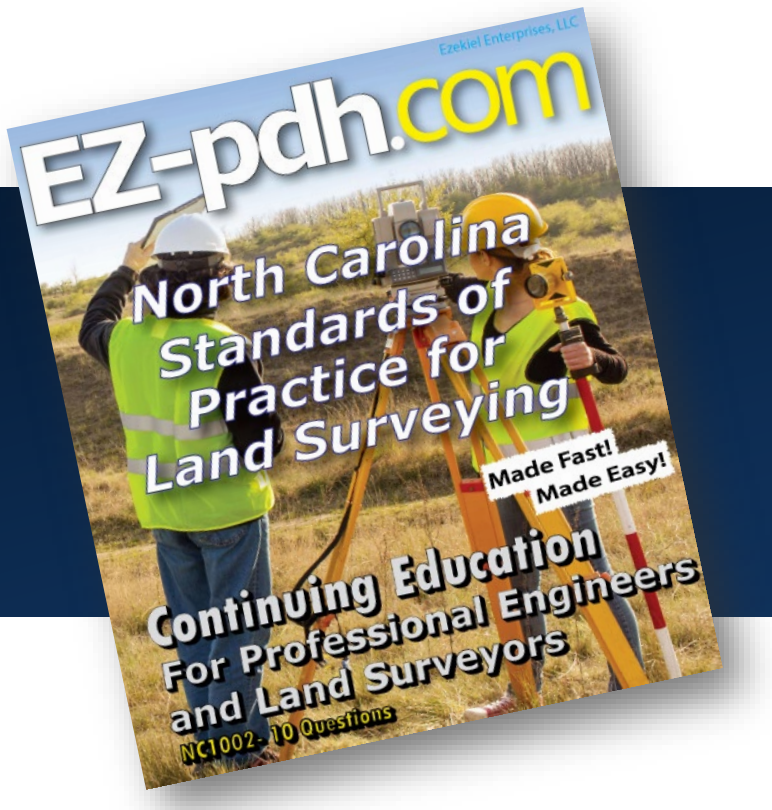

North Carolina Standards of Practice for Land Surveying

One (1) Continuing Education Hour
Course #NC1002

Approved Continuing Education for Licensed Professional Engineers & Professional Land Surveyors

EZ-pdh.com
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301 Mission Dr. Unit 571
New Smyrna Beach, FL 32170
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Course Description:

The North Carolina Standards for the Practice of Land Surveying course satisfies the Continuing Professional Competency (CPC) requirement of one (1) hour in standards of practice for boundary surveys, ref 21 NCAC 56.1703.

The course is designed as a distance learning interactive course that enables the practicing professional land surveyor or engineer to examine and revisit the North Carolina standards for the practice of land surveying.

Objectives:

The primary objective of this course is to familiarize the student with the standards of practice for land surveying in North Carolina and satisfy the one required hours of continuing education required by 21 NCAC 56.1703.

Upon successful completion of the course, the student will have a thorough understanding of this topic.

Grading:

Students must achieve a minimum score of 70% on the online quiz to pass this course. The quiz may be taken as many times as necessary to successful pass and complete the course.

A copy of the quiz questions are attached to last pages of this document.

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North Carolina Minimum Standards for the Practice of Land Surveying

SECTION .1600 – STANDARDS OF PRACTICE FOR LAND SURVEYING IN NORTH CAROLINA

21 NCAC 56 .1601 GENERAL

In order to better serve the general public in regulating the practice of land surveying in North Carolina, the minimum standards of practice set forth in this Section are established, and shall be observed by Professional Land Surveyors in the practice of land surveying.

21 NCAC 56 .1602 SURVEYING PROCEDURES

(a) A Professional Land Surveyor shall spend the necessary time and effort to make investigation to determine if there are encroachments, gaps, lappages, or other irregularities along each line surveyed. Points may be placed on the line from closed or verified traverses and the necessary investigations made from these points. If these investigations are not made, then the surveyor shall not certify to an actual survey of that line and the plat must contain the appropriate qualifications in accordance with the rules in this Section.

