Services Guide

Surveyors - Land

**NOTE 1: This information is pulled from credible sources. This information is a guide. Any information used from this guide must be re-contextualized (no copying and pasting). Re-contextualize information incorporating SEO and business specifics.*

**NOTE 2: For MCP websites, stick to general information and avoid specifics.*

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1. SURVEYORS - LAND OVERVIEW

1.1 GENERAL INFORMATION

http://www.abcls.ca/
https://en.wikipedia.org/wiki/Surveying

- Surveying or land surveying is the technique, profession, and science of determining the terrestrial or three-dimensional position of points and the distances and angles between them. A land surveying professional is called a land surveyor. These points are usually on the surface of the Earth, and they are often used to establish land maps and boundaries for ownership, locations like building corners or the surface location of subsurface features, or other purposes required by government or civil law, such as property sales.
- Land surveyors as public officers, play a quasi-judicial role and are therefore impartial. They provide assistance independent of and uninfluenced by the interests of a client; avoid and reject the role of advocate; are unbiased; and abide by precepts of procedural fairness.
- Surveyors work with elements of geometry, trigonometry, regression analysis, physics, engineering, metrology, programming languages and the law. They use equipment like total stations, robotic total stations, GPS receivers, retroreflectors, 3D scanners, radios, handheld tablets, digital levels, drones, GIS and surveying software.
- Surveying has been an element in the development of the human environment since the beginning of recorded history. The planning and execution of most forms of construction require it. It is also used in transport, communications, mapping, and the definition of legal boundaries for land ownership. It is an important tool for research in many other scientific disciplines.

1.2 SEO

Keywords (First Row – BEST, Last Row – LEAST)			
○ survey	○ site survey	○ construction survey	○ land surveyor
○ geodetic survey	○ topographic survey	○ property survey	○ survey companies
○ contour survey	○ cadastral survey	○ leveling	○ hydrographic survey

1.3 TYPES OF LAND SURVEYING

https://en.wikipedia.org/wiki/Surveying
https://en.wikipedia.org/wiki/Cadastral_surveying
https://en.wikipedia.org/wiki/Construction_surveying

https://en.wikipedia.org/wiki/Levelling

Types of Land Surveying:

Type	Description
Cadastral or Boundary Survey	○ Cadastral surveying is the sub-field of surveying that specializes in the establishment and re-establishment of real property boundaries. It is an important component of the legal creation of properties. A cadastral surveyor must apply both the spatial-measurement principles of general surveying and legal principles such as respect of neighboring titles.
Construction Survey	○ Construction surveying or building surveying (otherwise known as "staking", "stake-out", "lay-out" or "setting-out") is to stake out reference points and markers that will guide the construction of new structures such as roads or buildings. These markers are usually staked out according to a suitable coordinate system selected for the project.
Deformation Survey	○ Deformation monitoring (also referred to as deformation survey) is the systematic measurement and tracking of the alteration in the shape or dimensions of an object as a result of stresses induced by applied loads. Deformation monitoring is a major component of logging measured values that may be used to for further computation, deformation analysis, predictive maintenance and alarming.
Hydrographic Survey	○ Hydrographic survey is the science of measurement and description of features which affect maritime navigation, marine construction, dredging, offshore oil exploration/offshore oil drilling and related activities. Strong emphasis is placed on soundings, shorelines, tides, currents, seabed and submerged obstructions that relate to the previously mentioned activities.
Leveling	○ Levelling is the measurement of geodetic height using an optical levelling instrument and a level staff or rod having a numbered scale. Common levelling instruments include the spirit level, the dumpy level, the digital level, and the laser level.
Mortgage Survey	○ A mortgage survey or physical survey is a simple survey that delineates land boundaries and building locations. It checks for encroachment, building setback restrictions and shows nearby flood zones. In many places a mortgage survey is a precondition for a mortgage loan.
Topographic Survey	○ A survey that measures the elevation of points on a particular piece of land, and presents them as contour lines on a plot.

