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# A VIEW TO THE FUTURE

## A SURVEYOR GENERAL'S PERSPECTIVE

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## What of the future?

Can anyone really predict the future? Allan Kay (then of Apple Corporation) suggested in 1989 that “the best way to predict the future is to invent it. This is the century in which you can be proactive about the future; you don’t have to be reactive.”<sup>1</sup> Without a doubt, predicting is a challenging task! It is daunting, given the broad array of variables, participants and complexities in the property rights regimes underpinned by the Canada Lands Surveys System (CLSS). Yet, to plan effectively it is imperative that the most probable scenario for the future operating environment on Canada Lands be developed, based on well-defined trends and the aspirations and values of Canadian society.

This compilation of ideas is based on numerous conversations with users and stakeholders of the survey system including extensive input from employees of the Surveyor General Branch (SGB) and members of the Association of Canada Lands Surveyors (ACLS). It has been written to provide a view to the future, both near (1 to 2 years) and medium (3 to 5 years), and perhaps help to articulate an optimum future vision for the CLSS. Some parts will therefore be clearly related to trends supported by empirical evidence; others will be a synthesis of visioning from various sources that provide a longer term view of the land survey system of the future.

Explorers and surveyors have long met the geographic challenges of this vast developing country, from mapping of early fur trading routes to surveying land for settlement, to pushing the Canadian Pacific Railway westward. Today’s nation building drivers include reconciliation with Canada’s Indigenous peoples, the transfer of responsibilities to northern Territorial governments and the need to administer the full sovereign extent of Canada’s offshore regions.<sup>2</sup> Further, responsibly developing natural resources, managing Canadian communities and coping with the impact of a changing climate all signal the need to care for Canada’s land endowment in a more collaborative and integrated means than has traditionally been employed.

Integration will be an underlying theme that will guide the development of modern approaches to land administration (i.e. integration of government policies to address the issues of the day with modernized legislation that formally links all key disciplines related to land management). Shared leadership and applied technology will lead to the implementation of on-line applications that connect land administration silos such as land use planning, registration of rights, land surveys, environmental assessments and resource management systems. Finally, emerging approaches to data acquisition such

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<sup>1</sup> Kay. Predicting the future. *Stanford Engineering*. v1-n1. pp1-6. Autumn 1989.

<sup>2</sup> Government of Canada. Budget 2015. Minister of Natural Resources Mandate Letter. November 2015.

as crowdsourcing<sup>3</sup>, supported by a foundation of authoritative data, will ensure that the full power of land related information can be brought to bear on issues confronting Canadians.

### **So, what are the key trends that will influence the management of Canada Lands?**

Many of the priorities of the Government of Canada in the 2015 Speech from the Throne<sup>4</sup> will influence the near and medium term strategies for land management. These include a commitment to a “clean environment and a strong economy, a renewed nation-to-nation relationship with Canada’s Indigenous Peoples, and significant investments in public transit, green infrastructure, and social infrastructure.” Canada is also committed to “making evidence-based decisions and consulting with Canadians, including Indigenous Peoples.”

Climate change is impacting the operating environment on numerous levels.<sup>5</sup> For example, there is an increased interest in the Arctic as sea ice thins; an emerging need for revised land use planning and environmental legislation to address climate change; and an ongoing requirement to understand the impact on Canada’s ocean space and coastal regions resulting from sea level rise. Land administration systems underpinned by the CLSS must adapt to meet these demands.

Devolution of the responsibility for land administration from the federal government to the northern territorial governments is signaling a new working relationship with users of the CLSS in the North.<sup>6</sup> The devolution process is also driving the need to modernize both land tenure legislation and the information infrastructure required to enable more efficient and effective land administration in northern Canada.<sup>7</sup>

Overarching technical trends include the promotion of “Open Government” and “Open Data” driven by the demand to integrate data from numerous sources to inform solutions for a multitude of problems.<sup>8</sup> This trend is catalyzed by the availability of open

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<sup>3</sup> Crowdsourcing – The practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people and especially from the online community rather than from traditional employees or suppliers. Merriam-Webster dictionary, 2016

<sup>4</sup> Speech from the Throne. Policy documents, footnote 2. December 4, 2015

<sup>5</sup> International Panel on Climate Change. Fifth Assessment Report. 2014.

<sup>6</sup> The Northwest Territories (NWT) devolution occurred on April 1, 2014; at which time NWT assumed responsibility for managing public land, water, and resources.

