Parcel Accuracy in the Hamilton County GIS

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Introduction

Parcel mapping in a geographic information system (GIS) is a complex proposition. The legal description of a parcel may be a reference to a subdivision plat, a metes and bounds legal description, or an aliquot part. For an excellent and detailed reference, see:

http://www.fairview-industries.com/gismodule/intro.html

There are two distinct methods of mapping parcels in a GIS. One method is to attempt to map every parcel from its legal description and the other is to create a generalized representation of land ownership.

Legal Descriptions

In the first method (using legal descriptions), you must be able to locate the points of beginning for metes and bounds legal descriptions (parcels and subdivision boundaries). Section corners and quarter section corners are frequently used as points of beginning, and they are also essential for mapping aliquot part parcels. Many metes and bounds legal descriptions refer to an "assumed north" which may be several degrees off from true north, so a "rotate to fit" step is frequently required when mapping metes and bounds parcels and subdivisions.

There are errors in legal descriptions. Section corners can be problematic. In some cases, there may be multiple section corners in place physically, and more than one of them are valid. It's easy to use the wrong corner or a mistaken corner when writing or reading a legal description. Other errors are introduced when someone simply writes down the wrong number in a legal description. Because of errors, parcels sometimes overlap one another or have gaps between them. This kind of parcel mapping should show all gaps and overlaps that are apparent from the legal descriptions.

Generalized Representation

The second method of parcel mapping, which I call a generalized representation of land ownership, is much less precise than using legal descriptions. In this method, the parcels are mapped as an "ideal," continuous land fabric with few or no gaps or overlaps other than public rights of way and large bodies of water. The parcel fabric is fitted to digital orthophotography, paying special attention to the location of roads, water features, and sometimes even fence lines or other visual evidence.

Accuracy of Parcel Mapping

The accuracy of planimetric features (photo identifiable features on maps, such as roads, buildings, and bodies of water) or orthophotography is generally specified as, "Not more than x% of the well defined points are in error by more than y feet." A

statement of the accuracy for the Hamilton County orthophotography (for most years) is, "Not more than 10% of the well defined points are in error by more than 2.5 feet." The accuracy of a parcel layer is much more difficult to describe because parcels are not photo identifiable.

How the Hamilton County Parcels were Mapped

Prior to 1997, our parcel maps were maintained with ink on Mylar using unrectified aerial photography as a reference. Unrectified aerial photography has distortions due to variations in ground elevation. It also is less accurate at the edges than at the center. The accuracy of the ink on Mylar parcel maps suffered from these two factors.

In 1997, the parcel maps were scanned and rubber sheeted to generally fit the original digital orthophotography of Hamilton County. These orthophotos were obtained in 1997 (Noblesville Township) and 1996 (the rest of the county). Digital orthophotography has been corrected for variations in ground elevation and is uniformly accurate even at the edges of the individual photos.

Since 1997, new parcels have been added directly to the GIS by fitting them into the parcel fabric. Each time we get new orthophotography (1998, 2000, 2001, 2003 (Fishers & Carmel only), 2004, and 2005), some of the subdivisions added since the previous orthophotography were adjusted to fit roads and other visible features.

In summary, the parcels in the Hamilton County GIS are mapped using the generalized representation method. This decision was made for a number of reasons. First, would have been much more expensive to read over 60,000 legal descriptions in the original parcel conversion project. Second, we didn't and still don't have a good set of survey grade section corner points for the county. Section corners tend to be destroyed in areas of rapid growth and many of them simply don't exist anymore.

Accuracy of the Hamilton County Parcels

When asked about the accuracy of the parcel layer in the Hamilton County, I generally explain the parcel layer is a generalized representation of land ownership, and some parcel lines may be inaccurate by as much as 10 feet, 20 feet or even more. If more information is required, I explain how the parcel layer was converted from ink and Mylar and how it is being maintained.

This accuracy is called absolute accuracy, and it is the measure of the distance from the location of a point on the map to its true location. When the type of accuracy is not specified, it is generally assumed to be absolute accuracy.

Another kind of accuracy is relative accuracy. It is the comparison of how the distance between two points on a map relate to the distance between the true locations of the two points. Relative accuracy is generally much better than absolute accuracy, but is much more difficult to quantify.

The accuracy of calculated areas and perimeters is a special case of relative accuracy, and is the most difficult of all to quantify. The errors associated with relative accuracy may partially cancel each other out or may be additive to one another when calculating areas and perimeters. Absolute accuracy, however, may or may not affect these calculated values. To illustrate, here are a few examples for a rectangular parcel 100' x 200':

Example 1
The parcel is drawn on the map as 100' x 200', but shifted 15 feet to the east of its true location. In this case, its absolute accuracy is off by 15 feet but its relative accuracy is perfect. The area and perimeter of this parcel calculated by the GIS would be accurate.

Example 2
The parcel is drawn on the map as 95' x 195', but each line is within 4 feet of its true location. In this case, its absolute accuracy is quite good (± 4'), but its relative accuracy is worse (± 5'). The area and perimeter of this parcel calculated by the GIS is off by -7.4% and -3.3% respectively.

Example 3
The parcel is drawn on the map as 110' x 210', but each line is within 5 feet of its true location. In this case, its absolute accuracy is quite good (± 5'), but its relative accuracy is worse (± 10'). The area and perimeter of this parcel calculated by the GIS is off by +15.5% and +6.7% respectively.

Example 4
The parcel is drawn on the map as 90' x 190', but each line is within 5 feet of its true location. In this case, its absolute accuracy is quite good (± 5'), but its relative accuracy is worse (± 10'). The area and perimeter of this parcel calculated by the GIS is off by +14.5% and -6.7% respectively.

