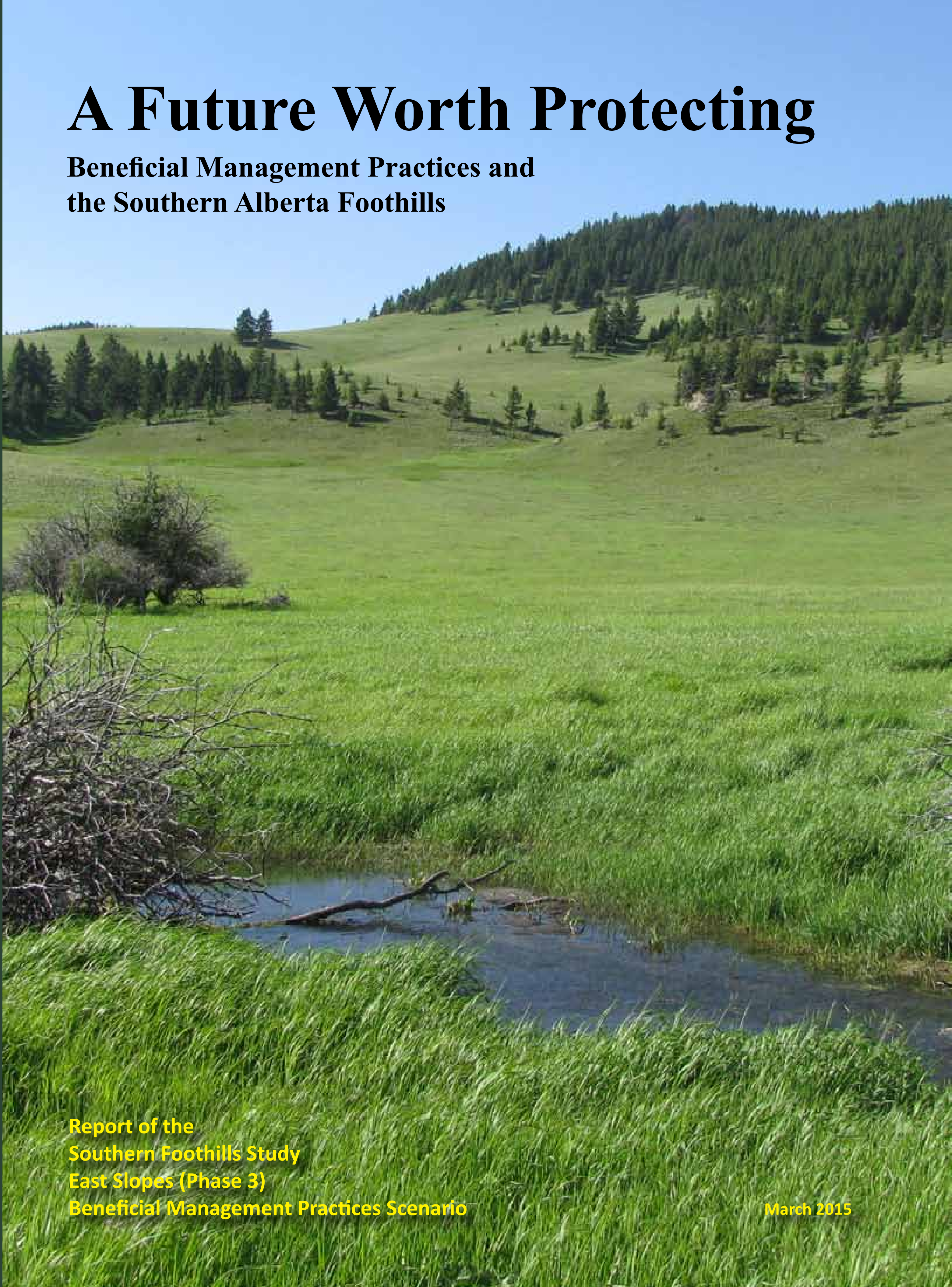
A Future Worth Protecting

Beneficial Management Practices and the Southern Alberta Foothills



Report of the
Southern Foothills Study
East Slopes (Phase 3)
Beneficial Management Practices Scenario

March 2015

Acknowledgements

This project is and has been very much a grass-roots initiative from the beginning; a coming together of ranchers, environmental and wildlife groups, government, industry, recreation and interested individuals in a common purpose. These people and organizations that often had very different opinions and agendas were nevertheless able to sit around a conference table and work effectively on a common challenge: how to protect and sustain our iconic foothills landscape, its unique ecology, and the ecosystem services it provides.

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www.alces.ca

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Lastly, the staff and board of the Southern Alberta Land Trust Society has provided both time and expertise, much of it on a volunteer basis. Alan Gardner organized and directed the process and wrote the report. In writing the report the content was informed by the input from all participants but the conclusions and recommendations herein may not necessarily reflect the opinions or policies of specific individuals, organizations, or funders.

All photographs by Alan Gardner unless otherwise labelled.

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Executive Summary

The original Southern Foothills Study (SFS) was centered around the question of "How do we respect and protect the essential qualities and existing valuable assets of this landscape while still allowing for an evolution of land uses?" It examined the future trajectory of existing land uses and found that key environmental indicators showed a slow but steady loss of environmental health and ecological integrity. The projected future decline is in addition to already significant negative changes.

The purpose of the current study was to examine whether the application of Beneficial Management Practices would halt or reverse the decline in the environmental indicators which the first phase of the study showed to be happening under a Business as Usual Scenario. Though this loss is not rapid, it is steady. Unless Albertans act now to change this trajectory, today's children can expect to see severe degradation in their lifetime, while unborn generations will never know and enjoy the rich natural bounty we take for granted in the Southern Foothills today

The scientific methodology developed to examine land use by the ALCES® Group and deployed with the ALCES® (A Landscape Cumulative Effects Simulator) was central to this study. From the very beginning of the Southern Foothills Study, all participants agreed that bringing a rigorous scientific approach to bear on this challenge was critical to finding appropriate solutions.

The study methodology required the participation of representatives from relevant land use sectors in the study area including croplands, livestock, forestry, mining, residential and recreation. Advisory groups for each sector were formed and these people met at regular intervals to discuss key land use issues, help define the scenarios, and contribute to the identification of critical data sources.

Concurrently, the ALCES® team assembled GIS, landscape and land use data from available sources to populate the ALCES® model, thus creating a customized version of the simulator that reflected the unique physical, meteorological, biological and land use characteristics of the region. Once data and coefficients were entered into the ALCES®, a series of simulations were completed to illustrate historical trends and generate future trajectories of land use intensity and environmental health for the period 2010 to 2060.

The boundary of the study area, which was enlarged from the original boundary, encompasses over 30,000 km^2 and includes both urban centers and the Eastern Slopes region from the Bow River Valley to Waterton. The study area is therefore representative of the landscapes, land uses, and natural disturbance regimes of southwestern Alberta.

The fundamental pattern revealed by this study is that the human population in the study area will continue to increase, almost doubling in only twenty five years (by 2040), and this increase will be the fundamental driving force affecting all land use sectors in the decades to come. Considering this population increase, when environmental health indicators are projected into the future the simulator reveals that the adoption of "Beneficial Management Practices" (BMP) will generally slow the rate of degradation relative to the "Business as Usual" (BaU) scenario but will not ultimately stop or reverse the downward trends. Within the simulation period, the status of Biodiversity and Ecosystem Services indicators ultimately continue a general downward trend that adds to large historical declines.

As such, the simulations suggest that Alberta's East Slopes will continue to undergo a land use transformation and become progressively more industrialized and fragmented by roads, transmission lines, residential acreages, urban sprawl, wind energy turbines, feedlots, mines, cutblocks and a host of other land use features; all resulting in a continued reduction in the amount and value of ecosystem services flowing from these landscapes.

Landscapes inevitably change and human-induced changes bring both benefits and liabilities. The magnitude of the 2013 flooding is a profound reminder of how natural processes and human infrastructure can interact to cause significant social, economic and ecological liabilities.

It is the goal of land use planning to balance the benefits with the liabilities both today and into the future, as well as to provide protection for those valuable assets that the 'free' market will not protect on its own. This is a difficult task for government because the case for short-term economic stimulus is always louder than the case for protecting, for example, a wild landscape and aquifer that delivers a continuous long-term flow of clean water.

The results of this study suggest that major improvements in land-use planning will be required to protect the Eastern Slopes foothills landscape and the ecosystem services and other values this landscape provides. The Alberta Land Stewardship Act (ALSA) provides a legislative basis for a number of useful tools, both market-based and regulatory. These tools include the defining and enforcement of limits on specific land uses, possibly through the implementation of a Dominant Land Use (DLU) protocol. We strongly recommend that such options be explored and adopted as soon as possible.

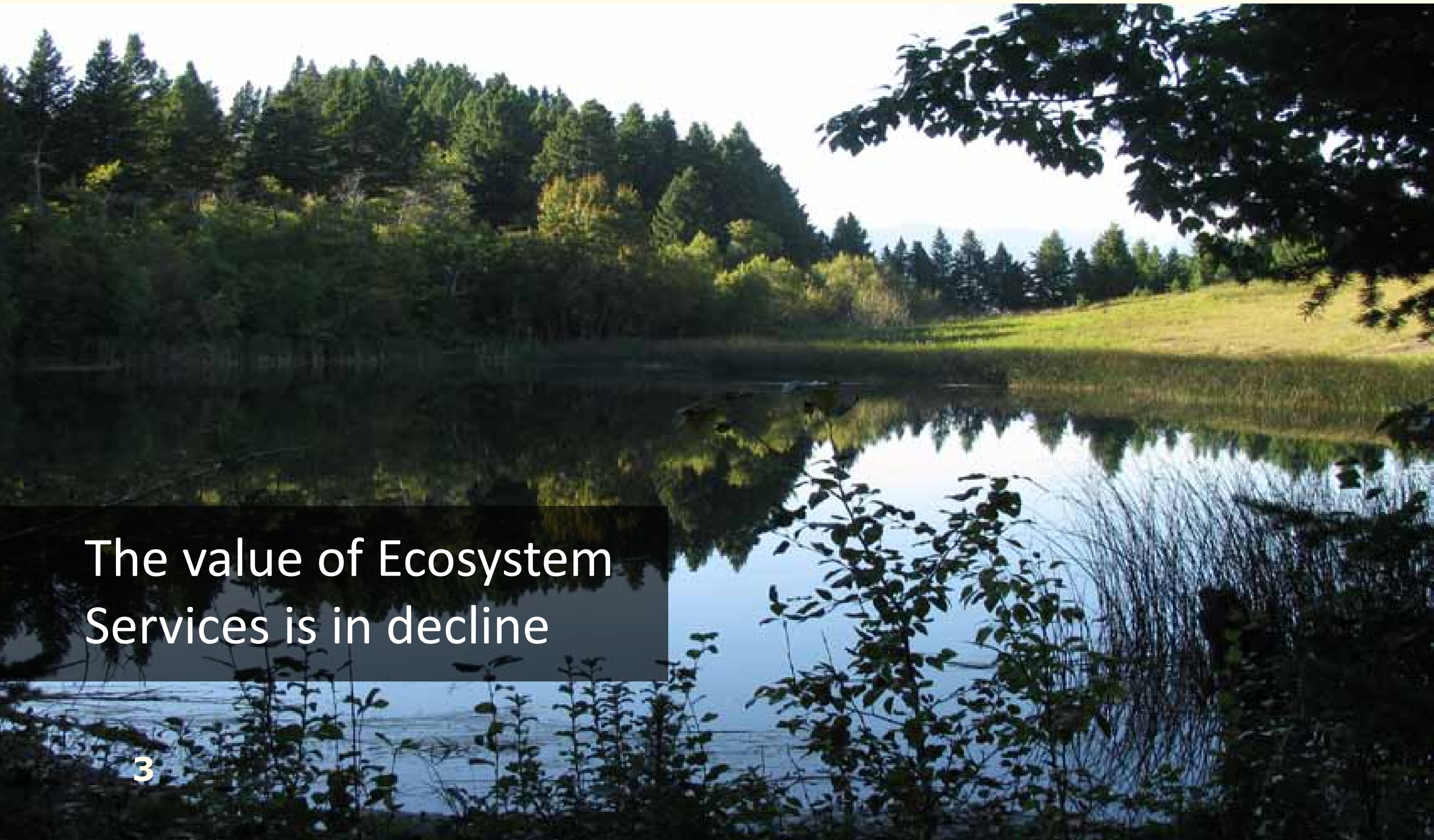
- March 2015

Background and Focus

Almost a decade ago in September 2005 a group of some twenty five people came together on a sunny afternoon at the M.D. of Ranchland hall to discuss land use in the southern foothills of Alberta. They represented landowners, community groups, local government and interested parties. Most of them were directly connected to the land and all of them were concerned about the potential loss of what they considered a priceless asset of Alberta: the native fescue grasslands and forests that underpinned the iconic and historic aboriginal and ranching culture of the area. They were not the first to appreciate the natural value of these foothills. The Dominion Forest Reserves Act of 1906 which focused on these foothills was passed in order to "protect the resource for the purpose of maintaining a continuous supply of timber, to benefit water supply, and to protect the animals, fish and birds within the reserves."

The participants were people who exhibited what one longtime resident called a 'land ethic', a culture that appreciated how much value this landscape provided to Albertans. Today we usually call that value Ecosystem Services (ES). The perception of the people around the table was that poorly controlled and uncoordinated development was taking place along the foothills without any effective land use policy that would allow reasonable development without the loss of such a significant asset. This was prior to the government initiative called the Land Use Framework (LUF).

As the discussion proceeded around the table it became evident that some form of scientific basis would be necessary to frame an effective argument for protecting these lands and guiding land-use planning. Finally, one of the participants suggested that a landscape ecologist, Dr. Brad Stelfox, had an interest in the foothills and could perhaps be contracted to do a scientific study of how the foothills landscape is changing. The Southern Alberta Land Trust Society, which was already heavily involved in protecting rangeland along the foothills, agreed to contact Dr. Stelfox and coordinate a study. Thus the Southern Foothills Study was born.



