Montana Ground-Water Assessment Atlas No. 2, Part B, Map 11
December 2004

Montana Bureau of Mines and Geology
A Department of Montana Tech of The University of Montana

Thickness of Shallow Alluvium, Flathead Lake Area,
Flathead, Lake, Missoula, and Sanders Counties,
Montana

by
Larry N. Smith

Note - this map was originally published at a scale of 1:100,000 but the page sizes have been modified to fit the size of the paper in your printer. A full sized 36” X 48” colored print of this map can be ordered from the Office of Publications and Sales of the Montana Bureau of Mines and Geology, 1300 West Park Street, Butte, MT 59701.
Phone: 406-496-4167    Web Address: www.mbmgs.mtech.edu
Explanation

- Location of well with >5 ft of shallow alluvium

Thickness of shallow alluvium (ft), dashed where approximate, hachures denote closed areas where unit is thin

0 - 50’
>50’ - 100’
>100 - 150’
>150’ - 200’
>200’

Nitrate concentrations - mg/L as N
- 0-1.5
- 1.5-3
- >3-10
- >10

Nitrate research site

Major roads

Principal streams and water bodies

Township boundaries

Section boundaries

Cross-section location

Belt Supergroup bedrock at land surface

Map Areas

Ground-Water Characterization
Program Study Areas

Scale 1:100,000
Universal Transverse Mercator Projection
Zone 11
Horizontal Datum: NAD 27
Vertical Datum: Land Surface

N

R 22 W  R 21 W  R 20 W  R 19 W

December 2004
Figure 1. Thickness of shallow alluvium in the Kalispell valley.
Thickness of Shallow Alluvium, Flathead Lake Area, Flathead Lake, Missoula, and Sanders Counties, Montana

by

Larry N. Smith

Introduction

This map shows the generalized thickness of sand and gravel (including minor amounts of silt and clay and wind-blow sand) that are present near land surface in the Flathead Lake area. These surficial deposits are called the “shallow alluvium.” The extent of shallow alluvium in the Kalispell and part of the Swan River valleys is shown in figure 1; the extent of these deposits in the Mission and Jocoto valleys is shown in figure 2.

The shallow alluvium occurs within stream valleys, on alluvial fans, in stabilized wind-blown (colluvial) dune fields, in previous beach and deltaic positions of Flathead Lake, or in areas of glacial outwash (sand and gravel deposits of streams in front of former glaciers). The shallow alluvium overlies older deposits and bedrock, including Precambrian Belt Supergroup (bedrock) and Tertiary sedimentary rocks in the mountains, and glacial and post-glacial unconsolidated sediments in the mountains, foothills, and valleys (fig. 3; Johns, 1970; Harrison and others, 1986, 1992; Ostenaa and others, 1990; Smith, 2002b; Smith and others, 2000). Interpretation of drillers logs of water wells and examination of surface exposures in the field show that the shallow alluvium is widespread, but can be correlated with confidence in the subsurface only where thicknesses reported on the logs are greater than 5 ft.

VARIATION IN THICKNESSES

Thickness variations in the shallow alluvium were caused by erosion of underlying units before its deposition, by intertonguing between the shallow alluvium and finer-grained glaciolacustrine sediments, and by irregularities in the land surface. Thicknesses are generally less than 50 ft and decrease laterally toward the edges of the shallow alluvium, which are defined by the mapped geologic boundaries of various sand and gravel bodies (Ostenaa and others, 1990; Smith, 2002b; Smith, unpub. mapping). Although thicknesses generally increase near some major streams in the area, notably the Whitefish, Flathead, and Swan Rivers, due to backfilling of river scours with sand and gravel, the thick accumulations of shallow alluvium are apparently related to other processes.

Thicknesses of shallow alluvium are greatest in the southern part of the Kalispell valley, at the Lost Creek fan area, in the northwestern Swan River valley, and just southeast of Polson. In the southwestern portion of the Kalispell valley (fig. 1; T. 27–28 N., R. 21 W.) the shallow alluvium reaches thicknesses greater than 100 ft in two elongate areas that may represent paleo-channels along a prior course of the Flathead River. The greatest thicknesses of alluvium are in the south-central Kalispell valley (centered on sec. 31, T. 28 N., R. 20 W.) where a sub-circular accumulation of sand and gravel exceeds 200 ft in thickness. This deposit, like similar-sized accumulations on the Lost Creek fan (T. 29 N., R. 22 W.), in the Columbia Falls area (centered on secs. 2, 3, 16, and 11; T. 30 N., R. 20 W.), and south of Lake Blaine (centered on sec. 35, T. 29 N., R. 20 W.) may be related to...

Data Sources

Water well drillers logs were obtained from the Montana Bureau of Mines and Geology. Ground surface topographic data were obtained from Survey DEMs for western Montana, hydrography, and roads were obtained from the Montana Information System. Helena (http://gis.digitalmt.gov). Other information, including geology, was obtained from the U S Geological Survey.

Acknowledgements

This work was supported by the Montana Bureau of Mines and Geology. Costarphan, Limited helped in the interpretation, and improvements were made due to review by Voast and Edmond Deal.

