Lakeland Industry and Community Association
Box 8237, 5107W - 50 Street, Bonnyville, AB T9N 2J5
780 812-2182 780 812-2186 www.lica.ca

Integrated Watershed Management Plan Committee

Meeting Minutes
Tuesday, May 17, 2022
9:00 a.m. – 12:00 p.m.
LICA Boardroom

Present:	Clem Parenteau Louise White-Gibbs Maureen Delorme-Ouellette Amanda Avery Bibo Roxane Bretzlaff Kristen Berezanski Bill Parker Kellie Nichiporik Richard Bourgeois Dana Swigart
Observers and Guests:	Sandi Riemersma, Palliser Environmental (via Microsoft Teams) Kelly Dion-McFeeters
Staff:	Kayla Hellum, LICA Environmental Coordinator Vicky Krawchuk, Incoming LICA Executive Director Kristina Morris, Exiting LICA Executive Director Tina Johnson, LICA Administrative Professional Eveline Hartog, LICA Administrative Professional
Regrets:	Delano Tolley Richard Pearce Robert Machatis Sharron Blyan-White Annette Hobart Abdi Siad-Omar Ted Traikovski Randi Dupras Mitch Sylvestre Madison Arsenault Shana Langley Al Bertschi

Initials

1.0 CALL TO ORDER

Amanda Avery-Bibo, Committee Chairperson, called the meeting to order at 9:03 a.m.

1.1 Territorial Acknowledgement

1.2 Vision, Mission, and Values

1.3 Introductions

1.4 Roll Call

The Committee was reminded that the continued absence of Richard Pearce is due to his work schedule.
Three consecutive absences were also noted for Al Bertschi. The exiting LICA Executive Director clarified that this Committee member was a reference person, and his absence is to be expected unless we require his expertise.

1.5 Approval of Agenda

1.5.1 May 17, 2022, IWMP Agenda

#1 Moved by Louise White AND CARRIED that the May 17, 2022, Agenda be approved as presented.

1.6 Approval of Minutes

1.6.1 April 7, 2022, IWMPC Minutes - Draft

#2 Moved by Roxane Bretzlaff AND CARRIED that the April 7, 2022, Minutes be approved as presented.

2.0 NEW BUSINESS

2.1 Draft #2 Beaver River IWMP

Sandi reviewed how the edits in the document are marked and updated the Committee that work is ongoing to match the boundaries between the government maps of the LICA region and the sub-basins. The Treaty and Metis maps will also need to be updated to incorporate the changes to the LICA boundary.

The Cold Lake Subregional Plan (CLSRP), approved in April 2022, has been reviewed and it was asked if the Committee would like to have a separate section in the IWMP to share Indigenous and Metis perspectives, as the CLSRP does, or continue to incorporate those perspectives throughout the entire plan. The Committee Chairperson felt that the footnotes with Indigenous and Metis information should be incorporated directly into the plan to demonstrate its importance. The Committee agreed that incorporation was still desired.

An additional item of discussion was the 250m setback mentioned in the CLSRP. It appears that new development may need to abide by this setback; however, clarification on this will be sought as sections of the plan are not consistent. Further information will be provided as received.

Sandi clarified that the next steps towards the completion of the IWMP were:

- The addition of the riparian intactness reports completed by Fiera,
- Complete section 9.5 Wetlands, the Executive Summary, and References,
- Finalize the recommendations and refine implementation tables,
- Revise Appendices to include background material from the body of the plan,
- Present the Final Draft for revisions (August),
- Incorporate the final revisions,
- Approve the complete Plan (September),
- Seek stakeholder support for the implementation of the plan (October 2022-March 2023), and
- Track progress towards plan goals and objectives (Fall 2023 onward).

2.1.1 Overview of Key Changes

The key changes in the Draft #2 Beaver River IWMP are:

- Recommendations have been revised based on feedback,
- Revision of numbering,
- Updated Section 3.1 to include a historic timeline of events,
- Moved Section 7.0 to Section 4.0,
- Updated Section 9.5 Wetlands,
- Completed Section 9.7 Land Management, and 9.8 Knowledge and Understanding,
- Definitions section has been added, and
- The preliminary implementation tables have been completed.

2.1.2 Review Implementation Table

Concern was expressed by a Committee member that actions for specific stakeholders were hard to discern by reading the plan as it is organized currently. Sandi presented the implementation tables as a place to focus on specific actions. It is in this section that the responsible jurisdictions are specified, the actions for completion, which recommendation they reference, and the priority level of the action. The Committee felt these tables were some of the most helpful parts of the plan and should be expanded. Alternatively, this table could be moved to an Appendix for ease of reference, if the Committee felt this would be helpful.

Roles and Responsibilities

The Committee felt that this section should be moved to the beginning of the document, new Section 5, with the following numbering corrected accordingly. Further, the Committee would like Sand and Gravel to be added as a section within the Roles and Responsibilities and the Implementation Table. It was pointed out that Industry is highly regulated, so those items do not need to be listed individually. A few key guidance documents can be referenced for these regulations (not a comprehensive

Initials

list). It was also noted that Indigenous must follow regulations, which are primarily governed at the federal level. Consultation on this section will be ongoing as we need to ensure that those assigned are willing and able to complete assigned tasks.

Actions

The Committee did a brief overview of the Actions within the Implementation table. They would like Palliser to add links within the actions that take the reader to the relevant section of the IWMP document. It was noted that the Sand and Gravel industry were not listed as responsible jurisdictions, and that any regulated Industry items be removed. Fisheries management has also been missed as responsible jurisdictions and is an important item to stakeholders. Sandi pointed out that most of the current actions are also marked as High priority and this will need to be further refined as we proceed through the planning process.

Timelines

The Environmental Coordinator shared that most of the current timeline events were found through the local museum and Municipal Archives. It was noted that the timeline was not inclusive of Indigenous events and relevant representatives would like to work further with her to integrate these. The Committee would also like to see citations for who or where information that formed the timeline was found.

#3 Moved by Clem Parenteau AND CARRIED to accept the Draft #2 Beaver River IWMP with today's edits for recommendation to the Board, use at the Engagement III sessions, and posted to the LICA website.

The Committee requested that, going forward, they would like to receive documents more than a week in advance of the meeting due to the document length. They would also like it shared as an editable Google doc so live edits can be added. This would streamline the review process and reduce strain on Committee members.

2.2 Engagement Session 3

The focus of the third round of engagement will be targeted questions for the attendees to discuss and decide upon.

2.2.1 Venue, Date, Time

The upcoming in-person engagement session will be held in the same meeting room at the Bonnyville and District Centennial Centre as engagement session two. It is to occur on June 14th, 2022, from 10:00 a.m. until 3:00 p.m. with a soup and sandwich lunch provided.

The virtual Engagement Session III will be held through Zoom on June 20th, 2022, from 1:00 to 4:00 p.m.

Private Engagement Sessions can also be booked directly with the LICA office.

For networking purposes, the Committee suggested LICA hold a brief open house in advance of the in-person session from 9:00 to 10:00 a.m.

2.2.2 Survey 3: Response Form

Summaries of the previous drafts of the IWMP and a copy of the State of the Watershed Report will be provided at the beginning of the survey for reference. There will be two to three key recommendations for participants to consider and a place to enter additional comments.

#4 Moved by Dana Swigart AND MOVED that the Survey 3: Response Form be approved including the edits discussed today.

2.2.3 Summary Document

Sandi presented the Summary Document to the Committee. To assist with public understanding of the plan, the Committee would like the Implementation Table added to this document. The Committee also requested that the next steps in the planning process be added.

A Committee member noticed that the document being reviewed did not have the same title as the agenda item. The Committee would like these two titles to be the same. A title of “A Summary of Key Contents” was suggested and approved by the Committee when referencing this document going forward. A footer should also be added on every page documenting the Draft and Version that is being reviewed.

#5 Moved by Clem Parenteau AND MOVED that the Summary of Key Contents be approved as amended, including the edits discussed today.

3.0 ONGOING BUSINESS

3.1 Review Work Schedule

Sandi reviewed the Work Schedule with the Committee. A Committee member queried why the tight deadline was necessary. The Executive Director clarified that the requirement for prior Board approval, the budget, and the upcoming AGM required that the Beaver River IWMP be completed in advance of the new Board year. Sandi will provide an email debrief of the third round of Engagement once all sessions have been completed. This will negate the need to host a committee meeting before the end of August.

3.1.1 Determine a Meeting Date for August

A Committee meeting will be required in August to revise Draft #2 of the IWMP based on feedback received at the engagement sessions. The Committee decided the next meeting will be held on August 30th, 2022, from 9:00 a.m. until 12:00 p.m. The Committee would like Sandi to have the Google doc of the plan posted, for comments and edits, at least two weeks prior to the meeting.

4.0 ACTION LIST

4.1 Follow-up on Action List

4.1.1 April 7, 2022

The IWMP Committee reviewed the action list from the April 7, 2022, IWMP Meeting noting that:

- Free advertising for the IWMP events has been completed.
- Next steps were established at this meeting.
- The MD of Bonnyville has been contacted for data on wetland and riparian areas. No response has yet been received. The MD representative suggested that the Environmental Coordinator contact Ester to send over the required data.
- The Appendix of historical events is ongoing.
- The Committee has completed their edits to Draft #2.
- Sandi has been in contact with AEP on biodiversity.
- A message regarding the concerns on the Cold Lake Air Weapons Range (CLAWR) was left with the military representative. If no response is received, research alternative contacts.

5.0 UPCOMING MEETING DATES

5.1 Board Meeting – May 26, 2022

5.2 Next IWMPC Meeting – TBD

This has been set for August 30, 2022, from 9:00 a.m. until 12:00 p.m.

6.0 ADJOURNMENT

The meeting adjourned at 12:07 p.m.

#3 Moved by Maureen Delorme-Ouellette AND CARRIED that the meeting be adjourned.

Approved on: _____
Date

_____
Signature

_____
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LICA ENVIRONMENTAL STEWARDS
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LICA Integrated Watershed Management Plan Committee
LICA Boardroom
Tuesday, May 17, 2022
9:00 am – 12:00 p.m.

Time	Item	Agenda	Discussion Leader	Required Outcome
9:00	**1.0**	**CALL TO ORDER**		
	1.1	Territorial Acknowledgment	**Amanda**	
	1.2	Vision, Mission, and Values	**Amanda**	
	1.3	Introductions	**All**	
	1.4	Roll Call	**Amanda**	For Review
9:15	1.5	Approval of Agenda 1.5.1 May 17, 2022, IWMPC Agenda	**Amanda**	For Decision
9:20	1.6	Approval of Minutes 1.6.1 April 7, 2022, IWMPC Minutes	**Amanda**	For Decision
	2.0	**NEW BUSINESS**		
9:25	2.1	Draft #2 Beaver River IWMP (Final decision of draft required) 2.1.1 Overview of Key Changes 2.1.2 Review Implementation Table • Roles and Responsibilities • Actions • Timelines	 **Sandi** **Sandi**	 For Decision For Decision
11:20	2.2	Engagement Session 3 2.2.1 Venue, Date, Time 2.2.2 Survey 3: Response Form 2.2.3 Summary Document	 **Kayla** **Sandi** **Sandi**	 For Information For Decision For Decision
	3.0	**ONGOING BUSINESS**		
11:35	3.1	Review Work Schedule 3.1.1 Determine a Meeting Date for August	**Kayla**	For Discussion
	4.0	**ACTION LIST**		
11:45	4.1	Follow-up on Action List 4.1.1 April 7, 2022	**Amanda**	For Review

	5.0	**UPCOMING MEETING DATES**		
11:50	5.1	Board Meeting – May 26, 2022	**Amanda**	For Information
11:50	5.2	Next IWMPC Meeting – TBD (2nd week in August?)	**Amanda**	For Information
11:55	**6.0**	**ADJOURNMENT**	**Amanda**	For Decision

2022-23 Attendance
Integrated Watershed Management Plan Committee Meetings

NAME	December 1, 2021	January 17, 2022	April 7, 2022		
Delano Tolley	✓	A	A		
Richard Pearce	A	A	A		
Louise White-Gibbs	✓	✓	A		
Robert Machatis	TC	TC	A		
Clem Parenteau	✓	TC	✓		
Sharron Blyan-White	-	TC	A		
Maureen Delorme-Ouellette	✓	TC	A		
Amanda Avery-Bibo	✓	TC	✓		
Roxane Bretzlaff	TC	TC	✓		
Kristen Berezanski	TC	TC	✓		
Annette Hobart	A	TC	A		
Abdi Siad-Omar	TC	Alt. TC	✓		
Bill Parker	✓	✓	✓		
Joe Kopala	A	TC	A		
Randi Dupras	TC	TC	A		
Kellie Nichiporik	TC	TC	A		
Mitch Sylvestre	TC	TC	✓		
Richard Bourgeois	✓	TC	✓		
Al Bertschi	A	A	A		
Madison Arsenault	A	TC	A		
Shana Langley	TC	A	A		

Notes: ✓ = Present TC = Telephone Conference A = Absent from Meeting

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Integrated Watershed Management Plan Committee

Meeting Minutes
Thursday, April 7, 2022
9:00 a.m. – 4:00 p.m.
LICA Boardroom

Present:	Clem Parenteau Amanda Avery Bibo Roxane Bretzlaff (arrived at 9:20 a.m.) Kristen Berezanski Abdi Siad-Omar Bill Parker Mitch Sylvestre Richard Bourgeois
Observers and Guests:	Sandi Riemersma, Palliser Environmental (via Microsoft Teams) Fin MacDermid (left at 3:08 p.m.) Barry Kalinski Leo Paquin (arrived at 12:00 p.m.)
Staff:	Kayla Hellum, LICA Environmental Coordinator Kristina Morris, LICA Executive Director Tina Johnson, LICA Administrative Professional Eveline Hartog, LICA Administrative Professional
Regrets:	Delano Tolley Richard Pearce Louise White-Gibbs Robert Machatis Sharron Blyan-White Maureen Delorme-Ouellette Annette Hobart Joe Kopala Dana Swigart Randi Dupras Kellie Nichiporik Al Bertschi Madison Arsenault Shana Langley

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1.0 CALL TO ORDER

Amanda Avery-Bibo, Committee Chairperson, called the meeting to order at 9:10 a.m.

1.1 Territorial Acknowledgement

1.2 Introductions

1.3 Vision, Mission, and Values

1.4 Roll Call

1.5 Approval of Agenda

1.5.1 April 7, 2022, IWMP Agenda

#1 Moved by Clem Paranteau AND CARRIED that the April 7, 2022, Agenda be approved as presented.

1.6 Approval of Minutes

1.6.1 January 17, 2022, IWMPC Minutes - Draft

#2 Moved by Richard Bourgeois AND CARRIED that the January 17, 2022, Minutes be approved as presented.

2.0 ONGOING BUSINESS

2.1 Review Work Schedule

The Environmental Coordinator reviewed the updated work schedule for completing the Beaver River IWMP, noting that September 2022 is the end of Palliser's current contract. The Chair suggested that the Committee meet over the summer months, July, and August, to keep progress on track. The Committee agreed with this.

The following are key dates to note within the Schedule:

- The Draft #2 IWMP will be produced on May 9th and circulated to the Committee for comments and revisions to be provided to Sandi.
- The Committee will meet on May 17th to conduct a final review of the DRAFT #2 IWMP document, which will than be presented to the Board of Directors for approval at the end of the month.
- June 13-15 will draft the implementation responsibilities of the Plan
- Round 3 of Engagement Sessions are proposed to be held in mid-June.
- A committee meeting will be held in July to review and discuss feedback received.
- In August, the final draft of the IWMP will be circulated to the Committee and Board for review and feedback, prior to another committee meeting that will scheduled at the end of August for final review and acceptance.

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- Sandi will produce the finalized IWMP document and a summary document to be presented to the Board of Directors at the September Board Meeting.

2.2 2021-2022 IWMP Budget Summary

The Environmental Coordinator reviewed the 2021-2022 IWMP budget, ending March 31, 2022, noting that many administrative expenses incurred were covered by the WPAC grant carry-over. The Committee had no concerns with what was presented.

2.3 2022-2023 IWMP Budget Review

The Environmental Coordinator reviewed the forecasted 2022-2023 IWMP budget. It was noted that:

- Considerably less budget has been allocated to advertising for the following reasons:
  - LICA is operating on a more restrictive budget this year. The IWMP budget is allocated specifically to Palliser's contract work, and the Advertisement budget within LICA's consolidated budget is shared with other LICA project work. Publicly paid advertisement, such as newspaper ads can be very costly.
  - LICA is targeting a specific audience to participate in the engagement sessions, in which many pertinent individuals are already on the invitation list.
  - It was identified that there was a very small number of individuals that attended the last engagement session directly as a result of previous public advertisement.
- The overall budget is less because LICA is not anticipating carry-over this year. It does, however, reflect what is remaining within the Palliser contract work plan and budget.

She also inquired as to what types of advertising the Committee would like to see for the next round of engagement sessions, provided the above-mentioned reasons. The radio and newspaper advertising were quite expensive and produced no results, as most attendees came from personal invitations. The Committee requested that we continue doing the personal invitations and, additionally, pursue any free advertising that is available.

3.0 NEW BUSINESS

3.1 Meeting Expectations & Potential Future Format Change

The Chair reminded the Committee to come prepared to meetings due to the content being reviewed and the tight timelines LICA faces for completion of this project. She also mentioned that, moving forward, there may be some meetings where select Committee members will be invited to provide their input and expertise, depending on the content being reviewed.

She also noted that if the entire agenda is not covered today, the Committee will need to have an additional April meeting to complete the review of outstanding sections.

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3.2 Engagement Session 2 Debrief

Sandi reviewed a summary of the input received from Engagement Session 2, AEP, and the LISC respectively. She noted that the plan is intended to cover the next 10 years or so, at which time it should be reviewed and updated for current circumstances.

3.2.1 Committee Insight

Sandi asked the Committee Members who were present during the engagement sessions for feedback on whether they felt it was successful and achieved desired outcomes. The Committee Member comments were as followed:

- A member felt that this is an ambitious undertaking and there may be challenges with implementation. In addition, one member mentioned that they didn't see anything written about maintaining wetlands. The member thinks we should include 2-3 items at a maximum and get them done in the implementation phase.
- A member mentioned that the presenters at the Cold Lake First Nations (CLFN) engagement session did a great job speaking to community members and noted the complexities around Indigenous Communities. He also mentioned that the LARP is up for review in September and that the Cold Lake Subregional Plan is awaiting cabinet approval and thus not publicly available to ensure we align with the document. He also pointed out that a large portion of the watershed is federal green zone that we have no control over.
- The Alberta Environment and Parks Committee Member shared documents to support and compliment the Subregional Plan. He felt we needed to establish what actions are remaining that will move the IWMP process along. He also pointed out that there are different levels of monitoring, with the majority occurring at the community level. Examples of community monitoring plans created by CLFN and the ALMS LakeWatch Program.

Overall, the Committee Members present did not identify any issues with how the engagement sessions were delivered.

3.2.2 What We Heard Summary Document

Sandi reviewed the Summary of the input received at the second round of engagement sessions and from the post-engagement survey. She noted that she had received 1 additional survey response a few days ago, which has not yet been included within this summary document.

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3.3 Next Steps

Sandi shared the anticipated next steps in the IWMP Process. As the Committee reviews the second round of engagement feedback today, we will then be able to determine desired outcomes. At the Committee Meeting in May, the Committee will need to verify which decision makers should be responsible for implementing actions suggested in the Plan.

3.3.1 Engagement Session 3 (Date & Desired Outcomes)

Based on Sandi's available schedule, the Environmental Coordinator proposes that the third round of engagement sessions be scheduled for June 13-15, 2022. At that time Draft #2 of the IWMP will be presented to participants and the desired outcomes will be to receive feedback to further refine the implementation and responsibilities sections of the Plan.

The Environmental Coordinator noted that she will conduct another round of municipal delegations and contact each Indigenous Community/Settlement prior to June to ensure we maximize participation in the third round of engagement and continue to get support in the Plan.

3.3.2 IWMP Draft 2 Survey

Sandi noted that another survey will be developed for the third round of engagement as it provides another opportunity for decision-makers to provide their input. This will be brought to the Committee for approval in May.

3.4 IWMP Draft 1 Section Review (Feedback & Preliminary Notes on Implementation)

The Committee and invited LISC members reviewed all feedback received, as outlined within the spreadsheet provided in the Agenda Package. Throughout the discussion, Sandi captured the recommended changes requested by the Committee directly within the Draft #2 document.

Specific highlights from the Committee's review are as followed:

- The AEP Committee Member offered to provide Sandi with contact information of the person in charge of biodiversity at AEP.
- AHS may be able to provide information regarding water quality advisories.
- The Committee agreed to include an Appendix which would include key historical events that occurred within the Beaver River Watershed. AEP has adopted this as a tool to be inclusive as history is different for everyone.
    - It was noted that there was a need for a more simplified approach, such as this, to fill in the historical data gaps as well as not to exclude or highlight specific groups within the Plan.
    - The committee was notified that some indigenous communities may wish to produce a historical report, rather than provide informal historical data, which may require a longer timeframe than what we currently face.

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- A committee member suggested to connect with local museums and research local history books, in addition to engaging with indigenous community members.
- The Committee is encouraged to also share contact information with Sandi of someone they may know who has lived in the region for many years and relate some historical information regarding watersheds.

- The AEP committee member suggested that LICA may want to look into completing a flood mapping project in collaboration with municipalities. This may be a project LICA can obtain funding through WRRP. The Environmental Coordinator made note of this for future grant opportunities.

4.0 ACTION LIST

4.1 Follow-up on Action List

4.1.1 January 17, 2022

The IWMP Committee reviewed the action list from the December 1, 2021, IWMP Meeting noting that action item 3.5 should be updated to September once the plan is finalized.

5.0 UPCOMING MEETING DATES

5.1 Board Meeting – April 28, 2022

5.2 Next IWMPC Meeting – May 17, 2022

6.0 ADJOURNMENT

The meeting adjourned at 4:04 p.m.

#3 Moved by Clem Parenteau AND CARRIED that the meeting be adjourned.

Approved on: _____
Date

_____
Signature

Initials

LICA
ENVIRONMENTAL STEWARDS

BEAVER RIVER

INTEGRATED WATERSHED MANAGEMENT PLAN

DRAFT #2

Note to Reader: This is a working draft document intended to support discussions with IWMP Committee members, Stakeholders, First Nations and the Métis. The content is considered preliminary and is subject to change. **Blue text** indicates new text from PESL. **Brown text** indicates new text derived from feedback. **Red text** indicates questions to discuss or comments that will be deleted.

Prepared by:
Palliser Environmental Services Ltd.

DRAFT May 9, 2022

ACKNOWLEDGEMENTS

LICA would like to thank the following people for their contribution to the Draft #1 Beaver River Integrated Watershed Management Plan. This acknowledgement will be updated in the final Beaver River IWMP.

LICA IWMP Committee

Abdi Siad-Omar, Alberta Environment and Parks
Al Bertschi, Portage College
Amanda Avery-Bibo, LICA Board
Annette Hobart, Alberta Energy Regulator
Bill Parker, City of Cold Lake
Bob Buckle, City of Cold Lake
Clem Parenteau, Métis Nation Region 2
Delano Tolley, Community
Dylan Landstrom, Beaver Lake Cree Nation
Fin MacDermid, Cold Lake First Nations
Joe Kapala, Town of Bonnyville
Katlyn Degenhardt, MD of Bonnyville
Kellie Nichiporik, Lakeland Agriculture Research Association
Kristin Berezanski, Strathcona Resources
Louise White-Gibbs, Community
Madison Arsenault, Youth
Madison Rehm, MD of Bonnyville
Maureen Delorme-Ouellette, Fishing Lake Métis Settlement
Mitch Sylvester, Moose Lake Watershed Society
Monty Moore, Husky Energy
Randi Dupras, Lac la Biche County
Richard Bourgeois, Muriel Lake Basin Management Society
Richard Pearce, Community
Roxane Bretzlaff, Canadian Natural Resources Ltd.
Robert Machatis, Cold Lake First Nations
Shana Langley, Military
Shelby Kennedy, Kikino Métis Settlement

Ex-officio Members

Kayla Hellum, Environmental Coordinator
Kristina Morris, Executive Director
Rachel Bates, Education & Outreach Coordinator

Cover Photo Credit

Amber Martin

Palliser Environmental Services Ltd.

EXECUTIVE SUMMARY

To complete in Final Draft Beaver River IWMP. Refer to Draft #2 Key Contents Summary Document.

TABLE OF CONTENTS

ACRONYMS

AAF	Alberta Agriculture and Forestry
ABMI	Alberta Biodiversity Monitoring Institute
AEP	Alberta Environment and Parks
AER	Alberta Energy Regulator
AIS	Aquatic Invasive Species
ALMS	Alberta Lake Management Society
ALSA	Alberta Land Stewardship Act
ALUS	Alternative Land Use Services
ASB	Agricultural Service Board
AOPA	Agricultural Operations Practices Act
ASVA	Association of Summer Villages in Alberta
AWC	Athabasca Watershed Council
BMP	Beneficial (Best) Management Practice
BRWA	Beaver River Watershed Alliance
CLAWR	Cold Lake Air Weapons Range
CLBR WMP	Cold Lake-Beaver River Water Management Plan
CLFN	Cold Lake First Nation
CLSR	Cold Lake Subregion
CLSRP	Cold Lake Subregional Plan
DUC	Ducks Unlimited Canada
EPEA	Environmental Protection and Enhancement Act
FIN	Fall Index Netting
FSI	Fish Sustainability Index
GOA	Government of Alberta
IBA	Important Bird Area
IBI	Index of Biological Integrity
IRP	Industry Respected Practice
GOWN	Groundwater Well Observation Network
IWMP	Integrated Watershed Management Plan
IWMPC	Integrated Watershed Management Plan Committee
LARA	Lakeland Agriculture Research Association
LARP	Lower Athabasca Regional Plan
LICA	Lakeland Industry Community Association
LUB	Land Use Bylaw
MDP	Municipal Development Plan
LICA	Lakeland Industry Community Association
PPWB	Prairie Provinces Water Board
QWAES	Qualified Wetland and Aquatic Environmental Specialist
SHL	Special Harvest Licence
SWAD	Surface Water Allocation Directive
TEK	Traditional Ecological Knowledge
USEPA	United States Environmental Protection Agency
WCO	Water Conservation Objective
WPAC	Watershed Planning and Advisory Council
WQO	Water Quality Objective
WSG	Watershed Stewardship Group

1.0 INTRODUCTION

LICA is a community-based not-for-profit association that is a Synergy Group, the Watershed Planning and Advisory Council (WPAC) for the Beaver River watershed, and an Airshed Zone. LICA focuses on environmental monitoring, environmental management, and community education and outreach. As the designated provincial WPAC for the Beaver River watershed in Alberta, LICA reports on watershed health, leads collaborative planning, and facilitates education and stewardship activities. This work supports the goals of Alberta's *Water for Life Strategy*, namely:

- Healthy aquatic ecosystems
- Safe, secure drinking water supplies
- Reliable, quality water supplies for a sustainable economy

LICA initiated the Beaver River Integrated Watershed Management Plan (IWMP) process to help direct future watershed management activities and achieve the vision of *"A healthy Beaver River watershed for the future"*. The Beaver River IWMP is a guidance document and planning tool for resource managers, including governments, planners, Indigenous communities, other stakeholders and landowners in the watershed. The plan identifies goals for improving and/or maintaining watershed health, and makes recommendations on how to reach those goals. An implementation strategy accompanies the IWMP to indicate implementation roles and responsibilities, priorities and timelines.

LICA's IWMP Committee (IWMPC) provided technical knowledge and support in the development of the draft plan in collaboration with stakeholders, First Nations and the Métis. LICA's IWMPC is working collaboratively with communities and stakeholders in the watershed to establish goals and objectives, supported by clear and comprehensive recommendations regarding water quantity, water quality, wetlands and riparian areas, biodiversity and land use. Effort is being made to ensure that this plan is relevant and reflects local and regional concerns to achieve shared environmental, social, and economic outcomes supportive of a healthy watershed. This Plan builds on previous initiatives devoted to resource management in the Beaver River watershed and is aligned with current provincial and municipal initiatives that support watershed planning in the basin. Appendix A provides a list of key stakeholders, First Nations and Métis in the watershed.

1.1 Previous Planning Initiatives

Coordinated planning efforts for the management of natural resources in the Beaver River watershed have occurred for more than 30 years. More detail regarding the plans listed below can be found in Appendix B.

- 1985 Cold Lake-Beaver River Water Management Plan; An existing plan focused on water quantity and quality to meet long-term user requirements (AENV 2006a)
- 1996 Cold Lake Sub-Regional Integrated Resource Plan
- 2006 Cold Lake-Beaver River Water Management Plan; An update of the 1985 plan to align with the Water Act (1999) and Water for Life Strategy (2003). It included a key shift to an integrated approach that recognized surface water and groundwater interactions. The Director under the *Water Act*, considers this plan in decision-making.
- 2012 Lower Athabasca Regional Plan (LARP) established under the *Alberta Land Stewardship Act* (ALSA)
- 2022 Cold Lake Sub-Regional Plan; A plan developed reduce human footprint in caribou range; implemented under ALSA

1.2 Need for a New Plan

Healthy watersheds support interdependent human, animal, and ecosystem health. Integrated Watershed Management Plans (IWMP) are important for guiding land and water resource management in consideration of the environment, sociocultural values and the economy. Implementation strategies that accompany IWMPs are essential for initiating action. Although the 2006 Cold Lake-Beaver River Water Management Plan (CLBR WMP) provides a strong foundation for management of the eastern Lower Beaver River, it pre-dates important legislative changes that affect watershed management, and excludes parts of the greater Beaver River watershed. A new plan should also better reflect all stakeholder concerns, including First Nations and Métis Rights and Indigenous knowledge.

2.0 PURPOSE, INTENT, PLANNING CONTEXT AND SCOPE

2.1 Purpose, Intent and Authority

The Beaver River IWMP provides broad guidance for watershed management, and sets out clear direction that will result in consistent, specific actions for integrated management of land and water resources to support long-term watershed health. The IWMP will not replace the existing authorized 2006 CLBR WMP [1] but rather augment it with aspects not previously considered.

While the watershed plan is not legally binding, developing the plan collaboratively means it is more likely to be supported and implemented by decision-makers in the Beaver River watershed.

To maximize opportunities for successful implementation, the IWMP should be supported by all stakeholders, First Nations and the Métis. Recommendations should be incorporated in future planning documents and updates of existing plans that have legal/regulatory authority (e.g., the CLBR WMP (2006), the Lower Athabasca Regional Plan and sub-regional management frameworks, and municipal statutory plans and policies).

2.2 Legislative Policy and Planning Context

The development of the Beaver River IWMP is guided in part by the Framework for Water Management Planning (1999), the Guide to Watershed Planning in Alberta (~~Alberta Government~~ GOA 2015) and *Water for Life Strategy* (GOA 2003; renewed in 2008).

The IWMP:

- was developed within the context of existing federal, provincial and municipal legislation, policies and regional plans
- acknowledges and adheres to the commitments outlined in the Inter-provincial Master Agreement on Apportionment (1969) as administered by the Prairie Provinces Water Board[2]
- reflects current policies and practices in place since the CLBR WMP was completed in 2006

[1] Water Management Plans provide a framework for Alberta Environment and Parks to make water management decisions under Alberta's *Water Act* and *Environmental Protection and Enhancement Act* (EPEA).
[2] 68% of the natural flow of the Beaver River and Cold Lake basins must be allowed to flow to the adjacent province (Saskatchewan).

- encourages the advancement of policies and practices for continued effort to steward the Beaver River watershed

A compilation of legislation, policy, plans and procedures relevant to the Beaver River watershed was prepared as a reference that will be available as part of the Beaver River IWMP. At the provincial level, the most notable changes to legislation, policies and plans since 2006 are the *Alberta Land Stewardship Act*, the *Alberta Wetland Policy*, and the Lower Athabasca Regional Plan (2012).

2.3 Scope

In response to recommendations put forward in the 2006 CLBR WMP, the IWMP:

- Includes the entire Beaver River watershed in its planning area
- Better reflects all stakeholder concerns, including First Nations and the Métis
- Improves municipal influence by providing recommendations related to municipal development planning, including area structure plans for lakeshore (subdivision) development
- Creates a more comprehensive plan by broadening the focus from a specific sector (i.e., oil/gas) to address additional resource management objectives that consider and reflect watershed-scale processes and needs
- Integrates and addresses wildlife and fisheries management issues
- Provides specific recommendations with more implementation detail, as opposed to general recommendations that are not easily implemented

The scope of issues addressed in the plan includes those identified in Section 5.0 and are subject to change according to further engagement with stakeholders, First Nations and the Métis.

Limitations

The IWMP will not:

- Gather new information to fill data gaps
- Formulate legislation, policy, or regulations
- Address air quality unless it relates to other watershed issues
- Consider the Saskatchewan portion of the watershed

3.0 PLANNING AREA

The Beaver River watershed is located in the boreal plain of east-central Alberta and west-central Saskatchewan (Figure 1), in Treaty 6, 8 and 10 territories and in the Métis homeland northeast of Edmonton (Figure 2). The Beaver River originates near the Town of Lac La Biche as the outflow from Beaver Lake. It flows in an easterly direction for about 250 km, flowing south of Cold Lake (*Kinosoo*- before entering Saskatchewan. The Cold River originates at the east end of Cold Lake in Saskatchewan becoming the Waterhen River, and continues flowing east to join the Beaver River. The river flows north and joins the Churchill River at Île à-la-Crosse before flowing into Hudson Bay. The length of the river from its source to its mouth is about 661 km. The total drainage area of the Beaver River at its confluence with the Churchill River is 50,003 km^2. About 22,000 km^2 of the watershed is in Alberta (Beaver River Watershed Alliance (BRWA) 2013).

Additional detail about the Beaver River watershed and its sub-watersheds can be found in Appendix C, and in the Beaver River State of the Watershed Report (BRWA 2013).

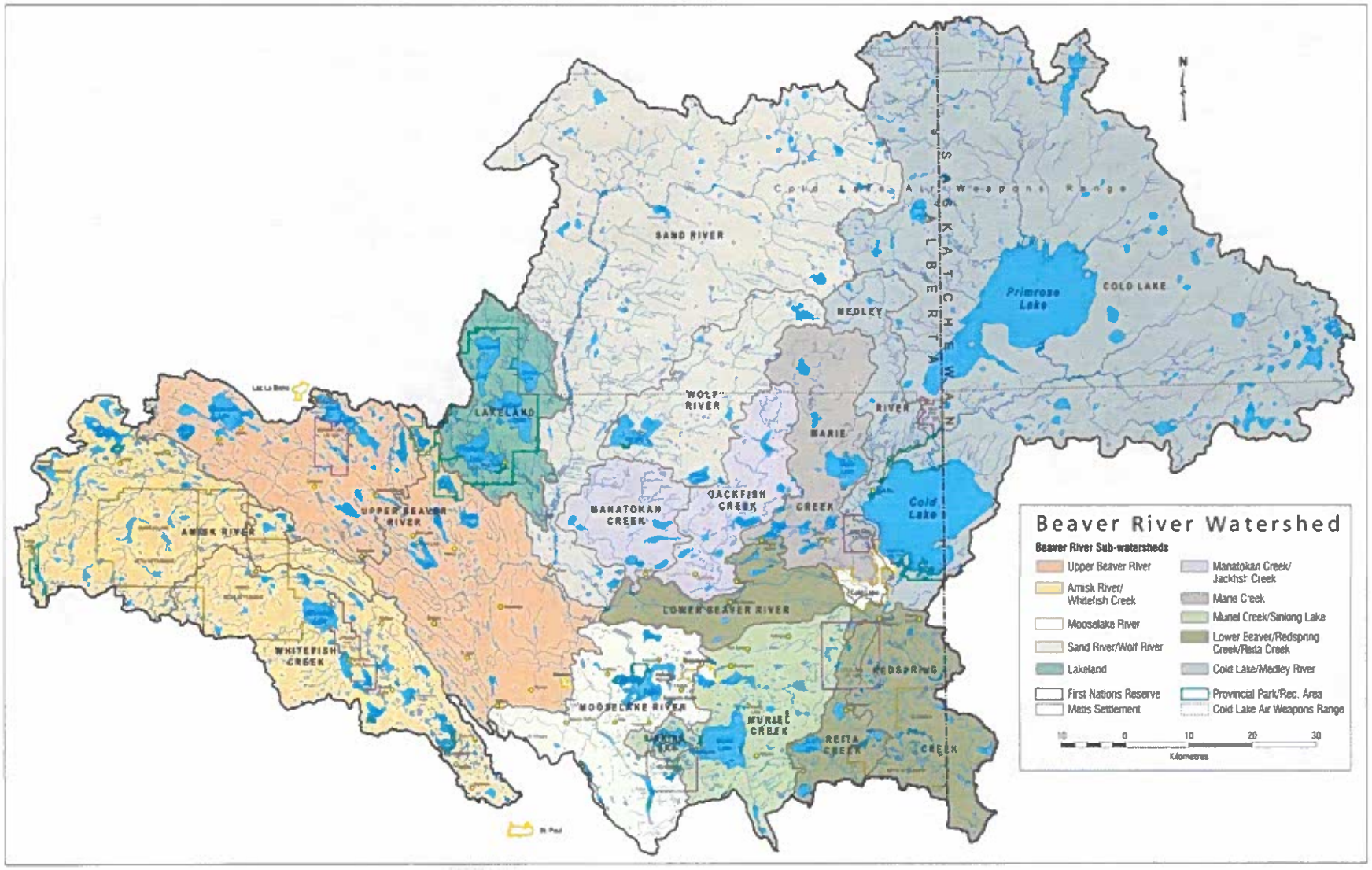


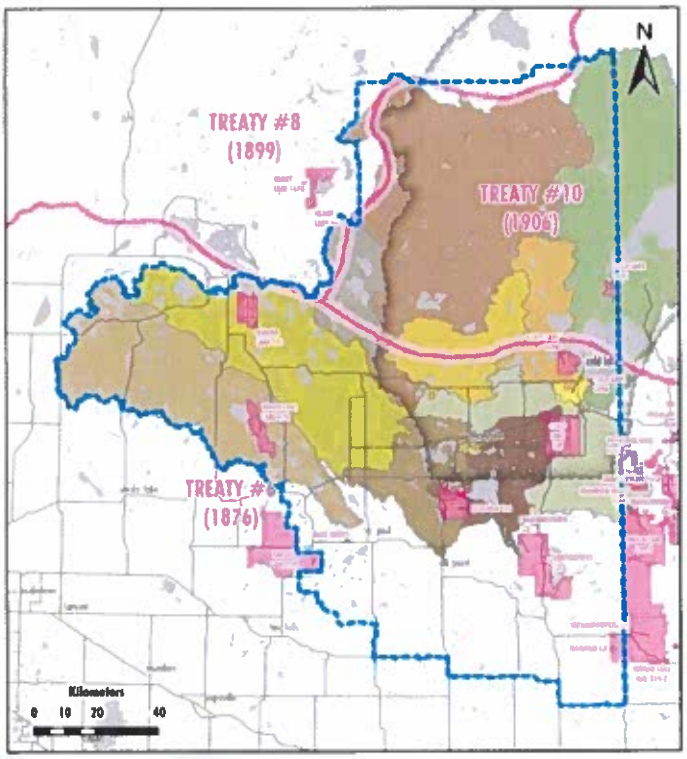
Figure 1. Map of the Beaver River watershed planning area (BRWA 2013).

