



Miistakis  
Institute

# Least Conflict Lands

Municipal Decision Support  
Tool for Siting Renewable  
Energy Development

Tracy Lee, Kelly Learned and  
Ken Sanderson

PHOTO: SARAH SCHUMACHER

**Municipal Decision Support Tool for  
Siting Renewable Energy Development**

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Sincerely, the Miistakis Project Team:

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# Executive Summary

Alberta is investing in renewables as a key strategy to reduce greenhouse gas emissions. Alberta's Climate Leadership Plan aims to generate 30% of electricity from renewable sources by 2030. A key challenge is to manage land use issues associated with the rapid growth in energy projects in the province. Many land use impacts can be addressed through proper siting and avoidance of areas important to ecology, agriculture or culture and scenic resources. A key lesson from other jurisdictions supporting renewable energy development is the importance of siting renewable energy development to reduce impacts to other land uses.

The Miistakis Institute partnered with the County of Newell and Wheatland County to develop a least conflict lands decision support tool to inform planning of renewable energy development. This process and decision support tool was modeled after the Least Conflict Lands for Solar PV development in the San Joaquin Valley of California developed by Conservation Biology Institute, UC Berkeley School of Law, and Terrell Watt Planning Consultants.

In the County of Newell and Wheatland County this process aimed to identify areas for utility scale wind and solar developments while avoiding important agriculture, ecology and cultural and scenic resources at a municipal scale. The process was completed in six months, engaged

37 stakeholders including representatives from municipal staff and council, provincial government, irrigation districts and NGO's. The process resulted in a series of spatial models that identified high value agriculture, ecology and cultural and scenic resources. In addition, industry identified opportunity areas for wind and solar development. The resulting spatial models identify areas of lowest ecology, agriculture and culture and scenic values that represent the best opportunity areas for wind and solar development.

This results of this process are non-regulatory, and do not necessarily represent the individual views of stakeholders presence or the participating councilors.



PHOTO: SARAH SCHUMACHER

## What do we value in the region?

Stakeholders identified three important themes to consider; ecosystems, agriculture and culture and scenery. Each theme group was asked to “identify the most valuable lands for their perspective theme.” For each theme group, important features were identified that could be represented spatially on the landscape. Using an on-line survey, theme group participants scored each feature based on its importance to the area using a scoring system ranging from very high (100), high (75), medium (50), low (25) and very low (0).

### WE VALUE AGRICULTURE

Stakeholders identified 65% of the study areas as high to very high agriculture value.

The agriculture stakeholder group was tasked with identifying the highest valued lands from an agriculture perspective. Four agriculture features were identified and represented spatially on the landscape.

Agriculture Feature	Value
1. Irrigation Infrastructure right of ways and setbacks	100
2. Land Suitability (alfalfa, canola, spring grains and brome)	
LSRS class 2 (slight limitations to growth)	100
LSRS class 3 (moderate limitations to growth)	75
LSRS class 4 (severe limitations to growth)	50
LSRS class 5 (very severe limitations to growth)	0
3. Irrigation Acres	
IL Class 1 (excellent for irrigated agriculture with no significant limitations)	100
IL Class 2 (good irrigation land with moderate limitations)	100
IL Class 3 (fair for irrigation)	50
IL Class 4 (severe limitations for irrigation, requires special management practices)	25
4. Native Grasslands	100

Ecological Importance Score: ■ 100=Very High ■ 75=High ■ 50=Medium ■ 25=Low ■ 0=Very Low

Once all agriculture features were assigned appropriate values, all 4 layers were overlaid and the maximum value was assigned per polygon.

## WE VALUE CULTURE AND SCENERY

Stakeholders identified 3% of the study areas as high to very high culture and scenic value.

The culture and scenic resources stakeholder group was tasked with identifying the highest valued lands from a culture and scenic perspective. Thirteen features were identified and represented spatially on the landscape.

Culture and Scenic Resources Feature	Value
<b>Footprint features</b>	
Provincial parks and protected areas	100
Historic Resource Value (Classes 1 and 2)	100
Campgrounds and reservoirs	50
Dark skies	75
Golf courses	25
Historic Resource Value (classes 3 and 4)	25
Named lakes (2 km buffer)	50
<b>Scenic Resources</b>	
Dinosaur Provincial Park (5 km buffer)	100
Kinbrook Island Provincial Park (1 km buffer)	50
Red Deer River (1.5 km buffer)	75
Bow River (1 km buffer)	50
Rosebud River (1 km buffer)	75

Cultural Importance Score: ■ 100=Very High ■ 75=High ■ 50=Medium ■ 25=Low ■ 0=Very Low

Once all cultural and scenic features were assigned appropriate values, all 4 layers were overlaid and the maximum value was assigned per polygon.

## WE VALUE ECOSYSTEMS

Stakeholders identified 41% of the study areas as high to very high ecological value.

The ecology stakeholder group was tasked with identifying the highest valued lands from an ecological perspective. Eleven ecological features were identified and represented spatially on the landscape.

Ecological Feature	Value
Provincial parks and protected areas	100
County environmental reserve/conservation agreement lands	100
Piping Plover critical habitat	100
Large permanent water courses (100m)	100
Smaller water courses (45m buffer)	100
Wetlands class A (percentage of section)	
<i>&gt;45% of section is class A wetlands</i>	75
<i>16-45% of section is class A wetlands</i>	50
<i>6-15% of section is class A wetlands</i>	25
Native grassland (removed parcels <155 acres)	100
Named water bodies plus 1000m buffer	75
Important bird area	75
Environmental significant areas (scores >1.89)	75
Key wildlife and biodiversity zones	75

Ecological Importance Score: ■ 100=Very High ■ 75=High ■ 50=Medium ■ 25=Low ■ 0=Very Low

Once all ecological features were assigned appropriate values, all 11 layers were overlaid and the maximum value was assigned per polygon.

## Where can renewable energy development go?

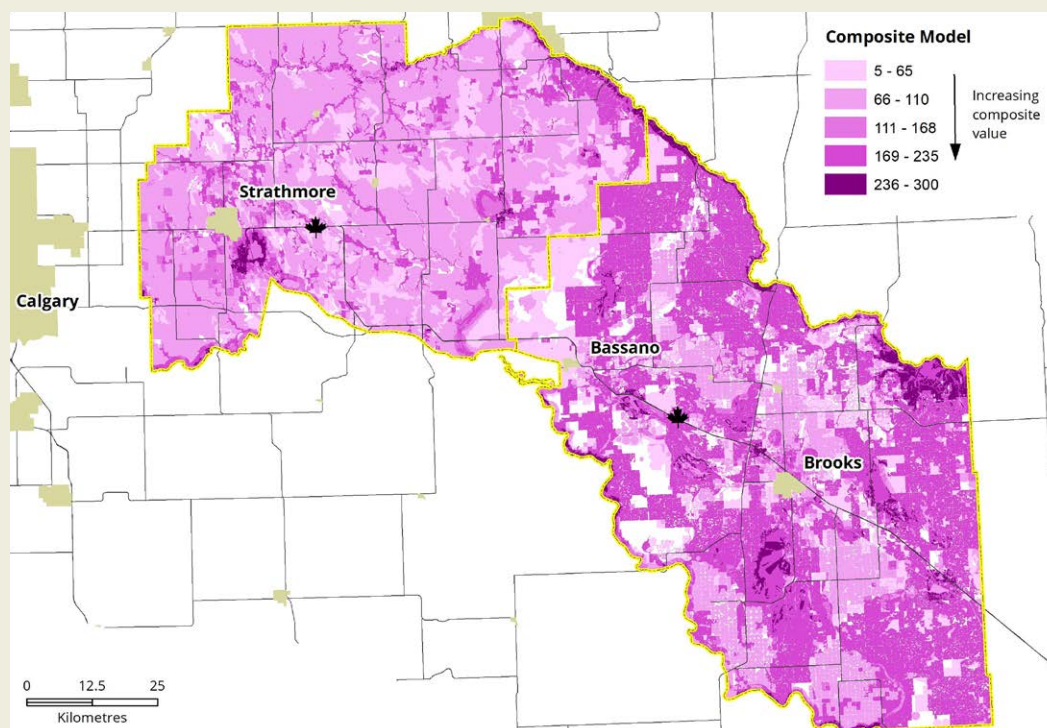
84% of the landscape was identified as opportunity areas for wind and solar development.

The industry stakeholder group was tasked with identifying opportunity areas for solar and wind development within the two pilot municipalities. There were 6 stakeholders who participated in workshops but numerous solar and wind industry representatives played background roles in terms of guidance at key decision points.

Stakeholders identified opportunity areas by simply removing regulatory no-go areas. All other lands besides regulated no-go areas were considered opportunity areas for wind and solar.

## Putting it all together...

A composite map was developed by overlaying and summing the ecology, agriculture, and culture and scenic resource spatial models. This approach highlighted areas of mutual high scores between theme areas and conversely highlights the best opportunity areas for renewable energy development. Using the composite map, zero values (representing no conflict) and the bottom 20% of values were identified as least conflict lands (best opportunity areas for renewable energy development). In addition, due to industry needs any parcel less than 10 acres was removed for wind and any parcel under 50 acres was removed for solar. Only those parcels falling within the wind and solar opportunity area were considered as least conflict lands or best opportunity areas for renewable energy development.



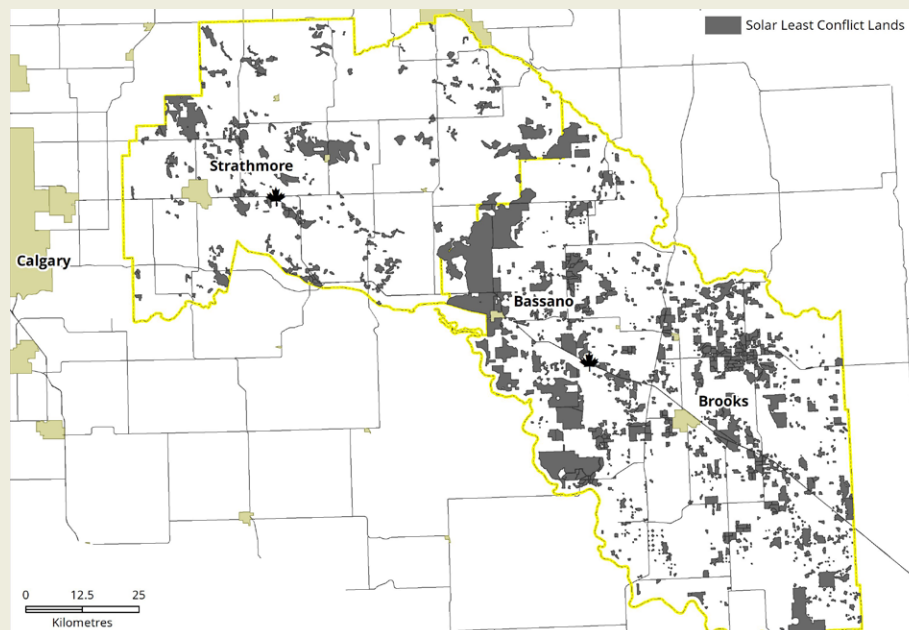
Lighter colour lands represent least conflict areas for renewable energy development while darker colours represent areas of importance based on ecology, agriculture and culture scenic resource considerations.



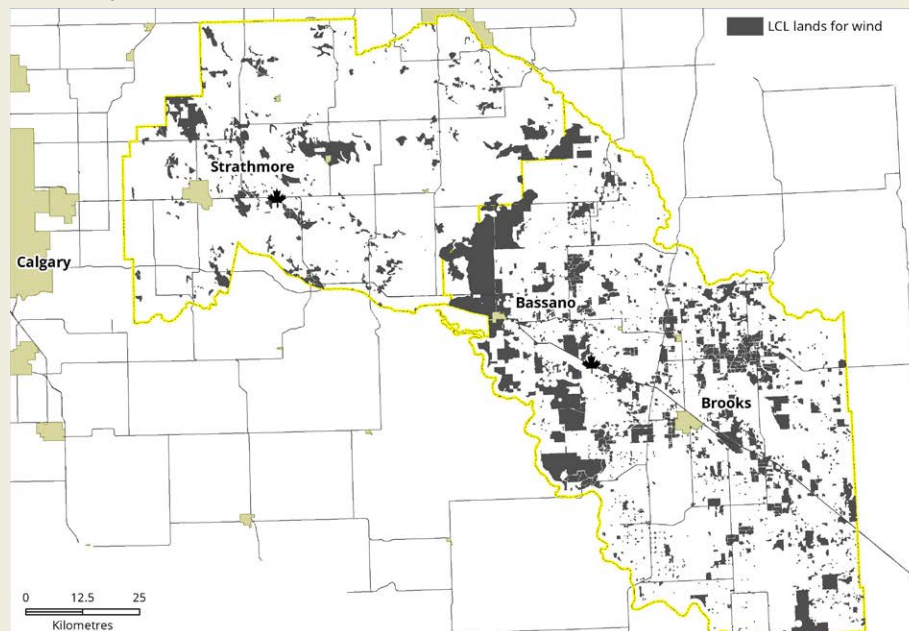
## Where are the best places for renewable energy development?

The decision support tool identified 15% of the study area, or 399,432 acres for solar and 413,530 acres for wind as least conflict lands for renewable energy development. These lands represent opportunity areas for renewable energy development that do not conflict with ecological, agriculture and culture and scenic resources.

**Least Conflict Lands Solar**



**Least Conflict Lands Wind**



# Introduction

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“Smart from the Start: Renewable energy development planning that encourages developers to locate projects in areas with low environmental value and in proximity to existing transmission corridors.”

*Kate Kelly and Kim Delfino, 2012*

Many jurisdictions are focused on increasing wind and solar developments to meet renewable energy targets in an effort to reduce our carbon footprint. Alberta is also investing in renewables as a key strategy to reduce greenhouse gas emissions. Alberta’s Climate Leadership Plan aims to generate 30% (currently at 9%) of electricity from renewable sources by 2030. This 21% increase in electric power production from renewables over the next 23 years is equivalent to 5,000 MW of power production.<sup>1</sup>

As a result of the Alberta Climate Leadership Plan, both wind and solar utility scale developments are expected to increase in Alberta, particularly in southern Alberta where there is some of the best potential for wind and solar development. While this is an opportunity for municipalities, it also raises some challenges from competing land uses. Many land use impacts can be addressed through proper siting and avoidance of areas important to ecological, agriculture, or culture and scenic resources.

In a recent survey by the Miistakis Institute, rural municipalities in Alberta identified a number of concerns in relation to renewable energy land use decisions including competing interests in relation to high valued agriculture and ecological lands as well as impacts to views of the landscape<sup>2</sup>. Municipal respondents to the survey indicated support for a process to help inform decision making related to the siting of renewable energy development.

As a result of the survey responses, Miistakis completed an assessment of work other jurisdictions and organizations have undertaken to assist with municipal decision making and renewable energy siting. The research revealed a “least conflict lands” tool developed by a collaborative in the San Joaquin Valley of California as a potential approach to assist rural municipalities in Alberta (Conservation Biology Institute, UC Berkeley School of Law, and Terrell Watt Planning Consultants 2016). This project was modeled on the San Joaquin Valley project, but adjusted to the Alberta context and stakeholder interests.



<sup>1</sup> <https://www.alberta.ca/climate-leadership-plan.aspx>

<sup>2</sup> [http://www.rockies.ca/miradm/uploads/WISO\\_Survey%20Report\\_FINAL1.pdf](http://www.rockies.ca/miradm/uploads/WISO_Survey%20Report_FINAL1.pdf)

# Project Expectations and Constraints

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The least conflict lands project does not solve all land use decisions that will be made at the pilot municipal scale. This tool is the starting point for discussions between staff, the developers, and Council members. Depending on how the municipalities choose to use it, it may become a way to begin broader discussions with the public.

## Project Constraints

**This is not a regulatory tool.** This tool helps visualize what the various perspectives, interests, and (to a certain extent) Provincial regulatory requirements are in the two counties. It shows ecological, agricultural, cultural/viewshed features on the landscape spatially. If an area is shown outside of a least conflict land area, it does not necessarily mean it is not appropriate for development. It does however indicate there may be something that needs further discussion, mitigation or investigation.

**This is not a parcel level assessment.** Typically, when people see a map they look for the place they live or frequent and are most familiar with. Due to the scale of this tool and the available data, there may be discrepancies between what the map indicates conceptually and what is on the ground at the parcel level. Again, the tool is a starting point for discussion and a way to indicate that further investigation may need to be done once a development interest is indicated.

**This project represents diverse perspectives and not the opinions of individual participants.** The process is described below and outlines how there were many perspectives at each table and involved throughout the process. There are some features that had a high level of agreement in terms of how the feature should be valued in the model, and there are some features that had a dispersed level of agreement. For those features that did not have a high level of agreement, the project team investigated how those features could be represented in a way that reflected the differing opinions. In some cases (as noted in the report) there are certain features that are defined differently by stakeholders' local knowledge and experience, by the regulations, or by science. These differences have been noted.

### **There are other important considerations not included in this process:**

Distance to transmission lines was not included because industry representatives noted technological advances and size of the project greatly influence how far renewable energy will be sited from transmission.

Proximity to settlement was not included in this analysis, but is considered an important influencer.



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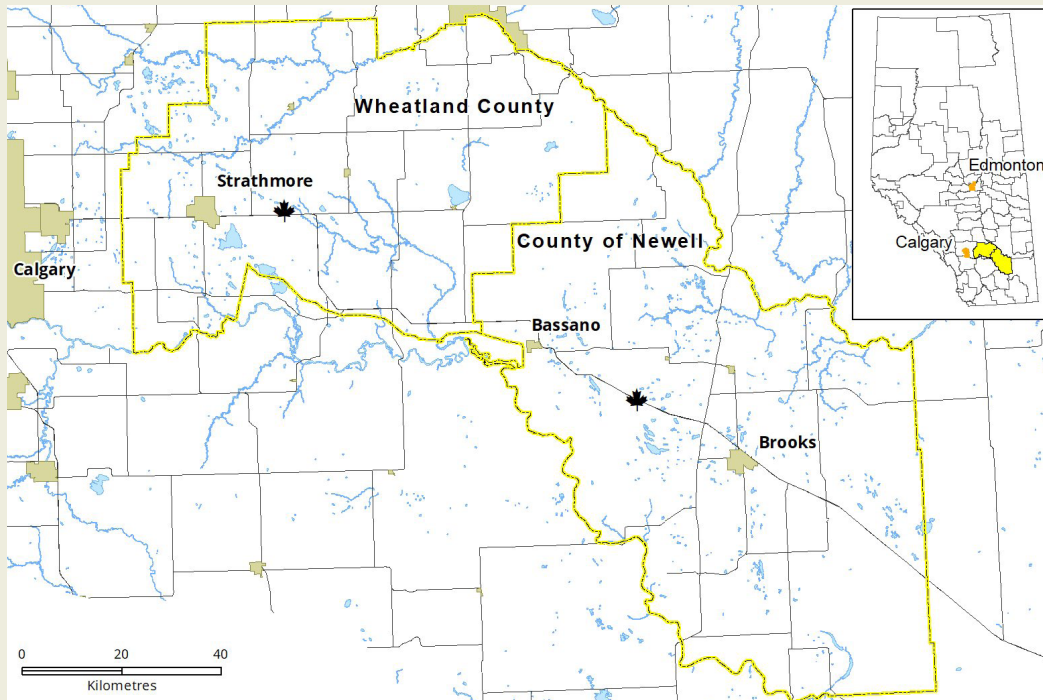
# The Process

Rural municipalities sit at the nexus of land use planning and decision making around competing land use interests. In rural Alberta, new renewable development will occur in communities where citizens care deeply about lands of high agriculture, ecological, and cultural/heritage value as well as maintaining integrity of picturesque views. To start smart (Kelly and Delfino 2012) Miistakis facilitated a pilot project to complete a stakeholder driven process to identify least conflict lands in rural municipalities in Alberta. The pilot involved two rural municipalities in southern Alberta that acknowledge the increasing interest in renewable energy development in their jurisdictions, County of Newell and Wheatland County (figure 1)<sup>3</sup>

As described by Oldman River Services Commission the County of Newell spans an area of approximately 620,000 hectares (1.5 million acres) with a population of 7,138. The County of Newell surrounds four urban municipalities, contains ten hamlets and is bordered by four municipalities, one Special Area and one First Nation. The economy of the County of Newell is based on agriculture and energy resource development. The County of Newell includes several large reservoirs, the two largest being Lake Newell and Crawling Valley, which provide irrigation and recreational opportunities (Klassed et al. 2015).