The value of Ecosystem Services is in decline

Business as Usual Scenario (Phase 1 and 2 Study)

The first study, titled “***The Changing Landscape of the Southern Alberta Foothills***” and released in 2007, examined what is called the ‘Business as Usual’ scenario. That is to say, how would the landscape change in the future if the current land use practices and trends were to continue unabated? Recognizing that environmental variables and ecosystem services are intertwined, the following measures were selected by the project stakeholders to indicate the overall environmental performance of the study area:

- Water quality;
- Water quantity;
- Native fescue grasslands;
- Mortality risk index for grizzly bears.

The results of the simulations back-casting approximately one hundred years (1910 - 2010) and projecting into the future (2010 - 2060) revealed that the quality of the environment as shown by the indicators had been reduced significantly during the past century and this decline was likely to continue in an incremental fashion into the future. It was important to recognize that much of this historic and future decline is characterized by small incremental changes that occur each year. The overall effect of these year-to-year changes can be very difficult to detect over short periods of time but can amount to profound changes when examined over multiple decades.

Phase Two of the study was devoted to seven public meetings around southern Alberta (Black Diamond, Ranchland, High River, Claresholm, Nanton, Pincher Creek and Cowley) to present the findings of the study to the stakeholders and public. It also included a formal public survey of public attitudes and concerns about the foothills landscape and its natural assets.

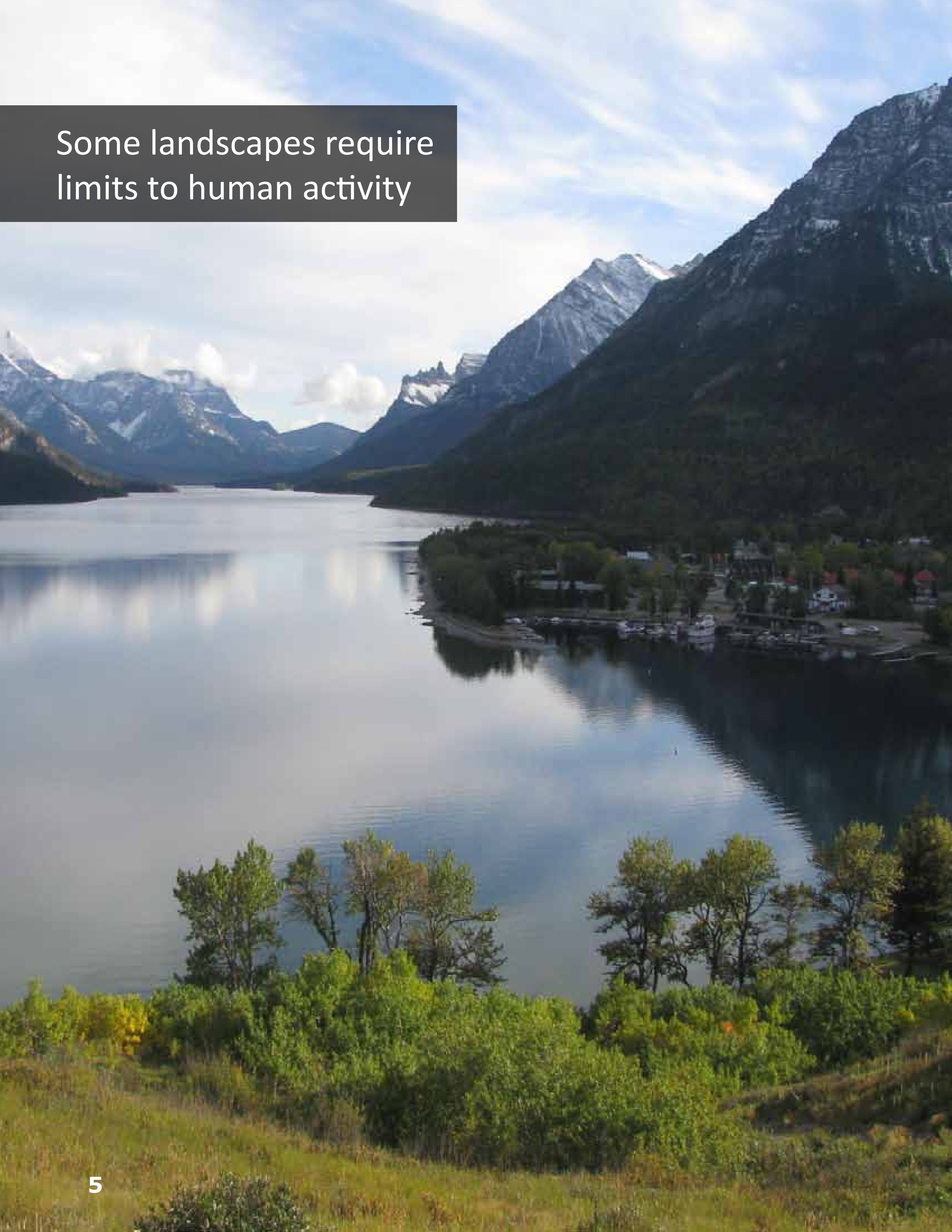
Beneficial Management Practices Scenario (Current Study)

The question that arose within the group after the completion of the original study was: considering the value of the landscape, would improved land use practices driven by progressive land use policies halt or reverse the decline in environmental quality? This became the fundamental question of the current study. These improved practices are generally termed Beneficial Management Practices (BMP).

The study was initiated in 2007 with the formation of the Sectoral Groups and subsequent initial meetings. Work continued through 2008 with discussions centered on the key BMP drivers. Then, as the consultation portion of the project was being completed, the Government of Alberta questioned the accuracy of the water quality coefficients being used in the ALCES® simulator. This uncertainty resulted in a pause in the project while a water scientist, Dr. Bill Donahue, completed an independent assessment of water quality coefficients for the region. Once completed, these updated water quality runoff coefficients were incorporated into the study.

The project then resumed with five meetings of the Advisory Group during 2013 to review progress and discuss the way forward. At the first meeting in 2013 the proposal was made by Dr. Stelfox to increase the study area to incorporate the geography of other more recent initiatives including the Chief Mountain Study, the Oldman Watershed Study, the Upper Bow Basin Study, and the Ghost Cumulative Effects Study. This approach also allowed the city of Calgary to be incorporated into the study area such that its urban dynamics could be examined. This proposal was accepted by the study Advisory Group and the results shown in this report relate to the larger area.

Some landscapes require limits to human activity



Land Use Planning

By natural processes and at the hands of humans, landscapes have changed through time. Whether from climate change, geological shifts, human activities, biological invasions or other factors, the landscapes that we know today have been altered over centuries and millennia to assume their current state. Most of this change has been slow but recent anthropogenic activities have sped up this transformation significantly.

While recognizing that this transformation process will continue to unfold, we must also appreciate that contemporary landscapes generate a broad suite of ecosystem services (ES) for society. It is these natural assets that provide value for current (and hopefully future) generations and it would be unwise for these values to be lost through ignorance or negligence. Thus we come to a fundamental question of land use planning on natural landscapes: *How do we respect and protect the essential qualities and existing valuable assets of this landscape while still recognizing and allowing the continued evolution of land-uses?*

We recognize that land-use planning is difficult. Finding the balance between protecting key ecosystem assets (water, land, air) and accommodating demands for its use (energy, residences, crops, livestock, recreation, mining) is an exercise that governments find both difficult and challenging. Nevertheless the Land Use Framework (LUF) process initiated by the Alberta Government is an ongoing attempt to find such a balance and we have supported it with more than one submission. The original Southern Foothills Study, which was in some ways a precursor to the LUF, provided content and context about the foothills landscape and was made available as part of our contribution.

A fundamental challenge to decision-makers when it comes to achieving land use planning goals is the discussion of thresholds. At what point does an ecosystem change clearly violate societal objectives and enter a state where its condition becomes unstable and the produced ecosystem services are reduced. Over time the reduction in available ecosystem services will conflict with the increasing demand for them due to a steadily increasing population.

These points of instability (sometimes called tipping points) occur where a small marginal action causes what would appear to be an unusually large effect. In essence, a state-change from one stable pattern to a different pattern which may or may not be beneficial, or stable. In layman's terms it is the straw that breaks the camel's back. The solution is to set a limit and stick to it. The difficulty in human decision making is that similar actions in the past have not caused significant problems and thus the difficulty in defining, and sticking to, limits. The project stakeholders repeatedly expressed concern that the incessant annual additions of incremental human activities might push the East Slopes ecosystem into a state that is undesirable to Albertans and result in a significant decline in ecosystem services.

The concept of cumulative effects requires landscape managers to address the sum consequences of all overlapping land uses and natural disturbances that are collectively shaping the East Slopes region.   To address this effectively it is important that it be done using appropriate scales of both time and space. This understanding helped to define the study boundary and time-scale trajectories used in the study.

While the concept of cumulative effects is straightforward, the application of it to landscape-level planning is not. It is a difficult but rewarding process that combines complex systems, multiple stakeholders, competing demands for limited resources, and trade-offs between short-term gain and long-term sustainability. It is an important goal of this study to pro-actively contribute to this dialogue and offer the Government of Alberta meaningful input by stakeholders committed to protecting the value of Alberta's East Slopes.

Study Methodology

This Phase of the study followed the structure of the initial study by examining human population plus seven drivers of human induced landscape change. The sectors representing these drivers are:

- Cropland Agriculture
- Livestock Agriculture
- Forestry
- Hydrocarbon Energy
- Rural Residential
- Mining
- Recreation and Tourism

For each sector a working group was formed with people who had a high degree of understanding of that sector. The members of each Sectoral Group then met in workshop settings to discuss the suite of Beneficial Management Practices (BMP) to be explored using the ALCES® landscape simulator. The workshop discussions informed the key input assumptions (coefficients) incorporated into the ALCES®.

At each Sectoral Group meeting, Dr. Stelfox introduced the subject, the ALCES® model, and explained that the objective was to discuss innovative approaches to mitigating the effect of that sector on landscape performance metrics. Special attention was directed to those land use activities that generated most of the landscape disturbance and which would therefore provide the best payback. Subsequent discussions focused on specific actions and their likely mitigating effect.

Study Area

The Phase 3 study area (shown in the diagram) is larger than that of the original SFS Phase One study. After completion of the original SFS, several other studies were completed on the East Slopes landscape. As a result, the Advisory Group chose to expand the study boundary to incorporate the data and learnings of these other studies. A benefit of this expanded geography was the integration of a more diverse set of stakeholders and the knowledge and issues they reflected.

The new study area encompasses approximately 30,048 km², includes the Bow River Basin and the City of Calgary, and extends down to the USA border. It also extends eastward in the south portion to the town of Cardston.

Drivers and Trends

Landscapes experience both natural disturbances and human activities that alter and define the form and function of the related ecosystem. Natural disturbance regimes in Alberta's East Slopes include fire, erosion, flood, drought, avalanches and insect outbreaks. Anthropogenic (man-made) effects are related to the land uses of forestry, energy, croplands, grazing, mining, residential, and recreation. Still others are a combination of both natural and anthropogenic origins such as invasion by exotic species, or driven by climate change. The trends created by the drivers related to each sector will over time create a new landscape and ecological pattern that is appropriate to the climate and land uses.

Ultimately, the dominant catalyst of change within the East Slopes is that of human population growth and the resulting increasing demand for living space plus renewable and non-renewable resources. Most of the resulting commodity production is destined for export from Alberta and all of it contributes to the provincial economic performance. But each requires the construction of footprints that collectively alter the landscape composition and ecological function.

Indicators

While the ALCES® model simulates many hundreds of indicators in the social, economic and ecological domains, it is important that any one project reduce this list to a minimal number of indicators that resonate with stakeholders while efficiently capturing the key changes in landscape performance. Considerable discussion between the ALCES® Group and the project stakeholders resulted in the following environmental indicators being used:

- Water quality;
- Water quantity;
- Native fescue grasslands;
- Mortality risk index for grizzly bears.

While the area and edge of a land use footprint is not generally considered an ecological indicator it is a key determinant of performance of the indicators listed above. For this reason we present output that quantifies and compares the direct and indirect footprint of the land use sectors.

Scenarios

The key comparison of the study focused on the simulated differences in indicator performance between the 'Business as Usual' (BaU) scenario, and when the landscape is subjected to land uses that differ in type and intensity due to the implementation of 'Beneficial Management Practices' (BMP scenario).

In devising the details of the BMP scenario, project stakeholders agreed that the study simulations would not vary the amount of commodity produced during the simulation of future landscape effects. This would maintain the focus upon the effects of BMPs. In essence, keeping the focus on the difference between BaU and BMP; or the type of activity rather than the quantity of production.

Adoption of best management practices can generate counter-intuitive (unexpected) results. For the purposes of this study, BMPs were assessed as an integrated whole, rather than individually. As such, an improvement in a particular indicator caused by the adoption of BMPs for one sector may cause another indicator to change in an adverse way, for example in the mining sector.

For each indicator, the ALCES® simulations were used to generate tabular, graphic and map output that compared the two scenarios. Note that while the graphs project the trajectories 45 years into the future (2060), the associated discussion uses a projection of 25 years into the future (2040). This was done to make the projection discussion more meaningful to the reader by focusing on only one generation into the future, thus emphasizing those projected changes that will likely happen in their lifetime.

