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Summary of Findings: Municipal District of Acadia and Special Areas Joint Irrigation Feasibility Study

Prepared for:

Canada Infrastructure Bank

Special Areas Board

The Municipal District of Acadia No. 34

Government of Alberta (Ministry of Alberta Agriculture, Forestry and Rural Economic Development)

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Executive Summary

An opportunity exists in the Municipal District of Acadia and Special Areas region of Alberta to develop an irrigation system that will transform the existing dryland agricultural industry. Access to a reliable water supply through irrigation will bring greater security to the existing industry and support a growing value-added agri-food industry by enabling increased crop production and introduction of higher value crops.

Initial investigation demonstrates that it is feasible to develop up to 108,000 irrigated acres in the region. Quality land, sufficient water resources, and access to transportation can support this opportunity for irrigation development.

This opportunity will leverage the region's existing resources to expand agriculture and agri-food while addressing current, regional economic challenges. For the last several decades, the Municipal District of Acadia and Special Areas region has contributed to Alberta's economy through resource development, power production, transportation, and traditional dryland agriculture. However, as the economy changes, the region's ability to support its communities – along with its population, employment, and tax revenue – is declining. The risk of climate change impacts is further increasing the region's vulnerability to economic, social, and environmental challenges. Establishing a highly efficient and modern agriculture and agri-food industry through irrigation development will generate economic growth and bring back jobs.

The Canada Infrastructure Bank (CIB), the Special Areas Board (SAB), the Municipal District of Acadia No. 34 (MD of Acadia), and the Government of Alberta (as represented by the Ministry of Alberta Agriculture, Forestry and Rural Economic Development (AFRED)) came together in April 2021 to assess the technical and financial feasibility of developing an irrigation system in the MD of Acadia and Special Areas region using water from the Red Deer River (the Project).

The feasibility study considered factors related to irrigable land, water availability, financial and economic benefits, social and environmental benefits, costs, and environmental and permitting risks. Preliminary engagement with First Nations and numerous stakeholders including producers, the local watershed organization, environmental non-governmental organizations (NGOs), surrounding municipalities and elected officials was completed throughout the feasibility study. This report is a summary of the findings and recommendations.

Key findings

At a high level, the findings (see Section 11.0) indicate:

- Based on the available water and suitable land, 108,000 acres of previously cultivated land could be irrigated, and storage reservoirs on both sides of the river are conceptually feasible to support effective management of the estimated water demand.

- Conceptual estimates[1] for capital, non-energy operating, and energy operating costs are significant; design optimization is needed to refine the current cost estimates.
- Contributions from the irrigators toward capital and operating costs will be required in addition to grant support from the GoA and financing from the CIB and private investors.
- There is strong interest from local producers for the Project to move forward, and they understand the need to contribute to the Project for capital and annual operating costs.

Recommendations and next steps

At a high level, the recommendations (see Section 12.0) include:

- Proceed with the next phase of work to complete preliminary engineering in order to optimize the design, explore further opportunities to generate revenue, apply for a water licence, prepare for regulatory approvals, and refine the financial structure.
- Develop and manage a living risk register and remediation action plan.
- Continue engagement with First Nations.
- Continue engagement with local producers and residents, and Project stakeholders.

The proposed Project is significant in terms of cost, required approvals, impact on the landscape, and impact on the community. Should this Project proceed to the next phase, it will require external expertise and resources. A workplan for the next phase was developed as part of this study and is presented in Section 13.2.

[1] Conceptual or Class D estimates indicate a range of accuracy from -30% (low cost) to +25 to +50% (high cost)

1.0 Introduction

The Canada Infrastructure Bank (CIB) together with the Special Areas Board (SAB), the Municipal District of Acadia No. 34 (MD of Acadia), and Alberta Agriculture, Forestry and Rural Economic Development (AFRED), collectively the Project sponsors, are currently assessing the technical and financial feasibility of creating an irrigation system in the MD of Acadia and Special Areas region using water from the Red Deer River (the Project).

The Project sponsors reached a memorandum of understanding (MOU) in April 2021 that established the framework for the Project sponsors' cooperation in the feasibility assessment.

This report, assembled by the Project Operations Committee, is presented to the Project Steering Committee as a summary of the feasibility study and resulting recommendations for the proposed Project.

The feasibility study components included:

- **Irrigable land**: The total area of previously cultivated land that is suitable for irrigation based on irrigation land classification.
- **Water availability**: The amount of water available to support the Project under current regulatory conditions.
- **Financial and economic benefits**: GDP growth, project revenue, and attractions to private sector investment.
- **Social and environmental benefits**: Impacts for the community, such as sustained populations, increased income, and water security.
- **Costs**: Capital and operational costs to construct and maintain the irrigation system, as well as how those costs are recovered.
- **Environment and permitting risks**: Impact on flows of the Red Deer River and expected regulatory approvals processes.

Figure 1 outlines the Project team's feasibility study approach. Draft and subject to change.

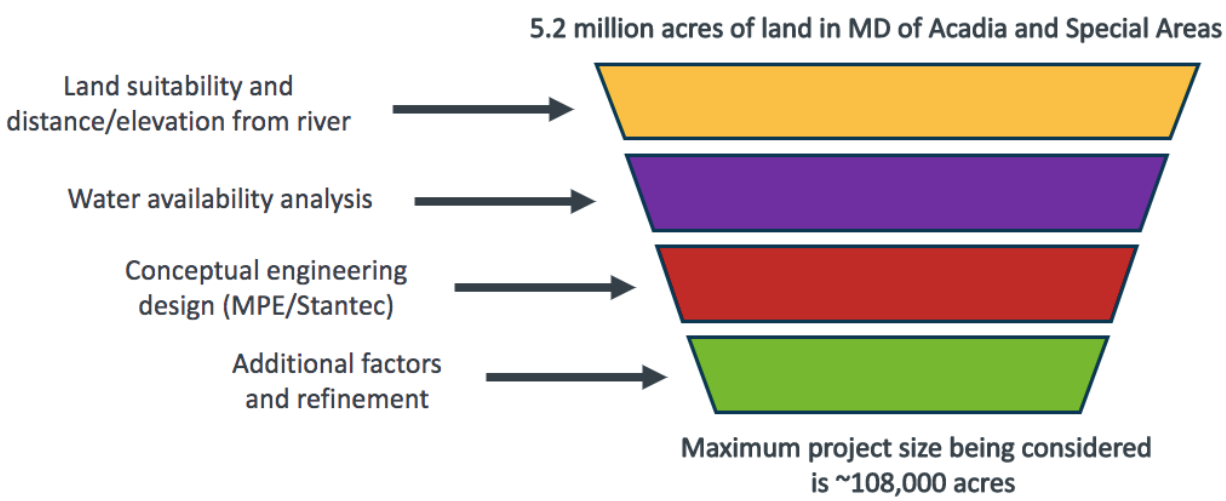

Figure 1: The funneled study approach.

Throughout the feasibility study, the Project team engaged with several stakeholders including producers, the local watershed organization, environmental non-governmental organizations (NGOs), surrounding municipalities, and elected officials. Stakeholders were engaged through virtual or in person presentations, public open houses, phone calls, or by email. Many individuals chose to sign up for future project updates and communications and were added to the Project mailing list. The Project team will continue to engage with local residents, producers, and Project stakeholders for future project updates and communications.

Preliminary engagement with First Nations was conducted during the feasibility study. This was achieved through direct outreach in letter and email format as well as a virtual presentation. The Project team will continue to engage with First Nations for future project updates and communications.

2.0 Project Opportunity

An opportunity exists in the MD of Acadia and Special Areas region of Alberta to develop an irrigation system that will transform the existing dryland agricultural industry. Access to a reliable water supply through irrigation will bring greater security to the existing industry and support a growing value-added agri-food industry by enabling increased crop production and introduction of higher value crops.

Initial investigation demonstrates that it is feasible to develop up to 108,000 irrigated acres in the region. Quality land, sufficient water resources, and access to transportation can support this opportunity for irrigation development.

This opportunity will leverage the region's existing resources to expand agriculture and agri-food while addressing current, regional economic challenges. For the last several decades, the MD of Acadia and Special Areas region has contributed to Alberta's economy through resource development, power production, transportation, and traditional dryland agriculture. However, as the economy changes, the region's ability to support its communities – along with its population, employment, and tax revenue – is declining. The risk of climate change impacts is further increasing the region's vulnerability to economic, social, and environmental challenges. Establishing a highly efficient and modern agriculture and agri-food industry through irrigation development will generate economic growth and bring back jobs.

3.0 Project Scale

This section describes the Project location and size, the buildout timeline, the infrastructure requirements, and the water availability.

3.1 Land Requirements

The general Project location is approximately 250 km east of Calgary, Alberta, and 100 km north of Medicine Hat, Alberta. The Project region is located within the Municipal District of Acadia and Special Area No. 2 (Figure 2).

