Lethbridge County

Final Report

8 Mile Lake
Master Drainage Plan

November 2022

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Executive Summary

Introduction

Lethbridge County engaged ISL Engineering and Land Services to provide a Master Drainage Plan for the 8 Mile Lake Drainage Basin. This report follows the County's existing Stormwater Master Plan (MPE, 2018), which identified major catchment areas within the County requiring further analysis. The 8 Mile lake catchment boundaries, identified by ISL, differ slightly from the previous master plan. ISL worked from most recent available data and differences are minor and generally limited to the edges, whereas the general shape and flow directions of the catchment remain similar and the overall intent of the study is preserved. 8 Mile Lake has experienced property damage and crop loss due to flooding in the past. Since this area has undergone significant residential, commercial, and industrial development in recent years and has further future development planned, it has been identified in the County's Stormwater Master Plan as an immediate priority.

To effectively budget and plan for upgrades in future years, the County requires a more consolidated understanding of the existing drainage problems in the 8 Mile Lake catchment, as well as management solutions and associated costs. Furthermore, the MDP will assist the County in making decisions regarding development approvals pertaining to stormwater. This report encompasses an assessment of the current storm water system, including an identification of the existing hot spots within the study area. A prioritization of the upgrades to the existing system to address the current issues as well as to support future development within the drainage basin has been developed as part of this study to provide an efficient plan for improvement implementation which will mitigate ponding issues and ensure no downstream impacts will be incurred within the irrigation district because of the stormwater works.

Stakeholder Engagement

Several stakeholders are present within the County who may have a vested interest in, or be impacted by, stormwater works within the Battersea Drainage Basin. These include Lethbridge County, individual landowners, Alberta Transportation, Alberta Environment and Parks, and St. Marry River Irrigation District. Considering this, these stakeholders must be considered during the prioritization of stormwater infrastructure upgrades as well as the phasing of improvements. A stakeholder virtual engagement session (open house) was held for the 8 Mile Lake MDP. The results of this engagement were considered in understanding current flooding concerns and recommendations for future upgrades.

Study Objectives

The MDP was prepared to achieve the following objectives:

- Assess existing drainage conditions and pinpoint areas of concern;
- Analyzing existing natural drainage conveyance;
- Provide cost estimates related to required infrastructure upgrades, which will also provide inputs to capital planning; and
- Comment on phasing of upgrades for the most effective implementation of The County's needs.
- Provide governing stormwater management guidelines for future development within the watershed; and
- Provide baseline stormwater modelling for the watershed to vet future development against within the context of pre-development and no-net impact.

Conclusions

The 8 Mile drainage system consists of entirely overland drainage (i.e., no underground piped system). A 2D model was constructed in InfoWorks ICM to assess the 8 Mile drainage system. Design rainfall events produced from The County's IDF parameters were utilized to assess the major system using a 1:100 year 24-hour Chicago rainfall distribution. Model results of the overland drainage system under the 1:100 year 24-hour Chicago design storm suggest that there are several locations throughout 8 Mile drainage basin that would experience surface flooding, exceed depths vs. velocity criteria, and under capacity culverts. Several notable areas of concern were flagged for further investigation and potential remediation measures.

Recommendations

Several recommendations were made based on the findings of this study. This includes the findings of the existing system assessment, and development of the proposed stormwater concept for priority areas. Additionally, 2 locations were flagged for immediate attention and culvert upgrades were prioritized into 2 categories.

For future development and any Water Act applications, impacts are to be outlined within the context of existing ponding depths outlined in this MDP. No generalized Water Act was obtained for the area due to the limited amount of proposed development, therefore developers are still required to obtain Water Acts as required, however this MDP forms the basis for existing conditions. Pre-development and "no-net increase" stormwater management design ideologies are to be compared to governing model results. Developers can deviate from the below guidelines and model results outlined in this report provided technical rational and stormwater modeling outlines how development deviates from the MDP but still achieves the intent of the design guidelines.

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1.0 Introduction

Lethbridge County (the County) engaged ISL Engineering and Land Services (ISL) to provide a Master Drainage Plan (MDP) for the 8 Mile Lake Drainage Basin (Study Area). This report follows the County's existing Stormwater Master Plan (MPE, 2018), which identified major catchment areas within the County requiring further analysis. The 8 Mile lake catchment boundaries, identified by ISL, differ slightly from the previous master plan. ISL worked from most recent available data and differences are minor and generally limited to the edges, whereas the general shape and flow directions of the catchment remain similar and the overall intent of the study is preserved. 8 Mile Lake has experienced property damage and crop loss due to flooding in the past. Since this area has undergone significant residential, commercial, and industrial development in recent years and has further future development planned, it has been identified in the County's Stormwater Master Plan as an immediate priority.

To effectively budget and plan for upgrades in future years, the County requires a more consolidated understanding of the existing drainage problems in the 8 Mile Lake catchment, as well as management solutions and associated costs. Furthermore, the MDP will assist the County in making decisions regarding development approvals pertaining to stormwater. This report encompasses an assessment of the current storm water system, including an identification of the existing hot spots within the study area. A prioritization of the upgrades to the existing system to address the current issues as well as to support future development within the drainage basin has been developed as part of this study to provide an efficient plan for improvement implementation which will mitigate ponding issues and ensure no downstream impacts will be incurred within the irrigation district because of the stormwater works.

1.1 Purpose of the Study

The objectives of developing the 8 Mile Lake MDP include the following:

- To review and summarize existing background information on the study area
- To delineate sub-catchment areas contributing to the study area based on topographic data
  - Potential land depressions issues are to be identified
- To conduct field reconnaissance of drainage infrastructure, including survey, where necessary
- To inventory and analyze the infrastructure under existing conditions
  - Culvert capacities should be determined and culverts lacking capacity should be identified
  - Assess existing ponding conditions
  - Assess depth vs. velocity for overland flows and identify areas exceeding limits
- To highlight and prioritize significant stormwater issues (significant ponding) within the study area
- To determine if any upgrades are required to the existing system to properly meet the needs of the County and to address existing issues
- To determine if any upgrades are required to support future development within the study area
- To ensure the planned stormwater management system meets regulatory requirements, including Alberta Environment and Parks (AEP) Water Act requirements
- To prioritise and develop a phasing plan for the required upgrades to stormwater infrastructure
- To develop cost estimates (Class D) related to the required stormwater infrastructure upgrades

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2.0 Site Description

2.1 Location

The Lethbridge County is an agricultural-based rural municipality located in Southern Alberta. Pertinent urban municipalities within the County include the villages of Barons and Nobleford, the Towns of Picture Butte, Coaldale and Coalhurst, and the City of Lethbridge. Smaller communities within the County include the Hamlets of Chin, Diamond City, Fairview, Kipp, Monarch, Iron Springs, Shaughnessy and Turin. Two significant irrigation districts exist within the county which supply irrigation-based agricultural operations with water. These include the Lethbridge Northern Irrigation District (LNID) and the St. Mary River Irrigation District (SMRID). It is critical that stormwater works within the County be coordinated with these irrigation districts, as discussed further in Section 2.3.

The 8 Mile Lake Drainage Basin is in the East-Central area of the County, bounded loosely by the Oldman River to the north, the Crowsnest Highway (Highway 3) and the Town of Coaldale to the south, the City of Lethbridge to the west, and Range Road 190 to the east. The overall study area is heavily irrigated and consists of approximately 20,700 ha of land and can be seen in Figure 2.1. The 8 Mile Lake catchment primarily consists of agricultural land with relatively flat terrain. Elevations in the study area vary moderately, ranging from 920.05 m in the southwest extremity of the catchment to 841.39 m in the east-most portion of the catchment. Generally, the topography falls from west to east, as can be seen in Figure 2.2.

2.2 Land Use

The study area is largely undeveloped with areas of farmland and residential acreages primarily used for agricultural purposes. The southwest stretches of the catchment overlap the City of Lethbridge and include areas of industrial and residential land use. Potential future development is anticipated within the 8 Mile Lake catchment in proximity to the City of Lethbridge, which is demonstrated in Figure 2.3. Specific details on the land use of the potential future development are not available at this time, but due to its proximity to the Sherring Industrial Park as well as other industrial areas within the City of Lethbridge, it has been considered as industrial land use. Table 2.1 summarizes the specific land uses within the 8 Mile Lake catchment for existing and future conditions, as well as the runoff coefficient stipulated by the City of Lethbridge Design Standards (City of Lethbridge, 2016) and Stormwater Management Guidelines for the Province of Alberta (Alberta Environment, 1999) associated with each land use.

Table 2.1: Summary of Existing and Future Land Use

Land Use	Existing Area (ha)	Proposed Area (ha)	Runoff Coefficient
Paved Surfaces	295	295	0.95
Agricultural (Field)	18,923	18,782	0.20
Agricultural (Feed Lot)	130	130	0.50
Residential	307	307	0.60
Waterbodies/Wetlands	327	327	1.00
Industrial/Commercial Farmland	1,042	1,183	0.70

2.3 Stakeholders

Several stakeholders are present within the County who may have a vested interest in, or be impacted by, stormwater works within the 8 Mile Lake Drainage Basin. These include Lethbridge County, individual landowners, Alberta Transportation (AT), Alberta Environment and Parks (AEP), and the SMRID. Considering this, these stakeholders must be considered during the prioritization of stormwater infrastructure upgrades as well as the phasing of improvements. A stakeholder virtual engagement session (open house) was held for the 8 Mile Lake MDP. The results of this engagement were considered in understanding current flooding concerns and recommendations for future upgrades.

Lethbridge County

By undertaking MDPs within specific drainage catchment within the County, Lethbridge County provides solutions to existing stormwater management issues. In the forefront of their focus is addressing impacts to private properties by providing a comprehensive plan to mitigate overland flooding and to ensure additional development within the catchment does not negatively impact the stormwater management system. Many impacts to residences and road infrastructure have been noted within the 8 Mile Lake Drainage Basin, which are anticipated to be caused by a lack in culvert capacity and overall conveyance shortcomings. Given the high potential for future development within this catchment, shortcomings should be addressed to allow for continual development to occur. These shortcomings are to be ranked based on their relative effects on infrastructure, and subsequently prioritized for improvements.

Landowners

At present, ponding issues arise throughout the study area, many of which encroach on private land. Landowners generally rely on the implemented stormwater infrastructure to effectively operate such that their land is not negatively impacted due to flooding. Prioritization of stormwater upgrades should consider the impacts on private properties. Landowners were engaged through a virtual open house.

Alberta Transportation

AT is responsible for highway infrastructure within the study area. Thus, stormwater issues or improvements impacting Highway 3 will need to be coordinated with AT. AT was engaged for in person meetings during the stakeholder engagement phase of the project.

Alberta Environment and Parks

Collaboration with AEP will be critical for the successful execution of stormwater works within the study area. AEP is the regulatory authority for stormwater management within Alberta, thus this MDP has been constructed to assist developers in obtaining Water Act approval for the stormwater improvements. AEP was engaged for in person meetings during the stakeholder engagement phase of the project and provided an opportunity to review and comment on the draft MDP.

Due to the limited amount of current development in the area, a governing water act for future impacted wetlands and formal signoff from Alberta Environment and Parks was not obtained at this time. If in future, larger developments are proposed within the area, a Water Act should be pursued.

St. Mary River Irrigation District

The SMRID diverts water from the St. Mary, Waterton, and Belly Rivers to support users involved in economic, agricultural, and environmental activities in Southern Alberta. Irrigation is supplied to water users through a complex network of reservoirs, canals, and pipelines. It is imperative that stormwater improvements required to address the issues noted herein do not negatively impact SMRID infrastructure, considering the irrigation canals are not designed to convey stormwater. The SMRID is also currently investing $5.4 million into the replacement of a deteriorated lateral canal system with PVC pipeline approximately 5.6 km north of Coaldale. Thus, analysis must also account for the impacts of filling in existing canals on the overall stormwater drainage patterns. SMRID was engaged for in person meetings during the stakeholder engagement phase of the project.

2.4 Geotechnical Conditions

According to the Lethbridge County Stormwater Master Plan (MPE Engineering Ltd., 2018), the geology within the study area has been shaped by the different glaciations. The specific surficial material type within the 8 Mile Lake catchment can be classified as glaciolacustrine with gently sloping topography. Glaciolacustrine materials are sediments deposited by glacial meltwater in lakes. These sediments are typically silts and clays which remain suspended in the water column as the bedload of a stream is deposited at the lake margin. Glaciolacustrine sediments tend to have a layered nature as different sized particles are deposited over the annual cycle. Larger particles settle in the summer when highly turbid water enters lakes due to spring melt. Freezing temperatures during the winter reduce the discharge of inbound streams, this results in calmer conditions within lakes and thus allows smaller-sized particles to settle.

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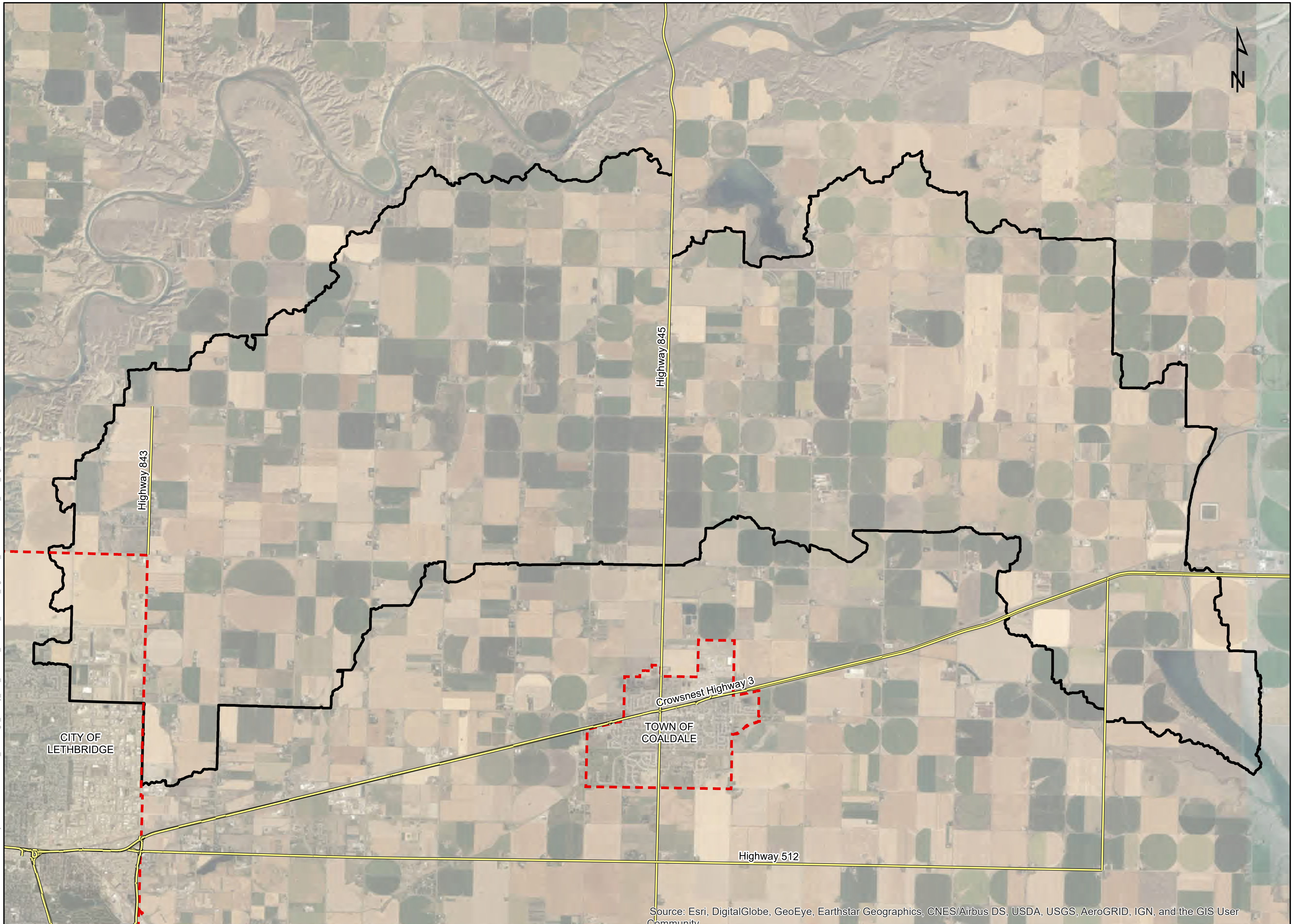

Legend

- 8 Mile Study
- Municipal Boundaries
- Major Highways

Coordinate System:
NAD 1983 UTM Zone 12N

1:80,000

0 800 1,600 3,200 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 2.1
STUDY AREA

