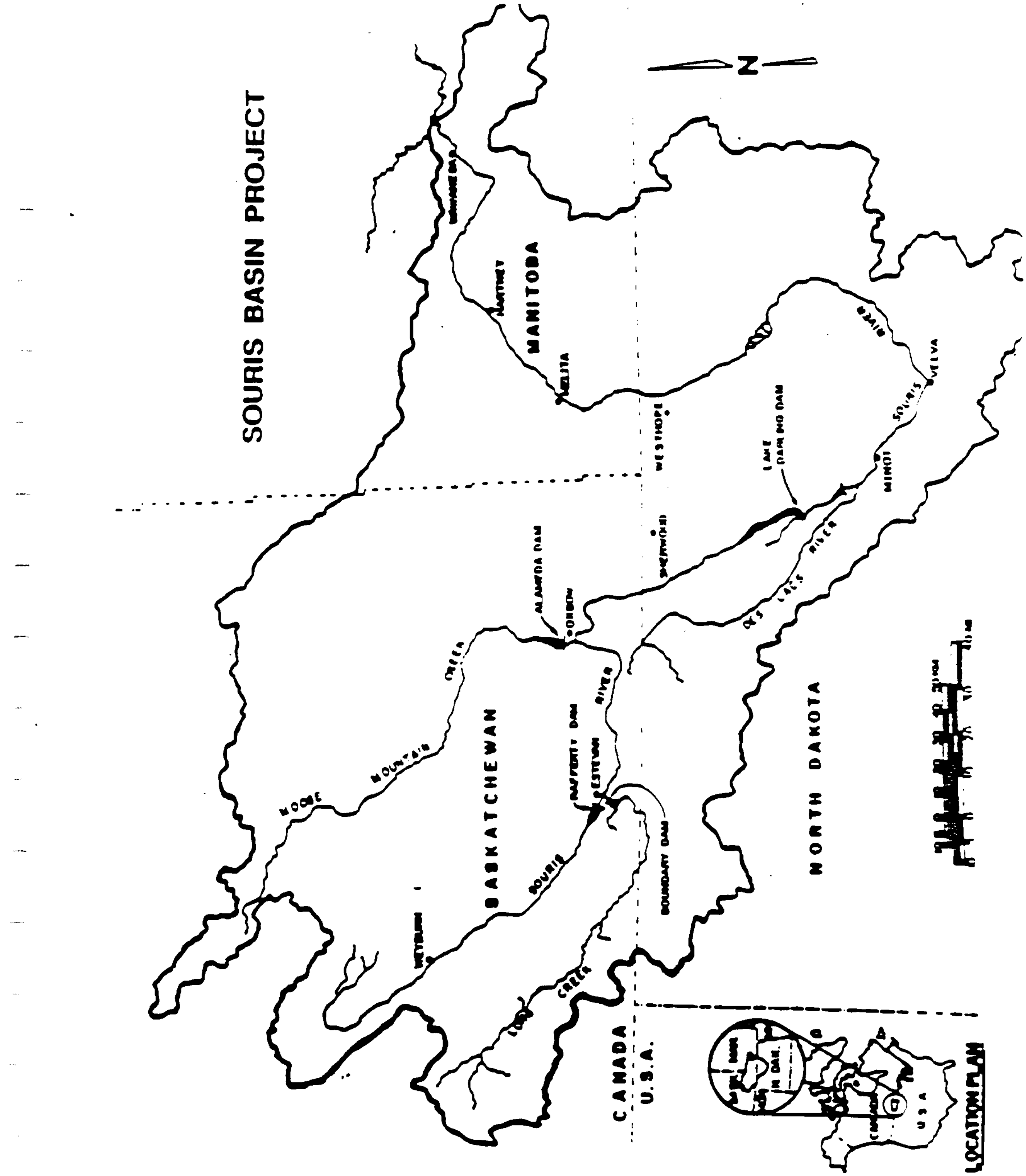
- To provide 1-percent (100-year) flood protection at Minot, North Dakota;

- To provide flood protection to urban and rural areas downstream from Rafferty Dam, Alameda Dam, and Lake Darling Dam;

- To ensure, to the extent possible, that the existing benefits from the supply of water in the Souris River Basin and the supply of water to the Souris Basin Project are not compromised.

Document: This Operating Plan establishes guidelines for operation of the Souris Basin Project. It also includes the following information on the operation of the Souris Basin Project: data on the physical characteristics of the dams and reservoirs, rules for flood and non-flood operation, and procedures for communication and exchange of information. This Operating Plan was developed based on computer simulation of floods having temporal and spatial characteristics of those actually experienced in floods of 1969, 1974, 1975, 1976, 1979, and 1982. It is recognized that this Operating Plan may not cover all possible flood circumstances, and it may be necessary to jointly agree on changes to the Operating Plan. It will be necessary for agencies directly responsible for the daily operation of each improvement covered by this Operating Plan to develop detailed Reservoir Regulation Manuals to operate the reservoirs in accordance with the terms of the subject Agreement. A Basin map is shown in figure A-1.

Forecasting: The ability to provide increased flood protection (including the ability to limit flows at Minot to 5,000 cfs for floods up to the 1-percent event) while optimizing the potential supply of water in the Souris River Basin is dependent upon the accuracy of the estimates of runoff provided to the agencies responsible for the daily operation of each improvement (Section 4.3.1). The runoff estimates used in this Operating Plan are: runoff volume, 30-day; runoff volume, 90-day; Sherwood Crossing uncontrolled runoff volume; and runoff volume, 90-percent, 90-day. Data used to develop the runoff estimates are gathered by Environment Canada and Saskatchewan Water Corporation in Canada and the National Weather Service in the United States. As noted in Section 2.4, new estimating techniques will be developed. If the new estimating techniques cannot be developed for the four items listed above, (with sufficient accuracy to meet the dual objectives of flood control and water conservation), then the Operating Plan will be modified to use existing methods of estimating runoff.


SOURIS BASIN PROJECT
MANITOBA
SASKATCHEWAN
NORTH DAKOTA
CANADA
U.S.A.
ALAMEDA DAM
RAFFERTY DAM
BOUNDARY DAM
LAKE DARLING DAM
ESTEVAN
WEYBURN
MELITA
MINOT
WESTHOPE
SHERWOOD
VELVA
MOOSE MOUNTAIN CREEK
SOURIS RIVER
DES LACS RIVER
LONG CREEK
LOCATION PLAN

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1.0 TERMINOLOGY

1.1 Glossary of Terms and Definitions

Alameda Dam	The dam which will be constructed on Moose Mountain Creek in the Province c Saskatchewan approximately four kilometre upstream from its confluence with the Souris River.
Authority	The Souris Basin Development Authority.
Bankfull capacity	The maximum flow that a given watercourse ca convey in a specified reach without th water level rising above the level of either bank.
Boundary Dam	An existing dam located on Long Creek approximately seven kilometres in a southwesterly direction from the City c Estevan in the Province of Saskatchewan.
Boundary Diversion Channel	A channel that will be constructed in th Province of Saskatchewan with a maximum capacity of 60 m^3/s (2,100 cfs) to allow the conveyance of water from the Boundar Reservoir to the impoundment behind Raffert Dam.
Canadian reservoirs	A collective term for Rafferty Reservoi Boundary Reservoir, and Alameda Reservoir.
Control point	A streamflow gaging station or dam which i used to develop operating decisions fc Rafferty Reservoir, Alameda Reservoir Boundary Reservoir, and Lake Darlir Reservoir.
Controlled volume	The volume of runoff that can b controlled by using available floc control storage.
Drawdown	The physical act of lowering the poc level of a reservoir through controlled releases.
Estimate	A value based on the best judgment c qualified personnel using all available data.

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Flood control storage	The volume below the maximum allowable water level in a reservoir to store flood event runoff.
Full Supply Level (FSL)	The maximum elevation that the reservoir pool is allowed to attain when operations are not directed at achieving flood control benefits.
Lake Darling Dam	An existing structure which is part of the Upper Souris National Wildlife Refuge located on the Souris River approximately 25 kilometres in a northwesterly direction from the City of Minot in the State of North Dakota.
Local flow	The runoff that occurs between two given locations.
Maximum allowable flood level	The highest level a reservoir is allowed to reach while storing water for flood control purposes. When a reservoir reaches this level, any flows into the reservoir must be spilled.
Maximum level prior to spring runoff	The reservoir level which must not be exceeded prior to the spring runoff, regardless of the predicted volume of runoff.
Minimum supply level	The lowest level at which water can be released from a reservoir (invert of conduits).
Natural flow	The volume of runoff determined by the International Souris River Board of Control.
1-percent flood (100-year flood)	A runoff event which is estimated to generate a total 30-day continuous flow volume equal to 721,000 cubic decametres (584,500 acre-feet) as determined at Sherwood Crossing based on data recorded at that station prior to 1986.
Rafferty Dam	The dam which is under construction at a location on the Souris River approximately six kilometres upstream in a northwesterly direction from the City of Estevan in the Province of Saskatchewan.
Releases	The controlled discharge of water from a reservoir other than spills.

Reservoir level	The static water surface elevation of a reservoir.
Reservoir Regulation Manual	A document which is to be used as a guide by the responsible agency in the day to day operation of a reservoir. The manual shall discuss the following topics: description of the project, history of the project, watershed characteristics, data collection and communication networks, hydrologic forecasts, the water control plan, and water control management.
Runoff	The flow of water in a watercourse in response to rainfall or snowmelt or a combination of rainfall and snowmelt.
Runoff volume, 30-day (30-day volume)	Maximum 30-consecutive-day runoff volume that occurs in any water year.
Runoff volume, 90-day (90-day volume)	Maximum 90-consecutive-day runoff volume that occurs in any water year.
Runoff volume, 90-percent, 90-day	The estimated 90-day volume of unregulated runoff with a 90-percent probability of being equalled or exceeded by the actual runoff.
Saskatchewan works	The works described in Article III of the subject Agreement in Saskatchewan, Canada to include Rafferty Dam, Alameda Dam, and the Boundary Diversion Channel.
Sherwood Crossing	The International gaging station, number 05114000 (05ND007), latitude 48:59:24, longitude 101:57:28, on the Souris River, 0.8 mile downstream of the International boundary.
Sherwood Crossing uncontrolled runoff volume	The uncontrolled volume from the Canadian Reservoirs, if any, and the local flow between the Canadian Reservoirs and Sherwood Crossing.
Souris Basin Project (Project)	The development and operation of the Saskatchewan works in Canada; the operation of the existing Boundary Reservoir in Saskatchewan and the operation of the existing Lake Darling Reservoir in North Dakota in the United States.
Spills	The uncontrolled discharge of water from a reservoir.

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Target drawdown level	A pool level to which a reservoir should be lowered in response to estimated spring runoff so that the desired level of flood protection will be provided.
Target flow	The instantaneous flow at a given location that should not be exceeded during a given flood event as a result of releases from a reservoir or reservoirs.
Temporary target flow	A target flow at Sherwood Crossing that has been modified to take into account available storage in Lake Darling.
Uncontrolled volume	The volume of runoff that cannot be controlled by the available flood control storage.
Unregulated flow at Sherwood Crossing	That flow that would occur at Sherwood Crossing if Rafferty Dam and Alameda Dam were not in place.
Water year	October 1 to September 30.
Westhope Crossing	The International gaging station, number 05NF012 (15124000), latitude 48:59:47, longitude 100:57:29, on the Souris River 1.6 kilometres upstream of the International boundary.

1.2 Abbreviations and Symbols

Following is a list of abbreviations and symbols used in this Operating Plan:

- ac-ft - acre-feet
- cfs - cubic feet per second
- dam^3 - cubic decametre
- ft - feet
- m - metre
- m^3/s - cubic metres per second
- km - kilometre

1.3 Conversion Factors

As provided in the subject agreement, the following table may : used to convert measurements in the English (United States system of units to the SI or metric (Canadian) system of units.

Multiply English Units	by	To obtain SI Units
	Length	
inch (in)------------------	25.4	----millimetre (mm)
foot (ft)------------------	0.3048	----metre (m)
mile (mi)------------------	1.609344	----kilometre (km)
	Area	
square mile (mi^2)----------	2.590	----square kilometre (k:
acre (ac)------------------	4046.9	----square metre (m^2)
	Flow	
cubic foot per second------ (cfs)	0.02831685	----cubic metre per secor (m^3/s)
	Volume	
acre-foot (ac-ft)----------	1.233482	----cubic decametre (dam^3
	Velocity	
foot per second (ft/s)-----	0.3048	----metre per second (m/s
	Slope	
foot per mile (ft/mi)------	0.1894	----metre per kilometre (m/km)

1 ha = 10,000 m^2 == ha x 2.471054 = acre

1 dam^3 = 1,000 m^3 == dam^3 x 0.811 = ac-ft

2.0 HYDROMETEOROLOGICAL DATA NETWORK

2.1 General

The collection and distribution of hydrologic r meteorological data in the Souris River basin involves governm r agencies in the United States and Canada. The data collectic network is vital to the successful operation of Raffert Reservoir, Boundary Reservoir, and Alameda Reservoir in Canada r Lake Darling in the United States. The network may be modifie from time to time. The data collection network is operated by th following agencies.

Canada

In Canada, the Water Resources Branch operates and maintains a network of hydrometric stations to record streamflow and water levels and the Atmospheric Environment Service operates and maintains a network of meteorological stations. Both the Water Survey of Canada and the Atmospheric Environment Service are part of Environment Canada, a Federal government agency. In addition, the Saskatchewan Water Corporation, a Provincial Crown Corporation, operates a number of snow course stations in the basin. The purpose of the snow course measurements is to provide additional data for estimating spring runoff.

United States

In the United States, the U.S. Geological Survey operates and maintains a network of hydrometric stations to record streamflow and water levels, and the National Weather Service operates and maintains a network of meteorological stations. Both organizations are Federal agencies. In addition to the meteorological stations, the National Weather Service undertakes aerial gamma surveys to provide additional snow data for estimating spring runoff.

The networks operated by these agencies are shown on the map in figure A-2 and are described in the following section.

2.2 Station Networks

The existing hydrometric station networks are shown on Table 2.1 for Canada and on Table 2.2 for the United States.

The existing meteorological station networks are shown on Table 2.3 for Canada and on Table 2.4 for the United States.

2.3 Additional Stations

Gages and methods will be established to measure inflow, pool levels, and downstream flows for Rafferty Reservoir and for Alameda Reservoir. Additional gaging stations may be added to ensure the appropriate operation of the Project.

2.4 Data Collection, Estimating, and Coordination

Close coordination and exchange of data will be maintained by the Government of the United States and the Government of Canada to facilitate Project operation, with particular reference to pre-flood drawdown. Other items will be detailed in the Reservoir Regulation Manual.

Improved estimating techniques will be developed by the Parties to the subject Agreement. These estimating techniques will be based on the mutual agreement of the Parties and will be included as part of the Reservoir Regulation Manuals, which will be written at a later date.

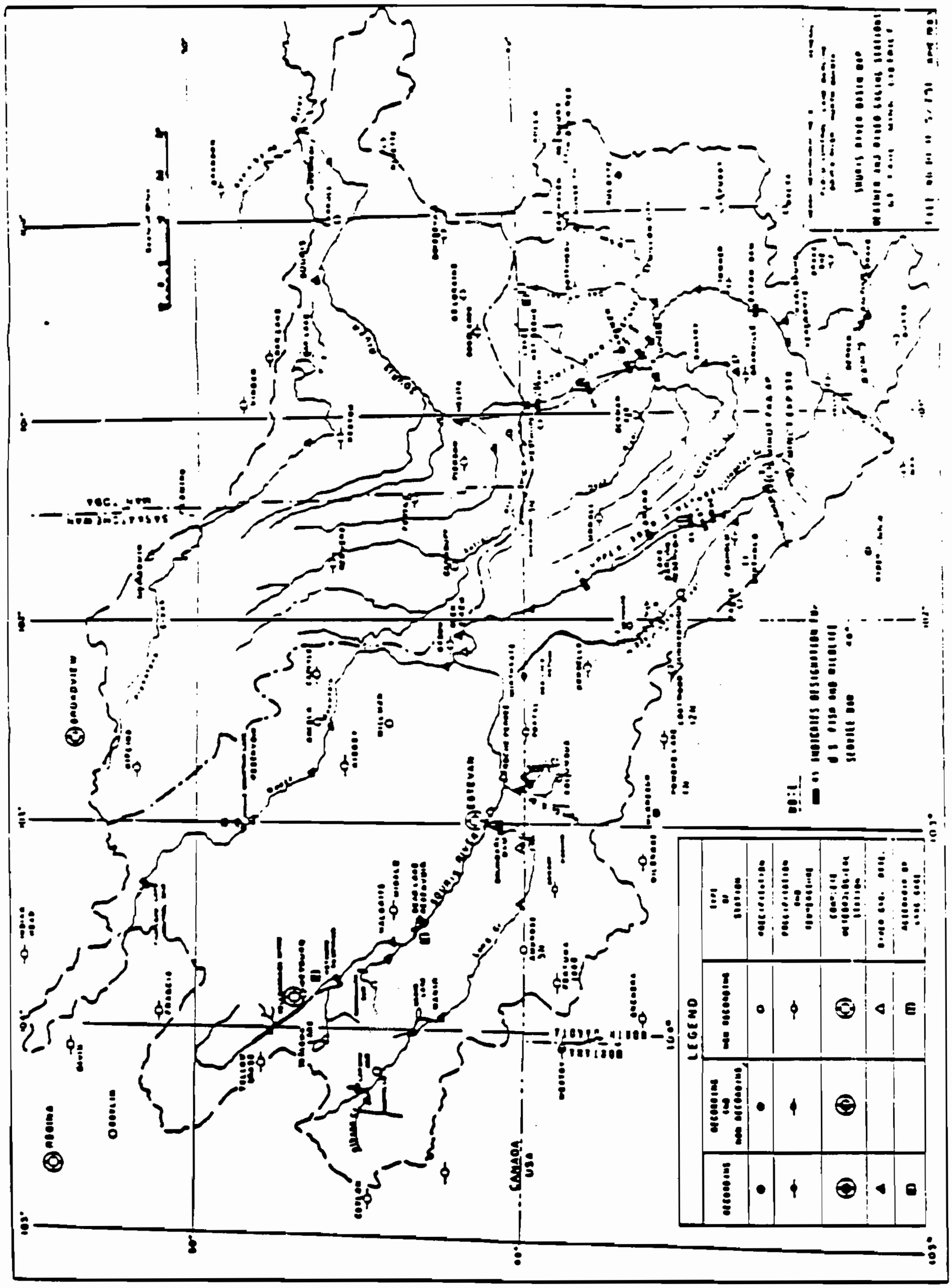

FIGURE A-2

30 July 1987

Revised 04 Sep 1987

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TABLE 2.1
HYDROMETRIC STATION NETWORK FOR SOURIS BASIN IN SASKATCHEWAN

Station No.	Station Name	Location Latitude	Location Longitude	Type
05NA003 (05113360)	Long Creek at Western Crossing	49 00 01	103 21 08	Flow; auto recorder; Telemark
05NA004	Long Creek near Maxim	49 15 32	103 57 22	Flow; auto recorder; seasonal
05NA005	Gibson Creek near Radville	49 29 02	104 20 11	Flow; auto recorder; seasonal
05NA006	Larson Reservoir near Radville	49 28 30	104 16 50	Water level; auto recorder
05NB001	Long Creek near Estevan	49 06 15	103 00 48	Flow; auto recorder
05NB009	Souris River nr. Roche Percee	49 04 34	102 45 53	Flow; auto recorder
05NB011	Yellow Grass ditch near Yellow Grass	49 47 11	104 02 16	Flow; auto recorder; seasonal
05NB012	Boundary Res. near Estevan	49 05 49	103 01 28	Water level; auto recorder
05NB014	Jewel Creek nr. Goodwater	49 23 10	103 42 42	Flow; auto recorder; seasonal
05NB016	Roughbark Res. near Weyburn	49 30 08	103 43 07	Water level; auto recorder
05NB017	Souris River nr. Halbrite	49 29 37	103 39 44	Flow; auto recorder; seasonal
05NB018	Tatagwa Lake Dr. near Weyburn	49 35 58	103 56 50	Flow; auto recorder; seasonal
05NB020	Nickle Lake nr. Weyburn	49 36 33	103 47 28	Water level; auto recorder
05NB021 (05113800)	Short Creek nr. Roche Percee	49 01 52	102 50 57	Flow; auto recorder
05NB022	Dead Lake Res. near Midale	49 17 23	103 26 40	Water level; auto recorder
05NB025	Souris River near Lewvan	49 58 37	104 04 33	Flow; auto recorder; seasonal

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TABLE 2.1 (cont.)
HYDROMETRIC STATION NETWORK FOR SOURIS BASIN IN SASKATCHEWAN

Station	Station Name	Location Latitude	Location Longitude	Type	No.
05NB029	Dead Lake - Souris River	49 17 23	103 26 40	Water level; auto recorder	
05NB030	Souris River near McTaggart	49 46 10	104 00 54	Flow; auto recorde seasonal	
05NB031	Souris River near Bechard	49 59 20	104 11 24	Flow; auto recorde seasonal	
05NC001	Moose Mountain Creek below Moose Mountain Lake	49 52 23	103 00 54	Flow; auto recorde seasonal	
05NC002	Moose Mountain Reservoir nr. Corning	49 53 29	103 01 58	Water level; auto recorder	
05ND001	Souris River nr. Glen Ewen	49 11 02	102 01 42	Flow; auto recorde	
05ND004	Moose Mountain Creek nr. Oxbow	49 13 58	102 13 41	Flow; auto recorde seasonal	
05NF006	Lightning Creek near Carnduff	49 13 17	101 43 06	Flow; auto recorder seasonal	
05NF010	Antler River near Wauchope	49 35 03	101 50 52	Flow; auto recorder seasonal	
05NF013	Gainsborough Creek near Starthoaks	49 24 51	101 31 36	Flow; auto recorder seasonal	
24-131	Souris River at #18 Highway	49 07 42	103 01 17	Flow; manual recorder; Extreme flow only	
24-132	Souris River at #47 Highway	49 07 11	102 59 32	Flow; manual recorder; Extreme flow only	
24-133	Souris River at Oxbow	49 13 04	102 11 08	Flow; manual recorder; Extrem flow only	
	Souris River at Pulfer's Farm	49 40 50	103 54 09	Flow; manual recorder; Extreme flow only	

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TABLE 2.2
HYDROMETRIC STATION NETWORK FOR SOURIS BASIN IN NORTH DAKOTA

Station No.	Station Name (Corps DCP)	Location Latitude	Location Longitude	Type
05114000	Souris River nr. Sherwood	48 59 24	101 57 28	Flow; auto recorder; Telemark
05115500	Lake Darling near Foxholm	48 27 27	101 35 14	Water level; auto recorder
05116000	Souris River near Foxholm	48 22 20	101 30 18	Flow; auto recorder; Telemark
05116500	Des Lacs River near Foxholm	48 22 14	101 34 11	Flow; auto recorder; Telemark
05117500	Souris River above Minot ✓	48 14 45	101 22 15	Flow; auto recorder; Telemark
05120000	Souris River near Verendrye	48 09 35	100 43 45	Flow; auto recorder
05120500	Wintering River near Karlsruhe	48 10 14	100 32 20	Flow; auto recorder CR500
05122000	Souris River near Bantry	48 30 20	100 26 04	Flow; auto recorder; Telemark CR500
05123000	Lake Metigoshe near Bottineau	48 59 05	100 20 52	Water level; auto recorder X DISCONT.
05123400	Willow ~~River~~ Creek near Willow City	48 35 20	100 26 30	Flow; auto recorder DCP 17AF66C8
05123500	Deep River near Upham	48 35 03	100 51 44	Flow; auto recorder; Telemark LARC
05123900	Boundary Creek near Landa	48 48 46	100 51 46	Flow; auto recorder DISCONTINUED
05124000	Souris River near Westhope ✓	48 59 47	100 57 29	Flow; auto recorder

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TABLE 2.3
METEOROLOGICAL STATION NETWORK FOR SOURIS BASIN IN SASKATCHEWAN

Station Name	Station	Location Latitude	Location Longitude	TE	PR	HW	RR	ST	EV	SU	SS	NS	WS
Alameda		49 24	102 16								X		
Amulet	4010150	49 37	104 44	X	X								
Arcola COA	4010240	49 38	102 32		X								
Bechard	4010540	50 03	104 13	X	X								
Broadview	4010879	50 23	102 35	X	X	X	X	X	X	X	X	X	
Carlyle	4011160	49 38	102 17	X	X								
Carlyle		49 39	102 16								X		
Carlyle C-7		49 39	102 20								X		
Carnduff	4011250	49 13	101 45		X								
Ceylon	4011441	49 24	104 39	X	X								
Davin	4012162	50 24	104 11		X								
Davin	4012165	50 22	104 09		X								
Davin	4012166	50 23	104 10	X	X		X		X				
Estevan		49 05	102 59								X		
Estevan A	4012400	49 04	103 00	X	X	X	X	X	X	X	X	X	
Estevan C-9		49 08	102 56								X		
Fertile	4012485	49 20	101 27	X	X								
Fleming S.	4012525	50 02	101 35		X								
Francis	4012720	50 07	103 55	X	X								
Frobisher		49 13	102 09								X		
Gainsborough	4012790	49 18	101 32		X								
Glenavon		50 12	103 08								X		
Handsworth	4013098	48 51	102 52	X	X								
Handsworth		49 53	103 02								X		
Heward	4013221	49 45	103 09	X	X								
Hitchcock		49 15	103 10								X		
Hume		49 40	103 37								X		
Indian Head CDA	4013480	50 32	103 40	X	X			X				X	
Indian Head PFRA	4013490	50 31	103 41	X	X			X	X	X			
Kipling	4014040	50 12	102 44	X	X								
Kisbey		49 40	102 45								X		

Observing Programs *

*TE - Temperature
PR - Precipitation
HW - Hourly Weather
RR - Rate of Rainfall
ST - Soil Temperature
EV - Evaporation
SU - Sunshine
SS - Snow Survey
NS - Nipher Snow Measurements
WS - Windspeed

TABLE 2.3 (cont.)
METEOROLOGICAL STATION NETWORK FOR SOURIS BASIN IN SASKATCHEWAN

Station Name	Station	Location Latitude	Location Longitude	TE	PR	HW	RR	ST	EV	SU	SS	NS	WS
Macoun	4014870	49 14	103 14		X								
Maryfield	4015045	49 50	101 32	X	X								
Maxim		49 19	103 57								X		
Midale	4015160	49 24	103 25	X	X								
Moose Mountain Reservoir	4015344	49 53	103 02	X	X				X				
Moosomin	4015360	50 09	101 40	X	X								
Neptune		49 22	104 06								X		
Neptune S.		49 19	104 02								X		
Noonan N.D.		48 57	103 03								X		
Odessa	4015648	50 20	103 41	X	X								
Oungre		49 09	103 45								X		
Oxbow	4015800	49 19	102 07	X	X								
Oxbow		49 14	102 07								X		
Radville CDA	4016400	49 30	104 17			X							
Redvers	4016522	49 32	101 42	X	X								
Torquay	4018105	49 05	103 30		X								
Trossachs N.E.		49 36	104 11								X		
Trossachs S.		49 34	104 17								X		
Wapella - Newfinland	4018508	50 27	101 56	X	X								
Wawota	4018678	49 56	101 58	X	X			X	X	X			X
Weyburn		49 40	103 53								X		
Weyburn 2	4018762	49 40	103 51		X								
Willmar	4018960	49 25	102 30		X								
Yellow Grass	4019040	49 48	104 10	X	X								

Observing Programs *

*TE - Temperature
PR - Precipitation
HW - Hourly Weather
RR - Rate of Rainfall
ST - Soil Temperature
EV - Evaporation
SU - Sunshine
SS - Snow Survey
NS - Nipher Snow Measurements
WS - Windspeed

TABLE 2.4
METEOROLOGICAL STATION NETWORK FOR SOURIS BASIN IN NORTH DAKOTA

Station Name	Location Latitude	Location Longitude	Observing Programs * PR	TE	SS	HW	SU	EV
Ambrose	49 00	103 28	X		X			
Belcourt	48 50	99 45	X	X	X			
Berthold	48 19	101 44	X		X			
Bottineau	48 50	100 27	X	X	X			
Bowbells	48 48	102 15	X	X	X			
Butte	47 50	100 40	X	X	X			
Columbus	48 55	102 50	X		X			
Crosby	48 54	103 18	X	X	X			
Drake 8NE	48 02	100 17	X	X	X			
Fortuna 1W	48 55	103 49	X	X	X			
Foxholm 7N	48 20	101 33	X	X	X			
Granville	48 16	100 51	X	X	X			
Kenmare	48 40	102 06	X	X	X			
Lake Metigoshe	48 59	100 21	X		X			
Max	47 49	101 18	X	X	X			
Minot FAA	48 16	101 17	X	X	X	X		
Minot Exp. St.	48 11	101 18	X	X	X		X	X
Mohall	48 48	101 31	X	X	X			
Rolla 3NW	48 54	99 40	X	X	X			
Rugby	48 21	100 00	X	X	X			
Sherwood 3N	49 00	101 38	X		X			
Tagus	48 20	101 56	X		X			
Tower NE	48 21	100 24	X	X	X			
Upham 3N	48 37	100 44	X	X	X			
Westhope	48 55	101 22	X	X	X			

*PR - Precipitation
TE - Temperature
SS - Snow Survey
HW - Hourly Weather
SU - Sunshine
EV - Evaporation

3.0 CONTROL POINTS

3.1 Rafferty Dam

The relevant data for this control point are presented on Tables 3.1 and 3.2. The elevation-area-capacity curves are shown on Plate A-7. In the event of a discrepancy, the tabulated values will be used.