Other Information about Types of Land Surveying and Surveyors:

- The basic principles of surveying have changed little over the ages, but the tools used by surveyors have evolved. Engineering, especially civil engineering, often needs surveyors.
- Surveyors help determine the placement of roads, railways, reservoirs, dams, pipelines, retaining walls, bridges, and buildings. They establish the boundaries of legal descriptions and political divisions. They also provide advice and data for geographical information systems (GIS) that record land features and boundaries.
- Surveyors must have a thorough knowledge of algebra, basic calculus, geometry, and trigonometry. They must also know the laws that deal with surveys, real property, and contracts.
- Most jurisdictions recognize three different levels of qualification:
    - *Survey assistants* or *chainmen* are usually unskilled workers who help the surveyor. They place target reflectors, find old reference marks, and mark points on the ground. The term 'chainman' derives from past use of measuring chains. An assistant would move the far end of the chain under the surveyor's direction.
    - *Survey technicians* often operate survey instruments, run surveys in the field, do survey calculations, or draft plans. A technician usually has no legal authority and cannot certify his work. Not all technicians are qualified, but qualifications at the certificate or diploma level are available.
    - *Licensed, registered, or chartered surveyors* usually hold a degree or higher qualification. They are often required to pass further exams to join a professional association or to gain certifying status. Surveyors are responsible for planning and management of surveys. They have to ensure that their surveys, or surveys performed under their supervision, meet the legal standards. Many principals of surveying firms hold this status.

1.4 TYPES OF SURVEYING EQUIPMENT

https://en.wikipedia.org/wiki/Surveying#Types_of_surveys

General:

- The main surveying instruments in use around the world are the theodolite, measuring tape, total station, 3D scanners, GPS/GNSS, level and rod. Most instruments screw onto a tripod when in use. Tape measures are often used for measurement of smaller distances. 3D scanners and various forms of aerial imagery are also used.

Product	Description
Theodolite	○ The theodolite is an instrument for the measurement of angles. It uses two separate circles, protractors or alidades to measure angles in the horizontal and the vertical plane. A telescope mounted on trunnions is aligned vertically with the target object.

	○ When beginning the survey, the surveyor points the instrument in a known direction (bearing), and clamps the lower plate in place. The instrument can then rotate to measure the bearing to other objects.
Measuring Tape	○ A tape measure or measuring tape is a flexible ruler. It consists of a ribbon of cloth, plastic, fiberglass, or metal strip with linear-measurement markings.
Total Station	○ The total station is a development of the theodolite with an electronic distance measurement device (EDM). A total station can be used for leveling when set to the horizontal plane.
3D Scanner	○ A 3D scanner is a device that analyses a real-world object or environment to collect data on its shape and possibly its appearance (e.g. colour). The collected data can then be used to construct digital three-dimensional models.
GPS/GNSS	○ The Global Positioning System (GPS) is a global navigation satellite system (GNSS) that provides geolocation and time information to a GPS receiver in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.
Level	○ An optical instrument used to establish or verify points in the same horizontal plane. It is used in surveying and building with a vertical staff to measure height differences and to transfer, measure and set heights.
Rod	○ The rod, also called a Philadelphia rod, is a level staff used in surveying. The rod is used in leveling procedures to determine elevations. It is read using a level.

2. CADASTRAL OR BOUNDARY SURVEY

https://en.wikipedia.org/wiki/Cadastral_surveying

General:

- Cadastral surveying is the sub-field of surveying that specializes in the establishment and re-establishment of real property boundaries. It is an important component of the legal creation of properties. A cadastral surveyor must apply both the spatial-measurement principles of general surveying and legal principles such as respect of neighboring titles.
- One of the primary roles of the land surveyor is to determine the boundary of real property on the ground. That boundary has already been established and described in legal documents and official plans and maps prepared by attorneys, engineers, and other land surveyors. The

corners of the property will either have been monumented by a prior surveyor, or monumented by the surveyor hired to perform a survey of a new boundary which has been agreed upon by adjoining land owners.

Cadastral Survey Process:

Steps	Description
1. Obtain Records	○ Obtain copies of the deed description and all other available documents from the owner. The deed description is that of the deed and not a tax statement or other incomplete document. The surveyor should then obtain copies of deed descriptions and maps of the adjoining properties, any records from the municipality or county, utility maps, and any records of surveys.
2. Examine	○ The surveyor examines the documents for errors, such as closure errors. When a metes and bounds description is involved, the seniority of the deeds must be determined. The title abstract usually gives the order of seniority for the deeds related to the tract being surveyed and should be used if available.
3. Survey	○ The initial survey operations should be concentrated on locating monuments. In urban regions, monuments should be sought initially; but in the absence of monuments, property corners marked by iron pins, metal survey markers, iron pipes, and other features possibly establishing a line of possession should be located. ○ When the approximate positions for the boundaries of the property have been located, a traverse is run around the property. While the control traverse is being run, ties should be measured and all details relevant to the boundaries should be acquired. This includes but is not limited to locating the property corners, monuments, fences, hedge rows, walls, walks, and all buildings on the lot.
4. Compare	○ The surveyor then takes this collected data and compares it to the records which were received. When a solution is reached, the chosen property corners (those that best fit all the data) are coordinated, and ties by direction and distance are computed from the nearest traverse point. Once this has been established the features on the lot can be drawn, dimensions can be shown from these features to the boundary line, and a map or plat is prepared for the client.

