GOING THE DISTANCE

By Landon Blake

FEATURE ARTICLE

Introduction

This article is the second in a series of articles on how to improve the quality of boundary survey maps. In the first article, we discussed the 4 types of distances you can show on a boundary survey map. In this article, we will continue our discussion about distances shown on boundary survey maps. We will cover these topics:

1) Understanding the difference between implied precision, actual precision, and accuracy.

2) Identifying your distance unit.

3) How to handle the difference between ground distances and grid distances.

The Difference Between Implied Precision, Actual Precision, and Accuracy

I wanted to start this article by taking a loot at the differences between implied precision, actual precision and accuracy. We will limit our topic in this article to understanding how these 3 terms relate to distances shown on boundary survey maps. Let's define each term, and then see how they are important to the distances we show on our maps.

Implied Precision:

The level of precision in a measurement implied (or indicated) by the display of the measurement value. Implied precision is usually determined by the number of significant digits. On most modern survey maps, this is the number of digits shown to the right of the decimal point.

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Actual Precision. The level of precision in a measurement calculated based on (1) the capabilities of the measurement system or (2) an analysis of many measurements of the same value.

Accuracy: The gap between a measured value and the true value. Accuracy can be difficult to determine in land surveying. This is because we often can't determine absolutely true values to an infinite degree of precision. We can estimate accuracy in the following 3 ways:

1) By substituting the average value or best fit value for the true value.

2) By substituting the measured value from a more accurate survey for the true value.

"When you are determining the type of distances shown on your boundary survey map, it is helpful to properly understand the "current" survey. The current survey is your survey! It is the result of your fieldwork, calculations and analysis. Measured and calculated values are all based on this current survey."

"If you are using a distance from a previous survey of yours that has been filed, or from a land description or other document that has been recorded or made official, those distances should be shown as record, not measured or calculated."

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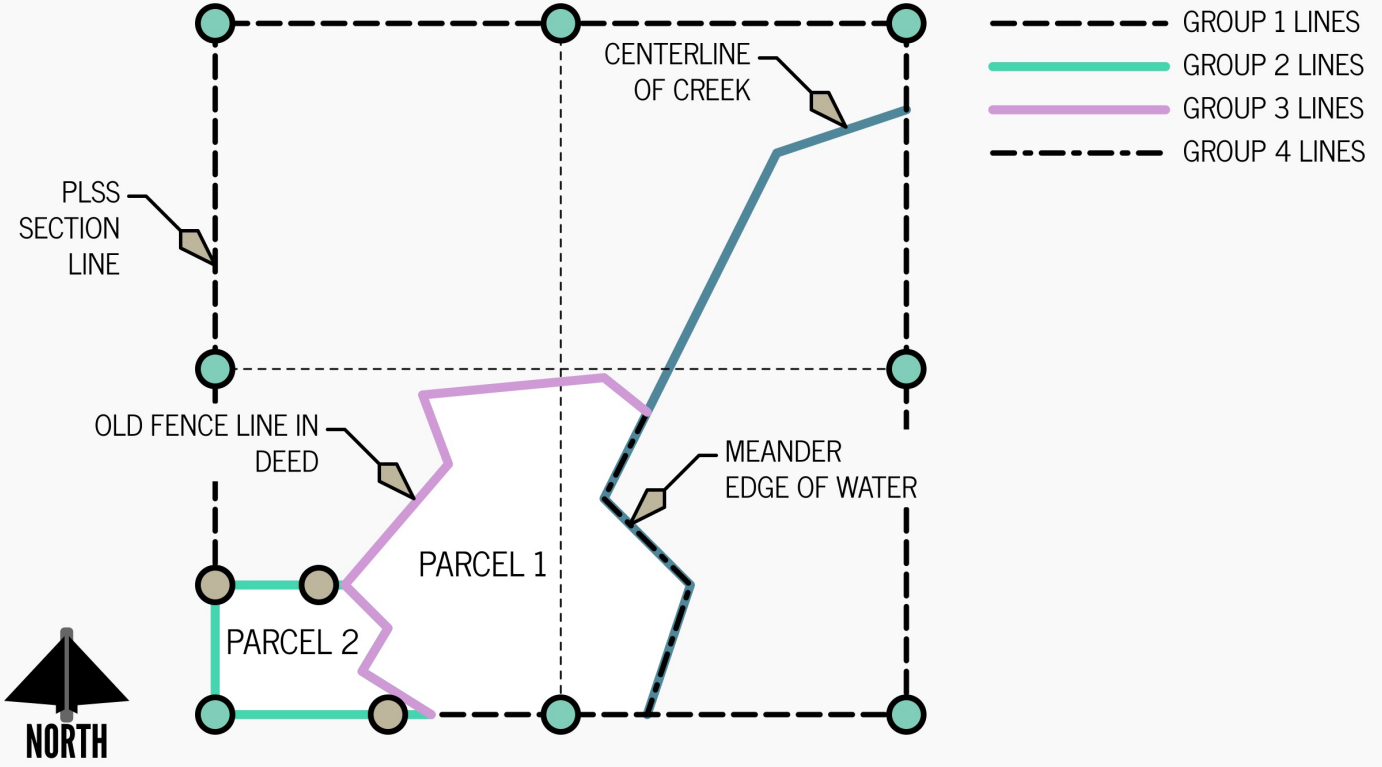

DIAGRAM #1

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3) By calculating a true value based on principles of math and geometry. (For example, We can calculate the true value of an interior angle of a polygon. We do this with our knowledge of geometry and the values of other angles in the polygon.)

