Metadata for Montana Ground Water Information Center (GWIC): Groundwater data

The descriptions of fields and the discussion of spatial coordinates apply to the downloadable zip files described below, and their equivalent reports viewable directly on the GWIC website. Other reports, available on the website but not specifically described, consist of subsets and recombinations of the fields included here and these descriptions apply to those reports also. For example, the definition of the GEOMETHOD field applies to any GWIC product containing that field, and is not specific to the reports described below.

Table of Contents:

Identification Information:

Originator: Montana Bureau of Mines and Geology (MBMG)

Publication Date: Date of download

Title: Montana Ground Water Information Center (GWIC): Groundwater data

Description:

Abstract: These reports contain point locations and selected attributes for many water wells– and some boreholes, springs, and petroleum exploration wells located within Montana. The data in the reports are retrieved from databases maintained at the Ground Water Information Center (GWIC) at the Montana Bureau of Mines and Geology. Original data sources include water rights filings and water well logs, and visits to water wells, publications of the Montana Bureau of Mines and Geology, publications of the U.S. Geological Survey, and others. Additional data for ground-water resources in Montana can be obtained from the GWIC website at http://mbmggwic.mtech.edu.

Purpose: Data from GWIC are useful for describing the ground-water resources of Montana, land use planning, determination of drilling depths, and understanding ground-water flow. The data should be considered **"unpublished"** and the user should recognize that additional work on their part may be necessary, especially to confirm locations and coordinates, to improve the utility of the information.

Time Period of Content:

Beginning Date: 1860
Ending Date: Date of download
Currentness Reference: Date of download
Maintenance and Update Frequency: The GWIC database is active and thousands of data corrections and as many as 10,000 new well logs are added to the system annually. Users of the data are encouraged to note errors and forward corrections to GWIC.
Use Constraints: These data currently provide information on the distribution of wells and descriptions of ground-water resources in general, rather than the locations of specific wells. Most of the well coordinates (latitudes and longitudes) are derived from 1:250,000 scale maps and individual well identities should not be shown at larger map scales.

Data Quality Information:

Attribute Accuracy Report: New well log data are entered into the database from original documents and verified one time during the data entry process. Historic data are verified against historic documents on a county by county basis. Due to work loads, well records for all Montana counties have not yet been verified against the original documents. To view the current status of verification, go to the 'Help' section of the GWIC website at http://mbmggwic.mtech.edu/.
Completeness Report: Well locations in GWIC do not represent the locations of all water wells in Montana. The total number of water wells constructed in the state is unknown.
Horizontal Positional Accuracy Report: Locations in the GWIC database are considered either "verified" or "unverified" based on whether or not a site-visit record is present. The reported GEOMETHOD and the existence of a site-visit record determine the accuracy and reliability of the coordinates. Geographic coordinates are derived from GWIC reported locations using a variety of GEOMETHODS. The table below illustrates commonly used GEOMETHODS and the relative reliability of locations in the database. **Significant errors in location are possible with unverified data.**

			GEOMETHOD					
Location verified ?	**Horizontal error**	**Field visit**	**TRS TWN**	**TRS SEC**	**NAV GPS**	**SUR GPS**	**MAP**	**Restrictions / Comments**
No	Substantial errors in location are possible from driller/landowner. Conversion will generally fall within last tract described.	No	Yes					Township corners digitized at 1:250,000. Plot at 1:250,000 or smaller scale. Most common method of coordinate creation

			GEOMETHOD					
Location verified ?	**Horizontal error**	**Field visit**	**TRS TWN**	**TRS SEC**	**NAV GPS**	**SUR GPS**	**MAP**	**Restrictions / Comments**
								in GWIC.
No	Substantial errors in location are possible from driller/landowner. Conversion will generally fall within last tract described.	No		Yes				Section corners digitized at 1:24,000 Can be plotted at 1:24,000 for most sections. Available in Flathead, Lake, Sanders, Missoula, Ravalli, Treasure, and Yellowstone counties.
No	< 25 feet after May 1, 2000. (selective availability disabled).	No			Yes			Can be plotted at 1:24,000. Location considered unverified but coordinates may be substantially more accurate than those of other unverified locations.
No	< 10 feet.	No				Yes		Some consultant-drilled monitoring wells and coalbed methane wells claim SUR-GPS GEOMETHODS.
No	Substantial errors possible in location from driller/landowner. Conversion will generally fall within last tract described.	No					Yes	Substantial errors possible based on mis-location by driller/landowner location.
Yes	Dependent on township/range of location. Will generally fall within smallest described tract.	Yes	Yes					Plot at 1:250,000 or smaller scale
Yes	Dependent on section of location. Will generally fall within smallest described tract.	Yes		Yes				Plot at 1:24,000 or smaller scale
Yes	< 25 feet after May 1, 2000. (selective	Yes			Yes			Plot at 1:24,000 or smaller scale.

