Landbase Accuracy with Cadastral Editor

City makes enhancements for improved planning.

By Kristy M. Capobianco and William C. Mann

Accurate documentation of property boundaries is a widespread issue for cities and counties throughout the U.S. With more precise parcel and right-of-way datasets, otherwise known as landbases, local governments are able to provide a variety of public safety and planning services with a much higher level of confidence and precision. Jacksonville Beach in Northeast Florida, for instance, experienced significant spatial and attribute inaccuracies within its existing landbase, including a large number of parcel boundaries and right-of-way lines that did not correspond to their known dimensions or locations. Having an inaccurate landbase poses many problems. When there are spatial inaccuracies there is the potential of placing utilities or other structures inadvertently on someone's property when they were intended for the right-of-way. Another potential issue may arise if a natural disaster should ever hit the area and homes and hardcopy landbase records are destroyed. There can also be disputes over property lines.

Donald F. Terrell, Senior Network and GIS Administrator with the information technology division for Jacksonville Beach, soon realized the city's need for much more accurate landbase information so that his team could provide the correct data to the public, as well as his internal clients, city staff. In 2007, the city teamed with facilities and infrastructure consulting firm RS&H (www.rsandh.com) to develop a more accurate landbase of all parcels within city boundaries using GIS technology. RS&H's team of GIS analysts designed and implemented the solution as one of the first firms in the nation to apply the new Cadastral Editor, part of ESRI's (www.esri.com) ArcGIS Survey Analyst Extension, to manipulate and correct the city's existing landbase data using known dimensions, field collected control points, and high-resolution aerial imagery.

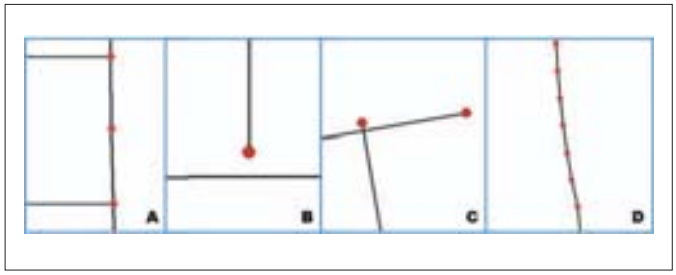
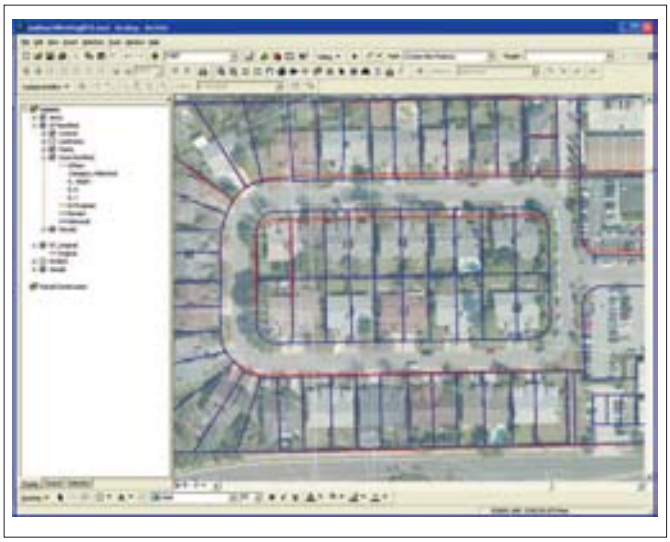


Figure 1. Challenges Encountered. Some examples of the challenges encountered: A—pseudo nodes; B—undershoot; C—overshoots with dangling nodes; and D—densified arcs.

According to Terrell, "The new landbase is not meant to replace the existing property appraiser or tax information, but rather it will be used to help enhance public safety. This information will be used by both the police and fire departments to aid them in building their Enhanced 911, or E911, emergency services."

In the summer 2007, ESRI released a new version of its Survey Analyst Extension with Cadastral Editor. This new editor added advanced parcel editing tools and allowed RS&H to create an integrated dataset, dubbed the "cadastral fabric," for Jacksonville Beach. The cadastral fabric is made up of lines, line points, points, and polygons that represent each parcel layer. Once the team imported the existing parcel data into the cadastral fabric, new fields were generated by the software containing the dimensions of each parcel segment. These dimensions were then compared to their known dimensions and corrected using coordinate geometry or COGO based data entry.

