



Data for Water Wells Visited during the
Park-Sweet Grass Ground Water Characterization Study

Megan N. Heath, Camela A. Carstarphen, Donald C. Mason, John I. LaFave, Michael G. Richter,
James P. Madison, Sara C. Edinberg, and Daniel D. Blythe

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Author's Note: This map is part of the Montana Bureau of Mines and Geology (MBMG) Ground Water Assessment Atlas for the Park-Sweet Grass Area groundwater characterization. It is intended to stand alone and describe a single hydrogeologic aspect of the study area, although many of the area's hydrogeologic features are interrelated. For an integrated view of the hydrogeology of the Park-Sweet Grass Area, the reader is referred to the other maps of Montana Ground Water Assessment Atlas 9. (<https://mbmg.mtech.edu>).

INTRODUCTION

The Montana Bureau of Mines and Geology (MBMG) Ground Water Characterization Program staff visited 526 groundwater and surface-water sites, including 470 water wells, 47 springs, and 9 streams between 2012 and 2018 as part of the Park-Sweet Grass Ground Water Characterization Study (fig. 1). The sites were chosen from 8,500 recorded wells in Park and Sweet Grass Counties, excluding Yellowstone National Park. Visited sites were selected to obtain representative data from all aquifers. Monthly groundwater levels were measured from a subset of 73 wells between 2012 and 2018 to understand seasonal groundwater fluctuations; 25 of those wells are part of the statewide monitoring network (GWAAMON), which continue to be monitored.

GEOLOGIC UNITS

Geologic units for each well and spring were assigned by comparing the completion interval and lithologic information from the well log to geologic maps (Berg and others, 1999, 2000; Kellogg and Williams, 2006; Lopez, 2000, 2001; McDonald and others, 2005; Wilde and Porter, 2001). The geology of the study area varies between the bedrock and basin-fill of the upper Yellowstone Valley (Paradise Valley) and the bedrock dominated plateaus and mountain ranges of the Shields and Middle Yellowstone River Valleys (table 1). Of the 526 inventoried wells, 351 (67%) are completed in the bedrock units with ages ranging from Tertiary to Proterozoic.

SELECTED REFERENCES

- Berg, R.B., Lonn, J.D., and Locke, W.W., 1999, Geologic map of the Gardiner 30' x 60' quadrangle, south-central Montana: Montana Bureau of Mines and Geology Open-File Report 387, 11 p., 1 sheet, scale 1:100,000.
- Berg, R.B., Lopez, D.A., and Lonn, J.D., 2000, Geologic map of the Livingston 30' x 60' quadrangle, south-central Montana: Montana Bureau of Mines and Geology Open-File Report 406, 21 p., 1 sheet, scale 1:100,000.
- Kellogg, K.S., and Williams, V.S., 2006, Geologic map of the Ennis 30' x 60' quadrangle, Madison and Gallatin counties, Montana, and Park County, Wyoming: Montana Bureau of Mines and Geology Open-File Report 529, 27 p., 1 sheet, scale 1:100,000.
- Lopez, D.A., 2000, Geologic map of the Big Timber 30' x 60' quadrangle, south-central Montana: Montana Bureau of Mines and Geology Open-File Report 405, 17 p., 1 sheet, scale 1:100,000.

SITE VISITS

Visited sites were selected to provide baseline data for alluvial and bedrock aquifers. Coordinates for each visited site were determined using a hand held global positioning system receiver and USGS 1:24,000 topographic maps. Where possible, data collected included the static-water level, temperature, pH, and specific conductance of the water. The water-quality parameters represent stabilized readings attained after an average 30-min pumping duration. Samples (147) were collected from selected wells, springs, and streams after field parameters stabilized and/or three well volumes of water were discharged. Samples were analyzed at the MBMG Analytical Lab and include major ions, trace metals, and nitrate. Some wells could not either be pumped to measure field parameters or accessed to measure water levels. Field data for the inventoried sites and sampling status are included in the appendix; complete analytical results (major ions, trace metals, and nitrate) are available from the Ground Water Information Center (GWIC) database (<https://mbmg.mtech.edu>).

