Table of Contents

1.0 INTRODUCTION.............................................................................................................................. 1-1
  1.1 Purpose .................................................................................................................................. 1-1
  1.2 Organization of this Report ................................................................................................. 1-1

2.0 AQUIFER SENSITIVITY ASSESSMENT ..................................................................................... 2-1
  2.1 Background ............................................................................................................................ 2-1
  2.2 Assessment Methods .............................................................................................................. 2-2
  2.3 Drastic Model Method ............................................................................................................ 2-2
  2.4 Modification of Drastic .......................................................................................................... 2-4

3.0 SOURCES OF DATA........................................................................................................................ 3-1

4.0 MODEL METHODOLOGY ............................................................................................................ 4-1
  4.1 Depth to Groundwater ............................................................................................................ 4-1
  4.2 Recharge .................................................................................................................................. 4-2
    4.2.1 Recharge Due to Precipitation .................................................................................. 4-2
    4.2.2 Recharge Due to Streamflow and Irrigation Water .................................................. 4-3
    4.2.3 Recharge Zones Associated with Faulting ................................................................ 4-3
  4.3 Geohydrologic Setting ............................................................................................................ 4-4
  4.4 Soils ........................................................................................................................................ 4-6
  4.5 Slope ....................................................................................................................................... 4-7
  4.6 Vadose Zone ........................................................................................................................... 4-8
  4.7 Aquifer Sensitivity ............................................................................................................... 4-10

5.0 PROJECT SUMMARY ..................................................................................................................... 5-1
  5.1 Public Involvement ................................................................................................................. 5-1
  5.2 GIS Tool for Sensitivity Mapping Applications .................................................................... 5-1
  5.3 Future Recommendations ...................................................................................................... 5-1

6.0 REFERENCES.................................................................................................................................. 6-1
List of Tables

4-1. Groundwater Depth Ratings
4-2. Geohydrologic Ratings for Surficial Materials
4-3. Geohydrologic Ratings for Bedrock Formations
4-4. General Criteria for Assigning Soil Sensitivity Ratings
4-5. Land Surface Slope Ratings
4-6. Vadose Zone Ratings for Surficial Materials
4-7. Vadose Zone Ratings for Bedrock Formations
List of Figures

1. Study Area Location Map
2. Available Water Depth Locations
3. Depth to Initial Groundwater
4. Depth to Initial Groundwater Ratings
5. Bedrock Geology
6. Surficial Geology
7. Geohydrologic Setting Ratings
8. Aquifer Recharge Ratings
9. Land Surface Slope
10. Land Surface Slope Ratings
11. Soil Units
12. Soils Ratings
13. Vadose Zone Ratings
14. Aquifer Sensitivity
15. Septic System Locations
List of Plates

1. Aquifer Sensitivity
List of Appendices

A. BEDROCK GEOLOGY DESCRIPTIONS
B. SOIL UNITS DATA AND RATINGS
C. INSTRUCTIONS FOR USING AQUIFER SENSITIVITY GIS MODEL
D. METADATA
E. HERRERA REVIEW
1.0 INTRODUCTION

1.1 PURPOSE
Lewis and Clark County was awarded a Montana Department of Natural Resources and Conservation (DNRC) Reclamation and Development Planning Grant to complete the Helena Valley Groundwater Vulnerability Mapping Project. The primary intent of the project was to develop mapping products to delineate areas which may be susceptible to impacts resulting from potential septic system discharges. Trihydro Corporation (Trihydro) was contracted on November 8, 2007 to complete the aquifer sensitivity assessment for the Helena Valley study area. Trihydro was selected due to their experience with aquifer sensitivity mapping, geologic/hydrogeologic expertise, Geographic Information Systems (GIS) capabilities, and their neutrality in Lewis and Clark County planning issues. This document represents the final results of the aquifer sensitivity mapping for the study area. Additionally, Trihydro partnered with Herrera Consulting to provide an independent hydrogeologic review of the aquifer sensitivity mapping process, which is included as Appendix E. A map depicting the location of the Helena Valley study area is included as Figure 1.

1.2 ORGANIZATION OF THIS REPORT
The results of the aquifer sensitivity mapping completed for Lewis and Clark County are summarized in the following sections of this report:

   Section 2.0 – Aquifer Sensitivity Assessment
   Section 3.0 – Sources of Data
   Section 4.0 – Model Methodology
   Section 5.0 – Project Summary
   Section 6.0 – References
2.0 AQUIFER SENSITIVITY ASSESSMENT

2.1 BACKGROUND

A key element of many groundwater resource protection programs is an assessment of potential groundwater vulnerability (USEPA, 1993a). In general, groundwater vulnerability assessments are aimed at determining the tendency or likelihood for contaminants to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer (NRC, 1993). Vulnerability assessments combine the physical and chemical components of groundwater (i.e., hydrogeologic setting) with indicators of the nature and extent of potential contaminant sources to determine the potential impact of these anthropogenic influences on the groundwater quality.

The U.S. Environmental Protection Agency defined the term “groundwater vulnerability” as part of a 1993 pesticide contamination study (USEPA 1993b). Groundwater vulnerability was described as “the relative ease with which a contaminant applied on or near the land surface can migrate to the aquifer of interest under a given set of agronomic management practices, pesticide characteristics, and hydrogeologic sensitivity conditions”. In the same publication, aquifer sensitivity was defined as “the relative ease with which a contaminant applied on or near the land surface can migrate to the aquifer of interest ... [It] is not dependent on agronomic practices or pesticide characteristics” (USEPA, 1993b).

Simply put, “aquifer sensitivity” is based on the hydrogeologic setting of the particular location while “groundwater vulnerability” also takes into account potential point and non-point pollution sources. While the terms “aquifer sensitivity” and “groundwater vulnerability” are occasionally used interchangeably in both common practice and the scientific literature, within this document these EPA definitions have been adopted.

Aquifer sensitivity mapping can be used as an effective planning tool for environmental protection by allowing communities to strive to locate potential pollution sources in areas with lower aquifer sensitivities. Aquifer sensitivity mapping is therefore the foundation of the Helena Valley Project. Alternatively, groundwater vulnerability mapping can be used to develop ambient groundwater monitoring programs to assess impacts in areas that are most likely to develop contamination due to high sensitivity and the presence of pollution sources. Groundwater vulnerability mapping can also be used as a planning tool by allowing communities to consider avoiding the location of potential pollution sources in areas of high groundwater vulnerability, thereby reducing potential cumulative impacts of pollution sources.
2.2 ASSESSMENT METHODS

A wide range of methods have been developed to assess aquifer sensitivity (Focazio, et al. 2002). These methods generally fall within three categories (1) overlay and index models which combine various physiographic attributes of a region by assigning a numerical index or score to each attribute, (2) process-based simulation models which attempt to simulate contaminant transport through a series of numerical equations, and (3) statistical methods which use known contaminant distributions to predict the probability of future contamination occurring (NRC, 1993). These different approaches can often be differentiated by the way they address several factors: the reference location of concern within the groundwater system, vulnerability of specific contaminants or intrinsic groups, inclusion of contaminant pathways other than direct percolation, and spatial scales of study.

Of the sensitivity and vulnerability approaches, most overlay and index methods, as well as statistical methods, tend to be applied to large study areas (small map scales) while process-based models are commonly applied to very small study areas. Process models cannot account for the vast amount of variability that can occur over large areas, while other methods can’t account well for the effects of specific contaminant pathways that may exist in smaller study areas or for the chemical processes that may affect individual chemicals. Overlay and index methods are the easiest to apply, especially to a larger area, because they are more general in nature, while statistical techniques can become extremely complicated as study sizes increase. This particular project utilizes an index and overlay method as described below.

2.3 DRASTIC MODEL METHOD

With the increasing occurrence of aquifer contamination in the United States, aquifer sensitivity modeling has become a frequent topic within the scientific literature in the last 20 years. The DRASTIC method, first published in 1987 (Aller et al., 1987), has served as a model for many regional and statewide studies and is arguably the most widely used for such efforts.

The model seeks to identify areas where aquifers are most susceptible to contamination from surficial pollutants. DRASTIC was originally designed as an easy-to-use model that would allow a user with only a basic knowledge of hydrogeology to assess the relative potential for groundwater contamination. The model was neither designed nor intended to replace on-site inspections, or to site any specific type of facility or practice. Specifically, the system was designed to generalize the pollution potential for typical areas of 100 acres or larger. Because pollutants vary widely in their mobility and attenuation characteristics, a generic pollutant with the travel properties of water was assumed. The principal DRASTIC model development group, which was both a very broad-based and highly qualified technical
group, eventually developed a compromise model approach. Because it was neither practical nor feasible to obtain quantitative evaluations of the many micro-scale processes that affect contaminant transfer from a regional perspective, it was necessary to look at the broader physical parameters that incorporate the many processes. When these processes were coupled with an evaluation of the hydrogeology of the area, a realistic estimation of contamination potential was possible.

DRASTIC, an overlay and index method as described above, defines contamination potential based on seven independent parameters that form the acronym:

- **Depth to Initial Groundwater**
- **Recharge (net annual from natural sources)**
- **Aquifer Media**
- **Soil Media**
- **Topography (slope)**
- **Impact of the Vadose Zone**
- **Conductivity (saturated hydraulic)**

These seven parameters form the pollution potential equation:

\[
\text{Pollution Potential} = D_r D_w + R_r R_w + A_r A_w + S_r S_w + T_r T_w + I_r I_w + C_r C_w
\]

Where the subscript “\(r\)” denotes the rating and the subscript “\(w\)” represents the weight for each factor. Ratings range from one to ten based on the relative role that the unit plays in pollution potential. Higher numbers indicate greater potential for pollution. For example, fine textured (e.g., clay) soils are assumed to be less permeable to water than coarse (e.g., sandy) soils. Fine textured soils are, therefore, assigned a lower rating than soils having a coarse texture because, all other things being equal, they are less likely to allow infiltration of a pollutant. Likewise, areas where depth-to-water is great are assigned low ratings because it is assumed that, all other things being equal, pollutants are less likely to reach the deeper water table (Merchant et al., 1987). DRASTIC weights can range from one to five, and reflect the relative importance that each of the seven parameters has in relation to each other. The weight factors for
each parameter may be varied based on the perceived relative importance of each parameter for a particular land-use or application; however most recent studies have ultimately utilized equal weights.

The sensitivity index value calculated by the model is considered a relative indicator of pollution potential. The value has no real quantitative meaning other than to describe, in relative terms, which regions within the study area have a higher potential for contamination than others. This index value must then be applied only within its hydrogeologic setting. The DRASTIC manual indicates that each index must be interpreted within an area of similar hydrologic characteristics (Aller et al., 1987) and would not be numerically comparable with indices developed in other locales.

### 2.4 MODIFICATION OF DRASTIC

While many modifications to DRASTIC have been made since its initial publication, this Helena Valley project utilized the modified DRASTIC model developed for the State of Wyoming. Using the definitions of aquifer sensitivity and groundwater vulnerability defined earlier, the Wyoming model approaches the sensitivity/vulnerability delineations in a two step process: first the calculation of aquifer sensitivity (Hamerlinck and Arneson, 1998a) and then the addition of human factors/pollution sources to arrive at groundwater vulnerability (Hamerlinck and Arneson, 1998b). The Helena Valley project was limited to an aquifer sensitivity analysis, although a separate mapping of septic system locations, a potential pollution source, has also been provided (Figure 15).

Aquifer sensitivity mapping requires consideration of the hydrogeologic environment and the surrounding landscape characteristics that influence the transport of potential contaminants from the ground surface into an aquifer. An aquifer sensitivity map thus describes the inherent capacity of the terrestrial and underground environments to transport available pollutants.

While DRASTIC has been used in studies throughout the world, it has often been modified to better address local issues or to slightly alter the model’s goal to better represent a local setting (Merchant, 1994). The Wyoming sensitivity mapping procedure differed from DRASTIC in a number of key aspects. First, the Wyoming procedure utilizes several different mapping layers from DRASTIC. While DRASTIC uses map layers for saturated hydraulic conductivity and aquifer media, the Wyoming study replaces the two layers with a more comprehensive geohydrologic mapping unit layer. Second, the Wyoming procedure does not adhere to the DRASTIC method for assigning rating values to pre-defined map classes. New rating systems were developed which reflect the local area’s unique hydrogeologic environment and landscape characteristics influencing contaminant transport. Third, the Wyoming
procedure did not apply weights to each of the individual sensitivity maps. Instead, Wyoming used equal weights based on the lack of scientific evidence to support an alternative weighting selection.

The final aquifer sensitivity product uses the following parameters: (1) depth to groundwater, (2) net annual aquifer recharge from precipitation and snow melt, (3) geohydrologic environment of the aquifer, (4) soils, (5) land surface slope, and (6) characteristics of the vadose zone. For each of these characteristic maps, ratings are assigned to the descriptive map classes relating the capacity of that environmental characteristic to influence the movement of contaminants to the groundwater. The final sensitivity layer is created by overlaying the six individual rating maps and summing their rating values. The ratings on the final sensitivity map reflect the contribution of each individual map layer. Higher ratings depict areas where the groundwater is likely intrinsically more sensitive to contamination. Lower ratings highlight areas that may be less sensitive.
3.0 SOURCES OF DATA

Creating a complete and accurate GIS dataset of aquifer sensitivity required the combination of multiple data sources. Sources of information described in this section ranged from crude spreadsheets and paper maps to fully attributed GIS data. The data types and sources discussed in this section are organized by their order of use within the modified-DRASTIC sensitivity process. These data sources and their uses are described in detail below. For more information about the data used for this project, please consult the metadata in Appendix D. Metadata are the vital statistics of a data set. They include contact, source, time period, and spatial reference information as well as data quality statements and attribute definitions.

- Well Data
  Well locations and groundwater level sampling information was provided by the Groundwater Information Center (http://www.gwic.com). Samples were collected within the county at variable intervals. For the purposes of this analysis, only data from samples collected in 2007 were used.

- Wetlands
  Wetlands information for the project was compiled from the National Wetlands Inventory (NWI) which is available nationally in GIS format (http://www.fws.gov/nwi). NWI mapping within the county was conducted in 1999 based on color infrared photography available at that time.

- Hydrography
  Streams and lakes for the county are currently maintained by USGS within the National Hydrography Dataset (NHD) at 1:24,000-scale. This data is downloadable at http://nhd.usgs.gov.

- Bedrock Geology
  The best available mapping for bedrock geology within the study area was available from USGS at 1:100,000-scale (Reynolds and Brandt, 2000). This data is available in GIS format from: (http://pubs.usgs.gov/wri/wri-00-4212/).

- Surficial Geology
  Surficial geology was available for the study area from a USGS Investigations Report (Briar and Madison, 1992). This map was scanned, georeferenced, and then screen-digitized within the GIS. The result is a coarse digital map for the study area.
• Precipitation
Precipitation data for the study area was acquired from several different sources. Initially contour lines were
digitized into the GIS from the 2000 USGS Water Resources Investigations Report (Thamke, 2000). Independent
data was then acquired from the PRISM Group at Oregon State University. The PRISM methodology utilizes
modeling techniques analyzing orographic effects to effectively map long-term precipitation patterns
(http://www.prism.oregonstate.edu).

• Soils
Soils information from the Natural Resources Conservation Service (NRCS) was acquired for the county. This
data is produced at a 1:24,000 scale and is typically field verified with test pits throughout the county.

• Elevation
Elevation data for the study area was compiled from several sources. The USGS National Elevation Dataset
(http://ned.usgs.gov) contains elevation data points throughout the county at 10 meter spacing. While this quality
of data is typically sufficient for a project of this nature, recent floodplain mapping information was available for
significant portions of the study area. This data contained contour lines ranging from 1 to 5 foot intervals, which
were then converted to GIS raster format for use in the project.

• Other Cartographic Layers
Several cartographic base layers were acquired for use in the final project maps. ESRI StreetmapUSA data was
used to illustrate roads within the study area. Public Land Survey System (PLSS) data was acquired from the
county at 1:24,000-scale. Municipal boundaries were provided by the County GIS staff.
4.0 MODEL METHODOLOGY

This section details the methodology used to create each of the data layers utilized in the aquifer sensitivity map product. Sensitivity rating scales were assigned to each of the characteristics depicted in the project base layers described in Section 2.4 and then compiled into the final sensitivity map.

4.1 DEPTH TO GROUNDWATER

Depth to water calculations for the study area were developed based on groundwater sampling data maintained by the Montana Ground-Water Information Center in Butte ([http://mbmgwie.mtech.edu/](http://mbmgwie.mtech.edu/)). GWIC staff provided 2007 sampling information for the county, complete with geographic coordinates for each sample. Depth to water data locations are shown on Figure 2. After reviewing the input data, it was decided that the shallowest groundwater sample from each location would be utilized in order to provide a conservative overall approach.

Following a thorough review of the data, deeper samples from the same (or nearby) locations were removed from the dataset. The edges of Lake Helena and perennial wetlands were then assumed to have a depth to water of zero (0) feet and added to the dataset. This information was interpolated into a raster layer. A standard Inverse Distance Weighted (IDW) technique utilizing a power of 2, variable search radius, and 12 point search radius was applied. This resultant layer was clipped to the study area and locations within 50 horizontal meters of a perennial surface water feature were given a depth value of zero (0) feet.

Sensitivity ratings were calculated for this layer utilizing the equations developed for the State of Wyoming Vulnerability Mapping Project by Hamerlinck and Arneson (1998). The DRASTIC ratings as defined by Aller et al. (1987) were used as a guide for developing these equations. Higher sensitivities correlate with shallowest groundwater depths. GIS was used to facilitate the conversion of the groundwater depth layer to a sensitivity rating map by processing the mapped data through the functions listed below:

<table>
<thead>
<tr>
<th>Range of Depth (feet)</th>
<th>Rating Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 5</td>
<td>10</td>
</tr>
<tr>
<td>5 – 30</td>
<td>10.60 – 0.12 (depth)</td>
</tr>
<tr>
<td>30 – 100</td>
<td>23.94 – [4.98 x ln (depth)]</td>
</tr>
<tr>
<td>&gt; 100</td>
<td>1</td>
</tr>
</tbody>
</table>
Within the ArcGIS Spatial Analyst Raster Calculator these ratings are calculated using the following expression:

\[
\text{con} \left( \begin{array}{c} 
\text{DTW}_\text{Final} < 5, 10, \text{con} \left( \begin{array}{c} 
\text{DTW}_\text{Final} < 30, (10.6 - (\text{DTW}_\text{Final} \times 0.12)), \text{con} \left( \begin{array}{c} 
\text{DTW}_\text{Final} < 100, (23.94 - (\ln(\text{DTW}_\text{Final}) \times 4.98)), 1 \end{array} \right) \end{array} \right) \end{array} \right)
\]

The resulting map showing depth to initial groundwater is presented as Figure 3 and the associated sensitivity ratings are presented as Figure 4.

### 4.2 RECHARGE

The Helena valley-fill aquifer is the primary source of domestic drinking water in the study area. Recharge is reportedly from several sources which infiltrate through the overlying soil or recharge the aquifer as inflow. The primary sources of aquifer recharge in the valley are from inflow from fractures in the surrounding Pre-Tertiary bedrock and infiltration of streamflow and irrigation water (Briar and Madison, 1992). Recharge to the valley-fill aquifer from inflow through bedrock fractures is not considered in this model layer, only the potential for infiltrating recharge from the surface into the underlying bedrock units.

#### 4.2.1 RECHARGE DUE TO PRECIPITATION

Briar and Madison (1992) concluded that recharge by precipitation percolating downward through the soil is a relatively insignificant source of recharge on non-irrigated areas in the valley. This is due to the semi-arid environment and the fact that evapotranspiration (evaporation and water uptake by vegetation) is greater than the amount of precipitation. Except for the infrequent periods of sustained precipitation that can overcome the soil-moisture deficit present in the valley soils, the underlying aquifer units will receive little to no recharge directly from precipitation in
non-irrigated areas (Briar and Madison, 1992). In irrigated areas, the application of irrigation waters during the growing season will result in higher soil moisture contents, and recharge through infiltration of precipitation and irrigation water will be a potential source for contaminant migration.

The surficial geologic map produced by Briar and Madison (1992) is utilized in this model layer to identify surface areas where bedrock units are exposed. While it is likely that a thin veneer of sediments may exist overlying the pre-Tertiary bedrock unit, which could retard or inhibit infiltrating recharge from precipitation, this entire unit is assigned a recharge rating value of three. This recharge rating value accounts for the potential for precipitation falling on exposed bedrock units, where infiltration through fractures to the underlying water table is a potential transport mechanism for contaminants. All other units will be assigned a recharge rating value of one, reflecting the lack of recharge from precipitation due to the soil moisture deficit present in the soils and sediments of the study area.

4.2.2 RECHARGE DUE TO STREAMFLOW AND IRRIGATION WATER

Additional significant sources of recharge in the study area include: infiltration of streamflow, infiltration of irrigation water through the irrigation canal network in the valley, and infiltration of excess applied irrigation water. The recharge model layer accounts for infiltration of streamflow and canal irrigation water by applying a 100 foot buffer around the four streams that have sustained periods of streamflow entering the valley (Prickly Pear Creek, Tenmile Creek, Sevenmile Creek, and Silver Creek) and along the approximately 68 mile network of irrigation canals in the valley. This buffer is assigned a maximum rating value of 10, indicating a high potential for recharge to the underlying aquifer and thus a high potential for contaminant transport from the surface to the water table.

Potential recharge through applied irrigation water and precipitation on irrigated lands is not accounted for in this aquifer sensitivity model layer. Should the county decide at a later date to model groundwater vulnerability by including human impacts, a layer which includes both agricultural and urban irrigation should be considered.

4.2.3 RECHARGE ZONES ASSOCIATED WITH FAULTING

Buffer zones have also been established in this model layer to account for the potential increased susceptibility of groundwater in zones of significant faulting, where preferential pathways for downward migration of contaminants may exist. Mapped faults from the bedrock map of the study area (Thamke and Reynolds, 2000) have been identified in this layer, and a 100 foot buffer zone established around these faults where the recharge rating has been assigned a value of 10. The aquifer recharge ratings map is shown as Figure 8.
4.3 GEOHYDROLOGIC SETTING

The geohydrologic layer represents the hydraulic character of the uppermost aquifer. This layer combines the aquifer media and saturated hydraulic conductivity layers of the DRASTIC model to produce a rating system of the aquifer’s likely ability to transmit and store water. Rating values range between 1 and 10, with 1 representing unfractured massive shale with low pollution potential and 10 representing a well-developed karst limestone with a high pollution potential.

Geologic mapping from two sources was utilized to evaluate the geohydrologic character of the aquifers in the study area. Surficial geologic mapping by Briar and Madison (1992) was utilized to assess the alluvial aquifers which occupy the basin center and represent the valley-fill aquifer, which is the primary aquifer in the study area for domestic usage. At the basin margins, bedrock units mapped by Thamke and Reynolds (2000) have varying capacity for groundwater yield. Hydraulic conductivity in these units is primarily dominated by secondary porosity channels, such as fractures and faults. Matrix porosity for these units is relatively low, due to the finer grained sedimentary deposits or igneous and volcanic rock units with limited primary porosity.

Three surficial geologic units mapped by Briar and Madison (1992) were evaluated for this model layer, including the Quaternary-age alluvium deposits, the Quaternary-age pediment deposits, and the undifferentiated Tertiary-age deposits. The Quaternary-age alluvium represents relatively coarse-grained stream-channel, alluvial-plain, terrace, and fan deposits. The Quaternary-age pediment deposits are poorly sorted and unstratified gravel, sand, and silt lag deposits. The Quaternary-age pediment deposits are poorly sorted and unstratified gravel, sand, and silt lag deposits. The undifferentiated Tertiary-age deposits are composed of sandy siltstone with laterally discontinuous coarser grained interbeds and lenses. Reported well yields for all three units vary, as the alluvium deposits have reported yields of 20 to 300 gallons per minute (gpm), the pediment deposits have reported yields between 2 to 100 gpm, and the undifferentiated Tertiary deposits have reported yields from 2 to 15 gpm, and may exceed 100 gpm in well locations completed in this unit (Briar and Madison, 1992).

Table 4-2 summarizes the rating values assigned to these three units. The tabulated values reflect the relatively conductive nature of all three aquifer units. As reported in Briar and Madison (1992), the valley-fill aquifer in the study area has only localized finer-grained aquicludes, and generally behaves as a single complex aquifer system due to the lateral discontinuity of these finer grained deposits. Due to the relatively lower reported yields in the pediment and Tertiary deposits, the rating values for these units are slightly less than the larger alluvium deposits.
TABLE 4-2. GEOHYDROLOGIC RATINGS FOR SURFICIAL MATERIALS

<table>
<thead>
<tr>
<th>Surficial Geologic Unit</th>
<th>Unit Code</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alluvium</td>
<td>Qal</td>
<td>8</td>
</tr>
<tr>
<td>Pediments</td>
<td>QTp</td>
<td>7</td>
</tr>
<tr>
<td>Undifferentiated Tertiary Sediments</td>
<td>Tsu</td>
<td>7</td>
</tr>
</tbody>
</table>

Mapped bedrock units which outcrop in the study area and their assigned geohydrologic ratings are summarized in Table 4-3. General geologic characteristics and inferred hydrologic characteristics are included in Appendix A (Source: Thamke and Reynolds, 2000). Permeabilities of all bedrock units in the study area generally range from low to moderate, with the presence of conduits created by secondary porosity (e.g. fractures, faults, dissolution channels) representing the most likely path for potential downward migration of potential contaminant flow. Bedrock units surrounding the Helena Valley have undergone several periods of tectonic activity, with the most recent occurring with renewed Miocene-age faulting. In the absence of fractures in these geologic units, the potential conductivity in these units would be relatively low, as these units are primarily volcanic, igneous, limestone, and fine grained sedimentary rocks. The presence of fractures, or other potential preferential pathways, likely increases the potential transmission of groundwater and contaminants. As documented in Appendix A, all bedrock units in the study area have the potential for fracture-dominated flow. Lacking unit-specific data or more detailed hydraulic evaluations of the bedrock aquifers, all bedrock units have been assigned the same rating value, reflecting a moderate capacity for transmission of groundwater.

TABLE 4-3. GEOHYDROLOGIC RATINGS FOR BEDROCK FORMATIONS

<table>
<thead>
<tr>
<th>Bedrock Geologic Formation</th>
<th>Formation Code</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oligocene volcanic rocks</td>
<td>OGvt</td>
<td>5</td>
</tr>
<tr>
<td>Oligocene sedimentary rocks</td>
<td>OGs</td>
<td>5</td>
</tr>
<tr>
<td>Cretaceous intrusive rocks, mainly granitic</td>
<td>Kg</td>
<td>5</td>
</tr>
<tr>
<td>Madison Group</td>
<td>Mml</td>
<td>5</td>
</tr>
<tr>
<td>Three Forks Formation and Jefferson Formation, undivided</td>
<td>Dtj</td>
<td>5</td>
</tr>
<tr>
<td>Upper and Middle Cambrian carbonate rocks</td>
<td>Cc</td>
<td>5</td>
</tr>
<tr>
<td>Middle Cambrian clastic rocks</td>
<td>Ccl</td>
<td>5</td>
</tr>
<tr>
<td>Intrusive rocks</td>
<td>Zg</td>
<td>5</td>
</tr>
<tr>
<td>Shepard and Snowslip Formations, undivided</td>
<td>Yss</td>
<td>5</td>
</tr>
<tr>
<td>Helena and Empire Formations, undivided</td>
<td>Yhe</td>
<td>5</td>
</tr>
<tr>
<td>Spokane Formation</td>
<td>Ys</td>
<td>5</td>
</tr>
<tr>
<td>Greyson Formation</td>
<td>Yg</td>
<td>5</td>
</tr>
</tbody>
</table>
4.4 SOILS

The soils layer summarizes an evaluation of the ability of contaminants to migrate through the soil and potentially move into the underlying groundwater. The source of information for the evaluation of soils in this model is the Soil Survey Geographic (SSURGO) database, produced by the NRCS (2007). This database provides detailed soils characteristics of the study area, mapped at a 1:24,000 scale.

Soil texture, or the size of the soil particles, was the primary characteristic evaluated for the evaluation of soils and the ability of contaminants to migrate through the soil profile. An average weighted value of the percent sand and percent clay from the SSURGO database was utilized to produce an average texture for the entire soil profile based on the USDA soil texture triangle (e.g. sandy loam, silty loam, etc.).

Additionally, the fragments in the soil were also compiled for each soil unit by individual soil horizons. Fragments are defined as unattached pieces of bedrock or bedrock-like material 2 millimeters or larger, and are not considered in the calculation of the percent sand and percent clay values. A skeletal soil is classified as being composed of 35% or greater rock fragments by volume. The presence of rock fragments can affect the infiltrative capacity of the soil, as these larger clasts can produce voids or preferential pathways for downward flow of contaminants. Generally, clasts larger than 3 millimeters are not included in the evaluation of percent sand and percent clay. Most of the soils in the study area are composed of relatively coarser grained particles with a high percentage of rock fragments that generally increases with depth and proximity to the soil parent material. As a result, this soil component was included in the ratings analysis for this model layer.

Finally, the calculated permeability, or saturated hydraulic conductivity value for the soil unit was evaluated in this analysis. Permeability was calculated as a weighted average value, and ranges between approximately 104 micrometers per second (μm/s) and 3 μm/s. A summary of general criteria utilized to assess the soil sensitivity ratings is included in Table 4-4.

Weighted averages of percent sand and percent clay, a general USDA textural description based on these textural values, the weighted average permeability value, and horizon-specific ranges of rock fragments are summarized in Appendix B. Assigned soil rating values are also included in the table in Appendix B.
TABLE 4-4. GENERAL CRITERIA FOR ASSIGNING SOIL SENSITIVITY RATINGS

<table>
<thead>
<tr>
<th>Particle Size</th>
<th>Other Characteristics</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedrock outcrop</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Sandy</td>
<td>Gravelly to very gravelly in most of horizon; high percentage of fragments; Permeability &gt; 50 m/s</td>
<td>9</td>
</tr>
<tr>
<td>Sandy loam-skeletal</td>
<td>Greater than 35% fragments in appreciable portion of soil unit; permeability &gt; 30 m/s</td>
<td>8</td>
</tr>
<tr>
<td>Loamy-skeletal; coarse-loamy</td>
<td>Greater than 35% fragments in appreciable portion of soil unit; permeability &gt; 15 m/s</td>
<td>7</td>
</tr>
<tr>
<td>Loamy; fine loamy-skeletal</td>
<td>Permeability &lt; 15 m/s and &gt; 5 m/s</td>
<td>6</td>
</tr>
<tr>
<td>Fine loamy-skeletal</td>
<td>Permeability &lt; 5 m/s</td>
<td>5</td>
</tr>
<tr>
<td>Fine loamy</td>
<td>Permeability &lt; 5 m/s, few fragments</td>
<td>4</td>
</tr>
</tbody>
</table>

As this model layer only considers the migration of contaminants from the uppermost soil horizons down through the soil profile, a general observation can be made from the textural characteristics of most of the mapped soil units in the study area. Most soils overlie alluvial deposits, and as the distance to the parent material decreases, the percentage of coarser grained sediments and the percentage of rock fragments significantly increases with depth. This is an important consideration for the construction of septic leach fields, where design objectives are percolation and saturation of the surrounding soil. For septic construction in many of the soils in the study area, leach field construction at typical depths of three to five feet, or more, below ground surface could result in rapid infiltration of septic discharges to the underlying aquifers.

4.5 SLOPE

Land surface slope calculations for the study area were developed based on elevation data from several data sources. Initially the county-wide USGS 10 meter National Elevation Dataset was used (http://seamless.usgs.gov/). A standard GIS routine calculated percent slope from this layer. The county also provided detailed topographic contours from 2001 and 2006. This data contained more detail and was assumed to be more accurate. These contours were interpolated into a raster GIS layer and then percent slope was calculated for each. These three layers were merged into one single slope representation for the study area. Where detailed contour information existed, this data provided the slope information. Areas that were not covered by the detailed contour information were represented with the standard NED slope derivations.

Land surface slope refers to the steepness of the land surface and can be represented as a degree or as a percentage (45 degrees = 100 percent). Land surface slopes have been expressed as a percentage on Figure 9. The flatter the slope, the longer water resides in one place on the land surface, which results in greater potential for infiltration. Flatter
slopes would therefore correlate with higher sensitivities. Sensitivity ratings were calculated for this layer utilizing the equations developed for the State of Wyoming Vulnerability Mapping Project by Hamerlinck and Arneson (1998). These equations are:

\[
\text{TABLE 4-5. LAND SURFACE SLOPE RATINGS}
\]

<table>
<thead>
<tr>
<th>Percent Slope</th>
<th>Rating Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 1</td>
<td>10</td>
</tr>
<tr>
<td>1 – 18</td>
<td>(5.5 + 4.5 \sin ((\text{slope} + 7) \times 0.19))</td>
</tr>
<tr>
<td>&gt; 18</td>
<td>1</td>
</tr>
</tbody>
</table>

Within the ArcGIS Spatial Analyst Raster Calculator these ratings are calculated using the following expression:

\[
\text{con} (\{\text{Slope} < 1, 10, \text{con}(\{\text{Slope} < 18, (5.5 + (4.5 \times \sin((\text{Slope} + 7) \times 0.19))), 1))\})
\]

The resulting map showing land surface slopes is presented as Figure 9 and the associated sensitivity ratings are presented as Figure 10.

4.6 VADOSE ZONE

The vadose zone refers to the unsaturated zone above the water table and below the soil horizon. For input into the DRASTIC model, the vadose zone ratings range between 1 and 10, where a value of 1 represents a confining layer. A value of 10 represents a highly fractured igneous or volcanic rock, or karst limestone, where secondary porosity creates preferential pathways for infiltrating water to more quickly reach the groundwater table.
The vadose zone in the study area can be generally divided into two distinct geologic settings; the alluvial sediments representing the valley-fill and the surrounding bedrock units. Available data on the units that comprise the vadose zone is relatively general in character, compiled from Briar and Madison (1992) and Thamke and Reynolds (2000).

The valley-fill sediments of the Helena Valley are composed of three separate sedimentary units, including the unconsolidated Quaternary-age alluvium and Quaternary-age pediment deposits, and undifferentiated Tertiary-age deposits. Appendix A includes a summary table of the lithologic characteristics of these units, including water-yielding properties (Source: Briar and Madison, 1992). The geologic characteristics of these units are relatively general, and reported well-yields for individual units can vary widely.

The Quaternary-age alluvium represents relatively coarse-grained stream-channel, alluvial-plain, terrace, and fan deposits. Vertical infiltration through the unsaturated portion of this unit would likely be relatively fast, though laterally discontinuous lenses of relatively finer grained material may retard downward migration of potential contaminants. The Quaternary-age pediment deposits are poorly sorted and unstratified gravel, sand, and silt lag deposits. Due to the unstratified nature of these deposits and the likely absence of finer grained lenses, the vertical infiltration of potential contaminants to the water table would likely be faster than in the alluvium sediments; therefore, this unit receives a higher rating. Potential contaminant migration in the vadose zone of both Quaternary-age units will likely also be slowed by the relatively dry nature of the sediments for most of the year in a semi-arid environment. Potential migration of downward flowing contaminants must overcome the soil moisture deficit, thus potentially slowing infiltration. The undifferentiated Tertiary-age deposits are composed of sandy siltstone with laterally discontinuous coarser grained interbeds and lenses. Due to the relatively finer grained composition of these sediments, this unit likely represents a relatively lower potential for contaminant migration to the water table in the surficial geologic units. Table 4-6 includes a summary of the surficial geologic units and assigned vadose zone ratings.

<table>
<thead>
<tr>
<th>Surficial Geologic Unit</th>
<th>Unit Code</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alluvium</td>
<td>Qal</td>
<td>6</td>
</tr>
<tr>
<td>Pediments</td>
<td>QTp</td>
<td>7</td>
</tr>
<tr>
<td>Undifferentiated Tertiary Sediments</td>
<td>Tsu</td>
<td>5</td>
</tr>
</tbody>
</table>

Mapped bedrock units which outcrop in the study area and their assigned vadose zone ratings are summarized in Table 4-7. General geologic characteristics and inferred hydrologic characteristics are included in Appendix A (Source: Thamke and Reynolds, 2000). Permeabilities of all bedrock units in the study area generally range from low to
moderate, with the presence of conduits created by secondary porosity (e.g. fractures, faults, dissolution channels) representing the most likely path for potential downward migration of potential contaminant flow. Bedrock units surrounding the Helena Valley have undergone several periods of tectonic activity, with the most recent occurring with renewed Miocene-age faulting. In the absence of fractures in these geologic units, the potential infiltration in these units would be relatively slow, as these units are primarily volcanic, igneous, limestone, and fine grained sedimentary rocks. The presence of fractures, or other potential preferential pathways, likely increases the potential downward migration of contaminants. As documented in Appendix A, all bedrock units in the study area have the potential for fracture-dominated flow. Lacking unit-specific data or more detailed mapping, all bedrock units have been assigned the same rating value, reflecting the potential for infiltration through fracture systems, or other secondary porosity pathways.

<table>
<thead>
<tr>
<th>Bedrock Geologic Formation</th>
<th>Formation Code</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oligocene volcanic rocks</td>
<td>OGVt</td>
<td>7</td>
</tr>
<tr>
<td>Oligocene sedimentary rocks</td>
<td>OGs</td>
<td>7</td>
</tr>
<tr>
<td>Cretaceous intrusive rocks, mainly granitic</td>
<td>Kg</td>
<td>7</td>
</tr>
<tr>
<td>Madison Group</td>
<td>Mml</td>
<td>7</td>
</tr>
<tr>
<td>Three Forks Formation and Jefferson Formation, undivided</td>
<td>Dtj</td>
<td>7</td>
</tr>
<tr>
<td>Upper and Middle Cambrian carbonate rocks</td>
<td>Cc</td>
<td>7</td>
</tr>
<tr>
<td>Middle Cambrian clastic rocks</td>
<td>Ccl</td>
<td>7</td>
</tr>
<tr>
<td>Intrusive rocks</td>
<td>Zg</td>
<td>7</td>
</tr>
<tr>
<td>Shepard and Snowslip Formations, undivided</td>
<td>Yss</td>
<td>7</td>
</tr>
<tr>
<td>Helena and Empire Formations, undivided</td>
<td>Yhe</td>
<td>7</td>
</tr>
<tr>
<td>Spokane Formation</td>
<td>Ys</td>
<td>7</td>
</tr>
<tr>
<td>Greyson Formation</td>
<td>Yg</td>
<td>7</td>
</tr>
</tbody>
</table>

Buffer zones have also been established in this model layer to account for the potential increased susceptibility of groundwater in zones of significant faulting, where preferential pathways for downward migration of contaminants likely exist. Mapped faults from the bedrock map of the study area (Thamke and Reynolds, 2000) have been identified in this layer, and a 100 foot buffer zone was established around these faults with an assigned vadose rating value of 10. Vadose zone sensitivity ratings are summarized on Figure 13.

