Chapter 4

Calculation of Overburden above the LaClede Bed of the Laney Member of the Eocene Green River Formation, Green River and Washakie Basins, Southwestern Wyoming

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By Tracey J. Mercier

Chapter 4 of 6
Oil Shale Resources of the Eocene Green River Formation, Greater Green River Basin, Wyoming, Colorado, and Utah

By U.S. Geological Survey Oil Shale Assessment Team

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Calculation of Overburden above the LaClede Bed of the Laney Member of the Eocene Green River Formation, Green River and Washakie Basins, Southwestern Wyoming

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Introduction

As part of the U.S. Geological Survey's National Oil Shale Assessment, a determination was made of the volume of overburden material above the LaClede Bed of the Laney Member of the Eocene Green River Formation in the Green River and Washakie Basins, southwestern Wyoming (Johnson and others, this report, chap. 1). A common Geographic Information System (GIS) method was used to calculate the amount of overburden by subtracting a model of the LaClede Bed surface from a Digital Elevation Model (DEM). To maintain consistency with other models in the assessment, all overburden calculations and resultant files were analyzed using a one-acre (208.7 ft (63.6 m) per side) raster model cell size with an effective area of 43,560 ft^2 (4,047 m^2).

Procedure

The first step in the calculation was to create a limiting-resource polygon file for the LaClede Bed by superimposing a digital file consisting of the Laney Member outcrop with a Wyoming Public Land Survey System (PLSS) township grid using publicly available data (Green and Drouillard, 1994; BLM, 2002). In areas where the Laney Member was not mapped, the stratigraphically-closest contact was used. Elevations on top of the LaClede Bed were obtained from a digital file compiled by the assessment team. The digital file was then used to generate a model of the surface at the top of the bed in ArcGIS (ESRI, 2006) by using the GeoStatistical Analyst's Radial Basis Function (RBF) contouring method (fig. 1). The RBF surface model was converted to an ESRI GRID and a Triangulated Irregular Network (TIN) model (fig. 2) to use in ArcGIS's 3D Analyst extension.

An ArcGIS GRID (fig. 3) containing values of total overburden, in feet, above the LaClede Bed for each one-acre cell was created by subtracting the LaClede surface GRID from the DEM GRID using the ArcGIS Spatial Analyst Raster Calculator. The overburden GRID was converted to a TIN. Figure 4 shows the effect of applying hillshade to the overburden TIN to aid in visual analysis. In order to calculate the volume of overburden material contained in specific polygonal areas, ArcToolbox's TIN Polygon Volume function was used to calculate the total volume of overburden, in mi3, within the basins as well as the amount of overburden within each PLSS township (fig. 5). Overburden calculations were not made in areas with insufficient control within the limiting-resource polygon file. The areas where overburden calculations were made corresponds to the area assessed for oil shale (Johnson and others, this report, chap. 1).

Conclusion

The total volume of overburden above the LaClede Bed in the Green River and Washakie Basins was determined to be approximately 730 mi^3. For comparison, that amount is approximately equal to 84 times the volume of water in Lake Mead, 1,090 times the amount of rock removed during the Mt. St. Helens eruption, 75 percent of the volume needed to fill the Grand Canyon, or over 27 billion hopper cars at 4,000 ft^3 capacity.

References Cited

Bureau of Land Management (BLM), 2002, Public Land Survey: township/range (Wyoming), available at *http://www.blm.gov/wy/st/en/resources/public_room/gis/datagis/state/wytwnsh.html*.

Environmental Systems Research Institute, Inc. (ESRI), 2006, ArcMap, version 9.2.

Green, G.N., Drouillard, P.H., 1994, The digital geologic map of Wyoming in ARC/INFO format**:** U.S. Geological Survey Open-File Report OFR 94–425. Available at *http://pubs.er.usgs.gov/usgspubs/ofr/ofr94425*.