Table 3.1
DATA FOR RESERVOIRS

Description	Elevation	Total Storage
<u>Rafferty Reservoir</u>		
Maximum allowable flood level	554.00 m (1817.59 ft)	633,000 dam^3 (513,000 ac-ft)
Full supply level	550.50 m (1806.10 ft)	439,600 dam^3 (356,400 ac-ft)
Normal level prior to spring runoff	549.50 m (1802.82 ft)	394,000 dam^3 (319,000 ac-ft)
Minimum supply level	537.50 m (1763.45 ft)	13,000 dam^3 (10,000 ac-ft)
<u>Boundary Reservoir</u>		
Full supply level	560.83 m (1840.00 ft)	61,500 dam^3 (49,800 ac-ft)
Minimum supply level	553.21 m (1815.00 ft)	24,900 dam^3 (20,800 ac-ft)
<u>Alameda Reservoir</u>		
Maximum allowable flood level	567.00 m (1860.24 ft)	189,600 dam^3 (153,710 ac-ft)
Full supply level	562.00 m (1843.83 ft)	105,500 dam^3 (85,530 ac-ft)
Normal level prior to spring runoff	561.00 m (1840.55 ft)	94,245 dam^3 (76,400 ac-ft)
Minimum supply level	555.85 m (1823.65 ft)	50,700 dam^3 (41,100 ac-ft)
<u>Lake Darling Reservoir</u>		
Maximum allowable flood level	1601.00 ft (487.98 m)	158,600 ac-ft (195,630 dam^3)
Full supply level	1597.00 ft (486.77 m)	110,000 ac-ft (136,000 dam^3)
Minimum supply level	1577.00 ft (480.67 m)	3,500 ac-ft (4,300 dam^3)

Table 3.2
SUMMARY OF RAFFERTY ELEVATION-AREA-CAPACITY DATA

Elevation		Storage		
metres	feet	dam^3	ac-ft	
547.5	1796.26	305287	247500	Maximum required drawdown (1)
549.5	1802.82	392371	318100	Normal drawdown (2)
550.5	1806.10	439613	356400	FSL
554.0	1817.59	632776	513000	Maximum storage level

Elevation		Surface Area		Storage	
metre	feet	ha	acres	dam^3	ac-ft
535.0	1755.25	0	0	0	0
537.0	1761.81	807	1992	4737	3840
538.0	1765.09	1464	3614	16159	13100
540.0	1771.65	2495	6159	56370	45700
545.0	1788.06	3574	8822	209075	169500
546.0	1791.34	3795	9367	245833	199300
547.0	1794.62	4022	9928	284811	230900
547.5	1796.26	4134	10205	305287	247500
549.0	1801.18	4480	11060	369675	299700
549.5	1802.82	4599	11353	392371	318100
550.0	1804.46	4719	11649	416547	337700
550.5	1806.10	4881	12048	439613	356400
551.0	1807.74	5045	12454	464406	376500
551.5	1809.38	5212	12866	490062	397300
552.0	1811.02	5407	13347	516582	418800
552.5	1812.66	5605	13836	543966	441000
553.0	1814.30	5807	14334	572459	464100
553.5	1815.94	6012	14841	602063	488100
554.0	1817.59	6222	15360	632776	513000
555.0	1820.87	6651	16418	697041	565100

1. Assuming starting elevation of 547.5 metres, flood control storage available would be 632,776 (513,000) - 305,287 (247,500) = 327,489 dam^3 (265,500 ac-ft) {FSL = 550.5{.

2. Assuming starting elevation of 549.5 metres, flood control storage available would be 632,776 (513,000) - 392,371 (318,100) = 240,405 dam^3 (194,900 ac-ft) {FSL = 550.5{.

3.2 Boundary Dam

The relevant data for this control point are shown on Tables 3.1 and 3.3.

Table 3.3
SUMMARY OF BOUNDARY ELEVATION-AREA-CAPACITY DATA

Elevation metre	Elevation feet	Storage dam^3	Storage ac-ft	
557.8	1830.0	44725	36259	Max required drawdown (1)
560.8	1840.0	61480	49845	FSL, Normal, & Max.

Elevation metre	Elevation feet	Surface Area ha	Surface Area acres	Storage dam^3	Storage ac-ft
554.7	1820.0	407	1005	30691	24882
555.5	1822.5	425	1049	33970	27540
556.3	1825.0	445	1098	37400	30320
557.0	1827.5	486	1200	41000	33240
557.8	1830.0	506	1249	44725	36259
558.5	1832.5	546	1348	48625	39420
559.3	1835.0	547	1350	52670	42700
560.1	1837.5	607	1498	56910	46140
560.8	1840.0	688	1698	61480	49845

1. At maximum required drawdown level of 557.8 metres (1830 feet), storage available would be 61,480 (49,845) - 44,725 (36,259) = 16,755 dam^3 (13,586 == 13,600 ac-ft). This necessary storage may also be obtained by drawing Rafferty below required levels and diverting the 16,755 dam^3 (13,600 ac-ft) to Rafferty Reservoir.

3.3 Alameda Dam

The relevant data for this control point are shown on Tables 3.1 ar 3.4. The elevation-area-capacity curves are shown on Plate A-8.

Table 3.4
SUMMARY OF ALAMEDA ELEVATION-AREA-CAPACITY DATA

Elevation metres	Elevation feet	Storage dam^3	Storage ac-ft	
555.85	1823.65	50700	41100	Maximum required drawdown (1)
561.0	1840.55	94245	76400	Normal drawdown (2)
562.0	1843.83	105500	85530	FSL
567.0	1860.24	189600	153710	Maximum storage level

Elevation metres	Elevation feet	Surface Area ha	Surface Area acres	Storage dam^3	Storage ac-ft
528.0	1732.28	0	0	0	0
530.0	1738.84	11	27	110	90
532.0	1745.41	27	67	490	400
534.0	1751.97	41	101	1170	950
536.0	1758.53	58	143	2160	1750
538.0	1765.09	77	190	3500	2840
540.0	1771.65	93	230	5200	4215
542.0	1778.21	124	306	7370	5975
544.0	1784.78	156	385	10170	8245
546.0	1791.34	200	494	13700	11110
548.0	1797.90	253	625	18260	14805
550.0	1804.46	318	785	23970	19430
552.0	1811.02	386	953	31000	25130
554.0	1817.59	495	1222	39800	32265
555.85	1823.65	624	1540	50700	41100
556.0	1824.15	635	1567	51100	41425
558.0	1830.71	770	1900	65160	52825
560.0	1837.27	1010	2493	82990	67280
561.0	1840.55	1125	2777	94245	76400
562.0	1843.83	1240	3061	105500	85530
564.0	1850.39	1520	3752	133200	107990
566.0	1856.96	1940	4789	167800	136040
567.0	1860.24	2180	5381	189600	153710
568.0	1863.52	2420	5974	211400	171385
569.0	1866.80	2660	6566	236800	191980

1. Assuming starting elevation of 555.85 metres, flood control storage available would be 189,600 (153,710) - 50,700 (41,100) = 138,900 dam 3 (112,608 ac-ft) (FSL = 562.0(.

2. Assuming starting elevation of 561.0 metres, flood control storage available would be 189,600 (153,710) - 94,245 (76,400) = 95,355 dam^3 (77,305 ac-ft) (FSL = 562.0(.

3.4 Lake Darling Dam

The relevant data for this control point are shown on Tables 3.2 and 3.5. The elevation-area-capacity curves are shown on Plate A-9.

Table 3.5
SUMMARY OF LAKE DARLING ELEVATION-AREA-CAPACITY DATA

Elevation feet	Elevation metres	Storage ac-ft	Storage dam^3	
1591	484.94	53,000	65,375	Maximum drawdown (1)
1596	486.46	99,000	122,115	Normal drawdown (2)
1597	486.77	110,100	135,800	Normal pool
1601	487.98	158,600	195,063	Existing maximum

Elevation		Surface Area		Storage	
feet	metres	acres	ha	ac-ft	dam^3
1591.0	484.94	7,431	3,010	53,000	65,375
1592.0	485.24	8,200	3,322	60,800	75,000
1593.0	485.55	8,910	3,610	69,400	85,600
1594.0	485.85	9,650	3,910	78,600	96,950
1595.0	486.16	10,220	4,140	88,600	109,290
1596.0	486.46	10,800	4,375	99,000	122,115
1597.0	486.77	11,270	4,566	110,100	135,800
1598.0	487.07	11,750	4,760	121,600	150,000
1599.0	487.38	12,150	4,922	133,600	164,790
1600.0	487.68	12,550	5,084	145,900	179,965
1601.0	487.98	12,900	5,226	158,600	195,630

Service spillway crest at 1598.0 feet.

1. Assuming a starting elevation of 1591 feet, flood control storage available would be 158,600 (195,630) - 53,000 (65,375) = 105,600 ac-ft (130,255 dam^3)

2. Assuming a starting elevation of 1596 feet, flood control storage available would be 158,600 (195,630) - 99,000 (122,115) = 59,600 ac-ft (73,515 dam^3)

3.5 Souris River near Sherwood Crossing

This control point is the International gaging station, number 05114000, latitude 48:59:24, longitude 101:57:28, on the Souris River, 0.8 mile downstream of the International boundary.

3.6 Souris River above Minot

The control point, Souris River above Minot, is a flow gaging station operated by the U.S. Geological Survey and maintained by the North Dakota State Water Commission. The station number is 05117500.

The station is located approximately 3.5 miles (5.8 km) west of Minot, North Dakota, and approximately 7 miles (11 km) downstream from the confluence of the Souris and Des Lacs Rivers. The coordinates of the station are latitude 48:14:45, longitude 101:22:15.

3.7 Souris River near Westhope Crossing

This control point is the International gaging station, number 05NF012, latitude 48:59:47, longitude 100:57:29, on the Souris river 1.6 kilometres upstream of the International boundary near Westhope, North Dakota.

3.8 Boundary Diversion Channel

Boundary Diversion Channel may be used for flood control provided that storage is available in Rafferty Reservoir in excess of the amount required to meet United States flood control requirements in that year, by the amount of volume to be diverted.

3.9 Other Considerations

This Operating Plan for the Canadian reservoirs and Lake Darling Reservoir requires that flood protection be provided for urban and rural downstream areas. The operation of the Project for flood

flows will consider the approximate bankfull channel capacities of urban and rural reaches. Release rates will be based on reducing flood damages as much as possible. An indication of the flows at which flooding occurs is provided in Table 3.6, for various reaches of the Souris River, Long Creek and Moose Mountain Creek. These flows should be considered as approximate only.

Table 3.6
APPROXIMATE BANKFULL CHANNEL CAPACITY

Description of Reach	Bankfull Capacity
Long Creek	
Boundary Dam to Souris River	25 m^3/s (900 cfs)
Moose Mountain Creek	
Alameda Dam to Souris River	50 m^3/s (1,800 cfs)
Souris River	
Rafferty Dam to Long Creek	14 m^3/s (500 cfs)*
Long Creek to Shand	85 m^3/s (3,000 cfs)
Shand to Moose Mountain Creek	60 m^3/s (2,000 cfs)
Souris River at Oxbow	90 m^3/s (3,200 cfs)
Souris River at Sherwood Crossing	90 m^3/s (3,200 cfs)
Sherwood to Upper Souris Refuge	60 m^3/s (2,000 cfs)
Upper Souris Refuge to Lake Darling Dam	Reservoir pool
Lake Darling Dam to Minot	2,500 cfs (70 m^3/s)
Souris River at Minot	5,000 cfs (215 m^3/s)
Minot to Logan	2,500 cfs (70 m^3/s)
Logan to Velva	1,400 cfs (40 m^3/s)
Velva to Verendrye	1,400 cfs (40 m^3/s)
Verendrye to Wintering River	1,500 cfs (42 m^3/s)
Wintering River to Towner	600 cfs (17 m^3/s)
Towner to Coulter	200 cfs (6 m^3/s)
Coulter to Melita	600 cfs (17 m^3/s)
Melita to Hartney	1,100 cfs (31 m^3/s)

*With proposed channel improvements.

4.0 PROJECT OPERATION

4.1 Objectives and Procedures

The objectives to be implemented by this Operating Plan include the following: (1) provide 1-percent (100-year) flood protection at Minot, North Dakota; (2) provide flood protection to urban and rural areas downstream from Rafferty Dam, Alameda Dam, and Lake Darling Dam; and (3) ensure, to the extent possible, that the existing benefits from the supply of water in the Souris River Basin and the supply of water to the Souris Basin Project are not compromised.

In order to ensure that these objectives are met, it is necessary to distinguish between flood and nonflood operation. To meet the flood and nonflood Operating Plan objectives, the following procedure will be used to identify the proper mode of operation while complying with the terms of the 1959 Interim Measures as modified.

Flood Operation

If a February 1 or subsequent spring runoff estimate shows a reasonable chance (50 percent) of a runoff volume at Sherwood Crossing being equal to or greater than a 10-percent (1 in 10 years) flood, then operations will proceed on the basis of the flood Operating Plan. Flood operation will cease when flood volumes have been discharged and streamflows are at or below 500 cfs at Minot.

Nonflood Operation

If a February 1 or subsequent spring runoff estimate shows a reasonable chance (50 percent) of a runoff event less than a 10-percent (1 in 10 years) flood, then operations will proceed on the basis of the nonflood Operating Plan.

4.2 Consistency with Interim Measures

As set out in the 1959 Interim Measures as modified, under certain conditions, a portion of the North Dakota share will be in the form of evaporation from Rafferty Reservoir and Alameda Reservoir. During years when these conditions occur, the minimum amount of flow actually passed to North Dakota will be 40 percent of the natural flow at Sherwood Crossing. This lesser amount is in recognition of Saskatchewan's agreement to operate both Rafferty Dam and Alameda Dam for flood control and for evaporation as a result of the Project. Therefore, this is deemed to be in compliance with all applicable obligations. The volume of natural flow will be determined by the International Souris River Board of Control ("the Board").

The following rules determine the percentage of the natural flow at Sherwood Crossing which is to be passed to North Dakota.

a. If the level of Lake Darling Reservoir is below an elevation of 1592.0 feet (485.24 metres) on October 1 in any calendar year, Saskatchewan will pass 50 percent of the natural flow at Sherwood Crossing in that year and in succeeding years until the level of Lake Darling Reservoir is above an elevation of 1593.0 feet (485.55 metres) on October 1.

b. If the natural flow at Sherwood Crossing is equal to or less than 20,000 acre-feet (24,700 cubic decametres) prior to October 1 of that year, then Saskatchewan will pass 50 percent of that natural flow to North Dakota in that calendar year.

c. If the conditions specified in subparagraphs 4.2(a) and 4.2(b) do not appply, then Saskatchewan will pass at least 40 percent of the natural flow at Sherwood Crossing to North Dakota.

d. If releases are delayed, they may be called for at any time before October 1. If they are not called for before October 1, the water may be retained for use in Saskatchewan.

Lake Darling Reservoir and the Canadian reservoirs will be operated (insofar as is compatible with the Project's purposes and consistent with past practices) to ensure that the pool elevations, which determine conditions for sharing evaporation losses, are not artificially altered. The triggering elevation of 1592.0 feet (485.24 metres) for Lake Darling Reservoir is based on existing water uses in North Dakota, including refuges operated by the U.S. Fish and Wildlife Service. Each year, operating plans for the refuges on the Souris River will be presented to the Board. Barring unforeseen circumstances, operations will follow said plans during each given year. Lake Darling Reservoir will not be drawn down for the sole purpose of reaching the elevation of 1592.0 feet (485.24 metres) on October 1.

Late season releases will not be made by Saskatchewan Water Corporation from the Canadian reservoirs for the sole purpose of raising the elevation of Lake Darling Reservoir above 1593.0 feet (485.55 metres) on October 1.

Flow releases to the United States should occur (except in flood years) in the pattern which would have occurred in a state of nature. To the extent possible and in consideration of potential channel losses and operating efficiencies, releases from the Canadian dams will be scheduled to coincide with periods of beneficial use in North Dakota. Normally, the period of beneficial use in North Dakota coincides with the timing of the natural hydrograph, and that timing should be a guide to releases of the United States portion of the natural flow. The flow release to the United States may be delayed when the State of North Dakota determines and notifies Saskatchewan through the Board that the release would not be of benefit to the State at that time. The delayed release may be retained for use in Saskatchewan, notwithstanding the minimum release limits, unless it is called for by the State of North Dakota through the Board before October 1 of each year. The delayed release shall be measured at the point of release and the delivery at Sherwood Crossing shall not be less than the delayed release minus the conveyance losses that would have occurred under natural conditions between the point of release and the Sherwood Crossing. Prior to these releases being made, consultations shall occur between the Saskatchewan Water Corporation, the U.S. Fish and Wildlife Service, and the State of North Dakota. All releases will be within the specified target flows at the control points.

4.3 Flood Operation

General

This section sets forth the Operating Plan for Rafferty Reservoir, Alameda Reservoir, Boundary Reservoir, and Lake Darling Reservoir for flood control. In general, the purpose is as follows: the three reservoirs in Canada are to be operated in such a manner so that, along with Lake Darling Reservoir, it will be possible to obtain 1-percent (100-year) level of protection at Minot. The 1-percent level of protection at Minot allows a maximum discharge of 5,000 cfs. After the spring estimate of streamflow is received, if a 1-percent or greater flood volume is anticipated, it will be necessary to draw Lake Darling Reservoir down to an elevation of 1591.0 feet, to draw Rafferty Reservoir down to an elevation of 547.5 metres, to draw Alameda Reservoir down to an elevation of 555.85 metres, and to draw Boundary Reservoir down to an elevation of 557.8 metres given that the estimated 90-day volume as set forth in Plates A-1 to A-3 and the estimated 30-day volume in Plate A-4 will require the maximum required drawdown levels. As discussed in Section 3.2, additional drawdown in Rafferty Reservoir may be used in lieu of drawdown of Boundary Reservoir. The manner in which this is to be accomplished and the reasons for doing so are presented in the following sections. In those cases where the flood event is greater than a 1-percent (100-year) event, the Project will be operated as set forth in the Reservoir Regulation Manuals to attempt to reduce downstream damages without endangering the structures themselves. This may require flows greater than 5,000 cfs at Minot for the period before June 1, and may also require flows greater than 500 cfs (which could also exceed 5,000 cfs) after June 1.

The Canadian reservoirs will be operated for Sherwood Crossing giving due consideration to the level at Lake Darling Reservoir and the flow at Minot. It is not possible to obtain 1-percent (100-year) flood protection at Minot unless Rafferty Reservoir, Alameda Reservoir, Boundary Reservoir, and Lake Darling Reservoir are operated as a complete system.

This section will be used when the estimated 30-day unregulated volume at Sherwood Crossing equals or exceeds a 10-percent (10-year) event, which is equal to 175,200 ac-ft (216,110 dam^3); and/or when the local 30-day volume at Sherwood Crossing is expected to equal or exceed 30,000 acre-feet (37,000 dam^3). From the period of record at Sherwood Crossing, 1930 to 1988, 58 years, the Operating Plan would have been used approximately 6 times, or about 10 percent of the time.

The flood Operating Plan is divided into four separate phases in accordance with the annual hydrograph. These phases relate to:

a. Operations to lower reservoirs prior to spring runoff.
b. Operations during spring runoff.
c. Operations after runoff to restore reservoirs to full supply level.
d. Operations during the summer, fall, and winter.

4.3.1 Drawdown Prior to Spring Runoff

The drawdown of Rafferty Reservoir, Boundary Reservoir, Alameda Reservoir and Lake Darling Reservoir in response to a given predicted flood event is an integral part of the Operating Plan. The extent of drawdown will depend on the estimated spring runoff volume for each as shown on the curves in Plates A-1 to A-4.

Any releases from Lake Darling Reservoir must take into consideration inflows resulting from releases from the Canadian reservoirs and any local inflow between the Canadian reservoirs and Lake Darling Reservoir.

Regardless of the estimated volumes of runoff, the reservoirs will be operated to ensure that each is at or below the following pool levels by February 1.

a. Rafferty Reservoir - 549.50 m. (1802.82 ft.)
b. Alameda Reservoir - 561.00 m. (1840.55 ft.)
c. Lake Darling Reservoir - 1596.00 ft. (486.46 m.)

The reservoirs will be drawn down, as appropriate, over the summer, fall, and winter months, and release rates will take into consideration channel and ice conditions. Release rates will be set to ensure that the maximum controlled flow at Sherwood Crossing will not exceed the following rates, provided Lake Darling Reservoir is at or below full supply level:

a. June 1 to August 31 - 11 m^3/s (400 cfs)
b. September 1 to January 31 - 14 m^3/s (500 cfs)
c. February 1 to March 15 - 60 m^3/s (2,120 cfs)
d. March 16 to May 31 - 90 m^3/s (3,200 cfs; up to 50-yr)
113 m^3/s (4,000 cfs; over 50-yr)

Estimates of spring runoff will be made initially on February 1 and thereafter on the 15th and last day of each month until runoff occurs. The target drawdown levels will be as shown on Plates A-1 through A-4. For the Canadian reservoirs, these levels are based on the 90-percent 90-day spring runoff volume for each reservoir. Using this parameter will ensure that operating the Canadian reservoirs for flood control will not compromise the potential for the supply of water. For Lake Darling Reservoir, the target drawdown level is based on the estimated Sherwood Crossing uncontrolled runoff volume and a sliding scale relating the runoff volume to a Lake Darling Reservoir level as shown on

Plate A-4. As the estimated spring runoff volume is updated during the spring, the Lake Darling Reservoir target level will also change.

Should the level of any reservoir on February 1 be higher than its target drawdown level, releases will be made as described below. Should the level for a reservoir on February 1 be equal to or lower than the target drawdown level, no releases need be made from that reservoir.

Channel Ice Effects

The Reservoir Regulation Manuals will include features that will directly address the ice problems that may occur.

Rafferty Reservoir and Alameda Reservoir

The drawdown of Rafferty Reservoir and Alameda Reservoir will be the responsibility of the Saskatchewan Water Corporation. Releases from each reservoir will be made to achieve its target drawdown level. While the reservoirs are being drawn down, the total flow at Sherwood Crossing should not exceed the peak target flow from Plate A-5.