4.7 AQUIFER SENSITIVITY

The final aquifer sensitivity model was created by simply “adding” the ratings from each of the six rated characteristic layers. The result was a possible range of values of six (assuming each layer had a rating of one for the particular area)
up to 60 (if each layer were rated a 10). The actual range of values for the Helena Valley ranged from 23 to 54 with the highest sensitivity ratings attributed to those areas near perennial water features, with shallow groundwater and coarse sediments.

A five-class categorization was then developed by applying a natural break categorization routine (readily available within ArcView GIS software) to the sensitivity rating distribution. The calculated classes capture the natural groupings of the ratings (low rating = 23-30, medium-low rating = >30-36, medium rating = >36-40, medium-high rating = >40-46, and high rating = >46-54). The High Sensitivity category includes approximately 2,670 acres or about 4.77% of the land in the study area. The Low Sensitivity category includes approximately 4,735 acres or about 8.45% of the land in the study area. The Medium-High, Medium, and Medium-Low categories include approximately 13,862 acres (24.75%), 16,101 acres (28.75%), and 18,639 acres (33.28%) respectively.

Although land areas that are included within the Low Sensitivity category may have a lower inherent susceptibility to groundwater pollution, this does not necessarily mean that such areas would be most appropriate for septic system construction. For example, some areas with low sensitivity with respect to groundwater pollution may have extremely steep land surface slopes and may be unsuitable for housing and/or septic system construction. The aquifer sensitivity ratings only address groundwater pollution potential and are unrelated to septic system construction issues or other concerns. The overall aquifer sensitivity ratings for the Helena Valley project (June 2008) are depicted on Figure 14 and also on Plate 1.
5.0 PROJECT SUMMARY

This section summarizes the public outreach component of the project, the opportunities for updating the sensitivity mapping and recommendations for future modifications and applications.

5.1 PUBLIC INVOLVEMENT

Two public presentations were conducted during the course of the project. A public meeting was held in Helena on January 8th, 2008 to describe the project, explain its purpose, outline the proposed aquifer sensitivity model, and solicit public involvement. The project was generally well received with the vast majority of comments being positive. The few concerns expressed were primarily related to the coarseness of the model and the lack of specific pollution predictability based on the methodology. Later, on April 9th, 2008, a final public meeting was held to present the draft results of the project. A brief project background was provided for those who had not attended the first meeting and the individual data layers and maps were presented. Again, the response was generally favorable with most questions pertaining to what the “next step” for the county should be. Potential approaches to address the human factors differentiating aquifer sensitivity mapping (DRASTIC-based) from groundwater vulnerability mapping were discussed. In addition, a summary presentation of the final report was conducted at the County Commissioners’ public meeting held on June 24, 2008. This final report was revised in response to comments received on June 24th clarifying septic system construction issues and incorporating data on the acreages in each category distribution (Section 4.7).

5.2 GIS TOOL FOR SENSITIVITY MAPPING APPLICATIONS

The final GIS maps produced for Lewis and Clark County are designed to be dynamic products that can and should be updated and improved over time. With this goal in mind, Trihydro has provided the county with the individual source GIS layers, the characteristic layers, as well as the ArcGIS ModelBuilder application that can re-develop the final sensitivity map based on newly updated data. A brief discussion on the use of this application is included in Appendix C. This tool is designed so that County staff can add or update any of the source data layers within the model such as additional well depth locations or newly created geological maps.

5.3 FUTURE RECOMMENDATIONS

The sensitivity map created for this project can be used as a planning tool, to provide the County with information regarding which areas are more or less inherently susceptible to groundwater impacts from human activities. However,
caution should be used when applying this information to particular land parcels, since the scale of data used to generate the mapping may not be sufficient to base site-specific zoning or land-use decisions without corroboration with site-specific data. In addition, based on the public input received during the final results presentation, as well as concerns expressed by individual County officials, the County may want to consider evaluating approaches to more completely characterize groundwater vulnerability in addition to sensitivity. As mentioned earlier, groundwater vulnerability assessments can be used as a planning tool to address cumulative potential groundwater impacts. The sensitivity results that have been completed to date characterizing the general geohydrologic environment within the Helena Valley could be combined with potential point and non-point pollution source data to introduce human-influenced risk factors. For groundwater pollution by nutrients such as nitrate, human-influenced risk factors could be incorporated by delineating former agricultural areas which might still contain nitrogen below the typical root zone, current septic system locations in the rural county, or even currently irrigated lawns and croplands, among others.
6.0 REFERENCES


FIGURES
FIGURE 3

DEPTH TO INITIAL GROUNDWATER

HELENA VALLEY GROUNDWATER
VULNERABILITY STUDY
LEWIS AND CLARK COUNTY, MONTANA

Drawn By: BR    Checked By: CSA    Scale: 1:100,000    Date: 4/24/08    File: DTW initial.mxd
FIGURE 6

SURFICIAL GEOLOGY

HELENA VALLEY GROUNDWATER VULNERABILITY STUDY
LEWIS AND CLARK COUNTY, MONTANA
FIGURE 7

GEOHYDROLOGIC SETTING RATINGS

HELENA VALLEY GROUNDWATER VULNERABILITY STUDY
LEWIS AND CLARK COUNTY, MONTANA

RATING SCALE

<table>
<thead>
<tr>
<th>High : 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low : 1</td>
</tr>
</tbody>
</table>

Drawn By: BR  Checked By: CSA  Scale: 1:100,000  Date: 4/22/08  File: Geohydro.mxd
FIGURE 10

LAND SURFACE SLOPE RATINGS

HELENA VALLEY GROUNDWATER VULNERABILITY STUDY
LEWIS AND CLARK COUNTY, MONTANA

Drawn By: BR  Checked By: CSA  Scale: 1:100,000  Date: 4/18/08  File: Slope_Ratings.mxd
FIGURE 11

SOIL UNITS

HELENA VALLEY GROUNDWATER VULNERABILITY STUDY
LEWIS AND CLARK COUNTY, MONTANA

Drawn By: BR      Checked By: CSA      Scale: 1:100,000      Date: 4/18/08      File: Soil_units.mxd

1252 Commerce Drive
Laramie, WY 82070
www.trihydro.com
(P) 307/745.7474  (F) 307/744.5729

Lake
Helena

Helena City Limits
FIGURE 12

SOILS RATINGS

HELENA VALLEY GROUNDWATER VULNERABILITY STUDY
LEWIS AND CLARK COUNTY, MONTANA

Drawn By: BR  Checked By: CSA  Scale: 1:100,000  Date: 4/18/08  File: Soils.mxd

RATING SCALE

High : 10

Low : 1

Helena City Limits

Lake

Helena

0 1 Miles

Trihydro

1252 Commerce Drive
Laramie, WY 82070
www.trihydro.com
(P) 307/742.7474  (F) 307/745.7292
FIGURE 13

VADOSE ZONE RATINGS

HELENA VALLEY GROUNDWATER VULNERABILITY STUDY
LEWIS AND CLARK COUNTY, MONTANA

RATING SCALE

<table>
<thead>
<tr>
<th>Rating</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>10</td>
</tr>
<tr>
<td>Low</td>
<td>1</td>
</tr>
</tbody>
</table>

Drawn By: BR  Checked By: CSA  Scale: 1:100,000  Date: 4/22/08  File: Vadoze_zone.mxd
HELENA VALLEY GROUNDWATER
VULNERABILITY STUDY
LEWIS AND CLARK COUNTY, MONTANA

FIGURE 14
AQUIFER SENSITIVITY

SENSITIVITY SCALE

- 23 - 30 LOW
- 30 - 36 MEDIUM - LOW
- 36 - 40 MEDIUM
- 40 - 46 MEDIUM - HIGH
- 46 - 54 HIGH

Helena City Limits
Lake Helena

Scale: 1:100,000
Date: 4/24/08
File: Aquifer_sensitivity.mxd
FIGURE 15
SEPTIC SYSTEM LOCATIONS

HELENA VALLEY GROUNDWATER VULNERABILITY STUDY
LEWIS AND CLARK COUNTY, MONTANA

Drawn By: BR  Checked By: CSA  Scale: 1:100,000  Date: 4/16/08  File: Septic.mxd
APPENDIX A

BEDROCK GEOLOGY DESCRIPTIONS


<table>
<thead>
<tr>
<th>Era</th>
<th>System or series</th>
<th>Formation</th>
<th>Approximate thickness (feet)</th>
<th>General character</th>
<th>Water-yielding properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cenozoic</td>
<td>Quaternary</td>
<td>Holocene Alluvium (Qal)</td>
<td>0-100</td>
<td>Unconsolidated stream-channel, alluvial-plain, terrace, and fan deposits. Along the southern and western margins of the valley, deposits are coarse, moderately sorted, and well-rounded to subrounded cobbles, gravel, and sand intercalated with silt and clay. Material becomes better sorted and more fine grained near Lake Helena.</td>
<td>Deposits yield abundant water to wells at all locations in the valley. Yields are commonly 20 to 300 gal/min.</td>
</tr>
<tr>
<td>Cenozoic</td>
<td>Pleistocene</td>
<td>Pediments (Qtp)</td>
<td>0-50</td>
<td>Light-brown, poorly sorted, unstratified gravel, sand, and silt lag deposits unconformably overlying eroded Tertiary sediments and pre-Tertiary bedrock. Subrounded to sub-angular, pebble-to-cobble gravel clasts reflect local bedrock lithologies. Along the toe of the mapped pediments, deposits may represent thick sequences of Tertiary-Quaternary deposition in front of the pediment erosional surface.</td>
<td>Thin lag deposits are generally not an aquifer except along the toe of the pediments where thick deposits are hydraulically connected to the adjacent Quaternary alluvium and provide abundant water to wells. Yields are commonly 2 to 100 gal/min.</td>
</tr>
<tr>
<td>Tertiary</td>
<td>Pliocene to Eocene (?)</td>
<td>Sediments (undifferentiated) (Tsd)</td>
<td>0-6,000</td>
<td>Moderately well indurated, poorly sorted, tan-to-brown, micaceous sandy siltstone with laterally discontinuous sandy-pebble and cobble-gravel interbeds and lenses. Includes both Renova- and Sixmile-Creek equivalent sediments. Previous authors have referred to exposed Tertiary sediments as &quot;lake beds&quot; owing to the fine-grained nature of most of the deposits. The upper part of the unmapped sediments underlying Quaternary alluvium in the central valley represents either a different facies or stratigraphic horizon; they are indistinguishable from Quaternary alluvium in drillers' logs.</td>
<td>Sediments generally yield small quantities of water to wells owing to the small permeability of the fine-grained material and the discontinuous nature of the permeable interbeds and lenses. The upper parts of sediments underlying Quaternary alluvium in the central valley supply abundant water to wells. Yields are commonly 2 to 15 gal/min but may exceed 100 gal/min at places.</td>
</tr>
<tr>
<td>pre-Tertiary</td>
<td>Bedrock (PTb)</td>
<td>--</td>
<td>--</td>
<td>Cretaceous to Precambrian sedimentary rocks and Cretaceous plutonic and volcanic rocks surrounding the valley.</td>
<td>Permeability is mainly secondary, with wells obtaining variable quantities of water from fractures. Unit supplies significant sub-surface recharge to the valley fill. Yields are commonly 2 to 15 gal/min.</td>
</tr>
</tbody>
</table>

(Modified from Stickney, 1987)
Table 2a. Geologic and inferred hydrologic characteristics of Helena area bedrock

[Descriptions and inferences are based on detailed examination of the rocks on outcrop, drill cuttings, and cores; on examination of the rocks under the microscope; and on comparison of observed rock characteristics to descriptions of fluid production from drilling and well records. Qualitative descriptions low, moderate, and high applied to permeability and hydraulic conductivity of Helena area bedrock units can be interpreted in approximate general terms using Table 2b (Freeze and Cherry, 1979; annotations from the current study). Values on Table 2a cannot be applied for detailed quantitative evaluation at a specific site without laboratory tests of the properties of rocks drilled at the site.]

<table>
<thead>
<tr>
<th>Geologic characteristics</th>
<th>Inferred hydrologic characteristics</th>
<th>Inferred hydrologic responses in study area to</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Geologic map unit and map symbol (pl. 1)</strong></td>
<td><strong>Generalized distribution in study area</strong></td>
<td><strong>Generalized rock type</strong></td>
</tr>
<tr>
<td>Pliocene (?) and Miocene sedimentary rocks</td>
<td>Northern part of western mountains and possible thin remnants in southern part of North Hills area</td>
<td>Interbedded conglomerate, sandstone, siltstone, and tuff; minor mudstone</td>
</tr>
<tr>
<td>Oligocene volcanic rocks; may include some rocks of possible late Eocene age in the southwest part of the map area</td>
<td>South Hills, Montana City area; southern part of western mountains</td>
<td>Rhyolite flows and intrusive bodies, minor tuff, breccia, and tuffaceous sandstone; unit OvT is mainly stratified tuff and thin interbeds of sandstone and pebble conglomerate</td>
</tr>
<tr>
<td>OvT, OvVT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hydrology of the Helena Area Bedrock, West-Central Montana, 1993-98
Table 2a. Geologic and inferred hydrologic characteristics of Helena area bedrock (Continued)

<table>
<thead>
<tr>
<th>Geologic characteristics</th>
<th>Inferred hydrologic characteristics</th>
<th>Recharge</th>
<th>Protracted withdrawal of ground water</th>
<th>Protracted fluid waste disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Geologic map unit and map symbol</strong> (pl. 1)</td>
<td><strong>Generalized distribution in study area</strong></td>
<td><strong>Generalized rock type</strong></td>
<td><strong>Parallel to stratification</strong></td>
<td><strong>Perpendicular to stratification</strong></td>
</tr>
<tr>
<td>Ogs</td>
<td>Spokane Bench, South Hills, and East Helena area</td>
<td>Interbedded sandstone, conglomerate, and tuff; minor carbonaceous siltstone and mudstone</td>
<td>Moderate to high porosity and low permeability, but highly variable laterally in sandstone and conglomerate intervals; moderate to low porosity and low permeability in tuff and mudstone beds</td>
<td>Local moderate hydraulic conductivity in fractured sandstone and conglomerate intervals; clay derived from alteration of tuff can seal fractures and faults; low fluid flow in fractured tuff</td>
</tr>
<tr>
<td>Eov</td>
<td>Western mountains, including Mullan Pass areas and Dreadnought Hill</td>
<td>Andesitic and basaltic flows, breccia, and intrusive bodies</td>
<td>Low porosity and permeability where not fractured; can have intervals of moderate permeability at bases or tops of volcanic flows</td>
<td>Low porosity and permeability where not fractured</td>
</tr>
<tr>
<td>Kg</td>
<td>Western mountains, Scratch-gravel Hills, and South Hills</td>
<td>Quartz monzonite, monzonite, granite and some mafic intrusive rocks</td>
<td>Not stratified; local alignment of minerals can produce planar and linear fabrics; low porosity and permeability unless weathered and fractured</td>
<td>Not stratified; local alignment of minerals can produce planar and linear fabrics; low porosity and permeability unless weathered and fractured</td>
</tr>
<tr>
<td>Geologic characteristics</td>
<td>Inferred hydrologic characteristics</td>
<td>Inferred hydrologic responses in study area to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------------------</td>
<td>-----------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Geologic map unit symbol and map distribution in study area</strong></td>
<td><strong>Generalized rock type</strong></td>
<td><strong>Parallel to stratification</strong></td>
<td><strong>Perpendicular to stratification</strong></td>
<td><strong>Where fractured or faulted</strong></td>
</tr>
<tr>
<td>Elkhorn Mountains Volcanics</td>
<td>Western mountains; South Hills, including Prickly Pear Creek and Clancy Creek drainages</td>
<td>Andesitic volcanic rocks; ash flow tuffs; shallow intrusive rocks, and minor sedimentary rocks; mainly well indurated and locally metamorphosed</td>
<td>Generally low porosity and permeability in volcanic flows and most welded ash flow tuffs; low to locally moderate porosity and low permeability in some thin sedimentary units</td>
<td>Generally low permeability across interbedded units and within volcanic flows and shallow intrusive rocks</td>
</tr>
<tr>
<td>Upper and Lower Cretaceous sedimentary rocks: Colorado Group and Kootenai Formation; locally includes Slim Sam Formation</td>
<td>Western mountains, including Dog Creek, Uncle George Creek, and tributaries of Tenmile Creek; North Hills, northeast part; and South Hills</td>
<td>Mudstone, siltstone, thin sandstone units; some conglomerate and very thin tuff beds; locally metamorphosed adjacent to younger intrusive bodies</td>
<td>Low to moderate porosity and low permeability in mudstone and siltstone intervals; low to moderate porosity and permeability, laterally variable, in sandstone and some conglomerate intervals; low porosity and permeability in all rock types where metamorphosed</td>
<td>Fractures and faults increase permeability and hydraulic conductivity</td>
</tr>
<tr>
<td>Geologic characteristics</td>
<td>Inferred hydrologic characteristics</td>
<td>Inferred hydrologic responses in study area to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------------------------</td>
<td>-----------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Geologic map unit and map symbol (pl. 1)</strong></td>
<td><strong>Generalized distribution in study area</strong></td>
<td><strong>Generalized rock type</strong></td>
<td><strong>Parallel to stratification</strong></td>
<td><strong>Perpendicular to stratification</strong></td>
</tr>
<tr>
<td>Jurassic sedimentary rocks: Morrison Formation and Ellis Group</td>
<td>Western mountains, South Hills, and northeast part of North Hills</td>
<td>Mudstone, siltstone, and thin units of fine-grained sandstone with minor carbonaceous shale and limestone beds; locally metamorphosed where intruded by igneous rocks</td>
<td>Generally low porosity and permeability; low permeability where metamorphosed</td>
<td>Low to moderate porosity and permeability within sandstone; low permeability across mudstone and interbedded rock types</td>
</tr>
<tr>
<td>Permian and Pennsylvanian sedimentary rocks: Phosphoria, Quadrant, and Amsden Formations</td>
<td>South Hills and northeast part of North Hills</td>
<td>Silica- and calcium carbonate-cemented sandstone; thin limestone, siltstone, and dolostone beds; some thin chert in upper part</td>
<td>Generally low porosity and permeability; locally moderate porosity in intervals of dissolution in limestone and calcareous sandstone beds</td>
<td>Low to locally moderate porosity and permeability within carbonate and sandstone intervals; low permeability across mudstone and quartz-cemented sandstone intervals</td>
</tr>
</tbody>
</table>
Table 2a. Geologic and inferred hydrologic characteristics of Helena area bedrock (Continued)

<table>
<thead>
<tr>
<th>Geologic map unit and map symbol (pl. 1)</th>
<th>Generalized distribution in study area</th>
<th>Generalized rock type</th>
<th>Geologic characteristics</th>
<th>Inferred hydrologic characteristics</th>
<th>Inferred hydrologic responses in study area to</th>
<th>Protracted fluid waste disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Snowy Group; Heath, Otter, and Kibbey Formations</td>
<td>Northeast part of North Hills</td>
<td>Mudstone, siltstone, and thin limestone beds; calcareous sandstone; local dolostone breccia near base</td>
<td>Generally low porosity and permeability; locally moderate porosity and permeability in breccia near base</td>
<td>Low permeability across mudstone intervals except where fractured, and then moderate at boundaries with sandstone or limestone</td>
<td>Permeability is increased by fractures in all rock types but particularly in mudstone intervals</td>
<td>Limited episodic recharge mainly through fractures; recovery slow in mudstone intervals where not densely fractured; slow recovery after withdrawal</td>
</tr>
<tr>
<td>Madison Group: Mission Canyon Limestone and Lodgepole Limestone</td>
<td>South Hills, northeastern part of North Hills, and locally in central part of western mountains</td>
<td>Thick bedded limestone; thin bedded limestone with some calcareous siltstone in lower part; metamorphosed to calc-silicate rock where intruded by Cretaceous igneous rocks</td>
<td>Moderate porosity, permeability, and hydraulic conductivity in intervals of dissolution; low porosity and permeability where metamorphosed</td>
<td>Discontinuous low to moderate porosity and permeability; locally moderate to high permeability and hydraulic conductivity in areas of dissolution</td>
<td>Fractures significantly enhance dissolution, permeability, and hydraulic conductivity throughout the rocks; fractures are likely the main source of permeability where unit is metamorphosed</td>
<td>Moderate recovery, but strongly episodic; slow recovery after protracted withdrawal</td>
</tr>
<tr>
<td>Geologic map unit and map symbol (pl. 1)</td>
<td>Geologic characteristics</td>
<td>Inferred hydrologic characteristics</td>
<td>Inferred hydrologic responses in study area to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>---------------------------</td>
<td>------------------------------------</td>
<td>---------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three Forks and Jefferson Formations, undivided; as mapped includes some Mississippian strata at the top Dtj</td>
<td>three Forks and Jefferson Formations, undivided; as mapped includes some Mississippian strata at the top Dtj</td>
<td>Thin bedded dolostone and minor very thin limestone; mudstone and carbonaceous mudstone in uppermost part; locally metamorphosed to calcite-silicate rock adjacent to Cretaceous intrusive rocks</td>
<td>Low porosity and permeability with low hydraulic conductivity; parting parallel to stratification can locally have moderate hydraulic conductivity; low porosity and permeability where metamorphosed</td>
<td>Dissolution of carbonate minerals along and adjacent to fractures likely accounts for much of the secondary porosity, permeability, and hydraulic conductivity of the carbonate beds and mudstone</td>
<td>Moderate recovery mainly through fractures; recharge episodic; slow recovery after protracted withdrawal</td>
<td>Slow to moderate drawdown, locally rapid in intervals of dissolution; moderate to rapid drawdown where metamorphosed and fractured; overall water-level decline likely on a secular basis with protracted withdrawal</td>
</tr>
<tr>
<td>Upper and Middle Cambrian carbonate rocks: Hasmark, Pilgrim, Park and Meagher Formations Co</td>
<td>Upper and Middle Cambrian carbonate rocks: Hasmark, Pilgrim, Park and Meagher Formations Co</td>
<td>Thin to thick bedded limestone, with limestone pebble conglomerate and dolostone at top; mudstone at center and as partings in lower part; locally metamorphosed to calcisilicate rock</td>
<td>Low porosity and permeability in carbonate rocks; moderate porosity, mainly secondary, and permeability in areas of dissolution; low permeability in mudstone intervals; low or no porosity and permeability where metamorphosed</td>
<td>Dissolution of carbonate minerals along and adjacent to fractures likely accounts for much of the secondary porosity, permeability, and hydraulic conductivity of the carbonate beds and mudstone</td>
<td>Limited episodic recharge mainly through fractures; locally moderate recharge where fractures connect units containing dissolution cavities and vugs; generally slow, but locally moderate recovery; slow recovery after protracted withdrawal</td>
<td>Moderate drawdown in intervals of dissolution; moderate to rapid drawdown where fractured; overall water-level decline likely on a secular basis with protracted withdrawal</td>
</tr>
<tr>
<td>Geologic map unit and map symbol (pl. 1)</td>
<td>Generalized distribution in study area</td>
<td>Generalized rock type</td>
<td>Geologic characteristics</td>
<td>Inferred hydrologic characteristics</td>
<td>Inferred hydrologic responses in study area to</td>
<td>Recharge</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>----------------------------------------</td>
<td>-----------------------</td>
<td>--------------------------</td>
<td>-------------------------------------</td>
<td>-----------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Middle Cambrian clastic rocks: Wolsey Shale and Flathead Formation</td>
<td>Western mountains in northern tributaries of Tennesse Creek; South Hills; east of North Hills</td>
<td>Upper part: micaceous mudstone and siltstone beds with local thin limestone beds. Lower part: quartz-cemented sandstone and thin conglomerate with mudstone partings</td>
<td>Low porosity and permeability; where not fractured low hydraulic conductivity</td>
<td>Low porosity and permeability; where not fractured low hydraulic conductivity</td>
<td>Fluid flow and storage primarily in fractures and faults; low to moderate fluid flow through fractures</td>
<td>Likely slow recharge through fractures; episodic; slow recovery after withdrawal</td>
</tr>
<tr>
<td>Intrusive rocks: Late Proterozoic</td>
<td>Scratchgravels Hills; western mountains in lower reaches of Sevensmile Creek</td>
<td>Medium to coarsely crystalline gabbro and diorite</td>
<td>Generally no stratification but can have parallel alignment of platy and tabular minerals; generally low porosity and permeability; low hydraulic conductivity; may have moderate permeability where deeply weathered</td>
<td>Generally low porosity and permeability; low hydraulic conductivity; may have moderate permeability where deeply weathered</td>
<td>Fluid flow and storage primarily in fractures; generally low fluid flow through fractures</td>
<td>Area-limited outcrop area; likely very slow recharge through fractures; episodic; slow recovery after withdrawal</td>
</tr>
<tr>
<td>Geologic map unit and map symbol (pl. 1)</td>
<td>Generalized distribution in study area</td>
<td>Generalized rock type</td>
<td>Geologic characteristics</td>
<td>Inferred hydrologic characteristics</td>
<td>Inferred hydrologic responses in study area to</td>
<td>Protraced withdrawal of ground water</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>----------------------------------------</td>
<td>-----------------------</td>
<td>--------------------------</td>
<td>-------------------------------------</td>
<td>-----------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Bonner Quartzite</td>
<td>Western mountains including upper tributaries of Dog Creek and Greenhorn Mountain area</td>
<td>Medium- and coarse-grained quartzite; some fine pebbles; argillite partings</td>
<td>Low porosity and permeability where not fractured; low moderate porosity where cement has dissolved; low hydraulic conductivity</td>
<td>Low porosity and permeability where not fractured; low hydraulic conductivity</td>
<td>Fluid flow and storage primarily in fractures and faults; low to moderate fluid flow through fractures</td>
<td>Recharge episodic; mainly through fractures; likely slow recharge</td>
</tr>
<tr>
<td>Ybo</td>
<td>Interbedded argillite and siltite with thin intervals of quartzite; quartzite beds fine upward into argillite</td>
<td>Low porosity and permeability where not fractured; low hydraulic conductivity</td>
<td>Low porosity and permeability where not fractured; low hydraulic conductivity across stratification</td>
<td>Hydraulic conductivity, fluid flow, and storage mainly in fractures and some faults</td>
<td>Recharge episodic, mainly through fractures; likely slow recharge; slow recovery after withdrawal</td>
<td>Moderate drawdown; overall water-level decline likely on a secular basis with protracted withdrawal</td>
</tr>
<tr>
<td>Mount Shields Formation</td>
<td>Western mountains, north-central part</td>
<td>Quartzite; argillite and siltite; some calcareous argillite and limestone in Shepard Formation</td>
<td>Low porosity and permeability where not fractured; low hydraulic conductivity</td>
<td>Limited porosity and permeability where not fractured; low to no hydraulic conductivity across stratification</td>
<td>Fluid flow and storage mainly in fractures and some faults</td>
<td>Recharge episodic, mainly through fractures; likely slow recharge</td>
</tr>
<tr>
<td>Yms</td>
<td>Quartzite; argillite and siltite; some calcareous argillite and limestone in Shepard Formation</td>
<td>Low porosity and permeability where not fractured; low hydraulic conductivity</td>
<td>Low porosity and permeability where not fractured; low hydraulic conductivity across stratification</td>
<td>Limited porosity and permeability where not fractured; low to no hydraulic conductivity across stratification</td>
<td>Fluid flow and storage mainly in fractures and some faults</td>
<td>Recharge episodic, mainly through fractures; likely slow recharge</td>
</tr>
<tr>
<td>Geologic map unit and map symbol (pl. 1)</td>
<td>Generalized distribution in study area</td>
<td>Generalized rock type</td>
<td>Geologic characteristics</td>
<td>Inferred hydrologic characteristics</td>
<td>Inferred hydrologic responses in study area to</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>---------------------------------------</td>
<td>-----------------------</td>
<td>--------------------------</td>
<td>------------------------------------</td>
<td>-----------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Helena and Empire Formations, undivided</td>
<td>Western mountains, east-central and northern parts; Scratch-gravel Hills; South Hills, south of East Helena</td>
<td>Dolomitic argillite and siltite; limestone and dolostone; argillite and very thin quartzite beds in lowest parts; locally metamorphosed to calc-silicate rock</td>
<td>Generally low porosity and permeability</td>
<td>Porosity enhanced in carbonate beds and some sandstone beds by dissolution of carbonate and silica; generally low permeability across beds</td>
<td>Fluid flow and storage mainly in fractures and some faults; some dissolution of carbonate beds adjacent to fractures</td>
<td>Slow to moderate recharge; episodic recharge mainly through fractures; slow recovery after withdrawal</td>
</tr>
<tr>
<td>Spokane Formation</td>
<td>North Hills; South Hills east of Helena</td>
<td>Argillite and siltite with very thin limestone and quartz sandstone in uppermost and lowest part; recrystallized to coarser grains by metamorphism adjacent to intrusive bodies</td>
<td>Low porosity, permeability and hydraulic conductivity where not fractured; no porosity and permeability where strongly metamorphosed</td>
<td>Generally low hydraulic conductivity where not fractured</td>
<td>Porosity, fluid storage, and fluid flow mainly in fractures and some faults</td>
<td>Recharge episodic, mainly through fractures; likely slow recharge; slow recovery after withdrawal</td>
</tr>
</tbody>
</table>
Table 2a. Geologic and inferred hydrologic characteristics of Helena area bedrock (Continued)

<table>
<thead>
<tr>
<th>Geologic characteristics</th>
<th>Inferred hydrologic characteristics</th>
<th>Inferred hydrologic responses in study area to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geologic map unit and map symbol (pl. 1)</td>
<td>Generalized distribution in study area</td>
<td>Generalized rock type</td>
</tr>
<tr>
<td>Greyson Formation Yg</td>
<td>North Hills; South Hills east of Helena</td>
<td>Siltite and argillite with quartzite in uppermost part</td>
</tr>
</tbody>
</table>

---

**Table 2a:**

Continued below.
APPENDIX B

SOIL UNITS DATA AND RATINGS
<table>
<thead>
<tr>
<th>Soil Unit Description</th>
<th>Unit Symbol</th>
<th>% Clay, Soil Unit</th>
<th>% Sand, Soil Unit</th>
<th>Ksat, Soil Unit</th>
<th>USDA Texture</th>
<th>Rock Fragments</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aridic Ustifluvents, 0 to 4 percent slopes</td>
<td>1B</td>
<td>9.5</td>
<td>64.1</td>
<td>58.1</td>
<td>sandy loam</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Scravo gravelly loam, 0 to 2 percent slopes</td>
<td>9A</td>
<td>7.4</td>
<td>83.6</td>
<td>72.1</td>
<td>loamy sand</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Fairway silt loam, 0 to 2 percent slopes</td>
<td>20A</td>
<td>19.3</td>
<td>39.9</td>
<td>29.1</td>
<td>loam</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Sappington-Amesha loams, 1 to 4 percent slopes</td>
<td>33B</td>
<td>14.8</td>
<td>48.2</td>
<td>9.2</td>
<td>loam</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Sappington</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60%</td>
<td></td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>60</td>
<td>0</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amesha</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35%</td>
<td></td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>32</td>
<td>0</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td></td>
<td>60</td>
<td>0</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sappington-Amesha loams, 4 to 8 percent slopes</td>
<td>33C</td>
<td>15.0</td>
<td>48.8</td>
<td>9.0</td>
<td>loam</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Sappington</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50%</td>
<td></td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>60</td>
<td>0</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amesha</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40%</td>
<td></td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>32</td>
<td>0</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td></td>
<td>60</td>
<td>0</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinook sandy loam, 2 to 8 percent slopes</td>
<td>39B</td>
<td>10.8</td>
<td>65.6</td>
<td>27.1</td>
<td>sandy loam</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Rock outcrop-Rubble land</td>
<td>40D</td>
<td>21.9</td>
<td>39.1</td>
<td>48.6</td>
<td>loam</td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

No data
### APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY

<table>
<thead>
<tr>
<th>Soil Unit Description</th>
<th>Unit Symbol</th>
<th>Top Depth, inches</th>
<th>Bottom Depth, Inches</th>
<th>% Clay, Soil Unit</th>
<th>% Sand, Soil Unit</th>
<th>Ksat, Soil Unit</th>
<th>USDA Texture</th>
<th>Rock Fragments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rootel-Musselshell loams, 2 to 8 percent slopes</td>
<td>41C</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rootel</td>
<td>55%</td>
<td>4</td>
<td>36</td>
<td>15</td>
<td>45</td>
<td>36</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>Musselshell</td>
<td>35%</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>15</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Holter-Castner channery loams, 8 to 45 percent slopes</td>
<td>61E</td>
<td>0</td>
<td>8</td>
<td>25</td>
<td>45</td>
<td>8</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Holter</td>
<td>60%</td>
<td>8</td>
<td>12</td>
<td>50</td>
<td>70</td>
<td>12</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>Castner</td>
<td>25%</td>
<td>0</td>
<td>4</td>
<td>25</td>
<td>40</td>
<td>4</td>
<td>13</td>
<td>40</td>
</tr>
<tr>
<td>Windham channery loam, 4 to 15 percent slopes</td>
<td>64D</td>
<td>95%</td>
<td>0</td>
<td>7</td>
<td>25</td>
<td>30</td>
<td>0</td>
<td>75</td>
</tr>
<tr>
<td>Geohrock channery loam, cool, 4 to 25 percent slopes</td>
<td>89D</td>
<td>85%</td>
<td>0</td>
<td>4</td>
<td>25</td>
<td>4</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td>Neen silt loam, 0 to 2 percent slopes</td>
<td>115A</td>
<td>97%</td>
<td>0</td>
<td>60</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Amesha silt loam, 1 to 3 percent slopes</td>
<td>136B</td>
<td>90%</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40</td>
<td>0</td>
</tr>
</tbody>
</table>

H:\Projects\Lewis&ClarkCounty\944-001-001\Final\Final Revised Report\200807_Soil Units Data and Ratings_APP-B
<table>
<thead>
<tr>
<th>Soil Unit Description</th>
<th>Unit</th>
<th>% Clay, Soil Unit</th>
<th>% Sand, Soil Unit</th>
<th>Ksat, Soil Unit</th>
<th>USDA Texture</th>
<th>Top Depth, inches</th>
<th>Bottom Depth, Inches</th>
<th>% Fragments, Estimated Range</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musselshell-Crago complex, 2 to 8 percent slopes</td>
<td>Musselshell</td>
<td>70%</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>15</td>
<td>4</td>
<td>34 60 45 70</td>
<td>6</td>
</tr>
<tr>
<td>Crago</td>
<td>25%</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>6</td>
<td>34 60 45 70</td>
<td>4</td>
<td>32 60 65 85</td>
<td></td>
</tr>
<tr>
<td>Musselshell-Crago complex, 2 to 8 percent slopes</td>
<td>Musselshell</td>
<td>70%</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>15</td>
<td>4</td>
<td>34 60 45 70</td>
<td>6</td>
</tr>
<tr>
<td>Crago</td>
<td>25%</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>6</td>
<td>34 60 45 70</td>
<td>4</td>
<td>32 60 65 85</td>
<td></td>
</tr>
<tr>
<td>Crittenden-Tolman complex, 4 to 35 percent slopes</td>
<td>138D</td>
<td>17.4</td>
<td>17</td>
<td>15</td>
<td>8</td>
<td>31 50 50 70</td>
<td>5 60 60 Unw Bdx</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Crittenden</td>
<td>70%</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>25</td>
<td>20 31 15 40</td>
<td>31 50 50 70</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Tolman</td>
<td>25%</td>
<td>0</td>
<td>10</td>
<td>5</td>
<td>15</td>
<td>10 19 50 60</td>
<td>19 60 Unw Bdx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crittenden-Tolman complex, 4 to 35 percent slopes</td>
<td>138D</td>
<td>17.4</td>
<td>17</td>
<td>15</td>
<td>8</td>
<td>31 50 50 70</td>
<td>5 60 60 Unw Bdx</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Crittenden</td>
<td>70%</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>25</td>
<td>20 31 15 40</td>
<td>31 50 50 70</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Tolman</td>
<td>25%</td>
<td>0</td>
<td>10</td>
<td>5</td>
<td>15</td>
<td>10 19 50 60</td>
<td>19 60 Unw Bdx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crago-Pensore channery loams, 15 to 45 percent slopes</td>
<td>141E</td>
<td>22.4</td>
<td>22</td>
<td>4</td>
<td>9</td>
<td>40</td>
<td>45</td>
<td>32 60 Unw Bdx</td>
<td>7</td>
</tr>
<tr>
<td>Crago</td>
<td>55%</td>
<td>0</td>
<td>4</td>
<td>30</td>
<td>45</td>
<td>4</td>
<td>30 45</td>
<td>32 60 Unw Bdx</td>
<td>7</td>
</tr>
<tr>
<td>Pensore</td>
<td>35%</td>
<td>0</td>
<td>4</td>
<td>15</td>
<td>40</td>
<td>4</td>
<td>15 45</td>
<td>15 60 Unw Bdx</td>
<td></td>
</tr>
<tr>
<td>Geohrock-Tolman channery loams, 4 to 35 percent slopes</td>
<td>163D</td>
<td>22.1</td>
<td>22</td>
<td>4</td>
<td>16</td>
<td>16</td>
<td>20 65 80 100</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Geohrock</td>
<td>55%</td>
<td>0</td>
<td>4</td>
<td>25</td>
<td>45</td>
<td>4</td>
<td>10 30</td>
<td>10 18 40 Unw Bdx</td>
<td>8</td>
</tr>
<tr>
<td>Tolman</td>
<td>40%</td>
<td>0</td>
<td>5</td>
<td>40</td>
<td>45</td>
<td>5</td>
<td>19 50</td>
<td>5 19 60 Unw Bdx</td>
<td></td>
</tr>
</tbody>
</table>
# APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY

<table>
<thead>
<tr>
<th>Soil Unit Description</th>
<th>Unit Symbol</th>
<th>% Clay, Soil Unit</th>
<th>% Sand, Soil Unit</th>
<th>Ksat, Soil Unit</th>
<th>USDA Texture</th>
<th>Rock Fragments</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windham-Lap channery loams, 8 to 45 percent slopes</td>
<td>164E</td>
<td>25.2</td>
<td>38.6</td>
<td>9.1</td>
<td>loam</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Windham</td>
<td>75%</td>
<td>0</td>
<td>7</td>
<td>25</td>
<td>75</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>30</td>
<td>15</td>
<td>65</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>60</td>
<td>70</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lap</td>
<td>20%</td>
<td>0</td>
<td>6</td>
<td>30</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>8</td>
<td>45</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td>14</td>
<td>65</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14</td>
<td>60</td>
<td>Unw Bdx</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nippt very cobbly loam, 0 to 4 percent slopes</td>
<td>206A</td>
<td>7.0</td>
<td>84.3</td>
<td>73.5</td>
<td>loamy sand</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>95%</td>
<td>0</td>
<td>3</td>
<td>35</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>9</td>
<td>25</td>
<td>65</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
<td>15</td>
<td>55</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>60</td>
<td>65</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thess loam, 0 to 2 percent slopes</td>
<td>209A</td>
<td>9.8</td>
<td>73.8</td>
<td>84.8</td>
<td>sandy loam</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>90%</td>
<td>0</td>
<td>25</td>
<td>0</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>60</td>
<td>70</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meadowcreek-Fairway complex, 0 to 2 percent slopes</td>
<td>218A</td>
<td>16.1</td>
<td>55.4</td>
<td>38.8</td>
<td>sandy loam</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Meadowcreek</td>
<td>70%</td>
<td>0</td>
<td>35</td>
<td>0</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>60</td>
<td>65</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairway</td>
<td>25%</td>
<td>0</td>
<td>45</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>45</td>
<td>60</td>
<td>0</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geohrock-Crago very cobbly loams, 2 to 8 percent slopes</td>
<td>233C</td>
<td>19.8</td>
<td>46.5</td>
<td>20.8</td>
<td>loam</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Geohrock</td>
<td>60%</td>
<td>0</td>
<td>4</td>
<td>60</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>10</td>
<td>40</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>18</td>
<td>45</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
<td>60</td>
<td>75</td>
<td>90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crago</td>
<td>30%</td>
<td>0</td>
<td>4</td>
<td>35</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>32</td>
<td>25</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>32</td>
<td>60</td>
<td>55</td>
<td>75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY

<table>
<thead>
<tr>
<th>Soil Unit Description</th>
<th>Unit Symbol</th>
<th>% Clay, Soil Unit</th>
<th>% Sand, Soil Unit</th>
<th>Ksat, Soil Unit</th>
<th>USDA Texture</th>
<th>Rock Fragments</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assinniboine-Chinook sandy loams, 2 to 8 percent slopes</td>
<td>238B</td>
<td>14.3</td>
<td>65.8</td>
<td>23.8</td>
<td>sandy loam</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Assinniboine</td>
<td>45%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinook</td>
<td>40%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hauz-Sieben-Tolman channery loams, 8 to 45 percent slopes</td>
<td>263E</td>
<td>22.3</td>
<td>39.7</td>
<td>11.8</td>
<td>loam</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Hauz</td>
<td>35%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15 45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sieben</td>
<td>30%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15 45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolman</td>
<td>25%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15 45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woodgulch-Elbeth-Rock outcrop complex, 8 to 35 percent slopes</td>
<td>286E</td>
<td>8.6</td>
<td>79.5</td>
<td>80.5</td>
<td>loamy sand</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Woodgulch</td>
<td>45%</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elbeth</td>
<td>30%</td>
<td>0</td>
<td>38</td>
<td>5</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock outcrop</td>
<td>15%</td>
<td>38</td>
<td>60</td>
<td>10</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frenchcreek very gravelly loam, 2 to 15 percent slopes</td>
<td>288C</td>
<td>15.2</td>
<td>55.0</td>
<td>38.4</td>
<td>sandy loam</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>90%</td>
<td>0</td>
<td>5</td>
<td>50</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>5</td>
<td>65</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>5</td>
<td>75</td>
<td>85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typic Ustifluvents, 0 to 4 percent slopes</td>
<td>301B</td>
<td>21.8</td>
<td>45.2</td>
<td>26.2</td>
<td>loam</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>90%</td>
<td>0</td>
<td>5</td>
<td>50</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>12</td>
<td>65</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>60</td>
<td>75</td>
<td>85</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

H:\Projects\Lewis\ClarkCounty\944-001-0001\Final\Final Revised Report\200807_Soil Units Data and Ratings_APP-B

5 of 11
### APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY

<table>
<thead>
<tr>
<th>Soil Unit Description</th>
<th>Unit Symbol</th>
<th>% Clay, Soil Unit</th>
<th>% Sand, Soil Unit</th>
<th>Ksat, Soil Unit</th>
<th>USDA Texture</th>
<th>Rock Fragments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nippt-Attewan-Beaverell complex, 0 to 4 percent slopes</td>
<td>306A</td>
<td>7.9</td>
<td>78.1</td>
<td>79.9</td>
<td>loamy sand</td>
<td>9</td>
</tr>
<tr>
<td>Nippt</td>
<td></td>
<td>55%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>3</td>
<td>25</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>9</td>
<td>30</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
<td>15</td>
<td>65</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>60</td>
<td>75</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Attewan</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>10</td>
<td>0</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>23</td>
<td>0</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>23</td>
<td>60</td>
<td>50</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Beaverell</td>
<td></td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>3</td>
<td>25</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>11</td>
<td>50</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>11</td>
<td>60</td>
<td>45</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Villy silt loam, 0 to 2 percent slopes</td>
<td>308A</td>
<td>27.6</td>
<td>8.0</td>
<td>3.7</td>
<td>silty clay loam</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>95%</td>
<td>0</td>
<td>60</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Thess-Scravo complex, 0 to 2 percent slopes</td>
<td>309A</td>
<td>8.7</td>
<td>78.5</td>
<td>78.8</td>
<td>sandy loam</td>
<td>9</td>
</tr>
<tr>
<td>Thess</td>
<td></td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>25</td>
<td>0</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>60</td>
<td>70</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Scravo</td>
<td></td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>6</td>
<td>25</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>60</td>
<td>70</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Musselshell-Crago-Pensore complex, 4 to 25 percent slopes</td>
<td>341D</td>
<td>19.7</td>
<td>44.8</td>
<td>12.4</td>
<td>loam</td>
<td>6</td>
</tr>
<tr>
<td>Musselshell</td>
<td></td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>34</td>
<td>0</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>34</td>
<td>60</td>
<td>45</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Crago</td>
<td></td>
<td>25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>4</td>
<td>30</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>32</td>
<td>40</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>32</td>
<td>60</td>
<td>65</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Pensore</td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>4</td>
<td>25</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>15</td>
<td>45</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>60 Unw Bdx</td>
<td>45</td>
<td>65</td>
<td></td>
</tr>
</tbody>
</table>
## APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY

<table>
<thead>
<tr>
<th>Soil Unit Description</th>
<th>Unit Symbol</th>
<th>% Clay, Soil Unit</th>
<th>% Sand, Soil Unit</th>
<th>Ksat, Soil Unit</th>
<th>USDA Texture</th>
<th>Rock Fragments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Depth, inches</td>
<td>Bottom Depth, Inches</td>
<td>% Fragments, Estimated Range</td>
<td>Rating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolman-Rock outcrop complex, 15 to 60 percent slopes</td>
<td>363F</td>
<td>25.1</td>
<td>37.0</td>
<td>10.0</td>
<td>loam</td>
<td>8</td>
</tr>
<tr>
<td>Tolman</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Fragments, Estimated Range</td>
<td>Top Depth, inches</td>
<td>Bottom Depth, Inches</td>
<td>% Fragments, Estimated Range</td>
<td>Rating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock outcrop</td>
<td>25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nipit gravelly loam, 0 to 2 percent slopes</td>
<td>406A</td>
<td>7.0</td>
<td>84.0</td>
<td>73.0</td>
<td>loamy sand</td>
<td>9</td>
</tr>
<tr>
<td>Nipit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Fragments, Estimated Range</td>
<td>Top Depth, inches</td>
<td>Bottom Depth, Inches</td>
<td>% Fragments, Estimated Range</td>
<td>Rating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Villard-Villy silt loams, 0 to 2 percent slopes</td>
<td>408A</td>
<td>18.6</td>
<td>46.0</td>
<td>60.3</td>
<td>loam</td>
<td>8</td>
</tr>
<tr>
<td>Villard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Fragments, Estimated Range</td>
<td>Top Depth, inches</td>
<td>Bottom Depth, Inches</td>
<td>% Fragments, Estimated Range</td>
<td>Rating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attewan loam, 0 to 2 percent slopes</td>
<td>413A</td>
<td>11.1</td>
<td>65.0</td>
<td>63.7</td>
<td>sandy loam</td>
<td>9</td>
</tr>
<tr>
<td>Attewan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Fragments, Estimated Range</td>
<td>Top Depth, inches</td>
<td>Bottom Depth, Inches</td>
<td>% Fragments, Estimated Range</td>
<td>Rating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crago-Musselshell gravelly loams, 4 to 35 percent slopes</td>
<td>433E</td>
<td>21.5</td>
<td>44.4</td>
<td>12.5</td>
<td>loam</td>
<td>7</td>
</tr>
<tr>
<td>Crago</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Fragments, Estimated Range</td>
<td>Top Depth, inches</td>
<td>Bottom Depth, Inches</td>
<td>% Fragments, Estimated Range</td>
<td>Rating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Musselshell</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

H:\Projects\Lewis&ClarkCounty\944-001-001\Final\Final Revised Report\200807_Soil Units Data and Ratings_APP-B 7 of 11
# APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY

<table>
<thead>
<tr>
<th>Soil Unit Description</th>
<th>Unit Symbol</th>
<th>% Clay, Soil Unit</th>
<th>% Sand, Soil Unit</th>
<th>Ksat, Soil Unit</th>
<th>USDA Texture</th>
<th>Rock Fragments</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Top Depth, inches</td>
<td>Bottom Depth, Inches</td>
</tr>
<tr>
<td>Beaverell-Ashlo very cobbly loams, 0 to 2 percent slopes</td>
<td>465A</td>
<td>10.1</td>
<td>48.9</td>
<td>86.1</td>
<td>loam</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td>Fluvaquents and Fluvaquentic Haplustolls soils, 0 to 4 percent slopes</td>
<td>501B</td>
<td>20.9</td>
<td>38.6</td>
<td>21.7</td>
<td>loam</td>
<td>0</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>43</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>Nippt-Attewan complex, 0 to 2 percent slopes</td>
<td>506A</td>
<td>7.7</td>
<td>80.7</td>
<td>104.1</td>
<td>loamy sand</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23</td>
<td>60</td>
</tr>
<tr>
<td>Attewan-Nippt complex, 0 to 2 percent slopes</td>
<td>513A</td>
<td>9.6</td>
<td>71.9</td>
<td>65.3</td>
<td>sandy loam</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>Soil Unit Description</td>
<td>Unit Symbol</td>
<td>% Clay, Soil Unit</td>
<td>% Sand, Soil Unit</td>
<td>Ksat, Soil Unit</td>
<td>USDA Texture</td>
<td>Rock Fragments</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>-------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>--------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>Top Depth, inches</td>
<td>Bottom Depth, Inches</td>
<td>% Fragments, Estimated Range</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairway-Villy silt loams, 0 to 2 percent slopes</td>
<td>520A</td>
<td>22.7</td>
<td>26.8</td>
<td>18.6</td>
<td>silt loam</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Fairway</td>
<td>45%</td>
<td>0</td>
<td>45</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Villy</td>
<td>40%</td>
<td>0</td>
<td>60</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geohrock gravelly loam, 2 to 8 percent slopes</td>
<td>532B</td>
<td>19.5</td>
<td>43.5</td>
<td>24.5</td>
<td>loam</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Tolex-Tolman-Hauz channery loams, 8 to 45 percent slopes</td>
<td>563E</td>
<td>23.4</td>
<td>38.4</td>
<td>25.7</td>
<td>loam</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Tolex</td>
<td>40%</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolman</td>
<td>35%</td>
<td>0</td>
<td>5</td>
<td>40</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hauz</td>
<td>20%</td>
<td>0</td>
<td>5</td>
<td>25</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yamacall-Attewan loams, 0 to 2 percent slopes</td>
<td>569A</td>
<td>18.0</td>
<td>49.7</td>
<td>33.3</td>
<td>loam</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Yamacall</td>
<td>50%</td>
<td>0</td>
<td>60</td>
<td>0</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attewan</td>
<td>45%</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crago gravelly loam, 0 to 8 percent slopes</td>
<td>637B</td>
<td>24.4</td>
<td>39.4</td>
<td>12.1</td>
<td>loam</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>90%</td>
<td>0</td>
<td>4</td>
<td>30</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>32</td>
<td>40</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>60</td>
<td>65</td>
<td>85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Unit Description</td>
<td>Symbol</td>
<td>% Clay, Soil Unit</td>
<td>% Sand, Soil Unit</td>
<td>Ksat, Soil Unit</td>
<td>USDA Texture</td>
<td>Rock Fragments</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------</td>
<td>--------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>--------------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>Windham-Whitecow-Lap channery loams, 15 to 45 percent slopes</td>
<td>664E</td>
<td>25.4</td>
<td>38.4</td>
<td>10.0</td>
<td>loam</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Windham</td>
<td></td>
<td>45%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 7 25 75</td>
<td>30 60 70 85</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whitecrow</td>
<td></td>
<td>35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 1 0 0</td>
<td>1 3 15 40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 25 40 75</td>
<td>25 60 65 85</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lap</td>
<td></td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 6 30 50</td>
<td>6 8 45 70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 14 65 80</td>
<td>14 60 Unw Bdx</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whitecow channery loam, cool, 25 to 60 percent slopes</td>
<td>685F</td>
<td>25.8</td>
<td>38.0</td>
<td>11.6</td>
<td>loam</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>95%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 1 0 0</td>
<td>1 3 15 40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 25 40 75</td>
<td>25 60 65 85</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crittenden-Kalsted, bedrock substratum, sandy loams, 2 to 8 percent</td>
<td>738B</td>
<td>13.4</td>
<td>61.3</td>
<td>38.3</td>
<td>sandy loam</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Crittenden</td>
<td></td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 20 0 25</td>
<td>20 31 15 40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>31 50 50 70</td>
<td>50 60 Unw Bdx</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kalsted</td>
<td></td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 30 0 15</td>
<td>30 50 15 45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 60 Unw Bdx</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Villy silt loam, 0 to 2 percent slopes, very rarely flooded</td>
<td>808A</td>
<td>27.8</td>
<td>7.0</td>
<td>2.9</td>
<td>silty clay loam</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Villy</td>
<td></td>
<td>95%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 60 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY

<table>
<thead>
<tr>
<th>Soil Unit Description</th>
<th>Unit Symbol</th>
<th>% Clay, Soil Unit</th>
<th>% Sand, Soil Unit</th>
<th>Ksat, Soil Unit</th>
<th>USDA Texture</th>
<th>Top Depth, inches</th>
<th>Bottom Depth, Inches</th>
<th>% Fragments, Estimated Range</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whitecow-Warneke channery loams, 15 to 45 percent slopes</td>
<td>885F</td>
<td>23.7</td>
<td>39.3</td>
<td>10.9</td>
<td>loam</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Whitecrow</td>
<td>70%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>25</td>
<td>40</td>
<td>75</td>
</tr>
<tr>
<td>Warneke</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>60</td>
<td>65</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>4</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>16</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>60</td>
<td>Unw Bdx</td>
<td></td>
</tr>
<tr>
<td>Tolex-Mocmont-Rock outcrop complex, 25 to 60 percent slopes</td>
<td>963F</td>
<td>23.1</td>
<td>38.0</td>
<td>43.7</td>
<td>loam</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tolex</td>
<td>45%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>5</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>18</td>
<td>75</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
<td>60</td>
<td>Unw Bdx</td>
<td></td>
</tr>
<tr>
<td>Mocmont</td>
<td>35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>16</td>
<td>45</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>60</td>
<td>60</td>
<td>90</td>
</tr>
<tr>
<td>Rock Outcrop</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unw Bdx</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
Percent clay, percent sand, and saturated hydraulic conductivity are calculated as a weighted average for the entire map unit, and USDA textural description is based on these average values.

Rock fragments are defined as those clasts greater than 2 mm, and is a visual observation made in the field. Estimated ranges are indicated based on individually identified soil horizons. "Unw Bdx" indicates that unweathered bedrock was encountered at the base of soil unit.

Soil unit may be composed of several soils. The percent of each individual soil that comprises the soil unit is indicated.
APPENDIX C

INSTRUCTIONS FOR USING
AQUIFER SENSITIVITY GIS MODEL
Appendix C
Aquifer Sensitivity GIS Model Instructions

The Aquifer Sensitivity model is an ArcToolbox (v. 9.2) tool created within ModelBuilder. It was created to assist in and document the workflow used to develop an aquifer sensitivity analysis for Lewis & Clark County, Montana as well as re-develop the final sensitivity map based on newly updated data.

The following graphic shows a portion of the dialog box for the tool.

The ability to select input data sets, paths for output data sets, and fields necessary for analysis have been provided. Help for each parameter within the dialog box has also been provided.

Before the model is run for the first time, output paths for intermediate data will need to be set. To do this, open the model for editing within ModelBuilder by right-clicking the model and choosing ‘Edit’. Then double-click on intermediate output data sets (green ovals) and enter the appropriate path. There are 7 intermediate data sets.

Metadata for this tool is accessible from the ‘Metadata’ tab in ArcCatalog.
APPENDIX D

METADATA
## Appendix D – Metadata

### Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.1</td>
<td>Helena Valley Montana 2001 Land Surface Contour DEM</td>
<td>2</td>
</tr>
<tr>
<td>D.2</td>
<td>Helena Valley Montana 2006 Land Surface Contour DEM</td>
<td>5</td>
</tr>
<tr>
<td>D.3</td>
<td>Lewis &amp; Clark County Address Points</td>
<td>8</td>
</tr>
<tr>
<td>D.4</td>
<td>Generalized Bedrock Geologic Map of the Helena Area, West-Central Montana</td>
<td>12</td>
</tr>
<tr>
<td>D.5</td>
<td>Helena Valley Montana Surficial Geology</td>
<td>25</td>
</tr>
<tr>
<td>D.6</td>
<td>BLM Quarter-Quarter Sections</td>
<td>29</td>
</tr>
<tr>
<td>D.7</td>
<td>BLM Sections</td>
<td>45</td>
</tr>
<tr>
<td>D.8</td>
<td>BLM Townships</td>
<td>55</td>
</tr>
<tr>
<td>D.9</td>
<td>Lewis &amp; Clark County Blocks</td>
<td>69</td>
</tr>
<tr>
<td>D.10</td>
<td>Helena Valley Montana 10 Meter DEM</td>
<td>72</td>
</tr>
<tr>
<td>D.11</td>
<td>Helena Valley Montana Extended Study Area Boundary</td>
<td>75</td>
</tr>
<tr>
<td>D.12</td>
<td>Montana Groundwater Information Center Water Well Data</td>
<td>79</td>
</tr>
<tr>
<td>D.13</td>
<td>Helena City Limit Boundary</td>
<td>86</td>
</tr>
<tr>
<td>D.14</td>
<td>Helena Valley Montana Hillshade</td>
<td>90</td>
</tr>
<tr>
<td>D.15</td>
<td>NHD 1:24,000 scale Lakes</td>
<td>93</td>
</tr>
<tr>
<td>D.16</td>
<td>Helena Valley Montana National Wetlands Inventory</td>
<td>99</td>
</tr>
<tr>
<td>D.17</td>
<td>NHD 1:24,000 scale Streams</td>
<td>105</td>
</tr>
<tr>
<td>D.18</td>
<td>Lewis &amp; Clark County Parcels</td>
<td>111</td>
</tr>
<tr>
<td>D.19</td>
<td>Montana Average Annual Precipitation, 1971-2000</td>
<td>114</td>
</tr>
<tr>
<td>D.20</td>
<td>Helena Valley Montana Precipitation Isohyets</td>
<td>121</td>
</tr>
<tr>
<td>D.21</td>
<td>Lewis &amp; Clark County Roads</td>
<td>125</td>
</tr>
<tr>
<td>D.22</td>
<td>Extended Study Area Septic System Locations in Lewis &amp; Clark County Montana</td>
<td>132</td>
</tr>
<tr>
<td>D.23</td>
<td>Helena Valley Montana Slope</td>
<td>135</td>
</tr>
<tr>
<td>D.24</td>
<td>Soil Survey Geographic (SSURGO) database for Lewis and Clark County Area, Montana</td>
<td>138</td>
</tr>
<tr>
<td>D.25</td>
<td>Lewis &amp; Clark County Zoning</td>
<td>159</td>
</tr>
<tr>
<td>D.26</td>
<td>Depth to Water Rating</td>
<td>163</td>
</tr>
<tr>
<td>D.27</td>
<td>Geohydrologic Setting - Rating</td>
<td>168</td>
</tr>
<tr>
<td>D.28</td>
<td>Aquifer Recharge - Rating</td>
<td>173</td>
</tr>
<tr>
<td>D.29</td>
<td>Land Surface Slope Rating</td>
<td>177</td>
</tr>
<tr>
<td>D.30</td>
<td>Soils Rating</td>
<td>181</td>
</tr>
<tr>
<td>D.31</td>
<td>Vadose Zone Ratings</td>
<td>185</td>
</tr>
<tr>
<td>D.32</td>
<td>Aquifer Sensitivity for the Helena Valley Area, Montana</td>
<td>189</td>
</tr>
</tbody>
</table>
D.1 HELENA VALLEY MONTANA 2001 LAND SURFACE CONTOUR DEM

Identification Information:
Citation Information:
Originator: Trihydro Corporation
Publication Date: 20080501
Title: Helena Valley Montana 2001 Land Surface Contour DEM
Geospatial Data Presentation Form: raster digital data
Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Grids\cont_01

Description:
Abstract: This data set is a raster interpolated from 2001 variable interval contours.
Purpose: To aid in an aquifer sensitivity analysis

Time Period of Content:
Single Date/Time:
Calendar Date: 2001
Currentness Reference: ground condition
Status:
Progress: Complete
Maintenance and Update Frequency: None planned

Spatial Domain:
Bounding Coordinates:
West Bounding Coordinate: -112.133813
East Bounding Coordinate: -111.847144
North Bounding Coordinate: 46.767340
South Bounding Coordinate: 46.540243

Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Topography
Theme_Keyword: DEM
Theme_Keyword: Elevation

Place:
Place_Keyword: United States
Place_Keyword: Montana
Place_Keyword: Lewis & Clark County
Place_Keyword: Helena
Place_Keyword: Helena Valley

Access Constraints: None
Use Constraints: None

Point of Contact:
Contact Information:
Contact Organization Primary:
Contact Organization: Trihydro Corporation
Contact Position: GIS Analyst
Contact Address:
Address_Type: mailing and physical address
Address: 1252 Commerce Dr.
City: Laramie
State or Province: WY
Postal Code: 82070
Contact Voice Telephone: 307 745-7474
Contact Facsimile Telephone: 307 745-7729
Contact Electronic Mail Address: GISSupport@trihydro.com

Native Data Set Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data Quality Information:
Lineage:

Process Step:
- Process Description: Dataset copied.
- Source Used Citation Abbreviation: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\coverages\cont_01_clip

Process Step:
- Process Description: Used IDW interpolation (power = 2, variable search radius) to create this grid from contour lines.

Spatial Data Organization Information:
Direct Spatial Reference Method: Raster

Raster Object Information:
- Raster Object Type: Grid Cell
- Row Count: 2457
- Column Count: 2116
- Vertical Count: 1

Spatial Reference Information:
Horizontal Coordinate System Definition:
Planar:
- Map Projection:
  - Map Projection Name: Lambert Conformal Conic
  - Lambert Conformal Conic:
    - Standard Parallel: 45.000000
    - Standard Parallel: 49.000000
    - Longitude of Central Meridian: -109.500000
    - Latitude of Projection Origin: 44.250000
    - False Easting: 600000.000000
    - False Northing: 0.000000

Planar Coordinate Information:
- Planar Coordinate Encoding Method: row and column
- Coordinate Representation:
  - Abscissa Resolution: 10.000000
  - Ordinate Resolution: 10.000000
- Planar Distance Units: meters

Geodetic Model:
- Horizontal Datum Name: D_North_American_1983_HARN
- Ellipsoid Name: Geodetic Reference System 80
- Semi-major Axis: 6378137.000000
- Denominator of Flattening Ratio: 298.257222

Distribution Information:
Distributor:
- Contact Information:
  - Contact Organization Primary:
    - Contact Organization: City of Helena and Lewis & Clark County
    - Contact Position: GIS Center
    - Contact Address:
      - Address Type: physical address
      - Address: 316 N. Park Avenue, Room 147
      - City: Helena
      - State or Province: Montana
      - Postal Code: 59624
    - Contact Voice Telephone: 406-447-8389
    - Contact Facsimile Telephone: 406-447-8386
    - Contact Electronic Mail Address: giscenter@co.lewis-clark.mt.us

Resource Description: Downloadable Data

Standard Order Process:
Digital Form:
- Digital Transfer Information:
  - Transfer Size: 19.943

Metadata Reference Information:
- Metadata Date: 20080420
Metadata Contact:

Contact Information:

  Contact Organization Primary:
  Contact Organization: Trihydro Corporation
  Contact Person: Brian Robeson
  Contact Position: GIS Analyst

Contact Address:
  Address Type: mailing and physical address
  Address: 1252 Commerce Dr.
  City: Laramie
  State or Province: WY
  Postal Code: 82070
  Contact Voice Telephone: 307 745-7474
  Contact Facsimile Telephone: 307 745-7729
  Contact Electronic Mail Address: GISSupport@trihydro.com

Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Time Convention: local time
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
D.2 HELENA VALLEY MONTANA 2006 LAND SURFACE CONTOUR DEM

Identification Information:
Citation:
Originator: Trihydro Corporation
Publication_Date: 20080501
Title: Helena Valley Montana 2006 Land Surface Contour DEM
Geospatial Data Presentation Form: raster digital data
Online_Links: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Grids\cont_06

Description:
Abstract: This data set is a raster interpolated from 2006 variable interval contours.
Purpose: To aid in an aquifer sensitivity analysis

Time_Period_of_Content:
Single_Date/Time:
Calendar_Date: 2001

Currentness_Reference: ground condition

Status:
Progress: Complete
Maintenance_and_Update_Frequency: None planned

Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -112.086386
East_Bounding_Coordinate: -111.953987
North_Bounding_Coordinate: 46.648205
South_Bounding_Coordinate: 46.566362

Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Topography
Theme_Keyword: DEM
Theme_Keyword: Elevation

Place:
Place_Keyword: United States
Place_Keyword: Montana
Place_Keyword: Lewis & Clark County
Place_Keyword: Helena
Place_Keyword: Helena Valley

Access_Constraints: None
Use_Constraints: None

Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Trihydro Corporation
Contact_Position: GIS Analyst
Contact_Address:
Address_Type: mailing and physical address
Address: 1252 Commerce Dr.
City: Laramie
State_or_Province: WY
Postal_Code: 82070
Contact_Voice_Telephone: 307 745-7474
Contact_Facsimile_Telephone: 307 745-7729
Contact_Electronic_Mail_Address: GISSupport@trihydro.com

Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:
Lineage:

Process_Step:
  Process_Description: Used IDW interpolation (power = 2, variable search radius) to create this grid from contour lines.

Process_Step:
  Process_Description: Metadata imported.

Source_Used_Citation_Abbreviation: C:\DOCUME~1\brobeson\LOCALS~1\Temp\xml302D.tmp

Spatial_Data_Organization_Information:
  Direct_Spatial_Reference_Method: Raster
  Raster_Object_Information:
    Raster_Object_Type: Grid Cell
    Row_Count: 878
    Column_Count: 986
    Vertical_Count: 1

Spatial_Reference_Information:
  Horizontal_Coordinate_System_Definition:
    Planar:
      Map_Projection:
        Map_Projection_Name: Lambert Conformal Conic
        Lambert_Conformal_Conic:
          Standard_Parallel: 45.000000
          Standard_Parallel: 49.000000
          Longitude_of_Central_Meridian: -109.500000
          Latitude_of_Projection_Origin: 44.250000
          False_Easting: 600000.000000
          False_Northing: 0.000000
    Planar_Coordinate_Encoding_Method: row and column
    Planar_Coordinate_Information:
      Planar_Coordinate_Encoding_Method: row and column
      Abscissa_Resolution: 10.000000
      Ordinate_Resolution: 10.000000
      Planar_Distance_Units: meters

  Geodetic_Model:
    Horizontal_Datum_Name: D_North_American_1983_HARN
    Ellipsoid_Name: Geodetic Reference System 80
    Semi-major_Axis: 6378137.000000
    Denominator_of_Flattening_Ratio: 298.257222

Distribution_Information:
  Distributor:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: City of Helena and Lewis & Clark County
        Contact_Position: GIS Center
        Contact_Address:
          Address_Type: physical address
          Address: 316 N. Park Avenue, Room 147
          City: Helena
          State_or_Province: Montana
          Postal_Code: 59624
        Contact_Voice_Telephone: 406-447-8389
        Contact_Facsimile_Telephone: 406-447-8386
        Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us

Resource_Description: Downloadable Data

Standard_Order_Process:
  Digital_Form:
    Digital_Transfer_Information:
      Transfer_Size: 3.326

Metadata_Reference_Information:
  Metadata_Date: 20080420
Metadata Contact:

Contact Information:

  Contact Organization Primary:
  Contact Organization: Trihydro Corporation
  Contact Person: Brian Robeson
  Contact Position: GIS Analyst
  Contact Address:
    Address Type: mailing and physical address
    Address: 1252 Commerce Dr.
    City: Laramie
    State or Province: WY
    Postal Code: 82070
  Contact Voice Telephone: 307 745-7474
  Contact Facsimile Telephone: 307 745-7729
  Contact Electronic Mail Address: GISSupport@trihydro.com

Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Time Convention: local time
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
D.3 LEWIS & CLARK COUNTY ADDRESS POINTS

Identification Information:
Citation:
Citation Information:
Originator: City of Helena and Lewis & Clark County GIS
Publication Date: Unknown
Title: Address pts
Geospatial Data Presentation Form: vector digital data
Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_FINAL.gdb
Description:
Abstract: Address points for all structure located in Lewis & Clark County. Initially derived from GPS field survey, currently maintained via heads up digitizing from aerial photo and by placing point in parcel.
Purpose: Addressable structures used for public safety and E911.
Supplemental Information:
*IMPORTANT* These data are NOT the official record *IMPORTANT*
The data contained herein are NOT the official records and may be inaccurate and incomplete! By using this GIS information, the user acknowledges and accepts full responsibility for verifying the correctness and the completeness of any of the information provided here.

The City of Helena and Lewis & Clark County do not warrant, either explicit or implied, the completeness or accuracy of the information provided. Additionally, the city and county accept no liability of any kind, including but not limited to any losses or damages that may result from the wrongful reliance on this information, and the user also accepts full responsibility for any subsequent use or reuse of the data, and shall be solely responsible for results or any damages which may result from the use of any of these data

Time Period of Content:
Time Period Information:
Single Date/Time:
Calendar Date: REQUIRED: The year (and optionally month, or month and day) for which the data set corresponds to the ground.
Currentness Reference: ground condition
Status:
Progress: Complete
Maintenance and Update Frequency: As needed

Spatial Domain:
Bounding Coordinates:
West Bounding Coordinate: -112.892618
East Bounding Coordinate: -111.643844
North Bounding Coordinate: 47.644285
South Bounding Coordinate: 46.432390
Keywords:
Theme:
Theme Keyword: Address Points
Access Constraints: This data set is public record and subject to public right to know laws
Use Constraints:
USES PROHIBITED: The following uses are prohibited except with the express written consent of the City of Helena and Lewis & Clark County:

1. Giving the Data to third parties or using the Data for the benefit of third parties except authorized agents of the Licensee;
2. Making copies or reproducing the Data, or any part thereof, except for making backup and archival copies solely for the Licensee;
3. Selling, distributing, loaning, or offering for use of the Data, in whole or in part, to others; and
4. Reproducing hardcopy products as provided by the Owner with the intent to sell for a profit.

Point of Contact:
Contact Information:
Contact Organization Primary:
Contact Organization: City of Helena and Lewis & Clark County
Contact Position: GIS Center
Contact Address:
Address Type: physical address
Address: 316 N. Park Avenue, Room 147
City: Helena
State or Province: Montana
Postal Code: 59624
Country: USA
Contact_Voice_Telephone: 406-447-8389
Contact_Voice_Telephone: 406-447-8367
Contact_Facsimile_Telephone: (406) 447-8386
Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us
Hours_of_Service: Mon-Fri 8-5
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350
Data_Quality_Information:

Lineage:

Process_Step:

Process_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: City of Helena and Lewis & Clark County
Contact_Position: GIS Center
Contact_Address:

Address_Type: physical address
Address: 316 N. Park Avenue, Room 147
City: Helena
State or Province: Montana
Postal Code: 59624
Country: USA
Contact_Voice_Telephone: (406) 447-8389
Contact_Facsimile_Telephone: (406) 447-8386
Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us

Hours_of_Service: Mon-Fri 8-5

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Entity point
Point_and_Vector_Object_Count: 0

Spatial_Reference_Information:

HorizontalCoordinateSystemDefinition:

Planar:

MapProjection:

Map_Projection_Name: Lambert Conformal Conic
Lambert_Conformal_Conic:

Standard_Parallel: 45.000000
Standard_Parallel: 49.000000
Longitude_of_Central_Meridian: -109.500000
Latitude_of_Projection_Origin: 44.250000
False_Easting: 600000.000000
False_Northing: 0.000000

PlanarCoordinateInformation:

Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000100
Ordinate_Resolution: 0.000100

Planar_Distance_Units: meters

Geodetic_Model:

HorizontalDatum_Name: D North American 1983 HARN
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222
Vertical Coordinate System Definition:
Altitude System Definition:
Altitude Resolution: 0.000100
Altitude Encoding Method: Explicit elevation coordinate included with horizontal coordinates

Entity and Attribute Information:
Detailed Description:
Entity Type:
Entity Type Label: Address_pts
Attribute:
Attribute Label: HOUSENUMBER
Attribute:
Attribute Label: ADDRESS
Attribute:
Attribute Label: COMMENTS
Attribute:
Attribute Label: ALIAS
Attribute:
Attribute Label: SIDE
Attribute:
Attribute Label: ZIPCODE
Attribute:
Attribute Label: LASTEDIT
Attribute:
Attribute Label: CREATED
Attribute:
Attribute Label: SHAPE
Attribute Definition: Feature geometry.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Coordinates defining the features.
Attribute:
Attribute Label: EDITOR
Attribute:
Attribute Label: USETYPE
Attribute:
Attribute Label: GEOCODE
Attribute:
Attribute Label: CITY
Attribute:
Attribute Label: BASENAME
Attribute:
Attribute Label: ADDRKEY
Attribute:
Attribute Label: STREETTYPE
Attribute:
Attribute Label: PREFIX
Attribute:
Attribute Label: SUFFIX
Attribute:
Attribute Label: Shape
Attribute Definition: Feature geometry.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Coordinates defining the features.
Attribute:
Attribute Label: HASSUBADDR
Attribute:
Attribute Label: OBJECTID
Attribute Definition: Internal feature number.
Attribute Definition Source: ESRI
Attribute Domain Values:
  Unrepresentable Domain: Sequential unique whole numbers that are automatically generated.
Detailed Description:
  Entity Type:
    Entity Type Label: GIS.GISOWNER.Addresspoint
Distribution Information:
  Resource Description:
    Downloadable Data
http://www.co.lewis-clark.mt.us/index.php?id=102
  Standard Order Process:
    Digital Form:
      Digital Transfer Information:
        Transfer Size: 0.000
Metadata Reference Information:
  Metadata Date: 20080307
Metadata Contact:
  Contact Information:
    Contact Organization Primary:
      Contact Organization: City of Helena and Lewis & Clark County
      Contact Person: GIS Staff
      Contact Position: GIS Center
    Address:
      Address Type: physical address
      Address: 316 N. Park Avenue, Room 147
      City: Helena
      State or Province: Montana
      Postal Code: 59624
      Country: USA
    Contact Telephone:
      Contact Voice Telephone: 406-447-8389
      Contact Voice Telephone: 406-447-8367
      Contact Facsimile Telephone: 406-447-8386
      Contact Electronic Mail Address: giscenter@co.lewis-clark.mt.us
    Hours of Service: Mon-Fri 8-5
Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Time Convention: local time
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
D.4 GENERALIZED BEDROCK GEOLOGIC MAP OF THE HELENA AREA, WEST-CENTRAL MONTANA

Identification_Information:
Citation:
Citation_Information:
Originator: Mitchell W. Reynolds
Originator: Theodore R. Brandt
Publication_Date: 2000
Title: Generalized Bedrock Geologic Map of the Helena Area, West-Central Montana
Edition: 1.0
Geospatial_Data_Presentation_Form: map
Series_Information:
Series_Name: USGS Water-Resources Investigations Report
Issue_Identification: WRI-00-4212
Publication_Information:
Publication_Place: Denver, CO
Publisher: U.S. Geological Survey
Online_Linkage: http://geology.cr.usgs.gov/pub/wri/wri-00-4212/
Larger_Work_Citation:
Citation_Information:
Originator: Joanna N. Thamke
Originator: Mitchell W. Reynolds
Publication_Date: 2000
Title: Hydrology of Helena Area Bedrock, West-Central Montana, 1993-98 with a section on Geologic Setting and a Generalized Bedrock Geologic Map
Edition: 1.0
Geospatial_Data_Presentation_Form: map
Series_Information:
Series_Name: USGS Water-Resources Investigations Report
Issue_Identification: WRI-00-4212
Description:
Abstract:
The Generalized Bedrock Geologic Map of the Helena Area, West-Central Montana (plate 1 in the report) provides an intermediate-scale overview of bedrock in the Helena area. The geologic map has been compiled at a scale of 1:100,000 from the most widely available sources of geologic map information (see index to geologic mapping on pl. 1). That information has been updated by M.W. Reynolds for this report with more recent geologic mapping and field revision of published maps. All well locations and all bedrock units penetrated during drilling have been confirmed on geologic maps at the largest scale available. Source geologic maps are all at scales larger than 1:100,000 scale. Care has been taken to ensure accurate representation of the original geology at the compilation scale. However, positional accuracy of some features might be somewhat diminished at the smaller scale of the base map when compared with the original data source. Also, line thicknesses for contacts and faults necessarily assume a greater width, relative to the real geologic feature, at the scale of the generalized map than on any original map. The map is not intended for large-scale, site-specific detailed planning.

