Coordinate Use in the Restoration of Lost and Obliterated Public Land Survey Corners

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ABSTRACT

The idea of using coordinates to restore lost or obliterated corners has been a frequent topic of discussion within the surveying community however little has been written on the subject. The issues involved are not necessarily technical in nature and resolve to a discussion of under what conditions such restorations are feasible or desirable. This issue may be returning to the forefront now that very precise GPS equipment is readily available to the professional surveyor, and also more accurate reference networks are in place. This paper will attempt to discuss some of the legal as well as technical issues and illustrate with a few examples.

Introduction

The ideal concept of defining property boundaries and corners by absolute coordinates has probably been around for as long as the science of surveying itself. Recent rapid deployment of highly precise GPS technology has probably reawakened this concept. This paper seeks to discuss some of the issues relating to coordinate use and propose some guidelines which the author feels should govern such practice.

GPS is not the only new thing that has revived such hopes in recent years. Over the past 30 or so years there have been a number of similar technological advances which have led to belief in a new surveying nirvana. Photogrammetry was the great hope of the 60's, EDM and electronic computation the hope of the early 70's, inertial surveying and advanced total stations became the saviors of the late 70's and 80's. In each case new technology has yielded hopes for error free surveying or simplified surveying. Virtually all have been followed by some degree of abuse and then a return to or more rational understanding of measurement and legal issues.

This hope for an easy path to avoid the many complexities of boundary surveying seems to get more out of hand if the process produces coordinates as direct output, rather than other forms of data. This can be referred to as “the Magic Coordinate Machine or Black Box” syndrome. Coordinate outputs can create an illusion of correctness because they bypass attention to normal methods of measurement analysis and consideration of error. All measurement systems have error, and all surveying systems derive coordinates from measurements. However, it is necessary to have a certain amount of information about what the coordinates are, how they were determined, and what errors may be involved in determining them before they can be readily used. Frequently such information is omitted from a coordinate record. Later in this paper more detailed criteria for evaluating a coordinate record will be discussed.

Lost or Obliterated?

The precise meaning of the terms “lost” and “obliterated” are often confused since they deal with similar issues. However, in the context of this discussion, the difference between them is important if not essential. In the PLSS context, it is the author’s opinion that once a corner is determined as lost, it can only be restored by the Manual procedures for lost corners. These procedures are the proportions based upon the original survey record (corollary to original deed or plat description) that we are all familiar with. Although these procedures may not always follow the literal "footsteps" of the original surveyor, they have been prescribed and recognized by the courts because they provide equity, and not merely as technical procedures.

Note, we have still not really defined what lost means. The Manual of Surveying Instructions, 1973, which guides many of us in PLSS surveying, seems to define lost more by describing what it is not. For your review, refer to sections 5-1 through 5-9 of the Manual. In part we have the language:

5-5. An existent corner is one whose position can be identified by verifying the evidence of the monument or its accessories, by reference to the description in the field notes, or located by an acceptable supplemental survey record, some physical evidence, or testimony.

Even though its physical evidence may have entirely disappeared, a corner will not be regarded as lost if its position can be recovered through the testimony of one or more witnesses who have a dependable knowledge of the original location.

Thus we quickly arrive at the definition for obliterated:

"5-9 An obliterated corner is one at whose point there are no remaining traces of the monument or its accessories, but whose location has been perpetuated, or the point for which may be recovered beyond reasonable doubt by the acts and testimony of the interested landowners, competent surveyors, other qualified local authorities, or witnesses, or by some acceptable record evidence."

Basically, if there is any additional information (over the measurements of the original record) that might be used to replace a corner in its original position, then the corner is considered as “obliterated.”

It is the author’s opinion that the use of coordinates is no different from the use of any other survey record, requiring application of the same type of judgement and assessment of it's value, accuracy and usefulness. But what criteria are suitable for evaluating a coordinate record for this purpose?

Evaluation Criteria.

Let me suggest that the questions you should ask yourself should be similar to the questions you should ask about acceptance of monument evidence for a corner. There are some unique aspects for a coordinate record, however.

In determining the value of coordinates for relocating an obliterated corner position, consideration should be made of the following factors:

1) Who established the coordinates?

a) What do you know about their expertise and methodology?

b) How can you validate the reliability of this coordinate record?