As described by Oldman River Services Commission Wheatland County covers an area of approximately 460,000 hectares (1.1 million acres), with a population of 8,285 (Alberta Municipal Affairs, 2013). Wheatland County surrounds four urban municipalities, contains twelve hamlets and a number of other communities not officially designated as hamlets. The County is bordered by five rural municipalities, one urban municipality and one First Nation. The economy of Wheatland County is based on agriculture, including beef and grain production. In recent years industry, manufacturing, oil and gas have played key roles in the County's economic growth (Klassed et al. 2015).

Figure 1: Planning Area



3 For this process the First Nation reservation on the south side of study areas was not included in the assessment and is also not included in any of the area calculations.



The least conflict lands tool is unique as it was developed in consideration of multiple interests (ecological, agriculture, culture and scenic resources and renewable energy development), included a strong engagement approach by involving numerous stakeholders (including county representatives and elected officials), and identified areas where land use conflicts could lengthen or complicate the approvals process for renewable energy development.

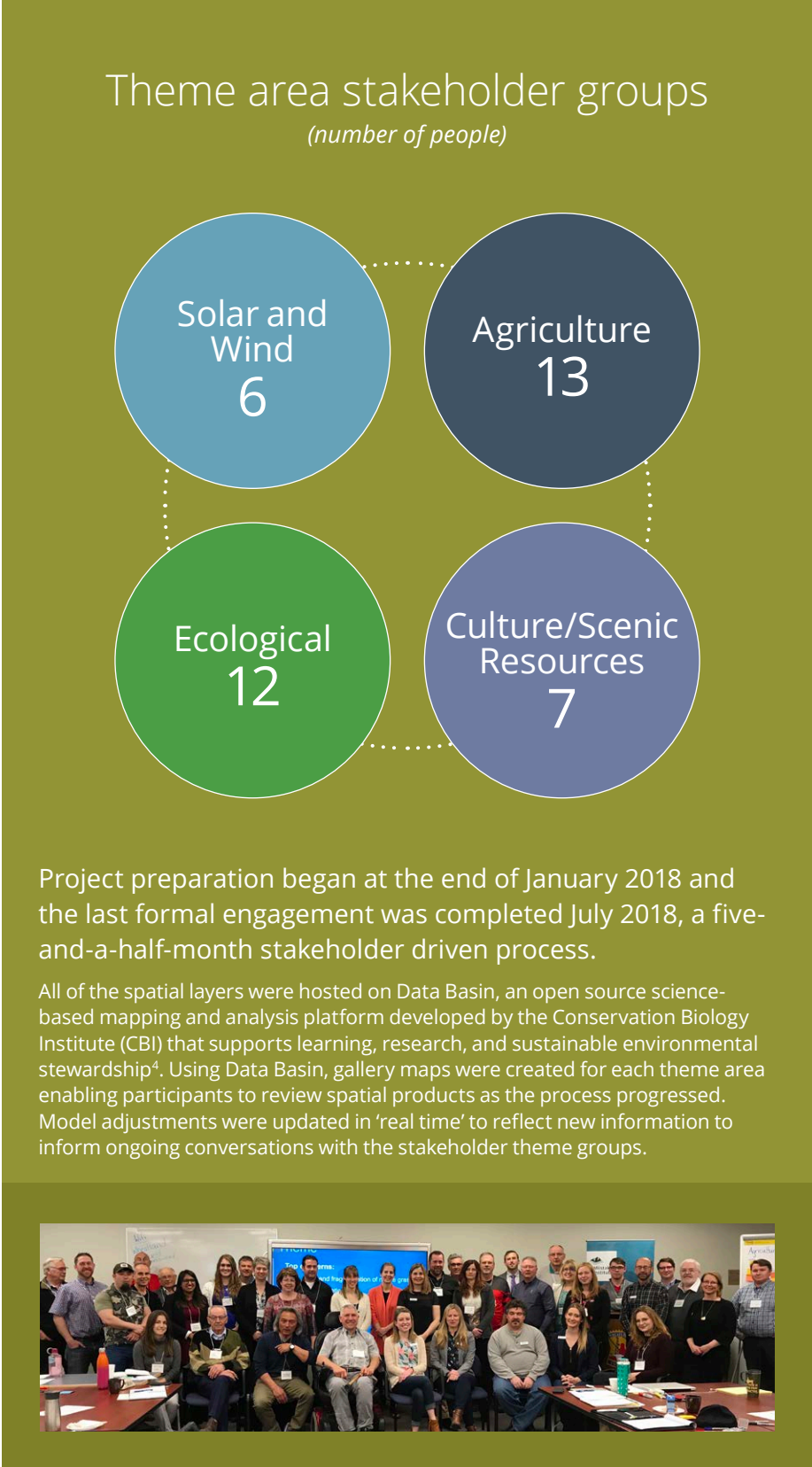
### Project Objectives

Convene local stakeholder groups to represent the following land uses within a rural municipality:

- wind,
- solar,
- transmission,
- agriculture,
- ecosystems, and
- culture/scenic resources

Use existing data to develop spatial maps that depict the best opportunities for wind and solar planning, while also identifying the highest value lands for ecological, agriculture and cultural/scenic resources. We did not assess best location for transmission planning in this process;

Identify lands where there is the least conflict for solar and for wind energy development projects within a relatively quick timeframe (as applications are already underway throughout Alberta).



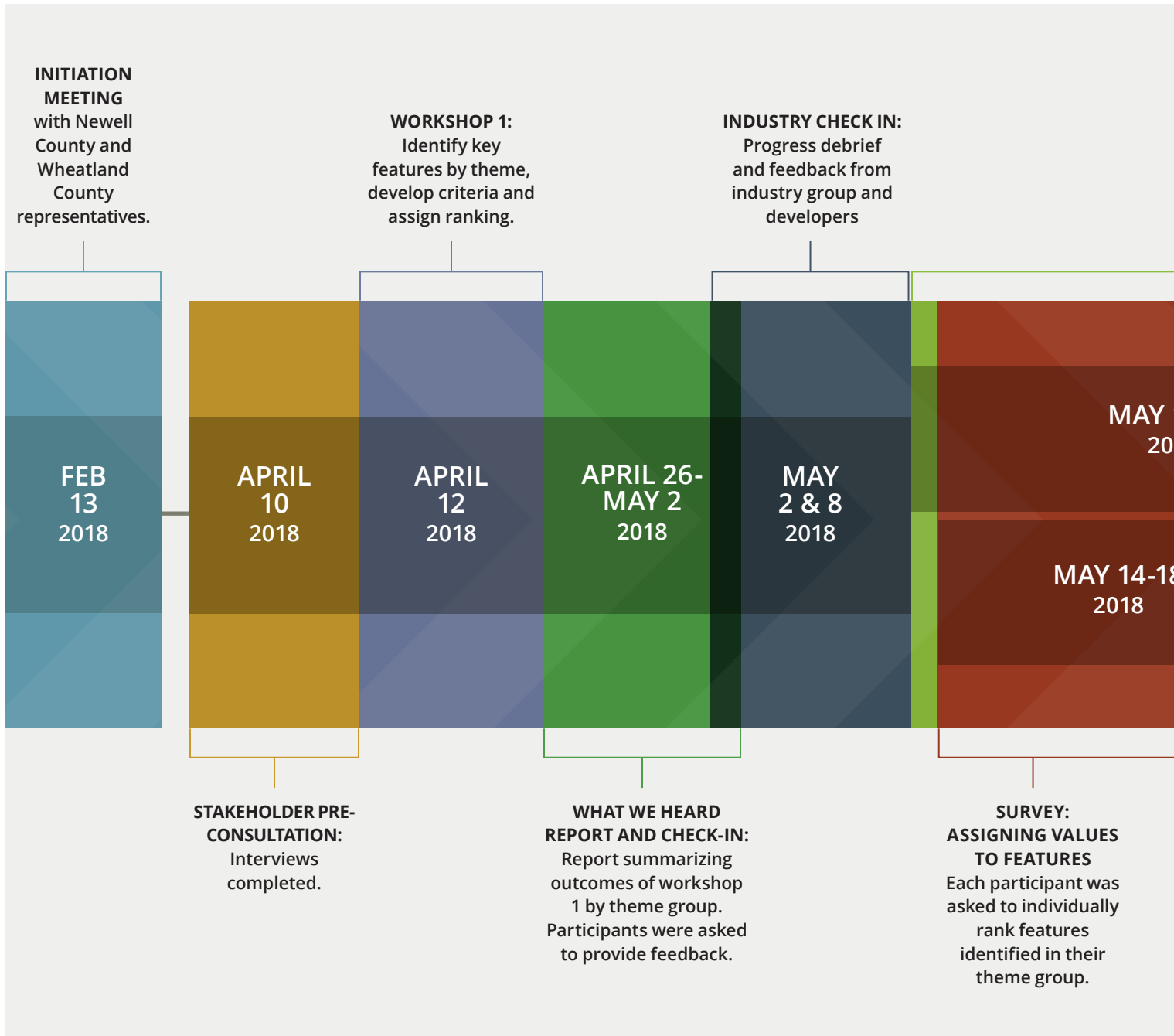
Project preparation began at the end of January 2018 and the last formal engagement was completed July 2018, a five-and-a-half-month stakeholder driven process.

All of the spatial layers were hosted on Data Basin, an open source science-based mapping and analysis platform developed by the Conservation Biology Institute (CBI) that supports learning, research, and sustainable environmental stewardship<sup>4</sup>. Using Data Basin, gallery maps were created for each theme area enabling participants to review spatial products as the process progressed. Model adjustments were updated in 'real time' to reflect new information to inform ongoing conversations with the stakeholder theme groups.



<sup>4</sup> <https://databasin.org/>

Key events are summarized in the diagram below:

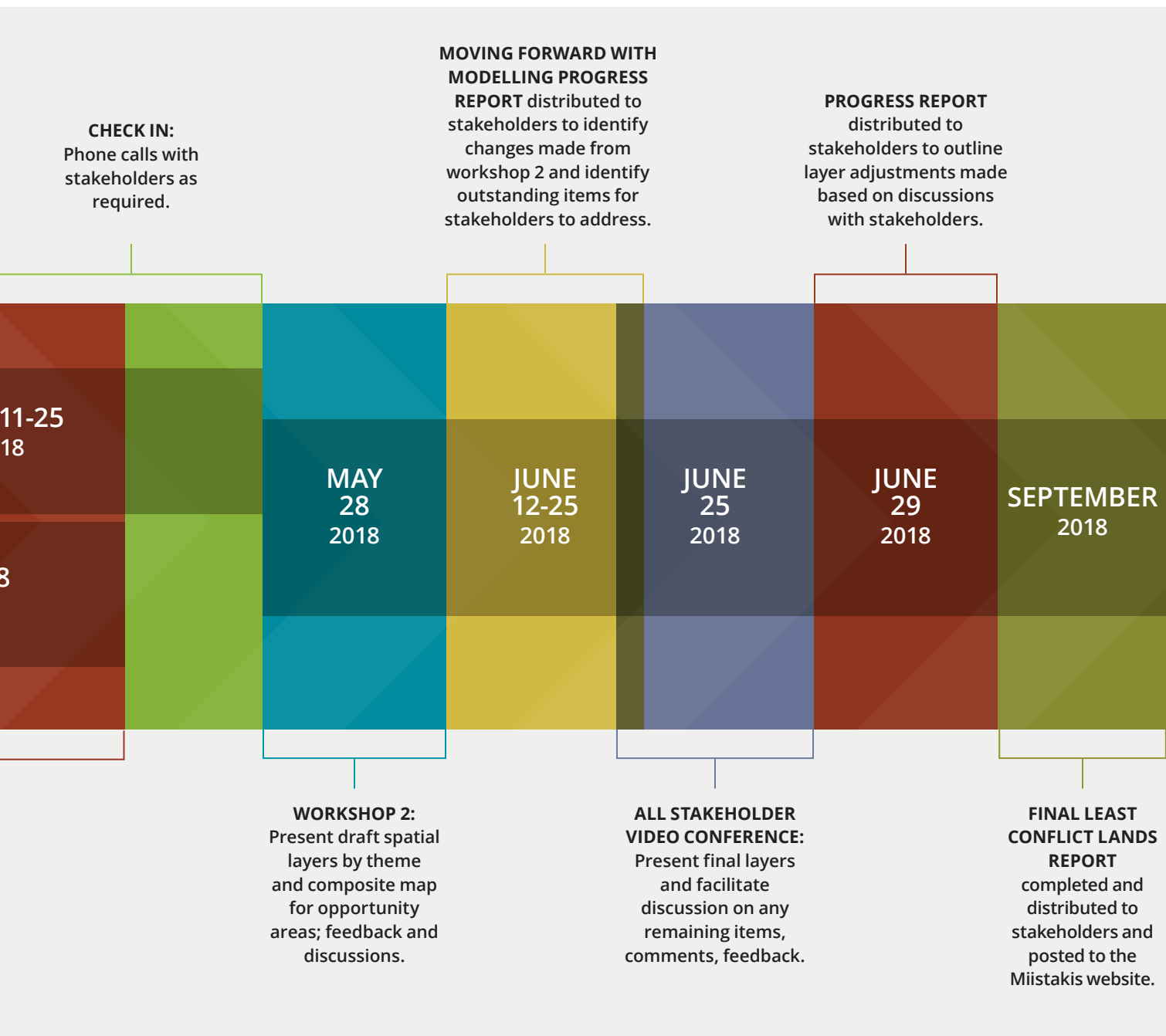


**IN SUMMARY:**

Over **20 individual interviews** were hosted by the project team for pre-consultation interviews, data gathering and touch points throughout the process

**2** all-stakeholder workshops

**1** survey



**8 video or conference call group meetings** were hosted to touch base with participants, hear feedback and host discussion opportunities on how the process was going, what needed to be adjusted, and what the next steps were

**2** progress reports to all stakeholders  
.....  
**1** final report

Where are the opportunity areas for **wind and solar** in Wheatland County and County of Newell?



## Wind and Solar Opportunity Areas

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The industry stakeholder group was tasked with identifying opportunity areas for wind and solar development within the two pilot municipalities. The municipalities have a combined land base of 2,695,278 acres (10,900km<sup>2</sup>), the majority in agricultural production across relatively flat, open landscapes with a high number of sunny days and consistent wind speeds throughout the area – an ideal context for wind and solar developers.

To address concerns from municipal administrators of perceived future bias, developers that were active or may have an interest in developing in the two counties did not participate as stakeholders at the workshops. However, industry organization representatives did participate (CanSIA and CanWEA). In addition, Miistakis ensured a number of touch points with solar and wind developers to provide progress reports, test findings and compile their feedback and recommendations.



## STAKEHOLDERS

### Patrick Bateman

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### Stewart Musgrove

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## Model Design Process

There were six participants in the Industry Theme Stakeholder group. Five of the six were interviewed prior to the workshop as well as one wind industry expert that did not participate in the process.

The interviews provided insight into the type of data to collect and some of the key considerations for solar and wind developers.

Pre-workshop interviews identified several features that could influence renewable energy development:

- distance from transmission line and/or existing system substation
- voltage of transmission required for commercial sites
- slope restrictions
- areas off-limit for solar or wind development based on regulation
- quality of solar or wind resource potential

During workshop 1, the industry group was asked to test the features identified through the pre-workshop activities that would define opportunity areas for wind and solar.

Participants were asked how identifying least conflict lands might impact (positively or negatively) the Industry Theme area. Discussion points were grouped by the stakeholders into the following categories:

- Risk management – risk to different projects in development outside the least conflict areas; what if the amount of land identified by the least conflict tool is not considered economically significant to industry?
- Data and planning tool – assist in defense of site selection; increased data quality and availability to stakeholders; minimize project stakeholder/regulatory conflict.
- Landowner property rights – is there a risk to property rights for landowners/industry? Potential impacts on land values within and outside the least conflict areas.
- Existing regulatory environment – opportunity for education and outreach on what current regulations exist related to renewables and the standards developers are held to.
- Proximity to existing infrastructure – efficiency in future projects; shortest route for distribution and transmission.
- Impact analysis – micro opportunities outside wind and solar and the consequential impacts of these large projects.



PHOTO: SARAH SCHUMACHER

Key considerations for solar and wind development were identified and included:

- Solar development costs are scalable, proximity to distribution and cost of connection is proportionate to project size (i.e. the further from connection to the grid, the larger the project needs to be).
- Wind is more constrained than solar technology as it is reliant on wind consistency and proximity to interconnection.
- Environmental considerations include: avoidance of migratory pathways; native grassland disturbance; wetlands; and crown land restrictions.
- Crown land is a no-go; native grassland and wetlands are highly regulated; migratory bird pathways are regulated and local monitoring is required; habitat for wildlife setbacks are defined in AEP directives for wind and solar.
- AUC Noise Guidelines – cumulative noise must be considered.
- Municipal setbacks.
- Proximity to road and rails to get product to and from the site. Often requires road agreements between the municipality and the developer.
- Pipelines, oil and gas infrastructure.
- Parcel size would be project specific so too difficult to estimate as a feature.
- Ecological features should be determined by the Ecological Theme group.
- Noise is cumulative and not spatially identifiable, so it cannot be mapped.
- Focus on mapping no-go areas that are regulated.
- Don't map oil and gas infrastructure as it would sterilize the entire study area at the scale we are working at.
- Map irrigation infrastructure as no-go areas.
- Airports and municipal airstrips.
- Railways, highways and secondary road right of ways.
- Transmission line ROWs.
- Solar potential exists throughout the two counties minus the absolute no-go areas.
- NRCAN model could be used to identify wind opportunity areas.