Example 5
The parcel is actually drawn as a trapezoid with sides of 102', 203', 105', and 207', and one of its corners are 13' from its true location. In this case, its absolute accuracy is not very good (± 13') and neither is its relative accuracy (± 7'). The area and perimeter of this parcel calculated by the GIS is off by +6.0% and +2.8% respectively.

Example 6
The parcel is actually drawn as a trapezoid with sides of 94', 196', 105', and 207', and one of its corners are 13' from its true location. In this case, its absolute accuracy is not very good (± 13') and neither is its relative accuracy (± 7'). The area and perimeter of this parcel calculated by the GIS is off by +0.2% and +0.3% respectively.

Table 1 shows a summary of the absolute, relative, and calculated area and perimeter accuracies of examples 1 through 6.

Table 1

Example	Absolute Accuracy	Relative Accuracy	Error in Area	Error in Perimeter
1	15 feet	0 feet	0%	0%
2	4 feet	5 feet	-7.4%	-3.3%
3	4 feet	10 feet	+15.5%	+6.7%
4	4 feet	10 feet	-14.5%	-6.7%
5	13 feet	7 feet	+6.0%	+2.8%
6	13 feet	7 feet	+0.2%	+0.3%

Figure 1 shows the percentage of error in the area of a parcel graphed against the errors in the parcel dimensions for six typical parcel sizes in several platted subdivisions in Hamilton County. In this graph, an error in the parcel dimensions is applied to both the width and the depth of the parcel. For example, a plus 5 foot error in each dimension of an 80 foot by 120 foot parcel would result in a parcel 85 feet by 125 feet. Notice how an error of 5 feet in both parcel dimensions can cause an error in the parcel area of 6% to 18%, depending on the parcel dimensions. An error of 10 feet in both parcel dimensions can cause an error in the parcel area of 12% to 38%, depending on the parcel dimensions. The smaller the parcel, the greater the effect on the parcel area of a small error in the parcel dimensions.

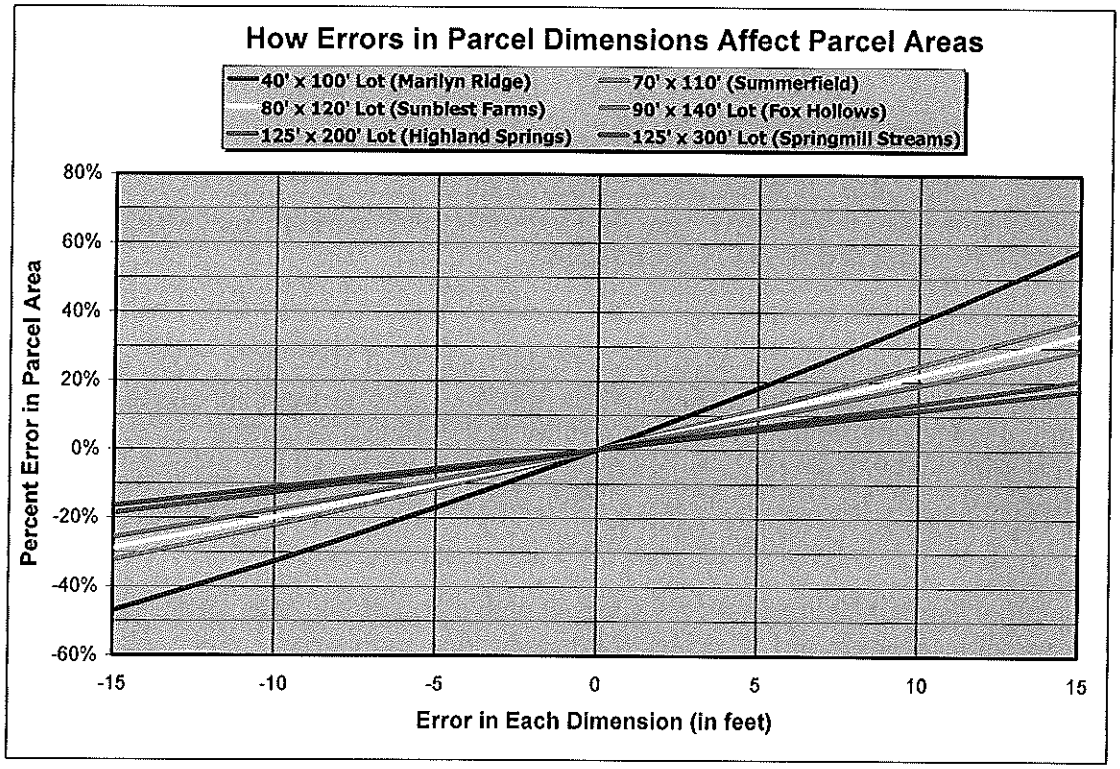

Figure 1

Summary

The parcel layer in the Hamilton County GIS is a generalized representation of land ownership. The parcels are mapped as an "ideal," continuous fabric with few or no gaps or overlaps between parcels except for public rights of way and large bodies of water. Parcel lines may be in error by 10 feet, 20 feet, or even more in some cases. The accuracy of the parcel layer is difficult to grasp without a general understanding of the methods used for the original conversion of the ink and Mylar parcel maps into digital data, and the methods used to maintain the parcel layer in the GIS. The accuracy of calculated areas and perimeters of the parcels is even more difficult to quantify than the absolute and relative accuracy of the parcel layer. Relatively small errors in parcel dimensions can result in large errors in parcel areas. This effect is more pronounced in small parcels than in large parcels.