Before building the cadastral fabric, the team had to first perform a massive clean-up effort on the existing parcel data. The most common data issues included pseudo nodes, dangling nodes caused by overshoots, undershoots, and densified arcs (Figure 1).



Jacksonville Beach decided to develop a more accurate landbase of all parcels within city boundaries using GIS technology.

- Pseudo nodes are arbitrary nodes located along the parcel vertex, which split the line into multiple segments. Without correcting, the dimensions created in the fabric would be split between those two segments causing multidirectional distortions in the parcel shapes.
- Undershoots occur when the parcel line is too short and does not connect to the intended vertex leaving a gap, while overshoots occur when the parcel line segment is too long and crosses its intended vertex leaving a dangling node. These two errors became a major issue when building the polygon layer of the cadastral fabric since the Cadastral Editor will not create polygons unless the parcel line segments are all connected at nodes. When undershoots were present in the initial dataset, the parcel polygon layer could not be created because the line segments were not snapped together. Overshoots caused a similar problem that also prevented the polygon from being created.
- Densified arcs are a sequence of many straight lines that are connected to make a curve. Since the cadastral fabric only supports true arcs, RS&H acquired a developer sample from ESRI called the CurveConversion Command, which is not an out-of-the-box tool and only available upon request. With this tool, the analysts were able to convert the densified arcs into true arcs needed to create the cadastral fabric.

Field Data Collection

Concurrent to the data clean-up effort, a data collection effort was also underway. The team collected benchmarks, monuments, and known locations of points, such as manholes, fire hydrants, and light poles, that were easily visible on the high-resolution aerial photography provided by the city. Using this information, the team created a 14-section grid dividing the project at major roadways. A minimum of two points were collected for each grid location using a Trimble GeoXH GPS (www.trimble.com) unit coupled with a Zepher antenna (www.trimble.com), providing sub-meter horizontal accuracy. These points were collected to improve the accuracy of the information contained in the cadastral fabric and were post-processed in the office before incorporating them into the fabric to ensure the highest horizontal accuracy possible (sub-foot) from the GPS unit.

The team began parcel rectification once the clean parcel data and control points were built into the cadastral fabric. With nearly 15,000 parcels to rectify, RS&H designed a workflow that maintained the 14 city grid sections and created a separate fabric for each one. This step was implemented for two reasons: 1) to streamline the quality control and quality assurance process and 2) to reduce the amount of data so the software could process the fabric (ESRI recommends a maximum of 10,000 input arcs when building the cadastral fabric).

Three parcel status categories were identified at the project's onset: 1) in-progress (IP), 2) review, and 3) historical. The project also required a five-ft tolerance on the parcels. The IP parcels were those that still needed to be edited, while the review parcels were those that were edited but did not fall within the five-ft tolerance or were missing dimensions. The historical parcels were those that were edited and within the five-ft tolerance. The initial analysis of the data involved identifying the parcels in the cadastral fabric that exhibited the correct dimensions and marking them as historical. If the parcels fell into the review category, they were plotted on top of an aerial background and given to the city for final approval or direction for further correction.

While rectifying the parcels, the team used the high-resolution aerial photography as the base layer to ensure proper placement of city blocks after they were disconnected and edited. It was extremely important to maintain and correct right-of-way information when reconnecting the parcel blocks. The accuracy of parcel corner points and dimensions were maintained within five ft. Having an accurate right-of-way dataset allows for the creation of a more accurate street centerline shapefile, which will aid emergency services as the city geocodes addresses for the E911.

The benefits of correcting parcel data in this innovative manner are numerous and could be applied to other cities looking for ways to improve their planning activities. In addition to enhancing public safety services, the improved landbase will be used by the city's planning and development and public works departments to make better decisions involving utility locations and other improved services. It will also provide more ease for the management of the city's assets, as well as facilitate the development of Web-based land use and zoning maps that can be made available to city staff and the general public. GE

Ms. Capobianco, GISP, is a Project Manager and GIS Analyst with RS&H. She can be reached at kristy.capobianco@rsandh.com or 904-256-2251. Mr. Mann, AICP, is the Senior Planner for the City of Jacksonville Beach who has over 24 years of community and facilities planning experience in both public and private sectors. Mr. Mann can be reached at planning@jaxbchfl.net or 904-247-6231.

Field data collection included benchmarks, monuments, and known locations of points.