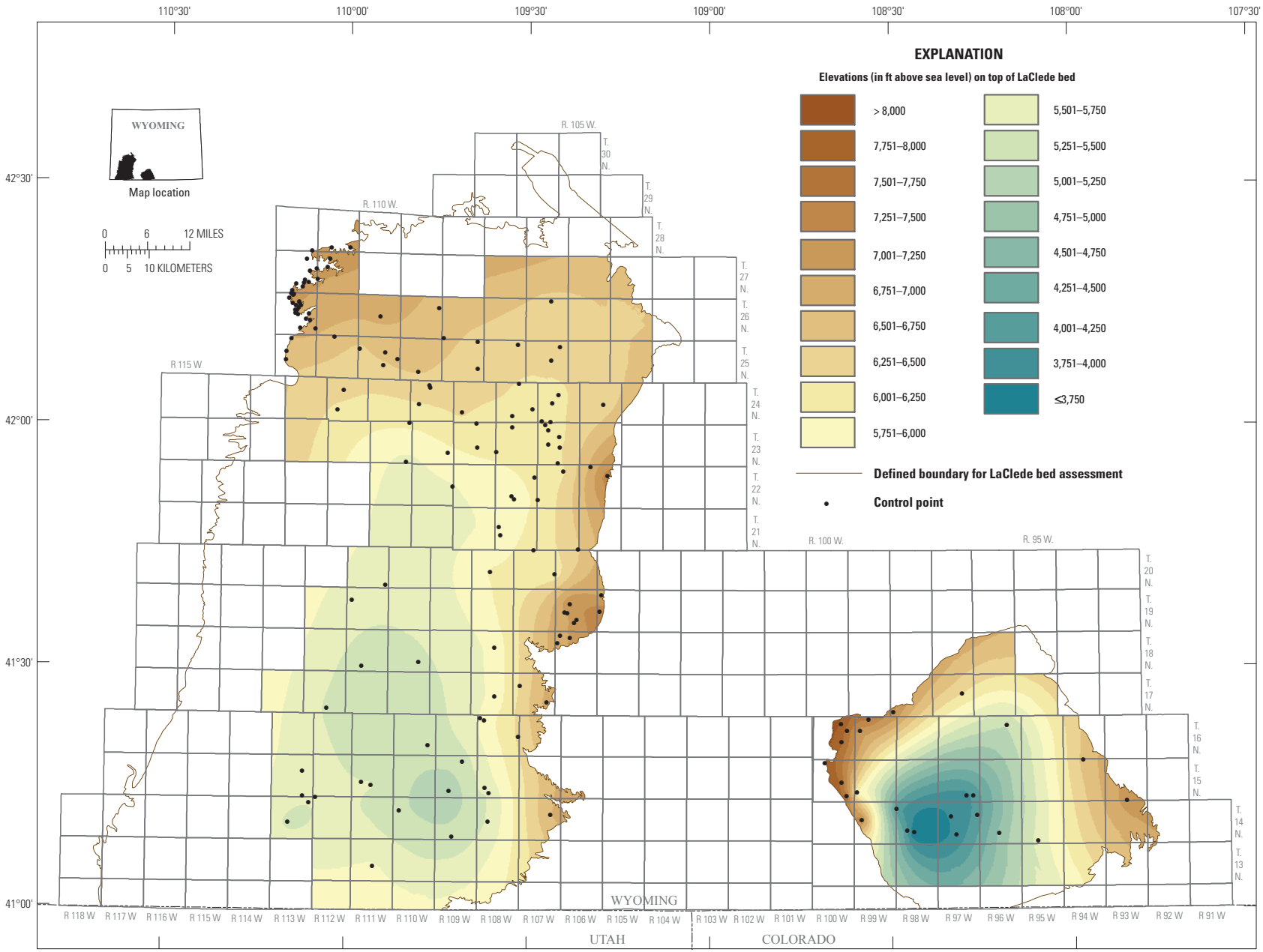

Figure 1. Elevations on top of the LaClede Bed of the Laney Member of the Green River Formation.