All four subdivisions of the Project region share a border to the east with the province of Saskatchewan. The Project region contains the towns of Oyen and Hanna, as well as part of the Red Deer River. The Red Deer River flows from Red Deer east across Alberta before joining the South Saskatchewan River and

Diefenbaker Lake in western Saskatchewan. The Red Deer River would be the water source for new irrigation infrastructure in the Project region.

Initial investigation determined that the Project could develop a maximum of 108,000 acres. This number takes into account water availability and potentially irrigable land, as well as the current basin allocation framework and the ability to limit water deficits to acceptable levels. Potentially irrigable land was identified as previously cultivated farmland within the area likely to be classified as suitable for irrigation development and could therefore become part of the Project. Actual irrigable acres would need to be verified before they could be irrigated.

This Project proposes to only irrigate lands that are previously cultivated, and no native grasslands would be converted to cultivation. Certain lands outside of the irrigated area are needed for supporting infrastructure and reservoirs. These lands may impact native grasslands and are estimated to represent less than 10% of the total project footprint. The preliminary work identified sub-blocks with irrigation development potential in Special Area No. 2 and the Municipal District of Acadia. Table 1 provides a breakdown of the 108,000 acres by irrigation sub-blocks. Figure 2 and Figure 3 show the location and breakdown of the irrigation blocks.

Table 1: Irrigation sub-blocks. Estimates are draft and subject to change.

MD of Acadia		Special Area No. 2	
Sub-Block	**Irrigation Acres**	**Sub-Block**	**Irrigation Acres**
Block 1A	12,500	Bindloss A	9,600
Block 1B	3,200	Bindloss B	10,600
Block 2	11,800	Bindloss C	9,100
Block 3	6,600	Bindloss D	7,200
Block 4	7,200	Bindloss E	8,900
Block 5	7,800	Buffalo	8,500
--		Cavendish	5,000
Subtotal	**49,200**	**Subtotal**	**58,900**
	108,000[1]		
Note 1: the total number of acres is rounded to 108,000 throughout this report.			

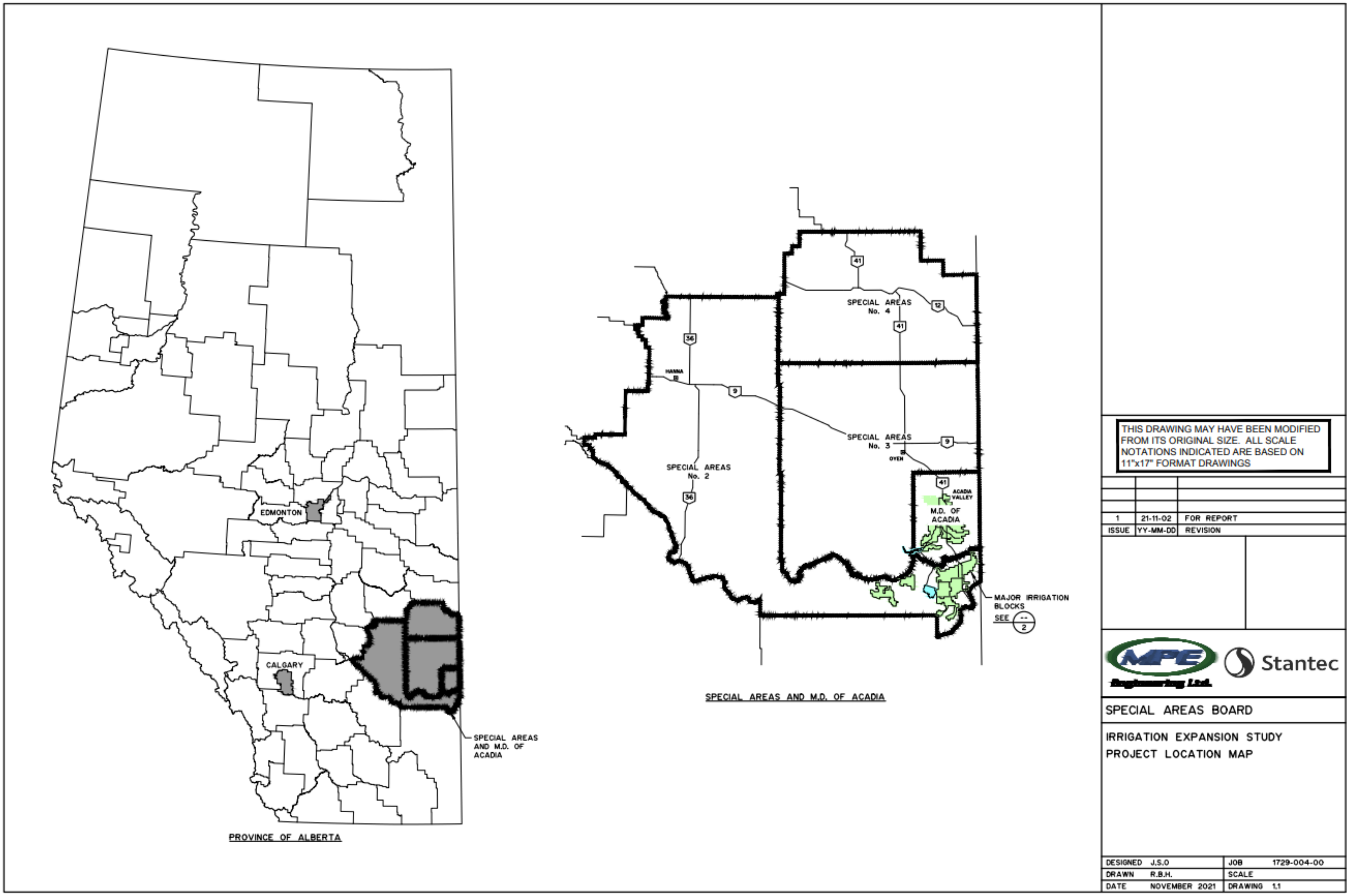

Figure 2: Irrigation Feasibility Study Project region map. Location estimates are draft and subject to change.

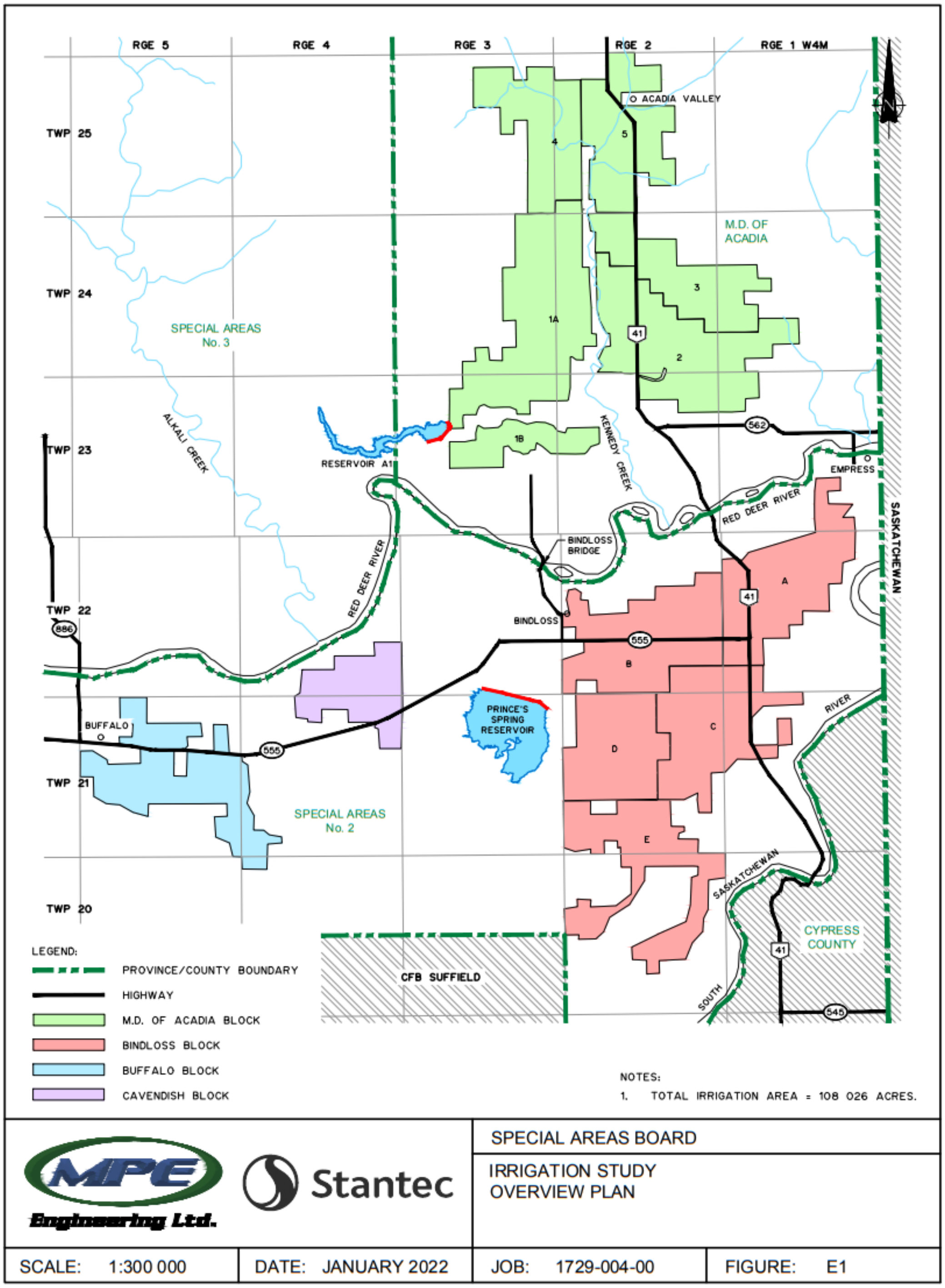

Figure 3: Irrigation expansion study infrastructure plan. Location estimates are draft and subject to change.

