

# Mapping the Future: Land Stewardship Through Geographic Information Systems

Western Canadian landscapes are faced with increasing pressures for natural resource extraction, urban growth, agricultural production, and recreational activities. At the same time, there are growing concerns for the conservation of important ecological systems. As a result, decision-makers are faced with complex decisions and potential land use conflicts.

Geographic information systems (GIS) can aid governments with these types of complex land use decisions. GIS enables policy-makers to better understand and analyze the implications of land use decisions on the environment, to evaluate the cumulative effects of individual land use decisions across large spatial

areas, and to prioritize specific areas for conservation. More and more, land stewardship initiatives turn to GIS to identify the potential implications of land use policies and to identify priority areas for conservation.

Although GIS is not the panacea of conservation policy, it is a valuable tool that can inform policy decisions in rapidly changing landscapes.

## What is GIS?

Generally speaking, GIS is an interactive computer program that efficiently collects geographically referenced data, then organizes, analyzes, and visualizes data.

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A leading source of strategic insight, conducting and communicating non-partisan economic and public policy research of importance to the four western provinces and all Canadians.

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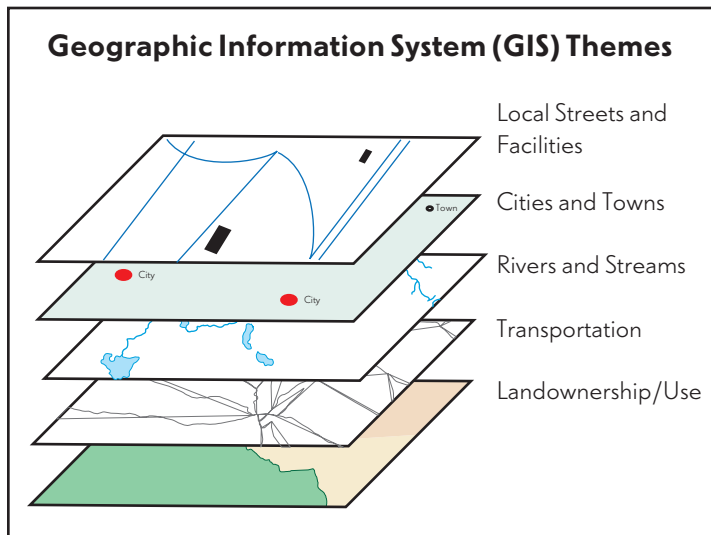
You may have your economic house in order, but don't forget about the yard

# yardwork



GIS incorporates “layers” of information and combines these layers into a single map. Data layers can include both natural features as well as built or human constructed features. Example layers include soil classifications, wetlands, vegetation, migratory bird routes, roads, forestry activity, and sour gas pipelines.

GIS enables users or stakeholders—governments, nonprofit organizations, industry, landowners and residents—to view, understand, question, and interpret data to reveal relationships, patterns, and trends in the form of maps.



### What can GIS do?

The applicability of GIS is much broader than land stewardship or land use planning. GIS can be used for a wide variety of applications such as the design of emergency response systems, to help businesses select site locations, to identify transportation corridors, to analyze voting patterns, and to map crime patterns in a city.

Generally speaking, GIS can map:

- 1. Locations**—identify either a specific location or a specific landscape pattern. For example, GIS can map hospital and grocery store locations. And in terms of patterns, GIS can map floodplains and earthquake zones.
- 2. Quantities**—illustrate where the most and least are. For example, how many hectares of wheat are harvested in Alberta, Saskatchewan, and Manitoba?

**3. Densities**—determine the number of people, buildings, or features in a specified geographic area. For example, what is the number of people per census tract?

**4. Proximity**—identify what is nearby. For example, what hotels are located within three kilometres of Calgary’s International Airport.

**5. Change**—anticipate future conditions, evaluate and illustrate the results of a policy action, and identify the most affected areas. For example, if a new subdivision is built at the edge of a city, how much forest cover is lost? How many wetlands would be drained? What type of road network will be required to connect the subdivision to other parts of the city?

GIS is not a simply a map displayed in an electronic format. GIS maps are based on data layers, which are generated by information stored in databases. This format enables users to make data queries and GIS software analyzes the results and illustrates these in the form of a map.

### Examples of GIS used in land stewardship initiatives

The application of GIS is broad and there are many examples to draw from. The following examples highlight the application in land stewardship initiatives:

#### 1. Montana State Natural Heritage Program (NHP) Stewardship Map

The NHP’s stewardship map is a statewide landscape planning and conservation tool that is used by government, realtors, planners, land trusts, businesses, and economic development organizations. The GIS map identifies public and private lands managed for conservation purposes such as federal and state parks, forest areas, wildlife research areas, wildlife management zones, private lands with conservation easements, wildlife movement routes, wildlife observation points, and private reserves.