X The release rate will take into consideration ice and channel conditions between the Canadian reservoirs and Lake Darling Reservoir. Such releases will be reviewed and adjusted as necessary on a regular basis, at a minimum after each estimate of the spring runoff volume.

Releases will be established to achieve the target drawdown levels prior to the occurrence of spring runoff to the reservoirs.

Boundary Reservoir and Boundary Diversion Channel

Boundary Reservoir and the Boundary Diversion Channel will be operated within the limits of the drawdown curves. Boundary Reservoir will be drawn down to the elevation shown on Plate A-2 provided that the associated drawdown volume shown on Plate A-2 is equal to the estimated 90-percent 90-day runoff volume. To operate the Boundary Diversion Channel, there must be excess capacity available in Rafferty Reservoir to store the diverted amount. This excess capacity must be in addition to the capacity that would be made available as per Plate A-1. The operation of each will attempt to maximize flood reduction within the constraints of the requirements for water supply in Canada. The operation of each will be such to ensure that the resulting peak flow at Sherwood Crossing during runoff is not greater than the peak that would have occurred without the operation of Boundary Reservoir and Boundary Diversion Channel; and that flood control be provided as set forth above.

Preflood Lake Darling Spring Drawdown

Drawdown of the Lake Darling Reservoir prior to a given flood event is an integral part of the overall Operating Plan. Lake Darling Reservoir drawdown is the first step in the Operating Plan and is important because the extent of drawdown has a direct relationship to the amount of storage available for flood control. Drawdown is dependent upon the runoff volume (uncontrolled) at Sherwood Crossing, the rate of drawdown, and the time available for drawdown between March 1 and spring breakup. In addition, it must include the release of water from the Canadian reservoirs if needed, or it could be reduced based on reservoir levels in Canada lower than what is needed for flood control based on the estimated 30-day volume. The rate of drawdown shall be reviewed and adjusted on a regular schedule, as the winter progresses, to ensure that the Lake Darling Reservoir will be at or below the target elevation by April 1. Any drawdowns required after April 1 shall be made after consultation with Manitoba.

4.3.2. Spring Runoff

If the estimated uncontrolled volume is sufficient to raise Lake Darling Reservoir to its full supply level of 1597.0 feet, then the Canadian dams will store water until they have reached their respective full supply levels of 550.5 metres for Rafferty Reservoir and 562.0 metres for Alameda Reservoir. Once a reservoir has reached its full supply level, excess water will be released at a controlled rate in accordance with the terms of the Operating Plan.

If target drawdown levels for Rafferty Reservoir and Alameda Reservoir were not reached prior to the spring runoff, then the volume in the reservoir above the target drawdown level on February 1 will be released within the specified target flows at control points, and they will be coordinated with the U.S. Fish and Wildlife Service and the State of North Dakota.

Saskatchewan Water Corporation may draw down the level of the Canadian reservoirs below their target drawdown level. Releases resulting from said drawdown shall remain within the specified target flows at control points, however, and will be coordinated with the representatives of the United States Department of the Army.

The U.S. Fish and Wildlife Service may draw down the level of Lake Darling Reservoir below its target drawdown level to meet fish and wildlife needs. Releases resulting from said drawdown will remain within the specified target flows at control points; however, they will be coordinated with the Saskatchewan Water Corporation, Manitoba Department of Natural Resources, and the U.S. Department of the Army.

Sherwood Crossing Target Flow

The Sherwood Crossing target flow is a function of the Lake Darling Reservoir level which is itself a function of the target flow at Minot. To enable the operation of the total system for those objectives set forth in Section 4.1, it is necessary to vary the target flows at Sherwood Crossing as given on Plate A-5.

The maximum target flow at Sherwood Crossing will be as provided in Plate A-5, except that, under certain conditions, the target flow may be temporarily lowered. Once Lake Darling Reservoir levels are lowered to a level which allows the Minot target flow to be maintained, the Sherwood Crossing target flow can be increased to the starting value as was determined from Plate A-5. If releases from the Canadian reservoirs are not increased, then the Lake Darling Dam operator must be notified immediately and releases from Lake Darling Reservoir reduced accordingly. The maximum target flow will continue while water remains above FSL in either Rafferty Reservoir or Alameda Reservoir and Lake Darling Reservoir is below 1597 feet. By having a varying target flow at Sherwood Crossing, the summer release period would decrease, as well as the problems which occur with long summer releases.

Lake Darling Level

The release of the maximum target flow at Sherwood Crossing will allow Lake Darling Reservoir to release water at the Minot target level which may be above the Sherwood Crossing maximum target level resulting in the lowering of the Lake Darling Reservoir below 1597 feet. The need to draw Lake Darling Reservoir below 1597 feet will only occur when there is sufficient water in Rafferty Reservoir and Alameda Reservoir above their FSL's to fill Lake Darling Reservoir back to 1597 feet and will enable releases of excess water during the period before May 15 and at reduced levels before June 1. The drawing of Lake Darling Reservoir below 1597 feet will allow the summer release period to be shortened and in some cases it will not be needed.

4.3.3 Drawdown after Spring Runoff

If any of the reservoirs are above full supply level after the spring runoff has occurred, the reservoir or reservoirs will be brought down to full supply level using the methods outlined in Section 4.3.2. It should be noted that at no time will releases from the Canadian reservoirs cause the flows at Sherwood

Crossing to exceed the target flow from Plate A-5 unless the flow cannot be controlled by the reservoirs.

Post-Peak Flood Storage Release

After the peak stage has been reached in Lake Darling Reservoir, target releases are maintained until the pool has returned to full supply level, with the following exceptions:

a. After June 1, 500 cfs or less is maintained.

b. After May 15, but before June 1, the target flow at Minot is maintained at a level not to exceed 2,500 cfs until pool levels reach FSL, unless the 5,000 cfs target must be extended to enable the desired reservoir levels to be reached by February 1 of the following year.

4.3.4 Significant Spring and Summer Rainfall

If significant rainfall occurs during the spring or summer flood recession, the Reservoir Regulation Manual will provide for discharging the rainfall runoff based on following the unregulated flow recession. All rainfall inflow to Lake Darling Reservoir above FSL is discharged until the unregulated flow recession at Minot reaches 500 cfs. All rainfall runoff upstream of Lake Darling Reservoir which would cause flows in excess of 500 cfs at Minot would be stored, but not to exceed a reservoir elevation of 1598 feet. (Des Lacs flow could at times cause flows higher than 500 cfs at Minot.)

4.3.5 Flood System Operation Steps

The following operating steps would be used when the February 1 flow estimate exceeds the limits as set forth in Section 4.3.

OPERATING PLAN STEPS

These steps use English Units only to avoid confusion.

I. PRE-FLOOD (February 1 to start of runoff)

A. Determine Sherwood Crossing 30-day volume

B. Determine Rafferty Reservoir 30-day volume

C. Determine Alameda Reservoir 30-day volume

D. Determine local Sherwood Crossing 30-day volume:

1. Subtract Rafferty Reservoir 30-day volume from Sherwood Crossing 30-day volume (I.A - I.B = I.D.1(

2. Subtract Alameda Reservoir 30-day volume from result of above (I.D.1 - I.C = I.D.3(

3. This result is the Sherwood Crossing local 30-day volume

E. Determine 30-day volume not controlled by Rafferty Dam and Alameda Dam

1. Determine Rafferty Reservoir starting storage value in ac-ft

Based on the estimated runoff volume and Plate A-1, determine what level Rafferty Reservoir should be at or below.

a. If the actual reservoir level is below that level required, use the actual level in the following steps.

b. If the actual reservoir level is above the level required, use the level shown on Plate A-1 in the following steps.

2. Subtract starting storage from 513,000 ac-ft (513,000 - I.E.1=I.E.2)

3. Determine if 30-day volume is controlled:

a. if result from E.2 above is larger than 30-day volume, there is no excess (I.E.2 I.B).

b. if not, subtract E.2 amount from 30-day value, this is the Rafferty Reservoir excess (I.B - I.E.2 = I.E.3b)

4. Determine Alameda Reservoir starting storage value in ac-ft

Based on the estimated runoff volume and Plate A-3, determine what level Alameda Reservoir should be at or below.

a. If the actual reservoir level is below that level required, use the actual level in the following steps.

b. If the actual reservoir level is above the level required, use the level shown on Plate A-3 in the following steps.

5. Subtract starting storage from 153,710 ac-ft (153,710 - I.E.4 = I.E.5)

6. Determine if 30-day volume is controlled:

a. if result from E.5 above is larger than 30-day volume, there is no excess (I.E.5 I.C)

b. if not, subtract E.5 amount from 30-day value; this is the Alameda Reservoir excess (I.C - I.E.5 = I.E.6b)

7. If it is determined that the estimated 30-day volumes from Rafferty Reservoir and Alameda Reservoir will not exceed their FSL's and therefore minimum releases are

expected, the Lake Darling Dam operator MUST be informed, so that Lake Darling Reservoir can be at full supply level after flood

{If (I.B - (356,400 - I.E.1)) 0 and
(I.C - (85,530 - I.E.4)) 0, then call}

F. Determine the uncontrolled 30-day volume at Sherwood Crossing by adding the Rafferty Reservoir and Alameda Reservoir excesses, if any, to the Sherwood Crossing local 30-day volume found above {I.D.3 + I.E.3.b + I.E.6.b = I.F}

G. Using result from "F" above, determine Lake Darling Reservoir starting level from Plate A-4 {I.F + Plate A-4 == I.G}

H. Determine starting Sherwood Crossing target flow by using Plate A-5 and the total Sherwood Crossing 30-day volume from "A" above {I.A + Plate A-5 == I.I}

I. Determine Minot target flow by using Plate A-6 and the total Sherwood Crossing 30-day volume from "A" above {I.A + Plate A-6 == I.H}

J. Determine Boundary Reservoir 30-day volume

K. Determine if Boundary Reservoir storage must be used from Plate A-2

L. Determine if Boundary Diversion Channel will be used

M. Adjust estimate of 30-day volume at Sherwood Crossing based on use of Boundary Reservoir and Boundary Diversion Channel

II. DURING FLOOD (March 16 to May 31)

A. Using data as is available from within basin, estimate the peak discharge to be expected at Sherwood Crossing:

1. if discharge is less than target flow at Sherwood Crossing, releases can be made from Rafferty Reservoir and Alameda Reservoir which increase the peak to, but not greater than, target

2. if discharge is greater than target flow at Sherwood Crossing, releases are not to be made from Rafferty Reservoir and Alameda Reservoir which will add to the peak flow at Sherwood Crossing

B. Sherwood Crossing Target (After peak at Sherwood Crossing)

After the peak flow has occurred at Sherwood Crossing, estimate the average daily flows expected at Sherwood Crossing from the uncontrolled areas. Using this flow, the current Lake Darling Reservoir elevation, and the local flows at Minot, estimate future Lake Darling Reservoir elevations. Using this data, to include the Sherwood Crossing target flows, make releases to drawdown Rafferty Reservoir and Alameda Reservoir within the target flows in Plate A-5. Plate A-9 contains storage data for Lake Darling Reservoir to aid in the estimates.

Repeat this operation as needed to reduce reservoir levels to FSL.

Note: The same starting Sherwood Crossing target flow is used for the entire flood event, UNLESS, the estimated 30-day volume at Sherwood Crossing is adjusted based on updated data.

C. To aid in the operation of ALL reservoirs ALL operators must communicate on a regular basis.

D. Based on reservoir levels, determine if the Minot target date of May 15 must be extended so that the 500 cfs maximum at Minot after June 1 will not be exceeded.

III. POST FLOOD (June 1 to January 31)

A. Following the operating guidelines, release allowable flows to bring the reservoirs to their FSL's.

B. Review actions taken during flood and note problems which occurred.

C. If flood was a large event, prepare a Post Flood Report.

4.4 Nonflood Operation

Primary emphasis is given to operations during years of flood runoff; i.e., when the spring runoff volume exceeds a 10-percent flood. Nonflood operations are guided primarily by the Board. This Operating Plan sets forth the understanding between the Parties regarding flows in nonflood years, and provides guidance on the implementation of that understanding. It is recognized, however, that the actual implementation of the Operating Plan will be dependent upon the close coordination of the Parties during the hydrologic year.

4.4.1. Nonflood Project Operation Steps

1. The flow passed to North Dakota shall be either 40 percent or 50 percent of the natural flow at Sherwood Crossing according to the 1959 Interim Measures as modified.

2. An apportionment balance will be estimated at the spring meeting of the Board.

3. If additional releases are needed to meet the apportionment balance, North Dakota will assess its needs. If the releases would not be of benefit at that time, they may be delayed.

4. If releases are delayed, they may be called for by North Dakota at any time before October 1. If they are not called for before October 1, the water may be retained for use in Saskatchewan.

5. If delayed releases are called for, the delayed release shall be measured at the point of release and the delivery at Sherwood Crossing shall not be less than the delayed release minus the conveyance losses that would have occurred under natural conditions between the point of release and the Sherwood Crossing.

6. On October 1, a final apportionment balance will be determined. Any portion of the North Dakota apportionment remaining in Saskatchewan on October 1 shall be added arithmetically to the storage in Lake Darling Reservoir on October 1 to determine the October 1 level of Lake Darling Reservoir for purposes of Section 4.2.a.

4.5 Operating Provisions During Construction and Filling

The Parties agree to use their best efforts to provide flood protection during construction of the Project.

5.0 REPORTS

Reports will be prepared each year on behalf of the United States and Canada by both the Saskatchewan Water Corporation and the U.S. Fish and Wildlife Service describing the operation of the Project. The reports will be issued to the Board and at a minimum will include a description of the operation of the reservoirs including any problems encountered, a summary of water levels, inflows and releases from each reservoir, and an estimate of reservoir levels, inflows and releases for the remainder of the calendar year. In any year in which flood operations occur, the U.S. Army Corps of Engineers will prepare a post-flood report. This report will then become a part of the U.S. Fish and Wildlife Service report.

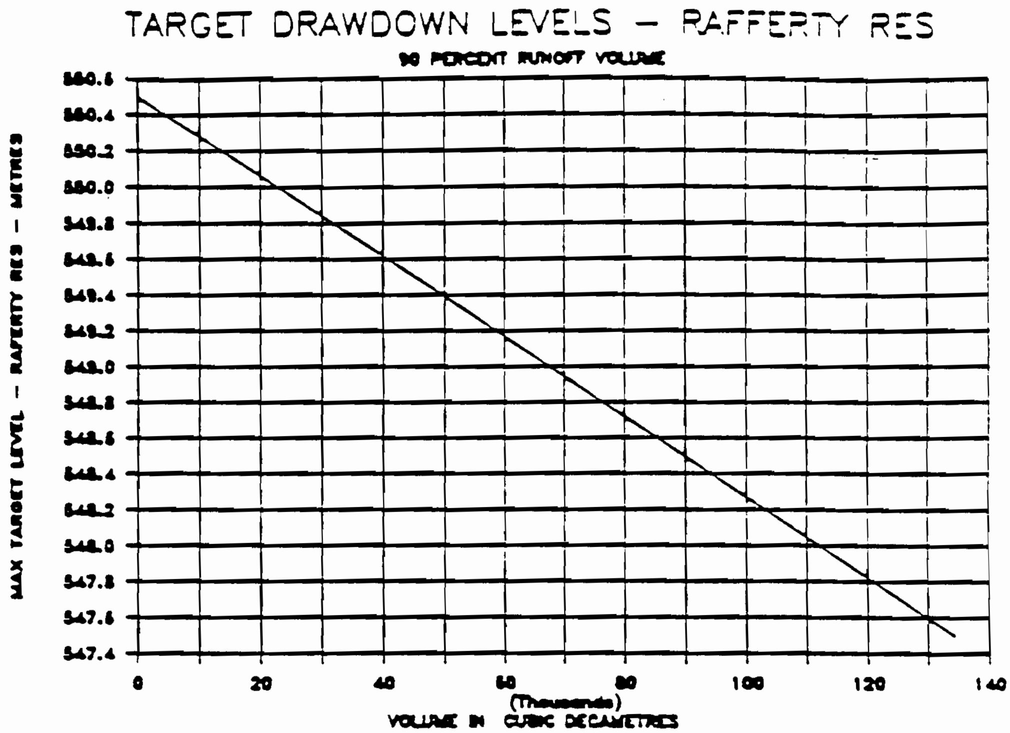
6.0 LIAISON

The Government of Saskatchewan, the Department of the Army, and the U.S. Fish and Wildlife Service within the Department of the Interior shall appoint a liaison person with whom interested States, Provinces, and Agencies may consult from time to time as to the operation of the improvements constructed and operated under the terms of the subject Agreement.

Representatives of the U.S. Department of the Army, Saskatchewan Water Corporation, U.S. Fish and Wildlife Service, and the North Dakota State Engineer will be responsible for monitoring the Operating Plan. It is expected that the reservoir operations will need to be closely monitored for the first several years after the project goes into operation.

7.0 DATA AND COMMUNICATION

The Parties shall exchange all desired data collected with respect to the management of water in the Souris River Basin and will use their best efforts to keep all interested States, Provinces, and Agencies adequately informed of all activities related to this Operating Plan.


TARGET DRAWDOWN LEVELS – RAFFERTY RES
90 PERCENT RUNOFF VOLUME
MAX TARGET LEVEL – RAFFERTY RES – METRES
550.6
550.4
550.2
550.0
549.8
549.6
549.4
549.2
549.0
548.8
548.6
548.4
548.2
548.0
547.8
547.6
547.4
0
20
40
60
80
100
120
140
(Thousands)
VOLUME IN CUBIC DECAMETRES

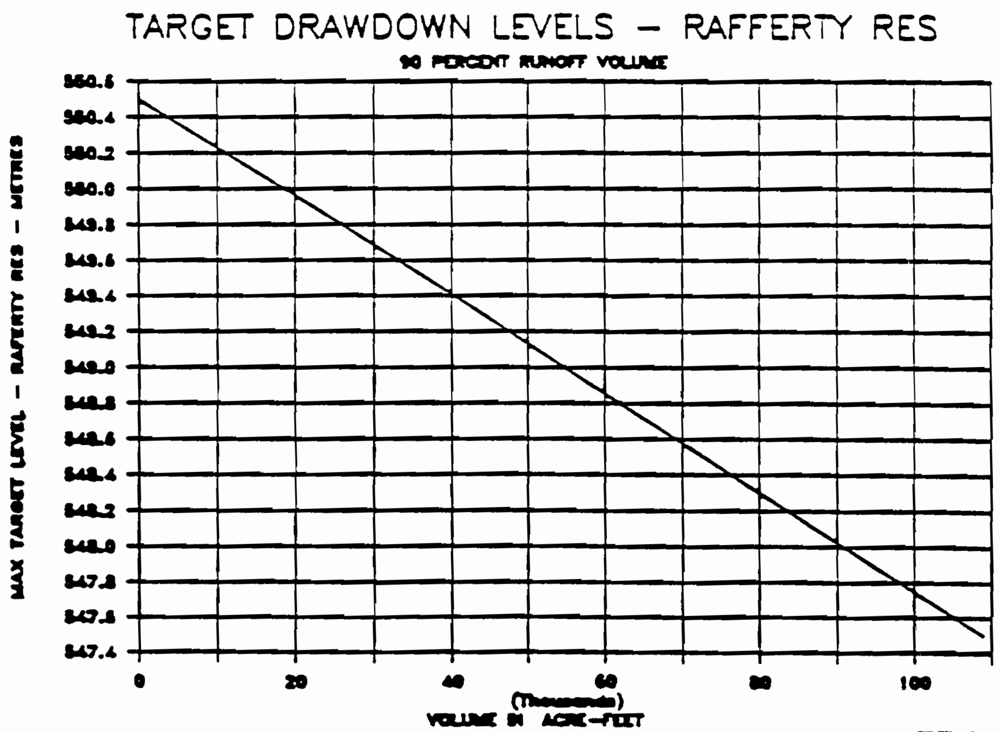
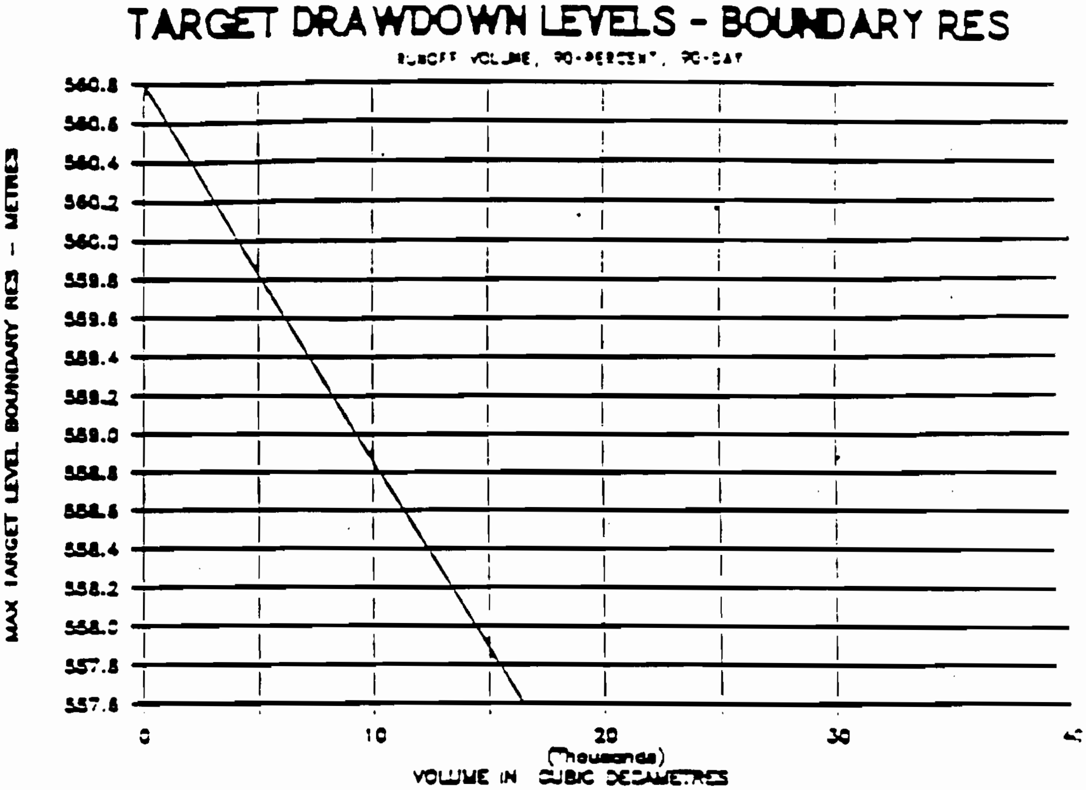

TARGET DRAWDOWN LEVELS – RAFFERTY RES
90 PERCENT RUNOFF VOLUME
MAX TARGET LEVEL – RAFFERTY RES – METRES
550.6
550.4
550.2
550.0
549.8
549.6
549.4
549.2
549.0
548.8
548.6
548.4
548.2
548.0
547.8
547.6
547.4
0
20
40
60
80
100
(Thousands)
VOLUME IN ACRE–FEET

PLATE A-1


TARGET DRAWDOWN LEVELS - BOUNDARY RES
MAX TARGET LEVEL BOUNDARY RES - METRES
560.8
560.6
560.4
560.2
560.0
559.8
559.6
559.4
559.2
559.0
558.8
558.6
558.4
558.2
558.0
557.8
557.6
0
10
20
30
(Thousands)
VOLUME IN CUBIC DECAMETRES

