Over the past few years, I have become convinced that Google Earth represents an extraordinary opportunity to visualize and communicate survey data, though I too was skeptical of its value as a professional land surveying tool in the beginning. At the time, Metzger + Willard, Inc. (MWI) was making AutoCAD base maps with orthophotos in the vicinity of NGS control stations. Our reasoning was that, equipped with the orthophotos, party chiefs could more quickly find unfamiliar job control, but the amount of time spent in the office to prepare the maps was significant. The first timesaving measure we took was simply to add Google Earth placemarks at control station locations, set the view size for print output, save an image, and print it. Initially, I made static KML maps of NGS control in our ten-county service area with links to datasheets, and then realized that what I really wanted was real-time access to the latest NGS data, not just for datasheets, but also for the placemarks themselves. NGSCS (see “Visualizing National Geodetic Control Stations in Google Earth,” November 2008) was the first tool in the Earth Survey geodetic toolkit. We are currently able view output from NGSCS in Google Maps on an Android smartphone or pad and dispense with printed maps and datasheets altogether.

The second major application in the Earth Survey toolkit was QUADS (see “USGS Quadrangles in Google Earth,” October 2009), which includes USGS orthoimagery, topo maps, and a quadrangle index. The 24k quadrangle map sometimes represents the best available topographic information, and QUADS provides...
access to thousands of high-resolution, georeferenced PDFs (GeoPDFs), which are now supported by Global Mapper. USGS topos often make a good base map for large-scale planning, permitting, and presentation, or may be required by a permitting body. Merely knowing the 24k quad name can be the key to finding other survey data that is categorized by USGS quadrangle.

The third major application, described in this issue, provides direct access to real-time BLM data, including section geometry and land records. If you work in a public land state, I do not need to emphasize the importance of the PLSS. For others, I hope that the topic may be of historical or academic interest.

MWI routinely uses Google Earth for estimating and planning survey projects, route selection, construction inspection, and testing services with a net savings of many hours in both the field and office. Survey estimates are more accurate when sections and control stations are visible and the lengths of traverses and level runs can be determined with the Google Earth distance tool. Apparent discrepancies involving topographic survey data are often resolved by Google Earth’s street view. And communication with party chiefs and clients is greatly enhanced with Google Earth images and KML files. As Google Earth and the tools that use it continually improve, I believe that every surveyor, big and small, can work smarter and more profitably by integrating Google Earth into their workflow. MWI invites you to explore the entire Earth Survey geodetic toolkit (http://www.metzgerwillard.us/EarthSurvey.html), which now comprises thirteen applications including a new browser plugin.

>> By Thomas G. Davis, PhD, PE, PLS
LSGE (http://www.metzgerwillard.us/plss/) is a web-based service for visualizing the Public Land Survey System (PLSS) in Google Earth. The principal component of PLSGE is a Google Earth implementation of the Bureau of Land Management (BLM) GeoCommunicator map service (BLM 2011c). It retrieves multiresolution images of the BLM PLSS.


PLSGE also includes an implementation of the GeoCommunicator Identify service and a facility to draw approximate PLSS boundaries, many with links to BLM land records (BLM 2011b). Land records are currently available for Alabama, Arizona, Arkansas, California, Colorado, Florida, Idaho, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, Wisconsin, and Wyoming.
OVERLAYS

Refresh Mode
The Refresh Mode buttons provide a mechanism to control the Overlays network links. When Refresh Mode is Manual, the contents of the network links are effectively frozen, allowing the user to pan and zoom without prompting a refresh. This is particularly useful for inspecting overlays or gaining an overview of network link contents. To display an overlay:

1. Position the area of interest (AOI) in the viewer.
2. Check the radio button beside the Townships, Meridians, or Special Surveys network link.
3. On subsequent uses, reposition the AOI and ensure that the network link is checked and selected. When Refresh Mode is Automatic, overlays are refreshed two seconds after camera movement stops. When Refresh Mode is Manual, choose Refresh from the Edit menu, or right-click and select Refresh in the context menu.

The Manual and Automatic network links may be used to stop and start refreshes for the Overlays network links. The default refresh mode is Automatic. To stop refreshes, check Manual; to restart refreshes, check Automatic.