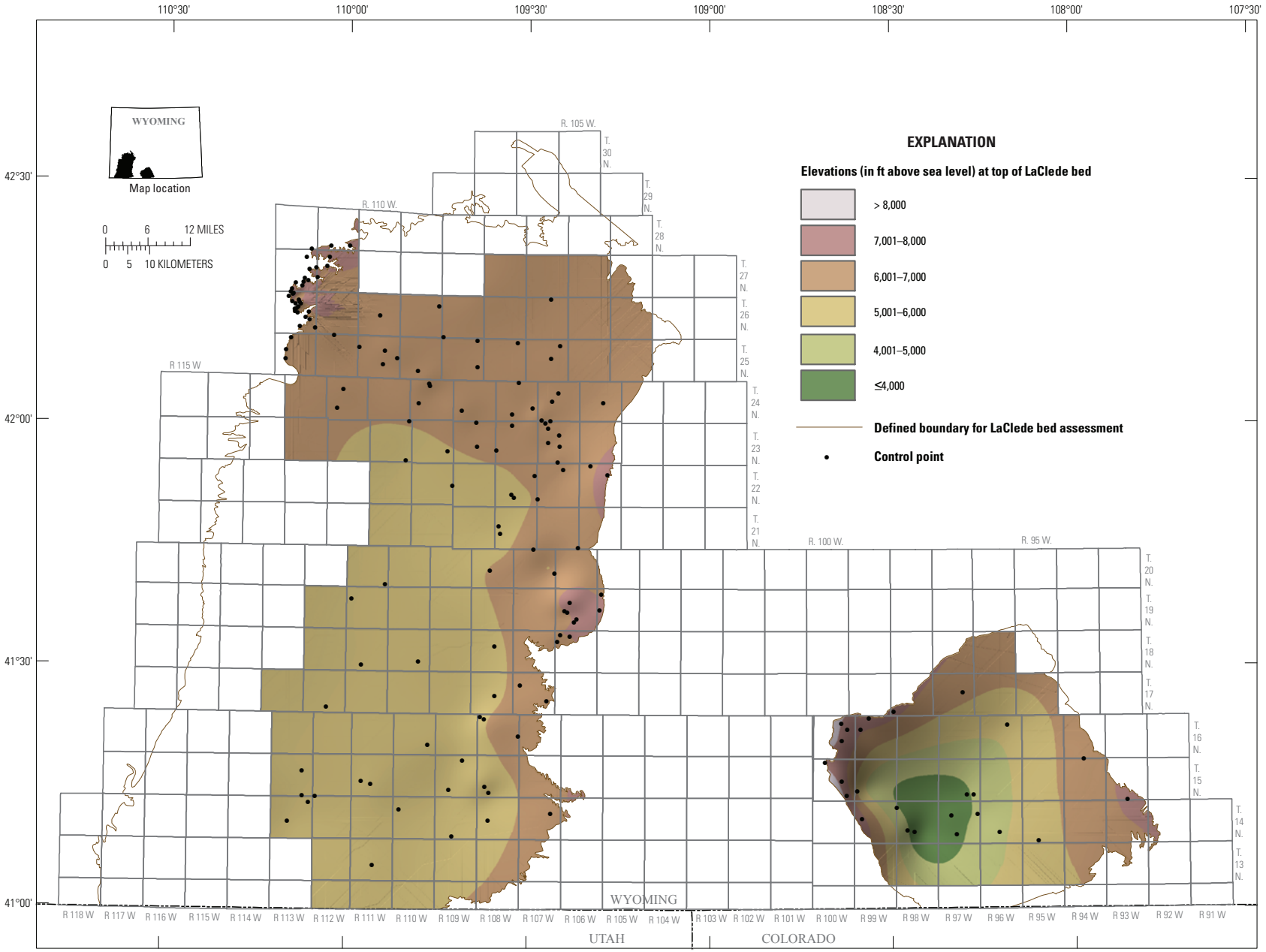

Figure 2. The Triangular Irregular Network (TIN) model and control points on the top of the LaClede Bed of the Laney Member of the Green River Formation. Colors show elevations at the top of the bed.