A. Treaty Areas, Reserve Lands, Traditional Territories

Current LICA Boundary
Historic Treaty
First Nations' Reserve Land
Cold Lake First Nations - Traditional Territory

Beaver River Watershed Sub-Watersheds (amalgamated basins)

Amisk River Sub-Watershed
Cold Lake Sub-Watershed
Lakeland Sub-Watershed
Lower Beaver Sub-Watershed
Manatokan and Jackfish Creek Sub-Watershed
Marie Creek Sub-Watershed
Moose Lake Sub-Watershed
Muriel Lake Sub-Watershed
Sand River Sub-Watershed
Upper Beaver River Sub-Watershed



B. Metis Nation of Alberta Association Regions, Settlements

Current LICA Boundary
Metis Nation of Alberta Association (MNAA) Region
Metis Settlement

Beaver River Watershed Sub-Watersheds (amalgamated basins)

Amisk River Sub-Watershed
Cold Lake Sub-Watershed
Lakeland Sub-Watershed
Lower Beaver Sub-Watershed
Manatokan and Jackfish Creek Sub-Watershed
Marie Creek Sub-Watershed
Moose Lake Sub-Watershed
Muriel Lake Sub-Watershed
Sand River Sub-Watershed
Upper Beaver River Sub-Watershed

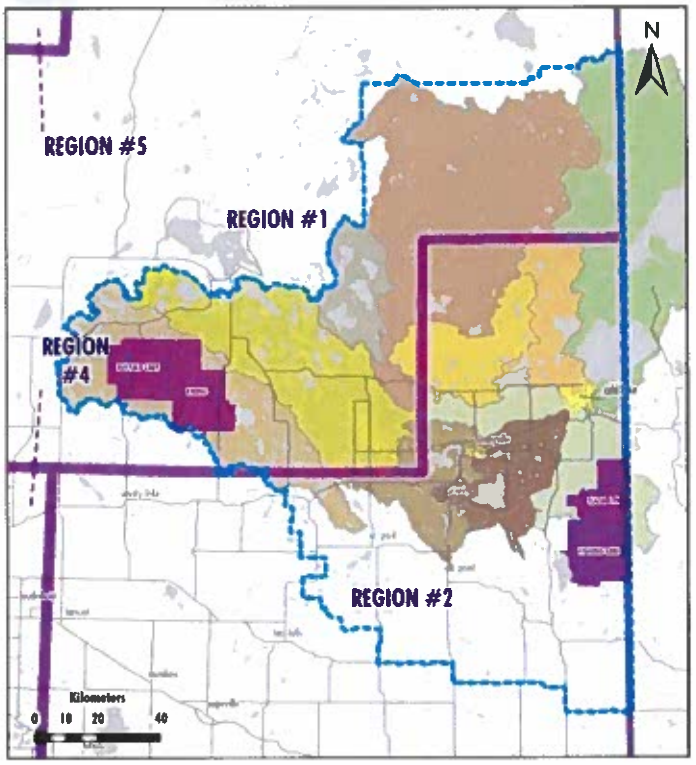


Figure 2. Maps showing A) First Nations treaty areas, reserve lands and traditional territories, and B) Métis Nations of Alberta Association Regions and Métis Settlements.

3.1 ~~Cumulative Effects~~ Human Footprint (to be refined)

Human presence in the Beaver River watershed dates back to time in memorial.

The Beaver River watershed is rich in natural resources and supports a variety of industries that contribute to the local, regional and provincial economy, including oil and gas, agriculture, mining, forestry, development, and tourism and recreation. The human footprint is an important indicator of watershed health. The cumulative impact of land use activities in the watershed can affect local hydrology, water quality, riparian areas and wetlands, and biodiversity by altering the natural system that functions to maintain balance in the watershed. The evolving human presence in the watershed and features key events that has shaped the watershed today is documented in the following figure (will update reference).

Pre-European Settlement
- Indigenous Peoples inhabited shores and woodlands in the watershed.
- Cold Lake was known as "Kinosoo" or "big fish" after Cree Legend.

→

1700s
- Western settlement. Angus Shaw, a fur trader in the North West Company, came to Moose Lake in 1789 and established the North West Company post on the Northwest shores of Cold Lake.

→

1876
- Signing of Treaty 6

1899
- Signing of Treaty 8

→

1900s
Two sawmills were operating on the north and east shores of Muriel Lake.

→

1906
- Signing of Treaty 10
- Traditional lands of the Dene, Cree, and Metis homeland continue to span the Beaver River watershed as members of Treaty 6, 8 and 10 territories.

1920-1930
- Tourism bloomed in the Cold Lake area with fishing a large attraction
- Major drought in the region (1920)
- A wildfire struck the timber around Muriel Lake. Much of the land transitioned to agricultural use from forestry, and the local sawmill lost timber supply.

→

1930s
- Jessie Lake dried up and looked like a hay field.

→

1949
- A natural gas field was discovered in the town limits.

1950s
- Flood at Muriel Lake (1950)
- Construction of Canadian Air Force Base Cold Lake began, resulting in the loss of Cold Lake First Nations Traditional Territory.

→

1980s
- Oil resources first tapped. In 1980, a plant near Cold Lake was one of only two under construction in the oil sands.
- Murphy Road was upgraded to a high-grade road dividing Muriel Lake to the west and its tributaries to the east (1987-1988)

1985
- Imperial Oil Ltd. began production of heavy oil in the region.
- Moose Lake Weir was built to improve fish and wildlife habitat, stabilize the lake level, and improve the water supply storage for the Town of Bonnyville.

→

2000
- Drought in the region

2010-2020
- Funnel Cloud touches down at Cold Lake (2016)
- Highest recorded lake levels at Moose Lake since 1966 causing flooding (2017)
- Wildfires at Moose Lake (2019)

→

2021
- Removal of Moose Lake Weir

In 2018, the total human footprint covered about 20% of the Beaver River watershed. Agriculture accounted for the largest percentage of the human footprint (72%), the oil and gas industry footprint accounted for 9%, roads and trails (7%) and forestry accounted for 6% of the total human footprint (Figure 3). Watershed management planning should consider the cumulative impact of land use and recommend strategies to minimize and mitigate impacts to watershed health.

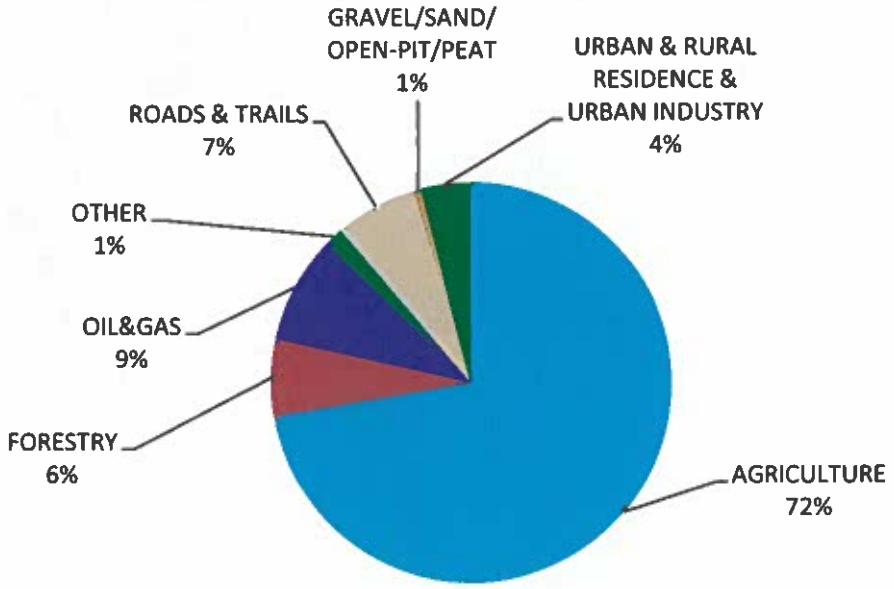


Figure 3. Summary of land use activities that contribute to the total human footprint in the Beaver River watershed (ABMI 2018).

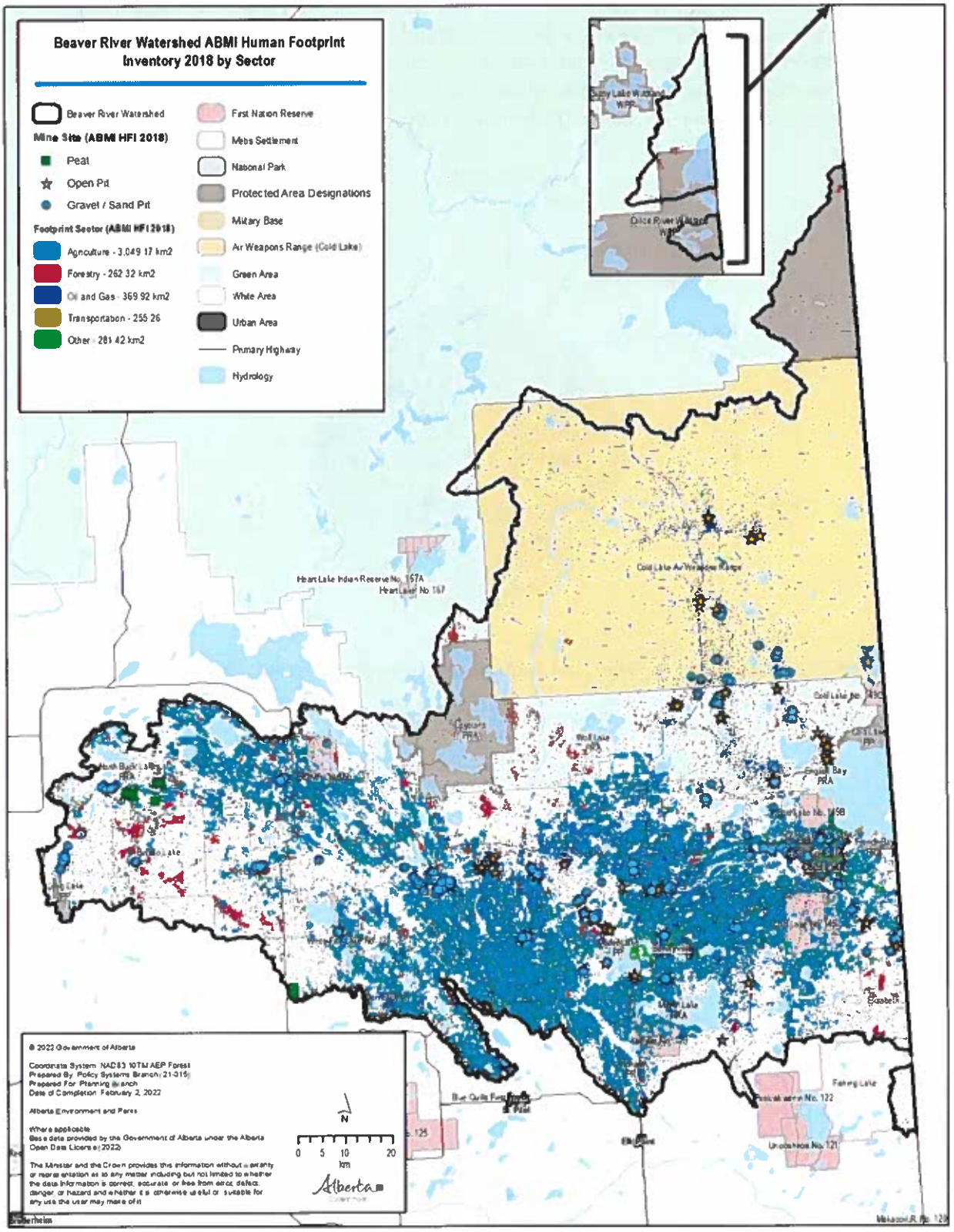


Figure 4. Human footprint in the Beaver River watershed (ABMI 2018; AEP 2022). A high-resolution map is available at www.lica.ca . The map inset shows two small parts of the watershed that are disconnected to the north from the larger watershed in Alberta, and are not visible at this scale.

4.0 INFORMATION ASSEMBLED

LICA worked closely with the IWMP Committee and technical advisors to compile relevant plans, policies and technical reports for the Beaver River watershed. In some instances, raw data was collected and analyzed to support **draft** recommendations. Refer to Section 12.0 for a complete list of literature cited in the development of this **draft** plan.

- Alberta Lake Management Society, LakeWatch Lake Water Monitoring Reports
- Aquatic Ecosystem Health Assessment Program (Fish-based Index of Biotic Integrity, 2009-2011)
- Beaver River State of the Watershed Report (2013)
- Bibliography of scientific research related to watershed issues (Section 12 Bibliography)
- Cold Lake-Beaver River Water Management Plan (2006)
- Community Groundwater Monitoring - Domestic Well Survey (2009, 2011)
- Enhanced Wetland Classification for Beaver River Watershed (Ducks Unlimited Canada 2010)
- Lakeland Uranium Study (2009-11)
- LICA long-term Soil Acidification Monitoring Project reports
- Stakeholder workshops held in 2013-2014 to identify and prioritize issues (BRWA 2013, BRWA 2014, CPP Environmental 2014)
- The Technical Advisory Team that reviewed and prioritized issues identified through prior stakeholder engagement (2016)
- Wetland Inventory (2009-10)
- Winter Lake Level Study (2008-11)

5.0 ISSUES, GOALS AND OBJECTIVES

5.1 Issues

The summary of issues reflects concerns expressed by the community during engagement (Section 8), as well as best available science. Concerns are related to surface water and groundwater quantity and quality, wetlands and riparian areas, biodiversity, land management, climate change and knowledge and understanding.

Surface Water

Quantity

- Fluctuating water levels (lakes and wetlands) and streamflows caused by climate change and climate variability (e.g., temperature, evaporation, and precipitation) that can:
    - Impact water availability for municipal water supplies, agricultural uses, and First Nations and Métis
    - Increase risk of flooding, and impacts associated with drought
    - Impact recreation activity
    - Alter aquatic, riparian and upland habitat
    - Alter land use (e.g., cultivation, development) around wetlands and ephemeral streams (watercourses that flow briefly in direct response to rainfall or snowmelt (USEPA 2015)).
- Surface water withdrawals.
- Altered drainage patterns and/or discharges of treated effluent, and stormwater.

Quality

- Water quality in lakes and streams does not meet desired end uses (e.g., drinking water, contact recreation, agriculture, Indigenous traditional practices, and/or wildlife and aquatic species needs) in some areas due to soil type and geology, climate change and variability, and/or influx of point and non-point source pollution from adjacent lands (e.g., nutrients, sediment, bacteria).
- The influx of nutrients originating from external sources and the internal natural cycling of nutrients contributes to eutrophication[3] in many lakes in the watershed.

Groundwater

Quantity

- Uncertainty regarding groundwater quantity resulting from climate change and variability, and withdrawals for human and industrial use.
- Limited understanding of the impact that groundwater withdrawals have on aquifer dynamics (e.g., shallow/deep aquifer interactions) and on lake water levels and streamflows (i.e., groundwater-surface water interactions).

Quality

- Human health concerns related to naturally occurring and/or human-caused mobilization (e.g., thermal mobilization[4]) of trace metals (i.e., arsenic and uranium) in concentrations above drinking water guidelines.
- Concerns related to land use, including potential contamination from improperly abandoned water wells, landfills, agricultural activity, septic fields and, oil and gas activity (casing failures).

Wetlands and Riparian Areas

- Loss of wetland and riparian areas and their respective functions:
  - Water storage (absorptive capacity, flood control) and water balance in lakes/streams
  - Groundwater recharge
  - Water quality (retention of nutrients, suspended sediment, soil and associated contaminants)
  - Biodiversity
  - Ecological services[5] (recreation, carbon sequestration, stormwater treatment)

Biodiversity

- Fragmented and poor-quality habitat, due to increased road density, access, recreational activity, industrial activity (e.g., pipelines, well-sites, mining [sand and gravel]), forestry and other developments).
- Changing abundance and/or size of certain fish and wildlife species in the watershed.
- Potential threat of terrestrial and aquatic invasive species (e.g., quagga mussel, Himalayan Balsam) in and adjacent to waterbodies in the watershed.
- Berries, plants and animals are safe to eat.

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[3] Eutrophication: Enrichment of aquatic ecosystems by plant nutrients (e.g., phosphorus and nitrogen); characterized by increased growth of plants and algae. The process of eutrophication can be accelerated by human activity (e.g., effluent disposal, land drainage), and can have negative impacts on aquatic health.

[4] Thermal mobilization: Refers to the mobilization of trace metals when heat or steam is used to assist in the recovery of heavy oil

[5] Ecological services: The direct and indirect benefits ecosystems provide for humans.

Land Management

- Cumulative impact of development[6] and industry[7] on water resources, ecosystem and landscape function (including riparian areas and wetlands), biodiversity, and First Nations and Métis traditional land use[8].

Climate Change

- Impacts of climate change as it relates to:
  - Water availability and quality
  - Increased risk of drought, fire and floods,
  - Pest management (e.g., forest insects and diseases)
  - Altered landscapes and habitat conditions
  - Risks to fish, wildlife, and vegetation

Knowledge and Understanding

- Gaps in knowledge and understanding of natural conditions and anthropogenic (human-caused) impacts on watershed function.
- Limited public understanding or use of First Nations and Métis Rights, Indigenous Knowledge[9] and Practices in the development and implementation of plans and policies.

5.2 IWMP Goals and Objectives

5.2.1 Overarching Goal

Collaborative management of land and water resources that results in a healthy Beaver River watershed.

The LICA IWMP Committee (2020) established that a healthy watershed supports interdependent human, animal, and ecosystem (aquatic and terrestrial) health where:

- Human health is described by individual and community physical, mental and social well-being, including the ability to express one's culture.
- Domestic and production animal health involves physical and psychological well-being that supports productivity, reproduction, and expressions of innate characteristics.

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[6] Development: Includes urban and recreation developments.

[7] Industry: Generally refers to oil and gas, forestry, agriculture, and sand and gravel extraction, among others

[8] Tradition Land Use: Traditional land use (TLU) refers to any land use by an Indigenous person that is rooted in their cultural identity and ancestral connection to certain areas. This includes the Treaty right to hunt, fish, and trap for food, but may also include plant harvesting and/or spiritual ceremonies. Analogous terms or phrases may include any combination of 'Indigenous', 'aboriginal', or 'ancestral' and 'users', 'land uses' or 'harvesting'. TLU is often shown as map data or geographic information in both qualitative and quantitative forms.

[9] Indigenous Knowledge: Traditional Knowledge held by First Nations, Inuit and Métis peoples that is transmitted from generation to generation. Indigenous Knowledge emerges from complete knowledge systems and is expressed in many formats (e.g., oral, ceremony, artistic creations, and artifacts). Indigenous Knowledge is not all in the past; there is continued growth, innovation and change in practices. Indigenous Knowledge includes history, law, spirituality, agriculture, environment, science, medicine, animal behaviour and migration patterns, art, music, dance, craft, construction, among others. Indigenous (Traditional) Knowledge is held collectively by all members of a community, although some members may have particular responsibility for its transmission. The terms "traditional knowledge" and "Indigenous knowledge" are sometimes used interchangeably (University of Alberta 2020; Government of Canada 2020b).

- Wildlife health involves resiliency under changing environmental conditions and the ability to sustain their ecological, social, and cultural roles.
- Ecosystem health involves the ability to maintain and improve organizational structure and function, resilience under stress, and to continuously provide quality ecosystem services.

5.2.2 Specific Goals and Objectives

Specific goals and objectives were formed to provide clear direction of purpose for the Beaver River IWMP (Table 1). The goals are broad statements that reflect the main concerns for natural resource management in the basin; the goals emphasize what the IWMP will accomplish (the outcomes of the Plan). Objectives were established to guide the planning process and achieve the goals. These objectives are measurable and may be used to indicate milestones throughout the planning process.

Table 5.1. Values, goals and objectives leading the development of the Beaver River IWMP.

Value	Goal (Outcome)	Objective
Water Quantity	Secure, reliable water supplies are available for desired uses (i.e., environmental, First Nations and Métis, municipal, agricultural, industrial and recreational).	1. Review and determine status of existing Water Conservation Objectives in the original Cold Lake Beaver River Water Management Plan (CLBR WMP 2006). 2. Review the need to establish Water Conservation Objectives for streams and lakes outside of the original CLBR WMP planning area. 3. Recommend strategies to address fluctuating water levels at priority lakes where human impacts contribute to flooding or low water levels in the watershed. 4. Recommend strategies that encourage water conservation. 5. Understand the status of current surface water and groundwater initiatives and recommend strategies to better manage the resource.
Water Quality	Surface water and groundwater quality that is protected from external sources of contamination, and are maintained within the range of natural variability~~, and meets end-use criteria~~.	1. Establish Water Quality Objectives for the Beaver River and select tributaries that are compatible with the Surface Water Quality Management Framework. 2. Establish Water Quality Objectives for major recreational lakes. 3. Identify stormwater management targets and Low Impact Development strategies to minimize development impacts to water quality (and quantity). 4. Identify appropriate land use, management and stewardship strategies to maintain and/or improve water quality.
Riparian Areas and Wetlands	Healthy riparian areas and wetlands contribute to watershed resiliency	1. Establish riparian[10] setbacks[11] and management objectives/targets that can be applied consistently throughout the watershed.

[10] Riparian: Riparian lands are transitional areas between upland and aquatic ecosystems that have soil and vegetation characteristics that reflect the influence of water. They have variable width and extent both above and below ground.
[11] Setback: A minimum distance that must be maintained between a land use or development activity and a waterbody/watercourse.

Value	Goal (Outcome)	Objective
	with respect to flood and drought, quality water, and critical habitat.	2. Recommend actions that contribute to healthy riparian areas and wetlands.
Biodiversity	Fish, wildlife, and plants are healthy and resilient to changing environmental conditions. Their ecological, social, and cultural roles in the watershed are sustained.	1. Identify appropriate land use targets and thresholds ~~(e.g., stream crossings and linear features)~~ to better understand and track cumulative impacts on aquatic and terrestrial habitat. 2. Recommend best management practices and actions that improve wildlife habitat, health, and biodiversity. 3. Recommend appropriate actions to address the risks associated with invasive species.
Land Management	Cumulative effects of diverse land uses are reduced or mitigated to maintain and/or improve ecosystem health.	i. Recommend appropriate water and land management practices that mitigate impacts of industry and development (i.e., urban, recreation, agriculture, oil and gas, forestry, and sand and gravel extraction), and maintain and/or improve ecosystem health.
Climate Change	Climate change considerations are central to all watershed-related planning and decision-making processes.	1. Recommend climate actions and climate change mitigation and adaptation strategies related to watershed management for consideration by decision-makers, resource managers and residents.
Knowledge and Understanding	Indigenous Knowledge and scientific research guide decision-making.	1. Assess and prioritize knowledge gaps in the Beaver River watershed. 2. Recommend outreach materials and other tools to disseminate Indigenous Knowledge, and scientific research related to watershed health.

6.0 INDICATORS, TARGETS AND THRESHOLDS

Indicators, targets and thresholds will be used to measure success in achieving watershed goals, objectives, and desired outcomes. Indicators were identified for major watershed values (Table 2). Indicators refer to an easily measurable attribute that reflect one aspect of the underlying condition or state of watershed health (ESRD 2012b). Examples of indicators include nutrient concentrations and riparian health scores. The indicators expand on those identified in the State of the Watershed Report (BRWA 2013). Criteria used to establish indicators included: relevance to the watershed, importance to residents and stakeholders, and measurability.

Targets and thresholds are numerical (quantitative) or written (quantitative statements) that reflect desired or achievable conditions of attributes used to measure watershed health. Targets are used to determine how valued components in the watershed rate or compare to acceptable or desired ratings and/or conditions. Interim targets, thresholds and objectives may be established when comprehensive or local data is unavailable.

Table 2. Watershed condition indicators for the Beaver River watershed.

Value	Indicator	Measure	Significance
Water Quantity	Water Supply	Streamflow volume (deviation from natural condition)	Streamflow and water levels should reflect a normal range of condition and support channel processes (erosion/bank building), aquatic life, the riparian environment and communities.
		Lake water Levels	Maintaining appropriate water levels supports: - Water supplies for communities - Recreation (boat access, beaches, fish habitat) - Aquatic life - Downstream needs for aquatic life and waste assimilation
		Water Conservation Objectives/Instream Flows	Established to maintain a minimum flow in streams to support aquatic life, or meet transboundary water apportionment.
	Water allocation and use	Water licences and registration; water use reports	Water supplies support aquatic life, communities and economic activity.
	Groundwater	Water levels	Groundwater is an important water supply.
			Groundwater contributes to the overall water balance in watersheds.
Water Quality	Lake trophic status	Phosphorus, chlorophyll *a* and secchi disk measurements	Deviation from normal conditions (established through long-term trend analysis) suggests a change in water quality (e.g., a degradation or improvement). Surface water quality should support designated or desired end uses.
	Water chemistry	Dissolved oxygen, salt, nutrients, metals, pathogens, other toxins (arsenic). Concentration and/or load, spatial and temporal trends	
		Number of parameters and frequency that parameters exceed established guidelines or objectives	Guidelines and objectives are established to determine water suitability for a variety of uses (e.g., drinking water, contact recreation, crop irrigation, livestock water, aquatic life).
	Aquatic Life	Species diversity and abundance	Tolerance of benthic invertebrates and fish to water quality conditions differs among species.
	Water temperature	Optimum (range) and maximum (threshold) water temperature	Optimum and maximum water temperature tolerance should be maintained to support all life stages of aquatic life.
	Recreation	Number of water quality advisories posted per year	Posted water quality advisories indicates poor water quality and concerns for human health.
Riparian Areas and Wetlands	Riparian function (lotic systems)	Riparian health scores (condition)	Functioning riparian areas contribute to water supply, water quality, river channel and shoreline stability, and biodiversity.
		Intactness (condition, extent)	
	Wetland cover (lentic systems)	Percentage wetland area	
		Wetland loss	

Value	Indicator	Measure	Significance
		Impact thresholds (i.e., footprint on each wetland type)	
Biodiversity	Fish, Wildlife and Vegetation	Species composition (variety of seasonal and resident species)	Aquatic and upland systems that support a diverse group of native fish, wildlife, and plant species are more resilient to ecological adversity or changes to environmental condition.
		Population estimates	
		Index of Biological Integrity	
		Regulated invasive plants, disturbance and rare plants	
		Percentage change in land cover (footprint, linear disturbance, critical habitat)	
		Watercourse crossings and stream connectivity.	Poorly placed or maintained crossings and culverts can increase sediment and erosion, and impede fish passage.
Land Use	Change to human footprint	Percentage change in land use cover (agriculture, forestry, oil and gas)	Monitors land use changes in the watershed, and quantifies cumulative impacts of multiple land uses in watersheds.
	Population	Census data	Important social and economic indicator for municipalities
		Growth rate	
	Recreation and Tourism	User data (day use, registrations)	Trends indicate whether pressure on resources is increasing, stable or decreasing.
	Access	Road density	High road densities can impact fish through increased sedimentation, impassable culverts that prevent upstream migration and increased harvest due to improved accessibility.

Recommendations in the IWMP will be reviewed using a social and economic filter. Watersheds should be liveable places and support thriving communities.

7.0 ROLES AND RESPONSIBILITIES

Watershed management planning and implementation of recommendations is a shared responsibility, and requires the collaboration of multiple levels of government, various industries (e.g., agriculture, oil and gas), non-government organizations, landowners, leaseholders, and residents in the watershed. The planning process is considered successful when stakeholders recognize and support their individual or shared responsibility for achieving the collective goals and objectives of the IWMP. General roles and responsibilities for Beaver River watershed management are further described below.

7.1 Lakeland Industry and Community Association

LICA will manage the development of the Beaver River IWMP including:

- Forming, managing and overseeing the IWMP Committee and their meetings
- Overseeing contractors and their work pertaining to IWMP development
- Managing product quality for reports, communication material, and any supporting documents
- Identifying and addressing data gaps

- Collaborating and engaging with stakeholders, First Nations, and the Métis throughout the process
- Ensuring the best combination of scientific information, Indigenous Knowledge and stakeholder, First Nations and Métis feedback is used to develop the IWMP
- Lead communication, education and engagement
- Helping to implement the IWMP by acting on action items in the IWMP implementation plan specific to LICA and providing support to others implementing the plan

IWMP Committee

The role of LICA's IWMP Committee is to provide technical knowledge and support to develop the IWMP, help to plan for future phases, and to ensure that the work is being conducted in a transparent manner (LICA IWMP Committee TOR 2020).

7.2 General: Stakeholders, First Nations, and the Métis

- Participate in engagement sessions to provide feedback at key stages in the development of the IWMP
- Respect, support and collaborate with other participants
- Support implementation of the IWMP to achieve common goals and objectives for the Beaver River watershed, where possible

7.3 Federal Government

The federal government performs a key role in shared management of watershed resources. The *Canada Water Act* enables co-operative agreements between the federal, provincial, and territorial governments to regulate, apportion, and monitor water resources, and to implement joint programs. The federal government has authority for water quality and publishes water quality guidelines pertaining to the environment, drinking water and recreation. The Department of Fisheries and Oceans oversees fisheries resources and fish habitat under the *Fisheries Act*. Other federal roles include pollution control, and the management of interprovincial waters (e.g., Cold Lake), navigation and water on federal lands.

Department of National Defence (CFB Cold Lake)

The National Department of Defence has created a Defence Environmental Strategy that identifies the military's approach to integrating environmental management into activities that support its mandate, including the use of best practices and sustainable development.

7.4 First Nations

The Beaver River watershed is located on Treaty 6, 8, and 10 territories. Beaver Lake Cree Nation, Cold Lake First Nations, Kehewin Cree Nation, and Whitefish (Goodfish) #128 Lake First Nations ~~(Goodfish)~~ have reserve lands and associated traditional territories located in this region.

First Nations have traditional values and rights, constitutional rights and key principles embodied in their treaties, which guide their way of life and jurisdiction in the watershed. Treaty rights are recognized and affirmed in the *Constitution Act* (S. 35), 1982. Treaty rights include protection of traditional ways of life, the right to occupy and use lands and resources (e.g., the right to hunt, fish and trap on unoccupied

Crown land), cultural and social rights, rights to consultation, and rights to participate in land and resources management decisions (Government of Canada 2020).

In 2007, the United Nations Declaration on the Rights of Indigenous Peoples was signed. The Declaration affirms and sets out minimum standard rights of Indigenous peoples related to self-determination and self-government, culture and identity, lands, territories and resources, and environment to name a few.

First Nations are reliant on healthy watersheds for sustenance, and to support their way of life. They retain Indigenous Knowledge and information regarding Indigenous Practices that can increase common understanding of watershed resources, and inform recommendations that support protection and/or restoration of water and land resources.

LICA wants to clearly communicate to First Nations that by participating in the Beaver River watershed planning process, First Nations will not abrogate any rights they have, and the obligation of governments to duly consult with First Nations will not be diminished. Neither the LICA Board of Directors, nor LICA staff considers any discussion entered into with First Nations to fall within any mandated duty to consult.

7.5 Provincial Government

The provincial government includes multiple ministries that are responsible for the management of public lands and natural resources on behalf of Albertans.

Alberta Agriculture and Forestry (AAF)

AAF is a *Water for Life* partner and shares responsibility for achieving its goals. AAF is responsible for the *Agricultural Operations Practices Act* (*AOPA*), legislation that sets manure management standards in Alberta. AAF strives to develop the agriculture and food industry, sustain the industry's natural resource base and encourage the development of rural communities.

Alberta Energy Regulator

The Alberta Energy Regulator (AER) was founded in 2013 as the single regulator of energy development (e.g., oil, oil sands, natural gas, and coal projects) in Alberta. AER regulates application and exploration, construction and development, and abandonment, reclamation and remediation activities. AER is authorized to make decisions on applications for energy development, monitoring for compliance assurance, decommissioning of developments, and all other aspects of energy resource activities. This authority extends to authorizations pursuant to the *Public Lands Act*, the *Environmental Protection and Enhancement Act* and the *Water Act* that relate to energy resource activities.

Alberta Environment and Parks (AEP)

AEP has a legislated mandate to manage air quality, water resources, waste management, cumulative effects, provincial Crown (public) lands, the bed and shore of naturally occurring water bodies, and biodiversity (including fish and wildlife resources). AEP is responsible for key legislation and policies influencing watershed management, including Alberta's *Water Act* and Wetland Policy.

7.6 Municipal Governments

The Beaver River watershed is represented by the rural municipalities of Athabasca County, County of St. Paul, Lac La Biche County, Municipal District of Bonnyville, Smoky Lake County, and Thorhild County. Urban centres include the City of Cold Lake, the Town of Bonnyville, and Village of Glendon.

Under Part 17 of the *Municipal Government Act* (MGA), municipalities have responsibilities in planning, regulating, subdividing, and developing land in Alberta. Municipalities have the authority to create statutory plans (i.e., intermunicipal development plans, municipal development plans, area structure plans, and area redevelopment plans) to identify future plans for development within municipal boundaries and the immediate surrounding area. Municipalities are required, by the MGA, to adopt a Land Use Bylaw that divides the municipality into districts, prescribes the types of land uses permitted, establishes development standards, and provides a system for issuing permits. Municipalities promote economic development in the region. Many municipalities also support programs, services and education initiatives that promote stewardship of watershed resources.

Agricultural Services Boards (ASBs) form part of the rural municipal government and are responsible for administering and developing programs to compliment Provincial legislation, including the *Agricultural Service Board Act*, the *Weed Control Act*, the *Agricultural Pests Act*, and the *Soil Conservation Act*. It is generally the role of the Agricultural Fieldman to implement the work plan established by the ASB.

Summer Villages

Summer Villages are designated municipalities established by the Government of Alberta. The Summer Villages of Bondiss, Bonnyville Beach, Mewatha Beach and Pelican Narrows are in the Beaver River watershed. All four Summer Villages have Land Use Bylaws in place, some with specific reference to shoreline management. The Association of Summer Villages in Alberta (ASVA) provides a forum for all Summer Villages in the province. The ASVA undertakes special initiatives that seek to address challenges facing Alberta's lake communities (e.g., Lake Stewardship Guide). Summer villages strive to minimize or mitigate human impact on the environment by promoting lake stewardship, including lake planning and implementation of actions that help protect water quality.

7.7 The Métis

Métis Nation of Alberta

The Métis Nation of Alberta (MNA) is the representative voice of the Métis people in Alberta. The MNA governance is divided into six regions across the province, including Region 1 and Region 2 that span areas of the Beaver River watershed. The MNA represents all Métis at the provincial and federal level. The MNA is striving to establish a modern-day treaty with the Federal Government that recognizes land and resource rights including secure harvesting rights, and rights to self-government.

In 2019, the MNA signed the first self-government agreement between the Government of Canada and a Métis government.

Métis Settlements

In 1938, the MNA lobbied for the *Métis Population Better Act* that provided Métis with a secure land base and services on Métis settlements. In the Beaver River watershed, the Métis Settlements of Elizabeth, Fishing Lake, Buffalo Lake and Kikino coordinate the development of natural resources with the GOA. The Métis Settlements General Council (MSGC), established by the *Métis Settlements Act,* addresses matters that affect the collective interests of the Métis Settlements.
The Métis Harvesting in Alberta Policy (2018) ensures that Métis people who are entitled to harvesting rights as guaranteed by the *Constitution Act (s. 35), 1982*, have the ability to hunt, fish and trap for subsistence (food). Both the Métis Nation of Alberta and Métis Settlement members have harvesting rights in designated harvesting areas if they have a demonstrated historical connection to a Métis

Harvesting Area in Alberta, and a contemporary connection to the same community. Harvesting Areas B and D are represented in the Beaver River watershed.

7.8 Industry

Agriculture

Agricultural lands cover about one-third of the watershed. About half of the agricultural land in the watershed is pasture land and 36% of the area is cropland. As a main industry in the Beaver River watershed, farmers and ranchers have a large role in watershed management, including the maintenance of water quantity and quality, and healthy riparian areas and grassland. Agricultural activity must comply with provincial legislation (*AOPA)*. The Grazing Lease Stewardship Code of Practice was signed by the Alberta Beef Producers, the Alberta Grazing Leaseholders Association, the Western Stock Growers Association, and the provincial government. The Code of Practice identifies the roles and responsibilities that public land grazing leaseholders have in land management.

Forestry

Two Community Timber Permit Programs are currently active in the Lac La Biche Forest Area's Forest Management Unit LO1. The programs' annual volume harvests are 30,000 m^3 of deciduous and 14,000 m^3 of conifer trees. All forestry operations in the watershed are conducted according to the Northeast Alberta Timber Harvest Planning and Operating Ground Rules (GOA 2018). Approximately 8 timber permits are issued annually to program members and competitive sale winners.

Oil and Gas

The Cold Lake oil sands deposit is one of the largest in Alberta. Since Imperial Oil began production of bitumen in 1975, oil and gas exploration and development has increased in the Beaver River watershed. Several companies now conduct *in situ* recovery operations from the Cold Lake oil sands, including areas within the Cold Lake Air Weapons Range (BRWA 2013). Oil and gas activity is regulated by the Alberta Energy Regulator. Oil and gas companies have a responsibility to develop resources in a way that minimizes impacts on watershed resources. The Canadian Association of Petroleum Producers (CAPP) encourages responsible development in the upstream oil and gas industry. CAPP aims to enable environmentally and socially responsible performance, and encourages the use of best management practices to reduce impacts on air, land, water, and people.

