# Living Right of Way Boundaries in GIS

## An innovative visualization

In Maryland, digitization and GIS are significantly improving speed of access to the Department of Transportation (DOT) land parcel information and positively influencing overall accuracies.

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The U.S. has embarked on a once-in-a-generation investment in infrastructure, covering everything from roads and bridges to building the infrastructure to support the electrification of the vehicle fleet. Most of these funds go to the state departments of transportation (DOTs) that are responsible for building and maintaining the multimodal transportation networks within their states.

The vast majority of a DOT's assets are in their right of way (ROW), the land owned by the state surrounding the highway. In fact, in many states, the DOT is the single largest public landholder, and the right of way can total hundreds of thousands of acres.

Despite the overall value of that land and associated assets, many DOTs still manage their ROW with traditional paper document management techniques, which can pose unnecessary risks of document deterioration and/or destruction. On top of that, the time spent trying to locate specific ROW documents for customers can be considerable — time which could be more productively spent.

This was the challenge the Maryland DOT (MDOT) faced as they sought to digitize their ROW. To meet this challenge, the Plats and Surveys Division (PSD) within the MDOT State Highway Administration (SHA) Office of Highway Development (OHD) is digitizing existing right of way plats, which are maps showing official land transactions. These documents are vital historical records used in the planning and designing of SHA projects. This data is being presented uniformly within the Maryland ArcGIS Online environment as authoritative feature layers: MDOT SHA Right of Way and MDOT SHA Right of Way Polygon.

Now, both internal MDOT users and members of the public can access ROW and associated plat information from a single location via the web.

### **Creating Quality Data**

Initial discussions about digitizing images in the plat archives extends as far back as 2015, originating from PSD's desire to modernize and enhance its own internal research capabilities. The process of georeferencing over 60,000 plat images began around this time.

Initially, the end goal was simply to have the scanned images (TIFFs) georeferenced and organized by location. However, as the effort began to yield tangible benefits for project-related research, extracting more spatial data from the plat images became a greater priority. By 2018, the georeferencing effort had expanded to include the creation of a digital right of way boundary line in GIS.

Early in the process, the PSD staff needed to formulate ways to manage internal project deliverables. This was critical because, without a system in place to capture newly obtained survey data and plat CADD files, the product of a large-scale digitization effort would quickly become obsolete. To ensure that project deliverables remained organized, the team established workflows and reporting systems within PSD.

The digitization of plat ROW was a significant undertaking for the GIS team. It began in 2018, after the team had successfully georeferenced approximately 80% of all scanned plat images. To ensure an efficient and organized process, the team organized the digitization efforts by county and route. PSD GIS specialists were assigned to sort through all plats associated with a particular county and route, identifying the plats that provided the most accurate source of ROW information.



*Figure 1:* The PSD Digital Asset Referencing System is an ArcGIS Online web mapping application built specifically for PSD internal research and planning purposes. This mapping application hosts the MDOT SHA Plat Boundary Polygon layer, MDOT SHA Right of Way feature layer and the MDOT SHA Right of Way Polygon layer.



Figure 2: Statewide coverage of the public MDOT SHA Plats and Surveys Right of Way feature layer is displayed in the image above.

Throughout the process, PSD always sought out the highest quality information to guide their efforts. Whenever a CADD file representing the field-surveyed boundaries of the ROW was available, staff would extract the features from the file and incorporate them into the GIS layer.

This meant that the latest and greatest information available in any given area was used to create the ROW layer. However, in areas where CADD or georeferenced plats were not available, the GIS team incorporated ROW lines from the Maryland Department of Planning's Parcel Boundary GIS layer. The result of this digitization was a patchwork of ROW lines from a variety of sources.

As the ROW database feature count grew from the consistent digitization and CADD extraction efforts, the differences in precision between the various resources used to create the ROW line data became more apparent. PSD felt that it was necessary to illustrate these differences to convey a level of confidence that users could have in the ROW line's source assets. After much consideration, the GIS team decided to classify the data on five levels of ROW line quality: surveyed, computed, marginal, estimated and intermediary. This unique approach to representing ROW data by quality level has proven to be valuable for planning purposes and site research within MDOT SHA.

**1. Surveyed:** The boundaries have been established directly through actual ground surveys and are associated with an original CADD design file (DGN). The design file for a surveyed ROW must be created or overseen by a professional land surveyor licensed in

Maryland. Additionally, it must meet the Maryland minimum standards as found in the Code of Maryland Regulations (COMAR). This level of quality is ideal for project planning and preliminary engineering design.