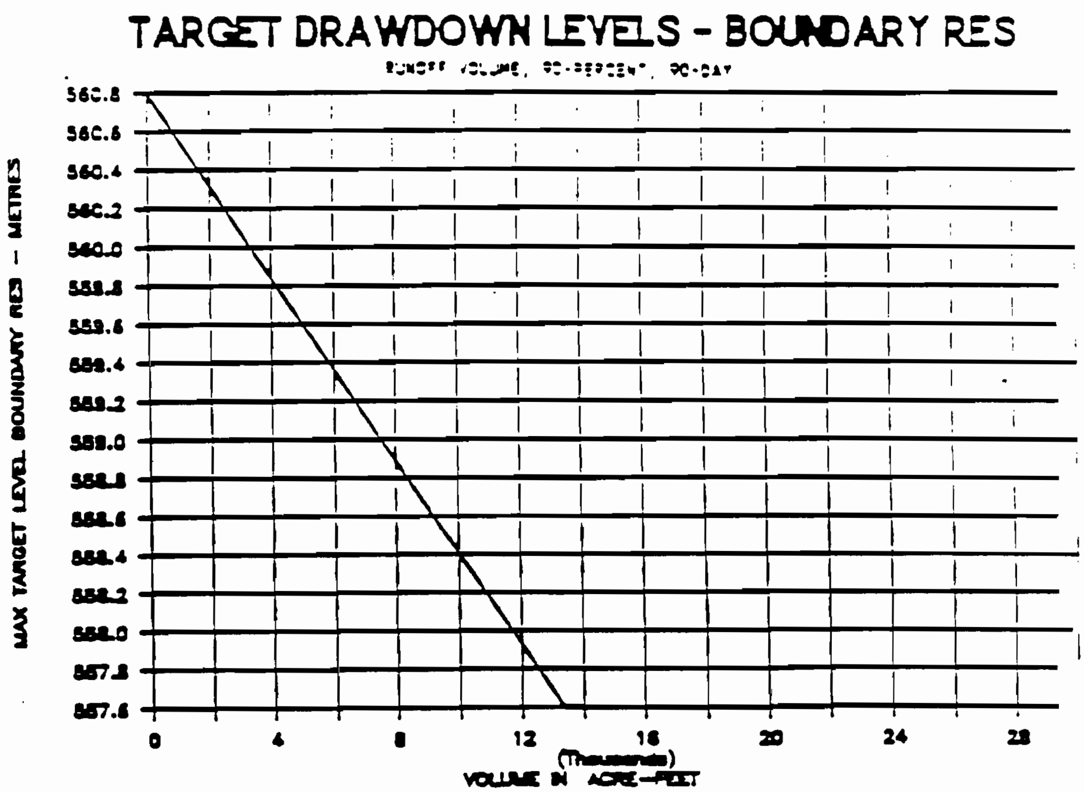
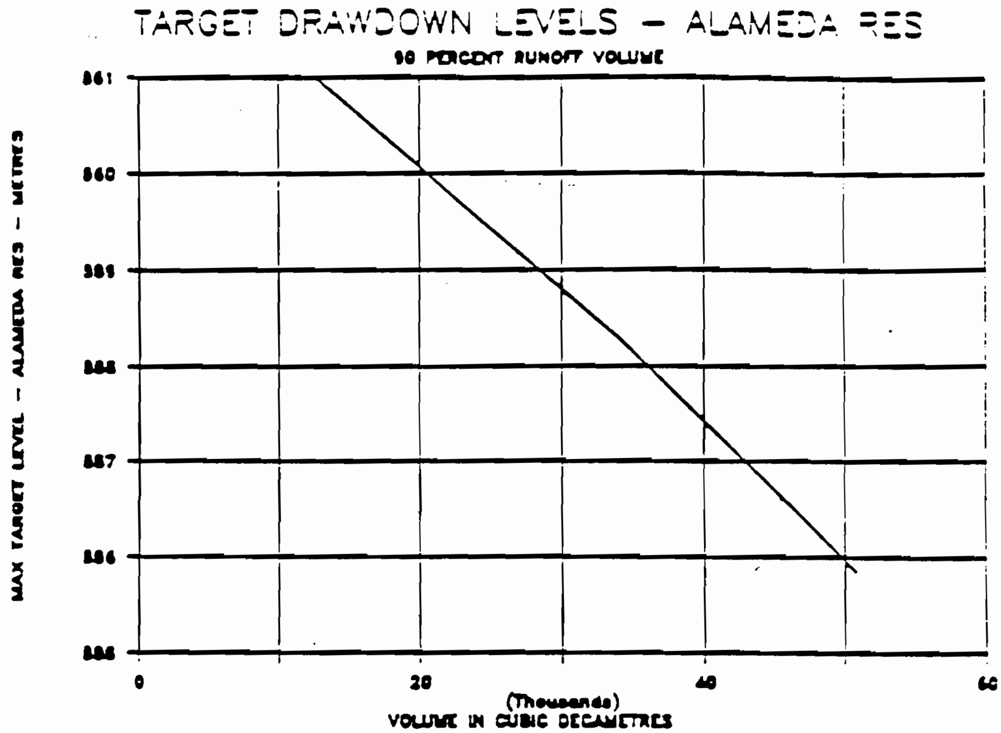
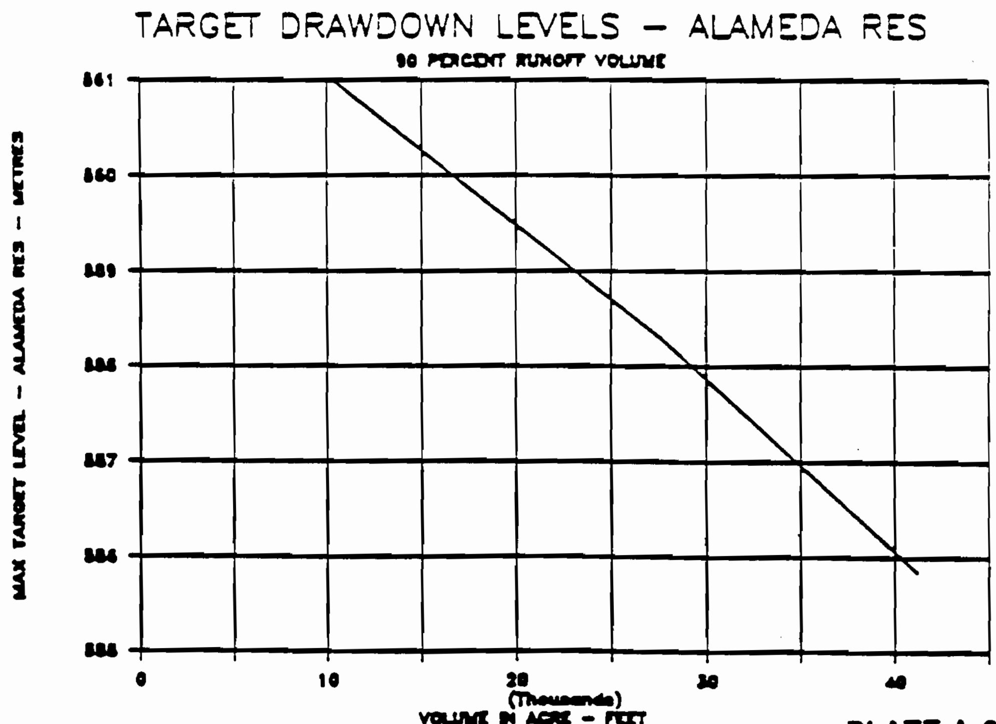

TARGET DRAWDOWN LEVELS - BOUNDARY RES
MAX TARGET LEVEL BOUNDARY RES - METRES
560.8
560.6
560.4
560.2
560.0
559.8
559.6
559.4
559.2
559.0
558.8
558.6
558.4
558.2
558.0
557.8
557.6
0
4
8
12
16
20
24
28
(Thousands)
VOLUME IN ACRE-FEET

PLATE A-2

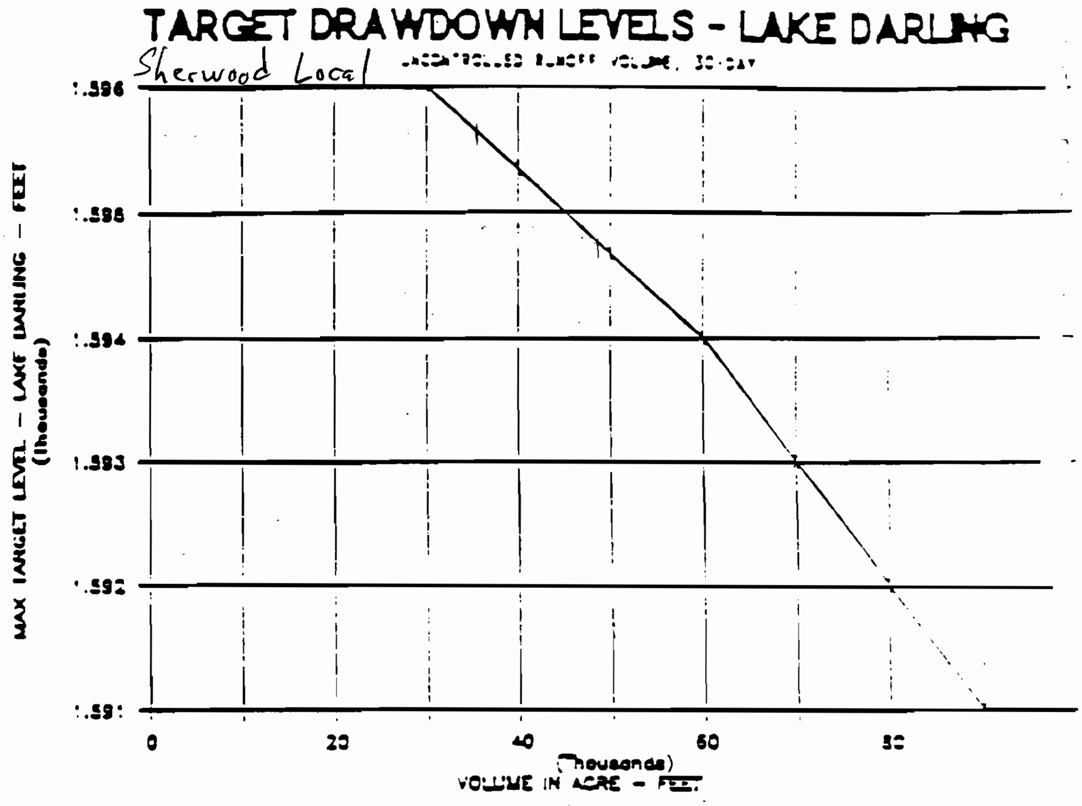


TARGET DRAWDOWN LEVELS — ALAMEDA RES
90 PERCENT RUNOFF VOLUME
MAX TARGET LEVEL — ALAMEDA RES — METRES
561
560
0
20
40
60
(Thousands)
VOLUME IN CUBIC DECAMETRES



TARGET DRAWDOWN LEVELS — ALAMEDA RES
90 PERCENT RUNOFF VOLUME
MAX TARGET LEVEL — ALAMEDA RES — METRES
561
560
0
10
20
30
40
(Thousands)
VOLUME IN ACRE — FEET

PLATE A-3


TARGET DRAWDOWN LEVELS - LAKE DARLING
Sherwood Local
MAX TARGET LEVEL - LAKE DARLING - FEET
(Thousands)
0
20
40
60
80
(Thousands)
VOLUME IN ACRE - FEET

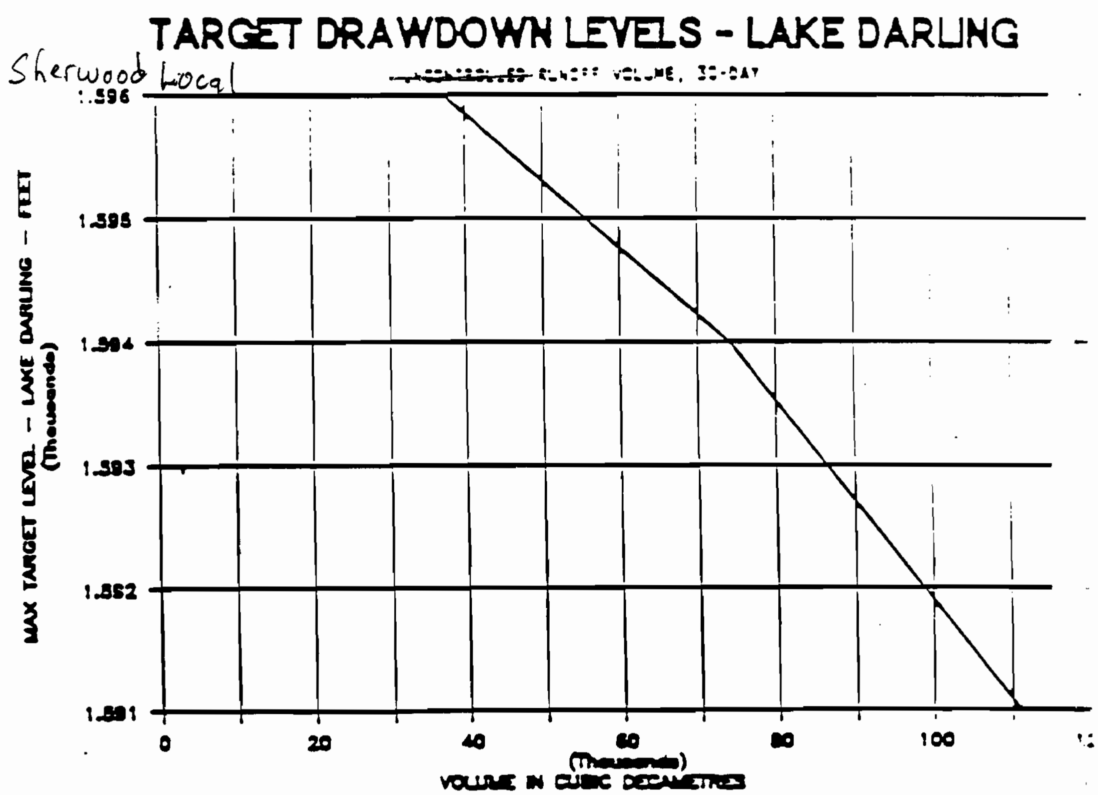
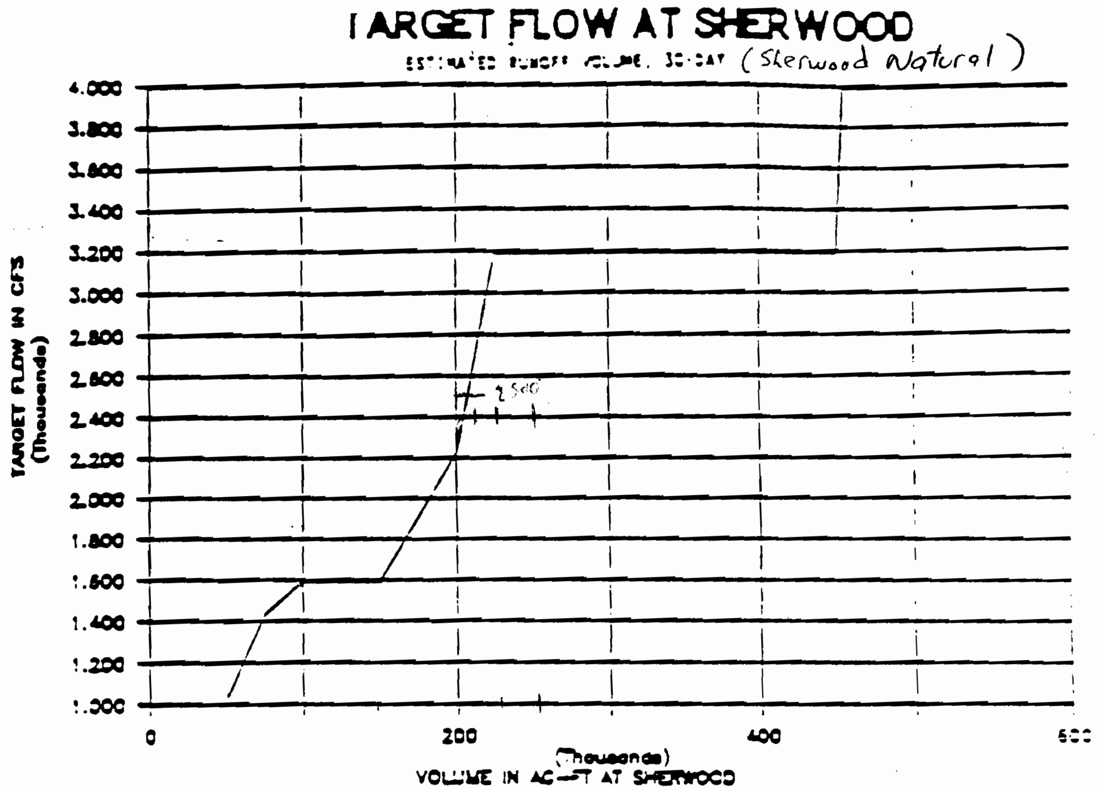

TARGET DRAWDOWN LEVELS - LAKE DARLING
Sherwood Local
MAX TARGET LEVEL - LAKE DARLING - FEET
(Thousands)
0
20
40
60
80
100
(Thousands)
VOLUME IN CUBIC DECAMETRES

PLATE A-4


TARGET FLOW AT SHERWOOD
ESTIMATED RUNOFF VOLUME, 30-DAY (Sherwood Natural)
TARGET FLOW IN CFS
(Thousands)
VOLUME IN AC-FT AT SHERWOOD
(Thousands)

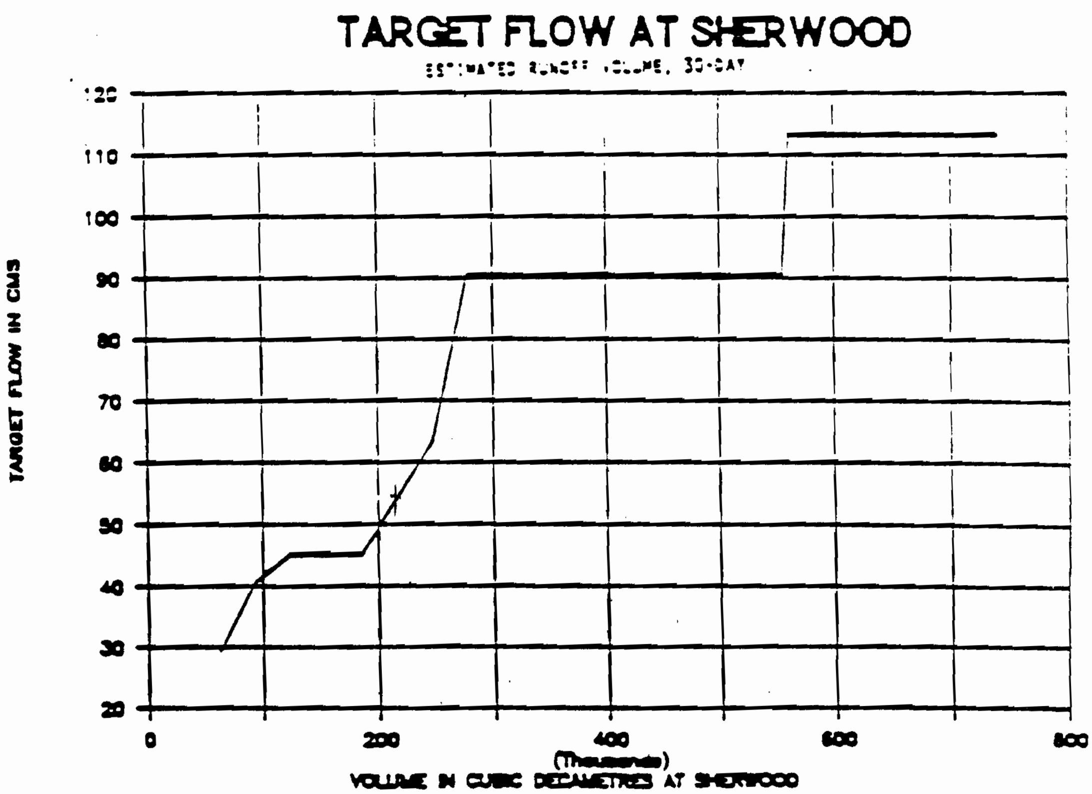
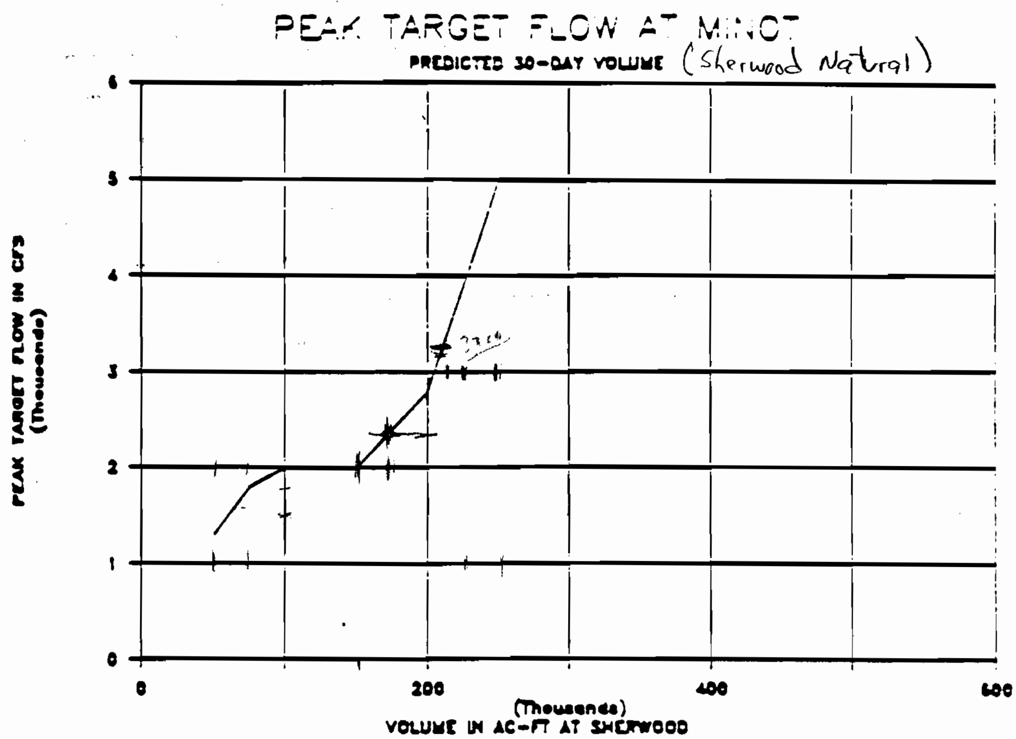
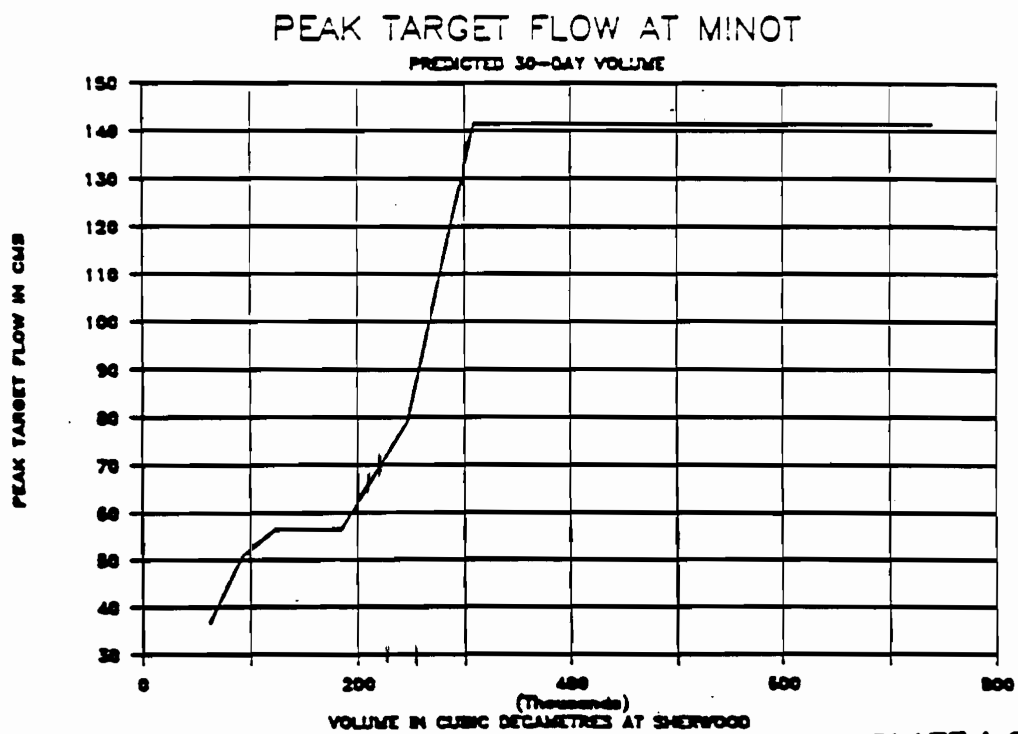

TARGET FLOW AT SHERWOOD
ESTIMATED RUNOFF VOLUME, 30-DAY
TARGET FLOW IN CMS
VOLUME IN CUBIC DECAMETRES AT SHERWOOD
(Thousands)

PLATE A-5



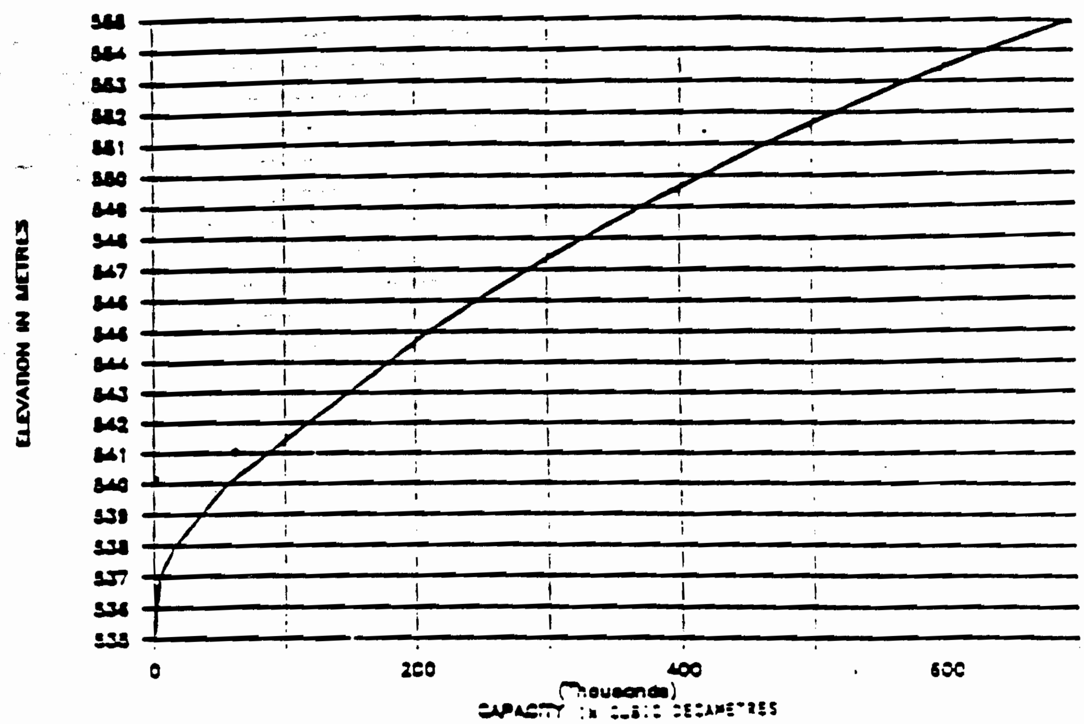
PEAK TARGET FLOW AT MINOT
PREDICTED 30-DAY VOLUME (Sherwood Natural)
PEAK TARGET FLOW IN CFS (Thousands)
0
1
2
3
4
5
6
0
200
400
600
(Thousands)
VOLUME IN AC-FT AT SHERWOOD



PEAK TARGET FLOW AT MINOT
PREDICTED 30-DAY VOLUME
PEAK TARGET FLOW IN CMS
30
40
50
60
70
80
90
100
110
120
130
140
150
0
200
400
600
800
(Thousands)
VOLUME IN CUBIC DECAMETRES AT SHERWOOD