Bedrock units throughout the Helena area are generally covered by young surficial deposits such as alluvium, colluvium, glacial debris, or windblown sediment. Thickness of such deposits varies from vaneers through which the underlying bedrock is clearly discernible to major thicknesses that conceal all underlying bedrock and structure. Boundaries of major accumulations of surficial deposits are attributed separately from bedrock contacts. These boundaries should not be considered precise at the map scale or at larger scales. Boundaries shown may be less accurate positionally than bedrock contacts and faults because (1) surficial deposits commonly thin to a knife edge; (2) different mappers will interpret the edge differently when drawing a boundary; or (3) the original geologic map maker was concerned principally with bedrock units and structure and thus overlooked, or did not originally map as consistently, some surficial deposits. Veneers of surficial sediment, when saturated, can be local sources of recharge to underlying bedrock. Use of the generalized map to define their distribution does not substitute for site specific mapping of such deposits.

Specific knowledge is needed to determine the water-bearing properties of the geologic units at and surrounding a site because the units, including the igneous and metamorphic rocks, have internal differences in stratigraphy, composition, mineralogy and grain size or crystallinity. These differences, together with structural imprints such as faults, folds, and the spacing, orientation, degree of openness of fractures, and extent and type of mineral filling in fractures and faults, all affect the ability of rocks to store and transmit water.
Purpose: To display the bedrock geology of the Helena Valley, Montana area and to provide sufficient geologic information for land-use and land-management decisions.

Supplemental Information:
Map political location: Jefferson, Lewis and Clark, and Powell Counties, Montana  Compilation scale 1:100,000
Geospatial data files included in this data set:
- helen: geologic units, faults, and other line features
- helenard: USGS DLG highways and roads
- helenarr: USGS DLG county boundaries
- helenahy: USGS DLG hydrography
- helenapl: BLM PLSS boundaries
- heltrln: electric transmission lines
- helctdiv: continental divide boundary
wpgmykg.shd: This shadeset file defines the rgb values of colors assigned to polygons in the geologically themed coverage (see SYMBOL item).
- alcwrg.lin: This lineset file defines geologic line types in the geologically themed coverage.
- geoscamp1.lin: This lineset file defines thrust fault geologic line types not found in alcwrg.lin in the geologically themed coverage.

Time_Period_of_Content:
Time_Period_Information:
- Single_Date/Time:
  - Calendar_Date: 2000
Currentness_Reference: Publication date
Status:
- Progress: Complete
Maintenance_and_Update_Frequency: As needed
Spatial_Domain:
- Bounding_Coordinates:
  - West_BoundingCoordinate: -112.375
  - East_BoundingCoordinate: -111.786
  - North_BoundingCoordinate: 46.792
  - South_BoundingCoordinate: 46.375

Keywords:
Theme:
- Theme_Keyword_Thesaurus: American Geological Institute Glossary of Geology
- Theme_Keyword: geology
Place:
- Place_Keyword_Thesaurus: Board of Geologic Names
- Place_Keyword: USA
- Place_Keyword: Montana
- Place_Keyword: Lewis and Clark County
- Place_Keyword: Jefferson County
- Place_Keyword: Powell County
- Place_Keyword: Helena
- Place_Keyword: Helena Valley
Access_Constraints: None
Use_Constraints: None. Acknowledgment of the U.S. Geological Survey would be appreciated in products derived from these data. These data are not to be used at scales greater than 1:100,000.

Point_of_Contact:
Contact_Information:
- Contact_Person_Primary:
  - Contact_Person: Mitchell W. Reynolds
  - Contact_Organization: U.S. Geological Survey
Contact_Address:
- Address_Type: mailing
  - Address: P.O. Box 25046, MS 980
  - Address: Denver Federal Center
  - City: Denver
  - State_or_Province: CO
Data Set_Credit: The assistance of Janelle Luppen, who digitized the map and performed initial quality checks on the GIS database is gratefully acknowledged.

Native_Data_Set_Environment:
- Windows_NT, 5.0, Intel
- ARC/INFO version 8.1.2

Data_Quality_Information:

Attribute_Accuracy:
- Attribute_Accuracy_Report: Data were entered and checked by the geologist that made the field observations. The attributes of this geospatial data set consist of text identifiers and numeric codes that indicate the identity of the geologic unit or type of geologic feature, and determine how each feature is colored or symbolized. To check attribute accuracy, a color check plot was visually compared to the geologist's original compilation. Discrepancies between the digital geospatial dataset and the original analog compilation were corrected as needed. Machine-created listings of unique attribute values were used to identify spelling errors or other inconsistencies, and corrections were made as needed. Automated (ArcInfo) routines were also used to check the databases for polygon label errors, line or point attribution errors, sliver polygons, dangling arcs, intersection errors, and projection information. This map has been thoroughly reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.
- Logical_Consistency_Report: Map elements were visually checked for overshoots, undershoots, duplicate features, polygon closure, and other errors by the author and by the GIS technician(s) that created the digital database. Check plots of the map were reviewed by at least two other geologists for consistency with basic geologic principles and general conformity to USGS map standards.
- Completeness_Report: Data are complete: no features that could be displayed at the compilation scale of 1:100,000 were eliminated or generalized. The smallest area represented is approximately 477 square meters. All geospatial database elements are attributed. Unit properties are described in the text explanation. Digital base map coverages, which are not fully attributed, are included for the convenience of users.

Positional_Accuracy:
- Horizontal_Positional_Accuracy_Report: Lines were scanned from the base map using a large format Anatech Eagle scanner. The resultant scanned image was edited, geo-registered and vectorized in LT4X software and subsequently imported into ArcInfo GIS software. The ArcInfo coverage was given projection information and attributed. Most digitized positions on the map are estimated to have at least 40 m horizontal accuracy.

Lineage:
- Source_Information:
- Source_Citation:
- Citation_Information:
- Originator: Becraft, G.E.
- Originator: Pinckney, D.M.
- Originator: Rosenblum, Sam
- Publication_Date: 1963
- Title: Geology and mineral deposits of the Jefferson City quadrangle, Jefferson and Lewis and Clark Counties, Montana
- Series_Information:
- Series_Name: U.S. Geological Survey Professional Paper
- Issue_Identification: 428
- Source_Scale_Denominator: 48000
- Type_of_Source_Media: paper
- Source_Time_Period_of_Content:
- Time_Period_Information:
- Single_Date/Time:
- Calendar_Date: 1963
- Source_Currentness_Reference: publication date
- Source_Citation_Abbreviation: Becraft and others (1963)
- Source_Contribution: geologic data source
- Source_Information:
Publication_Date: 1969
Title: Geologic map of the Upper Holter Lake quadrangle
Series_Information:
  Series_Name: U.S. Geological Survey Geologic Quadrangle Map
  Issue_Identification: GQ-840
Source_Scale_Denominator: 24000
Type_of_Source_Media: paper
Source_Time_Period_of_Content:
  Single_Date/Time:
    Calendar_Date: 1969
  Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: Robinson and others (1969)
Source_Contribution: geologic data source
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: Ruppel, E.T.
      Publication_Date: 1963
      Title: Geology of the Basin quadrangle, Jefferson, Lewis and Clark, and Powell Counties, Montana
      Series_Information:
        Series_Name: U.S. Geological Survey Bulletin
        Issue_Identification: 1151
      Source_Scale_Denominator: 48000
      Type_of_Source_Media: paper
      Source_Time_Period_of_Content:
        Single_Date/Time:
          Calendar_Date: 1963
        Source_Currentness_Reference: publication date
      Source_Citation_Abbreviation: Ruppel (1963)
      Source_Contribution: geologic data source
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: Smedes, H.W.
      Publication_Date: 1966
      Title: Geology and igneous petrology of the northern Elkhorn Mountains, Jefferson and Broadwater Counties, Montana
      Series_Information:
        Series_Name: U.S. Geological Survey Professional Paper
        Issue_Identification: 510
      Source_Scale_Denominator: 48000
      Type_of_Source_Media: paper
      Source_Time_Period_of_Content:
        Single_Date/Time:
          Calendar_Date: 1966
        Source_Currentness_Reference: publication date
      Source_Citation_Abbreviation: Smedes (1966)
      Source_Contribution: geologic data source
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: Schmidt, R.G.
      Originator: Loen, J.S.
      Originator: Wallace, C.A.
      Originator: Mehnert, H.H.
      Publication_Date: 1994
Title: Geology of the Elliston region, Powell and Lewis and Clark Counties, Montana
Series Information:
  Series Name: U.S. Geological Survey Bulletin
  Issue Identification: 2045
Source Scale Denominator: 62500
Type of Source Media: paper
Source Time Period of Content:
  Time Period Information:
    Single Date/Time:
      Calendar Date: 1994
Source Currentness Reference: publication date
Source Citation Abbreviation: Schmidt and others (1994)
Source Contribution: geologic data source
Source Information:
  Citation Information:
    Originator: Wallace, C.A.
    Publication Date: 1987
    Title: Generalized geologic map of the Butte 1 x 2 quadrangle, Montana
Series Information:
  Series Name: U.S. Geological Survey Miscellaneous Field Studies Map
  Issue Identification: MF-1925
Source Scale Denominator: 250000
Type of Source Media: paper
Source Time Period of Content:
  Time Period Information:
    Single Date/Time:
      Calendar Date: 1987
Source Currentness Reference: publication date
Source Citation Abbreviation: Wallace and comp. (1987)
Source Contribution: geologic data source
Process Step:
  Process Description: scan mylar original artwork into tiff file
  Process Date: 19990129
Process Step:
  Process Description: Registration of tiff and vectorization in LT4X
  Process Date: 19990210
Process Step:
  Process Description: Import as Arc/Info coverage; project into UTM
  Process Date: 19990303
Process Step:
  Process Description: Transfer attributes from existing fault coverage to new coverage
  Process Date: 19990322
Process Step:
  Process Description: Download and append PLSS data
  Process Date: 19990312
Process Step:
  Process Description: Download, convert and append DLG data of hydrography, roads, railroads & misc. transportation
  Process Date: 19990314
Process Step:
  Process Description: Digitize new line work and insert as correction to original artwork
  Process Date: 19990316
Process Step:
  Process Description: Append boundary lines, build polygon coverage, and begin attribution of polygons
  Process Date: 19990609
Process Step:
  Process Description: Append rock unit descriptions and full descriptive text to polygon coverage
  Process Date: 20010620
Process Step:
Process_Description: Run data integrity checks and attribute arcs and label points as necessary
Process_Date: 20010621

Process Step:
Process_Description: Scan published map and generate browse graphic
Process_Date: 20010625

Process Step:
Process_Description: Metadata created using FGDCMETA.AML ver. 1.2 05/14/98 and MP version 2.7.28
Process_Date: 20010625

Process Step:
Process_Description: Metadata imported.
Source_Used_Citation_Abbreviation: C:\DOCUME~1\brobeson\LOCALS~1\Temp\xml7F8.tmp

Process Step:
Process_Description: Dataset copied.
Source_Used_Citation_Abbreviation: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_County.gdb

Process Step:
Process_Description: Dataset copied.
Source_Used_Citation_Abbreviation: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_FINAL.gdb

Spatial Data Organization Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: 150

Spatial Reference Information:
Horizontal_Coordinate_System.Definition:
Planar:
Map_Projection:
Map_Projection_Name: Lambert Conformal Conic
Lambert_Conformal_Conic:
Standard_Parallel: 45.000000
Standard_Parallel: 49.000000
Longitude_of_Central_Meridian: -109.500000
Latitude_of_Projection_Origin: 44.250000
False_Easting: 600000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 5
Ordinate_Resolution: 5
Planar_Distance_Units: Meters

Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Vertical_Coordinate_System_Definition:
Altitude_System_Definition:
Altitude_Resolution: 0.000100
Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Helena_bedrock
Overview_Description:

Entity and Attribute Overview:

DATABASE STRUCTURE - ARC/INFO

The database of the map consists of one coverage, including corresponding info files:

This database structure is more fully described in USGS OFR 99-438. This GIS database includes related look-up tables, which store detailed attribute information. Arc/Info relates for each coverage are saved in a file named <covername>.rel. Use the RELATE command with the restore argument at the arc prompt to make the relates active. Alternatively, in Arctools, use the Relate environment: open dialog in the Manage - Relates flyout menu under the Arctools menu to make the relates active.

helena coverage: contains all contact lines and label points for each geologic polygon. In the helena.pat INFO file UNIT item indicates the numeric code of the rock unit related to the detailed unit description found in the snedgeo.ru lookup table. The LABEL item indicates the rock unit label (abbreviation) used to label the unit on the map. The DESC item contains the formal or informal unit name. The SOURCE item contains the numeric code used to identify the data source for the rock unit. The SYMBOL item contains the shadeset symbol number used by ArcInfo to plot a filled/shaded polygon. The symbol numbers for this item refer to the wpgcmykg.shd shadeset.
The PATTERN item contains the shadeset symbol number used by ArcInfo to plot a hatchured polygon. The symbol numbers for this item refer to the helena4.shd shadeset.

In the coverage's helena.aat INFO file the NAME item contains the name given to the structural feature. The SOURCE item contains the numeric code used to identify the data source for the structural feature. The SYMBOL item contains the lineset symbol number used by ArcInfo to plot a line. The symbol numbers in this coverage refer to the alcwrg.lin and geoscamp1.lin linesets. All symbol numbers reference the alcwrg.lin lineset except those coded 113 and 116, which reference the geoscamp1.lin lineset.

In the coverage's helena.ref INFO file the SOURCE item lists the numeric code used to identify the data source. The scale item lists the scale of the source map. (This value is the denominator of the proportional fraction that identifies the scale of the map that was digitized or scanned to produce the digital map.) The AUTHORS item lists the author(s) or compiler(s) of source map entered as last name, first name or initial, and middle initial. The YEAR item lists the source (map) publication date. The REFERENCE item lists the remainder of the reference in USGS reference format.

In the coverage's helena.ru INFO file the UNIT item lists numeric code used to identify the rock unit. This item also occurs in helena.pat. The LABEL item lists the rock unit label (abbreviation) used to label the unit on the map. The DESC item lists the formal or informal unit name. The DESC1, DESC2, and DESC3 items list the full descriptive text for each formal or informal unit.

helctdiv coverage: contains the portion of the U.S. Continental Divide line which does not run coterminous with the Lewis and Clark/Powell County boundary line. This line was digitized from a U.S. Geological Survey 1:100,000 scale topographic base map.

In the coverage's helctdiv.aat INFO file the SOURCE item contains the numeric code used to identify the data source for the feature.

helenact coverage: contains county boundary lines derived from U.S. Geological Survey 1:100,000 scale Digital Line Graph data.

In the coverage's helenact.aat INFO file the SOURCE item contains the numeric code used to identify the data source for the feature.

helenahy coverage: contains hydrographic lines derived from U.S. Geological Survey 1:100,000 scale Digital Line Graph data.

In the coverage's helenahy.aat INFO file the SOURCE item contains the numeric code used to identify the data source for the feature.

helenapl coverage: contains U.S. Public Land Survey lines derived from U.S. Bureau of Land Management 1:100,000 scale data.

In the coverage's helenapl.aat INFO file the SOURCE item contains the numeric code used to identify the data source for the feature.

helenard coverage: contains highway and road transportation lines derived from U.S. Geological Survey 1:100,000 scale Digital Line Graph data.

In the coverage's helenard.aat INFO file the SOURCE item contains the numeric code used to identify the data source for the feature.

helenarr coverage: contains railroad transportation lines derived from U.S. Geological Survey 1:100,000 scale Digital Line Graph data.

In the coverage's helenarr.aat INFO file the SOURCE item contains the numeric code used to identify the data source for the feature.

The INFO structure of these files is listed below:

>HELENA.PAT:

>COLUMN ITEM NAME WIDTH OUTPUT TYPE N.DEC ALTERNATE NAME
>  1 AREA 8 18 F 5
>  9 PERIMETER 8 18 F 5
> 17 HELENA# 4 5 B -
> 21 HELENA-ID 4 5 B -
> 25 UNIT 4 4 I -
> 29 SOURCE 3 3 I -
> 32 LABEL 10 10 C -
> 42 DESC 100 100 C -
> 142 SYMBOL 3 3 I -
> 145 PATTERN 3 3 I -

>HELENA.AAT:

>COLUMN ITEM NAME WIDTH OUTPUT TYPE N.DEC ALTERNATE NAME
>  1 FNODE# 4 5 B -
>  5 TNODE# 4 5 B -
>  9 LPOLY# 4 5 B -
> 13 RPOLY# 4 5 B -
> 17 LENGTH 8 18 F 5
> 25 HELENA# 4 5 B -
> 29 HELENA-ID 4 5 B -
> 33 NAME 80 80 C -
HELENA.REF

<table>
<thead>
<tr>
<th>COLUMN ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOURCE</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>SCALE</td>
<td>8</td>
<td>8</td>
<td>I</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>AUTHORS</td>
<td>200</td>
<td>200</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>YEAR</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>REFERENCE</td>
<td>250</td>
<td>250</td>
<td>C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HELENA.RU:

<table>
<thead>
<tr>
<th>COLUMN ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESC</td>
<td>100</td>
<td>100</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESC1</td>
<td>160</td>
<td>160</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESC2</td>
<td>160</td>
<td>160</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESC3</td>
<td>160</td>
<td>160</td>
<td>C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HELCTDIV.AAT:

<table>
<thead>
<tr>
<th>COLUMN ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LENGTH</td>
<td>8</td>
<td>18</td>
<td>F</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>HELCTDIV#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HELCTDIV-ID</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOURCE</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HELENACT.AAT:

<table>
<thead>
<tr>
<th>COLUMN ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LENGTH</td>
<td>8</td>
<td>18</td>
<td>F</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>HELENACT#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HELENACT-ID</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOURCE</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HELENAHY.AAT:

<table>
<thead>
<tr>
<th>COLUMN ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LENGTH</td>
<td>8</td>
<td>18</td>
<td>F</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>HELENAHY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HELENA.REF

<table>
<thead>
<tr>
<th>COLUMN ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOURCE</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>SCALE</td>
<td>8</td>
<td>8</td>
<td>I</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>AUTHORS</td>
<td>200</td>
<td>200</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>YEAR</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>REFERENCE</td>
<td>250</td>
<td>250</td>
<td>C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HELENA.RU:

<table>
<thead>
<tr>
<th>COLUMN ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESC</td>
<td>100</td>
<td>100</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESC1</td>
<td>160</td>
<td>160</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESC2</td>
<td>160</td>
<td>160</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESC3</td>
<td>160</td>
<td>160</td>
<td>C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HELCTDIV.AAT:

<table>
<thead>
<tr>
<th>COLUMN ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LENGTH</td>
<td>8</td>
<td>18</td>
<td>F</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>HELCTDIV#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HELCTDIV-ID</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOURCE</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HELENACT.AAT:

<table>
<thead>
<tr>
<th>COLUMN ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LENGTH</td>
<td>8</td>
<td>18</td>
<td>F</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>HELENACT#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HELENACT-ID</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOURCE</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HELENAHY.AAT:

<table>
<thead>
<tr>
<th>COLUMN ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LENGTH</td>
<td>8</td>
<td>18</td>
<td>F</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>HELENAHY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
HELENAPL.AAT:

<table>
<thead>
<tr>
<th>COLUMN</th>
<th>ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>TNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>LPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>RPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>LENGTH</td>
<td>8</td>
<td>18</td>
<td>F</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>HELENAPL#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>HELENAPL-ID</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>SOURCE</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

HELENARD.AAT:

<table>
<thead>
<tr>
<th>COLUMN</th>
<th>ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>TNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>LPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>RPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>LENGTH</td>
<td>8</td>
<td>18</td>
<td>F</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>HELENARD#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>HELENARD-ID</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>SOURCE</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

HELENARR.AAT:

<table>
<thead>
<tr>
<th>COLUMN</th>
<th>ITEM NAME</th>
<th>WIDTH</th>
<th>OUTPUT</th>
<th>TYPE</th>
<th>N.DEC</th>
<th>ALTERNATE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>TNODE#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>LPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>RPOLY#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>LENGTH</td>
<td>8</td>
<td>18</td>
<td>F</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>HELENARR#</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>HELENARR-ID</td>
<td>4</td>
<td>5</td>
<td>B</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>SOURCE</td>
<td>4</td>
<td>4</td>
<td>I</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Unique item values in helena.pat

<table>
<thead>
<tr>
<th>UNIT</th>
<th>LABEL</th>
<th>DESC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No bedrock</td>
<td>No bedrock data</td>
</tr>
<tr>
<td>2</td>
<td>POMIs</td>
<td>Pliocene(?) and Miocene sedimentary rocks</td>
</tr>
<tr>
<td>3</td>
<td>OGv</td>
<td>Oligocene volcanic rocks</td>
</tr>
<tr>
<td>4</td>
<td>OGvt</td>
<td>Oligocene volcanic rocks (tuffaceous)</td>
</tr>
<tr>
<td>5</td>
<td>OGs</td>
<td>Oligocene sedimentary rocks</td>
</tr>
<tr>
<td>6</td>
<td>EOv</td>
<td>Eocene volcanic rocks</td>
</tr>
<tr>
<td>7</td>
<td>Kg</td>
<td>Cretaceous intrusive rocks, mainly granitic</td>
</tr>
<tr>
<td>8</td>
<td>Kev</td>
<td>Elkhorn Mountains Volcanics</td>
</tr>
<tr>
<td>9</td>
<td>Kck</td>
<td>Upper and Lower Cretaceous sedimentary rocks</td>
</tr>
<tr>
<td>10</td>
<td>Jme</td>
<td>Jurassic sedimentary rocks</td>
</tr>
<tr>
<td>11</td>
<td>PIPqa</td>
<td>Permian and Pennsylvanian sedimentary rocks</td>
</tr>
<tr>
<td>12</td>
<td>Mb</td>
<td>Big Snowy Group</td>
</tr>
<tr>
<td>13</td>
<td>Mml</td>
<td>Madison Group</td>
</tr>
<tr>
<td>14</td>
<td>Dlj</td>
<td>Three Forks Formation and Jefferson Formation, undivided</td>
</tr>
</tbody>
</table>
>15  Cc  Upper and Middle Cambrian carbonate rocks
>16  Cel  Middle Cambrian clastic rocks
>17  Zg  Intrusive rocks
>18  Ybo  Bonner Quartzite
>19  Yms  Mount Shields Formation
>20  Yss  Shepard and Snowslip Formations, undivided
>21  Yhe  Helena and Empire Formations, undivided
>22  Ys  Spokane Formation
>23  Yg  Greyson Formation
>24  Open water  Significant water bodies
>25  Fault - Certain
>3  Fault - Approximately located
>5  Fault - Concealed
>25  Map boundary
>35  Contact - Between exposed bedrock and bedrock concealed by Quaternary deposits
>49  Contact - Certain
>51  Contact - Approximately located
>113  Thrust fault - Certain
>116  Thrust fault - Concealed
>525  Water body
>725  Contact - Scratch boundary

Entity_and_Attribute_Detail_Citation: http://wrgis.wr.usgs.gov/open-file/of99-438/

Distribution_Information:

Distributor:
Contact_Information:
  Contact_Organization_Primary:
    Contact_Organization: U.S. Geological Survey
  Contact_Address:
    Address_Type: mailing address
    Address: Central Publications Group
    Address: MS 902, Box 25046 DFC
    City: Lakewood
    State_or_Province: CO
    Postal_Code: 80225-0046
    Country: USA
  Contact_Voice_Telephone: 303-236-5486

Distribution_Liability: Although these digital spatial data have been subjected to rigorous review and are substantially complete, they are released on the condition that neither the USGS nor the United States Government may be held liable for any damages resulting from their authorized or unauthorized use.

Standard_Order_Process:

Digital_Form:
  Format_Name: ARCE, SHP
  Format_Version_Number: created with ArcInfo v. 8.1.2
  File_Compression_Technique:
    .tar.gz - UNIX gzip-compressed TAR file (ARCE and SHP files) - use GNU zip and TAR
    .zip - self-extracting Windows ZIP archive (ARCE and SHP files) - unzip the file to extract

Digital_Transfer_Option:
  Online_Option:
    Computer_Contact_Information:
      Network_Address:
        Network_Resource_Name: http://geology.cr.usgs.gov/pub/wri/wri-00-4212/

Fees: none

Distribution_Information:

Distributor:
Contact Information:
Contact Organization Primary:
Contact Organization: U.S. Geological Survey
Contact Address:
Address Type: mailing address
Address: USGS Information Services
Address: PO Box 25286
Address: Denver Federal Center
City: Denver
State or Province: CO
Postal Code: 80225
Country: USA
Contact Voice Telephone: (888) ASK-USGS
Resource Description: WRI-00-4212
Distribution Liability: none
Standard Order Process:
Non-digital Form: Available as a printed volume with 3 plates.
Fees: For current prices of USGS information products, please see http://mapping.usgs.gov/esic/prices/
Metadata Reference Information:
Metadata Date: 20010625
Metadata Contact:
Contact Information:
Contact Organization Primary:
Contact Organization: U.S. Geological Survey
Contact Person: Theodore R. Brandt
Contact Address:
Address Type: mailing
Address: P.O. Box 25046, MS 980, Denver Federal Center
City: Denver
State or Province: CO
Postal Code: 80225-0046
Country: USA
Contact Voice Telephone: 303-236-1901
Contact Electronic Mail Address: tbrandt@usgs.gov
Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Time Convention: local time
Metadata Access Constraints: none
Metadata Use Constraints: none
Metadata Extensions:
Online Linkage: http://www.esri.com/metadata/esriprof80.html
Profile Name: ESRI Metadata Profile
D.5 HELENA VALLEY MONTANA SURFICIAL GEOLOGY

Identification Information:
Citation:
Citation Information:
Originator: Trihydro Corporation
Publication_Date: 20080501
Title: Helena Valley Montana Surficial Geology
Geospatial Data Presentation Form: vector digital data
Online Linkage: \fs1\home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_FINAL.gdb
Larger Work Citation:
Citation Information:


Purpose: To fulfill the need for a surficial geology layer.

Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 1992
Currentness_Reference: publication date

Status:
Progress: Complete
Maintenance_and_Update_Frequency: None planned

Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -112.089956
East_Bounding_Coordinate: -111.889022
North_Bounding_Coordinate: 46.725294
South_Bounding_Coordinate: 46.565175

Keywords:
Theme:
Theme_Keyword_Thesaurus: None.
Theme_Keyword: Geology
Theme_Keyword: Surficial Geology
Place:
Place_Keyword: United States
Place_Keyword: Montana
Place_Keyword: Lewis & Clark County
Place_Keyword: Helena
Place_Keyword: Helena Valley

Access_Constraints: None
Use_Constraints: None

Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Trihydro Corporation
Contact_Position: GIS Analyst
Contact_Address:
Address_Type: mailing and physical address
Address: 1252 Commerce Dr.
City: Laramie
State_or_Province: WY
Postal_Code: 82070
Contact_Voice_Telephone: 307 745-7474
Contact_Facsimile_Telephone: 307 745-7729
Contact_Electronic_Mail_Address: GISSupport@trihydro.com
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.0.1324
Data_Quality_Information:
  Attribute_Accuracy:
    Attribute_Accuracy_Report: 100%  Verified by comparison with the source document.
  Logical_Consistency_Report: These data are topologically consistent. All polygons are closed and labeled.
  Completeness_Report: These data are as complete as the figure from which they were digitized (see source information).
Positional_Accuracy:
  Horizontal_Positional_Accuracy:
    Horizontal_Positional_Accuracy_Report: Unknown
Lineage:
  Source_Information:
    Source_Citation:
      Citation_Information:
        Originator: USGS: Briar, D.W. and J.P. Madison
        Publication_Date: 1992
        Source_Scale_Denominator: Unknown
        Type_of_Source_Media: paper
        Source_Contribution: Provided the surficial geology units and descriptions.
  Process_Step:
    Process_Description:
      Screen digitized from Fig. 5, "Hydrogeology of the Helena Valley - Fill Aquifer System, West -Central Montana" USGS Water-Resources Investigations Report 92-4023
      Process_Date: 20071128
  Process_Step:
    Process_Description: Dataset copied.
    Source_Used_Citation_Abbreviation: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_County.gdb
  Process_Step:
    Process_Description: Dataset copied.
    Source_Used_Citation_Abbreviation: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_FINAL.gdb
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
  SDTS_Terms_Description:
    SDTS_Point_and_Vector_Object_Type: G-polygon
    Point_and_Vector_Object_Count: 24
Spatial_Reference_Information:
  Horizontal_Coordinate_System_Definition:
    Planar:
      Map_Projection:
        Map_Projection_Name: Lambert Conformal Conic
        Lambert_Conformal_Conic:
          Standard_parallel: 45.000000
          Standard_parallel: 49.000000
          Longitude_of_Central_Meridian: -109.500000
          Latitude_of_Projection_Origin: 44.250000
          False_Easting: 600000.000000
          False_Northing: 0.000000
      Planar_Coordinate_Information:
        Planar_Coordinate_Encoding_Method: coordinate pair
        Coordinate_Representation:
          Abscissa_Resolution: 0.000156
          Ordinate_Resolution: 0.000156
          Planar_Distance_Units: meters
      Geodetic_Model:
        Horizontal_Datum_Name: D_North_American_1983_HARN
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222
Vertical_Coordinate_System_Definition:
Altitude_System_Definition:
Altitude_Resolution: 0.000100
Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Helena_surficial
Attribute:
Attribute_Label: OBJECTID
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: SHAPE
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.
Attribute:
Attribute_Label: Code
Attribute:
Attribute_Label: Description
Attribute:
Attribute_Label: SHAPE_Length
Attribute_Definition: Length of feature in internal units.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute:
Attribute_Label: SHAPE_Area
Attribute_Definition: Area of feature in internal units squared.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.

Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: City of Helena and Lewis & Clark County
Contact_Position: GIS Center
Contact_Address:
Address_Type: physical address
Address: 316 N. Park Avenue, Room 147
City: Helena
State_or_Province: MT
Postal_Code: 59624
Contact_Voice_Telephone: 406-447-8389
Contact_Facsimile_Telephone: 406-477-8386
Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us
Resource_Description: Downloadable Data
Metadata_Reference_Information:
Metadata_Date: 20080420
Metadata_Contact:
D.6 BLM QUARTER-QUARTER SECTIONS

Identification Information:
Citation:
Originator: Bureau of Land Management
Publication_Date: 20060503
Title: BLM_qqsec
Geospatial Data Presentation Form: vector digital data
Publication Information:
Publication Place: Denver, Colorado
Publisher: Bureau of Land Management
Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Lewis_Clark_FINAL.gdb

Description:
Abstract: This layer is based on Geographic Coordinate Data Base (GCDB) coordinate data. The locations of Public Land Survey System (PLSS) corners, as represented in geographic coordinate pairs, were derived from a variety of source documents, which include U.S. General Land Office and BLM survey plats/notes, as well as survey data obtained from other U.S. Government agencies, private sector survey firms, and local governments. The attributes assigned to PLSS polygons were taken from the BLM's Legal Land Description (LLD) data set, contained within the Legacy Rehost for the year 2000 (LR2000) automated records system. The coordinate data was produced by using control stations of known location, with varying degrees of accuracy, from various sources which include but are not limited to; U.S. Geological Survey (USGS) topological quadrangles and other sources, National Geodetic Survey (NGS) and US Coast & Geodetic Survey (USC&GS) Cooperative Base Network (CBN) control, Federal Base Network control (FBN), and Continuous Operating Reference Stations (CORS), and Global Positioning System (GPS) data, which is then analyzed and adjusted in concert with official survey data for any given geographic area. The Land Survey Information System Data Base (LSIS) data is a useful representation of the geometry and topology of parcels contained within the PLSS, but its application is intended for mapping purposes only. The GCDB data served from LSIS is not a substitute for a legal land survey.

Purpose: The GCDB Data was created to provide the BLM and its public with a set of geographic foundation data that accurately portrays the locations of PLSS corners. The GCDB data is based on the best and most current survey records available and uses known geographic positions of control stations within the PLSS network. This data is a key component of the Land Survey Information System (LSIS) framework upon which parcel boundary information will be assembled.

Time Period of Content:
Time Period Information:
Range of Dates/Times:
Beginning_Date: 18490303
Ending_Date: present
Currentness Reference: ground condition
Status:
Progress: In work
Maintenance and Update Frequency: As needed
Spatial Domain:
Bounding Coordinates:
West Bounding Coordinate: -112.089956
East Bounding Coordinate: -111.889022
North Bounding Coordinate: 46.725294
South Bounding Coordinate: 46.565175
Keywords:
Theme:
Theme Keyword Thesaurus: None
Theme Keyword: General Land Office
Theme Keyword: GLO
Theme Keyword: Bureau of Land Management
Theme Keyword: BLM
Theme Keyword: Public Land Survey System
Theme Keyword: PLSS
Theme Keyword: Geographic Coordinate Data Base
Theme Keyword: GCDB
Use_Constraints: The geographic coordinates and their associated products are NOT legal land survey records. The coordinates can NOT be used as a substitute for a legal land survey. They can be used for record keeping, mapping, graphics and planning purposes only. No warranty is made by the Bureau of Land Management for use of the data for purposes not intended by BLM.
For information about the data content, please contact the BLM State Office, GCDB Manager or GCDB Contact at: http://www.blm.gov/gcdb/gcdbsites/index.html

For information directly relating to metadata, please contact Regina LeFort at regina.lefort@blm.gov

Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:

Attribute_Accuracy:
- Attribute_Accuracy_Report: Data was checked for attribute accuracy by the GCDB personnel in each of the respective BLM State Offices.

Logical_Consistency_Report: The data set is topologically structured with nodes at all intersections. Labels representing the legal land description are assigned to each land unit.

Completeness_Report: All GCDB spatial outputs are visually inspected for completeness to ensure that all survey data for a given geographic area is included in the data set.

Positional_Accuracy:
- Horizontal_Positional_Accuracy:

Accuracy of the individual points contained within the GCDB layers of LSIS that were determined using GMM software were adjusted using both compass rule and a least squares analysis, which examines the geometry of PLSS parcels in relation to the coordinate values of known locations for control points within the PLSS grid. Each individual point carries a reliability factor indicating the error ellipse in both northing and easting which is reported after the least squares analysis is completed.

Accuracy of the individual points contained within the GCDB layers of LSIS that were determined using PCCS software were adjusted using a succession of compass rule adjustments between the control points followed by a least squares analysis, which examines the geometry of PLSS parcels in relation to the coordinate values of known locations for control points within the PLSS grid. Each individual point carries positional reliability factors for the average of the misclosures in the data set and the maximum misclosure in the data set.

Lineage:

Source_Information:
Source_Citation:

Citation_Information:
- Originator: Bureau of Land Management
- Publication_Date: 20041029
- Title: Land Survey Information System (LSIS)
- Geospatial_Data_Presentation_Form: tabular digital data
- Publication_Information:
  - Publication_Place: Denver, Colorado
  - Publisher: Bureau of Land Management
- Type_of_Source_Media: online
- Source_Time_Period_of_Content:
  - Time_Period_Information:
    - Range_of_Dates/Times:
      - Beginning_Date: 18490303
      - Ending_Date: present
  - Source_Currentness_Reference: ground condition
- Source_Citation_Abbreviation: BLM
- Source_Contribution: Survey data in the form of official (microfilm, CD, other) survey and BLM, abstracted into a vector digital format.

Source_Information:
Source_Citation:

Citation_Information:
- Originator: U.S. Forest Service
- Publication_Date: 19980601
- Title: Automated Lands Project (ALP)
- Geospatial_Data_Presentation_Form: tabular digital data
- Publication_Information:
  - Publication_Place: Washington, D.C.
  - Publisher: U.S. Forest Service
- Type_of_Source_Media: disc
- Source_Time_Period_of_Content:
Time_Period_Information:
  Range_of_Dates/Times:
    Beginning_Date: 19980601
    Ending_Date: present
  Source_Currentness_Reference: ground condition
  Source_Citation_Abbreviation: USFS
Source_Contribution: Survey and control data from the Cartographic Feature File (CFF) data set.
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: U.S Geological Survey
      Publication_Date: 1931
      Title: USGS standard topological quadrangles
      Geospatial_Data_Presentation_Form: tabular digital data
    Publication_Information:
      Publication_Place: Denver, Colorado
      Publisher: U.S. Geological Survey
    Type_of_Source_Media: disc
  Source_Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 1931
        Ending_Date: present
      Source_Currentness_Reference: ground condition
      Source_Citation_Abbreviation: USGS
      Source_Contribution: Digitized control data from standard topological quadrangle sheets.
    Source_Information:
      Source_Citation:
        Citation_Information:
          Originator: National Geodetic Survey
          Publication_Date: 20000101
          Title: Official Control Station Sheets
          Geospatial_Data_Presentation_Form: tabular digital data
        Publication_Information:
          Publication_Place: Silver Springs, Maryland
          Publisher: National Geodetic Survey
        Type_of_Source_Media: disc
      Source_Time_Period_of_Content:
        Time_Period_Information:
          Range_of_Dates/Times:
            Beginning_Date: 19010101
            Ending_Date: present
          Source_Currentness_Reference: ground condition
          Source_Citation_Abbreviation: NGS
          Source_Contribution: Survey control data from the official control station sheets (CBN, FBN, CORS).
        Process_Step:
          Process_Description: Compile survey input data from current BLM official measurements, supplemented in some locations with USFS and private survey records.
          Source_Used_Citation_Abbreviation: BLM database of the index to all official (microfilm, CD, other) BLM survey records.
          Source_Used_Citation_Abbreviation: USFS survey records.
          Source_Used_Citation_Abbreviation: Private land surveyor records
          Source_Used_Citation_Abbreviation: GCDB Data Collection Attribute Definitions Version 2.0, Appendix A, 2/14/1991. Survey records used - source abbreviations.
        Process_Date: Unknown
      Process_Step:
        Process_Description: Compile listings of known locations of PLSS corners.
        Source_Used_Citation_Abbreviation: USGS topographic quadrangles and other sources.
        Source_Used_Citation_Abbreviation: USC&GS published coordinate data.
Source_Used_Citation_Abbreviation: NGS published coordinate data.
Source_Used_Citation_Abbreviation: BLM global positioning Data.
Source_Used_Citation_Abbreviation: USFS global positioning data.
Process_Date: Unknown
Process_Step:
Process_Description: Coordinates of control stations are entered into a control data base with associated reliabilities.
Process_Date: Unknown
Process_Step:
Process_Description: This data has been created in either the GMM or PCCS format. The following process steps refer to data in GMM format.

With GMM survey data, abstracted from survey plats, and control stations extracted from the control database, are manually entered with weighting factors into GMM software. Compass rule and least squares adjustments are performed using weighting factors assigned to both control stations and survey line data, based on methodologies and vintage of survey.

With GMM, section subdivision is performed to achieve land unit detail to at least the forty acre parcel level. Instructions for calculating non-regular and minor subdivisions are persistently stored during collection and rerun after every new adjustment in order to achieve the detail necessary to delineate all lines required for depicting federal rights, interests, restrictions, and encumbrances. Coincident lines and lines identified as non-boundary lines are removed from the data set used for final land unit constructions. Line intersections are computed and given unique identifiers and land units are constructed.