The map is used to identify gaps in the land stewardship network and to prioritize areas for conservation programs. Land use planners also use the stewardship map to examine the potential implications of approving new housing developments, roads, and utility corridors before the necessary permits are approved. The stewardship map is an important tool that is used to guide development throughout the state.

#### 2. Southern Nevada Water Authority (SNWA) Turf Grass Mapping

Approximately 70% of water consumed in Southern Nevada is used outdoors, primarily for grass watering. In 2002, the SNWA created the Water-Smart Landscape program that provides a cash incentive for commercial and residential customers to replace their grass with more drought-tolerant landscaping.

This document is part of the Canada West Foundation’s Land Stewardship Initiative—a two-year research and communications endeavour focused on the role of public policy in facilitating land stewardship in western Canada. Land stewardship is the practice of responsible land use to ensure that natural capital is maintained or enhanced for future generations.

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The program has been very successful, but peaked in 2004. To continue to advance the initiative, SNWA created a GIS program to map the remaining locations of turf in Southern Nevada. The map not only identifies where the turf is and how much there is, it links parcel ownership and water consumption data, too. The GIS program identifies how much water (and money) can be saved if a landowner replaced traditional grass lawns with alternative, water saving options.

This mapping program has enabled SNWA to target its marketing and conservation programs to specific neighbourhoods, institutions, and municipalities that have not replaced their green grass. This program also enables SNWA to track change, measure water savings, and communicate the benefits to residents and governments.

### Why is GIS an important tool for land stewardship?

There are many benefits to using GIS for land stewardship initiatives. GIS is a valuable tool because it:

- **Visualizes the future and alternative scenarios.** It enables policy-makers to ask the “what if” questions and assess and evaluate the results of decisions. The what if scenarios enable policy-makers and the public to evaluate the consequences of decisions before they are implemented.
- **Acts as a communication tool.** GIS raises awareness by providing an understandable, visual representation of policy decisions. This can encourage and enable broader public participation in the decision-making process.
- **Enables large-scale landscape analysis.** GIS has the ability to conduct analyses at a variety of spatial scales. Prior to GIS, working at a large spatial scale would have been difficult, costly, and time consuming.
- **Has the capacity to integrate socio-economic and environmental considerations into land use decisions.** In other words, both the built and natural environment can be integrated into the decision-making process.
- **Analyzes landscape information as a whole rather than each “information layer” separately.** For example, soil type, slope, drainage, wildlife movement, and a transportation network can be combined into a single landscape change analysis. This ability enables a greater understanding of the complexity of land use decisions and the potential range of implications.
- **Supports coordination between different governments, nonprofit organizations, and private landowners.** GIS is a mechanism to share information, coordinate action, and visualize a common goal.

### What are the challenges of using GIS?

GIS is a valuable tool that can aid with land stewardship initiatives. However, GIS does come with its own set of challenges, which need to be identified and understood at the onset of a project. The main challenges include:

- **GIS may not be appropriate in all situations.** Policy-makers interested in using GIS need to ask themselves a number of questions in order to determine if GIS is appropriate and has the capabilities to achieve their goals. The key questions include: what are you trying to measure, what are you trying to determine, what data will be required and are the data available?
- **GIS is resource intensive.** Effective GIS databases require extensive staff resources to gather and analyze the data. Data must be entered into GIS

in a compatible format which can also be time consuming. In addition, start up costs for GIS can be substantial as investments in hardware and software technologies are required.

- **Data availability can be limited.** Increasingly, data are available for use in GIS. However, there may be a specific data set or format that is not available. Data holes directly affect the overall accuracy of the system.
- **Data are not always accurate.** Data accuracy is crucial to building a useful and successful GIS. Accuracy can be affected by the quality of the data gathered, how this data is interpreted and how it is inputted into GIS. Data accuracy cannot just be assumed, accuracy must be considered at every stage of GIS development. In cases where data is missing and where accuracy is comprised, GIS developers must communicate this to the users.
- **GIS development is an ongoing process.** Landscapes are constantly changing, which means that new data must be entered to stay up to date with current landscape conditions. GIS systems require continuous updating, maintenance, and investment to ensure that the quality of the GIS outputs remain high.

Overall, the utility of GIS as a decision-making tool outweighs its challenges. However, the challenges need to be identified, understood, and communicated at the onset of a project.

### Conclusion

GIS can input, store, and analyze geographically referenced data to be used to make informed land use decisions. Although GIS has its challenges, it has proven to be a valuable tool for governments, nonprofit organizations, landowners, and resource companies. GIS does require significant investments upfront, but the long-term value outweighs the startup costs. GIS use has grown tremendously in the last 15 years and, as technology evolves, the role of GIS as a tool for land use planning and land stewardship will only be strengthened.

Despite the benefits of GIS, it will not do governments’ “dirty work” and tough decisions will still have to be made. GIS does not provide a definitive answer or identify the best solution for policy-makers. GIS is good at what it does—it informs decisions, but it does not make decisions. ■

