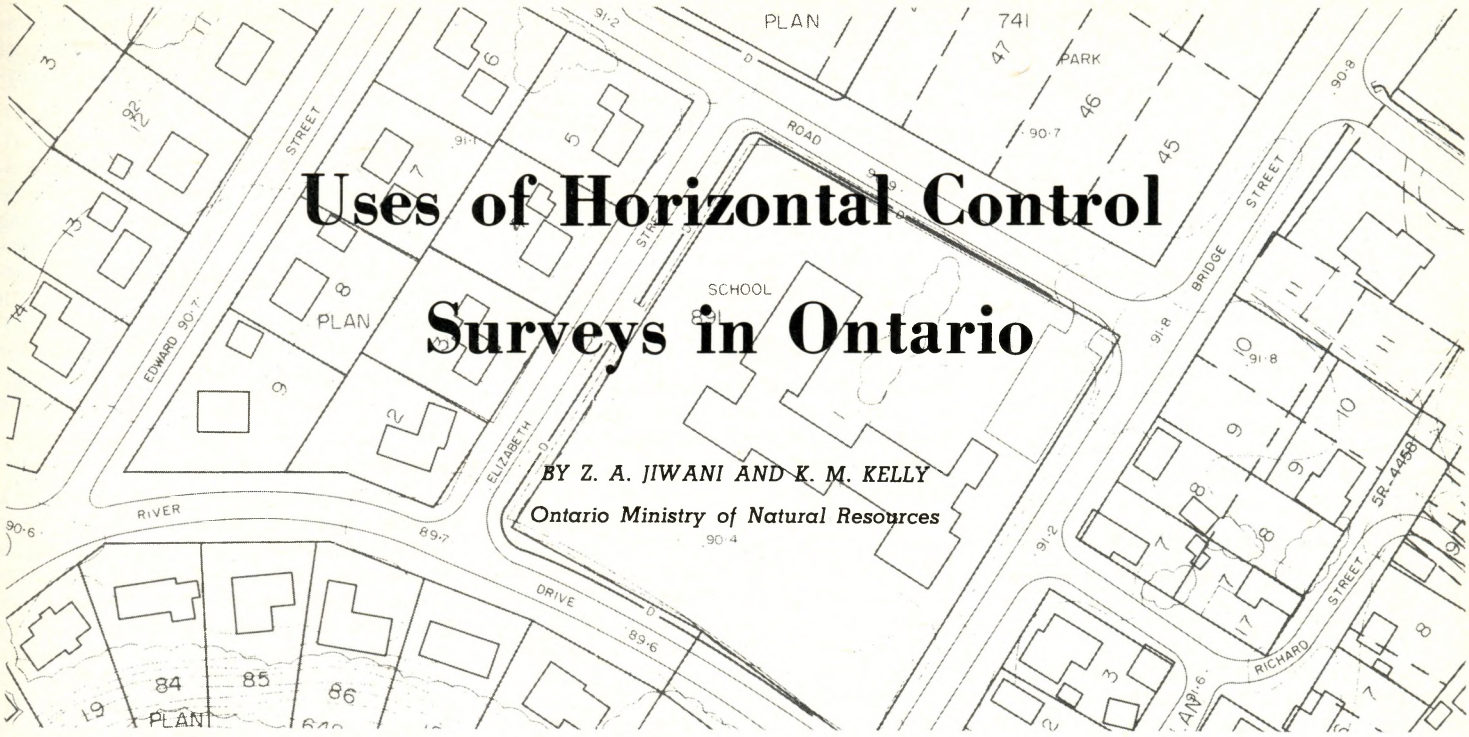

Uses of Horizontal Control Surveys in Ontario

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THE SHORES of the St. Lawrence River, near Kingston, were the site of Ontario's first surveys made under executive and civil authority. These early township surveys began in 1783 and provided large tracts of land to settle the United Empire Loyalists arriving from the American Colonies. Although not geodetic surveys by modern standards, these surveys might be considered Ontario's first control surveys. Indeed, the concept of working from the general to the particular was employed even in this early stage of the surveying profession in Ontario. Township boundaries were surveyed first, followed by proof lines and meridian lines and finally the concession lines and lot corners were established. Thus the township lots, road allowances and subsequent land development and construction projects were "controlled" by the surveyed boundaries, proof and meridian lines.

It wasn't until just after the turn of this century that the first control surveys were initiated in Canada to satisfy military mapping requirements. Four years hence, in 1909, the Geodetic Survey of Canada (GSC) was formed and these initial control surveys were incorporated into the National Geodetic Framework. Southern Ontario received its first geodetic control network around this time. In addition to the mandate of GSC to provide a national framework, was the need for control surveys in the rapidly growing urban areas. By 1922, GSC had established second-order triangulation networks in Halifax, Saint John, Quebec, Montreal, Toronto, London and Vancouver, and precise traverse nets had been provided for Toronto and London to control large scale mapping projects.