3.2 Buildout Timeline

The Project will require new infrastructure to support irrigation needs (see Section 3.3). Due to the Project's size, and considering potential funding constraints and risk mitigation objectives, taking a phased approach may be most optimal. Certain components of the required, shared infrastructure would need to be constructed early in the project to enable a phased buildout.

Project development and implementation timeline

A preliminary estimate of the Project implementation timelines was developed. Due to the diversion volume, dam height, and reservoir surface area, this Project would trigger several federal and provincial regulatory requirements, including a federal Impact Assessment and provincial Environmental Impact Assessment. Both are typically multi-year processes and would significantly influence the implementation timeline.

Table 2 outlines major Project work components and estimated Project timelines.

Table 2: Estimated overall Project implementation timeline. Key work items should be further divided into different phases of Project implementation due to the complex nature of the Project. Draft and subject to change.

Key Work Items	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Environmental and Historical Resources																																				
Regulatory Meetings and Consultations																																				
Field Surveys																																				
Impact Assessments																																				
IR Responses																																				
Hearing and Approval																																				
Engineering																																				
Preliminary Engineering Design																																				
Water Licence and Water Act																																				
Detailed Design and Tendering																																				
Electrical Distribution and Transmission																																				
ROW and Land Negotiations																																				
Construction Administration																																				
Construction																																				
Red Deer River Pump Station																																				
Reservoirs																																				
Electrical Distribution and Transmission																																				
Reservoir Supply Pipelines																																				
Secondary A Canal																																				
Secondary Pumpstations																																				
Conveyance Pipelines and Laterals																																				
Commissioning and Reservoir Filling																																				

Acre absorption timeline

Once the Project is constructed, water can be delivered to individual fields. However, the uptake of irrigation by farmers is variable and not all the acres will come online in year one. The rate of acre absorption depends on several variables, including initial capital investment, interest rates, annual operating costs, and the ability of farmers to finance the required on-farm irrigation infrastructure. Keeping upfront investment and borrowing costs affordable for the farmers will increase the initial and ongoing uptake of irrigation.

For the purposes of this Study, full absorption of the available irrigation acres was assumed to take place within a 10-year period. The 10-year absorption period assumes that there is a financial structure that is acceptable and encouraging to producers. With these assumptions, there will likely be a strong initial uptake in year one, after which the demand for new irrigation acres and absorption will flatten.

Based on the initial local producers' engagement feedback (Section 7.2), a low rate and long maturity financing proposal from the CIB may result in a faster absorption rate.

3.3 Infrastructure Requirements

Regardless of the procurement method selected by the Project sponsors, a phased approach to construction is recommended. Once the major infrastructure components are installed, individual sub-blocks can be brought online as practical. Regardless of the phased approach and acre absorption rate, the following infrastructure should be fully constructed at the beginning of the Project:

- Red Deer River Intake and Pump Station
- Supply Pipelines from the Red Deer River Pump station to the Reservoirs
- Reservoir A1
- Prince's Spring Reservoir
- Secondary A Canal and MD of Acadia Recreational Reservoir Feed

Components such as the secondary pump stations for MD of Acadia, Bindloss, and Cavendish could be built later. Even full pump capacity in the Red Deer River Pump station could be staged as acres come online.

3.4 Water Availability

Water availability was investigated to understand the potential impacts of the proposed irrigation Project on the Red Deer River Basin and its water users. A secondary objective was to determine the limitations on Project scale from a water availability perspective.

Water supply was modelled using an 82-year historical Red Deer River flow data set from the period 1928-2009. Water demand was modelled using an Irrigation Demand Model (IDM) demand pattern based on an existing irrigated crop mix in southern Alberta. The demand pattern was modified so that no more than 16" of water could be delivered to the crop in a growing season.

The results demonstrate that there is sufficient water available in the Red Deer River Basin to support an irrigation Project scale of 108,000 acres. Key results that demonstrate the ability of this Project to fit within the Red Deer River Basin include:

- **Project water allocation:** The analysis suggests there is enough water in the basin available for allocation to support a Project scale of 108,000 irrigated acres.
- **Environmental flows:** A comparison of the percentage of days exceeding 45% of naturalized flows between the Base Case scenario (no Project) and the 108,000-acre scenario suggests the Project would not substantially alter streamflow. Further analysis is needed to determine the significance of these changes and their implications for aquatic ecosystems.
- **Water shortages:** The Project is expected to experience a manageable frequency and magnitude of water shortages (deficits). No water deficits greater than four inches are expected based on this analysis.
- **Climate change considerations:** Based on climate change scenarios modelled under an annual time step, it is likely that water supply will either remain similar to historical, or increase. During the growing season, water supply is likely to be reduced due to an advancement of the spring freshet and increase in water loss through evapotranspiration. It is likely that with storage, the water supply risk to the Project is manageable under future climates.

4.0 Project Costs

This section outlines the estimated operating and capital costs.

4.1 Estimated Operating Costs

Annual operating and maintenance (O&M) costs were split into four components: fixed, variable, life cycle (major rehabilitation), and energy costs. Annual fixed and variable costs were based on the costs within five major irrigation districts in southern Alberta. The average operation and maintenance costs of the five irrigation districts come to $22.84/acre per year based on publicly available financial statements for 2017-2020. Though it varies by district, the fixed cost to variable cost ratio is roughly 70% fixed and 30% variable.

For the proposed irrigation Project, the fixed costs are estimated to be approximately $15/acre/year, and the variable costs are approximately $8/acre/year. These costs would begin during the first year of operation (assumed to be 2028 for the Project cost estimates).

To estimate life-cycle costs, it was assumed that major maintenance would take place at the end of 30 years. The Project components that are likely to require some upgrading and major maintenance within 30 years include pump station pumps, motors, and electrical, reservoir outlet structure gates and electrical, and some minor canal rehabilitation work. This infrastructure is estimated to require $78,000,000 to repair/replace. A flat fee of $25/acre annually, with 2% annual inflation, will enable rehabilitation of the system after 30 years with no outside grants or funding.

Energy operating costs were estimated assuming a direct grid connection paying market rates for electricity with no internal power generation for all Project energy supply. Since all water is pumped and lifted up from the river the energy costs per acre are substantial at estimated electricity market rates. If the Study moves on to the next phase of work, then further analysis will be needed to mitigate estimated significant energy costs. Once the entire 108,000-acre system is operational and assuming direct grid connection, the total operating costs including energy are estimated to range from $180-$300/acre annually. Some areas were identified that could be fed with conveyance that relies on topography (gravity) and would not receive operating pressure from the irrigation system. Therefore, booster pumps from the canal to the field would be required and an additional on-farm pumping cost of $48/acre/year would be added.

4.2 Capital Costs

The capital costs for the Project are based on recent tenders completed within southern Alberta and Saskatchewan for other irrigation systems. Given the long lead time from Project concept and the level of conceptual design completed at this stage of the Project, this report provides ranged estimates of probable capital costs. The ranged estimates took the probable cost and subtracted 10% for the low scenario and added 25% for the high scenario.

In total, the probable capital cost of the Project (at full buildout for 108,000 acres based on current conceptual design assumptions) was an estimated $1.3 billion, including 20% contingency and 15% for engineering. This represents a Class D[2] cost estimate that will be subject to change as further design work is completed. Changes in the capital cost estimate are likely to occur from inflation over time in addition to changes and refinement in the design.

Given the estimated capital cost and the potential need to put forward smaller projects, four development scenarios were proposed. See Table 3 for estimated capital costs for each scenario.

- **Scenario 1**: Project as envisioned: 108,000 acres.
- **Scenario 2**: This scenario removed the three highest cost-per-acre blocks, resulting in a reduced Project size of 81,000 acres.
- **Scenario 3**: Developing irrigation in the MD of Acadia only, the Project size is reduced to 49,000 acres.