GMM lists all coordinates produced by the compass rule and least squares adjustments and subdivision, with connectivity codes between points and compiles them into a single file for development of Geographic Information Systems (GIS) output.

With PCCS, survey data abstracted from survey plats and control stations extracted from control database are manually entered into the PCCS processing software. A succession of compass rule adjustments is performed on the lines to adjust them to the control points, followed by a least squares analysis. The resulting coordinates are accompanied by indications of positional reliability; the average of misclosures in the data set and the maximum misclosure in the data set.

With PCCS, section subdivision is performed to achieve land unit detail to at least the forty acre parcel level.

PCCS lists all coordinates produced by the compass rule and least squares adjustments with connectivity codes between points and compiles them into a single file for development of GIS files.

With PCCS, section subdivision is performed to achieve land unit detail to at least the forty acre parcel level.

Process_Date: Unknown
Process_Step:
Process_Description: GCDB data conversion software verifies correctness of GCDB file formats and content.
Process_Date: Unknown
Process_Step:
Process_Description: Verified coordinate, line and label files are converted to GIS coverages using the topology check application. All errors in topology are flagged for editing and correction.
Process_Date: Unknown
Process_Step:
Process_Description: If topological errors exist, editing of arc and node data, as well as parcel labels, is performed using either GMM or ArcInfo Interface (AII). (PCCS townships can only be edited using AII). Final edits are entered into input files and the process is repeated until all errors are corrected and a successful GIS coverage is created.
Process_Date: Unknown
Process_Step:
Process_Description: GIS coverages are edgematched with adjoining township data sets to insure a seamless PLSS grid is created.
Process_Date: Unknown
Process_Step:
Process_Description: Topologically correct GIS coverages are modified to use FGDC compliant naming conventions and then loaded into the LSIS database. These layers can then be downloaded as shapefiles through the LSIS website.
Process_Date: Unknown
Process_Step:
Process_Description: Metadata imported.

Process_Step:

Source_Used_Citation_Abbreviation: Fs1\home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Orig_data\BLM_PLSS\Lewis_and_Clark_County\laldesc.xml

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 2048

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Lambert Conformal Conic

Lambert_Conformal_Conic:

Standard Parallel: 45.000000

Standard Parallel: 49.000000

Longitude_of_Central_Meridian: -109.500000

Latitude_of_Projection_Origin: 44.250000

False_Easting: 600000.000000

False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: coordinate pair

Coordinate_Representation:

Abscissa_Resolution: 0.000100

Ordinate_Resolution: 0.000100

Planar_Distance_Units: meters

Geodetic_Model:

Horizontal_Datum_Name: D_North_American_1983_HARN

Ellipsoid_Name: Geodetic Reference System 80

Semi-major_Axis: 6378137.000000

Denominator_of_Flattening_Ratio: 298.257222

Vertical_Coordinate_System_Definition:

Altitude_System_Definition:

Altitude_Resolution: 0.000100

Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: BLM_qqsec

Entity_Type_Definition: A Legal Area Description provides the structure for assembling the components of a single legal description into one. The components of the legal area description can be used to build legal descriptions based on areas. For example, a legal area description could be a lot in a subdivision and that lot may be contained in a Public Land Survey System Area.

Entity_Type_Definition_Source: FGDC

Attribute:

Attribute_Label: objectid

Attribute_Definition: Internal feature number.

Attribute_Definition_Source: ESRI

Attribute_Domain_Values:

Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.

Attribute:

Attribute_Label: lndkey

Attribute_Definition: Compilation of state, principal meridian, township and range.

Attribute_Definition_Source: BLM

Attribute_Domain_Values:

Unrepresentable_Domain: See individual attributes for range values.
Attribute:
  Attribute_Label: surnum
  Attribute_Definition: An alpha-numeric value for a small division of non-aliquot land, established at parcel creation and noted on the survey plat. For example, when sursys value is equal to "L" for a Government Lot, the surnum will reflect the Government Lot number.
  Attribute_Definition_Source: BLM
  Unrepresentable_Domain: Integer value
Attribute:
  Attribute_Label: surnote
  Attribute_Definition: Administrative code depicting the status and validity of parcel entry.
  Attribute_Definition_Source: BLM
  Attribute_Domain_Values:
    Enumerated_Domain:
      Enumerated_Domain_Value: A
      Enumerated_Domain_Value_Definition: unknown
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: D
      Enumerated_Domain_Value_Definition: Do not add acreage.
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: E
      Enumerated_Domain_Value_Definition: Exception to topology rule(s) exist.
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: R
      Enumerated_Domain_Value_Definition: Replaced
      Enumerated_Domain_Value_Definition_Source: BLM
Attribute:
  Attribute_Label: OBJECTID_1
  Attribute_Definition: Internal feature number.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Enumerated_Domain:
      Enumerated_Domain_Value: A
      Enumerated_Domain_Value_Definition: NE 1/4 of NE 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: B
      Enumerated_Domain_Value_Definition: NW 1/4 of NE 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: C
      Enumerated_Domain_Value_Definition: SW 1/4 of NE 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: D
      Enumerated_Domain_Value_Definition: SE 1/4 of NE 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: E
      Enumerated_Domain_Value_Definition: NE 1/4 of NW 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: F
      Enumerated_Domain_Value_Definition: NW 1/4 of NW 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain_Value: G
Enumerated_Domain_Value_Description: SW 1/4 of NW 1/4 of
Enumerated_Domain_Value_Description_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: H
  Enumerated_Domain_Value_Description: SE 1/4 of NW 1/4 of
  Enumerated_Domain_Value_Description_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: I
  Enumerated_Domain_Value_Description: NE 1/4 of SW 1/4 of
  Enumerated_Domain_Value_Description_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: J
  Enumerated_Domain_Value_Description: NW 1/4 of SW 1/4 of
  Enumerated_Domain_Value_Description_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: K
  Enumerated_Domain_Value_Description: SW 1/4 of SW 1/4 of
  Enumerated_Domain_Value_Description_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: L
  Enumerated_Domain_Value_Description: SE 1/4 of SW 1/4 of
  Enumerated_Domain_Value_Description_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: M
  Enumerated_Domain_Value_Description: NE 1/4 of SE 1/4 of
  Enumerated_Domain_Value_Description_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: N
  Enumerated_Domain_Value_Description: NW 1/4 of SE 1/4 of
  Enumerated_Domain_Value_Description_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: O
  Enumerated_Domain_Value_Description: SW 1/4 of SE 1/4 of
  Enumerated_Domain_Value_Description_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: P
  Enumerated_Domain_Value_Description: SE 1/4 of SE 1/4 of
  Enumerated_Domain_Value_Description_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: Q
  Enumerated_Domain_Value_Description: All existing nominal locations within this section.
  Enumerated_Domain_Value_Description_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: Z
  Enumerated_Domain_Value_Description: Nominal location not relevant.
  Enumerated_Domain_Value_Description_Source: BLM

Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.

Attribute:
  Attribute_Label: ladescar
  Attribute_Description: Acreage of polygon
  Attribute_Description_Source: BLM
  Attribute_Domain_Values:
    Unrepresentable_Domain: Positive floating point number.

Attribute:
  Attribute_Label: ladunt
  Attribute_Description: Unit of measure for ladescar
  Attribute_Description_Source: BLM
Attribute Domain Values:
Attribute: ladsrc
Attribute Label: ladsrc
Attribute Definition: Code depicting source of acreage value or how it was determined.
Attribute Definition Source: BLM
Attribute Domain Values:
Enumerated Domain:
  Enumerated Domain Value: 0
  Enumerated Domain Value Definition: LLD (not total acreage, only within section)
  Enumerated Domain Value Definition Source: BLM
Enumerated Domain:
  Enumerated Domain Value: A
  Enumerated Domain Value Definition: Calculated by query that added all LLD acreages by special survey.
  Enumerated Domain Value Definition Source: BLM
Enumerated Domain:
  Enumerated Domain Value: B
  Enumerated Domain Value Definition: Acreage is from official plat and agrees with LLD sum.
  Enumerated Domain Value Definition Source: BLM
Enumerated Domain:
  Enumerated Domain Value: C
  Enumerated Domain Value Definition: Acreage is from official plat and disagrees with LLD sum.
  Enumerated Domain Value Definition Source: BLM
Enumerated Domain:
  Enumerated Domain Value: D
  Enumerated Domain Value Definition: Acreage is approximated from MTP or other paper map.
  Enumerated Domain Value Definition Source: BLM
Enumerated Domain:
  Enumerated Domain Value: E
  Enumerated Domain Value Definition: Acreage is derived from GIS coverage or AutoCAD drawing.
  Enumerated Domain Value Definition Source: BLM
Attribute: disccd
Attribute Label: disccd
Attribute Definition: Code identifying differences between LR2000 and GIS polygons. Not used - reserved for future use.
Attribute Definition Source: BLM
Attribute Domain Values:
Enumerated Domain:
  Enumerated Domain Value: 1
  Enumerated Domain Value Definition: This nominal part contains a piece of this special survey in LR2000, but not in GIS polygon.
  Enumerated Domain Value Definition Source: BLM
Enumerated Domain:
  Enumerated Domain Value: 2
  Enumerated Domain Value Definition: This nominal part contains a piece of special survey in GIS polygon, but not in LR2000.
  Enumerated Domain Value Definition Source: BLM
Enumerated Domain:
  Enumerated Domain Value: 3
  Enumerated Domain Value Definition: A piece of this special survey is listed in GIS polygon as being in nominal location X, but not in GIS polygon.
  Enumerated Domain Value Definition Source: BLM
Enumerated Domain:
  Enumerated Domain Value: 4
  Enumerated Domain Value Definition: A piece of this special survey is listed in LR2000 as being in nominal location X, but not in GIS polygon.
  Enumerated Domain Value Definition Source: BLM
Enumerated Domain:
  Enumerated Domain Value: 5
  Enumerated Domain Value Definition: A piece of this special survey is listed in LR2000, but this special survey has not yet been collected in GCDB, so only the nominal location is used to display this mineral survey.
Attribute:
  Attribute_Label: exccd
  Attribute_Definition: BLM-defined code for topology rule that this polygon correctly violates. Not used - reserved for future use.
  Attribute_Definition_Source: BLM
  Attribute_Domain_Values:
    Range_Domain:
      Range_Domain_Minimum: 1
      Range_Domain_Maximum: 18
  Attribute:
  Attribute_Label: validcd
  Attribute_Definition: Validation Code
  Attribute_Definition_Source: BLM
  Attribute:
  Attribute_Label: descdup
  Attribute_Definition: Duplicate Description Code
  Attribute_Definition_Source: BLM
  Attribute:
  Attribute_Label: subonly
  Attribute_Definition: Subsurface Only Code
  Attribute_Definition_Source: BLM
  Attribute:
  Attribute_Label: qqsection
  Attribute_Definition: Quarter-quarter section - corresponds to nomloc.
  Attribute_Definition_Source: BLM
  Attribute_Domain_Values:
    Enumerated_Domain:
      Enumerated_Domain_Value: NENE
      Enumerated_Domain_Value_Definition: NE 1/4 of NE 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: NWNE
      Enumerated_Domain_Value_Definition: NW 1/4 of NE 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: SWNE
      Enumerated_Domain_Value_Definition: SW 1/4 of NE 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: SENE
      Enumerated_Domain_Value_Definition: SE 1/4 of NE 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: NENW
      Enumerated_Domain_Value_Definition: NE 1/4 of NW 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: NWNW
      Enumerated_Domain_Value_Definition: NW 1/4 of NW 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: SWNW
      Enumerated_Domain_Value_Definition: SW 1/4 of NW 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
    Enumerated_Domain:
      Enumerated_Domain_Value: SENW
      Enumerated_Domain_Value_Definition: SE 1/4 of NW 1/4 of
      Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
Enumerated_Domain_Value: NESW
Enumerated_Domain_Value_Definition: NE 1/4 of SW 1/4 of
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: NWSW
Enumerated_Domain_Value_Definition: NW 1/4 of SW 1/4 of
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: SWSW
Enumerated_Domain_Value_Definition: SW 1/4 of SW 1/4 of
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: SWSW
Enumerated_Domain_Value_Definition: SW 1/4 of SW 1/4 of
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: SESW
Enumerated_Domain_Value_Definition: SE 1/4 of SW 1/4 of
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: NESE
Enumerated_Domain_Value_Definition: NE 1/4 of SE 1/4 of
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: NWSE
Enumerated_Domain_Value_Definition: NW 1/4 of SE 1/4 of
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: SWSE
Enumerated_Domain_Value_Definition: SW 1/4 of SE 1/4 of
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: SESE
Enumerated_Domain_Value_Definition: SE 1/4 of SE 1/4 of
Enumerated_Domain_Value_Definition_Source: BLM

Attribute:
Attribute_Label: shape
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI

Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.

Attribute:
Attribute_Label: sursys
Attribute_Definition: Survey Type of parcel.
Attribute_Definition_Source: BLM

Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: A
Enumerated_Domain_Value_Definition: Aliquot parts
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: B
Enumerated_Domain_Value_Definition: Aliquot parts less than 40 acres.
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: C
Enumerated_Domain_Value_Definition: Coal (reserved)
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: D
Enumerated_Domain_Value_Definition: Allotment (reserved)
Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: E
    Enumerated_Domain_Value_Definition: Metes and bounds
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: F
    Enumerated_Domain_Value_Definition: Farm unit (reserved)
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: G
    Enumerated_Domain_Value_Definition: Land Grant (reserved)
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: H
    Enumerated_Domain_Value_Definition: Homestead Entry Survey
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: I
    Enumerated_Domain_Value_Definition: Indian Allotment
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: J
    Enumerated_Domain_Value_Definition: Small tract and small holding claim (reserved)
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: K
    Enumerated_Domain_Value_Definition: Block and lot within a townsite
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: L
    Enumerated_Domain_Value_Definition: Lot
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: M
    Enumerated_Domain_Value_Definition: Mineral Survey
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: N
    Enumerated_Domain_Value_Definition: Townsite
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: O
    Enumerated_Domain_Value_Definition: Fractional part of a section
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: P
    Enumerated_Domain_Value_Definition: Parcel
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: Q
    Enumerated_Domain_Value_Definition: Donation Land Claim
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: R
    Enumerated_Domain_Value_Definition: Private land (reserved)
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
Enumerated_Domain_Value: S
Enumerated_Domain_Value_Definition: United States survey
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: T
Enumerated_Domain_Value_Definition: Tract (cadastral surveyed)
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: U
Enumerated_Domain_Value_Definition: Unsurveyed - protracted
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: W
Enumerated_Domain_Value_Definition: Water
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: X
Enumerated_Domain_Value_Definition: Exchange survey
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: Y
Enumerated_Domain_Value_Definition: Townsite outlet (reserved)
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: Z
Enumerated_Domain_Value_Definition: Unsurveyed - unprotracted
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: 2
Enumerated_Domain_Value_Definition: Tract (other than cadastral survey - reserved)
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: AB
Enumerated_Domain_Value_Definition: Sections
Enumerated_Domain_Value_Definition_Source: BLM

Attribute:
  Attribute_Label: secfrt
Attribute_Definition: Sectional fractional code. Not used - reserved for future use.
Attribute_Definition_Source: BLM

Attribute_Domain_Values:
  Enumerated_Domain:
    Enumerated_Domain_Value: (Blank)
    Enumerated_Domain_Value_Definition: Full section
    Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: 1
Enumerated_Domain_Value_Definition: 1/4 section
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: 2
Enumerated_Domain_Value_Definition: 1/2 section
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
  Enumerated_Domain_Value: 3
Enumerated_Domain_Value_Definition: 3/4 section
Enumerated_Domain_Value_Definition_Source: BLM

Attribute:
  Attribute_Label: minorsub
Attribute Definition: Code describing location within a (40 acre) nominal location. Not used - reserved for future use.
Attribute Definition Source: BLM

Attribute Domain Values:
Enumerated Domain:
  Enumerated Domain Value: NE
  Enumerated Domain Value Definition: NE 1/4 of Not used - reserved for future use.
  Enumerated Domain Value Definition Source: BLM

Enumerated Domain:
  Enumerated Domain Value: NW
  Enumerated Domain Value Definition: NW 1/4 of Not used - reserved for future use.
  Enumerated Domain Value Definition Source: BLM

Enumerated Domain:
  Enumerated Domain Value: SW
  Enumerated Domain Value Definition: SW 1/4 of Not used - reserved for future use.
  Enumerated Domain Value Definition Source: BLM

Enumerated Domain:
  Enumerated Domain Value: SE
  Enumerated Domain Value Definition: SE 1/4 of Not used - reserved for future use.
  Enumerated Domain Value Definition Source: BLM

Attribute:
Attribute Label: secdup
Attribute Definition: Section duplicate code. Not used - reserved for future use.
Attribute Definition Source: BLM

Attribute Domain Values:
Enumerated Domain:
  Enumerated Domain Value: (Blank)
  Enumerated Domain Value Definition: Not duplicate
  Enumerated Domain Value Definition Source: BLM

Enumerated Domain:
  Enumerated Domain Value: A
  Enumerated Domain Value Definition: First duplicate (second occurrence of same section number)
  Enumerated Domain Value Definition Source: BLM

Enumerated Domain:
  Enumerated Domain Value: B
  Enumerated Domain Value Definition: Second duplicate (third occurrence of same section number)
  Enumerated Domain Value Definition Source: BLM

Attribute:
Attribute Label: sectn
Attribute Definition: Section number
Attribute Definition Source: BLM

Attribute Domain Values:
Range Domain:
  Range Domain Minimum: 1
  Range Domain Maximum: 100

Attribute:
Attribute Label: Shape
Attribute Definition: Feature geometry.
Attribute Definition Source: ESRI

Attribute Domain Values:
Unrepresentable Domain: Coordinates defining the features.

Attribute:
Attribute Label: qsection
Attribute Definition: The nominal quadrant within the PLSS section
Attribute Definition Source: BLM

Attribute Domain Values:
Enumerated Domain:
  Enumerated Domain Value: NE
  Enumerated Domain Value Definition: NE 1/4 of Not used - reserved for future use.
Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: NW
  Enumerated_Domain_Value_Definition: NW 1/4 of Not used - reserved for future use.
Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: SW
  Enumerated_Domain_Value_Definition: SW 1/4 of Not used - reserved for future use.
Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: SE
  Enumerated_Domain_Value_Definition: SE 1/4 of Not used - reserved for future use.
Enumerated_Domain_Value_Definition_Source: BLM
Attribute:
  Attribute_Label: shape
  Attribute_Definition: Feature geometry.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Coordinates defining the features.
Attribute:
  Attribute_Label: sursurf
Attribute:
  Attribute_Label: Shape_Length
  Attribute_Definition: Length of feature in internal units.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute:
  Attribute_Label: Shape_Area
  Attribute_Definition: Area of feature in internal units squared.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Positive real numbers that are automatically generated.
Overview_Description:
  Entity_and_Attribute_Overview: The LSIS Land Description Area layer (LADESC) is the smallest area unit of the GCDB.
  Entity_and_Attribute_Detail_Citation: U.S Department of the Interior, Bureau of Land Management, LSIS Database Description Document other supporting documentation. Internet versions are available at: www.blm.gov/gcdb/standards/index.htm
Distribution_Information:
  Distributor:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: Regina LeFort
        Contact_Organization: Bureau of Land Management
        Contact_Position: L&RPO GCDB Lead
        Contact_Address:
          Address_Type: mailing address
          Address: P. O. Box 25047
          Address: WO-330D (DFC)
          Address: Building 40, Denver Federal Center
          City: Denver
          State_or_Province: Colorado
          Postal_Code: 80225-0047
          Country: USA
        Contact_Voice_Telephone: (303) 236-0951
        Contact_Facsimile_Telephone: (303) 236-6691
        Contact_Electronic_Mail_Address: regina_lefort@blm.gov
        Contact_Instructions:
For information about the data content, please contact the BLM State Office, GCDB Manager or GCDB Contact at:
http://www.blm.gov/gcdb/gcdbsites/index.html
For information directly relating to metadata, please contact Regina LeFort at regina.lefort@blm.gov

Resource_Description: Downloadable Data

Distribution_Liability: Although these data have been processed successfully on a computer system at the U.S Bureau of Land Management, no warranty, expressed or implied, is made by the BLM regarding the utility of the data on any other system, nor shall the act of distribution constitute any such warranty.

Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: ARCE
Transfer_Size: 5
Digital_Transfer_Option:
Online_Option:
Computer_Contact_Information:
Network_Address:
Network_Resource_Name: LSIS Download Site
Access_Instructions: http://www.lsi.blm.gov

Fees: No fees are required for downloading the data that is on-line.

Metadata_Reference_Information:
Metadata_Date: 20080420
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Regina LeFort
Contact_Organization: Bureau of Land Management
Contact_Position: L&RPO GCDB Lead
Contact_Address:
Address_Type: mailing address
Address: P.O. Box 25047
Address: WO - 330D (DFC)
Address: Building 40, Denver Federal Center
City: Denver
State_or_Province: Colorado
Postal_Code: 80225-0047
Country: USA
Contact_Voice_Telephone: (303) 236-0951
Contact_Facsimile_Telephone: (303) 236-6691
Contact_Electronic_Mail_Address: regina_lefort@blm.gov
Contact_Instructions:

For information about the data content, please contact the BLM State Office, GCDB Manager or GCDB Contact at:
http://www.blm.gov/gcdb/gcdbsites/index.html
For information directly relating to metadata, please contact Regina LeFort at regina.lefort@blm.gov

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time
D.7 BLM SECTIONS

Identification_Information:

Citation:

  Originator: Bureau of Land Management
  Originator: U.S. Forest Service
  Publication_Date: 20060503
  Title: BLM_sec
  Geospatial_Data_Presentation_Form: vector digital data
  Publication_Information:
    Publication Place: Denver, Colorado
    Publisher: Bureau of Land Management
  Online_Linkage: \\fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Lewis_Clark_FINAL.gdb

Description:

  Abstract: This layer is based on Geographic Coordinate Data Base (GCDB) coordinate data. The locations of Public Land Survey System (PLSS) corners, as represented in geographic coordinate pairs, were derived from a variety of source documents, which include U.S. General Land Office and BLM survey plats/notes, as well as survey data obtained from other U.S. Government agencies, private sector survey firms, and local governments. The attributes assigned to PLSS polygons were taken from the BLM's Legal Land Description (LLD) data set, contained within the Legacy Rehost for the year 2000 (LR2000) automated records system. The coordinate data was produced by using control stations of known location, with varying degrees of accuracy, from various sources which include but are not limited to; U.S. Geological Survey (USGS) topological quadrangles and other sources, National Geodetic Survey (NGS) and US Coast & Geodetic Survey (USCGS) Cooperative Base Network (CBN) control, Federal Base Network control (FBN), and Continuous Operating Reference Stations (CORS), and Global Positioning System (GPS) data, which is then analyzed and adjusted in concert with official survey data for any given geographic area. The Land Survey Information System Data Base (LSIS) data is a useful representation of the geometry and topology of parcels contained within the PLSS, but its application is intended for mapping purposes only. The GCDB data served from LSIS is not a substitute for a legal land survey.

  Purpose: The GCDB Data was created to provide the BLM and its public with a set of geographic foundation data that accurately portrays the locations of PLSS corners. The GCDB data is based on the best and most current survey records available and uses known geographic positions of control stations within the PLSS network. This data is a key component of the Land Survey Information System (LSIS) framework upon which parcel boundary information will be assembled.

  Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 18490303
        Ending_Date: present
    Currentness_Reference: ground condition

  Status:
    Progress: In work
    Maintenance_and_Update_Frequency: As needed

  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -112.089956
      East_Bounding_Coordinate: -111.889022
      North_Bounding_Coordinate: 46.725294
      South_Bounding_Coordinate: 46.565175

  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: General Land Office
      Theme_Keyword: GLO
      Theme_Keyword: Bureau of Land Management
      Theme_Keyword: BLM
      Theme_Keyword: Public Land Survey System
      Theme_Keyword: PLSS
      Theme_Keyword: Geographic Coordinate Data Base
      Theme_Keyword: GCDB
Theme_Keyword: National Spatial Data Infrastructure
Theme_Keyword: NSDI
Theme_Keyword: Land Information System
Theme_Keyword: LIS
Theme_Keyword: Land Survey Information
Theme_Keyword: LSI
Theme_Keyword: Cadastral
Theme_Keyword: Township
Theme_Keyword: Range
Theme_Keyword: Land Survey Information System
Theme_Keyword: LSIS

Theme:
Theme_Keyword_Thesaurus: BLM-State
Theme_Keyword: Arizona
Theme_Keyword: Arkansas
Theme_Keyword: California
Theme_Keyword: Colorado
Theme_Keyword: Idaho
Theme_Keyword: Michigan
Theme_Keyword: Montana
Theme_Keyword: Nebraska
Theme_Keyword: Nevada
Theme_Keyword: New Mexico
Theme_Keyword: North Dakota
Theme_Keyword: Oregon
Theme_Keyword: Utah
Theme_Keyword: Washington
Theme_Keyword: Wyoming

Theme:
Theme_Keyword_Thesaurus: BLM-Theme
Theme_Keyword: Cadastral

Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Contiguous US

Access_Constraints: None
Use_Constraints: The geographic coordinates and their associated products are NOT legal land survey records. The coordinates can NOT be used as a substitute for a legal land survey. They can be used for record keeping, mapping, graphics and planning purposes only. No warranty is made by the Bureau of Land Management for use of the data for purposes not intended by BLM.

Point_of_Contact:
Contact_Information:
  Contact_Person_Primary:
    Contact_Person: Regina LeFort
    Contact_Organization: Bureau of Land Management
    Contact_Position: L&RPO GCDB Lead
    Contact_Address:
      Address_Type: mailing address
      Address: P.O. Box 25047
      Address: Mail Stop: WO - 330D (DFC)
      Address: Building 40, Denver Federal Center
      City: Denver
      State_or_Province: Colorado
      Postal_Code: 80225-0047
      Country: USA
    Contact_Voice_Telephone: (303) 236-0951
    Contact_Facsimile_Telephone: (303) 236-6691
    Contact_Electronic_Mail_Address: regina_lefort@blm.gov
    Contact_Instructions:
For information about the data content, please contact the BLM State Office, GCDB Manager or GCDB Contact at: http://www.blm.gov/gcdb/gcdbsites/index.html

For information directly relating to metadata, please contact Regina LeFort at regina.lefort@blm.gov

Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: Data was checked for attribute accuracy by the GCDB personnel in each of the respective BLM State Offices.

Logical_Consistency_Report: The data set is topologically structured with nodes at all intersections. Labels representing the legal land description are assigned to each land unit.

Completeness_Report: All GCDB spatial outputs are visually inspected for completeness to ensure that all survey data for a given geographic area is included in the data set.

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Accuracy of the individual points contained within the GCDB layers of LSIS that were determined using GMM software were adjusted using both compass rule and a least squares analysis, which examines the geometry of PLSS parcels in relation to the coordinate values of known locations for control points within the PLSS grid. Each individual point carries a reliability factor indicating the error ellipse in both northing and easting which is reported after the least squares analysis is completed.

Accuracy of the individual points contained within the GCDB layers of LSIS that were determined using PCCS software were adjusted using a succession of compass rule adjustments between the control points followed by a least squares analysis, which examines the geometry of PLSS parcels in relation to the coordinate values of known locations for control points within the PLSS grid. Each individual point carries positional reliability factors for the average of the misclosures in the data set and the maximum misclosure in the data set.

Lineage:

Source_Information:

Source_Citation:

Originator: Bureau of Land Management
Publication_Date: 20041029
Title: Land Survey Information System (LSIS)
Geospatial_Data_Presentation_Form: tabular digital data
Publication_Information:
Publication Place: Denver, Colorado
Publisher: Bureau of Land Management
Type_of_Source_Media: online
Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 18490303
Ending_Date: present
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: BLM
Source_Contribution: Survey data in the form of official (microfilm, CD, other) survey and BLM, abstracted into a vector digital format.

Source_Information:

Source_Citation:

Originator: U.S. Forest Service
Publication_Date: 19980601
Title: Automated Lands Project (ALP)
Geospatial_Data_Presentation_Form: tabular digital data
Publication_Information:
Publication Place: Washington, D.C.
Publisher: U.S. Forest Service
Type_of_Source_Media: disc
Source_Time_Period_of_Content:
Time_Period_Information:
  Range_of_Dates/Times:
    Beginning_Date: 19980601
    Ending_Date: present
  Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: USFS
Source_Contribution: Survey and control data from the Cartographic Feature File (CFF) data set.
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: U.S Geological Survey
      Publication_Date: 1931
      Title: USGS standard topological quadrangles
      Geospatial_Data_Presentation_Form: tabular digital data
    Publication_Information:
      Publication_Place: Denver, Colorado
      Publisher: U.S. Geological Survey
  Type_of_Source_Media: disc
  Source_Time_Period_of_Content:
    Range_of_Dates/Times:
      Beginning_Date: 1931
      Ending_Date: present
    Source_Currentness_Reference: ground condition
  Source_Citation_Abbreviation: USGS
Source_Contribution: Digitized control data from standard topological quadrangle sheets.
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: National Geodetic Survey
      Publication_Date: 20000101
      Title: Official Control Station Sheets
      Geospatial_Data_Presentation_Form: tabular digital data
    Publication_Information:
      Publication_Place: Silver Springs, Maryland
      Publisher: National Geodetic Survey
  Type_of_Source_Media: disc
  Source_Time_Period_of_Content:
    Range_of_Dates/Times:
      Beginning_Date: 19010101
      Ending_Date: present
    Source_Currentness_Reference: ground condition
  Source_Citation_Abbreviation: NGS
Source_Contribution: Survey control data from the official control station sheets (CBN, FBN, CORS).
Process_Step:
  Process_Description: Compile survey input data from current BLM official measurements, supplemented in some locations with USFS and private survey records.
  Source_Used_Citation_Abbreviation: BLM database of the index to all official (microfilm, CD, other) BLM survey records.
  Source_Used_Citation_Abbreviation: USFS survey records.
  Source_Used_Citation_Abbreviation: Private land surveyor records
  Source_Used_Citation_Abbreviation: GCDB Data Collection Attribute Definitions Version 2.0, Appendix A, 2/14/1991. Survey records used - source abbreviations.
  Process_Date: Unknown
Process_Step:
  Process_Description: Compile listings of known locations of PLSS corners.
  Source_Used_Citation_Abbreviation: USGS topographic quadrangles and other sources.
  Source_Used_Citation_Abbreviation: USC&GS published coordinate data.
Source _Used_Citation_Abbreviation: NGS published coordinate data.
Source _Used_Citation_Abbreviation: BLM global positioning Data.
Source _Used_Citation_Abbreviation: USFS global positioning data.
Process_Date: Unknown
Process Step:
Process Description: Coordinates of control stations are entered into a control data base with associated reliabilities.
Process Date: Unknown
Process Step:
Process Description: This data has been created in either the GMM or PCCS format. The following process steps refer to data in GMM format.

With GMM survey data, abstracted from survey plats, and control stations extracted from the control database, are manually entered with weighting factors into GMM software. Compass rule and least squares adjustments are performed using weighting factors assigned to both control stations and survey line data, based on methodologies and vintage of survey.

With GMM, section subdivision is performed to achieve land unit detail to at least the forty acre parcel level. Instructions for calculating non-regular and minor subdivisions are persistently stored during collection and rerun after every new adjustment in order to achieve the detail necessary to delineate all lines required for depicting federal rights, interests, restrictions, and encumbrances. Coincident lines and lines identified as non-boundary lines are removed from the data set used for final land unit constructions. Line intersections are computed and given unique identifiers and land units are constructed.

GMM lists all coordinates produced by the compass rule and least squares adjustments and subdivision, with connectivity codes between points and compiles them into a single file for development of Geographic Information Systems (GIS) output.
Process Date: Unknown
Process Step:
Process Description: This data has been created in either the GMM or PCCS format. The following process steps refer to data in PCCS format.

With PCCS, survey data abstracted from survey plats and control stations extracted from control data base are manually entered into the PCCS processing software. A succession of compass rule adjustments is performed on the lines to adjust them to the control points, followed by a least squares analysis. The resulting coordinates are accompanied by indications of positional reliability; the average of misclosures in the data set and the maximum misclosure in the data set.

PCCS lists all coordinates produced by the compass rule and least squares adjustments with connectivity codes between points and compiles them into a single file for development of GIS files.

With PCCS, section subdivision is performed to achieve land unit detail to at least the forty acre parcel level.
Process Date: Unknown
Process Step:
Process Description: GCDB data conversion software verifies correctness of GCDB file formats and content.
Process Date: Unknown
Process Step:
Process Description: Verified coordinate, line and label files are converted to GIS coverages using the topology check application. All errors in topology are flagged for editing and correction.
Process Date: Unknown
Process Step:
Process Description: If topological errors exist, editing of arc and node data, as well as parcel labels, is performed using either GMM or ArcInfo Interface (AII). (PCCS townships can only be edited using AII). Final edits are entered into input files and the process is repeated until all errors are corrected and a successful GIS coverage is created.
Process Date: Unknown
Process Step:
Process Description: GIS coverages are edgematched with adjoining township data sets to insure a seamless PLSS grid is created.
Process Date: Unknown
Process Step:
Process Description: Topologically correct GIS coverages are modified to use FGDC compliant naming conventions and then loaded into the LSIS database. These layers can then be downloaded as shapefiles through the LSIS website.
Process Date: Unknown
Process Step:
Process_Description: Metadata imported.
Process_Step:
   Process_Description: Metadata imported.
Source_Used_Citation_Abbreviation: \Fs1\home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Orig_data\BLM_PLSS\Lewis_and_Clarck_County\first.xml
Spatial_Data_Organization_Information:
   Direct_Spatial_Reference_Method: Vector
   SDTS_Terms_Description:
      SDTS_Point_and_Vector_Object_Type: G-polygon
      Point_and_Vector_Object_Count: 122
   Spatial_Reference_Information:
      Horizontal_Coordinate_System_Definition:
         Planar:
            Map_Projection:
               Map_Projection_Name: Lambert Conformal Conic
               Lambert_Conformal_Conic:
                  Standard Parallel: 45.000000
                  Standard Parallel: 49.000000
                  Longitude_of_Central_Meridian: -109.500000
                  Latitude_of_Projection_Origin: 44.250000
                  False_Easting: 600000.000000
                  False_Northing: 0.000000
            Planar_Coordinate_Information:
               Planar_Coordinate_Encoding_Method: coordinate pair
               Coordinate_Representation:
                  Abscissa_Resolution: 0.000100
                  Ordinate_Resolution: 0.000100
               Planar_Distance_Units: meters
            Geodetic_Model:
               Horizontal_Datum_Name: D_North_American_1983_HARN
               Ellipsoid_Name: Geodetic Reference System 80
               Semi-major_Axis: 6378137.000000
               Denominator_of_Flattening_Ratio: 298.257222
            Vertical_Coordinate_System_Definition:
               Altitude_System_Definition:
                  Altitude_Resolution: 0.000100
                  Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates
      Entity_and_Attribute_Information:
         Detailed_Description:
            Entity_Type:
               Entity_Type_Label: BLM_sec
               Entity_Type_Definition: Public Land Survey System Townships first divisions are normally Public Land Survey System Tracts or Public Land Survey System Sections. This entity is the primary or first subdivisions of a Public Land Survey System Township.
               Entity_Type_Definition_Source: FGDC
            Attribute:
               Attribute_Label: objectid
               Attribute_Definition: Internal feature number.
               Attribute_Definition_Source: ESRI
               Attribute_Domain_Values:
                  Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
            Attribute:
               Attribute_Label: lndkey
               Attribute_Definition: A unique identifier for each township. The lndkey is read: State, Prime Meridian, Township (including fractions and direction), and range (including fractions and direction). Ex: ST00T0000N0000E. The numbers directly before the direction indicate if a township or range is fractional. See attributes twnfrt and rngfrt for values and definitions of the fractions.
               Attribute_Definition_Source: BLM
               Attribute_Domain_Values:
Unrepresentable_Domain: See individual attributes for range values.

Attribute:
Attribute_Label: sectn
Attribute_Definition: Section number
Attribute_Definition_Source: GCDB
Attribute_Domain_Values:
  Range_Domain:
  Range_Domain_Minimum: 1
  Range_Domain_Maximum: 100

Attribute:
Attribute_Label: secfrt
Attribute_Definition: Section fractional code. Not used - reserved for future use.
Attribute_Definition_Source: BLM
Attribute_Domain_Values:
  Enumerated_Domain:
    Enumerated_Domain_Value: (Blank)
    Enumerated_Domain_Value_Definition: Full section
    Enumerated_Domain_Value_Definition_Source: BLM
  Enumerated_Domain:
    Enumerated_Domain_Value: 1
    Enumerated_Domain_Value_Definition: 1/4 section
    Enumerated_Domain_Value_Definition_Source: BLM
  Enumerated_Domain:
    Enumerated_Domain_Value: 2
    Enumerated_Domain_Value_Definition: 1/2 section
    Enumerated_Domain_Value_Definition_Source: BLM
  Enumerated_Domain:
    Enumerated_Domain_Value: 3
    Enumerated_Domain_Value_Definition: 3/4 section
    Enumerated_Domain_Value_Definition_Source: BLM

Attribute:
Attribute_Label: sectionkey
Attribute_Definition: Concatenation of section, secfrt, and secdup columns, used to easily join/relate sections and ladesc records.
Attribute_Definition_Source: BLM
Attribute_Domain_Values:
  Range_Domain:
  Range_Domain_Minimum: 1
  Range_Domain_Maximum: 100

Attribute:
Attribute_Label: OBJECTID_1
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
  Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.

Attribute:
Attribute_Label: secdup
Attribute_Definition: Section duplicate code. Not used - reserved for future use.
Attribute_Definition_Source: BLM
Attribute_Domain_Values:
  Enumerated_Domain:
    Enumerated_Domain_Value: (Blank)
    Enumerated_Domain_Value_Definition: Not duplicate
    Enumerated_Domain_Value_Definition_Source: BLM
  Enumerated_Domain:
    Enumerated_Domain_Value: A
    Enumerated_Domain_Value_Definition: First duplicate (second occurrence of same section number)
    Enumerated_Domain_Value_Definition_Source: BLM
   Enumerated_Domain:
Enumerated_Domain_Value: B
Enumerated_Domain_Value_Definition: Second duplicate (Third occurrence of same section number).
Enumerated_Domain_Value_Definition_Source: BLM

Attribute:
Attribute_Label: shape
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.

Attribute:
Attribute_Label: Shape
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.