7.9 Watershed Stewardship Groups, Non-Profit Organizations, Academia

As partners in the *Water for Life Strategy*, Watershed Stewardship Groups (WSGs) are key partners in watershed management planning, beneficial management practice implementation, and education and outreach programs in the Beaver River watershed. WSGs encourage watershed stewardship at a local level. Similarly, many non-profit organizations support watershed management and stewardship efforts through planning, environmental condition monitoring and evaluation, and education initiatives. Universities and research institutes provide essential data and perspective on emerging watershed issues and environmental conditions by undertaking primary research. Academia may identify research needs, as well as suggest how data and knowledge gaps can be addressed.

7.10 Residents

Residents have valuable knowledge and insight about current watershed condition and can provide direction on how to achieve community goals. Residents also have a role in stewardship.

8.0 ENGAGEMENT PROCESS

8.1 Goal

Watershed stakeholders, First Nations and the Métis participate in the development of the Beaver River IWMP to ensure relevancy, long-term viability, and collaborative implementation of the plan.[12]

8.2 Engagement Objectives

1. Involve stakeholders, First Nations and the Métis in the IWMP development process
2. Share information with stakeholders, First Nations and the Métis about the IWMP, Beaver River watershed, and progress related to IWMP development
3. Identify and gather existing technical and scientific material to support the development of the IWMP, and address stakeholder, First Nations and Métis questions and concerns
4. Facilitate and establish a common public understanding of the hydrological, ecological, socio-cultural and economic state of the Beaver River watershed and associated issues
5. Obtain stakeholder, First Nations and Métis input at key stages in the development of the IWMP; consider this information alongside best scientific information and Indigenous Knowledge to develop credible recommendations for resource management
6. Promote communication between agencies responsible for watershed management, stakeholders, First Nations and the Métis to maximize collaboration and effective stewardship of the Beaver River watershed.

8.3 Engagement Opportunities

Stakeholder input to the IWMP is sought by the IWMP Committee at scheduled engagement sessions (Table 3). Opportunities for input will be provided during question, answer and discussion periods, through online response forms (surveys), and through written letters or email submitted to LICA or the IWMP Committee during the designated time periods. Throughout the engagement process, stakeholders, First Nations and the Métis are encouraged to contribute insight, ideas, technical information, and general input to LICA or the IWMP Committee who will consider it during the development of the IWMP. All summaries and reports related to stakeholder engagement can be found on the LICA website.

Table 3. Schedule of stakeholder, First Nations and Métis engagement at key stages in the development of the Beaver River IWMP.

Schedule	Engagement Session	Purpose
February-April 2021	1. Draft Beaver River IWMP Terms of Reference	• Review intent and scope of the Beaver River IWMP • Review and confirm watershed condition, key issues and opportunities for watershed management • Review roles and responsibilities • Review work plan and schedule • Seek input into availability of data, technical reports, research in the watershed relevant to the main IWMP objectives

[12] Appendix B lists key stakeholders in the Beaver River watershed.

Schedule	Engagement Session	Purpose
March 2022	2: Draft I Beaver River IWMP – Indicators, Targets and Thresholds, Early Recommendations	• Review "What we Heard: Session I • Review and confirm draft indicators, targets and thresholds • Review and discuss preliminary recommendations
June 2022	3. Draft II Beaver River IWMP Recommendations and Implementation Strategy	• Review "What we Heard: Session II • Review, discuss and refine recommendations and implementation strategy
December 2022	4. Final Beaver River IWMP Presentation	• Presentation of the Final Beaver River IWMP and summary of next steps

9.0 DRAFT RECOMMENDATIONS AND IMPLEMENTATION TABLES

Recommendations are put forward to address issues, and to achieve the objectives and outcomes listed in Section 5.0, Table 5.1. Relevant recommendations from previous planning initiatives were carried forward in the Beaver River IWMP. New recommendations were developed collaboratively to align with current initiatives and directions.

9.1 General Plan Administration

The Beaver River IWMP should be reviewed annually and used to develop work plans that will support active implementation of recommendations. LICA should assist in tracking IWMP implementation progress in collaboration with its partners and develop an annual plan implementation progress report to disseminate to stakeholders.

A more comprehensive review of the IWMP should occur every five years. At that time, the implementation status of the recommendations should be thoroughly reviewed; recommendations that have been achieved should be removed from the plan, new legislation, policies or plans should be documented, and new issues should be highlighted and addressed. LICA should lead the review and update of the plan in collaboration with stakeholder, First Nations and the Métis.

9.2 Water Quantity

9.2.1 Goals and Objectives (from Section 5.0)

Goal: Secure, reliable water supplies are available for desired uses (i.e., environmental, First Nations and Métis, municipal, agricultural, industrial and recreational).

Objective 1. Review and determine status of existing Water Conservation Objectives (WCOs) in the original Cold Lake Beaver River Water Management Plan (CLBR WMP 2006) (see 9.2.2 b).

Objective 2. Review the need to establish WCOs for streams and lakes outside of the original CLBR WMP planning area.

Objective 3. Recommend strategies that encourage water conservation and how to achieve them.

Objective 4. Understand the status of current surface water and groundwater initiatives and recommend strategies to better manage the resource.

9.2.2 Targets and Thresholds

A. Existing 1969 Master Agreement on Apportionment

Water management in the Beaver River and the Cold Lake sub-basins must adhere to the Inter-provincial Master Agreement on Apportionment (1969) that states:

> "Sixty-eight percent (68%) of the natural flow of the Beaver River and Cold Lake basins must be allowed to flow to the adjacent province (Saskatchewan)."

B. Existing Cold Lake-Beaver River Water Management Plan (2006)

Water management targets were established as recommendations in the CLBR WMP (2006) specifically for the Beaver and Sand rivers, and for May, Manatokan, Muriel, Reita and Tucker lakes (Table 9.2). In addition, general targets were established for other streams, lakes and wetlands in the watershed. Recommended targets relate to

- Diversions and withdrawals for industrial use (namely steam injection) and municipal purposes (refer to the next section for household and traditional agricultural use)
- Licensed withdrawals (restrictions when water levels reach a particular threshold)

This Beaver River IWMP confirms the continued use of existing targets (Table 4), and recommends that additional targets for rivers and lakes in the watershed be explored (Table 5).

Table 4. Established targets for select rivers and lakes named in the CLBR WMP (2006).

Watercourse/ Waterbody	Target	Objective
Rivers		
Beaver River	No diversions for steam injection purposes. Other diversions will be considered on a case-by-case basis, providing they do not harm these values and functions (Section 7.4.1, Recommendation 4 (AE 2006a)).	Protection of recreational values, fish populations, other freshwater aquatic life, and aquatic ecosystem functions.
Sand River		
Other Streams		
Lakes		
May	No licensed withdrawals (1985; Alberta Environment 2006a; Section 7.4.1, Recommendation 1).	Conservation of fisheries, wildlife and recreation.
Manatokan		
Muriel		
Reita		
Tucker		
Cold River and Long Bay	The cut-off level for industrial diversions from Cold Lake is 534.55 m a.s.l. When this cut-off level is reached, municipal withdrawals shall also be reduced through implementation of additional conservation measures (1985; AE 2006a; Section 7.4.1, Recommendation 2).	Maintain access to critical fish spawning habitats.
Lakes and Wetlands	No long-term diversions (i.e., more than one year) for steam injection purposes from lakes and wetlands in the CLBR Basin outside Cold Lake. Other diversions from surface waters will be considered on a case-by-case basis, providing they do not harm these values and functions. (Section 7.4.1, Recommendation 3 (AE 2006a)).	Protection of fish, wildlife and recreational values and aquatic ecosystem functions

C. Existing Household Statutory Right and Traditional Agricultural Registration

Under the *Water Act*, the Household Statutory Right provides for the use of up to 1,250 m^3 per year of water for human consumption, sanitation, the watering of lawns, gardens, trees and some animals. This water use must be associated with a household or dwelling place and the water must be sourced on or under the land where it is used. There is no document issued for household users who have priority over all other users in the basin.

When the *Water Act* was first proclaimed (1999), traditional agricultural users were encouraged to register their livestock use and establish priority within the prior allocation system. The Traditional Agricultural Registration is for water use within a farm unit of up to 6,250 m^3 per year for the purpose of raising animals or applying pesticides to crops. The water must be sourced on or under the land where it is used. A document provides record of the registration including the location of the water source and a priority number (first date of use). Registrations differ from licenses in that they cannot be transferred to another location. The registration is similar to a license as it determines who is entitled to receive water first during a water shortage.

D. Surface Water Allocation Directive (GOA 2021)

Uncertainty exists for the future condition of rivers flows and lake water levels in the watershed. This uncertainty stems from unknown developments that may be proposed, and the impact that climate change and climate variability may have on watershed hydrology in the future.

Water Conservation Objectives (WCOs) and Instream Objectives (IOs) are administrative tools that are implemented by the Director appointed to manage water under Alberta's *Water Act*. Currently, no WCOs or IOs have been established for watercourses in the watershed to protect low flow conditions, except for the Beaver River in the Master Agreement on Apportionment (1969) (AEP, pers. comm. October 19, 2021 meeting), and for select lake water levels in the CLBR WMP (2006) (Table 4).

In the absence of a Ministerial Order, water management plan, water conservation objective, or an environmental management framework, the Surface Water Allocation Directive (SWAD) (GOA 2021) is applied and provides water allocation and use guidance for all new water licences across all sectors, including Temporary Diversion Licenses (TDLs), under the *Water Act*.

Consistent application of the SWAD (GOA 2021) is recommended to address uncertainty of future water use (e.g., additional withdrawals) and its impact on low flow conditions (Table 5). An additional target is recommended to address high flow conditions that may impact lakeside communities where local infrastructures has been built on the floodplain (Table 5). Refer to Section 9.6.2 for targets established by the SWAD related to biodiversity.

Table 5. Application of the Surface Water Allocation Directive target to achieve low flow condition objectives and recommended target to maintain natural flow variation.

Condition	Target	Objective
Low Flow	In the absence of a Ministerial Order, consistently apply the Surface Water Allocation Directive (GOA 2021) for lakes and rivers in the Beaver River watershed where: i) A streamflow threshold of Q80 for headwater streams (Order 1-4) would be applied prior to approving temporary diversion license applications. Use mean annual discharge where possible as determined by the Alberta Flow Estimation Tool for Ungauged Watersheds and/or an evaluation of flow conditions at key gauging stations (Water Survey of Canada). ii) When streamflow falls below Q80, withdrawal from the upstream smaller creeks with stream order 1-4 are suspended. If flow at the key station continues to decrease below Q95 then stream orders 5 and 6 will be closed for diversion until sustainable flows are observed. iii) Water can be diverted from stream orders 7 and 8 with limitations to a cumulative diversion of 5% (GOA 2021).	Future withdrawals should not impact on the aquatic environment. moved from target Protection of water quality and aquatic life.
	A net increase in hydrologic connectivity where possible.	
Natural Variation	The number of unregulated streams and lakes in the watershed is maintained or increased.	Natural variability in streamflows and lake water levels support watershed health.
	A net decrease in flood damage from high water due to improved floodplain management.	Land use strategies are in place to minimize flood impacts to infrastructure.

9.2.3 Recommendations

9.2.3.1 General

a) In the absence of a Ministerial Order (specific advice or objectives), the Surface Water Allocation Directive (GOA 2021) should be used to provide consistent, predictable provincial water allocation guidance ~~consistently applied~~ in the Beaver River watershed (Table 5).

b) No new dams (as described in the 1985 CLBR Water Management Plan) should be constructed for water storage and multiple uses in the planning area (Alberta Environment 2006a Section 7.4.1, Recommendation 5).

c) As much is practicable, maintain hydrologic processes and connectivity in the watershed to minimize the potential to isolate lakes and wetlands from their catchment. Where water level drivers are understood, effort should be made to remediate hydrologic processes. Refer to Section 9.6 for linkages to fish and fish habitat, and beaver).

Naturalizing water levels and restoring connectivity through the removal of weirs, dams and dykes, should be carefully considered, particularly at waterbodies that have been modified in other ways to accommodate infrastructure such as railways and highways.

9.2.3.1 Groundwater

There are two regional groundwater models relevant to the Beaver River watershed: a model for the Cold Lake Beaver River Basin (that covers the footprints of the CLBR Basin), and a model for the South Athabasca Oil Sands Area (a newer model, but provides only partial coverage of the CLBR Basin).

The Alberta Geological Survey has used available regional models to determine groundwater availability based on the regional water balance. AER used this information to report on total allocations relative to availability at the HUC8 watershed scale. The allocated volumes were provided separately for "shallow" groundwater allocations obtained from within 150 m of ground surface (vs) deeper groundwater allocations obtained from depths greater than 150 m. Estimates of groundwater availability, and the ratio of allocation to availability is reported. The availability of deep groundwater is not currently reported for the area south of Cold Lake in the CLBR Basin.

The current groundwater models were developed at a regional scale, and only provide high-level regional information. The existing regional models can provide guidance on the overall long-term capacity of the groundwater system for withdrawals, but more localized models are needed to refine the current understanding of water balance, and groundwater-surface water interactions.

a) Continue to refine groundwater models in the CLBR area as information from the CLBR groundwater monitoring network becomes available. Future efforts may consider:
   i. An integrated modelling tool (including groundwater, surface water, land cover and climate) to assess long-term trends and predict cumulative effects on water resources in the future.
   ii. Subwatershed-scale groundwater models to refine current understanding of hydrological processes near key surface water features. This could include a desktop assessment of groundwater availability and use for specific aquifers to provide insight into the local water balance.

b) Alberta Geological Survey in partnership with AER should complete the mapping for deep groundwater availability and non-saline water use (south of Cold Lake) in the CLBR Basin.

c) There are 17 Groundwater Observation Well Network (GOWN) wells in the watershed (http://environment.alberta.ca/apps/GOWN/#). Most wells used to monitor water level and water quality are north of the Beaver River and east of the Sand River. Continue to monitor these wells, by collecting continuous water level data and annual water quality data. In addition to data storage in an online, interactive map that is publicly available, report on long-term trends and disseminate findings to the community every five years.

9.2.3.3 Monitoring and Evaluation

Lake water levels may vary depending on lake characteristics, interaction with groundwater, surrounding land cover, tributary characteristics, stream connectivity (impacted by anthropogenic and natural disturbance), climate change and climate variability. Fluctuating lake water levels are a concern for communities. While there is limited ability to manage natural flood and drought events, other factors impacting lake water levels may be managed.

a) Improve understanding of hydrological processes and drivers of fluctuating water levels for lakes and associated catchments to aid land use decision-making and stewardship. Based on a preliminary assessment of available data (Appendix D), current water level trends show
   - Declining lake levels at: Mann, Skeleton, Manatokan, Charlotte, Jessie and Muriel lakes
   - Increasing lake levels at: Kehewin, Pinehurst, Touchwood lakes
   - High variability in lake water levels at Mann, Marie and Muriel lakes

b) Lake water levels on First Nation lands and Métis Settlements are generally not monitored. Explore opportunities to implement collaborative lake level monitoring programs with First Nations and the Métis, as well as at other lakes in the watershed, particularly those proposed for increased recreational use (LARP 2012, CLSRP 2021), and/or where fish habitat restoration is a priority.

Flood maps that are generated using consistent methods are an important planning tools for municipalities. Municipalities have observed that the magnitude of floods in flood maps that are submitted as part of the development application process (i.e., at the Area Structure Plan stage) tend to be underestimated.

c) Flood maps should be created for lakes where development is occurring or planned using methods consistent with Provincial standards, and include the full extent of the floodplain. The flood maps should be used as an early planning tool for municipal planners, to inform infrastructure design (ditch/culvert sizing), and to educate land owners and land managers about risk of development in the floodplain. Priorities may include Crane (Moore) Lake, Moose Lake (due to many subdivisions) and Marie Creek.

9.2.3.4 Development

a) Development setbacks should account for natural variability in the hydrologic cycle, and be established with consideration for flood and drought conditions, as well as for riparian health. (Refer to Section 9.4.2, riparian management targets and thresholds). moved from b to a

b) Stormwater inputs from urban areas to lakes should be managed to maintain the natural variability of flow rate and volume in each system. By managing stormwater runoff rates and volumes, the quality of stormwater will also invariably improve (refer to water quality recommendations in Section 9.3.3).

Low impact development strategies can reduce stormwater runoff volume and rate, thereby contributing to maintaining water quality in receiving water bodies (City of Edmonton 2016). "Low impact" developments have post-development runoff conditions that mimic the pre-development rates and volumes for smaller storm events, and severe, infrequent events. This is generally achieved through the reduction of imperviousness and integration of "green infrastructure" and stormwater capture and use in developments.

c) Low impact development practices should be incorporated, wherever feasible, in all new developments and/or areas of redevelopment according to best available science. Low impact development practices may include, but not be limited to
   - A reduction in hard surface area
   - Stormwater capture and use

- Absorbent landscaping (e.g., rain gardens, increased topsoil depths)
- Standards for maximum footprint per lot/land area
- Stormwater retention (storage) in ponds and landscaped areas where runoff can be stored/absorbed
- Retention of natural areas. Gentle grades, cross-cutting slopes to reduce flow rates
- Dry riverbed and swales to direct runoff to treatment areas

9.2.3.5 Water Conservation

a) Encourage water conservation by all sectors.

Strategies for reducing household water use are listed in the Appendix: (this list will be put in appendix)

Outdoors

- Watering your lawn or garden in the morning or evening to minimize evaporation
- Adjusting sprinklers to only water the lawn (not the side of the house or sidewalk)
- Installing a rain sensor so your sprinklers don't turn on when it's raining
- Spreading organic mulch around plants to retain moisture
- Installing drip irrigation for shrubs and trees
- Converting some lawn space to a patio (with permeable paving stones) to reduce the area needing water
- Landscaping with native plants that won't need irrigation once established
- Installing a rain barrel to collect runoff from your roof to use for watering your garden
- Directing downspouts onto plants, lawn, or a rain barrel and away from impermeable surfaces
- Fixing any leaking faucets/pipes
- Using a broom instead of a hose to clean driveways and sidewalks

Indoors

- Install high efficiency showerheads
- Turn off faucets while shaving or brushing teeth
- Only run the dishwasher when full
- Install aerators in the kitchen and bathroom faucets
- Replace dishwashers, toilets, and washing machines with high efficiency models

b) Consider a study to investigate actual water used through Household Statutory Rights and Traditional Agricultural Use to inform water conservation efforts.

9.2.4 Implementation

Recommendation	Responsible Jurisdiction	Actions	Priority[a]
9.2.3.1 Low streamflows and lake water levels			
a) Consistently apply the SWAD	AEP	Consistently apply the SWAD when considering applications for water withdrawals or the temporary diversion of water.	H
b) Dams	AEP	Consider existing water supplies to meet the needs of water users in the Beaver River basin.	H
c) Hydrologic processes and connectivity	AER, Alberta Transportation, municipalities, Cold Lake Air Weapons Range, industry (oil and gas, agriculture)	Document the scale of the problem, prioritize culverts, assess need to remediate. Consider the outflow of Marie Lake (AB Transportation, CLAWR)	M
		See Section 9.6.3.5 for beaver management recommendations.	-
9.2.3.2 Groundwater			
a) Refine groundwater models	AB Geological Survey, AER, AEP, Industry, LICA, CLFN, municipalities	AEP should consider this recommendation as the regional Groundwater Management Framework is developed. Refer to existing groundwater numerical models where available (e.g., for Muriel and Skeleton lakes (2008-2010), developed to understand declining lake water levels (currently Muriel is a gaining lake)).	H
		Identify priority lakes where groundwater-surface water interactions are of interest (e.g., Crane Lake)	M
		Gather additional data from stakeholders to support groundwater modelling efforts (e.g., industry seismic/report mapping the groundwater, Environmental Impact Assessment work, Pengrowth? Muriel Lake basin).	M
b) Deep groundwater availability mapping	AB Geological Survey, AER	Continue with the provincial effort to map deep groundwater availability by completing the work for the Beaver River watershed.	M
c) GOWN wells	AEP	Continue to collect continuous water level data and annual water quality data at GOWN wells. Report on long-term trends and disseminate findings to the community every five years.	M
9.2.3.3 Monitoring and Evaluation			
a) Improve understanding of hydrologic processes	AEP, LICA	Assess available water level data (preliminary assessment in Appendix D), and report on historic and current water level trends.	H

Recommendation	Responsible Jurisdiction	Actions	Priority[a]
b) Monitor lake water levels of interest to First Nations and Métis	First Nations; Métis; AEP; LICA	Determine FN and Métis interests in lake and stream monitoring. First, identify culturally significant lakes[13]. Establish appropriate indicators to address interest, including lake water levels and water quality (Section 9.3).	H
c) Flood mapping	AEP; LICA; Municipalities	Collaborate to apply for funding and retain a consultant to complete the flood mapping. The Watershed Resiliency and Restoration Program (WRRP). This should be completed by AEP	H
9.2.3.4 Development			
a) Development setbacks	Municipalities	Use provincial flood maps where available to delineate floodplains. Establish appropriate setbacks.	H
b) Stormwater Discharge c) Low Impact Development	Municipalities	Explore concepts of Low Impact Development in urban areas to manage rates and volumes of stormwater discharge; consider deep frost and spring conditions (e.g., maximize retention in spring and release at a variable rate).	H
9.2.3.5 Water Conservation			
a) Encourage water conservation by all sectors.	AWC; Municipalities; Industry; Agriculture; LICA	The AWC should continue to publish and disseminate the water conservation and efficiency performance reports to all sectors and LICA every five years.	H
		LICA and municipalities should collaborate to establish water conservation performance targets for municipal water users as part of the Keep Our Lake Blue campaign (see Section 9.3.3.4). A 'friendly competition' could be struck among municipalities to help encourage participation.	M
	Residents	Participate in the Keep Our Lake Blue campaign.	H
b) Household and agricultural water use	AWC; Municipalities, LICA	Explore strategies for water use monitoring and reporting for household water users, and for agricultural water users.	L

[a]H=High Priority (implement in 1-3 years); M=Medium Priority (implement in 4-6 years); L=Low Priority (implement in 7-10 years)

[13] A lake may be viewed as culturally significant because it has been or is a source of subsistence fishing, where medicinal plants were or are grown and gathered, where a certain language is spoken, and/or has been or is being used as sacred traditional ceremonial grounds for the community.

9.3 Water Quality

Current and historic land cover and land use were examined to identify and explain the human influence on spatial and temporal patterns in water quality during the development of the 2006 Cold Lake-Beaver River Water Management Plan (AEP 2006). The differences in productivity among lakes were attributed to the amount of disturbance in each lake's watershed (AEP 2006b). Increasing land disturbance was correlated with increased lake productivity as indicated by high total phosphorus concentrations (AEP 2006b). Water depth was also significantly correlated with lake productivity (as indicated by total phosphorus concentration); as water depth increased, productivity decreased (AEP 2006b).

In 2013, CPP Environmental (2013) identified potential suitable watershed-scale indicators that influence lake water chemistry. Relationships were derived between water quality of 25 lakes and lake morphometry, natural watershed metrics and land cover, and land use. Natural landscape features (e.g., lake depth) and indicators of human disturbance (e.g., agricultural intensity and disturbance associated land use cover) were significantly related to nutrients, ions and metals in lakes. Key findings:

- Nutrient concentrations and algal biomass tend to be higher in shallower lakes (AEP 2006b; CPP Environmental 2013)
- Landscape position influences salts and minerals; the higher the landscape position the more evaporation and climate are factors; the lower the landscape position, groundwater influences become the greater factors (CPP Environmental 2013)

Current water quality conditions of concern:

- Low dissolved oxygen in winter months (Beaver River)
- Elevated nutrient concentrations during the summer months (streams and lakes)
- Water quality impacts due to recreation (e.g., shoreline erosion, debris left behind from ice fishing activities)

9.3.1 Goals and Objectives (from Section 5.0)

Goal: Surface water and groundwater quality that is protected from contamination, maintained within the range of natural variability, and meets end-use criteria.

Objective 1. Establish Water Quality Objectives for the Beaver River and select tributaries that are compatible with the Surface Water Quality Management Framework.

Objective 2. Establish Water Quality Objectives for major recreational lakes.

Objective 3. Identify stormwater management targets and Low Impact Development strategies to minimize development impacts to water quality (and quantity).

Objective 4. Identify appropriate land use, management and stewardship strategies to maintain and/or improve water quality.

9.3.2 Targets and Thresholds

A. Beaver River

General provincial water quality guidelines are established for livestock water, irrigation water, contact recreation and the protection of aquatic life for many physical, chemical and biological parameters (GOA 2018) (Table 6). These guidelines can be used to determine if water quality is meeting the quality necessary for irrigation, contact recreation and protection of aquatic life when site-specific water quality objectives are not available. Although the Cold Lake-Beaver River planning area was included in the Lower Athabasca Regional Plan (GOA 2012), the Surface Water Quality Management Framework did not establish water quality objective triggers and limits for either the Beaver River or its major tributaries (GOA 2012).

Site specific water quality objectives for the Beaver River are defined by the Prairie Provinces Water Board (PPWB) under the 1969 Interprovincial Master Agreement on Apportionment. These objectives were last updated in 2021 (PPWB 2021) (Table 6; Appendix F). Nutrient objectives were developed with a two-tiered approach depending on whether there was a significant trend in the historical dataset. When there was a significant trend, two objectives for a season (open or closed) were established: Open water season (April 1 to October 31st) and the Closed ice-covered season (November 1 to March 31). The first objective being the 90th percentile of the lowest ten years and the second objective the 90th percentile of the period of record. A 10% excursion frequency is expected for the period of record objective, while the expected frequency using the lowest ten years in not known and will be different among parameters and each site because of the different nature of the trends for each parameter and each site (PPWB 2013).

B. Select Tributaries

Tributaries were selected based on availability of water quality data and the relative contribution of flow to the Beaver River. A minor amount of data was available for the Wolf River for 1984 (8 samples), 1985 (2 samples) and 1986 (1 sample). All samples were collected in the months of November to February.

- Sand River at the confluence with the Beaver River (2003-04 and 2010-2014 data) (Table 7)
- Yelling Creek upstream of the confluence with Chickenhill Creek and at Hwy 28 near Mallaig (March and April samples only, 2004-2007; June-August 2017, 2019 and 2020 (LARA 2021)) (Table 7)

A summary of existing water quality data for other tributaries to Moose Lake is provided in Appendix E.

Data collected in future water monitoring programs at the Beaver River and at main tributaries, may be compared to the benchmark data, as well as to other applicable water quality guidelines to identify spatial and temporal trends (e.g., improving, stable or degrading). The results of the future water monitoring program should be used to establish comprehensive site-specific water quality objectives for tributaries not currently monitored by AEP, PPWB or LARA.

Table 6. Existing provincial guidelines (GOA 2018) and water quality objectives (PPWB 2021) for select water quality indicators.

Indicator	Significance	Provincial Guideline	Beaver River WQOs	
			Open	Closed
Physical/Routine				
pH, pH Units	Influences biochemical processes, has implications for aquatic life.	≥6.5 and ≤9.0	≥6.5 and ≤9.0	≥6.5 and ≤9.0
Dissolved Oxygen, mg/L	Indicator for aquatic life.	Acute: ≥5.0 Chronic: ≥6.5 Mayfly Emergence: ≥8.3; mid-May to end of June	≥5.0	No Objective
Temperature, °C (See Section 9.6.2.1)	Influences biochemical processes and metabolism of micro-organisms. Thresholds important to various life-stages of fish.	-	-	-
Total Dissolved Solids, mg/L	Indicator of ions in water.	Irrigation: 500 to 3500 Livestock: 3000	≤500	≤500
Specific Conductance, µS/cm	Can interfere with plant growth, indicator of ions in water.	≤ 1,000: safe for irrigation >1,000 to <2,000: Possibly Safe ≥2,000: unsafe for irrigation	-	-
Total Suspended Solids, mg/L	Can transport nutrients and contaminants downstream, can bury fish spawning habitat, impact wear-and-tear of equipment, and reduce water treatment efficiency. May have regulatory requirements.	Maximum increase of 25 mg/L from background levels for short-term exposure (<24 hours). Maximum increase of 5 mg/L from background levels for long-term exposure (24 hours to 30 days).	3.0-48.8	3.0-48.8
Nutrients				
Total Phosphorus, mg/L	Stimulates plant growth in aquatic systems, implications for conveyance, recreation and aquatic life.	**Where site-specific nutrient objectives do not exist:** Nitrogen (total) and phosphorus concentrations should be maintained to prevent detrimental changes to algal and aquatic plant communities, aquatic biodiversity, oxygen concentration, and recreational quality.	0.171	0.127
Total Dissolved Phosphorus, mg/L			0.060	0.060
Total Nitrogen, mg/L	Can stimulate plant growth. Nitrogen fractions can be a concern for potable water.		1.140	1.862
Nitrate as N, mg/L	Concern for potable water and can stimulate plant growth.	3 (chronic 30-d average) 124 (acute instantaneous maximum)	3	3
Bacteria				
Enterococcus spp. (qPCR), cce/100 mL	Bacterial contamination can impact human health via drinking water, irrigation and contact recreation.	<300 (Geometric Mean (30-d interval) <1,280 (Statistical threshold value, no more than 10% of samples should exceed over a 30-d interval)	-	-
Fecal Coliform Bacteria, cfu/100 mL		≤100	≤100	≤100

Table 7. Water quality at the Sand River and Yelling Creek. Red text indicates that the value did not meet the provincial water quality guideline (GOA 2018). Additional tributary data is summarized in Appendix F-2.

Indicator		Sand River				Yelling Creek					
						At Hwy 28 Near Mallaig				U/S ChickenHill	
Parameter	Statistic	N	Open	N	Closed	N	2004-07[a]	N	2017, 19 & 20[b]	N	2004-07[c]
Seasonal											
Total Phosphorus, mg/L	90th		0.098		0.041		1.215		1.10		2.668
	Median		0.083		0.035		0.843		0.56		1.610
	Min		0.022		0.022		0.381		0.46		0.354
	Max		0.098		0.045		1.430		3.10		3.260
Total Dissolved Phosphorus, mg/L	90th		0.024		0.022		1.01		0.60		2.33
	Median		0.019		0.013		0.691		0.36		1.125
	Min		0.012		0.008		0.287		0.091		0.133
	Max		0.025		0.024		1.14		0.98		2.98
Total Nitrogen, mg/L	90th		ND		ND		6.337		4.200		7.225
	Median		1.000		1.000		4.142		2.800		4.756
	Min		ND		ND		2.025		2.000		1.650
	Max		ND		ND		7.650		8.000		8.900
Nitrate as N, mg/L	90th		0.016		0.164		1.035				2.746
	Median		0.002		0.019		0.675				0.985
	Min		0.002		0.002		0.285				0.0003
	Max		0.019		0.200		3.3				6.12
Dissolved Oxygen, mg/L	90th		11.53		5.24		7.94				12.19
	Median		9.11		3.88		5.92				11.33
	Min		8.38		2.43		0.50				9.27
	Max		11.83		5.24		10.61				14.69
Annual											
Water Temperature, °C	90th				19.98		5.37				9.62
	Median				6.64		0.68				0.52
	Min				-0.33		0.19				-0.16
	Max				21.75		6.72				11.39
pH, pH Units	90th				8.18		7.33				7.85
	Median				7.94		7.16				7.36
	Min				7.03		6.91				7.08
	Max				8.57		7.39				8.23
Total Dissolved Solids, mg/L	90th				219		267				291
	Median				144		196				203
	Min				88		108				105
	Max				227		378				338
Specific Conductance, µS/cm	90th				381		511				552
	Median				212		357				368
	Min				162		207				198
	Max				406		683				650
Total Suspended Solids, mg/L	90th				48		18		25		81
	Median				3		4.5		5		20
	Min				1		1		2		4
	Max				58		22		30		232
Fecal Coliform Bacteria, cfu/100 mL	90th				58		210		347		100
	Median				25		5		116		10
	Min				10		5		16		5
	Max				70		330		410		270

[a] March/April **Instantaneous discharge:** 90th Percentile0.492 m^3/s; Median: 0.137 m^3/s; Min: 0.009 m^3/s; Max: 0.562 m^3/s;

[b] Source: LARA 2021.

[c] March/April **Instantaneous discharge**: 90th Percentile: 2.669 m^3/s ; Median: 0.501 m^3/s : Min: 0.010 m^3/s ; Max: 5.630 m^3/s

C. Lakes

The provincial water quality guidelines provide a general target for nitrogen and phosphorus concentrations for lakes in Alberta (Table 8). Site-specific objectives can be established by assessing the trophic status of lakes to indicate productivity. Values associated with lake productivity indicators are reported by Nurnberg (1996) (Table 8). Chlorophyll *a* is an indicator used to measure phytoplankton (algae) suspended in water. The visibility of a Secchi disk at depth measures water transparency in a lake that is partly influenced by the presence of algae (Noton 1998).

Table 8 summarizes water quality targets for lakes. Site-specific targets should be developed for lakes that have need for increased management and sufficient water quality available. Table 9 lists monitored lakes and their associated trophic status. Management strategies to maintain lake water quality are recommended in Section 9.3.3.

Table 8. Water quality targets for lakes in the Beaver River watershed (GOA 2018 and Nurnberg 1996).

Source	Target		
GOA 2018	No increase in total phosphorus (or nitrogen) above historic conditions should occur at all lakes in the Beaver River watershed. Where nitrogen and/or phosphorus have increased due to human activity, develop lake-specific nutrient objectives and management plans where warranted.		
General	Reduction in external phosphorus load to lake nutrient budgets where it has been quantified.		
	Where a current nutrient budget exists and indicates anthropogenic impacts to water quality from external sources (e.g., from point-source discharge, recreational activity, other), efforts should be made to reduce the external phosphorus load.		
Water quality associated with trophic classes (Nurnberg 1996)			
Trophic Class	Chlorophyll a (mg/m^3)	Total Phosphorus (mg/L)	Secchi Depth (m)
Mesotrophic	3.5-9.0	0.010-0.030	4 - 2
Eutrophic	9.0-25.0	0.030-0.100	2 - 1
Hyper-Eutrophic	>25	>0.100	<1

Table 9. Baseline trophic status condition of lakes in the Beaver River watershed (ALM Reports; AEP Trophic Graph). Italicized and bolded lake names are those that were of community interest and identified during engagement.

Sub-Watershed	Oligotrophic	Mesotrophic	Eutrophic	Hyper-Eutrophic
	Increasing Productivity →			
Amisk		Amisk Lake North Buck ***Skeleton Lake North*** Whitefish Lake	***Long Lake*** ***Skeleton Lake South*** Floating Stone Lake Garner Lake Goodfish Lake ***Upper Mann Lake***	*Lower Mann*
Cold Lake		Cold Lake Primrose Lake - S Basin	Primrose Lake - N Basin	
Lower Beaver River		Angling Lake		
Manatokan/Jackfish		Bourque Lake	Tucker Lake	

Sub-Watershed	Oligotrophic	Mesotrophic	Eutrophic	Hyper-Eutrophic
	Increasing Productivity →			
Marie Creek		***Crane (Moore) Lake*ALMS*** Ethel Lake Hilda Lake ***Marie Lake***		
Moose Lake		Chickenhill Lake	Minnie Lake ***Moose Lake***	***Kehewin Lake***
Muriel Creek		Beartrap Lake Garnier (Bluet) Lake	***Muriel Lake***	Jessie Lake
Sand River - Lakeland		Pinehurst Lake Touchwood Lake Wolf Lake		
Upper Beaver		Elinor Lake	Beaver Lake Fork Lake Kinosiu Lake	

9.3.3 Preliminary Recommendations

9.3.3.1 Maintain and Improve Water Quality

a) Maintain and/or improve water quality condition in lakes and streams by reducing external nutrient[14] and sediment inputs through BMP implementation appropriate to each sector (see 9.3.3.2 to 9.3.3.6).

b) Adopt riparian health targets and apply riparian setbacks to maintain functioning riparian areas and wetlands that contribute to improved water quality, stable streambanks, and reduced erosion in the watershed (see Section 9.4 Riparian Areas).

c) Retain wetlands. Mitigate loss or degradation of wetlands, and replace wetlands to maintain water quality (see Section 9.5 Wetlands).

d) ~~Review~~ Assess septic and sewage discharges to the Beaver River, tributaries, and lakes; upgrade systems that contribute to external nutrient loading to surface water using incentives where possible.

e) Industrial reclamation should meet end-use criteria according to current requirements. (move to 9.3.3.4?)

[14] At Ethel Lake, the external sources of phosphorus contributed about 32% of the load (12% attributed to residential areas, 15% to atmospheric deposition, and 5% to the inflow from other lakes. At Moose Lake (2017-2019), 80% of the P load originated from external sources; internal loads represented a large proportion (60-70%) of phosphorus loads during summer for the bays without large tributary inflows: Vezeau, Bonnyville Bay and Island Bay (Associated Engineering 2021).

9.3.3.2 Agriculture

a) For agricultural areas, consider the following beneficial (best) management practices to protect and maintain water quality:
   i. Provide off-stream watering (seasonally or year-round) to prevent livestock from wading in lakes, streams and wetlands. Off-stream watering has proven to increase weight-gain, and reduce scours and hoof problems in livestock.
   ii. Manage stocking rate, timing and duration of livestock on grazing lands to maintain healthy upland pastures.
   iii. Use temporary or permanent fencing adjacent to lakes, watercourses and wetlands to maintain healthy riparian areas, when management of stocking rate, timing and duration on grazing lands cannot be met.
   iv. Develop grazing management plans that promote healthy riparian areas identified by stable streambanks, and supported by deep rooted vegetation.
   v. Use bioengineering techniques to stabilize and restore eroded streambanks, where possible.
   vi. Practice soil conservation on cropped lands to reduce soil erosion, conserve topsoil and protect water quality.
   vii. Minimize or eliminate the use of herbicides and fertilizers adjacent to watercourses. Apply according to *AOPA*.

9.3.3.3 Forestry

a) Apply forest industry standards to harvest practices according to the Northeast Alberta Timber Harvest Planning and Operating Ground Rules (GOA 2018):
   I. Avoid excessive soil disturbance through careful planning
   II. Avoid construction or harvest near ephemeral draws, tributaries and source water areas. Maintain adequate buffers (minimum setbacks for disturbance from watercourses and wetlands (Appendix H-3)
   III. Conduct proper road construction, maintenance and reclamation. Culverts should be properly sized and installed correctly so as not to affect the natural flow of water or increase soil erosion. Consult the Code of Practice for Watercourse Crossings
   IV. Minimize the number of roads crossing streams and wetlands, and reduce the use of culverts using clear-span bridges on fish bearing streams where practical.
   V. Avoid steep slope road construction or logging activity.

