GIS Tips & Tricks

By Al Karlin, Ph.D. CMS-L, GISP, and Brandon Gravett

Have you ever used the PLSS in your GIS?

If you are unfamiliar with the Public Land Survey System (PLSS) or have never used it in your GIS, here are a few tips and tricks, along with a little history.

The Public Land Survey System (PLSS), sometimes referred to as the "Rectangular Survey System", or the BLM (Bureau of Land Management) System has been around since the post-Revolutionary War days. Originally created by the Land Ordinance of 1785 to survey the land ceded to the newly founded United States government by the Treaty of Paris in 1783, the system divides land into rectangular, one-square mile "Sections", and accumulates those sections into 36-square mile (6 mile x 6 mile) rectangular Townships north or south of a "Base Line", and Ranges, east or west of a "Principal Meridian". With some exceptions, most notably, territory under the jurisdiction of the original 13 colonies at the time of independence and select others, the PLSS is the "law of the land" in the United States regarding survey and conveyance of public lands.

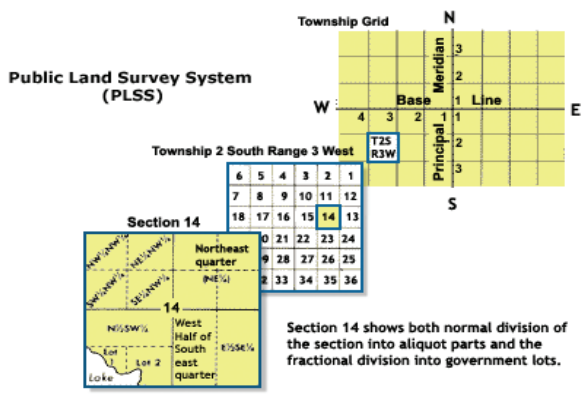

Figure 1. General layout for Sections (square miles), Townships, Ranges, Base Lines and Principal Meridians as described in the Public Land Survey System.

The system was constructed based on an "Initial Point" from which a parallel of latitude, a Base Line, and a Principal Meridian, a true meridian running through the Initial Point, were surveyed. From these two lines, the hierarchical system of Townships (north or south of the Base Line) and Ranges (east or west of the Principal Meridian) were constructed. Within each Township/Range, 36 – one square mile sections were surveyed in a 6 x 6 square mile rectangle as shown below in Figure 1. The BLM Map (Figure 2) shows the Principal Meridians and Base Lines for those states surveyed with the PLSS. States not colored are the "exceptions" noted above.

It is important to understand that the PLSS is not a coordinate system. You will not find the PLSS in the Esri Spatial Reference List, the European Petroleum Survey Group (EPSG) Codes, or the Well Known Text (WKT) files. However, almost all historic and current topographic maps from the US Geological Survey (USGS) include PLSS tic marks or grids, and in recent years, surveyors have been recovering the historical PLSS marker-posts and assigning GPS-coordinates, usually in State Plane systems. As an example, the State of Florida maintains a set of PLSS Certified Corner Records (CCRs) referenced to Florida State Plane Coordinates. The state plane coordinates and survey data sheets can be easily retrieved from the Land Boundary Information System at https://www.LABINS.org. Many other states are likewise publishing CCRs to their