LETHBRIDGE COUNTY

ISL

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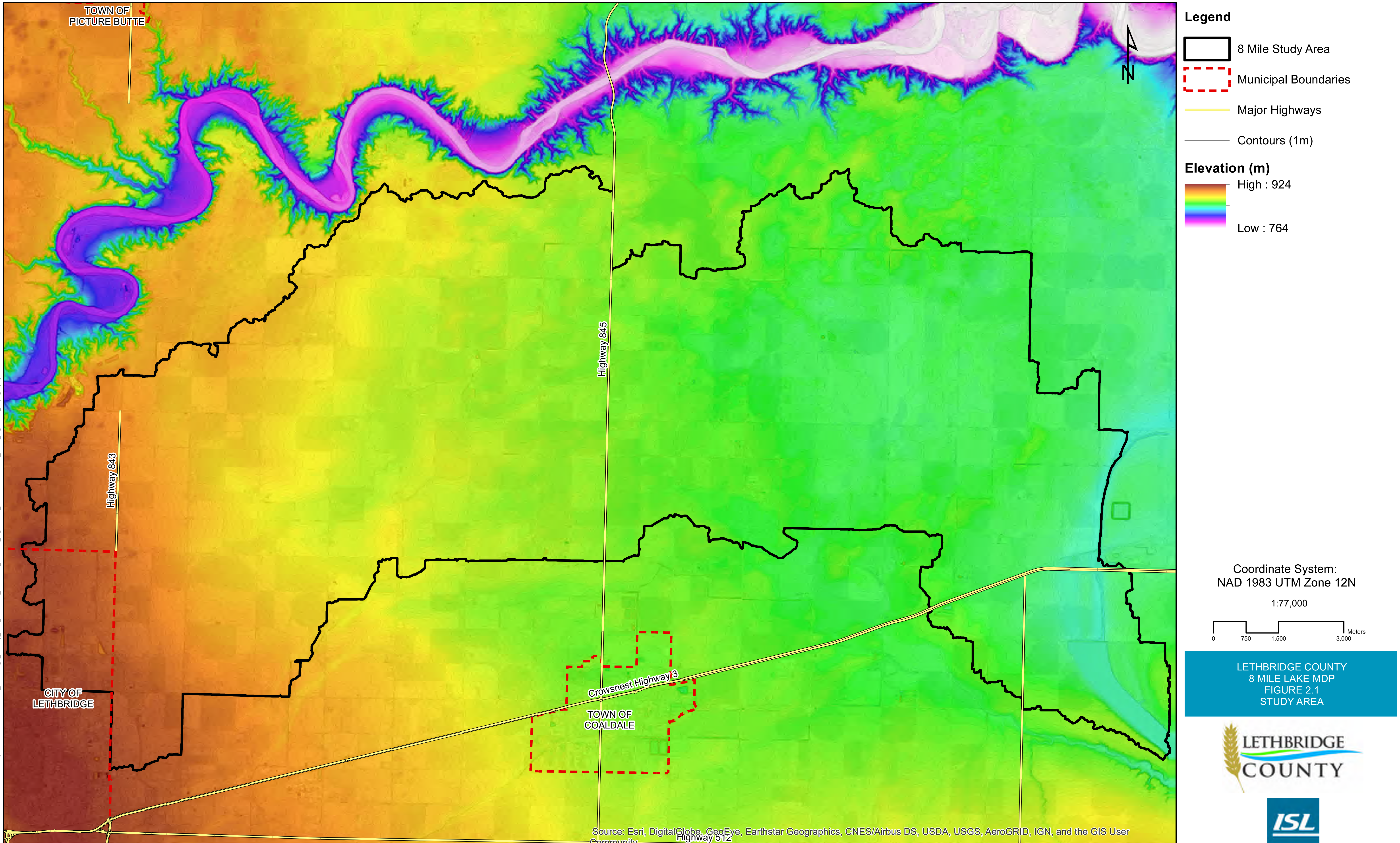
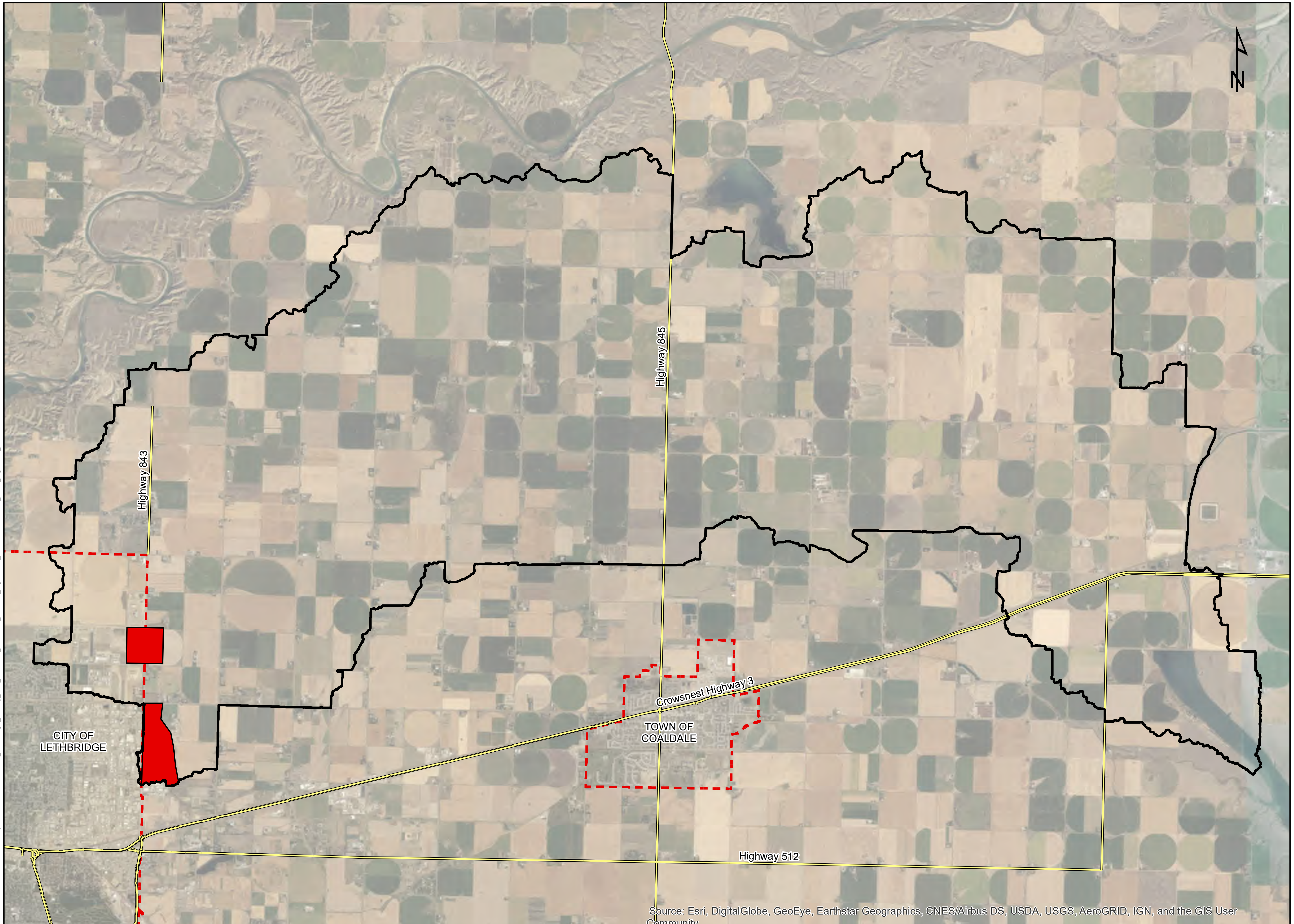


LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 2.1
STUDY AREA

LETHBRIDGE COUNTY

ISL



Legend

- 8 Mile Lake Study Area
- Municipal Boundaries
- Major Highways
- Potential Future Development Area

Coordinate System:
NAD 1983 UTM Zone 12N

1:80,000

0 800 1,600 3,200 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 2.3
POTENTIAL FUTURE DEVELOPMENT

LETHBRIDGE COUNTY

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3.0 Existing Stormwater System

3.1 Existing Drainage Patterns

As previously noted, the Study Area largely drains from southwest to east, away from the City of Lethbridge and outlets to the 8 Mile Lake drain in proximity to the Stafford Reservoir. From here, runoff follows a network of drainage canals and reservoirs in the County. Existing drainage patterns can be seen in Figure 3.1. The catchment ultimately appears to discharge to the Oldman River, and as such, the study area is located within the Oldman River watershed as part of the Nelson-Churchill (Hudson Bay) continental drainage basin.

3.2 Stormwater Conveyance System and Existing Infrastructure

The 8 Mile Lake catchment has experienced flooding in the past which has resulted in property damage and loss of agricultural crops. Flooding likely arises as backup in low-lying lands as a result of undersized culverts creating capacity issues within the catchment. As part of the Lethbridge County Stormwater Master Plan, several culverts at identified hotspots and along the 8 Mile Lake drain and Cameron Extension Lateral in the study area were examined to highlight whether capacity constraints existed. The analysis found that, of the culverts examined, only three were able to accommodate the 1:100 year storm event, and an additional two were able to accommodate the 1:10 year storm event. Analysis performed on the SMRID canals determined that the main canal was able to manage runoff from a 1:100 year event, excluding the north/northeast section, which was only able to manage runoff from a 1:10 year event. It should be noted, however, that the irrigation canals have not been designed as stormwater management infrastructure. Table 3.1 summarizes the hotspots and corresponding constraint responsible for the stormwater issues noted at each location as determined by the Lethbridge County Stormwater Master Plan.

Table 3.1: Hot Spot Summary (MPE Engineering Ltd., 2018)

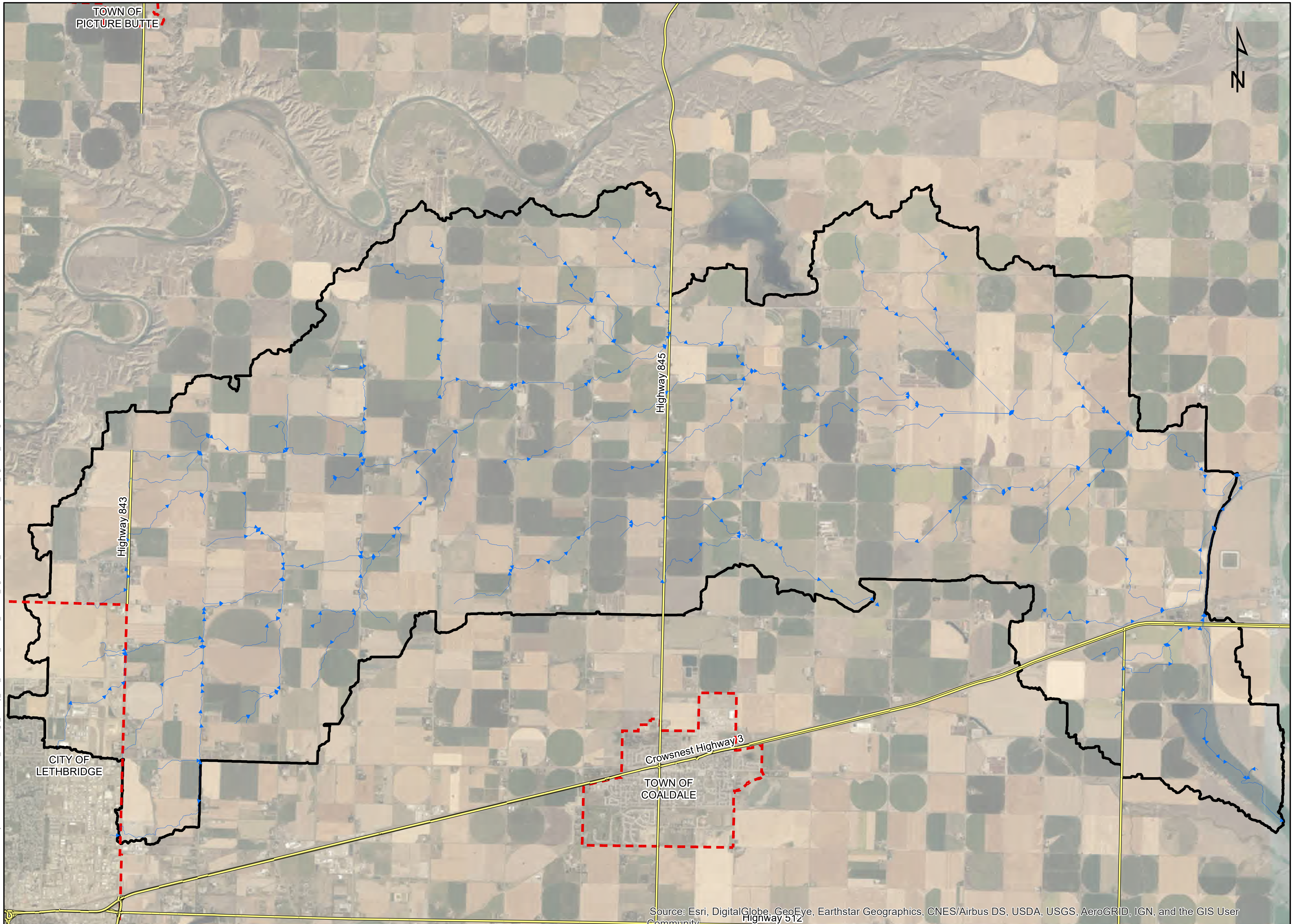
ID Number	Location	Priority	Problem	Main Infrastructure Impacted
52	NE 25-8-21 W4	2	Lack of capacity in 1200 mm diameter culvert.	Homes, roads
94	NE 24-9-21 W4	3	Flooding at intersection from stormwater in ditch which flows from the west and should be directed north.	Roads, fields
95	Ne 31-9-21 W4	4	Lack of capacity causes backup.	Fields, roads

ISL has continued this analysis, carrying out a detailed examination of the stormwater system within the 8 Mile Lake catchment to further the understanding of the existing system performance.

3.3 Environmentally Sensitive Areas

Several existing wetlands are located within the Study Area, including a number of permanent water bodies. Any changes to these existing water bodies, including alteration of flow or level, change in the location of water, or infilling of wetlands, may require a Water Act approval. Prior to development or stormwater improvements, wetlands must be classified using the Alberta Wetland Classification System and assigned an ecological wetland value using the Alberta Wetland Rapid Evaluation Tool. This standardized method must be performed by a Qualified Wetland Science Practitioner to ensure that any required wetland replacement considers the loss of wetland area as well as the specific wetland function. Wetlands which have been permanently impacted by development may be replaced by stormwater management facilities (SWMF). A detailed SWMF report may be used to assist the County in gaining credit for future wetland development, offsetting the impacts to existing wetlands.

In addition to this, several sensitive watercourses exist in proximity to the study area including the Oldman River. As such, stormwater design must work to minimize the negative impacts to the ecology of any water body within the County. This study has been conducted with the goal of adhering to the recommendations of the SWMP in order to minimize negative impacts to the overall stormwater management system.



Legend

- 8 Mile Study Area
- Municipal Boundaries
- Major Highways
- Drainage Path

Coordinate System:
NAD 1983 UTM Zone 12N

1:77,000

0 750 1,500 3,000 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 3.1
EXISTING DRAINAGE

LETHBRIDGE COUNTY

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4.0 Hydraulic Model Development

4.1 Model Set-Up

The model used for assessing the 8 Mile Lake Drain was InfoWorks ICM developed by Innovyze, which was selected for its advanced capabilities associated with 2D modelling. Some of the advantages of InfoWorks ICM that were an asset for this project are summarized below:

- Effective in urban applications, InfoWorks ICM is the preferred modelling software utilized by numerous municipalities across the country.
- Ease with applying differential cell sizing.
- Rain on Mesh option is available, meaning that overland flow path assumptions are not necessarily required upfront.
- Triangular mesh elements mean that the surface can be modelled with extreme accuracy.
- Ability for terrain sensitive meshing, ensuring that changes in topography are reflected in the mesh.
- Mesh generation effectively accounts for building footprints.
- Many result formats are available, including 3D videos that can be used for presentations to stakeholders.
- There is complete integration with ArcGIS.

The model was constructed by utilizing available LiDAR data combined with confirmations from survey and certain assumptions. Section 4.1.2 describes the process that was undertaken to develop the 2D model. This includes a discussion of the features and parameters that were required as input into the mesh development process, and a summary of the mesh generation itself.

4.1.1 Road Survey

To provide an accurate representation of the surface for 2D modeling purposes, all roads within the site were surveyed. The survey was conducted by attaching equipment to a truck which captured survey points along the center of the roadway as the truck drove down every roadway within the site. The data was then processed to provide an accurate representation of each roadway which allows for a highly accurate representation of the surface in the 2D modeling. Existing culverts were also captured during this survey.

4.1.2 Major (2D) System Development

The major system consists of all overland drainage components including roads, ditches, culverts, surface storage elements, and receiving water bodies. The following parameters have been considered to develop a mesh, which ultimately represents the overland drainage system:

- 2D Zone
- Mesh Zones
- Roughness Zones
- Infiltration Zones

The 2D Zone represents the boundary in which the 2D analysis will occur in. The 2D Zone was digitized to be a simplified version of the proposed area. A mesh was created within a 2D Zone and represents the surface using triangulation. Each triangle is referred to as a mesh element, each with its own unique elevation, which is calculated using surface data, ultimately making each mesh element flat. Together with other mesh elements, a surface is formulated. The number of mesh elements has a direct impact on simulation run times. Various parameters can be considered when developing a mesh. For the model that has been developed as part of this MDP, these parameters include the Mesh, Roughness, and Infiltration Zones.

The Mesh Zone specifies different mesh element densities for various zones, to either increase or decrease the resolution of a zone depending on its importance. For example, in order to capture pertinent features such as the crowns of roads, roadways are generally defined by denser, smaller elements. Alternatively, greenfields that do not impact existing developments could be considered for larger mesh elements.

The Roughness Zone allows various Manning's n roughness values for different parts of the mesh. A roughness value is assigned to each mesh element depending on which Roughness Zone that mesh element is a part of. The Roughness Zone allows for a more accurate representation of different surfaces within the model.

The Infiltration Zone allows for various infiltration parameters across the mesh, depending on the different surfaces that are apparent within the mesh. Each Infiltration Zone is designated an Infiltration Surface, where an Infiltration Type can be specified. Four Infiltration Types are available along with their related parameters, including:

- Fixed
  - Fixed Runoff Coefficient
- Horton
  - Horton Initial
  - Horton Limiting
  - Horton Decay
  - Horton Recovery
- Constant Infiltration
  - Fixed Runoff Coefficient
  - Infiltration Loss Coefficient
- Green-Ampt
  - Green-Ampt Suction
  - Green-Ampt Conductivity
  - Green-Ampt Deficit

In this model, surfaces are represented through a fixed runoff coefficient, as either paved, unpaved, or field surfaces.

Default mesh, roughness, and infiltration parameters were defined in the 2D Zone to represent impervious areas such as roadways and buildings. These default parameters are stipulated below in Tables 4.1, 4.2, and 4.3. Additionally, the options to 'Apply rainfall etc. directly to mesh' and 'Terrain-sensitive meshing' were selected. The 'Apply rainfall etc. directly to mesh' option ensures that rainfall is falling directly onto the surface, which provides a more accurate representation of overland flows. The 'Terrain-sensitive meshing' option better represents the surface topography among the mesh elements.

The Mesh, Roughness, and Infiltration Zones were generated through the geospatial development type information, to be able to specify different criteria depending on the development type. It is noted that the physical boundaries of each Mesh, Roughness, and Infiltration Zone polygon are identical, however the parameters vary depending on the type of polygon (i.e., whether it is a Mesh, Roughness, or Infiltration Zone). Maintaining the same extent for each polygon type ensured there would be no errors regarding overlaps between the different polygon layers.

The parameters applied per development type are specified in Tables 4.1, 4.2, and 4.3 below for the Mesh, Roughness, and Infiltration Zones, respectively. The Mesh Zone parameters are based on ISL's experience using InfoWorks ICM, optimizing both model simulation time and level of detail. The Roughness Zone parameters are based on engineering best practices, and are consistent with past projects completed by ISL. The Infiltration Zone parameters are based on a combination of the runoff coefficients stipulated in the Stormwater Management Guidelines for the Province of Alberta (AEP, 1999)

Table 4.1: Mesh Zone Parameters per Land Use Type

Land Use	Maximum Triangle Area	Minimum Element Area
	m^2	m^2
Paved Road	20	1
Unpaved Road	20	1
Field	100	20

Table 4.2: Roughness Zone Parameters per Land Use Type

Land Use	Roughness Coefficient
Paved Road	0.016
Unpaved Road	0.023
Field	0.030

Table 4.3: Infiltration Zone Parameters per Land Use Type

Land Use	Infiltration Type	Fixed Runoff Coefficient
Paved Road	Fixed	0.85
Unpaved Road	Fixed	0.70
Field	Fixed	0.20

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5.0 Design Criteria

The design criteria used to assess the stormwater system was based primarily on Lethbridge County – Engineering Guidelines & Minimum Servicing Standards while also considering City of Lethbridge Design Standards. The design criteria selected were then used for input into the InfoWorks ICM model to design and assess the stormwater drainage system.

5.1 Design Rainfall Event

The design storms applied in this study are based on Lethbridge County's tabular design storms stipulated in the Engineering Guidelines & Minimum Servicing Standards (Lethbridge County, 2019). Table 5.1 summarizes the 1:100 year 24 hour design storm utilized for modeling purposes.