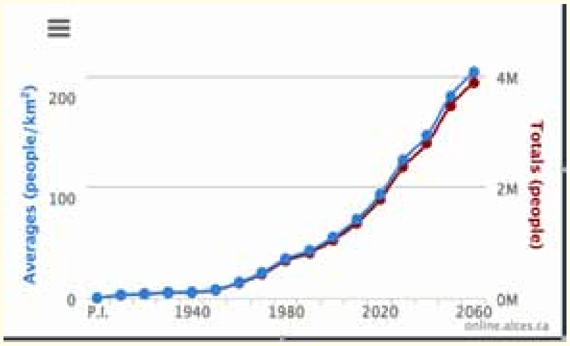
Population Increase is the Most Significant Driver of Landscape Change Today

Landscape Drivers

Population

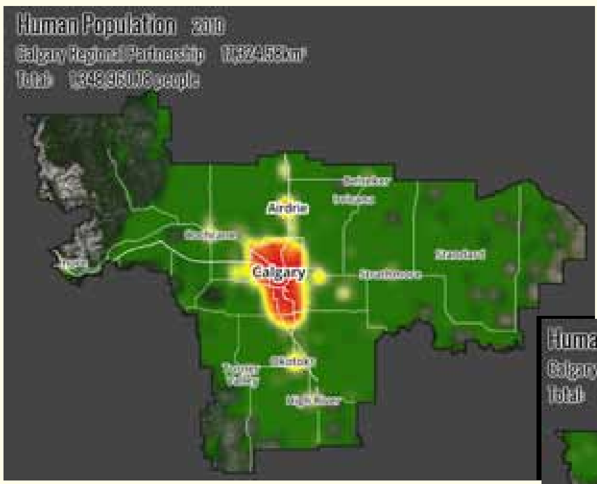
Human population increase is undoubtedly the most important driver of landscape change today. Within the current study boundary the population is approximately 1.44 million and this is projected to increase to some 2.54 million by 2040, 3.10 million by 2050, and four million by 2060. Increased urbanization will continue, leading to a strong need to increase the density in the urban areas and especially Calgary. This higher density would reduce the financial burden on taxpayers due to an increase in efficiency related to servicing costs, plus it will act to reduce the area of high-quality agricultural soil that is currently being paved over annually and thus taken out of production.

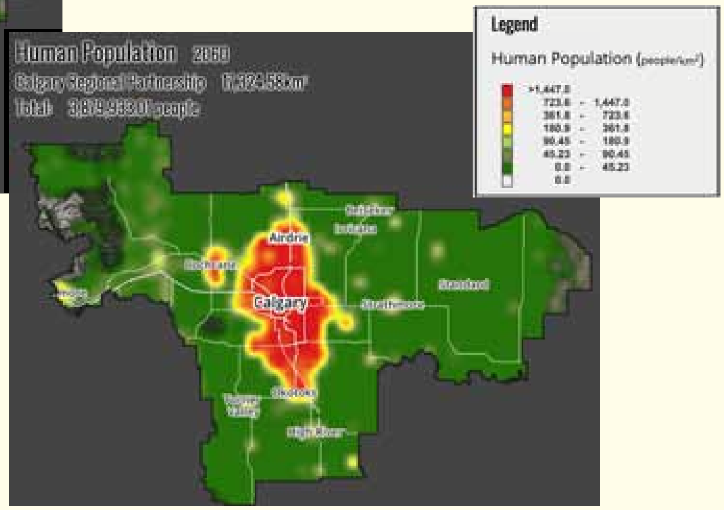
The Calgary Regional Partnership Area, with a current population of 1.4 million could reach close to three million people by the end of the 2040s. This growth will drive demand for water, hydrocarbon energy, electrical power lines, roads, urban and rural residential expansion, recreational opportunities, commercial and industrial space, and communication infrastructure. Much of this demand will focus on the resources of the Eastern Slopes region for that is where the recreational facilities will be required, that is where people will want to build their rural residences, and that is where most of our water will originate.



Population growth within the study area on a decadal basis from 1900 to 2060

Population growth will occur throughout the study area, increasing the size of towns along Highway 2 and ricocheting down the Cowboy Trail (Hwy 22). We need to ensure through effective land use planning that this population growth does not result in a declining standard of living for the average citizen. Recent flooding suggests that we need to do a better job of protecting our ecological assets.

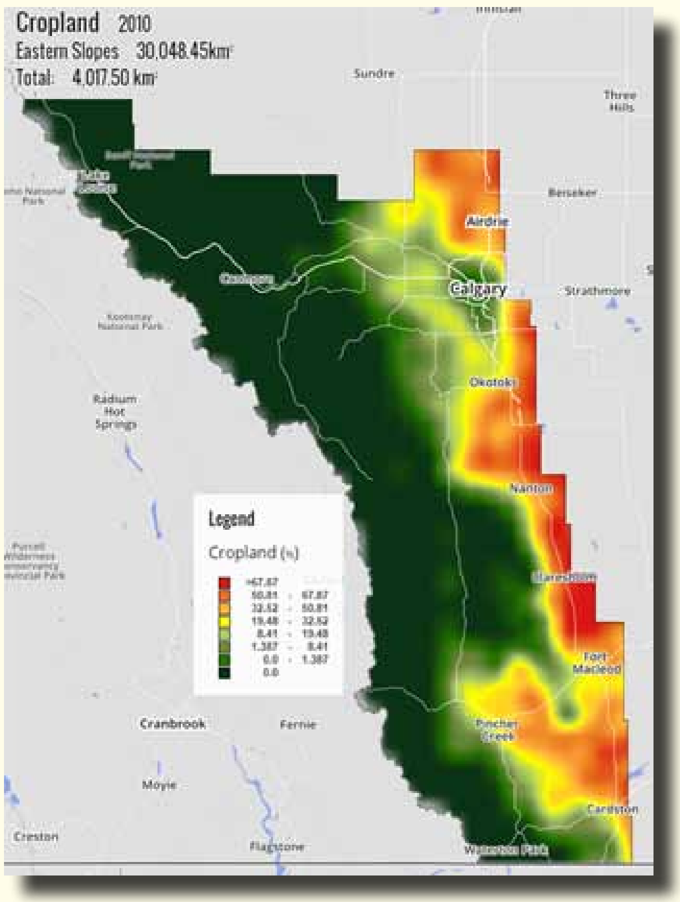




Human density in the Calgary Regional Partnership in the decade of the 2010's (above) and in the decade of the 2060's (right). Future projection in human density is based on a moderate growth scenario.

Agriculture - Cropland

The area of cropland has been declining in the study area since the 1960s and is projected to continue this downward trend. Prior to that time the increase in cropland was mainly due to the plowing up of native grasslands. In several instances, the loss of cropland to urban and acreage sprawl has displaced farming to areas of less-desirable soils that will likely require more intensive farming practices. Currently, the cropland area is 4,018 km^2 (993,000 acres).

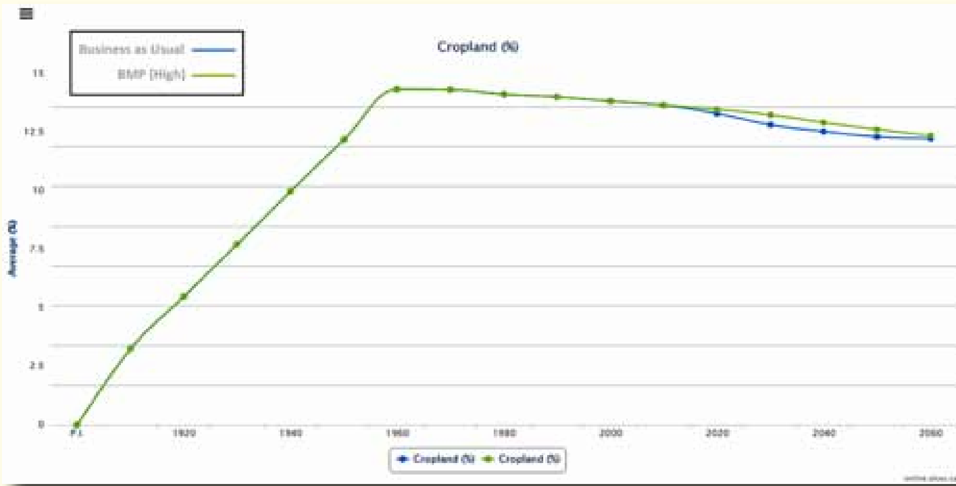


Fraction of area used as cropland in the 2010 decade.

Landscape Implications

Following a pattern seen in many other global regions, Alberta is progressively destroying (through scraping, paving over, or contamination) its best soils with the hardened footprint of land uses (roads, settlements, acreages, wellsites, industrial sites). The combination of increasing population and decreasing cropland leads down a path of decreasing food security. If intensive farming can grow sufficient food to feed a single person with ~0.5 hectares, then the cropland loss of a projected 22,000 ha in the region over the next twenty five years suggests that its capacity to feed people will be reduced by ~44,000 people. To illustrate the key balance between food demand and food growing capacity, a 2040 population of 2.5 million in the region would require about 1,250,000 ha of cropland, a value more than three times greater than the cropland area which exists in the region today. Potential negative effect of more intensive farming often includes loss of soil carbon, increased silt in water, and the migration of nitrogen, phosphorous, herbicides and pesticides into both lotic and lentic water systems.

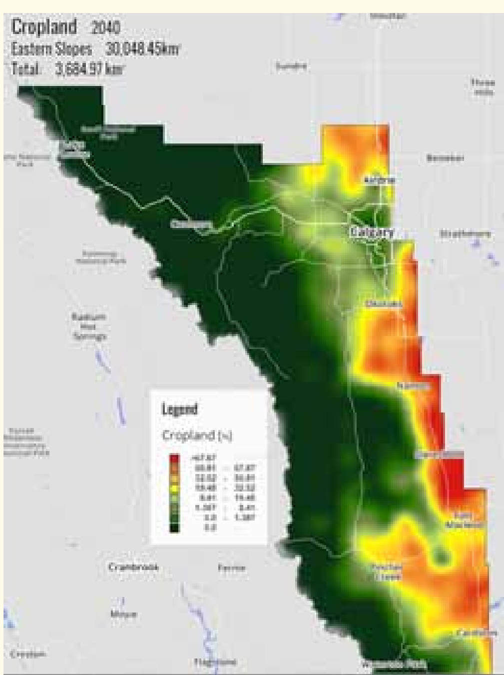
Beneficial Practices Effect



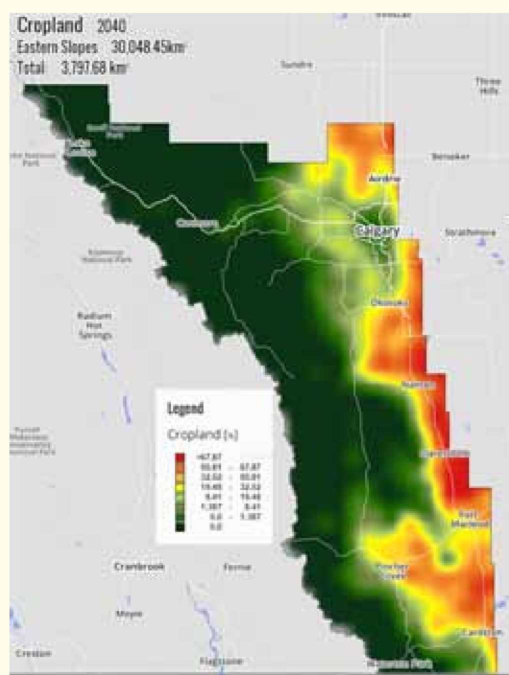
Area under cropland (km²) on a decadal basis to 2060 with a BaU vs BMP comparison from 2010

Change from 2010 to 2040 and beyond

Under a Business as Usual scenario the total cropland is projected to decrease to 3,684 km² (910,300 acres) by 2040. This represents a loss of some 334 km² (82,500 acres). Applying a Beneficial Management Practices scenario shows that the amount of cropland will decrease to 3,798 km² (938,500 acres) resulting in a loss of 220 km² (54,400 acres). Thus, while the application of BMP's would slow the decline, Alberta will continue to lose its best and highest quality soils. The key reason that adoption of BMPs does not result in a noticeably higher area of cropland is that cropland lost to urban sprawl under a BaU scenario is compensated by displaced farmers moving to other regions within the study area, often to areas with less productive soils.



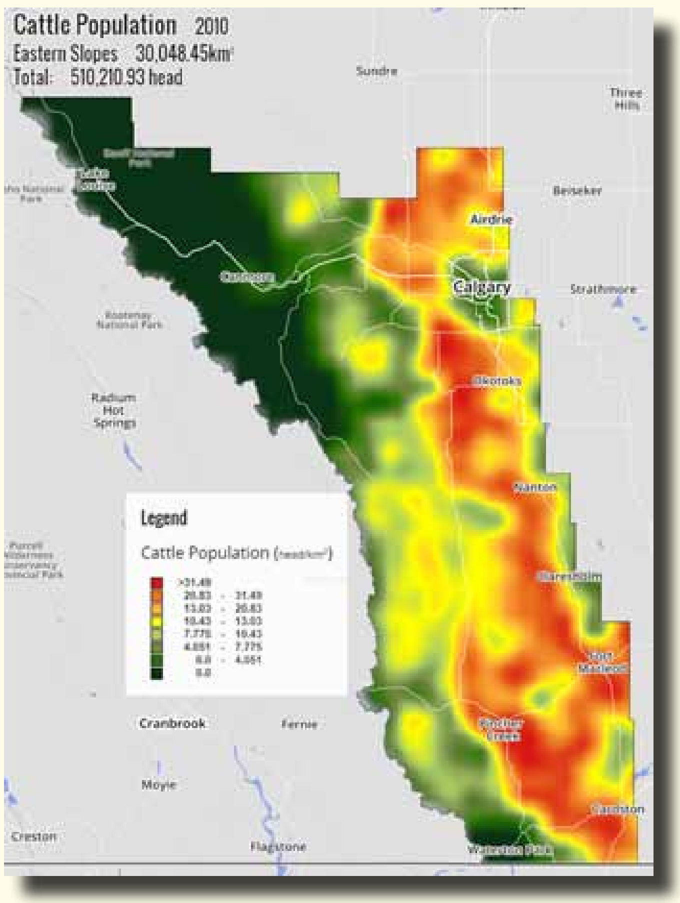
Projected fraction of land used as cropland by 2040 under a BaU Scenario



Projected fraction of land used as cropland by 2040 under a BMP Scenario

Agriculture - Livestock

Cattle are the dominant livestock in the study area, with populations peaking in the decade of 2000 prior to a significant cull caused by the BSE outbreak. The current population of cattle is ~500,000 with highest densities near and to the west of Highway 2, particularly in regions where feedlots are common.