9.3.3.4 Oil and Gas

a) Consider the following to maintain water quality,
   I. Apply industry standards and practices to oil and gas development in the watershed according to 'Integrated Standards and Guidelines: Enhanced Approval Process (EAP)" (GOA 2012).
   II. Assess strategies to reduce water quality impacts from road construction and stream crossings, including
      1. Use of existing roads and horizontal drilling techniques to access resources.
      2. Collaborations with other industry sectors on road development planning.

9.3.3.5 Urban Areas

a) Implement strategies to improve the quality of urban stormwater ~~runoff entering~~ discharged to surface water. Consider the following:
   i. Inventory stormwater outfalls and place a sign at each site with outfall number/name.
   ii. Ensure proper storage, handling and application of road salt in winter, and herbicides and pesticides during the growing season.
   iii. Use stormwater ponds and low impact development practices that manage stormwater volume and release rate, and improve stormwater quality.
   iv. Conduct a water quality study to assess stormwater quality based on development type.
   v. Educate residents about their role in stormwater management.
   vi. Engage partners to implement the Yellowfish Road Program in local schools.

b) Stockpiled snow, when melting, can be a significant source of contaminants (e.g., salts, nutrients and sediment) to surface water. Care should be taken to stockpile snow away from surface water.

9.3.3.6 Tourism and Recreation

a) Collaborate with OHV clubs and trappers to construct bridges at watercourses on main trail systems.

b) Develop and provide educational stewardship resources for specific tourism and recreational users, that may include OHV clubs, campgrounds and resorts, and ice fishermen.

9.3.3.3 Monitoring and Evaluation

Currently, Alberta Environment and Parks monitors three locations at the Beaver River: At Gravel Pit U/S AB_SK Border, At Hwy 892 and At Hwy 28 Near Beaver River Crossing. These sites satisfy the needs of the PPWB's WQO assessments. In addition to the lower reach of the Beaver River (downstream of Hwy 28), there is interest in water quality in the upstream of the confluence with the Sand River to the headwaters. Additional water quality data at major tributaries to the Beaver River (e.g., the Sand River) and to recreation lakes would help determine sources of nutrients or other parameters of concern.

a) Implement a water monitoring program for major rivers that includes the mainstem Beaver River upstream of Hwy 28, and its major tributaries. Monitoring locations should correspond with Water Survey of Canada gauging stations where possible. Recommended sites are:
   - Upper Beaver River, including at Hwy 881
   - Sand River
   - Amisk River
   - Martineau (Primrose) River
   - Medley River

   Objectives of the major river monitoring program should include to
   i. Establish baseline conditions
   ii. Evaluate current water quality conditions with respect to established guidelines and objectives

iii. Maintain long-term records to examine trends in the relationship to land cover, land use and climate change and climate variability
iv. Report and disseminate findings to the public to encourage stewardship

Water quality should be reported annually and the monitoring program reviewed every three-to-five years.

b) Continue to monitor lake water quality in the watershed. Consider expanding the ~~lake~~ monitoring program to include lakes not currently monitored and where community interest is high (e.g., Fishing Lake). Integrate the Indigenous Lake Monitoring Program and other ways of knowledge generation into the program (e.g., give examples).

Lake characteristics should be used to help refine monitoring programs. Consider unique features of individual lakes to identify parameters that reflect local geology, and/or historic and current land use that may influence water quality (e.g., sulphate resulting from fertilization of lakes with sulphur in the 1930s to increase fish production; lake mixing and internal nutrient sources – iron, sulphur and phosphorus cycles).

Where possible, group similar lakes based on

- Lake depth (shallow (mixed) lakes vs. deep (stratified) lakes)
- Water residence times to indicate sensitivity (long residence time higher sensitivity, short residence time less sensitive)
- Landscape position: headwaters tend to be more productive
- Internal vs. external loading processes (combined previously 9.3.3 e, g, h)

c) Implement a lake tributary monitoring program. Lake tributary monitoring objectives may include

- Establish baseline conditions
- Detect changes in water quality
- Inform lake nutrient budgets

d) In addition to water chemistry, the monitoring program should consider other water quality indicators, including fish and benthic invertebrates. Explore the use of the Canadian Aquatic Biomonitoring Network (CABIN) protocol[15] for tributaries in the basin.

e) Discharge (streamflow) measurements should accompany the water quality monitoring program to better understand nutrient load and flux.

9.3.3.4 Lake Stewardship

a) Explore opportunities to support lake stewardship initiatives that improve and maintain water quality with residents and rural landowners. Keys areas of focus may include:
   i. Adopting programs such as Keep Our Lake Blue to encourage participation from all stakeholders.

[15] The Canadian Aquatic Biomonitoring Network is a monitoring program developed by Environment and Climate Change Canada that provides a standardized sampling protocol and recommended approach to assess aquatic ecosystem condition. Benthic macroinvertebrates are collected as part of the program as an indicator of condition.

ii. Winter recreation impacts, including management of the input of debris from winter recreation activities.
iii. Hosting Septic Sense Workshops
iv. Tree planting or shoreline restoration using bioengineering techniques

9.3.3.5 Groundwater

a) Consider monitoring water quality parameters that pose the highest risk to human health (e.g., arsenic).

b) Explore opportunities to create a community-based groundwater monitoring program for areas within the watershed where water level and/or water quality data is limited.

c) For industrial reclamation, activities should meet end-use criteria according to current requirements.

d) Assess the number of domestic abandoned water wells in the watershed and develop a plan to decommission sites with incentives.

e) Host working water well workshops. As part of the program, teach rural residents how to properly abandon water wells.

9.3.4 Implementation

Recommendation	Responsible Jurisdiction	Actions	Priority[a]
9.3.3.1 Maintain and Improve Water Quality			
a) Reduce external nutrient and sediment inputs	AEP; AER; AAF	Encourage the use of beneficial management practices, and monitor and report compliance on existing regulation on Crown Land.	H
	Municipalities	Minimize the potential for erosion at stormwater discharge locations. See 9.3.3.5.	H
		Develop integrated stormwater management policies that support low impact development.	H
	Industry	Apply industry best practices as recommended and/or according to regulation. See 9.3.3.2 Agriculture, 9.3.3.3 Forestry, 9.3.3.4 Oil and Gas.	H
	Landowners	Manage shoreline property to reduce impacts to lakes.	H
b) Adopt riparian targets and setbacks	GOA	See Section 9.4.	H
	Municipalities; Industry	Incorporate riparian health targets and setback into land use bylaws.	
c) Retain wetlands, mitigate loss	GOA; Municipalities, Industry (Agriculture, Oil and Gas)	See Section 9.5.	H
d) Assess septic and sewage discharge	Alberta Health Services	Collaborate to understand and document the occurrence of septic/sewage discharge or leakage to surface water. Establish an incentive program to upgrade old systems that may be leaking. Inform landowners of the impact leaking septic systems have on water quality.	H
	Municipalities		
	LICA		
	Landowners	Prevent septic leakage and/or nutrient rich runoff water from fertilized lawns from reaching surface water.	H
e) Industrial reclamation	Oil and Gas Industry		H
9.3.3.2 Agriculture			
a) Agricultural BMP implementation	Municipalities; LARA; LICA	Increase collaboration among municipal Agricultural Service Boards, and other local agricultural organizations to promote the use of BMPs that protect, maintain and improve water quality in agricultural areas.	H
9.3.3.3 Forestry			
a) Apply forestry industry standards	Alberta Agriculture and Forestry; Forestry Industry	Apply industry best practices as recommended or according to regulation.	H
9.3.3.4 Oil and Gas			
a) Apply oil and gas industry standards	Alberta Energy Regulatory; Oil and Gas Industry	Apply industry best practices as recommended or according to regulation.	H

Recommendation	Responsible Jurisdiction	Actions	Priority[a]
9.3.3.5 Urban Areas			
a) Stormwater strategies	Municipalities	Review standards and procedures; consider updates to design standards, construction specification and maintenance procedures that consider Low Impact Development (e.g., minimum topsoil depths of 300 mm, bioretention).	M
b) Manage snow melt	Municipalities; Alberta Transportation	Develop a snow management strategy to minimize impacts of snow removal and storage on surface water, and riparian areas and wetlands.	M
9.3.3.6 Tourism and Recreation			
a) Bridges on trail network	AEP; Municipalities	Encourage stewardship by OHV and off-road motorized vehicle clubs and users.	M
	LICA	Collaborate with OHV clubs, dealerships, and AEP to develop resources specific to the Beaver River watershed.	
	Trail Users	Use bridge crossings to cross rivers and creeks when possible.	H
b) Stewardship education resources	LICA; Watershed Stewardship Groups	Continue to disseminate existing stewardship resources to the public. Develop new resources to reflect new knowledge and understanding of watershed resources.	H
9.3.3.2 Monitoring and Evaluation			
a) Monitoring the Beaver River and its tributaries	PPWB	Continue to monitor three sites on the Beaver River and report on discursions and trends. Share results with LICA and other watershed stakeholders.	H
	LICA (Partners: AEP, Watershed Stewardship Groups, Industry and Academia)	Coordinate partners to secure funding for the monitoring program. Funds may be sought through grant programs or through partner contributions.	H
		Identify and prioritize sites to include in the program.	H
		Establish the list of parameters to measure.	H
		Implement the program.	H
		Refer to the water quality objectives and historic water quality summaries in Table 6, Table 7, and Appendix F when evaluating and reporting on water quality conditions.	H
b) Lake water quality	ALMs (Partners: AEP; LICA; Watershed Stewardship Groups; Academia)	Continue to monitor lake water quality in the watershed. Host a meeting with the community to present results, and discuss additional program opportunities (e.g., other lakes, water quality indicators, etc.).	H
c) Lake tributary water quality	LICA (Partners: AEP, Watershed Stewardship Groups, Industry and Academia)	See actions for 9.3.3.2 a.	H
d) Water quality indicators	LICA (Partners: AEP, Watershed Stewardship Groups, Industry and Academia)	Coordinate partners in a meeting to discuss water quality indicators to use in the long-term monitoring program.	H

Recommendation	Responsible Jurisdiction	Actions	Priority[a]
e) Discharge (streamflow)	AEP; WSC; LICA; Watershed Stewardship Groups; Academia	Access Water Survey of Canada (WSC) streamflow data to use in assessment of water quality at major tributaries to the Beaver River. Where WSC does not collect streamflow data, consider measuring streamflow either at time of sampling or continuously using appropriate instruments.	H
9.3.3.4 Lake Stewardship			
a) Support stewardship initiatives	Municipalities; Summer Villages; Watershed Stewardship Groups; LICA	Host a meet with Partners to discuss the implementation of the Keep our Lakes Blue campaign. Present an annual report to the public regarding the successes of the program. Identify actions that could increase the success of the program (e.g., contests, awards, etc.).	H
9.3.3.5 Groundwater			
a) Groundwater water quality indicators	Industry; AHS; Academia; LICA	Collaborate to identify a list of groundwater parameters to monitor in support of community-based program.	M
b) Community-based monitoring	Academia; LICA; Industry; LICA	Lead the development of a community-based monitoring program.	M
c) Industrial reclamation	Industry		
d) Abandoned water wells	LICA (Partners: AEP; AAF; AHS; municipalities; watershed stewardship groups)	Host groundwater working well workshop(s).	H
		Coordinate partners and create an inventory of abandoned water wells using community surveys.	M
e) Working water well workshops and well decommissioning		Secure funding from federal and provincial programs to properly decommission abandoned water wells. Prioritize those wells that may be located in vulnerable aquifer areas. Promote a water well abandonment program.	M

[a]H=High Priority (implement in 1-3 years); M=Medium Priority (implement in 4-6 years); L=Low Priority (implement in 7-10 years)

9.4 Riparian Areas and Wetlands

Riparian areas are the transition zones between upland and aquatic environments. As such, riparian areas and wetlands provide critical hydrologic, ecologic, social and economic functions in watersheds. These areas trap and store sediment; build and maintain banks and shores; store water and energy; recharge aquifers; filter and buffer water and moderate water temperatures; reduce and dissipate energy; and support biodiversity.

About 33% of the Beaver River watershed is considered wetland, with ecologically significant areas of poorly drained fens and swamps found in the northern part. Ducks Unlimited Canada classified the water and wetland features: Fens comprised 46.5% of wetland area; swamps represented 23.5%, marshes represented 4.5%; bogs 3%; and open water 22.5% of wetlands (BRWA 2013).

Current Conditions (this may move to the appendix in final Draft)

Three common methods to assess riparian condition have been used in the Beaver Creek watershed: riparian health inventory, aerial videography and riparian intactness assessment (Table 10). All methods rely on riparian health indicators to determine the status of condition. Riparian condition reporting varies between methods, but unhealthy, poor or low intactness rated riparian areas tend to have similar characteristics.

Table 10. Summary of riparian condition assessment methods used in the Beaver River watershed.

Method	Best Condition	Impacted	Degraded Condition
Riparian Health Inventory	Healthy	Healthy but with Problems	Unhealthy
Aerial Videography	Good	Fair	Poor
Riparian Intactness Assessment	High Intactness	Moderate Intactness	Low Intactness

Three data sets report on riparian condition in the Beaver River watershed. Cows and Fish completed Riparian Health Inventories that assess riparian functions related to vegetation, soil and hydrology (Fitch et al. 2001). In the Beaver River watershed, 59 sites were assessed between 2002 and 2019. The **Average Health Rating** for these sites was 59.1% (unhealthy)[16] which is below the provincial average of 69% (healthy but with problems)[17].

In 2012, aerial videography was used to assess riparian condition at the Beaver River and at seven lakes in the watershed (Crane, Ethel, Hilda, Marie, Moose, Muriel and Tucker). Results ranged from 99% healthy at Tucker Lake to 0% healthy at Muriel Lake (ref). In general, unhealthy scores were mainly attributed to recreation and residential development (as well as climate change).

Most recently, Riparian Intactness Assessments were completed for many named and unnamed lakes in the Jackfish-Muriel basin using a GIS-based approach (Fiera Biological 2021); a total of 16 creeks and rivers and 40 lakes were assessed. The resulting shoreline intactness ratings are provided in Appendix B.

[16] Beaver (Churchill) River Basin Overall Riparian Health 2002-2017 (n=59 sites), based on data up to 2019 and is subject to change once 2020 data is included.

[17] Cows and Fish Riparian Health Inventory Data 1996 – 2019. Based on 2,974 sites, on 822 waterbodies in Alberta.

When intactness was compared by subwatershed, the Marie Creek subwatershed had the greatest proportion of shoreline rated as High Intactness (97%), followed by the Middle Beaver River (88%) and Jackfish Creek (85%) subwatersheds. Conversely, the proportion of shoreline rated Very Low and Low Intactness was greatest in the Muriel Creek basin (33%) (Fiera Biological 2021).

Although data collection methods differed among the riparian assessments, fundamental characteristics of riparian health are similar and thus the results can be combined to further evaluate pressures and consider common management strategies to improve conditions. In all three studies, riparian condition scored poorest in areas where shorelines were developed (e.g., vegetation removed, shorelines hardened using rock and retaining walls, etc.). The relationship between shoreline intactness and water quality (i.e., as shoreline intactness decreases, water quality decreases) is established.

9.4.1 Goals and Objectives (from Section 5.0)

Goal: Healthy riparian areas and wetlands contribute to watershed resiliency with respect to flood and drought, quality water, and critical habitat.

Objective 1. Establish riparian management indicators, targets and thresholds that are recognized and applied consistently throughout the watershed.

Objective 2. Recommend actions to conserve intact riparian areas and wetlands, and to restore areas that rate unhealthy or poor condition, or have low intactness.

9.4.2 Targets and Thresholds

Targets and thresholds were identified using literature and existing available data (Table 11). While not all watercourses and lakes have been assessed, trends in riparian condition were apparent that help to generalize watershed-scale targets and thresholds. Typically, Riparian Health Inventories are completed on a smaller scale within land management units; thus, they provide greater detail related to specific indicators of riparian **condition**. Both aerial videography and riparian intactness assessments evaluate the **extent** of riparian condition at a coarse scale (e.g., entire watercourse or waterbody). An initial assessment may be provided using aerial videography or riparian intactness assessment, followed by a field validation process using riparian health inventory. The riparian health inventory introduces field technicians who can collect detailed information, recommend management actions and interact with landowners, residents and the public to heighten awareness and increase knowledge.

Note: There is evidence that increasing land use disturbance results in poorer water quality and fewer recreation opportunities in lakes; targets and thresholds are used to minimize degradation and maintain key riparian functions. The targets should be applied in consideration of other recommendations.

**The CLSRP (GOA 2022) indicates that new permanent footprint is not permitted within 250 m of the bed and shore of named waterbodies and watercourses in the planning area, including the Beaver River.

Table 11. Proposed targets and thresholds to manage riparian areas in the Beaver River watershed. A combination of riparian extent, condition and setback measures should be applied.

Measure	Method	Watershed-Wide Target	Watershed-Wide Threshold
Federal, Municipal, First Nations and Métis Lands			
Extent (Area)	Aerial Videography	≥75% of assessed riparian area at watercourses and waterbodies is rated good or high intactness[a]	<10% of riparian area at watercourses and waterbodies rate poor, or very low+low intactness.
	Riparian Intactness		
Condition (Score)[b]	Riparian Health Assessment and Inventory	Riparian areas rate healthy (Score ≥80)[c]	Riparian areas rate healthy but with problems (Score ≥60). <10% of riparian areas score unhealthy or poor.
Setbacks (Buffer Width)[d]	Fixed-Width	≥50 m minimum[e]	30 m[h]
	Setback Guidelines (GOA 2012)	20 m to 60 m + Slope qualifier[f]	
	Riparian Setback Matrix Model (Aquality 2012)	Variable based on site conditions[g]	
Pressure[i]	Riparian Intactness	No net increase in the pressure score of local catchments adjacent to streams.	
		Net increase in the cover of natural vegetation (e.g., forest) and/or wetlands within High Pressure catchments adjacent to streams.	
Industry			
Extent, Condition, Pressure	See Above	Apply Extent, Condition and Pressure targets and thresholds.	
Setbacks	Industry Requirements/Standards	Adhere to industry provincial requirements and standards (Appendix H). Generally, a minimum 100 m setback from waterbodies and watercourses applies to the oil and gas and forestry industries.	

[a] Environment Canada (2013)

[b] Function Score: Riparian areas that score ≥ 80 are not pristine, there is a level of disturbance accounted for in the target.

[c] Riparian Health Inventory Scores: Healthy (Score>80); Healthy but with Problems (Score 60 to 79); Unhealthy (Score <60) (Fitch et al. 2001).

[d] Industry should abide by standards set out in relevant legislation (e.g., for agriculture – the Agricultural Operations Practices Act (AOPA), for Oil and Gas – Drilling and Completion Activity (DACC) 2015)

[e] City of Cold Lake. Industry has requirements for fixed widths that differ (Appendix H)

[f] Stepping Back from the Water (GOA 2012)

[g] Requires a Professional Biologist or QWAES to apply model, working with a land surveyor and others as required.

[h] A minimum environmental reserve setback of 30 m from either the top of the bank of a river or stream or the high-water mark of a lake applied in MD of Bonnyville (MDP 2007).

[i] Pressure scores may be assigned that broadly characterizes the existing condition of local catchments as it relates to type of land cover and intensity of land use present. These catchments and their associated scores provide general measures to assess and track land use and land cover changes through time (Fiera 2021).

9.4.3 Preliminary Recommendations

9.4.3.1 Riparian Area Condition

a) Adopt the riparian area **condition** targets presented in Table 11. Effort should focus on decreasing the percentage of riparian area in the unhealthy, poor and low intactness categories and increasing the percentage of sites in the healthy, good and high intactness categories in priority areas (refer to Appendix G for existing conditions).

c) Establish a riparian condition monitoring strategy that includes:
   - The completion of a riparian intactness assessment for each of the main subwatersheds in the Beaver River watershed.
   - Periodic re-visits to monitor riparian health at previously assessed sites to determine progress in achieving watershed goals.

9.4.3.2 Riparian Protection

a) Municipalities should develop riparian policies to maintain functioning (healthy) riparian areas in the watershed.

b) Development in the floodplain should be discouraged.[18] Consider developing a flood map (see Section 9.2.3.3 c), that includes a GIS overlay delineating Environmental Reserve and Municipal Reserve at the lakeshore to support application review processes and decision-making.

c) At the time of subdivision, development setbacks should be applied consistently to waterbodies and watercourses (e.g., lakes, rivers, creeks) to maintain important riparian functions in the watershed. Setbacks should be applied to new developments at the time a development permit is issued by the municipality.

   A minimum setback of 50 m should apply from the top of bank of waterbodies and watercourses. This should consist of 30 m Environmental Reserve (ER) dedication (as required by the MDP), with the balance of 20 m taken as Environmental Reserve (ER), Municipal Reserve (MR) and / or conservation easement.
   - The 30 m should commence from the 1 in 100-year flood line unless a discernable top of bank exists beyond this.
   - The embankment is often geotechnical containment and therefore the 50 m setback shall commence beyond this.
   - To enable the determination of top of bank setbacks, a top of bank survey for the subject watercourse as a condition of a development permit. (City of Cold Lake LUB 382-LU-10)

d) Setbacks related to agricultural activities, including manure storage, manure application, and seasonal feeding and bedding sites, are established and regulated through the *Agricultural Operations Practices Act* (*AOPA*). The application of Inorganic fertilizer is indirectly regulated by

[18] Existing municipal bylaws state: No development shall be permitted within the 1 in 100-year flood line of any lake, river or creek as established by Alberta Environment (City of Cold Lake LUB 382-LU-10; MD of Bonnyville MDP 2007).

the *Environmental Protection and Enhancement Act* and pesticide use, application, and storage or washing of equipment is regulated through The *Environmental Code of Practice for Pesticides* and administered by AEP. The agricultural industry should abide by provincial setbacks and established application regulations and Codes of Practice. Refer to Appendix H for agricultural related setbacks.

e) Timber harvest is regulated by legislation (*Forests Act* and Timber Management Regulation). The forestry industry should abide by the setbacks outlined in the Northeast Alberta Timber Harvest Planning and Operating Ground Rules (GOA 2018). Refer to Appendix H for forestry-related setbacks.

f) The oil and gas industry is regulated by the Alberta Energy Regulator. The oil and gas industry should abide by the setbacks outlined in the Integrated Standards and Guidelines: Enhanced Approval Process (GOA 2012a) and apply industry respected practices (IRPs). Refer to Appendix H for oil and gas related setbacks.

g) At the lake or stream level, ~~implement~~ a shoreline protection policy should be implemented that protects ≥75% of the shoreline according to Table 11.

h) At the lot level, ~~implement~~ a shoreline protection policy and regulation should be implemented to protect trees and other natural vegetation on ≥75% of the land area within a 30-metre shoreline setback (or other recommended width) on new residential lots. Encourage this practice on existing residential lots.

9.4.3.3 Riparian Conservation

For the Jackfish-Muriel sub-basin, 14 of 15 unnamed lakes had "high intactness (100%)", and one had a lower "high intactness score (74%)". Unnamed Lakes should be given special consideration to conserve riparian extent and function in the future.

a) Riparian conservation opportunities exist for all lakes in the Beaver River watershed. Consider policy, planning and conservation measures to conserve high quality riparian areas (where intactness scores are ≥90%). Consider the following recommendations (from Fiera 2021):

   i. Incentivize voluntary conservation of riparian habitat on private land through payment for ecosystem services, changes to tax regimes, or other BMP programs,
   ii. Develop education and outreach programs to encourage stewardship and conservation of riparian habitats on private land,
   iii. Secure high conservation priority riparian habitats through purchase or through other land securement mechanisms available to conservation groups, land trusts, or municipalities,
   iv. Develop provincial, municipal and/or First Nation development setback and riparian land management policies,
   v. Create a municipal habitat conservation and restoration fund to allow for the securement of high priority riparian conservation areas.

c) Unnamed Lakes (located on Crown Land) generally have high riparian intactness. These lakes should be mapped in provincial and municipal planning documents and provided special designation through planning, policy and conservation tools.

d) Explore Ecological Goods and Services Programs to encourage riparian area and wetland conservation (ALUS program, conservation easements) in agricultural areas.

9.4.3.4 Riparian Restoration

Natural and anthropogenic pressure within local catchments was evaluated to identify riparian areas that may be functionally impaired due to surrounding land use activities (Fiera Biological 2021). Low level of intactness was attributed to hardened shorelines, and most often associated with shoreline development within urban municipalities, and highly valued recreational lakes.

a) For existing developed areas, explore opportunities to restore shorelines to meet watershed ~~goals~~ targets and thresholds (Table 11). Measures should be taken to improve streambank and shoreline vegetation at priority lakes and watercourses (i.e., those with <75% intactness rating, or with >10% low+very low intactness ratings) (Table 13), considering: (combined a, b and c)
    i. Field validation using riparian health inventory methods to determine site details contributing to low condition ratings
    ii. Incentives for riparian habitat restoration on private land through payment for ecosystem services, changes to tax regimes, or other BMP programs (Fiera 2021).
    iii. Education and outreach programs to encourage private land restoration, particularly for landowners located upstream of flood prone areas.
    iv. Partnerships with conservation organizations to promote and encourage restoration on private lands.
    v. Creating a municipal habitat conservation and restoration fund to pay for riparian habitat restoration on public lands, with a specific focus on restoring areas identified as Very Low or Low Intactness.

b) Complete riparian health assessments/inventories using appropriate methods (e.g., Fitch et al. 2001; Ambrose et al. 2004) at priority areas to assess individual indicators and inform restoration actions.

Table 13. Riparian restoration priorities based on riparian intactness assessment (modified from Fiera 2021). Note priorities may change based on resource availability and other priorities. The Muriel Creek subwatershed contained the three highest priority waterbodies for restoration (i.e., Muriel Creek, Charlotte Lake, Jessie Lake).

Sub-Watershed	Waterbody/ Watercourse	Does not meet Target (≥75% High Intactness/Good Condition)	Exceeds Threshold (<10% Low Intactness/Poor Condition)	Restoration Priority		
				#	% Shoreline	Length kms
Jackfish Creek	Jackfish Creek	-	16	8	14	18
Marie Creek	Ethel Lake	72	11	12	<1	Minor
Middle Beaver River	Manatokan Lake	66	24	6	23	3
	Osborne Creek	72	7	11	3	1
Moose Lake	Kehiwin Lake	69	18	9	12	3
	Moose Lake	66	20	7	15	10
	S. Trib of Kehiwin Lake	65	8	-	-	Minor
	S. Trib of Kehiwin Lake-01	20	27	5	28	3
	UL-120201-02	74	21	-		-
Muriel Creek	Charlotte Lake	4	73	2	70	19
	Jessie Lake	33	33	3	36	6
	Landry Lake B	32	32	-	-	-
	Muriel Creek	36	52	1	51	45
	Muriel Lake	68	13	10	10	5
Reita Creek	Reita Creek	64	-	-	-	-
Crane Lake	Crane Lake	-	14	-	-	-
Beaver River	Upper Beaver River	67	27	4	-	-

9.4.4 Implementation

Recommendation	Responsible Jurisdiction	Actions	Priority[a]
9.4.3.1 Riparian Area Condition			
a) Adopt targets and thresholds	Alberta Environment and Parks; AAF; AER	Adopt riparian area condition targets for Crown Land and integrate targets in industry codes of practice and/or operating standards and guidelines.	H
	Municipalities	Adopt the riparian area condition targets and include them in applicable policy and planning documents.	H
	LICA	Develop a strategy to prioritize riparian health assessment work in the watershed.	H

Recommendation	Responsible Jurisdiction	Actions	Priority[a]
b) Riparian condition monitoring	Municipalities; Watershed Stewardship Groups; LICA	Host a workshop with shoreline owners to present riparian health assessment methods and encourage them to complete a self-assessment using incentives.	H
9.4.3.2 Riparian Protection			
a) Riparian policy	Municipalities	Develop a riparian policy to guide planning and developing riparian strategies to manage future development lands and municipal lands.	H
b) Development in the floodplain	Municipalities	Determine the potential impact of riparian setbacks on landowners adjacent to recreation lakes and watercourses.	H
		Specify and apply development setbacks at time of subdivision that would apply to land located adjacent to water (e.g., lakes, rivers, creeks, and ephemeral and intermittent streams).	H
		Develop a tool that clearly shows the riparian setback delineation.	H
	Landowners	Identify riparian setbacks on all site plans submitted to the appropriate jurisdiction for permitting. A development permit should only be approved after the delineation of the riparian setback is completed.	H
	Municipalities; Realtors; Lawyers	Explore opportunities to educate lawyers and real estate agents of ER and MR that exist on private lands (e.g., place ER and MR on land titles so buyer is aware). These areas provide community access to the lake and should be disclosed at time of sale/purchase.	H
c) Development setbacks	Municipalities	Determine the potential impact of riparian setbacks on landowners adjacent to recreation lakes and watercourses.	H
		Specify and apply development setbacks at time of subdivision that would apply to land located adjacent to water (e.g., lakes, rivers, creeks, and ephemeral and intermittent streams).	H
		Develop a tool that clearly shows the riparian setback delineation.	H
	Landowners	Identify riparian setbacks on all site plans submitted to the appropriate jurisdiction for permitting. A development permit should only be approved after the delineation of the riparian setback is completed.	H
	Municipalities; Realtors; Lawyers	ER and MR provide community access to the lake and should be disclosed at time of sale/purchase. Explore opportunities to educate lawyers and real estate agents of ER and MR that exist on private lands (e.g., place ER and MR on land titles so buyer is aware).	H
d) Setbacks related to agricultural	AAF	Develop and share resources related to agricultural responsibilities outline in *AOPA*.	H
	Agricultural Industry	Adhere to established agricultural setbacks regulated by *AOPA* (Appendix H)	
e) Setbacks related to forestry	AAF	Monitor harvest practices to ensure setback compliance.	H
	Forest Industry	Adhere to forestry setbacks established in Northeast Alberta Timber Harvest Planning and Operating Ground Rules (GOA 2018) (Appendix H).	
	AER	Monitor harvest practices to ensure setback compliance.	H

Recommendation	Responsible Jurisdiction	Actions	Priority[a]
f) Setbacks related to oil and gas	Oil and Gas Industry	Adhere to oil and gas activity setbacks established in the Integrated Standards and Guidelines: Enhanced Approval Process.	
g) Shoreline protection policy	Alberta Environment and Parks; Municipalities	Develop a policy to maintain >75% of shoreline habitat.	H
h) Lot level shoreline protection policy	Municipalities	Explore opportunities to maintain >75% of shoreline at the lot level using policy and incentives. Examples	H
9.4.3.3 Riparian Conservation			
a) Riparian conservation	GOA; Municipalities	Update Figure 10 in the CLSRP (GOA 2022) to include names of the named waterbodies and watercourse where the 250 m setback applies.	H
b) Unnamed lakes	GOA	Explore the use of Protected Notation and/or Consultative Notation to protect and/or conserve critical shoreline habitat on Crown Land.	M
c) Incentive programs	GOA; Municipalities	Complete	
9.4.3.4 Riparian Restoration			
a) Restoration to achieve targets and thresholds	Alberta Environment and Parks	Identify partners interested in restoring riparian function on private lands. Complete	
	Municipalities; Watershed Stewardship Groups; LICA	Complete	
b) Riparian health assessment/inventory	Watershed Stewardship Groups; LICA; Cows and Fish	Complete	

[a]H=High Priority (implement in 1-3 years); M=Medium Priority (implement in 4-6 years); L=Low Priority (implement in 7-10 years)

9.5 Wetlands

9.4.1 Goals and Objectives (from Section 5.0)

Goal: Healthy riparian areas and wetlands contribute to watershed resiliency with respect to flood and drought, quality water, and critical habitat.

Objective 2. Recommend actions to conserve intact riparian areas and wetlands, and to restore areas that rate unhealthy or poor condition, or have low intactness.

9.5.2 Targets and Thresholds

All wetlands contribute to the health of the Beaver River watershed and should be retained. Effort should be made to retain wetlands, avoid impacts to all wetlands through design, and to mitigate impacts where avoidance is not possible.

9.5.3 Recommendations

9.5.3.1 Wetland Inventory and Valuation

The Alberta Wetland Policy defines wetland values based on functional groups (Table 14). The Alberta Wetland Evaluation Tool (ABWRET-A) provides guidance regarding wetland values, however, assigning values to wetlands remains a challenge for land managers. In the boreal ecosystem, many wetlands are interconnected below ground and the hydrology of these systems is not well understood. Carbon storage potential should also be valued as an important wetland function.

Table 14. Wetland value functional groups based on the Alberta Wetland Policy (AEP 2013).

Wetland Value Functional Groups		Value Category
Biodiversity and Ecological Health	Wetlands are dynamic, complex habitats that contribute to biodiversity and other ecological functions.	A (High)
Water Quality Improvement	Wetlands improve water quality by facilitating sedimentation and filtering pollutants.	B (Moderate)
Hydrologic Function	Wetlands help reduce flooding and soil erosion by storing runoff and slowing its downstream release. They are also important as areas of groundwater recharge and discharge.	C (Moderately Low)
Human Uses	Wetlands support multiple human activities (e.g., recreation, and education) and have varying degrees of cultural significance.	D (Low)
Relative Abundance	The relative abundance of wetlands in an area strongly affects the sensitivity of an area to the effects o further wetland loss.	

a) Complete a detailed wetland inventory for the watershed using the enhanced wetland classification method.

b) Identify tools to assist with wetland valuation, considering the Alberta Wetland Policy and criteria established in the ABWRET-A. Establish a comprehensive inventory of high-valued wetlands in the watershed based on hydrological, ecological, and cultural values.

c) Consider the Biodiversity Valuation Calculation Matrix (DUC 2017) to examine the biodiversity value of specific wetland types to species-at-risk in the watershed.

9.5.3.2 Wetland Retention

a) To maintain high valued wetlands (Category A and B based on wetland value functional groups in Table 14), adopt a policy to avoid impacts to wetlands (through project redesign or relocation). If avoidance cannot occur, minimize impacts to the greatest extent possible using mitigation strategies (BMP implementation during planning and operation). Compensation should apply when wetlands are permanently lost.

b) Similar to riparian areas, apply appropriate development setbacks in the watershed to maintain hydrologic function (flood and drought protection), water quality, and biodiversity functions on the landscape. Refer to Appendix H for industry related setbacks.

c) Explore opportunities to establish a carbon credit system as a tool to retain wetlands on the landscape.

9.5.3.3 Wetland Mitigation

a) Consider resource road construction and maintenance practices that mitigate impacts on wetland environments (Ptartington et al. 2016), including but not limited to
   a. Size and space culverts
   b. To complete

b) In agricultural areas, minimize impacts to wetlands by
   i. Retaining temporary wetlands in pastures and cropland to provide early spring breeding habitat for wildlife
   ii. Maintain or restore permanent cover (e.g., perennial forages for hay) in wet areas to provide habitat
   iii. Avoid cultivating near the edge of wetlands
   iv. Maintain, restore or enhance riparian vegetation for flood and drought mitigation, water quality, and wildlife habitat
   v. Delay mowing and haying of grassed waterways and other wet areas until mid-July to reduce nesting losses and fawn mortality. Use a flushing bar when haying
   vi. Provide alternative water to livestock to deter use of wetlands by livestock, and prevent soil compaction in low-lying areas. Use temporary or permanent fencing

9.5.3.4 Wetland Compensation

a) Where wetland compensation applies, encourage that the compensation is applied in the same sub-watershed as where the loss occurred.

9.5.3.5 Stewardship

a) Guiding Principles for Wetland Stewardship and Forest Management

9.5.4 Implementation

To be completed.

Recommendation	Responsible Jurisdiction	Actions	Priority[a]
9.5.3.1 Wetland Inventory and Valuation			
a) Detailed wetland inventory			
b) Wetland valuation			
c) Biodiversity Valuation Calculation Matrix	DUC		
9.5.3.2 Wetland Retention			
a) Avoid impacts			
b) Setbacks			
c) Carbon credit system			
9.5.3.3 Mitigation			
a) Road construction			
b) Agricultural activity			
9.5.3.4 Wetland Restoration			
a) Wetland compensation			
9.5.3.5 Stewardship			
a) Forest management			

[a]H=High Priority (implement in 1-3 years); M=Medium Priority (implement in 4-6 years); L=Low Priority (implement in 7-10 years)

9.6 Biodiversity

The watershed is a significant recreational fishery for the province, accounting for 25% of the annual provincial harvest (BRWA 2013). Fish are vulnerable to lake level fluctuations and the effects on shoreline vegetation, which provide spawning and feeding habitat for adults and rearing habitat for young fish. Low lake levels can result in loss of habitat that increase the risk of fish kills in summer and winter. Lake fisheries can also be impacted by surrounding land use in the watershed, particularly where nutrients and other contaminants drain uncontrolled to lakes (BRWA 2013). In the Beaver River, fish diversity and abundance are impacted by poor habitat conditions that include low streamflow velocities, poor water quality (low dissolved oxygen and high nutrient concentrations), and poor riparian condition.

Fish communities in the Beaver River watershed are summarized in Table 15. Key lake fishes important to First Nations, the Métis and recreational fishermen include Lake Whitefish, Northern Pike, and Walleye.

Marie Lake: Poor translation of the Cree word for the place *methai*, pronounced merai, which translates as a fish (Harrison, date).

Moose Lake: Known to early French-Canadian fur traders as lac d'Orignal, meaning Moose Lake. This may have been a direct translation of the local Cree name of the same meaning, Mōswa sākahikan (Wikepedia).