<sup>7</sup> The *Northwest Territories Devolution Act* of March 25, 2014 amends the *Territorial Lands Act*, the *Northwest Territories Waters Act*, and the *Mackenzie Valley Resource Act*.

<sup>8</sup> Geogratis.gc.ca is Natural Resources Canada’s open source portal for sharing data. The portal is available to any user and data is downloadable free of charge.

source software that provides more options for utilizing the information than ever before.<sup>9</sup>

The ubiquitous availability of high resolution imagery, from satellite, aircraft or drone platforms provides an effective view of activity on the landscape. Over the last 20 years GPS<sup>10</sup> has revolutionized how land surveyors measure and conduct field surveys and will continue to improve access to precise positioning.

The land surveying community in government, academia and the private sector will continue to stay ahead of these trends, lever emerging opportunities and provide the “foundational land management knowledge”<sup>11</sup> to support development on Canada Lands.

### What strategies will position the Canada Lands Surveys System for the future?

The CLSS is modernizing to meet this ever changing and demanding environment. The information component of the System is now almost completely virtual. The Canada Lands Surveys Records (CLSR), a legal archive that contains land survey and legal boundary records dating to before Confederation, will be transformed to an electronic environment by 2018. Original records will be relocated to Library and Archives Canada for historical preservation, while the electronic version will be used to support daily operations as well as to provide the legal land descriptors for land transactions. Land surveyors will submit their records in digital format supported by secure electronic signatures.

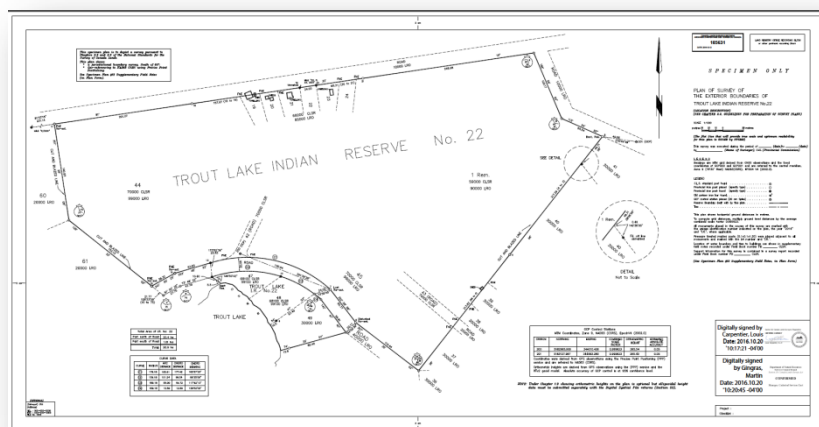


Figure 1 – Example of a digitally signed plan

<sup>9</sup> QGIS is open source GIS software that is available to any user free of charge. This software can be downloaded online; there are many FAQ sites on using and manipulating data.

<sup>10</sup> GPS – Global Positioning System, part of the Global Navigation Satellite System GNSS that includes the US Navstar or GPS System, and various other international systems.

<sup>11</sup> Canadian Generally Accepted Land Surveying Principles (2016), Canadian Council on Geomatics, Cadastral Forum.

My CLSS<sup>12</sup>, a joint initiative between the Association of Canada Lands Surveyors (ACLS) and Natural Resources Canada, Surveyor General Branch (SGB), provides an on-line environment used to guide surveyors and track survey projects, support the Association's Practice Review Department and provide a collaborative environment for government departments or agencies to engage in the survey process. Links are provided to procedures, standards, other land registries and quality control checklists.

My CLSS will continue to form the backbone of an on-line land survey system that supports the multiple property rights regimes operating on Canada Lands, regardless of where they may be on the modernization continuum. Components to be added in the near term will facilitate on-line submission of digital survey plans as well as the ability to add electronic approvals from land administrators. The result will be reduced processing timelines, in addition to a more efficient land transaction and economic development regime.<sup>13</sup>

Figure 2 - MyCLSS login page

<sup>12</sup> My Canada Lands Surveys System.

<sup>13</sup> Surveyor General Branch. Project Management Information System; *Annual Reviews*.