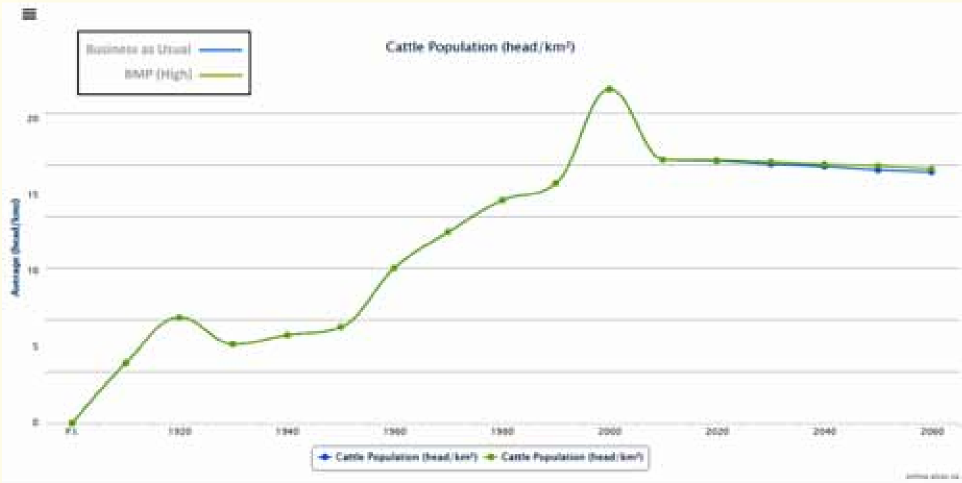


Number of cattle per km² in the 2010 decade

Landscape Implications

Although cattle populations vary through time, reflecting commodity prices and land availability, there has been a notable trend in the study area to confine a greater number of cattle (and a greater fraction of their lives) within feedlots or confined feeding operations. Thus more cattle will be concentrated in smaller areas leading to challenges with manure disposal and its potential effect on water quality. With competing land uses and economics resulting in the loss of low-intensity rangeland (family ranches), the decline in land available for cattle grazing has implications for Alberta beef production and the export industry. A reduction in number and distribution of grazing herbivores in Alberta's East Slopes can influence many aspects of foothill ecosystems including soil formation, forest expansion, and grassland integrity.

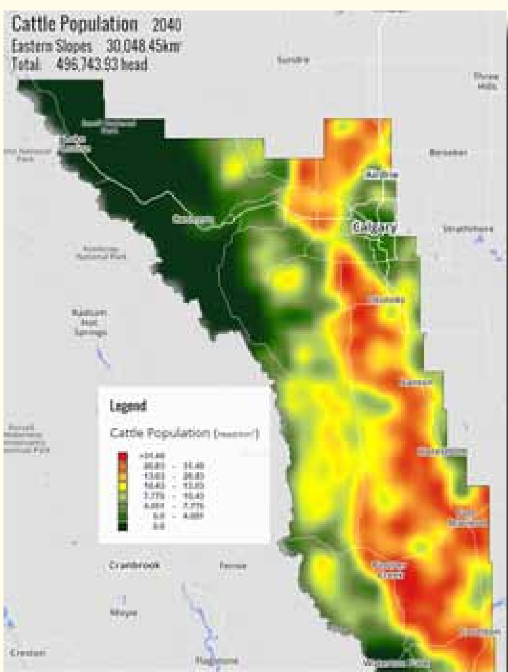
Beneficial Practices Effect



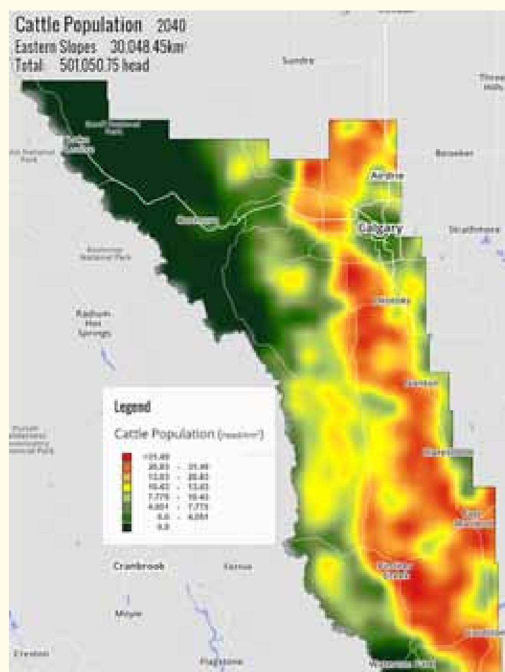
Cattle population on a decadal basis to 2060 with a BaU vs BMP comparison from 2010.

Change from 2010 to 2040 and beyond

Under both Business as Usual and Beneficial Management Scenarios the total number of cattle is projected to decrease by 9-13 thousand head by 2040. Benefits created by best management practices are relatively minimal as the loss of extensive livestock rangeland in the BaU scenario is compensated by increasing dependence on feedlots and the importation of forage crops from outside of the study area. The key reason for loss of rangeland used for extensive cow/calf operations (historically due to the conversion of rangeland to cropland) is the ongoing and incremental expansion of settlements, acreages, and the transportation network. Again, while the implementation of BMPs will slow the decline in the number of cattle, the trend will not be reversed.



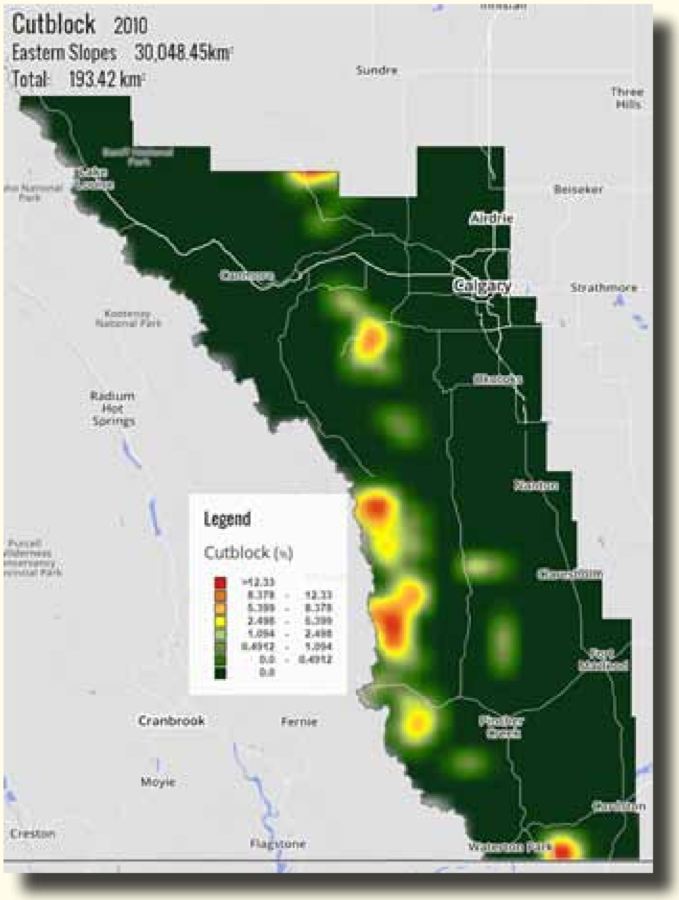
Projected number of cattle per km^2 in the study area by 2040 under a Business as Usual Scenario



Projected number of cattle per km^2 in the study area by 2040 under a Beneficial Management Practices Scenario

Forestry

For the purposes of this study, a cutblock is that area within the "merchantable" forest landbase that has been logged within the past 20 years. The total area of cutblocks will vary between decades and was 193 km^2 (47,700 acres) during the decade of 2010

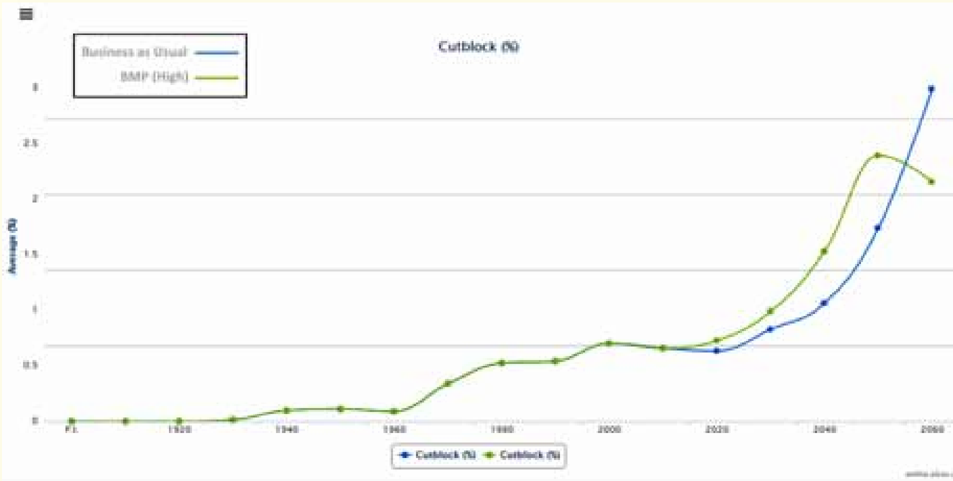


Fraction of area in cutblocks in the 2010 decade

Landscape Implications

Forestry has a long history in the foothills and has a relatively large footprint. From a management perspective, all of the "net" landbase (once areas that are non-productive, too steep, and too close to water have been omitted) will be harvested once every 100 years. During the past several decades the amount of cutblock area has increased, but this value should generally stabilize as the area of new cutblocks is offset by the area of old cutblocks that are now considered forests older than 20 years. In addition to the actual harvest of the cutblock, the forest sector must also construct in-block trails, access roads, and landings to pile the trees for subsequent transportation by logging trucks. Collectively, these forest sector footprints can lead to increased surface water runoff and erosion, particularly during heavy rain events. Increased surface water runoff can also reduce the amount of water that seeps into the ground and replenishes aquifers. A reduction in the amount of water stored in surficial groundwater can result in lower streamflow during mid to late summer months. A key challenge confronting forest managers is that of devising plans that effectively integrate the timber and non-timber values (water, wildlife, carbon, recreation) of the forested lands of Alberta's East Slopes.

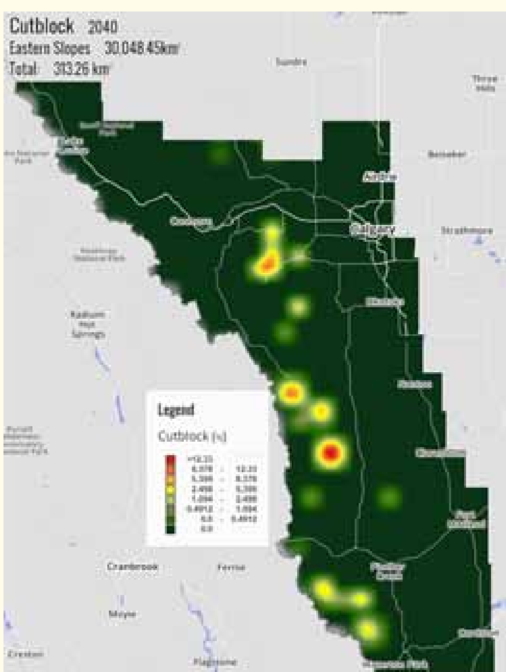
Beneficial Practices Effect



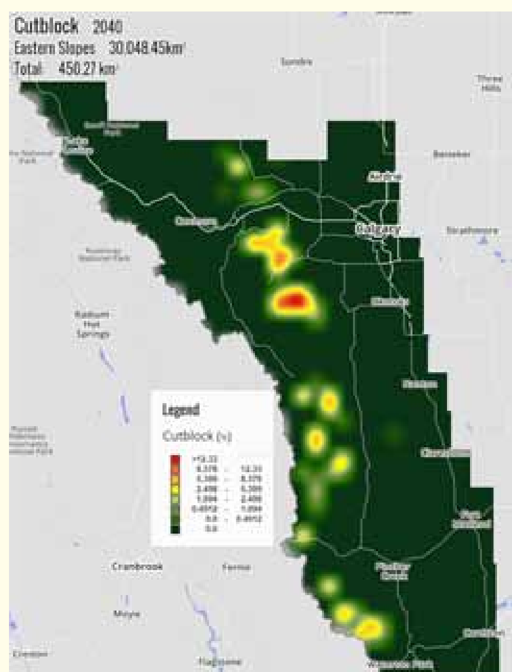
Total area (km^2) of cutblocks on a decadal basis from to 2060 with a BaU vs BMP comparison from 2010

Change from 2010 to 2040 and beyond

Under a Business as Usual scenario the cutblock area will increase to 313 km^2 (77,300 acres) by 2040. The implementation of Beneficial Management Practices will increase the area in cutblocks to 450 km^2 (111,200 acres) by 2040. The increased area associated with BMP is caused by the requirement that forest harvest increase the amount of residual green trees retained on the cutblock and near ephemeral drainages. Since the BMP scenario assumes that timber harvest will remain constant, this requires the total annual harvest area to increase marginally. In total, the amount of wood volume provided to the mill remained the same, but the functional amount of area used increased.