Table 15. Fish community in the Beaver River watershed (moved from Section 9.6.2)

Waterbody/Watercourse	Fish Community
Lakes (general)	Coldwater Fish: Lake Cisco, Lake Trout and Lake Whitefish, with Lake Trout only found in Cold Lake Coolwater Fish: Burbot, Northern Pike, Walleye and Yellow Perch.
Upper Beaver River	Fish species tolerant of degraded habitat (i.e., White Sucker and a few minnow species). It is thought that more sensitive species (i.e., Walleye, Northern Pike and Spottail Shiner) may have been present in the Upper Beaver River in the 1950s
Lower Beaver River Upstream of the City of Cold Lake	Dominated by White Sucker and Lake Chub. Fish species diversity tends to be greater upstream of the City of Cold Lake and includes Burbot, Northern Pike, Walleye and Yellow Perch. It is likely that there is an influx of better-quality water discharged from the Sand River to the Beaver River that supports these coolwater fishes.
Lower Beaver River – Downstream of the City of Cold Lake	Only species that are more tolerant of degraded habitat conditions were observed downstream (e.g., White Sucker, Brook Stickleback) (BRWA 2013). Fish captured furthest downstream had a higher prevalence of infection and parasites indicating habitat stress (BRWA 2013).

9.6.1 Goals and Objectives (from Section 5.0)

Goal: Fish, wildlife, and plants are healthy and resilient to changing environmental conditions. Their ecological, social, and cultural roles in the watershed are sustained.

Objective 1. Identify appropriate land use targets and thresholds (e.g., stream crossings and linear features) to better understand and track cumulative impacts on aquatic and terrestrial habitat.

Objective 2. Recommend best management practices and actions that improve wildlife habitat, health, and biodiversity.

Objective 3. Recommend appropriate actions to address the risks associated with invasive species.

9.6.2 Targets and Thresholds

9.6.2.1 Fish and Fish Habitat

Index of Biological Integrity (IBI) The IBI was used to assess the condition of aquatic ecosystems at 47 locations on the Beaver River, Amisk and Sand rivers (CPP Environmental in BRWA 2013). Indicators used in the assessment included: fish composition and size, and road density, riparian condition and water quality. Many sites in the upper Beaver River were rated in poor condition. These results are consistent with riparian condition findings (see Section 9.4) where riparian health scored poorly in the same reaches. At the Sand River, ratings were somewhat better, generally ranging from average to good, with few areas rating fair (CPP Environmental). Sites at Amisk rated poor to fair. A high IBI would suggest that conditions were suitable for aquatic life. Table 15 identifies targets for IBI scores.

. **Table 15.** Fish and fish habitat targets.

Indicator	Target
IBI Scores	>90% of IBI scores rate high for a given stream.
	Improve IBI scores at the Amisk and Beaver River.
Lake FSI Scores	Fish habitat is restored, and fish harvest is in balance with a sustainable fish population.
	No lakes have fish species listed as Functionally Extirpated (Refer to Table 9.16)
	A decrease in the number of lakes that have Northern Pike or Walleye populations listed as High or Very High Risk to sustainability (Refer to Table 9.16)
Species Composition	The Upper and Lower Beaver River support a sustainable, coolwater fishery.
	Maintain a sustainable Lake Trout population in Cold Lake.
	Consider smaller fish and other food sources for sportfish as indicators of the health of the system.
Water Temperature	Water temperature should be maintained within the optimum range described in Table 18 for select fish species. A general water temperature of ≤20°C is recommended. Refer to Section 9.3 for additional water quality targets.
Stream Connectivity	Achieve ≥90% stream connectivity in sportfish streams, with 100% connectivity in the mainstem reaches of third-order streams and higher.

Fall Index Netting and Fish Sustainability Index Fall Index Netting methods are used by Alberta Environment and Parks to monitor the status of fish populations (i.e., Northern Pike and Walleye). Fall index netting typically occurs during late summer and fall when water temperatures are between 10 and 15°C, when fish are known to be more evenly distributed within the lakes https://www.alberta.ca/fall-index-netting-overview.aspx# .

Fish Sustainability Index (FSI) is the provincial fish-population assessment measure. It evaluates provincial fish status by assessing numerous metrics that are grouped into 3 main categories:

- population integrity
- productive potential of the habitat
- threats and their mitigation

Indicators are summarized into scores that are reported as a risk rating, from very low risk to very high risk to the fish population. Scores for most recent FSI assessments in the Beaver River watershed are summarized in Table 16. Targets for FSI scores are established in Table 15.

Table 16. Most recent risk sustainability rating for lakes monitored in the Beaver River watershed. A rating of Low indicates a low risk to fish population sustainability, a rating of Very High indicates a very high risk to the fish population.

Sub-Watershed	Watercourse/ Waterbody	Northern Pike	Walleye
Amisk	Amisk Lake	High (2019)	Low-Moderate (2019)
	Goodfish Lake	Very High (2020)	Very High (2018)
	Long Lake	Low (2020)	Low (2020)
	Skeleton Lake	Moderate-High (2020)	Moderate-High (2020)
Manatokan/ Jackfish Creek	Jackfish Lake	High (2017)	High (2017)
Marie Creek	Crane Lake	Moderate-High (2018)	Very High (2018)
	Ethel Lake	Low (2017)	Moderate (2017)
	Marie Lake	Very High (2020)	High (2020)
	May Lake	High (2019)	High (2019)
Moose Lake	Chickenhill Lake	Extirpated (2019)	-
	Kehiwin Lake	High (2018)	High (2018)
	Moose Lake	Moderate-High (2020)	High (2020)
	Muriel Lake	Extirpated (2012)	Extirpated (2012)
Sand River-Lakeland	Pinehurst	Very High (2020)	High (2020)
	Touchwood	High (2019)	High (2019)
	Wolf	High (2018)	-
Upper Beaver	Beaver Lake	High (2016)	High (2016)
	Elinor Lake	High (2020)	Low (2020)
	Ironwood Lake	High (2019)	Moderate-High (2019)

Water Temperature Continuous water temperature data is not available for the Beaver River or its tributaries. However, monitoring at the lower reach of the Beaver River (2016-2020) recorded an average maximum temperature of 22.87°C, with 10% of observations greater than 20°C (Average 90th percentile value of 20.2°C) (Appendix F, Table F2). Water temperature targets are identified in Table 15.

9.6.2.2 Wildlife

The Surface Water Allocation Directive provides protection for wildlife sensitive to human disturbance and changing water levels (GOA 2021). For lakes and standing water bodies, important breeding sites for trumpeter swan, piping plover and colonial nesting birds (American white pelican and great blue heron) should be protected by consistently applying the timing restrictions identified in the SWAD or by using site-specific timing information where available (Table 17) (GOA 2021) (see Section 9.6.3 for additional recommendations related to biodiversity).

Table 17. Wildlife sensitive to human disturbance, breeding season and associated restrictions.

Sensitive Wildlife Species	Breeding Season	Restriction
Trumpeter Swan	April 1 – Sep 30	No water diversions during breeding season.
Colonial nesting birds	April 15 – July 31	
Piping plover	April 15 – July 31	

Table 18. Summary of water temperatures required for key sport fish species in rivers and lakes in the Beaver River watershed. Temperatures in **green** are optimum temperatures for growth. Temperatures in **black** are the tolerance range (sub-optimum growth at the lower and upper extreme temperature). Temperatures higher than the upper tolerance range may result in mortality for all life history components and cessation of spawning. Temperatures lower than the lower tolerance range may result in reduced growth for all components, cessation of spawning and increased mortality for incubating eggs and newly-emerged fry.

Species	Egg Incubation	Egg Incubation Timing	Fry	Juvenile	Adult	Spawning	Spawning Timing	Reference
Burbot (*Lota lota*)	**4 - 7°C** **1 - 7°C**	30 days: February to April	NA	**16 - 18°C** **8 - 23°C**	**16 - 18°C** **1 - 23°C**	**1 - 2°C**	February to March (under ice)	1, 2
Lake Trout (*Salvelinus namaycush*)	**5°C** **0.3-10°C**	100 - 150 days: September to January	**12°C**	**6 - 13°C** **0 - 18°C**	**<10°C** **0 - 18°C**	**10°C** **8 - 11°C**	September to October	1, 2, 3, 5, 10
Lake Whitefish (*Coregonus clupeaformis*)	**3 - 6°C** **0 - 12°C**	42 - 182 days: October to April	**14°C** **12 - 20°C**	**14 - 20°C**	**8 - 14°C** **0 - 22°C**	**3 - 6°C** **0 - 7°C**	late-September to January	1, 2, 3, 5, 10
Northern Pike (*Esox lucius*)	**6 - 15°C** **3 - 17°C**	14 days: mid-April to mid-May	**21 - 26°C** **6 - 26°C**	**26°C** **6 - 33°C**	**19 - 21°C** **0 - 29°C**	**6 - 12°C**	April to early-May	1, 5, 9
Walleye (*Sander vitreus*)	**9 - 15°C** **6 - 19°C**	17 - 21 days: mid-April to mid-June	**22°C** **13 - 28°C**	**22 - 28°C** **15 - 31°C**	**20 - 23°C** **0 - 28°C**	**6 - 12°C**	April to May	1, 2, 5, 6, 7, 8, 11
Yellow Perch (*Perca flavescens*)	**10°C** **7 - 20°C**	8 - 14 days: late-April to late-May	**3 - 28°C**	**19 - 24°C** **6 - 31°C**	**19 - 24°C** **6 - 31°C**	**7 – 12°C**	mid-April to early-May	2, 3, 4

Note: Where temperature data is not available for 'fry' component, use temperature data from 'juvenile'.

References:

1 - Ford *et al.* 1995
2 - Joynt and Sullivan 2003
3 - Scott and Crossman 1973
4 - Krieger *et al.* 1983
5 - Nelson and Paetz 1992
6 - AEP 1996
7 - Carlander 1997
8 - McMahon *et al.* 1984
9 - Inskip 1982
10 - McPhail 2007
11 - Clapp *et al.* 1997

9.6.3 Recommendations

9.6.3.1 Fisheries

a) Determine local and regional goals, and update fisheries management objectives for ~~Northern Pike~~ lake fisheries in the watershed through conversation with First Nations, anglers and the public. Design and implement effective regulations and management tools to achieve these goals (adapted from Northern Pike (Lakes) FSI | Alberta.ca).

b) Implement effective sport fishing regulations, with goals of recovering fisheries and providing more sport fishing opportunities (adapted from Northern Pike (Lakes) FSI | Alberta.ca). Consider the potential to develop a 'catch-and-keep' fishery at lakes to support tourism and recreation opportunities and the local economy.

c) Fall Index Netting programs should include additional key species in lakes (e.g., Burbot, Yellow Perch, Whitefish).

d) Consider other methods to monitor fish populations. Complete angler effort surveys to understand angling pressure and harvest from key lakes of interest in the watershed (e.g., creel surveys), and consider electrofishing at streams.

e) Increase knowledge and understanding among land managers and lake users about the relationships between development, water quality and healthy ecosystems to support the conservation of clean water and healthy fisheries (adapted from Northern Pike (Lakes) FSI | Alberta.ca).

9.6.3.2 Fish Habitat and Restoration

a) Continuous water temperature data should be collected at several locations in the Beaver River to assess current fish habitat conditions. Sites may be located downstream of the Amisk River, Downstream of Sand River, upstream of City of Cold Lake, downstream of the City of Cold Lake.

b) Identify key drivers of high-water temperature (e.g., lack of riparian vegetation, water diversion or discharge) and develop a strategy to mitigate the impact.

c) Conduct fish spawning surveys to identify lake areas that should be protected from future development, and/or recreation activity during critical spawning periods.

d) Lakes that have been closed to fishing should be assessed to determine the cause of the fishery decline and if the cause of impact has been resolved. Consider restoring a fishery at these lakes if habitat conditions are suitable (see 9.6.3.1 b). Candidate lakes for restoration include Beaver Lake and Muriel Lake, other - complete

9.6.3.3 Watercourse Crossings and Stream Connectivity

Studies have shown that as the number of stream crossings increase, fish habitat tends to degrade. Poorly constructed and/or poorly maintained watercourse crossings can result in habitat fragmentation,

habitat degradation, and barriers to fish passage. Streams impacted by stream crossings tend to have poor water quality and increased sedimentation. There are an estimated 1,395 watercourse crossings in the Beaver River watershed (WorleyParsons 2012). To increase availability of productive fish habitat, consider the following:

a) Limit new stream crossings, particularly culverts, and improve existing crossings to ensure fish passage (i.e., single-span bridges or open-bottom channels) according to the Watercourse Crossings Management Directive (AEP 2020).

b) Engage stakeholders and land users in the monitoring of watercourse crossings using the Alberta Watercourse Inventory (ABWCI) App to improve the inventory in the Beaver River watershed ~~and to identify restoration priorities~~. Priority subwatersheds where additional assessment is warranted may be directed to those classified as having "Elevated Disturbance" in the previous watercourse crossing assessment (WorleyParsons 2012), and may include the Upper Beaver River, Moose Lake, Muriel Lake, Reita Creek and Redspring Creek subwatersheds (Appendix J).

c) Create and implement a watershed-wide stream crossing remediation plan including inspection and assessment output, fish passage ratings, sediment/erosion assessment, restoration/replacement priorities, planned remedial work, and timelines (AEP 2020). ~~ESRD2015~~

   Prioritize sites for stream crossing restoration so stream crossings that fully impede fish movement with the highest sediment load are given a higher priority for remediation or replacement. ~~Use~~ Consider the hanging culvert assessment and inventory (Worley Parsons 2012) as a starting place.

9.6.3.4 Shoreline Management (Littoral Zone)

a) Shorelines ~~habitat~~ (the littoral zone) ~~is~~ provide critical habitat for fish and waterfowl. These shorelines should be inventoried and managed to maintain critical habitat, particularly spawning areas and identified Important Bird Areas. Consider key lakes of interest, including the Long Bay area of Cold Lake, islands of Moose Lake, and French Bay.

b) Administrative tools should be ~~developed~~ identified and implemented to manage lakeside development and limit future loss of ~~lake~~ shoreline habitat. The location and type of development should be assessed alongside shoreline function. ~~These~~ Tools may include:
   - Master planning, shoreline zoning, and development plan review that considers dynamic shoreline processes and protects ecological functions provided by shores
   - Development setbacks and vegetated buffers adjacent to streams, wetlands and lakes (Refer to riparian recommendations in Section 9.4.3)
   - Limits on continuous hard surfaces (e.g., retaining walls) to minimize erosion of neighbouring properties. Natural shorelines dissipate wave energy and minimize erosion.
   - Requirements for restoration of the littoral zone where necessary
   - Lot clearing criteria for new developments (e.g., limit lot clearing to improve views to 30% of the property area, in addition to maintaining ≥75% of lot shoreline at the lot level)
   - Encourage yard management strategies that maintain shoreline functions
   - Identify and promote best practices for marinas

c) Manage human-induced shoreline erosion by establishing wake-free zones and/or posting speed limits in areas most vulnerable (e.g., shallow water adjacent to exposed shoreline). Maintain a near-shore speed limit to reduce suspension of bottom sediments and shoreline erosion induced by wave action.

9.6.3.5 Beavers

Beavers are generally beneficial to watersheds as the dams they create store water in surface and groundwater reservoirs, increase open-water area, aid riparian vegetation, and slow water velocity to reduce streambank erosion and trap sediment. While beavers contribute to watershed health, they can be a nuisance when their activity impacts infrastructure. Effort has increased in recent years to identify tools that can be used to mitigate the impacts of beaver activity on infrastructure, to allow humans to better coexist with them on the landscape. Tools include fencing of desired trees to prevent harvest, use of repellents/deterrents, and water level controls (Fitch 2016).

a) Assess the occurrence of beavers where there is community concern (e.g., Moose Lake).

b) Explore tools to manage beaver activity where it has impacted infrastructure and hydrologic connectivity (see Water Quantity 9.2.3.1 c). Sites should be reviewed on a case-by-case basis.

9.6.3.6 Cormorants

The double-crested cormorant (*Phalacrocorax auritus*) is a migratory bird that breeds in the northern hemisphere, nesting in trees or on the ground on islands at waterbodies across Alberta. Cormorants consume up to 20% of their body weight in fish per day (AEP 2021). These birds feed on fish species that are easiest to catch, and will fly up to 30 – 60 km from their nesting colony to feed. Cormorants can negatively affect fisheries populations when the number of cormorants feeding exceeds the fish resources available in the area (AEP 2021). There are conflicting opinions on whether cormorants are impacting on the fishery in the Beaver River watershed, and the concerns vary by waterbody.

The following recommendations are modified from current Cormorant Management Program Activities (AEP 2021):

a) Determine cormorant numbers in the Beaver River watershed (current program extent is the Bonnyville area), and establish a management program to reduce the population size in problem areas.

b) Complete fish community assessments on waterbodies ~~in the Moose Lake area~~ to determine number and size of fish and any population trends (current program is confined to the Moose Lake area) (see 9.6.3.1 d).

c) Better understand cormorant population dynamics and life strategies in the Beaver River watershed ~~by expanding existing studies~~:
   - Complete movement surveys to determine where cormorants are coming from and where they are feeding.
   - Collect and analyze cormorant diet samples to determine what the birds are feeding on.
   - Identify other birds that co-nest with cormorants, inventorying and implementing mitigation measures to prevent disturbance to these species.

9.6.3.7 Key Wildlife and Biodiversity Zones

a) The Beaver River, Sand River and several other areas are indicated as key wildlife and biodiversity zones in the watershed (Figure 5). These areas should be managed to maintain quality habitat:
   i. Avoid development in key wildlife and biodiversity zones
   ii. Minimize and mitigate impacts from future development when it cannot be avoided
   iii. Plan future tourism and recreation to avoid sensitive areas (see 9.6.3.1 a)
   iv. Implement riparian and wetland management recommendations (Sections 9.4 and 9.5)

b) Effort should be made to restore habitat where human footprint has already encroached on sensitive areas within key wildlife and biodiversity zones.

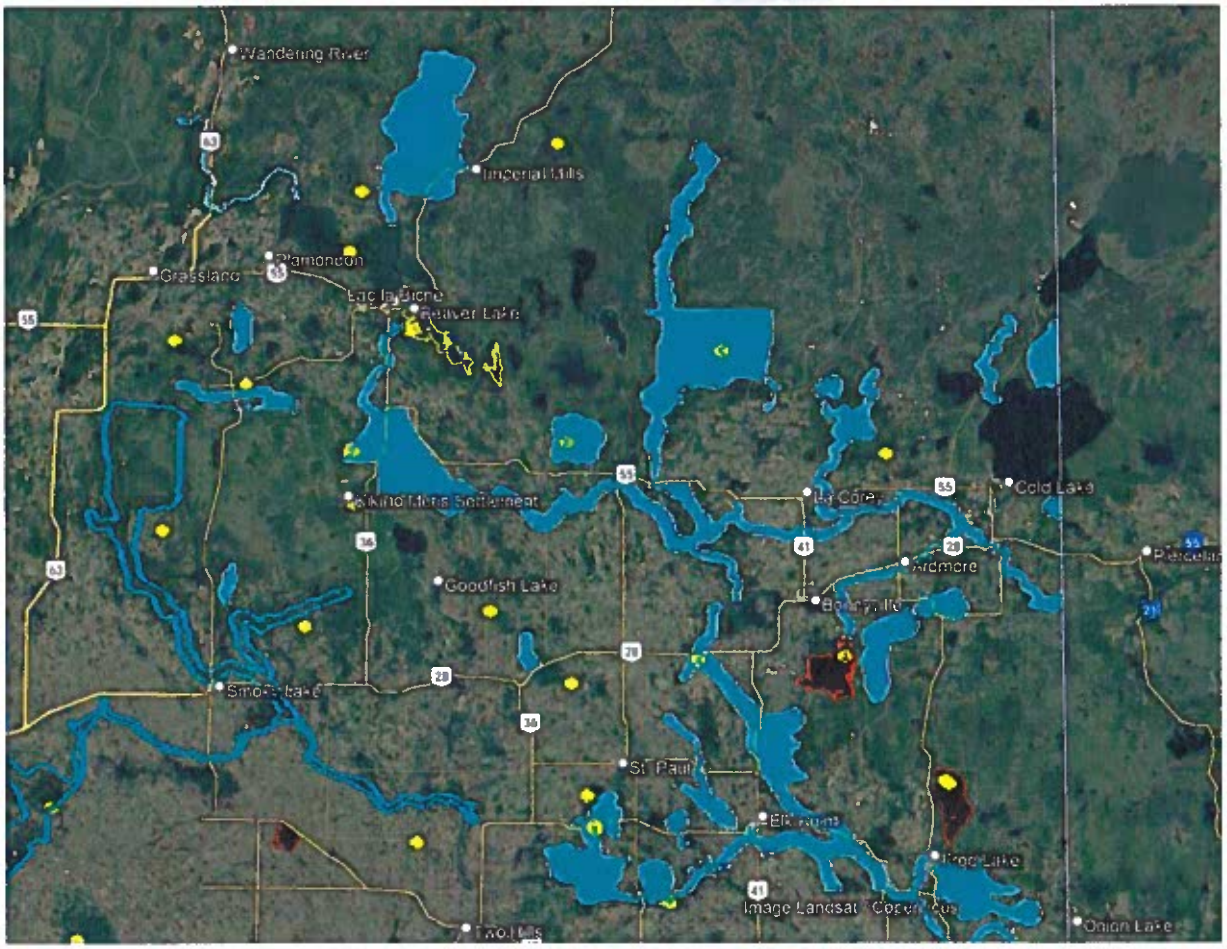

Figure 5. Key wildlife and biodiversity zones in the Beaver River watershed (turquoise, filled polygons). Orange outlined polygons indicated Piping Plover habitat (Muriel Lake, Frog Lake), yellow outlined polygons are important Trumpeter Swan habitat (Beaver Lake, Elinor Lake). Yellow dots indicate colonial nesting bird habitat (e.g., great blue heron).

9.6.3.8 Aquatic Invasive Species and Disease

Himalayan balsam (*Impatiens glandulifera*) is a regulated plant under the *Alberta Weed Control Act* and listed provincially as Prohibited Noxious. It is a summer annual that reproduces by seed only. It is found in riparian areas, and requires moist soils and some soil disturbance to establish (e.g., uprooted trees, flooding).

a) Spread of Himalayan balsam occurs mostly from the dispersal of seed from landscape plantings. Consider the following to help control its spread:
   i. Avoid the selling or purchase of Himalayan balsam for ornamental purposes
   ii. Minimize the potential to spread seed by minimizing soil disturbance and erosion in riparian areas
   iii. Himalayan balsam has a shallow root system. Hand-pulling is an effective way to control plants. Plant debris should be incinerated or bagged and sent to landfill
   iv. Explore biological control options

Aquatic invasive species (AIS), pose an ongoing risk to Alberta's lakes and streams. Species of concern include zebra and quagga mussels, flowering rush, Prussian Carp, and Eurasian milfoil. Whirling disease is also a concern that is present in other watersheds (Oldman, Bow, Red Deer and North Saskatchewan rivers), but has not yet been detected in the Beaver River watershed (as of May 1, 2018).

b) To minimize the potential to spread ~~of~~ AIS ~~zebra and quagga mussels~~, consider:
   i. Posting signage at all access points to increase awareness regarding the threat of AIS
   ii. Making boat wash stations available at key access points, particularly during fishing tournaments and the peak summer season
   iii. Re-instating provincial highway inspection stations for watercraft
   iv. Reducing the number of unmanaged boat launches in the watershed where possible.

9.6.4 Implementation

Recommendation	Responsible Jurisdiction	Actions	Priority
9.6.3.1 Fish Habitat			
a) Determine local and regional goals for fisheries	AEP	Meet with the community to determine local goals for fisheries in the Beaver River watershed.	H
		Review fisheries management objectives with the community.	
		Explore more opportunities for catch-and-keep fishing in the watershed, using science to help the fishery adapt and grow (GOA n.d).	
	Watershed Stewardship Groups; Municipalities; LICA	Support AEP in effort to determine local goals for fishery by circulating information and hosting forums.	
b) Sport fish regulations	AEP	Meet with the community to determine fisheries management objectives for species other than Northern Pike and Walleye.	H
c) Fall Index Netting	AEP	Consider including additional key species in lakes in the FIN monitoring program.	H
d) Fishery monitoring	AEP; Academia; ACA	Collaborate to collect additional fisheries information using a community-based approach. Consider reporting tools, and student-lead research to augment FIN data.	H
e) Fish education	LICA	Develop educational resources about the state of the fishery in the watershed, linkages to development, ecosystem processes and water quality to support a healthy fishery.	H
9.6.3.2 Fish Habitat and Restoration			
a) Water temperature monitoring	Watershed Stewardship Groups; LICA	Deploy water temperature loggers in the Beaver River and other streams based on community interests, to determine if water temperature is meeting fish habitat needs.	H
b) Strategy to maintain water temperature	LICA	Review IBI scores and riparian intactness assessment to prioritize riparian and streambank restoration activities that could improve fish habitat condition.	H
c) Fish spawning habitat survey	LICA, Watershed Stewardship Groups	Collaborate to better understand and document critical fish habitat in recreation lakes to inform fisheries goals and management objectives (see 9.6.3.1 a).	H
		Develop resource material to inform community about fish habitat and actions that can be taken to maintain healthy fisheries (see 9.6.3.1 e).	H
	AEP	Collaborate with the community to better understand critical fish habitat.	H
d) Determine status of lakes closed to fishing	AEP	Lakes previously closed to fishing should be assessed to determine the current status (see 9.6.3.1 a)	H
9.6.3.3 Watercourse Crossings and Stream Connectivity			
a) Manage watercourse crossings	AEP; Municipalities; AB Transportation; Industry	Consider the need for new stream crossings in project planning.	H
b) and c) Monitor and remediate watercourse crossings	AEP; Watershed Stewardship Groups; LICA	Collaborate according to the Watercourse Crossings Management Directive (GOA 2020) to inventory and prioritize crossings for remediation.	M

Recommendation	Responsible Jurisdiction	Actions	Priority
9.6.3.4 Shoreline Management (Littoral Zone)			
a) Shoreline habitat inventory	AEP; Municipalities; Watershed Stewardship Groups; LICA	Collaborate to map important shoreline habitat, including spawning areas at recreation lakes. Prioritize recreation lakes for shoreline habitat inventory based on community goals and fisheries management objectives (9.6.3.1 a).	H
b) Administrative tools	Municipalities	Use the resulting shoreline habitat inventory (9.6.3.4 a) to establish shoreline policies to preserve critical habitat and support healthy fisheries.	M
		Enforce LUBs to maintain shorelines designated as municipal environmental reserve.	H
	AEP	Maintain natural shoreline functions on Public Lands, including in provincial parks and recreation areas.	H
c) Shoreline erosion	AEP	Post speed limits in critical fish and waterfowl habitat areas in recreation lakes.	M-H
	Residents and lake users	Respect speed limits at recreation lakes in the watershed to help maintain the fishery.	H
9.6.3.5 Beavers			
a) Assess occurrence	LICA; Municipalities; Cows and Fish	Use drone technology to better understand the occurrence (distribution/abundance) of beaver in the watershed.	M-L
b) Management tools		Identify appropriate management tools. complete	M
9.6.3.6 Cormorants			
a) to c) Cormorant management	AEP, Municipalities; Watershed Stewardship Groups; LICA	Implement recommendations to better understand the impact of cormorants on the local fishery.	L
		Establish a community-based monitoring program that documents the occurrence of cormorants at recreation lakes and where community interest is high.	M
9.6.3.7 Key Wildlife and Biodiversity Zones			
a) Key wildlife and biodiversity zones	AEP; Industry; Municipalities	Overlay key wildlife and biodiversity zones on maps to assess potential impacts from proposed new developments.	H
b) Habitat restoration	AEP; Municipalities; Watershed Stewardship Groups; LICA	See recommendations for riparian and wetland restoration.	H
9.6.3.8 Aquatic Invasive Species and Disease			
a) Himalayan balsam	Municipalities; LICA; LARA(?); Watershed Stewardship Groups	Document the occurrence of Himalayan balsam in the watershed.	H
		Create a factsheet about Himalayan balsam and disseminate to landowners and residents. Collaborate to organize an event to hand-pull plants.	M-H
b) Implement strategies to mitigate potential for AIS	AEP	Re-establish highway check-stops for AIS.	H
	Municipalities	Establish a boat inspection station, and boat-wash stations at major access points, particularly during fishing tournaments and peak season	H
		Provide training to summer staff working at municipal boat launches to assist with education and proper cleaning techniques for boats.	
		Work with LICA to circulate a notice to rate-payers regarding AIS risks and stewardship.	

9.7 Land Management

The Cold Lake Sub-Regional Plan (CLSRP) was recently published (GOA 2022). The CLSRP outlines a series of management approaches and requirements for development and human footprint restoration. These aim to maintain or re-establish ecological processes, including landscape and habitat intactness, so that public lands may support the interests of all Albertans, including Indigenous peoples, for the present and into the future. The three outcomes of the statutory CLSRP align with the current Beaver River IWMP recommendations. The CLSRP regulations will not be repeated here, rather the Beaver River IWMP will focus on minimizing impacts of urban development, tourism and recreation and industry, agriculture, forestry and the tourism and recreation footprints outside of the caribou range (entire Beaver River watershed (Figure 4 this is being revised) (Sections 9.2 to 9.6), and will provide recommendations to consider in the proposed Recreation Management Plan identified in the CLSRP (GOA 2022).

9.7.1 Goals and Objectives (from Section 5.0)

Goal: Cumulative effects of diverse land uses are reduced or mitigated to maintain and/or improve ecosystem health.

Objective 1. Recommend appropriate water and land management practices that mitigate impacts of industry and development (i.e., urban, recreation, agriculture, oil and gas, forestry, and sand and gravel extraction), and maintain and/or improve ecosystem health.

9.7.2 Targets and Thresholds

Requirements for managing industry footprint in caribou range are established in the CLSRP (2022). No additional targets or thresholds are recommended in the Beaver River IWMP for land management, beyond those recommended in previous sections (Sections 9.2 to 9.5). Industry should refer to the CLSRP (2022) for current requirements related to:

- Access management
- Energy and mineral activity
- Pipeline development and maintenance
- Geophysical exploration
- Forestry
- Surface material extraction (sand, gravel, and borrow)
- Peat
- Transmission Lines
- Livestock grazing
- Seismic lines

9.7.3 Recommendations

9.7.3.1 Tourism and Recreation

The GOA plans to increase revenue generated from tourism and recreation to $20 billion by 2030 (CLSRP 2022). Water is a central feature of existing and proposed tourism and recreation areas in the watershed (Figure 6). Many of these areas fall within key wildlife and biodiversity zones (Figure 5). Activities will need to be carefully considered to ensure ecological, cultural and historical values are not compromised.

The Cold Lake Subregional Plan recommends actions to manage tourism and recreation, including the creation of a recreation management plan (excluding the CLAWR), and a recreational trail system network to connect important tourism and recreation features, scenery and settings (CLSRP 2022). Recommendations in the Beaver River IWMP are intended to support recreation management planning, and should inform the recreation management plan created for the CLSR. Note that proposed new Recreation Management Areas are located outside of the Beaver River watershed boundary, but any new areas will have implications for existing areas in the region.

From the CLSRP (2022): A recreation management plan will be developed that will:

- identify areas to prioritize for outdoor recreation and tourism development opportunities
- maintain high-quality, natural areas on the landscape that will support outdoor recreation activities and tourism development opportunities
- ensure recreation management areas support outdoor recreation activities and tourism development opportunities that are compatible with the ecological values of the area
- consider and manage land uses to ensure they do not compromise the cultural and historical values that also attract users to these areas

Added pressure from increased tourism and recreation may put additional stress on the local fishery.

a) Prior to developing a recreation management plan for the area, AEP should consider the following:
   i. Inclusion of the entire Beaver River watershed in the planning area to ensure that proposed activity considers the existing tourism and recreation footprint
   ii. Indigenous land use and traditional rights
   iii. Review available riparian intactness assessment data for Crown Land and develop policy for its conservation (in addition to the 250 m setback established for the Beaver River and other waterbodies in the CLSRP (2022))
   iv. Develop and/or refine fisheries management objectives with the community (see 9.6.3.1 a)
   v. Identify and assess critical fisheries habitat and spawning areas (see 9.6.3.4 a)
   vi. Monitor user data as socio-economic performance indicator, in addition to recreational facilities.

b) Trail networks should:
   - Avoid sensitive, ecologically important and culturally significant habitat, including species-at-risk and bird habitat
   - Make use of existing, linear disturbances
   - Have interpretive signage
   - Be equipped with proper washroom facilities at trail heads and tamper proof garbage cans

c) Maintain infrastructure (e.g., roads) to support a healthy tourism and recreation economy in the watershed

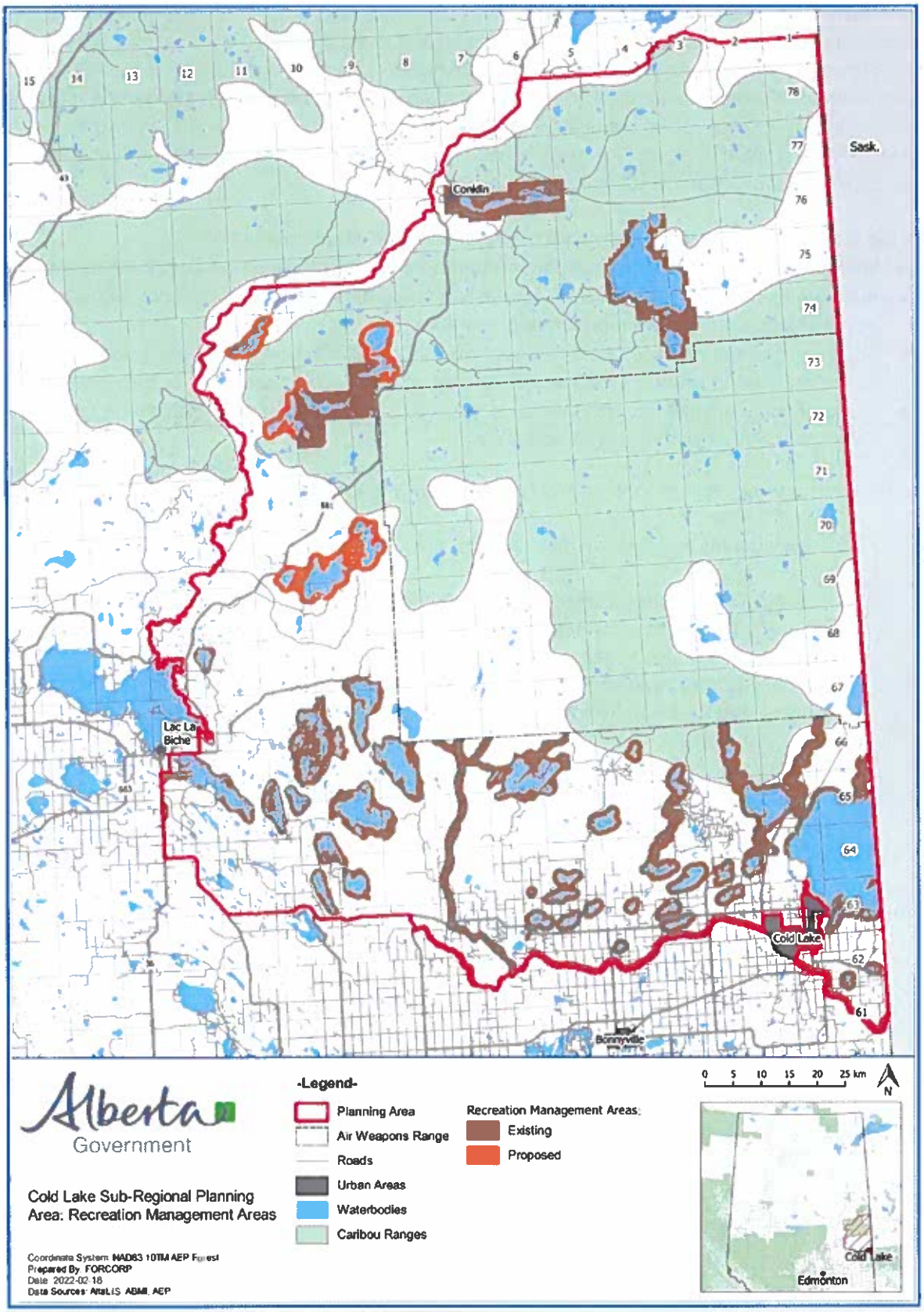

Figure 6. Recreation management areas in the Cold Lake Sub-region (CLSRP 2022).

9.7.4 Implementation

Recommendation	Responsible Jurisdiction	Actions	Priority[a]
9.6.3.1 Tourism and Recreation			
a) Recreation management plan	GOA	The recreation management plan should align with the goals and objectives outlined in the Beaver River IWMP.	H
		In addition to the considerations outlined for the recreation management plan (CLSRP 2022), planners should consider existing watershed health data and or generate new data related to riparian and biodiversity health.	M-H
b) Trails		Collaborate with the community to plan the proposed trail network. The new trails should not impact water quality, riparian and wetland health, biodiversity or traditional uses.	H
c) Infrastructure supports (e.g., roads)		Ensure that necessary upgrades to highways/access are completed alongside promotion of tourism and recreation to improve visitor experience.	L-M

[a]H=High Priority (implement in 1-3 years); M=Medium Priority (implement in 4-6 years); L=Low Priority (implement in 7-10 years)

9.8 Knowledge and Understanding

9.8.1 Goals and Objectives (from Section 5.0)

Goal: Indigenous Knowledge and scientific research guide decision-making.

Objective 1. Assess and prioritize knowledge gaps in the Beaver River watershed.

Objective 2. Recommend outreach materials and other tools to disseminate Indigenous Knowledge, and scientific research related to watershed health.

9.8.2 Targets and Thresholds

Knowledge and understanding of key ecosystem process increases among land managers and residents.

Knowledge is used to support sound resource management decisions to maintain watershed health.

9.8.3 Recommendations

9.8.3.1 Collaboration

a) The role of stewardship groups in the Beaver River watershed is essential to understanding and managing specific lake management concerns. As a WPAC, LICA can support stewardship group activity by
   i. Assisting with joint funding applications for projects that will achieve common goals across the watershed (e.g., riparian intactness assessment, water quality investigations, other)
   ii. Collaborating to host an annual Stewardship Group Forum to facilitate sharing of knowledge and joint planning across the watershed

9.8.3.2 State of the Watershed Report

a) The Beaver River State of the Watershed Report was completed in 2013. This report should be updated to reflect the current status of the watershed condition, and reflect new information collected to support the assessment.

9.8.3.2 Indigenous Knowledge

a) Comprehensive knowledge of watershed resources is desired. Collaborate with First Nations and Métis to conduct interviews/studies to document experience and knowledge to support future watershed condition reporting and decision-making.