Attribute:
Attribute_Label: label
Attribute_Definition: Section number used for data labeling purposes.
Attribute_Definition_Source: BLM
Attribute_Domain_Values:
Unrepresentable_Domain: Integer

Attribute:
Attribute_Label: Shape_Length
Attribute_Definition: Length of feature in internal units.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.

Attribute:
Attribute_Label: Shape_Area
Attribute_Definition: Area of feature in internal units squared.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.

Overview_Description:
Entity_and_Attribute_Overview: The LSIS PLSS Land Survey System Township First Division layer (FIRST) contains first division polygons representing surveyed sections.
Entity_and_Attribute_Detail_Citation: U.S Department of the Interior, Bureau of Land Management, LSIS Database Description Document other supporting documentation. Internet versions are available at: www.blm.gov/gcdb/standards/index.htm

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
  Contact_Person: Regina LeFort
  Contact_Organization: Bureau of Land Management
  Contact_Position: L&RPO GCDB Lead
Contact_Address:
  Address_Type: mailing address
  Address: P. O. Box 25047
  Address: WO-330D (DFC)
  Address: Building 40, Denver Federal Center
  City: Denver
  State_or_Province: Colorado
  Postal_Code: 80225-0047
  Country: USA
  Contact_Voice_Telephone: (303) 236-0951
  Contact_Facsimile_Telephone: (303) 236-6691
  Contact_Electronic_Mail_Address: regina_lefort@blm.gov
  Contact_Instructions:
For information about the data content, please contact the BLM State Office, GCDB Manager or GCDB Contact at:
http://www.blm.gov/gcdb/gcdbsites/index.html
For information directly relating to metadata, please contact Regina LeFort at regina.lefort@blm.gov

Resource_Description: Downloadable Data
Distribution_Liability: Although these data have been processed successfully on a computer system at the U.S Bureau of Land
Management, no warranty, expressed or implied, is made by the BLM regarding the utility of the data on any other system, nor shall the act
of distribution constitute any such warranty.

Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: ARCE
Transfer_Size: 5
Digital_Transfer_Option:
Online_Option:
Computer_Contact_Information:
Network_Address:
Network_Resource_Name: LSIS Download Site
Access_Instructions: http://www.lsi.blm.gov
Fees: No fees are required for downloading the data that is on-line.

Metadata_Reference_Information:
Metadata_Date: 20080420
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Regina LeFort
Contact_Organization: Bureau of Land Management
Contact_Position: L&RPO GCDB Lead
Contact_Address:
Address_Type: mailing address
Address: P.O. Box 25047
Address: WO - 330D (DFC)
Address: Building 40, Denver Federal Center
City: Denver
State_or_Province: Colorado
Postal_Code: 80225-0047
Country: USA
Contact_Voice_Telephone: (303) 236-0951
Contact_Facsimile_Telephone: (303) 236-6691
Contact_Electronic_MailAddress: regina_lefort@blm.gov
Contact_Instructions:
For information about the data content, please contact the BLM State Office, GCDB Manager or GCDB Contact at:
http://www.blm.gov/gcdb/gcdbsites/index.html
For information directly relating to metadata, please contact Regina LeFort at regina.lefort@blm.gov

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time

Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile

Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile

Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile

Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile

Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile

Trihydro
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile

Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
D.8 BLM TOWNSHIPS

Identification_Information:
Citation:
Originator: Bureau of Land Management
Publication_Date: 20060503
Title: BLM_twnshp
Geospatial_Data_Presentation_Form: vector digital data
Publication_Information:
Publication_Place: Denver, Colorado
Publisher: Bureau of Land Management
Online_Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Lewis_Clark_FINAL.gdb

Description:
Abstract: This layer is based on Geographic Coordinate Data Base (GCDB) coordinate data. The locations of Public Land Survey System (PLSS) corners, as represented in geographic coordinate pairs, were derived from a variety of source documents, which include U.S. General Land Office and BLM survey plats/notes, as well as survey data obtained from other U.S. Government agencies, private sector survey firms, and local governments. The attributes assigned to PLSS polygons were taken from the BLM's Legal Land Description (LLD) data set, contained within the Legacy Rehost for the year 2000 (LR2000) automated records system. The coordinate data was produced by using control stations of known location, with varying degrees of accuracy, from various sources which include but are not limited to; U.S. Geological Survey (USGS) topological quadrangles and other sources, National Geodetic Survey (NGS) and US Coast & Geodetic Survey (USC&GS) Cooperative Base Network (CBN) control, Federal Base Network control (FBN), and Continuous Operating Reference Stations (CORS), and Global Positioning System (GPS) data, which is then analyzed and adjusted in concert with official survey data for any given geographic area. The Land Survey Information System Data Base (LSIS) data is a useful representation of the geometry and topology of parcels contained within the PLSS, but its application is intended for mapping purposes only. The GCDB data served from LSIS is not a substitute for a legal land survey.

Purpose: The GCDB Data was created to provide the BLM and its public with a set of geographic foundation data that accurately portrays the locations of PLSS corners. The GCDB data is based on the best and most current survey records available and uses known geographic positions of control stations within the PLSS network. This data is a key component of the Land Survey Information System (LSIS) framework upon which parcel boundary information will be assembled.

Time_Period_of_Content:
Range_of_Dates/Times:
Beginning_Date: 18490303
Ending_Date: present
Currentness_Reference: ground condition

Status:
Progress: In work
Maintenance_and_Update_Frequency: As needed

Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -112.089956
East_Bounding_Coordinate: -111.889022
North_Bounding_Coordinate: 46.725294
South_Bounding_Coordinate: 46.565175

Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: General Land Office
Theme_Keyword: GLO
Theme_Keyword: Bureau of Land Management
Theme_Keyword: BLM
Theme_Keyword: Public Land Survey System
Theme_Keyword: PLSS
Theme_Keyword: Geographic Coordinate Data Base
Theme_Keyword: GCDB
Theme_Keyword: National Spatial Data Infrastructure
Theme_Keyword: NSDI
Theme_Keyword: Land Information System
Theme_Keyword: LIS
Theme_Keyword: Land Survey Information
Theme_Keyword: LSI
Theme_Keyword: Cadastral
Theme_Keyword: Township
Theme_Keyword: Range
Theme_Keyword: Land Survey Information System
Theme_Keyword: LSIS
Theme:
Theme_Keyword_Thesaurus: BLM-State
Theme_Keyword: Arizona
Theme_Keyword: Arkansas
Theme_Keyword: California
Theme_Keyword: Colorado
Theme_Keyword: Idaho
Theme_Keyword: Michigan
Theme_Keyword: Montana
Theme_Keyword: Nebraska
Theme_Keyword: Nevada
Theme_Keyword: New Mexico
Theme_Keyword: North Dakota
Theme_Keyword: Oregon
Theme_Keyword: Utah
Theme_Keyword: Washington
Theme_Keyword: Wyoming
Theme:
Theme_Keyword_Thesaurus: BLM-Theme
Theme_Keyword: Cadastral
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Contiguous US
Access_Constraints: None
Use_Constraints: The geographic coordinates and their associated products are NOT legal land survey records. The coordinates can NOT be used as a substitute for a legal land survey. They can be used for record keeping, mapping, graphics and planning purposes only. No warranty is made by the Bureau of Land Management for use of the data for purposes not intended by BLM.
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Regina LeFort
Contact_Organization: Bureau of Land Management
Contact_Position: L&RPO GCDB Lead
Contact_Address:
Address_Type: mailing address
Address: P.O. Box 25047
Address: Mail Stop: WO - 330D (DFC)
Address: Building 40, Denver Federal Center
City: Denver
State_or_Province: Colorado
Postal_Code: 80225-0047
Country: USA
Contact_Voice_Telephone: (303) 236-0951
Contact_Facsimile_Telephone: (303) 236-6691
Contact_Electronic_Mail_Address: regina_lefort@blm.gov
Contact_Instructions:
For information about the data content, please contact the BLM State Office, GCDB Manager or GCDB Contact at:
http://www.blm.gov/gcdb/gcdbsites/index.html

For information directly relating to metadata, please contact Regina LeFort at regina.lefort@blm.gov

Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:

Attribute_Accuracy:
Attribute_Accuracy_Report: Data was checked for attribute accuracy by the GCDB personnel in each of the respective BLM State Offices.

Logical_Consistency_Report: The data set is topologically structured with nodes at all intersections. Labels representing the legal land description are assigned to each land unit.

Completeness_Report: All GCDB spatial outputs are visually inspected for completeness to ensure that all survey data for a given geographic area is included in the data set.

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Accuracy of the individual points contained within the GCDB layers of LSIS that were determined using GMM software were adjusted using both compass rule and a least squares analysis, which examines the geometry of PLSS parcels in relation to the coordinate values of known locations for control points within the PLSS grid. Each individual point carries a reliability factor indicating the error ellipse in both northing and easting which is reported after the least squares analysis is completed.

Accuracy of the individual points contained within the GCDB layers of LSIS that were determined using PCCS software were adjusted using a succession of compass rule adjustments between the control points followed by a least squares analysis, which examines the geometry of PLSS parcels in relation to the coordinate values of known locations for control points within the PLSS grid. Each individual point carries positional reliability factors for the average of the misclosures in the data set and the maximum misclosure in the data set.

Lineage:

Source_Information:
Citation_Information:
Originator: Bureau of Land Management
Publication_Date: 20041029
Title: Land Survey Information System (LSIS)
Geospatial_Data_Presentation_Form: tabular digital data
Publication_Information:
PublicationPlace: Denver, Colorado
Publisher: Bureau of Land Management
Type_of_Source_Media: online
Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times: Beginning_Date: 18490303
Ending_Date: present
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: BLM
Source_Contribution: Survey data in the form of official (microfilm, CD, other) survey and BLM, abstracted into a vector digital format.

Source_Information:
Citation_Information:
Originator: U.S. Forest Service
Publication_Date: 19980601
Title: Automated Lands Project (ALP)
Geospatial_Data_Presentation_Form: tabular digital data
Publication_Information:
PublicationPlace: Washington, D.C.
Publisher: U.S. Forest Service
Type_of_Source_Media: disc
Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
  Beginning_Date: 19980601
  Ending_Date: present
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: USFS
Source_Contribution: Survey and control data from the Cartographic Feature File (CFF) data set.
Source_Information:
Source_Citation:
  Originator: U.S Geological Survey
  Publication_Date: 1931
  Title: USGS standard topological quadrangles
  Geospatial_Data_Presentation_Form: tabular digital data
  Publication_Information:
    Publication_Place: Denver, Colorado
    Publisher: U.S. Geological Survey
Source_Time_Period_of_Content:
  Time_Period_Information:
    Range_of_Dates/Times:
      Beginning_Date: 1931
      Ending_Date: present
    Source_Currentness_Reference: ground condition
    Source_Citation_Abbreviation: USGS
    Source_Contribution: Digitized control data from standard topological quadrangle sheets.
Source_Information:
Source_Citation:
  Originator: National Geodetic Survey
  Publication_Date: 20000101
  Title: Official Control Station Sheets
  Geospatial_Data_Presentation_Form: tabular digital data
  Publication_Information:
    Publication_Place: Silver Springs, Maryland
    Publisher: National Geodetic Survey
Source_Time_Period_of_Content:
  Time_Period_Information:
    Range_of_Dates/Times:
      Beginning_Date: 19010101
      Ending_Date: present
    Source_Currentness_Reference: ground condition
    Source_Citation_Abbreviation: NGS
    Source_Contribution: Survey control data from the official control station sheets (CBN, FBN, CORS).
Process_Step:
  Process_Description: Compile survey input data from current BLM official measurements, supplemented in some locations with USFS and private survey records.
    Source_Used_Citation_Abbreviation: BLM database of the index to all official (microfilm, CD, other) BLM survey records.
    Source_Used_Citation_Abbreviation: USFS survey records.
    Source_Used_Citation_Abbreviation: Private land surveyor records
    Source_Used_Citation_Abbreviation: GCDB Data Collection Attribute Definitions Version 2.0, Appendix A, 2/14/1991. Survey records used - source abbreviations.
    Process_Date: Unknown
Process_Step:
  Process_Description: Compile listings of known locations of PLSS corners.
    Source_Used_Citation_Abbreviation: USGS topographic quadrangles and other sources.
    Source_Used_Citation_Abbreviation: USC&GS published coordinate data.
Source_Used_Citation_Abbreviation: NGS published coordinate data.
Source_Used_Citation_Abbreviation: BLM global positioning Data.
Source_Used_Citation_Abbreviation: USFS global positioning data.

Process_Date: Unknown

Process_Step:
Process_Description: Coordinates of control stations are entered into a control database with associated reliabilities.
Process_Date: Unknown

Process_Step: This data has been created in either GMM or PCCS format. The following process steps refer to data in GMM format.

With GMM survey data, abstracted from survey plats, and control stations extracted from the control database, are manually entered with weighting factors into GMM software. Compass rule and least squares adjustments are performed using weighting factors assigned to both control stations and survey line data, based on methodologies and vintage of survey.

With GMM, section subdivision is performed to achieve land unit detail to at least the forty acre parcel level. Instructions for calculating non-regular and minor subdivisions are persistently stored during collection and rerun after every new adjustment in order to achieve the detail necessary to delineate all lines required for depicting federal rights, interests, restrictions, and encumbrances. Coincident lines and lines identified as non-boundary lines are removed from the data set used for final land unit constructions. Line intersections are computed and given unique identifiers and land units are constructed.

GMM lists all coordinates produced by the compass rule and least squares adjustments and subdivision, with connectivity codes between points and compiles them into a single file for development of Geographic Information Systems (GIS) output.

Process_Date: Unknown

Process_Step: This data has been created in either GMM or PCCS format. The following process steps refer to data in PCCS format.

With PCCS, survey data abstracted from survey plats and control stations extracted from control database are manually entered into the PCCS processing software. A succession of compass rule adjustments is performed on the lines to adjust them to the control points, followed by a least squares analysis. The resulting coordinates are accompanied by indications of positional reliability; the average of misclosures in the data set and the maximum misclosure in the data set.

With PCCS, section subdivision is performed to achieve land unit detail to at least the forty acre parcel level.

PCCS lists all coordinates produced by the compass rule and least squares adjustments with connectivity codes between points and compiles them into a single file for development of GIS files.

With PCCS, section subdivision is performed to achieve land unit detail to at least the forty acre parcel level.

Process_Date: Unknown

Process_Step: GCDB data conversion software verifies correctness of GCDB file formats and content.
Process_Date: Unknown

Process_Step: This data has been created in either GMM or PCCS format. The following process steps refer to data in PCCS format.

With PCCS, section subdivision is performed to achieve land unit detail to at least the forty acre parcel level.

PCCS lists all coordinates produced by the compass rule and least squares adjustments with connectivity codes between points and compiles them into a single file for development of GIS files.

With PCCS, section subdivision is performed to achieve land unit detail to at least the forty acre parcel level.

Process_Date: Unknown

Process_Step: If topological errors exist, editing of arc and node data, as well as parcel labels, is performed using either GMM or ArcInfo Interface (AII). (PCCS townships can only be edited using AII). Final edits are entered into input files and the process is repeated until all errors are corrected and a successful GIS coverage is created.

Process_Date: Unknown

Process_Step: GIS coverages are edgematched with adjoining township data sets to insure a seamless PLSS grid is created.
Process_Date: Unknown

Process_Step: Topologically correct GIS coverages are modified to use FGDC compliant naming conventions and then loaded into the LSIS database. These layers can then be downloaded as shapefiles through the LSIS website.

Process_Date: Unknown

Process_Step:
Process_Description: Metadata imported.
Process_Description: Metadata imported.
Source_Used_Citation_Abbreviation: \Fs1\home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Orig_data\BLM_PLSS\Lewis_and_Clark_County\township.xml
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: 9
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Lambert Conformal Conic
Lambert_Conformal_Conic:
Standard_Parallel: 45.000000
Standard_Parallel: 49.000000
Longitude_of_Central_Meridian: -109.500000
Latitude_of_Projection_Origin: 44.250000
False_Easting: 600000.000000
False_Northing: 0.000000
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000100
Ordinate_Resolution: 0.000100
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: D_North_American_1983_HARN
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222
Vertical_Coordinate_System_Definition:
Altitude_System_Definition:
Altitude_Resolution: 0.000100
Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: BLM_twnshp
Entity_Type_Definition: In the Public Land Survey System, a township refers to a unit of land, nominally 6 miles per side, usually containing 36 sections.
Entity_Type_Definition_Source: FGDC
Attribute:
Attribute_Label: objectid
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: lndkey
Attribute_Definition: A unique identifier for each township. The lndkey is read: State, Prime Meridian, Township (including fractions and direction), and range (including fractions and direction). Ex: ST00T0000N0000E. The numbers directly before the direction indicate if a township or range is fractional. See attributes twnfrt and rngfrt for values and definitions of the fractions.
Attribute_Definition_Source: BLM
Attribute_Domain_Values:
Unrepresentable_Domain: See individual attributes for range values.

Attribute:
Attribute_Label: range
Attribute_Definition: Numeric code identifying range number.
Attribute_Definition_Source: BLM
Attribute_Domain_Values:
Unrepresentable_Domain: 3 digit non-zero value

Attribute:
Attribute_Label: rngdir
Attribute_Definition: Alpha code for identifying direction of township.
Attribute_Definition_Source: BLM
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: E
Enumerated_Domain_Value_Definition: East of base meridian
Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
Enumerated_Domain_Value: W
Enumerated_Domain_Value_Definition: West of base meridian.
Enumerated_Domain_Value_Definition_Source: BLM

Attribute:
Attribute_Label: rngfrt
Attribute_Definition: Numeric code identifying fractional range.
Attribute_Definition_Source: BLM
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 0
Enumerated_Domain_Value_Definition: Not a fractional range.
Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
Enumerated_Domain_Value: 1
Enumerated_Domain_Value_Definition: 1/4 range
Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
Enumerated_Domain_Value: 2
Enumerated_Domain_Value_Definition: 1/2 range
Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
Enumerated_Domain_Value: 3
Enumerated_Domain_Value_Definition: 3/4 range
Enumerated_Domain_Value_Definition_Source: BLM

Attribute:
Attribute_Label: twndup
Attribute_Definition: Alpha code for determining a duplicate township.
Attribute_Definition_Source: BLM
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: (Blank)
Enumerated_Domain_Value_Definition: Not a duplicate.
Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
Enumerated_Domain_Value: A
Enumerated_Domain_Value_Definition: First duplicate
Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
Enumerated_Domain_Value: B
Enumerated_Domain_Value_Definition: Second duplicate.
Enumerated_Domain_Value_Definition_Source: BLM
<table>
<thead>
<tr>
<th>Enumerated_Domain_Value</th>
<th>Enumerated_Domain_Value_Definition</th>
<th>Enumerated_Domain_Value_Definition_Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>First principal</td>
<td>BLM</td>
</tr>
<tr>
<td>02</td>
<td>Second principal</td>
<td>BLM</td>
</tr>
<tr>
<td>03</td>
<td>Third principal</td>
<td>BLM</td>
</tr>
<tr>
<td>04</td>
<td>Fourth principal</td>
<td>BLM</td>
</tr>
<tr>
<td>05</td>
<td>Fifth principal</td>
<td>BLM</td>
</tr>
<tr>
<td>06</td>
<td>Sixth principal</td>
<td>BLM</td>
</tr>
<tr>
<td>07</td>
<td>Black Hills</td>
<td>BLM</td>
</tr>
<tr>
<td>08</td>
<td>Boise</td>
<td>BLM</td>
</tr>
<tr>
<td>09</td>
<td>Chickasaw</td>
<td>BLM</td>
</tr>
<tr>
<td>10</td>
<td>Choctaw</td>
<td>BLM</td>
</tr>
<tr>
<td>11</td>
<td>Cimarron</td>
<td>BLM</td>
</tr>
<tr>
<td>12</td>
<td>Copper River</td>
<td>BLM</td>
</tr>
<tr>
<td>13</td>
<td>Fairbanks</td>
<td>BLM</td>
</tr>
</tbody>
</table>
Enumerated_Domain_Value: 14
Enumerated_Domain_Value_Definition: Gila and Salt River
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 15
Enumerated_Domain_Value_Definition: Humboldt
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 16
Enumerated_Domain_Value_Definition: Huntsville
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 17
Enumerated_Domain_Value_Definition: Indian
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 18
Enumerated_Domain_Value_Definition: Louisiana
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 19
Enumerated_Domain_Value_Definition: Michigan
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 20
Enumerated_Domain_Value_Definition: Principal
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 21
Enumerated_Domain_Value_Definition: Mount Diablo
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 22
Enumerated_Domain_Value_Definition: Navajo
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 23
Enumerated_Domain_Value_Definition: New Mexico Principal
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 24
Enumerated_Domain_Value_Definition: St. Helena
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 25
Enumerated_Domain_Value_Definition: St. Stephens
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 26
Enumerated_Domain_Value_Definition: Salt Lake
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 27
Enumerated_Domain_Value_Definition: San Bernadino
Enumerated_Domain_Value_Definition_Source: BLM

Enumerated_Domain:
Enumerated_Domain_Value: 28
Enumerated_Domain_Value_Definition: Seward
Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 29
  Enumerated_Domain_Value_Definition: Tallahassee
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 30
  Enumerated_Domain_Value_Definition: Unitah
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 31
  Enumerated_Domain_Value_Definition: Ute
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 32
  Enumerated_Domain_Value_Definition: Washington
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 33
  Enumerated_Domain_Value_Definition: Willamette
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 34
  Enumerated_Domain_Value_Definition: Wind River
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 35
  Enumerated_Domain_Value_Definition: Ohio River Survey
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 36
  Enumerated_Domain_Value_Definition: Between the Miamis
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 37
  Enumerated_Domain_Value_Definition: Muskingham River Survey
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 39
  Enumerated_Domain_Value_Definition: Scioto River Base (First)
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 40
  Enumerated_Domain_Value_Definition: Scioto River Base
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 41
  Enumerated_Domain_Value_Definition: Scioto River Base (Third)
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 43
  Enumerated_Domain_Value_Definition: Twelve-Mile-Square
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
  Enumerated_Domain_Value: 44
  Enumerated_Domain_Value_Definition: Kateel River
  Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
Enumerated_Domain_Value: 45
Enumerated_Domain_Value_Definition: Umiat
Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: 46
    Enumerated_Domain_Value_Definition: Fourth Principal
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: 47
    Enumerated_Domain_Value_Definition: West of the Great Miami
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: 48
    Enumerated_Domain_Value_Definition: U.S. Military Survey
    Enumerated_Domain_Value_Definition_Source: BLM
Enumerated_Domain:
    Enumerated_Domain_Value: 91
    Enumerated_Domain_Value_Definition: Connecticut Western
    Enumerated_Domain_Value_Definition_Source: BLM
Attribute:
    Attribute_Label: state
    Attribute_Definition: 2 Letter State Abbreviation
    Attribute_Definition_Source: BLM
    Attribute_Domain_Values:
        Codeset_Domain:
            Codeset_Name: State abbreviation as defined in FIPS PUB 5-2
            Codeset_Source: U.S. Postal Service
Attribute:
    Attribute_Label: shape
    Attribute_Definition: Feature geometry.
    Attribute_Definition_Source: ESRI
    Attribute_Domain_Values:
        Unrepresentable_Domain: Coordinates defining the features.
Attribute:
    Attribute_Label: twntype
    Attribute_Definition: Not used
    Attribute_Definition_Source: BLM
Attribute:
    Attribute_Label: town
    Attribute_Definition: Numeric code identifying tier number.
    Attribute_Definition_Source: BLM
    Attribute_Domain_Values:
        Unrepresentable_Domain: 3 digit non-zero value
Attribute:
    Attribute_Label: OBJECTID_1
    Attribute_Definition: Internal feature number.
    Attribute_Definition_Source: ESRI
    Attribute_Domain_Values:
        Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
    Attribute_Label: label
    Attribute_Definition: Township/range columns concatenated for map labeling purposes.
    Attribute_Definition_Source: BLM
    Attribute_Domain_Values:
        Unrepresentable_Domain: Alphanumeric
Attribute:
    Attribute_Label: twndir
    Attribute_Definition: Alpha code for identifying direction of township.
Overview_Description:
Entity_and_Attribute_Overview: The LSIS PLSS Land Survey System Township layer (TWNSHP) contains polygons representing surveyed townships.
Entity_and_Attribute_Detail_Citation: U.S Department of the Interior, Bureau of Land Management, LSIS Database Description Document other supporting documentation. Internet versions are available at: www.blm.gov/gcdb/standards/index.htm
Distribution_Information:
Distributor:
Contact Information:
Contact Person Primary:
Contact Person: Regina LeFort
Contact Organization: Bureau of Land Management
Contact Position: L&RPO GCDB Lead
Contact Address:
Address Type: mailing address
Address: P. O. Box 25047
Address: WO-330D (DFC)
Address: Building 40, Denver Federal Center
City: Denver
State or Province: Colorado
Postal Code: 80225-0047
Country: USA
Contact Voice Telephone: (303) 236-0951
Contact Facsimile Telephone: (303) 236-6691
Contact Electronic Mail Address: regina_lefort@blm.gov
Contact Instructions:
For information about the data content, please contact the BLM State Office, GCDB Manager or GCDB Contact at:
http://www.blm.gov/gcdb/gcdbsites/index.html
For information directly relating to metadata, please contact Regina LeFort at regina.lefort@blm.gov
Resource Description: Downloadable Data
Distribution Liability: Although these data have been processed successfully on a computer system at the U.S Bureau of Land Management, no warranty, expressed or implied, is made by the BLM regarding the utility of the data on any other system, nor shall the act of distribution constitute any such warranty.
Standard Order Process:
Digital Form:
Digital Transfer Information:
Format Name: ARCE
Transfer Size: 5
Digital Transfer Option:
Online Option:
Computer Contact Information:
Network Address:
Network Resource Name: LSIS Download Site
Access Instructions: http://www.lsi.blm.gov
Fees: No fees are required for downloading the data that is on-line.
Metadata Reference Information:
Metadata Date: 20080420
Metadata Contact:
Contact Information:
Contact Person Primary:
Contact Person: Regina LeFort
Contact Organization: Bureau of Land Management
Contact Position: L&RPO GCDB Lead
Contact Address:
Address Type: mailing address
Address: P.O. Box 25047
Address: WO - 330D (DFC)
Address: Building 40, Denver Federal Center
City: Denver
State or Province: Colorado
Postal Code: 80225-0047
Country: USA
Contact Voice Telephone: (303) 236-0951
Contact Facsimile Telephone: (303) 236-6691
Contact Electronic Mail Address: regina_lefort@blm.gov
Contact Instructions:
For information about the data content, please contact the BLM State Office, GCDB Manager or GCDB Contact at: http://www.blm.gov/gcdb/gcdbsites/index.html

For information directly relating to metadata, please contact Regina LeFort at regina.lefort@blm.gov

Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Time Convention: local time
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
D.9 LEWIS & CLARK COUNTY BLOCKS

Identification Information:
Citation:
Originator: Lewis & Clark County
Publication_Date: Unknown
Title: LC_blocks
Geospatial Data Presentation Form: vector digital data
Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Lewis_Clark_FINAL.gdb
Description:
Supplemental Information: Downloaded on 11/21/07 from: http://www.co.lewis-clark.mt.us/index.php?id=52
Time Period of Content:
Single_Date/Time:
Calendar_Date: unknown
Currentness Reference: Unknown
Status:
Progress: Complete
Maintenance and Update Frequency: None planned
Spatial Domain:
Bounding Coordinates:
West_BoundingCoordinate: -112.089956
East_BoundingCoordinate: -111.889022
North_BoundingCoordinate: 46.725294
South_BoundingCoordinate: 46.565175
Keywords:
Theme:
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point and Vector Object Information:
SDTS Terms Description:
SDTS_Point_and_Vector_Object_Type: G-polygon
Point and Vector_Object_Count: 1516
Spatial_Reference_Information:
Horizontal Coordinate System Definition:
Planar:
Map Projection:
Map_Projection_Name: Lambert Conformal Conic
Lambert_Conformal_Conic:
Standard Parallel: 45.000000
Standard Parallel: 49.000000
Longitude of Central Meridian: -109.500000
Latitude of Projection Origin: 44.250000
False_Easting: 600000.000000
False_Northing: 0.000000
Planar Coordinate Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate Representation:
Abscissa Resolution: 0.000100
Ordinate Resolution: 0.000100
Planar_Distance_Units: meters
Geodetic Model:
Horizontal_Datum_Name: D_North_American_1983_HARN
Ellipsoid_Name: Geodetic Reference System 80
Semi-major Axis: 6378137.000000
Denominator of Flattening Ratio: 298.257222

Vertical Coordinate System Definition:
  Altitude System Definition:
    Altitude Resolution: 0.000100
    Altitude Encoding Method: Explicit elevation coordinate included with horizontal coordinates

Entity and Attribute Information:
  Detailed Description:
    Entity_Type:
      Entity_Type_Label: LC_blocks
    Attribute:
      Attribute_Label: OBJECTID
      Attribute_Description: Internal feature number.
      Attribute_Description_Source: ESRI
      Attribute_Domain_Values:
        Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
    Attribute:
      Attribute_Label: Shape
      Attribute_Description: Feature geometry.
      Attribute_Description_Source: ESRI
      Attribute_Domain_Values:
        Unrepresentable_Domain: Coordinates defining the features.
    Attribute:
      Attribute_Label: ID
    Attribute:
      Attribute_Label: STFID
    Attribute:
      Attribute_Label: SUMLEV
    Attribute:
      Attribute_Label: LOGRECNO
    Attribute:
      Attribute_Label: COUNTY
    Attribute:
      Attribute_Label: TRACT
    Attribute:
      Attribute_Label: BLKGRP
    Attribute:
      Attribute_Label: BLOCK
    Attribute:
      Attribute_Label: IUC
    Attribute:
      Attribute_Label: AIANHHCC
    Attribute:
      Attribute_Label: AIHHTLI
    Attribute:
      Attribute_Label: AREALAND
    Attribute:
      Attribute_Label: AREAWATR
    Attribute:
      Attribute_Label: NAME
    Attribute:
      Attribute_Label: POP100
    Attribute:
      Attribute_Label: INTPTLAT
    Attribute:
      Attribute_Label: INTPTLON
    Attribute:
      Attribute_Label: SDELM
Attribute Label: SDSEC
Attribute:
Attribute Label: SDUNI
Attribute:
Attribute Label: P0010001
Attribute:
Attribute Label: P0010002
Attribute:
Attribute Label: P0010003
Attribute:
Attribute Label: P0010004
Attribute:
Attribute Label: P0010005
Attribute:
Attribute Label: P0010006
Attribute:
Attribute Label: P0010007
Attribute:
Attribute Label: P0010008
Attribute:
Attribute Label: P0010009
Attribute:
Attribute Label: P0020002
Attribute:
Attribute Label: P0030001
Attribute:
Attribute Label: Shape_Length
Attribute Definition: Length of feature in internal units.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Positive real numbers that are automatically generated.
Attribute:
Attribute Label: Shape_Area
Attribute Definition: Area of feature in internal units squared.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Positive real numbers that are automatically generated.
Distribution Information:
Resource Description: Downloadable Data
Standard Order Process:
Digital Form:
Digital Transfer Option:
Online Option:
Computer Contact Information:
Network Address:
Network Resource Name: http://www.co.lewis-clark.mt.us/index.php?id=52
Metadata Reference Information:
Metadata Date: 20080420
Metadata Contact:
Contact Information:
Contact Organization Primary:
Contact Address:
Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Time Convention: local time
Metadata Extensions:
Online Linkage: http://www.esri.com/metadata/esriprof80.html
Profile Name: ESRI Metadata Profile
D.10 HELENA VALLEY MONTANA 10 METER DEM

Identification_Information:

Citation:
Originator: U.S. Geological Survey (USGS), EROS Data Center
Publication_Date: 1999
Title: Helena Valley Montana 10 Meter DEM
Edition: 1
Geospatial_Data_Presentation_Form: raster digital data
Publication_Place: Sioux Falls, SD
Publisher: U.S. Geological Survey
Online_Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Grids\usgs_dem

Description:
Abstract: The U.S. Geological Survey has developed a National Elevation Dataset (NED). The NED is a seamless mosaic of best-available elevation data. The 7.5-minute elevation data for the conterminous United States are the primary initial source data. In addition to the availability of complete 7.5-minute data, efficient processing methods were developed to filter production artifacts in the existing data, convert to the NAD83 datum, edge-match, and fill slivers of missing data at quadrangle seams. One of the effects of the NED processing steps is a much-improved base of elevation data for calculating slope and hydrologic derivatives. The specifications for the NED 1 arc second and 1/3 arc second data are:

Geographic coordinate system
Horizontal datum of NAD83, except for AK which is NAD27 Vertical datum of NAVD88, except for AK which is NAVD29 Z units of meters

Purpose: Geospatial elevation data are utilized by the scientific and resource management communities for global change research, hydrologic modeling, resource monitoring, mapping, and visualization applications.

Time_Period_of_Content:

Range_of_Dates/Times:
Beginning_Date: 19990201
Ending_Date: unknown
Currentness_Reference: publication date

Status:
Progress: In work
Maintenance_and_Update_Frequency: As needed

Spatial_Domain:
Bounding_Coordinates:
West_Bounding Coordinate: -112.089922
East_Bounding Coordinate: -111.888999
North_Bounding Coordinate: 46.725313
South_Bounding Coordinate: 46.565163

Keywords:
Theme:
Theme_Keyword_Thesaurus: GCMD Parameter Keywords
Theme_Keyword: EARTH SCIENCE
Theme_Keyword: LAND SURFACE
Theme_Keyword: TOPOGRAPHY
Theme_Keyword: LANDFORMS
Theme_Keyword: TERRAIN ELEVATION
Theme_Keyword: 1-DEGREE DEM
Theme_Keyword: 2-ARC-SECOND DEM
Theme_Keyword: 7.5-MINUTE DEM
Theme_Keyword: CARTOGRAPHY
Theme_Keyword: DEM
Theme_Keyword: DIGITAL ELEVATION MODEL
Theme_Keyword: DIGITAL MAPPING
Theme_Keyword: EDC
Theme_Keyword: EROS
Theme_Keyword: GEODATA
Theme_Keyword: GIS
Theme_Keyword: MAPPING
Theme_Keyword: RASTER
Theme_Keyword: USGS

Place:
  Place_Keyword_Thesaurus: GCMD Location Keywords
  Place_Keyword: NORTH AMERICA
  Place_Keyword: UNITED STATES
  Place_Keyword: UNITED STATES OF AMERICA

Access_Constraints: None
Use_Constraints: None. Acknowledgement of the originating agencies would be appreciated in products derived from these data.

Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:
  Lineage:
    Process Step:
      Process Description: Metadata imported.

  Spatial_Data_Organization_Information:
  Direct_Spatial_Reference_Method: Raster
  Raster_Object_Information:
    Raster_Object_Type: Grid Cell
    Row_Count: 1733
    Column_Count: 1483
    Vertical_Count: 1

Spatial_Reference_Information:
  Horizontal_Coordinate_System_Definition:
    Planar:
      Map_Projection_Name: Lambert Conformal Conic
        Lambert_Conformal_Conic:
          Standard_Paraal: 45.000000
          Standard_Paraal: 49.000000
          Longitude_of_Central_Meridian: -109.500000
          Latitude_of_Projection_Origin: 44.250000
          False_Easting: 600000.000000
          False_Northing: 0.000000

      Planar_Coordinate_Information:
        Planar_Coordinate_Encoding_Method: row and column
        Coordinate_Representation:
          Abscissa_Resolution: 10.000000
          Ordinate_Resolution: 10.000000
          Planar_Distance_Units: meters

      Geodetic_Model:
        Horizontal_Datum_Name: D North American 1983 HARN
        Ellipsoid_Name: Geodetic Reference System 80
        Semi-major_Axis: 6378137.000000
        Denominator_of_Flattening_Ratio: 298.257222

  Distribution_Information:

  Distributor:
  Contact_Information:
    Contact Person_Primary:
      Contact Person: Customer Services Representative
      Contact Organization: EROS Data Center
    Contact_Address:
      Address_Type: mailing and physical address
      Address: U.S. Geological Survey EROS Data Center
      City: Sioux Falls
State or Province: SD  
Postal Code: 57198  
Country: USA  
Contact_Voice_Telephone: 605-594-6151  
Contact_Facsimile_Telephone: 605-594-6589  
Contact_Electronic_Mail_Address: custserv@edcmail.cr.usgs.gov  
Resource_Description: National Elevation Dataset (NED)  
Distribution_Liability: Although these data have been processed successfully on a computersystem at the U.S. Geological Survey, EROS Data Center, no warranty expressed or implied is made by either regarding the utility of the data on any system, nor shall the act of distribution constitute any such warranty. The USGS will warrant the delivery of this product in computer-readable format and will offer appropriate adjustment of credit when the product is determined unreadable by correctly adjusted computer peripherals, or when the physical medium is delivered damaged condition. Requests for adjustments of credit must be made within 90 days from the date of this shipment from the ordering site.  
Standard_Order_Process:  
Digital_Form:  
Digital_Transfer_Information:  
Transfer_Size: 10.212  
Metadata_Reference_Information:  
Metadata_Date: 20080420  
Metadata_Contact:  
Contact_Information:  
Contact_Person_Primary:  
Contact_Person: Customer Services Representative  
Contact_Organization: EROS Data Center  
Contact_Address:  
Address_Type: mailing and physical address  
Address: U.S. Geological Survey EROS Data Center  
City: Sioux Falls  
State_orProvince: SD  
Postal_Code: 57198  
Country: USA  
Contact_Voice_Telephone: 605-594-6151  
Contact_Facsimile_Telephone: 605-594-6589  
Contact_Electronic_Mail_Address: custserv@edcmail.cr.usgs.gov  
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata  
Metadata_Time_Convention: local time  
Metadata_Extensions:  
Online_Linkage: http://www.esri.com/metadata/esriprof80.html  
Profile_Name: ESRI Metadata Profile
D.11  HELENA VALLEY MONTANA EXTENDED STUDY AREA BOUNDARY

Identification Information:
Citation:
Title: Helena Valley Montana Extended Study Area Boundary
Geospatial Data Presentation Form: vector digital data
Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Lewis_Clark_FINAL.gdb

Description:
Abstract: This dataset represents the Helena Valley Aquifer Sensitivity Extended Study Area. It was originally digitized from a graphic obtained from Lewis & Clark County. The original study area followed roads and section lines but was extended to include the northern portion of the Helena Valley Canal as this feature was determined to influence ground water recharge in the area and be relatively close to the existing study area.

Purpose: This dataset is intended to delineate the Study Area and serve as a layer with which to clip other data.