Table 5.1: Lethbridge County Tabular Design Storms, 1:100 Year 24 Hour Rainfall Distribution

Hour	Depth (mm)	Hour	Depth (mm)	Hour	Depth (mm)
1	0.1	9	6.2	17	2.8
2	0.2	10	37.0	18	1.7
3	0.3	11	21.8	19	0.0
4	0.4	12	15.7	20	0.0
5	0.6	13	9.0	21	0.0
6	0.8	14	5.6	22	0.0
7	0.9	15	4.5	23	0.0
8	1.1	16	3.4	24	0.0

In assessing the storm drainage system in the area, a design rainfall event is required to generate runoff that will subsequently enter the network. The major system is assessed to handle the runoff from storms up to the 1:100 year storm event. These return periods are consistent with many other municipalities, therefore were used in assessing the drainage in the area. The storm is set in 5-minute time steps, with the peak intensity set to a 5-minute duration for the selected storm return period.

5.2 Assessment Criteria

The performance of the major system under the existing conditions is ultimately determined based on depth vs. velocity for surface flows, and capacity of culverts.

In assessing the storm drainage system in an area, typically a 1:100 year storm is used to assess the major drainage system under large flow volumes once the system is saturated, this would typically be a 1:100 year, 24-hour event. Therefore, the existing drainage system was analyzed under the 1:100 year 24 hour event.

Peak Discharge Relative to Culvert Capacity

Peak Discharge Relative to Culvert Capacity indicates the ratio of peak flow to pipe capacity; as a corollary to this, the data can be interpreted to indicate the amount of spare capacity during peak flows. This is calculated by employing a ratio of modelled flow in the culvert and its corresponding capacity. Culverts with ratios greater than one are considered to have no spare capacity thus indicating a culvert that might require upgrading, particularly where the length of the section is long enough to cause surcharge conditions immediately upstream.

Hence, the Peak Discharge Relative to Culvert Capacity (Q/Qman) with a ratio of:

- Greater than 300% – significantly over capacity
- Between 150% and 300% – over capacity
- Between 100% and 150% – slightly over capacity
- Less than 100% – spare capacity available

Depth vs. Velocity

To present and evaluate 2D assessment model results, model files were reviewed, and results data was extracted for both depth and velocity at the maxima, for the 1:100 year event. The complete model file contains velocity and depth properties at any time step within the simulation in the event they are required.

To increase public safety, the Province of Alberta has stipulated permissible depths for submerged objects in relation to water velocity. This guideline, Stormwater Management Guidelines for the Province of Alberta, 1999, was implemented to ensure that a 20 kg child would be able to withstand the force of moving water, thus preventing possible tragedies. Figure 5.1 indicates these requirements.

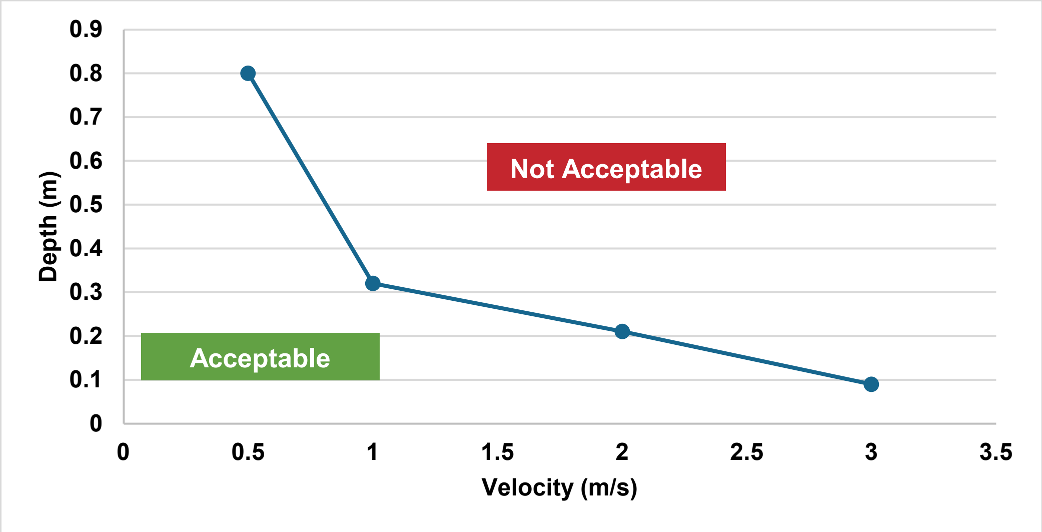


Figure 5.1: Permissible Depths for Submerged Objects

6.0 Existing System Assessment

The existing system was assessed using the design criteria stipulated above in Section 5.0. The existing system was assessed under the 1:100 year 24 hour design storm. Simulation results under the rainfall distribution are covered in the sections below.

6.1 2D Model Results

2D model results were generally analyzed relative to ponding depths, overland flow depth vs. velocity, and culvert capacities as discussed in the subsections below.

6.1.1 Ponding Depths and Overland Flows

To assess existing overland drainage system, model results were extracted at the maxima for both water depth relative to the LiDAR surface and surface flow velocity. It is noted that the maxima represent the peak depth/velocity value of each mesh element at a specific point in time. That said, the time stamps for each mesh element do not necessarily overlap, and each occurrence is independent of the next. The water depth and surface flow velocity results are illustrated in Figures 6.1 and 6.2, respectively.

The results shown on Figures 6.1 and 6.2 indicate that there are few locations throughout the study area along roadways would experience surface flooding to some extent under the 1:100 year rainfall event. Table 6.1 summarizes critical locations in terms of surface depths and velocities, while Table 6.2 details areas where there is significant impounding of water adjacent to roadways; (greater than 0.6m maximum depth); Figure 6.3 shows these data points compared to the Province's requirements and Figure 6.4 illustrates these locations geographically. Note that due to the size of the data set only depths vs. velocities that exceed the acceptable limits are shown. The extent of these areas of concern vary, depending on how many mesh elements exceed or are close to exceeding the depth-velocity criteria. In Table 6.1 below, the maximum depth and maximum velocity among all exceeded mesh elements are recorded.

Table 6.1: 1:100 Year Event 2D Modelling Critical Location - Surface Depths vs Velocities

ID	Location	Maximum Depth (m)	Maximum Velocity (m/s)	Priority
1	NE-22-9-21-4	0.618	1.598	3
2	SE-26-9-21-4	1.055	1.787	3
3	SE-25-9-21-4	0.769	1.194	2

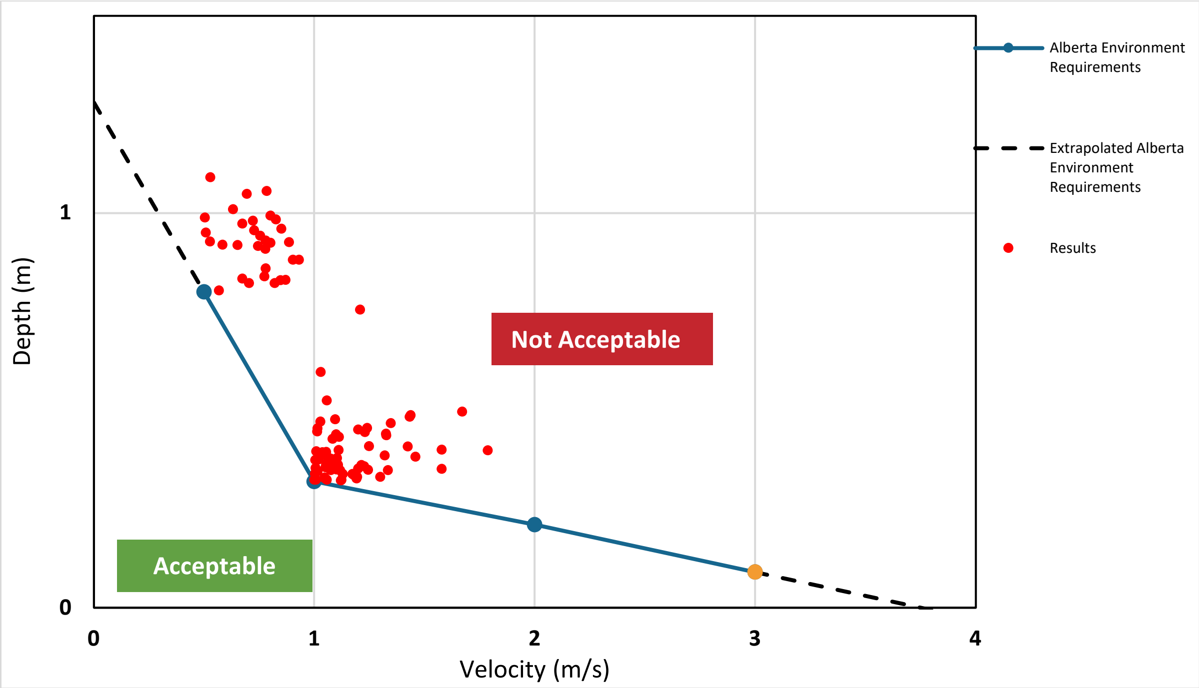


Figure 6.3: Velocity and Depth Guidelines

Table 6.2: 1:100 Year Event Modelling Critical Locations – Surface Depths

ID	Location (QTR-SEC-TWP-RGE-MER)	Maximum Depth (m)	Priority	Notes
1	SE-21-09-21-4	1.096	2	Natural depression
2	NE-28-09-21-4	0.989	1	Highway 843 mitigation
3	SE/NE-33-09-21-4	1.246	1	Highway 843 mitigation
4	SE-03-10-21-4	0.705	3	Natural depression
5	SE/NE-34-09-21-4	1.077	3	Natural depression
6	NE-27-09-21-4	1.110	2	Natural depression
7	SE-27-09-21-4	1.211	2	Natural depression
8	NE-14-09-21-4	1.169	3	Natural depression
9	SE/NE-26-9-21-4, NE23-9-21-4	1.055	2	Natural depression
10	SE/NE-12-10-21-4	1.523	2	Natural depression
11	SE-1-10-21-4, NE-36-9-21-4	1.264	3	Natural depression
12	NE-25-09-21-4	1.542	1	8 mile mitigation
13	NE-6-10-20-4	0.802	3	Natural depression
14	SE-07-10-20-4	0.830	3	Natural depression
15	NE-32-09-20-4	0.839	1	Undersized culvert
16	SE-11-10-20-4, NE-2-10-20-4	0.795	2	Natural depression
17	NE-32-09-19-4	1.396	3	Natural depression
18	SE/NE-22-9-19-4	1.109	2	Natural depression
19	SE-02-10-19-4	2.733	2	Natural depression

6.1.2 Culvert Capacities

Known culverts were included in the modeling based on data obtained from the County. Table 6.3 below detail model results culverts, with under capacity culverts bolded below. Figure 6.5A and Figure 6.5B are provided to reference locations. Refer to Table 7.5 for recommended sizing for proposed upgrades.

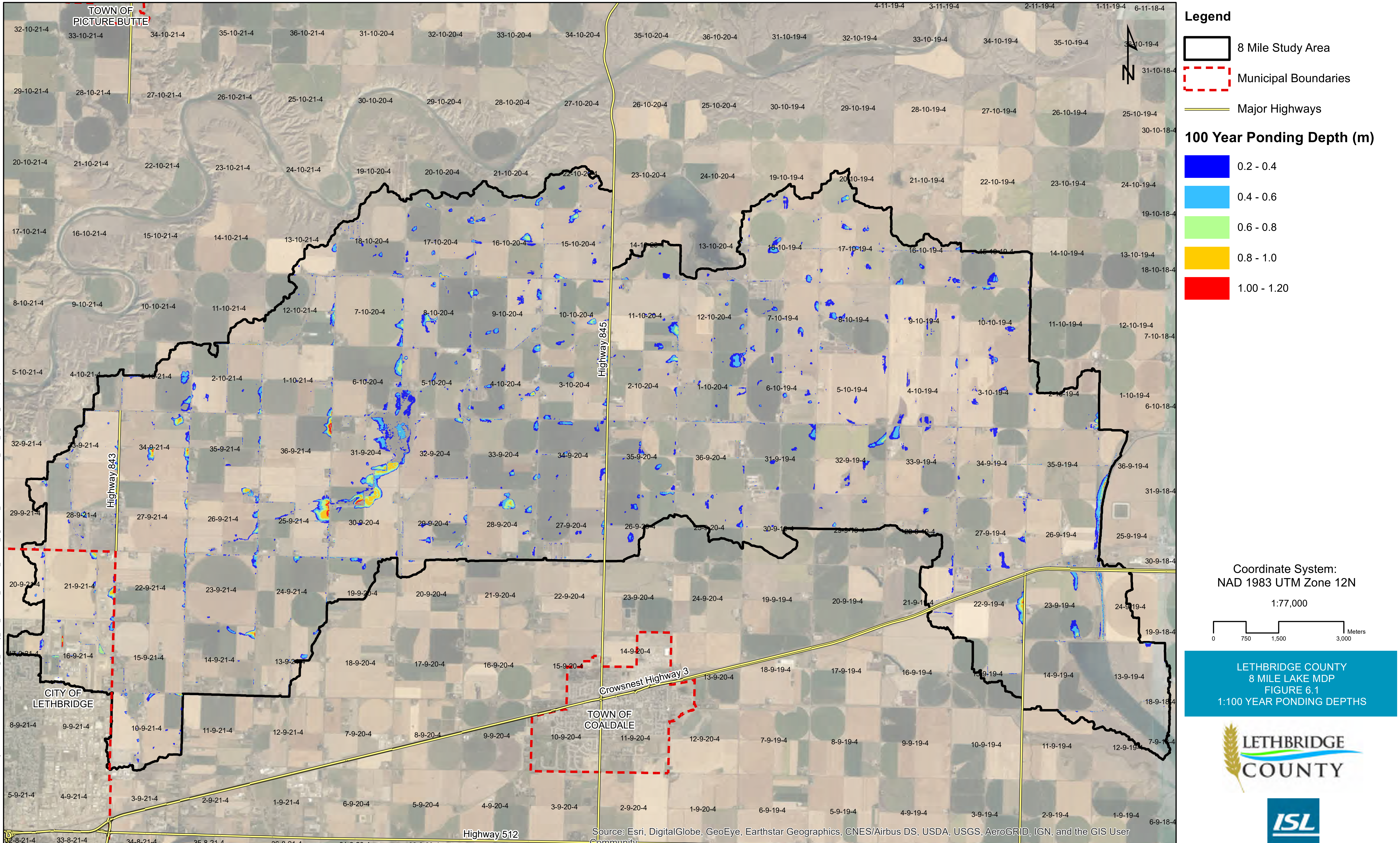
Table 6.3: Over Capacity Culverts

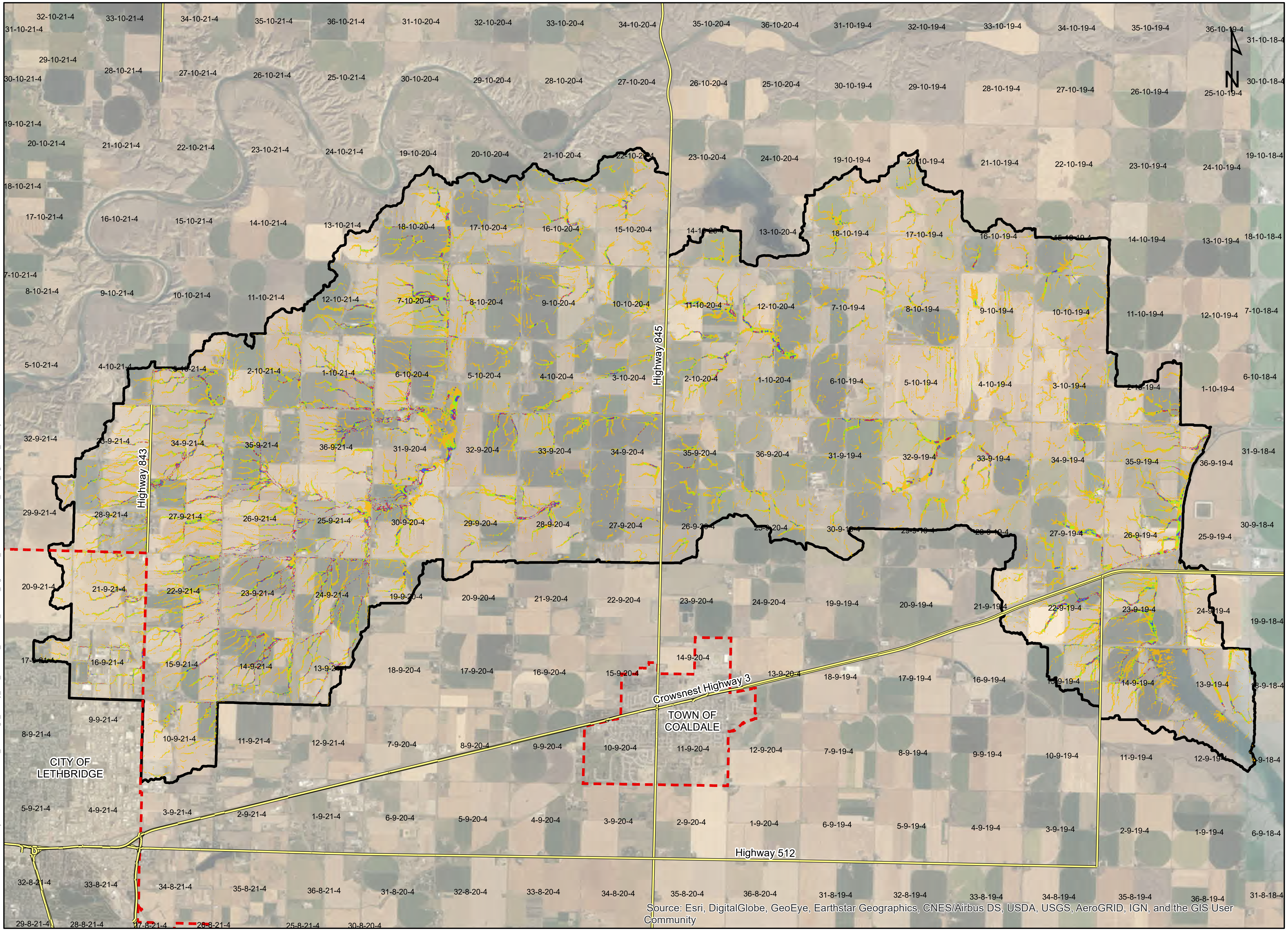
Culvert ID	Diameter (mm)	Capacity (m^3/s)	Max Depth (m)	Max Flow (m^3/s)	Ratio Headwater /Diameter	Remaining Capacity (%)	Upgrade Priority
CUL1	1500	1.276	0.08	0.000	0.05	100%	-
CUL2	500	0.072	0.07	0.004	0.15	95%	-
CUL3	1000	1.342	0.61	0.890	0.61	34%	-
CUL4	1000	0.503	0.11	0.011	0.11	98%	-
CUL5	600	0.211	0.36	0.162	0.60	23%	-
CUL6	**1000**	**1.408**	**1.18**	**2.071**	**1.18**	**-47%**	**1**
CUL7	500	0.134	0.19	0.051	0.39	62%	-
CUL8	**500**	**0.110**	**0.45**	**0.131**	**0.90**	**-19%**	**2**
CUL9	500	0.118	0.03	0.001	0.07	100%	-
CUL10	500	0.032	0.07	0.001	0.13	96%	-
CUL11	500	0.079	0.23	0.012	0.46	84%	-
CUL12	500	0.051	0.25	0.046	0.50	10%	-
CUL13	500	0.027	0.41	0.001	0.83	98%	-
CUL14	500	0.030	0.09	0.002	0.18	93%	-
CUL15	600	0.187	0.03	0.000	0.06	100%	-
CUL16	**500**	**0.076**	**0.41**	**0.115**	**0.82**	**-52%**	**1**
CUL17	500	0.061	0.04	0.000	0.07	99%	-
CUL18	500	0.116	0.04	0.001	0.09	99%	-
CUL19	500	0.042	0.13	0.004	0.25	89%	-
CUL20	700	0.101	0.22	0.034	0.32	66%	-
CUL21	500	0.121	0.28	0.067	0.56	45%	-
CUL22	**500**	**0.041**	**0.71**	**0.194**	**1.42**	**-373%**	**1**
CUL23	**400**	**0.077**	**1.43**	**0.156**	**3.58**	**-103%**	**1**
CUL24	900	0.430	0.05	0.001	0.06	100%	-
CUL25	400	0.057	0.03	0.000	0.07	100%	-
CUL26	**400**	**0.016**	**0.66**	**0.084**	**1.64**	**-422%**	**2**
CUL27	500	0.239	0.63	0.096	1.26	60%	-
CUL28	500	0.109	0.04	0.001	0.08	99%	-
CUL29	500	0.037	0.05	0.001	0.11	97%	-
CUL30	300	0.019	0.04	0.000	0.12	98%	-
CUL31	400	0.078	0.03	0.001	0.08	99%	-