After workshop 1, the project team compiled a 'What we Heard' report that listed each theme group's features, criteria for assessing that feature, and data required to map it. Through direct distribution and a remote presentation, Industry Theme

Group stakeholders and wind and solar developers were asked for feedback to confirm the discussions and if findings appropriately reflected identification of opportunity areas for wind and solar. No-go areas for modeling were also confirmed. The industry group advised that negotiations may happen on certain features (i.e. slopes, setbacks from roadways, etc.) or there may be context specific influencers and those types of features should not be included as no-go areas. The agreed to no-go areas include:

- Crown land
- Roadways – only the right-of-way
- Transmission lines – only right-of-way
- Irrigation infrastructure and setbacks
- Permanent watercourses with 100m setback for large rivers, and 45m setback on smaller watercourses (AUC 007)

- Piping plover water bodies and 200m setback (AUC 007)
- Parks and protected areas
- Historic Resources Value class 1 and 2 (Alberta Historic Resources Act 2.0)

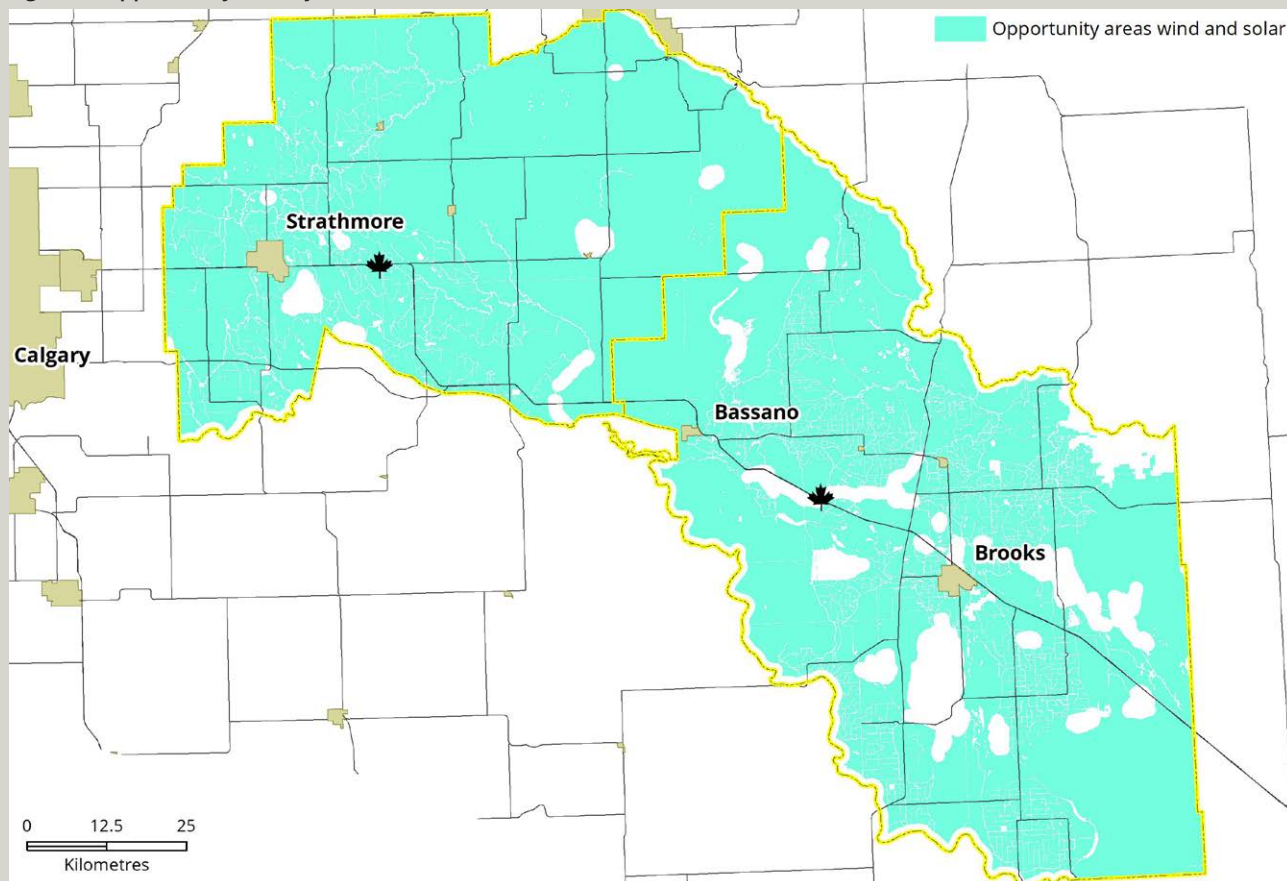
Stakeholder discussions prior to and after workshop 2 confirmed the approach to mapping opportunity areas for least conflict lands:

- Solar resource is sufficient throughout the study area
- Wind resource < 3m/sec is likely not economically viable for wind development
- Remove absolute no-go areas (listed above).

## Opportunity Areas Modelling Results

Wind and solar opportunity areas within the counties represent 1,046,237 acres or 84% of the study area (figure 2).

**Figure 2: Opportunity Areas for Wind and Solar**



Where are the least conflict lands for renewable energy development from an **ecological perspective?**



PHOTO: SARAH SCHUMACHER

## Ecological Theme

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Wheatland County and the County of Newell are predominately composed of native grassland and large and small waterways, wetlands, lakes and associated riparian areas. Both counties are located in the grasslands natural region, and as with other jurisdictions the region supports multiple land use activities resulting in pressure on natural features. A recent report released by ABMI noted that as of “2016, the human footprint occupied 57.12% of the Grassland Natural Region. Agriculture was the predominant human footprint, covering 49.59% of the landscape. Transportation (2.66%), energy (2.47%), and urban/industrial (1.47%) footprint all covered similar areas.” Within the study area native grassland has been predominantly converted to agriculture and is heavily fragmented from oil and gas activity(Alberta Biodiversity Monitoring Institute 2017).

Native grasslands are important because they provide a suite of ecological goods and services, including but not limited to: providing wildlife and fish habitat, promoting healthy riparian areas to maintain water quality and quantity, providing clean air, maintaining biodiversity, preventing soil erosion, providing carbon sinks, stabilizing ecosystems during drought, and providing economic opportunities (Alberta Biodiversity Monitoring Institute 2015). In addition, native grasslands support numerous species at risk in the counties including burrowing owl, prairie rattlesnake, and piping plover (Alberta Environment and Parks: Fish and Wildlife 2017).

Both counties have established policies in regard to natural resources in their Municipal Development Plans (MDPs), including protecting, enhancing or conserving natural assets such as environmentally significant areas and other significant natural areas. The Intermunicipal Development Plan for the counties identified the following important ecological features: natural water features; highly suitable natural habitats for species-at-risk and keystone wildlife; and Environmentally Sensitive Areas (Klased et al. 2015).

## STAKEHOLDERS

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Association*

The following resources<sup>5</sup> from Alberta Environment and Parks informed discussions for the Ecological Theme group process:

- *Wildlife Directive for Alberta Wind Energy Projects*: summarizes potential wildlife issues associated with wind energy projects and provides direction for minimizing effects to wildlife and wildlife habitat during siting, construction, and operation of wind energy projects.
- *Wildlife Directive for Alberta Solar Energy Projects*: summarizes potential wildlife issues associated with solar energy projects and provides direction for minimizing effects to wildlife and wildlife habitat during siting, construction, and operation of solar energy projects
- *Renewable Energy and Wildlife Habitat Sensitivity Map*: map includes four categories; critical wildlife, high risk, moderate risk and lower risk. Critical areas must be avoided for renewable energy projects. Areas of high risk require increased pre-assessment work, mitigation and specialized construction or operation techniques/rules.

<sup>5</sup> <http://aep.alberta.ca/fish-wildlife/wildlife-land-use-guidelines/default.aspx>

## Model Design Process

There were 11 participants in the Ecological Theme Stakeholder group. Prior to the first workshop, four participants were interviewed (one staff person from each county, and two subject matter experts) to help identify a list of key ecological features and concerns. Pre-workshop interviews identified three key ecological impacts from renewable energy development for consideration:

- loss and fragmentation of native grassland;
- loss of wetlands; and
- direct mortality for birds and bats.

In addition, pre-workshop interviews resulted in the development of a preliminary list of ecological features important to the area, and highlighted provincial regulations, municipal plans and bylaws aimed at conserving ecological features.

At the first workshop participants refined the list of ecological features, identified why it was ecologically important and discussed regulatory requirements. The 11 features included in the ecological model:

- Provincial parks and protected areas
- County Environmental Reserve/conservation agreement lands
- Piping Plover critical habitat
- Wetlands
- Large permanent water courses (100m)
- Smaller water courses (45m buffer)
- Named water bodies (plus 1000m buffer)
- Native grassland (removed parcels <155 acres and 2016 human footprint)
- Important bird areas
- Environmentally Significant Areas (scores >1.89)
- Key wildlife and biodiversity zones

Details on each feature, including why it is important, supporting regulations and/or plans are outlined in appendix 1.

Once the 11 features were agreed on by stakeholders, spatial layers were developed for each feature and shared on Data Basin for participants to review. Using an on-line survey, theme group participants scored each feature based on its ecological importance to the area using a scoring system ranging from very high (100), high (75), medium (50), low (25) and very low (0). The value with the highest percentage of votes was applied to each feature (table 1). Detailed summary of the survey can be found in appendix 2.

**Table 1: Ecological features and ecological value**

Ecological Feature	Value
Provincial parks and protected areas	100
County environmental reserve/conservation agreement lands	100
Piping Plover critical habitat	100
Large permanent water courses (100m)	100
Smaller water courses (45m buffer)	100
Wetlands class A (percentage of section)	
>45% of section is class A wetlands	75
16-45% of section is class A wetlands	50
6-15% of section is class A wetlands	25
Native grassland (removed parcels <155 acres)	100
Named water bodies plus 1000m buffer	75
Important bird area	75
Environmental significant areas (scores >1.89)	75
Key wildlife and biodiversity zones	75

Ecological Importance Score: ■ 100=Very High ■ 75=High ■ 50=Medium ■ 25=Low ■ 0=Very Low

Once all features were assigned appropriate values, all 11 layers were overlaid and the maximum value was assigned per polygon. Therefore, there is no cumulative value, but instead we assign the highest value to each polygon (a spatial area).

The ecological features and their values were used to develop the ecological model. No new data was developed for this process, so the project team was dependent on existing datasets. For each feature a spatial layer was developed then assigned an ecological value as defined by the ecological stakeholder group (see table 1). Maps of source feature files are displayed in appendix 2.

There were a number of data gaps identified during the overall process:

- Many of the stakeholders expressed concern in using the provincial merged wetland layer in the modeling process due to inaccuracies with findings on the ground.
- Bird and bat migration areas are not well documented in the area or include very wide bands that are not appropriate for the scale of the study area. We addressed this by assuming riparian areas associated with large river valleys and lakes likely represent important migration pathways.
- Wildlife connectivity is not well understood in the study area.

## Theme Layer Development

1. Parks and Protected Areas: shapefile acquired from Alberta Parks (Last updated in November 2017, with a scale at 1:20K).
2. County Environmental Reserve and Conservation Agreement Lands was developed using the following six data sources:
  - a. County of Newell Environmental Reserves
  - b. Wheatland County Environmental Reserves
  - c. Nature Conservancy of Canada Conservation Easements. (Updated 2018, scale quarter section).
  - d. Western Sky Land Trust Conservation Easements. (Updated 2018, scale quarter section level).
  - e. Alberta Conservation Association, lands with Conservation Agreements (Updated 2018, legal land descriptions).
  - f. Ducks Unlimited, Lands with Conservation Agreements. (Updated 2018, legal land descriptions).
3. Piping Plover waterbodies: a shapefile acquired from AEP of Piping Plover Waterbodies includes all water bodies as of 2009 with confirmed breeding pairs as determined by annual surveys. An entire water body is considered a nesting site. (Last updated in 2010).
4. Large Permanent Water Course extracted from Alberta base features. (Updated in 2016, scale at 1:20K).
5. Small Permanent Water Courses extracted from Alberta base features. (Updated in 2016, scale at 1:20K).
6. Wetlands: Developed a spatial layer based on the offset wetland provincial data by identifying the number of hectares of class A wetlands per section. We valued the sections as followed:
  - 5-14% of section is class A (25)
  - 15-44% of section is class A (50)
  - >45% of section is class A (75)
7. Native grassland: was identified native grassland from the Grassland Vegetation Index (GVI) – using native vegetation upland (where there was 50% herbaceous veg within a quarter section). The GVI was updated in 2009. We extracted human footprint (Alberta Biodiversity Monitoring Institute 2016) features including well pads, well pad roads, unknown clearings, crop, and tame pasture from the native grassland footprint. lastly parcel sizes under 155 acres were removed.
8. Named water bodies and 1000m buffer developed using Alberta base features extracted hydro waterbodies that had names (Last Updated in 2016, scale 1:20K)
9. Important bird area shapefile acquired from Bird Studies Canada. Important Bird Areas (IBAs) are discrete sites that support specific groups of birds: threatened birds, large groups of birds, and birds restricted by range or by habitat. IBAs are identified using criteria that are internationally agreed upon, standardized, quantitative, and scientifically defensible. This gives them a conservation currency that transcends international borders and promotes international collaboration for the conservation of the world's birds (Bird Studies Canada 2015).
10. Environmentally significant Areas: shapefile was acquired from Alberta Parks. Environmentally Significant Areas (ESAs) are generally defined as areas that are important to the long-term maintenance of biological diversity, physical landscape features and/ or other natural processes, both locally and within a larger spatial context (Fiera Biological Consulting LTD. 2014). (Last updated in 2014, scale per quarter section).
11. Key Wildlife and Biodiversity Zones: Endorsed by the Government of Alberta, includes a combination of key wildlife habitat from both uplands and major watercourse valleys. The basis of this zone was determined using major river corridors, valley topography, valley slope breaks and ungulate winter densities. The Key Wildlife and Biodiversity Zone is intended to prevent loss and fragmentation of habitat; prevent short and long-term all-weather public vehicle access; prevent sensory disturbance during periods of thermal or nutritional stress on wildlife; and prevent the development of barriers to wildlife corridors (e.g., stream crossings). Note that this layer is a consolidation of previous Key Ungulate Areas, Key Ungulate Winter ranges, and Class C - Key Wildlife and Watercourse areas.(Last updated in 2010).

## Modelling Results

The ecological model is displayed in figure 4 (next page). In this model darker green represents higher ecological importance and lighter green to white represent lower ecological importance. Figure 3 shows the percentage of land considered very high and high ecological value for County of Newell County (58%), Wheatland County (19%) and across the study area (41%). This model is intended for high-level planning purposes and is not appropriate for parcel level evaluations. In addition, model outputs represent a snap shot in time and are dependent on resolution and accuracy of the source data used to represent each layer.

**Figure 3: Percent of land in high to very high ecological value**

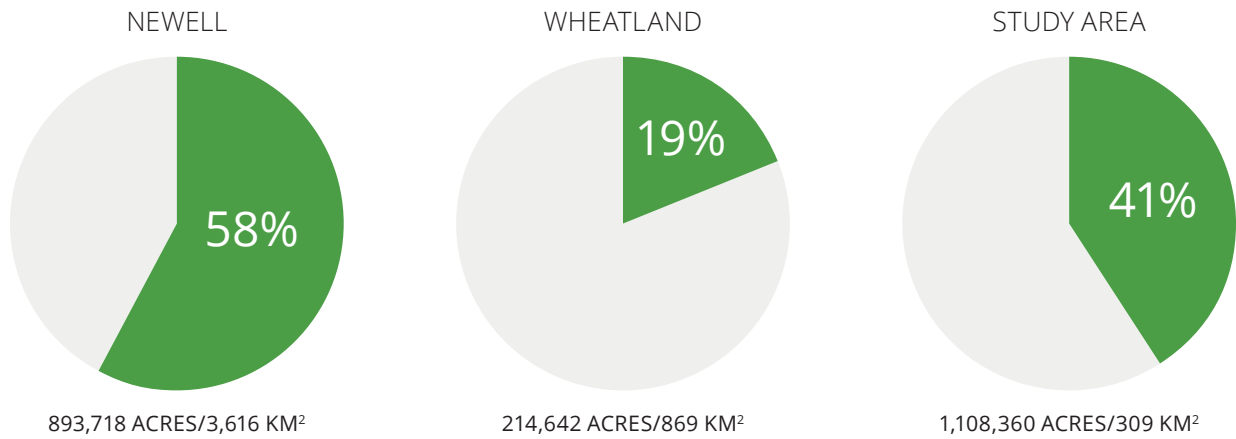




Figure 4: Ecological Theme Model

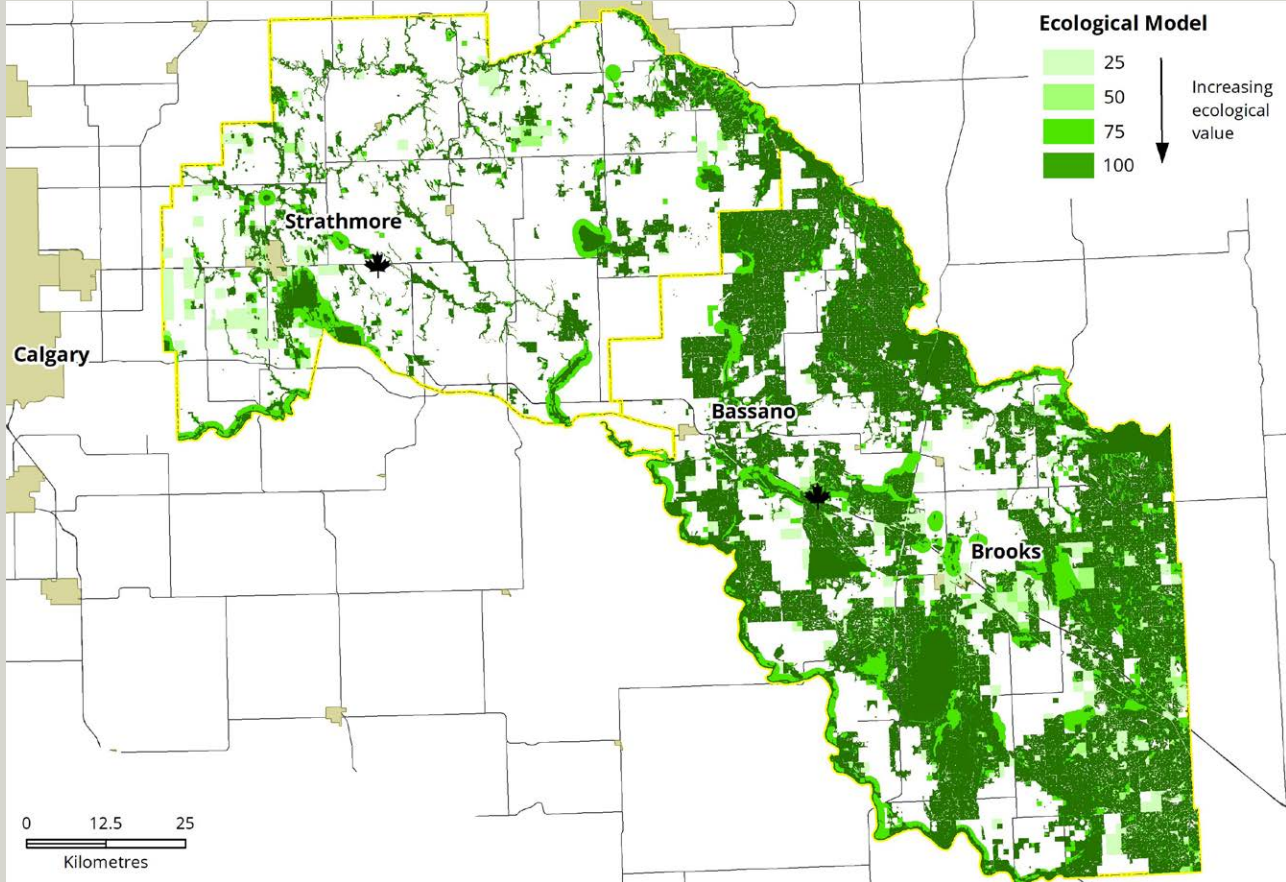


PHOTO: SARAH SCHUMACHER

Where are the least conflict lands for renewable energy development from an **agriculture perspective?**



## Agriculture Theme

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An important economic driver in Wheatland County and the County of Newell is agriculture; including the production of a diversity of crops and beef cattle. Forage and silage production support a livestock industry including feedlot and cow-calf operations. Both counties support high levels of crop production and diversity due to readily available water from irrigation. Wheatland County is irrigated in the southern portion by the Western Irrigation District which operated 1,200 km canal system to support various land uses in the county. County of Newell is also irrigated in the southern portion by the Eastern Irrigation District. Irrigated crops are dedicated to cereal and corn silage, feed grains and alfalfa hay for livestock. Non-irrigated crops common in the region include mainly wheat, canola and barley.

Native grasslands play an important role in livestock production, because forage quality on native grasslands is high for livestock. In addition, natural grasslands are hardy, drought resistant, and evolved as highly adapted to the climate for the past 50 million years. "Ranchers and livestock farmers often have a combination of forage types for grazing, including some natural grasslands, tame perennial grasslands, annual forages, stubble crop residues, annual crop windrows, and occasionally irrigated pastures. Some tame perennial grasses, such as crested wheatgrass and smooth brome grass, can provide quality spring to early summer pasture" (Bailey, McCartney, and Schellenberg 2010).

An Economic Development Strategy 2016-2019 for Wheatland County noted that "a strong agricultural sector is the backbone of the local economy, and agricultural land and activity need to be maintained" (Ingenuity Services Consulting 2016). A key concern for the region is loss and/or fragmentation of agriculture lands due to competing land uses such as energy production and acreage developments.

## STAKEHOLDERS

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### Karen Raven

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### Rich Smith

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### Alyce Wickert

Manager Planning and Development, County of Newell

### Jason Wilson

Councillor, ASB Farm Representative, Wheatland County

## Model Design Process

There were 12 participants in the Agriculture Theme Stakeholder group. Prior to the first workshop, five participants were interviewed (one staff person from each county, a subject matter expert and representatives from both irrigation districts) to help identify a list of key agricultural features and concerns. Pre-workshop interviews identified three key agricultural impacts from renewable energy development for consideration:

- loss of high value agricultural lands;
- fragmentation of high value agricultural lands; and
- invasive species (ag-economic concern).