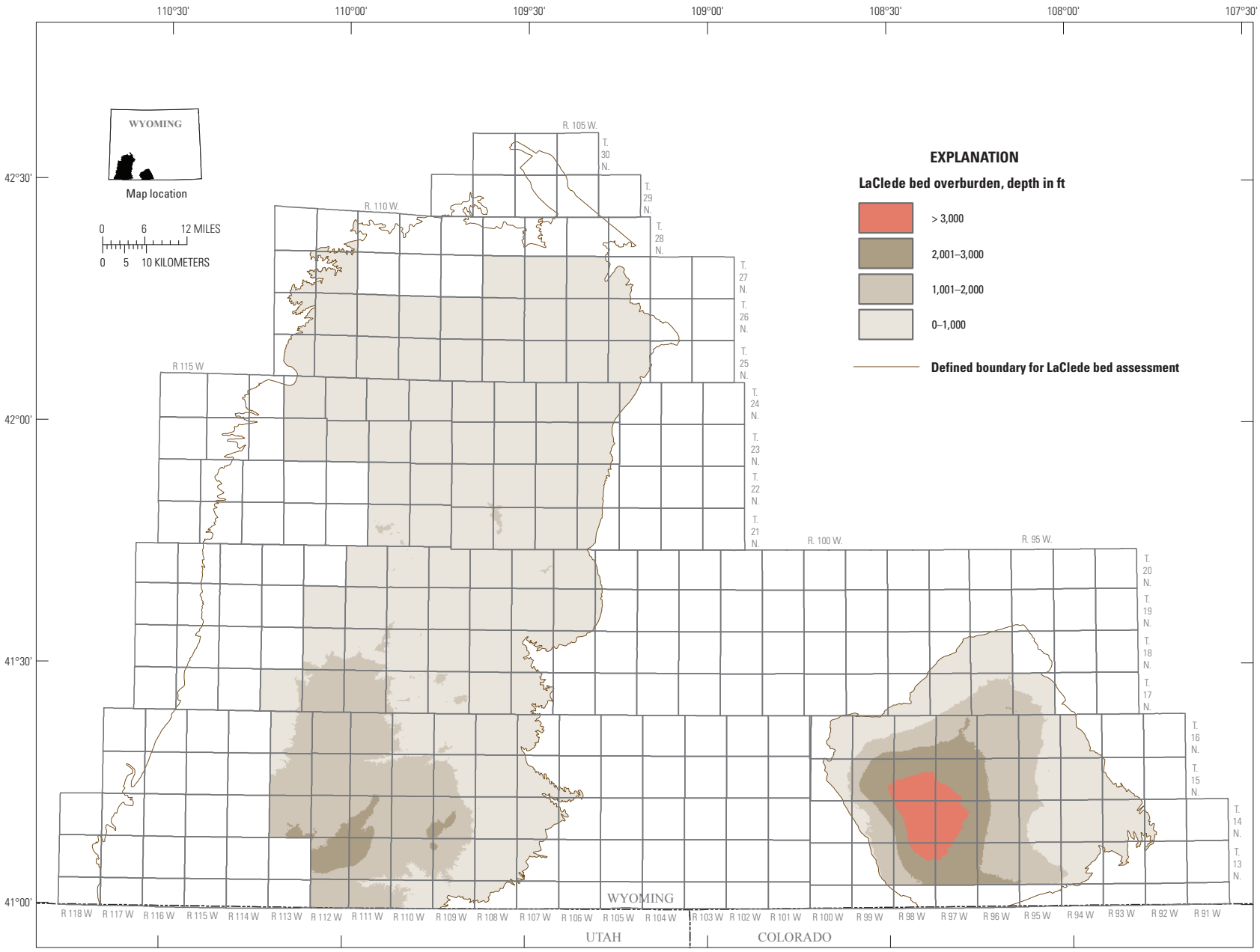

Figure 3. Overburden above the LaClede Bed of the Laney Member of the Green River Formation, Green River and Washakie Basins, Wyoming.