			GEOMETHOD					
Location verified ?	**Horizontal error**	**Field visit**	**TRS TWN**	**TRS SEC**	**NAV GPS**	**SUR GPS**	**MAP**	**Restrictions / Comments**
	availability disabled)							
Yes	< 10 feet.	Yes				Yes		Plot at 1:24,000 or smaller scale.
Yes	Generally within 100 ft of true location. Should plot within last described tract.	Yes					Yes	Plot at 1:24,000 or smaller scale.

The meanings of commonly used **GEOMETHOD** codes are as follows:

TRS-TWN: generated from township, range, section, and tract using township corners digitized by the U.S. Geological Survey in the 1970s from 1:250,000 scale maps. Section corners inside the township are interpolated assuming a regular, square township. Irregular townships or irregular sections within townships introduce error into the conversion.
TRS-SEC: generated from township, range, section, and tract using section corners digitized from 1:24,000 maps. The TRS-SEC conversion is more accurate because section corners are digitized and not interpolated, but irregular sections can still cause errors. Counties where TRS-SEC conversions are available are Flathead, Lake, Mineral, Missoula, Ravalli, Treasure, and Yellowstone.
NAV-GPS: uncorrected Global Positioning System locations. Accuracy depends on whether selective availability was operating at the time of the measurement, and on the number of satellites available at the time of the reading. Selective availability was turned off on May 1, 2000.
SUR-GPS: differentially corrected Global Positioning System coordinates.
MAP: digitized from 1:24,000 U.S. Geological Survey Topographic maps or the Natural Resources Information System's Topofinder application.

The coordinates for the majority of the wells in GWIC are obtained from unverified locations using the TRS-TWN or TRS-SEC methods. However, in both cases the greatest source of locational error is the original landowner/water well driller's variable ability to correctly report the township, range, section, and tract description.

Lineage:

Source Information: Original paper documents.
Originator: Ground-Water Assessment Program at the Montana Bureau of Mines and Geology

Publication Date: Date of download
Title: Montana Ground Water Information Center (GWIC): Groundwater data

Publication Information:

Publication Place: 1300 West Park Street Butte, Montana.
http://mbmggwic.mtech.edu.
Publisher: Montana Bureau of Mines and Geology
Source Scale Denominator: Varies
Type of Source Media: Paper well log and well appropriation records
Source Time Period of Content: 1860 to date of download
Source Contribution: The database was generated from this source.

Process Step–Data acquisition:

Process Description: Water well log data are entered into the GWIC database from original paper documents and verified to match original data during the data entry process. Some well records may be created from visits to wells discovered during field work by various projects at the Montana Bureau of Mines and Geology. For well records created from site visits, there will be no paper well log at the Montana Bureau of Mines and Geology and the database will only contain information discovered during the field visit. The database is corrected when errors are discovered through use of data or by outside data users.

Process Step–Coordinate assignment:

Process Description: Coordinates are assigned to GWIC records using a variety of methods as described by the GEOMETHOD flag in the data retrieval. See the description of common GEOMETHOD flags used in GWIC in the Horizontal Positional Accuracy Report section of this document. TRS-TWN and TRS-SEC based coordinates are calculated automatically at the time a record is first filed or the location is modified. MAP, NAV-GPS, and SUR-GPS coordinates are posted to the database and remain unchanged until an error may be discovered. At that time corrected coordinates for the point are entered into the database and the township, range, section and tract modified to match the digitized or GPS coordinates. The system will only automatically generate coordinates if the GEOMTHOD is TRS-TWN, TRS-SEC, UNKNOWN, or is blank.