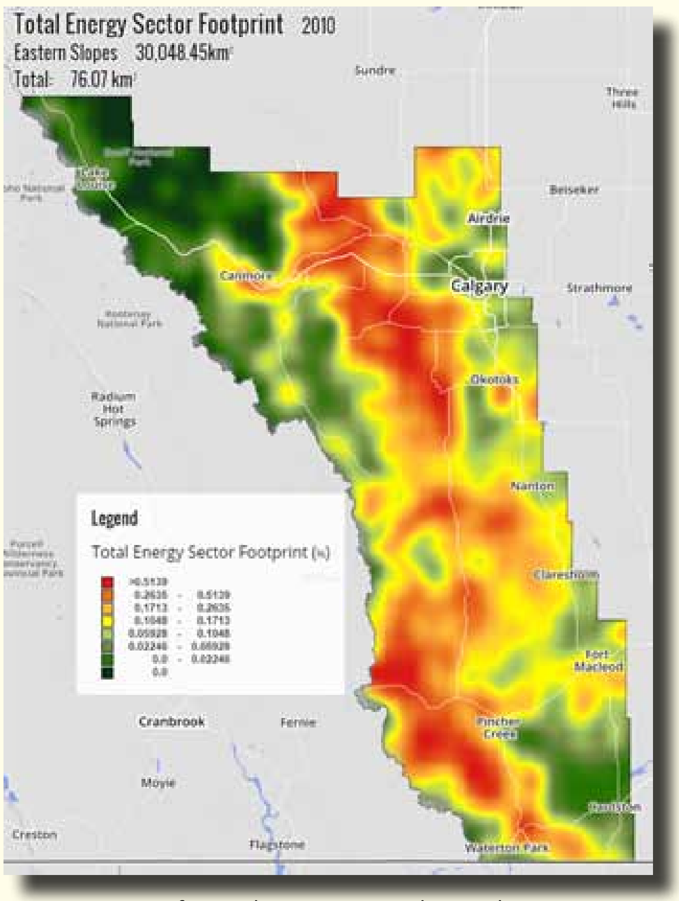
Projected fraction of area in cutblocks by 2040 under a Business as Usual Scenario



Projected fraction of area in cutblocks by 2040 under a Beneficial Management Practices Scenario

Hydrocarbon Energy

The footprint of the energy sector, which includes wellpads, pipelines, seismic lines, and assorted processing facilities, has a combined area of ~76 km^2 (18,800 acres). Although some of the footprints of this sector have been reclaimed in past decades, the pace of new features has outpaced the reclamation rates

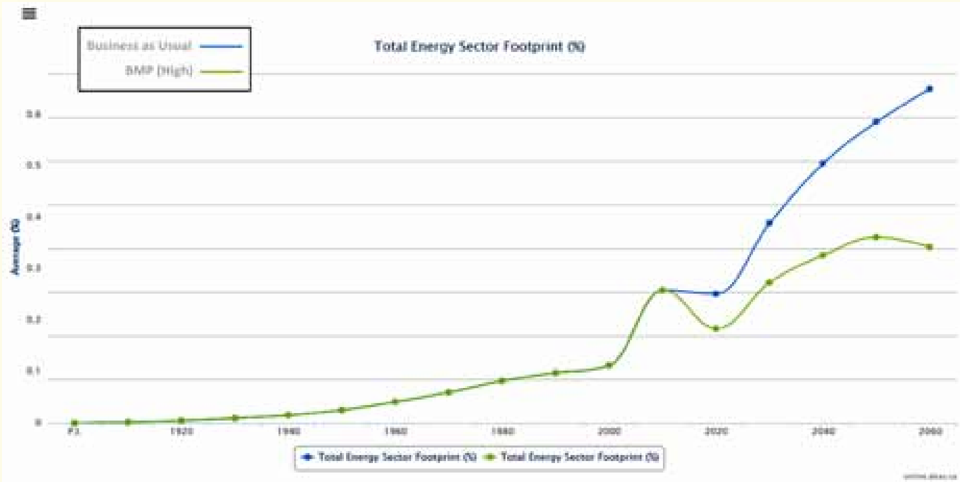


Fraction of area that comprises the total energy footprint in the 2010 decade

Landscape Implications

Although the actual footprint area of the hydrocarbon industry along the East Slopes is small, its effects on water quality, landscape fragmentation, and wildlife habitat are large. There is concern among the public about the potential adverse effects of fracking on the quality and the underground flow of groundwater, and that these adverse effects may not become evident until long after the drilling and well stimulation has occurred. Relative to the BaU scenario, the footprint of the hydrocarbon industry can be reduced in future decades by adopting Beneficial Management Practices including smaller seismic lines, greater spatial overlap between existing linear features and new pipelines, using multi-well pads where feasible, and an aggressive approach to reclaiming existing linear features. In combination, these BMPs result in a reduced footprint and mitigation of damage to water, landscape, and wildlife

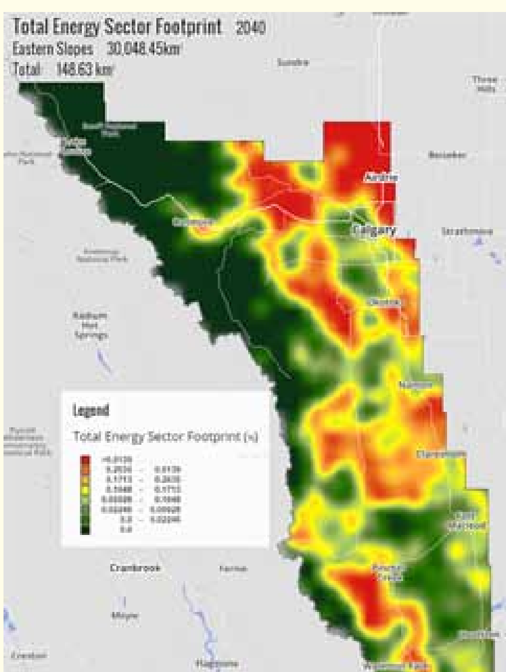
Beneficial Practices Effect



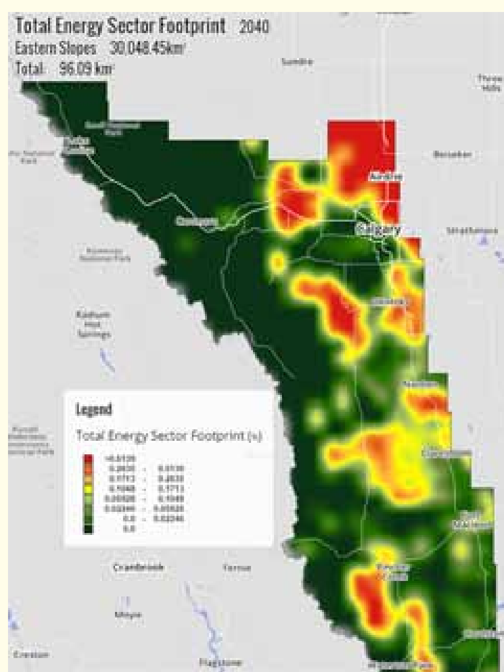
Total energy footprint on a decadal basis to 2060 with a BaU vs BMP comparison from 2010

Change from 2010 to 2040 and beyond

The ALCES simulations indicate that the energy sector footprint will continue to expand in decades to come with future growth being significantly less under the Beneficial Management Practices scenario (96 km^2 by 2040) than the BaU scenario (148 km^2 by 2040). The adoption of BMPs could lead to the energy sector footprint peaking in 2050, whereas the continued use of BaU practices will see the area continue to expand through the simulation period.



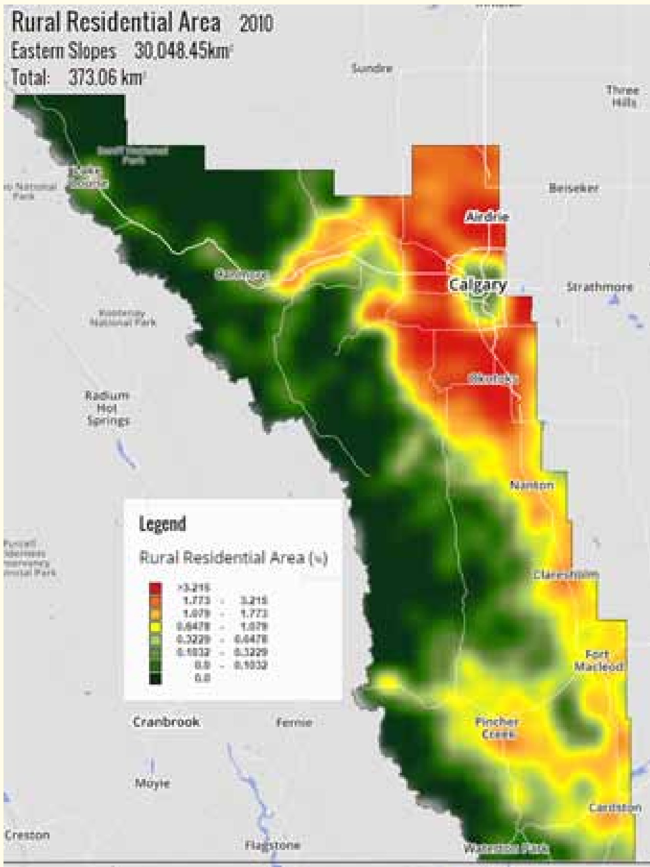
Projected fraction of area as energy footprint by 2040 under a Business as Usual Scenario



Projected fraction of area as energy footprint by 2040 under a Beneficial Management Practices Scenario

Rural Residential

The rural residential area was chosen rather than just the total residential as it is a better reflection of the effect on the foothills landscape. It is evident from the map for the 2010 decade that the center of demand for rural residential dwellings is Calgary. The rural residential area in the 2010 decade was approximately 373 km^2 (92,200 acres)

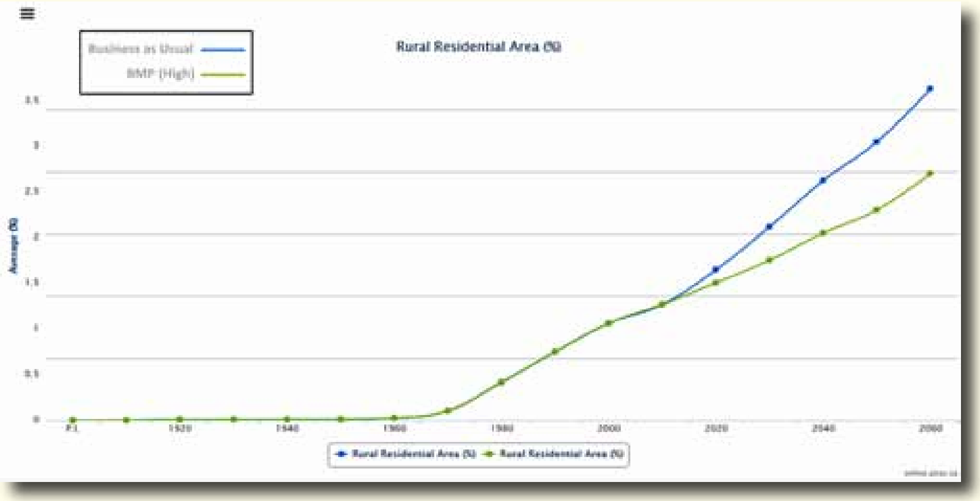


Fraction of area comprised of the direct rural residential footprint in the 2010 decade

Landscape Implications

Rural residential development, termed sprawl when close to cities and towns, is driven by population growth and is arguably one of the greatest threats to farmland and watershed integrity. It is also an important contention point around property rights. Adopting a set of BMPs for residential design, including limiting the area available for acreage development, reveals that enlightened policies by local governments can help retain quality farmland and minimize losses to watershed integrity. To be effective, both BMPs and limits to urban sprawl must be embraced under the Alberta Land Stewardship Act. Rural residential acreages, which typically have a high owner turnover rate, can create economic issues for local government, use significant volumes of groundwater, encourage expansion of invasive weeds, lead to overgrazing by horses, and often result in unregulated year-round Off Highway Vehicle (OHV) use.

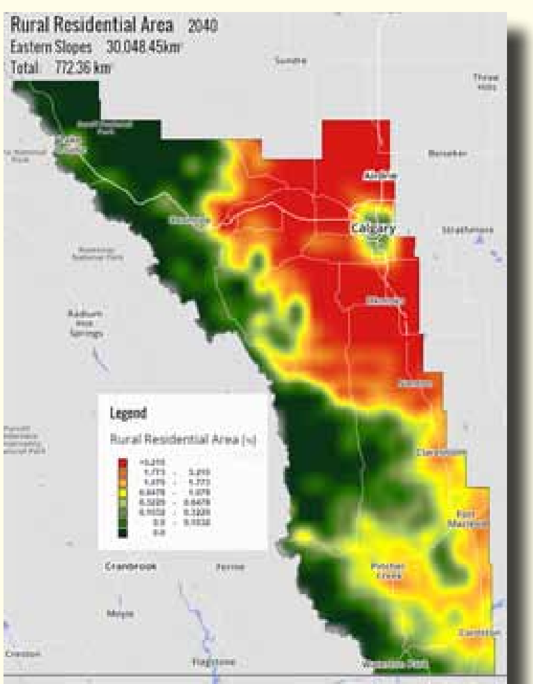
Beneficial Practices Effect



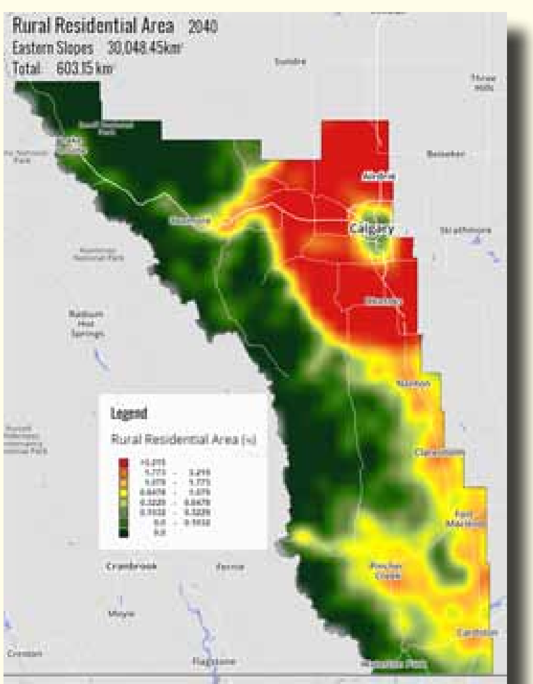
Total rural residential area on a decadal basis to 2060 with a BaU vs BMP comparison from 2010

Change from 2010 to 2040 and beyond

The maps of future rural residential area reveal the potentially large difference between the Business as Usual and Beneficial Management Practices scenarios. If regulations and land use planning restrict rural subdivisions in area and distribution, the amount of farmland converted to residential will be reduced significantly. Under BaU the total area is projected to be 772 km^2 (190,800 acres) by 2040 compared to 603 km^2 (149,000 acres) under a BMP regime. This is a difference of 169 km^2 (41,800 acres). The heat map in particular shows that implementation of BMPs for this sector will have a strong impact on the foothills landscape.