PLATE A-6

RAFFERTY ELEVATION–CAPACITY



RAFFERTY ELEVATION–AREA

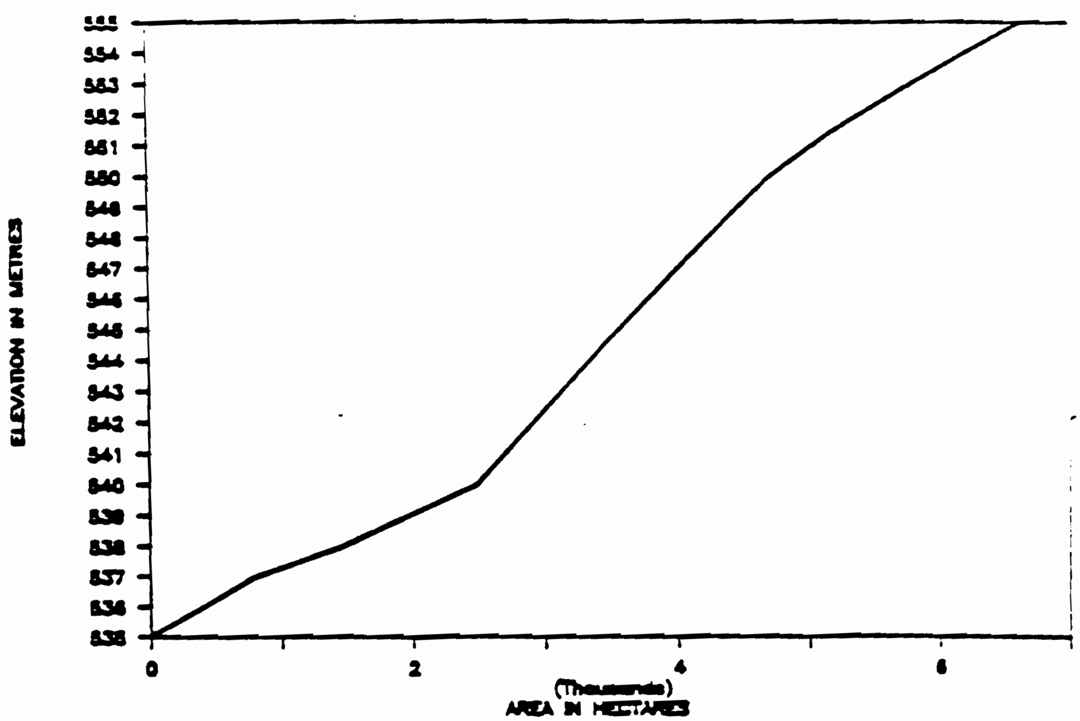
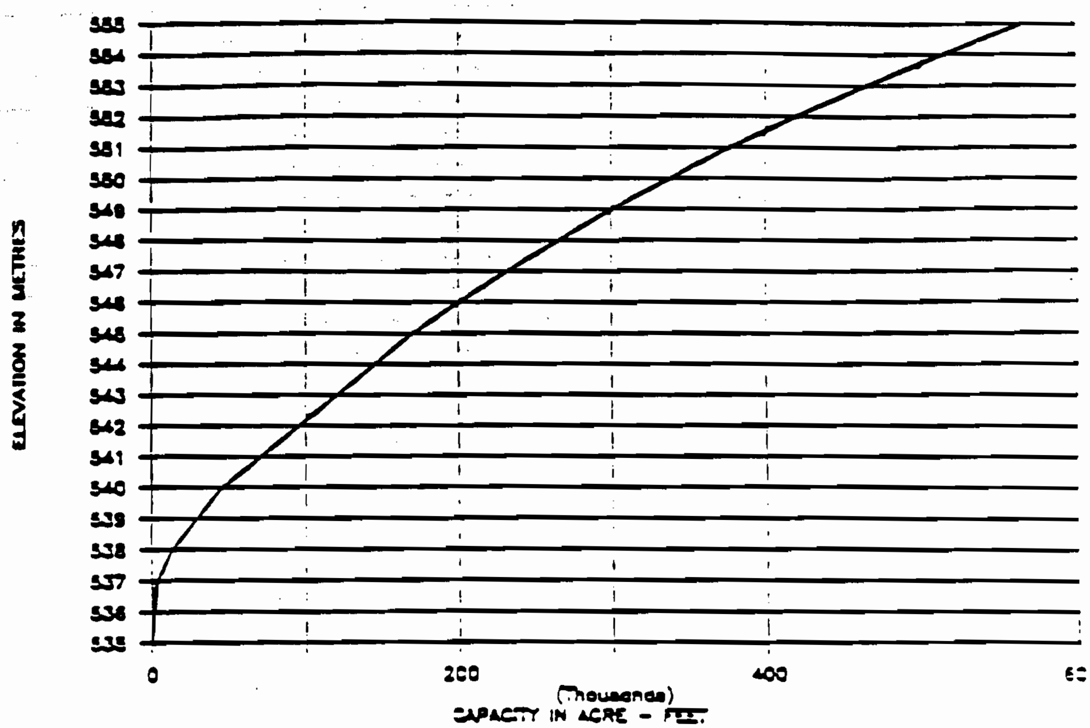


PLATE A-71

RAFFERTY ELEVATION-CAPACITY



RAFFERTY ELEVATION-AREA

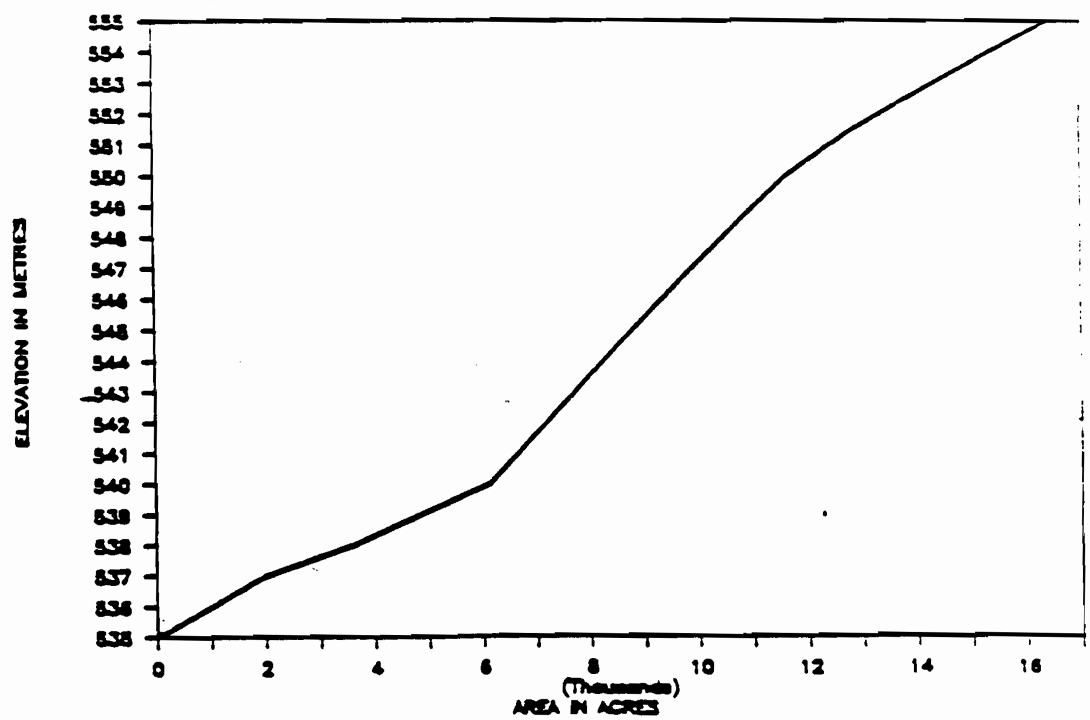
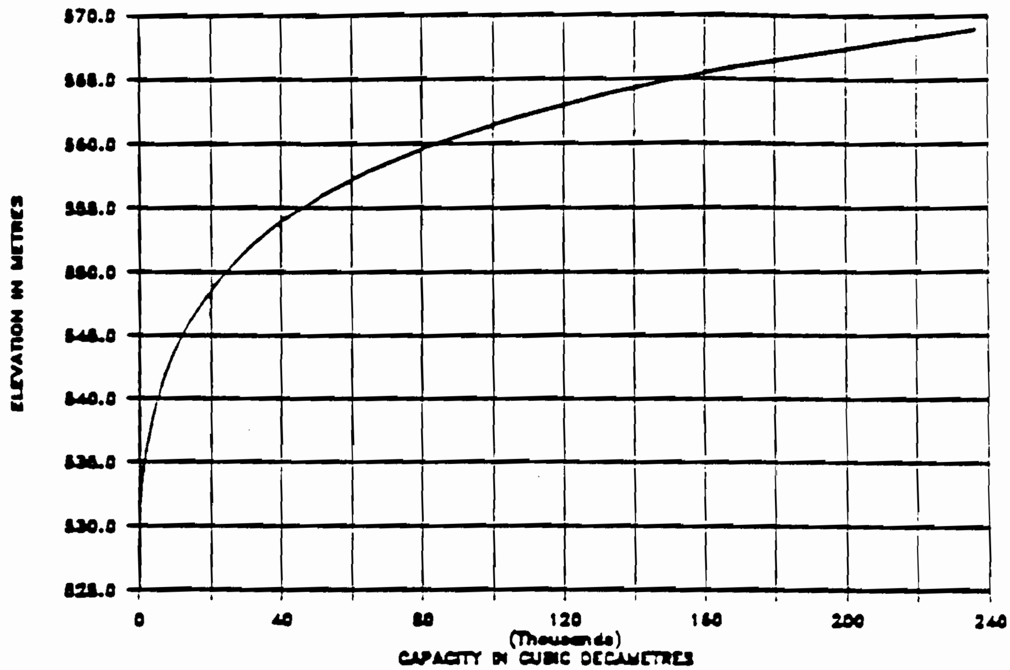


PLATE A-7

ALAMEDA ELEVATION—CAPACITY



ALAMEDA ELEVATION—AREA

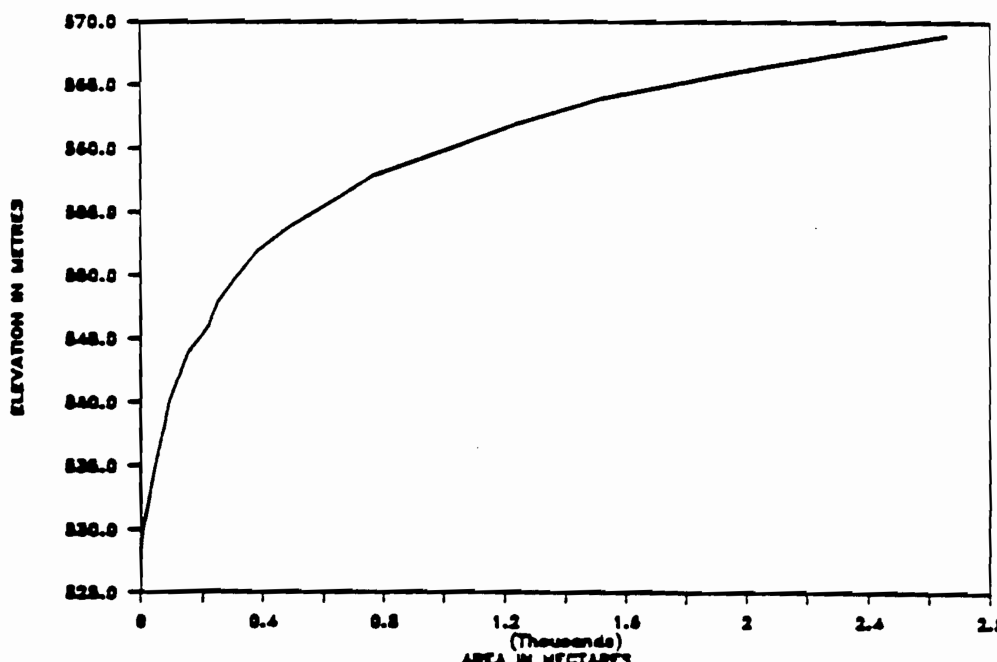
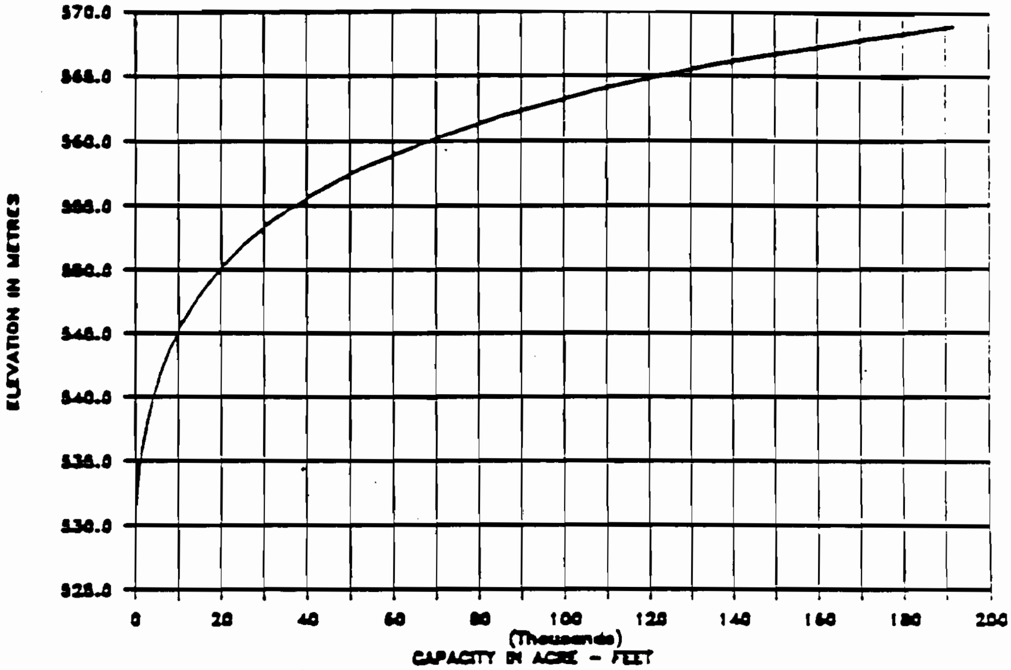


PLATE A-8A

ALAMEDA ELEVATION—CAPACITY



ALAMEDA ELEVATION—AREA

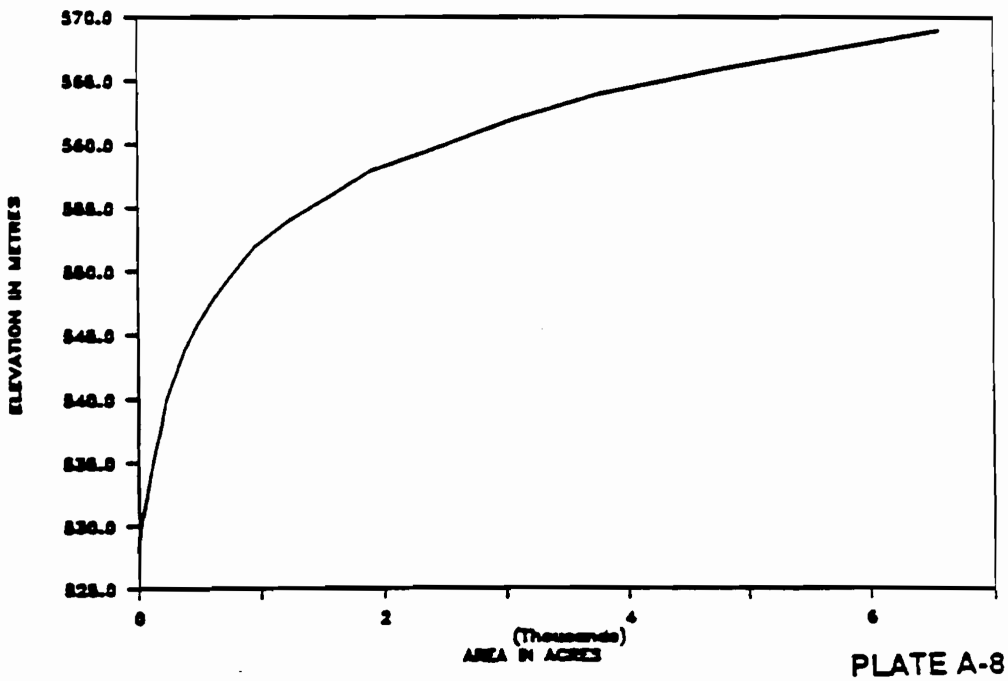
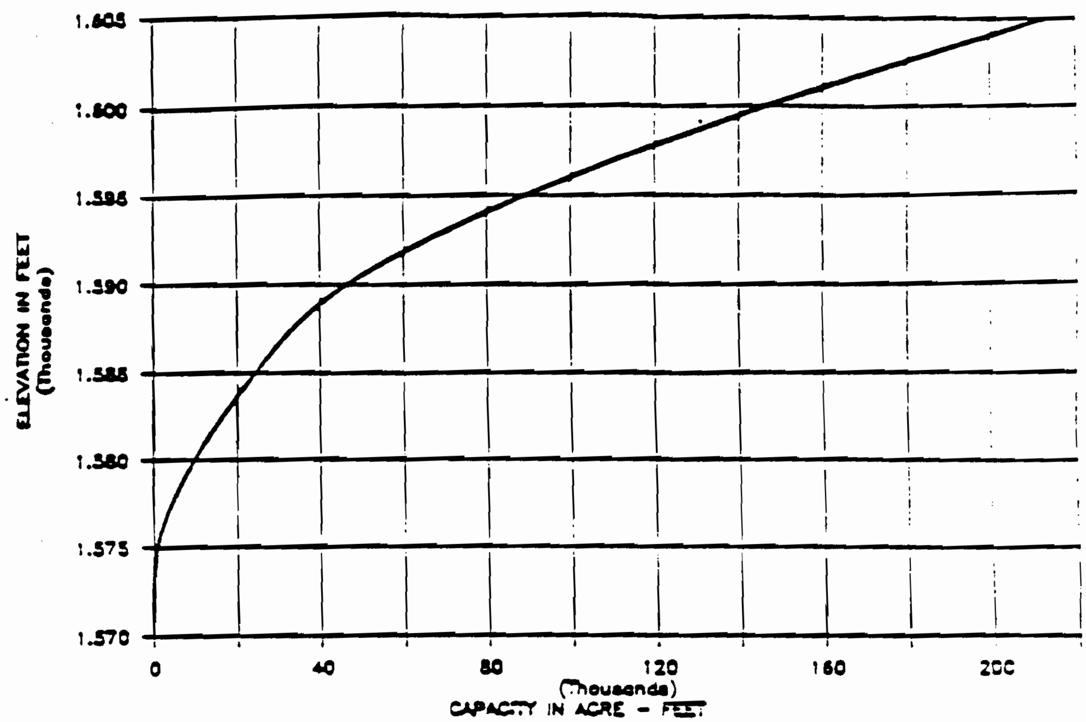


PLATE A-8B

LAKE DARLING ELEVATION-CAPACITY



LAKE DARLING ELEVATION-AREA

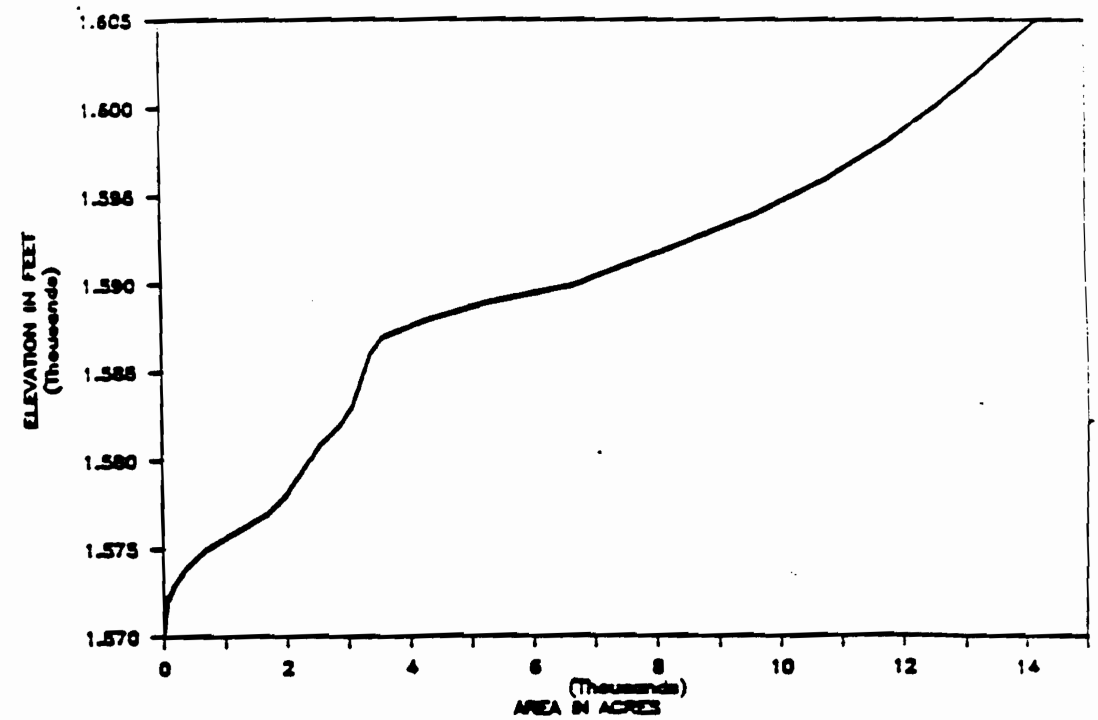
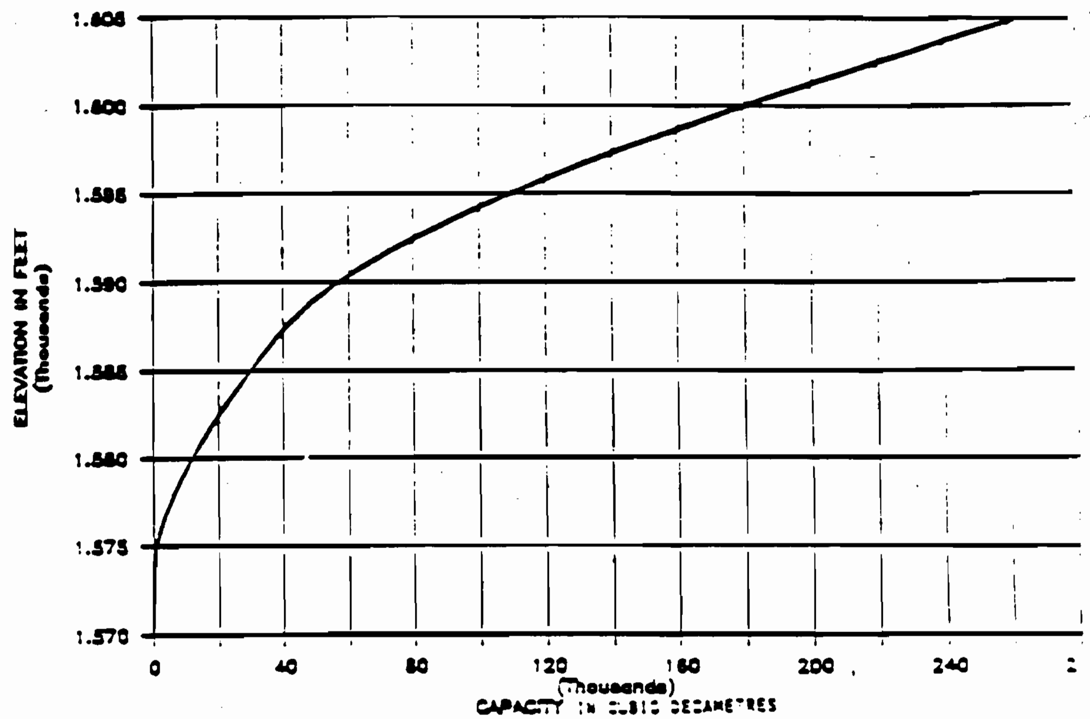


PLATE A-9

LAKE DARLING ELEVATION–CAPACITY



LAKE DARLING ELEVATION–AREA

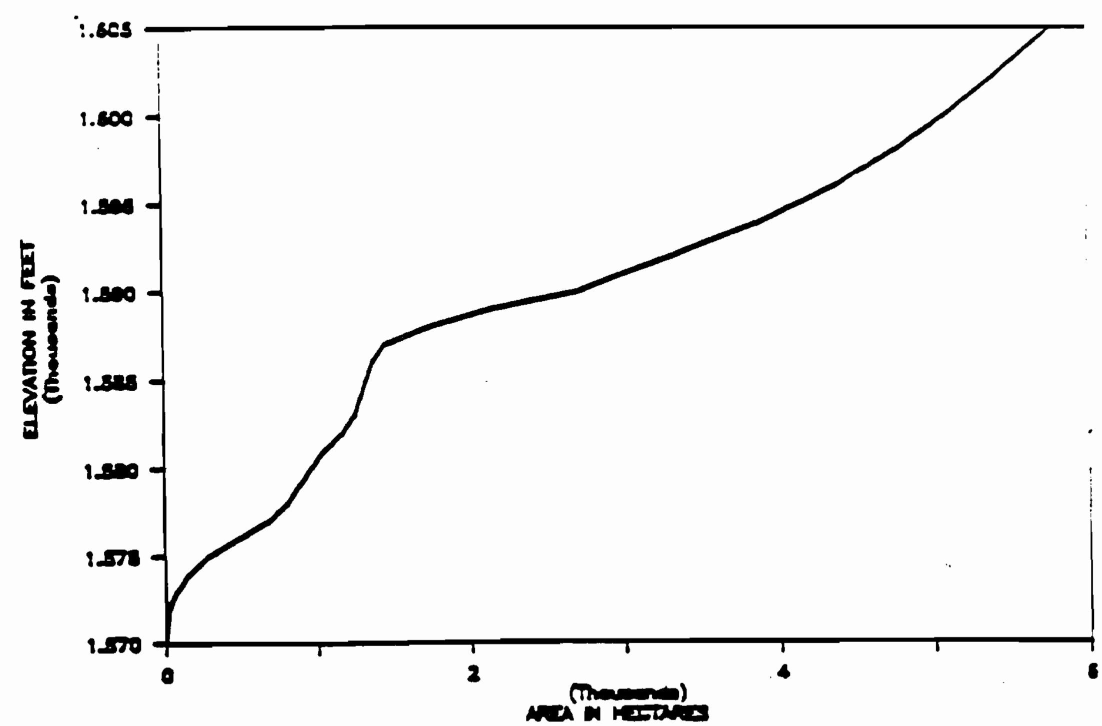


PLATE A-9

ANNEX B

1. The Province of Saskatchewan shall have the right to divert, store, and use waters which originate in the Saskatchewan portion of the Souris River Basin, provided that such diversion, storage, and use shall not diminish the annual flow of the river at the Sherwood Crossing more than 50 percent of that which would have occurred in a state of nature, as calculated by the Board. For the benefit of riparian users of water between the Sherwood Crossing and the upstream end of Lake Darling, the Province of Saskatchewan shall, so far as is practicable, regulate its diversions, storage, and uses in such a manner that the flow in the Souris River channel at the Sherwood Crossing shall not be less than 0.113 cubic meters per second (4 cubic feet per second) when that much flow would have occurred under the conditions of water use development prevailing in the Saskatchewan portion of the Souris River Basin prior to construction of the Boundary Dam, Rafferty Dam and Alameda Dam.