Spatial Data Organization Information:

Direct Spatial Reference Method: Point
Number of Points: Dependent on date of download and geographic area.
Spatial Reference Information: Downloads with coordinates are in geographic projection. To be posted to maps the coordinates must be imported to mapping software and correctly projected to match base layers selected by the user.

Entity and Attribute Information:

Wells file (downloadable zip file or "Wells Downloadable" report from website).

Field Name	Description
gwic_id	Key field for GWIC database.
dnrc_no	Department of Natural Resources and Conservation water right number.
site_name	Most current known owner of the site.
latitude	Latitude of site in decimal degrees.
longitude	Longitude of site in decimal degrees.
geomethod	Method used to determine the latitude and longitude.
datum	Geodetic datum of the latitude and longitude.
township	Montana township of the site.
range	Montana range of the site.
section	Section where the site is located.
tract	Quarter sections from largest to smallest that describe the location of the site. (A=Northeast, B=Northwest, C=Southwest, D=Southeast). See http://mbmggwic.mtech.edu/sqlserver/v11/help/reports/ABCDGraphic.asp for a description of tract usage in GWIC.
location_verified?	Yes indicates the presence of a site visit record in GWIC.
type	Type of site. The well report is limited to site types: well, borehole, spring, and coal bed methane well.
aquifer	GWIC aquifer code for geologic source of water. See http://mbmggwic.mtech.edu/sqlserver/v11/help/reports/listAquifer.asp for listing. May have more than one value per record.
total_depth	Reported depth of the well/borehole in feet below ground surface.
static_water_level	Reported distance in feet below ground surface the water is found when the well is not pumping.
pumping_water_level	Reported distance in feet below ground surface the water is found during pumping. Usually reported in conjunction with the time since pumping started (test_hours field).
yield	Reported yield of the well in gallons per minute (gpm).
test_type	Reported method by which the yield was determined.
test_hours	Reported length of the performance test in hours.
drillstem_setting	Reported distance below ground surface (in feet) the drill stem was placed during an AIRLIFT production test.
recovery_water_level	Reported distance below ground surface (in feet) of the water level at the time specified in the recovery_time field after a production test has been completed.
recovery_time	Reported length of time in hours after production stopped that the recovery_water_level was measured.

Field Name	Description
who_drilled	Name of the well driller, contractor, or company.
comp_date	Date the well/borehole was completed.
use	Reported purpose for water from the well as listed on the log. May have more than one value per record.
status	Current known status of the site. Can be abandoned, deepened, destroyed, etc.
perf_from	Top of perforated or well-completion interval. May have more than one value per record.
perf_to	Bottom of perforated or well-completion interval. May have more than one value per record.
perf_dia	Diameter in inches of perforated or well-completion interval. May have more than one value per record.
perf_desc	Description of perforated or well-completion interval. May have more than one value per record.

Lithology file (downloadable zip file or "Lithology" report from website).

Field Name	Description
gwic_id	Key field for GWIC database.
site_name	Most current known owner of the site.
township	Montana township of the site.
range	Montana range of the site.
section	Section where the site is located.
tract	Quarter sections from largest to smallest that describe the location of the site. (A=Northeast, B=Northwest, C=Southwest, D=Southeast). See http://mbmggwic.mtech.edu/sqlserver/v11/help/reports/ABCDGraphic.asp for a description of tract usage in GWIC.
location_verified?	Yes indicates the presence of a site visit record in GWIC.
aquifer	GWIC aquifer code for geologic source of water. See http://mbmggwic.mtech.edu/sqlserver/v11/help/reports/listAquifer.asp for listing. May have more than one value per record.
total_depth	Reported depth of the well/borehole in feet below ground surface.
static_water_level	Reported distance in feet below ground surface the water is found when the well is not pumping.
depth_water_enters	Reported depth to top of shallowest completion zone.
who_drilled	Name of the well driller, contractor, or company.

Field Name	Description
comp_date	Date the well/borehole was completed.
lithology_from	Beginning/top of described interval (feet below ground surface).
lithology_to	End/bottom of described interval (feet below ground surface).
description	Driller's description of the materials found in the described interval.