3. CONSTRUCTION SURVEY

https://en.wikipedia.org/wiki/Construction_surveying

General:

- Construction surveying or building surveying (otherwise known as "staking", "stake-out", "lay-out" or "setting-out") is to stake out reference points and markers that will guide the construction of new structures such as roads or buildings. These markers are usually staked out according to a suitable coordinate system selected for the project.
- Land surveys and surveys of existing conditions are generally performed according to geodesic coordinates. However for the purposes of construction a more suitable coordinate system will often be used. During construction surveying, the surveyor will often have to convert from geodesic coordinates to the coordinate system used for that project.

Construction Survey Process:

Steps	Description
1. Evaluate Site	○ Survey existing conditions of the future work site, including topography, existing buildings and infrastructure, and underground infrastructure whenever possible (for example, measuring invert elevations and diameters of sewers at manholes)
2. Site Preparation	○ Stake out lot corners, stake limit of work and stake location of construction trailer (clear of all excavation and construction) ○ Stake out reference points and markers that will guide the construction of new structures
3. Monitoring	○ Verify the location of structures during construction ○ Provide horizontal control on multiple floors
4. As-Built Survey	○ Conduct an As-Built survey: a survey conducted at the end of the construction project to verify that the work authorized was completed to the specifications set on plans

Other Information about Construction Surveys:

- Surveying equipment, such as levels and theodolites, are used for accurate measurement of angular deviation, horizontal, vertical and slope distances. With computerization, electronic distance measurement (EDM), total stations, GPS surveying and laser scanning have supplemented (and to a large extent supplanted) the traditional optical instruments.
- The builder's level measures neither horizontal nor vertical angles. It simply combines a spirit level and telescope to allow the user to visually establish a line of sight along a level plane. When used together with a graduated staff it can be used to transfer elevations from one location to another. An alternative method to transfer elevation is to use water in a transparent

hose as the level of the water in the hose at opposite ends will be at the same elevation. A double right angle prism verifies grid patterns, isolating layout errors.

4. DEFORMATION SURVEY

https://en.wikipedia.org/wiki/Deformation_monitoring

General:

- Deformation monitoring (also referred to as deformation survey) is the systematic measurement and tracking of the alteration in the shape or dimensions of an object as a result of stresses induced by applied loads. Deformation monitoring is a major component of logging measured values that may be used to for further computation, deformation analysis, predictive maintenance and alarming.
- Deformation monitoring is primarily related to the field of applied surveying, but may be also related to civil engineering, mechanical engineering, construction, and geology. The measuring devices used for deformation monitoring depend on the application, the chosen method and the preferred measurement interval.
- Deformation monitoring can be manual or automatic. Manual deformation monitoring is the operation of sensors or instruments by hand or manual downloading of collected data from deformation monitoring instruments. Automatic deformation monitoring operation of a group of software and hardware elements for deformation monitoring that, once set up, does not require human input to function.
- The monitoring regularity and time interval of the measurements must be considered depending on the application and object to be monitored. Objects can undergo both rapid, high frequency movement and slow, gradual movement. For example, a bridge might oscillates with a period of a few seconds due to the influence of traffic and wind and also be shifting gradually due to tectonic changes.

Applications of Deformation Surveying:

- Dams
- Roads
- Tunnels
- Bridges and Viaducts
- High-rise and historical buildings
- Foundations
- Construction sites
- Mining
- Landslide areas
- Volcanoes
- Settlement areas
- Earthquake areas

Other Information about Deformation Surveying:

- Measuring devices (or sensors) can be sorted in two main groups, geodetic and geotechnical sensors. Both measuring devices can be seamlessly combined in modern deformation monitoring.
- Geodetic measuring devices measure georeferenced (relative to established locations outside the monitoring area) displacements or movements in one, two or three dimensions. It includes the use of instruments such as total stations, levels, InSAR, and global navigation satellite system receivers.
- Geotechnical measuring devices measure displacements or movements and related environmental effects or conditions without external georeferencing. It includes the use of instruments such as extensometers, piezometers, pressuremeters, rain gauges, thermometers, barometers, tilt meters, accelerometers, seismometers etc.

5. HYDROGRAPHIC SURVEY

https://en.wikipedia.org/wiki/Hydrographic_survey

General:

- Hydrographic survey is the science of measurement and description of features which affect maritime navigation, marine construction, dredging, offshore oil exploration/offshore oil drilling and related activities. Strong emphasis is placed on soundings, shorelines, tides, currents, seabed and submerged obstructions that relate to the previously mentioned activities. The term hydrography is l used synonymously to describe maritime cartography, which in the final stages of the hydrographic process uses the raw data collected through hydrographic survey into information usable by the end user.
- Hydrography is collected under rules which vary depending on the acceptance authority. Traditionally conducted by ships with a sounding line or echo sounding, surveys are increasingly conducted with the aid of aircraft and sophisticated electronic sensor systems in shallow waters.