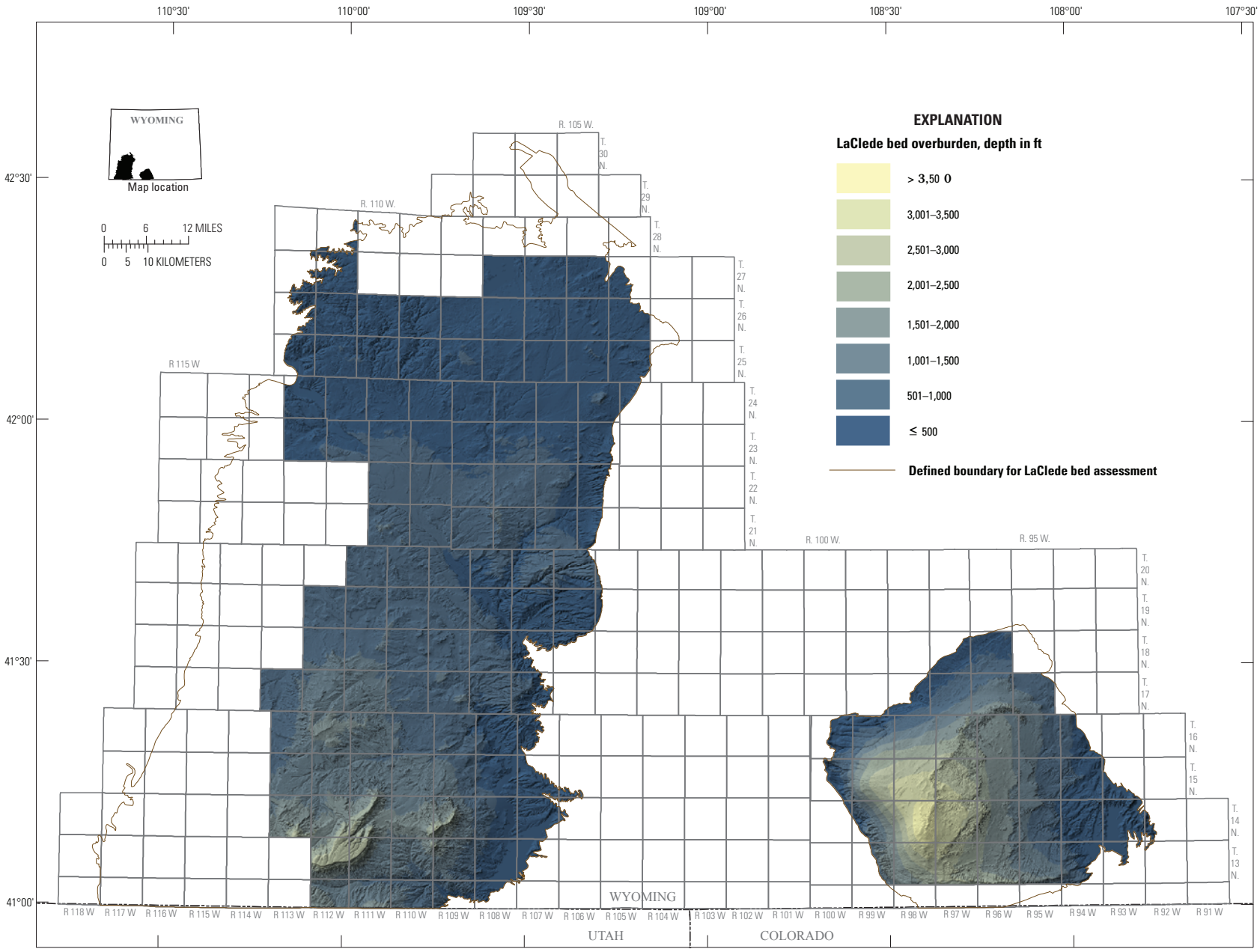

Figure 4. Overburden above the LaClede Bed of the Laney Member of the Green River Formation, Green River and Washakie Basins, Wyoming. Hillshade effect applied.