(b) Any and all visible or determined encroachments or easements on the property being surveyed shall be accurately located and indicated.

(c) With respect to investigation of property boundaries and recorded easements, the surveyor shall examine the most recent deeds and recorded plats adjacent to the subject property as well as all deeds and plats recorded after the date of the deed or plat upon which the survey is being based (the survey reference deed or plat).

(d) Except as provided in Paragraph (e) of the Rule, metal stakes or materials of comparable permanence shall be placed at all corners.

(e) Where a corner falls in a right-of-way, in a tree, in a stream, or on a fence post, boulder, stone, or similar object, one or more monuments or metal stakes shall be placed in the boundary so that the inaccessible point may be located accurately on the ground and the map.

(f) The results of a survey shall be reported to the user of that survey as a map or report of survey and, whether in written or graphic form, shall be prepared in a clear and factual manner. All reference sources shall be identified. Artificial monuments called for in such reports shall be described as found or set. When no monument is found or set for points described in Paragraph (e) of this Rule, that fact shall be noted.

(g) Where the results of a survey are reported in the form of a plat or a written description, one or more corners shall, by a system of azimuths or courses and distances, be accurately tied to and coordinated with a horizontal control monument of some United States or State Agency survey system, such as the North Carolina Geodetic Survey, where such monument is within 2000 feet of the subject property, right-of-way, easement or other surveyed entity. Where the North Carolina grid system coordinates of said monument are on file in the Division of Energy, Mineral, and Land Resources of the Department of Environment and Natural Resources, the coordinates of both the referenced corner or point and the monument(s) shall be shown in X (easting) and Y (northing) coordinates on the plat or in the written description or document. The coordinates shall be identified as based on 'NAD 83', indicating North American Datum of 1983 or as 'NAD 27' indicating North American Datum of 1927. The tie lines to the monuments must be sufficient to establish true north or grid north bearings for the plat or description if the monuments exist in pairs. Control monuments within a previously recorded subdivision may be used in lieu of grid control. In the interest of bearing consistency with previously recorded plats, existing bearing control may be used where practical. In the absence of Grid Control, other natural or artificial monuments or landmarks shall be used. In all cases, the tie lines shall be sufficient to accurately reproduce the subject lands from the control or reference points used.

(h) Area is to be computed by double meridian distance or equally accurate method and shown on the face of the plat, written description or other document. Area computations by estimation, by planimeter, by scale, or by copying from another source are not acceptable methods, except in the case of tracts containing inaccessible areas and in these areas the method of computation shall be stated.

21 NCAC 56 .1603 CLASSIFICATION OF BOUNDARY SURVEYS

General. "Boundary surveys" are defined as surveys made to establish or to retrace a boundary line on the ground, or to obtain data for constructing a map, plat, or report showing a boundary line. For the purpose of this Rule, the term refers to all surveys, including "loan" or "physical" surveys, that involve the determination or depiction of property lines. For the purpose of specifying minimum allowable surveying standards for boundary surveys, the following four general classifications of lands in North Carolina are established from the standpoint of their real value, tax value, or location. Each map shall contain a statement of the calculated ratio of precision before adjustments or a statement of positional accuracy.

(1) Local Control Network Surveys (Class AA). Local control network surveys are traverse networks utilizing permanent points for the purpose of establishing local

horizontal control networks for future use by local surveyors. For Class AA boundary surveys in North Carolina, the angular error of closure shall not exceed ten seconds times the square root of the number of angles turned. The ratio of precision shall not exceed an error of closure of one foot per 20,000 feet of perimeter of the parcel of land (1:20,000). When using positional accuracy standards for Class AA control and boundary surveys, neither axis of the 95 percent confidence level error ellipse for any control point or property corner shall exceed 0.05 feet or 0.015 meters plus 30 ppm measured relative to the position(s) of the horizontal control points used and referenced on the survey.