Culvert ID	Diameter (mm)	Capacity (m^3/s)	Max Depth (m)	Max Flow (m^3/s)	Ratio Headwater /Diameter	Remaining Capacity (%)	Upgrade Priority
CUL32	2200	6.327	0.11	0.001	0.05	100%	-
CUL33	500	0.084	0.23	0.038	0.45	55%	-
CUL34	400	0.021	0.03	0.000	0.08	99%	-
CUL35	400	0.024	0.07	0.002	0.18	90%	-
CUL36	800	0.161	0.05	0.000	0.06	100%	-
CUL37	1200	0.489	0.42	0.026	0.35	95%	-
CUL38	500	0.051	0.05	0.001	0.10	98%	-
CUL39	**1500**	**1.733**	**0.96**	**2.140**	**0.64**	**-23%**	**2**
CUL40	500	0.136	0.04	0.001	0.08	99%	-
CUL41	2200	5.892	0.11	0.001	0.05	100%	-
CUL42	2200	4.180	0.11	0.001	0.05	100%	-
CUL43	1100	0.339	0.07	0.001	0.06	100%	-

6.2 Landowner Engagement

A virtual engagement session was carried out via a virtual open house tool to share key information and gather stakeholder and public feedback. The virtual open house tool provided participants with an interactive opportunity that simulates the experience of an in-person open house by using a 360º view of a meeting room with links to display boards, questions tool and online feedback tool. Overall, the engagement session was successful in identifying some landowner concerns. A detailed summary of the engagement feedback, initial responses from ISL, and high-level solutions is included in Appendix A.


Legend
8 Mile Study Area
Municipal Boundaries
Major Highways
100 Year Ponding Depth (m)
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1.0
1.00 - 1.20
Coordinate System:
NAD 1983 UTM Zone 12N
1:77,000
0 750 1,500 3,000 Meters
LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 6.1
1:100 YEAR PONDING DEPTHS
TOWN OF PICTURE BUTTE
CITY OF LETHBRIDGE
TOWN OF COALDALE
Highway 843
Highway 845
Crowsnest Highway 3
Highway 512
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Date: 2021-12-16



Legend

- 8 Mile Lake Study Area
- Municipal Boundaries
- Major Highways

Overland Flow Velocity (m/s)

- 0.000000 - 0.050000
- 0.050001 - 0.100000
- 0.100001 - 0.150000
- 0.150001 - 0.200000
- 0.200001 - 0.250000

Coordinate System:
NAD 1983 UTM Zone 12N

1:80,000

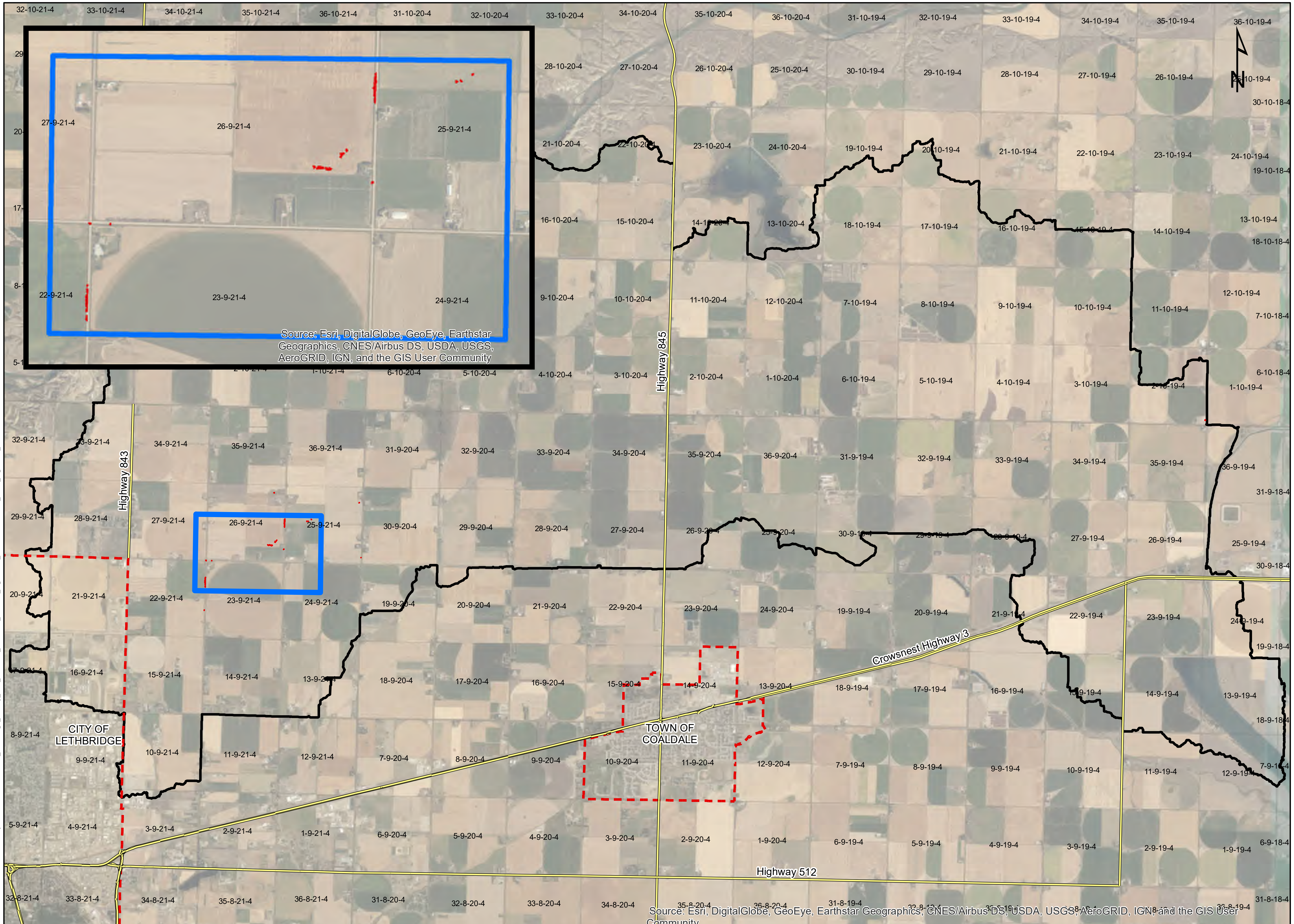
0 800 1,600 3,200 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 6.2
1:100 OVERLAND FLOW VELOCITY

LETHBRIDGE COUNTY

ISL

Date: 2021-12-16 Document: G:\Projects\27000\27300\27310_Lethbridge_County_Two_MDPs\02_CADD\25_GIS\251_Figures\09_MDPs\8Mile\27310_8Mile_Figure6.2_Velocity.mxd



Legend

- 8 Mile Study
- Municipal Boundaries
- Major Highways
- Depth Vs. Velocity Limits Exceeded
- Zoomed In

Coordinate System:
NAD 1983 UTM Zone 12N

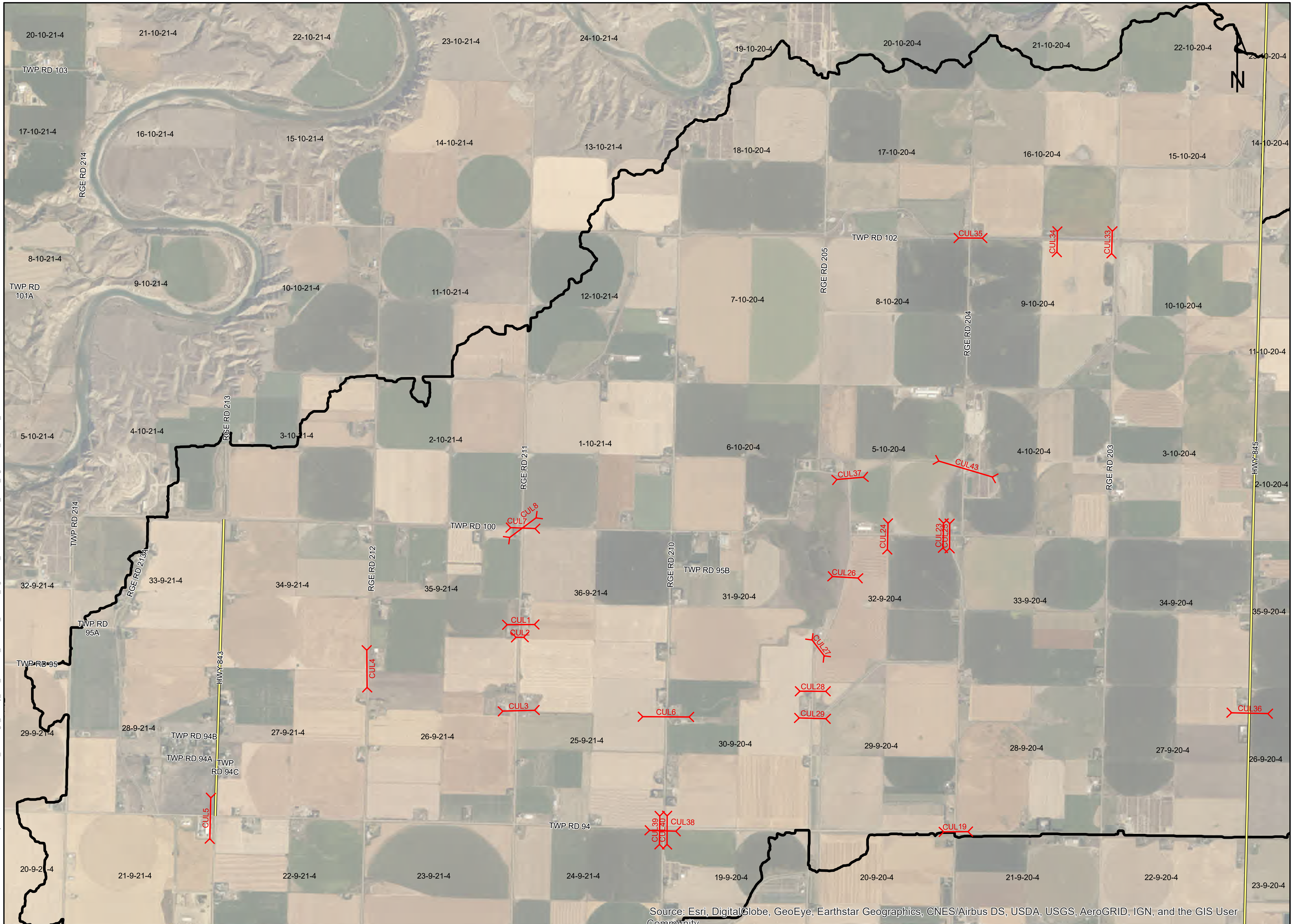
1:77,000

0 750 1,500 3,000 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 6.4
DEPTH VS. VELOCITY

LETHBRIDGE COUNTY

ISL



Legend

- 8 Mile Study Area
- Municipal Boundaries
- Major Highways
- Culvert

Coordinate System:
NAD 1983 UTM Zone 12N

1:40,000

0 400 800 1,600 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 6.5A
WEST CULVERTS

LETHBRIDGE COUNTY

ISL

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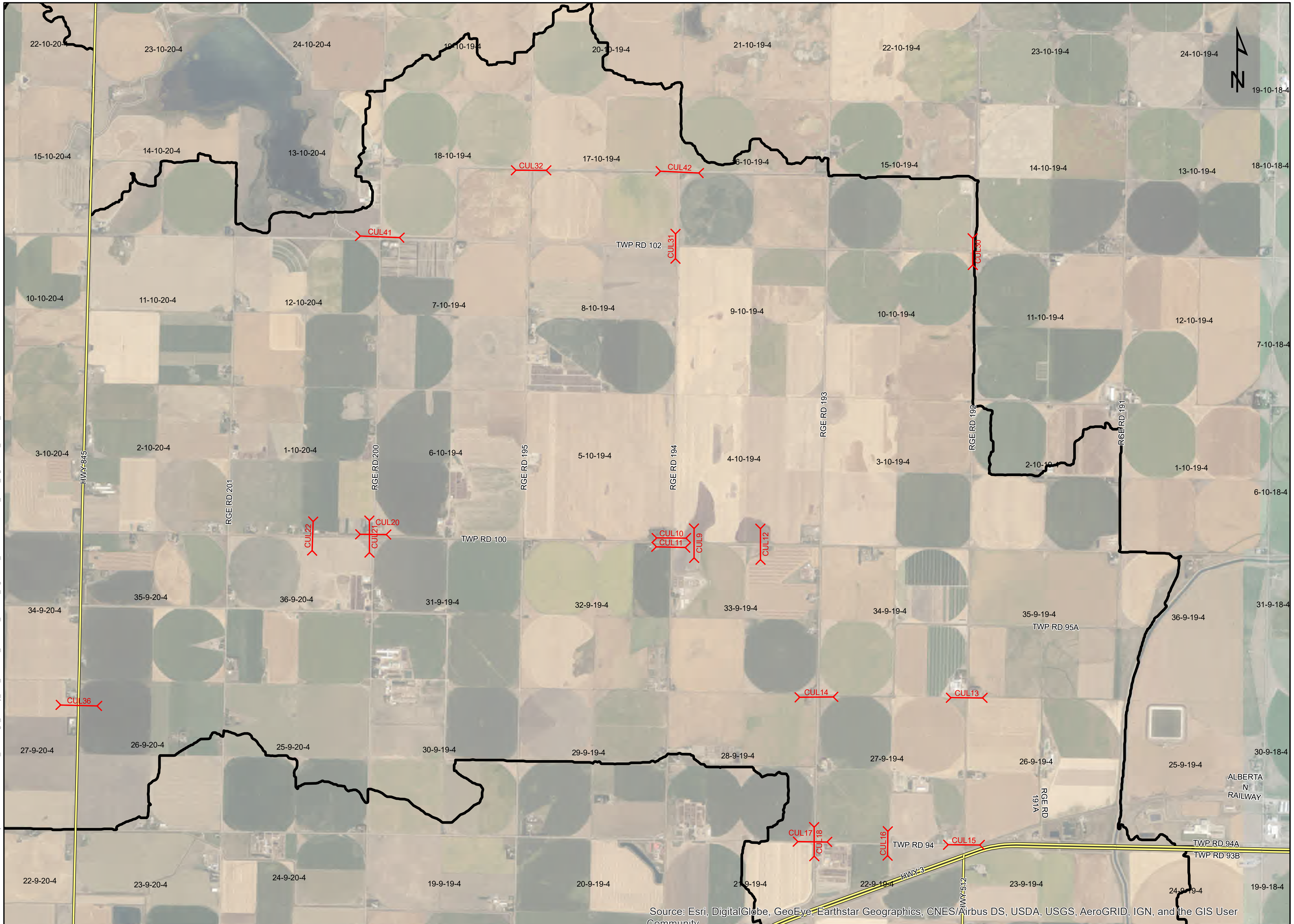

Legend

- 8 Mile Study Area
- Municipal Boundaries
- Major Highways
- Culvert

Coordinate System:
NAD 1983 UTM Zone 12N

1:40,000

0 400 800 1,600 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 6.5BB
EAST CULVERTS

LETHBRIDGE COUNTY

ISL

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Date: 2022-03-16

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7.0 Recommended Drainage Improvements

7.1 Proposed Improvement Concepts

Each of the hotspots identified in Section 6.0 were ranked in terms of priority. The below sections provide further detail for priority rankings and high level commentary on how these concerns are to be mitigated or monitored. Section 7.1.4 discusses some higher priority areas of concern that stuck out through the evaluation process ahead of all other areas and would require more complex solutions.

7.1.1 Depth Vs. Velocity Hotspots

There were 3 locations, as noted in Table 6.1 where depth vs. flow exceeded Alberta Environment criteria. Generally, the overland flow conditions in these areas could improve by increasing the cross section of the ditch and/or flattening out the slope of the ditch. A larger ditch cross sections would allow for peak runoffs to flow at a shallower depth, decreasing the velocity. Given the typography along roadway ditches, it is unlikely that slopes can be reduced while maintaining natural drainage but is considered on a case-by-case basis.

Priorities are for depth vs. velocity based on the following; priority 1 locations are where there are compounding issues such as high ponding depths combined with high depth vs. velocity criteria, undersized culverts, or were reported during consultations and require recommended mitigation; priority 2 are areas that could potentially impact buildings/houses but no feasible or cost effective solution is available and should be monitored post major rain events; priority 3 are all other areas that are identified under the given criteria but do not warrant any further action.

7.1.2 Ponding Up Against Roadways

Ponding issues can arise for various reasons, but in most cases is due to lack of culverts to convey overland flows under roadways or an existing culvert being undersized. There can also be instances where these areas are natural low points and there may not be a practical solution. In any case, solutions need to be considered in more detail case-by-case but can often be solved with local grading improvements and/or additions of culverts to promote positive drainage. Prior to completing any drainage works, downstream impacts must be considered in greater detail to ensure flooding issues are not passed on to other landowners. Section 7.1.4 details areas where ISL will recommend mitigation measures.

Priorities ponding depths are based on the following; priority 1 locations are where there are compounding issues such as high ponding depths combined with high depth vs. velocity criteria, undersized culverts, or were reported during consultations and require recommended mitigation; priority 2 are areas that could potentially impact buildings/houses but no feasible and/or cost effective solution is available and should be monitored post major rain events; priority 3 are all other areas that are identified under the given criteria but do not warrant any further action.

7.1.3 Culverts

Undersized culverts can lead to ponding issues upstream which in turn can result in excess sediment accumulation and have even greater impacts that that indicated in modeling. Generally, this can be solved with a culvert upsize, however each location must consider constraints in terms of available slope for the culvert dictated by the topography, cover relative to the roadway, depth of the roadway structure, and downstream impacts. In cases where culverts cannot be upsized, there are other options, such as twinning and or modifying the inlet to increase inlet capacity. Again prior to detailed design of any upgrades, the area should be reviewed in greater detail to determine the most optimal solution.