In addition, pre-workshop interviews resulted in the development of a preliminary list of agricultural features which were finalized during workshop 1.

- crop production (canola, spring grains, alfalfa and brome);
- native grassland/tame pasture;
- irrigation infrastructure; and
- irrigation acres.

Using an on-line survey, theme group participants scored each feature based on its agriculture importance to the area using a scoring system ranging from very high (100), high (75), medium (50), low (25) and very low (0). The value with the highest percentage of votes was applied to each feature (table 2). Detailed summary of the survey can be found in appendix 2.

**Table 2: Agriculture features and values**

Agriculture Feature	Value
1. Irrigation Infrastructure right of ways and setbacks	100
2. Land Suitability (alfalfa, canola, spring grains and brome)	
LSRS class 2 (slight limitations to growth)	100
LSRS class 3 (moderate limitations to growth)	75
LSRS class 4 (severe limitations to growth)	50
LSRS class 5 (very severe limitations to growth)	0
3. Irrigation Acres	
IL Class 1 (excellent for irrigated agriculture with no significant limitations)	100
IL Class 2 (good irrigation land with moderate limitations)	100
IL Class 3 (fair for irrigation)	50
IL Class 4 (severe limitations for irrigation, requires special management practices)	25
4. Native Grasslands	100

Ecological Importance Score: 100=Very High 75=High 50=Medium 25=Low 0=Very Low

Each feature was represented spatially using existing datasets.

1. Irrigation Infrastructure and setbacks were provided by the Western Irrigation District (WID) and Eastern Irrigation District (EID) and include canals, pipelines, reservoirs, spillways and natural waterways. Setbacks vary depending on location (tend to be around 15-30m) and were provided by Western Irrigation District. For the Eastern Irrigation District similar setbacks were applied.
2. Crop productivity was evaluated using the land suitability rating system developed by Alberta Soils Inventory database (AGRSID 4.1) provided by Alberta Agriculture and Forestry. Stakeholders opted to value all crops of equal value (canola, brome (tame pasture), spring seed grains and alfalfa) as crops are often rotated (note: irrigation acres were included as a separate evaluation).

Land suitability polygons (defined area spatially) for small spring seeded grains, alfalfa, canola and brome have assigned LSRS classes. Each polygon has a percentage of primary, secondary and sometimes classes that add up to 100 percent. To produce a crop and pasture suitability layer we used the assigned value (very high, high, medium, low and very low) to each class type based on stakeholder feedback.

Each polygon was scored using the following formula: (primary class score assigned by participants \* percent of polygon + secondary class score assigned by participants \* percentage of polygon + tertiary class score assigned by participants \* percent of polygon). This was re-run for each type of crop small spring seeded grains, alfalfa, canola and brome. This resulted in four models, one for each crop type. Since stakeholders equated all crop types to be equal, to create the final LSRS model the four models were overlaid and the highest value was assigned to the polygon.

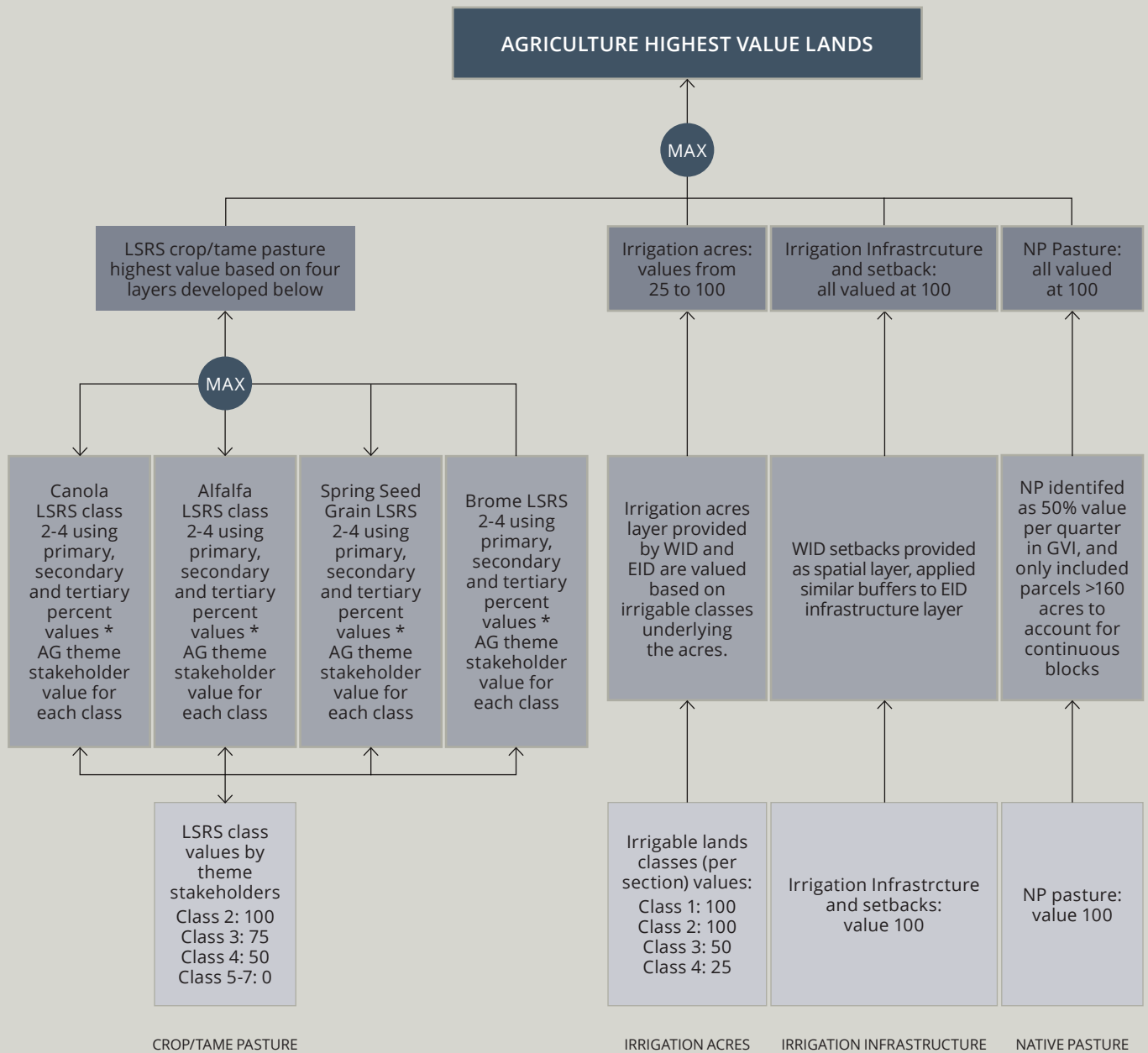
3. Irrigation Acres (lands currently under irrigation) was provided by WID and EID. Alberta Agriculture and Forestry provided land classes for irrigation (1-5), where 1 is excellent for irrigation and 5 is non-irrigable. Each land class was given a value based on agriculture stakeholder score (table 2). The land classes were then equated to lands in irrigation provided by WID and EID.
4. Native grasslands play an important role in livestock production. Other forage types were addressed in the LSRS layer. The native grasslands layer developed using the same methodology as out lined in the Ecological Theme. Native grassland was identified using the Grassland Vegetation Index (GVI) – using native vegetation upland (where there was 50% herbaceous veg within a quarter-section). The GVI was updated in 2009. We extracted human footprint (Alberta Biodiversity Monitoring Institute 2016) features including well pads, well pad roads, unknown clearings, crop, and tame pasture from the native grassland footprint. Lastly parcel sizes under 155 acres were removed.

Details on each feature, including why it is important, supporting regulations and planning documents are located in appendix 1.

The agriculture features and their values were used to develop the agriculture model. Each feature layer was overlaid and the highest value was assigned to each polygon. There is no cumulative value between features. See figure 5 for the agriculture model methodology.

No new data was developed for this process, and therefore the project team was dependent on existing datasets. Maps of source feature files are displayed in appendix 3.

Figure 5: Model for Agriculture





The agriculture model is displayed in Figure 7. In this model brown represents higher agriculture importance and lighter brown to beige represent lower agriculture value. Figure 6 represents percentage of land considered very high and high agriculture value for County of Newell County (66%), Wheatland County (63%) and for the study area (65%). This model is intended for high-level planning purposes and is not appropriate for parcel level evaluations. In addition, model outputs represent a snap shot in time and are dependent on resolution and accuracy of the source data used to represent each layer.

**Figure 6: Percent of land in high to very high agriculture value**

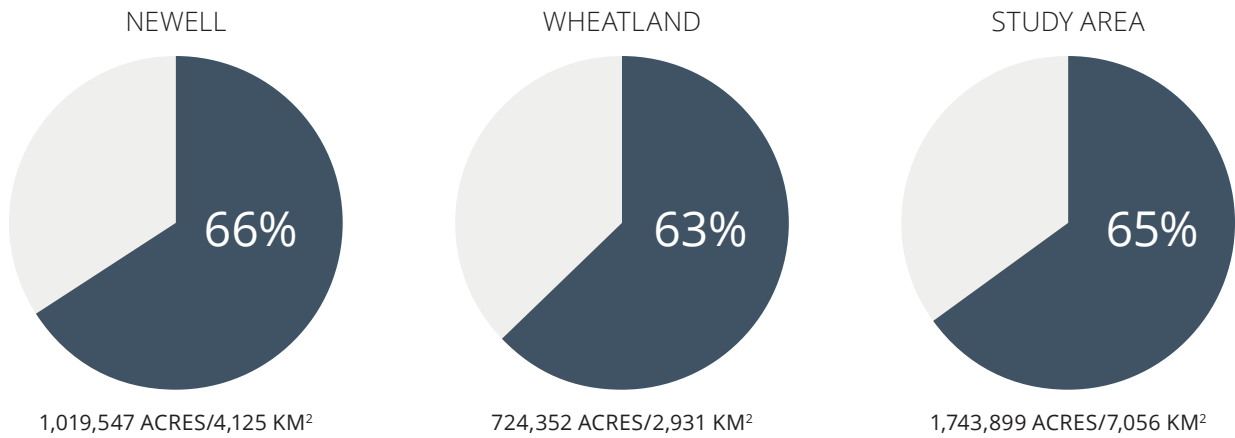
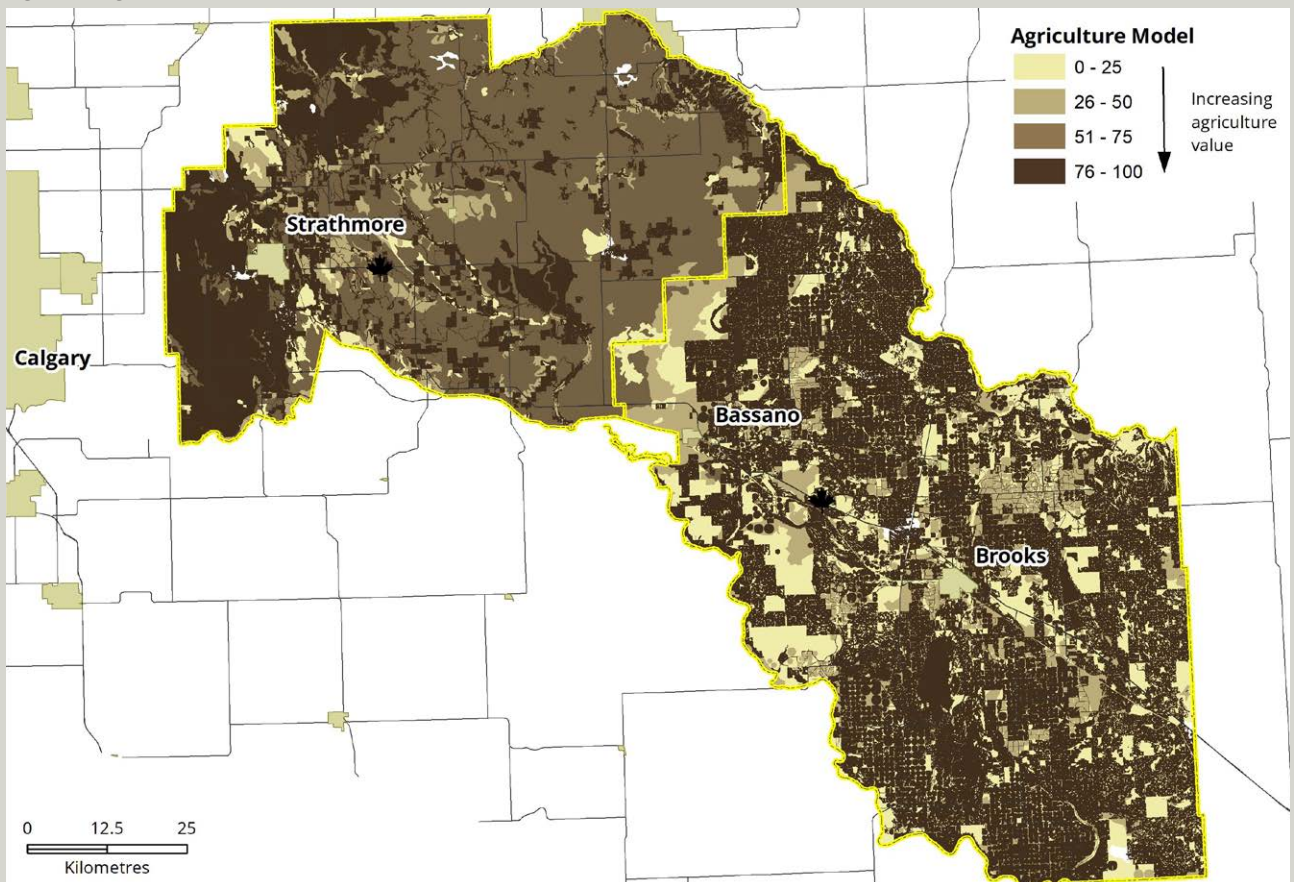




PHOTO: SARAH SCHUMACHER

Figure 7: Agriculture Theme Model



Where are the least conflict lands for renewable energy development from a **culture and scenic resources perspective?**



PHOTO: SARAH SCHUMACHER

## Culture and Scenic Resources Theme

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How people connect to a place depends on their personal value systems which tend to be context specific and can change over time. These connections to a place may be functional (land provides food) or may relate to how it makes one feel, which can be difficult to quantify. However, there is increasing recognition of the importance of less tangible or quantifiable benefits that people derive from nature (Barendse et al. 2016). A recent attempt to systematically identify scenic resources for the South Saskatchewan Regional Plan noted scenic resources are an “important element of recreation and tourism-based economic development, and scenic quality is an important aspect of quality-of-life” (O2 Planning and Design Inc. 2010).

A key challenge in trying to address this theme is the difference in how people react to renewable energy installations. While some may like seeing renewable energy development and even see tourism potential, others may see renewable developments as a negative impact on cultural assets or viewsheds (Barendse et al. 2016).

The Culture and Scenic Resources theme group was tasked with identifying features that are important to the community (provide a sense of place), such as features of historical significance, recreational areas and /or features where scenic resources are important.



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### **Tom Ikert**

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### **Lionel Juss**

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### **Ben Armstrong**

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### **Layne Johnson**

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### **Gavin Scott**

*Planner, Oldman Services  
Planning Commission.*

### **Collin Wildschut**

*Vice Chair, Newell Regional  
Tourism Association*

## Model Design Process

There were 7 participants in the Culture and Scenic Resources Theme Stakeholder group. Prior to the first workshop, three participants were interviewed (one staff person from each county and government representative from Alberta Culture and Tourism) to discuss the purpose of this theme area. Stakeholders were asked to identify cultural features, recreational features and areas where visual aspect is an important part of the experience.

During the first workshop, stakeholders were asked to identify features that the community uses for recreation or deems “iconic” in that it represents areas with less tangible or quantifiable benefits that people derive from nature. The stakeholders identified areas where renewable energy development would not be desirable. Additionally, stakeholders identified features where a person’s visual experience was deemed important. Visual experience can be represented by a viewshed, which is a geographical area that is visible from a specified location.

The following features were identified by stakeholders:

- Provincial Parks and protected areas
- Historic Resource Value (Classes 1 – 4)
- Campgrounds and reservoirs
- Dark skies
- Golf courses

In addition, the following features were identified as scenic resources where viewshed should be considered.

- Dinosaur Provincial Park
- Kinbrook Island Provincial Park
- Red Deer River
- Bow River
- Rosebud River
- Named lakes

Stakeholders discussed each feature and agreed to a buffer distance to represent a viewshed around the feature. Details on each feature, including why it is important, supporting regulations and planning documents are located in appendix 1.

Using an on-line survey, theme group participants scored each feature based on its cultural importance using a scoring system ranging from very high (100), high (75), medium (50), low (25) and very low (0). The value with the highest percentage of votes was applied to each feature (table 3). A detailed summary of the survey can be found in appendix 2.



PHOTO: SARAH SCHUMACHER

**Table 3: Culture and scenic resources features and values**

Culture and Scenic Resources Feature	Value
<b>Footprint features</b>	
Provincial parks and protected areas	100
Historic Resource Value (Classes 1 and 2)	100
Campgrounds and reservoirs	50
Dark skies	75
Golf courses	25
Historic Resource Value (classes 3 and 4)	25
Named lakes (2 km buffer)	50
<b>Scenic Resources</b>	
Dinosaur Provincial Park (5 km buffer)	100
Kinbrook Island Provincial Park (1 km buffer)	50
Red Deer River (1.5 km buffer)	75
Bow River (1 km buffer)	50
Rosebud River (1 km buffer)	75

Cultural Importance Score: 100=Very High 75=High 50=Medium 25=Low 0=Very Low

Dark skies were deemed an important scenic resource in the area, however modeling for this feature proved challenging. A world atlas of light pollution provides guidance on where in the study area dark skies are under the threshold considered for classification as a dark sky preserve. There are currently no dark sky preserves in the study area<sup>6</sup>. This is an area that requires further investigation and understanding of the potential (and desire) to protect dark skies. It was also unclear what impact renewable energy development has on dark skies.

No new data was developed for this process, and therefore the project team was dependent on existing datasets. Maps of source feature files are displayed in appendix 3.

The culture and scenic resource features and their values were used to develop the culture and scenic resource model. Each feature layer was overlaid and the highest value was assigned to each polygon. There is no cumulative value between features. See figure 9.

<sup>6</sup> [http://www.darksky.org/wp-content/uploads/bsk-pdf-manager/IDSP\\_Guidelines\\_Oct2015\\_23.pdf](http://www.darksky.org/wp-content/uploads/bsk-pdf-manager/IDSP_Guidelines_Oct2015_23.pdf)

## Theme Layer Development

1. Parks and Protected Areas: shapefile acquired from Alberta Parks (Last updated in November 2017, with a scale at 1:20K. This layer was also used to identify campgrounds.
2. Historic Resources Class 1-4: Spatial layer provided by Alberta Tourism and Culture. The Listing of Historic Resources is comprised of all the polygons that represent Historic Resources areas in Alberta. Historic Resources are land sections that possess known historic resources or have high potential for their presence, including archaeological, palaeontological, historical, natural and cultural resources. The purpose is for the protection of historic resources in Alberta (Last Updated 2017)
3. Dark Skies were depicted using The World Atlas of the Artificial Night Sky Brightness calculated in 2006 by David Lorenz. According to the Bortle scale there are nine-level numeric scale that measures the night sky's brightness of a particular location. Areas within 1-3 on the Bortle scale were selected to represent possible dark sky areas in the study area.
4. Brook Aqueduct was digitized from basemap imagery provide by ESRI in ArcMap.
5. Names Lakes were developed using Alberta base features extracted hydro waterbodies that had names (Last Updated in 2016, scale 1:20K)
6. Viewsheds were depicted by buffering each feature with the distance specified by stakeholders and then were further refined by using high and very high classes from the Scenic Resource Assessments visual value map developed by O2 Planning and Design Inc. for Alberta Tourism, Parks and Recreation Land Use Secretariat.

## Culture and Scenic Resources Modelling Results

The culture and scenic resources model is displayed in figure 9. In this model darker red represents higher cultural importance and lighter red represents lower cultural value. Figure 8 represents the percentage of land considered very high and high culture and scenic resources value for County of Newell County (4%), Wheatland County (1%) and across the study area (3%). This model is intended for high-level planning purposes and is not appropriate for parcel level evaluations. In addition, model outputs represent a snap shot in time and are dependent on resolution and accuracy of the source data used to represent each layer.

