The 2017 NACo Awards – Technology Category

Greenscapes: Expert GIS Map Creation in the Hands of GIS Novices

ABSTRACT OF THE PROGRAM

In 2016, Montgomery County Department of General Services enlisted the help of the County's Department of Technology Services GIS Team to map facilities and inventory their area measurements. DGS maintains County facilities, including mowing lawns and trimming brush – maintaining the "greenscapes" – surrounding more than 150 recreation centers, libraries, County offices, and other locations. Planning such maintenance requires delineating for staff and contractors which green areas near each facility need to be maintained as well as calculating the square footage of area of responsibility at each location. Such tasks can be accomplished easily using desktop GIS software to create aerial photo maps and calculate areas, but DGS' work needed to be completed by DGS staff who were familiar with the facilities but not with GIS software. GIS software is very useful but can be confusing and intimidating to novices.

DTS-GIS designed a template map document that used software extensions to greatly simplify the processes for both map creation and area calculation by DGS staff. Furthermore, DTS-GIS made use of the database versioning feature of the ArcGIS software to allow multiple DGS staff to edit the greenscapes data simultaneously, with the master copy of the database synced for all edits by DTS-GIS staff at the end of each day. The final product was 148 PDF maps, some displaying more than one adjacent facility. Each map highlighted the greenscape areas drawn by DGS staff atop aerial photos and property lines, with various information about each location automatically added in the margins, including square footage of each green area. Upon completing the project, in addition to the PDF maps, DGS also now possesses GIS data its staff can edit for future greenscape inventory needs.

THE PROBLEM OR NEED FOR THE PROGRAM

DGS must issue a solicitation for landscaping services for almost 200 facilities, but needed (1) maps delineating the areas to be maintained and (2) an estimate of the square footage of the area to be maintained at each facility. It was appropriate for DGS Staff, who have unique understanding of the areas of responsibility at each facility, to make the delineations on maps themselves, but they had no prior familiarity with GIS software. A process needed to be established that put the powerful tools of GIS in their hands but in a simple way easy enough for GIS novices to use.

DESCRIPTION OF THE PROGRAM

When DGS staff first approached DTS-GIS about their need for maps and area measurements at each location, they provided a Word document listing 161 facilities and the asset number and address for each. Members of the two offices worked together to put the list in spreadsheet form usable by the GIS software for geocoding, which is the GIS process of automatically producing points on a map from a set of addresses. Among the list of addresses were several that were not detailed enough for the GIS software to determine the facility's precise location, for example when multiple facilities were part of a larger campus or if a street intersection were used instead of an address; these addresses were clarified by DGS staff and adjusted in the data by DTS-GIS. Also, DGS staff noticed that several facilities on the original list were not applicable to the Greenscapes project, and struck them from the list. Some other facilities were also added.

When the adjust list was ready in spreadsheet form, DTS-GIS staff needed to geocode it, which produces a GIS map point data file with all of the geographic locations as well as the tabular data such as name, address, and

asset number for each facility. DTS-GIS regularly uses several more generic geocode locators configured in their ArcGIS software that locate points against building footprints, properties, and street centerline GIS data. However, because most of the DGS facilities are County facilities that have already been mapped and heavily quality-controlled by DTS-GIS staff who maintain a Places of Interest (PLOI) GIS data layer, a customized geocode locator was created. Every address in the spreadsheet was first checked to see if already matched a location in the long-maintained PLOI database, and only if it didn't match PLOI was then matched against building footprints, properties, or centerlines. This additional step in the geocoding process leveraged the manual work DTS-GIS staff have done over many years to correct or fine-tune any geographic locations for frequently mapped facilities that may not have been optimally or precisely located by the automatic geocoding process.

With the creation of a GIS data file of points for each facility location, or "assets", it was now possible for an experienced GIS user to zoom in on one of the assets using the GIS software to do some work at each location and export a PDF map before zooming to the next location. The first step towards simplifying the process for the DGS staff who were completely new to GIS software was to design the look and feel of the geographic content on the map as well as the layout of each PDF map into a template that could be applied to every facility in the data. The latest orthophotos available from 2015 were added to the map as a base. An editable polygon GIS layer was created to allow drawing of the Greenscape areas. It was tempting to color the Greenscape areas green on the map, but yellow was used because it was easier to see atop the aerial photos. Important text elements were added to the top and bottom of the map's page layout, including the name, address, and asset number of the facility, the square footage of the facility, and the date the map was produced. A sample PDF map was produced for one of the facility locations, and DGS approved the design and layout.

Even with a good map template designed, the work required to zoom from one map point to the next requires a high level of comfort with the GIS software as well as a lot of manual work. To simplify this process for the novice GIS users from DGS, DTS-GIS staff implemented ArcGIS' Data Driven Pages extension. The extension adds a toolbar with simple forward and reverse buttons similar to those on media playback devices. The tools are configured with a GIS data layer to allow quick panning of the map view to each feature in the dataset. In addition to adjusting the area viewed on the map, various text boxes on the map layout can be configured to automatically populate with values from the tabular data associated with the current map feature.

Data Driven Pages was configured on the Greenscapes map template to work with the GIS point layer of assets. Text boxes were configured on the map layout to automatically populate the name, address, and asset number of each asset at the top of the page as well as the current date in small text at the bottom of the page. A final text box was added to display the square footage of each location; this would automatically display as "Empty" before the DGS staff drew the green area on each map and automatically calculated the area, but would automatically populate with the actual number once the DGS staff entered the number into the asset data.