DATA SOURCES

All data and water-quality analysis results are available from the GWIC database (<https://mbmg.mtech.edu>). Land ownership, hydrography, public land survey, and road data were obtained from the Natural Resource Information System, Helena (<https://nris.mt.gov>).

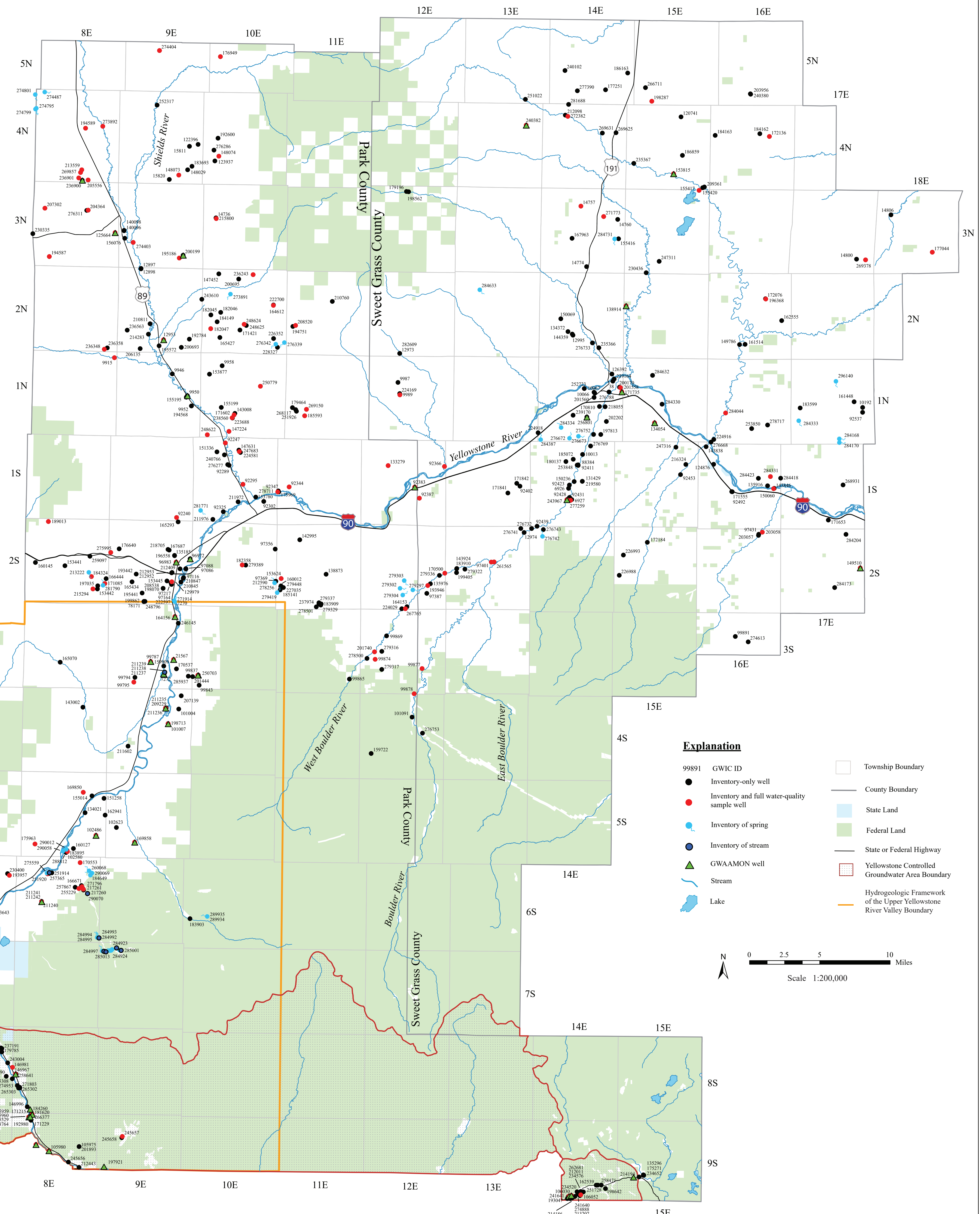
ACKNOWLEDGMENTS

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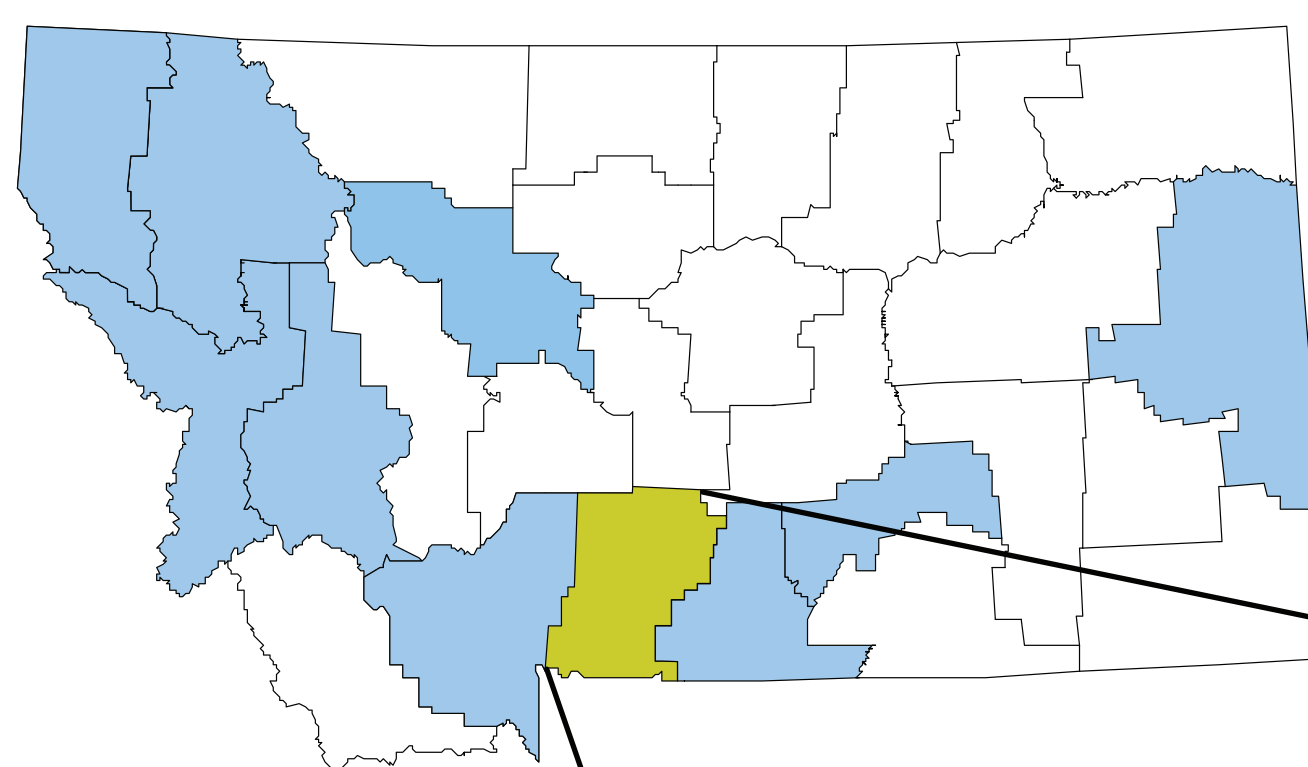
- Lopez, D.A., 2001, Preliminary geologic map of the Red Lodge 30' x 60' quadrangle, south-central Montana: Montana Bureau of Mines and Geology Open-File Report 423, 17 p., 1 sheet, scale 1:100,000.
- McDonald, C., Lopez, D.A., Berg, R.B., and Gibson, R.J., 2005, Preliminary geologic map of the Ringling 30' x 60' quadrangle, central Montana: Montana Bureau of Mines and Geology Open-File Report 511, 27 p., 1 sheet, scale 1:100,000.
- Wilde, E.M., and Porter, K.W., 2001, Geologic map of the Harlowton 30' x 60' quadrangle, central Montana: Montana Bureau of Mines and Geology Open-File Report 434, 20 p., 2 sheets, scale 1:100,000.

Table 1. The 526 visited wells, springs, and streams are completed in 33 geologic units. The geologic units were consolidated into 9 hydrogeologic codes, used to represent aquifers in the study area.