**Figure 8: Percent of land in high to very high culture and scenic resource value**

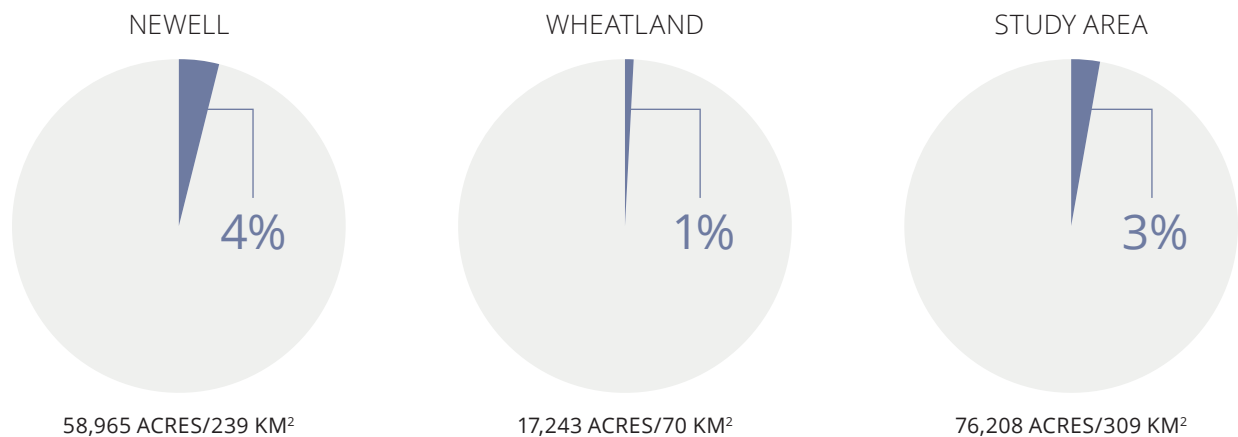


Figure 9: Culture and Scenic Resources Theme Model

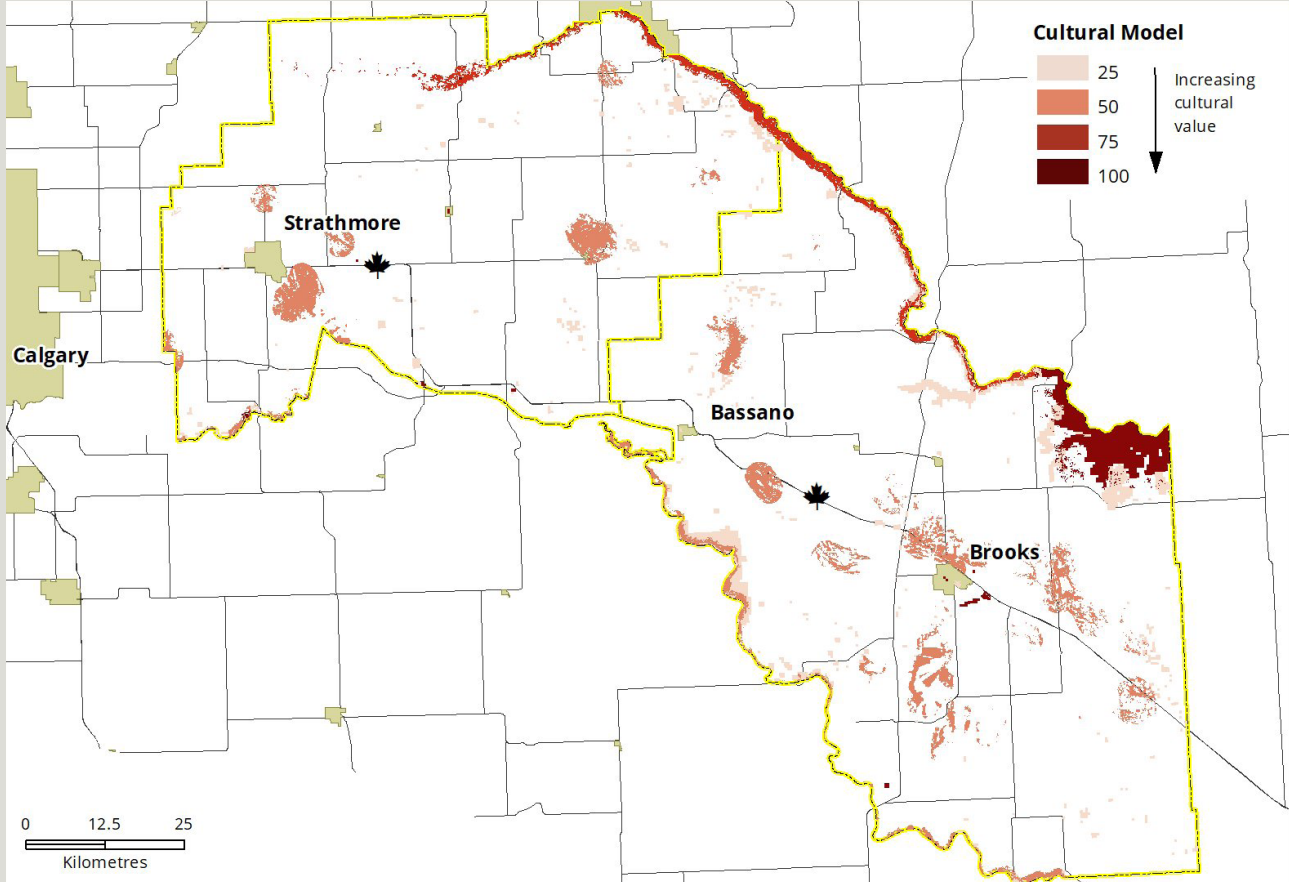


PHOTO: SARAH SCHUMACHER

# Composite Map and Least Conflict Lands

To develop a composite map that considers ecological, agricultural and cultural lands we summed the three maps, where by values ranged from a low of 0 to a high of 300 (figure 11). This approach best highlights areas of agreement between the three theme areas and helps us understand where most valued lands are located based on all three themes. Using the composite map, any value classified as 65 or lower was considered least conflict lands for renewable energy development. Data is displayed in quantiles, producing five bins of data that each hold 20% of the composite map output.

Zero values were classified as least conflict lands as these lands were not assigned a high value for any of the three themes, and potential least conflict lands were classified as any value 65 and lower on the composite map (figure 11). The composite model was displayed using quantiles as the stakeholders agreed to identify least conflict lands as those lands in the bottom 20% of values (>65 value). This can be adjusted by municipalities in the future by changing the data display inputs. For example, a municipality might choose the bottom 50% of values as least conflict instead of the bottom 20%. In addition, only those parcels falling within the wind and solar opportunity area were considered for inclusion as least conflict lands.

The least conflict lands were smoothed in GIS to remove sliver polygons from the analysis. Based on recommendations from industry stakeholders, for wind, parcels under 10 acres were removed from the least conflict lands (figure 13). For solar, parcels under 50 acres were removed from the least conflict lands (figure 12). These recommendations were made to align with the project focus on large scale renewable energy development.

A histogram of least conflict lands shows the range of parcel sizes available for solar and wind development (figure 10).

Figure 10: Histogram of number of LCL parcels based on acres

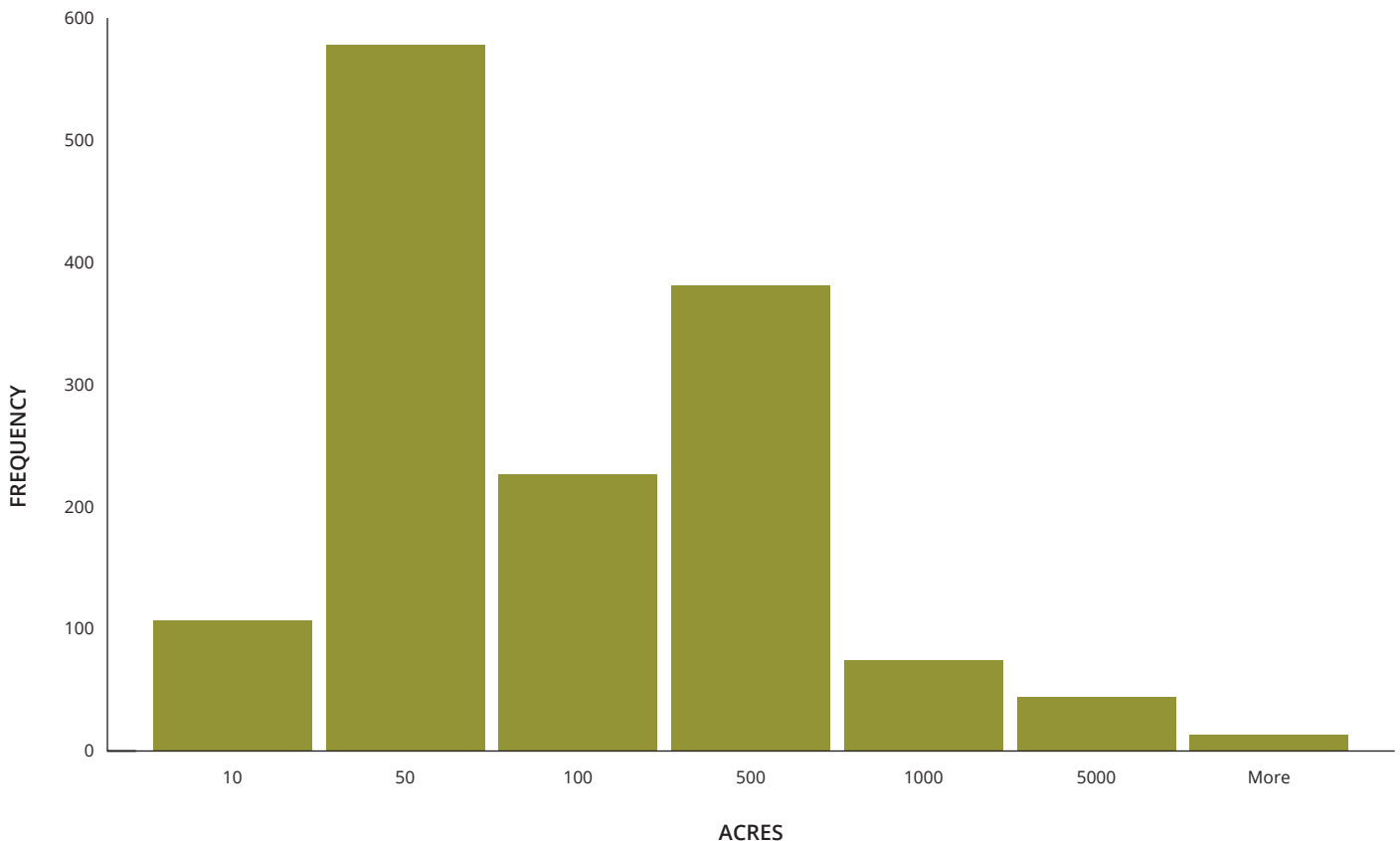


Figure 11: Composite Model

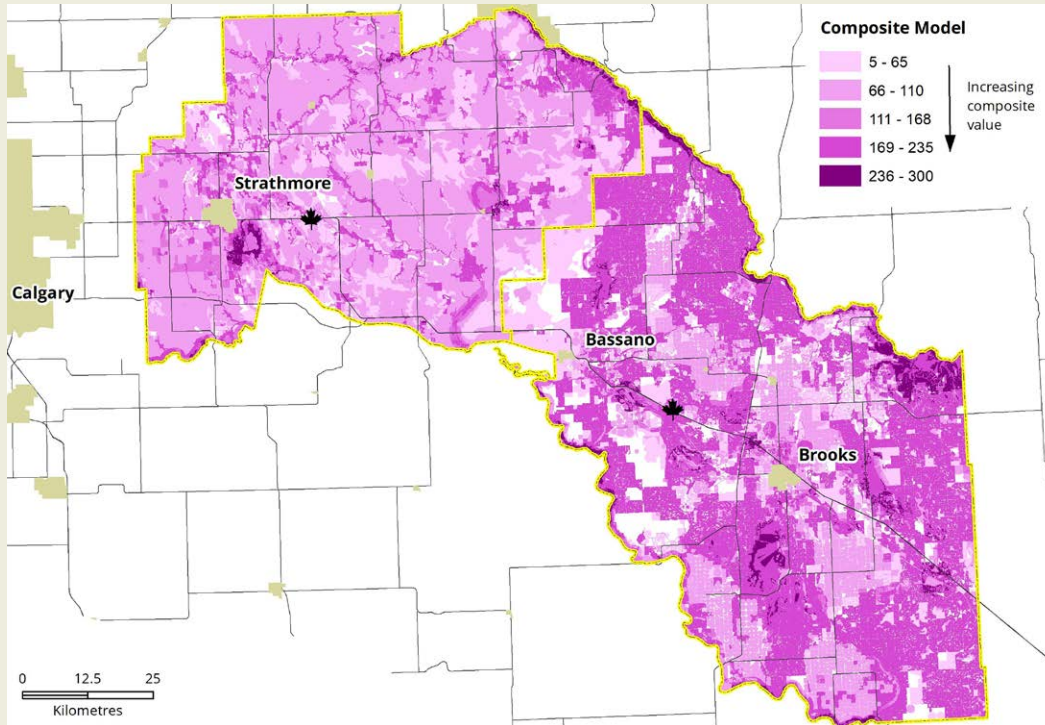


Figure 12: Least Conflict Lands Solar

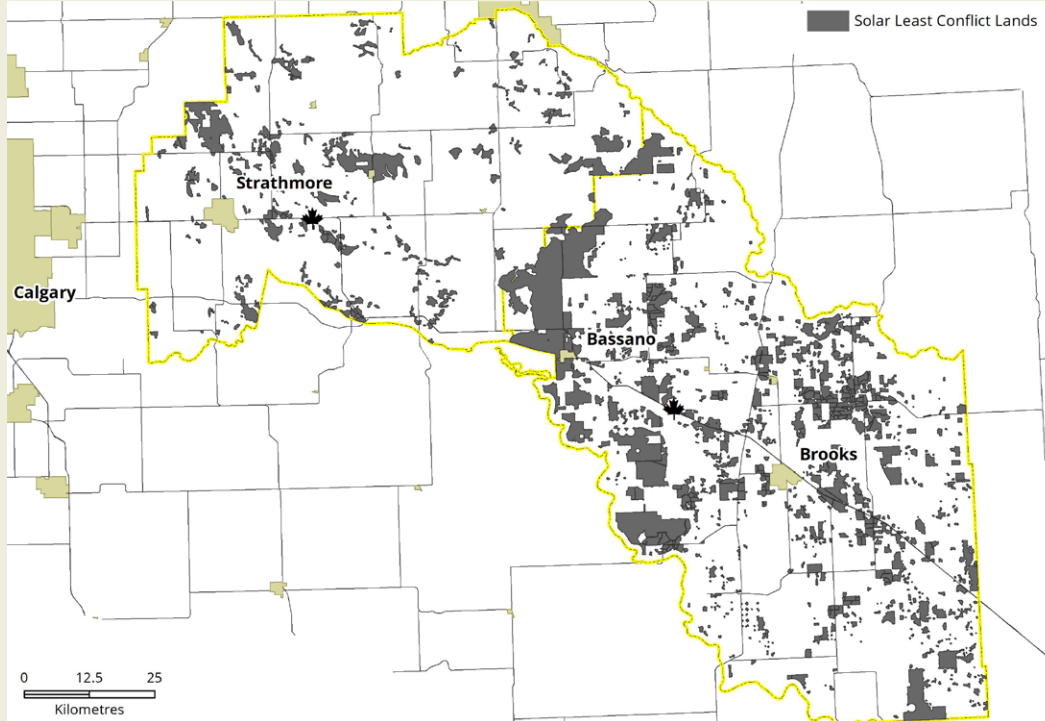
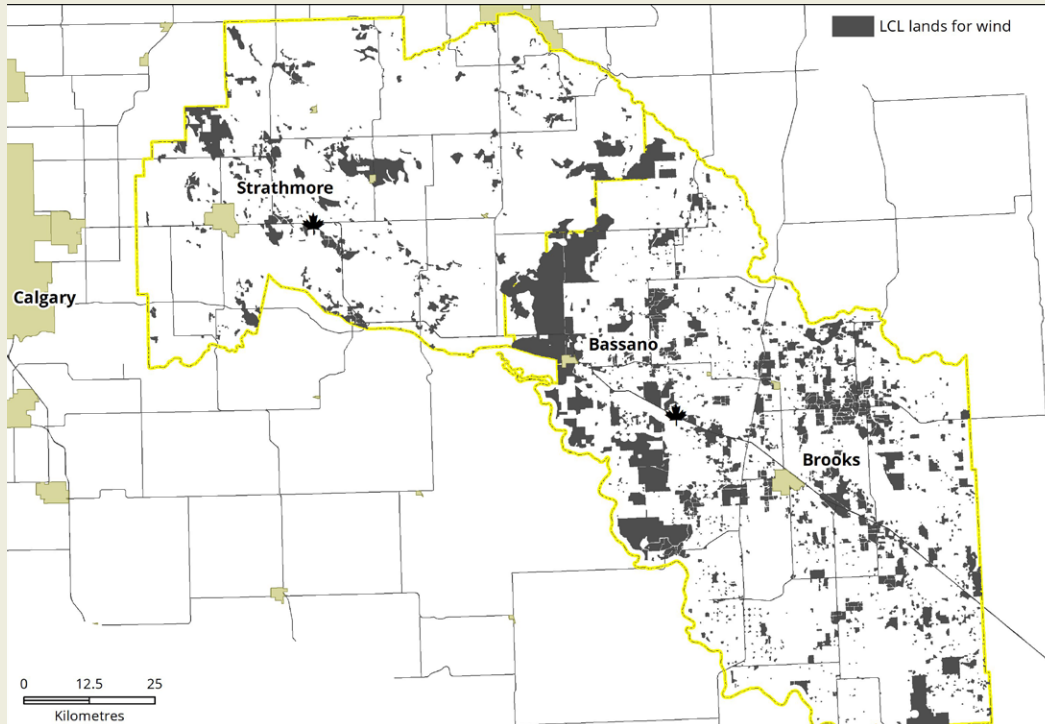


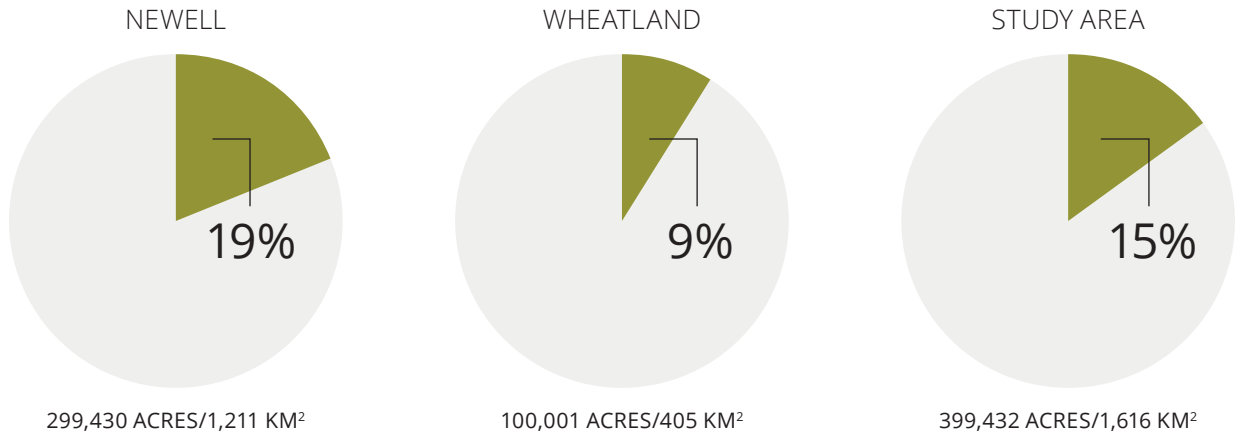
Figure 13: Least Conflict Lands Wind



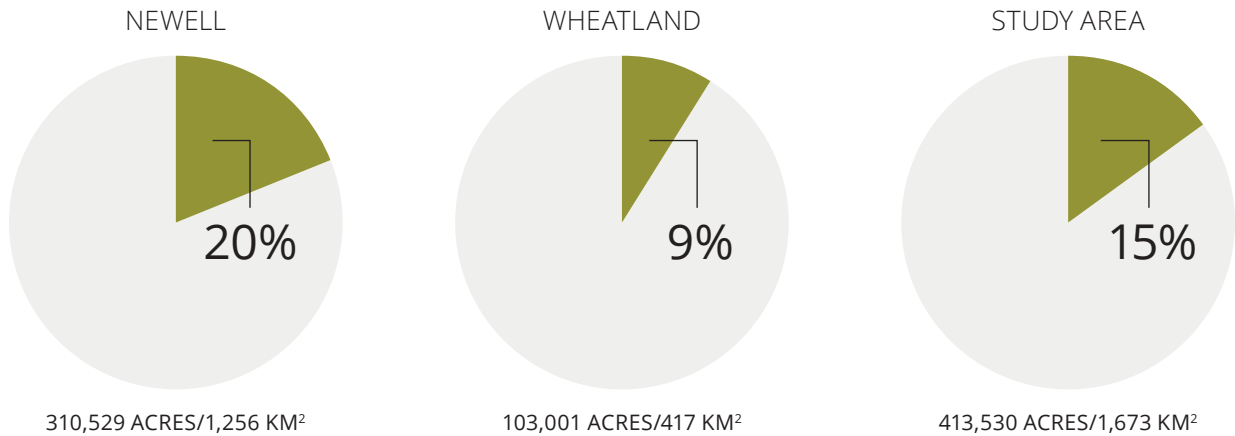


Approximately 15% of the study area is considered least conflict lands for renewable energy development based on wind and solar opportunity areas and ecological, agriculture and culture and scenic resources identified by the stakeholders in this process (figures 14 and 15). These lands represent the best opportunity areas for wind and solar development from a least conflict lands perspective.