[2] Conceptual or Class D estimates indicate a range of accuracy from -30% (low cost) to +25 to +50% (high cost)

Table 3: Base and alternative development scenarios ranged probable capital cost estimates. Draft and subject to change.

Estimated Capital Costs ($)				
	Acres	Low	Probable	High
Scenario 1 (Base)	108,026	$1,197,000,000	$1,330,000,000	$1,663,000,000
Scenario 2	81,052	$918,000,000	$1,019,000,000	$1,275,000,000
Scenario 3	49,151	$348,000,000	$387,000,000	$483,000,000

These costs do not include the on-farm equipment that is required for irrigation. Local producers would be responsible for supplying their own on-farm equipment. This would likely include a pivot, on-farm water distribution lines, pumping, instrumentation, other equipment, and installation. On-farm costs will be unique to each operation. At current market rates, the total on-farm cost to enable irrigation is estimated at $250,000 per quarter section.

5.0 Project Impact Assessment

This section outlines the current economic challenges in the Project region, provides an economic footprint analysis, and describes the Project's environmental, social, and community impacts.

5.1 Current Economic Challenges

MD of Acadia and the Special Areas region have contributed to Alberta's economy for the last several decades through industries like natural gas, traditional agriculture, transportation corridors, and electricity generation that supported the growth of southern and eastern Alberta. Unfortunately, the decline in resource production and the energy transition have compromised the ability for the economy to support these communities. Compared to the rest of the province, the region has seen a significant drop in natural gas production over the past five years:

- Special Areas #2: -27.4%
- Special Areas #3: -79.5%
- MD of Acadia: -63.0%
- AB Provincial Average: -3.8%

Projections indicate that gas production will continue to decrease by 57% between 2020 and 2030 for the southeastern Alberta region (Figure 4).

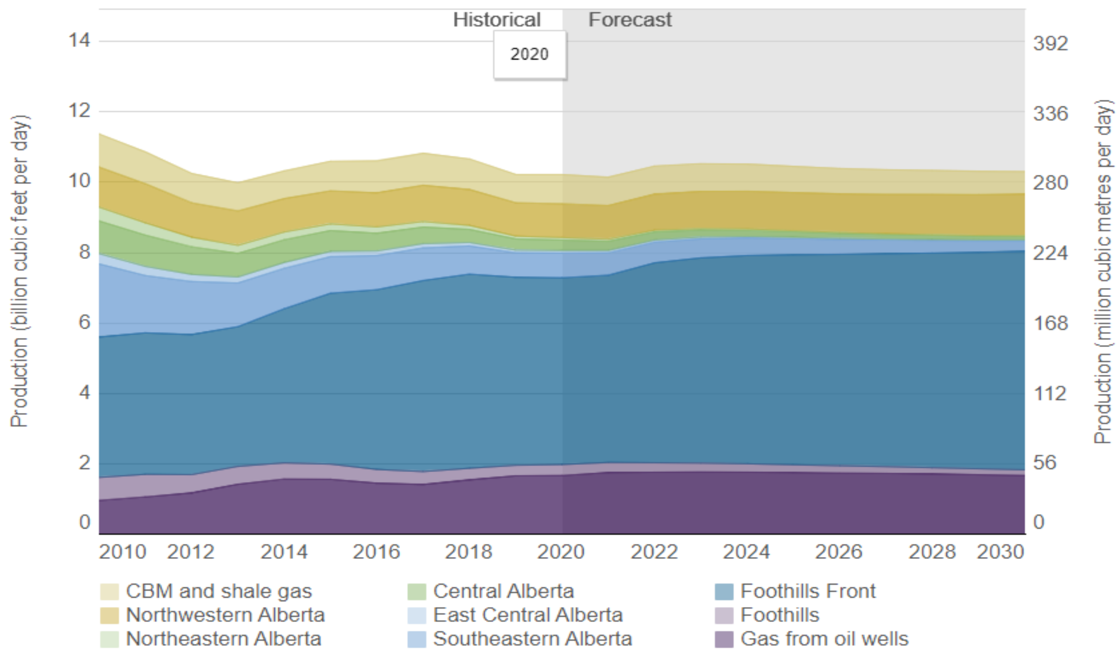

Figure 4 Alberta marketable gas average daily production. Source: Alberta Regional Dashboard.

The provincial transition away from coal-fired electricity generation has resulted in a net loss of approximately 150 jobs in the region. Coal production is projected to continue declining (Figure 5).

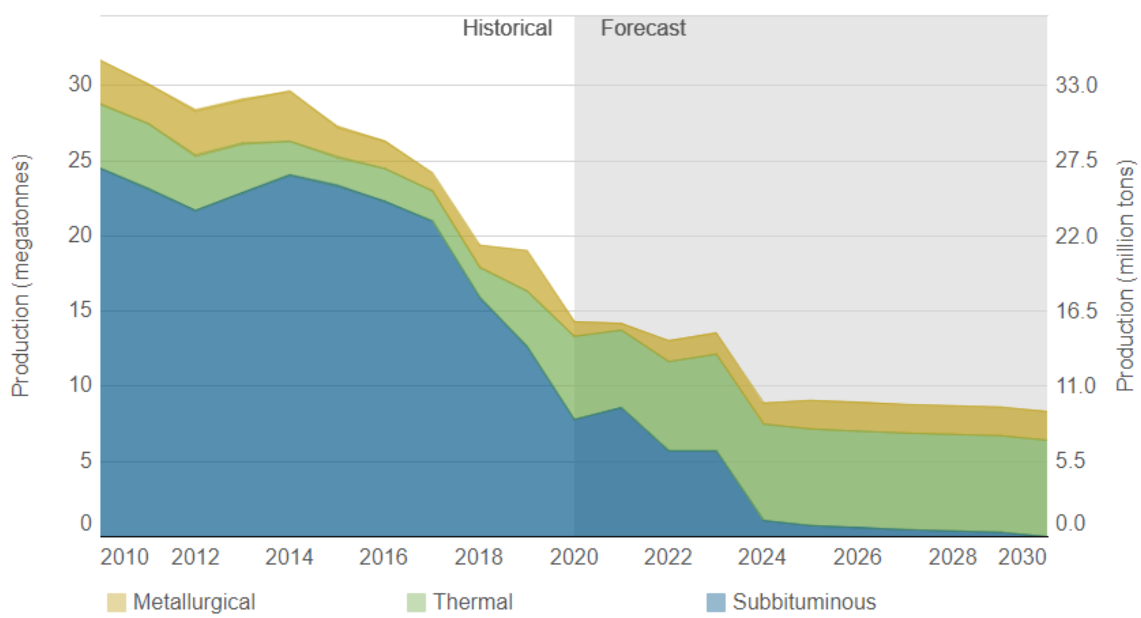

Figure 5: Alberta marketable coal production. Source: Alberta Regional Dashboard.

As a result of these significant changes in economic development opportunities, the population in these communities is forecasted to decrease more than anywhere else in Alberta over the next 25 years.

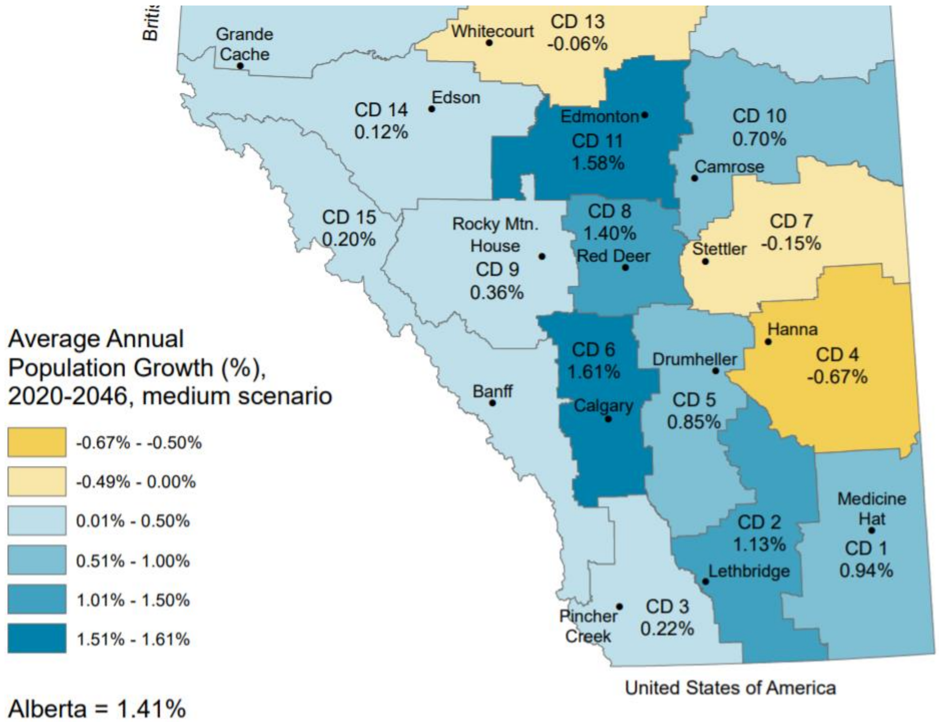

Figure 6: The Special Areas and MD of Acadia are expected to see the greatest population decline of any region in Alberta over the next 26 years (-0.67%), compared to an overall annual growth of 1.41% across Alberta. Source: Population Projections: Alberta and Census Divisions, 2021–2046 | Treasury Board and Finance | July 2, 2021.