Townships
The Townships overlay (Fig. 1) provides the following layers from the PLSS web map service (WMS):

- Minor Subdivision
- Special Surveys
- Quarter-Quarters—Alternate Source
- Quarter-Quarters
- Sections—Alternate Source
- Sections
- Townships—Alternate Source
- Townships

This overlay displays multi-resolution images of the PLSS from the BLM, U.S. Forest Service, and other sources. Click on the Availability folder name to test the map service. The map service will not return an image for the Townships overlay if the target resolution is greater than 1 millidegree per pixel. Service parameters are adjusted to allow township displays at target resolutions up to 2 millidegrees per pixel with a corresponding decrease in label size. Zoom in to display sections, aliquots, and lots where available.

Protracted townships west of the antimeridian are provided by the Alaska Spatial Data Management System (BLM-Alaska 2011).

Meridians
The Meridians overlay provides the following layers from the Land Survey Information System (LSIS) WMS:

- meridians
- meridian_lines
- meridian_line_labels
- states
- base_lines
- base_line_labels
- meridian_labels

This overlay displays low-resolution images of state and meridian boundaries. Because these boundaries were created independently for high-altitude viewing, they will not coincide, nor will they encompass all PLSS divisions.

Special Surveys
The Special Surveys overlay provides the following layers from the LSIS WMS:

- all_ladesc
- twp_labels
- detail_alt_first
- detail_alt_first_labels
- detail_alt_twp
- detail_alt_ladesc
- detail_alt_ladesc_labels
- detail_alt_ladesc_labels_survey_type
- detail_first
- detail_first_labels
- detail_twp
- detail_ladesc
- detail_ladesc_labels
- detail_ladesc_special
- detail_ladesc_special_labels
- detail_ladesc_minor_sub
- detail_ladesc_minor_sub_labels

This overlay displays detailed, multi-resolution images of the PLSS with all available divisions and labels.
**SECTION GEOCODER**

**Point Search**
The Point Search network link (Fig. 2) is a Google Earth implementation of the GeoCommunicator Derive LD and Find LD data services (BLM 2011c). This feature should be used in conjunction with the Townships overlay to ensure that the point of interest (POI) is contained within a section boundary. Click on the Availability folder name to test the Find LD data service.

1. Position the POI in the center of the view. One way to do this is to double-click an unmarked location. To precisely position the POI in the center of the view, add a placemark at the desired location; then edit the properties of that placemark and reset the view.
2. Check the box beside the Point Search network link. The section boundary that contains the POI will be added to the Search Results folder. A successful point search will also update initial values in the TRS Search form.
3. On subsequent uses, reposition the POI and ensure that the network link is checked and selected. Then choose Refresh from the Edit menu, or right-click and select Refresh in the context menu.

Alaska and many coastal areas, e.g., FL29 T31S R17E S004, are not currently supported by Derive LD. The inability of Derive LD to find sections in coastal areas has been attributed to low-resolution state boundaries and does not affect TRS Search which relies solely on Find LD.

**TRS Search**
The TRS Search application is a Google Earth implementation of the GeoCommunicator Find LD data service. This feature should be used in conjunction with the Townships or Special Surveys overlay to ensure that the requested township, section, or subsection (Table 1) exists. Use the Townships overlay to find townships and sections. Use the Special Surveys overlay to find other divisions.

1. Optionally, use the Point Search network link to preset initial values to the section level.
2. Click on the TRS Search folder name to open a form (Fig. 3) with input fields for state, meridian, township, range, section, and subsection.
   - Mouse-over input fields for brief instructions.
   - An aliquot number is a series of digits that represents a quartered subdivision with 1 = NE, 2 = SE, 3 = SW, and 4 = NW, e.g., 23 = SESW, 411 = NWNENE, etc. Subdivision to the 1/4-1/4-1/4-1/4 (2.5-ac) level is supported where available (Fig. 4).