(2) Urban Land Surveys (Class A). Urban surveys include lands that normally lie within a town or city. For Class A boundary surveys in North Carolina, the angular error of closure shall not exceed 20 seconds times the square root of the number of angles turned. The ratio of precision shall not exceed an error of closure of one foot per 10,000 feet of perimeter of the parcel of land (1:10,000). When using positional accuracy standards for Class A control and boundary surveys, neither axis of the 95 percent confidence level error ellipse for any control point or property corner shall exceed 0.10 feet or 0.030 meters plus 50 ppm measured relative to the position(s) of the horizontal control points or property corners used and referenced on the survey.

(3) Suburban Land Surveys (Class B). Suburban surveys include lands in or surrounding the urban properties of a town or city. For Class B boundary surveys in North Carolina, the angular error of closure shall not exceed 25 seconds times the square root of the number of angles turned. The ratio of precision shall not exceed an error of closure of one foot per 7,500 feet of perimeter of the parcel of land (1:7,500). When using positional accuracy standards for Class B control and boundary surveys, neither axis of the 95 percent confidence level error ellipse for any control point or property corner shall exceed 0.12 feet or 0.037 meters plus 90 ppm measured relative to the position(s) of the horizontal control points or property corners used and referenced on the survey.

(4) Rural and Farmland Surveys (Class C). Rural and farmland surveys include lands located in rural areas of North Carolina and generally outside the suburban properties. For Class C boundary surveys in North Carolina, the angular error of closure shall not exceed 30 seconds times the square root of the number of angles turned. The ratio of precision shall not exceed an error of closure of one foot per 5,000 feet of perimeter of the parcel of land (1:5,000). When using positional accuracy standards for Class C control and boundary surveys, neither axis of the 95 percent confidence level error ellipse for any control point or property corner shall exceed 0.15 feet or 0.046 meters plus 150 ppm measured relative to the position(s)

of the horizontal control points or property corners used and referenced on the survey.

21 NCAC 56 .1604 MAPPING REQUIREMENTS FOR BOUNDARY SURVEYS

(a) The size of a map shall be such that all details are legible on a copy.

(b) Any lines that are not actually surveyed shall be indicated on the map and a statement included revealing the source of information from which the line is derived.

(c) All surveys based on the North Carolina grid system shall contain a statement identifying the coordinate system referenced datum used.

(d) All plats (maps), unless marked as "Preliminary Plat - Not for recordation, conveyances, or sales" shall be sealed, signed, and dated by the Professional Land Surveyor and shall contain the following:

(1) An accurately positioned north arrow coordinated with any bearings shown on the plat. Indication shall be made as to whether the north index is true, magnetic, North Carolina grid ('NAD 83' and realization (date of adjustment of coordinate system) or 'NAD27'), or is referenced to old recorded deed or recorded plat bearings. If the north index is magnetic or referenced to old recorded deed or recorded plat bearings, the date and the source (note if not determined) shall be indicated.

(2) The azimuth or courses and distances of every property line surveyed shall be shown. Distances shall be in feet or meters and decimals thereof. The number of decimal places shall be appropriate to the class of survey required in Rule .1603 of this Section.

(3) All plat lines shall be horizontal or grid measurements. All lines shown on the plat shall be correctly plotted to the scale shown. Enlargements of portions of a plat are not required to be to scale. Where the North Carolina grid system is used, the combined grid factor shall be shown on the face of the plat. If grid distances are used, they shall be shown on the plat.

(4) Where a boundary is formed by a curved line, the following data shall be given: actual survey data or a series of subchords with bearings and distances around the curve. If standard curve data is used, the bearing and distance of the long chord (from point of curvature to point of tangency) shall be shown on the face of the plat.

(5) Where a subdivision of land is set out on the plat, all streets and lots shall be accurately plotted with dimension lines indicating widths and all other information pertinent to retracing all lines in the field. This shall include bearings and distances to form a continuous closure of the entire perimeter.