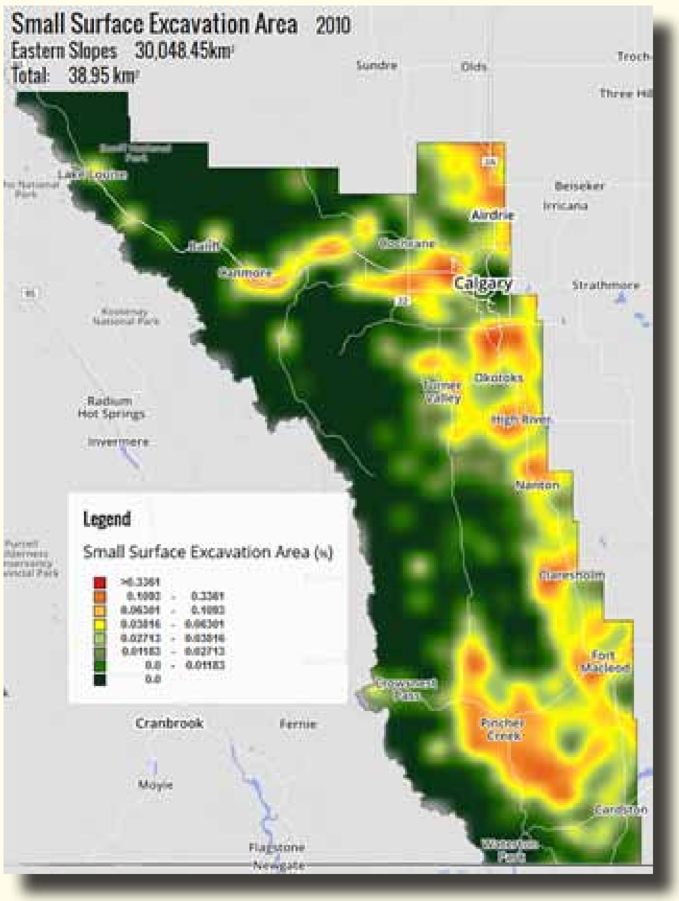
Projected fraction of area in rural residential by the 2040 decade under a Business as Usual Scenario



Projected fraction of area in rural residential by the 2040 decade under a Beneficial Management Practices Scenario

Surface Excavations (Mining)

Small surface excavations of 39 km² (9,625 acres) occur in the study area and include gravel pits, borrow pits, watering holes (dugouts), and lagoons. There is no active coal mining in the study area though coal mining has a long history in the region. Gravel mining is the most common type of surface excavation with its aggregate product used for the construction of all land use footprints (roads, wellsites, residential, industrial).

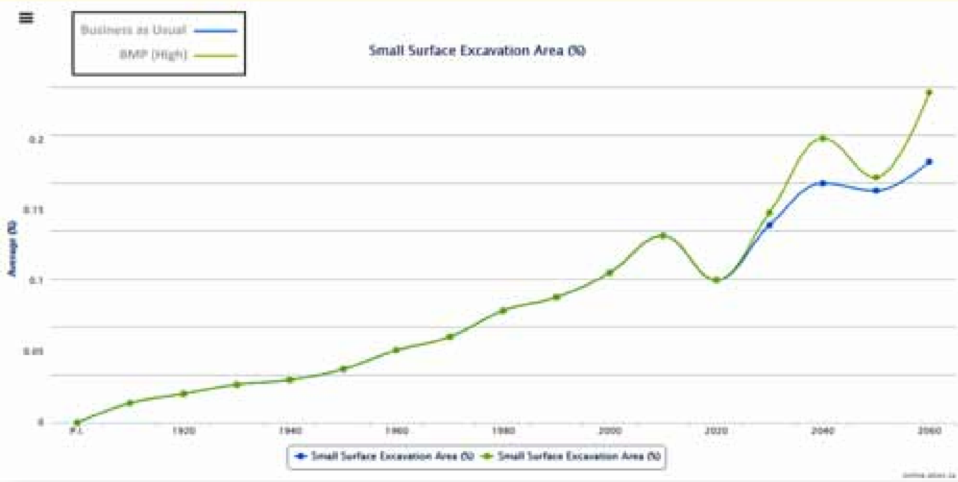


Fraction of area used for small surface mining area in the 2010 decade

Landscape Implications

The major type of surface excavation affecting landscape metrics in the study area is that of gravel operations. Although their individual size is small, these features are generally not reclaimed, represent a loss of topsoil, and are common sites for the introduction of invasive plants. Cattle grazing in them and garbage dumped in them can introduce contaminants directly into surficial water. The area of gravel pits did not decrease with adoption of BMP; in fact the area increased slightly because of the additional cutblock area associated with forest sector BMPs.

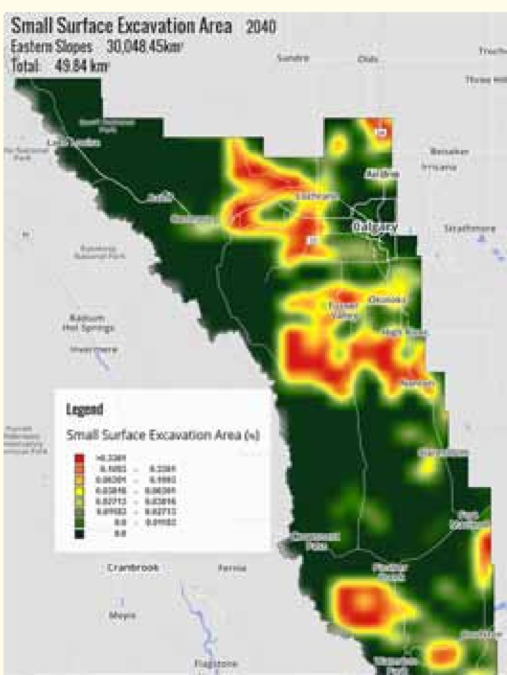
Beneficial Practices Effect



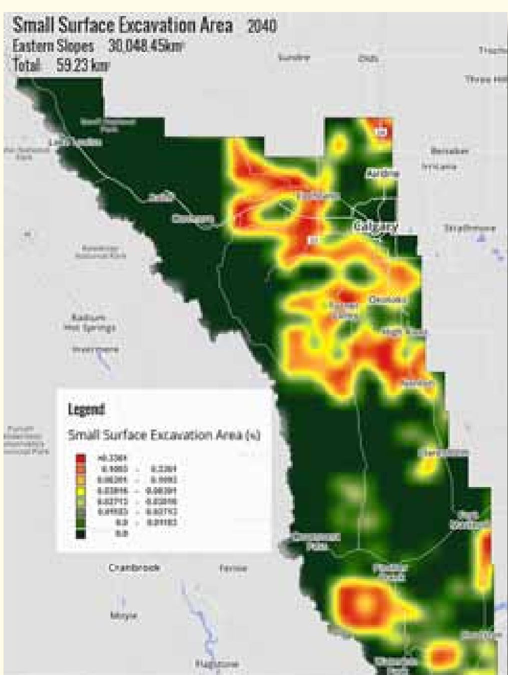
Total area used for small surface mining on a decadal basis to 2060
with a BaU vs BMP comparison from 2010

Change from 2010 to 2040 and beyond

Simulations suggest that surface excavations will decline in area during the next decade to less than 30 km² (7,350 acres) and then subsequently grow significantly. Inter-decadal variation in area of gravel pits reflects a variety of factors, the major one being the variable investment in new roads, buildings, and other infrastructure



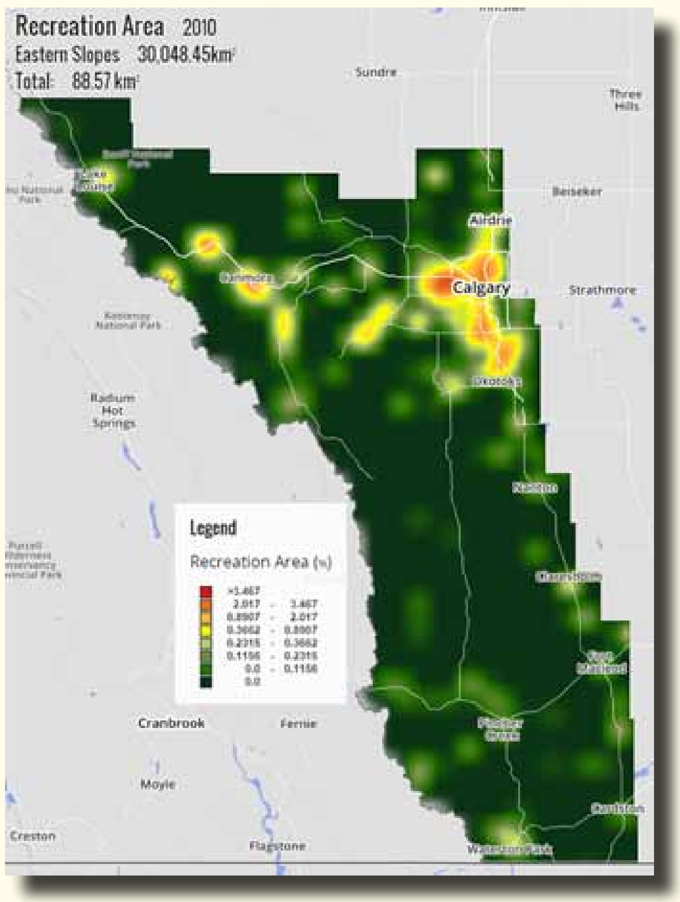
Projected fraction of area in surface mining by the 2040 decade under a Business as Usual Scenario



Projected fraction of area in surface mining by the 2040 decade under a Beneficial Management Practices Scenario

Recreation

Recreation area is comprised of the direct footprint of golf courses, campgrounds and ski resorts. Each of these facilities requires access roads and their area is highly correlated to population growth and disposable income. The indirect effect of recreational features can be much larger than the direct area, particularly for those features that are staging areas for activities associated with hiking, snowmobiling, equestrian riding, and off-highway vehicles (OHV).

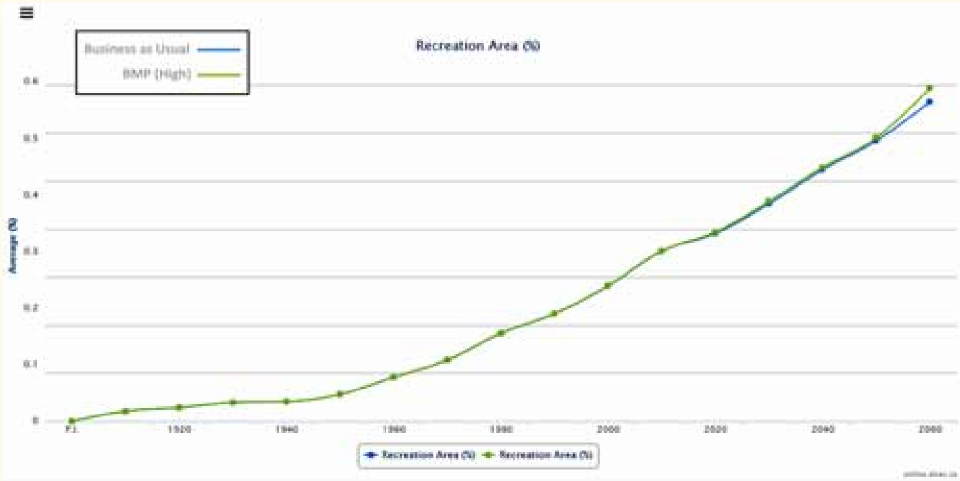


Fraction of area used for recreation features in the 2010 decade

Landscape Implications

The effect of recreation features on water quality, water quantity, and biodiversity extend beyond the relatively small area these features occupy. Golf courses frequently use more water per unit area than do other land use footprints, including irrigated cropland. They also require very high levels of nutrient applications. While the area devoted to campgrounds is small, the related land uses such as hiking and OHV affect a much greater area. Also, the effect of OHV use (winter and summer) is generally far more than an equivalent amount of hiking both in the distance travelled, speed and noise, and tendency to damage water courses. The demand for recreation in the watershed is high and projected to increase with little effect from the implementation of BMPs.

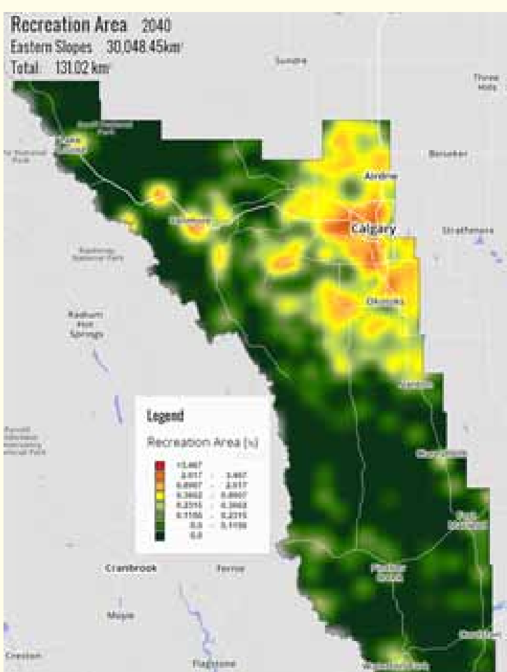
Beneficial Practices Effect



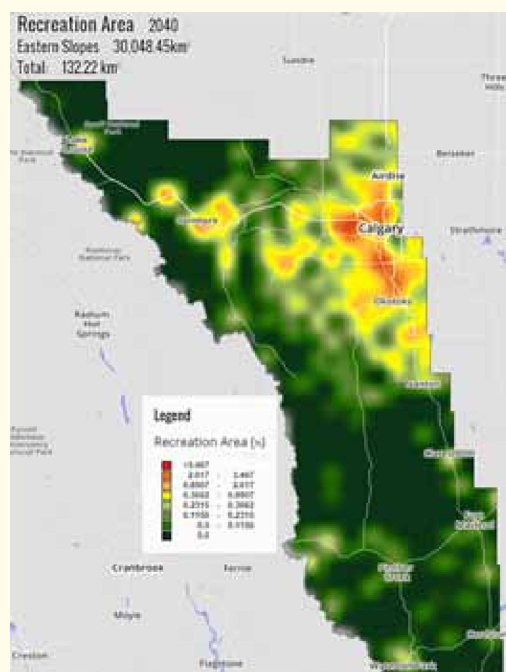
Recreation feature area (km²) on a decadal basis to 2060 with a BaU vs BMP comparison from 2010

Change from 2010 to 2040 and beyond

The maps of recreation facilities show a significant increase in the next few decades originating mainly from the Calgary area. The area taken up in the 2010 decade is some 89 km² (21,885 acres) and this increases steadily over the following decades with the implementation of Beneficial Management Practices having little effect. In the 2040 decade the expected area is 131 km² (32,370 acres) under a BaU scenario and 132 km² (32,620 acres) under a BMP scenario.