**Figure 14: Percent of Area in Solar LCL**



**Figure 15: Percent of Area in Wind LCL**



The least conflict lands planning process does not address individual landowner values in relation to renewable energy development. There are likely landowners who are enthusiastic about having renewable energy development that are in areas of higher value and vice versa.

## Next Steps

The Least Conflict Lands pilot with Wheatland County and County of Newell was completed to demonstrate how a decision support tool can support renewable energy development and to test if the process was helpful to municipal decision making. Feedback from the pilot indicates there is a high level of interest to expand the tool to other municipalities. Miistakis is in the process of exploring the evolution of the Least Conflict Lands tool in Alberta. Sign up to the Miistakis Miinute newsletter to stay informed of our progress at [www.rockies.ca](http://www.rockies.ca)

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# Appendix 1: Feature, Justification and Regulations

## Ecological Theme

<i>Important features</i>	<i>Why is this feature important?</i>	<i>Regulations</i>	<i>Model inputs</i>
<b>Native grassland (consideration of intactness)</b>	Only 36% of native grasslands remain in grassland and parkland subregions in Alberta. Native grasslands provide a suite of ecological goods and services, including but not limited to: providing wildlife and fish habitat, promoting healthy riparian areas to maintain water quality and quantity, providing clean air, maintaining biodiversity, preventing soil erosion, providing carbon sinks, stabilizing ecosystems during drought, providing economic opportunities, etc. Supports numerous species at risk in the counties including burrowing owl, prairie rattlesnake, piping plover, etc. Intactness is important to support species at risk, large native grassland patches that are not disrupted by roads and other developments are important for supporting wildlife, including species at risk, reducing degradation of habitat due to invasive species, and reducing fragmentation of habitat.	AUC Rule 007  Native grassland is ranked a high sensitivity layer by AEP, and the Wildlife Directive for Solar Energy Projects and Wildlife Directive for Alberta Wind Energy Projects outline that native grasslands should be avoided when siting renewable energy projects	Grassland Vegetation Index (GVI)  Native grassland Vegetation Inventory (NPVI)
<b>Wetlands and associated riparian habitat</b>	Properly functioning riparian areas help maintain water quality and quantity, filter nutrients and pollutants, prevent erosion, and provide fish and wildlife habitat. Wetlands and their surrounding riparian habitat play an important role in providing habitat for species at risk, enhancing water quality by filtering pollutants and fine sediments.	AUC Rule 007  Water Act, Wetland Policy, SSRP, Wildlife Directive for Solar Energy Projects and Wildlife Directive for Alberta Wind Energy Projects: 100 m buffer around wetlands classes as bog, fen, marsh, shallow open water and swamp).	Alberta merged wetland inventory
<b>Riverine Riparian systems (rivers, creeks/streams and tributaries)</b>	Riparian areas provide important functions such as: trapping and storing sediment; building and maintaining banks and shores; storing water and energy; recharging aquifers; filtering and buffering water; reducing and dissipating energy created by the water body; maintaining biodiversity; and creating primary productivity like forage and browse	AUC Rule 007  Wheatland County and Newell County have setback bylaws (100 ft approximately 30 meters)	AB base features

<i>Important features</i>	<i>Why is this feature important?</i>	<i>Regulations</i>	<i>Model inputs</i>
<b>Conservation Lands</b>	Lands that have already been identified as having conservation value and where an agreement is in place that prevent renewable energy development	Alberta Land Stewardship Act Agreements may prevent wind development, conservation easement and or environmental reserve	Conservation easements on title (Western Sky, NCC_alberta, Ducks Unlimited, and Alberta Conservation Association), Environmental Reserves from WC and CofN
Large water bodies (lakes and reservoirs)	Important wildlife habitat (i.e. birds – resting areas tend to be around large water bodies)	AUC Rule 007 AEP wind and solar directives have setback no-go area of 1000m	AB base features
Environmentally Significant Areas	GOA process to identify important ecological features on the landscape, including unique ecological systems (i.e. Eagle lake and Wintering Hills)	Wheatland County Land Use Bylaw 7.10 states that no natural vegetation removal or alteration of natural drainage shall occur in an ESA.	GOA, ESA 2014
Species at Risk	Piping plover, trumpeter swan spatial datasets are refined and can be included	AUC Rule 007 AEP wind and solar directives	Due to wind and solar directives the follow spatial datasets will be incorporated into the model Piping plover, IBA areas, Key Wildlife and Biodiversity Zones

## Agriculture Theme

<i>Important features</i>	<i>Why is this feature important? (Description of feature)</i>	<i>Regulations</i>	<i>Model inputs (how can we represent this feature on a map?)</i>
<b>Irrigation infrastructure (canals)</b>	No-go area; Irrigation districts need to be able to access their infrastructure easily for maintenance, repairs, etc	Land Use Bylaw - setback requirements are in the Land Use Bylaw; Newell has discussed setback with the EID to give them what they need	Acquired from EID and WID and will put a 30 m setback from infrastructure. Technically it is from the irrigation districts' right of way.
<b>Irrigated acres (assessments)</b>	The land is already licensed and receiving irrigation, increases production, investment in infrastructure ID/farmer, increase in diversity of available options, reservoir's support tourism/recreation opportunities, climate resiliency and production/ community resiliency	Irrigation Act	Acquired from WID and EID
<b>Irrigable lands</b>	lands not in irrigation but assessed and has potential		Alberta Agriculture Irrigable Lands Class 1-4

<i>Important features</i>	<i>Why is this feature important? (Description of feature)</i>	<i>Regulations</i>	<i>Model inputs (how can we represent this feature on a map?)</i>
<b>Native grassland private lands</b>	Grazing, biodiversity/habitat, resiliency, (carbon sequestration), flood mitigation and water filtration	Public lands act, species at risk, migratory birds, federal species at risk, wildlife act	GVI unless AB Agriculture layer has better representation
<b>Crown Land</b>	No development	GOA: no renewable development on Crown land	
<b>Land Productivity_crop</b>	Productivity for crops including: alfalfa, canola, 'sss' grain as per LSRS	SSRP and Land Stewardship Act support protection of high value agriculture land	AGRASID LSRS
<b>Land Productivity_crop/pasture</b>	Pasture supports cattle		AGRASID LSRS
<b>Intactness of pasture land and crop land</b>	Economics of scale, easier to manage, less edge effect to reduce invasive species/pests impacts, proximity to farmyards, distance to market/facilities – also, ssrp, mdp		

## Culture and Scenic Resources

<i>Important features</i>	<i>Why is this feature important? (Description of feature)</i>	<i>Are there regulations related to this feature?</i>	<i>Are there viewshed concerns related to this feature?</i>
<b>River Valleys:</b> - Rosebud - Red Deer River - Bow River	Area of unspoiled beauty, natural beauty, limited or no industry, high eco-tourism potential		Viewshed important: 1 km buffer for Bow River and Rosebud. Red Deer River 1.5 km buffer
<b>Dinosaur Provincial Park</b>	Unique, historical, world heritage site, iconic	Prov. Park and Alberta Culture and Tourism as a HRV 1 class under Alberta Historic Resources Act and UNESCO site	Viewshed important: 5 km buffer so you can't see anything (wind) from within the park or approaching. Want to protect the view from south entrance
<b>Kinbrook Island Provincial Park</b>	Escape from industry/development, bird watching area. Really important to local community		Viewshed important: 2 km buffer

<i>Important features</i>	<i>Why is this feature important? (Description of feature)</i>	<i>Are there regulations related to this feature?</i>	<i>Are there viewshed concerns related to this feature?</i>
<b>Brooks Aqueduct</b>	The Brooks Aqueduct site contains the remains of a 3.2 kilometre-long reinforced concrete flume designed to carry water east from Lake Newell. It was built between 1912 and 1914 northeast of the lake and just east of the town of Brooks. The designation applies to an area of 19.11 hectares, including the flume and an unusual siphon system designed to take water under the Canadian Pacific Railway line. The Brooks Aqueduct is operated by Alberta Culture and Community Spirit as an interpreted Provincial Historic Site.	Historical Resources Act	
<b>Tourism sites (not provincial parks) include campgrounds and recreational reservoirs.</b>			0.5 km viewshed buffer on campgrounds and recreational reservoirs
<b>Lakes (named)</b>			Viewshed important: 2 km buffer
<b>Wyndham-Carseland Provincial Park</b>		Provincial Park	No viewshed concerns
<b>Historic sites identified by Alberta Tourism and Culture</b>	Low importance for this process, as site specific and requires on the ground assessment	HRV status code 1-5 and categories	No viewshed concerns
<b>Dark Skies</b>	No dark sky preserves in the area. Consideration could be given to combining dark sky preserves with viewshed protected areas in close proximity to parks and undisturbed natural features like Dinosaur Provincial Park and the Red Deer River Valley.		
<b>Golf courses</b>			No viewshed concerns (could be at specific sites but will not be considered for this process)

# Appendix 2: Stakeholder Survey

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## Ecological Theme

### ECOLOGICAL THEME MODEL METHODOLOGY:

The following changes were made on the model based on feedback received and the research team's findings:

- Conservation agreement lands and environmental reserves were separated so they can be scored as two different features
- Key Wildlife and Biodiversity Zones were added in as suggested from the What We Heard feedback. The layer impacts Wheatland County near Bow River in the southwest corner.

The final product for the Ecological Theme will be a spatial layer (GIS raster based on 30m pixels) with corresponding ecological values scored by the Ecological Theme stakeholder group. Areas with important ecological features will reflect stakeholder ratings from very high to very low ecological value (100=very high, 75=high, 50=medium, 25=low, 0=very low).

The following features were identified in AEP regulations and/or municipal bylaws and have been assigned a very high ecological value of 100:

- Crown Land (displayed in data basin);
- Provincial Parks and Protected Areas (displayed in data basin);
- County Environmental Reserves;
- Trumpeter Swans Critical Habitat (displayed in data basin);
- Piping Plover Critical Habitat (displayed in data basin);
- Wetlands (class 'A' with 100m buffer);
- Large Permanent Water Courses (100m buffer)
- Small and Intermittent Water Courses (45m buffer)

In addition to the above features, the following features will be scored based on your feedback in the survey below:

- Conservation Agreement Lands;
- Named Water Bodies plus 1000m buffer;
- Native grassland (removed parcels <160 acres unless within the riparian buffers);
- Important Bird Area (displayed in databasin);

- Environmentally Significant Areas (use top 25% rating system);
- Key Wildlife and Biodiversity Zones.

Your individual scores will be reviewed and the most common score will be applied to each of the ecological features in the model.

Each spatial layer (representing an ecological feature) will be acquired or developed and assigned the max ecological value (100, 75, 50, 25 or 0). A cell statistics tool in GIS will be used to extract the highest value for each grid cell enabling the highest value to be assigned when there are overlapping values. Therefore there is no cumulative value, but instead we assign the highest value per 30m grid cell.

Please now respond to the survey questions below.

### SURVEY QUESTIONS AND RESULTS (BASED ON 11 RESPONDENTS)

1. The following features were identified in AEP regulations and/or municipal by-laws and have automatically been assigned a very high ecological value of 100. Please comment if you have any concerns. Comments listed below the feature.
  - Crown land (displayed in data basin)
    - Crown land is not analogous with high ecological value/native lands. Some may be converted to tame species or agricultural uses that don't have a high ecological value.
  - Provincial Parks and protected areas (displayed in data basin)
    - No comments
  - County Environmental Reserve
    - Could CAs be included with this feature layer
    - Might be hard to get for Wheatland County
  - Trumpeter swans critical habitat (displayed in data basin)
    - Is this duplicated with the IBA data?

- Piping Plover critical habitat (displayed in data basin)
    - Is this duplicated with the IBA data?
    - I'm wondering if 'critical habitat' could just be lumped into one category.
  - Wetlands (class a with 100m buffer)
    - No concerns
  - Large permanent water courses (100m)
    - No concerns
  - Small and intermittent water courses (45m buffer)
    - No concerns
2. Please score each of the following features in terms of ecological value. Note: this is not a ranking exercise this time round! You may have the opinion that some features are more important than others. Or, you may think some features are of the same value/importance.

Feature	100	75	50	25	0
Conservation Agreement Lands	57%	14%	29%	0%	0%
Named Water Bodies with 1000m buffer	14%	86%	0%	0%	0%
Native grassland	86%	0%	14%	0%	0%
Important Bird Areas	14%	57%	29%	0%	0%
Environmentally Significant Areas	43%	43%	14%	0%	0%
Key Wildlife and Biodiversity Zones	29%	71%	0%	0%	0%

3. Please enter any comments/concerns you would like to share about the Ecological Theme modeling approach:
- No concerns. Looking forward to seeing what the map turns out like!
  - Few of these issues are black and white. Although we always like to measure these issues it is definitely a challenge to do so. Even as an individual I have great difficulty putting numbers to them. Good luck in your efforts.
  - Would this modeling take into account the buffers necessary for different types of energy development? Just thinking the impacts from a buried pipeline would be different than a wind farm, but maybe this has already been addressed.
  - I think you are on the right track. I agree with the modeling approach.
  - Within the datasets used, is there information specifically related to Migratory bird paths or areas of bat abundance? For wind farms, these species will see direct impact, and therefore these features may want to be considered from a specific data layer to represent this aspect of the equation. IBAs don't get at flyways, and I don't believe this is considered in ESA data either.
  - I am not concerned about it. I think it very comprehensive. The concerns tend to arise in actuality and whether these guidelines are followed, but that is in the next steps.
  - No concerns.



# Agriculture Theme

## METHODOLOGY FOR AGRICULTURE THEME

The product from the Agriculture Theme will be a spatial layer (GIS raster) with corresponding agriculture values scored by the Agriculture Theme stakeholders. Areas with important agriculture features will be scored from very high to low agricultural value (100= very high, 75= high, 50= medium, 25= low, 0=very low).

The following areas were identified in municipal bylaws and have automatically be assigned a very high agricultural value of 100.

- Irrigation Infrastructure (canals, pipelines, reservoirs, spillways and natural waterways) with buffer.

In addition to the above layers, you are being asked to score the following agriculture features in the survey below. Descriptions of the different classes are provided within the survey.

- Irrigation acres (lands currently in irrigation, displayed in data basin) from Alberta Agricultural Irrigable lands dataset classes 1-4.

- Irrigable lands (lands not in irrigation but have been assessed and have potential) from Alberta Agriculture Irrigable Lands data set classes 1-3.
- Native grassland (private lands) as pasture
- Land suitability polygons (defined areas) for small spring seeded grains, alfalfa, canola and brome. Each have a primary and secondary LSRS class assigned to them. We will use a matrix to assign each polygon based on the percentage of polygon and primary and secondary class types. This is GIS talk for saying we need to refine the model to pull out what stakeholders consider high value agriculture lands.

In the other theme models we have selected the highest value for each grid cell enabling the highest value to be assigned when there are overlapping values. Therefore there is no cumulative value, but instead we assign the highest value per grid cell.

In agriculture we will assess all the features with their scores and then determine best approach for developing agriculture model. Please begin the survey below.

## SURVEY QUESTIONS AND RESULTS (BASED ON 11 RESPONDENTS)

1. Irrigation infrastructure and setback are regulated by the Irrigation Act and municipal bylaws which prevent development and have automatically been assigned a very high agriculture value of 100. Please comment if you have any concerns.
  - a. No one had concerns.
2. Please score Irrigation acres (lands currently in irrigation, displayed in data basin) in terms of agricultural value. This not necessarily rating system, you can score different classes with the same value. Percent of respondents

Irrigation Class	Very High	High	Medium	Low	Very Low
Class 1: excellent for irrigated agriculture with no significant limitations.	91%	9%	0%	0%	0%
Class 2: good irrigation land with moderate limitations.	70%	30%	0%	0%	0%
Class 3: fair for irrigation.	18%	18%	45%	18%	0%
Class 4: severe limitations for irrigation and requires special crop, soil and water management practices.	0%	18%	27%	45%	9%

3. Please score each Land Suitability Rating Class in terms of agricultural value. This not necessarily rating system, you can score different classes with the same value. There is not any LSRS class 1 in the study area.

Land Suitability Rating System	Very high	High	Medium	Low	Very Low
LSRS class 2 (slight limitations to growth)	67%	33%	0%	0%	0%
LSRS class 3 (moderate limitations to growth)	33%	33%	33%	0%	0%
LSRS class 4 (severe limitations to growth)	0%	22%	33%	22%	22%
LSRS class 5 (very severe limitations to growth)	0%	0%	22%	22%	56%

4. Please enter any comments/concerns you would like to share about the Agriculture Theme modeling approach:
- We need to consider that low suitability for growth as an irrigated crop does not negate the ability of the land to be used for pasture. So, a low ranking for irrigation may also translate into a high ranking for pasture.
  - Clearly, the agricultural value of a particular piece of land will need to be considered along with other values in assessing conflict potential
  - More clear definitions about “agricultural value”... for annual crop production or forage production or both. I think the potential sweet spot for renewable energy locations are the lands not in irrigated or annual crop production on high value (LSRS 2 and 3 lands) or native grassland but some of the lower classification tame pasture.

## Culture and Scenic Resource

### CULTURAL AND VIEWSHED THEME MODEL METHODOLOGY

The product from the cultural and viewshed theme model will be a spatial layer (GIS raster based on 30m pixels) with corresponding cultural and viewshed values agreed on by the cultural and viewshed theme group. Areas with important cultural features will be rated from very high to very low cultural and viewshed value.

The following areas were identified in AEP regulations and/or municipal bylaws and will therefore automatically be assigned a very high cultural and viewshed value of 100:

- Provincial Parks and Protected Areas footprint (displayed in data basin);

In addition to these layers the following layers will be considered as higher value areas and afforded a value of 100, 75, 50, 25 or 0 as determined by the cultural viewshed stakeholder group:

- Dinosaur Provincial Park viewshed represented with a buffer from park boundary of 5 km
- Kinbrook Island Provincial Park viewshed represented with a buffer from parking boundary of 1 km

- Red Deer River viewshed presented with a 1.5 km buffer
- Bow River viewshed represented with a 1 km buffer
- Rosebud River viewshed represented with a 1 km buffer
- Brooks Aqueduct footprint
- Campgrounds and reservoirs footprint
- Campgrounds and reservoirs viewshed represented with a 0.5 km buffer
- Names lakes viewshed represented with a 2 km buffer
- Historic sites identified by GOA footprint
- Dark Skies
- Golf courses footprint

Your individual scores will be reviewed and the most common score will be applied to the cultural and viewshed in the model.