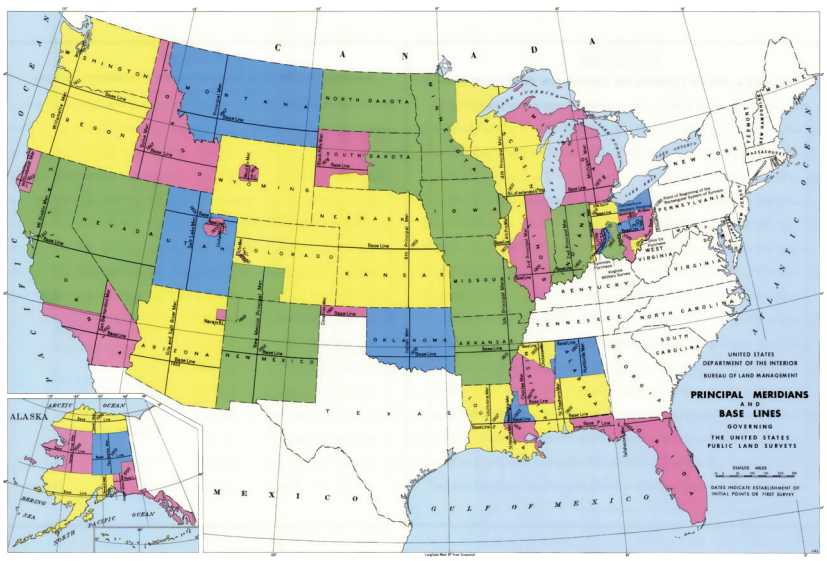

Figure 2. Bureau of Land Management map showing the Principal Meridians and Base Lines used in the Public Land Survey System.

Photogrammetric Engineering & Remote Sensing
Vol. 87, No. 7, July 2021, pp. 469–471.
0099-1112/21/469–471

doi: 10.14358/PERS.87.7.469

websites, and entire PLSS data layers are available through REST services from the BLM at the following:

https://gis.blm.gov/arcgis/rest/services/Cadastral/BLM_Natl_PLSS_CadNSDI/MapServer

The PLSS also provides a system of subdivisions and number systems. Many large facilities have post office box addresses with no street address, but include a PLSS field for reference. This PLSS field can provide valuable information in verifying that a facility was damaged from the actual path of a storm or other natural disaster through the use of PLSS locator "add-ons".

The technique described below uses the PLSS "add-ons" or descriptions in order to confirm addresses for large surface features such as quarries or other types of facilities that would be readily identifiable via on-line aerial photography.

FACILITY	PLSS DESCRIPTION	CITY, STATE
Auburndale WWTP	NWQ SEQ SEC 23 T25N R4E	Auburndale, WI US

The above is an example of a facility with only minimal information about its location available. The city (Auburndale) and state (Wisconsin) for the PLSS description is provided along with a, rather cryptic, PLSS Description. A more interpretable, natural-language, description for the highlighted PLSS record is "North-West Quarter of the South East Quarter of Section 23, Township 25 North, Range 4 East". The diagram, in Figure 2, helps clarify the PLSS description where Township 25N, Range 4E, Section 23 is shown highlighted in the center, with further quarter and 16th subdivisions shown. In this case, they are further subdividing the facility location to the northwest quarter of the southeast quarter.

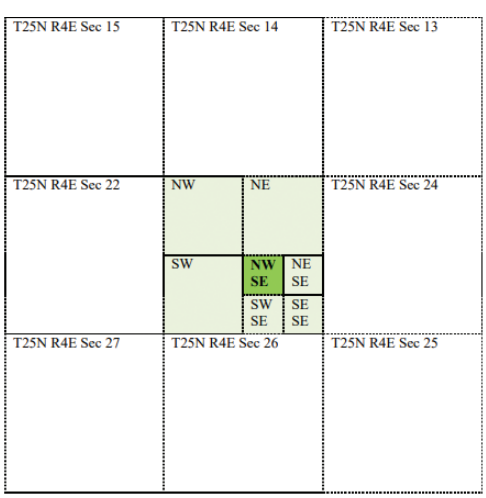

Figure 3. PLSS Grid showing Quarter-Quarter divisions for the Auburndale facility search example.