Projected fraction of area used for recreation features by the 2040 decade under a Business as Usual Scenario



Projected fraction of area used for recreation features by the 2040 decade under a Beneficial Management Practices Scenario

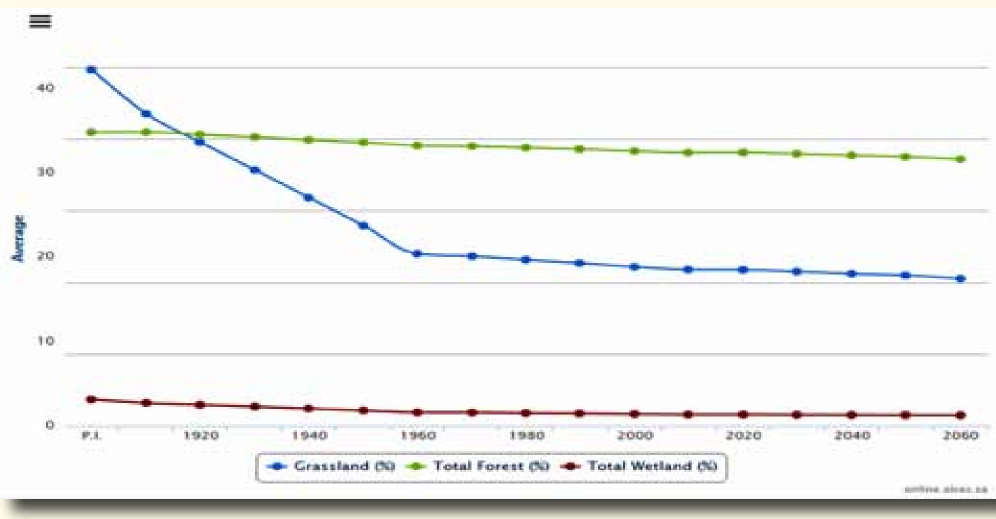
Environmental health will continue to decline

Environmental Health Indicators

Environmental health is a general term used to describe a landscape's capacity to support wildlife and plant biodiversity, supply ecosystem services, and maintain ecological function at a level desired by the public. The indicators chosen for this study are intended to reflect possible spatial and temporal changes in environmental health.

To many, water quality and quantity are viewed as the most foundational ecosystem service of the foothills region. Native grassland area was selected as an indicator because of its relatively comparatively high levels of biodiversity, significant soil carbon, and because its area has been greatly reduced in the past several decades. Grasslands are also important in preventing erosion and holding water long enough that it has time to seep into aquifers.

A grizzly bear mortality metric was selected as a wildlife indicator because of its capacity to integrate several key landscape metrics including landscape composition, fragmentation, and density and activities of humans.



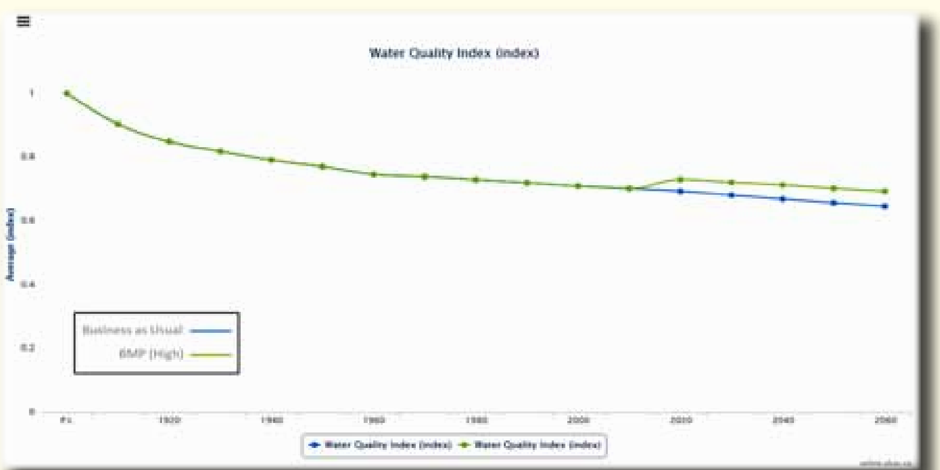
The percent of land area remaining in grassland, forest and wetlands to the 2060 decade under a BMP scenario using the aggregate of all drivers.

It is generally understood that the amount of intact grasslands, forests and wetlands correlates positively with healthy biodiversity and the provision of ecosystem services. The graph depicts a historical decline in area of forests, grasslands, and wetland; and suggests this pattern of decline will continue incrementally into the future. One concern associated with gradual declines in landscape indicators is that of stakeholder complacency; as society often fails to detect and respond to the change because of the largely imperceptible annual difference. It is often only in hindsight, measured in intergenerational time (from grandparents to grandchildren) that societies look back and reflect on profound losses in environmental health. It is, essentially, a tendency for each generation to ignore the need for action to halt the decline because it is not perceived as an impending crisis or serious problem at the time.

Water Quality

For this study, water quality index refers to the relative landscape-level change in runoff of nitrogen, phosphorous, and sediment. An index value of 1.00 indicates that these runoff emissions are occurring at rates equivalent to pre-industrial landscape. The index is the reciprocal of runoff rate; hence the index declines as runoff rates increase relative to the reference condition.

The index value in 2010 was 0.697 which represents an approximately 30% decline in quality over the past one hundred years.



Water quality on a decadal basis to 2060 with a comparison of BaU vs BMP from 2010

Change from 2010 to 2040 and beyond

Water quality, tied to elevated runoff of nitrogen, phosphorus and sediment, has declined during the past century and this degradation is projected to continue. Key factors to this historic decline have been conversion of grassland to cultivated crops, increasing livestock populations, headwater logging, plus the expansion of human population and their residential footprint. The adoption of BMPs (index of 0.708 vs 0.664 in the 2040 decade) for East Slope land uses will mitigate future losses of water quality but will not reverse historic declines.

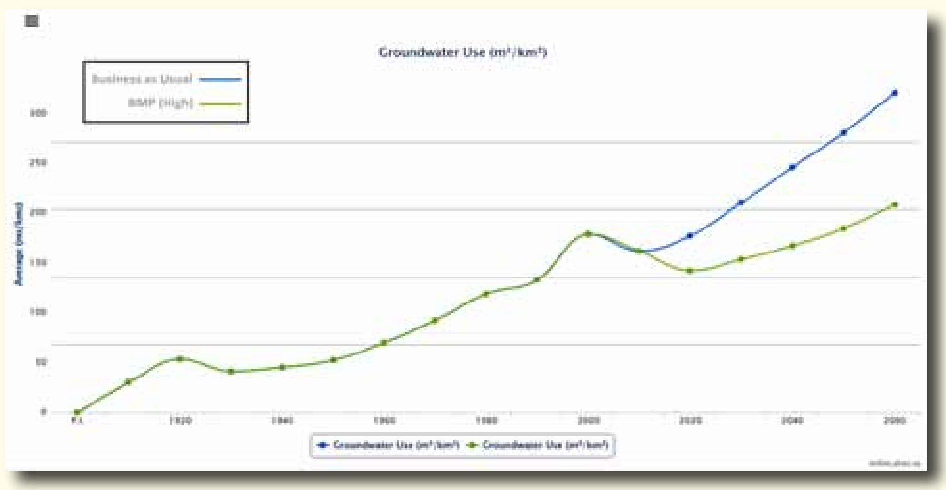
Concern

Water is arguably the most important ecosystem service provided by a healthy environment and is a highly desired attribute for society. Loss of water quality generally equates to higher treatment costs for both humans and livestock grazing systems, hence environmental quality can have a direct effect on the performance of our economy.

As such, the pollution of aquifers, lakes, and rivers by silt, chemicals, manure, and fertilizers will not just compromise fish habitat but will have direct adverse effects on all aspects of human health and wealth.

Water Use

Water use refers to the total annual net consumption of water associated with all land use sectors. The total annual water use within the study area in 2010 was simulated at 168.6 million m^3, of which 89.8 million m^3 was used for municipal purposes. The remaining water use (78.8 million m^3) can be attributed to crops (irrigated), livestock, forestry, energy, recreation, and different industrial processing plants.



Water use on a decadal basis to 2060 with a comparison of BaU vs BMP from 2010

Change from 2010 to 2040 and beyond

Demand for water continues to increase within the study area. While Beneficial Management Practices will have a short-term mitigative effect on demand, the increase in human population and land use sectoral demand ultimately turns the water use curve upward again. Total annual water use in 2040 under the BaU scenario (257.2 million m^3) is higher than the BMP scenario (171.9 million m^3) by 85.3 million m^3. As land use sectors continue to grow in amount and area, their attendant water demands will contribute to water shortages and lower water volumes in watercourses.

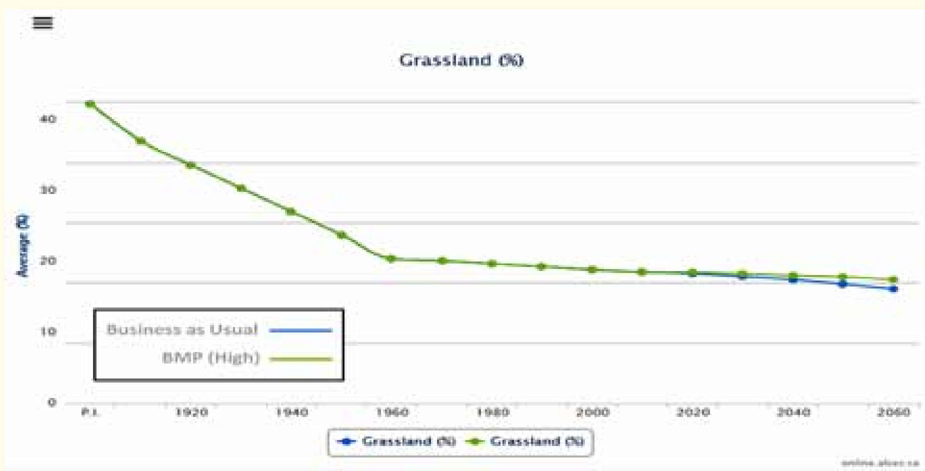
Concern

Water supply is a limiting factor for any society as it is critical for agriculture, industry, urban centers, rural residents and recreationalists. As development and water demand grows within a watershed, progressively less water will be available to downstream users and to maintain instream flow. The construction of reservoirs, although altering natural water dynamics and creating problems for fish, can be critical to providing water of adequate volume and seasonal timing. Much can and is being done to increase our efficiency of water use but ultimately we need to protect the health of our watersheds and aquifers to sustain our economic viability.

Native Grassland

Historically, native fescue grasslands were perceived as less valuable than areas that could be cultivated for crops. While much of the foothills avoided the plow because it was too steep and rugged compared to the plains to the East, it was nevertheless plowed under, paved over, and degraded by non-native invasive grasses and forbs. It wasn't until the 1960s that agriculturalists recognized its value. Since then, subsequent loss has been caused by incremental expansions of roads, residential, and the energy sector.

The amount of grassland in the 2010 decade was 5,400 km^2 (1,334,000 acres), down 56% from 12,241 km^2 (3,025,000 acres) in pre-industrial times.



Total grassland on a decadal basis to 2060 with a BaU vs BMP comparison from 2010

Change from 2010 to 2040 and beyond

By the 2040 decade the adoption of Beneficial Management Practices is projected to conserve ~200 km^2 (49,400 acres) relative to a Business as Usual scenario. The aspects of BMP creating this improved performance of native grassland includes reduced urban and acreage expansion and accelerated reclamation of non-used linear features.

Concern

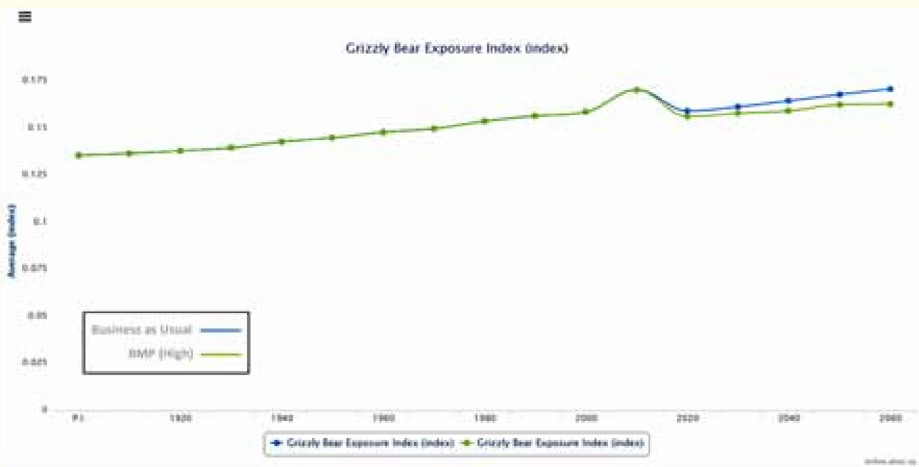
Intact native grasslands can rival, if not exceed, forests in biodiversity and soil carbon. Native grasslands with healthy species composition and litter layers can retain much of their rainfall to recharge aquifers and slow runoff during major storm events. Healthy native grasslands can also resist invasions by alien plant species. The ongoing incremental loss of foothill grassland should be of great concern to Albertans as it has a deleterious effect on water quantity, water quality, biodiversity, and the extensive cow/calf ranching operations that have characterized this region for most of the past century.

Grizzly Population

The grizzly bear was originally common on the plains but settlement and farming pushed them up higher into the foothills and beyond. Threats to the bear population include roads (collisions) and trails (negative encounters), general habitat loss, and lack of connectivity between sub-populations (habitat fragmentation).

The exposure index shown in the graphs below refers to the level of adult female sow bear mortality relative to pre-industrial landscapes.

The higher the graph the higher the mortality and thus fewer bears.



Grizzly bear exposure index on a decadal basis to 2060 with a BaU vs BMP comparison from 2010

Change from 2010 to 2040 and beyond

The mortality index in the 2010 decade is 0.170 which is above the past trend. With the recent provincial protection of this species the mortality is expected to decline temporarily and then resume its upward trajectory. By the 2040 decade the index under a BaU scenario is expected to be 0.164 with an improvement to 0.159 under a BMP scenario.