Field visit file (downloadable zip file or "Field Visit" report from website). Note: there may be more than one field visit record per GWIC Id and the field visits may represent visits by more than one project.

Field Name	Description
gwic_id	Key field for GWIC database.
site_name	Most current known owner of the site.
latitude	Latitude of site in decimal degrees.
longitude	Longitude of site in decimal degrees.
geomethod	Method used to determine the latitude and longitude.
datum	Geodetic datum of the latitude and longitude.
township	Montana township of the site.
range	Montana range of the site.
section	Section where the site is located.
tract	Quarter sections from largest to smallest that describe the location of the site. (A=Northeast, B=Northwest, C=Southwest, D=Southeast). See http://mbmggwic.mtech.edu/sqlserver/v11/help/reports/ABCDGraphic.asp for a description of tract usage in GWIC.
location_verified?	"Yes" indicates the presence of a site visit record in GWIC.
type	Type of site.
aquifer	GWIC aquifer code for geologic source of water. See http://mbmggwic.mtech.edu/sqlserver/v11/help/reports/listAquifer.asp for listing. May have more than one value per record.
altitude	Altitude of site in feet above mean sea level.
total_depth	Reported depth of the well/borehole in feet below ground surface.
date	Date the site was visited.
investigator	The person who conducted the field visit.

Field Name	Description
agency	Agency where the investigator works.
inventory_total_depth	Measured depth of well in feet below ground surface at the time of the visit.
td_how_measured	Method used to measure the total depth.
swl_mp	The measured distance in feet below the measuring point the water was in the well at the time of the visit.
inventory_pwl	The measured pumping water level at the time listed in the test_hours field.
inventory_yield	The measured yield in gallons per minute (gpm) during the visit.
yield_how_measured	The method of measurement for the yield.
test_hours	The length of pumping in hours at the time of the pumping water level measurement.
water_condition	A brief description of water condition at the time of the visit.
well_condition	A brief description of the well condition at the time of visit. Usually GOOD, FAIR, or POOR.
inventory_project	The GWIC project code assigned to this visit.
before_treatment	Can the well be sampled before the water is treated?
inventory_water_temperature	Measured temperature of the water (degrees C) at the time of the visit.
field_sc	Measured specific conductance of the water (micromhos) at the time of the visit.
field_ph	Measured pH of the water at the time of the visit
alkalinity	The alkalinity (mg/L as CaCo3) of the water at the time of the visit.
redox	The reduction/oxidation potential of the water at the time of the visit.
nitrate	The nitrate (mg/L) concentration in the water at the time of the visit. Usually measured by test strip method. Order of magnitude accuracy.
chloride	The chloride concentration (mg/L) in the water measured at the time of the visit.

Water quality file (downloadable zip file or "Water-Quality" report from website). Note: there may be more than one water-quality analysis per GWIC Id.

Field Name	Description
sample_id	Unique sample identifier
gwic_id	Key field for GWIC database.
site_name	Most current known owner of the site.
latitude	Latitude of site in decimal degrees.

Field Name	Description
longitude	Longitude of site in decimal degrees.
geomethod	Method used to determine the latitude and longitude.
datum	Geodetic datum of the latitude and longitude.
basin	2-letter GWIC drainage basin code. See http://mbmggwic.mtech.edu/sqlserver/v11/help/reports/listDBasin.asp for listing.
township	Montana township of the site.
range	Montana range of the site.
section	Section where the site is located.
tract	Quarter sections from largest to smallest that describe the location of the site. (A=Northeast, B=Northwest, C=Southwest, D=Southeast). See http://mbmggwic.mtech.edu/sqlserver/v11/help/reports/ABCDGraphic.asp for a description of tract usage in GWIC.
location_verified?	"Yes" indicates the presence of a site visit record in GWIC.
county	Montana county.
type	Type of site.
aquifer	GWIC aquifer code for geologic source of water. See http://mbmggwic.mtech.edu/sqlserver/v11/help/reports/listAquifer.asp for listing. May have more than one value per record.
total_depth	Reported depth of the well/borehole in feet below ground surface.
comp_date	Date the well/borehole was completed.
agency	Agency collecting the sample.
sample_date_time	Date-time that the sample was collected. Should match date-time on field visit record.
water_temp	Measured temperature of the water (degrees C) at the time of field visit.
lab_name	Acronym for laboratory conducting analysis.
lab_ph	Laboratory measured pH in standard units.
lab_sc	Laboratory measured specific conductance in micromhos.
ca	Concentration of calcium in milligrams per liter (ppm).
mg	Concentration of magnesium in milligrams per liter (ppm).
na	Concentration of sodium in milligrams per liter (ppm).
k	Concentration of potassium in milligrams per liter (ppm).
fe	Concentration of iron in milligrams per liter (ppm).