Time Period of Content:
Calendar_Date: 20080501
Currentness Reference: publication date
Status:
Progress: Complete
Maintenance and Update Frequency: None planned

Spatial Domain:
Bounding Coordinates:
West Bounding Coordinate: -112.089956
East Bounding Coordinate: -111.889022
North Bounding Coordinate: 46.725294
South Bounding Coordinate: 46.565175

Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Water
Theme_Keyword: Ground water
Theme_Keyword: Aquifer
Theme_Keyword: Aquifer Sensitivity

Place:
Place_Keyword: United States
Place_Keyword: Montana
Place_Keyword: Lewis & Clark County
Place_Keyword: Helena
Place_Keyword: Helena Valley

Access Constraints: None
Use Constraints: None

Point of Contact:
Contact Information:
Contact Organization Primary:
Contact Organization: Trihydro Corporation
Contact Position: GIS Analyst
Contact Address:
Address_Type: mailing and physical address
Address: 1252 Commerce Dr.
City: Laramie
State or Province: WY
Postal Code: 82070
Contact_Voice_Telephone: 307 745-7474
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:
Logical_Consistency_Report: This dataset contains a single, closed and attributed polygon.
Completeness_Report: This dataset is complete.

Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: Accuracy of these data depend on the accuracy of the data from which it was derived. Specifically, roads, PLSS, and NHD. The input data are accurate to 1:24,000 scale or +/- 40 feet on the ground. Since snapping and tracing were used in creating these data, the previously mentioned accuracy statement is valid for this data set as well.

Lineage:

Source_Information:
Source_Citation:
Citation_Information:
Originator: City of Helena and Lewis & Clark County GIS
Publication_Date: 20031210
Title: Lewis & Clark County Roads
Geospatial_Data_Presentation_Form: vector digital data
Source_Scale_Denominator: 3 - 5 meters
Type_of_Source_Media: vector digital data
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20031210
Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: L&C_roads
Source_Contribution: Provided some study area boundaries.

Source_Information:
Source_Citation:
Citation_Information:
Originator: Bureau of Land Management, Montana State Office
Publication_Date: 20060503
Title: BLM Sections
Source_Scale_Denominator: 24000
Type_of_Source_Media: vector digital data
Source_Citation_Abbreviation: BLM_PLSS
Source_Contribution: Provided some study area boundaries.

Source_Information:
Source_Citation:
Citation_Information:
Originator: USGS
Publication_Date: 2004
Title: Streams
Source_Scale_Denominator: 24000
Type_of_Source_Media: vector digital data
Source_Citation_Abbreviation: USGS_NHD
Source_Contribution: Provided some study area boundaries.

Process_Step:
Process_Description: Extended study area by 400 meters on north side of Helena Valley Canal. This was done by tracing the canal with a 400 meter offset.

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: 1

Spatial_Reference_Information:
Horizontal Coordinate System Definition:
Planar:
  Map_Projection:
    Map_Projection_Name: Lambert Conformal Conic
    Lambert_Conformal_Conic:
      Standard_Parallel: 45.000000
      Standard_Parallel: 49.000000
      Longitude_of_Central_Meridian: -109.500000
      Latitude_of_Projection_Origin: 44.250000
      False_Easting: 600000.000000
      False_Northing: 0.000000
Planar_Coordinate_Information:
  Planar_Coordinate_Encoding_Method: coordinate pair
  Coordinate_Representation:
    Abscissa_Resolution: 0.000100
    Ordinate_Resolution: 0.000100
  Planar_Distance_Units: meters
Geodetic_Model:
  Horizontal_Datum_Name: D_North_American_1983_HARN
  Ellipsoid_Name: Geodetic Reference System 80
  Semi-major_Axis: 6378137.000000
  Denominator_of_Flattening_Ratio: 298.257222
Vertical Coordinate System Definition:
Altitude_System_Definition:
  Altitude_Resolution: 0.000100
  Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates
Entity and Attribute Information:
Detailed_Description:
  Entity_Type_Label: ExtendedStudyArea
Attribute:
  Attribute_Label: OBJECTID
  Attribute_Definition: Internal feature number.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
  Attribute_Label: SHAPE
  Attribute_Definition: Feature geometry.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Coordinates defining the features.
Attribute:
  Attribute_Label: SHAPE_Length
  Attribute_Definition: Length of feature in internal units.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute:
  Attribute_Label: SHAPE_Area
  Attribute_Definition: Area of feature in internal units squared.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Positive real numbers that are automatically generated.
Distribution Information:
Distributor:
  Contact_Information:
    Contact_Organization_Primary:
Contact_Organization: City of Helena and Lewis & Clark County
Contact_Position: GIS Center
Contact_Address:
  Address_Type: physical address
  Address: 316 N. Park Avenue, Room 147
  City: Helena
  State_or_Province: MT
  Postal_Code: 59624
  Contact_Voice_Telephone: 406-447-8389
  Contact_Facsimile_Telephone: 406-447-8367
  Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us
Resource_Description: Downloadable Data
Metadata_Reference_Information:
Metadata_Date: 20080420
Metadata_Contact:
  Contact_Information:
    Contact_Organization_Primary:
      Contact_Organization: Trihydro Corporation
      Contact_Person: Brian Robeson
      Contact_Position: GIS Analyst
    Contact_Address:
      Address_Type: mailing and physical address
      Address: 1252 Commerce Dr.
      City: Laramie
      State_or_Province: WY
      Postal_Code: 82070
      Contact_Voice_Telephone: 307 745-7474
      Contact_Facsimile_Telephone: 307 745-7729
      Contact_Electronic_Mail_Address: brobeson@trihydro.com
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time
Metadata_Extensions:
  Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile
D.12 MONTANA GROUNDWATER INFORMATION CENTER WATER WELL DATA

Identification Information:
Citation:
Originator: Montana Bureau of Mines and Geology (MBMG)
Publication Date: 20070716
Title: Montana Groundwater Information Center Water Well Data
Geospatial Data Presentation Form: vector digital data
Publication Information:
Publication Place: Helena, Montana
Publisher: Montana State Library
Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Lewis_Clark_FINAL.gdb

Description:
This data set contains point locations and selected attributes for water wells within Montana abstracted 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, water well logs, visits to water wells, and publications of the Montana Bureau of Mines and Geology, the U.S. Geological Survey, and others. The databases are maintained at the Ground-Water Information Center. Ground-water site locations and selected fields are forwarded quarterly to NRIS.

Fields provided in this data set are a subset of the fields available in the database at the GWIC. 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.

Supplemental Information: Clipped from data downloaded from GWIC website 11/21/07.

Time Period of Content:

Currentness Reference: ground condition
Status:
Progress: Current with receipts of new water well logs
Maintenance and Update Frequency: The GWIC database is active and thousands of data corrections and thousands of new well logs are added to the system annually. Updates of the database are forwarded quarterly to NRIS.

Spatial Domain:
Bounding Coordinates:
West Bounding Coordinate: -112.081316
East Bounding Coordinate: -111.892319
North Bounding Coordinate: 46.717730
South Bounding Coordinate: 46.580858

Keywords:
Theme:
Theme Keyword Thesaurus: none
Theme Keyword: wells
Theme Keyword: well
Theme Keyword: ground water
Theme Keyword: ground-water
Theme Keyword: groundwater
Place:
Place Keyword Thesaurus: none
Place Keyword: Montana

Access Constraints: None
Use Constraints:
These data are currently intended to provide information on the distribution of wells in general rather than the locations of specific wells. Most of the well locations are derived from 1:250,000 scale maps and individual well identities should not be shown at map scales larger than this.

Well data is updated continually at GWIC, and individual records at NRIS may be obsolete. Current data for any well, or updated data sets, can be obtained directly from the GWIC website at http://mbmggavic.mtech.edu.

Point_of_Contact:

Contact_Information:
  Contact_Organization_Primary:
    Contact_Organization: Montana Bureau of Mines and Geology
    Contact_Person: Thomas Patton
    Contact_Address:
      Address_Type: mailing address
      Address: 1300 West Park Street
      City: Butte
      State_or_Province: MT
      Postal_Code: 59701
    Contact_Voice_Telephone: (406) 496-4153
    Contact_Electronic_Mail_Address: tpatton@mtech.edu

Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

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 been verified against the original documents. To view the current status of verification, go to the "On-Line Help" section of the GWIC website at http://mbmggavic.mtech.edu.
  Logical_Consistency_Report: None
  Completeness_Report: Well locations in GWIC do not represent the locations of all water wells in Montana. Although the total number of water wells constructed in the state is unknown, GWIC locations are thought to represent 50-60% of all water wells.

Positional_Accuracy:
  Horizontal_Positional_Accuracy_Report:
    Unless otherwise noted in the GWIC database by the presence of a site visit record, coordinates are derived from unverified locations provided by the landowner or water well driller. Significant errors in location occur in the unverified data. Points with verified locations are generally within 10's of feet of their true position. The GEOMETHOD attribute indicates how the coordinates were obtained and are an indicator of the positional accuracy of each point.

The meaning 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.
  - TRS-SEC: generated from township, range, section, and tract using section corners digitized from 1:24,000 maps.
  - NAV-GPS: uncorrected Global Positioning System locations.
  - SUR-GPS: corrected Global Positioning System locations.
  - MAP: digitized from 1:24,000 USGS Topographic maps

NAV-GPS, SUR-GPS, and MAP represent confirmed locations. TRS-SEC and TRS-TWN represent unconfirmed locations if the number of tract designations in the TRACT field is less than 4 and there is no site visit record in the GWIC database. A complete description of the GEOMETHOD flags can be found in the "On-Line Help" section of the GWIC website at http://mbmggavic.mtech.edu.

The coordinates for the majority of the wells were obtained with the TRS-TWN method. Coordinates in selected counties (Flathead, Lake, Mineral, Missoula, Ravalli, Yellowstone, and Treasure) were obtained using the TRS-SEC method. However, in both cases the greatest source of horizontal error is the original landowner/water well driller's ability to correctly fill out the township, range, section, and tract description.

Coordinates converted from township, range, section, and tract descriptions generally fall within the boundaries of the smallest described tract. Section based conversions are more accurate than township based conversions because the section corners used in section based conversions have been digitized, and not interpolated from township corners.

Lineage:
Source Information:

Source Citation:

Citation Information:

Originator: Ground-Water Assessment Program at the Montana Bureau of Mines and Geology
Publication Date: 20070703
Title: Montana Ground-Water Information Center Water well log data
Publication Information:

Publication Place: Butte
Publisher: Montana Bureau of Mines and Geology
Type of Source Media: paper records
Source Time Period of Content:

Time Period Information:

Range of Dates/Times:
Beginning Date: 1860
Ending Date: 20070621
Source Currentness Reference: ground condition
Source Citation Abbreviation: GWIC
Source Contribution: The data set was generated from this source.

Process Step:

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 are 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 Date: 20030109
Process Step:

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 remained unchanged until an error may be discovered. At that time corrected coordinates for the point would be entered into the database and the township, range, section and tract modified to match the digitized or GPS coordinates.

Process Date: 20030109
Process Step:

Process Description: Dataset copied.

Source Used Citation Abbreviation:

Spatial Data Organization Information:

Direct Spatial Reference Method: Vector
Point and Vector Object Information:
SDTS Terms Description:

SDTS_POINT and VECTOR_OBJECT_Type: Entity point
Point and Vector Object Count: 88
Spatial Reference Information:
Horizontal Coordinate System Definition:
Planar:

Map Projection:
Map Projection Name: Lambert Conformal Conic
Lambert Conformal Conic:

Standard Parallel: 45.000000
Standard Parallel: 49.000000
Longitude of Central Meridian: -109.500000
Latitude of Projection Origin: 44.250000
False_Easting: 600000.000000  
False_Northing: 0.000000  
Planar_Coordinate_Information:  
  Planar_Coordinate_Encoding_Method: coordinate pair  
  Coordinate_Representation:  
    Abscissa_Resolution: 0.000100  
    Ordinate_Resolution: 0.000100  
  Planar_Distance_Units: meters  
Geodetic_Model:  
  Horizontal_Datum_Name: D_North_American_1983_HARN  
  Ellipsoid_Name: Geodetic Reference System 80  
  Semi-major_Axis: 6378137.000000  
  Denominator_of_Flattening_Ratio: 298.257222  
Vertical_Coordinate_System_Definition:  
  Altitude_System_Definition:  
    Altitude_Resolution: 0.000100  
    Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates  
Entity_and_Attribute_Information:  
Detailed_Description:  
  Entity_Type:  
    Entity_Type_Label: swl_2007_clip  
    Entity_Type_Definition: Point feature class  
    Entity_Type_Definition_Source: ESRI  
  Attribute:  
    Attribute_Label: OBJECTID  
  Attribute:  
    Attribute_Label: Site_Name  
  Attribute:  
    Attribute_Label: Latitude  
  Attribute:  
    Attribute_Label: Longitude  
  Attribute:  
    Attribute_Label: Geomethod  
  Attribute:  
    Attribute_Label: Township  
  Attribute:  
    Attribute_Label: Range  
  Attribute:  
    Attribute_Label: Shape  
    Attribute_Definition: Feature geometry.  
    Attribute_Definition_Source: ESRI  
  Attribute_Domain_Values:  
    Unrepresentable_Domain: Coordinates defining the features.  
  Attribute:  
    Attribute_Label: SITE_NAME  
    Attribute_Definition: Name of the well/site. Most often the name under which the well was originally drilled.  
    Attribute_Definition_Source: GWIC  
  Attribute_Domain_Values:  
    Unrepresentable_Domain: Character Field  
  Attribute:  
    Attribute_Label: LATITUDE  
    Attribute_Definition: Latitude of well/site  
    Attribute_Definition_Source: GWIC  
  Attribute_Domain_Values:  
    Range_Domain:  
      Range_Domain_Minimum: 44  
      Range_Domain_Maximum: 50  
      Attribute_Units_of_Measure: Decimal Degrees
Attribute:
  Attribute_Label: LONGITUDE
  Attribute_Definition: Longitude of well/site
  Attribute_Definition_Source: GWIC
  Attribute_Domain_Values:
    Range_Domain:
      Range_Domain_Minimum: -116.5
      Range_Domain_Maximum: -104
    Attribute_Units_of_Measure: Decimal Degrees
Attribute:
  Attribute_Label: GEOMETHOD
  Attribute_Definition: Method used to determine the latitude and longitude
  Attribute_Definition_Source: GWIC
  Attribute_Domain_Values:
    Enumerated_Domain:
      Enumerated_Domain_Value: TRS-TWN
      Enumerated_Domain_Value_Definition: 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
      Enumerated_Domain_Value_Definition_Source: GWIC
      Enumerated_Domain_Value: TRS-SEC
      Enumerated_Domain_Value_Definition: generated from township, range, section, and tract using section corners digitized from 1:24,000 maps
      Enumerated_Domain_Value_Definition_Source: GWIC
      Enumerated_Domain_Value: NAV-GPS
      Enumerated_Domain_Value_Definition: uncorrected Global Positioning System locations
      Enumerated_Domain_Value_Definition_Source: GWIC
      Enumerated_Domain_Value: SUR-GPS
      Enumerated_Domain_Value_Definition: corrected Global Positioning System locations
      Enumerated_Domain_Value_Definition_Source: GWIC
      Enumerated_Domain_Value: MAP
      Enumerated_Domain_Value_Definition: digitized from 1:24,000 USGS Topographic maps
      Enumerated_Domain_Value_Definition_Source: GWIC
Attribute:
  Attribute_Label: TOWNSHIP
  Attribute_Definition: The township in which the well/site is located
  Attribute_Definition_Source: GWIC
  Attribute_Domain_Values:
    Unrepresentable_Domain: Character Field
Attribute:
  Attribute_Label: RANGE
  Attribute_Definition: The range in which the well/site is located
  Attribute_Definition_Source: GWIC
  Attribute_Domain_Values:
    Unrepresentable_Domain: Character Field
Attribute:
  Attribute_Label: GWICID
Attribute:
  Attribute_Label: REPLICATED
Attribute:
  Attribute_Label: DATUM_LATL
Attribute:
  Attribute_Label: SECTION
Attribute:
  Attribute_Label: QSECTION
Attribute:
  Attribute_Label: ALTITUDE
Attribute:
  Attribute_Label: _MEASU
Attribute:
  Attribute_Label: MAX_WL
Attribute:
  Attribute_Label: MAX_DATE
Attribute:
  Attribute_Label: MIN_WL
Attribute:
  Attribute_Label: MIN_DATE
Distribution_Information:
  Distributor:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: Montana State Library
        Contact Person: Gerry Daumiller
        Contact Position: Senior GIS Programmer
        Contact_Address:
          Address_Type: mailing and physical address
          Address: 1515 East 6th Avenue
          City: Helena
          State_or_Province: Montana
          Postal_Code: 59620-1800
          Country: USA
        Contact_Voice_Telephone: (406) 444-5358
        Contact_Facsimile_Telephone: (406) 444-0581
        Contact_Electronic_Mail_Address: gdaumiller@mt.gov
        Hours_of_Service: Monday-Friday, 8-5, Mountain Time
  Resource_Description: Downloadable Data
  Distribution_Liability: The user of this data set agrees to release The Montana Natural Resource Information System and 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.
  Standard_Order_Process:
    Digital_Form:
      Digital_Transfer_Information:
        Format_Name: ESRI Shapefile
        Digital_Transfer_Option:
          Online_Option:
            Computer_Contact_Information:
              Network_Address:
                Network_Resource_Name: http://nris.mt.gov/nsdi/nris/shape/gwicwells.zip
              Fees: For-profit organizations must pay our costs to reproduce the data. Fees can be waived if doing Government work
  Metadata_Reference_Information:
    Metadata_Date: 20080420
    Metadata_Review_Date: 20070104
    Metadata_Review_Date: 20051003
    Metadata_Review_Date: 20010822
    Metadata_Contact:
      Contact_Information:
        Contact_Organization_Primary:
          Contact_Organization: Montana Bureau of Mines and Geology
          Contact Person: Thomas Patton
          Contact Position: Program Leader, Montana Ground-Water Assessment Program
          Contact_Address:
            Address_Type: mailing address
            Address: 1300 West Park Street
City: Butte
State_or_Province: MT
Postal_Code: 59701
Contact_Voice_Telephone: (406) 496-4153
Contact_Electronic_Mail_Address: tpatton@mtech.edu
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time
Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile
Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile
D.13 HELENA CITY LIMIT BOUNDARY

Identification Information:

Citation:
  Citation Information:
    Originator: City of Helena and Lewis & Clark County GIS
    Publication_Date: January 1, 2002
    Title: Helena City Limit
    Geospatial Data Presentation Form: vector digital data
    Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_FINAL.gdb

Description:
  Abstract: City Limits of Helena
  Purpose: Provide a boundary of the Helena City limits - for planning, government jurisdictional issues

Supplemental Information:
  *IMPORTANT* These data are NOT the official record *IMPORTANT*

The data contained herein are NOT the official records and may be inaccurate and incomplete! By using this GIS information, the user acknowledges and accepts full responsibility for verifying the correctness and the completeness of any of the information provided here.

The City of Helena and Lewis & Clark County do not warrant, either explicit or implied, the completeness or accuracy of the information provided. Additionally, the city and county accept no liability of any kind, including but not limited to any losses or damages that may result from the wrongful reliance on this information, and the user also accepts full responsibility for any subsequent use or reuse of the data, and shall be solely responsible for results or any damages which may result from the use of any of these data.

Time_Period_of_Content:
  Time_Period_Information:
    Single_Date/Time:
      Calendar_Date: 10-04-2004
    Currentness_Reference: publication date

Status:
  Progress: Complete
  Maintenance_and_Update_Frequency: As needed

Spatial Domain:
  Bounding Coordinates:
    West_BoundingCoordinate: -112.084542
    East_BoundingCoordinate: -111.946822
    North_BoundingCoordinate: 46.628907
    South_BoundingCoordinate: 46.557003

Keywords:
  Theme:
    Theme_Keyword_Thesaurus: REQUIRED: Reference to a formally registered thesaurus or a similar authoritative source of theme keywords.
    Theme_Keyword: REQUIRED: Common-use word or phrase used to describe the subject of the data set.
  Access_Constraints: This data set is public record and subject to public right to know laws.
  Use_Constraints:
    USES PROHIBITED: The following uses are prohibited except with the express written consent of the City of Helena and Lewis & Clark County:
    1. Giving the Data to third parties or using the Data for the benefit of third parties except authorized agents of the Licensee;
    2. Making copies or reproducing the Data, or any part thereof, except for making backup and archival copies solely for the Licensee;
    3. Selling, distributing, loaning, or offering for use of the Data, in whole or in part, to others; and
    4. Reproducing hardcopy products as provided by the Owner with the intent to sell for a profit.

Point_of_Contact:
Contact Information:
Contact Organization Primary:
Contact Organization: City of Helena and Lewis & Clark County
Contact Position: GIS Center
Contact Address:
Address Type: mailing and physical address
Address: 316 N. Park Avenue, Room 147
City: Helena
State or Province: Montana
Postal Code: 59624
Country: USA
Contact Voice Telephone: (406) 447-8389
Contact Voice Telephone: (406) 447-8389
Contact Facsimile Telephone: (406) 447-8386
Contact Electronic Mail Address: giscenter@co.lewis-clark.mt.us
Hours of Service: Mon-Fri 8-5
Native Data Set Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350
Data Quality Information:
Lineage:
Process Step:
Process Description: Metadata imported.
Source Used Citation Abbreviation: C:\contactinfo.xml
Process Contact:
Contact Information:
Contact Person Primary:
Contact Organization: City of Helena and Lewis & Clark County
Contact Position: GIS Center
Contact Address:
Address Type: mailing and physical address
Address: 316 N. Park Avenue, Room 147
City: Helena
State or Province: Montana
Postal Code: 59624
Country: USA
Contact Voice Telephone: (406) 447-8389
Contact Facsimile Telephone: (406) 447-8386
Contact Electronic Mail Address: giscenter@co.lewis-clark.mt.us
Hours of Service: Mon-Fri 8-5
Process Step:
Process Description: Metadata imported.
Source Used Citation Abbreviation: c:\ArcTemp\xml42.tmp
Process Step:
Process Description: Dataset copied.
Source Used Citation Abbreviation: Server=sde.co.lewis-clark.mt.us; Service=5151; Database=GIS; User=GISOwner;
Version=sde.DEFAULT
Spatial Data Organization Information:
Direct Spatial Reference Method: Vector
Point and Vector Object Information:
SDTS Terms Description:
SDTS Point and Vector Object Type: G-polygon
Point and Vector Object Count: 0
Spatial Reference Information:
Horizontal Coordinate System Definition:
Planar:
Map Projection:
Map Projection Name: Lambert Conformal Conic
Lambert Conformal Conic:
Standard Parallel: 45.000000
Standard Parallels: 49.000000
Longitude of Central Meridian: -109.500000
Latitude of Projection Origin: 44.250000
False Easting: 600000.000000
False Northing: 0.000000
Planar Coordinate Information:
  Planar Coordinate Encoding Method: coordinate pair
  Coordinate Representation:
    Abscissa Resolution: 0.000100
    Ordinate Resolution: 0.000100
  Planar Distance Units: meters
Geodetic Model:
  Horizontal Datum Name: D North American 1983 HARN
  Ellipsoid Name: Geodetic Reference System 80
  Semi-major Axis: 6378137.000000
  Denominator of Flattening Ratio: 298.257222
Vertical Coordinate System Definition:
  Altitude System Definition:
    Altitude Resolution: 0.000100
Altitude Encoding Method: Explicit elevation coordinate included with horizontal coordinates
Entity and Attribute Information:
Detailed Description:
  Entity Type:
    Entity Type Label: Helena City Limit
  Attribute:
    Attribute Label: len
  Attribute:
    Attribute Label: HELENA
    Attribute Definition: City name
  Attribute:
    Attribute Label: SQMILES
    Attribute Definition: Area in square miles
  Attribute:
    Attribute Label: ACRES
    Attribute Definition: area in acres
  Attribute:
    Attribute Label: GIS_DBO_HE
  Attribute:
    Attribute Label: HECTARES
    Attribute Definition: area in hectares
  Attribute:
    Attribute Label: PERIMETER
  Attribute:
    Attribute Label: SHAPE
    Attribute Definition: Feature geometry.
    Attribute Definition Source: ESRI
    Unrepresentable Domain: Coordinates defining the features.
  Attribute:
    Attribute Label: Shape
    Attribute Definition: Feature geometry.
    Attribute Definition Source: ESRI
    Unrepresentable Domain: Coordinates defining the features.
  Attribute:
    Attribute Label: OBJECTID
    Attribute Definition: Internal feature number.
    Attribute Definition Source: ESRI

Trihydro
Attribute_Domain_Values:
  Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.

Attribute:
  Attribute_Label: Shape_Length
  Attribute_Definition: Length of feature in internal units.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Positive real numbers that are automatically generated.

Attribute:
  Attribute_Label: area

Attribute:
  Attribute_Label: Shape_Area
  Attribute_Definition: Area of feature in internal units squared.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Positive real numbers that are automatically generated.

Distribution_Information:
  Resource_Description:
    Downloadable Data
    http://www.co.lewis-clark.mt.us/index.php?id=102

Standard_Order_Process:
  Digital_Form:
    Digital_Transfer_Information:
      Transfer_Size: 0.000

Metadata_Reference_Information:
  Metadata_Date: 20080414
  Metadata_Contact:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: City of Helena and Lewis & Clark County
        Contact_Position: GIS Center
        Contact_Address:
          Address_Type: physical address
          Address: 316 N. Park Avenue, Room 147
          City: Helena
          State_orProvince: Montana
          Postal_Code: 59624
        Country: USA
        Contact_Voice_Telephone: (406) 447-8389
        Contact_Voice_Telephone: (406) 447-8389
        Contact_Facsimile_Telephone: (406) 447-8386
        Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us
      Hours_of_Service: Mon-Fri 8-5

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time

Metadata_Extensions:
  Online_Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile_Name: ESRI Metadata Profile

Metadata_Extensions:
  Online_Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile_Name: ESRI Metadata Profile

Metadata_Extensions:
  Online_Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile_Name: ESRI Metadata Profile
D.14 HELENA VALLEY MONTANA HILLSHADE

Identification Information:
Citation:
  Originator: U.S. Geological Survey (USGS), EROS Data Center
  Publication_Date: 1999
  Title: Helena Valley Montana Hillshade
  Edition: 1
  Geospatial_Data_Presentation_Form: raster digital data
  Publication Information:
    Publication Place: Sioux Falls, SD
    Publisher: U.S. Geological Survey
    Online_Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Grids\hillshade

Description:
  Abstract: The U.S. Geological Survey has developed a National Elevation Dataset (NED). The NED is a seamless mosaic of best-available elevation data. The 7.5-minute elevation data for the conterminous United States are the primary initial source of data. In addition to the availability of complete 7.5-minute data, efficient processing methods were developed to filter production artifacts in the existing data, convert to the NAD83 datum, edge-match, and fill slivers of missing data at quadrangle seams. One of the effects of the NED processing steps is a much-improved base of elevation data for calculating slope and hydrologic derivatives. The specifications for the NED 1 arc second and 1/3 arc second data are:
  - Geographic coordinate system: Horizontal datum of NAD83, except for AK which is NAD27
  - Vertical datum of NAVD88, except for AK which is NAVD29
  - Z units of meters
  Purpose: Geospatial elevation data are utilized by the scientific and resource management communities for global change research, hydrologic modeling, resource monitoring, mapping, and visualization applications.

Time_Period_of_Content:
  Time_Period_Information:
    Range_of_Dates/Times:
      Beginning_Date: 19990201
      Ending_Date: unknown
    Currentness_Reference: publication date

Status:
  Progress: In work
  Maintenance_and_Update_Frequency: As needed

Spatial_Domain:
  Bounding_Coordinates:
    West_Bounding_Coordinate: -112.089922
    East_Bounding_Coordinate: -111.888999
    North_Bounding_Coordinate: 46.725313
    South_Bounding_Coordinate: 46.565163

Keywords:
  Theme:
    Theme_Keyword_Thesaurus: GCMD Parameter Keywords
    Theme_Keyword: EARTH SCIENCE
    Theme_Keyword: LAND SURFACE
    Theme_Keyword: TOPOGRAPHY
    Theme_Keyword: LANDFORMS
    Theme_Keyword: TERRAIN ELEVATION
    Theme_Keyword: 1-DEGREE DEM
    Theme_Keyword: 2-ARC-SECOND DEM
    Theme_Keyword: 7.5-MINUTE DEM
    Theme_Keyword: CARTOGRAPHY
    Theme_Keyword: DEM
    Theme_Keyword: DIGITAL ELEVATION MODEL
    Theme_Keyword: DIGITAL MAPPING
    Theme_Keyword: EDC
    Theme_Keyword: EROS
Theme_Keyword: GEODATA
Theme_Keyword: GIS
Theme_Keyword: MAPPING
Theme_Keyword: RASTER
Theme_Keyword: USGS
Place:
  Place_Keyword_Thesaurus: GCMD Location Keywords
  Place_Keyword: NORTH AMERICA
  Place_Keyword: UNITED STATES
  Place_Keyword: UNITED STATES OF AMERICA
Access_Constraints: None
Use_Constraints: None. Acknowledgement of the originating agencies would be appreciated in products derived from these data.
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350
Data_Quality_Information:
  Lineage:
    Process_Step:
      Process_Description: Metadata imported.
      Source_Used_Citation_Abbreviation: C:\DOCUME~1\brobeson\LOCALS~1\Temp\xml3029.tmp
    Process_Step:
      Process_Description: Created a hillshade from the USGS 10 meter DEM.
Spatial_Data_Organization_Information:
  Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
  Raster_Object_Type: Grid Cell
  Row_Count: 1733
  Column_Count: 1483
  Vertical_Count: 1
Spatial_Reference_Information:
  Horizontal_Coordinate_System_Definition:
    Planar:
      Map_Projection:
        Map_Projection_Name: Lambert Conformal Conic
        Lambert_Conformal_Conic:
          Standard Parallel: 45.000000
          Standard Parallel: 49.000000
          Longitude_of_Central_Meridian: -109.500000
          Latitude_of_Projection_Origin: 44.250000
          False_Easting: 600000.000000
          False_Northing: 0.000000
          Planar_Coordinate_Encoding_Method: row and column
          Coordinate_Representation:
            Abscissa_Resolution: 10.000000
            Ordinate_Resolution: 10.000000
            Planar_Distance_Units: meters
    Geodetic_Model:
      Horizontal_Datum_Name: D_North_American_1983_HARN
      Ellipsoid_Name: Geodetic Reference System 80
      Semi-major_Axis: 6378137.000000
      Denominator_of_Flattening_Ratio: 298.257222
Entity_and_Attribute_Information:
  Detailed_Description:
    Entity_Type:
      Entity_Type_Label: hillshade.vat
    Attribute:
      Attribute_Label: Rowid
      Attribute_Definition: Internal feature number.
      Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
  Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.

Attribute:
  Attribute_Label: VALUE
Attribute:
  Attribute_Label: COUNT

Distribution_Information:
  Distributor:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: Customer Services Representative
        Contact_Organization: EROS Data Center
      Contact_Address:
        Address_Type: mailing and physical address
        Address: U.S. Geological Survey EROS Data Center
        City: Sioux Falls
        State_or_Province: SD
        Postal_Code: 57198
        Country: USA
        Contact_Voice_Telephone: 605-594-6151
        Contact_Facsimile_Telephone: 605-594-6589
        Contact_Electronic_Mail_Address: custserv@edcmail.cr.usgs.gov
  Resource_Description: National Elevation Dataset (NED)
  Distribution_Liability: Although these data have been processed successfully on a computersystem at the U.S. Geological Survey, EROS Data Center, no warranty expressed or implied is made by either regarding the utility of the data on any system, nor shall the act of distribution constitute any such warranty. The USGS will warrant the delivery of this product in computer-readable format and will offer appropriate adjustment of credit when the product is determined unreadable by correctly adjusted computer peripherals, or when the physical medium is delivered in damaged condition. Requests for adjustments of credit must be made within 90 days from the date of this shipment from the ordering site.
  Standard_Order_Process:
    Digital_Form:
      Digital_Transfer_Information:
        Transfer_Size: 1.143
  Metadata_Reference_Information:
    Metadata_Date: 20080420
    Metadata_Contact:
      Contact_Information:
        Contact_Person_Primary:
          Contact_Person: Customer Services Representative
          Contact_Organization: EROS Data Center
        Contact_Address:
          Address_Type: mailing and physical address
          Address: U.S. Geological Survey EROS Data Center
          City: Sioux Falls
          State_or_Province: SD
          Postal_Code: 57198
          Country: USA
          Contact_Voice_Telephone: 605-594-6151
          Contact_Facsimile_Telephone: 605-594-6589
          Contact_Electronic_Mail_Address: custserv@edcmail.cr.usgs.gov
    Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
    Metadata_Time_Convention: local time
    Metadata_Extensions:
      Online_Linkage: http://www.esri.com/metadata/esriprof80.html
      Profile_Name: ESRI Metadata Profile
D.15 NHD 1:24,000 SCALE LAKES

Identification Information:
Citation:
Originator: U.S. Geological Survey in cooperation with U.S. Environmental Protection Agency, USDA Forest Service, and other Federal, State and local partners (see dataset specific metadata under Data_Set_Credit for details).
Publication Date: See dataset specific metadata.
Publication Time: Unknown
Title: Lakes_24k
Geospatial Data Presentation Form: vector digital data
Publication Information:
Publication Place: Reston, Virginia
Publisher: U.S. Geological Survey

Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_FINAL.gdb

Description:
Abstract: The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD data was originally developed at 1:100,000-scale and exists at that scale for the whole country. This high-resolution NHD, generally developed at 1:24,000/1:12,000 scale, adds detail to the original 1:100,000-scale NHD. (Data for Alaska, Puerto Rico and the Virgin Islands was developed at high-resolution, not 1:100,000 scale.) Local resolution NHD is being developed where partners and data exist. The NHD contains reach codes for networked features, flow direction, names, and centerline representations for areal water bodies. Reaches are also defined on waterbodies and the approximate shorelines of the Great Lakes, the Atlantic and Pacific Oceans and the Gulf of Mexico. The NHD also incorporates the National Spatial Data Infrastructure framework criteria established by the Federal Geographic Data Committee.

Purpose: The NHD is a national framework for assigning reach addresses to water-related entities, such as industrial discharges, drinking water supplies, fish habitat areas, wild and scenic rivers. Reach addresses establish the locations of these entities relative to one another within the NHD surface water drainage network, much like addresses on streets. Once linked to the NHD by their reach addresses, the upstream/downstream relationships of these water-related entities--and any associated information about them--can be analyzed using software tools ranging from spreadsheets to geographic information systems (GIS). GIS can also be used to combine NHD-based network analysis with other data layers, such as soils, land use and population, to help understand and display their respective effects upon one another. Furthermore, because the NHD provides a nationally consistent framework for addressing and analysis, water-related information linked to reach addresses by one organization (national, state, local) can be shared with other organizations and easily integrated into many different types of applications to the benefit of all.

Time Period of Content:
Time Period Information:
Single Date/Time:
Calendar Date: REQUIRED: The year (and optionally month, or month and day) for which the data set corresponds to the ground.
Currentness Reference: See dataset specific metadata.

Status:
Progress: In work
Maintenance and Update Frequency: Irregular

Spatial Domain:
Bounding Coordinates:
West Bounding Coordinate: -168.500000
East Bounding Coordinate: -64.549578
North Bounding Coordinate: 71.499607
South Bounding Coordinate: 17.673030

Keywords:
Theme:
Theme_Keyword: FWHYDROGRAPHY
Theme_Keyword: Hydrography
Theme_Keyword: Stream / River
Theme_Keyword: Lake / Pond
Theme_Keyword: Canal / Ditch
Theme_Keyword: Reservoir
Theme_Keyword: Spring / Seep
Theme_Keyword: Swamp / Marsh
Theme_Keyword: Artificial Path
Theme_Keyword: Reach Code

Place:
Place_Keyword: US

Access_Constraints: None
Use_Constraints:
None. Acknowledgment of the originating agencies would be appreciated in products derived from these data.

Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Earth Science Information Center, U.S. Geological Survey
Contact_Address:
Address_Type: mailing address
Address: 507 National Center
City: Reston
State_or_Province: VA
Postal_Code: 20192
Country: USA
Contact_Voice_Telephone: 1 888 ASK USGS
Contact_Voice_Telephone: 1 888 275 8747
Contact_Electronic_Mail_Address: ask@usgs.gov
Hours_of_Service: 0800-1600 Eastern Time

Data_Set_Credit: See dataset specific metadata.
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report:
Statements of attribute accuracy are based on accuracy statements made for U.S. Geological Survey Digital Line Graph (DLG) data, which is estimated to be 98.5 percent. One or more of the following methods were used to test attribute accuracy: manual comparison of the source with hardcopy plots; symbolized display of the DLG on an interactive computer graphic system; selected attributes that could not be visually verified on plots or on screen were interactively queried and verified on screen. In addition, software validated feature types and characteristics against a master set of types and characteristics, checked that combinations of types and characteristics were valid, and that types and characteristics were valid for the delineation of the feature. Feature types, characteristics, and other attributes conform to the Standards for National Hydrography Dataset (USGS, 1999) as of the date they were loaded into the database. All names were validated against a current extract from the Geographic Names Information System (GNIS). The entry and identifier for the names match those in the GNIS. The association of each name to reaches has been interactively checked, however, operator error could in some cases apply a name to a wrong reach.

This statement is generally true for the most common sources of NHD data. Other sources and methods may have been used to create or update NHD data. In some cases, additional information may be found in the NHDMetadata table.
Logical_Consistency_Report: Points, nodes, lines, and areas conform to topological rules. Lines intersect only at nodes, and all nodes anchor the ends of lines. Lines do not overshoot or undershoot other lines where they are supposed to meet. There are no duplicate lines. Lines bound areas and lines identify the areas to the left and right of the lines. Gaps and overlaps among areas do not exist. All areas close.
Completeness_Report:
The completeness of the data reflects the content of the sources, which most often are the published USGS topographic quadrangle and/or the USDA Forest Service Primary Base Series (PBS) map. The USGS topographic quadrangle is usually supplemented by Digital Orthophoto Quadrangles (DOQs). Features found on the ground may have been eliminated or generalized on the source map because of scale and legibility constraints. In general, streams longer than one mile (approximately 1.6 kilometers) were collected. Most streams that flow from a lake were collected regardless of their length. Only definite channels were collected so not all swamp/marsh features have stream/rivers delineated through them. Lake/ponds having an area greater than 6 acres were collected. Note, however, that these general
rules were applied unevenly among maps during compilation. Reaches codes are defined on all features of type stream/river, canal/ditch, artificial path, coastline, and connector. Waterbody reach codes are defined on all lake/pond and most reservoir features. Names were applied from the GNIS database. Detailed capture conditions are provided for every feature type in the Standards for National Hydrography Dataset available online through http://mapping.usgs.gov/standards/.

