HYDROGEOLOGIC ATLAS OF THE NORTHERN BLACK HILLS:

ELEVATION AND DEPTH-TO-AQUIFER MAPS

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INTRODUCTION

Increases in groundwater development and use within the Northern Black Hills have created a rising concern about the sustainable yield and overuse of the underlying aquifers. This concern creates the need for accurate and accessible aquifer information. Having access to various information, including well locations, aquifer properties, and withdrawal impacts, is becoming crucial for the agriculture community, government officials, and urban development planners.

The goal of this project initiative was to more fully characterize the groundwater sources within the watershed by generating a suite of elevation (structure contour) and depth-to-aquifer maps. The project area includes all of Butte, Meade, and Lawrence Counties of the Northern Black Hills, South Dakota. The study focused on the four major aquifers in the region:

- Inyan Kara Group,
- Minnelusa Formation,
- Madison Limestone, and
- Deadwood Formation.

The elevation maps are presented as contours on the top of the formation relative to sea level. The depth-to-aquifer maps are presented as a color gradient to indicate the approximate depths to the top of the aquifer for drilling. The maps were constructed by compiling numerous data sources including structural contour maps, oil and gas wells, and water wells logs as described below.

DATA

The outcrops and structural features shown on the map are from Martin and others (2004), with modifications to the structural features from Lisenbee (1985). The data points shown on this map were compiled from the interpretations of drillers' logs of numerous monitoring, water, and oil and gas test holes. The primary drill-hole data sources used in this study are digital databases generated by state government programs: (1) the well completion report database created by the Water Rights Program, South Dakota Department of Environment and Natural Resources, (2) the lithologic logs database created by the South Dakota Geological Survey Program, and (3) the oil and gas database created by the Minerals and Mining Program, South Dakota Department of Environment and Natural Resources (see REFERENCES). The locations of wells and drill holes are typically recorded based on legal location, thus the plotted latitude and longitude of these points is only approximate. The ground-surface elevation was also determined in ArcGIS from 30 m DEMs.

Existing structural contour maps, such as those produced by Gries (1981) and by the U.S.G.S. as part of the Black Hills Hydrology study, were used as guides and modified according to available well log data. Few modifications were made to the U.S.G.S. structure contour maps near the outcrop, unless justified by additional well control data. In areas where no wells penetrated the formation, the altitude of the top of the formation was estimated based on the structural contours and well logs of shallower units; these areas are less accurate than areas nearer the outcrop and are dashed as distance from known data points increases.

The contour interval on the 1:180,000-scale maps is 100 feet in proximity to the outcrop and where data points are dense enough to warrant such an interval. At distance from the outcrop, the contour interval is increased to 250 feet. A few data in the drill-hole database are excluded from the map because they are interpreted to yield improbable elevations. In all cases where drill-hole data were not used for contouring, the data are still within the drill-hole database, and thus, can be considered in alternative interpretations by users of the map. Both the database and the contour lines are available digitally.

The decision of which data in the drill-hole database are reliable is based on all available geologic information, but ultimately it was subjective and at the discretion of the author. In general, the accuracy of the lithologic log may be questionable and/or the location could be inaccurate. Only wells that were believed to be accurate are displayed on the maps.

FUNDING & DISTRIBUTION

This project was prepared for the Belle Fourche River Watershed Partnership with funding from the South Dakota Conservation Commission, Butte County Conservation District, Butte County Commissioners, Meade County Commissioners, and the City of Spearfish.

The map products and associated GIS data for this project are available for public use with unlimited distribution.

Map Citations

Inyan Kara Group

Hocking, C.M., 2013. Depth to Top of the Inyan Kara Group: Butte, Meade, and Lawrence Counties, South Dakota, prepared by RESPEC, Rapid City, SD, for Belle Fourche River Watershed Partnership, Belle Fourche, SD.

Hocking, C.M., 2013. *Elevation Contour Map of the Inyan Kara Group: Butte, Meade, and Lawrence Counties, South Dakota*, prepared by RESPEC, Rapid City, SD, for Belle Fourche River Watershed Partnership, Belle Fourche, SD.

Minnelusa Formation

Hocking, C.M., 2013. Depth to Top of the Minnelusa Formation: Butte, Meade, and Lawrence Counties, South Dakota, prepared by RESPEC, Rapid City, SD, for Belle Fourche River Watershed Partnership, Belle Fourche, SD.

Hocking, C.M., 2013. Elevation Contour Map of the Minnelusa Formation: Butte, Meade, and Lawrence Counties, South Dakota, prepared by RESPEC, Rapid City, SD, for Belle Fourche River Watershed Partnership, Belle Fourche, SD.

Madison Limestone

Hocking, C.M., 2013. Depth to Top of the Madison Limestone: Butte, Meade, and Lawrence Counties, South Dakota, prepared by RESPEC, Rapid City, SD, for Belle Fourche River Watershed Partnership, Belle Fourche, SD.

Hocking, C.M., 2013. Elevation Contour Map of the Madison Limestone: Butte, Meade, and Lawrence Counties, South Dakota, prepared by RESPEC, Rapid City, SD, for Belle Fourche River Watershed Partnership, Belle Fourche, SD.

Deadwood Formation

Hocking, C.M., 2013. Depth to Top of the Deadwood Formation: Butte, Meade, and Lawrence Counties, South Dakota, prepared by RESPEC, Rapid City, SD, for Belle Fourche River Watershed Partnership, Belle Fourche, SD.

Hocking, C.M., 2013. Elevation Contour Map of the Deadwood Formation: Butte, Meade, and Lawrence Counties, South Dakota, prepared by RESPEC, Rapid City, SD, for Belle Fourche River Watershed Partnership, Belle Fourche, SD.

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——1999b. Altitude of the top of the Minnelusa Formation in the Black Hills area, South Dakota: U.S. Geological Survey Hydrologic Investigations Atlas HA-744-C, 2 sheets, scale 1:100,000.

———1999d. Altitude of the top of the Deadwood Formation in the Black Hills area, South Dakota: U.S. Geological Survey Hydrologic Investigations Atlas HA-744-E, 2 sheets, scale 1:100,000.

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