(6) Control corners, and all other corners that are marked by monument or natural object shall be identified on all plats, and all corners of adjacent owners along the boundary lines of the subject tract that are marked by monument or natural object shall be shown.

(7) The surveyor shall show one of the following (or note if could not be determined):

(A) The names of adjacent land owners;

(B) The lot, block, parcel, and subdivision designations; or

(C) Other legal reference.

(8) All visible and apparent rights-of-way, easements, watercourses, utilities, roadways, and other such improvements shall be accurately located where crossing or forming any boundary line of the property shown.

(9) Tie lines as required and defined in Rule .1602(g) of this Section shall be accurately shown on the face of the plat, whether or not the plat is to be recorded.

(10) A vicinity map (location map) shall appear on the face of the plat.

(11) Each map shall contain:

(A) the property designation;

(B) the name of owner or prospective owner;

(C) the location (including township, county, and State);

(D) the date or dates the survey was conducted;

(E) a scale of the drawing listed in words or figures;

(F) a bargraph;

(G) the title source; and

(H) a legend depicting nomenclature or symbols not otherwise labeled.

(12) Any map not certified for recording under G.S. 47-30, and all reports of survey, shall contain this certificate signed by the Professional Land Surveyor in substantially the following form:

"I certify that this map was drawn under my supervision from an actual survey made under my supervision (deed description recorded in Book _____, page _____ or other reference source _____); that the boundaries not surveyed are indicated as drawn from information in Book _____, page _____ or other reference source _____; that the ratio of precision or positional accuracy is

_____; and that this map meets the requirements of The Standards of Practice for Land Surveying in North Carolina (21 NCAC 56. 1600)." This _____ day of _____, 2_____. Seal _____
Professional Land Surveyor

21 NCAC 56 .1605 CLASSIFICATION OF VERTICAL CONTROL SURVEYS

(a) General. Vertical control surveys are defined as measurements taken by surveying methods (differential leveling, trigonometric leveling, and global positioning surveys) to determine elevation with respect to vertical datum, usually National Geodetic Vertical Datum of 1929 (NGVD29) or North American Vertical Datum of 1988 (NAVD88). Global Position Surveys shall only be used to obtain Class C surveys. For the purpose of specifying minimum allowable surveying standards, the following three general classifications of vertical control surveys are established.

(1) For Class A vertical control surveys in North Carolina, the vertical error in feet shall not exceed 0.10 times the square root of the number of miles run from the reference datum.

(2) For Class B vertical control surveys in North Carolina, the vertical error in feet shall not exceed 0.20 times the square root of the number of miles run from the reference datum.

(3) For Class C vertical control surveys in North Carolina, the vertical error in feet shall not exceed 0.30 times the square root of the number of miles run from the reference datum. The vertical error in global position surveys shall not exceed five centimeters relative to the referenced benchmark(s) at the 95 percent confidence level (2 sigma) accuracy as defined in Federal Geographic Data Committee Standards.

(b) A certificate, substantially in the following form, shall be affixed to all maps or reports:

" I, _____, certify that this vertical control survey was completed to the Class ___ standard [(21 NCAC 56.1605(a)] under my direct and responsible charge from an actual survey made under my supervision."

21 NCAC 56 .1606 SPECIFICATIONS FOR TOPOGRAPHIC AND PLANIMETRIC MAPPING, INCLUDING GROUND, AIRBORNE, AND SPACEBORNE SURVEYS

(a) General.

(1) Topographic surveys are defined as surveys that have as their major purpose the determination of the configuration (relief) of the earth (ground) and the location of natural or artificial objects thereon.

(2) Planimetric mapping is defined as producing a map that presents the horizontal positions only for the features represented; distinguished from a topographic map by the omission of relief in measurable form.

(3) Airborne and spaceborne surveys are defined as the use of photogrammetry, LIDAR, IFSAR, or other similar measurement technologies for obtaining reliable information about physical objects and the environment, including terrain surface, through the process of recording, measuring, and interpreting images and patterns of electromagnetic radiant energy and other phenomena. This Rule establishes minimum allowable photogrammetric production procedures and standards for photogrammetric mapping and digital data production.