Opportunities to support renewed growth in the region are being pursued, including:

- The Hanna and Special Areas region will receive significant funding through Canada Coal Transition Initiative.
- Sheerness Industrial Park is being developed to attract industrial investment.
- Oyen Rail and Logistics Park redevelopment and rail tie replacement program along the CN Mainline from Saskatoon to Oyen is currently underway with CN.
- Many proposed renewable energy (wind/solar) projects are under development/construction in both MD of Acadia and Special Areas.

It is uncertain whether these efforts will be enough to support these communities. Irrigated agriculture is a significant opportunity to leverage the region’s existing resources. The following sections summarize how the region’s existing resources support irrigation potential, demonstrate the Project's feasibility, and provide rationale for further investigation of the opportunity.

5.2 Economic Footprint Analysis

The economic footprint of the Project was estimated across capital expenditures, O&M costs, crop production, and crop processing at the direct, indirect, and induced levels to demonstrate how the activities associated with construction and ongoing operations could ripple throughout Alberta’s economy. This analysis modelled the following timelines: construction (2024-2027), ongoing operations (2028-2100), and Project lifetime (2024-2100).

The one-time capital expenditures of the Project are estimated to facilitate a total of 5,650 jobs (FTE person years[3]) in Alberta during construction. The Project is estimated to facilitate 9,058 additional person-years jobs in Alberta during the Project's ongoing operations.

The incremental crop production associated with increased crop production on new irrigated acres is estimated to facilitate 4,720 person-year jobs to Alberta over the Project's lifetime. Additional irrigation may bring new food processors, including livestock producers (downstream industries), into the region and adjacent areas, which was estimated to result in 2,124 person-year jobs facilitated in Alberta over the Project's lifetime.

Overall, the Project is estimated to contribute more than $3.9 billion in GDP to the Alberta economy over its lifetime, generating and facilitating over $1.7 billion in aggregate labour income and over $524 million in federal and $414 million in provincial tax revenues.

In addition to the province-wide impacts, the Project is expected to benefit the regional economy. An estimated 2,106 person-year jobs will be facilitated within the Project region during construction, 4,875 person-year jobs due to its operations and maintenance, and 1,786 due to the incremental crop production during ongoing operations.

5.3 Environmental Impacts

The environmental impact of the Project resulting from construction and operations was assessed. In this context, affected stakeholders include local residents and the rest of Canada. Values generated, whether positive (benefits) or negative (costs), represent incremental changes as a result of the Project. Metrics have been developed for the following six impact areas: air quality, water quality, water security, ecological systems, greenhouse gas emissions, and impacts on communities. This analysis modelled the following timelines: construction (2024-2027), ongoing operations (2028-2100), and Project lifetime (2024-2100).

Though the Project is expected to negatively impact the environment through increased air pollutants, greenhouse gas emissions, and risk to water quality, the Project would also recover and create additional acres of wetland, resulting in incremental benefits to ecological systems. Various environmental impacts to air quality, water quality, ecological systems, and greenhouse gas emissions were evaluated quantitatively and monetized.

The cumulative net environmental benefit of the Project during ongoing operations was estimated at over $589 million (in undiscounted 2020 dollars), driven by wetland creation. The annual net environmental benefit was calculated from 2037 onwards to represent the impact at full buildout of all acres and was estimated at $9.8 million (in undiscounted 2020 dollars). Table 4 summarizes results from the

[3] Full-time equivalent measures the equivalent value of a position. FTE is calculated by dividing an employee's scheduled hours by the employer's hours for a full-time workweek. For example, one full-time employee can be classified as 1.0 FTE

environmental impact assessment and social impact analysis. Due to data limitations, other environmental impacts and social impacts were evaluated at a qualitative level.

Table 4: Environmental and social impacts summary (undiscounted 2020 dollars). Draft and subject to change.

Incremental environmental/social impact	Benefit or Cost
Increased wetland area (2037-2100)	Project would produce a maximum gain of 6,836 additional acres of wetlands across the Project region. The maximum value of additional wetlands is estimated at $1.06 billion benefit over the life of the Project.
Reversing negative demographic trends	Project is expected to benefit the region by reversing some of the negative demographic trends in the Project region, namely declining population, and the outflow of young people.
Economic opportunities	The Project would create benefit by ideally creating a number of new jobs through the construction of the irrigation system, and additional farming, food processing, and other opportunities enabled by the increased agricultural production in the Project region.
Food and water security	By increasing efficiency of crop production, controlling extra floodwater, as well as storing water for dry periods, the Project is expected to improve food and water security in the region. Cattle feed security will be improved due to expected higher outputs of forages in the region.
Recreation opportunities	New reservoirs and wetlands would provide additional recreation opportunities (fishing, swimming, camping, and hunting) and bring more wildlife into the Project region for an overall benefit.
Air quality impacts - NOx, SOx, PM10, PM2.5 emissions (2028-2100)	Air pollution related to agricultural tractor operation, wind erosion, tillage practices, and harvesting methods with a shift from dryland to irrigated agriculture. Estimated at $4.1 million societal cost.
Greenhouse gas emissions (2028-2100)	Conversion of dryland acres to irrigated acres would result in changes in farming practices, soil moisture, and crop mix which leads to an increase in emissions output. Estimated at $403.4 million societal cost.
Water quality impacts (2028-2100)	Risk of nitrogen and phosphorus leaching can impact water quality and taste and increase algae blooms and toxicity. Estimated at $59.4 million societal cost.

5.4 Social and Community Impacts

A key socio-economic impact of the Project identified by the interviewed stakeholders is the potential of the irrigation infrastructure to generate economic opportunities in agriculture and other sectors that would stop the shrinking of the regional population and encourage new settlements.

In particular, the Project would bring more essential workers to the region and make it more attractive for new migrants. By allowing effective crop production to take place regardless of drought conditions, it would reduce uncertainty and help the region become significantly more drought and recession proof. The Project would also contribute to land and farmland value uplift in the region. Increased wealth of residents and continued investment in the Project region would spur further economic growth.

A significant issue faced by rural and small urban municipalities, particularly along the eastern side of the province, is the lack of opportunities to diversify the municipal assessment base. Historically, assessment bases have been driven by oil and gas development, residential property, and farmland. Farmland assessment is regulated in the province of Alberta, meaning that it is not based on market values.

The conversion of dryland farmland to irrigation will have a very modest increase in the assessment base for the municipality, even though it will significantly increase the value of the land. As a result, this increase will not significantly increase tax revenues for the municipality. The real win for the municipalities will be with the opportunity that irrigation brings to the region in terms of value-added crops, secondary processing, and investment to support primary agriculture production.

The Project represents a scale that has potential to attract this type of investment into the region, which would have a significant and positive impact for the assessment base. Investment by private industry in processing, value add, transportation, and logistics create an environment whereby local municipal governments can truly work towards a more diversified assessment base and local economy.

6.0 Governance Model

This section provides an analysis of governance options.

6.1 Governance Options Analysis

Several options for types of entities that could carry out the Project were investigated. A Municipally Controlled Corporation (MCC) and an Irrigation District (ID) were found to be the most suitable governance structures. Each structure examined a set of key parameters:

Incorporation: The process for incorporating an MCC can be done more efficiently than establishing an ID. The major hurdle in establishing an ID is the regulatory process of submitting a petition to the Minister of Agriculture and Forestry signed by the registered owners of more than 75% of the land and who make up more than 50% of the total number of registered owners of the proposed district.

Capacity to take on debt: An ID is limited in borrowings to its statutory debt limit unless there is ministerial approval. An MCC has no debt limit unless the municipality elects to have consolidated financials. In which case, the municipality and the MCC are bound by the municipal debt limit under the Municipal Government Act (MGA).

Third-party investment: A third party may become an equity shareholder in an MCC provided it is less than 50% ownership. Although a statutory corporation, an ID does not have an equity share structure, and therefore is incapable of allowing direct third-party equity investment. To facilitate any equity investment, an ID needs to create a separate special purpose vehicle.

It should be noted that establishing an MCC for the initial construction and operation of the system does not preclude an eventual establishment and transition to an ID. The Project team acknowledged that this flexibility was an important consideration when investigating the potential governance structure.

7.0 Revenue Recovery Model

The Project will incur capital, operations, and maintenance costs. Based on a scenario with the full buildout of 108,000 acres and feedback from local producers, the total estimated Project costs do not align with the estimated revenue and producers' ability to pay for large upfront capital or annual operating costs. However, some contribution from the producers is required in addition to other investment and funding sources. In the context of the revenue recovery model, the contribution from producers is considered as Project revenue.