Thus, the process required of the DGS staff who were new to using GIS software was the following:

1. Click the Next Page button (resembles Play button on a media device) to zoom to next asset. The name, address, asset number, and date should automatically populate for the new asset as the map view zooms to the new location.

2. Click around with the editing tool to draw a polygon atop the aerial photo of the facility that delineates the "greenscape" area of DGS maintenance for that facility. Some facilities require multiple polygons, for example islands of green area that must be maintained by DGS in large parking lots.

3. Open the attribute table for the polygon layer. If there were multiple polygons for the asset, select all the new records and use the "Union" command to combine them into one record. Enter the name of the asset into the

combined record so the polygon can be easily found later, and copy the automatically filled square footage of the polygon.

4. Open the attribute table for the point layer of assets. Enter the square footage into the "Green_Area" field. The "Green Area" text display on the map layout will automatically populate with the number entered.

5. Export the map to a PDF document, using the asset number as the file name.

Some facilities were in close proximity or even adjacent to each other, and DGS requested that each map only display one asset to avoid confusion; for these special cases, the DGS staff were provided instructions for querying the point asset and polygon greenscape they wanted to show and temporarily hide any others, which added a few additional steps to the above instructions.

Sometimes the directly overhead view of the orthophoto images in the GIS software was not enough for the DGS staff to delineate the green spaces to be maintained by DGS. DTS-GIS also provided the staff with Pictometry Explorer accounts that allowed them to, within a web browser, view oblique (at an angle) aerial shots of facilities. Often this additional angle allowed them to see the detail they needed to make the determination of what areas to include in the polygons they drew on the map.

Two DGS staff worked in the DTS-GIS computer lab on the project, usually at the same time. To allow them to edit the assets point layer and greenscapes polygon layer simultaneously, DTS-GIS implemented another ArcGIS feature called Versioning. The two data sets were stored in a Master geodatabase, and this feature allowed two additional versions of the geodatabase to be used for editing by the DGS staff that were synced with the Master copy at the end of each work day by DTS-GIS. The syncing by DTS-GIS involved two Versioning commands – Reconcile and Post. Reconciling pulled all changes in the parent version to the child version by merging all of the data. Occasionally, a conflict would be detected, and the software would prompt for a decision to be made between the two conflicting version of the data, complete with a visual and tabular comparison of what was different between the versions. Once reconciling was completed, DTS-GIS would then click the Post command to push changes from the child version to the parent version. Because of this Versioning setup and workflow, the DGS staff started each day in the GIS lab with both versions of their data updated to reflect the work of both of them the previous day.

After the two DGS staff completed their first run of drawing greenscape areas and exporting PDF maps of all of the DGS assets, the PDF maps were reviewed by area managers at DGS who worked more closely with the facilities. Many of the managers suggested edits to some of the maps. The two DGS staff returned to the GIS lab to make the edits, and the forward and reverse buttons on the Data Driven Pages toolbar easily allowed them to return to an asset later to do the additional work and recreate the PDF maps. For both the initial run and subsequent editing at the request of area managers, the two DGS staff reported to the DTS-GIS lab two to three times a week for two-and-a-half months to complete 148 total PDF maps, some of which included multiple facilities that were on a campus-like setting. Also, several facilities were brand new, being rebuilt, or under heavy construction at the time of the 2015 aerial photos, making it very difficult if not impossible to delineate the green space with all the "dirt" areas on the photo. It was agreed that for the facilities under construction, DGS staff would return when newer aerial photos were available,

USE OF TECHNOLOGY

After the initial adjustments to the DGS inventory within Microsoft Office software that allowed the data to be geocoded, the process was entirely completed using ArcGIS desktop software, including ArcMap 10.3 and ArcCatalog 10.3. As mentioned above, ArcGIS' Data Driven Pages tool was used to simplify the map creation process, and the Versioning feature was used to allow the geodatabase to be edited by multiple users

simultaneously. The two DGS staff were also provided with Pictometry Explorer accounts so they had an additional resource in researching the green areas of each facility.

THE COST OF THE PROGRAM

DTS-GIS already possessed the necessary licenses for ArcGIS desktop software as well as browser-based Pictometry Explorer software. A jurisdiction that needed to purchase such licenses to do similar work would have to pay $9,900 for the *ArcGIS for Desktop Advanced* license from ESRI. Pictometry oblique images pricing varies according to the area and resolution of image acquisition. The online *Pictometry Explorer* costs about $200 per user per year for an entry-level 5-user subscription.

The RESULTS/SUCCESS OF THE PROGRAM

DGS now has 148 PDF maps with square footage measurements to use in their solicitation for greenscape work at their facilities. As noted earlier, a few facilities have either been built or improved too recently for accurate maps or measurements to be made using our 2015 aerial photos. Nevertheless, DGS now has geodatabases maintained by DTS-GIS for both point locations of their assets and polygons of the green areas around each. This data can be updated going forward to more easily produce updated maps in the future.

WORTHINESS OF AWARD

DGS Staff who are experts in their own subject matter did not need to be experts in GIS software to use its powerful tools. DTS-GIS implemented lesser known features of the ArcGIS software to make the task of drawing and measuring areas for greenscape areas and exporting PDF maps a task ready for GIS novices. The 148 maps quickly prepared for Greenscape contracting allowed DGS to start the contract bidding timely. The highly automated map preparation challenge allowed the DTS-GIS to showcase its GIS skillset to a higher level. It saved DGS significant contract document preparation expenses.

SUPPLEMENTAL MATERIALS (attached)