We should note that accuracy is not precision. A very precise measurement can be inaccurate. This typically occurs when there is a blunder or mistake in an otherwise precise measurement system. (For example Distance measurement made with a total station to a rod with a 1-foot rod height bust.)

How do actual precision, implied precision, and accuracy related to the distances we show on our boundary survey maps? Each distance on our boundary survey map will have an implied precision based on how we show its value. Each distance on our boundary survey map will have an actual precision based on our measurement system and methods.

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"Each distance on our boundary survey map will have an implied precision based on how we show its value. Each distance on our boundary survey map will have an actual precision based on our measurement system and methods. Each distance on our boundary survey will have a level of accuracy, which is the gap between the value we show and the 'true' value."

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Each distance on our boundary survey will have a level of accuracy, which is the gap between the value we show and the "true" value.

Identifying Your Distance Unit

Don't force the map reader to make assumptions about your distance unit. If your distance unit is the United States Survey Foot, state that clearly on the map. If you've converted distances in other units contained in record documents to United States Survey Feet, explain that with a map note. If you've made corrections for a short or long chain or adjusted other distance errors, also explain that on the map. Tell the map reader if your distances are in ground or grid, and provide an appropriate scale factor. (We will talk ore about grid distances in the next section.)

Sample Distance Unit Notes For Your Boundary Survey Map

Here are a few sample distance unit notes you can tweak and use on your next boundary survey map.

Unit System:
Unless otherwise noted, all distances shown on this map are in the United States Survey Foot. All distances shown are ground distances based on a common survey elevation of 88.00 feet.

Distance Conversions and Corrections:
The original GLO field notes for Section 12 (R2) and the Survey of Duck Creek Ranch by WB Buckley (R8) contain distances in "chains". We've assumed the standard conversion of 1 GLO chain to 66 United States Survey Feet when converting distances on these references for our

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Showing Ground Distances and Grid Distances

Almost all of my boundary surveys are calculated and measured using grid distances. On other surveys, I need to scale grid distances shown on a record reference to my ground survey. What type of distances should you show on your boundary survey map in these situations?

You have 3 options:
1) Convert all ground distances to the grid. You'll show record ground distances as converted grid distances on your map.

2) Convert all grid distances to ground. You'll show record grid distances as converted ground distances on your map.

3) Show ground and grid distances for all lines on your map.

I prefer to use one of the first 2 options. I'm occasionally asked survey.

The grant deed recorded as Document Number 2006-005233 (R4) contains a distance of 520 feet for the line identified on this survey as "L16". We've correct this distance to 250 feet to remove a large closure error in the deed courses.

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by a map checker to use the third method. I don't like to do this because it quickly clutters the map and leads to information overload.

You shouldn't ever mix measured or calculated grid distances with unconverted record ground distances on your map. In a similar way, don't mix measured or calculated ground distances with record grid distances. Pick grid or pick ground, and then convert distances to match.

If you are going to show grid distances on your map, you need to provide the map reader with basic information about your scale factor. This information includes:

1) The combined scale factor to convert grid distances to ground distances.

2) The identity and elevation of the point on your survey where you calculated the combined scale factor.

It is also helpful to provide the map reader with the map projection, horizontal datum, and vertical datum you are using to calculate your grid distances.

The surveyor would show distances in Group #4 to the nearest whole foot or nearest 10 whole feet. (You could show these distances with a greater level of precision. In this case, you should explain the precision of the original lines you're retracing with a, not on the map.)
Here are a couple of important principles to remember when preparing your boundary survey map:

1) Calculate or understand the actual precision of your distance measurements.

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2) Make sure the implied precision of your distance measurements matches the actual precision as closely as possible.

3) Estimate the accuracy of the distances on your map, and show this accuracy with a note or other graphics.

4) Identify groups of distances on your map that may have different levels of actual precision and accuracy.

Grouping Distances On Your Map By Level Of Precision

We should remember that we may have groups of distances on our boundary survey with different levels of precision and accuracy.

Consider the boundary survey shown in Diagram #1. The land surveyor tied the PLSS section corners on this survey with static GNSS survey methods. The land surveyor tied the property corners for Parcel #1 using a total station traverse. The land surveyor located a meander of the edge of water forming the east boundary of Parcel #2 using RTK GNSS surveying methods. The land surveyor also surveyed the remnants of an old fence mentioned in the deed for Parcel #2 using RTK GNSS surveying methods. The courses in that run along the old fence are shown to the nearest 1/2 degree and 10 feet.

How many distance groups would we have to consider when preparing the boundary survey map for this survey? There are at least 4 groups:

Group #1: The distances between PLSS section corners and 1/4 corners.

Group #2: The distances between the corners of Parcel #1.

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Group #3: The distances between corners of the old fence line on the boundary of Parcel #1 and Parcel #2.

Group #4: The distances along the meander line of the creek on the Boundary of Parcel #2.

I'd propose most of the distances in Group #1 and Group #2 be shown to the nearest hundredth of a foot. I'd include a note on the map stating the level of precision for each group.

I'd propose the surveyor show most of the distances in Group #3 to the nearest whole foot. The surveyor would show distances in Group #4 to the nearest whole foot or nearest 10 whole feet. (You could show these distances with a greater level of precision. In this case, you should explain the precision of the original lines you're retracing with a, not on the map.)

Here are a couple of important principles to remember when preparing your boundary survey map:

1) Calculate or understand the actual precision of your distance measurements.

2) Make sure the implied precision of your distance measurements matches the actual precision as closely as possible.

3) Estimate the accuracy of the distances on your map, and show this accuracy with a note or other graphics.

4) Identify groups of distances on your map that may have different levels of actual precision and accuracy.