(b) Production procedures for topographic and planimetric mapping surveys shall be in accordance with the standards established by Part 3 of the Federal Geographic Data Committee (FGDC) Geospatial Positioning Accuracy Standard and applicable extensions and revisions. These standards are incorporated by reference including subsequent amendments and editions. The material is available from the Board office at the cost of reproduction as a public record or from the FGDC at www.fgdc.gov at no cost. Reporting accuracy shall be in accordance with Part 1 of the FGDC geospatial standards.

(c) Topographic or planimetric maps, orthophotos, and related electronic data, unless marked as "Preliminary Map," shall meet contractually specified FGDC Standards for horizontal and vertical accuracies (in the absence of specified standards, the National Map Accuracy Standards apply) and shall be certified by the licensee.

(d) When the resulting product is a digital (electronic) data set, or a map or document consists of more than one sheet or otherwise cannot be certified, a project report shall be certified. The report shall be marked "Preliminary" if applicable.

(e) Ground control for topographic and planimetric mapping projects shall be in North Carolina State Plane Coordinate System grid coordinates and distances when the project is tied to Grid. A minimum of one permanent project vertical control point shall be shown.

(f) The project map or report shall contain the following information:

(1) Date of original data acquisition;

(2) Altitude of sensor and sensor focal length, as applicable;

(3) Date of document or data set compilation;

(4) If hard copy product is produced, the maps shall contain a north arrow, map legend, final document scale, including bar graph, and contour interval, as applicable;

(5) Coordinate system for horizontal and vertical denoting SI or English units (i.e., NAD83, assumed, or other coordinate system);

(6) A list or note showing the control points used for the project. The minimum data shown for each point shall include: physical attributes e.g. iron rod, railroad spike), latitude and longitude (or X and Y Grid coordinates), and elevation, as applicable;

(7) If other data is included, the source and accuracy of those items must be indicated;

(8) A statement of horizontal and vertical accuracy at the 95 percent confidence level (2 sigma) complying with contractually specified FGDC standards consistent with Paragraph (c) of this Rule;

(9) For topographic maps or data sets, contours in areas obscured by man-made or natural features shall be uniquely identified or enclosed by a polygon identifying the obscured area. The accuracies of the contours or of features in this obscured area shall be noted "No reliance is to be placed on the accuracy of these contours;"

(10) A vicinity map depicting the project location on the first sheet of all hard copy maps or in the report accompanying digital files; and

(11) The name of the client for whom the project was conducted.

(g) Nothing in this Section shall be construed to negate or replace the relative accuracy standards found in Rules .1601 through .1608.

(h) A certificate, substantially in the following form, shall be affixed to all maps or reports:

" I, _____, certify that this project was completed under my direct and responsible charge from an actual survey made under my supervision; that this_____ (insert as appropriate: ground, airborne or spaceborne) survey was performed at the 95 percent confidence level (2 sigma) to meet Federal Geographic Data Committee Standards; that the horizontal accuracy is _____, that the vertical accuracy is _____ and that the original data was obtained on _____(date)_____; that the survey was completed on ___(date)_____; that contours shown as [broken lines] may not meet the stated standard; and all

coordinates are based on_____(NAD 83 (NSRS 2007), NAD 83/2001, or other); and all elevations are based on _____ (NGV 29, NAVD 88, or other)."

(i) Documents transmitted electronically shall have the computer-generated seal removed from the original file and a copy of the project report shall be certified and sent to the client. The electronic data shall have the following inserted in lieu of the signature and date:

"This document originally issued and sealed by (name of sealer), (license number), on (date of sealing). This electronic media shall not be considered a certified document. See the project report for certificate and seal."