The opportunities for integration go far beyond *MyCLSS*. SGB maintains and offers digital cadastral or property maps for Canada Lands as open data. The mapping provides a virtual representation of the property fabric on the ground and has been built using international standards for land administration (ISO<sup>14</sup>). Rigorous mechanisms and tools such as *Parcel Editor*<sup>15</sup> will be implemented over the near term to improve the content and positional accuracy of the data and support a statistical valuation of coordinates.<sup>16</sup>

Accurate property infobases<sup>17</sup> and maps built on a solid geodetic reference frame provide the common geospatial foundation for integrated land management<sup>18</sup> activities. These include land use planning, community infrastructure, land valuation, environmental assessment and any other activity or community need that is related to a parcel of land. When combined with other datasets, the opportunities for analysis and visualization are almost limitless. A challenge is to enhance current activity related to collecting community data from as-built housing to road infrastructure and embrace new approaches to data collection which includes harnessing local geo-capacity<sup>19</sup>. For example, crowdsourcing from local residents to add data from current events such as floods that can be applied to address specific issues such as those resulting from a changing climate.<sup>20</sup>

Opportunities for an expanded role for the CLSS to be explored in the medium term include multi-dimensional components. Beyond traditional condominiums and strata plans, there is the possibility of including mineral title parcels and underground services in three dimensions.

SGB has completed significant research into the state of the property fabric on First Nations Reserves that can provide a blueprint for future development of parts of the land survey system for the near to medium term. Parcel fabric renewal<sup>21</sup> applied information collected from five pilot projects across the country to develop a series of recommendations to encourage integrated land management. The findings emphasize the importance of community engagement in lands modernization and introduce a *Community Parcel Plan* concept. The *Community Parcel Plan* integrates a renewed authoritative parcel fabric with community based thematic information to support Indigenous cultural views and local needs related to land development.

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<sup>14</sup> International Organization for Standardization. Land Administration Data Model (ISO 19152).

<sup>15</sup> Environmental Systems Research Institute (ESRI).

<sup>16</sup> A statistical confidence region will be estimated for the accuracy of point coordinates.

<sup>17</sup> In this context, infobases are geospatial information data bases linking cadastral data.

<sup>18</sup> In this context, integrated land management refers to the integration through policy or legislation of the land survey, land registration and land use planning components of a land administration regime.

<sup>19</sup> In this context, geo-capacity refers to the geomatics capacity available in a community.

<sup>20</sup> World Bank Youth Summit. Crowd sourcing solutions for climate change. 2015.

<sup>21</sup> *Final report: Parcel Fabric Renewal*. Surveyor General Branch - Natural Resources Canada. 2014.

There are parallels to the FIG, “Fit for Purpose”<sup>22</sup> land administration model in that the CLSS is: “**Flexible** in the spatial data capture approaches to provide for varying use and occupation; **Inclusive** in scope to cover all tenure and all land; **Participatory** in approach to data capture and use to ensure community support; **Affordable** for the government to establish and operate, and for society to use; **Reliable** in terms of information that is authoritative and up-to-date; **Attainable** in relation to establishing the system within a short timeframe and within available resources; and **Upgradeable** with regard to incremental upgrading and improvement over time in response to social and legal needs and emerging economic opportunities.”

In the Canada Lands context, particularly on First Nations Reserves, land survey systems must be as efficient and effective as those operating within neighbouring provincial and territorial regimes. Further, should a community decide to do so, it must be possible to migrate to the provincial or territorial systems with minimal cost.

The *Community Parcel Plan* concept facilitates these added criteria and allows the application of “Fit for Purpose” principles to co-exist in a cohesive manner with existing systems such that a “made in Canada” variant is possible. The key is bridging between the formal federal and provincial systems of land administration and the local needs of a community.



*Figure 3 - parcel fabric renewal pilot project – Uashat First Nation Quebec*

<sup>22</sup> International Federation of Surveyors (FIG)/World Bank. *Fit-For-Purpose Land Administration*. FIG Publication No. 60, 2<sup>nd</sup> Edition. March 2014.



Successful implementation will require close collaboration between local land surveyors and communities as well as the Surveyor General Branch. Extensive community engagement in the land survey process along with expanded land management roles related to the various forms of self-government highlights the need to develop capacity in Indigenous communities and to support land management institutions.

### **Are legislative changes required to support the future Canada Lands Surveys System?**

There is an opportunity to modernize legislation to promote better integration of land management activities while considering the cultural and regional diversity of users of the System. The Canada Lands Surveys Act evolved from the Dominion Lands Surveys Act and its predecessors. The legislation was initially developed to support the Dominion Land Surveys System<sup>23</sup>, with the primary objective of subdividing land for settlement in Western Canada. Although some changes have been made over time, this foundation legislation would be reviewed to consider the modifications needed to support a modern integrated context. A key driver is the societal need for legislation that reflects Canadians' evolving relationship with the land. Examples could include mechanisms that enable engagement with Indigenous peoples in the land survey and boundary definition process, formally connects to land use plans and encourages collaboration to address key policy priorities such as the mitigation of the impacts from climate change.