References

[Note: The references list is not transcribed, but it is implied that the text refers to these sources for more detailed information.]
occur in an area where the deep alluvium is 0-200 ft (Smith, 2002a), suggesting that the shallow alluvium to the deep alluvium.

Alluvium were derived from about 9,700 drillers that penetrated the shallow alluvium, about 4,200 greater than 5 ft. Only wells with locations in section or smaller were used. Most well logs. However, some locations were refined by log descriptions of the well owners and about 11% were confirmed by field work. The unit for each point was converted by subtracting the depth from land-surface at each well location were obtained from U.S. I models (DEMs) using ArcInfo™ computer software. At the determined in the field from elevations showed that the values were precise and field-determined values were closer. The altitudes were contoured by hand, and contours supported the contour location. Alluvium was calculated by subtracting the from the land surface altitude using the thickness grid was smoothed and contoured. A new grid was then drawn by hand and edited.

All locations are stored in the GWIC database of the Montana Geology (http://www.mttech.edu). Data are from the 1:24,000-scale U.S. Geological Survey. Public Land Survey System data, obtained from Montana's Natural Resources Division (nrisc.state.mt.us/).

The Ground-Water Characterization Program and Geology, Don Mason and Cami Patton, John LaFaye, Wayne Van
**NITRATE**

Where shallow alluvium is thick enough below the water table, it is a source of ground-water. Because the aquifers are unconfined, near-surface, and unprotectected from surface sources of pollutants, water quality in these unconfined aquifers can be compromised. Nitrate concentrations in milligrams per liter as nitrogen (mg/L-N) are often used to illustrate contamination of aquifers by domestic sewage and agricultural sources. Nitrate contamination of ground water in the shallow alluvium has been shown in the Flathead River valley north of Flathead Lake (Evergreen aquifer) (Noble and Stanford, 1986) and has been highlighted as a concern in the Mission and Jocko valleys (Makepeace and Mladenich, 1995). High nitrate concentrations are well documented at two sites northeast of Kalispell where 35 wells were sampled in the mid-1980's (fig. 1).

Although recent Ground-Water Characterization Program work for the Flathead Lake area emphasized water quality in the deeper aquifers (LaFave, 2002a, b), data from 127 wells sampled for nitrate in the Ground-Water Information Center (GWIC) database for the shallow alluvium. These nitrate data were collected between 1975 and 2000 and are shown on the maps (figs. 1, 2). Of the 127 wells sampled, 3 had at least one sample that exceeded the health standard of 10 mg/L-N; 11 wells had samples that were between 3.0 and 10 mg/L-N, a level that suggests possible contamination by surface sources (Madin and Brunett, 1984). Most wells (80%) showed either non-detectable concentrations or concentrations less than 1.5 mg/L-N (figs. 1, 2). Although the available analyses show local nitrate contamination of the shallow alluvium, the geographical coverage and dates of sampling are not sufficient to discern if there is a regional contamination problem.

**MAP USE**

These maps may be used to evaluate locations where shallow aquifers may exist and to help determine the location of sand and gravel resources near the land surface. Productive water wells occur mostly along stream valleys where the shallow alluvium is continually saturated with water. Most wells completed in the shallow alluvium are along the Flathead River between Columbia Falls and Flathead Lake (fig. 1). Many wells were also completed in areas of shallow alluvium that extend beyond Columbia Falls and Flathead Lake (fig. 2). Aquifers in the shallow alluvium are locally important where alluvium or outwash was deposited on till in isolated areas (e.g., south half T. 31 N. R. 21 W.). In these areas, outwash was deposited by glacier-margin streams (Smith, 2002b).

Further mapping of these features may help to locate productive wells. In areas where the shallow alluvium is greater than 100 ft thick, unconfined aquifers are more likely to be hydraulically connected to deeper aquifers. The presence of thick shallow alluvium over the deep aquifer may delineate areas where the deeper aquifer is more susceptible to contamination from near-surface sources. For example, in the Lost Creek fan area, greater thicknesses

**REFERENCES**


Wright, K. T., 1972, Stratigraphic structure maps of the Kalispell (Flathead Valley) area, Montana, Geological Survey Miscellaneous Investigations Series Map I-221.


Smith, L. N., 2002a, Depth to the uppermost glacial ground water of the Kalispell watershed, Flathead County: Montana Bureau of Mines and Geology, Open-File Report 02-081, 30 p., scale 1:25,000.

Smith, L. N., 2002b, Surficial geology and ground water resources of the Kalispell valley (Kalispell valley) area, Flathead County, Montana: Montana Bureau of Mines and Geology, Bulletin 182, 207 p., scale 1:100,000.

Smith, L. N., 2002c, Surficial geology and ground water resources of the Kalispell valley (Kalispell valley) area, Flathead County, Montana: Montana Bureau of Mines and Geology, Open-File Report 01-32, 56 p., scale 1:25,000.

Smith, L. N., 2002d, Surficial geology and ground water resources of the Kalispell valley (Kalispell valley) area, Flathead County, Montana: Montana Bureau of Mines and Geology, Open-File Report 01-33, 56 p., scale 1:25,000.
Figure 2. Thickness of shallow alluvium in the southern part of the Flathead Lake area.