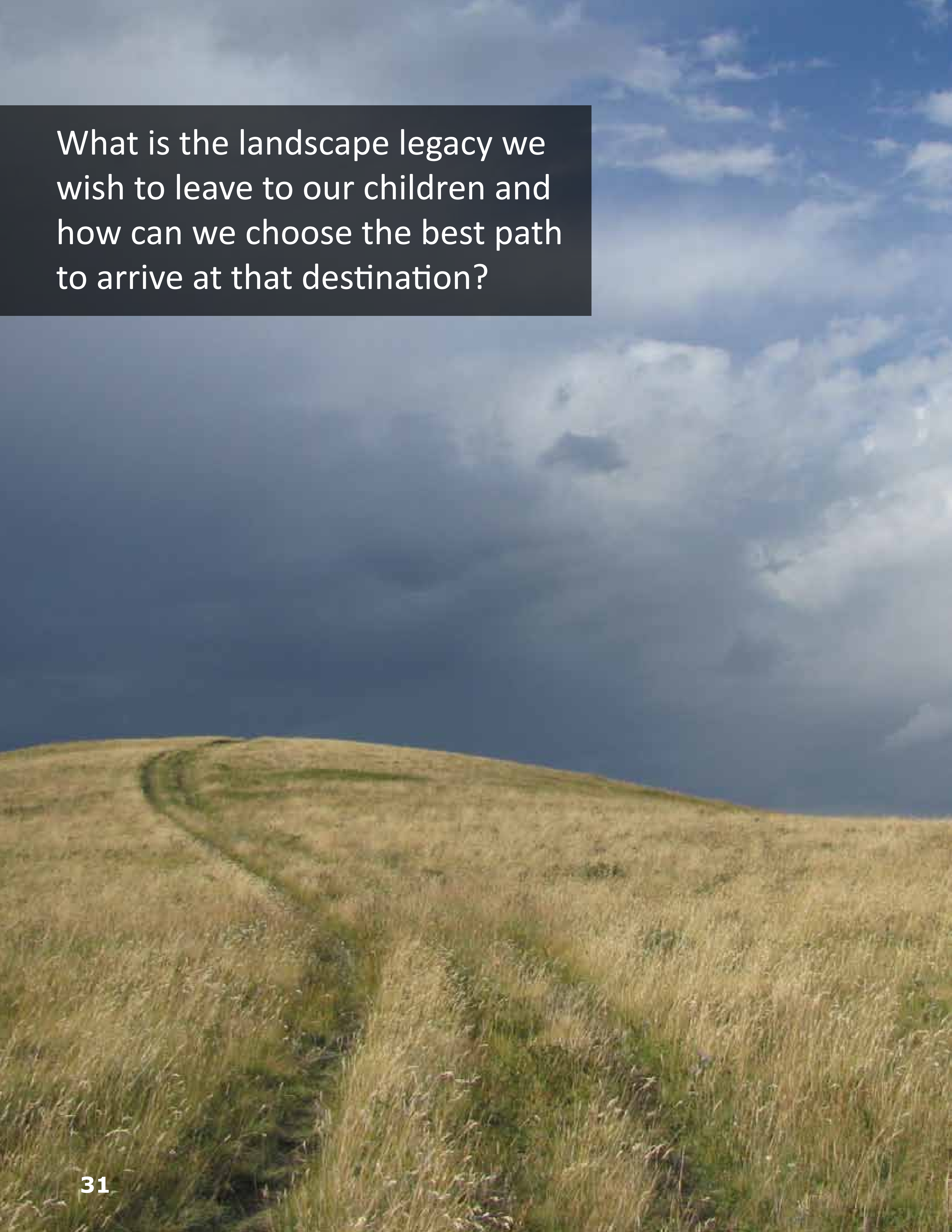
The resumption in the mortality index increase in the 2020s is due to increased interactions with humans and vehicles as the increased human population puts more people into bear country.

Concern

As an apex megafauna species, grizzly bear populations are often used as an indicator of general ecosystem quality as well as wildlife health. A complete loss of grizzly bears from the study area would indicate a serious decline in the biodiversity of the natural wildlife ecosystem.

Biodiversity is being increasingly recognized as an important element in the natural health of our world.

What is the landscape legacy we wish to leave to our children and how can we choose the best path to arrive at that destination?



Conclusions
and
Recommendations

Today, the iconic foothills of southern Alberta are less healthy and produce fewer ecosystem services than they did yesterday, and much less than a century ago. Without a change in how we plan future development, the years ahead will witness a continuing decline in the natural foothills ecosystem that provides us with water, recreation, food and esthetic pleasure, to name just a few benefits. Thus, while an increasing population demands more ecosystem services, the supply will continue to dwindle. That is the inescapable conclusion of the Southern Foothills Study completed using the science of the ALCES® Group.

This phase of the study looked at whether the implementation of improved practices, called Beneficial Management Practices (BMP), could reverse the ecological decline experienced historically and shown to continue under a Business as Usual (BaU) scenario. While the adoption of BMPs is shown to improve key indicators relative to BaU, the mounting demands placed on the landscape from increasing population (and attendant land uses) ultimately result in a continued downward trajectory of ecological health. Thus, improved management practices alone will not be enough to preserve the Southern Foothills ecosystem. This is not to say that BMPs are not critically important, for they will play a key role in mitigating the adverse effects of land use on natural capital. However, any discussion of BMPs must also incorporate the concept of limits to particular land uses. Discussions must also address directly the issue of what landscape legacy we wish to leave to our children and how we can choose the best path to arrive at that destination

From the start, the Southern Foothills Study was meant to inform and encourage good land use planning. It was initiated a decade ago by people who believed through their culture, experience, and logic that how we treat the land ultimately reflects back on our spiritual, physical and economic health both individually and as a society. The argument is not just about saving wildlife or keeping things the way they were in times past; it is about choices for the future. Landscapes change due to both natural and anthropogenic processes. Today the changes are driven primarily by human activities and that means we can make choices. It is a microcosm of similar challenges occurring on a global scale.

South Saskatchewan Regional Plan

The Land Use Framework process instituted by the Government of Alberta has resulting in the Alberta Land Stewardship Act (ALSA), a good piece of legislation that lays the foundation for informed and enlightened land use planning. Under this Act, the South Saskatchewan Regional Plan (SSRP), released in September 2014, was preceded by much dialogue and research overseen by the Regional Advisory Committee.

A weakness of the ALSA, and thus the SSRP, is that it centralizes planning power in the provincial Cabinet, thus creating a highly politicized planning system. While there is political logic in this approach, it may also damage the credibility of future land use decisions. The ALSA provides for the implementation of new conservation and stewardship tools, such as the use of offsets, but the focus to date has been on regional planning rather than promoting actual implementation of the new tools and guiding local governments in their land use decisions. While an independent multi-stakeholder group has been working to foster an understanding of offsets, the process is slow. Conservation easements continue as an existing effective tool but without needed support for an expansion in order to protect productive farmland and high-value soils.

Conclusions

The released SSRP speaks to environmental outcomes, the managing of cumulative effects, the need to control linear disturbances, recreation on public land, and the importance of biodiversity. It includes little that would help implement these actions and create improved coordination among decision makers. In addition, it provides scarce guidance for the use of the new tools and does not provide any legal requirement that would alter Business as Usual in those sectors that place the largest footprint on the landscape. This is especially the case when it come to private land or land with high resource value. One example is the protection of biodiversity where final "conservation" maps appear to carefully avoid applying a high biodiversity designation to areas of potential development.

Water

The importance of water has long been recognized as a matter of critical public policy. Alberta's ***Water for Life*** strategy, begun in the early part of this century, continues to operate in parallel with the Land Use Framework. It has been effective in supporting education and the creation of organizations such as the Watershed Planning and Advisory Councils (WPACs) and Watershed Groups.

The work of the WPACs in education, planning, studying watersheds and creating reports on the state of their watershed is critical. Nonetheless, their work will ultimately fail to protect watersheds without progressive policies and the political will to impose limits to land use growth, both of which are embodied in the ALSA and the South Saskatchewan Regional Plan (SSRP). Clearly, our knowledge of watersheds and related government policies need to be integrated. This was implied in the original 2003 ***Water for Life*** document that had as one of its Actions: "Integrate water and land management" and is one of the foundations of regional plans under the LUF. We know that water supply and quality is a function of the landscape ecosystem on which rain falls. Although the approval of the SSRP is a step forward, implementation of this integration is still lagging. The protection of the foothills watershed and ecosystem will require specific limits on the amount and type of land uses allowed on that landscape.

The development of the Surface Water Quality Management Framework in the SSRP, and the commitment to develop a Biodiversity Management Framework and linear footprint management plan for the green and white area public lands, to be effective, needs to change the downward trajectory shown in this report. The need for developing information on beneficial management practices is mentioned in the ***Water For Life Action Plan*** and the development and facilitation of the continued voluntary adoption of BMPs is an important part of the strategy for the stewardship and conservation of private lands. However, the results of this SFS study indicate that the adoption of BMPs, by themselves, will ultimately not reverse the decline.

Cumulative Effects and Limits

Humans are adept at ignoring trends until they become crises. One of the most difficult policy areas confronting government is the slow (almost imperceptible) accumulation of human actions that finally reach a point where a small action can result in a sudden large irreversible ecosystem change. This dynamic applies to ecological systems in particular. Each new proposed land use development is advocated aggressively by a person or organization that expects to gain a specific benefit. The expected adverse effect of each action on the ecosystem is perceived as small and follows many similar actions from which no serious negative consequence has resulted. Thus it is very difficult for local planning bodies to justify the denial of the new action based on an accumulating effect. The accumulating effect is exacerbated when one considers multiple actions by multiple parties under different regulatory regimes. This concept of cumulative effects was explained in the original SFS report, is formally recognized in the ALSA, and is the basis for the cumulative effects approach and the environmental management frameworks currently approved and committed to within the SSRP. However, the only effective means of dealing with cumulative effects is to place defensible limits on key environmental metrics that are affected by individual and aggregate land use activities within defined watersheds.

Dominant Land Use

The application of limits to land use under a cumulative effects policy regime is best guided by a clear set of priorities supporting the achievement of specific goals. In natural areas, the protection of biodiversity, our best remaining agricultural soils, our remaining native grasslands, and our water sources are some of these specific goals. Interesting enough, there is a great deal of positive synergy between many of the key objectives. That is, protecting one has a beneficial effect on the others. But to achieve any of these will require some form of limit on where and what anthropogenic footprint can be placed on the landscape. We would argue that a Dominant Land Use (DLU) protocol can deliver these key objectives and should therefore be a key component of the proposed linear disturbance plan and biodiversity management framework.

Under a Dominant Land Use protocol a defined area would be designated with a dominant, or priority, land use. An example relevant to the East Slopes would be a “headwaters conservation designation.” Under such a designation, the thresholds for both water quality and quantity would be defined, as well as the effect of various land uses on these metrics. Specific land uses could then be hierarchically categorized as to whether they are synergistic or incompatible with the DLU. This, in combination with the science-based limits would then provide both guidance and good rules for local planning boards in reviewing new development applications. On public lands a similar methodology would need to be adopted; perhaps using a planning board that would also be informed by the work of specific organizations such as WPACs. An example of this would be the existing commitment to protect key headwaters through the establishment of conservation areas in the SSRP which could be strengthened with a “headwaters conservation designation.” This approach should be expanded to other key areas in the SSRP.

A Future Worth Protecting

Southern Alberta remains one of the best places on earth to live. The people who make their home here are creative, active and well educated. They love the lifestyle and the landscape and they will drive the new economy. We need to ensure that we continue to attract and hold the best and most innovative people; those that form such a large part of our human capital.

The decisions made now to protect the Eastern Slopes will have far reaching effects. People come for the jobs and stay for a lifestyle that delivers recreation, clean air and water, and beautiful open spaces, not to speak of political and financial stability. In the short-term we can attract bright and creative people with high wages and economic opportunity. But for the long-term prosperity of southern Alberta we need to protect the ecosystems that provide a healthy and productive environment for people to live and prosper.

We have lost much already. Without effective land use planning we will continue to lose, one small step at a time, those environmental benefits that help maintain our lifestyle and economy. Ultimately, our society will be happier, healthier and more prosperous if we manage this landscape with care and vision.

It is hoped that this report will help to inform and invigorate the protection of our iconic landscapes and the ecosystem services they provide to current and future generations.

"The bottom line is that our society will be happier, healthier and more prosperous if we protect this landscape."

Participants

A great number of people and organizations donated time, expertise and advice to make this study happen. They were passionate and committed to working within a multi-stakeholder grassroots process to find ways to protect the value of this special place: the Eastern Slopes of southern Alberta.

Some of the participants are shown in the photo below from a meeting in 2013. A full list including those who participated in the sectoral discussions would include over one hundred people. They represented:

- Landowner Groups throughout the study area;
- Agriculture including ranchers and farmers;
- Municipal, Municipal District and County governments;
- Provincial and federal government departments and organizations;
- Environmental non-government organizations (NGOs);
- WPACs and watershed groups;
- Petroleum and natural gas companies;
- Mining;
- Forestry;
- Electrical and wind energy;
- Community initiative organizations;
- University departments plus research and policy organizations;
- Surface rights and environmental rights organizations;
- Recreation including urban and wildland activities;
- Off-highway vehicle organizations;
- Experts in wildlife, botany and grassland ecosystems.

While this report was informed by input from all participants, the conclusions and recommendations herein may not necessarily reflect the opinions or policy of specific individuals or organizations.

Southern Foothills Study

The fundamental message of this study is that the implementation of beneficial management practices within the reviewed land use sectors will not by itself stop or reverse the continued slow decline in the amount and value of ecosystem services flowing from the study area.

This decline will negatively affect the standard of living of the people of southern Alberta.

Protecting the water, biodiversity and ecosystem services of the Eastern Slopes will require the implementation of various tools within the Alberta Land Stewardship Act including limits on specific and aggregate activities.

The bottom line is that our society will be happier, healthier and more prosperous if we protect this landscape.

Southern Alberta Land Trust Society

www.salts-landtrust.org