In some jurisdictions, modernization of land-related legislation is already underway. Nunavut has modern land titles legislation that supports a completely virtual operating environment. Given the number of remote communities and the need to streamline land registration processes, an on-line solution was essential to support economic development. In Yukon, a modernized land titles act will ensure compatibility with modern information systems and land administration processes. Indigenous peoples across Canada are also implementing many varieties of land-related self-governing legislation, driven by community aspirations and values regarding how they interact with the land.

It is imperative that legislation and policy frameworks modernize to allow for transformational changes, such as the migration to an electronic operating environment and the use of geospatial information to help define parcels and boundaries.

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<sup>23</sup> McKercher & Wolfe. *Understanding Western Canada's Land Survey System*. University of Saskatchewan. 1978.

## What is the long term view for the Canada Lands Surveys System?

Adopting a common vision for integrated land management across all Canada Lands jurisdictions will facilitate system modernization and yield optimum results. Strong leadership will be required to achieve such a future state. Developing a common way forward will be a challenge given the diverse needs of each regime. For example, adopting a common reference grid for resource development could simplify disposition regimes and facilitate investment. Further, migrating to a digital *cadastre*<sup>24</sup> model, supported by homogeneous cadastral or property maps with unique parcel identifiers will eliminate the need to produce survey plans for land descriptions and allow integration with numerous other themes of land related information. Similar systems are already in place in Quebec and Europe.

In such a streamlined modern cadastral system, land surveyors will conduct surveys, record the measurements and amend the cadastre on-line. This leverages the geospatial data management skills of the land surveyor and provides opportunities for expanded services to clients. The role of the Surveyor General will evolve to approving changes to the cadastre as opposed to survey plans as we know them today (although sketches and other documents will still be required to legally record the method and evidence used to construct or re-construct a boundary). In this way, the cadastre will increase in utility and form the virtual or geospatial foundation for an integrated approach to land management.

The Surveyor General will maintain the authoritative legally recognized data base of geographic coordinates and parcels and periodically perform re-adjustments to improve positional accuracy. Legislation will increasingly be amended to allow the use of geographic coordinates as an official reference or evidence for boundary definition, guided by standards for use.

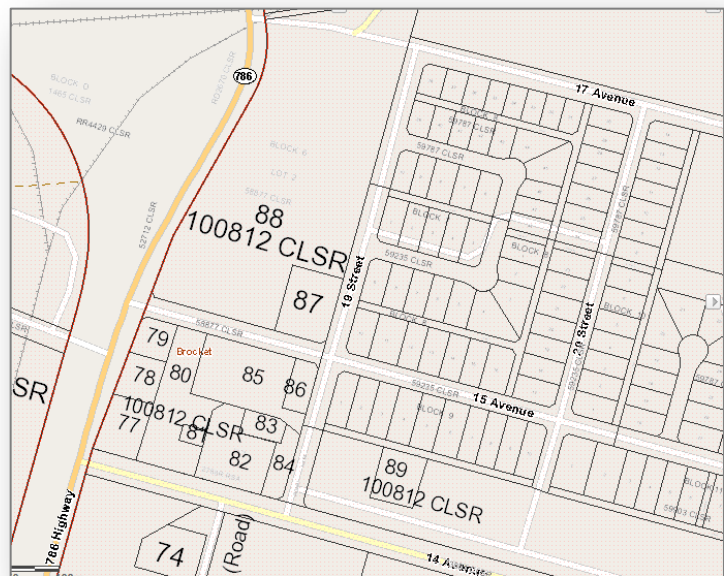


Figure 4 - CLSS map browser showing a First Nation Reserve (AB); the first version of an online tool to amend data.

<sup>24</sup> Direction générale de l'arpentage et du cadastre. Québec.

Maintaining a stable geodetic foundation will be required to sustain the trend towards the space based (GPS) positioning approach to cadastral surveying. Regardless of the future state, it is clear that geodetic capacity will be essential. Such specialized expertise will be difficult to maintain, but is mission critical and will likely be shared by all levels of government. Private sector vendors of positioning services are currently collaborating with the Canadian Geodetic Survey and will continue to provide data to users in the land survey community, to clearly specified standards, integrated into the national spatial reference system.<sup>25</sup> A national collaborative and strategic approach will be required to ensure that government, private sector and academia use limited resources effectively. Given the size and nature of our country such an approach will be essential to facilitate the development and maintenance of the geodetic infrastructure necessary to support innovation in property rights systems as well as the rapidly expanding location based industry.