This PLSS description can be used as location input at websites like Earth Point which can then return real-world coordinates for the corners and centroid of the section:

http://www.earthpoint.us/TownshipsSearchByDescription.aspx

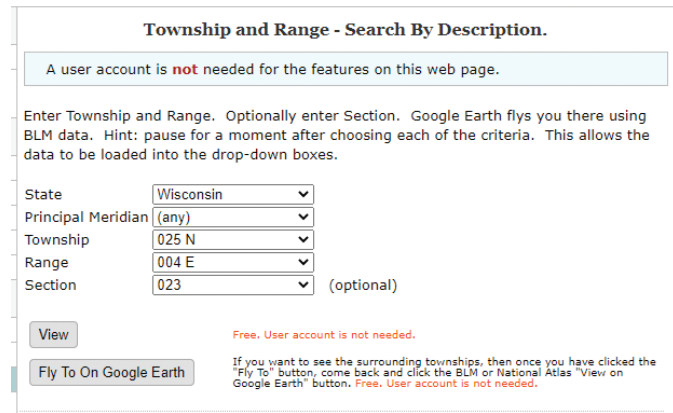

Figure 4. EarthPoint website PLSS Entry Form.

Entering the State and associated PLSS Township, Range, and Section data, and pressing the "View" button to confirm the coordinates returns the PLSS/BLM data and geographic coordinates for the Township (left) and the selected section (right) as shown below:

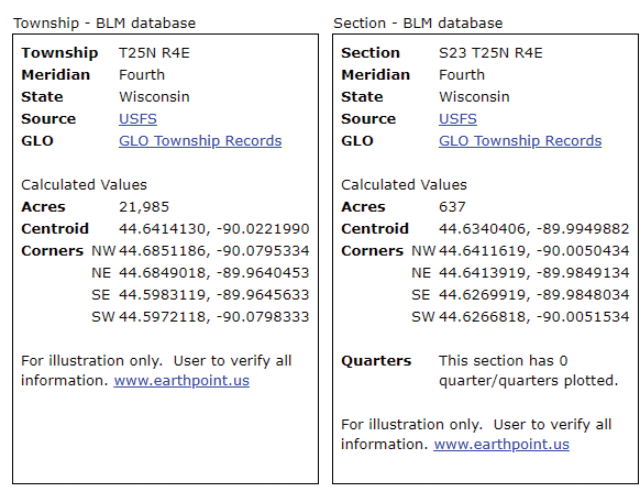

Figure 5. Geographic Coordinates for the Township and Section input.

Pressing the "Fly to on Google Earth" button (on Figure 4) will generate a GoogleEarth KML file and open a file browser to save the KML file on your computer. Opening the GoogleEarth KML you can visually confirm proximity to Auburndale, WI and as in many cases, the road grid also follows the PLSS sections and outlines section 23:

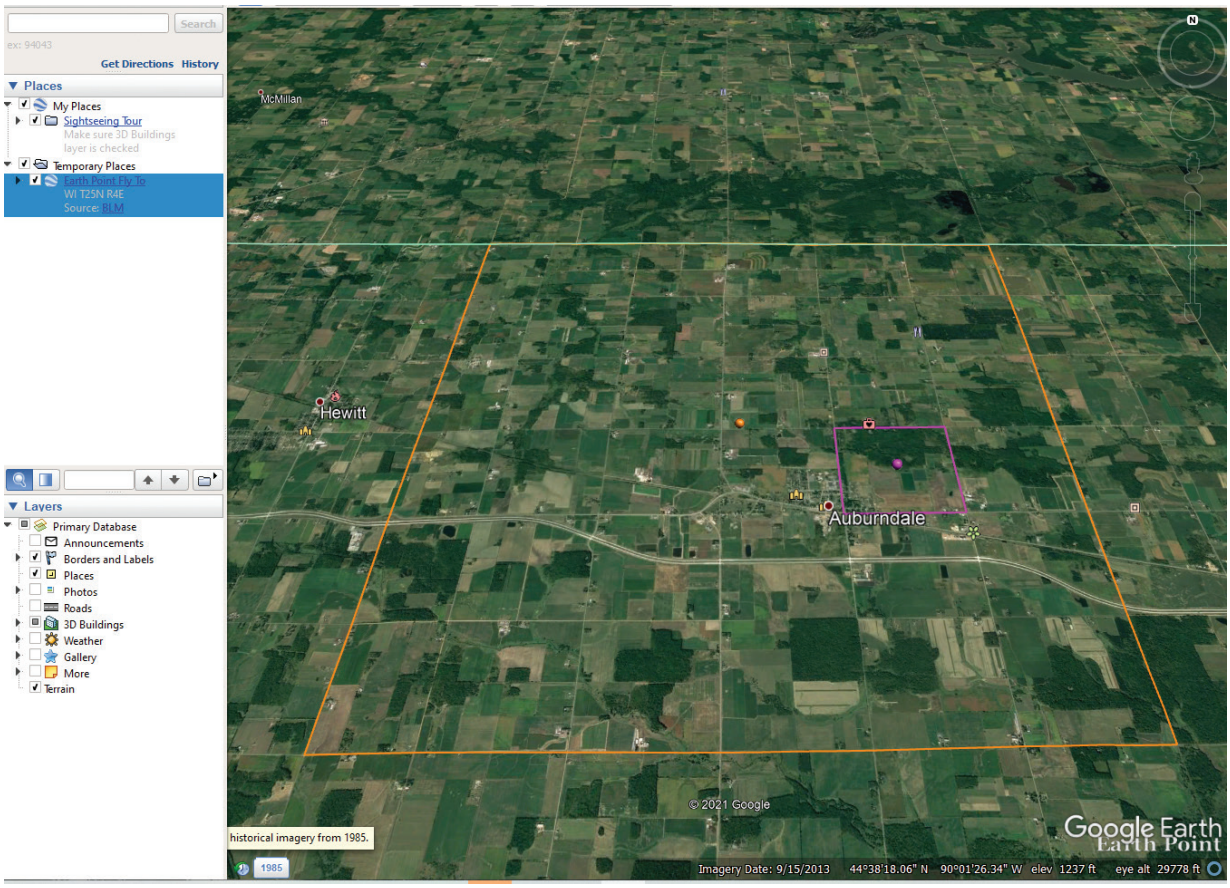

Figure 6. GoogleEarth view of the Auburndale facility showing the PLSS Township (in orange) and the Section (in purple).

In this specific example, you can zoom-in to the area of the plant and the sewage lagoon is visible in the Google Earth aerial photo, located exactly as described in the northwest quadrant of the southeast quarter-section.

Knowing the Public Land Survey System nomenclature and PLSS locators can add fast and reliable information to a GIS inquiry.

Send your questions, comments, and tips to GISTT@asprs.org.

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data and does not begin to cover everything that ArcGIS Pro can do. This knowledge is particular to ArcGIS Pro, although other software may have similar tools and functionality.

Despite its success in achieving its stated goals, the title *Focus on Geodatabases in ArcGIS Pro* is not very descriptive of the breadth or emphasis of the book. Data Integrity with Geodatabases in ArcGIS Pro or Focus on Data Quality and Maintenance with Geodatabases in ArcGIS Pro are more descriptive, if wordier, alternatives as one of its potential strengths is helping GIS professionals' transition from ArcGIS Desktop to ArcGIS Pro.

Focus on Geodatabases also lacks a conclusion, with a review of the geodatabase topology section being the final text. This is a missed opportunity to emphasize the attention to detail required over the life course of operational spatial data.

Users achieve quality spatial data by not only having sound data design and implementation but also careful use of appropriate data creation and editing techniques verified by quality assurance and topology checks.

Overall, *Focus on Geodatabases* achieves its goals and provides a solid introduction, textbook or GIS lab manual, or transition guide to both geodatabases and editing functionality in ArcGIS Pro. The real-world data scenarios are an asset to classroom use and relate to working professionals. As a textbook, *Focus on Geodatabases* is ideal for instructors that wish to emphasize planning before doing, creating and editing realistic local government property and utilities data, and maintaining data quality through structural geodatabase settings, good technique, and topology tools.