Each spatial layer representing cultural and viewshed features will be acquired or developed and assigned the max cultural and/or viewshed value (100, 75, 50, 25 or 0). A grid statistics tool will be used to extract the highest value for each grid cell enabling the highest value to be assigned when there are overlapping values. Therefore there is no cumulative value, but instead we assign the highest value per 30m grid cell.

SURVEY QUESTIONS AND RESULTS (BASED ON 6 RESPONDENTS)

1. Please score each of the following cultural features in terms of value. These features are about the footprint only as viewshed was not deemed important.

Features	Very High	High	Medium	Low	Very Low
Brooks Aqueduct footprint	0%	33%	33%	33%	0%
Campgrounds and reservoirs footprint	0%	0%	100%	0%	0%
Dark Skies	33%	33%	33%	0%	0%
Golf courses footprint	0%	0%	25%	50%	25%
HRV class 3 and 4					

2. Please score each of the following view shed features in terms of value.

Viewsheds	Very High	High	Medium	Low	Very Low
Dinosaur Provincial Park (5 km buffer)	80%	0%	20%	0%	0%
Kinbrook Island Provincial Park (1 km buffer)	0%	33%	67%	0%	0%
Red Deer River (1.5 km buffer)	0%	80%	20%	0%	0%
Bow River (1 km buffer)	0%	25%	50%	25%	0%
Rosebud River (1 km buffer)	0%	67%	33%	0%	0%
Named lakes (2 km buffer)	0%	0%	75%	25%	0%

3. Do you think we should include dark skies in the model? In the comments field please provide suggestions on how can represent this feature in the model.

- Yes: 60% of stakeholders
- No: 40.00% of stakeholders

Comments field:

- That is hard to quantify and could be difficult to implement in this type of model. I would leave it to individual Counties and MD's to provide appropriate policy framework to maintain their dark skies and view sheds. There are so many factors that can come into play that impact dark skies.
- I think that if you drive 30 minutes east of Strathmore, it will be relatively easy to find Dark Sky area's
- If it is a designated dark sky park then include not just a personal opinion

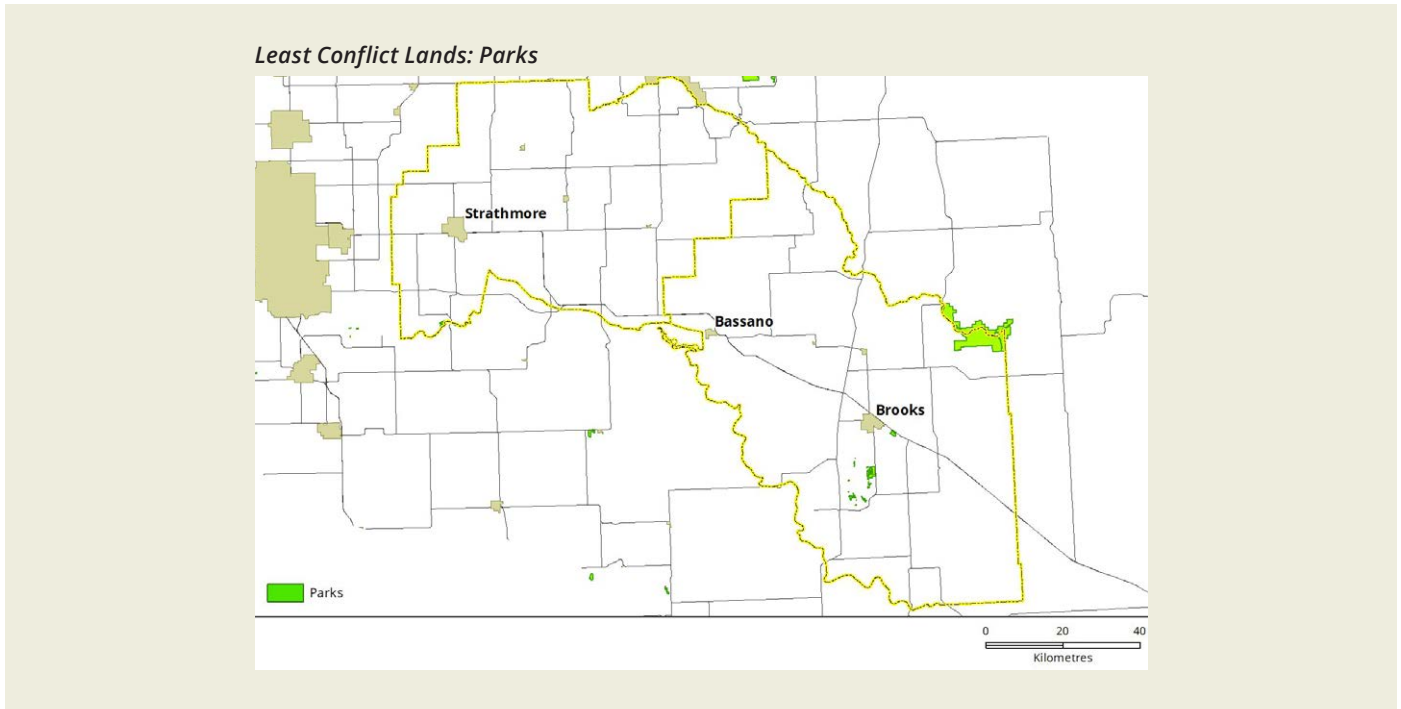
4. Please enter any comments/concerns you would like to share about the cultural and viewshed theme modeling approach:

- At the end of the day, cultural places and view sheds are all individually constructed. However, I think the historically identified and documented areas are the most important, as their importance has been recognized by the Province and other government bodies, that can further provide more regulatory and protective measures to protect them in the future.
- No concerns
- This will be a tough area to come to consensus.
- RE is looked at by people differently. Some people look at the windmills as awe inspiring, (look what Man can do) and has tourist potential. I, however see a monstrosity (folly of Man). If I see another it will be too soon. How do you balance these 2 equally important viewpoints?"

# Appendix 3: Features Source Layers

## Ecological

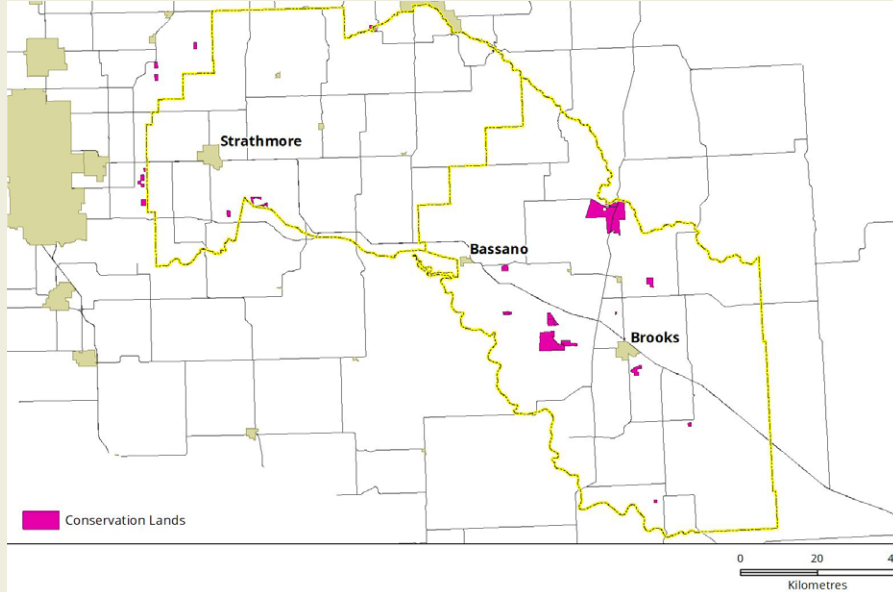
1. Parks and Protected Areas: shapefile<sup>7</sup> acquired from Alberta Parks (Last updated in November 2017, with a scale at 1:20K).



2. County Environmental Reserve and Conservation Agreement Lands was developed using the following six data sources:
  - a. County of Newell Environmental Reserves
  - b. Wheatland County Environmental Reserves
  - c. Nature Conservancy of Canada Conservation Easements. (Updated 2018, scale quarter section).
  - d. Western Sky Land Trust Conservation Easements. (Updated 2018, scale quarter section level).
  - e. Alberta Conservation Association, lands with Conservation Agreements (Updated 2018, legal land descriptions).
  - f. Ducks Unlimited, Lands with Conservation Agreements. (Updated 2018, legal land descriptions).

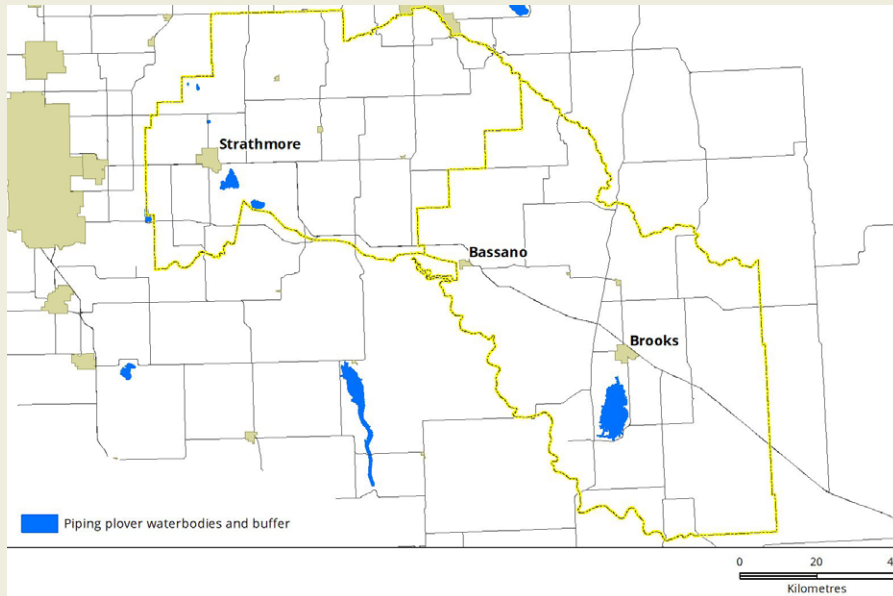
<sup>7</sup> <https://www.albertaparks.ca/albertaparksca/library/downloadable-data-sets/>

**Least Conflict Lands: Environmental Reserve and Conservation Agreement Lands**



3. Piping Plover waterbodies: a shapefile<sup>8</sup> acquired from AEP of Piping Plover Waterbodies includes all water bodies as of 2009 with confirmed breeding pairs as determined by annual surveys. An entire water body is considered a nesting site. (Last updated in 2010).

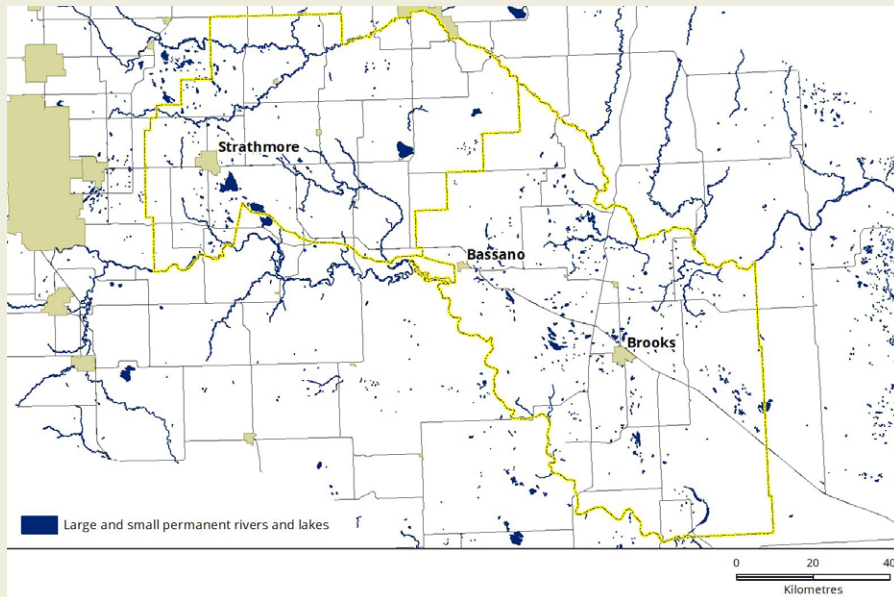
**Least Conflict Lands: Piping Plover Waterbodies**



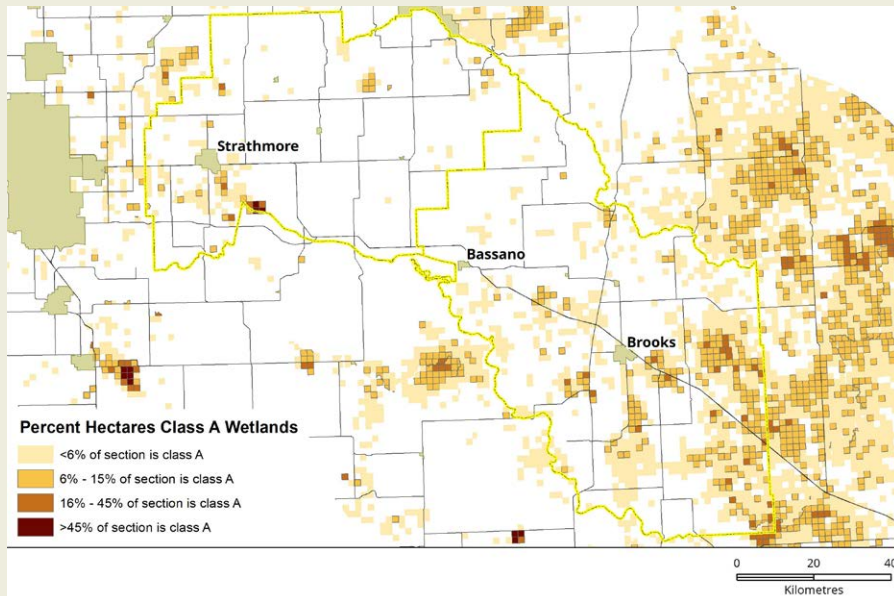
8 <http://aep.alberta.ca/forms-maps-services/maps/wildlife-sensitivity-maps/default.aspx>

4. Large and small Permanent Water Course extracted from Alberta base features. (Scale at 1:20K).
5. Wetlands: Developed a spatial layer based on the offset wetland provincial data by identifying the number of hectares of class A wetlands per section. These lands represent the best opportunity areas for wind and solar development from a lease conflict lands perspective.
  - 5-14% of section is class A (25)
  - 15-44% of section is class A (50)
  - >45% of section is class A (75)

**Least Conflict Lands: Large and Small Permanent Rivers and Lakes**

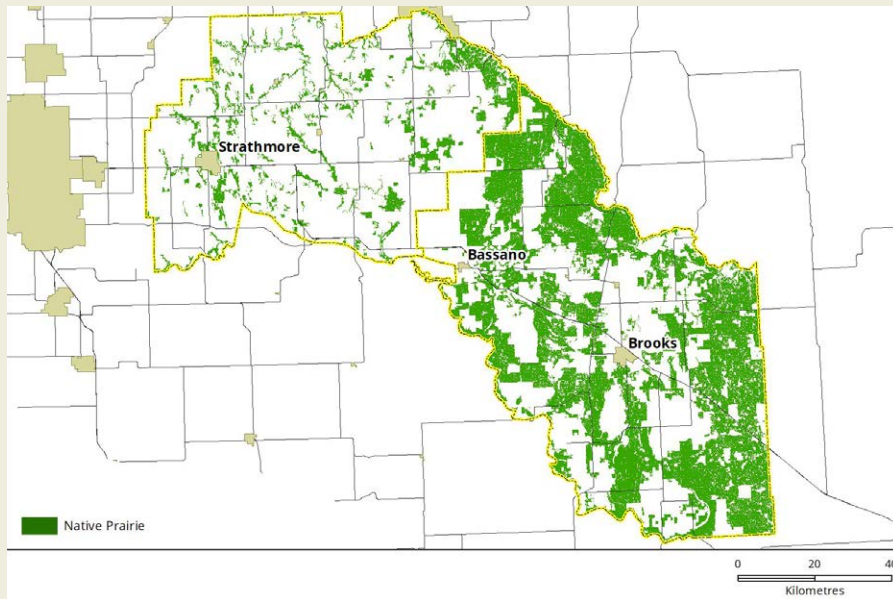


**Least Conflict Lands: Class A Wetlands**



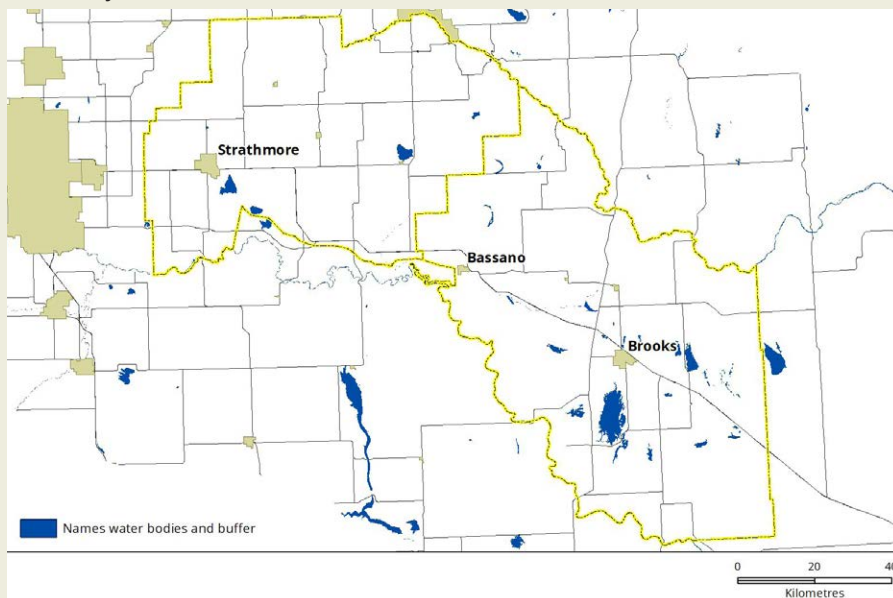
6. Native grassland: was identified native grassland from the Grassland Vegetation Index (GVI) – using native vegetation upland (where there was 50% herbaceous veg within a quarter section). The GVI was updated in 2009. We extracted human footprint (Alberta Biodiversity Monitoring Institute 2016) features including well pads, well pad roads, unknown clearings, crop, and tame pasture from the native grassland footprint.