### **How will this system be applied to the ground?**

The CLSS will maintain a strong connection to the land. That is, after all, where human activity happens and where land surveyors play a key role as land administration enablers. The CLSS will also continue to be rights and evidence-based, predicated on evidence of property boundaries as established by original surveys and instruments of transfer that set out the intent and legal definition of an interest in land. Surveyors will continue to search, analyze and apply well-developed principles<sup>26</sup> to provide the boundary certainty and stability required of Canadian property rights regimes.

Some may consider this to be the status quo and contrary to prior references to the use of coordinates and technical solutions for boundary definition. Far from it! Technology provides many ways to create and evaluate boundary evidence. In performing their craft, land surveyors are compelled to accept the best evidence that each case provides. This could be a geographic coordinate that has been repeatedly validated by multiple land surveyors and given official sanction in a formal and/or regulated process. Thus the coordinate or measurement as evidence might be considered the best evidence for boundary definition, depending on the situation and the property rights regime in which it is located. Humans do tend to err occasionally, so a legislated or regulated dispute resolution process will be an essential component of any future system.

It is also useful to keep in mind that it is likely to take decades to obtain geographic coordinates to accurately represent the tens of thousands of boundaries and corners

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<sup>25</sup> Canadian Spatial Reference System (NAD83, CSRS).

<sup>26</sup> Canadian Generally Accepted Land Surveying Principles, (2016), Canadian Council on Geomatics, Cadastral Forum.

that are currently legally defined by iron posts or occupational evidence. So it is suggested that the process towards accepting geographic coordinates as evidence would be evolutionary, however new techniques applied would be revolutionary in terms of their long term impact. A formal example is emerging in Alberta through a “hybrid cadastre”<sup>27</sup> that combines the use of officially sanctioned coordinates and traditional monuments. Boundary definition by coordinates and high resolution imagery can also reduce (not eliminate) the need for demarcation in many cases. Examples would include the isolated boundary standards applied in northern land claim surveys and the modernized, coordinate –based mineral regime proposed for Nunavut.

In the longer term (arguably medium term in some jurisdictions) when the quality of coordinate parcel data and the accuracy and availability of positioning systems converge, boundary definition could evolve to a technical activity for many applications. Perhaps an application from the local hardware store will allow fence layout with a GPS and parcel data enabled smart phone.<sup>28</sup> Land surveyors will continue to provide quasi-legal<sup>29</sup> interpretations on survey evidence to sort out boundary ambiguities and uncertainties. In this scenario, the public would demand that the profession provide and manage authoritative parcel and geodetic data and provide an expanded role in geospatial data management.

To support the near and long term vision, Natural Resources Canada’s *National Standards for Surveys of Canada Lands*<sup>30</sup> now require that all surveys be georeferenced such that precise geographic coordinates are generated to reference all new boundaries surveyed. This information is applied to cadastral mapping to improve the coordinate values for boundary related information. Coordinate data for existing boundaries will therefore continually improve and over time as confidence grows, become a primary source of boundary evidence.

Given our territorial nature, it is difficult to imagine a future generation without the need to physically mark boundaries on the ground. It is relatively safe to assume that fences will continue to be constructed, hedges will be planted and physical features will be employed to demarcate and assert rights to property. Society will however demand that government and the land survey profession apply the most cost effective solutions available to define the limits of rights and restrictions. The transition from near to long term will require implementing innovative and common sense approaches that strike the appropriate balance between the technical complexities of defining boundaries with intangible geographic coordinates and the traditional methodologies of marking boundaries with iron posts.

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<sup>27</sup> Alberta - Sustainable Resource Development. *Hybrid Cadastre Pilot Guidelines*. 2014.

<sup>28</sup> Conversation with Brian Maloney, former Surveyor General of Ontario. 2015.

<sup>29</sup> Cooley. *The Judicial Functions of Surveyors*. 1880.

<sup>30</sup> *National Standards for Surveys of Canada Lands*. Survey General - Natural Resources Canada. 2015.

On Canada Lands, a key challenge will be to maintain simplicity and consistency in the system while enabling the solutions that are required to support the varied jurisdictions that the CLSS serves. Given that a vibrant and innovative private sector is essential to support an effective property rights regime, a future system must operate such that broad participation by the profession is encouraged. Participation by both the profession and users must therefore be economically viable to ensure that the system is effective and accessible, but most importantly used by all with rights and responsibilities on Canada Lands.