This section explores the potential business model revenues, the feedback from producers on those models, areas for revenue generation, and the potential to attract private investors. Section 8.0 explores the various investment and funding structures in combination with the revenue models discussed here.

7.1 Business Model Revenues

The Project has two sources of revenue to partially cover the repayment of costs during construction and the ongoing costs during operations. The two sources of revenue will be paid to the Project by farmers who own lands that benefit from the irrigation infrastructure, as follows:

1. **Capital Asset Charge (CAC)**: The CAC is intended to partially repay the capital costs of constructing the irrigation infrastructure. The CAC is charged on a dollar-per-acre basis and is a one-time charge.
2. **Irrigation Charge**: The Irrigation Charge is intended to repay (or partially repay) the operating expenses associated with operating and maintaining the irrigation infrastructure. The Irrigation Charge is charged on a dollar-per-acre basis and is an ongoing annual charge. As modelled, the Irrigation Charge was subject to an annual inflation adjustment.

Given the greenfield nature of the Project, the total capital costs are significant. If the entire capital cost of the system was passed on to the producers via an upfront CAC, then it is unlikely that any producer could afford to participate in the Project. Therefore, a lower CAC was proposed to the producers during the local engagement sessions, as described in Section 7.2. This means that the CAC will not be sufficient to repay the entire capital cost of the Project. As a result, it is proposed that the funding for the remaining capital expenses is provided by a combination of a grant from the GoA, debt from the private sector and the CIB, and equity from the private sector.

The operating expenses for the Project are expected to be high, due primarily to the high energy costs that result from the Project's topography. As seen for the capital cost structure, passing the entire non-energy and energy operating costs onto the producer via the Irrigation Charge would very likely restrict the ability for producers to participate. A lower Irrigation Charge was proposed to the potential producers during local engagement sessions, as described in Section 7.2. As a result, the Irrigation Charge alone will not be sufficient to repay annual operating costs, and an ongoing annual grant (O&M availability payments) would be required to fill the gap.

7.2 Local Producer Engagement Feedback

The producers in both the MD of Acadia and Special Areas expressed strong interest in the Project and confirmed that they expect such investment to generate broad economic benefits for the area and particularly improve each farmer's financial position with value-added crops.

Beyond the social acceptability of the Project, the feedback of the producers also promises a potential for revenue generation through the collection of both CAC and Irrigation Charges.

On their ability to invest in shared infrastructure, the producers did not oppose the proposed range of $2,500-5,000 per acre, although there is a preference for a CAC closer to the low end of the range at $2,500 per acre. However, the producers expressed some flexibility in paying more than $2,500 per acre, subject to being offered flexible repayment terms (low rate and longer duration).

There were concerns that the Irrigation Charge presented ($100-$140 per acre) was significantly higher than other irrigation projects, especially when combined with CAC and other on-farm costs. There were also concerns related to the potential for highly variable energy and utility costs, and producers shared a need for stable or predictable rates to manage operations effectively.

One of the major comments received is on the ability of both the GoA and the CIB, as the main financiers to the Project, to include on-farm infrastructure in the Project scope so that producers can access favorable financing options for both on-farm and shared irrigation infrastructure. While some other jurisdictions (e.g., Saskatchewan) provide support to producers to acquire pivots, the GoA does not currently have this funding policy for agriculture projects. Other financing vehicles are available through traditional lenders and credit unions, such as Alberta Treasury Branch (ATB), Farm Credit Canada (FCC), and Agriculture Financial Services Corporation (AFSC).

7.3 Areas for Revenue Generation Improvements

There are four strategies suggested for improving revenue generation.

1. **Higher Capital Asset Charge**: Following the feedback from producers and based on the discussions with other Sponsors, producers may be open to paying a CAC higher than $2,500 if long-term low interest financing can be arranged.
2. **Energy as a Source of Revenue**: If the Project includes a 30 to 60MW renewable generation capacity (from wind, solar, geothermal, or other), the excess electricity outside irrigation months can generate additional revenue from selling excess power to the grid, providing energy services to producers and other investors in the area, and signing Power Purchase Agreements (PPAs) with companies that aim to reduce their carbon footprint (e.g., Amazon, Microsoft, and others). Another option could be to build a small-scale, efficient gas-fired power plant (e.g., GE 30MW gas turbine) which could result in lower costs and higher reliability but also higher GHG emissions.

3. **Offtake/Feedstock Supply**: Another consideration to improve revenue generation is to attract commodity investors who would sign offtake agreements with farmers. At a high level, the offtake agreement could include that the commodity investor agrees to buy crops from the farmer at a fixed price. Agreeing to a fixed price to sell crops would shield the farmer from volatility in crop prices (a benefit to farmers). Commodity investors could generate profits if crop prices on average exceed the fixed price over the period of the offtake agreement. While this is a risk for commodity investors, the potential for profit generation offsets the risk, incentivizing the investor to enter into the offtake agreement.
4. **Food Processing/Renewable Fuels**: By building a food processing plant, co-funding irrigation services, and signing offtake with producers, an investor could achieve a strategic vertically integrated investment by securing supply for its industrial site. A food processor could also be a co-investor in irrigation.

7.4 Role of the Private Sector and Potential to Attract Investors

Ideally, this Project presents an opportunity for investors with different skills and expertise to team up, creating synergies to optimize and innovate for the Project's design and partnerships.

Should the public sponsors proceed with engaging a private sector partner in the next phase of work, then the private investor could work on the design, scale, and revenue generation strategies in parallel with the environmental assessment process.

8.0 Investment Size and Shares

The impact of various funding structures, revenue inputs, operating expenses, and Project sizes was compared for each scenario to investigate the required GoA grant size for capital costs and/or availability payment for operating expenses. Three main scenarios were considered based on their acre size and description:

- **Scenario 1**: 108,000 acres, which includes both MD of Acadia and Special Areas.
- **Scenario 2**: 81,000 acres, which includes MD of Acadia and acres less than an $18,000 total capital expenditure cost in Special Areas.
- **Scenario 3**: 49,000 acres, which includes only the acres from MD of Acadia.

Cost Summary for Each Scenario

Moving from one scenario to the other by reducing the number of acres constructed in turn reduces the variable and fixed operating costs applied to each acre, as well as the Project's capital costs. Operating costs were also categorized as fixed, variable, energy, and life-cycle costs to determine whether they are subject to savings/economies of scale as the Project scope changes.

On energy costs, all scenarios are based on energy being supplied directly from the grid. Wholesale energy market price forecasts drive ongoing energy costs. Table 5 shows the capital and operating costs over the entire Project life for each scenario.

Table 5: Estimated capital and operating costs over 33 years (3 years construction and 30 years of operation) for

each scenario. Draft and subject to change.

Key Items		Scenario 1	Scenario 2	Scenario 3
Total Acres	acres	108,026	81,052	49,151
Total Capex	C$MM	$1,330.2	$1,019.9	$386.7
Total Capex/Acre	*C$/acre*	*$12,314*	*$12,584*	*$7,868*
Project Life Opex	C$MM	$998.0	$689.4	$370.3
Project Life Opex/Acre	*C$/acre*	*$9,239*	*$8,507*	*$7,535*

Financial Modelling Assumptions

In addition to the cost figures for construction and operations, key financial modelling assumptions include:

- Inflation of 2.00% on revenue and operating expenses.
- The financing structure was defined such that the CIB's minimum investment threshold is 25% private capital and 75% CIB debt net of capex (total capital costs minus grants).
- Targeted equity IRR of 2% or 12% depending on the governance model selected.[4]
- GoA grant is used solely for capital expenses.

Potential of CIB Financing in Future Project Development Phases

The goal of the CIB is to be an impact investor and deliver outcomes that benefit Canadians.[5] CIB debt can be further optimized through flexible repayment terms[6] and innovative financing[7] to help attract private capital and improve the Project's overall affordability.

The CIB can tailor its financing based on the repayment term of the CAC or a more refined revenue model as proposed by a private developer. Whether the CAC payment terms are increased or decreased, the CIB will optimize its debt to allow producers and the private sector investors flexibility in the Project. Furthermore, grace periods on key debt metrics can be introduced to allow a greater CIB investment into the Project until it is fully operational."

[4] The 2% comes from the Irrigation District governance model whereby it is assumed that the GoA will provide a 2% loan to the Irrigation District which can in turn invest as equity.

[5] .Concessionary financing: concessionary financing offers terms that are generally more generous than financing from the private markets. These terms could include lower interest rates, longer period to repay financing, and others

[6] For example, a flexible repayment term could include that repayment of debt does not have to begin in the first year of operations and can be delayed beginning at a future date

[7] Indicative term sheet: a term sheet is a document that shows the basic terms and conditions of the financing. Term sheets typically include terms and conditions such as the interest rate, term of the loan, and repayment terms. An indicative term sheet shows the proposed terms and conditions of the financing and is non-binding to the parties that proposed these terms.

