

# Integrated Cadastral Surveys

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## Abstract:

*The rapid convergence of geographic information, global positioning and traditional land surveying has created a demand for which adequate regulation does not presently exist. These demands originate from engineers, contractors, municipalities and other agencies that need georeferenced land surveys so that construction, planning and development are coherent over large extents of land. Anticipating the demand for spatially organized information, the Canadian Council on Geomatics (CCOG) commissioned studies, and in 2005 resolved that cadastral surveys should be referenced to a common geographic reference frame.*

*To fulfill these demands in an orderly manner, consistent with policies developed jointly on the provincial and national levels, new regulations are required. These regulations are needed to set the minimum standard of care for the integration of land surveys. The current regulations are inadequate or silent on these matters. In keeping with the principal object of the Surveyors Act, new regulations are needed to protect the public interest.*

## Discussion:

Cadastral surveys are legal surveys of the limits of estates of land. Ownership boundaries are surveyed in accordance with statutes, regulations and the common law. The surveyor's attention is directed to the subject parcel and the adjoining parcels with which it forms common boundaries. No effort is made to define the location of the lands geographically, that is, in terms of the precise latitude and longitude (coordinates) of a property corner, except to state where the land is situated in terms of Lot and Concession or Plan, Township, etc.

Integration of Cadastral surveys means that the surveyor's attention must also be directed to the determination of geographic positions on the earth. These may be expressed in terms of geographic latitude and longitude, or northing and easting in a map projection, based on a defined reference frame. The mandatory integration of cadastral surveys is intended to be limited to surveys that are deposited or registered and will not apply to real property reports, topographic or other survey plans or reports.

For decades Natural Resources Canada (NRCan) has been a partner with other nations in refining our knowledge of the shape of the Earth. This has culminated in the International Terrestrial Reference Frame (ITRF), maintained by a constellation of more than two dozen global positioning satellites and by more than 50 permanent and continuously operating tracking stations spaced around the globe.

Our local North American Datum has been refined several times. In common use during most of the last century was the 1927 datum (NAD27) based on the Clarke ellipsoid of 1866. This datum was redefined in 1983 (NAD83) based on modern measurements and the revised GRS-80 ellipsoid.

There are tens of thousands of monuments placed by federal, provincial and municipal agencies for which horizontal positions are available in NAD27 and NAD83. These monuments tend to be concentrated in urban areas and along major transportation routes.

Our ability to measure absolute positions has improved a hundred fold since NAD83(Original) was defined. Consequently a new system has been implemented that gives the average surveyor access to geographically referenced positioning that is accurate enough for legal surveys. The current system is the Canadian Spatial Reference System, or NAD83(CSRS). It is now possible to accurately locate and re-locate boundaries using modern positioning systems and equipment.

CSRS positions are no longer concentrated in urban areas and along the corridors connecting them. These positions can be obtained anywhere in Canada using GPS. To aid the surveyor, there are many sources of free data including:

1. A network of Canadian Active Control stations (CACs) established by NRCan that continuously collect satellite data;
2. Canadian Base Network stations (CBNs) established by NRCan, a high precision network of monuments in the ground that surveyors can occupy with GPS;
3. Precise Point Positioning (PPP), a service supplied by NRCan that allows a surveyor to determine an autonomous geographic position accurate to about five centimetres, practically as a by-product of normal GPS surveying;
4. Grid Shift files and software supplied by the Ministry of Natural Resources (MNR) and NRCan to convert NAD27 and NAD83(Original) to NAD83(CSRS).
5. Current and historical monument coordinates are available to surveyors from the MNR "Cosine" database.

Professional surveyors licensed or registered by the Association of Ontario Land Surveyors (AOLS) are trained in the use of GPS, reference frames, projections and computations. In addition, the AOLS has recently held a series of seminars on GPS and on the integration of cadastral surveys, and will continue to offer these seminars.

A committee of the AOLS has prepared draft regulations for integrated surveys to enhance or replace some of the current regulations under the Surveyors Act. These regulations will not change the principles by which a surveyor weighs physical and documentary evidence according to law when determining the limits of parcels. These ideas were presented to the general membership of the AOLS at the last two Annual General Meetings, as well as at several seminars in various regions of the province.

Today, many if not most surveying firms own GPS equipment and are capable of undertaking the integration of their surveys. In many municipalities there are sufficient existing horizontal



control monuments so that surveyors without GPS could integrate using conventional methods.

There are costs associated with acquiring and processing the additional measurements as well as representing the resulting data on drawings and reports. On a per project basis, it may require on average two or more hours of work in the field with specialized equipment and a corresponding increase in office work.

For some firms, no extra time will be required because their methods routinely comprise integration owing to the scale of their work and the need to carry accurate three-dimensional control over large developments. For them, the advantages of a common reference system when many developers and surveyors are working on adjoining projects far outweigh any initial inconvenience in acquiring the data. Many municipalities are requiring their surveys to be integrated but they are doing this in a piece-meal fashion, without any regulations in place to direct them.

For other firms, the extra work and the need for specialized equipment will be seen as a hardship and a burden both on the surveyor and the client. They believe the information is only of interest to government geographic information departments and will be paid for out of the pockets of the surveyors and their clients.

Indeed there are many advantages that can make the integration of cadastral surveys good for the public as well as good for surveyors and their clients.

### Surveyors will benefit because:

1. Surveys tied to geodetic control are more accurate in terms of their absolute position in the world.
2. Grid bearings eliminate rotation to old records and the hassle of convergence.
3. Survey scale can be controlled over large areas so that adjoining surveys fit and blunders can be detected and removed.
4. The disposition of lands in the north may be simplified by annulling old surveys and creating new integrated limits so that old evidence will not have to be retraced.
5. Future retracement costs will be reduced. Once surveys are integrated, existing monuments can be found more easily using their geographic position.
6. Coordinates derived from integrated surveys with sufficient redundancy will provide valuable evidence to assist in reestablishing corners when no other evidence remains. This is becoming increasingly important as Ontario's survey monumentation continues to erode.
7. Existing parcel records (including a surveyor's own job records) can be searched more efficiently in a georeferenced environment.
8. The continuing evolution and availability of both GPS and GIS hardware and software will result in lower costs in the future. It is a dynamic process; it will get faster, easier and more economical to integrate when standards are in place.

### The public will benefit because:

1. An improved ease with which cadastral fabric will be related to other geographic information such as environmental hazards and the built environment.
2. Personal safety can be enhanced by the ability to reference underground utilities to a common reference frame so they can be relocated more accurately.
3. Infrastructure planning will be streamlined and design and construction costs will be decreased when physical features are related to ownership limits.
4. The resource industry will be able to determine boundaries in their areas of operation more easily and accurately resulting in less conflict with the public and improved efficiency.
5. Parcel maintenance costs will be reduced by integrated surveys coupled with digital submissions.
6. The Cadastre will continually be improved and expanded.

### Conclusion:

Current geographic representations of the cadastre are generally unreliable. Decisions made with properly integrated survey information are of value to decision makers and to the public. With mandatory standards for positional accuracy, modern surveyors will be able to efficiently integrate their legal surveys into a reference frame that will produce data on which the surveying community and the public can rely. Regulations setting the standard of care for the integration of cadastral surveys must be enacted to ensure economy, safety and order.

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