21 NCAC 56 .1607 GLOBAL POSITIONING SYSTEMS SURVEYS

(a) General. Global Navigation Satellite Systems (GNSS) is the generic name of navigation and positioning systems with global coverage that is comprised of GPS (Global Positioning System, United States, originally Navstar), GLONASS (Global Navigation Satellite System, Russia), Galileo (Europe), BDS (BeiDou Navigation Satellite System, China, also known as COMPASS), and any other satellite-based navigation and positioning systems that provide global coverage.

(b) The Professional Land Surveyor in responsible charge of the GPS survey shall certify all prepared documents. When a map or document consists of more than one sheet, only one sheet must contain the certificate and all others must be certified. The certificate or metadata notes shall contain the following information:

(1) Class of GPS survey as defined in the Standards of Practice (or list the sections);

(2) Type of GPS field procedure, such as Static, Kinematic, Pseudo-Kinematic, Real-time Kinematic, Real-time Kinematic networks, and Online Position User Service;

(3) Positional accuracy;

(4) Dates of survey;

(5) What datum and epoch coordinates or geographic positions are based on;

(6) Designation of fixed-control stations and their positional data;

(7) Geoid model used;

(8) Combined grid factor(s); and

(9) Units. The certificate shall be substantially in the following form:

"I, _____, certify that this map was drawn under my supervision from an actual GPS survey made under my supervision and the following information was used to perform the survey:

(1) Class of survey:

_____

(2) Positional accuracy: _____

(3) Type of GPS field procedure: _____

(4) Dates of survey: _____

(5) Datum/Epoch: _____

(6) Published/Fixed-control use:

_____

(7) Geoid model: _____

(8) Combined grid factor(s):

_____

(9) Units: _____"

(c) GPS surveys to provide control networks shall be performed in such a manner that it meets a 95 percent confidence level of the positional accuracy of each point relative to the published positions of the control points used and shall meet the accuracy standards of a Class AA survey as set out in Rule .1603. (d) GPS surveys performed to provide local horizontal or vertical Grid control on a parcel of land where the boundary or topography of that parcel will be shown relative to NC Grid horizontal or vertical datum shall be performed using techniques that will provide the standards of accuracy for the class of survey being performed while determining the horizontal or vertical positions of objects as set out in Rule .1603 or Rule .1606 as applicable. (e) Fixed station(s) used for the project shall appear on the map, plat, or report. The minimum data shown for each fixed station shall be station name, horizontal position (northing and easting) or latitude, longitude, elevation (ellipsoid or orthometric), and datum and epoch.

21 NCAC 56 .1608 CLASSIFICATION/LAND INFORMATION SYSTEM/GEOGRAPHIC INFORMATION SYSTEM SURVEYS

(a) General: Land Information System/Geographic Information System (LIS/GIS) surveys are defined as the measurement of existing surface and subsurface features for the purpose of determining their accurate geospatial location for inclusion in an LIS/GIS database. All LIS/GIS surveys as they relate to property lines, rights-of-way,

easements, subdivisions of land, the position for any survey monument or reference point, the determination of the configuration or contour of the earth's surface or the position of fixed objects thereon, and geodetic surveying which includes surveying for determination of the size and shape of the earth both horizontally and vertically and the precise positioning of points on the earth utilizing angular and linear measurements through spatially oriented spherical geometry, shall be performed by a Land Surveyor who is a licensee of this Board unless exempt by G.S. 89C-25. For the purpose of specifying minimum allowable surveying standards, five general classifications of LIS/GIS surveys are established, any of which may be specified by the client. In the absence of a specified standard, the surveyor shall conform the survey to the requirements for a Class B survey. The five general classifications are:

(1) Class AA LIS/GIS Surveys. For Class AA LIS/GIS surveys in North Carolina, the relative accuracy shall be equal to or no less than 0.033 meter (0.10 feet);

(2) Class A LIS/GIS surveys. For Class A LIS/GIS surveys in North Carolina, the relative accuracy shall be equal to or less than 0.5 meter (1.64 feet);

(3) Class B LIS/GIS surveys. For Class B LIS/GIS surveys in North Carolina, the relative accuracy shall be equal to or less than 1.0 meter (3.28 feet);

(4) Class C LIS/GIS surveys. For Class C LIS/GIS surveys in North Carolina, the relative accuracy shall be equal to or less than 2 meters (6.56 feet); and

(5) Class D LIS/GIS surveys. For Class D LIS/GIS surveys in North Carolina, the relative accuracy shall be equal to or less than 5 meters (16.40 feet).