Field Name	Description
mn	Concentration of manganese in milligrams per liter (ppm).
sio2	Concentration of silica in milligrams per liter (ppm).
hco3	Concentration of bicarbonate in milligrams per liter (ppm).
co3	Concentration of carbonate in milligrams per liter (ppm).
so4	Concentration of sulfate in milligrams per liter (ppm).
cl	Concentration of chloride in milligrams per liter (ppm).
no3_n	Concentration of nitrate as N in milligrams per liter (ppm).
f	Concentration of fluoride in milligrams per liter (ppm).
opo4	Concentration of ortho-phosphate in milligrams per liter (ppm).
ag	Concentration of silver in micrograms per liter (ppb).
al	Concentration of aluminum in micrograms per liter (ppb).
as_	Concentration of arsenic in micrograms per liter (ppb).
b	Concentration of boron in micrograms per liter (ppb).
ba	Concentration of barium in micrograms per liter (ppb).
be	Concentration of beryllium in micrograms per liter (ppb).
br	Concentration of bromide in micrograms per liter (ppb).
cd	Concentration of cadmium in micrograms per liter (ppb).
co	Concentration of cobalt in micrograms per liter (ppb).
cr	Concentration of chromium in micrograms per liter (ppb).
cu	Concentration of copper in micrograms per liter (ppb).
hg	Concentration of mercury in micrograms per liter (ppb).
li	Concentration of lithium in micrograms per liter (ppb).
mo	Concentration of molybdenum in micrograms per liter (ppb).
ni	Concentration of nickel in micrograms per liter (ppb).
pb	Concentration of lead in micrograms per liter (ppb).
sb	Concentration of antimony in micrograms per liter (ppb).
se	Concentration of selenium in micrograms per liter (ppb).
sn	Concentration of tin in micrograms per liter (ppb).
sr	Concentration of strontium in micrograms per liter (ppb).

Field Name	Description
ti	Concentration of titanium in micrograms per liter (ppb).
tl	Concentration of thallium in micrograms per liter (ppb).
u	Concentration of uranium in micrograms per liter (ppb).
v	Concentration of vanadium in micrograms per liter (ppb).
zn	Concentration of zinc in micrograms per liter (ppb).
zr	Concentration of zirconium in micrograms per liter (ppb).
tds	Concentration of total dissolved solids in milligrams per liter (ppm).
cations	Total cations in milli-equivalents per liter (meq/L).
anions	Total anions in milli-equivalents per liter (meq/L).
procedure_type	Analysis type: dissolved, total, total recoverable, etc.

Description of Data Qualifiers:

A = Hydride atomic absorption;
E = Estimated due to interference;
H = Exceeded holding time;
J = Detected above MDL but less than MRL;
K = Na+K combined;
N = Spiked sample recovery not within control limits;
P = Preserved sample;
S = Method of standard additions;
U = Analyzed for but not detected above MDL;
* = Duplicate analysis not within control limits;

Distribution_Information:

Distribution_Liability: The user of these data agrees to release the Montana Bureau of Mines and Geology, its officers, directors, agents, employees, and those acting on its behalf from all debts, claims, and liability of any kind arising out of or in connection with the use of the data.

Metadata_Reference_Information:

Metadata_Date: 02/08/2021
Metadata_Contact: Luke Buckley
Contact_Organization: Montana Bureau of Mines and Geology
Contact_Position: Associate Professor—Data Scientist
Address: 1300 West Park Street
City: Butte
State_or_Province: MT
Postal_Code: 59701

Contact_Voice_Telephone: (406) 496-4677
Contact_Electronic_Mail_Address: LBuckley@mtech.edu