Priority 1 culverts are culverts that are undersized and are likely to be the reason for excessive ponding in the area and therefore immediate upgrades are recommended. Priority 2 culverts are culverts that are undersized, but not necessarily causing flooding concerns and should be monitored following major rain events. Proposed culvert upgrades were vetted through modeling to confirm no adverse impacts are created downstream.

7.1.4 Priority Drainage Issues

The following sections detail the priority drainage issues relative to modeling results and stakeholder engagement in addition to detailing the proposed mitigation.

8 Mile Lake Area

Significant feedback from landowners during the open house was directly related to the areas surrounding 8 Mile Lake. Significant ponding occurs upstream of, and adjacent to a drain canal that is no longer in use as demonstrated in Figure 7.1.

Since no longer in use by the SMRID, this drain canal could be converted for drainage purposes to improve flooding concerns in the area. This would involve coordination with the SMRID and possible transfer of ownership of the canal. Additionally, there appears to be several wetlands adjacent to the drain canal with no clear hydraulic connection which can lead to flooding of farmable land during major rain events, therefore it is also recommended to construct spillways from the wetlands to allow relief during flooding events. This would require a wetland delineation at the time of detailed design, by a qualified wetland ecologist, to determine spill elevations that would not impact the health of the wetlands.

In summary, the solution would require replacing the culvert crossing Range Road 210, grading improvements along the canal to provide positive drainage toward 8 Mile Lake, and installation of dedicated spill routes from the existing wetlands to the canal/ditch. The solution is visualized in Figure 7.2. See Section 7.2.2 for cost estimates.

Highway 843

A portion of Highway 843 along the City of Lethbridge limits to the NE experiences significant flooding along an approximately 3.2 km long section of the highway with the main concern being at one primary location as shown in Figure 7.3. The reason for choosing this location is due to the consistent ponding along this roadway, the likelihood of higher usage of this roadway due to its location relative to the City of Lethbridge, and that there is generally more businesses and residences along the road relative to other ponding hotspots.

The flooding seems to occur because of a discontinuation of the ditch and lack of culvert crossings to the north, which forces water to pool against the roadway and onto adjacent properties before potentially spilling across the road to the east. This issue could be solved through the installation of a culvert and ditch improvements along a small segment as shown in Figure 7.5. Note that the flooding shown in Figure 7.4 to the north was the result of 2 culverts missing from the model. Flows are expected to continue north along Highway 843. See Section 7.2.2 for cost estimates.

Township Road 94 at Range Road 204

Through the engagement process we were able to learn from a landowner that recent road improvements to Township Road 94, west of Range Road 204 has created increase runoff across the property directly to the north and has allegedly caused flooding of their land. Our modeling indicates this portion of the roadway does drain across their land and results also indicated a significant amount of flooding within the property as shown in Figure 7.5. Looking at the surface more closely indicated there is a break in the ditch on the north side of the road, forcing roadway drainage north instead of continuing through the ditch to the east toward a culvert crossing of Range Road 204. The recommendation for this area is to construct a continuous ditch east toward the culvert as shown in Figure 7.6. See Section 7.2.2 for cost estimates.

7.1.5 Overlapping Improvements With SMRID

Some of the drainage concerns and recommended improvement overlap with the SMRID, particularly the concerns and recommendations surrounding 8 Mile Lake and the drain canal no longer in use. It was discussed with the SMRID that this abandoned canal could be utilized for drainage relief. Additionally, SMRID will be provided an opportunity to review this draft report and offer feedback relative to any concerns noted by modeling results as it relates to their infrastructure. It is important to note that due to COVID19 impacts this Master Drainage Plan project schedule was extended. Over the time it took to finalize this report, the SMRID had already completed multiple upgrades to their network, which largely mitigated many existing drainage issues.

7.1.6 Overlapping Improvements with Alberta Transportation

In a consultation meeting with Alberta Transportation several drainage issues along AT highways were discussed at a high level. It was discussed that in general, AT prefers to resolve drainage issues in parallel with general highway maintenance, meaning if there are upgrades planned to existing roadways and there is a benefit to addressing drainage issues at the same time, they will do so. Like SMRID, AT will be provided an opportunity to review this draft report and offer feedback relative to any concerns noted by modeling results as it relates to their infrastructure.

7.2 Phasing

In terms of proposed upgrades for the identified areas of concern under existing conditions, it is recommended that phasing generally starts with the high priority drainage issues in Section 7.1.4 and the follows the priority level of the concern for culvert upgrades Identified in Table 6.3. That said, Priority 1 concerns should be dealt with first, followed by Priority 2. Priority 3 generally does not require any further action.

7.2.1 Capital planning

It is recommended that capital planning focus on the priority drainage issues discussed in Section 7.1.4. Additional planning should consider a program that tackles priority 1 culvert upgrades. The county should continue to monitor priority 2 culverts and add to capital planning as required. Each level of priorities should assume a detailed engineering and design cost at 15% of the estimated cost and a 20% contingency.

7.2.2 Opinion of Probable Cost

Table 7.1 below provides a summary of the probable project costs at the date of this report relative to the proposed mitigation measures. A more detailed breakdown of the solutions is provided in the sections below. Note that the construction industry has been hit with material delays, price spikes, and shortages in the last year. The County may want to apply an additional inflation factor to the probably costs outlined below at the time of capital planning.

Table 7.1: Summary of Probable Project Costs for Capital Planning

Description	Estimated Cost	Engineering Cost (15%)	Contingency (20%)	Total Cost
8 Mile Lake Improvements	$253,000	$37,950	$50,600	$341,550
Highway 843 Improvements	$75,000	$11,250	$15,000	$101,250
Township Road 94 and Range Road 204 Improvements	$50,000	$7,500	$10,000	$67,500
Priority 1 Culvert Replacements	$51,000	$7,650	$10,200	$68,850
Priority 2 Culvert Replacements (Optional)	$113,000	$16,950	$22,600	$152,550

8 Mile Lake Area

This cost estimate includes a culvert crossing of range road 210 upstream of the existing drain canal, regrading/reshaping of the drain canal, hydroseeding, wetland delineation, and construction of the wetland spillways.

Table 7.2: 8 Mile Lake Area Detailed Probable Cost Estimate

Activity	Estimated Quantity	Total Cost	Notes
Culvert Replacement	22m	$22,000	1200mm CSP
Ditch Construction	2.5km	$187,500	Assuming Net Cut/Fill
Ditch Hydroseeding	1.25ha	$10,000	5m Ditch Width
Wetland Delineation	1	$31,000	Includes All Wetlands
Spillway Construction	5	$2,500	3m Wide Trapezoidal Channel, 5m in Length
Total	-	$253,000	

Highway 843

This cost estimate includes general regrading and reshaping of the ditches and restorative works along the stretch of the highway, and a culvert crossing

Table 7.3: Highway 843 Detailed Probable Cost Estimate

Activity	Estimated Quantity	Total Cost	Notes
Culvert Replacement	60m	$21,000	600mm CSP
Ditch Construction	0.7km	$52,500	Assuming Net Cut/Fill
Ditch Hydroseeding	0.35ha	$3,000	5m Ditch Width
Total	-	$76,500	

TWP94 and RR204

This cost estimate includes general regrading and reshaping of the ditches and restorative works along the stretch of the highway.

Table 7.4: TWP84 and RR204 Detailed Probable Cost Estimate

Activity	Estimated Quantity	Total Cost	Notes
Ditch Construction	0.8km	$60,000	Assuming net cut/fill
Ditch Hydroseeding	0.4ha	$3,500	5m ditch width
Total	-	$63,500	

Culvert Replacements

Table 7.5 below provides cost estimates for each individual culvert. Total for Priority 1 culverts is $51,000, and total for priority 2 culvers is $113,000.

Table 7.5: Culvert Upgrades Probable Cost Estimate

Culvert ID	Existing Diameter (mm)	Proposed Diameter (mm)	Cost Estimate	Notes	Priority
CUL6	1000	1200	-	See 8 Mile Lake Mitigation	1
CUL8	500	600	$30,000		2
CUL16	500	700	$18,000		1
CUL22	500	700	$17,000		1
CUL23	400	600	$16,000		1
CUL26	400	700	$30,000		2
CUL39	1500	Twin 1000	$53,000	Assumes Slope Can be Increased	2

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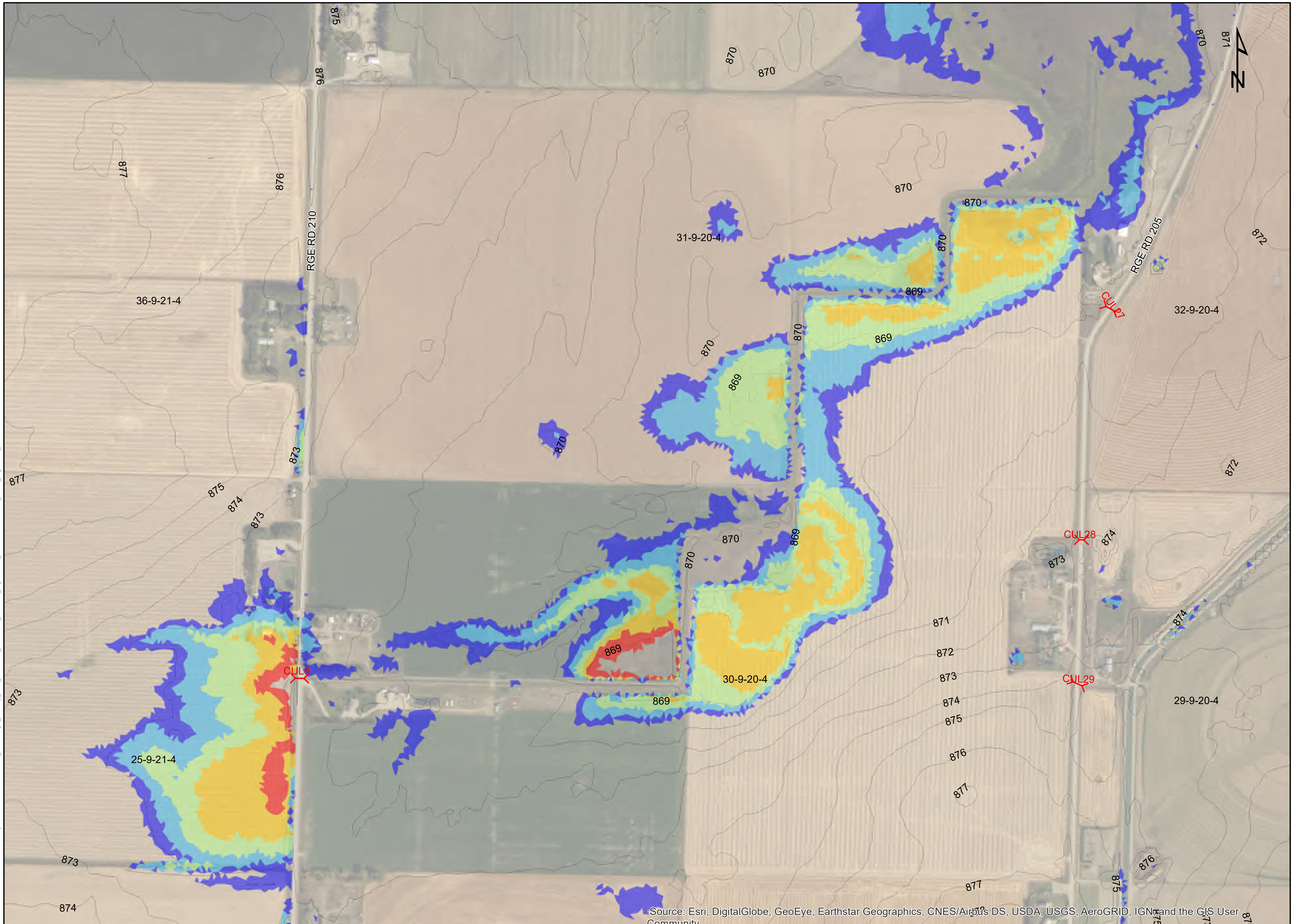

Legend

100 Year Ponding Depth (m)

- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.00 - 1.20
- Culvert
- Contours (1m)

Coordinate System:
NAD 1983 UTM Zone 12N

1:7,500

0 75 150 300 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 7.1
8 MILE LAKE AREA EXISTING CONDITIONS

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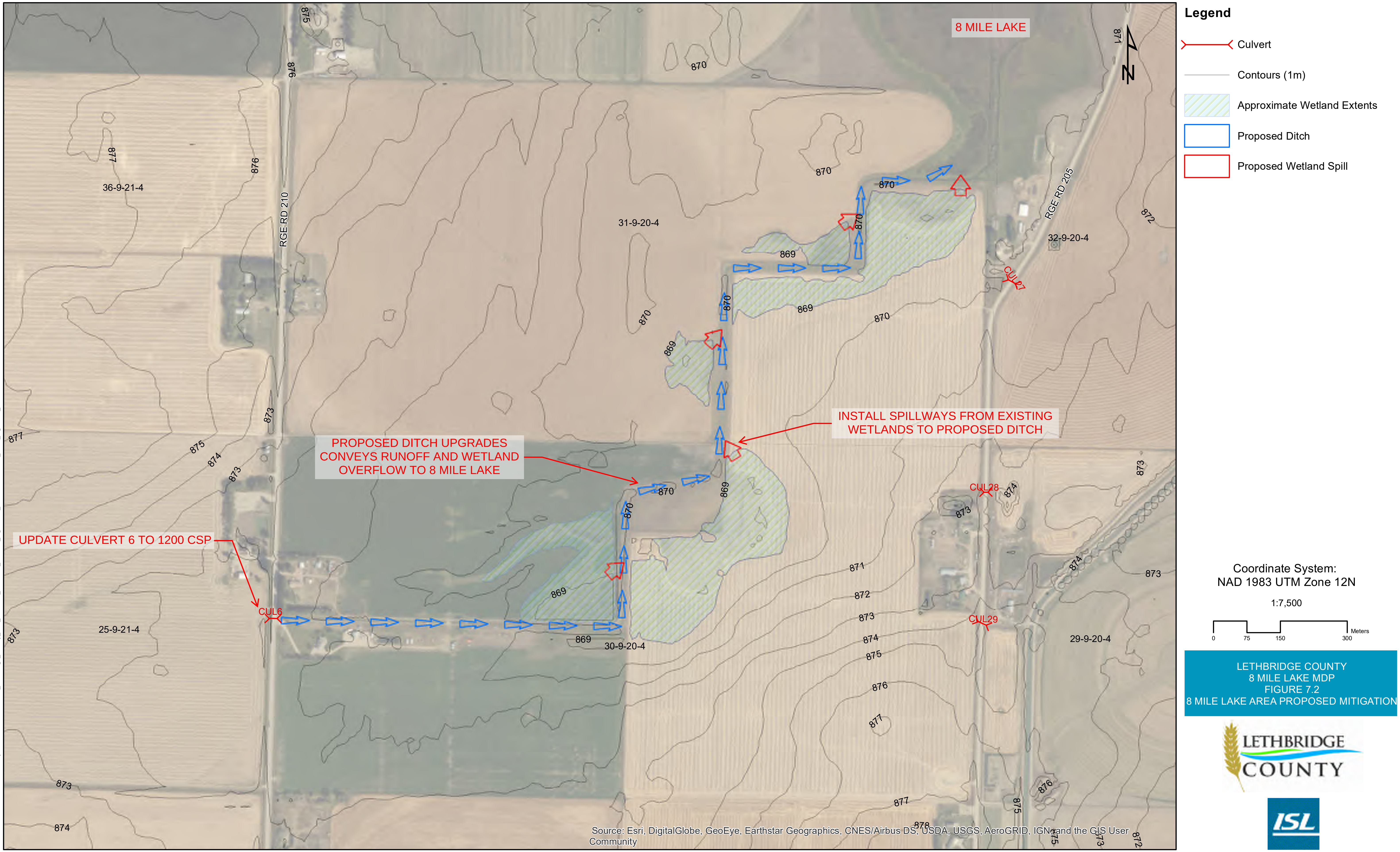

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 7.2
8 MILE LAKE AREA PROPOSED MITIGATION

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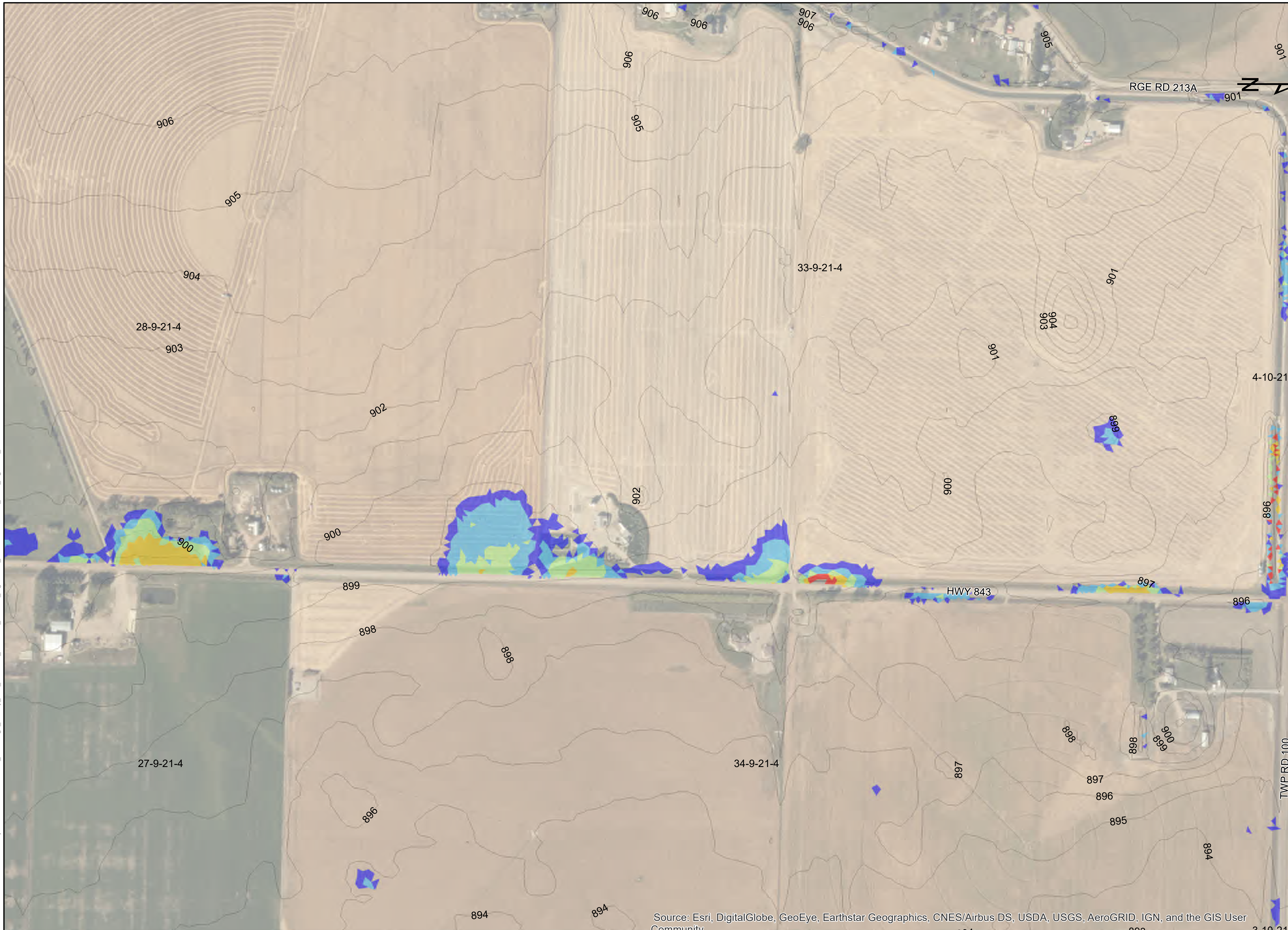