(b) Nothing in this Rule negates or replaces the relative accuracy standards found in Rules .1601 through .1607 of this Chapter.

(c) The Professional Land Surveyor in responsible charge of the LIS/GIS boundary or geodetic control survey shall certify to all of the following in either written or digital form:

(1) Class of LIS/GIS survey. Method used to evaluate the accuracy shall be described as either statistical testing or least squares adjustment results, comparison with values of higher accuracy, and repeat measurements. The reporting standard in the horizontal component is the radius of a circle of uncertainty, such that the true or theoretical location of the point falls within that circle 95 percent of the time. For vertical accuracy requirements, see 21 NCAC 56 .1605;

(2) Method of measurement (i.e. global navigation satellite systems, electronic scanners, theodolite and electronic distance meter, transit and tape);

(3) Date(s) of the survey; and

(4) Datum used for the survey.

(d) A certificate, substantially in the following form, shall be affixed to all maps or reports:

"I, _____, certify that this project was completed under my direct and responsible charge from an actual survey made under my supervision; that this survey was performed to meet the requirements for an LIG/GIS survey [21 NCAC 56.1608] to the accuracy of Class ____ and vertical accuracy; when applicable to the Class ___ standard [(21 NCAC 56.1605(a)]; method used to evaluate the accuracy was _____; method of measurement _____; date(s) of survey _____; datum used for survey _____; and all coordinates are based on _____(NAD 83 (NSRS 2007), NAD 83/2001, or other); and all elevations are based on _____ (NGV 29, NAVD 88, or other)."

Quiz Questions

1. **True or False? A Professional Land Surveyor shall spend the necessary time and effort to make investigation to determine if there are encroachments, gaps, lappages, or other irregularities along each line surveyed.**

   - True
   - False

2. **True or False? Where a corner falls in the right of way, in a tree, in a stream, or on a fence post, boulder, stone, or similar object, one or more monuments or metal stakes shall be placed in the boundary so that the inaccessible point may be located accurately on the ground and the map.**

   - True
   - False

3. **The results of the survey shall be reported to the user of that survey as a _____ or report of survey.**

   - document
   - graph
   - map
   - None of the above

4. **_____ is to be computed by double meridian distance or equally accurate method and shown on the face of the plat, written description, or other document.**

   - Area
   - Graph
   - Grid
   - Plat

5. **True or False? Class A Urban surveys include lands that normally lie within a town or city.**

   - ○ True
   - ○ False

6. **What is a Class B survey?**

   - ○ Rural and Farm Survey
   - ○ Suburban Land Survey
   - ○ Urban Land Survey
   - ○ None of the above

7. **True or False? Any lines that are not actually surveyed shall be indicated on the map and a statement included revealing the source of information from which the line is derived.**

   - ○ True
   - ○ False

8. **For Class C vertical control surveys in North Carolina, the vertical error in feet shall not exceed _____ times the square root of the number of miles run from the reference datum.**

   - ○ 0.10
   - ○ 0.20
   - ○ 0.30
   - ○ 0.40

9. _____ mapping is defined as producing a map that presents the horizontal positions only for the features represented; distinguished from a topographic map by the omission of relief in measurable form.

- Airborne
- Planimetric
- Spaceborne
- Topographic

10. GPS surveys to provide control networks shall be performed in such a manner that it meets a ____ percent confidence level of the positional accuracy of each point relative to the published positions of the control points used and shall meet the accuracy standards.

- 85
- 90
- 95
- 100