*Least Conflict Lands: Native Grassland*



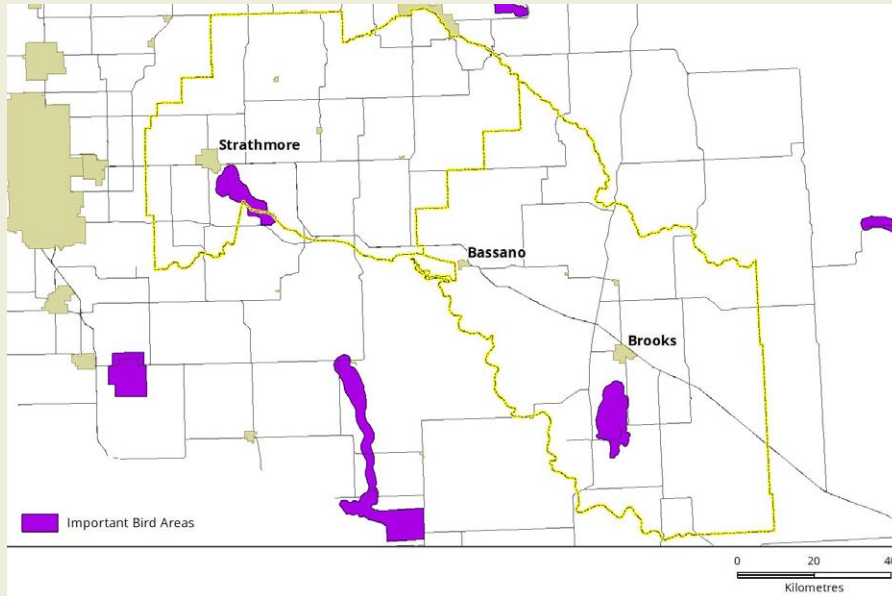
7. Named water bodies and 1000m buffer was developed using Alberta base features extracted hydro waterbodies that had names (Last Updated in 2016, scale 1:20K)

*Least Conflict Lands: Named Waterbodies*

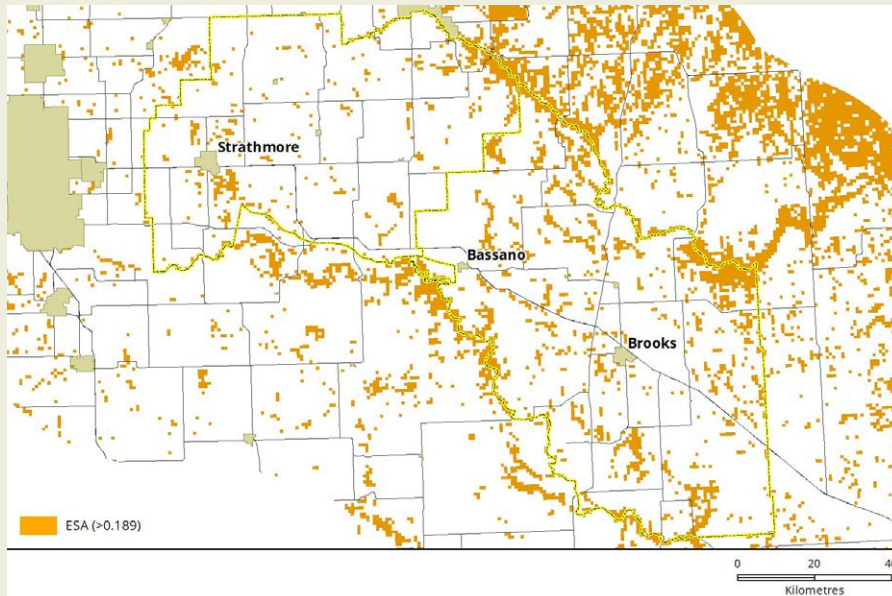


8. Important bird area shapefile<sup>9</sup> acquired from Bird Studies Canada. Important Bird Areas (IBAs) are discrete sites that support specific groups of birds: threatened birds, large groups of birds, and birds restricted by range or by habitat. IBAs are identified using criteria that are internationally agreed upon, standardized, quantitative, and scientifically defensible. This gives them a conservation currency that transcends international borders and promotes international collaboration for the conservation of the world's birds (Bird Studies Canada 2015).
9. Environmentally Significant Areas: shapefile<sup>10</sup> was acquired from Alberta Parks. Environmentally Significant Areas (ESAs) are generally defined as areas that are important to the long-term maintenance of biological diversity, physical landscape features and/or other natural processes, both locally and within a larger spatial context (Fiera Biological Consulting LTD. 2014). (Last updated in 2014, scale per quarter section).

**Least Conflict Lands: Important Bird Areas**



**Least Conflict Lands: Environmental Significant Areas**



<sup>9</sup> [https://www.ibacanada.org/explore\\_how.jsp?lang=EN](https://www.ibacanada.org/explore_how.jsp?lang=EN)

<sup>10</sup> <https://www.albertaparks.ca/albertaparksca/library/environmentally-significant-areas-report/>

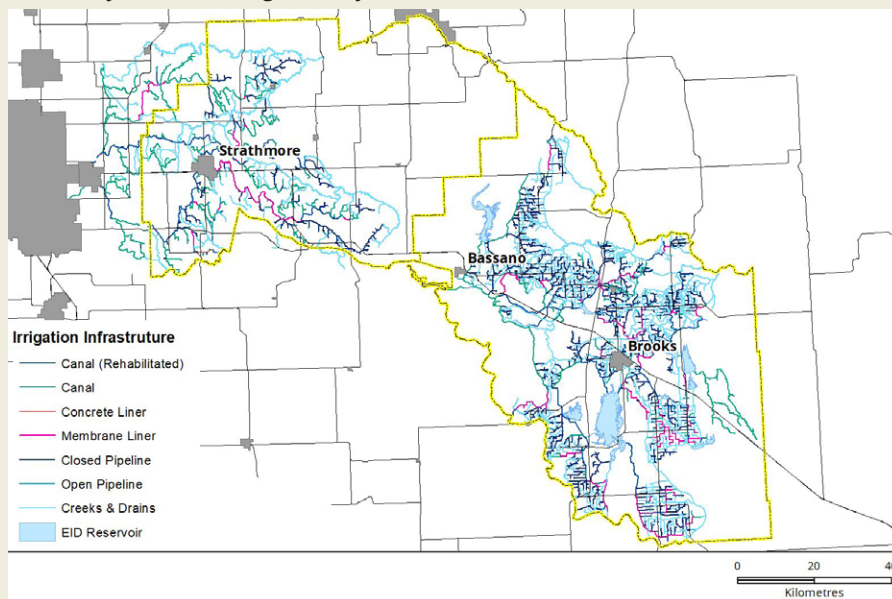


10. Key Wildlife and Biodiversity Zones: Endorsed by the Government of Alberta, includes a combination of key wildlife habitat from both uplands and major watercourse valleys. The basis of this zone was determined using major river corridors, valley topography, valley slope breaks and ungulate winter densities. The Key Wildlife and Biodiversity Zone is intended to prevent loss and fragmentation of habitat; prevent short and long-term all-weather public vehicle access; prevent sensory disturbance during periods of thermal or nutritional stress on wildlife; and prevent the development of barriers to wildlife corridors (e.g., stream crossings). Note that this layer is a consolidation of previous Key Ungulate Areas, Key Ungulate Winter ranges, and Class C - Key Wildlife and Watercourse areas. (Last updated in 2010)

## Agriculture

1. Irrigation Infrastructure and setbacks were provided by the Western Irrigation District (WID) and Eastern Irrigation District (EID) and include canals, pipelines, reservoirs, spillways and natural waterways. Setbacks vary depending on location (tend to be around 15-30m) and were provided by Western Irrigation District. For the Eastern Irrigation District similar setbacks were applied.

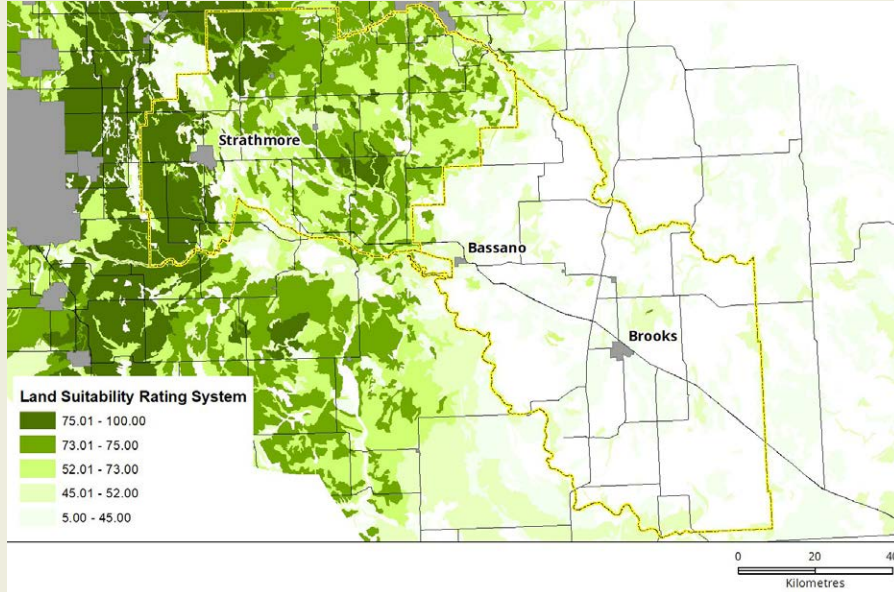
**Least Conflict Lands: Irrigation Infrastructure**



2. Crop productivity was evaluated using land suitability rating system developed by Alberta Soils Inventory database (AGRSID 4.1) provided by Alberta Agriculture and Forestry. Stakeholders opted to value all crops equally (canola, brome (tame pasture), spring seed grains and alfalfa) as crops are often rotated (note irrigation acres were included as a separate evaluation).

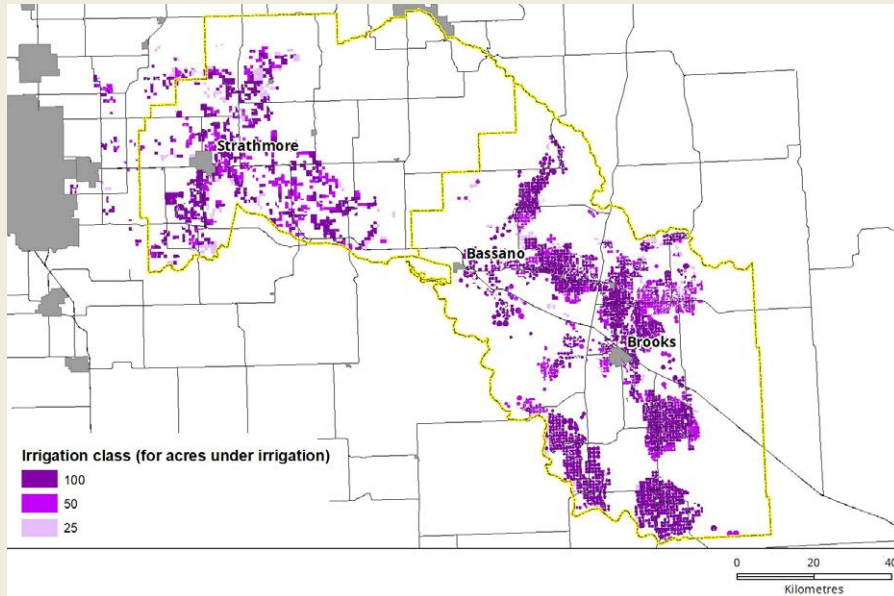
Land suitability polygons (defined area spatially) for small spring seeded grains, alfalfa, canola and brome have assigned LSRS classes. Each polygon has a percentage of primary, secondary and sometimes classes that add up to 100 percent. To produce a crop and pasture suitability layer, the value (high...etc.) was assigned to each class type based on stakeholder feedback. Each polygon was scored using the following formula: (primary class score assigned by participants \* percent of polygon + secondary class score assigned by participants \* percentage of polygon + tertiary class score assigned by participants \* percent of polygon). This was re-run for each type of crop small spring seeded grains, alfalfa, canola and brome. This resulted in four models, one for each crop type. Since stakeholder equated all crop types to be equal to create the final LSRS model, the four models were overlaid and the highest value was assigned to the polygon.

*Least Conflict Lands: LSRS*



3. Irrigation Acres (lands currently under irrigation) was provided by WID and EID. Alberta Agriculture and Forestry provided land classes for irrigation (1-5), where 1 is excellent for irrigation and 5 is non-irrigable. Each land class was given a value based on agriculture stakeholder score (figure 6). The land classes were then equated to lands in irrigation provided by WID and EID.

*Least Conflict Lands: Irrigation Acres*

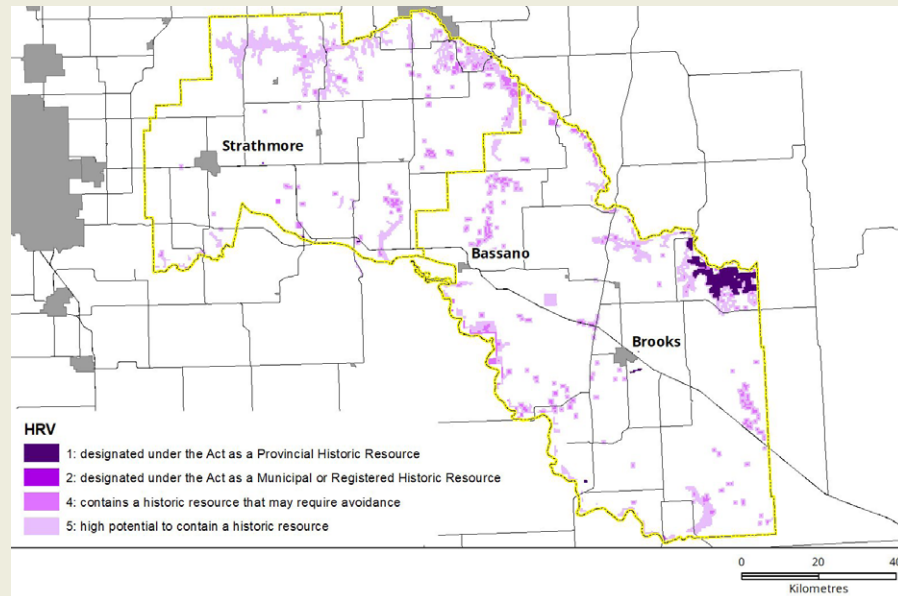


- Native grasslands play an important role in livestock production. Other forage types were addressed in the LSRS layer. Native grasslands was developed using the same methodology as outlined in the Ecological Theme. Native grassland was identified using the Grassland Vegetation Index (GVI) – using native vegetation upland (where there was 50% herbaceous veg within a quarter-section). The GVI was updated in 2009. We extracted human footprint (Alberta Biodiversity Monitoring Institute 2016) features including well pads, well pad roads, unknown clearings, crop, and tame pasture from the native grassland footprint. Lastly parcel sizes under 155 acres were removed. See Ecological section.

## Culture and Scenic Resources

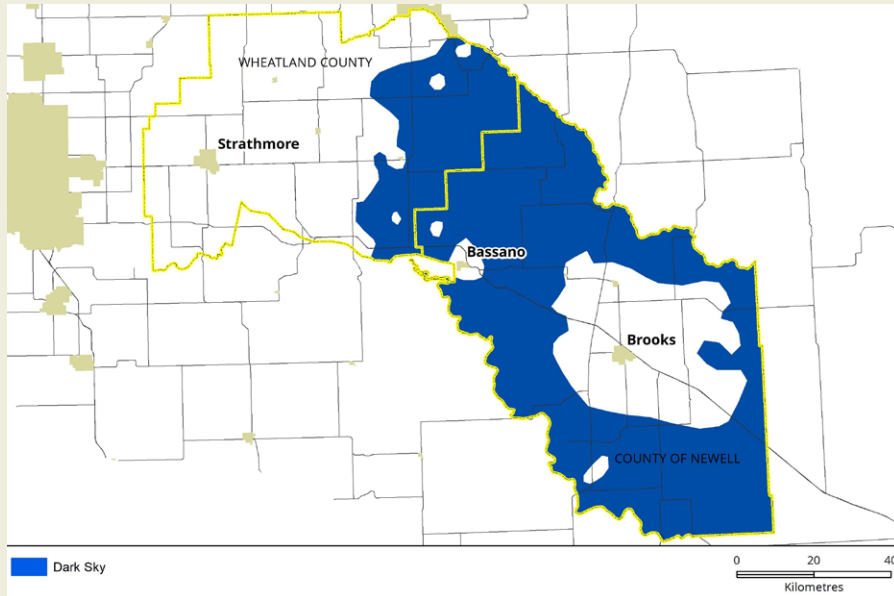
- Parks and Protected Areas: shapefile acquired from Alberta Parks (Last updated in November 2017, with a scale at 1:20K. This layer was also used to identify campgrounds. See spatial later in Ecological model.
- Historic Resources Class 1-4: Spatial layer provided by Alberta Tourism and Culture. The Listing of Historic Resources is comprised of all the polygons that represent Historic Resources areas in Alberta. Historic Resources are land sections that possess known historic resources or have high potential for their presence, including archaeological, palaeontological, historical, natural and cultural resources. The purpose is for the protection of historic resources in Alberta (Last Updated 2017).

**Least Conflict Lands: Historic Resource Value (HRV)**



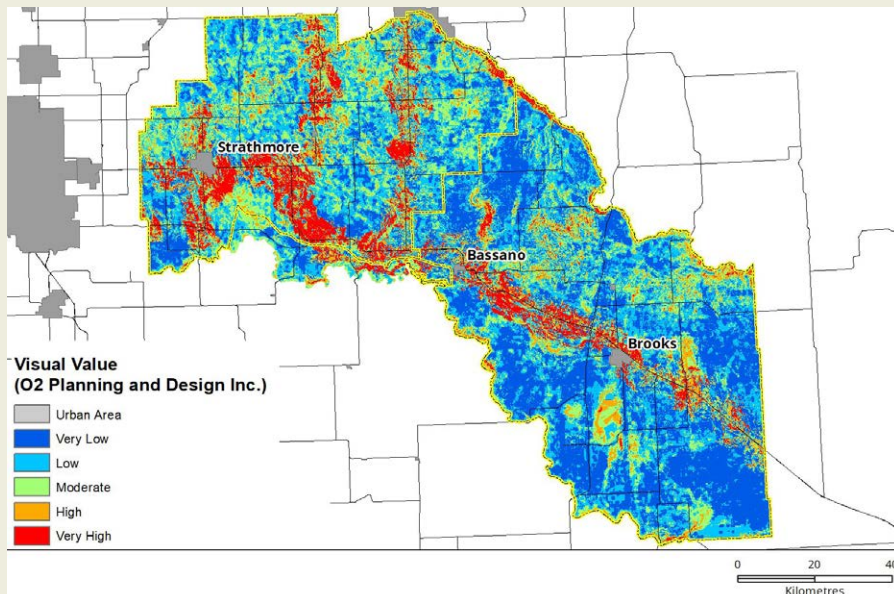
- Dark Skies were depicted using The World Atlas of the Artificial Night Sky Brightness calculated in 2006 by David Lorenz. According to the Bortle scale there are nine-level numeric scale that measures the night sky's brightness of a particular location. Areas within 1-3 on the Bortle scale were selected to represent possible dark sky areas in the study area.

*Least Conflict Lands: Dark Skies*

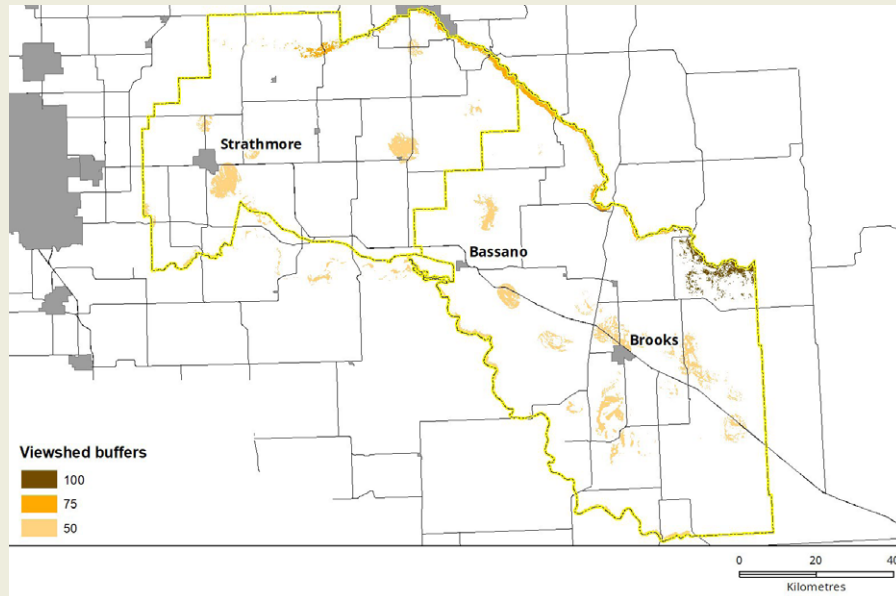


- Brook Aqueduct was digitized from basemap imagery provide by ESRI in ArcMap.
- Named Lakes were developed using Alberta base features extracted hydro waterbodies that had names (Last Updated in 2016, scale 1:20K). See the ecological section.
- Viewsheds were depicted by buffering each feature with the distance specified by stakeholders and then were further refined by using high and very high classes from the Scenic Resource Assessments visual value map developed by O2 Planning and Design Inc. for Alberta Tourism, Parks and Recreation Land Use Secretariat.

*Least Conflict Lands: Visual Value Model*



*Least Conflict Lands: Viewshed Values*





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