Legend

100 Year Ponding Depth (m)

- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.00 - 1.20
- Culvert
- Contours (1m)

Coordinate System:
NAD 1983 UTM Zone 12N

1:6,000

0 60 120 240 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 7.3
HIGHWAY 843 EXISTING CONDITIONS

LETHBRIDGE COUNTY

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Legend

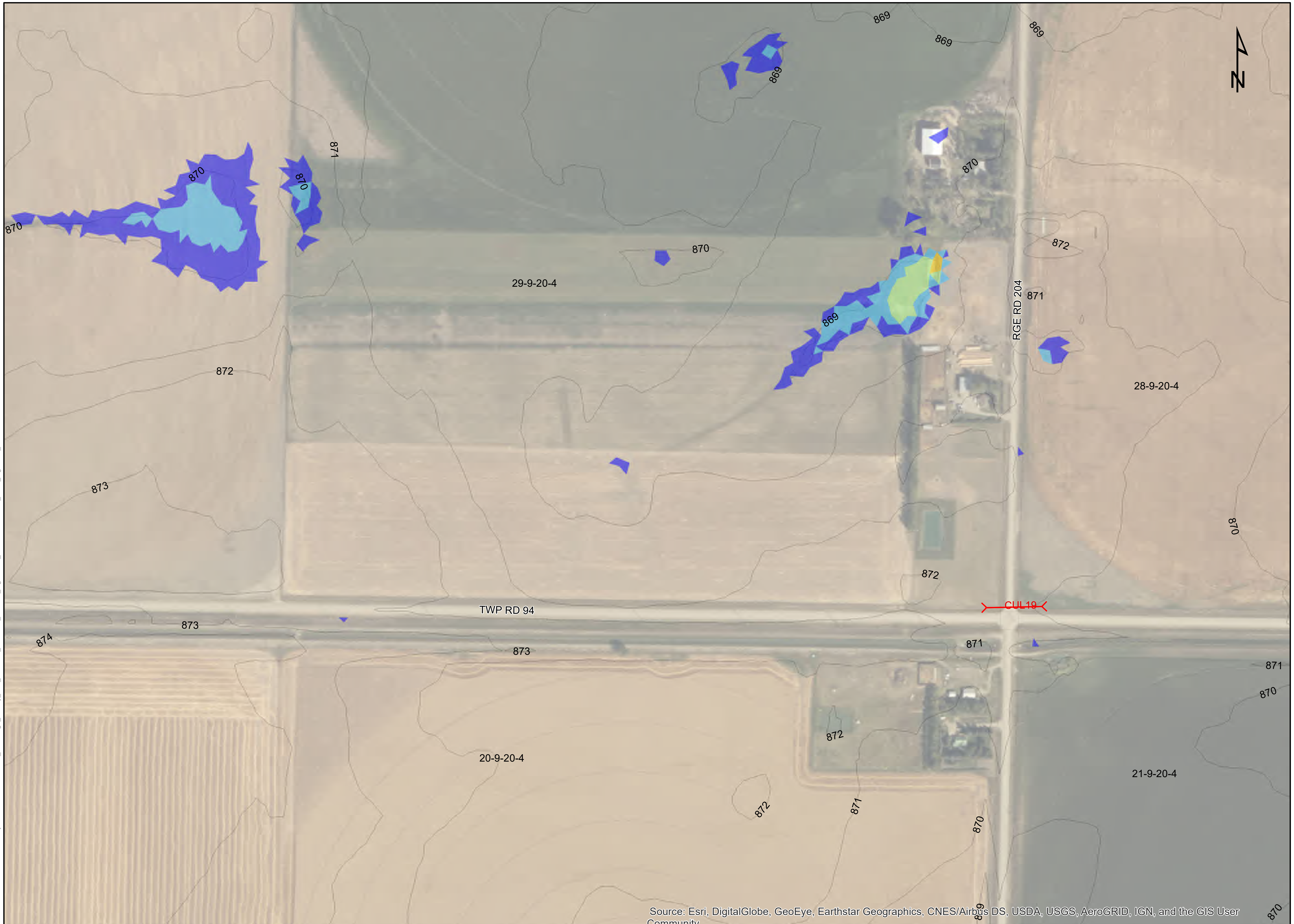
- Culvert
- Contours (1m)
- Proposed Culvert
- Proposed Ditch

Coordinate System:
NAD 1983 UTM Zone 12N

1:6,000

0 60 120 240 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 7.4
HIGHWAY 843 PROPOSED MITIGATION



Legend

100 Year Ponding Depth (m)

- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.00 - 1.20
- Culvert
- Contours (1m)

Coordinate System:
NAD 1983 UTM Zone 12N

1:4,000

0 40 80 160 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 7.5
TOWNSHIP ROAD 94
EXISTING CONDITIONS

LETHBRIDGE COUNTY

ISL

Integrated Expertise. Locally Delivered.

Legend

- Culvert
- Contours (1m)
- Proposed Ditch

Coordinate System:
NAD 1983 UTM Zone 12N

1:4,079

0 40 80 160 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
FIGURE 7.6
TOWNSHIP ROAD 94
PROPOSED MITIGATION

LETHBRIDGE COUNTY

ISL

8.0 Future Development Stormwater Guidelines

Future development within the 8 Mile Drainage Basin shall address stormwater management based on a no-net impact philosophy. This means matching existing peak runoff rates with post development runoff rates. This generally requires the use of stormwater management facilities and/or source control practices such as vegetated swales, absorbent landscapes, bioretention areas, permeable pavement, rainwater harvesting and re-use, green roofs or any other technology designed to reduce stormwater runoff. This section provides some general engineering design guidelines for post development runoff reduction solutions. This report shall act as a baseline for future development and shall be referenced to retrieve data for existing conditions. Models shall be provided to the County for reference and to be able to distribute existing condition information to future developers.

For future development and any Water Act applications, impacts are to be outlined within the context of existing ponding depths outlined in this MDP. Pre-development and “no-net increase” stormwater management design ideologies are to be compared to governing model results. Developers can deviate from the below guidelines and model results outlined in this report provided technical rational and stormwater modeling outlines how development deviates from the MDP but still achieves the intent of the design guidelines.

8.1 Design Guidelines for Future Stormwater Management Facilities

A set of design guidelines are required to govern the future stormwater conveyance management facilities in the Study Area. Numerous documents were reviewed to determine the recommended guidelines. These documents included the Stormwater Management Guidelines for the Province of Alberta (Alberta Environment, 1999), the Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems (Alberta Environment, 2006), the Stormwater Management & Design Manual (City of Calgary, 2011), and Engineering Guidelines & Minimum Servicing Standards (Lethbridge County, 2019). Recommended design guidelines for the stormwater management system include the following:

- **Stormwater Discharge Rates relative to model results demonstrated in this MDP:**
  - Post-development stormwater discharge velocities do not exceed the existing levels.
  - Maximum outlet rate to match existing conditions.

- **Stormwater Quality Controls:**
  - Minimum removal of 85% of particles 75 microns and larger on an annual basis as per Alberta Environment standards.

- **Stormwater Management Facility Design Guidelines:**
  - <u>Wet or Dry Ponds:</u>
    - Storage volume based on the greater of 1:100 year design storm or 1:100 year continuous simulation.
    - Continuous simulation is required for any SWM concept involving infiltration or evaporation methodologies.

* Maximum storage depth of 1.5m (dry) or 2.0m (wet).
* Permanent pool depth of 1.5m at minimum; 2.5m at maximum.
* Minimum pond area of 2.0ha at Normal Water Level (NWL)
* Maximum interior side slopes of 5:1 to 7:1 (H:V) within permanent pool, 5:1 between NWL and HWL and 4:1 to 5:1 above HWL.
* Minimum effective length to width ratio of 4:1 to 5:1
* Minimum freeboard of 0.15m (alternative is to increase freeboard)
* Overflow/overland escape route provided (alternative is to increase freeboard)
* Quality control provided – Generally done by the pond, but a forebay is strongly recommended. If additional quality control is required, an oil/grit separator can be included, normally upstream of the pond.

* Measures to mitigate erosion downstream of the pond must also be incorporated.
* Permeability of $1x10^{-8}$ m/s for clay or HDPE (Or equivalent) pond lining.
* Minimum nominal thickness of 0.6m for clay liners.

- <u>Constructed Wetlands:</u>
  * Storage volume based on the greater of 1:100 year design storm and 1:00 year continuous simulation.
  * Continuous simulation is required to provide the long term statistical HWL and NWL anticipated by the facility.
  * Maximum storage depth of 1.0m. This peak depth is to be achieved infrequently to ensure long term survival of wetland ecology.
  * Permanent pool depth of 1.0m at minimum; 2.0m at maximum (varying pool depth required).
  * Minimum pond area of 2.0ha at Normal Water Level (NWL)
  * Maximum interior side slopes of 5:1 to 7:1 (H:V) within permanent pool, 5:1 between NWL and HWL and 4:1 to 5:1 above HWL.
  * Minimum effective length to width ratio of 4:1 to 5:1
  * Minimum freeboard of 0.15m (alternative is to increase freeboard)
  * Overflow/overland escape route provided (alternative is to increase freeboard)
  * Quality control provided – Generally done by the pond, but a forebay is strongly recommended. If additional quality control is required, an oil/grit separator can be included, normally upstream of the facility.
  * Water permanency zones within the wetland identified based on the wetland elevation and modelled hydrologic regime. The hydro periodicity within each zone is critical for maintaining wetland vegetation and thereby wetland function
  * Wetland vegetation to be selected based on the appropriate ecological successional stage, hydrologic regime, the surrounding land use, individual species traits, wildlife habitat potential, provincial conservation status and origin (i.e., native).
  * All vegetation zones staked-out prior to planting, with planting occurring as soon as possible after the wetland cells have been constructed and under frost free conditions.

8.2 Source Control Best Management Practices

Source control best management practices (BMP) are becoming of increasing value in terms of stormwater management. A primary focus of these practices is sustainability in the form of pollution prevention strategies. These strategies involve the reduction of runoff volume and rate of flow as well as reduction of overall environmental impact in terms of water quality. Additional design guidelines should also be referenced from the City of Calgary's Stormwater Source Control Practices Handbook, as Lethbridge County, nor Lethbridge have source control BMP specific documents.

Evaporation Facilities

Description

Large stormwater management facilities could be designed to promote evaporation. These could either be wet or dry ponds with designs governed by continuous simulation to ensure that adequate volumes can be evaporated on an annual basis. To work properly, outlet rates must be virtually non-existent with at most an overflow provided for wet years.

Driving Forces

- Relatively simple facilities to design
- Eliminate up to virtually 100% of runoff volume
- Stormwater pollutants retained in the pond.
- Highly applicable to both residential and commercial/industrial areas.

Restraining Forces

- High amount of land required.
- Costly given the amount of land allocation required.
- Possible lack of evaporation in wet years causing problems in existing evaporation systems.

Synopsis

Evaporation facilities are very effective in limiting runoff, however they will require a significant amount of land in order to maximize surface area to allow for maximum effectiveness. As a result, they would work best in conjunction with other volume reduction methods. These facilities remove water that would otherwise ultimately reach rivers and stream, which could have a cumulative effect on the watershed as a whole. These facilities are larger are required to be much larger than conventional stormwater management facilities based on volume, to allow for full storage of 1:100 year runoff volumes with no outlet (and assuming no other practices for volume reduction exist). To ensure proper sizing of facilities detailed hydrologic and hydraulic modeling considering ambient air temperature and humidity would be required to properly estimate evaporation based on energy flux for evaporation (inclusion of humidity would allow for proper modeling in wet months). Models such as PCSWMM as well as DHI MIKE URBAN could incorporate this.

Preliminary design guidelines to this end would be:

- Active storage depth of 1.5m
- Grading details as noted previously.
- Surface area requirements of $1m^2$ for every $1m^2$ of impervious area as per County Standards.
- Hydraulic conductivity requirements for clay or plastic liner (HDPE) of less than 1x10-8 m/s.

- Clay liners must have a minimum nominal thickness of 0.6 m.
- Detailed long term hydraulic modelling is required to prove concept, including:
  - Up to 50 years of rainfall data is ideal, including snowpack.
  - Monthly evaporation data.
  - Statistical 1:100 year estimate of pond volumes from model results.

Stormwater Re-Use/Rainwater Harvesting

Description
Stormwater could be captured in stormwater management facilities and used for non-potable uses. Guidelines for household non-potable water usage are currently under development by Alberta Environment. This would potentially help address water supply issues in the area but would need to be assessed at the time of development as to whether suitable guidelines exist at that stage. Stormwater could certainly be used for irrigation.

Driving Forces

- Difficulty of obtaining water in Southern Alberta makes any solution that increases water supply very positive.
- Irrigation water could be readily used with minimal, if any, treatment.
- Potentially significant use of stormwater runoff.
- Stormwater pollutants retained by storage ponds.
- Highly applicable to both residential and commercial areas.

Restraining Forces

- Require storage facilities that are designed to ensure availability of water in dry years. Significant stormwater is available in wet years when it is not needed and often not enough is available in high demand dry years. Facilities would likely need to be larger than conventional stormwater management facilities to ensure security of supply.
- Guidelines for other uses (e.g. toilet flushing) generally not yet defined in Alberta.
- Irrigation users would not have demand during wet periods, thus resulting in significant amounts of runoff that must be stored.

Synopsis
Stormwater harvesting and re-use could work very well for the Study Area. For the purposes of this development, it is estimated that storage facilities would need to be larger than conventional stormwater management facilities based on volume, to allow for full storage of annual runoff flows in the statistically define “average” year (and assuming no other practices for volume reduction exist). This method of volume reduction is highly recommended for the Study Area and should be assessed in greater detail during pre-design of any development.

Bioswales/Vegetated Swales

Description
Stormwater is diverted into surface drainage swales that are vegetated. The net effect is like a combination of a grassed swale and an infiltration trench. Significant vegetation is planted to provide additional quality treatment. Ditch blocks are often installed to promote pollutant settling. Subdrains are often installed in soils with infiltration rates below 12.5mm/hr.

Driving Forces
- Provide a high amount of volume and rate control.
- Provide a high amount of stormwater pollutant control by retaining pollutants in the swales.
- Highly applicable to both residential and light commercial/industrial areas.
- Would reduce the size of stormwater management facilities downstream.

Restraining Forces
- Soils in the area may not be ideal, as a result, subdrains would likely be required but should be considered on a case-by-case basis.
- Relatively maintenance intensive (primarily to remove sediment).

Synopsis
Bioswales/vegetated swales could work very well for the Study Area but would require further review at the time of development. Geotechnical studies should be undertaken to determine suitability of infiltration techniques.

Bioretention Areas

Description
Stormwater is diverted into holding areas that allow for infiltration. Significant vegetation is planted in the area to provide additional quality treatment. Evaporation also contributes to volume reduction.

Driving Forces
- Provide a high amount of volume and rate control.
- Provide a high amount of stormwater pollutant control by retaining pollutants within the bioretention area.
- Highly applicable to both residential and light commercial areas.
- Can be used as on-lot stormwater control for commercial/residential areas.
- Would reduce the size of stormwater management facilities downstream.

Restraining Forces
- Soils in the area may not be ideal and as a result, design would carefully need to account for this.
- Relatively maintenance intensive (primarily to remove sediment).

Synopsis
Bioretention areas could work very well for the Study Area. They can be incorporated in boulevards etc. in the road network. This method of volume reduction would require further review at the time of development but could work well for the Study Area. Again, geotechnical studies should be undertaken to determine suitability of infiltration techniques.

Adsorbent Landscapes

Description
Stormwater runoff is reduced by promoting infiltration into the soil as runoff flows overland. This is often accomplished by designing for significant greenspace. Increased depth of topsoil and reduced soil compaction are also provided. This promoted infiltration and can allow the soil to work like a sponge to soak up stormwater.

Driving Forces

- Provide a high amount of volume and rate control.
- Highly applicable for light commercial areas.
- Somewhat applicable for residential areas.
- Would reduce the size of stormwater management facilities downstream.
- Minimal maintenance required.

Restraining Forces

- Do not provide much in the way of pollutant control.
- Tricky to enforce as homeowners/lot owners may modify property landscaping. This is the reason for its limited applicability in residential areas.
- Effectiveness severely reduced in wet years.

Synopsis
Absorbent landscapes could work well for the commercial/industrial areas planned within the Study Area. Given that it also does not provide much in the way of stormwater quality control, this method of volume reduction is not recommended as highly as others. It should, however, be considered for commercial/industrial areas given its strong applicability for application there as well as its limited maintenance.

Preliminary design guidelines to this end would be:

- Upstream flow should be distributed sheet flow, rather than a point source, with a maximum flow velocity of 0.9 m/s.
- Absorbent landscape areas should be either gently sloping with a grade less than or equal to 2% or act as a storage area with a maximum ponding time of 2 days.
- A minimum of 150 mm of organic compost should be introduced below 300mm of topsoil.
- Soil amendments to be used for stormwater management should be stable, mature compost from organic waste materials.
- Seasonally high groundwater table should be a minimum of 0.6 m to 0.9 m below the bottom of amended soils if filtered water is to be absorbed.

Permeable Pavement

Description

Stormwater runoff is reduced by promoting infiltration into pavement by providing a permeable surface. Stormwater is then either infiltrated into the underlying soil or diverted to a storage tank for later use in irrigation etc.

Driving Forces

- Works well for parking lots in commercial/industrial areas and residential back lanes.
- Provides a high amount of volume and rate control.
- Highly applicable for residential areas.
- Somewhat applicable for light commercial/industrial areas.
- Would reduce the size of stormwater management facilities downstream.
- Can be used as on-lot stormwater control for commercial/residential areas.

Restraining Forces

- Does not work well for higher traffic areas.
- Does not work well in areas with heavy truck traffic.
- Relatively expensive to install.
- More frequent long term maintenance

Synopsis

Permeable pavement could work well for parking lots in commercial/industrial areas and residential back lanes. These areas would, however, make up at most a small portion of the overall Study Area. Whilst this method could work reasonably well for on-lot systems for commercial/industrial areas, it would likely have only a nominal effect when considered in the bigger picture covering the entire Study Area. Accordingly, this method of volume reduction is recommended for on-lot use in commercial/industrial areas but would need to be integrated with other volume control methods in the broader context of the Study Area stormwater management system.