9.8.3.3 Climate Change and Climate Variability

Generally, Alberta is likely to be less cold than currently as a result of climate change, and have increased total precipitation that will occur mostly in winter and spring (Zhang et al. 2019). Evaporation and transpiration are expected to increase with warmer temperatures that will contribute to more frequent and intense summer droughts and soil moisture deficits, particularly in the south (Cohen et al.,

2019). Noteworthy is the distinction between the impacts of slow-onset climate change (e.g., changes in average temperature and precipitation patterns) vs. shifts in climate variability and the occurrence of extreme weather events associated with natural hazards (e.g., floods, drought and wildfire).

a) Climate change and climate variability should be considered in all land use planning activities, particularly as it relates to the aquatic environment, such that land use decisions related to urban and industrial development, and tourism and recreation accounts for and mitigates potential future impacts of decisions to the aquatic environment.

b) Assess regional climate (e.g., evapotranspiration, ecology [aquatic, terrestrial aspen]) in the watershed for the historic period of record, and potential impact on the occurrence of fire, flood and drought. Relate findings to regional infrastructure planning, including development, to promote watershed resiliency.

c) LICA should publish the current understanding of climate change impacts on the watershed with respect to literature and modelling.

9.8.4 Implementation

Recommendation	Responsible Jurisdiction	Actions	Priority
9.8.3.1 Collaboration			
a) Collaboration	LICA Watershed Stewardship Groups	Establish partnerships with watershed stewardship groups and other organizations whose goals align to increase understanding of watershed resources (research and monitoring), to leverage funding and to host community events.	H
9.8.3.2 State of the Watershed Report			
a) Update 2013 State of the Watershed Report	LICA	LICA should review the 2013 Beaver River State of the Watershed Report. Develop a Terms of Reference for the update of this report to include new information available since 2013, including but not limited to human footprint mapping, water level trends, water quality monitoring programs, riparian intactness assessments, wetland inventory; estimates of riparian loss, biodiversity (fisheries updates). Condition indicators identified in this IWMP should be considered in the report.	H
9.8.3.2 Indigenous Knowledge			
a) Conduct interviews and studies	LICA; First Nations; Métis; Consultant	Collaborate to document First Nation and Métis knowledge and experience to support watershed condition reporting and decision-making. This may be completed during the next 3 years, and prior to the next update of the Beaver River IWMP.	H
9.8.3.3 Climate Change and Climate Variability			
a) Consider climate change in land use planning	Municipalities	Develop and adopt principles to integrate climate change and climate variability assessment in decision-making. What does this look like - expand	H
b) Assess regional climate	LICA	Implications of climate change relate to a longer ice-free season, the fishery, more mixing in lakes, storage, wildfire, agriculture, among others. Collaborate to assess regional climate (historic and forecast). Evaluate climate scenarios as it relates to water quantity, water quality, riparian areas, biodiversity and land use. Consider connecting with the University of Saskatchewan (D. Sauchyn) for historical back-casting,	M-H
c) Publish research findings	LICA	Disseminate climate change and climate variability findings to stakeholders to consider in stewardship planning (water conservation, landscaping, development design, other).	M

[a]H=High Priority (implement in 1-3 years); M=Medium Priority (implement in 4-6 years); L=Low Priority (implement in 7-10 years)

10.0 SCHEDULE (WILL BE REMOVED IN FINAL DRAFT)

Phase	Task	2021											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DRAFT I IWMP	Collect, review and organize relevant data. Identify data gaps to support recommendations. Establish indicators. (Ongoing)												
	Interpret, analyze and synthesize findings. Establish Indicators, Targets and Thresholds; Leading recommendations												
	Circulate Draft I IWMP to IWMPC												
	IWMPC Meeting #4; Review Draft I IWMP												
	Consider IWMPC input; Revise Draft I IWMP												
Phase	Task	2022											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Circulate Draft I IWMP to IWMPC												
Draft #1 IWMP	IWMPC Meeting #5 Finalize Draft #1 IWMP, prepare for Engagement Session 2												
	Circulate materials for engagement												
	Engagement Session 2: Review Draft I IWMP												
	Engagement Session 2 Summary Report												
	Consider engagement input; Revise Draft #1 IWMP; Refine recommendations and prepare Implementation Strategy (Draft #2)												
Draft #2 IWMP	Circulate Draft #2 IWMP to IWMPC				Apr 19								
	IWMPC Meeting – Review Draft #2					May 2							
	IWMPC Meeting #6: Debrief engagement #2, Review Draft II IWMP; Final comments on draft					May 9							
	Materials circulated to LICA Board					May 18							
	Circulate Draft II IWMP for engagement					May 25							
	Engagement Session 3: Review Draft II IWMP						Jun 15	Response					
	IWMPC Committee Meeting						Jun 22-24						
	Consider engagement input; Revise Draft II IWMP												
Final IWMP	Circulate final draft IWMP to IWMPC								Aug 29				
	IWMPC Meeting #7 Review Final draft IWMP; discuss next steps									Sep 12			
	Finalize IWMP; Develop summary documents and communications										Oct 12		
	Final Beaver River IWMP is available to partners, stakeholders and public on website.										Oct 31		
	Seek support												

11.0 REVIEW AND AMENDMENT

It is expected that the Beaver River IWMP will be complete in 2022. Progress on its implementation should be tracked and reviewed annually. The plan should be reviewed in 2025, and every five years after – to ensure it remains relevant and addresses priority issues.

11.0 DEFINITIONS

To be completed.

Bed and Shore Public lands which form the definable channel of a river, stream, or watercourse; or the basin of a lake of other permanent and naturally occurring body of water that is bound by a bank as defined in section 17 of the *Surveys Act* which may or may not be fully covered by water. The shore is the exposed bed when not fully covered by water (CLSRP 2022).

Development Includes urban and recreation developments.

Ecological services The direct and indirect benefit that ecosystems provide for humans.

Eutrophication Enrichment of aquatic ecosystems by plant nutrients (e.g., phosphorus and nitrogen); characterized by increased growth of plants and algae. The process of eutrophication can be accelerated by human activity (e.g., effluent disposal, land drainage), and can have negative impacts on aquatic health.

Goals Broad statements that reflect the main concerns for natural resource management in the basin; goals emphasize what the IWMP will accomplish (the outcomes of the Plan).
Indicators

Indicators Specific physical, chemical, biological, sociological and economic attributes of the watershed and the environment that reflect conditions and dynamics of the broader ecosystem. Indicators can represent human activities on the landscape and the environmental response to those activities.

Indigenous Knowledge Knowledge held by First Nations, Inuit and Métis peoples that is transmitted from generation to generation. Indigenous Knowledge emerges from complete knowledge systems and is expressed in many formats (e.g., oral, ceremony, artistic creations, and artifacts). Indigenous Knowledge is not all in the past; there is continued growth, innovation and change in practices. Indigenous Knowledge includes history, law, spirituality, agriculture, environment, science, medicine, animal behaviour and migration patterns, art, music, dance, craft, construction, among others. Indigenous (Traditional) Knowledge is held collectively by all members of a community, although some members may have particular responsibility for its transmission. The terms "traditional knowledge" and "Indigenous knowledge" are sometimes used interchangeably (University of Alberta 2020; Government of Canada 2020b).

Industry Generally, refers to oil and gas, forestry, agriculture, sand and gravel extraction, and tourism and recreation, among others.

Integrated Watershed Management Plan (IWMP) A guidance document and planning tool for resource managers, including governments, planners, Indigenous communities, other stakeholders and landowners. An IWMP identifies goals for improving and/or maintaining watershed health, and makes recommendations on how to reach those goals. An implementation strategy accompanies the IWMP that will indicate implementation roles and responsibilities, priorities and timelines. Through implementation, the plan strives to achieve common goals.

Land Use All uses of land, such as agriculture, forestry, conservation, recreation, tourism, oil and gas, mining, utility corridors, transportation, cities and towns, industrial development, etc. (CLSRP 2022).

Objectives Measurable and may be used to indicate milestones throughout the planning process.

Protective Notations (PNT) Reservations are placed by public agencies in consultation with the public land manager. They identify land and resources that are managed to achieve particular land use or conservation objectives. Protective notations identify the agency that has placed the reservation, show allowable land uses and may give management guidelines for integrating different uses on the land. Restrictions on land use are based on the characteristics of the land itself. These include soil, vegetation and surface materials and drainage. Local and regional factors such as fish and wildlife requirements or timber regeneration and access, also receive consideration. A protective notation may be triggered by an application for a new or different land use, a municipal or provincial plan (e.g., Integrated Resource Plan) or other government programs. Protective notations specify different levels of allowable land use - limited development, grazing only, or no agricultural use at all. The public may request a review of the notation if they wish to have specific parcels considered for a land use that has been identified as incompatible.

Consultative Notations (CNT) are used to "flag" an interest in the land (e.g., administrative, planning or land inventory process) by a particular agency. They don't place restrictions on land use, but alert potential applicants to the agency's concern. Industry also uses consultative notations (identified as a CNC) to show an interest in the land.

Riparian Riparian lands are transitional areas between upland and aquatic ecosystems that have soil and vegetation characteristics that reflect the influence of water. They have variable width and extent both above and below ground.

Setback A minimum distance that must be maintained between a land use or development activity and a waterbody/watercourse.

Surface Water Allocation Directive In the absence of a Ministerial Order, water management plan, water conservation objective, or an environmental management framework, the Surface Water Allocation Directive (SWAD) (GOA 2021) is applied and provides water allocation and use guidance for all new water licences across all sectors, including Temporary Diversion Licenses (TDLs), under the *Water Act*. The SWAD incorporates the fundamental ecological principle of maintaining natural hydrologic variability.

Targets & Thresholds Used to determine how valued components in the watershed rate or compare to acceptable or desired ratings. Numerical or written statements that provide a measurable indication of success in achieving plan objectives.

Thermal mobilization Refers to the mobilization of trace metals when heat or steam is used to assist in the recovery of heavy oil.

Tradition Land Use Traditional land use (TLU) refers to any land use by an Indigenous person that is rooted in their cultural identity and ancestral connection to certain areas. This includes the Treaty right to hunt, fish, and trap for food, but may also include plant harvesting and/or spiritual ceremonies. Analogous terms or phrases may include any combination of 'Indigenous', 'aboriginal', or 'ancestral' and 'users', 'land uses' or 'harvesting'. TLU is often shown as map data or geographic information in both qualitative and quantitative forms.

Fisheries Management Objectives To complete

Water Conservation Objectives (WCOs) and Instream Objectives (IOs) are administrative tools that are implemented by the Director appointed to manage water under Alberta's *Water Act*. Currently, no WCOs or IOs

have been established for watercourses in the watershed, except for the Beaver River in the Master Agreement on Apportionment (1969) (AEP, pers. comm. October 19, 2021 meeting).

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13.0 APPENDIX

APPENDIX A. Key Stakeholders, First Nations, and Métis

Academic
Lakeland College
Portage College

Business and Industry
ATCO
Green Alberta Energy

CFB Cold Lake

Economic Development
Cold Lake Chamber
Bonnyville Chamber
St. Paul Chamber
Lac La Biche Chamber
Travel Lakeland

Federal government
Agriculture Canada
Fisheries and Oceans Canada

First Nations
Beaver Lake Cree Nation
Cold Lake First Nations
Kehewin Cree Nation
Whitefish Lake First Nation (Goodfish)

Industry
Bonnyville Chamber
Cold Lake Chamber
Forestry
Kalinko Enterprises
Lac La Biche Chamber
North East Bulk Transportation
Oil and gas
- Cenovus
- Husky
- Imperial
- Nexen
- OSUM Oils Sands Corp
- CNRL
- Devon Energy

St. Paul Chamber

Local Government (elected officials and staff)
Athabasca County
City of Cold Lake
Lac la Biche County
MD of Bonnyville
Smoky Lake County
St. Paul County
Thorhild County
Town of Bonnyville

Local Organizations
Beaver River Naturalists Society
Bonnyville Fish and Game Association
Crane Lake Advisory and Stewardship Society
Lac La Biche Birding Society
Lakeland Agricultural Research Association
Moose Lake Watershed Society
Muriel Lake Basin Management Society
Riverland Recreational Trail Society
Skeleton Lake Stewardship Association

Local Youth

Métis Settlements
Buffalo Lake Métis Settlement
Elizabeth Métis Settlement
Fishing Lake Métis Settlement
Kikino Métis Settlement

Métis Nation of Alberta Regions 1

Métis Nation of Alberta Regions 2

Provincial Government/Regulators
Alberta Energy Regulator (AER)
Alberta Environment and Parks (AEP)
Alberta Agriculture and Forestry (AAF)
Alberta Health (AH)

Provincial/Regional Associations
Agri-Environmental Partnership
Alberta Beef Producers Association
Alberta Biodiversity Monitoring Institute (ABMI)
Alberta Conservation Association
Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA)
Alberta Forest Products Inc (ALPAC)
Alberta Lake Management Society
Alberta Native Plant Council
Alberta Trappers Association
Alberta Wilderness Association
Canadian Association of Petroleum Producers
Cows and Fish (Alberta Riparian Habitat Management Society)
Ducks Unlimited Canada
Land Stewardship Centre

First Nations Technical Services Advisory Committee (TSAG)

APPENDIX B. SUMMARY OF PREVIOUS PLANNING INITIATIVES AND MANAGEMENT FRAMEWORKS

B.1. Previous planning initiatives

The following provides a brief overview of planning initiatives since 1985.

Cold Lake-Beaver River Water Management Plan (1985)

The Cold Lake-Beaver River Water Management Plan (CLBR WMP) was prepared in partnership with Alberta Environment, LICA, and the Cold Lake-Beaver River Basin Advisory Committee. The CLBR WMP was authorized by Alberta Environment under the *Water Act* in 1985 to manage water resources in the Cold Lake and Lower Beaver River Basin (Alberta Environment 1985). The intent of the plan was to provide adequate water quantity and quality to meet the long-term user requirements of the basin. The CLBR WMP made specific recommendations concerning:

- Major oil sands water supply
- Municipal, agricultural, industrial, and minor oil sands water supply
- Surface and groundwater quantity
- Surface and groundwater quality
- Identified lakes to be managed for the purposes of conservation, fisheries, wildlife or recreation.

The CLBR WMP (1985) projected a long-term increase in use of freshwater for industrial activity based on anticipated industrial and population growth in the region. However, this projected demand was not realized. After the plan was complete, significant improvements were made by industry to the efficiency of water use through water recycling and technology that enabled the use of brackish groundwater in operations. Although freshwater use diminished there was a greater need to assess and develop a better understanding of groundwater quality, availability and use.

Cold Lake Sub-Regional Integrated Resource Plan (1996)

The Cold Lake Sub-Regional Integrated Resource Plan (IRP) was initiated in 1986 by an interdepartmental planning Team coordinated by the Strategic and Regional Support Division of Alberta Environment and Protection. The plan was prepared in response to the development of heavy oil and oil sands resources in the area and was approved by Cabinet in 1996 (AEP 1996). The planning area covered the eastern part of the Beaver River watershed, excluding the Sand River, First Nation lands, Métis Settlements, and any other federal or private lands. The purpose of the IRP was to promote the coordinated management of public land and resources within the Cold Lake planning area to achieve maximum economic, environmental and social benefits for Albertans. The resource management strategy was based on a 20-year time period. The plan focused on energy, agriculture, forestry and recreation.

Cold Lake-Beaver River Water Management Plan (2006)

In 2006, the Cold Lake-Beaver River Water Management Plan (CLBR WMP) (1985) was updated by Alberta Environment, LICA and the Basin Advisory Committee. The 2006 Authorized Water Management Plan intended to provide direction in managing water resources in the combined Cold Lake-Lower Beaver River basin — specifically, to provide adequate water quantity and quality to meet long-term user requirements (Alberta Environment 2006a). The revised plan was prompted by increased industrial and population growth and extended periods of below-normal precipitation that occurred after the original plan was completed. The combined growth and dry weather had resulted in record low water levels in the area's lakes, and low flows in rivers and streams.

To support the update of the plan, four State of the Basin reports were developed for the Cold Lake-Beaver River area:

- Surface water quality (Alberta Environment 2006b)
- Surface water quantity and aquatic resources (Alberta Environment 2006c)

- Groundwater quantity and brackish water (Alberta Environment 2006d)
- Groundwater quality (Alberta Environment 2006e).

Key issues and objectives for the WMP were based on the findings presented in the State of the Basin reports. Recommendations addressed:

1) Water Supply and Demand
2) Surface and Groundwater Quality
3) Strategies for Protection of Aquatic Resources

These recommendations reflected additional stewardship needs in the basin, beyond infrastructure and engineered solutions (e.g., dams and diversions). Although regulatory (under the direct mandate of Alberta Environment) and non-regulatory (Best Management Practices) tools were provided to implement the recommendations, no implementation plan was developed to direct activity.

The updated 2006 WMP retains the same planning area as the original 1985 Plan (Figure 1) and continues to focus on lakes, downstream rivers, and aquifers that are most likely to be affected by existing water withdrawals and future withdrawal applications (AEP 2016). The extent to which the recommendations in the CLBR WMP (2006) were implemented is unclear.

Figure B.1. Cold Lake-Beaver River Water Management Plan planning area (2006) (AEP 2016).

Lower Athabasca Regional Plan (2012)

In August 2012, the Government of Alberta (GOA) approved the Lower Athabasca Regional Plan (LARP) which encompasses the Lower Beaver River watershed in its planning area. To support the LARP, the GOA is developing a series of Management Frameworks to identify management targets for air quality, surface water quality, groundwater, biodiversity and landscape management. To date, the Groundwater Management Framework, Surface Water Quality Management Framework, and Surface Water Quantity Management Framework (2015) have been completed. The Biodiversity Management Framework is in draft form (2014), and the Landscape Management Plan is underway. A summary of the frameworks is found in Appendix B.

Cold Lake Subregional Plan (2021)
The Cold Lake Subregional Plan is currently being developed by the GOA (AEP 2021). The sub-regional plan is intended to support a working landscape, which considers the economy, while also supporting caribou and other species, Indigenous traditional land use, and recreational activities. The Plan focuses on retaining and reclaiming caribou habitat by reducing the human footprint in critical habitat areas, including mitigating access. ...

B.2. Current Provincial Management Frameworks and Plans

Groundwater Management Framework (2013)
In 2013, the GOA completed the Groundwater Management Framework to support the Lower Athabasca Regional Plan (ESRD 2013). The Framework outlined two objectives for groundwater quality and quantity:

- Regional Groundwater Quality Objective: Groundwater quality is protected from contamination by maintaining conditions within the range of natural variability and not exceeding established limits.
- Regional Groundwater Quantity Objective: Groundwater resources continue to support human and ecosystem needs and the integrity of the regional flow system is maintained.

The Groundwater Framework requires the creation of site-specific groundwater management strategies and groundwater management plans (ESRD 2013). These actions are guided by:

- The Groundwater Monitoring Directive (2016)[19], which assists operators of industrial facilities across Alberta in developing and implementing site-specific Groundwater Management Plans.
- The Guidance Document for Groundwater Management Plans for In Situ Operations (pending)[20], which assists operators of in situ oil sands facilities in developing and implementing Groundwater Management Plans specifically, for the management of thermally mobilized elements.

Surface Water Quality Management Framework
The Surface Water Quality Management Framework for the Lower Athabasca applies to the Lower section of the Athabasca River, from just downstream of the Grand Rapids (approximately 135 km upstream of Fort McMurray) to the Athabasca River Delta. Water Quality Limits (WQLs) only apply to AEPs monitoring station on the Athabasca River at Old Fort. Although the framework does not apply to the Beaver River watershed, the goals and principles in the Framework are relevant for future planning.

The goals of the Surface Water Quality Management Framework are to:

1) Identify ambient surface water quality triggers (WQTs) and ambient surface water quality limits (WQLs) to protect surface water quality, clarify Government of Alberta expectations, address cumulative effects, and support pollution prevention and proactive management strategies.
2) Enhance transparency and assurance through regular monitoring, evaluation and reporting on ambient surface water quality conditions within the Lower Athabasca River from the Grand Rapids downstream to the Athabasca River Delta.

While no specific water quality objectives were developed in the provincial *Framework* for the Beaver River watershed, Environment Canada, on behalf of the Prairie Provinces Water Board, monitors water quality in the Lower Beaver River upstream of the interprovincial boundary and in the Cold River at the outlet of Cold Lake. Water quality objectives are established for the Beaver River and the Board regularly reports on whether the

[19] The Groundwater Monitoring Directive and the Guidance Document for Groundwater Management Plans for *In Situ* Operations are not completed as per the Groundwater Management Framework for CLBR. The directive has not been implemented yet; stakeholder consultation for the directive has been scheduled for early Fall 2016.

[20] For *in situ* operations, two directives were developed: 1) The assessment of thermally mobilized constituents and, 2) The assessment and management of non-saline groundwater in direct contact with bitumen. A decision to post these directives to the GOA website is pending (M. Klebek, pers. comm.).

objectives have been met (Appendix C). Water quality objectives have not been determined for the Cold River, the Upper Beaver River, or other major tributaries in the basin (Beaver River Watershed Alliance 2013).

Biodiversity Management Framework (2016)

In November 2014, the GOA completed the draft Biodiversity Management Framework for the Lower Athabasca watershed. This draft went for public consultation with comments received to January 16, 2016. The framework applies to public land in the Green Area and provincial parks in the Lower Athabasca Region. While the objectives set in this framework apply to the entire Lower Athabasca Region (including private lands), any actions by landowners towards meeting objectives is voluntary and subject to availability of tools that support their stewardship efforts.

The Biodiversity Management Framework maintains the following objectives:

- Biodiversity and healthy, functioning ecosystems continue to provide a range of benefits to Albertans and communities in the region, including First Nations' continued ability to exercise constitutionally protected rights to hunt, fish, and trap for food.
- Species at risk are recovered and no new species at risk are designated.
- Long-term regional ecosystem health and resiliency are sustained with consideration of natural disturbance patterns and processes.

Air Quality Management Framework

The Air Quality Management Framework includes setting ambient air quality triggers and limits for nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) with guidance for long-term decision making and management.

Landscape Management Plan

The Landscape Management Plan (LMP) will address issues related to the extent and duration of land disturbances (e.g., access management, recreation, industry access to resources, and Aboriginal interests and priorities) for public land in the Green Area (GOA 2015). The LMP is divided into smaller Resource Management Areas (RMAs) to address local priority issues separately. The following RMAs are relevant to the Beaver River watershed:

- Moose Lake RMA – an important area for traditional land use
- Richardson Backcountry RMA – an important area for traditional land use and motorized recreation
- South Athabasca Oil Sands RMA – a primary area for projected in-situ oil sands development

The Landscape Management Framework proposes to:

- Consider biodiversity indicators and caribou habitat requirements
- Set key areas for progressive and timely reclamation or restoration of legacy footprint
- Implement avoidance and minimization strategies through Integrated Land Management (ILM) practices to ensure areas that are currently intact remain relatively intact
- Set management direction for motorized and non-motorized access in the RMAs, or other areas as required
- Manage the cumulative effects of in-situ development and other footprint in the South Athabasca Oil Sands area
- Establish setbacks and buffers to protect river corridors, lakes and wetlands.
- Incorporate applicable Integrated Resource Plan (IRP) provisions
- Develop a system for monitoring and reporting linear footprint and land disturbance

APPENDIX C. Sub-Watersheds

The Beaver River watershed is comprised of ten sub-watersheds that were previously defined in the Beaver River state-of-the-watershed report by either a major lake, river or creek system (Figure 1).

Upper Beaver Sub-Watershed: Refers to the area upstream of the confluence of the Sand River, which contributes substantial flow and affects downstream water quality in the Beaver River (BRWA 2013). The Upper Beaver River has not typically been included in previous planning initiatives.

Amisk River Sub-Watershed: Located south of the Upper Beaver, originates in a former glacier outwash channel at Long Lake in the west. The Amisk River drains several large lakes and is considered a major tributary of the Beaver River (BRWA 2013).

Moose Lake River Sub-Watershed: Rises in the extreme south and joins the Beaver River a few kilometers upstream of the Sand River confluence. The watershed contains a number of long, shallow lakes within glacial outwash channels that generally flow north into Thinlake River before joining Moose Lake (BRWA 2013).

Sand River Sub-Watershed: The Sand River drains much of the watershed north of the Beaver River, including the Cold Lake Air Weapons Range. This river is considered a major tributary to the Beaver River. The upper part of the watershed lies in the central mixed wood natural sub-region, while the lower part is in the dry mixedwood sub-region (BRWA 2013). A major tributary to the Sand River is the Wolf River.

Lakeland Sub-Watershed: This area is comprised of the western tributaries that flow into the Sand River and includes Touchwood Lake, Spencer Lake, Seibert Lake, and Pinehurst Lake.

Manatokan and Jackfish Creek Sub-Watersheds: These sub-watersheds rise in the Moostoos Upland near the southern boundary of the Cold Lake Air Weapons Range. Manatokan Creek and Jackfish Creek flow south to join the Beaver River.

Marie Creek Sub-Watershed: Similar to Manatokan and Jackfish creeks, Marie Creek originates in the Moostoos Upland in the Cold Lake Air Weapons Range and flows south to join the Beaver River at Canadian Forces Base (CFB) – Cold Lake. Marie Lake is a dominant feature in the watershed.

Muriel Creek Sub-Watershed: Muriel Creek flows north to join the Beaver River south of CFB-Cold Lake. This sub-watershed is represented by Muriel Lake, and numerous smaller lakes, including Sinking lake, Jessie Lake and Charlotte Lake.

Lower Beaver River Sub-Watershed: This area includes the Beaver River lowlands from the confluence of the Sand River to the inter-provincial boundary, as well as Reita and Redspring creeks that flow from the south into the Beaver River east of CFB-Cold Lake.

Cold Lake Sub-Watershed: Cold Lake, the deepest lake in the watershed, and Primrose Lake are dominant features shared by Alberta and Saskatchewan. Medley River enters Cold Lake from the north and Martineau River (rising in Saskatchewan) enters Cold Lake from the north-east.

APPENDIX D. Water Level Fluctuation Preliminary Assessment of Lake Water Level Fluctuations at the Watershed Scale

The Alberta River Basins online database, as well as other local studies, were consulted to provide a preliminary assessment of lake water level trends and variability to support IWMP discussions. While a complete evaluation of lake water levels is beyond the scope of this plan, the intent was to identify potential lakes where more detailed hydrological investigation may be warranted.

Historic recorded water levels were plotted from the Alberta River Basins database (online), and descriptive water level statistics were computed (i.e., median, minimum, maximum and range). The results were used for a comparison of water level trends and variability of lakes in the watershed (Table 9.4). Medoid Partitioning was used to cluster individual lake water level ranges into low, moderate and high degree of relative variability categories (relative to other lakes in the watershed for the period of record), where:

- Low variability: <1.7 m
- Moderate variability: ≥1.7 m and <3.2 m
- High variability: ≥3.2 m

Generally,

- Declining lake level trends were observed at: Mann, Skeleton, Manatokan, Charlotte, Jessie and Muriel lakes
- Increasing lake level trends were observed at: Kehewin, Pinehurst, Touchwood lakes
- Variability in lake water levels was rated high at Mann, Marie and Muriel

Table D1. Preliminary assessment of lake water levels (descriptive statistics derived from data sourced from AEP).

SubWatershed	Watercourse/ Waterbody	Water Quantity – Lake Water Levels						Variability
		Period of Record	Median	Min	Max	Range	Trend	
Amisk	Amisk Lake	1969-2021	611.69	611.18	612.34	1.16	Stable	Low
	Long Lake	1969-2021	620.82	620.35	621.91	1.56	Stable	Low
	Mann Lake - Upper	1968-2021	614.48	611.30	616.32	5.02	Declining	High
	Mann Lake - Lower	1972-2021	614.28	612.25	616.20	3.94		
	Skeleton Lake (N)	2012-2021	621.92	621.61	622.86	1.25	Declining	Low-Moderate
	Skeleton Lake (S)	1965-2021	622.94	621.61	623.89	2.27		
Cold Lake	Cold Lake	1999-2022	534.94	534.00	535.59	1.59	Stable	Low
	Primrose Lake (N)	1992-2021	598.91	598.25	599.78	1.52	Stable	Low
	Primrose Lake (S)	-	-	-	-	-		
Lower Beaver	Angling Lake	1973-2021	556.89	556.52	557.72	1.20	Stable	Low
	Fishing Lake	No Data	-	-	-	-	-	
Manatokan/ Jackfish Creek	Manatokan Lake	1973-2002	555.23	554.14	556.08	1.94	Declining	Moderate
	Osborne Creek	-	-	-	-	-	-	
Marie Creek	Moore (Crane) Lake	2018-2022	549.25	548.25	550.31	2.06	Stable	Moderate
	Ethel Lake	1999-2022	541.18	540.30	541.77	1.47	Stable	Low
	Marie Lake	2000-2020	573.78	534.93	574.64	39.72	Stable	High
Mooselake River	Kehiwin Lake	1967-2021	539.55	538.95	540.36	1.41	Increasing	Low
	Moose Lake	1950-2021	532.66	531.95	534.10	2.15	Stable	Moderate
Muriel Creek	Charlotte Lake	1972-2002	548.28	547.49	549.88	2.39	Declining	Moderate
	Jessie Lake *High water concern*	1968-2019	548.07	547.25	549.32	2.07	Declining	Moderate
	Muriel Lake	1967-2022	555.86	555.16	560.43	5.27	Declining	High
Sand River-Lakeland	Pinehurst Lake	1968-2021	598.83	597.69	599.46	1.78	Stable-Increasing	Moderate
	Touchwood Lake	1969-2021	631.83	630.90	632.27	1.37	Increasing	Low
	Wolf Lake (Regulated?)	1968-1992	597.37	597.03	597.72	0.68	Stable?	Low
Upper Beaver	Beaver Lake	No Data	-	-	-	-	-	
	Elinor Lake	No Data	-	-	-	-	-	
Other	Frog Lake							
	Vincent Lake							

APPENDIX E. ~~Priority lakes~~ Lakes of stakeholder interest in the Beaver River watershed ~~(draft).~~

Effort was made to understand which lakes in the Beaver River watershed could benefit from additional management attention (e.g., monitoring, restoration). Lakes of public interest were identified during Engagement Session I discussions (PESL 2021). Additional lakes were included in the preliminary assessment if they were identified as:

- Important recreation lakes
- Having unique features that may contribute to poor water quality or be negatively impacted by poor water quality (BRWA 2013)
- Lakes that have increased risk to water quality from external pressures (BRWA 2013) (e.g., shoreline development, recreational activity, point source discharge, poor riparian condition)
- Lakes that have active stewardship groups to support management
- Summer village lakes: Skeleton Lake (Bondiss; Mewatha Beach), Moose Lake (Bonnyville Beach, Pelican Narrows)
- Lakes having cultural significance to First Nations and Métis

Table E.1. Select lakes of interest identified through Engagement sessions (highlighted in green) and a review of other lake values, including water quality and riparian condition, and importance to biodiversity, recreation, and the economy.

SubWatershed	Watercourse/ Waterbody	Water Quantity – Lake Water Levels						Variability	Water Quality	% Riparian Area Intact	Importance to Biodiversity	Recreation[c]
		Period of Record	Median	Min	Max	Range	Trend					
Amisk	Amisk Lake	1969-2021	611.69	611.18	612.34	1.16	Stable	Low	-	-		
	Long Lake	1969-2021	620.82	620.35	621.91	1.56	Stable	Low	Eutrophic	-		
	Mann Lake - Upper	1968-2021	614.48	611.30	616.32	5.02	Declining	High	Eutrophic	-		
	Mann Lake - Lower	1972-2021	614.28	612.25	616.20	3.94			H-Eutrophic	-		
	Skeleton Lake (N)	2012-2021	621.92	621.61	622.86	1.25	Declining	Low-Moderate	Mesotrophic	-		
	Skeleton Lake (S)	1965-2021	622.94	621.61	623.89	2.27			Eutrophic	-		
Cold Lake	Cold Lake	1999-2022	534.94	534.00	535.59	1.59	Stable	Low		-		Major
	Primrose Lake (N)	1992-2021	598.91	598.25	599.78	1.52	Stable	Low	Eutrophic	-	White Pelican[a]	
	Primrose Lake (S)	-	-	-	-	-			Mesotrophic	-		
Lower Beaver	Angling Lake	1973-2021	556.89	556.52	557.72	1.20	Stable	Low	Mesotrophic	-		Secondary
	Fishing Lake	No Data	-	-	-	-	-		-	-		
Manatokan/ Jackfish Creek	Manatokan Lake	1973-2002	555.23	554.14	556.08	1.94	Declining	Moderate	-	66		Secondary
Marie Creek	Moore (Crane) Lake	2018-2022	549.25	548.25	550.31	2.06	Stable	Moderate	Mesotrophic	NA		Major
	Ethel Lake	1999-2022	541.18	540.30	541.77	1.47	Stable	Low	Mesotrophic	72		Major
	Marie Lake	2000-2020	573.78	534.93	574.64	39.72	Stable	High	Mesotrophic	NA		Major
	Kehiwin Lake	1967-2021	539.55	538.95	540.36	1.41	Increasing	Low	H-Eutrophic	69		

SubWatershed	Watercourse/ Waterbody	Water Quantity – Lake Water Levels						Variability	Water Quality	% Riparian Area Intact	Importance to Biodiversity	Recreation[c]
		Period of Record	Median	Min	Max	Range	Trend					
Mooselake River	Moose Lake	1950-2021	532.66	531.95	534.10	2.15	Stable	Moderate	Eutrophic	66		Major
	S. Trib Kehiwin Lake	-	-	-	-	-	-		-	65		
	S. Trib Kehiwin Lake-01	-	-	-	-	-	-		-	20		
	UL-120201-02	-	-	-	-	-	-		-	74		
Muriel Creek	Charlotte Lake	1972-2002	548.28	547.49	549.88	2.39	Declining	Moderate	-	4		
	Jessie Lake *High water concern*	1968-2019	548.07	547.25	549.32	2.07	Declining	Moderate	H-Eutrophic	33		
	Landry Lake B	No Data	-	-	-	-	-		-	32		
	Muriel Creek	-	-	-	-	-	-		-	36		
	Muriel Lake	1967-2022	555.86	555.16	560.43	5.27	Declining	High	Eutrophic	68	Piping Plover	Major
Sand River-Lakeland	Pinehurst Lake	1968-2021	598.83	597.69	599.46	1.78	Stable-Increasing	Moderate	Mesotrophic	-		
	Touchwood Lake	1969-2021	631.83	630.90	632.27	1.37	Increasing	Low		-		
	Wolf Lake (Regulated?)	1968-1992	597.37	597.03	597.72	0.68	Stable?	Low	-	-		Secondary
Upper Beaver	Beaver Lake	No Data	-	-	-	-	-		Eutrophic	-	Trumpeter Swan[a,b]	
	Elinor Lake	No Data	-	-	-	-	-		Mesotrophic	-	Trumpeter Swan[a,b]	
	Vincent Lake											

[a]Important Bird Area

[b]Designated buffer zone around lake to protect habitat

[c]Major recreation lakes: those lakes generating 30,000 user-days of activity per year; Secondary recreation lakes: Have fewer facilities and generate less than 30,000 user-days of activity per year; Minor recreation lakes: Have few facilities and user activity is low (May, Reita and Tucker) (Ref)

APPENDIX F. Beaver River Water Quality Objectives and Tributary Baseline Conditions

F.1. PPWB Water Quality Objectives for the Beaver River (PPWB 2021).

Table F.1. PPWB WQOs.

WATER QUALITY OBJECTIVES – Updated 2021			
Beaver River Reach: Beaver Crossing to the Border			
Chemical, Physical or Biological Variable	Unit	Acceptable Limit or Limits	
Nutrients		Open	Closed
Total Phosphorus	mg/L	0.171	0.127
Total Dissolved Phosphorus	mg/L	0.043 0.060	0.042 0.060
Total Nitrogen	mg/L	1.140	1.862
Nitrate as N	mg/L	3	
Ammonia Un-ionized	mg/L	0.019[a]	
Major Ions			
Total Dissolved Solids	mg/L	500	
Sulphate Dissolved	mg/L	250	
Sodium Dissolved	mg/L	200	
Fluoride Dissolved	mg/L	0.19	
Chloride Dissolved	mg/L	100	
Physicals and Other			
pH Lab	pH units	6.5-9.0	
pH Field	pH units	6.5-9.0	
Oxygen Dissolved			
Temperature > 5°C (Open Season)	mg/L	5	
Temperature < 5°C (Closed Season)	mg/L	No Objective	
Sodium Adsorption Ratio	rel units	3	
Total Suspended Solids	mg/L	3.0-48.8	
Reactive Chlorine Species	mg/L	0.0005	
Cyanide (free)	mg/L	0.005	
E. Coli	No./100 mL	200	
Coliforms Fecal	No./100 mL	100	
Metals			
Arsenic Total	µg/L	5	
Arsenic Dissolved	µg/L	No Objective	
Barium Total	µg/L	1000	
Beryllium Total	µg/L	100	
Boron Total	µg/L	500	
Cadmium Total	µg/L	Calculated[b]	
Chromium Total	µg/L	50	
Cobalt Total	µg/L	50	
Copper Total	µg/L	Calculated[b]	
Iron Dissolved	µg/L	300	
Lead Total	µg/L	Calculated[b]	
Lithium Total	µg/L	2500	
Manganese Dissolved	µg/L	40.0	2270.0
Mercury Total	µg/L	0.026	
Molybdenum Total	µg/L	10	
Nickel Dissolved	µg/L	Calculated[b]	
Selenium Total	µg/L	1	
Silver Total	µg/L	0.25	
Thallium Total	µg/L	0.8	
Uranium Total	µg/L	10	
Vanadium Total	µg/L	100	
Zinc Dissolved	µg/L	Calculated[b]	

Pesticides		
Acid Herbicides		
2,4-D	µg/L	4
Bromoxynil	µg/L	0.33
Dicamba	µg/L	0.000
MCPA	µg/L	0.005
Picloram	µg/L	29
Organochlorine Pesticides in Water		
Endosulfan	µg/L	0.003
Hexachlorocyclohexane (gamma-HCH) (Lindane)	µg/L	0.01
Hexachlorobenzene	µg/L	0.52
Pentachlorophenol (PCP)	µg/L	0.5
Neutral Herbicides in Water		
Atrazine	µg/L	1.8
Diclofopmethyl (Hoegrass)	µg/L	0.18
Metolachlor	µg/L	7.8
Metribuzin	µg/L	0.5
Simazine	µg/L	0.5
Triallate	µg/L	0.24
Trifluralin	µg/L	0.2
Other		
Glyphosate	µg/L	Report Detections
AMPA	µg/L	Report Detections
Fish Tissue		
Mercury in fish (muscle tissue)	µg/kg	200
Arsenic in fish (muscle tissue)	µg/kg	3500
Lead in fish (muscle tissue)	µg/kg	500
DDT (total) in fish (muscle tissue)	µg/kg	5000
Aquatic Biota Consumption		
PCB in fish (muscle tissue) mammalian	µg TEQ/kg diet wet weight	0.00079
PCB in fish (muscle tissue) avian	µg TEQ/kg diet wet weight	0.0024
DDT (total) in fish (muscle tissue)	µg/kg diet wet weight	14
Toxaphene in fish (muscle tissue)	µg/kg diet wet weight	6.3
Radioactive		
Cesium-137	Bq/L	10
Iodine-131	Bq/L	8
Lead-210	Bq/L	0.2
Radium-226	Bq/L	0.5
Strontium-90	Bq/L	5
Tritium	Bq/L	7000

Protection of Aquatic Life
Ag-Livestock
Ag-Irrigation
Recreation
Treatability
Ag-Irrigation + Treatability
Ag- Irrigation and Livestock
Fish Consumption
Background

Superscripts

a. Ammonia objective: Expressed as mg unionized ammonia/L. This would be equivalent to 0.0156 mg ammonia-nitrogen/L (0.019*14.0067/17.031).

b. The objective value in µg/L is a function of total hardness ($CaCO_3$ mg/L) in the water column: Cadmium Total is calculated using $Cadmium = 10^{(0.83(\log[hardness]) - 2.46)}$. Copper Total's objective is 2 when total hardness is <82 or unknown, 4 when >180, and calculated using $0.2*e^{(0.8545[\ln(hardness)]-1.465)}$ when total hardness is ≥82 to ≤180. Lead Total's objective is 1 when total hardness is ≤60 or unknown, 7 when >180, and calculated using $e^{(1.273[\ln(hardness)]-4.705)}$ when total hardness is >60 to ≤180. Nickel Dissolved is calculated using $0.998*e^{(0.8460[\ln(hardness)]+2.255)}$. Zinc dissolved is calculated using Zinc = $\exp^{(0.947[\ln(hardness\ mg\ L^{-1})] - 0.815[pH] + 0.398[\ln(DOC\ mg\ L^{-1})] + 4.625)}$.