Ontario's control surveys have progressed ever since these early beginnings. Horizontal control densification throughout the province has provided the much-needed control networks for large and small scale mapping, road development and other engineering surveys that have contributed greatly to Ontario's growth. Control surveys in the Ontario Department of Highways, now the Ministry of Transportation and Communications, date from the early 1920s. Since then various federal and provincial agencies have established, and continue to establish, horizontal control in Ontario. Federal agencies establishing control in Ontario include:

— Energy, Mines and Resources
— National Defence
— Environment Canada
— Transport Canada
— Public Works Canada
— National Capital Commission

The provincial agencies are:
— Ministry of Transportation and Communications
— Ministry of Government Services
— Ministry of Natural Resources
— Ontario Hydro

Many of the larger Ontario Municipalities also establish horizontal control networks. Other agencies involved in establishing horizontal control in Ontario include:
— Bell Telephone Company
— Canadian National Railway
— Canadian Pacific Railway
— International Nickel Company

The federal and provincial agencies, with the exception of Energy, Mines and Resources Canada and the Ontario Ministry of Natural Resources, often establish horizontal control for very specific purposes. For example, the Ministry of Transportation and Communications establishes control primarily for the development and construction of major roadways. Any agency establishing horizontal control in Ontario, and desiring that the control network be stored in the provincial horizontal control survey database COSINE, must ensure that the control survey meets rigid provincial specifications. Provincial standards for control surveys in Ontario are set out in Ontario Specifications for Horizontal Control Surveys (0S79) and Ontario Guidelines for Horizontal Control Surveys (0G79). Most higher order control networks established in Ontario are required to meet provincial standards.

When considering horizontal control surveys we must distinguish between the purposes and the uses of such surveys. There is really only one purpose for establishing a control network and that is to provide a common reference system to support the systematic collection, recording, analysis, utilization, updating and dissemination of data pertaining to land and to geographic location. Such a reference system, consisting of permanently monumented control stations and based on a common reference system, exists in Canada in

the form of the National Geodetic Triangulation Framework. This massive network of horizontal control extends from coast to coast and is established and maintained by the Geodetic Survey of Canada. Secondary and tertiary networks are continually being established throughout Ontario by the Ministry of Natural Resources, through the Ontario Basic Mapping Program and by various other agencies for their specific purposes.

There are many uses for horizontal control surveys in Ontario. They provide not only a reference system for spatially qualified data but can also serve as the basis for land-related municipal information systems. Horizontal control surveys in Ontario are used to support one or more of the following functions:

— To provide a primary control framework for future densification surveys
— To provide ground control for conventional and photogrammetric mapping and charting activities
— To support a cadastral survey system.
— To provide coordinate control in a common reference system for engineering surveys
— To provide a framework for an integrated urban survey system
— To provide coordinate control for the exploration, mining and harvesting of natural resources
— To facilitate in monitoring the deformation of large engineering structures, tectonic movements, subsidence due to mining exploitation, etc.
— To support scientific studies such as the determination of the size and shape of the earth, crustal movements etc.
— To provide coordinate control for military exercises
— To provide a common reference system for indirect uses of control survey related data.

Primary Control Framework

Up to the early 1960's the role of the Geodetic Survey of Canada was to propagate national networks of primary geodetic points needed by others as a framework of reference for general surveying and mapping throughout Canada. In the early 1960's this mandate was broadened to include secondary surveys. The horizontal position system is composed of a framework of primary triangulation points, and a fabric of supplementary points related to the framework. When appropriately integrated, the framework and fabric form a position reference system for all general surveying and mapping activities. In essence, the geodetic position and elevation systems define the physical size and shape of Canadian Territory, with a precision determined by the spacing and accuracies of the component points (Report of The Task Force on National Surveying and Mapping, May 1978).

Mapping Control

Initially, the national geodetic control framework was established to provide a common reference system for mapping and charting activities in Canada. National topographic mapping is still referenced to this primary framework. In general, horizontal control surveys provide a uniform reference system for mapping and can serve as ground control for all types and scales of mapping operations.

Cadastral Survey Systems

A common reference framework within which property boundaries are coordinated will assist the surveyor in laying out new boundaries and retracing old ones. Accumulation of errors as a result of piecemeal surveying may be reduced by the use of coordinate control. Horizontal control networks can greatly assist in joining adjacent, discontinuous surveys, and in initiating a coordinate based land description system. Such networks can also serve as the foundation upon which to build a computerized system for the recording and manipulation of land titles records. To maintain accuracy, consistency and re-

liability all cadastral surveys can be inter-related by ties to a network of coordinated control stations. Such correlation will serve to lessen litigation over ownership and the position of parcel boundaries. In addition, the decay of the cadastral survey would be largely circumvented and accurate boundary surveys could be performed at minimum cost. Subdivision design and layout, expropriation proceedings and condominium properties could all be handled with greater efficiency and reduced cost when based on horizontal control surveys.