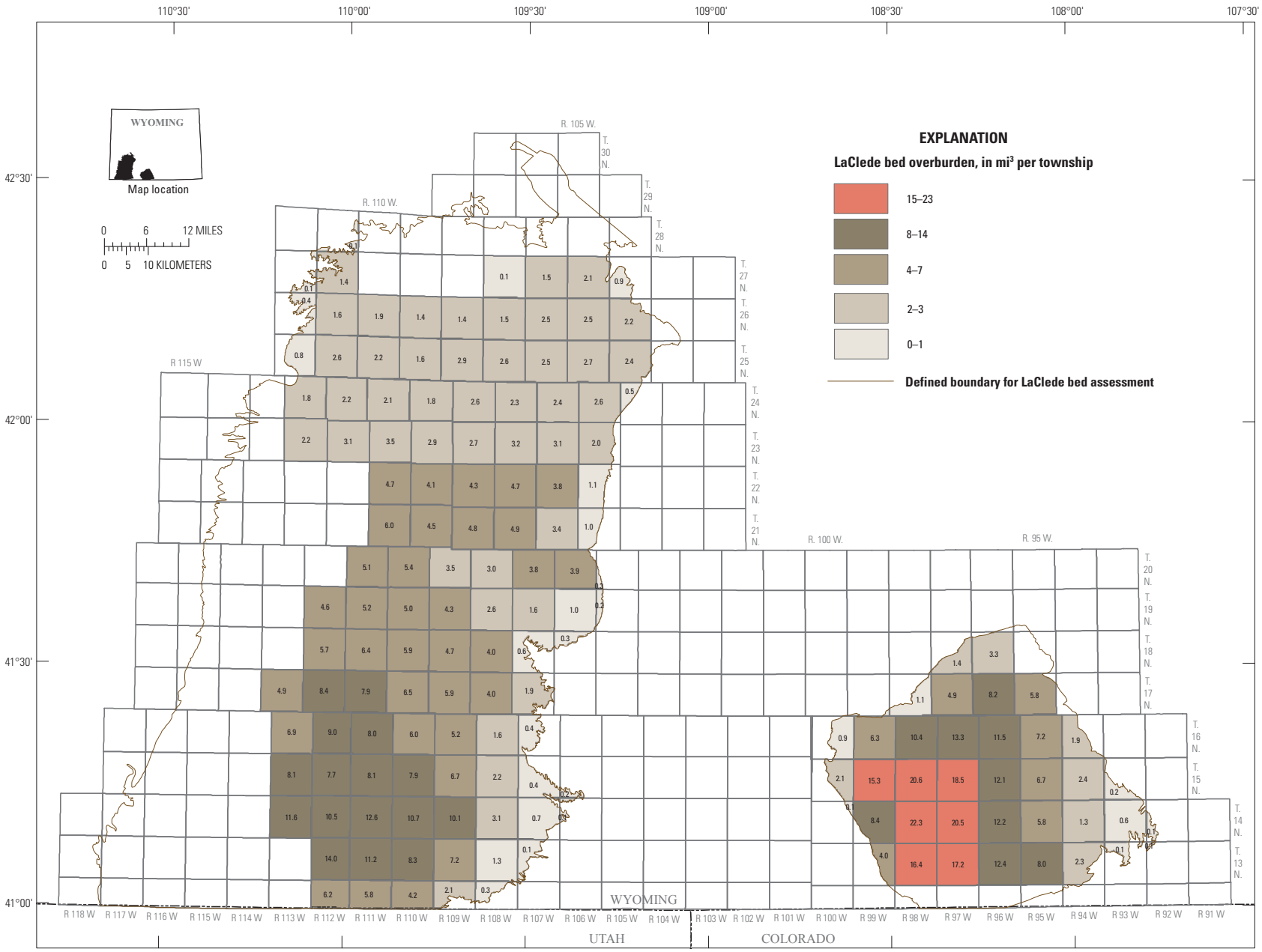

Figure 5. Cubic miles (mi³) of overburden per township above the LaClede Bed of the Laney Member of the Green River Formation, Green River and Washakie Basins, Wyoming.

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