9.0 Project Risks

This section outlines project risks, including producer interest, energy supply, and water access.

9.1 Producer Interest

A local producer engagement study was conducted to establish the level of interest by producers at the range of potential capital and operating costs being considered, provide local producers with the opportunity to learn more about the Project, and identify the areas of concern for future local engagement to maintain local support for the Project. At a high level:

- There is strong interest in the Project moving forward.
- There is an understanding of the need for producers to contribute to the Project through a CAC and Irrigation Charge.
- There is strong interest in financing at a low rate over a long term from a flexible lender.
- There is a preference for a Municipally Controlled Corporation.
- Ongoing local engagement is needed, including information targeted to specific issues/audiences.

A public "What We Heard" report was approved for public release following the engagement. Recommended next steps for maintaining producers' interest in the Project include prioritizing ongoing local engagement on specific topics including producer operational resources, transitioning to irrigation, irrigation-specific farming, crop analysis and planning, as well as special interests, such as governance models and financing options for producers.

9.2 Energy Supply

Due to the nature of the Project design, energy supply will be a major part of the initial capital and the ongoing operational costs. That is, energy is needed to pump water from the Red Deer River into the reservoirs on either side of the river. Secondary pump stations are also required to supply main distribution pipelines and, in some parts of the MD of Acadia blocks, secondary open canals.

While this feasibility study assumed direct grid connection and wholesale energy pricing as an initial scenario, the next phase of work is recommended to include further analysis and optimization of the ultimate energy supply.

9.3 Water Access

Access to water is critical to the success of this Project. Both volume and timing are essential for irrigation to be successful. As discussed in the water availability analysis (see Section 3.4), this Project at full buildout will require a water licence to annually divert water from the Red Deer River, for the purpose of irrigation.

Water availability modelling completed as part of this feasibility suggests that, with storage, this Project is feasible based on the 82-year historic flow record. A qualitative analysis of potential impacts of climate change suggests that the irrigation system as designed will continue to be effective given the projected changes for the Red Deer River Basin.

Water is a limited resource, and the other sub-basins of the South Saskatchewan River Basin (Oldman, Bow, and South Saskatchewan River) are closed to applications for new water licences. There is stakeholder concern about water supply risks today and under a changing climate. Further analysis and stakeholder engagement will be critical to mitigate concerns about water supply risks in the Red Deer River Basin and establish confidence in the system's ability to function long-term.

Water Licencing

A new water licence will be required to divert water from the Red Deer River for use in the Project and will have junior priority to all previously issued licences and the Water Conservation Objectives (WCOs). The Project application will need to satisfy all licence application requirements per the *Water Act* and as communicated by AEP. In the proposed process outlined in Figure 7, two separate applications are prepared. The first application is for a water diversion licence preliminary certificate. Following receipt of the preliminary certificate, a separate application is submitted for an approval under the *Water Act* to carry out the instream activity of constructing the water diversion structures once engineering has been completed for structure design.

The purpose of separating the application for a diversion licence from the future application for an approval is to provide the Project with greater water supply certainty at an early stage of Project development before significant time and cost are invested on detailed engineering. This certainty is also critical to allow the Project to attract funding and investment that is critical to the establishment and long-term success of the Project.

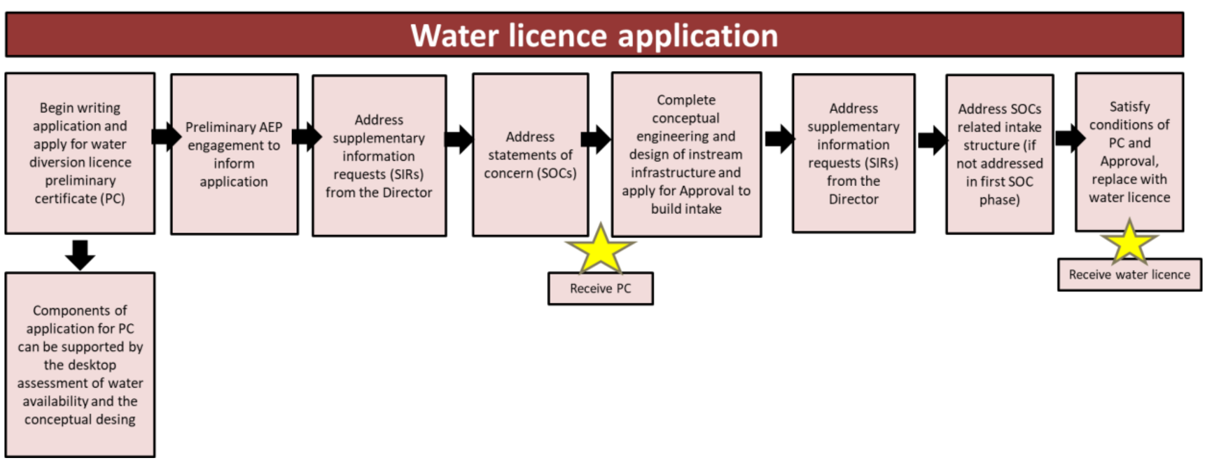

Figure 7 Detailed water licence application process including separate application for the diversion licence and approval to build the intake.

10.0 Timeline to Secure Regulatory Approvals

The major regulatory approvals (outlined in Table 6) are expected to take several years and require substantial effort both in application preparation, engagement, and review by regulatory agencies.

Table 6: Summary of select potential regulatory requirements (exclusive of energy related requirements). Draft and subject to change.

Regulator	Legislation	Requirements/Process	Estimated Length of Time for Process
Provincial			
Alberta Environment and Parks (AEP)	*Environmental Protection and Enhancement Act* (EPEA) Environmental Assessment Mandatory and Exempted Activities Regulation 111/93	Under *EPEA* Mandatory and Exempted Activities Regulation, an Environmental Impact Assessment (EIA) is required for: - A dam greater than 15 m in height - A water diversion structure and canals with a capacity greater than 15 cubic meters per second (m^3/s) - A water reservoir with a capacity greater than 30 Mm3	Two to four years to deem an application complete before the NRCB process begins.
Aboriginal Consultation Office (ACO)	The Government of Alberta's Policy on Consultation with First Nations on Land and Natural Resource Management, 2013	Aboriginal consultation requirements to fulfill the application requirements under the *Water Act*, *EPEA*, and the *Public Lands Act*.	Determined by the extent of consultation as determined by AEP on recommendation of the ACO.
Natural Resources Conservation Board (NRCB)	*Natural Resources Conservation Board Act*	The NRCB review process is triggered when a water management project requires an EIA (under *EPEA*).	One to three years to review and make a determination on a project.
AEP	*Alberta Water Act*	Authorization/approval	Variable from the time that the application is submitted. See Section 9.3 for details on water access.
	Alberta Water Act	Licence	Variable from the time that the application is submitted. See Section 9.3 for details on water access.
	Alberta Water Act	Agricultural Feasibility Report	Part of the review process for a water licence or transfer of allocation (variable from the time that the application is submitted).

Regulator	Legislation	Requirements/Process	Estimated Length of Time for Process
Federal			
Impact Assessment Agency of Canada (IAAC)	*Impact Assessment Act*	The federal Impact Assessment process may be triggered where a project type is listed as a designated project in the regulations under the *Impact Assessment Act* or where the Minister of Environment and Climate Change exercises discretion to designate a project. The federal impact assessment process would require extensive consultation and the production of an Impact Statement. The requirements are much more extensive than the provincial *EPEA* process.	Five to seven years.

11.0 Conclusions

Feasibility study results indicate that the development of 108,000 acres of irrigation from existing and previously cultivated lands in the MD of Acadia and the Special Areas is technically and financially feasible.

However, based on the current conceptual design assumptions, significant contributions are required from funders, lenders, and the producers themselves, both for upfront capital and ongoing operating expenses. There are many ways to potentially mitigate those costs, although further work is necessary to explore and document the opportunities.

Therefore, the results of the feasibility study support the following conclusions:

- Sufficient, previously cultivated land of suitable quality for irrigation exists in the Project region.
- There is enough water available for allocation in the Red Deer River Basin to support the irrigated acres based on this analysis.
- Based on the available water and suitable, previously cultivated land, 108,000 acres could be feasibly brought under irrigation.
- Reservoirs on both sides of river are conceptually feasible at the size required to support the estimated irrigation demand.
- Total operating expenses for fixed, variable, life cycle (major rehabilitation) and energy costs would range from $180-$300/acre annually. This assumes a direct grid connection and market electricity rates for Project power supply.
- Total capital costs of the Project (not including on-farm costs) for 108,000 acres are estimated at $12,300 per acre.