Types of Hydrographic Surveying:

Type	Description
Lead Lines, Sounding Poles, and Single Beam Echo Sounders	○ For many centuries, a hydrographic survey required the use of lead lines – ropes or lines with depth markings attached to lead weights to make one end sink to the bottom when lowered over the side of a ship or boat – and sounding poles, which were poles with depth markings which could be thrust over the side until they touched bottom. In either case, the depths measured had to be read manually and recorded, as did the position of each measurement with regard to mapped reference points as determined by three-point sextant fixes. ○ Single-beam echo sounders and fathometers began to enter service in

	the 1930s which used sonar to measure the depth beneath a vessel. This greatly increased the speed of acquiring sounding data over that possible with lead lines and sounding poles by allowing information on depths beneath a vessel to be gathered in a series of lines spaced at a specified distance. However, it shared the weakness of earlier methods by lacking depth information for areas in between the strips of sea bottom the vessel sounded.
Wire-Drag	○ In the wire-drag method, a wire attached to two ships or boats and set at a certain depth by a system of weights and buoys was dragged between two points. If the wire encountered an obstruction, it would become taut and form a "V" shape. The location of the "V" revealed the position of submerged rocks, wrecks, and other obstructions, while the depth at which the wire was set showed the depth at which the obstruction was encountered. This method revolutionized hydrographic surveying, as it allowed a quicker, less laborious, and far more complete survey of an area than did the use of lead lines and sounding poles.
Modern	○ In suitable shallow-water areas LIDAR (light detection and ranging) may be used. Equipment can be installed on inflatable craft, such as Zodiacs, small craft, autonomous underwater vehicles (AUVs), unmanned underwater vehicles (UUVs) or large ships, and can include side-scan, single-beam and multi-beam equipment. At one time different data collection methods and standards were used in collecting hydrographic data for maritime safety and for scientific or engineering bathymetric charts, but increasingly, with the aid of improved collection techniques and computer processing, the data is collected under one standard and extracted for specific use.

6. LEVELING SURVEY

https://en.wikipedia.org/wiki/Levelling

General:

- Levelling (or leveling in US English) is a branch of surveying, the object of which is to: 1) Find the elevation of a given point with respect to the given or assumed datum. 2) Establish a point at a given elevation with respect to the given or assumed datum.
- Levelling is the measurement of geodetic height using an optical levelling instrument and a level staff or rod having a numbered scale. Common levelling instruments include the spirit level, the dumpy level, the digital level, and the laser level.
- Spirit levelling employs a spirit level, an instrument consisting of a telescope with a crosshair and a tube level like that used by carpenters, rigidly connected. When the bubble in the tube

level is centered the telescope's line of sight is supposed to be horizontal (i.e., perpendicular to the local vertical).

- The spirit level is on a tripod with sight lines to the two points whose height difference is to be determined. A graduated leveling staff or rod is held vertical on each point; the rod may be graduated in centimeters and fractions or tenths and hundredths of a foot. The observer focuses in turn on each rod and reads the value. Subtracting the "back" and "forward" value provides the height difference.

Leveling Survey Process:

- A typical procedure is to set up the instrument within 100 metres (110 yards) of a point of known or assumed elevation. A rod or staff is held vertical on that point and the instrument is used manually or automatically to read the rod scale. This gives the height of the instrument above the starting (back sight) point and allows the height of the instrument (H.I.) above the datum to be computed.
- The rod is then held on an unknown point and a reading is taken in the same manner, allowing the elevation of the new (foresight) point to be computed. The procedure is repeated until the destination point is reached. It is usual practice to perform either a complete loop back to the starting point or else close the traverse on a second point whose elevation is already known. The closure check guards against blunders in the operation, and allows residual error to be distributed in the most likely manner among the stations.
- Some instruments provide three crosshairs which allow stadia measurement of the foresight and back sight distances. These also allow use of the average of the three readings (3-wire leveling) as a check against blunders and for averaging out the error of interpolation between marks on the rod scale.
- The two main types of levelling are single-levelling as already described, and double-levelling (Double-rodding). In double-levelling, a surveyor takes two foresights and two back sights and makes sure the difference between the foresights and the difference between the back sights are equal, thereby reducing the amount of error. Double-levelling costs twice as much as single-levelling.