Engineering Surveys

All phases of an engineering project, from the feasibility studies through the planning and design stages to the actual field layouts can be based on the horizontal control network. As-built conditions can also be obtained. Not only can utility lines, major roadways, large construction projects, commercial and residential complexes derive their precise position from a control network but they can also derive their positional inter-relationships using coordinate control. Various phases of a large engineering project can be designed, studied and analyzed piecemeal and made to correlate when the total project is finished. The control can aid in large scale photogrammetric mapping often used in the engineering design phase. Subsequent physical improvements can be related to the cadastral surveys when both the project and the legal boundaries are based on the same control network.

Integrated Urban Survey Systems

"Full survey integration is the coordination by survey of all definable, significant, physical, and legal elements of the environment, both above and below the ground, on a common datum, with a sufficient number of permanently marked reference points to re-establish with facility and precision the positions of any element that may have suffered removal or obliteration" (Andrews, 1960).

A horizontal control framework then, consisting of monumented control stations at a density sufficient for controlling all property boundaries, is the pre-requisite for an integrated land-related information system. Such coordinate control can also provide the basis for a computerized file of coordinated property boundaries which in turn can serve as the common denominator for a land titles file, assessment and tax data file, land use and inventory file, general statistics file and files on transportation, utilities, social services etc. Thus horizontal control surveys provide the foundation for a complete spatial and administrative, municipal land-related information system.

Mining Surveys

The horizontal control network can assist in coordinating surface and underground mining operations. Mining claim leases can then be related to the same coordinate system as the surrounding property boundaries.

Indirect Uses of Control Surveys

Control survey data is used indirectly when measurements are taken from a map or plan overlaid with a coordinate grid, rather than directly from the control monuments. Such indirect uses include mineral, water and forest resources inventory, geophysical surveys, urban and regional planning, accident reports, municipal services and civil emergencies.

Census and statistical data can also be collected and stored by the use of a geo-coding system based on coordinate control.

The Ministry of Natural Resources, through the Ontario Basic Mapping Program (OBM) has been establishing horizontal control throughout the province since 1978. To date, about fifty townships and municipalities in Northern Ontario and twenty-five in Southeastern Ontario use horizontal control established by MNR as a framework for their surveying activities. On the average, fifteen to twenty municipalities are provided with horizontal control networks annually. These networks provide the ground control for large scale photogrammetric mapping in the municipality. Control networks are also established to provide ground control for small scale mapping of large portions of Ontario.

Concurrent with the efforts of MNR in establishing horizontal control in the province, are other ministries engaged in similar activities. In order that the surveying community may be kept informed of areas in Ontario where horizontal control is being established by MNR, this column will appear in future issues of OLS Quarterly. This column will supply information on projects completed to date, and upcoming control surveys along with information such as location and type of control survey (horizontal or vertical) and proposed date of commencement and completion.

Horizontal and vertical field control surveys have been recently completed or are in progress in the areas listed below. Some will be completed by the time this OLS Quarterly is received. Users and those in related fields may obtain more information by contacting the authors at the Ministry of Natural Resources, Surveys and Mapping Branch, Geographical Referencing Section, Toronto (Tel. (416) 965-4538/4789).

CONTROL SURVEYS RECENTLY COMPLETED OR IN PROGRESS

AREA	TYPE OF SURVEY	TENTATIVE DATE OF COMPLETION
Alexandria, Town of	H/V	April, 1983
Almonte, Town of	H/V	November, 1982
Barry's Bay, Village of	H/V	April, 1983
Bath, Village of	H/V	April, 1983
Bruce Mines, Town of	H/V	March, 1983
Campbellford, Town of	H/V	February, 1983
Cardinal, Village of	H/V	January, 1983
Carleton Place, Town of	H/V	November, 1982
Chesterville, Village of	H/V	January, 1983
Cosby, Mason, Martland, Township of	H/V	Completed
Cumberland, Township of	H/V	March, 1983
Gananoque, Town of	H/V	April, 1983
Hagar, Township of	H/V	March, 1983
Iroquois, Village of	H/V	January, 1983
Marmora, Village of	H/V	April, 1983
Massey, Town of	H/V	March, 1983
Matilda, Township of	H/V	March, 1983
Township of Oso	H/V	February, 1983
Picton, Town of	H/V	January, 1983
Powassan, Town of	H/V	March, 1983
Rainy River and Southwest		
Kenora, Districts of	H	Completed
Kenora, Districts of	V	July, 1983
Spanish River, Township of The	H/V	March, 1983
Terrace Bay, Township of	H/V	January, 1983
Toronto/Guelph, Cities of	H/V	Completed
Trenton, City of	H/V	April, 1983
Tweed, Village of	H/V	Completed
Vankleek Hill, Town of	H/V	Completed
Webwood, Town of	H/V	Completed
White River, Township of	H/V	April, 1983
Winchester, Township of	H/V	January, 1983