- All costs prepared for this study are Class D[8] estimates; therefore, design optimization in the next phase of engineering is expected to further optimize both capital and operating cost estimates.
- The MCC is the preferred initial governance structure with potential for a transition to an ID.
- Financial analysis results provide a range of funding structures, revenue inputs, operating expenses, and construction sizes that are being considered by the Project sponsors.
- There is strong interest from local producers to see the regional irrigation Project move forward.
- Local producers understand the need to contribute to the Project through a CAC and Irrigation Charge.

12.0 Recommendations

The results of this study and its conclusions support the following recommendations:

- Proceed with the next phase of work to optimize the design, secure a water licence, prepare for regulatory approvals, and refine the business case.
- Prioritize seasonal geotechnical and environmental field work required for design and regulatory applications in next phase.
- Engage a third-party to refine the financial analysis results to identify the preferred funding structures, revenue inputs, operating expenses, and construction size.
- Include the following items in the next phase of work:
    - Prepare and submit an application for a licence to divert water.
    - Establish the Project governance structure with input from legal and accounting experts.
    - Complete an assessment of energy supply options, including opportunities for innovation, and refine the energy cost estimates.
    - Complete more detailed engineering and design optimization to mitigate capital cost estimates.
    - Complete environmental work to support regulatory assessments.
    - Refine the Project business case based on refined capital and operating costs. Engage an agricultural economist to refine the producer business case.
    - Continue engagement with First Nations to share project updates, receive additional information and feedback, and address concerns.
    - Engage with stakeholders and potential future irrigators to provide study updates, respond to concerns, and use feedback to guide Project development.

13.0 High-Level Project Risks, Remediation Options, and Potential Next Steps

This section outlines the next steps for the Project, including the high-level risks and remediation options

[8] Conceptual or Class D estimates indicate a range of accuracy from -30% (low cost) to +25 to +50% (high cost)

and the next phase of work.

13.1 High-Level Risks and Remediation Options

The proposed Project is significant in terms of cost, required approvals, impact on the landscape, and impact on the community. Over the course of this feasibility study, potential risks to the Project and their proposed remediation were identified (Table 7). Additional risks and different remediation plans will arise throughout the next phase of work, if it proceeds, and can build on the ones provided in this report.

Table 7: High level risks and remediation options. Draft and subject to change.

Risk	Mitigation	Remediation Options
CAC required from producers is too high and uptake is not sufficient	Optimized system design to minimize capital costs Flexible financing options as part of refined financial analysis GoA and CIB participation	Add design optimization to scope of next phase of work Continue to work with GoA and CIB to develop a financial structure that is favorable for all parties, including producers
Capital investment in on-farm infrastructure required from producers is too high and uptake is not sufficient	Identify different lending sources	Work with producers and potential lenders to identify how to access favorable and flexible financing options for on-farm infrastructure
Energy supply pricing is too high for the Project to be sustainable	Innovative energy supply option to minimize operating costs	Engage energy firm with expertise in strategic energy solutions in next phase
Delays in permitting/licencing from statements of concern by impacted stakeholders and from Indigenous Consultation	Collaboration with AEP and other regulatory agencies prior to making applications Proactive and transparent communication with impacted stakeholders and Indigenous communities	Engage AEP early in the next phase to begin conversations on project regulatory requirements including stakeholder engagement Develop targeted engagement plan early in next phase and begin implementation prior to formal regulatory application submission

Risk	Mitigation	Remediation Options
Delays in project development from stakeholder opposition to water use, land use change, impacts to wildlife, and others	Proactive and transparent communication with targeted stakeholders Complete thorough environmental impact assessments as per the provincial and federal regulatory processes	Implement suggestions for targeted key message communication through a strategic engagement plan in next phase Work with other organizations to communicate in support of irrigated agriculture (e.g., AIDA, Irrigating Alberta)
Extensive regulatory requirements including seasonal field work and approvals at multiple levels of government could extend implementation timeline	Optimize the regulatory approvals process to ensure maximum efficiency	Engage experts in regulatory processes to advise study team Develop a regulatory roadmap to inform scope of work for next phase
Application for water licence diversion is not approved	Meet all application requirements and address statements of concerns using science-based evidence (i.e., watershed modelling to demonstrate water supply security)	Engage with AEP and experts in water licencing during the next phase of work to navigate the application process
Preliminary engineering identifies physical limitations that significantly alter project design and costs	Complete preliminary engineering for all critical pieces of infrastructure and update project costs	Proceed with next phase of work including preliminary engineering and refined project costs
Producers are unable to generate enough revenue to pay operating costs and repay loans	Develop a business case based on agricultural economics that includes crop mix and potential access to market	Engage agricultural economist in next phase of work to refine the producer business case

13.2 Next Phase of Work: Regulatory, Preliminary Engineering, and Engagement

The study identified several areas where significantly mitigating costs through optimized design will be required to make the Project attractive to investment over the long term, as presented in Section 12.0 and shown in the "Phase 2 (Design Optimization)" work item (Figure 8).

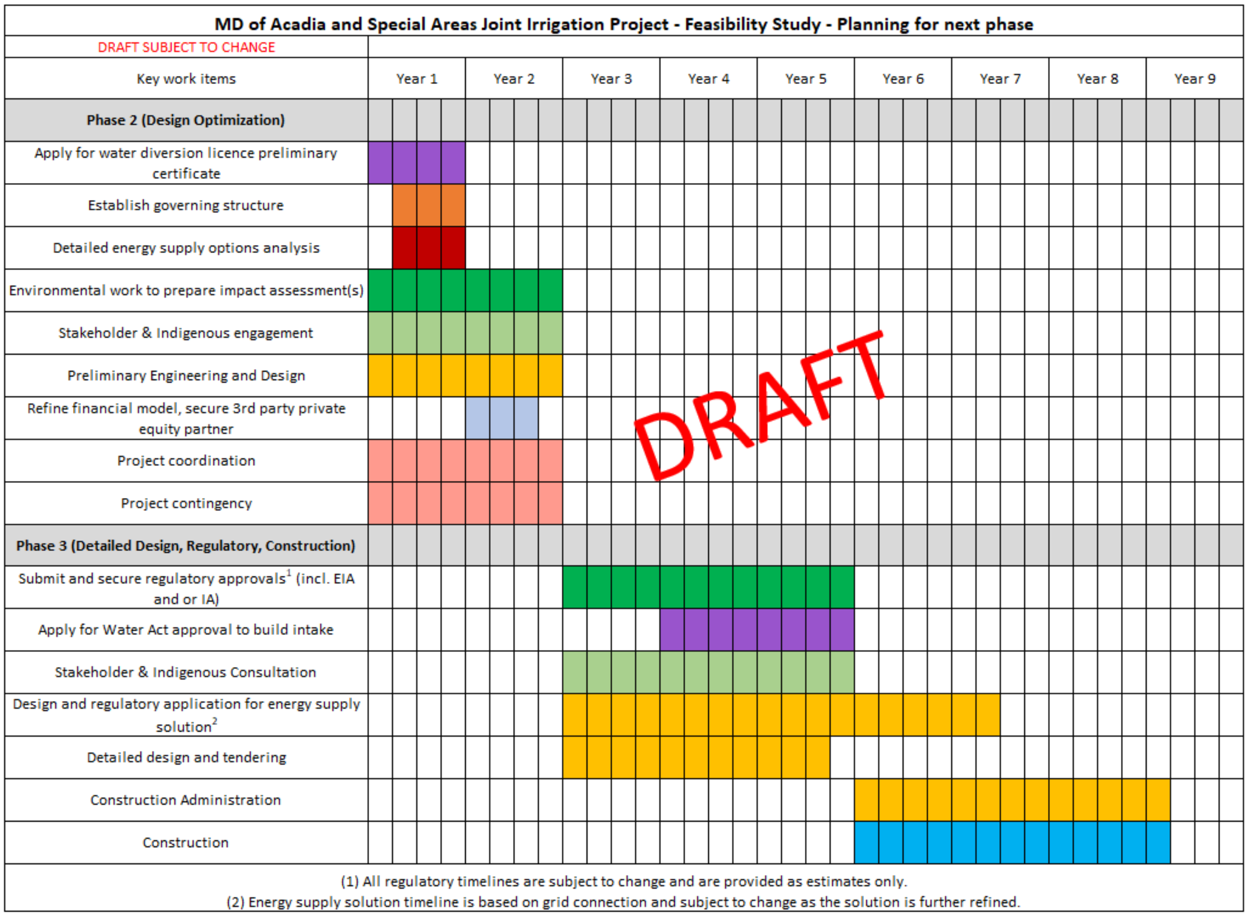

Figure 8 Estimate of tasks and timelines for potential future phases of work. All elements are draft and subject to change.

Based on the feasibility study results and conclusions, it is recommended to further refine the critical elements of the Project by proceeding with the recommended next steps in Phase 2 (Design Optimization). To secure funding for the Project, it is recommended that the Project sponsors develop a new MOU to guide them through the next phase.