To validate a coordinate record you may have to retrace between a number of positions in that record to determine to what degree they represent usable information about position, measurements and evidence, and to answer some of the questions below. It would be difficult to validate such a record on paper, although you can formulate some questions to ask.

2) How were the coordinates established?

a) What procedure was used?

The accuracy and precision of a control coordinate can be affected greatly by the procedures that were used to establish it. For example, 10 years ago doppler satellite methods were used having an accuracy of only 1 to 3 meters. There can be an extreme variation in the accuracy of photogrammetric data, not to mention conventional traverse methods. In addition sometimes sideshot or unchecked methods have been used.

b) What control was used in the determination the coordinate?

The specific origin of the control used to establish coordinates often affects the coordinates obtained. This is especially true with older state plane or geographic coordinates based on pre-NAD83 control, or mixed NAD27 and NAD83 control, although newer control is not immune from this problem. For example, one set of coordinates obtained in a GPS network using HPGN stations may not produce the same results as one done even a few years ago from different nearby NAD83 values.
Since establishing an absolute coordinate involves the combination of errors of the national control network, the local survey network, and imperfect measurement systems, it contains some amount of uncertainty. A different value will often be obtained dependent on the method and networks used and built. Thus the value of the coordinate is often strongly related to the specific way it was established.

c) What datum are the coordinates in?

It is difficult, if not impossible, to properly use a coordinate record without having some idea as to the system it is in. For geodetic surveys, the datum is a key factor. There is no way to tell by looking at a latitude and longitude whether they are NAD27, NAD83 or a subsequent HPGN representation based on NAD83, or even assumed values. It is generally necessary to validate

what you have by external information. Even if the value is stated, you cannot always be sure it is what is advertised. For example, a coordinate stated to be in NAD83, may have originated from NAD27 values transformed using NADCON. While this transformation is one of the best you can get, there is no absolute transformation between the datums. Depending on the area such a process can have several feet of error when compared to independently determined new control.

It usually requires recovering and evaluating a number of points in the record in order to determine it's the accuracy and orientation. A record based on a local coordinate system or project coordinates are often used in surveys.

d) State Plane all reductions applied?

i) State Planes determined from what control?

ii) NAD83, NAD27, local city, project or company datums?

iii) What units are they in?

iv) What degree of diligence was exercised in making corrections made for convergency factors, scale and elevation factors?

State Plane coordinate values have a whole host of problems in use in addition to how the control was run. There are large numbers of coordinates out there that look like state planes, but which are in actuality some form of adulterated system. In order to avoid the computations involved in properly reducing measurements for elevation and grid scale factors, these values are sometimes ignored, or only roughly estimated.

Another practice that we have seen is division of the state plane coordinate value by the local combined scale factors to obtain a "ground state plane". These coordinates can be shifted up to 1000 feet from proper state plane values. It is impossible to determine without some independent information what a state plane coordinate record actually represents.

As another example there can be uncertainty in units for NAD83 state plane values. While any given state's enabling legislation for their state plane coordinate system may have specified what units the system is in, this is frequently ignored and most software allows you to define meters, feet (U.S. Survey), and International feet. It is usually pretty easy to devine whether a record is metric or feet, however a state plane coordinate defined in U.S. Survey foot can be several feet different if converted back to geographic coordinates based on the SI foot.

3) What monumentation or evidence was found, recovered or set?

A coordinate on the wrong thing will not help you re-establish the right thing, thus in the case of restoration of corners it is usually critical to know what the coordinate represents in terms of monument and other evidence at the time it was determined.

4) Overall does the record give you sufficient confidence that you have sufficient information to rely on it for restoration of the corner.

There are undoubtedly other criteria which should be looked at, but which I have omitted. Suffice to say, that you need to exercise caution and judgement in the use of any survey record and coordinates are no exception..

For additional thoughts, Manual sections 5-9, 5-10 and 5-11 provide guidelines which apply equally well to a coordinate record as to other forms of testimony. By analogy, some of the language in section 5-16 which discusses the use of topographic calls can also provide guidance.

Clearly coordinates can be of great value as evidence of the original corner position if it is properly verified. Since it is positional in nature, the reference for that position must be determined. It is also true that a coordinate value by itself is of little value or can be extremely misleading.

Principal I: a single coordinate has no value in the restoration of obliterated corners.

The reason for this is that a single coordinate value has no way to validate it in terms of position, and also there is no information about what evidence the coordinate is purported to represent. A single coordinate may have some value in helping to locate and find direct evidence of a corner, but little else.