<table>
<thead>
<tr>
<th>SURVEY TYPE</th>
<th>DIVISION NAME</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Aliquot</td>
<td>NV21 T20S R60E S009 SWNE</td>
</tr>
<tr>
<td>B</td>
<td>Aliquot, Residual</td>
<td>OR33 T35S R7E S036 SWSW-02</td>
</tr>
<tr>
<td>G</td>
<td>Land Grant</td>
<td>OR33 T11R13E S009 G1</td>
</tr>
<tr>
<td>H</td>
<td>Homestead Entry</td>
<td>MT20 T26N R34W S020 H211</td>
</tr>
<tr>
<td>J</td>
<td>Small Holding Claim</td>
<td>NM23 T3S R1E S030 J2889</td>
</tr>
<tr>
<td>L</td>
<td>Lot</td>
<td>OR33 T36S R8E S006 L5</td>
</tr>
<tr>
<td>M</td>
<td>Mineral Survey</td>
<td>MT20 T4N R7W S031 M8154-02</td>
</tr>
<tr>
<td>N</td>
<td>Townsite</td>
<td>OR33 T11R13E S009 N14</td>
</tr>
<tr>
<td>O</td>
<td>Aliquot, Fractional</td>
<td>AZ14 T9S R20E S002 NWNE</td>
</tr>
<tr>
<td>Q</td>
<td>Donation Land Claim</td>
<td>OR33 T11R13E S004 Q40</td>
</tr>
<tr>
<td>T</td>
<td>Tract</td>
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<tr>
<td>U</td>
<td>Unsurveyed, Protracted</td>
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<td>CA21 T29N R3W S014 W</td>
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<td>Exchange</td>
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<tr>
<td>Z</td>
<td>Unsurveyed, Unprotracted</td>
<td>NM23 T14N R23E S001 Z</td>
</tr>
</tbody>
</table>

Table 1 Supported Subsections (BLM 2011a)
Subsection numbers may include an optional suffix preceded by a dash, e.g., MT20 T4N R7W S031 Mineral Survey 8154-02.

3. Press the Search button on the input form to add the requested parcel to the Search Results folder.

Alaska is not currently supported by Find LD. Nor does Find LD currently support suffixes with letters, e.g., WY06 T55N R100W S032 Lot 64T-B.

All geocoder results include information balloons with links to source data from Derive LD and/or Find LD, and many contain links to township-level land records.

Some Find LD representations, e.g., FL29 T25S R16E, are missing one or more vertices resulting in missing and extraneous lines. Survey type K (Townsite Block, e.g., ID08 T4S R34E S035 K39), P (Parcel, e.g., AZ14 T14N R5E S002 P1), and Y (Townsite Outlot, e.g., CA21 T43N R9W S018 Y14) do not appear to be supported by either Derive LD or Find LD. Fractional townships, e.g., OR33 T35 1/2S R32 3/4E, are fully supported; duplicate townships, e.g., OR33 T36S R7EA, are supported at the township level (enter 0 for the section number); and east tiers and north ranges are supported for townships in the Symmes Purchase, e.g., OH43 T3E R12N.

To save geocoder results from one Google Earth session to another, right-click on Search Results and select Save to My Places.
GEOCOMMUNICATOR IDENTIFY

To review PLSS boundaries identified by the LSIS in the current view:

1. Position the AOI in the viewer.
2. Check the box beside the Identify network link.
3. On subsequent uses, reposition the AOI and ensure that the network link is checked and selected. Then choose Refresh from the Edit menu, or right-click and select Refresh in the context menu.

Click on column headings to sort records (Fig. 5). GeoCommunicator map controls and search features do not work in Google Earth.

CONCLUSION

PLSGE provides user-friendly, graphically oriented access to a wealth of publicly available geospatial information maintained by the BLM. Metzger + Willard, Inc. is pleased to make PLSGE freely available to anyone having Google Earth installed on a computer with an Internet connection.

Tom Davis has worked in land surveying and design automation for more than 25 years and has held dual registration as a civil engineer and land surveyor for 18 years. He received his PhD in Civil Engineering from the University of South Florida (USF) where he taught prior to joining Metzger + Willard, Inc. (MWI). Tom is currently Professor of the Practice of Civil Engineering at USF and continues in an advisory capacity as Vice President of Surveying at MWI.

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References