   (a) Under certain conditions, a portion of the North Dakota share will be in the form of evaporation from Rafferty and Alameda Reservoirs. During years when these conditions occur, the minimum amount of flow actually passed to North Dakota will be 40 percent of the natural flow at the Sherwood Crossing. This lesser amount is in recognition of Saskatchewan's operation of Rafferty Dam and Alameda Dam for flood control.

   The following rules determine the percentage of the natural flow at Sherwood Crossing which is to be passed to North Dakota:

   i. If the level of Lake Darling is below an elevation of 485.24 meters (1592.0 feet) on October 1 in any calendar year, Saskatchewan will pass 50 percent of the natural flow at Sherwood Crossing in that year and in succeeding years until the level of Lake Darling is above an elevation of 485.55 meters (1593.0 feet) on October 1.

   ii. If the natural flow at the Sherwood Crossing is equal to or less than 24,670 cubic decameters (20,000 acre-feet) prior to October 1 of that year, then Saskatchewan will pass 50 percent of the natural flow to North Dakota in that calendar year.

   iii. If the conditions specified in subparagraphs 1(a)(i) and 1(a)(ii) do not apply, then Saskatchewan will pass at least 40 percent of the natural flow at the Sherwood Crossing to North Dakota.

(b) Flow releases to the United States should occur (except in flood years) in the pattern which would have occurred in a state of nature. To the extent possible and in consideration of potential channel losses and operating efficiencies, releases from the Canadian dams will be scheduled to coincide with periods of beneficial use in North Dakota. Normally, the period of beneficial use in North Dakota coincides with the timing of the natural hydrograph, and that timing should be a guide to releases of the United States portion of the natural flow. The flow release to the United States may be delayed when the State of North Dakota determines and notifies Saskatchewan through the Board that the release would not be of benefit to the State at that time. The delayed release may be retained for use in Saskatchewan, notwithstanding the minimum release limits, unless it is called for by the State of North Dakota through the Board before October 1 of each year. The delayed release shall be measured at the point of release and the delivery at Sherwood Crossing shall not be less than the delayed release minus the conveyance losses that would have occurred under natural conditions between the point of release and the Sherwood Crossing. A determination of the annual apportionment balance shall be made by the Board on or about October 1, of each year. Any shortfall that exists as of that date shall be delivered by Saskatchewan prior to December 31, if North Dakota requests the delivery.

APPENDIX B – DECEMBER 2000 AMENDMENTS TO ANNEX A AND ANNEX B OF THE 1989 AGREEMENT

December 2000 Amendment to the Agreement Between Canada and the United States for the Water Supply and Flood Control of the Souris River Basin

Department of Foreign Affairs and International Trade CANADA

Note No JLAB-0199

Excellency:
I have the honour to refer to discussions between representatives of our two Governments regarding the Agreement between the Government of Canada and the Government of the United States of America for the Water Supply and Flood control in the Souris River Basin, signed in Washington on October 26, 1989 and which entered into force on the same date, and to propose, on behalf of the Government of Canada, that the Agreement be amended as follows:

1. The text of Section 4.2 of Annex A is deleted in its entirety and replaced by the following: All non-flood operations will be consistent with Annex B.
2. The text of Section 4.4.1 of Annex A is deleted in its entirety and replaced by the following: All non-flood operations will be consistent with Annex B.
3. Annex B referred to in Article VII of the Agreement is deleted and replaced by the attached amended Annex B.

If these proposals are acceptable to your Government, I have the further honour to propose that this Note, which is equally authentic in English and French, with its Annex, together with your reply to that effect, shall constitute an Agreement between our two Governments which shall enter into force on the date of Your Excellency's Note in reply.

Minister of Foreign Affairs
Ottawa,
December 20, 2000

ANNEX B

The Province of Saskatchewan shall have the right to divert, store, and use waters which originate in the Saskatchewan portion of the Souris River basin, provided that such diversion, storage, and use shall not diminish the annual flow of the river at the Sherwood Crossing more than 50 percent of that which would have occurred in a state of nature, as calculated by the International Souris River Board of Control (the Board). For the purpose of these calculations, any reference to "annual" and "year" is intended to mean the period January 1 through December 31. For the benefit of riparian users of water between the Sherwood Crossing and the upstream end of Lake Darling, the Province of Saskatchewan shall, so far as is practicable, regulate its diversion, storage, and uses in such a manner that the flow in the Souris River channel at the Sherwood Crossing shall not be less than 0.113 cubic metres per second (4 cubic feet per second) when that much flow would have occurred under the conditions of water use development prevailing in the Saskatchewan portion of the Souris River basin prior to construction of the Boundary Dam, Rafferty Dam and Alameda Dam.

Under certain conditions, a portion of the North Dakota share will be in the form of evaporation from Rafferty and Alameda Reservoirs. During years when these conditions occur, the minimum amount of flow actually passed to North Dakota will be 40 percent of the annual natural flow volume at the Sherwood Crossing. This lesser amount is in recognition of Saskatchewan's operation of Rafferty Dam and Alameda Dam for flood control in North Dakota and of evaporation as a result of the project.

a. Saskatchewan will deliver a minimum of 50 percent of the annual natural flow volume at the Sherwood Crossing in every year except in those years when the conditions given in (i) or (ii) below apply. In those years, Saskatchewan will deliver a minimum of 40 percent of the annual natural flow volume at the Sherwood Crossing.
    i. The annual natural flow volume at Sherwood Crossing is greater than 50 000 cubic decametres (40 500 acre-feet) and the current year June 1 elevation of Lake Darling is greater than 486.095 metres (1594.8 feet); or
    ii. The annual natural flow volume at Sherwood Crossing is greater than 50 000 cubic decametres (40 500 acre-feet) and the current year June 1 elevation of Lake Darling is greater than 485.79 metres (1593.8 feet), and since the last occurrence of a Lake Darling June 1 elevation of greater than 486.095 metres (1594.8 feet) the elevation of Lake Darling has not been less than 485.79 metres (1593.8 feet) on June 1.
b. Notwithstanding the annual division of flows that is described in (a), in each year Saskatchewan will, so far as is practicable as determined by the Board, deliver to North Dakota prior to June 1, 50 percent of the first 50 000 cubic decametres (40 500 acre-feet) of natural flow which occurs during the period January 1 to May 31. The intent of this division of flow is to ensure that North Dakota receives 50 percent of the rate and volume of flow that would have occurred in a state of nature to try to meet existing senior water rights.
c. Lake Darling Reservoir and the Canadian reservoirs will be operated (insofar as is compatible with the Projects' purposes and consistent with past practices) to ensure that the pool elevations, which determine conditions for sharing evaporation losses, are not artificially altered. The triggering elevation of 485.79 metres (1593.8 feet) for Lake Darling Reservoir is based on existing water uses in North Dakota, including refuges operated by the U.S. Fish and Wildlife Service. Each year, operating plans for the refuges on the Souris River will be presented to the Board. Barring unforeseen circumstances, operations will follow said plans during each given year. Lake Darling Reservoir will not be drawn down for the sole purpose of reaching the elevation of 485.79 metres (1593.8 feet) on June 1.

Releases will not be made by Saskatchewan Water Corporation from the Canadian reservoirs for the sole purpose of raising the elevation of Lake Darling Reservoir above 486.095 metres (1594.8 feet) on June 1.

d. Flow releases to the United States should occur (except in flood years) in the pattern which would have occurred in a state of nature. To the extent possible and in consideration of potential channel losses and operating efficiencies, releases from the Canadian dams will be scheduled to coincide with periods of beneficial use in North Dakota. Normally, the period of beneficial use in North Dakota coincides with the timing of the natural hydrograph, and that timing should be a guide to releases of the United States portion of the natural flow.
e. A determination of the annual apportionment balance shall be made by the Board on or about October 1, of each year. Any shortfall that exists as of that date shall be delivered by Saskatchewan prior to December 31.
f. The flow release to the United States may be delayed when the State of North Dakota determines and notifies Saskatchewan through the Board that the release would not be of benefit to the State at that time. The delayed release may be retained for use in Saskatchewan, notwithstanding the 0.113 cubic metres per second (4 cubic feet per second) minimum flow limit, unless it is called for by the State of North Dakota through the Board before October 1 of each year. The delayed release shall be measured at the point of release and the delivery at Sherwood Crossing shall not be less than the delayed release minus the conveyance losses that would have occurred under natural conditions between the point of release and the Sherwood Crossing. Prior to these releases being made, consultations shall occur between the Saskatchewan Water Corporation, the U.S. Fish and Wildlife Service, and the State of North Dakota. All releases will be within the specified target flows at the control points.

EMBASSY OF THE UNITED STATES OF AMERICA
Ottawa, December 22, 2000

No. 915

Excellency:

I have the honor to acknowledge receipt of note No. JLAB-0199 from the Department of Foreign Affairs and International Trade, dated December 20, 2000, which states in its entirety as follows:

"Excellency,

I have the honour to refer to discussions between representatives of our two Governments regarding the Agreement between the Government of Canada and the Government of the United States of America for the Water Supply and Flood Control in the Souris River Basin, signed in Washington October 26, 1989 and which entered into force on the same date, and to propose, on behalf of the Government, that the Agreement be amended as follows:

1. The text of Section 4.2 of Annex A is deleted in its entirety and replaced by the following:
   All non-flood operations will be consistent with Annex B.
2. The text of Section 4.4.1 of Annex A is deleted in its entirety and replaced by the following:
   All non-flood operations will be consistent with Annex B.
3. Annex B referred to in Article VII of the Agreement is deleted and replaced by the Attached amended Annex B.

If these proposals are acceptable to your Government, I have the further honour to propose that this Note, which is equally authentic in English and French, with its Annex, together with your reply to that effect, shall constitute an Agreement between our two Governments which shall enter into force on the date of your Excellency's Note in reply."

I have the further honor to accept, on behalf of the Government of the United States of America, this proposal of the Government of Canada.

Accordingly, the Department of Foreign Affairs and International Trade's note No. JLAB-0199 along with this note shall constitute an agreement between our governments on this matter, which shall enter into force on December 22, 2000.

Accept, Excellency, the renewed assurances of my highest consideration.

His Excellency
John Manley,
Minister of Foreign Affairs,
Ottawa.

APPENDIX C – 2012 SOURIS RIVER BASIN TASK FORCE TERMS OF REFERENCE

Terms of Reference

International Souris River Board 2012 Souris River Basin Task Force
For the
Review of the Operating Plan Contained in Annex A of the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin
And to
Facilitate Collaboration amongst the various Federal, State, Provincial, and Local Agencies and Consultations with the Public and Local Government
March 28, 2012

Introduction

The 2011 flood in the Souris River basin has proven to be the largest flood of record in the last century and far surpasses any previous recorded floods. As a result, significant flooding was experienced throughout the basin, severely testing the water management systems and control structures in the basin. In addition to extensive flooding along the Souris River, significant flooding also occurred on the Assiniboine River, to which the Souris River is a tributary, entering just downstream of the City of Brandon.

The 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin governs the operation of the control structures during flood and non-flood events, as specified in Annex A of the Agreement. One outcome of the 2011 flood has been a call for a review of the 1989 Operating Plan.

The International Souris River Board (ISRB) has developed a stepped process to address the concerns raised by the 2011 flood event. The first step, which was to document the 2011 flood event, has been completed by the U.S. Army Corps of Engineers in its 2011 Post-Flood Report for the Souris River Basin. This report was submitted to the ISRB at its February 22, 2012 meeting in Bismarck, North Dakota. The next step is to coordinate and conduct a review of the Operating Plan for flood control and water supply detailed in the 1989 Agreement. As specified by Article V of the 1989 Agreement, the Parties through their "designated entities" will jointly review the Operating Plan in an effort to maximize the provision of flood control and water supply benefits consistent with the terms of the Agreement.

The designated entities are:

- The Saskatchewan Water Security Agency (WSA) is the designated entity of Canada.
- The U.S. Army Corps of Engineers (USACE) is the designated entity for the United States during flood operations.
- The U.S. Fish and Wildlife Service (USFWS) is the designated entity for the United States during non-flood periods.

In addition to the designated entities, the North Dakota State Engineer is assigned responsibility under the Agreement for monitoring the Operating Plan and in 2007 the ISRB was given an oversight function by governments for flood operations in cooperation with the designated entities identified in the Agreement.

Given the unprecedented flooding and the number of initiatives being undertaken by various Federal, State, Provincial, and Local agencies, the ISRB has agreed to establish a 2012 Souris River Basin Task Force.

The Task Force will be led by the Saskatchewan Water Security Agency (WSA) and the U.S. Army Corps of Engineers (USACE) as the designated entities for flood control under the 1989 Agreement and will include representation from other Federal, State, Provincial, and Local agencies as appointed by the ISRB. The Task Force will also make provision for public and local government consultation.

The 2012 Souris River Basin Task Force will report to the Co-chairs of the International Souris River Board.

Objective

The objectives of the ISRB 2012 Souris River Basin Task Force are:

* to conduct a review of the Operating Plan contained in Annex A of the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin for presentation to governments,
* to evaluate the impacts that changes to the Operating Plan of Annex A will have to downstream interests, and
* to facilitate collaboration amongst the various Federal, State, Provincial, and Local Agencies undertaking actions as the result of the 2011 flood and to provide for public and local government consultation.

Tasks

The proposed tasks are:

1. Develop a plan of study (POS) and scope of work (SOW) for studies and activities to be conducted to accomplish Task Force objectives, identifying the need for supporting consultants as well as outlining stakeholder engagement in Canada and the United States. The POS and SOW are to:
   a. Articulate all studies and activities to be performed and level of detail anticipated for each study;
   b. Recommend the agencies or organizations capable of conducting aspects of each study or activity, recognizing the need for involvement by a bi-national team
   c. Identify sources of, or means of obtaining, needed information
   d. Establish the priority, duration and timing of each study or activity, considering the inclusion of phases to assist in the organizational management of the overall review; and
   e. Estimate the human and financial resources, including expertise, required to conduct each individual study or activity and a summary for the entire review.

2. Conduct a review of post flood reports, watershed plans, proposed and existing flood mitigation efforts, and identify gaps with respect to non-flood and flood issues.
3. Gather information on initiatives being undertaken or proposed by various Federal, State, Provincial, and Local agencies and identify potential gaps or constraints with the intent of supplementing the work of the Task Force and avoiding duplication of effort.
4. Establish an analysis and modelling team to accomplish needed hydrology and hydraulic analysis as identified by the Task Force POS and SOW.
5. Evaluate the impact that changes to the Operating Plan Contained in Annex A will have to downstream interests.
6. Prepare progress reports, an interim draft report, and a final report summarizing flood and non-flood issues and current and proposed water management initiatives within the Souris River basin, identifying possible improvements for non-flood and flood management in the basin as well as possible changes to the Operating Plan as presented in Annex A of the 1989 Agreement.

APPENDIX D – LISTING OF HYDROLOGIC AND HYDRAULIC MODELLING PROJECTS BY OTHERS TO ADDREESS ISSUES RAISED BY THE 2011 SOURIS RIVER FLOOD

		River	Reach	Barr - NDSWC / SRJB	Houston - NDSWC / FEMA	USACE	Saskatchewan Watershed Authority	NWS	Data	Potential Overlap
HEC-RAS Modeling	Steady	Souris	Burlington to Velva (complete)	X					Ward County LiDAR, HEC2 Bath.	Two HEC-RAS models for the Mouse River through Ward County (Barr & Houston); Two HEC-RAS models for the Des Lacs River from Burlington to Foxholm; Steady and Unsteady Models; Some Bathymetric and Bridge Data is Available via Houston; Unsteady RAS Modeling in
		Souris	Burlington to Sawyer		X					
		Souris	Mouse River Park (Complete)	X					HEC2 X-Sec	
		Souris	HEC2 - Sherwood to Westhope			X			2-foot Topo, Salyer-Quads	
		Souris	Souris River through Estevan, adaptation of HEC-2				X			
		Puppy Dog Coulee			X					
		Livingston Coulee			X					
		First Larson			X					
		Second larson			X					
		Gasman			X					
		Des Lacs	Burlington to Des Lacs National Wildlife Refuge (Proposed Completion Date)		X					
	Unsteady	Souris	Rafferty to Sherwood			X			Provincial 20-m DEM	
		Souris	Border to Border	X						
		Des Lacs	Foxhom to Burlingtron	X						
		Wintering	USGS Gage to Souris Confluence	X						
		Willow Creek	USGS Gage to Souris Confluence	X						
		Deep	USGS Gage to Souris Confluence	X						
HEC-ResSim Modeling		Souis	Operation of Boundary, Rafferty, Alameda & Darling for FEMA hydrology		X					Two HEC-ResSim models for the operation of Boundary, Rafferty and Alameda reservoirs
		Souis	Operation of Boundary, Rafferty and Alameda for evauation of potential operational changes			X				
HEC5		Souis	Canadian Reserviors to Westhope			X				
		Souis	1999 Post Flood Report			X				
		Souis	Water Rights Study			X				
HEC-HMS Modeling		Souris	Ungaged Watersheds	X						
		Des Lacs				X				
MIKE-SHE			Entire Souris				X			
Sacramento Soil Moisture Accounting			Entire Souris					X		
AHPS								X		
Probable Maximum Flood (PMF) Analyses		Lake Darling (1980)				X				
		Canadian Reserviors					X			
HEC1		Puppy Dog Coulee			X					
		Livingston Coulee			X					
		First Larson			X					
		Second larson			X					
		Gasman			X					

APPENDIX E – COMPILATION OF REPORTS AND COMMENTS FROM THE PUBLIC CONSULTATION PROCESS

Dalrymple, Canadian Officials Review Souris River Spring Runoff Conditions

From: North Dakota Governor Jack Dalrymple

Governor Jack Dalrymple hosted a conference call which brought together officials from the state, Minot, Ward County and Saskatchewan, Canada to discuss the conditions for Souris River spring runoff.

"We coordinated this meeting because it's important that officials continue to share runoff information and that the lines of communication remain open as we approach spring," Dalrymple said. "At the same time, we must also continue to develop a basin-wide flood protection strategy."

Officials with the Saskatchewan Water Security Agency said they plan to provide officials in North Dakota with real-time rainfall data. Canadian officials said recent snowfall has led them to increase water releases from the Boundary and Rafferty dams to maintain adequate reservoir capacity during spring runoff. The U.S. Corps of Engineers is releasing 450 cubic feet of water per second from the Lake Darling Dam and Corps officials said they will make adjustments if conditions change.

Officials participating in the conference call included Saskatchewan Environment Minister Ken Cheveldayoff, Saskatchewan Water Security Agency President Wayne Dybvig, International Souris River Board member John Fahlman, North Dakota State Engineer Todd Sando, Minot Mayor Curt Zimbelman, Ward County Commission Chairman Jack Nybakken, Souris River Joint Board Chairman Dave Ashley, U.S. Army Corps of Engineers Col. Michael Price, Minot city council members and Ward County commission members.

Dalrymple also attended today a meeting held by the International Souris River Board which oversees the basin's international water issues. Dalrymple has called on the International Souris Board to pursue revisions to a 1989 Canada-U.S. water agreement which defines the objectives associated with international water supply and flood control practices within the Souris River Basin. Dalrymple said the agreement should be changed to reflect a basin-wide need for greater short-term and long-term flood protection. The International Souris River Board has developed a plan of study for submission to the International Joint Commission. The plan will guide a review of the operating plan for improved basin-wide flood protection.

From - Bismarck Government and Politics News

Hoeven Pushes Corps to Move Forward on Flood Protection Plan for Minot Region

Senator John Hoeven met with Col. Michael Price, Commander of the Army Corps of Engineers St. Paul District, to continue his push for flood protection in Minot.

Publish Date: 2013-03-15

BigNews.Biz - Mar 15,2013 –

Hoeven Pushes Corps to Move Forward on Flood Protection Plan for Minot Region

WASHINGTON – Senator John Hoeven met with Col. Michael Price, Commander of the Army Corps of Engineers St. Paul District, to continue his push for flood protection in Minot.

The senator said that includes revision of the International Agreement with Canada to improve flows through the city and the region. Col. Price said the Corps will hold a public meeting in Minot on March 20 to gather input from the public to present to the International Joint Commission on April 17.

Senator Hoeven said revising the International Agreement will be part of three-part strategy to help protect the city from future flooding. The plan also includes improving flood protection infrastructure in the city and expansion of storage, including in Lake Darling.

Col. Price has said the Corps' modeling indicated that a combination of the three elements could provide additional flood protection. By increasing capacity in dams and adjusting upstream flows, the Corps can help limit peak water levels through the basin during periods of heavy rainfall or heavy winter runoff and raising levees will provide further protection in key areas through the city and region.

Good afternoon, my name is Curt Zimbelman and I am Mayor of the City of Minot, North Dakota.

On behalf of the City of Minot, I thank you for taking on the monumental task of reviewing the operating plan of the Souris River Basin. As we are beginning the process of developing future flood protection for the City of Minot and the North Dakota portion of the basin, we urge the Commission to proceed as quickly as possible with the Full Scope Study, as this could have impact on our flood protection planning.

For years, we thought that previous flood control measures had given us a reasonable level of flood protection. Indeed, we believed that through management of the Souris River system, we would have very little risk of damage during major snow melt – runoff events. As we found out, spring snow runoff is not the only determining factor in water levels. The perfect mix of saturated soil, heavy snow through the winter, and much higher than average spring rainfall which continued through the month of June, led to a 2011 flood disaster of historic proportions. No one foresaw that event, and no one can predict with certainty when, if ever, it will happen again. Therefore, procedures need to be put in place that will better monitor and better respond to the kind of conditions that led to the 2011 flood.

We urge you to evaluate and produce a new operating plan that not only takes into consideration the spring snow melt and proper operating procedures during this time, but also takes into consideration abnormal rainfall during any time of the year and saturated conditions throughout the Souris River Basin.

In addition, we ask that you also study the potential effects to the operating plan, both positive and negative, of raising Lake Darling and other storage upstream of Minot.

Minot is currently actively working with the Souris River Joint Water Management Board in ND to develop and implement a flood protection plan that is estimated to cost over $800 million dollars for the North Dakota portion of the Basin. It will take many years to complete, but it is our intention that when it is done, it will provide protection to an event equal to 2011. In the meantime, we urge the Commission to not just implement the Full Scope Study, but to act on any changes to the operating plan possible that would more quickly improve protection against potential future flooding.

We understand that no man-made systems or management can absolutely guarantee that a flood disaster will not happen again, but we must do everything within our power to protect our citizens and their property from the kind of flood disaster we saw in 2011. In that vein, it is our request that the International Souris River Board look at every interim step possible to better manage water in the system in all conditions, even while you work at proceeding to implement what we recommend to be the full study scoping option. Clearly your efforts and this information will be very valuable for the entire Souris River Basin.

From: <kong234@srt.com>
Subject: Comments Souris River
Date: March 31, 2013 9:47:42 AM CDT
To: Bob White <bwhite@nd.gov>

Dear Mr. White

My name is Vern Kongslie and I live in McHenry County. I was born and raised on a ranch about 14 miles southwest of Towner ND along the Mouse River. I have ownership with my two brothers of my parents ranch. I have personal experience with the flooding since 1969. I was a county commissioner from 2006 through 2012 and dealt with four years of flooding of the roads in McHenry County.
I would like to comment on any proposed expansions of flood control of the Mouse River. Yes we need to protect the cities in the flood plain but not at the complete expense of the farmers and ranchers in the valley. Most of us in the Towner area are against raising the existing dams because if there is more storage provided how are you going to keep from flooding our hay land and farmland when the flood is over and you have to release water during the summer. We need the flows to be under 300 cfs by May 15 in the Towner Area. It is better for us to have flows as high as possible during the winter and spring months so the flows can be reduced by May. When I was commissioner I conveyed these comments to Tim Fay also with the ND State Water Commission and other public officials. There also needs to be a program to help relocate the homes in the floodplain funded by the state with any cost sharing by the homeowner and not McHenry County. McHenry County has limited revenues and cannot assist the flooded property owners. The state has plenty of money and needs to help these people relocate. Any homes built after 2011 in the floodplain should not be eligible because it makes no sense to build a house in the floodplain and then receive assistance after what we have all experienced in 2011. The only 100 percent protection against flooding is to build on a hill above the floodplain. Thank you for considering my comments.