Principal II: a set of coordinates has no value in and of itself in the restoration of obliterated corners.

A record set of coordinates is only of value when validated by some of the criteria outlined above as to what it is, how it was determined and what it represents and it’s use is subject to validation.

Judgement must apply.

As with many situations in land surveying, judgement must be applied to each individual situation and no general rule can be laid down. This judgement should be based on a statistical verification of the record being followed based on other recovered points from the same record or source. The criteria described above should be included in the evaluation. The record is suitable for use in restoration (and thus elevating the corner from lost to obliterated status), if the record and method tested will clearly determine position of the original corner more reliably than any other method or proportion.

Absent that level of confidence, the best use of coordinate data is to allow a careful and well defined search leading to the recovery of direct evidence of the monument or it's accessories, or validation of one set of conflicting evidence over another.

Generally, restoration of the obliterated corner from the coordinate record should follow similar methods and procedures that were used in the survey which established them (the coordinates).

For example: A corner established by triangulation methods 20 years ago using control points A, B, C and D, could be restored only if such information and the measurement ties were available and should proceed from the same control points, and not by using GPS methods based on completely different control points.

Improper use of coordinates.

Use of coordinates to extend new surveys, under any circumstances, without independent verification of all the required controlling monuments and corners that affect the corner being established is unwise and is an improper procedure. This is in effect establishing corners without survey.

Example 1:

For example, let us imagine a 1988 survey conducted by a county that involves section line corner recovery which has established state plane coordinates on each PLSS corner. This work was performed as part of a ongoing corner restoration project and coordinates were determined from nearby high-order GPS points. Based upon this data a local surveyor in 1996 computes the location for a clients boundary which requires the SE 1/16 sec. corner of the section, and then proceeds to monument the location from a nearby highway control monument, traversing to the appropriate 1/16 position.

This is an abuse because the surveyor did not verify the source or accuracy of the controlling corner coordinates, the relationship of the GPS coordinates to the highway control, the accuracy of the highway control, or even the actual existence of each 1/4 corner, other center 1/4 monuments or any controlling 1/16's monuments. In addition, only experience can verify whether the 1988 GPS work was in fact accurate enough to support determination of lines in the 1000 foot range to a reasonable degree of accuracy.

Example 2:

Under the particular state law surveyors are required to file monument records for PLSS corners which they use in the course of any survey (which have not been substantially described before). On this form is a space for state plane coordinates. Thus I find such a record for a monument I need in the course of my survey, but which has subsequently been destroyed. This record states that the surveyor found an original stone and it has state plane coordinates of:

x = 2,173,456.7
y = 500,451.1

Would you use that to restore the corner? Now if you knew it was from GPS survey done in 1991 what would you like to know to make you feel better about using it? How would you feel if it was the only corner tied in the survey and you have no idea what datum or what control was used? (in this case you don't).

Going backwards a second, if it didn't say he even original corner evidence , but you just have a corner card or state plane coordinate in a list that says it is "The corner of secs. 17, 18, 19 and 20". How would you feel about using it?

Returning to the monument record mentioned above, and say you dig up some more data from that and find an highway route survey which tied in the monument, which was wiped out under construction. And you can measure into other monuments of that survey and validate the coordinate system, determine it's basis, scale and orientation, or you know they used certain control and in NAD83(the first one and not the second or third one), etc. etc.?

Principal III: Often you end up not using the coordinate record itself so much as the survey that created it. The coordinate may serve only to carry a relative measurement in the same way you might use a local survey plat with assumed bearings and distances on it, and must validate it as evidence.

Summary

Once a corner is determined as LOST, then it should only be restored by the Manual procedures for lost corners. These procedures may not literally follow the "footsteps" of the original survey however they have been prescribed and recognized by the courts as a matter of equity, and not merely as a technical procedure.

Where there is any additional information, including a coordinate record, that after a full and thorough evaluation is of sufficient strength that you feel it can be used to replace a corner monument in it's original position, then the corner has been elevated to the status of an obliterated corner.

Use of coordinates without any knowledge or reference as to how they were established would be acceptable only under the most extreme circumstances. Such a case can best be made where there is substantial statistical verification of the reliability of the coordinate record and verification that it consistently provides more reliable corner locations than any other form of record where evidence remains and verification that the coordinates represent evidence of the original survey monument position.

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