- **2. Computed:** ROW lines of computed quality are also associated with an original CADD design file, however, the geometry in the file is a mosaic of calculations based on existing plats, deed descriptions and construction plans, as opposed to recent ground surveys. This quality level is ideal for situations where the ROW is well established and documented.
- **3. Marginal:** ROW lines derived from tracing scanned historical ROW plats that have been georeferenced to a  $\pm$  10-foot accuracy. ROW lines are digitized from the most recently issued plats. Marginal quality lines are not associated with an original CADD design file, as the file may no longer exist, or the plat predates CADD. This level of quality imparts an approximate location of the ROW, which is supported by recorded plat documents.
- **4. Estimated:** Originally derived from historical Maryland Department of Planning parcel boundaries on raster tax maps, this level of quality is ideal for situations where there are no existing ROW plats or other documentation, and a best estimate is needed.
- **5. Intermediary:** Extrapolated line segments are generated by a geoprocessing model developed by the PSD GIS team. Intermediary lines are used to connect the end points of adjacent ROW features to generate ROW polygons.

This quality level classification system is publicly available from MDOT, but it does not include any specific attributes which are reserved for state government and contractor access only. While a line feature layer is available, it serves primarily as a reference for the information. The GIS team has also created a polygon layer using the enclosed ROW boundary lines, which can be used with geoprocessing tools. However, it should be noted that the polygon layer does not include the various quality levels associated with the ROW line layer. Both the line and polygon layers are available through the MD iMap Open Data Catalog.

#### **Continuous Process Improvement**

MDOT's ROW digitization project has been in a continuous state of evolution, progressing from its initial concept to its current state over the course of five years. The team worked county by county and plat by plat. If a file was of field survey grade, extraction and attribution were relatively simple in the sense that the information contained could be held to be reliable. However, at other times, the information being extracted had to be checked more thoroughly to ensure that it was correct. Where subsequent work takes place, the marginal data is superseded by the new data. In this way, an already geographically complete map will see improvement in discrete areas over time. Another factor in the time taken for the build was people: Efrain Tacoronte, the GIS leader at the Office of Highway Development, noted that it took time to train individuals on the totality of the process, from georeferencing plats to digitizing ROW lines and accurately attributing those linear features. He adds that the task of updating will effectively never be completed, as once all locations have been brought up to a given standard, there will still be new projects, and therefore new information.

It is the qualitative element which makes the work done in Maryland stand out.

"We are seen as providing an accurate representation of the right of way data, with the different qualities reflected in the levels," said Tacoronte.

Data maintenance is critical to the ongoing success of the ROW digitization effort. PSD has developed rigorous processes to review and update the ROW layer when new MDOT SHA projects that alter ROW boundaries are completed or when newer information is found. To start, they developed a right of way error reporting tool in ArcGIS Survey123 which allows MDOT employees to report errors or outdated features.



Figure 3: The MDOT SHA Right of Way polyline and MDOT SHA Right of Way Polygon layers in the Digital Asset Referencing System are shown above.



Figure 4: The MDOT SHA Right of Way polyline layer's Right of Way Error Reporting Tool in PSD's Digital Asset Referencing System is shown above.

In addition, PSD has regular QA/QC checks they perform on the data, as well as a daily reconciliation of database versions to ensure data currency. The regular improvement and maintenance of this dataset have made it an essential tool for Maryland's transportation industry.

#### **On-Screen Asset**

The MDOT SHA's Plats and Surveys Division's georeferencing and right of way digitization initiatives demonstrate how technology and innovation can be used to preserve and make critical information accessible for public use. As of 2023, over 10,800 miles of ROW of different quality levels have been produced by the PSD GIS team across the state of Maryland. The dataset has been published as a feature service to MDOT SHA's ArcGIS Online data catalog and incorporated into web mapping applications accessible to MDOT users.

The MDOT SHA ROW dataset is a valuable resource for infrastructure planning and development, as well as for researchers and historians. Through the implementation of a quality-level system, MDOT SHA has been able to enhance the level of detail within the ROW boundary dataset, which has ultimately resulted in a more comprehensive and reliable source of information. MDOT SHA's commitment to maintaining and improving this dataset ensures that it will remain an invaluable asset for Maryland's land development and planning, while serving as a model for other transportation agencies seeking to improve upon their own GIS data.



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