Sincerely

Vern Kongslie
5577 2ND LN NE
Towner ND 58788

April 2, 2013

Bob White Secretary
ND State Water Comm.
Bismarck, ND

Dear Sir;

This is in response to the call for public comments on the operating plan for the Souris River.

I am 79 and have ranched here all my life except for about 8 years. Since my Grandfather, "Homesteader of this ranch" and his father moved their homes out of the flood plain as soon as the residence requirement was fullfilled in the late 1800's we are easy to please.

The Mouse river in the Towner and north area should be below 500 c.f.s. by the 15th of May and down to 100 cfs or lower by July 1st. If at all possible it should be in the neighborhood of 50 c.f.c. during Aug. and Sept. High flows in the spring are less important to us.

We would all be better off if no control structures were in the Mouse River Valley and everyone moved out of the 500 year flood plain.

In the late 1970's it would have cost 37 million to move everyone out of Minot" floodplain while the proposed Burlington Dam was estimated at 100 million including an underground pipe partial diversion of the DesLacs to behind the big Dam. The Politicians and city fathers of

(over)

Minot went for the Dam but Washington considered it a pork project and turned it down. If only they would have asked for moving everyone out of the floodplain our problems today would be minimal.

We lost all production from 330 Acres in 2011, 1/2 production in 2012. Didn't cover taxes. 240 Acres of this is under the Eaton Irrig. project and the balance is cropland and pasture, "timber pasture". We have given up on the cropland, farmed since the 1920's, diked in 1936-37 and seeded to grass in the late 1990's.

Illegal drainage in both canada and the U.S. is continuing and will only get worse, this together with Global weather change means we should not build in the flood plain.

Thanks for Listening

Sincerely Yours

Orlin R. Oium

Orlin R Oium
848 67th Dr NE
Towner, ND 58788-9501

APRIL-2-2013

TO THE SOURIS RIVER BOARD

TO HAVE FLOOD RELIEF UP STREAM YOU HAVE TO HAVE A GOOD OPENING DOWN STREAM.

FOR THE MCHENRY CO AREA FROM VELVA TO ABOUT HWY 14 NORTH OF UPHAM.

THE RIVER BED ELEV. FROM VELVA IS 1488 AT VELVA AT THE BANTRY GAUGE THE RIVER BED GAUGE IS 1430 = A 58 FOOT DROP

1488
1430
58

SO AT THE BANTRY GAUGE OR NELSON BRIDGE ROAD I BELIEVE A 1/4 MILE TEXAS CROSSING + PUT IN.

OR HANDLE ALL THE WATER THAT GOES THROUGH THE BRIDGE AND BOX CULVERTS ON HWY 14 BY TOWNER.

THEN ABOUT 3/4 MILE S.W. OF BANTRY GAUGE THERE IS A FARM YARD ROAD THEN WEST THE ROAD SHOULD BE RAISED AND MORE CULVERTS PUT IN.

THE BANTRY GAUGE ROAD OR NELSON BRIDGE ROAD IS ALL IN REFUGE FOR ABOUT 3/4 MILE.

THE ROAD IS ALSO IN AN UNORGANIZED TWP. SO THE COUNTY COMMISSIONERS HAVE CONTROL OVER THE ROAD.

FROM THE BANTRY GAUGE TO THE CANADA LINE THE RIVER BED IS ALL IN CLARK SALYER REFUGE.

ABOUT 3 MILE N.W. OF BANTRY GAUGE THE REFUGE HAS ABOUT 4-5 TEXAS CROSSINGS ON A ROAD

I HAVE SEEN THE POOL TO HOLD WATER ABOUT 5 MILE N.E. OF UPHAM IN THE LATE 1940s AND EARLY 1950s FULL BUT THE WATER ONLY BACK UP ABOUT TO THE WILLOW CREEK OUTLET AND ELEV. THERE IS ABOUT 1420

RECEIVED
APR 3 2013
STATE WATER COMMISSION

Marvin Block
BOX 201
Towner N. Dak. 58788

TEL-701-537-5413

TO:	**Bob White, ISRB Secretary**
FROM:	**Leland S. Goodman** **802 77th ST NE Willow City ND 58384** **701-366-4765**
DATE:	**April 3, 2013**
RE:	**Comments for Operating Plan of Souris River**

I am a lifetime resident and concerned citizen of the Souris River Basin. I am a homeowner, I am a landowner, I am a livestock producer, I am a recreation and wildlife enthusiast and I am a taxpayer – deserving of equal considerations to the well-being of my property and livelihood.

The past and current operating plan of the Souris River is not working in everyone's best interest. The monetary losses to the farmers and livestock producers upstream and downstream have not been a consideration in the entire flood and water management plan. The vast majority of North Dakota's economy is driven by agriculture and the livelihood of farmers and livestock producers should be given equal consideration along with the City of Minot and the recreational uses of the river as part of any short or long term plan.

Over the past 10+ years, water management issues and inadequate flood control of the Souris River has adversely affected production of over 40 thousand acres in northern McHenry County, ND alone. It is estimated that the economic impact on these lands and affiliated business resources far exceeds tens of millions of dollars. Impacts include land loss and use to overland flooding, forage yield losses, forage quality losses, infrastructure losses and more. Many of these losses can and have been quantified. I can provide direct accounting for my business losses alone that exceed $2 million. I've provided some examples below.

- Land Use Losses
  - Land's that are covered with standing flood waters for extended periods of time cannot be used for pasture, hay crops or farming. Additional acreage must be rented to make up for the loss of use – while still being required to make land payments on unusable lands. However, with excessive flooding, little acreage is available for rent and demand is higher forcing up rental rates and requiring travel to greater distances to put up crops.
    - IMPACT: Additional Pasture Rent Needed Due to Lost Acreage – 1000 acres X $20/acre = $20,000 x 2 years = $40,000
    - IMPACT: Additional Hayland Rent Needed Due to Lost Acreage – 1000 acres x $40/acre = $40,000 x 2 years = $80,000
- Forage Quality and Quantity Declines
  - Land's that are covered with standing flood waters for extended periods of time find the loss of native grasses and vegetation. Late season drainage results in the growth of low quality invader species including quack grass, foxtail barley, and annual/perennial weed species (predominately red goosefoot- *Chenopodium rubrum*L.)
    - EXAMPLE: Average production on my hayland near the Souris River
      - Prior to 1999 Flooding – Produced 2800 bales/year

        - 1999 – Produced no hay crop due to flooding
        - 2000 – Produced 480 bales
        - 2001 – 2010 – Produced 1600 bales/year
            - Required reseeding and weed management at additional costs of $150-$250/acre
            - Two of these years did not produce hay crops due to untimely water releases and infrastructure work.
        - 2011 – Flood Year – No Production
        - 2012 – 782 bales
            - Reseeding and weed management. Some areas, so heavily impacted by moss and mold would not allow seed germination and revegetation
                - Estimated Cost of Reseeding: $150-250/acre
        - 10 Year IMPACT: 21,938 bales lost x $60/bale = $1,316,280
    - EXAMPLE: Old Growth Forest Losses
        - 2011 flooding – caused by mismanagement of snow pack information, water holding and untimely rains led to extreme flooding and long term standing water with high forest and vegetation losses
            - Thousands of old growth ash and oak trees killed
            - Forestry Service Estimate to Replant - $450,000
            - Impact – habitat, erosion, loss of natural resources 100+ years in the making
    - EXAMPLE: Basic Infrastructure Losses
        - Pasture Fencing - $43,000/year x 2 years = $86,000
            - Has been replaced twice (1999, 2012)

My story is not unique or extreme. It is echoed by dozens of farmers and livestock producers in and around the Souris River and the Souris River Basin and it must be addressed at a multitude of levels.

First drainage plans need to be improved along the entire river channel. The structures are already in place to hold the water but we do not believe that enough time has been spent on making sure that the channels are clear and able to handle the flows downstream. Channels that existed in J. Clark Salyer Refuge in 1950 and 1960 are now filled with sedimentation, cattails, trees, and beaver dams. The floods of 1969 and 1976 have added to the problem, causing additional channel blockages. These channel blockages prevent water from moving through the basin and instead allow water pooling and overland flooding north of the Eaton Project.

Secondly, timing is an issue. Water releases have not been adequately timed and anticipated flows have been underestimated resulting in high volume releases that cause for significant overland flooding and prolonged standing water in agricultural lands preventing use. In turn, this prolonged standing water creates additional flow impairment by allowing for the growth of invasive species including cattails and willows that also hold water and sedimentation making parts of the agricultural lands difficult to reclaim even after the lands are drained.

Thirdly, research and recovery needs to be part of a long term plan to help restore native lands, habitat and agricultural grounds. Homes, businesses and infrastructures are rebuilt in cities and should be rebuilt in rural and agricultural areas as well. I have discussed the flooding and vegetation issues with

North Dakota State University's Range and Soil Agricultural Experiment Station and Extension personal. They feel there is a need to address the recovery of these flooded lands with research that will identify best management practices to reclaim native habitat and agricultural lands.

The need to address the opening of the blocked drains and channels within the J. Clark Salyer Refuge to move the water through the entire system is paramount to the survival of habitat and agricultural production on private lands near the Souris River and the diverse ecosystem of meadow grasses and trees within the J. Clark Salyer Refuge. It will be critical to manage flows that allow for early drain on meadows, pasture and farmland to allow for the maintenance and protection of natural resources and habitat, as well as agricultural use.

I have worked tirelessly on this issue for the past several years to not only understand the issues, but also to help find solutions. I am enclosing copies of letters that were sent to our local Souris River Planning Board. As you can see by these letters I have been asking questions about the planning process and asked them to respond to my questions about protecting my interests and other farmers and livestock producers. I have not had my concerns addressed even once. I have also attended meetings to address my concerns and have continued to hear silence on this issue.

As this board looks into an operating plan for the Souris River, I urge you to consider that the monetary losses are just as great upstream and downstream as they are in the cities. Quite honestly they are greater, with longer lasting impact.

I look forward to your feedback and hope we can work together for the best interests of the entire Souris River Basin.

TO: Souris River Planning Board – David Ashley
4893 7th Ave N; Voltaire, ND 58792

FR: Leland Goodman; McHenry County Landowner
802 77th St NE; Willow City, ND 58384

DA: June 12, 2012

RE: Impact Studies, Flood Protection & Remediation for Flood Impacted Regions of McHenry County

I'm writing to glean insight and answers regarding the gathering of information and the development of flood protection and remediation plans concerning short term and long term impacts of overland flooding in McHenry County and other surrounding agricultural areas.

It has come to my attention that the current decision making process is based on the use of environmental, economic and hydrological impact studies of the Mouse River Basin that were developed by the Corp of Engineers in 1986. However, I am concerned that the results of those studies are flawed based on the use of outdated maps from the 1950's. These older maps do not account for major flooding events that occurred in the 60's and 70's that would show differences in the watershed. Additionally, I understand that this plan was developed based on theoretical assumptions and did not include any site visits to verify data, gain firsthand accounts or collect additional critical research analysis. It is my understanding that the final plan cited no expectation of economic losses to agriculture and any water releases would be planned to return all lands to use by June to create no net losses with minimal impact to the J. Clark Salyer Wildlife Refuge.

In theory, in 1986 this appeared to be a viable plan – no impact – why wouldn't decision makers accept the plan and move forward. More importantly, why didn't they ask more questions and demand more current data. However, 1986 is a far cry from 2012 and we have a variety of observations under our belt, so it's disconcerting that we would use the same information to continue to proceed with flood protection planning.

What I know today is that with the flood control plan of 1986 in place, even without the serious flooding of 2011, the impact of water in the flood plain most years has been far greater than it was expected to be and has far exceeded the expected target water flows, drainage dates and controlled easement acreage. What we see on the ground – not in an office or report built on assumptions – is higher than normal CFS that exceeds what the river can handle, riverbank erosion and sediment buildup, slowing flows causing additional flooding and changes in the river path, encroachment of overland flooding onto hay meadows, pastureland, farmland and more beyond the easements, and water releases from upstream that last longer than the basins ability to drain that water and producers to reclaim use of the land for hayland, pasture or crops, along with along with extended subsoil infiltration causing sub-irrigation issues to wells and homes. Additionally, extended periods of overland flooding with standing water also cause degradation and long term impact of trees, soil quality and native grasses & foliage.

If the above mentioned issues don't illustrate flaws in the plan, I believe the following issues as it relates to J. Clark Salyer Refuge should at the very least make us all question the validity of the plan and the need for new assessments. In the 90's when this flood protection plan was put in place, J. Clark Salyer Wildlife Refuge was forced to accept the plan that was laid out based on the 1986 studies. Based on that plan, the J. Clark Salyer Refuge experienced significant shallow water pooling, loss of native grasses and increases of cattails in subsaturated areas, increases in sediment, and increases of willow tree and brush stands diminishing the overall quality of habitat. Unwilling to disregard the damaging effects of this new plan, the manager of the J. Clark Salyer Refuge, reviewed the plan in further detail and noted numerous flaws in the plan, many of which were contributing to the issues mentioned above. He fought for the repair and enhancements of flood damaged habitats and was awarded mitigation on behalf of the Corp of Engineers that included enhancements of dams and raised spillways among other actions inside the J.C. Salyer Wildlife Refuge.

I believe there is more than enough evidence that calls in to question the validity of the 1986 environmental, economic and hydrological studies that merit the need for new data before any short or long term flood plans are made or monies allocated. These studies should include the use of current maps and data, as well as field research to verify all assumptions. Additionally all outlying areas beyond the major population center of Minot, ND should be part of the study to assess not only the environmental and hydrological impact of flooding and proposed flood plans, but the economic impact of said plans on homes and businesses including agricultural lands and communities in rural areas.

As with any plan, it is normal to assess the greatest economic or community risk and make plans to accommodate those areas first, and it has been clear, that the City of Minot has been a priority in the development of flood protection plans. However, it is also important to note that the agricultural lands that make up the Mouse River Basin also provide a significant economic impact to the region and their communities. It is believed that McHenry County alone has between 30,000-40,000 acres of impacted farm and ranch lands with an economic impact far exceeding ten million dollars as a low guess. This number does not take into account additional lands affected in Ward, Renville or Bottineau counties. And in a rural county like McHenry County, the economic stability and livelihood of the people who live there depends on agriculture.

I'm asking that at the very least, current studies of all affected areas be conducted before any flood plans are evaluated or adopted. Additionally, I believe that opportunities exist to take a long term proactive approach to document and study the effects of flooding and recovery as it relates to the environmental and economic impacts on natural habitat and agricultural areas and the process and recovery of those affected areas. I believe such research would be beneficial not only to our area in the light of potential future flooding, but other areas around the country that experience similar devastation.

I look forward to your timely response and attention to this issue.

Leland Goodman
802 77th St NE
Willow City, ND 58384
701-366-4765

DATE: **June 14, 2012**

TO: **Souris River Planning Board**
Attn: Dave Ashley; President

FROM: **Leland Goodman**

RE: **Questions Regarding Economic Impact & Recovery Related to Flooding & Watershed Issues**

NOTE: The last 12 years have produced increased flooding in areas north of Towner near the J. Clark Salyer Wildlife Refuge and the last year produced some unprecedented and sustained flooding causing considerable financial damage and long term losses throughout the entire watershed. Prolonged water storage contributes to downstream flooding and increased flows which have an exacerbated effect of river bank erosion. When river bank erosion occurs, it causes overall reduced flows in the main downstream river channel leading to increased overland flooding and direct losses to agricultural landowners . Agriculture (both farming and ranching) is the main economic engine of this region. Flooded land is unusable while it is underwater. When the water recedes lands are often unusable for long periods of time as they are covered with debris and sediment that hinders the growth of native plants. In fact, these native plants can take up to 7 years to recover under ideal conditions and during that time, ranchers experience direct economic losses to pasture and haylands.

QUESTIONS:

1. First, what is your plan to compensate existing landowners for damages caused by previous flooding?

    a. What is your plan to restore grasslands? And what budget and timeline will you be working on?
    b. What is your plan for reforestation of forested areas? And what budget and timeline will you be working on?
    c. What is your plan to prevent riverbank erosion and repair? And what budget and timeline will you be working on?

2. What are the current predictions on this Spring's and future water issues?

    a. What are the flow levels expected to be?
    b. What is the timeline for release in dates and CFS?
    c. What is the CFS Flow going to be at the target date of June 10th?

Leland Goodman
802 77th St NE
Willow City, ND 58384
701-366-4765

d. Will the flow be lowered to allow timely crop seeding?
e. Will the target date flow be lowered early enough that the river in ranch country will return flows of 300 CFS or less by June 1 to allow runoff?

3. What information have you gathered to begin formulating a plan to prevent widespread flooding in the future?

    a. What documents have you obtained related to economic impact studies related to flood damage and watershed issues, specifically as it relates to agriculture?
    b. What documents have you obtained related to hydrology reports prior to 1969, 1969-1975 and 1975 through the 1990's?
        i. If these documents were received in the past, have they been recently reviewed and what findings are relevant today?
    c. What documents do you have related to the 1999 flood to show the effects and duration of water and the damages it caused?
        i. Have these documents been recently reviewed? If yes, what findings are relevant today?
    d. What steps have you taken to research and document the cause and effect damages from this past flood season as related to the ag industry – including the economic losses?
        i. Who is conducting the research?
        ii. Is this data complete or when is it expected to be completed?
        iii. How was the research funded?
    e. What hydrology reports have you obtained to show dates and CFS flows of target flows and dates in Canada and the length of time water flow takes to reach area north of Towner?
        i. Have these documents been recently reviewed? If yes, what findings are relevant today?
    f. What studies do you have showing the extended flow effect on the J. Clark Salyer Refuge area north of Towner?
        i. How are these findings being incorporated into your long term planning?
    g. Are all of your reports and studies available for review? If so, how do we obtain copies?

4. What is your plan to prevent this from happening again or to protect landowners in the future?

    a. Based on the above mentioned data you have gathered, what information have you found most beneficial in drafting your future water protection plans?

Page **2** of **3**
6.14.2012

Leland Goodman
802 77th St NE
Willow City, ND 58384
701-366-4765

b. What are all of the flood prevention and watershed changes you are considering and which plans look most viable?
    i. What plans have you considered and abandoned? And for what reasons?
c. What is the Souris River Planning Board's impact plan for higher than normal flow?
d. What is the water level proposed under the new plan opposed to the old plan?
e. What is the plan for the protection of our individual ranches and farms?
    i. What is your plan to protect the ranches and farms from continued expenses related to poorly planned water releases?
f. If planned releases do not coincide with dates to allow draining water from private lands timely, what have you done to see that private landowner's interests are protected or that they are financially compensated?
g. How have you identified and plotted all areas of the watershed and the five factions from Velva to Lower J. Clark Salyer Refuge and developed a fair plan to adjust the flow across the whole watershed to spread out the total impact versus putting all the impact on one area and completely devastating a few?
h. When will your formal plan be published for review? And how and when can we get a copy of this plan?
i. Will there be a comment period for revisions? And if so when will the comment period be and how long will it be?

I appreciate your time and I look forward to your timely responses. All responses can be sent in writing to the address listed in the letterhead. Any questions can be directed to my attention at 701-366-4765.

Signed: Leland Goodman

CC:
North Dakota State Water Commission

Page **3** of **3**
6.14.2012

Public Comment for operating plan of Souris River

Written comments will be considered if received by April 7, 2013. Comments should be directed to Bob White by phone, email or by mail at

Bob White, ISRB Secretary, North Dakota State Water Commission, 900 East Boulevard Avenue, Dept. 770, Bismarck, ND 58505-0850.

Contact Bob White at the North Dakota State Water Commission by phone at (701) 328-2756 or email bwhite@nd.gov

As a layman who has looked closely at the figures from the 2011 flood, I propose an elegantly simple idea for river management in flood years (1 in 10 years).

First, my suggestion assumes coordination with Canadian and North Dakota governments that are providing flood protection in the form of dikes and levees. I suggest protection to a level of 12,000 CFS for areas where protection is possible, and a program of compensation for landowners who are flooded by the higher levels where no levees are practical.

Next, I suggest setting the Rafferty, Alameda, and Lake Darling Dams at the levels currently required under the 1989 plan for high runoff years. Then, outflow from the dams would be tied to the measured and/or estimated inflows on a daily basis with a target flow maximum of 10,000 CFS, effectively keeping the reservoir levels steady. If inflows exceeded that rate, that maximum flow would be increased as levels of the reservoirs rose. For example, the rate could be increased by 1,500 CFS per one meter of rise above the FSL of Rafferty and Alameda and those higher discharge rates would continue until the reservoirs dropped back to their desired flood protection levels. A date could be set to lower outputs to raise the levels of the Canadian reservoirs to their FSL for desired summer usage.

I see a simple system such as this to have many positives: it would keep the reservoirs near their desired summer levels so managers do not have to try and predict future inflows, it would coordinate with downstream protection systems and give population centers ample warning of higher discharges for emergency levee additions, it would only take effect in 1 in 10 years.

And for me the most important consideration is that plugging in the 2011 data to this system would result in no levee overtopping.

Jim Olson
233 Souris Drive
Minot, ND
701-852-4968

From: Carol Kraft <ckraftnd@minot.com>
Subject: Souris flooding
Date: March 15, 2013 11:02:25 PM CDT
To: <bwhite@nd.gov>

From: Jim Kraft
701-839-6175
Minot, ND

We in Minot were first told the Canadian dams would be dry. We voted for "Flood Control Dams in Canada." In 2011 we learned our 40 plus million dollars bought us an agreement that releases from Canada would be limited to 5,000 cfs, which Canada did not honor. The most simple and lowest cost answer is to draw down all three lakes above us to minimum levels any year where sufficient snowpack will refill the dams. All other options cost too much money and are not reliable. This 2013 appears to be one of those years. We paid an unbearable price for those who lied to us and those who are determined to hold too much water. The benefit of high water levels in the dams cannot outweigh the cost of the 2011 flood. Why do the guilty in this matter go uncharged? When the guilty have to pay for their actions causing a flood, there is hope they will not repeat those actions. I have followed all of this closely since 1969 and have no faith in flood protection for the valley.

From: <bigboot@srt.com>
Subject: International Souris River Water/Public Comment
Date: March 10, 2013 9:15:04 PM CDT
To: <bwhite@nd.gov>

Mr White,

I'm certain you have gotten the suggestion I'm going to make repeatedly. The difference is, I will give you some reasons why my suggestion will benefit both North Dakota and Canadian residents near this proposed project.

I understand the complications presented by the international situation.

My suggestion:

> Calculate the size and number of underground pipes needed to divert excess cubic feet per second at the North Dakota border, and send it by gravity where it returns to Canada 50 miles to the East. Install equal, or negotiated, number of lines on each side of border to assist all other flood control projects. Bury lines below freeze line to insure early winter functionality. Topography between the West outlet and East reentry into Canada would of course be a major factor, but it is obvious the Reentry of the Souris into Canada is lower than the West outlet into North Dakota.

The Lower Mississippi River has a number of diversions to alleviate flooding and they work very well.

One major benefit for the area of the pipelines would be potential irrigation of croplands on both sides of the border. By tapping the pipelines, that excess water could be put to good use. The flooding in North Dakota happens usually during a time when much needed moisture would benefit crops.

Please read and record this comment into the public record.

Fred Hurt
Minot, North Dakota
bigboot@srt.com

From: Bonnie Feist <cbfeist@srt.com>
Subject: Comment from a Souris River valley resident concerning operating plans on the Souris
Date: April 6, 2013 11:11:33 AM CDT
To: <bwhite@nd.gov>

My name is Bonnie Feist. My husband ,Curtis, and I have lived on our Charolais ranch for 50 years approximately 1/2 mile from the Souris River near Velva, ND. We are the first property after the Velva Dike system. We are trying to rebuild and restore our property after the disaster of 2011, but our farm may never be the same. We support work to straighten areas of the river to make for a better flow and less holdups. We realize that our decision to stay where we are assures us that we may be flooded sometimes in high moisture years.

The flow rates in the river which are being considered as part of the overall -plan will not work for us or our neighbors. Raising the flow rates that MInot can manage will decimate all of the unprotected and undiked miles of the Souris River Valley. Please consider a flow rate that will not continually flood the valley and the ranches, farms, and people that make their living off this very fertile land. Don't turn the Souris Valley into another Devils Lake basin, where thousands of acres have become underwater.

We are in favor of raising Lake Darling Dam, if it can be managed correctly, and if people take precedence over fish and wildlife. A cutoff or diversion near the Canadian border would also be something we would be in favor of. We are at the mercy of the dams in Canada, which were built for flood control, but have not been managed correctly and fairly to the US citizens whose taxes helped pay for these very dams.

Just some areas of thought and concern. Please consider my input in this matter.

Thank you,
Bonnie Feist
PO Box 42
Velva, ND 58790 1519 44th St N. is my actual address cbfeist@srt.com is my e-mail address.

From: Ryan Taylor <ryan.m.taylor7@gmail.com>
Subject: public comment ISRB
Date: April 8, 2013 4:29:45 PM CDT
To: <bwhite@nd.gov>

Bob,
I trust these comments are accepted through the end of business, or the end of the day, today.
Thanks for the opportunity.
Regards,
Ryan

Ryan Taylor, McHenry County Commissioner
5435 13th Ave. NE
Towner, ND 58788

April 7, 2013

Bob White, ISRB Secretary
North Dakota State Water Commission
900 East Boulevard Avenue, Dept. 770
Bismarck, ND 58505-0850

Dear Mr. White,

I am writing this in response to the call made for public comments on the Mouse River Enhanced Flood Protection Project that is underway. As a commissioner representing the twelve townships of the fifth district in McHenry County, the Mouse River, its natural floods, extraordinary floods and induced floods are key determinants in the economic health of the county and in the condition of public infrastructure we are responsible for as county commissioners.