Preliminary design guidelines to this end would be:

- Infiltration rate of underlying soils should be greater than or equal to 12.5 mm/hr for full exfiltration.
- Seasonally high groundwater table should be a minimum of 0.6 m below the bottom of the pavement structure if filtered water is to be infiltrated.
- The bottom of the subbase should be a minimum of 0.9m above the bedrock level.
- A slop of 1-2% should be incorporated if the system is unable to infiltrate all runoff under winter conditions.
- Annual inspections should be completed in the spring along with vacuum removal of surface sediment.

Green Roofs

Description

Stormwater runoff is reduced by using vegetated roofs to reduce runoff. Stormwater is absorbed into soil and is then either evaporated naturally or collected by a subdrain system.

Driving Forces

- Works well for roofs for larger buildings (normally commercial/industrial).
- Provides a high amount of volume and rate control, particularly for small events.
- Highly applicable for light commercial/industrial areas.
- Would reduce the size of stormwater management facilities downstream.
- Can be used as on-lot stormwater control for commercial/residential areas.

Restraining Forces

- Not applicable for residential areas.
- Does not work well under larger rainfall events.
- Does not work well in the winter.

Synopsis

Green roofs could work well for commercial/industrial areas. Whilst this method could work reasonably well for on-lot systems for commercial/industrial areas, it would likely have only a nominal effect when considered in the bigger picture covering the entire Study Area. Accordingly, this method of volume reduction is recommended for on-lot use in commercial areas but would need to be integrated with other volume control methods in the broader context of the Study Area stormwater management system.

Most highly recommended would be a combination of stormwater re-use and/or evaporation facilities planned on a larger scale over the Study Area.

9.0 Conclusions and Recommendations

ISL was commissioned by the County to complete an MDP, including an assessment of the current drainage within the 8 Mile Lake drainage. The intent of this project is to provide The County a road map of existing infrastructure upgrades that are required to support capital planning.

The MDP was prepared to achieve the following objectives:

- Assess existing drainage conditions and pinpoint areas of concern;
- Analyzing existing natural drainage conveyance;
- Provide cost estimates related to required infrastructure upgrades, which will also provide inputs to capital planning;
- Comment on phasing of upgrades for the most effective implementation of The County's needs;
- Provide governing stormwater management guidelines for future development within the watershed; and
- Provide baseline stormwater modelling for the watershed to vet future development against within the context of pre-development and no-net impact.

9.1 Conclusions

The 8 Mile drainage system consists of entirely overland drainage (i.e., no underground piped system). A 2D model was constructed in InfoWorks ICM to assess the 8 Mile drainage system. The process that was used to generate the model is described in detail in Section 4.0. Design rainfall events produced from The County's IDF parameters were utilized to assess the major system using a 1:100 year 24-hour Chicago rainfall distribution.

Model results of the overland drainage system under the 1:100 year 24-hour Chicago design storm suggest that there are several locations throughout 8 Mile drainage basin that would experience surface flooding, exceed depths vs. velocity criteria. Additionally, several culverts were determined to be under capacity. Several notable areas of concern were flagged for further investigation and potential remediation measures.

9.2 Recommendations

Several recommendations were made based on the findings of this study. This includes the findings of the existing system assessment, and development of the proposed stormwater concept for priority areas. Additionally, 2 locations were flagged for immediate attention and culvert upgrades were prioritized into 2 categories.

For future development and any Water Act applications, impacts are to be outlined within the context of existing ponding depths outlined in this MDP. No generalized Water Act was obtained for the area due to the limited amount of proposed development, therefore developers are still required to obtain Water Acts as required, however this MDP forms the basis for existing conditions. Pre-development and "no-net increase" stormwater management design ideologies are to be compared to governing model results. Developers can deviate from the below guidelines and model results outlined in this report provided technical rational and stormwater modeling outlines how development deviates from the MDP but still achieves the intent of the design guidelines.

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10.0 References

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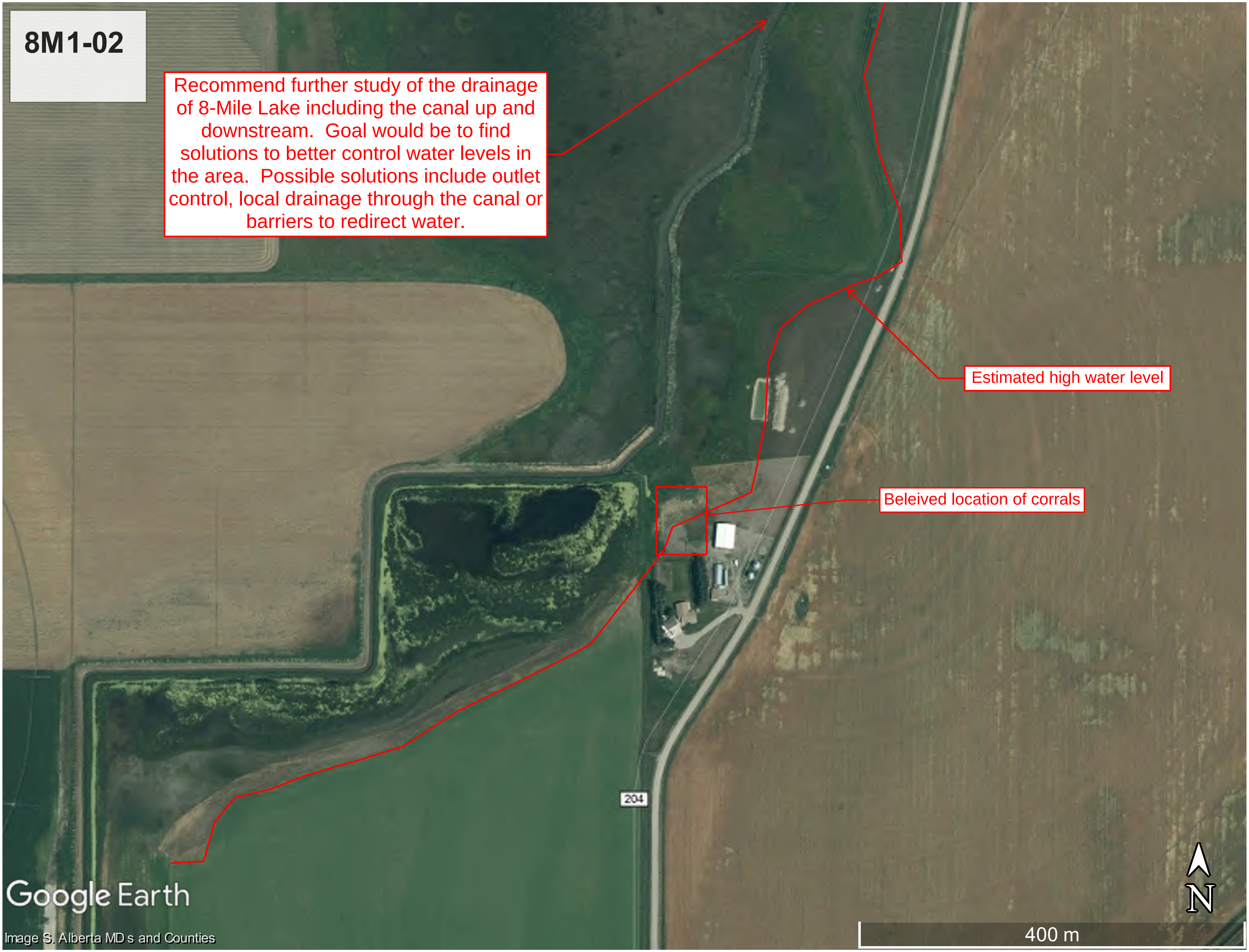
APPENDIX
Public Engagement Summaries

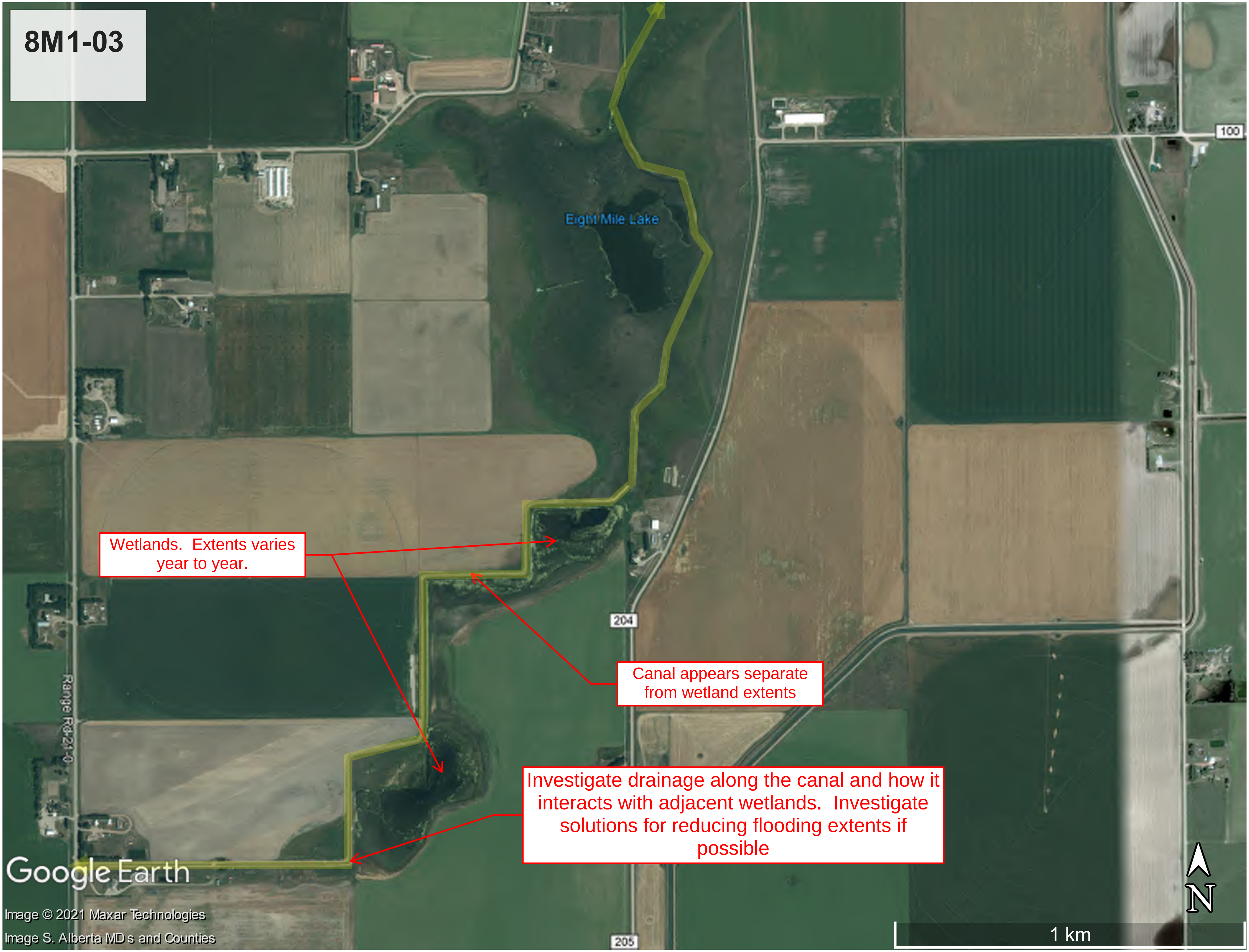
A

Feedback ID	Are there any significant flooding issues in the 8 Mile Lake study area that are not shown on our map? If so, please let us know where the flooding issues occur and provide details about the nature and frequency of the issue.	ISL Response/Comment	Figure (Y/N)	Concern related to: County (C), St. Mary's River Irrigation District (SMRID), or Wetlands (W)	High Level Solution
8M1-01	No (x3 responses)	No Action.	No	N/A	N/A
8M1-02	We live on the south end of 8 Mile Lake SW 32-09-20, It is a constant battle to keep water out of the corrals after moisture event.	Does not appear to be an overland drainage issue or a result of anything upstream. Could be due to high groundwater or high lake levels due to slow discharge. Property looks to be within the HWL extents of the lake and/or wetlands. The canal from Range Road 210 to Eight Mile Lake should be assessed further as several comments were related to this area.	Yes	AEP/C	Recommend considering modifications to the outlet of Eight Mile Lake to better control levels of the lake and upstream wetlands. Would require regulatory approvals and further study of contours in that area to determine the feasibility of this option.
8M1-03	We own the land SE 31-09-20 on the south side of the canal. The water is over 4 feet deep when the water overflows the canal on this property.	This area is within the extents of an existing wetland. Water levels fluctuate quite greatly year to year. It is unclear whether the canal contributes to this wetland or if they are hydraulically separated.	Yes	SMRID/AEP	Recommend considering modifications to the canal to improve drainage. Would need to investigate whether the Canal and the wetlands are hydraulically connected. Is the canal overflowing into the wetland or is the wetland overflowing into the canal?
8M1-04	Yes, the corner of 30-9-19 S.E. has flooded badly many times. I am getting water from neighbours fields too. G+H van de Bruinhorst Farms Ltd.	This area is commonly dry, however in 2014 formed a large ponding area. In other years the extent is visible which suggests it may be a wetland.	Yes	AEP	Natural condition, no mitigation recommended.
8M1-05	The map looks very accurate for the areas with which we are familiar, close by our place. We know 2-10-20-4 has a really low spot, and we know of some patches in the area that the map shows.	This area is commonly dry, however in 2014 there was significant ponding across the section which could indicate that larger less common events or accumulation of events would cause the ponding.	Yes	AEP	Natural condition, no mitigation recommended.
8M1-06	On the east side of E 1/2 of 26-9-19 there are perennial issues with flooding nearly every year. Highway drainage and smrid go down the ditch and it levels out and really floods the area. This ditch needs work.	Appears to be a ditch that parallels the canal to the west and does not have a proper outlet and stormwater has nowhere to go.	Yes	SMRID/C	Recommend assessing possible ditch modifications and a proper outlet to improve drainage along the canal.
8M1-07	Overall good. Should emphasize 1 in 10 also.	Noted.	No	N/A	N/A
8M1-08	The map does indicate a concern in SE 29-9-20-W4, when the map is blown up. This does indicate some concern (pale green = 0.6 - 0.8 and goldenrod 0.8 - 1.0) but the following is provided to enlighten you on the significance of the flooding, and the path that the water takes, due to a change made years ago by Lethbridge County to the east/west road allowance. The water that flows eastward in the ditch just south of Section 29 cannot continue eastward due to the rise in topography, and consistently cuts across SE-29 at a diagonal to the location indicated. Note that during their road improvement at that time, the County installed a small berm to hold the water here rather than the water continuing into LSD 4 where a home sits. Explanation at that time, when we were relatively new owners, was that 'it was not a big problem/not much water'. The problem is that there is no easy way to remove this captured water. We originally dug a small capture dugout at our expense to reduce the effects of the spread of water onto our cultivated acres there, but this, more often than not, is not large enough, as proven almost every 2nd year. Our most recent inquiry in 2018/2019 indicated the cost to enlarge this dugout is incredibly high if performed by an excavation company. Perhaps the county should and could incur this cost. If the water capture was controlled into this larger holding dugout, we would then be able to utilize this water as part of our irrigation of LSD's 1 and 2. Otherwise, and currently, it is frustrating and labor intensive to remove this water and use the land as intended. This year, we had to pump this out, and back onto our field, on two occasions. The previous time, the water was so high that it was over the berm, plus over the top of the fence posts in the fence surrounding the dugout. This problem is happening more often - perhaps due to more work by some to level their fields to force water off or perhaps with weather/climate changes.	Suggest ISL confirm road upgrades with the county. There does appear to be a diagonal ditch across the property but not connected to road drainage. Field visit could be warranted in the future to assess these claims.	Yes	AT/C	Recommend a more thorough assessment of highway drainage in this area. Possible ditch improvements or additional storage could mitigate this issue. Would need to confirm previous construction by the county.
8M1-09	We live adjacent to the west of 8 Mile lake. First property to the south. Ponding on the map looks correct. Flooding has occurred probably 3-4 times over the 20 years we have been living here. For example, last year there would have been standing water from the lake then west onto our property. A depth of 1 foot to a depth of about an inch 150 feet in on our land. If you look at your aerials or google maps, the point that the water reached was the last row on the east side of the orchard. The worst case of flooding was (? not sure when - maybe 8 years ago) & we had standing water 225 feet beyond the east edge of the orchard. Depth of water on the western edge was significant - maybe 2 feet.	Extents of this lake very greatly year to year and it seems highly likely that many dry years could be followed by a wet year that greatly expands the extents of the lake.	Yes	AEP/C	See 8M1-02
8M1-10	No other areas as long as no pumping is enforced with neighbors	Noted. No Action.	No	N/A	N/A
8M1-11	On the property line of the NW34-9-19W4 and SW34-9–19W4 this area floods. The Northwest corner of the NW 3-10-19W4 flooded area is large than indicated on the map since the county installed the culvert under the road.	ISL to confirm culvert installation with the County. This area looks to have several seasonal wetlands.	Yes	AT/C	Recommend assess road drainage through these quarter sections. Appears to be a low lying area, unclear if drainage could be improved to take water away.
8M1-12	None that we are aware of	Noted. No Action.	No	N/A	N/A
8M1-13	Glen Parker south half NW 30 T9 R20 w of 4th, 94061 RR 210. The water comes over the south bank of the drain ditch onto my property with heavy rain or fast melting. It also threatens my house and buildings when it comes over the highway and floods my fields and pastures.	The canal north of the property, which drains to 8 mile lake, doesn't appear to have great drainage. Several Comments related to this area and the canal.	Yes	SMRID	Recommend assessing the feasibility of drainage improvements along the canal. Also see 8M1-02

8M1-14	am located on the south half NW 30 T9 R20 W of 4th. 94061 RR 210. the ne corner of my property floods every time we have heavy rain or a fast melt of snow. It also comes over the highway and over my property. I have many pictures available. not able to view a close view of your map.	See 8M1-13	No	SMRID	See 8M1-13
8M1-15	Not in our area. The map is accurate.	Noted. No Action.	No	N/A	N/A
8M1-16	On SW-12-10-20, the SE quadrant fills up entirely, drowning approx. 40 ac of crop. This water comes from across the gravel road from the east (SE-11-20-20) through a culvert approx. 1/2 mile from the south boundary. It then flows across SW-12-10-20, and ponds in the SE corner. Additional water from NE & NW-11-10-20 flows south into SE-11-10-20 which brings more water into SW-12. Occasionally, SW-12 also receives water from NW-1-10-20. NE-35-10-20 gets the runoff from NW-35-9-20 and fills up the SW dry corner of NE-35, which is ok, UNTIL we have lots of water, and then it floods out close to 70 ac of NE-35. What is shown on the map as 'Existing Ponding' does look correct in our farming area. See image below.	This description seems consistent with contours/aerials/etc. No Action.	No	N/A	N/A
8M1-17a	We own the land on the south end of 8 mile lake (Cam and Louise Bridgeman) and we own the land west of it on the south side of the canal (Short Tail Ranch)	Seems like the same problem as 8M1-02. See 8M1-02	No	C	See 8M1-02
8M1-17b	The water backed up into the corrals and took a long time to drain out of the lake as the discharge is slow				
8M1-17c	We had 15 acres of crop land under water which was over 4 feet deep from the runoff overflowing the canal				