Basin-Fill	Era	Period/Age	Geologic Code	Hydro-geologic Code	No. of Sites Visited	No. of Sampled Sites	Aquifer Description
Basin-Fill	Quaternary	1.8 Ma	H0ALVM H1ALVM H2ALVM	Qal	123	27	Quaternary alluvial deposits consisting of clay, silt, sand and gravel; unconfined to semi-confined.
			H2DRFT H2OTSH H2SDMS	Og/Ogo	43	15	Quaternary (Pleistocene) glacial outwash, drift, and till (silt, clay, sand, gravel, and cobbles deposited by, or near to, glaciers); unconfined to semi-confined.
			H20PLNC H24ABS	TKig/Tav	24	11	Tertiary Absaroka volcanic and plutonic rocks consisting of dacitic or andesitic flows, dikes, sills, porphyries, and breccias. Cretaceous volcanic rocks located in the Paradise Valley, known as the Slidecock Volcanics (211VLCC), are included in the hydrogeologic code TKig. Fractured rock aquifer.
Bedrock	Cretaceous	63 Ma	H1LVVGS H11BMBK H11VCCC H110CKL H110BRPW	Khc and Kb	106	23	Cretaceous Livingston Group and Time equivalent sedimentary deposits; Hell Creek and Bear Paw Shale. Consists of alternating sandstone, siltstone, mudstone, claystone, and shale. Cretaceous Slidecock volcanics (211VLCC) consist mostly of andesite breccias. The Slidecock Volcanics are included in the hydrogeologic code TKig (above).
			H21EGL H21JREL	Kjrel	25	5	Cretaceous sandstones of the Judith River and Eagle Formations.
			H21TPCK H21CUDV H21FRNR H21MWRV	Kseds	24	6	Un differentiated Cretaceous sedimentary rocks: Telegraph Creek, Cody Shale, Frontier Formation, and the Mowry Shale. Consists of alternating sandstone, siltstone, mudstone, claystone, and shale.
Bedrock	Paleozoic	144.36 291.9 Ma	H30AMS H30MSN H30BGN H31PLGM	J-P Seds	13	9	Paleozoic lithology consists of sandstone, mudstone, interbedded shales, and limestone. Includes Arnsden Formation (Pennsylvanian and Mississippian); Madison Limestone (Mississippian); Big Horn Formations (Devonian/Ordovician); and Pilgrim Formations (Cambrian).
			H40NSC	Mm	22	4	Precambrian metamorphic rock that forms an aquifer where sufficiently fractured. Lithology consists of mylonite, granite-gneiss, biotite-schist, amphibolite, quartzite, and marble.
Bedrock	Precambrian	4.6 Ga	H50GNSC	pClb	22	4	Precambrian metamorphic rock that forms an aquifer where sufficiently fractured. Lithology consists of mylonite, granite-gneiss, biotite-schist, amphibolite, quartzite, and marble.
			Totals		517	141	



Ground Water Characterization Study Areas



- Park and Sweet Grass Counties are the 9th Ground-Water Characterization Study Area (GWCP09)
- Data and/or maps available



- Yellowstone Controlled Groundwater Area Boundary
- Hydrogeologic Framework of the Upper Yellowstone River Valley Boundary

Explanation

- GWIC ID
- Inventory-only well
- Inventory and full water-quality sample well
- Inventory of spring
- Inventory of stream
- GWAAMON well
- Stream
- Lake
- Township Boundary
- County Boundary
- State Land
- Federal Land
- State or Federal Highway
- Yellowstone Controlled Groundwater Area Boundary
- Hydrogeologic Framework of the Upper Yellowstone River Valley Boundary

Scale 1:200,000

Figure 1. Sites visited in Park and Sweet Grass Counties with Ground Water Information Center (GWIC) identification numbers. Most sites visited are wells, but visits also include 47 springs. Data obtained from inventories include static water levels and field chemistry parameters. Full water-quality samples collected from 147 sites were analyzed for major ions, trace metals, and nitrate. Site information, field data, and full water-quality analyses can be obtained from the GWIC database using GWIC Project Code GWCP09 (<https://mbmg.mtech.edu>). Site information is also available in appendix A.