There are two main points I would ask the ISRB to consider in its deliberations. One, responsible flood protection in the basin must serve all constituencies. With the technology of today and the resources of our state today, there need not be "winners and losers." We should be able to achieve long term flood protection for urban areas and new population growth without sacrificing multi generation farms and ranches that grow the food which sustains the urban growth. This may require different growth strategies for urban areas that keep new development and infrastructure away from flood prone areas, while protecting and insuring older homeowners who have no choice in the current tight housing market but to stay in some of those same areas, as well as ensure that new development has retention and not just drainage.

Second, with the overriding goal of "win/win" in the planning for flood protection, that considers the investments and livelihoods of all people up and down the river valley, when there is absolutely no other way but for someone to end up with a 'loss' from their current way of life and livelihood, there must be compensation for any such 'takings.' For some, the cost of flood protection is their share of the taxes necessary to implement the plan, for others, the cost could be their entire way of life and income earning ability built up over several generations. If some are asked to bear that extreme cost, it should be mitigated and built into the financial cost of the entire protection project.

I make these comments as a commissioner who is concerned for our public infrastructure in McHenry County, as a rancher and a neighbor to many who have been harmed by the river and don't want to be harmed by human 'fixes' to the river, and as a former state senator who realizes the hard task before you to serve multiple needs, rural and urban, housing and agriculture, cost and benefit.

Thank you for this opportunity to provide input. I look forward to the continued communication going forward.

Sincerely,
Ryan Taylor

--
Ryan Taylor
Taylor Ranch
Towner, North Dakota
www.mycowboylogic.com

Full Name: Paul Engeldinger

City, State/Province: Burlington, ND

Subject: Souris/Mouse River management

Over the years, and now most recently, I have become confused, disillusioned and now very angry that the retention of large amounts of water at the multiple dams is more in line with the protection of “fish and ducks” and the allure of “lake shore property” than it is with protecting lives and property from devastating floods. I am not alone in this view. If you err it should be on the side of safety. The fact that “water” causes more damage than any other natural disaster does not seem to make any difference in making the wise decision(s) for flood prevention. This “1 in 10” is a numbers game for gamblers. Quit gambling with our lives. How many of you actually have “skin in the game”? I would venture a guess that most of you do not, or if you do you have more than adequate resources to cover the loss. Please move quickly, all of you, and do the right thing in protecting all of us down stream.

Full Name: pat ryan

City, State/Province: minot,nd

Subject: Lake Darling Dam

I cannot believe there is so little mention of raising Lake Darling dam. There is actually no public discussion of the subject that I am aware of. To me it is an absolute no brainer. It should be raised 10 feet. You could then forget about Souris River channeling, new diking, green zones and all the other crap that's out there. Put a boat in at the dam and take it as far North as you can. Raising the dam 10 feet would not destroy 20 acres of crop land the entire distance. Prove me wrong Pat

From: <kongslieranch@srt.com>
Subject: Operating plan of Souris River
Date: April 5, 2013 3:42:13 PM CDT
To: <bwhite@nd.gov>

My name is Lynn Kongslie and I live downstream of Minot in McHenry Co. The flood of 2011 cost the ranch approx. a half of million dollars in lost of production and material damage. The worst thing that happened is we received water from the Canadian dams and local run off that last in to the fall. Which killed thousands of acres of hay land and thousand of tress, which some were old oaks (150 years old). Water has never been on any of this land for that length of time. And the record will show that Canadian dams were letting out approx. 500 cfs in to the late fall. And with the local run off it was enough to keep the water out of the banks. This is what caused all the damage, which can not be fixed. I understand that we have to try to protect the Town's, but should the land owners that are flooded out have to suffer these kind of losses. These kind of losses will put myself and my son out of business.

Sincerely

Lynn R. Kongslie
45-54th St. N.E.
Towner, N.D. 58788

From: <med1@srt.com>
Subject: Mouse River Flood Plan
Date: April 6, 2013 6:32:04 PM CDT
To: <bwhite@nd.gov>

Bob, As a landowner along the Mouse River, with meadows that can be seriously affected by river management, I put forth these thoughts. It is certainly better for those of us at Towner, with hay meadows that are greatly influenced by Mouse River water, if that water is pushed through in early spring. If we can have it on those meadows for 3-4 weeks and be able to drain down by May 15, that helps us. The worst thing we can have is a consistently high river all summer long. Keeping Lake Darling high and having summer releases of water is no good for us. Thankyou, Keith Medalen

Full Name: David W. Ashley, Chairman Souris River Joint Board

City, State/Province: Velva, North Dakota

Subject: Plan of Study

While working on our study I have traveled the Souris Basin extensively and attended all of the public meetings that have been held to address any solutions of the impacts of the flood event of 2011, both urban and rural. In working in close concert with the North Dakota State Water Commission and our engineering teams it was apparent that we needed to be extremely thorough in our study do to the diversity of the basin. We would of done a serious injustice to the basin if we would selected one or two areas to represent the rural areas and the same approach for the urban areas, it simply would of left to many stones unturned and I feel that the same should apply to the areas in Canada. It is with this knowledge of the diversity of Souris Basin that has been gained that we feel it imperative that the optimal approach to the scope of work be utilized.

The Souris River Joint Board and the North Dakota State Water Commission along with our engineering teams have compiled a wealth of information and data that we are ready and willing to share in order to be of assistance in your studies if you so desire. Please go to our website, www.mouseriverplan.com , that you reference in your Plan of Study and review our engineering plans for municipalities and the preliminary report on the rural reaches aspects of our study to get an overview of the work that has been done.

If I can be of any assistance please contact me.

David Ashley
Chairman SRJB
701-626-1566
davidashley@srt.com

Eaton Irrigation

847 68th Drive NE

Towner, ND 58788

Mr. Bob White, ISRB Secretary:

RE: Public Comments for the Operating Plan of the Souris River (Mouse River)

Eaton Irrigation is a project that consists of 6700 acres that is flood irrigated each spring from the Souris (Mouse) River. This is owned by 40+ individual landowners.

We need the water pushed through in the spring. Flows need to be reduced to 300 cfs or less by May 15 so that our hay meadows can be drained by June 1. This allows for the native grasses to start growing.

We are strictly against raising the Lake Darling Dam, as this would create flows that would flood our hay meadows in the summer and cause loss of hay production. These excessive summer releases in the past have drowned out Eaton Irrigation lands, which have a loss of at least $1,000,000 each time.

Please keep these lands in production as it is of great support for our area and the ranching industry.

Sincerely,

Cliff Hanretty

Chairman

From: <elliot@srt.com>
Subject: Public Comment for opperating plan of the Souris River
Date: April 5, 2013 11:17:04 AM CDT
To: <bwhite@nd.gov>

Mr. White,

I am writing as a rancher living north of Towner who depends on the spring floods to irrigate my native hay meadows, and also needs to get the river low enough in the early summer to drain the water off the meadows so they can be hayed.

I feel the best way to manage the residential, recreational and agricultural interests is to release water early, this way it can be released at a rate that will not flood residential property, then it can be utilized by agricultural interests, and then can also be used for the refuges to flood their duck ponds.

At the meeting in Minot it was proposed by the mayor to consider raising Lake Darling dam to hold more water. I feel this would be very negative for all those involved. History tells us that the Fish and Wildlife could fill the dam up for recreational interests, which of course would provide no flood control. And could misuse water that could be used for irrigation.

I think more could be accomplished with good communication from all involved, Canada, US, Fish and Wildlife, flood control and Ag interests, than spending more tax dollars trying to hold this water back then trying to manage it. Getting the water through the system early in the season is the best solution.

I of course have agriculture as my number one interest, but what is more important to the generations that come after us, saving residential property in the flood plain, fishing and boating interests, or agricultural land that can be used to feed generations to come.

Thank you for your time,
Chris Nelson

Chris Nelson
7135 Willow Rd
Towner, ND 58788

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Minot's undeniable watermark remains

BY EMMA GRANEY, THE LEADER-POST MARCH 15, 2013

Some Minot families took the heartbreaking option to board up their homes and move away from the city. (R

Photograph by: Bryan Schlosser, The Leader-Post, The Leader-Post

From the rapidly growing city of Minot to the picturesque community of Roche Percee and north to the peaceful Katepwa Beach, the effects of the Souris River floods remain. The Leader-Post continues its four-part series about the aftermath as communities rebuild in the shadow of a looming record snowpack melt headed our way this spring.

When a record amount of water roared out of Rafferty Dam in June 2011, it tore down the Souris River and burst uninvited through homes, farms and roads all the way along the river basin.

Being the headstrong river it is, the water pointedly ignored U.S. border control and continued its path of destruction south to Minot, changing its name to the Mouse River along the way.

The impending flood, helped along by record rainfall, led to the U.S. Army Corps of Engineers taking control of water infrastructure in the region - but the city was still decimated.

That summer, 2,700 Minot residents lost their houses to flood waters; only 10 per cent of them had flood insurance.

At first, city officials estimated residents in the flood zone would have four days to clear their homes, but the lack of automated river measurements in Canada meant the river rose much faster than predicted.

In the end, people had less than two days to move their belongings to higher ground.

At 1 p.m. on June 22, sirens wailed through the streets, directing people to evacuate. Now.

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More than 18 months later, about 20 per cent of those houses remain boarded up to the elements, red tape tied to their front door handles flittering in the breeze, an obvious sign of abandonment. Water marks line outer walls and condemned stickers and power notices are slapped onto windows that remain. "No trespassing" signs are everywhere.

Through an air of hopelessness, though, are pockets of rejuvenation.

Yellow signs - which last summer were speared in front gardens declaring "I'm coming back!" - now stand in front of freshly painted homes, the "coming" lined out with black spray paint.

The owners have transformed the sodden, mud-coated shells of their flooded houses into homes where the Stars and Stripes hang bright in the winter sunshine.

One woman who saw her house inundated by five feet of water was Wendy Howe.

She is also the executive director of Visit Minot, so she fought two battles as the city went underwater: The one to save her own home, and the rumours that Canadians were becoming the targets of Minot residents' fury.

Tales about northern neighbours' cars being vandalized persist to this day, though Howe maintains there wasn't a single report of anti-Canuck tire slashing or vehicle vandalism reported to Minot police.

But, she nods, there was a "small minority of the population who were angry and frustrated about being flooded" and did blame their neighbours to the north.

"But our citizens know that you were hit as well," she says in her office, a memorial 2011 Minot Floods hardcover book perched on the desk in front of her.

"And they realize how important Canada is to our city - you can't live here or have a business here without realizing that. And so many people curl with Canadians, they play hockey with Canadians, have relatives either side of the border."

And it seems Canadians are happier to head south again, with visits to Minot increasing by 15 per cent last year.

Repairs now finished, Howe is back living in her home.

Her tone is remarkably upbeat when talking about the floods; she mentions her brand-new kitchen and living room, later explaining how she and others have realized the importance of embracing positives rather than letting anger and frustration eat away at them.

Amazingly, despite being in an oil-boom city with rock-bottom vacancy rates where hotels burst at the seams, only about 250 people ended up needing the city's emergency shelter. The rest bunked down with family and friends as the worst passed.

"At first, yeah, it was really devastating for me," Howe says. "But I did my crying, then ... you realize other people had it way worse. I wasn't a 75-year-old with no family here who lost everything, you know? Nothing I didn't get out wasn't replaceable."

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The first few weeks after the flood waters subsided were, Howe says, "Like a war zone," with mud and debris everywhere, houses sopping.

By last summer, the neighbourhoods hit hardest - mainly north of the train tracks that divide the city - had started clearing up bit by bit.

On 4th Avenue NW, one grand pink building stood in a garden of green, looking as though it had escaped the worst.

It hadn't. Dakotah Rose Bed and Breakfast is a heritage-listed home that looks over the river.

Owners Jim and Carol Carr took seven months to repair the house to a point where people could stay there again - original oak trim from the walls and stair banisters had to be removed, cleaned, refinished and reinstalled, kitchen redone, inner staircase fixed, walls repainted.

They're hoping for a grant to help cover the cost of repainting the home's exterior, but otherwise you have to look hard for evidence of the waters that lapped halfway up the first-floor walls.

It's still emotional, though, and Jim Carr admits "Just telling this story affects me," as he points at the work completed throughout the house.

"The things you never imagined yourself doing, you end up doing during a flood."

???

In the hallways of Minot Town Hall - which was miraculously untouched by the water thanks to a system of heavy dikes - that unimaginable work took the form of 18-hour days as staff dealt with evacuations, shelters and the cleanup.

They are now in the midst of fine-tuning flood plans for the future, including the buyback of a swath of riverside homes where the city will build new dikes and flood protection measures.

As the city's finance director, Cindy Hemphill liaised with all manner of government agencies at a state and federal level, so far securing $80 million in relief funds. She's still hoping for close to $40 million more.

"I've spoken with so many people," she says, a fleeting smile flickering over her face. "Probably the only person I haven't spoken with is the president."

After the floods, the city's lift station had to be repaired, as did roads, bridges and traffic and street lights.

"It's been a long process," says city manager David Waind, nodding tiredly. "A very, very long process."

While many residents had access to Federal Emergency Management Agency loans, Waind says a lot also had to do repairs which took their mortgages well above the value of their homes.

"An awful lot of debt has been taken on by a lot of people," he says.

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While some residents chose to pack up and move, most elected to stay and rebuild their lives.

Howe says the floods have turned the city "into a bigger, better and stronger Minot," and brought everyone together to think about the future.

With that, she picks up the flood book on her desk.

Thumbing through the pages, she cocks her head to the side and says, almost as an afterthought, that she'll have to move the book off her desk soon.

After all, it's just a reminder. Instead, she says, it's important to keep looking to the fu ture.

FACES OF THE FLOOD

SOME BOBBLEHEADED WISDOM IN A TIME OF GREAT NEED

Meet Alan Walter, now-retired public works director of the city of Minot. At least, meet his bobble-head equivalent.

"Oh wow, yeah, these are great," Wendy Howe says with a laugh, telling the tale of the bobblehead sitting on her desk in the Visit Minot office. "They look exactly like him, too."

Back in June 2011, when parts of the city were underwater, Walter gave a frank assessment of concerns about how far to take a boil water advisory.

According to reports from the time, he stepped to the podium at news conference and called it as he saw it.

"There are people who are protecting this city, standing in this water, licking their hands, licking their fingers when they get done eating a sandwich out there, and we're worried about boiling the damn water," he said.

Within no time at all, Alan Walter Facebook fan pages were popping up and the slogan "Boil the damn water" was plastered on everything from Obamaesque posters to T-shirts, morphing into a kind of rallying cry for the community.

At first, the local woman who designed the T-shirts - donating the proceeds to the Minot Area

Community Foundation's Flood Recovery Fund - sold them out of her car in the Minot tourism office parking lot. But, Howe says, tourism staff ended up taking over the sale of shirts after demand for them exploded.

The moustached bobbleheads still pop up from time to time in offices around the city, a light-hearted reminder of the 2011 floods as they stare with a smile and remind everyone to "Boil the damn water."

egraney@leaderpost.com

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Previous Next

Some Minot families took the heartbreaking option to board up their homes and move away from the city. (R

Photograph by: Bryan Schlosser, The Leader-Post, The Leader-Post

  

Residents want basin-wide approach to study on river management

March 21, 2013

By JILL SCHRAMM - Staff Writer (jschramm@minotdailynews.com), Minot Daily News

Residents of the Souris River Basin downstream of Velva asked the International Souris River Board Wednesday to address their flow concerns when investigating possible changes to river management.

The board held a public meeting in Minot Wednesday to take comments on a proposed plan of study for the water supply and flood operating plan contained in a 1989 Canada-United States Agreement. The board wants the study to identify changes needed in the operating plan and determine how best to make them.

Members of the Souris River Joint Board, representing counties in the basin, urged a basinwide approach in revising the operating plan. Col. Michael Price with the U.S. Army Corps of Engineers responded that the intent is to look at the entire basin, of which 75 percent is in Canada.

Price said the board is considering three study options that vary in scope and estimated cost from about $1 million to $2.2 million. The board is favoring a middle option costing $1.33 million. Some elements of the research already are under way. Those costs, estimated at about $145,000, would be subtracted from the total when the board presents its recommendation to the International Joint Commission, which will take a recommendation to the U.S. and Canadian governments for approval and funding.

"I am OK with the Chevrolet model as long as you kick the tires and check the oil to make sure we get to the destination," Ward County Commissioner Alan Walter said, in support of something less than the $2.2 million study. "We want to have a basin-wide plan in this study, not just from the border down to Minot, but all the way from the border to Minot through Velva all the way up to the border again. There's some very important features beyond Velva that need to be addressed."

Clifford Issendorf, Kramer, with the Bottineau County Water Resource Board and Souris River Joint Board, said creation of the J. Clark Salyer Refuge and the raising of dams has increased problems along the river. That was evident in 2011, he said.

"If the last dam was not raised right before Canada, would we have lost Highway 5 in Bottineau County? Would we have had to spend millions of dollars to keep one road open between Westhope and Landa? That was the only road left in Bottineau County. So as we look at this basinwide approach, I really want you to look at the refuge. If we are going to have flow through the refuge, we are going to have to modify what's there," he said.

"We need cooperation from the Fish and Wildlife Service, not only in the valley in the bottoms but up on the toplands. If we are going to make this system work, we need their cooperation, not for them to turn around and stab us in the back whenever they can."

Minot Mayor Curt Zimbelman requested that the board take every interim step possible to better manage water in the system while waiting for results of a study. The study is expected to take two years, and Price could not say how long it might be before operating changes are made. However, Price said, the management plan already has been adjusted to take into consideration rainfall occurring after spring runoff. That had been an issue with Minot officials.

"As we found out, spring snow runoff is not the only determining factor in water level," Zimbelman said. "The perfect mix of saturated soil, heavy snow through the winter and much higher than average spring rain, which continued through the month of June, led to the 2011 flood disaster of historic proportions. No one foresaw that event, and no one can predict with certainty when it is ever going to happen again. Therefore, procedures need to be put in place that will better monitor and better respond to the kind of conditions that led to the 2011 flood."

He also asked that the Corps study the potential effect of raising Lake Darling and other storage upstream of Minot.

Cliff Hanretty, Towner, chairman of Eaton Irrigation Project, said raising Lake Darling is a problem because when that stored water is released, it destroys the hay meadows downstream.

"We have lost over a $1 million a year and we don't get compensated," he said."We need water pushed through in the spring. ... It will ruin our hay crop if you start running a late flow."

The public can view the proposed plan of study at (www.ijc.org) under "boards" by clicking on "ongoing task forces." Another opportunity to get information and make comments will be available during a webinar and teleconference Tuesday at 7 p.m. For instructions on how to join the online meeting or phone conference, contact Bob White at 328-2756 or bwhite@nd.gov.

Written comments will be considered if received by April 7. They should be sent to Bob White, International Souris River Board secretary, North Dakota State Water Commission, 900 East Boulevard Avenue, Dept. 770, Bismarck, N.D. 58505-0850.

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Residents want basin-wide approach to study on river management

March 21, 2013

Residents of the Souris River Basin downstream of Velva asked the International Souris River Board Wednesday to address their flow concerns when investigating possible changes to river management....

Comments
(3)

BryceJacobs
Mar-21-13 1:33 PM

Agree | Disagree

Hey Earlybird. It all boils down to politics. Somebody found a way to get some money for a study so they think they gotta spend it. Everybody knows the answer to flooding, it is too much water. How do you stop flooding. Empty the dams during the winter to make room for the spring runoff. There, now they know so they can save that money and give it to some of those poor people whose house was destroyed instead of lining their own pockets!

2 Agrees | 0 Disagrees | Report Abuse »

EarlyBird

Mar-21-13 8:19 AM

Agree | Disagree

The Clark Sayler was built long ago when the cities and people along the river were dumping all the sewer waste into the river. We used that flood plain to spread out the water de-silting and allowing the heavy contaminants to be trapped in the cattails that act as a filter before flowing back into Canada. This has caused the waterfowl to abandon the Clark Salyer refuge for the most part except around Newburg where the valley is narrower and the water a bit deeper yet. Between silt building up and increased drainage from the farmlands is some of the human problems that need studying.

0 Agrees | **0** Disagrees | Report Abuse »

EarlyBird

Mar-21-13 7:59 AM

Agree | Disagree

What do you want to know, I'll only charge $100.000.00 to research it for you. What the heck do they think is out there that needs to be studied? Then what will be done with the results? The only study that needs to be done is to remember why we built flood protection in the first place. Some people must think spending money is the solution to our problems, we solved the water problems long ago but these human problems do need studying.

0 Agrees | **0** Disagrees | Report Abuse »

Showing 3 of 3 comments

KQCD-TV News Stories

Souris River Basin Project | Video

Julie Leonardi | 3/20/2013

Representatives from the International Souris River Board were in Minot Wednesday afternoon. They gave residents the opportunity to give their input on a new study, and to possibly make changes on the current basin policy between the United States and Canada.

Colonel Michael Price conducted the meeting and asked for public comments on how they can improve a long term operating plan.

"We want to see if it's working. We want to see if the hydraulics changed in the basin, and then make recommendations to change the plan if we need to."

The study collaborates with all agencies and will implement a full scope study.

The study is based on two annexes. Annex A governs the operations of each of the reservoirs, and makes sure to provide 100 year flood protection. Annex B focuses on water supply, how much water Canada needs to hold, and how much they need to give to the United States.

A few people spoke up about what they would like to see in this new study. Mayor Curt Zimbelman hopes that the study helps with future flood protection. "We urge you to evaluate and produce a new operating plan that not only takes into consideration the spring snow melt and proper operating procedures during this time, but also takes into consideration abnormal rainfall during any time of the year."

Governor Dalrymple met with the group before the meeting to discuss the study, as well as the spring river run-off. "This will be a manageable situation, the way things stand right now."

Some technical parts of the study may be hard to understand, but the most important part is to make sure Minot is prepared in case of another disaster.

"We have very close communications with Saskatchewan, and we're very aware of any changes and conditions there. We know exactly what's happening with their reservoir pools, so we are really coordinated."

For a look at the full study, visit http://ijc.org/boards/isrb/publications.

Bob White
ND State Water Commission

Dear Bob,

I have taken the river readings at Towner going back to Martha Rolleto, Charlene Prindiville, & now Allen Schlag. I have taken all three of them down to the Eaton Dam + thru the entire Project so they could understand why readings at Towner fluctuate & so they could understand the project. All have been receptive and I'm sure Allen would tell you I understand the river above and below Towner better than anybody.

Here are my comments if I don't get too mad again to continue. Allen and I have had many discussions regarding the spring of 2011 & its tragic outcome for Minot and downstream. We have had disagreements & both have listened & as I have gotten to know Allen, I will say that his knowledge of water is unsurpassed and I have learned much from him. Our concern for the people of Minot is one of compassion – In 1969, my grandfather's home in Eastwood Park was the 1st home in Minot to have water on the main floor. He stayed with us for 2 months while his precious yard & garden were gutted by heavy equipment. When we took him back; the way he handled it, while in his 80's , provided an inspiration for me that remains.

No more comments on Minot – already hundreds of meetings & thousands of documents as the joint meetings in Canada followed, I told Allen. "If the time is spent with bureaucrats going on endlessly defending their decisions with numbers & what they perceived to be facts, the meetings would be a waste of time." On the other hand if the premise of the meetings was to ask "what could we have done different & how can we correct our mistakes in the future?" Then they could be helpful – I believe you attended enough meetings to answer that better than me. There was an editorial in the Minot paper which makes my point valid for Minot – Enough Minot.

What I said previously is only to prefix what I feel very strongly about & that is the Mouse River Valley approximately 10-15 miles above & below Towner. Allan had me reading the staff gauge at Towner & observing the river daily & many times twice daily beginning in Feb., 2011, when water was finally released where I could observe.

Comment #1 - Why not in the fall after freeze-up & hay is removed – A comment often heard down here as we got into spring is that "A blind man with a cane could have done a better job of predicting snow depth & moisture content" especially in Canada & Moose Mts.

Comment #2 – As Allen has pointed out to me, that amount of rain NW of Minot in June over so many square miles was an act of nature that could not have been prevented – True - & I will let the people of Minot debate what could have been done to protect Minot.

Comment #3 – Those of us in the Towner area, where thousands of acres; my guess up to 20,000 of valuable hayland are both in the Eaton Project & outside the project – We would have gotten the water anyway – the only question is when.

Comment #4 – We can take water late, even into July, and still have a good hay crop.

Comment #5 – And now is when I get MAD. I had read the readings twice a day since early spring & each time looked out at our hay crop under water with sadness – and then in August, the readings dropped dramatically and our meadows began to drain. "As I found out later, they were working on the Lake Darling Dam"

Now I want to emphasize we had given up on a hay crop that year, 2011, but we had been thru dry years; 1967 & the late 80's without a hay crop and we can tolerate that – But

Comment #6 – and my main point: Within 1 week or 10 days of continual draining which I observed with glee, the draining stopped and the river came back up & the meadows remained submerged until winter & freezeup.

Comment #7 – The fall of 2011 was a late warm fall with sunshine – No hay was cut but the native grasses were exposed to the sun & the ground warmed up.

Comment #8 – Where the meadows drained in the fall of 2011, last year, 2012 saw some of the best hay ever harvested – both in quality & quantity – But where the meadows had not drained, these valuable native grasses, which had survived numerous drought years and many late water years were killed – I mean dead and gone. I worked with the extension soils, grass & other experts last summer – you can ask them – and they had no viable solutions as this ground is unique and has never seen tillage equipment.

Comment #9 – If only we could have continued to drain those meadows & expose the grass to the fall of 2011, thousands of acres of hayland would have rejuvenated and not only produced hay in 2012 but excellent hay in quality & quantity, as did the meadows that were allowed to drain. That was evident summer of 2012 & I'm sure will be this summer also.

Comment #10 - And now I am drained. Bob, this summer I would be glad to show you or anybody interested, the contention I am making. Feel free to call me and please come up at your convenience after the haying begins in July, Aug, or Sept. and observe what I have been saying.   Thank you.

Tom Miller
Phone: 537-5674