Feedback ID	Are the ponding levels shown in the 8 Mile Lake study area consistent with your experience?	ISL Response/Comment	Figure (Y/N)	Concern related to: County (C), Irrigation Districts (ID), or Wetlands (W)	High Level Solution
8M2-01	Yes (x8 responses)	Noted. No Action.	No	N/A	N/A
8M2-02	Not exactly. Water was over my sprinkler mover frame - 5' wheels, and that was not at the deepest part. Map shows 0.4 to 0.6m and I would say it's at least 1 metre. It is critical that the borrow pit along WW 21-1 stays open - not full of drift soil.	Not descriptive enough, not sure where this is. No Action.	No	N/A	N/A
8M2-03	Ponding is an understatement.	Noted. No Action.	No	N/A	N/A
8M2-04	The "lake" that is formed on SE 31-09-20 covers 10 to 15 acres and is 4 to 5 feet deep.	The "lake" is a wetland with varying extents year to year.	Yes	AEP/C	See 8M1-02
8M2-05	Yes. We are at 1-10-20-4 (Hofsink). We have one area in our field that is low- along the eastern border of our land. We try to manage it by plugging sprinklers, and that works somewhat. However, the weak spot is clearly visible on Google Maps.	There are a number of wetlands on this property consistent with this comment.	Yes	AEP	Natural condition, no mitigation recommended.
8M2-06	Yes. But unlike 1 in 100-year event the 26-9-19 along the main canal floods regularly.	See 8M1-06	No	SMRID/C	See 8M1-06
8M2-07	Overall, yes.	Noted. No Action.	No	N/A	N/A
8M2-08	I live in the area and most farmers take care of small water pockets themselves your water pockets on map I wonder were you even came up with some are on land I own and cant remember last time I've seen that	Due to the flat terrain there are many wetlands throughout this area that will vary in depth and extent year to year. No Action.	No	AEP	Natural condition, no mitigation recommended.
8M2-09	See above. Water levels are gaining intensity each year that flooding occurs.	Due to the flat terrain there are many wetlands throughout this area that will vary in depth and extent year to year. No Action.	No	AEP	Natural condition, no mitigation recommended.
8M2-10	I would say the ponding levels are quite consistent with my experience. That being said the flooding on my property NE 33-09-19-W4 is experiencing an increased amount of flooding in the past number of years due to neighboring landowners sculpting there land.	Difficult to comment on effects of grading on adjacent land, however historically this area has flooded at times. Feedback 8M1-11 is referring to the same ponding and suggested it was due to a culvert the county installed.	Yes	AEP	Natural condition, no mitigation recommended.
8M2-11	Yes. Another point that I expect you are already aware of is the pipeline project that SMRID has undertaken. They will be eliminating the supply canal that drains into the south west corner of the lake. This will drastically reduce the inflow of excess irrigation water. Once the grading of the canal is removed, that will also reduce the effect of drainage from the larger storm water basin. The lake level have been higher the past few years. It has also taken longer at the end of the irrigation season for the lake level to drop. This is a result of maintenance on a drainage canal that leaves the lake to the north east. The canal provides for a controlled release from the lake. The growth of grass in the canal has reduced the rate of outflow. In talking to the people that lived here in the early 60's, that the lake would often flood right up to the barn in the spring. I expect that was rectified by adding the outflow canal	To consult with SMRID on recent work/plans.	No	SMRID	See 8M1-02
8M2-12	Yes, as shown on the map, my farmland at NE1/4 -1-10-20-4 has significant annual flooding. If the County has a way to resolve this issue, it would be greatly appreciated. Thanks, John Leusink	There is a wetland located to the NE of this section. No further action suggested	Yes	AEP	Natural condition, no mitigation recommended.
8M2-13	Yes as shown on the map my farmland at NE1/4 of 1-10-20-4 has flooding issues most years. It would be greatly appreciated if the county would be able to rectify this issue.	See 8M1-13	No	AEP	Natural condition, no mitigation recommended.
8M2-14	For the most part, but can be higher at the corner of 94 and Sunnyside Road	Noted. No Action.	No	N/A	N/A
8M2-15	The northwest corner of the NW3-10-19w4 covers a larger area than indicated since county put culvert under the road	Confirm with county, but this parcel is covered in wetlands and this could be coincidental.	Yes	C	Recommend confirming the location of culvert and assessing if there could have been adverse impacts due to the mentioned new culvert placed by the County.


8M1-02
Recommend further study of the drainage of 8-Mile Lake including the canal up and downstream. Goal would be to find solutions to better control water levels in the area. Possible solutions include outlet control, local drainage through the canal or barriers to redirect water.
Estimated high water level
Beleived location of corrals
204
Google Earth
Image S. Alberta MD s and Counties
N
400 m

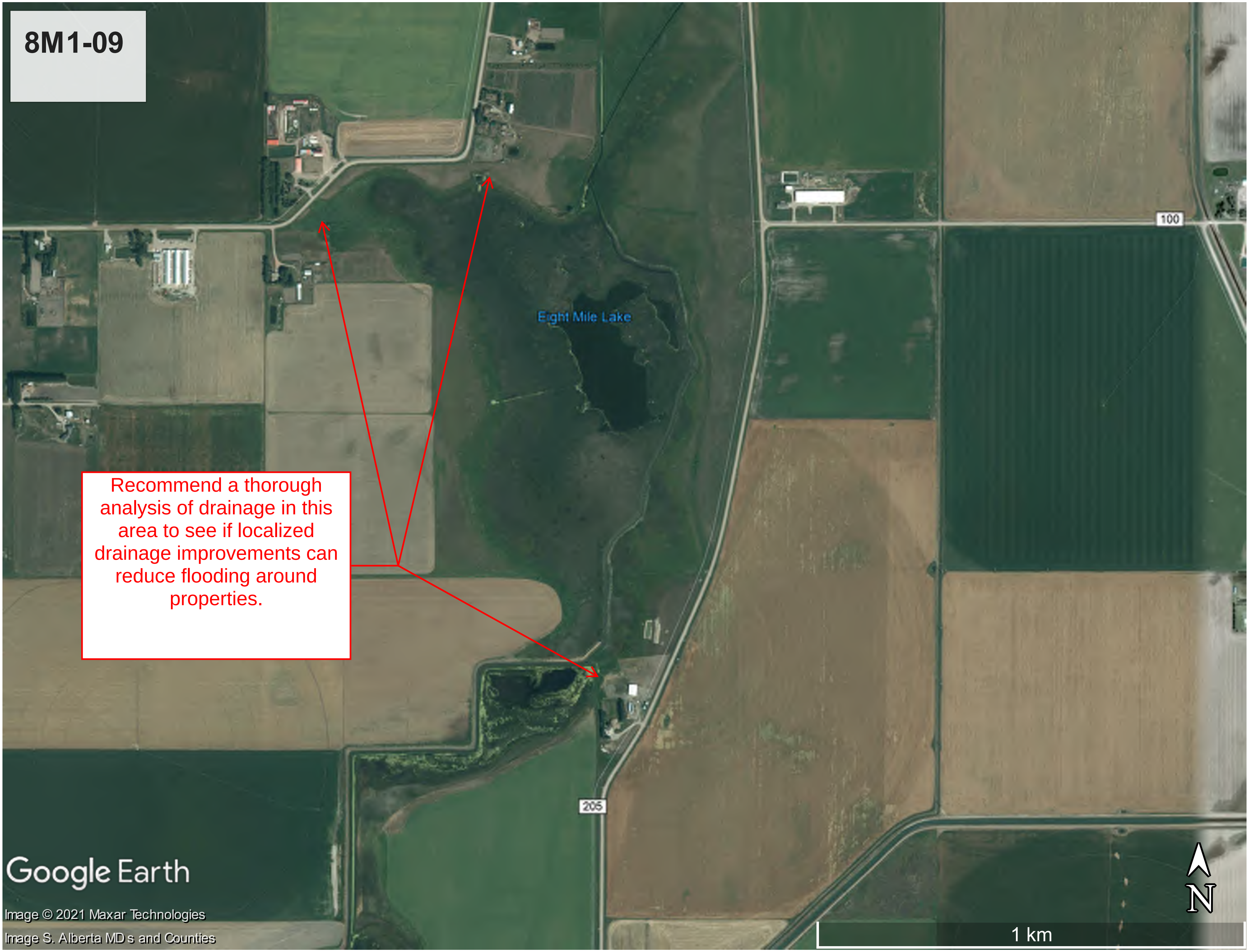

8M1-03
Eight Mile Lake
Wetlands. Extents varies year to year.
Canal appears separate from wetland extents
Investigate drainage along the canal and how it interacts with adjacent wetlands. Investigate solutions for reducing flooding extents if possible
100
204
205
Range Rd 21-0
Google Earth
Image © 2021 Maxar Technologies
Image S. Alberta MD s and Counties
N
1 km


8M1-04
Dry in most aerial photos but still visible, suggesting that it is a wetland. Natural condition, no mitigation recommended.
204
Google Earth
Image © 2021 Maxar Technologies
Image S. Alberta MD s and Counties
94
N
500 m


8M1-05
Commonly dry, but very wet in this specific year (2014), suggesting these are natural occurring wetlands, no mitigation recommended.
845
201
Google Earth
Image © 2021 Maxar Technologies
700 m
N


8M1-06
Ditch separate from canal but does not appear to outlet anywhere. Recommend closer look at localized drainage and ensuring the ditch has a proper outlet.
190
191
3
Crowsnest Hwy
Railway Ave S
Chin
Google Earth
Image © 2021 Maxar Technologies
1 km
N


8M1-08
This may be the dugout that is overflowing?
Ditch appears to end. Recommend looking closer at local drainage in this area.
204
94
It was suggeasted that road upgrades created drainage across this property.
Google Earth
Image © 2021 Maxar Technologies
N
400 m

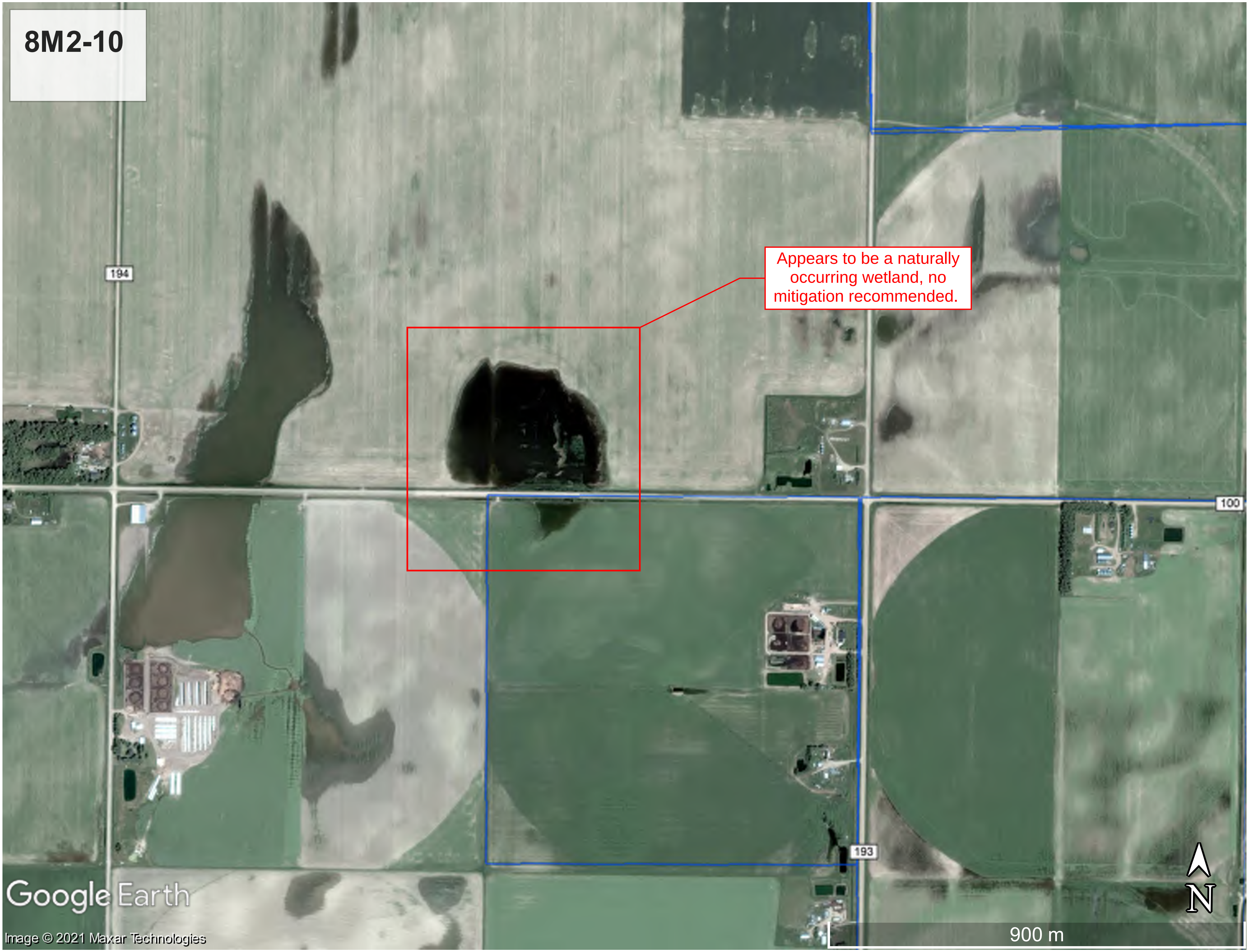

8M1-09
Eight Mile Lake
Recommend a thorough analysis of drainage in this area to see if localized drainage improvements can reduce flooding around properties.
100
205
Google Earth
Image © 2021 Maxar Technologies
Image S. Alberta MD s and Counties
N
1 km

8M1-11
Location where it was suggested the County installed a culvert. County to confirm? Suggest if localized improvements could be made to take drainage to the canal.
This appears to be a wetland. Natural condition, no mitigation recommended.
100
191
194
193
192
Google Earth
Image © 2021 Maxar Technologies
2 km
N

8M1-13
Appears to be poor drainage through this canal. Recommend further study to see if any localized drainage improvements could be made.
Range Rd 210
210
Google Earth
Image S. Alberta MD s and Counties
300 m
N

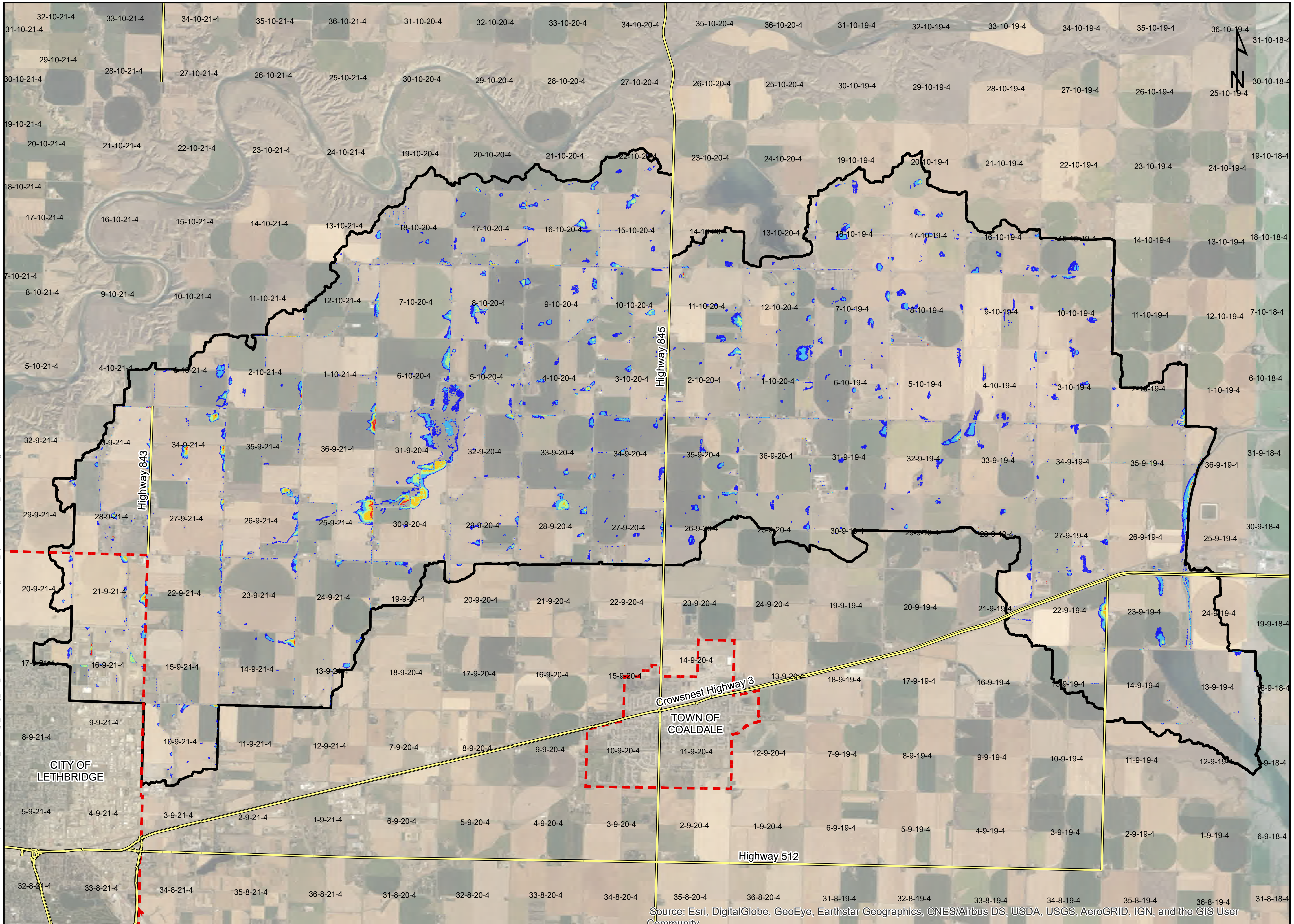

8M2-04
204
Google Earth
Image S. Alberta MD s and Counties
500 m
N


8M2-05
Wetlands in the area. Natural condition, no mitigation recommended.
201
200
100
Google Earth
Image © 2021 Maxar Technologies
800 m
N


8M2-10
Appears to be a naturally occurring wetland, no mitigation recommended.
194
100
193
Google Earth
Image © 2021 Maxar Technologies
N
900 m

8M2-12
Appears to be a naturally occurring wetland, no mitigation recommended.
200
Google Earth
Image © 2021 Maxar Technologies
700 m
N


8M2-15
Canal downstream
Location where it was suggested the County installed a culvert. County to confirm? Suggest if localized improvements could be made to take drainage to the canal.
193
Google Earth
Image © 2021 Maxar Technologies
N
500 m



Legend

- 8 Mile Study Area
- Municipal Boundaries
- Major Highways

100 Year Ponding Depth (m)

- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.00 - 1.20

Coordinate System:
NAD 1983 UTM Zone 12N

1:80,000

0 800 1,600 3,200 Meters

LETHBRIDGE COUNTY
8 MILE LAKE MDP
OPEN HOUSE
PONDING AREAS

LETHBRIDGE COUNTY

ISL

Integrated Expertise. Locally Delivered.