F.2. Beaver River Current Water Quality Condition Assessment

A water quality data request was made to AEP. Historic data was provided via Excel spreadsheet that included data to 2020. Current water quality conditions for the five-year period 2016 to 2020 for three sites currently monitored by AEP are reported using descriptive statistics (i.e., median, minimum, maximum and 90th percentile values) (Table 9.6). Descriptive statistics were also used to summarize historic data for the period (2003-04 and 2010-2014) at the Sand River, one of the main tributaries to the Beaver River, and at Yelling Creek (period 2004-07; 2017, 2019 and 2020) (Table 9.7).

Table F.2. Select water quality objectives for the reach Beaver River at Beaver Crossing to the Border (PPWB 2021) and current water quality conditions for the Beaver River, open (April-October) and closed periods (November-March), 2016-2020 (AEP 2021). Refer to Appendix E for a complete list of PPWB (2021) water quality objectives, including total metals, pesticides and radioactive parameters. Red text indicates that the value did not meet the water quality guideline or objective.

Indicator	PPWB WQO		Statistic	At Hwy 28 Near BR Crossing		At Hwy 892		At Gravel Pit us AB_SK Border	
Seasonal	**Open**	**Closed**	-	**Open**	**Closed**	**Open**	**Closed**	**Open**	**Closed**
Total Phosphorus, mg/L	0.171	0.127	90th	0.150	0.058	0.151	0.060	0.096	0.053
			Median	0.077	0.042	0.072	0.045	0.037	0.021
			Min	0.034	0.023	0.030	0.026	0.009	0.002
			Max	**0.200**	0.100	**0.190**	0.140	**0.490**	0.180
Total Dissolved Phosphorus, mg/L	0.060	0.060	90th	0.048	0.025	0.035	0.029	0.051	0.026
			Median	0.022	0.016	0.019	0.015	0.033	0.018
			Min	0.006	0.003	0.006	0.004	0.006	0.002
			Max	**0.093**	0.037	**0.100**	0.053	**0.360**	0.180
Total Nitrogen, mg/L	1.140	1.862	90th	1.100	1.300	1.100	1.380	1.300	1.380
			Median	0.930	1.100	0.910	1.100	1.000	1.200
			Min	0.590	0.640	0.570	0.650	0.650	0.810
			Max	**1.400**	1.600	**1.400**	1.700	**3.000**	1.500
Nitrate as N, mg/L	3	3	90th	0.065	0.276	0.057	0.274	0.089	0.296
			Median	0.021	0.170	0.020	0.150	0.044	0.180
			Min	0.002	0.002	0.002	0.002	0.002	0.002
			Max	0.110	0.330	0.110	0.340	0.510	0.340
Dissolved Oxygen, mg/L	≥5	≥5	90th	12.53	**6.15**	12.66	**4.89**	12.53	**5.89**
			Median	9.29	**2.95**	9.54	**2.39**	9.17	**2.55**
			Min	**5.46**	**0.00**	**5.10**	**0.00**	**5.55**	**0.00**
			Max	13.08	7.86	13.20	7.74	13.22	8.29
Annual									
Temperature, °C	Indicate max value for fish with highest sensitivity?		90th	20.23		20.04		20.23	
			Median	2.68		3.06		2.68	
			Min	-0.21		-0.25		-0.21	
			Max	23.16		22.30		23.16	
pH, pH Units	≥6.5 and ≤9.0		90th	8.11		8.16		8.10	
			Median	7.68		7.84		7.64	
			Min	**6.35**		6.51		**6.33**	
			Max	8.53		8.61		8.42	
Total Dissolved Solids, mg/L	≤500		90th	280		280		290	
			Median	200		185		200	
			Min	110		98		110	

Indicator	PPWB WQO		Statistic	At Hwy 28 Near BR Crossing		At Hwy 892		At Gravel Pit us AB_SK Border	
Seasonal	**Open**	**Closed**	-	**Open**	**Closed**	**Open**	**Closed**	**Open**	**Closed**
			Max	340		320		350	
Specific Conductance, µS/cm	≤1000 µS/cm**		90th	497		505		515	
			Median	346		321		341	
			Min	203		198		198	
			Max	569		536		594	
Total Suspended Solids, mg/L	3.0-48.8		90th	48		49		49	
			Median	10		10		11	
			Min	1		1		1	
			Max	**80**		**77**		**97**	
Fecal Coliform Bacteria, cfu/100 mL	≤100		90th	72		64		82	
			Median	10		20		20	
			Min	5		4		5	
			Max	**210**		**240**		**110**	

*Note a review of seasonal data showed that November dissolved oxygen concentrations was generally high (~10 mg/L or higher) at each site during the 5 year period. To reflect this trend, November dissolved oxygen concentrations were included in the open water season period (i.e., April-November).
**Environmental Quality Guidelines for Alberta Surface Waters (GOA 2018)

F.2. Tributary Data (LARA 2021)

Table F.3.

Tributary	Date Range	Statistic	E.Coli	pH	Dissolved Organic Carbon	Ammonia-N total	Total Kjeldahl Nitrogen	Dissolved Phosphorous	Total Phosphorous	Total Dissolved Solids	Total Suspended Solids
Mooselake River	2017-2020	Sample Size	4	4	17	17	17	17	17	17	17
		Median	55	8.495	19	0.170	1.800	0.056	0.095	560	4
		Min	22	8.28	16	0.008	1.500	0.025	0.052	240	1.3
		Max	300	9.17	28	0.830	2.700	0.210	0.320	590	24
Yelling Creek	2017, 2019, 2020	Sample Size	4		11	11	11	11	11	11	11
		Median	116		35	0.057	2.800	0.360	0.560	390	5.4
		Min	16		20	0.039	2.000	0.091	0.460	250	2.3
		Max	410		46	0.160	8.000	0.980	3.100	770	30
Thinlake River at Hwy 28	2017-2020	Sample Size	4	4	17	17	17	17	17	17	17
		Median	108	8.23	22	0.130	2.000	0.200	0.480	700	12
		Min	33	7.87	17	0.030	1.700	0.085	0.140	260	2
		Max	180	8.25	34	1.100	3.400	0.430	0.800	1100	87
Thinlake River at Franchere Bay	2017-2020	Sample Size	4	4	17	17	17	17	17	17	17
		Median	25.2	8.195	22	0.079	2.000	0.260	0.290	540	7.2
		Min	7	7.83	18	0.018	1.700	0.014	0.077	260	1.7
		Max	300	9.32	45	0.370	3.200	0.550	0.600	720	87
Valere Creek	2017-2020	Sample Size	4	4	17	17	17	17	17	17	17
		Median	90.5	8.44	24	0.170	2.500	0.390	0.480	560	11
		Min	29	7.89	16	0.026	1.400	0.038	0.150	250	3.2
		Max	370	9.17	37	1.800	500.000	0.690	72.000	720	9300
Wood Creek	2019-2020	Sample Size	1	2	8	8	8	8	8	8	8
		Median	43	8.32	39	0.130	3.950	1.300	1.300	390	11.85
		Min	43	8.21	30	0.042	2.800	0.550	0.990	230	7.3
		Max	43	8.43	51	0.260	4.400	1.600	1.800	510	28

APPENDIX G. Riparian condition assessments

G.1. Riparian Intactness Assessment

Table G.1. The proportion (%) of shoreline intactness categories, and conservation and restoration priorities for lakes and streams included in the riparian intactness assessment (Fiera Biological 2021).

HUC 8 Watershed	Watershed Waterbody	Length Assessed (km)	Proportion (%) of Shoreline with Intactness Category						Conservation Priority				Restoration Priority			
			Very Low	Low	Very Low+Low	Moderate	High	Moderate+High	High Conservation		Moderate Conservation		High Restoration		Moderate Restoration	
									%	km	%	km	%	km	%	km
Jackfish Creek	Bourque Lake	18.2	0	0	0	0	100	100	99	18						
	Bourque Lake-01	14.3	1	1	1	0	99	99	98	14				Minor		Minor
	Bourque Lake-02	9.8	4	3	7	0	93	93	92	9						Minor
	Bourque Lake-03	3.6	0	0	0	0	100	100	111	4						
	Jackfish Creek	131.4	11	5	16	7	77	84	60	79	24	31	14	18	2	3
	Tucker Lake	16.2	0	1	1	0	99	99	99	16						Minor
	UL-120201-07	4.6	0	0	0	0	100	100		-		-		-		-
	UL-120201-09	1.1	0	0	0	0	100	100		-		-		-		-
	UL-120201-10	1.5	0	0	0	0	100	100		-		-		-		-
	UL-120201-11	1.5	0	0	0	0	100	100		-		-		-		-
	UL-120201-12	1.5	0	0	0	0	100	100		-		-		-		-
Marie Creek	Burnt Lake	10.7	0	0	0	0	100	100	103	11						
	Ethel Lake	11	5	5	11	17	72	89	73	8	9	1		Minor		Minor
	Marie Creek	173.5	1	1	1	0	99	99	96	166	3	6		Minor	1	1
	Marie Lake	29.9	0	3	3	3	94	97	94	28		Minor		Minor		Minor
	May Lake	8.8	0	0	0	0	100	100	102	9						
	UL-120201-08	3	0	0	0	0	100	100		-		-		-		-
	UL-120201-13	3.3	0	0	0	0	100	100		-		-		-		-
	UL-120201-14	3.3	0	0	0	0	100	100		-		-		-		-
	UL-120201-15	2.7	0	0	0	0	100	100		-		-		-		-

HUC 8 Watershed	Watershed Waterbody	Length Assessed (km)	Proportion (%) of Shoreline with Intactness Category						Conservation Priority				Restoration Priority			
			Very Low	Low	Very Low+Low	Moderate	High	Moderate+High	High Conservation		Moderate Conservation		High Restoration		Moderate Restoration	
									%	km	%	km	%	km	%	km
Middle Beaver River	Beaver River	154.1	6	1	7	0	93	93	81	125	12	18	5	7	3	4
	Manatokan Creek	23.4	2	4	6	6	88	94	90	21	4	1		Minor		Minor
	Manatokan Lake	12.8	12	13	24	9	66	76	55	7	23	3	23	3		Minor
	Osborne Creek	32.3	3	5	7	20	72	93	65	21	28	9	3	1	6	2
Moose Lake	Bangs Lake	10.9	0	0	0	0	100	100	37	4	55	6		Minor		
	Bentley Lake	7.1	1	0	1	1	97	99	99	7		Minor		Minor		
	Chickenhill Lake	11.7	1	2	3	0	97	97	94	11				Minor		Minor
	Jessie Lake	16.6	24	8	33	35	33	67	24	4	42	7	36	6		
	Kehiwin Creek	13.6	1	2	3	10	88	97	81	11	15	2		Minor		
	Kehiwin Lake	25.2	11	8	18	12	69	82	63	16	20	5	12	3	8	2
	Kehiwin Lake-01	13.5	4	0	4	5	91	96	89	12		Minor		Minor		
	Moose Lake	67.5	12	8	20	13	66	80	64	43	16	11	15	10	6	4
	Mooselake River	32.2	1	1	2	1	98	98	99	32				Minor		Minor
	S. Trib of Kehiwin Lake	13.3	2	6	8	27	65	92	60	8	30	4		Minor		Minor
	S. Trib of Kehiwin Lake-01	10.6	20	8	27	53	20	73			75	8	28	3		
	Thin Lake	10.6	1	1	2	0	98	98	75	8	28	3		Minor		Minor
	Thinlake River	21.7	1	1	2	6	92	98	92	20	9	2		Minor		Minor
	UL-120201-01	4.1	0	0	0	0	100	100		-		-		-		-
	UL-120201-02	4.3	21	0	21	5	74	79		-		-		-		-
	UL-120201-04	2.7	4	0	4	0	96	96		-		-		-		-
	UL-120201-05	2.6	0	0	0	0	100	100		-		-		-		-
Muriel Creek	Charlotte Lake	27.3	58	14	73	23	4	27		Minor	26	7	70	19	4	1
	Garnier Lakes A	2.4	0	0	0	0	100	100	83	2						
	Garnier Lakes B	9.2	0	0	0	0	100	100	98	9						
	Garnier Lakes C	6.2	0	3	3	0	97	97	97	6						Minor
	Garnier Lakes D	3.3	3	0	3	0	97	97	91	3				Minor		

HUC 8 Watershed	Watershed Waterbody	Length Assessed (km)	Proportion (%) of Shoreline with Intactness Category						Conservation Priority				Restoration Priority			
			Very Low	Low	Very Low+Low	Moderate	High	Moderate+High	High Conservation		Moderate Conservation		High Restoration		Moderate Restoration	
									%	km	%	km	%	km	%	km
Muriel Creek	Jerome Lake	2.5	0	0	0	0	100	100	80	2						
	Landry Lake A	2.9	0	0	0	0	100	100	69	2	34	1				
	Landry Lake B	1.9	26	5	32	37	32	68								
	Michel Lake	4.5	0	0	0	0	100	100	89	4						
	Muriel Creek	88	42	10	52	12	36	48	5	4	43	38	51	45	1	1
	Muriel Lake	51.5	7	7	13	19	68	87	64	33	23	12	10	5	4	2
	Muriel Lake-01	19	4	1	4	0	96	96	95	18				Minor		Minor
	St. Pierre Lake	2.6	0	0	0	0	100	100	115	3						
	UL-120201-03	5.5	0	0	0	0	100	100		-		-		-		-
	UL-120201-06	1.3	0	0	0	0	100	100		-		-		-		-
Reita Creek	Reita Creek															

Table G-2. Summary of shoreline intactness by subwatersheds and municipal boundaries.

Spatial Extent	Length Assessed (km)	Proportion (%) of Shoreline within Intactness Category					
		Very Low	Low	Very Low + Low	Moderate	High	Moderate + High
Jackfish - Muriel Creeks Watershed	1168.8	9	4	13	7	80	87
Jackfish Creek Subwatershed	203.7	7	3	11	4	85	89
Marie Creek Subwatershed	246.2	1	1	2	1	97	98
Middle Beaver River Subwatershed	222.6	6	2	8	4	88	92
Moose Lake Subwatershed	268.2	7	4	12	12	77	88
Muriel Creek Subwatershed	228.1	25	7	33	12	56	67
Town of Bonnyville	7.3	42	19	62	38	0	38
CLFN Traditional Territory	888.7	10	4	14	6	80	86
MD of Bonnyville	989.5	10	4	14	6	80	86
Muriel Lake Basin	71.8	6	5	11	14	76	89

G.2. Riparian condition assessment results using aerial videography methods

G.3. Riparian condition assessment using aerial videography

HUC 8 Watershed	Watercourse/ Waterbody	Length Assessed (km)	% of Shoreline within Condition Category		
Aerial Videography			Poor	Fair	Healthy
	Crane Lake		14	7	79
	Ethel Lake		9	11	80
	Hilda Lake		9	13	78
	Marie Lake		9	9	82
	Moose Lake		26	13	61
	Muriel Lake		24	76	0
	Tucker Lake		0.4	0.4	99.2

G. 3. Riparian condition assessment results using riparian health inventory (Cows and Fish 2021).

G.4. Targets used to manage riparian areas, experience from elsewhere.

Targets	Source
Shoreline protection policy and regulation implemented to protect trees and other natural vegetation in 75 percent of the land area within the 30-metre shoreline residential water yard setback currently required by the Townships.	https://www.environmentcouncil.ca/healthy-shorelines
Environment Canada states that 75 per cent of the shore area 30 metres back from the water should be left in a natural state to protect water bodies and essential wildlife habitat.	Environment Canada (2013). How much habitat is enough? Third Edition. Environment Canada, Toronto, Ontario. 127 pp.
Shoreline property owners:75% natural shore, 25% accessible area	Ontario Ministry of Natural Resources Dufferin Simcoe Land Stewardship Network (2014)
A 2013 Environment Canada report* recommends that 75% of a shoreline's riparian habitat should be naturally vegetated, however, collected data through Love Your Lake shows that only 22% of assessed properties across Canada meet this recommendation.	Love Your Lakes
Existing property owners encouraged to begin naturalization process, a minimum width of three to five metres is suggested. In general, it is recommended that the entire shoreline frontage is vegetated leaving 15 metres or 25% (whichever is less) open for access (sitting and swimming areas, docks, etc.)	Rideau Valley Conservation Authority: https://www.rvca.ca/stewardship-grants/shoreline-naturalization/how-to-naturalize-your-shoreline#how-much-is-enough
The shoreline produces the ultimate "Edge" effect upon which 70% of land-based animals and 90% of the aquatic plants and animals rely (Kipp and Callaway, 2003)	Kipp, S. and C. Callaway, 2003. On the Living Edge: Your Handbook for Waterfront Living, Rideau Valley Conservation Authority.

APPENDIX H. Local Riparian Protection and Management Strategies, Beaver River watershed

Riparian setbacks are applied to land use activities by government, industry and landowners to minimize environmental impacts, risks to infrastructure, pollution prevention, and to maintain public safety. Setbacks from water are regulated by industry to prevent contamination of water from industrial practices, maintain stable streambanks to minimize erosion, and to support biodiversity. Industries have developed setback practices unique to their industry, and are bound by provincial acts and rules (e.g., AOPA, operating ground rules) to abide by these setbacks. The MGA stipulates a minimum setback of 6 m for development from water, however numerous municipalities have recognized that this is not sufficient to mitigate impacts of flooding to infrastructure, or for pollution prevention. The following highlights riparian setback guidelines for municipal development (E-1), and regulatory requirements for agriculture (AOPA) (E-2), forestry (E-3) and oil and gas activity (E-4).

H.1. Municipal

City of Cold Lake (LUB

6.9 ENVIRONMENTALLY SENSITIVE LANDS: DEVELOPMENT NEAR LANDS SUBJECT TO FLOODING, ADJACENT TO WATERCOURSES AND STEEPER SLOPES

(1) On lands identified as environmentally sensitive, City Council and/or the Development Authority may require the following information to be submitted as part of a development permit application, an application to amend this Bylaw, an application for subdivision approval, an application to amend a statutory plan, or an appeal:

(a) A geotechnical study, prepared by a registered professional engineer, addressing the proposed development. The geotechnical study will establish building setbacks from property lines based on the land characteristics of the subject property;

(b) A certificate from a registered professional engineer certifying that the design of the proposed development was undertaken with full knowledge of the soil and/or slope conditions of the subject property; and

(c) A certificate from a registered professional engineer when the proposed development includes cut and/or fill sections on slopes, including the addition of fill on the subject property. (2) The applicant shall be responsible for the expense of the geotechnical study or certificate. The City, at its discretion, may seek an independent review of a geotechnical analysis submitted by an applicant.

(3) No development shall be permitted within the 1 in 100-year flood line as established by Alberta Environment.

(4) A minimum setback of 50.00 metres is required from the top of bank of watercourses. This should consist of 30.00 metres Environmental Reserve (ER) dedication as required by the MDP, with the balance of 20.00 metres taken as Environmental Reserve (ER), Municipal Reserve (MR) and / or conservation easement. (a) The 30.00 metres shall commence from the 1 in 100-year flood line unless a discernable top of bank exists beyond this.

(b) The embankment is often geotechnical containment and therefore the 50.00 metres setback shall commence beyond this.

(c) To enable the determination of top of bank setbacks in Section 6.8(2), the applicant shall undertake a top of bank survey for the subject watercourse as a condition of the development permit.

HIGH WATER MARK TOP OF BANK TRAIL WATER- COURSE MIN 30 m (ER) MIN 20 m (ER), (MR) and / or CONSERVATION EASEMENT

(5) Notwithstanding the provisions of Section 6.9 (4) above, the City will require a minimum setback of 15-30 metres, from top-of-bank of a watercourse, in accordance with Department of Fisheries and Oceans requirements.

(6) Land dedicated as Environmental Reserve shall be left in its natural state. (7) The minimum setback in Section 6.9(4) may be reduced at the discretion of the Development Authority where a watercourse is considered to be of a minor nature and there is no risk of adverse effect on development or the environment as determined by the Development Authority.

(8) The Development Authority may increase any required setback or yard for any permitted or discretionary use where the regulation in the District would allow development that may be detrimental to the preservation of shoreland or environmentally sensitive areas, may be affected by being in a floodplain or in proximity to steep or unstable slopes, or may increase the degree of hazard.

(9) Trees shall not be cut, felled or removed on lands identified as environmentally sensitive, without the prior approval of the Development Authority.

MD of Bonnyville (MDP 2007, Section 3.5)

4) Setbacks

a) A minimum environmental reserve setback of 30 metres (100 feet) from either the top of the bank of a river or stream or the high-water mark of a lake shall be applied, subject to the discretion of Council/Development Authority.

b) Environmental setbacks shall be established as part of the Area Structure Plan approval process.

5) Development of Environmental Reserve land Development shall be allowed to exist on Environmental Reserve lands only if it serves the interests of the general public.

6) 1:100 Year Flood Plain

No permanent residential structures will be permitted within the 1:100-year floodplain of any river, stream or lake shore, unless proper flood proofing techniques are applied. A certificate from a qualified, registered professional engineer or architect will be required by the Municipal District to confirm that the development has been properly flood proofed.

7) Steep Slopes

Alberta Environmental Protection's Interim Guideline for the Subdivision of Land Adjacent to Steep Slopes (to define and protect the valley crest and toe of slope) will apply so that no development will be permitted within 30 metres (100 feet) from the top or bottom of a valley slope which exceeds a 30 percent grade.

General Development Setbacks

Stepping Back from the Water, GOA 2012

Summary of riparian setback guidelines (GOA 2012).

Waterbody	Substrate	Width	Modifiers	Notes
Permanent Water Bodies Lakes, Rivers, Streams, Seeps, Springs	Glacial till	20 m	If the average slope of the strip is more than 5%, increase the width of the strip by 1.5 m for every 1% of slope over 5%	Slopes >25% are not credited toward the filter strip.

Waterbody	Substrate	Width	Modifiers	Notes
Class III - VII Wetlands	Coarse textured sands and gravels, alluvial sediments	50 m	None	Conserve native riparian vegetation and natural flood regimes
Ephemeral and Intermittent Streams, Gullies	Not specified	6 m strip of native vegetation or perennial grasses adjacent to the stream channel crest	If the average slope of the strip is more than 5%, increase the width of the strip by 1.5 m for every 1% of slope over 5%	Maintain continuous native vegetation cover along channels and slopes
Class I & II Wetlands	Not specified	10 m strip of willow and perennial grasses adjacent to water body	None	Maintain and conserve native wetland or marshland plants on legal bed and shore

Riparian Setback Matrix Model (Aquality 2012)

The Riparian Setback Matrix Model (RSMM) can be used to establish site-specific, defensible Environmental Reserve setbacks, and to determine development setbacks and land uses for private lands located adjacent to environmentally sensitive areas and/or significant lands within a municipality (Aquality 2012). Input measures include slope of land, height of bank, groundwater table level, groundwater risk, soil type and texture, and vegetation/ground cover. Application of the RSMM generally results in a development setback of 10 m to 60 m in width (possibly greater, depending on local site conditions).

Example Setback Calculation 1. A completely forested site, with zero slope, low groundwater risk and peat soils, results in a 10 m setback.

Example Setback Calculation 2. A site with 100% impermeable surface area, 15% slope, high groundwater risk, and silt soils results in a setback of 60 m.
Sites having slope >15% are reviewed separately by a geotechnical engineer. Additional development restrictions may apply in the 1:100-year flood-prone zone (mapped at the provincial level) if the setback width does not encompass this width. The RSMM requires a Professional Biologist or QWAES to apply the model to individual sites, working with a land surveyor and others as required.

H.2. Setbacks Associated with Agricultural Activity (GOA 2008). Refer to the relevant legislation (i.e., *AOPA, EPEA*) for additional and the most recent requirements.

Excerpt of setback requirements for agriculture industry.

Activity	Setback Requirement
Manure Storage Facilities and Manure Collection Areas	**Common Body of Water**[a] Manure storage facilities[b] or manure collection areas[c] must be constructed at least 30 m (98 ft) away from a common body of water. This does not apply if the owner or operator demonstrates to the NRCB, prior to construction, that either: • The natural drainage from the facility or area is away from the common body of water, or • A berm or other secondary protection for the common body of water constructed by the owner or operator protects the common body of water from contamination. **Flooded Areas** A manure storage facility or manure collection area must not be in an area that floods. • The 1:25 year maximum flood level at a manure storage facility or manure collection area must not be less than one metre below any part of the facility where run-on can come into contact with the stored manure. • If the 1:25 year maximum flood level cannot be determined, the manure storage facility or manure collection area must be not less than one metre below any part of the facility where run-on from the highest known flood level can come into contact with the stored manure. **Natural Water and Wells** Manure storage facilities and manure collection areas must be constructed at least 100 m (328 ft) away from a spring or water well. This does not apply if the owner or operator: • Demonstrates to the NRCB, prior to construction, that an aquifer from which the spring rises, or into which the water well is drilled, is not likely to be contaminated by the facility, and • Implements a groundwater monitoring program if required by NRCB.
Groundwater Resource Protection	• All manure storage facilities and manure collection areas must have either a protective layer or liner that lays below the bottom of the facility and above the uppermost groundwater resource of the site and also meets regulatory requirements. • Solid Manure Storage Facility or Collection Area – The liner must be at least 0.5 m (1.6 ft) in depth with a hydraulic conductivity of not more than 5×10^{-7} cm/s.
Surface Water Control Systems	Surface water control systems are required to minimize run-on flowing through and runoff leaving a manure storage facility or manure collection area. These systems must not significantly alter regular water flow, must not affect or alter a non-flowing water body and must not be located on a fish-bearing water body. The NRCB will determine if the system has to be designed and certified by a professional engineer.
Runoff Control Catch Basin	Runoff control catch basins must have the following: • A storage capacity to accommodate a 1:30 year one-day rainfall, • A visible marker that clearly indicates the minimum volume possible to accommodate the 1:30 year one-day rainfall event, • A freeboard of not less than 0.5 m (1.6 ft) when the basin is filled to capacity.
Short-Term Solid Manure Storage	Short-term solid manure storage sites can only be used for an accumulated total of 7 months within a 3-year period regardless of the amount of manure stored. Feedlot pens are not considered short-term manure storage sites and must meet the requirements for a manure storage facility. Short-term solid manure storage sites must be located at least: • 150 m (492 ft) from a residence or occupied building that the producer does not own • 100 m (328 ft) from a spring or water well • 1 m (3.3 ft) above the water table

Activity	Setback Requirement
	• 1 metre above the 1-in-25-year maximum flood level or 1 m (3.3 ft) above the highest known flood level if the 1-in-25-year flood level is not known. If the land slopes towards a common body of water, the following setback distances must be observed: **Mean slope** — **Setback** 4% or less — - 30 m (98 ft) Greater than 4% to less than 6% — - 60 m (197 ft) 6% or greater, but less than 12% — - 90 m (295 ft) If the mean slope is 12% or greater, do not apply or store manure on the land.
Seasonal Feeding and Bedding (Wintering) Sites and Livestock Corrals	Seasonal feeding and bedding sites (wintering sites) and livestock corrals do not require a permit but must be sited and managed to protect surface waterbodies. A seasonal feeding and bedding site or livestock corral must be located at least 30 m (98 ft) away from a common body of water. If this cannot be achieved, the operator must either design the site to divert runoff away from the common body of water or move the manure to an appropriate location away from the common body of water prior to a runoff event.
Manure Incorporation	Manure must be incorporated within 48 hrs when applied to cultivated land except when applied to forages or direct-seeded crops, frozen or snow-covered land or unless an operation has a permit that specifies additional requirements.
Setbacks for Manure Application	Setback distances are required to reduce nuisance impacts on neighbours and to minimize the risk of manure leaving the land on which it is applied and entering a common body of water. Manure must be applied at least: • 150 m (492 ft) away from a residence or other occupied building if the manure is not incorporated • 30 m (98 ft) away from a water well • 10 m (33 ft) away from a common body of water if subsurface injection is used • 30 m (98 ft) away from a common body of water if manure is surface-applied and incorporated within 48 hrs of application, except when applied on forage, direct-seeded crops, frozen or snow-covered land. *The setbacks outlined in "short-term solid manure storage" for lands that slope to a common body of water also apply.
Inorganic Fertilizer Application	**Prohibited releases** *EPEA* prohibits operators from releasing into the environment a substance in an amount, concentration or level or at a rate of release that causes or may cause a significant adverse effect on the environment. An "adverse effect" is broadly defined to mean the "impairment of, or damage to, the environment, human health or safety or property." For example, if a farm operator spreads manure on land at a rate that will overload the nutrient levels in the soil, or releases manure on land where the manure will run into a water body, the operator is in violation of EPEA. **Best management practices** • Apply fertilizer rinsate to a cropped area at a distance greater than 10 m (33 ft) from any surface water source and greater than 60 m (197 ft) from any well. (http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex9398) • Storage facilities should be located more than 100 m (328 ft) from water wells and more than 20 m (66 ft) from surface water bodies. • Ensure that loading takes place at least 30 m (98 ft) away from a well or surface water (AARD 2004).
Pesticide Use, Application, Storage or	The use, application, storage or washing of equipment within 30 horizontal meters of an 'open body of water'[d] are regulated activities in Alberta. Pesticides include herbicides,

Activity	Setback Requirement
Washing of Equipment	insecticides, fungicides, rodenticides, and algaecides. Pesticide treatments must be in accordance with the *Environmental Code of Practice for Pesticides* as regulated by ESRD. Regulations concerning pesticide use near an open body of water apply only to undisturbed vegetation along rivers, streams and lakes. Persons applying a pesticide on cultivated land (cropland, improved pasture, managed turf and landscaped areas) must follow pesticide label directions including any buffers specified for open bodies of water. A sufficient buffer of natural vegetation should be left (similar to the buffers identified in *the Environmental Code of Practice for Pesticides*) between cultivated land and open bodies of water. Generally, - Application must not result in the deposit of pesticides into or onto any open body of water except in accordance with subsection 16(12). - Applications must not be made within 250 m (820 ft) upstream of any surface water intake of a waterworks system. - Aerial applications of pesticides to land must not be conducted while flying directly over an open body of water. - Herbicides must not be deposited on areas that have slumped, been washed out or are subject to soil erosion into the water body. Setback distances for pesticide application within 30 horizontal metres (98 ft) of an open body of water is generally determined by the type of pesticide being used, the application rate, type of weed listed under the *Weeds Control Act*, method of application and percentage of the infected area that receives application in a given year. Setbacks are variable but generally range from the edge of the bed and shore to 5 m (16 ft)) (*Environmental Code of Practice for Pesticides* 2010). Applicators may apply the herbicides aminopyralid (when used up to a maximum application rate of 0.12 kg/ha), chlorsulfuron, clopyralid, glyphosate, metsulfuron-methyl (when used up to a maximum application rate of 0.09 kg/ha) and triclopyr (when used up to a maximum application rate of 1.92 kg/ha) no closer than 1 horizontal metre (3.3 ft) from an open body of water (unless otherwise specified on the manufacturer's product label) provided that no more than 10% of any 100 m^2 (1,076 ft^2) in the zone 1 m to 5 m (3.3 to 16.0 ft) from an open body of water receives treatment in any calendar year.

[a]**Common body of water** includes the bed and shore of a water body that is shared by (common to) more than one landowner.

[b]**Manure storage facility** is a facility for composting or storing manure, composting material or compost (does not include facilities at an equestrian stable, auction market, racetrack or exhibition ground).

[c]**Manure collection area** refers to the floor or under-floor pits of a barn, the floor of a feedlot pen and a catch basin where manure collects (not including the floor of a livestock corral).

[d]**Open body of water** includes lakes, streams, rivers, irrigation canals and other natural water bodies. An "open body of water" does not include ponds or dugouts that have no outlet, are completely surrounded by private land, and are less than 4 hectares (10 acres) in area on private land or are less than 0.4 hectares on Public Land. Roadside ditches and small (less than 0.5 m (1.6 ft) wide), dry intermittent streams are also not considered open bodies of water (GOA 2013).

H.3 Setbacks and Other Watershed Protection Measures Associated with Forestry Activity

Timber Harvest Planning and Operating Ground Rules (Feb 2015) pertaining to riparian management and overall watershed protection

Ground Rule 3.5.5 Any changes that could adversely affect buffers established for the protection of riparian areas, wildlife sites, historical resources, or aesthetic values or any changes not listed will be considered a Major Amendment.

Ground Rule 4.2.7 All trees/pieces used in the construction of crossing structures may be scattered or piled along the ROW or in the harvest area, but they shall not be piled in riparian areas if any chance of re-entering the watercourse.

Forest Harvest Plans
3.4.7 The company shall follow existing integrated landscape management (ILM) or access development strategies when developing DLO roads. Alberta may approve deviations from these strategies after discussions with the company.

3.4.8 Individual block maps or shape files shall be provided depicting all blocks, watercourses, crossings and buffers. The following information shall be mapped and/or described for each affected block by:

a) layout bordering and encompassing riparian management zones when different than the standards in section 6.0;
b) watercourse classification and protective buffer;
c) layout bordering restricted areas (e.g., PSPs, private land);
d) identification of understorey (see section 7.5);
e) harvest area-specific structure retention and woody debris management strategies;
f) tactics to address forest health issues;
g) protection of roadside vegetation - applicable or not, and how to be done;
h) strategies to address sight distance concerns with an attempt to maintain sight distance of 400 m or less from Class I, II or III roads;
i) important wildlife sites as defined in section 7.7.7 (this information shall be made available for resource planning purposes only through Fish and Wildlife);
j) historical site considerations;
k) soil protection measures when any of the following are present:
• identified unstable areas, water-source areas, springs or seepages;
• steep or sustained slopes or grades (>30%);

3.4.9 Detailed block plans (DBP) are required when there is higher than average potential for environmental damage. Circumstances that merit DBPs are:

a) areas of steep topography requiring specific road location and construction or specialized harvesting equipment;
b) unstable slopes are generally to be avoided but if this is not possible it is necessary to plan operations carefully to minimize impacts;
c) harvest areas with numerous water source areas, seepages, intermittent, or ephemeral watercourses;
d) harvest areas that contain or border sensitive wildlife or fisheries areas;
e) harvest areas requiring understorey protection using protection techniques (see section 7.5);
f) harvest areas located near high-value recreation areas, tourism areas, and facilities;
g) partial harvests, excluding commercial thinning (CT) and pre-commercial thinning (PCT);
h) when harvesting is used as a tool to control insects (excluding mountain pine beetle (MPB)) and disease infestations;

The detailed block plan (DBP) shall include a map of appropriate scale to the issue(s) and describe how the concern will be addressed in operations. DBPs are not submitted to Alberta but must be available upon request.

3.4.10 Where a temporary field authority (TFA) is required to open access for the layout of harvest areas, this access shall be incorporated into the road system of the FHP.

Watershed Protection

PURPOSE
To manage the implications of timber operations on water quality, quantity, and flow regime by:

- minimizing the potential for sedimentation in watercourses;
- preventing soil, logging debris and deleterious substances from entering watercourses;
- maintaining aquatic and terrestrial habitat;
- complying with the *Water Act*.

6.0.2 Where an approved FMP does not provide an estimate of water yield, the following applies:

- watersheds shall not be unduly affected by large harvest areas or harvesting large amounts of timber in a watershed unless otherwise approved in the FMP;
- predicted average annual water yield increases should not exceed 15 percent within third-order streams;
- companies will report the increase in water yield annually in a mutually agreeable format.