To meet these challenges land surveyors are leveraging their role in boundary determination to develop new multi-disciplined business models that go far beyond traditional product and service offerings. Further, those with a view to the future encourage the land surveying community to think creatively and “seek guidance from clients and the public, as it is clear that even though past accomplishments may have served the public well, they do not ensure relevance going forward.”<sup>31</sup>

Finally, a challenge and critical responsibility for stewards of the Canada lands Survey System as well as practitioners will be to ensure that innovations don't compromise established and well-functioning property rights regimes. Land surveys and the survey system are essential components of the property rights regimes in Canada. The surveys will be used by current and future generations as one of the foundational components necessary for the socio-economic well-being of society. Major changes therefore need to be carefully thought through and implemented with due consideration to their long term impact.

### **Will jurisdictional boundaries be defined differently in the future?**

Canada's international and other jurisdictional boundaries are evolving as the nation matures. A well-defined international boundary on land and offshore will continue to be essential to support sovereignty, good governance and effective international relationships.<sup>32</sup> Given the national security requirements as well as the stability and visibility that are primary benefits of a well-defined international boundary vista and monuments, it is most probable that both Canada and the United States will continue their maintenance activities indefinitely.

Internal jurisdictional boundaries are however, evolving. For example, the survey of the boundary between Nunavut and the Northwest Territories is currently in the final demarcation stage. The boundary has been marked at roughly 10 kilometre intervals,

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<sup>31</sup> de Rijcke. Innovation in Geomatics Services for the Consumer: If “Walmart Law” is here, can “Costco Surveys” be far behind? *Ontario Professional Surveyor*. 2015.

<sup>32</sup> Carnaghan. *Canadian Arctic Sovereignty*. Political & Social Affairs Division - Library of Parliament. 2006.

driven by the need to clarify the location of resource development activity in each territory and to provide an anchor between the theoretical location of the boundary and the ground.

New demands for jurisdictional boundary definition are emerging.<sup>33</sup> Knowing the location of traditional indigenous lands has become increasingly important to resource development and major infrastructure projects.<sup>34</sup> The land surveying community has the ingenuity, competence and capacity to help Canadian society address these challenges as the profession has so many times throughout the development of the country.

### **So, is it really possible to predict the future?**

No not really, but as Kay suggests we can influence and contribute to authoring our destiny. With strong leadership the land surveying profession can leverage its current role as a multi-disciplinary source and home for knowledge of land and its administration, towards a renewed focus that will contribute the solutions to help address many contemporary issues for Canadians.

In 1989, Dr. John McLaughlin laid out many of the issues and societal influences impacting the future of the land surveying profession and survey system. Some 27 years on, many predictions have become reality. There have however been disruptions. The rapid maturation of GPS as a key public utility<sup>35</sup> along with the potential of the Internet and its link to information management changed a great deal in the land surveyor's world. Many of the issues that Dr. McLaughlin articulated remain critically important; such as "a growing concern for the preservation of prime soils for food and fiber production; ... for managing urban growth and containing urban sprawl; for providing access to recreational lands and the preservation of wildlife habitats; and for increased environmental monitoring and protection."<sup>36</sup> All of the above are underpinned by the land survey system and society will continue to rely on the land surveyor as the principal knowledge professional for land administration.

Regardless of the path(s) chosen by communities, government and the profession, it is most probable that the key principles for stewards of land survey systems will continue to apply; that is to ensure Canadian property rights and value are protected and land is used in a way that ensures sustainability for future generations, yet encourages economic prosperity.

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<sup>33</sup> Ballantyne. A modest proposal: A boundary tribunal for Aboriginal lands. *Geomatica*. v70-n1. 2016.

<sup>34</sup> Eyford. *A New Direction: Advancing Aboriginal and Treaty Rights*. Indigenous and Northern Affairs Canada. April 2015.

<sup>35</sup> Hurn, *GPS A Guide to the Next Utility*, 1989.

<sup>36</sup> McLaughlin. The Future. Chapter 12 in: *Survey Law in Canada*. pp507-518. 1989.

So, anyway...it's safe to say that parcels and boundaries will always be important to Canada and Canadians as a critical contribution to a "nation that is stable, safe, decent and well respected".<sup>37</sup>

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<sup>37</sup> Cleese. *So Anyway*. p213. 2015.