6.0.3 Measures must be implemented, including temporary and permanent erosion control measures, to minimize erosion and sedimentation into the watercourse or waterbody.
6.0.4 Riparian protection areas shall be established as in Table 2, Standards and Guidelines for Operating Beside Watercourses. Where uncertainty exists on the classification of the watercourse, the watercourse protection area shall be that required by the higher class of watercourse.
6.0.5 All unmapped or incorrectly classified watercourses encountered during operations shall be given the appropriate protection as described in Table 2.
6.0.6 Unless otherwise approved in an FMP, variances from the standards in Table 2 must demonstrate that aquatic and terrestrial objectives are met. Any such proposals shall undergo a full review by Alberta prior to being considered for approval.
6.0.7 Sediment, logging debris or deleterious materials (e.g., fuels, oils, greases, industrial or household chemicals or refuse) shall not be deposited into the water or onto the ice of any watercourse or water body during road construction, maintenance, harvesting, reclamation or silviculture operations.
6.0.8 Equipment shall cross watercourses only at approved crossings.
6.0.9 Logs shall not be decked in watercourses, riparian areas, or seepage areas.
6.0.10 Authorized in-stream activities in fish-bearing watercourses shall be scheduled to avoid disturbing migration, spawning and incubation of fish species, and carried out in such a manner as to avoid stream sedimentation.
6.0.11 Beaver ponds shall have a minimum buffer of 20 m or a buffer for the same classification as the watercourse flowing out of the pond, whichever is larger, as measured at a representative width within 50 m of the dam.
6.0.12 Harvesting is not permitted within water source areas during non-frozen periods.

Forestry Standards and Guidelines for Operating Beside Watercourses

Watercourse Classification	Roads, Landings, Decking and Bared Areas	Watercourse Protection Areas	Operating Conditions Within Riparian Areas and Water Source Areas Where Operations are Approved	
			Tree Felling	Equipment Operation
Class "A" Waterbodies	Not permitted within 100 m of high-water mark. Any existing roads may be maintained at present classification standards. Any proposed watercourse crossings within 2 km upstream must be specifically approved in the AOP	No disturbance or removal of timber within 100 m of the high-water mark; No duff disturbance of intermittent (min 10 m vegetated buffer) or ephemeral drainages (minimum 5 m vegetated buffer) within 2 km upstream of Class A waterbody.	Not permitted without specific Alberta approval	Not allowed without specific Alberta approval.
Class "B" Waterbodies	Not permitted within 60 m of high-water mark. Any existing roads may be maintained at present classification standards. Any watercourse crossings within 500 m upstream must be specifically approved in the AOP	No disturbance or removal of timber within the appropriate riparian area specified by stream type unless specifically approved in the AOP; No duff disturbance of intermittent (minimum 10m vegetated buffer) or ephemeral drainages (minimum 5m vegetated buffer) within 500 m upstream of Class B waterbody.	Trees shall be felled so that they do not enter watercourse. Should slash or debris enter the watercourse immediate removal is required without a machine entering the watercourse.	Where removal of timber within 60 m is approved, no machinery is permitted within 30 m of the high-water mark.

H.4. Setbacks Associated with Oil and Gas Activity (DACC 2015)

Watercourses

Type	Watercourse Width	Channel Characteristics	Setback Requirements[1]
Large Permanent[2]	> 5 m	Defined channel	100 m
Small Permanent[2]	0.7 – 5 m	Defined channel	45 m
Intermittent/Spring[2]	< 0.7 m	Defined channel	45 m
Ephemeral	-	No defined channel	15 m

Waterbodies

Type	Basin Characteristics	Setback Requirements[3]
Lakes	Open water (> 2 m depth)	100 m
Permanent Shallow Open Water Ponds (S&K V[4])	Open water (> 2 m depth) Deep marsh margin	100 m
Semi-permanent Ponds/wetlands (S&K IV[4])	Emergent deep marsh throughout	100 m
Non-permanent Seasonal Wetlands (S&K III[4])	Shallow marsh	45 m
Non-permanent Temporary Wetlands (S&K II[4])	Wet meadow	15 m setback requirement for well sites and pipelines
Fens	No defined channel; Slow flowing	No specific setback; attempt to leave undisturbed
Bogs	Peatland; Acidic wetland	No specific setback

[1]The setback for watercourses is measured from top of break (valley), or where undefined, from the top of the bank.
[2]May or may not contain continuous flow
[3]The setback from the defined bank of the waterbody or the outer margin of the last zone of vegetation that is not defined/bounded by upland vegetation communities.
[4]Steward, R.E., and H.A. Kantrud. 1971. Classification of natural ponds and lakes in the glaciated prairie region. Resource Publication 92, Bureau of Sport Fisheries and Wildlife, U.S. Fish and Wildlife Service, Washington, D.C. Northern Prairie Wildlife Research Centre Online, found at Norther Prairie Wildlife Research Centre.

Standard 100.9.6.2: Wellsites, pipeline installations, plant sites and camps shall maintain a minimum 100 m buffer to the edge of valley breaks. In the absence of well-defined watercourse valley breaks a 100 m buffer from the permanent watercourse bank applies.

APPENDIX I. Fish Sustainability Index Risk Thresholds for Walleye and Northern Pike

Fall Index Netting – Overview | Alberta.ca

Table 1 - Alberta's Fish Sustainability Index risk thresholds for Walleye and Northern Pike using the standardized Fall Index Net (FIN) method.

Mature Walleyes / net-night	Mature Pike / net-night	Risk to Sustainability
>29	>22	Very Low
20-29	15-22	Low
15-20	11-14	Moderate
6-15	4-10	High
<6	<4	Very High

APPENDIX J. Watercourse Crossings and Stream Connectivity

The importance of properly placed and maintained watercourse crossings to aquatic ecosystems has increased in recent years as biologists highlight the need to improve stream connectivity, reduce sediment and erosion impacts to streams, and restore fish passage. There are few examples of the use of targets and thresholds to management stream crossings, however the BC Government has established risk indicators for streams in interior BC (BC Government 2017), and the Athabasca Watershed Council has established risk and disturbance indicators (Table J.1). In addition, the Athabasca Watershed Council explored stream connectivity as indicated by the number of culverts per 100 km^2 area of tertiary watershed. This indicator has no ecological thresholds as classification was derived through Jenks statistical analysis and is only relative to the other tertiary watersheds in the Athabasca watershed (AWC 2012) (Table 9.18).

Table J.1. Risk ratings and disturbance classification examples determined for interior BC and the Athabasca watershed.

Risk/Pressure Rating	Interior BC (BC Government 2017)	Athabasca Watershed (Athabasca Watershed Council 2012)	
	Density (# stream crossings/km^2)	Density (# stream crossings/km^2)	Disturbance Classification (# stream crossings/100 km^2 watershed area)
Low	< 0.16	<0.4	Minimal: ≤3.5 culverts/100 km^2
Moderate	0.16 - 0.32	≥0.4 to <0.6	Moderate: >3 to≤9.5 culverts/100 km^2
High	> 0.32	≥0.6	Elevated: >9.5 culverts/100 km^2

A GIS inventory of watercourse crossings was completed in the Beaver River watershed, as well as a field survey in the Jackfish Creek and Manatokan Creek sub-basins to assess their functionality and integrity with respect to stream flow, fish passage, and potential for erosion (WorleyParsons 2012). Results of the GIS inventory are summarized in Table 19.

The number of crossings per km of channel length was determined for the Beaver River watershed data and compared to the BC density risk rating, and the connectivity disturbance classification indicator (number of stream crossings/100 km^2 watershed area) established for the Athabasca watershed. These two comparisons resulted in similar risk/disturbance class ratings. Medoid Partitioning was then used to cluster the culvert data into three groups (NCSS 2019; Bhat 2014). The values clustered together fell within the disturbance classifications developed for the Athabasca watershed, with the exception of the Upper Beaver watershed that was clustered with the Moderate Disturbance grouping rather than in the Elevated Disturbance classification. This preliminary assessment may be used to prioritize watersheds for further assessment and restoration of stream connectivity where feasible.

Table J.2. Number of culverts identified by subwatershed (WorleyParsons 2012). Note this table is preliminary.

SubWatershed	Number of Culverts	Watershed Area (km^2)	# culverts/ km^2	# culverts/100 km^2 watershed area	Disturbance Classification	Approx. Total Channel length (km)	# Crossings/km of Channel Length	Risk Rating
Beaver River-Lower	33	479	0.069	6.9	Moderate	133	0.248	Moderate
Beaver River-Upper	684	5844	0.117	11.7	Elevated	3151	0.217	Moderate
Cold Lake	37	6083	0.006	0.6	Minimal	2272	0.016	Low
Jackfish Creek	~~46~~ 51	553	0.092	9.2	Moderate	254	0.201	Moderate
Sand River	21	3609	0.006	0.6	Minimal	1852	0.011	Low
Manatokan Creek	35 (40)	430	0.093	9.3	Moderate	221	0.181	Moderate
Marie Creek	49	834	0.059	5.9	Moderate	325	0.151	Low
Medley River	11	385	0.029	2.9	Minimal	224	0.049	Low
Moose Lake	116	932	0.125	12.5	Elevated	361	0.321	High
Muriel Lake	145	870	0.167	16.7	Elevated	426	0.340	High
Reita Creek	70	293	0.239	23.9	Elevated	208	0.337	High
Redspring Creek	87 (120 BRWA 2013)	733	0.119	16.4	Elevated	356	0.337	High
Sinking Lake	7	80	0.0875	8.75	Moderate	11	0.636	High
Wolf River	16	731	0.022	2.19	Minimal	333	0.048	Low
Total Crossings	1,357 (1395)	21,856	-	-	-	10,127	-	-

DRAFT #2 Beaver River IWMP

Online Response Form

Draft May 9, 2022

LICA initiated the Beaver River Integrated Watershed Management Plan (IWMP) process to help guide watershed management activities in support of the vision "A healthy Beaver River watershed for the future". An IWMP is a guidance document and planning tool for resource managers, including governments, planners, Indigenous communities, other stakeholders, and landowners who manage water and land resources. The plan will identify goals for improving and/or maintaining watershed health, and will make recommendations on how to reach those goals.

About This Response Form

LICA and the IWMP Committee intend to gather stakeholder, First Nation and Métis feedback and input on Beaver River IWMP Draft #2, including input on watershed recommendations and implementation strategy (recommendations, responsibility and priority). Your feedback and input are important to creating an integrated watershed management plan that reflects community values. The response form should not take longer than 30 minutes to complete. Please refer to the Beaver River IWMP Draft #2 Key Content Summary Document for additional background information (link provided below).

Links:

1. Key Content Summary Document - Beaver River IWMP Draft #2
2. Key Content Summary Document – Beaver River IWMP Draft #1
3. Beaver River State of the Watershed Report (2013)

About

The following five questions will help us understand how responses may vary across demographics or locations.

Choose your age group:

Where do you live, or what community do you best associate with?

To which of the following agency, group or sector do you belong?

Have you read the Beaver River IWMP Draft #1 Key Content Summary Document?

Did you attend the stakeholder engagement session hosted by LICA to discuss the Beaver River IWMP Draft #2?

Water Quantity

- Identify 2-3 key recommendations to seek agreement from stakeholders, First Nations and Metis (Strongly Agree, Agree, Neither Agree Nor Disagree, Disagree, Strongly Disagree)
- Do you have comments to share regarding implementation of the recommendations Please indicate the recommendation number (letter) combination for reference.

Water Quality

- Identify 2-3 key recommendations to seek agreement from stakeholders, First Nations and Metis (Strongly Agree, Agree, Neither Agree Nor Disagree, Disagree, Strongly Disagree)
- Do you have comments to share regarding implementation of the recommendations Please indicate the recommendation number (letter) combination for reference.

Riparian Areas

- Identify 2-3 key recommendations to seek agreement from stakeholders, First Nations and Metis (Strongly Agree, Agree, Neither Agree Nor Disagree, Disagree, Strongly Disagree)
- Do you have comments to share regarding implementation of the recommendations Please indicate the recommendation number (letter) combination for reference.

Wetlands

- Identify 2-3 key recommendations to seek agreement from stakeholders, First Nations and Metis (Strongly Agree, Agree, Neither Agree Nor Disagree, Disagree, Strongly Disagree)
- Do you have comments to share regarding implementation of the recommendations Please indicate the recommendation number (letter) combination for reference.

Biodiversity

- Identify 2-3 key recommendations to seek agreement from stakeholders, First Nations and Metis (Strongly Agree, Agree, Neither Agree Nor Disagree, Disagree, Strongly Disagree)
- Do you have comments to share regarding implementation of the recommendations Please indicate the recommendation number (letter) combination for reference.

Land Management

- Identify 2-3 key recommendations to seek agreement from stakeholders, First Nations and Metis (Strongly Agree, Agree, Neither Agree Nor Disagree, Disagree, Strongly Disagree)
- Do you have comments to share regarding implementation of the recommendations Please indicate the recommendation number (letter) combination for reference.

Knowledge and Understanding

- Identify 2-3 key recommendations to seek agreement from stakeholders, First Nations and Metis (Strongly Agree, Agree, Neither Agree Nor Disagree, Disagree, Strongly Disagree)
- Do you have comments to share regarding implementation of the recommendations Please indicate the recommendation number (letter) combination for reference.

Please provide any additional comments that you would like the IWMP Committee to consider.

Help Us Improve Our Survey Quality

The survey was an effective way to provide input regarding Beaver River IWMP recommendations and implementation strategy.

BEAVER RIVER INTEGRATED WATERSHED MANAGEMENT PLAN

KEY CONTENTS FROM WORKING DRAFT #2

DRAFT FOR IWMPC REVIEW

1.0 BACKGROUND

The Lakeland Industry Community Association (LICA) initiated the Beaver River Integrated Watershed Management Plan (IWMP) to help guide watershed management activities and support the vision *"A healthy Beaver River watershed for the future"*.

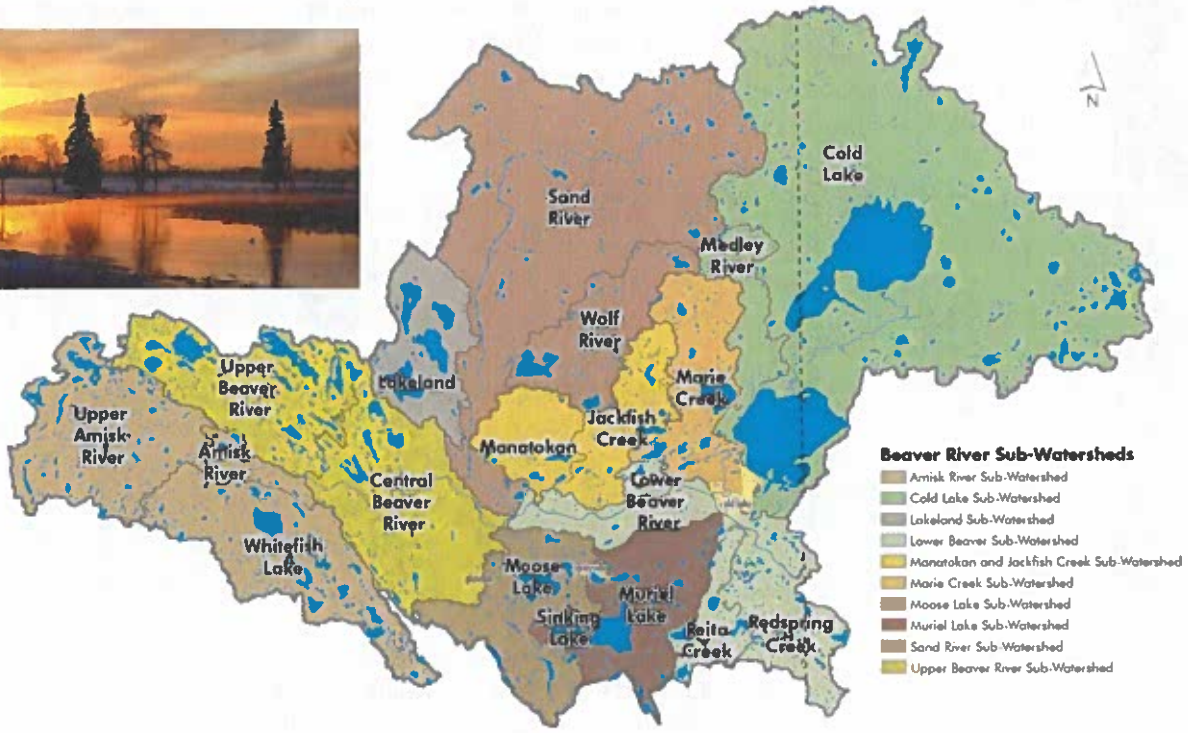
An IWMP is a guidance document and planning tool for resource managers, including governments, planners, First Nations, the Métis, other stakeholders, and landowners who manage water and land resources. The plan will identify goals for improving and/or maintaining watershed health, and will make recommendations on how to reach those goals.

LICA established an IWMP Committee to help oversee the development of the plan. LICA and the IWMP Committee are committed to engaging with stakeholders, First Nations and the Métis in the watershed throughout the development of the plan to ensure that it is relevant and reflects local and regional concerns.

This document summarizes key content from the more comprehensive Beaver River watershed plan Draft #2. It was created to support engagement in June 2022. The full IWMP Draft #2 is available by request.

2.0 PLANNING AREA

The Beaver River watershed is located in east-central Alberta and west-central Saskatchewan, in Treaty 6, 8 and 10 territories and the Métis homeland northeast of Edmonton (Figure 1). The Beaver River originates near the Town of Lac La Biche as the outflow from Beaver Lake and flows easterly into Saskatchewan to join the Churchill River at Île à-la-Crosse which flows into Hudson Bay. Although the Beaver River watershed spans Alberta and Saskatchewan, the Beaver River IWMP only applies to the Alberta portion.



4.0 VALUES, GOALS AND OBJECTIVES

Collaborative management of land and water resources that results in a healthy Beaver River watershed.

Table 1. Values, goals and objectives for the Beaver River watershed IWMP.

Value	Goal (Outcome)	Objective
Water Quantity	Secure, reliable water supplies are available for desired uses (i.e., environmental, First Nations and Métis, municipal, agricultural, industrial and recreational).	1. Review and determine status of existing Water Conservation Objectives in the original Cold Lake Beaver River Water Management Plan (CLBR WMP 2006). 2. Review the need to establish Water Conservation Objectives for streams and lakes outside of the original CLBR WMP planning area. 3. Recommend strategies to address fluctuating water levels at priority lakes where human impacts contribute to flooding or low water levels 4. Recommend strategies that encourage water conservation. 5. Understand the status of current surface water and groundwater initiatives and recommend strategies to better manage the resource.
Water Quality	Surface water and groundwater quality that is protected from contamination, maintained within the range of natural variability, and meets end-use criteria.	1. Establish Water Quality Objectives for the Beaver River and select tributaries that are compatible with the Surface Water Quality Management Framework. 2. Establish Water Quality Objectives for major recreational lakes. 3. Identify stormwater management targets and Low Impact Development strategies to minimize development impacts to water quality (and quantity). 4. Identify appropriate land use, management and stewardship strategies to maintain and/or improve water quality.
Riparian Areas and Wetlands	Healthy riparian areas and wetlands contribute to watershed resiliency with respect to flood and drought, quality water, and critical habitat.	1. Establish riparian[1] setbacks[2] and management objectives/targets that are applied consistently throughout the watershed. 2. Recommend actions that contribute to healthy riparian areas and wetlands.
Biodiversity	Fish, wildlife, and plants are healthy and resilient to changing environmental conditions. Their ecological, social, and cultural roles in the watershed are sustained.	1. Identify appropriate land use targets and thresholds (e.g., stream crossings and linear features) to better understand and track cumulative impacts on aquatic and terrestrial habitat. 2. Recommend best management practices and actions that improve wildlife habitat, health, and biodiversity. 3. Recommend appropriate actions to address risks associated with invasive species.
Land Management	Cumulative effects of diverse land uses are reduced or mitigated to maintain and/or improve ecosystem health.	1. Recommend appropriate water and land management practices that mitigate impacts of industry and development (i.e., urban, recreation, agriculture, oil and gas, forestry, and sand and gravel extraction), and maintain and/or improve ecosystem health.
Climate Change	Climate change considerations are central to all watershed-related planning and decision-making processes.	1. Recommend climate actions and climate change mitigation and adaptation strategies related to watershed management for consideration by decision-makers, resource managers and residents.
Knowledge and Understanding	Indigenous Knowledge and scientific research guide decision-making.	1. Assess and prioritize knowledge gaps in the Beaver River watershed. 2. Recommend outreach materials and other tools to disseminate Indigenous Knowledge, and scientific research related to watershed health.

[1] Riparian: Riparian lands are transitional areas between upland and aquatic ecosystems that have soil and vegetation characteristics that reflect the influence of water. They have variable width and extent both above and below ground.

[2] Setback: A minimum distance that must be maintained between a land use or development activity and a waterbody/watercourse.

5.0 draft RECOMMENDATIONS, IMPLEMENTATION RESPONSIBILITY, AND PRIORITY

Note to Reader: This summary is intended to support discussions with the broader watershed community. The following recommendations were paraphrased and correspond to the recommendations in the complete Draft #2 Beaver River Integrated Watershed Management Plan (IWMP).

The implementation tables found in the full IWMP, highlights who is responsible for the recommendation, the timeline/priority for implementation, and additional implementation actions. Refer to the full plan for more background information and the implementation actions.

Watershed management is a shared responsibility. There are numerous governments, agencies, organizations, and industries represented in the Beaver River watershed; all have varying levels of responsibility for land and water resource management. Responsible governments, agencies, industry, organizations, and others are highlighted in the implementation table below.

High priority recommendations (H) correspond to an implementation timeline of 2023-2025, Medium priority recommendations (M) correspond to the timeline 2026-2028, and Low priority recommendations (L) have an implementation timeline of 2029-2032.

WATER QUANTITY

Recommendations		Responsibility	Priority
9.2.3.1 Low streamflows and lake water levels			
Consistently apply the SWAD	**9.2.3.1 a** In the absence of a Ministerial Order (specific advice or objectives), the Surface Water Allocation Directive (GOA 2021) should be used to provide consistent, predictable provincial water allocation guidance in the Beaver River watershed.	AEP	H
Dams	**9.2.3.1 b** No new dams (as described in the 1985 CLBR Water Management Plan) should be constructed for water storage and multiple uses in the planning area.	AEP	H
Hydrologic processes and connectivity	**9.2.3.1 c** As much is practicable, maintain hydrologic processes and connectivity in the watershed to minimize the potential to isolate lakes and wetlands from their catchment. Where water level drivers are understood, effort should be made to remediate hydrologic processes. Refer to Section 9.6 for linkages to fish and fish habitat, and beaver).	AER, Alberta Transportation, municipalities, Cold Lake Air Weapons Range, industry (oil and gas, agriculture)	M -
9.2.3.2 Groundwater			
Refine groundwater models	**9.2.3.2 a** Continue to refine groundwater models in the CLBR area as information from the CLBR groundwater monitoring network becomes available. Future efforts may consider: i. An integrated modelling tool (including groundwater, surface water, land cover and climate) to assess long-term trends and predict cumulative effects on water resources in the future. ii. Subwatershed-scale groundwater models to refine current understanding of hydrological processes near key surface water features. This could include a desktop assessment of groundwater availability and use for specific aquifers to provide insight into the local water balance.	AB Geological Survey, AER, AEP, Industry, LICA, CLFN, municipalities	H
Deep groundwater availability mapping	**9.2.3.2 b** Alberta Geological Survey in partnership with AER should complete the mapping for deep groundwater availability and non-saline water use (south of Cold Lake) in the CLBR Basin.	AB Geological Survey, AER	M

Recommendations		Responsibility	Priority
GOWN wells	Continue to monitor Groundwater Observation Well Network (GOWN) wells, by collecting continuous water level data and annual water quality data. In addition to data storage in an online, interactive map that is publicly available, report on long-term trends and disseminate findings to the community every five years.	AEP	M
9.2.3.3 Monitoring and Evaluation			
Improve understanding of hydrologic processes	**a)** Improve understanding of hydrological processes and drivers of fluctuating water levels for lakes and associated catchments to aid land use decision-making and stewardship.	AEP; LICA	H
Monitor lake water levels of interest to First Nations and Métis	**b)** Lake water levels on First Nation lands and Métis Settlements are generally not monitored. Explore opportunities to implement collaborative lake level monitoring programs with First Nations and the Métis, as well as at other lakes in the watershed, particularly those proposed for increased recreational use (LARP 2012, CLSRP 2022), and/or where fish habitat restoration is a priority.	First Nations; Métis; AEP; LICA	H
Flood mapping	**c)** Flood maps should be created for lakes where development is occurring or planned using methods consistent with Provincial standards, and include the full extent of the floodplain. The flood maps should be used as an early planning tool for municipal planners, to inform infrastructure design (ditch/culvert sizing), and to educate land owners and land managers about risk of development in the floodplain.	AEP; LICA; Municipalities	H
9.2.3.4 Development			
Development setbacks	**a)** Development setbacks should account for natural variability in the hydrologic cycle, and be established with consideration for flood and drought conditions, as well as for riparian health. (See Section 9.4.2, riparian management targets and thresholds).	Municipalities	H
Stormwater Discharge	**b)** Stormwater inputs from urban areas to lakes should be managed to maintain the natural variability of flow rate and volume in each system. By managing stormwater runoff rates and volumes, the quality of stormwater will also invariably improve (See water quality recommendations in Section 9.3.3).	Municipalities	H
Low Impact Development	**c)** Low impact development practices should be incorporated, wherever feasible, in all new developments and/or areas of redevelopment according to best available science. Low impact development practices may include, but not be limited to • A reduction in hard surface area • Stormwater capture and use • Absorbent landscaping (e.g., rain gardens, increased topsoil depths)	Municipalities	H
9.2.3.5 Water Conservation			
Encourage water conservation by all sectors.	a) Encourage water conservation by all sectors.	AWC; Municipalities; Industry; Agriculture; LICA	H
Household and agricultural water use	b) Consider a study to investigate actual water used through Household Statutory Rights and Traditional Agricultural Use to inform water conservation efforts.	AWC; Municipalities; LICA	L

WATER QUALITY

Recommendation		Responsibility	Priority
9.3.3.1 Maintain and Improve Water Quality			
Reduce external nutrient and sediment inputs	a) Maintain and/or improve water quality condition in lakes and streams by reducing external nutrient and sediment inputs through BMP implementation appropriate to each sector (see 9.3.3.2 to 9.3.3.6).	AEP; AER; AAF; Municipalities; Industry	H
Adopt riparian targets and setbacks	b) Adopt riparian health targets and apply riparian setbacks to maintain functioning riparian areas and wetlands that contribute to improved water quality, stable streambanks, and reduced erosion in the watershed (see Section 9.4 Riparian Areas).	GOA; Municipalities; Industry	H
Retain wetlands, mitigate loss	c) Retain wetlands. Mitigate loss or degradation of wetlands, and replace wetlands to maintain water quality (see Section 9.5 Wetlands).	GOA; Municipalities, Industry (Agriculture, Oil and Gas)	H
Assess septic and sewage discharge	d) Assess septic and sewage discharges to the Beaver River, tributaries, and lakes; upgrade systems that contribute to external nutrient loading to surface water using incentives where possible.	Alberta Health Services; Municipalities; LICA; Landowners	H
Industrial reclamation	e) Industrial reclamation should meet end-use criteria according to current requirements.	Oil and Gas Industry	H
9.3.3.2 Agriculture			
Agricultural BMP implementation	a) For agricultural areas, consider the following beneficial (best) management practices to protect and maintain water quality: i. Provide off-stream watering (seasonally or year-round) to prevent livestock from wading in lakes, streams and wetlands. Off-stream watering has proven to increase weight-gain, and reduce scours and hoof problems in livestock. ii. Manage stocking rate, timing and duration of livestock on grazing lands to maintain healthy upland pastures. iii. Use temporary or permanent fencing adjacent to lakes, watercourses and wetlands to maintain healthy riparian areas, when management of stocking rate, timing and duration on grazing lands cannot be met. iv. Develop grazing management plans that promote healthy riparian areas identified by stable streambanks, and supported by deep rooted vegetation. v. Use bioengineering techniques to stabilize and restore eroded streambanks, where possible. vi. Practice soil conservation on cropped lands to reduce soil erosion, conserve topsoil and protect water quality. vii. Minimize or eliminate the use of herbicides and fertilizers adjacent to watercourses. Apply according to *AOPA*.	Municipalities; LARA; LICA	H
9.3.3.3 Forestry			
Apply forestry industry standards	a) Apply forest industry standards to harvest practices according to the Northeast Alberta Timber Harvest Planning and Operating Ground Rules (GOA 2018): i. Avoid excessive soil disturbance through careful planning ii. Avoid construction or harvest near ephemeral draws, tributaries and source water areas. Maintain adequate buffers (minimum setbacks for disturbance from watercourses and wetlands (Appendix H-3)	Alberta Agriculture and Forestry; Forestry Industry	H

Recommendation		Responsibility	Priority
	iii. Conduct proper road construction, maintenance and reclamation. Culverts should be properly sized and installed correctly so as not to affect the natural flow of water or increase soil erosion. Consult the Code of Practice for Watercourse Crossings iv. Minimize the number of roads crossing streams and wetlands, and reduce the use of culverts using clear-span bridges on fish bearing streams where practical. v. Avoid steep slope road construction or logging activity.		
9.3.3.4 Oil and Gas			
Apply oil and gas industry standards	a) Consider the following to maintain water quality, i. Apply industry standards and practices to oil and gas **development in the watershed according to 'Integrated Standards and Guidelines: Enhanced Approval Process (EAP)"** (GOA 2012). ii. Assess strategies to reduce water quality impacts from road construction and stream crossings, including 1. Use of existing roads and horizontal drilling techniques to access resources. 2. Collaborations with other industry sectors on road development planning.	Alberta Energy Regulatory; Oil and Gas Industry	H
9.3.3.5 Urban Areas			
Stormwater strategies	a) Implement strategies to improve the quality of urban stormwater runoff entering discharged to surface water. Consider the following: i. Inventory stormwater outfalls and place a sign at each site with outfall number/name. ii. Ensure proper storage, handling and application of road salt in winter, and herbicides and pesticides during the growing season. iii. Use stormwater ponds and low impact development practices that manage stormwater volume and release rate, and improve stormwater quality. iv. Conduct a water quality study to assess stormwater quality based on development type. v. Educate residents about their role in stormwater management. vi. Engage partners to implement the Yellowfish Road Program in local schools.	Municipalities	M
Manage snow melt	b) Stockpiled snow, when melting, can be a significant source of contaminants (e.g., salts, nutrients and sediment) to surface water. Care should be taken to stockpile snow away from surface water.	Municipalities; Alberta Transportation	M
9.3.3.6 Tourism and Recreation			
Bridges on trail network	a) Collaborate with OHV clubs and trappers to construct bridges at watercourses on main trail systems.	AEP; Municipalities; LICA; Trail Users	M
Stewardship education resources	b) Develop and provide educational stewardship resources for specific tourism and recreational users, that may include OHV clubs, campgrounds and resorts, and ice fishermen.	LICA; Watershed Stewardship Groups	H
9.3.3.2 Monitoring and Evaluation			
Monitoring the Beaver River and its tributaries	a) Implement a water monitoring program for major rivers that includes the mainstem Beaver River upstream of Hwy 28, and its major tributaries. Monitoring locations should correspond with Water Survey of Canada gauging stations where possible.	PPWB; LICA; AEP, Watershed Stewardship Groups, Industry; Academia	H
Lake water quality	b) Continue to monitor lake water quality in the watershed. Consider expanding the lake monitoring program to include lakes not currently monitored and where community interest is high (e.g., Fishing Lake).	ALMs; AEP; LICA; Watershed	H

Recommendation		Responsibility	Priority
	Integrate the Indigenous Lake Monitoring Program and other ways of knowledge generation into the program (e.g., give examples).	Stewardship Groups; Academia	
Lake tributary water quality	c) Implement a lake tributary monitoring program.	LICA; AEP, Watershed Stewardship Groups, Industry; Academia	H
Water quality indicators	d) In addition to water chemistry, the monitoring program should consider other water quality indicators, including fish and benthic invertebrates. Explore the use of the Canadian Aquatic Biomonitoring Network (CABIN) protocol for tributaries in the basin.	LICA; AEP, Watershed Stewardship Groups, Industry; Academia	H
Discharge (streamflow)	e) Discharge (streamflow) measurements should accompany the water quality monitoring program to better understand nutrient load and flux.	AEP; WSC; LICA; Watershed Stewardship Groups; Academia	H
9.3.3.4 Lake Stewardship			
Support stewardship initiatives	a) Explore opportunities to support lake stewardship initiatives that improve and maintain water quality with residents and rural landowners. Keys areas of focus may include: i. Adopting programs such as Keep Our Lake Blue to encourage participation from all stakeholders. ii. Winter recreation impacts, including management of the input of debris from winter recreation activities. iii. Hosting Septic Sense Workshops iv. Tree planting or shoreline restoration using bioengineering techniques	Municipalities; Summer Villages; Watershed Stewardship Groups; LICA	H
9.3.3.5 Groundwater			
Groundwater water quality indicators	a) Collaborate to identify a list of groundwater parameters to monitor in support of community-based program.	Industry; AHS; Academia; LICA	M
Community-based monitoring	b) Explore opportunities to create a community-based groundwater monitoring program for areas within the watershed where water level and/or water quality data is limited.	Academia; LICA; Industry; LICA	M
Industrial reclamation	c) For industrial reclamation, activities should meet end-use criteria according to current requirements.	AER; Industry	H
Abandoned water wells	d) Assess the number of domestic abandoned water wells in the watershed and develop a plan to decommission sites with incentives.	LICA; AEP; AAF; AHS; municipalities; watershed stewardship groups	M
Working water well workshops and well decommissioning	e) Host working water well workshops. As part of the program, teach rural residents how to properly abandon water wells.	LICA; AEP; AAF; AHS; municipalities; watershed stewardship groups	M

RIPARIAN AREAS – to complete following IWMPC review of Draft #2

WETLANDS – to complete following IWMPC review of Draft #2

BIODIVERSITY – to complete following IWMPC review of Draft #2

LAND MANAGEMENT

Recommendation		Responsibility	Priority
9.6.3.1 Tourism and Recreation			
Recreation management plan	a) Prior to developing a recreation management plan for the area, AEP should consider the following: i. Inclusion of the entire Beaver River watershed in the planning area to ensure that proposed activity considers the existing tourism and recreation footprint ii. Indigenous land use and traditional rights iii. Review available riparian intactness assessment data for Crown Land and develop policy for its conservation (in addition to the 250 m setback established for the Beaver River and other waterbodies in the CLSRP (2022) iv. Develop and/or refine fisheries management objectives with the community (see 9.6.3.1 a) v. Identify and assess critical fisheries habitat and spawning areas (see 9.6.3.4 a) vi. Monitor user data as socio-economic performance indicator, in addition to recreational facilities.	GOA	H
Trails	b) Trail networks should: • Avoid sensitive, ecologically important and culturally significant habitat, including species-at-risk and bird habitat • Make use of existing, linear disturbances • Have interpretive signage • Be equipped with proper washroom facilities at trail heads and tamper proof garbage cans	GOA	H
Infrastructure supports (e.g., roads)	c) Maintain infrastructure (e.g., roads) to support a healthy tourism and recreation economy in the watershed.	GOA	L-M

KNOWLEDGE AND UNDERSTANDING

6.0 NEXT STEPS

The next steps to complete the Beaver River Integrated Watershed Management Plan are:

i. Consider input from the IWMPC, stakeholders, First Nations and the Métis
ii. Finalize the Beaver River Integrated Watershed Management Plan.
iii. Final approval of IWMP by the Lakeland Industry Community Association. Seek support from stakeholders.
iv. As a living document, the plan will be reviewed and updated periodically to reflect current knowledge and activities in the watershed.

7.0 FOR MORE INFORMATION

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LICA ENVIRONMENTAL STEWARDS

April 2022

2022 IWMP Schedule

Phase	Task	2022											
		Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec
	Circulate Draft 1 to IWMPC												
Draft 1 IWMP	IWMPC Meeting #5. Finalize Draft 1 IWMP, Prepare for Engagement Session 2												
	Circulate Materials for Engagement												
	Engagement Session 2 Review Draft 1 IWMP			Mar 3, 7									
	Revision of Draft 1 IWMP (consider engagement session input, refine recommendations, and prepare Implementation Strategy)												
Draft 2 IWMP	Circulate Feedback Responses on Draft 1 to IWMPC & LISC			Mar 31									
	IWMPC & LISC Meeting 6: Debrief Engagement Session 2, IWMP Draft 1 Section Review (feedback & preliminary notes on implementation)				April 7								
	Circulate IWMP Draft 2 to IWMPC & LISC					May 9							
	Meeting 7: Approval of Draft 2 by IWMPC					May 17							
	Approval of Draft 2 by LICA BOD *Circulate Draft 2 IWMP for Engagement*					May 26							
	Engagement Session 3						June 14 & 20						
	Consider Engagement 3 Input IWMPC and LISC Meeting 8: Revise Draft 2 IWMP based on engagement feedback							TBD					
Final IWMP	**Circulate Final Draft to IWMPC and circulate to BOD via email for feedback**												
	Meeting 9: Approval of Final Draft IWMP								TBD				
	Provision of Final IWMP and Final Summary Document												
	Approval of Final IWMP by LICA Board									Sept 22			

IWMPC Meeting

Date: April 7, 2022 **Recorder: Eveline Hartog**

ACTION LIST

Task	Date to be completed	Person assigned to task	Y
2.1.1 Review Work Schedule			
• Determine a meeting date for the Committee for both July and August 2022	May 2022	Kayla	Y
3.1.1 2022 – 2023 IWMP Budget Review			
• Investigate avenues of free advertising for future events	April 2022	Kayla	IP
3.3 Next Steps			
• Establish desired outcomes and determine which decision makers will be responsible for implementing actions of the plans	May 2022	Committee/ Sandi	IP
3.4 IWMP Draft 1 Section Review (Feedback & Preliminary Notes on Implementation			
• Ask the M.D. of Bonnyville if raw data on wetlands and riparian areas within the Beaver River Basin can be provided	May 2022	Kayla	IP
• Contact Métis Region Zone 2 office to verify accent	April 2022	Kayla	Y
• Develop an Appendix to include historical events that occurred within the Beaver River Watershed	May 9, 2022	Kayla	IP
• Forward any final comments within the next 2 weeks so Sandi can develop and send the finalized Draft #2	April 21, 2022	Committee	IP
• Contact the AEP biodiversity lead for information on the Subregional Plan	April 2022	Sandi	IP
• Contact AHS to discover how they track water quality (i.e., advisories and social or recreational indicators)	April 2022	Kayla	Y
• LICA to connect with Cold Lake Air Weapons Range representative, if possible, to discuss jet fuel waste	April 2022	Kayla	IP

Next Meeting: May 17, 2022

Follow Up on Action List			
3.5 Process for Seeking Support			
• Reach out to municipal partners regarding IWMP & getting their support for the Plan	September 2022	Kayla	**IP**

Next Meeting: May 17, 2022