This statement is generally true for the most common sources of NHD data. Other sources and methods may have been used to create or update NHD data. In some cases, additional information may be found in the NHDMetadata table.

Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
Statements of horizontal positional accuracy are based on accuracy statements made for U.S. Geological Survey topographic quadrangle maps. These maps were compiled to meet National Map Accuracy Standards. For horizontal accuracy, this standard is met if at least 90 percent of points tested are within 0.02 inch (at map scale) of the true position. Additional offsets to positions may have been introduced where feature density is high to improve the legibility of map symbols. In addition, the digitizing of maps is estimated to contain a horizontal positional error of less than or equal to 0.003 inch standard error (at map scale) in the two component directions relative to the source maps. Visual comparison between the map graphic (including digital scans of the graphic) and plots or digital displays of points, lines, and areas, is used as control to assess the positional accuracy of digital data. Digital map elements along the adjoining edges of data sets are aligned if they are within a 0.02 inch tolerance (at map scale). Features with like dimensionality (for example, features that all are delineated with lines), with or without like characteristics, that are within the tolerance are aligned by moving the features equally to a common point. Features outside the tolerance are not moved; instead, a feature of type connector is added to join the features.

This statement is generally true for the most common sources of NHD data. Other sources and methods may have been used to create or update NHD data. In some cases, additional information may be found in the NHDMetadata table.

Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report:
Statements of vertical positional accuracy for elevation of water surfaces are based on accuracy statements made for U.S. Geological Survey topographic quadrangle maps. These maps were compiled to meet National Map Accuracy Standards. For vertical accuracy, this standard is met if at least 90 percent of well-defined points tested are within one-half contour interval of the correct value. Elevations of water surface printed on the published map meet this standard; the contour intervals of the maps vary. These elevations were transcribed into the digital data; the accuracy of this transcription was checked by visual comparison between the data and the map.

This statement is generally true for the most common sources of NHD data. Other sources and methods may have been used to create or update NHD data. In some cases, additional information may be found in the NHDMetadata table.

Lineage:

Process_Description: The processes used to create and maintain high-resolution NHD data can be found in the table called "NHDMetadata". Because NHD data can be downloaded using several user-defined areas, the process descriptions can vary for each download. The NHDMetadata table contains a list of all the process descriptions that apply to a particular download. These process descriptions are linked using the DuidID to the NHDFeatureToMetadata table which contains the com_ids of all the features within the download. In addition, another table, the NHDSourceCitation, can also be linked through the DuidID to determine the sources used to create or update NHD data.

Process_Date: Unknown
Process_Description: Converted NHD data to geodatabase format. Conversion included assignment of FCodes, FDate, and Resolution attribute values; assignment of reach codes to associated features; replacement of branched reaches with linear reaches; merge of area features with identical classification that adjoin or overlap; split of large area features that exceed 100/25 sq. km. (depending on feature type) at subbasin boundaries; reduction of feature classes, feature types, and attribution to simplify data; merge of network flow features at vertical relationship locations; conversion of artificial paths along coastline to coastline feature type; addition of M coordinates and values to network flow features; addition of Z coordinates, but not values, to all feature geometry; addition of value added attributes; switch to primary flow navigation by network features (NHDFlowline, route.drain) in place of reach features; and elimination of metadata boundaries.

Process_Date: 2004
Process_Description: See dataset specific metadata.

Process_Description: Dataset copied.
Source_Used_Citation_Abbreviation: %\f880\oracle_export\GDBExtractServer\Template\NHD_Template_High.mdb

Process_Description: Dataset copied.
Process Description: Dataset copied.

Spatial Data Organization Information:
- Direct Spatial Reference Method: Vector
- SDTS Terms Description:
  - SDTS Point and Vector Object Type: G-polygon
  - Point and Vector Object Count: 0
- Horizontal Coordinate System Definition:
  - Lambert_Conformal_Conic:
    - Standard Parallel: 45.000000
    - Standard Parallel: 49.000000
    - Longitude of Central Meridian: -109.500000
    - Latitude of Projection Origin: 44.250000
    - False Easting: 600000.000000
    - False Northing: 0.000000
  - Planar_Coordinate_Information:
    - Planar_Coordinate_Encoding_Method: coordinate pair
    - Coordinate_Representation:
      - Abscissa_Resolution: 0.000100
      - Ordinate_Resolution: 0.000100
    - Planar_Distance_Units: meters
- Geodetic_Model:
  - Horizontal_Datum_Name: D_North_American_1983_HARN
  - Ellipsoid_Name: Geodetic Reference System 80
  - Semi-major_Axis: 6378137.000000
  - Denominator_of_Flattening_Ratio: 298.257222
- Altitude System Definition:
  - Altitude_Datum_Name: National Geodetic Vertical Datum of 1929
  - Altitude_Resolution: 0.000100
  - Altitude_Distance_Units: meters
  - Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates

Entity and Attribute Information:
- Entity Type:
  - Entity_Type_Label: Lakes_24k
- Attribute:
  - Attribute_Label: OBJECTID
  - Attribute_Definition: Internal feature number.
  - Attribute_Definition_Source: ESRI
  - Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
- Attribute:
  - Attribute_Label: Shape
  - Attribute_Definition: Feature geometry.
  - Attribute_Definition_Source: ESRI
  - Unrepresentable_Domain: Coordinates defining the features.
- Attribute:
  - Attribute_Label: ComID
  - Attribute:
Attribute_Label: FDate
Attribute:
Attribute_Label: Resolution
Attribute:
Attribute_Label: GNIS_ID
Attribute:
Attribute_Label: GNIS_Name
Attribute:
Attribute_Label: AreaSqKm
Attribute:
Attribute_Label: Elevation
Attribute:
Attribute_Label: ReachCode
Attribute:
Attribute_Label: FType
Attribute:
Attribute_Label: FCode
Attribute:
Attribute_Label: Shape_Length
Attribute_Definition: Length of feature in internal units.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute:
Attribute_Label: Shape_Area
Attribute_Definition: Area of feature in internal units squared.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.
Detailed_Description:
Entity_Type:
Entity_Type_Label: NHDWaterbodyToMeta
Overview_Description:
Entity_and_Attribute_Overview: The National Hydrography Dataset is a comprehensive set of digital spatial data that encodes information about naturally occurring and constructed bodies of water, paths through which water flows, and related entities. The information encoded about features includes a feature date, classification by type, other characteristics, a unique common identifier, the feature length or area, and (rarely) elevation of the surface of water pools and a description of the stage of the elevation. For reaches, encoded information includes a reach code. Names and their identifiers in the Geographic Names Information System, are assigned to most feature types. The direction of flow is encoded for networked features. The data also contains relations that encode metadata, and information that supports the exchange of future updates and improvements to the data. The names and definitions of all feature types, characteristics, and values are in the Standards for National Hydrography Dataset: Reston, Virginia, U.S. Geological Survey, 1999. The document is available online through http://mapping.usgs.gov/standards/.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Earth Science Information Center, U.S. Geological Survey
Contact_Address:
Address_Type: mailing address
Address: 507 National Center
City: Reston
State_or_Province: VA
Postal_Code: 20192
Country: USA
Contact_Voice_Telephone: 1 888 ASK USGS
Contact_Voice_Telephone: 1 888 275 8747
Contact_Electronic_Mail_Address: ask@usgs.gov
Hours_of_Service: 0800-1600 Eastern Time

Contact_Instructions: In addition to the address above there are other ESIC offices throughout the country. A full list of these offices is at URL: http://mapping.usgs.gov/esic/esic_index.html

Resource_Description: Downloadable Data

Standard_Order_Process:
Digital_Form:
  Digital_Transfer_Information:
    Format_Name: ArcGIS Geodatabase
    Format_Version_Number: 8.3
    File_Decompression_Technique: tar and uncompress

Metadata_Reference_Information:
Metadata_Date: 20080414
Metadata(Contact):
Contact_Information:
  Contact_Organization_Primary:
    Contact_Organization: Earth Science Information Center, U.S. Geological Survey
    Contact_Person: REQUIRED: The person responsible for the metadata information.
    Contact_Address:
      Address_Type: mailing address
      Address: 507 National Center
      City: Reston
      State_or_Province: VA
      Postal_Code: 20192
      Country: USA
    Contact_Voice_Telephone: 1 888 ASK USGS
    Contact_Voice_Telephone: 1 888 275 8747
    Contact_Electronic_Mail_Address: nhd@usgs.gov
    Hours_of_Service: 0800-1600 Eastern Time

Contact_Instructions: In addition to the address above there are other ESIC offices throughout the country. A full list of these offices is at URL: http://mapping.usgs.gov/esic/esic_index.html

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time
Metadata_Extensions:
  Online_Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile_Name: ESRI Metadata Profile
D.16 HELENA VALLEY MONTANA NATIONAL WETLANDS INVENTORY

Identification Information:
Citation:
Originator: U.S. Fish and Wildlife Service
Publication Date: July 2007
Title: Helena Valley Montana National Wetlands Inventory
Geospatial Data Presentation Form: vector digital data
Series Information:
Publication Information:
Publication Place: Washington, D.C.
Publisher: U.S. Fish and Wildlife Service, Division of Habitat and Resource Conservation
Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Lewis_Clark_FINAL.gdb
Description:
Abstract:
This data set represents the extent, approximate location and type of wetlands and deepwater habitats in the conterminous United States. These data delineate the areal extent of wetlands and surface waters as defined by Cowardin et al. (1979).

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and near shore coastal waters. Some deepwater reef communities (coral or tuberificid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

By policy, the Service also excludes certain types of "farmed wetlands" as may be defined by the Food Security Act or that do not coincide with the Cowardin et al. definition. Contact the Service's Regional Wetland Coordinator for additional information on what types of farmed wetlands are included on wetland maps.

Purpose: The present goal of the Service is to provide the citizens of the United States and its Trust Territories with current geospatially referenced information on the status, extent, characteristics and functions of wetlands, riparian, deepwater and related aquatic habitats in priority areas to promote the understanding and conservation of these resources.

Supplemental Information:
The wetland maps were produced as topical overlays using U.S. Geological Survey topographic maps as the base. The hard copy product is a composite map showing topographic and planimetric features from the USGS map base and wetlands and deepwater habitats from the Service's topical overlay. Thus, the data are intended for use in publications, at a scale of 1:24,000 or smaller. Due to the scale, the primary intended use is for regional and watershed data display and analysis, rather than specific project data analysis. The map products were neither designed or intended to represent legal or regulatory products.

Comments regarding the interpretation or classification of wetlands or deepwater habitats can be directed to the U.S. Fish and Wildlife Service, Division of Federal Program Activities, Branch of Habitat Assessment <http://www.fws.gov/duspit/contactus.htm>

These data were developed in conjunction with the publication Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. FWS/OBS-79/31. Alpha-numeric map codes have been developed to correspond to the wetland and deepwater classifications described.

These spatial data are not designed to stand alone. They form topical overlays to the U.S. Geological Survey 1:24,000 or 1:25,000 scale topographic quadrangles. Note that coastline delineations were drawn to follow the extent of wetland or deepwater features as described by this project and may not match the coastline shown in other base maps.

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Although this Federal Geographic Data Committee-compliant metadata file is intended to document the data set in nonproprietary form, as well as in Arc/INFO format, this metadata file may include some Arc/INFO-specific terminology.

Time_Period_of_Content:
Time_Period Information:
Range_of_Dates/Times:
Beginning_Date: 1977
Attribute_Accuracy_Report: The source data was checked using standard review procedures. Attributes were checked by using visual inspection as well as automated verification routines. Quality of the attribute information varies with age and mapping protocols used when individual maps were prepared.

Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: All polygons are attributed.

Logical_Consistency_Report: Polygon and chain-node topology are present. Every polygon has a label.

Completeness_Report:
This data set represents the extent of wetlands and deepwater habitats that can be determined with the use of remotely sensed data and within the timeframe for which the maps were produced. Wetlands are shown in all of the conterminous 48 states and the District of Columbia. The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data, and the amount of ground truth verification work conducted.

There is a margin error inherent in the use of imagery, thus detailed on-the-ground inspection of any particular site, may result in revision of the wetland boundaries or classification, established through image analysis.

Wetlands or other mapped features may have changed since the date or the imagery and/or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: U.S. Fish and Wildlife Service
Publication_Date: 1977 to present
Title: Wetlands and Deepwater Habitats of the Conterminous United States
Series_Information:
Series_Name: National Wetlands Inventory Maps
Publication_Information:
PublicationPlace: Washington, D.C.
Publisher: U.S. Fish and Wildlife Service
Source_Scale_Denominator: 1:24,000 and 1:25,000
Type_of_Source_Media: Digital file and hard copy paper
Source_Time_Period_of_Content:
Range_of_Dates/Times:
Beginning_Date: 1977
Ending_Date: present
Source_Currentness_Reference: Various dates
Source_Contribution: Spatial information
Process_Step:
Process_Description: Original stable base hard copy maps of wetland and deepwater habitats were created based on USGS state and quadrangle boundaries. These maps were converted to digital files using various software packages (WAMS, ARC and others). The digital files were stored as ESRI Import/Export files corresponding to a single 1:24,000 USGS quadrangle. These digital files were imported and converted to ESRI Coverage format and checked for topological and attribute errors. All coverages were converted from a UTM map projection to an Alber's Equal Area map projection and the horizontal datum was converted from NAD27 to NAD83 were necessary. Polygons attributed as "Uplands" were removed from the dataset and polygons were merged at quadrangle boundaries where the quadrangle line divided polygons with the same attribute. The data was loaded into a seamless SDE geodatabase for the conterminous United States. These steps were conducted using both Arc Macro Language (AML) and ArcMap editing tools. All point data from the original ESRI Coverages were buffered by 11.28 meters (1/10 of an acre) and incorporated into this polygon feature class. Linear features from the original ESRI Coverages were merged at quadrangle boundaries where the quadrangle line divided lines with the same attribute. Linear data is stored in a separate feature class.
Further data improvements included the conversion of all old wetland codes that contained 'OW' to the new code containing 'UB'. All polygons labeled as 'OUT', 'No Data' and 'NP' were removed from the database.
Source_Used_Citation_Abbreviation: NWI
Process_Step:
Process_Description: The file was converted to NAD83 in geographic coordinates, and saved in geodatabase format.
Process_Date: 200401
Process_Step:
Process_Description: Metadata imported.
Process Step: Dataset copied.
Process Step: Metadata imported.
Process Step: Dataset copied.
Source Used Citation Abbreviation: Server=igsarchwdbgis01; Service=5151; User=NWIDBA; Version=SDE.DEFAULT
Process Step: Metadata imported.
Source Used Citation Abbreviation: C:\DOCUME~1\brobeson\LOCALS~1\Temp\xml2F55.tmp
Spatial Data Organization Information:
Direct Spatial Reference Method: Vector
Point and Vector Object Information:
SDTS Terms Description:
SDTS Point and Vector Object Type: G-polygon
Point and Vector Object Count: 618
Spatial Reference Information:
Horizontal Coordinate System Definition:
Planar:
Map Projection:
Map Projection Name: Lambert Conformal Conic
Lambert Conformal Conic:
Standard Parallel: 45.000000
Standard Parallel: 49.000000
Longitude of Central Meridian: -109.500000
Latitude of Projection Origin: 44.250000
False Easting: 600000.000000
False Northing: 0.000000
Planar Coordinate Information:
Planar Coordinate Encoding Method: coordinate pair
Coordinate Representation:
Abscissa Resolution: 0.000100
Ordinate Resolution: 0.000100
Planar Distance Units: meters
Geodetic Model:
Horizontal Datum Name: D_North_American_1983_HARN
Ellipsoid Name: Geodetic Reference System 80
Semi-major Axis: 6378137.000000
Denominator of Flattening Ratio: 298.257222
Vertical Coordinate System Definition:
Altitude System Definition:
Altitude Resolution: 0.000100
Altitude Encoding Method: Explicit elevation coordinate included with horizontal coordinates
Entity and Attribute Information:
Detailed Description:
Entity Type:
Entity Type Label: NWI_24k
Entity Type Definition: Reference: Cowardin et al. 1979
Entity Type Definition Source: U.S. Fish and Wildlife Service
Attribute:
Attribute Label: ACRES
Attribute:
Attribute Label: WETLAND_TY
Attribute:
Attribute Label: LEN
Attribute:
Attribute Label: Shape_Length
Attribute Definition: Length of feature in internal units.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
  Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute:
  Attribute_Label: Shape
  Attribute_Definition: Feature geometry.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Coordinates defining the features.
Attribute:
  Attribute_Label: OBJECTID
  Attribute_Definition: Internal feature number.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Enumerated_Domain:
      Enumerated_Domain_Value: Polygon
      Enumerated_Domain_Value_Definition: 2-dimensional element.
      Enumerated_Domain_Value_Definition_Source: ESRI GIS software
Attribute:
  Attribute_Label: ATTRIBUTE
Attribute:
  Attribute_Label: Shape_Area
  Attribute_Definition: Area of feature in internal units squared.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute:
  Attribute_Label: HGM_CODE
Attribute:
  Attribute_Label: SHAPE
  Attribute_Definition: Feature geometry.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Coordinates defining the features.
Attribute:
  Attribute_Label: DECODE
Attribute:
  Attribute_Label: GLOBALID
Attribute:
  Attribute_Label: AREA
Attribute:
  Attribute_Label: QAQC_CODE
Distribution_Information:
  Distributor:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: U.S. Fish and Wildlife Service
        Contact_Person: Tom Dahl
        Contact_Position: Division of Habitat and Resource Conservation
        Contact_Address:
          Address_Type: mailing address
          Address: 555 Lester Ave.
          City: Onalaska
          State_orProvince: WI
          Postal_Code: 54650
          Country: USA
        Contact_Voice_Telephone: 608-783-8425
        Contact_Facsimile_Telephone: 608-783-8450
Contact Electronic Mail Address: tom_dahl@fws.gov
Contact Instructions: Hard copy maps can be purchased through Cooperator-Run Distribution Centers. Each Center establishes its own pricing structure, product types and order procedures. View Cooperator-Run Distribution Centers. The wetlands data can also be viewed by accessing The National Map.
Resource Description: Downloadable Data
Distribution Liability: Although these data have been processed successfully on a computer system at the U.S. Fish and Wildlife Service, no warranty expressed or implied is made by the U.S. Fish and Wildlife Service regarding the utility of the data on any other system, nor shall the act of distribution constitute any such warranty. No responsibility is assumed by the U.S. Fish and Wildlife Service in the use of these data.
Standard Order Process:
Digital Form:
  Digital Transfer Information:
    Format Name: ESRI Shapefile or Personal Geodatabase
  Digital Transfer Option:
    Online Option:
      Computer Contact Information:
        Network Address:
          Network Resource Name: <http://wetlandsfws.er.usgs.gov/NWI/download.html>
    Offline Option:
      Offline Media: CD-ROM or DVD
      Recording Format: tar
Fees: There is no charge for the online option. Requests for large amounts of data are handled on a cost reimbursable basis.
Ordering Instructions: To order files on CD-ROM, please see
Metadata Reference Information:
Metadata Date: 20080420
Metadata Contact:
Contact Information:
  Contact Organization Primary:
    Contact Organization: U.S. Fish and Wildlife Service
    Contact Person: Tom Dahl
  Contact Position: Division of Habitat and Resource Conservation
  Contact Address:
    Address Type: mailing and physical address
    Address: 555 Lester Ave.
    City: Onalaska
    State or Province: WI
    Postal Code: 54650
    Country: USA
  Contact Voice Telephone: 608-783-8425
  Contact Facsimile Telephone: 608-783-8450
  Contact Electronic Mail Address: tom_dahl@fws.gov
Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Time Convention: local time
Metadata Security Information:
  Metadata Security Classification System: None
  Metadata Security Classification: Unclassified
  Metadata Security Handling Description: None
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
Profile Name: ESRI Metadata Profile
D.17 NHD 1:24,000 SCALE STREAMS

Identification Information:
  Citation:
    Originator: U.S. Geological Survey in cooperation with U.S. Environmental Protection Agency, USDA Forest Service, and other Federal, State and local partners (see dataset specific metadata under Data_Set_Credit for details).
    Publication_Date: See dataset specific metadata.
    Publication_Time: Unknown
    Title: Streams_24k_Clip
    Geospatial Data Presentation Form: vector digital data
    Publication Information:
      Publication Place: Reston, Virginia
      Publisher: U.S. Geological Survey
      Online Linkage: \Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_FINAL.gdb

Description:
  Abstract: The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD data was originally developed at 1:100,000-scale and exists at that scale for the whole country. This high-resolution NHD, generally developed at 1:24,000/1:12,000 scale, adds detail to the original 1:100,000-scale NHD. (Data for Alaska, Puerto Rico and the Virgin Islands was developed at high-resolution, not 1:100,000 scale.) Local resolution NHD is being developed where partners and data exist. The NHD contains reach codes for networked features, flow direction, names, and centerline representations for areal water bodies. Reaches are also defined on waterbodies and the approximate shorelines of the Great Lakes, the Atlantic and Pacific Oceans and the Gulf of Mexico. The NHD also incorporates the National Spatial Data Infrastructure framework criteria established by the Federal Geographic Data Committee.
  Purpose: The NHD is a national framework for assigning reach addresses to water-related entities, such as industrial discharges, drinking water supplies, fish habitat areas, wild and scenic rivers. Reach addresses establish the locations of these entities relative to one another within the NHD surface water drainage network, much like addresses on streets. Once linked to the NHD by their reach addresses, the upstream/downstream relationships of these water-related entities--and any associated information about them--can be analyzed using software tools ranging from spreadsheets to geographic information systems (GIS). GIS can also be used to combine NHD-based network analysis with other data layers, such as soils, land use and population, to help understand and display their respective effects upon one another. Furthermore, because the NHD provides a nationally consistent framework for addressing and analysis, water-related information linked to reach addresses by one organization (national, state, local) can be shared with other organizations and easily integrated into many different types of applications to the benefit of all.
  Time Period of Content:
    Time_Period Information:
      Single_Date/Time:
        Calendar_Date: REQUIRED: The year (and optionally month, or month and day) for which the data set corresponds to the ground.
        CurrentnessReference: See dataset specific metadata.
  Status:
    Progress: In work
    Maintenance and Update Frequency: Irregular
  Spatial Domain:
    Bounding Coordinates:
      West_BoundingCoordinate: -168.500000
      East_BoundingCoordinate: -64.549578
      North_BoundingCoordinate: 71.499607
      South_BoundingCoordinate: 17.673030
  Keywords:
    Theme:
        Theme_Keyword: FHWYDROGRAPHY
        Theme_Keyword: Hydrography
        Theme_Keyword: Stream/River
        Theme_Keyword: Lake/Pond
        Theme_Keyword: Canal/Ditch
        Theme_Keyword: Reservoir
Theme_Keyword: Spring / Seep  
Theme_Keyword: Swamp / Marsh  
Theme_Keyword: Artificial Path  
Theme_Keyword: Reach Code  

Place:  
Place_Keyword: US  
Access_Constraints: None  
Use_Constraints: None. Acknowledgment of the originating agencies would be appreciated in products derived from these data.  

Point_of_Contact:  
Contact_Information:  
Contact_Organization_Primary: Earth Science Information Center, U.S. Geological Survey  
Contact_Address:  
Address_Type: mailing address  
Address: 507 National Center  
City: Reston  
State_or_Province: VA  
Postal_Code: 20192  
Country: USA  
Contact_Voice_Telephone: 1 888 ASK USGS  
Contact_Voice_Telephone: 1 888 275 8747  
Contact_Electronic_Mail_Address: ask@usgs.gov  
Hours_of_Service: 0800-1600 Eastern Time  
Contact_Instructions: In addition to the address above there are other ESIC offices throughout the country. A full list of these offices is at URL: http://mapping.usgs.gov/esic/esic_index.html  

Data_Set_Credit: See dataset specific metadata.  

Data_Quality_Information:  
Attribute_Accuracy: Statements of attribute accuracy are based on accuracy statements made for U.S. Geological Survey Digital Line Graph (DLG) data, which is estimated to be 98.5 percent. One or more of the following methods were used to test attribute accuracy: manual comparison of the source with hardcopy plots; symbolized display of the DLG on an interactive computer graphic system; selected attributes that could not be visually verified on plots or on screen were interactively queried and verified on screen. In addition, software validated feature types and characteristics against a master set of types and characteristics, checked that combinations of types and characteristics were valid, and that types and characteristics were valid for the delineation of the feature. Feature types, characteristics, and other attributes conform to the Standards for National Hydrography Dataset (USGS, 1999) as of the date they were loaded into the database. All names were validated against a current extract from the Geographic Names Information System (GNIS). The entry and identifier for the names match those in the GNIS. The association of each name to reaches has been interactively checked, however, operator error could in some cases apply a name to a wrong reach.  
This statement is generally true for the most common sources of NHD data. Other sources and methods may have been used to create or update NHD data. In some cases, additional information may be found in the NHDMetadata table.  
Logical_Consistency_Report: Points, nodes, lines, and areas conform to topological rules. Lines intersect only at nodes, and all nodes anchor the ends of lines. Lines do not overshoot or undershoot other lines where they are supposed to meet. There are no duplicate lines. Lines bound areas and lines identify the areas to the left and right of the lines. Gaps and overlaps among areas do not exist. All areas close.  
Completeness_Report: The completeness of the data reflects the content of the sources, which most often are the published USGS topographic quadrangle and/or the USDA Forest Service Primary Base Series (PBS) map. The USGS topographic quadrangle is usually supplemented by Digital Orthophoto Quadrangles (DOQs). Features found on the ground may have been eliminated or generalized on the source map because of scale and legibility constraints. In general, streams longer than one mile (approximately 1.6 kilometers) were collected. Most streams that flow from a lake were collected regardless of their length. Only definite channels were collected so not all swamp/marsh features have stream/rivers delineated through them. Lake/ponds having an area greater than 6 acres were collected. Note, however, that these general
rules were applied unevenly among maps during compilation. Reaches codes are defined on all features of type stream/river, canal/ditch, artificial path, coastline, and connector. Waterbody reach codes are defined on all lake/pond and most reservoir features. Names were applied from the GNIS database. Detailed capture conditions are provided for every feature type in the Standards for National Hydrography Dataset available online through http://mapping.usgs.gov/standards/.

This statement is generally true for the most common sources of NHD data. Other sources and methods may have been used to create or update NHD data. In some cases, additional information may be found in the NHDMetadata table.

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:

Statements of horizontal positional accuracy are based on accuracy statements made for U.S. Geological Survey topographic quadrangle maps. These maps were compiled to meet National Map Accuracy Standards. For horizontal accuracy, this standard is met if at least 90 percent of points tested are within 0.02 inch (at map scale) of the true position. Additional offsets to positions may have been introduced where feature density is high to improve the legibility of map symbols. In addition, the digitizing of maps is estimated to contain a horizontal positional error of less than or equal to 0.003 inch standard error (at map scale) in the two component directions relative to the source maps. Visual comparison between the map graphic (including digital scans of the graphic) and plots or digital displays of points, lines, and areas, is used as control to assess the positional accuracy of digital data. Digital map elements along the adjoining edges of data sets are aligned if they are within a 0.02 inch tolerance (at map scale). Features with like dimensionality (for example, features that all are delineated with lines), with or without like characteristics, that are within the tolerance are aligned by moving the features equally to a common point. Features outside the tolerance are not moved; instead, a feature of type connector is added to join the features.

This statement is generally true for the most common sources of NHD data. Other sources and methods may have been used to create or update NHD data. In some cases, additional information may be found in the NHDMetadata table.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report:

Statements of vertical positional accuracy for elevation of water surfaces are based on accuracy statements made for U.S. Geological Survey topographic quadrangle maps. These maps were compiled to meet National Map Accuracy Standards. For vertical accuracy, this standard is met if at least 90 percent of well-defined points tested are within one-half contour interval of the correct value. Elevations of water surface printed on the published map meet this standard; the contour intervals of the maps vary. These elevations were transcribed into the digital data; the accuracy of this transcription was checked by visual comparison between the data and the map.

This statement is generally true for the most common sources of NHD data. Other sources and methods may have been used to create or update NHD data. In some cases, additional information may be found in the NHDMetadata table.

Lineage:

Process_Description: The processes used to create and maintain high-resolution NHD data can be found in the table called "NHDMetadata". Because NHD data can be downloaded using several user-defined areas, the process descriptions can vary for each download. The NHDMetadata table contains a list of all the process descriptions that apply to a particular download. These process descriptions are linked using the DuuID to the NHDFeatureToMetadata table which contains the com_ids of all the features within the download. In addition, another table, the NHDSourceCitation, can also be linked through the DuuID to determine the sources used to create or update NHD data.

Process_Date: Unknown

Process_Description: Converted NHD data to geodatabase format. Conversion included assignment of FCodes, FDate, and Resolution attribute values; assignment of reach codes to associated features; replacement of branched reaches with linear reaches; merge of area features with identical classification that adjoin or overlap; split of large area features that exceed 100/25 sq. km. (depending on feature type) at subbasin boundaries; reduction of feature classes, feature types, and attribution to simplify data; merge of network flow features at vertical relationship locations; conversion of artificial paths along coastline to coastline feature type; addition of M coordinates and values to network flow features; addition of Z coordinates, but not values, to all feature geometry; addition of value added attributes; switch to primary flow navigation by network features (NHDFlowline, route.drain) in place of reach features; and elimination of metadata boundaries.

Process_Date: 2004

Process_Description: See dataset specific metadata.

Source_Used_Citation_Abbreviation: \f880\oracle_export\GDBExtractServer\Template\NHD_Template_High.mdb

Process_Description: Dataset copied.
Source Used Citation Abbreviation: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_County.gdb
Spatial Data Organization Information:
Direct Spatial Reference Method: Vector
Point and Vector Object Information:
  SDTS Terms Description:
    SDTS Point and Vector Object Type: String
    Point and Vector Object Count: 0
Spatial Reference Information:
Horizontal Coordinate System Definition:
  Planar:
    Map Projection:
      Map Projection Name: Lambert Conformal Conic
      Lambert Conformal Conic:
        Standard Parallel: 45.000000
        Standard Parallel: 49.000000
        Longitude of Central Meridian: -109.500000
        Latitude of Projection Origin: 44.250000
        False Easting: 600000.000000
        False Northing: 0.000000
    Planar Coordinate Information:
      Planar Coordinate Encoding Method: coordinate pair
      Coordinate Representation:
        Abscissa Resolution: 0.000100
        Ordinate Resolution: 0.000100
        Planar Distance Units: meters
Geodetic Model:
  Horizontal Datum Name: D North American 1983 HARN
  Ellipsoid Name: Geodetic Reference System 80
  Semi-major Axis: 6378137.000000
  Denominator of Flattening Ratio: 298.257222
Vertical Coordinate System Definition:
  Altitude System Definition:
    Altitude Datum Name: National Geodetic Vertical Datum of 1929
    Altitude Resolution: 0.000100
    Altitude Distance Units: meters
    Altitude Encoding Method: Explicit elevation coordinate included with horizontal coordinates
Entity and Attribute Information:
Detailed Description:
  Entity Type:
    Entity Type Label: Streams_24k_Clip
  Attribute:
    Attribute Label: OBJECTID
    Attribute Definition: Internal feature number.
    Attribute Definition Source: ESRI
    Attribute Domain Values:
      Unrepresentable Domain: Sequential unique whole numbers that are automatically generated.
  Attribute:
    Attribute Label: Shape
    Attribute Definition: Feature geometry.
    Attribute Definition Source: ESRI
    Attribute Domain Values:
      Unrepresentable Domain: Coordinates defining the features.
  Attribute:
    Attribute Label: ComID
  Attribute:
    Attribute Label: FDate
  Attribute:
    Attribute Label: Resolution
Attribute:
  Attribute_Label: GNIS_ID
Attribute:
  Attribute_Label: GNIS_Name
Attribute:
  Attribute_Label: LengthKM
Attribute:
  Attribute_Label: ReachCode
Attribute:
  Attribute_Label: FlowDir
Attribute:
  Attribute_Label: WBAreaComID
Attribute:
  Attribute_Label: FType
Attribute:
  Attribute_Label: FCode
Attribute:
  Attribute_Label: Shape_Length
Attribute_Definition: Length of feature in internal units.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
  Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute:
  Attribute_LABEL: Enabled
Detailed_Description:
Entity_Type:
  Entity_Type_LABEL: NHDFlowlineToMeta
Overview_Description:
  Entity_and_Attribute_Overview: The National Hydrography Dataset is a comprehensive set of digital spatial data that encodes
information about naturally occurring and constructed bodies of water, paths through which water flows, and related entities. The
information encoded about features includes a feature date, classification by type, other characteristics, a unique common identifier, the
feature length or area, and (rarely) elevation of the surface of water pools and a description of the stage of the elevation. For reaches,
coded information includes a reach code. Names and their identifiers in the Geographic Names Information System, are assigned to
most feature types. The direction of flow is encoded for networked features. The data also contains relations that encode metadata, and
information that supports the exchange of future updates and improvements to the data. The names and definitions of all feature types,
characteristics, and values are in the Standards for National Hydrography Dataset: Reston, Virginia, U.S. Geological Survey, 1999. The
document is available online through http://mapping.usgs.gov/standards/.
  Entity_and_Attribute_Detail_Citation: The names and definitions of all feature types, characteristics, and values are in U.S. Geological
available online through http://mapping.usgs.gov/standards/. Information about tables and fields in the data are available from the user
documentation for the National Hydrography Dataset at http://nhd.usgs.gov. The National Map - Hydrography Fact Sheet is also available
Distribution_Information:
  Distributor:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: Earth Science Information Center, U.S. Geological Survey
        Contact_Address:
          Address_Type: mailing address
          Address: 507 National Center
          City: Reston
          State_or_Province: VA
          Postal_Code: 20192
          Country: USA
        Contact_Voice_Telephone: 1 888 ASK USGS
        Contact_Voice_Telephone: 1 888 275 8747
        Contact_Electronic_Mail_Address: ask@usgs.gov
        Hours_of_Service: 0800-1600 Eastern Time
Contact Instructions: In addition to the address above there are other ESIC offices throughout the country. A full list of these offices is at URL: http://mapping.usgs.gov/esic/esic_index.html

Resource Description: Downloadable Data

Standard Order Process:

Digital Form:
- Format Name: ArcGIS Geodatabase
- Format Version Number: 8.3
- File Decompression Technique: tar and uncompress

Metadata Reference Information:
- Metadata Date: 20080414
- Metadata Contact:

Contact Information:
- Contact Organization Primary:
- Contact Person: REQUIRED: The person responsible for the metadata information.
- Contact Address:
  - Address Type: mailing address
  - Address: 507 National Center
  - City: Reston
  - State or Province: VA
  - Postal Code: 20192
  - Country: USA
- Contact Voice Telephone: 1 888 ASK USGS
- Contact Voice Telephone: 1 888 275 8747
- Contact Electronic Mail Address: nhd@usgs.gov

Hours of Service: 0800-1600 Eastern Time

Contact Instructions: In addition to the address above there are other ESIC offices throughout the country. A full list of these offices is at URL:  http://mapping.usgs.gov/esic/esic_index.html

Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
- Metadata Time Convention: local time
- Metadata Extensions:
  - Online Linkage: http://www.esri.com/metadata/esriprof80.html
  - Profile Name: ESRI Metadata Profile
D.18 LEWIS & CLARK COUNTY PARCELS

Identification Information:
Citation:
   Citation Information:
      Title: Parcels
      Geospatial Data Presentation Form: vector digital data
      Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_FINAL.gdb
Description:
   Supplemental Information: Downloaded on 11/21/07 from: http://www.co.lewis-clark.mt.us/index.php?id=52
Time_Period_of_Content:
   Single_Date/Time:
Status:
   Spatial Domain:
      Bounding Coordinates:
         West_BoundingCoordinate: -113.181712
         East_BoundingCoordinate: -111.482000
         North_BoundingCoordinate: 47.988137
         South_BoundingCoordinate: 46.392283
Keywords:
   Theme:
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
   SDTS Terms Description:
      SDTS_Point_and_Vector_Object_Type: G-polygon
      Point_and_Vector_Object_Count: 0
   Spatial_Reference_Information:
      HorizontalCoordinate_System_Definition:
         Planar:
            Map_Projection:
               Map_Projection_Name: Lambert Conformal Conic
               Lambert_Conformal_Conic:
                  Standard_Parallel: 45.000000
                  Standard_Parallel: 49.000000
                  Longitude_of_Central_Meridian: -109.500000
                  Latitude_of_Projection_Origin: 44.250000
                  False_Easting: 600000.000000
                  False_Northing: 0.000000
            Planar_Coordinate_Information:
               Planar_Coordinate_Encoding_Method: coordinate pair
               Coordinate_Representation:
                  Abscissa_Resolution: 0.000100
                  Ordinate_Resolution: 0.000100
               Planar_Distance_Units: meters
Geodetic_Model:
   Horizontal_Datum_Name: D_North_American_1983_HARN
   Ellipsoid_Name: Geodetic Reference System 80
   Semi-major_Axis: 6378137.000000
   Denominator_of_Flattening_Ratio: 298.257222
   Vertical_Coordinate_System_Definition:
      Altitude_System_Definition:
         Altitude_Resolution: 0.000100
         Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
  Entity_Type_Label: Parcels
Attribute:
  Attribute_Label: len
Attribute:
  Attribute_Label: Shape
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
  Unrepresentable_Domain: Coordinates defining the features.
Attribute:
  Attribute_Label: PARCELID
Attribute:
  Attribute_Label: GEOCD
Attribute:
  Attribute_Label: OWNERCLASS
Attribute:
  Attribute_Label: OWNCODE
Attribute:
  Attribute_Label: DATESMOD
Attribute:
  Attribute_Label: SOURCE
Attribute:
  Attribute_Label: MAPPER
Attribute:
  Attribute_Label: PROPID
Attribute:
  Attribute_Label: OWNRNM
Attribute:
  Attribute_Label: SITEAD
Attribute:
  Attribute_Label: SECTN
Attribute:
  Attribute_Label: TOWNSP
Attribute:
  Attribute_Label: RANGE
Attribute:
  Attribute_Label: SCHOOL
Attribute:
  Attribute_Label: BLOCK
Attribute:
  Attribute_Label: SUBDIV
Attribute:
  Attribute_Label: LOTNUM
Attribute:
  Attribute_Label: MALIN1
Attribute:
  Attribute_Label: MALIN2
Attribute:
  Attribute_Label: MALIN3
Attribute:
  Attribute_Label: MACITY
Attribute:
  Attribute_Label: MASTAT
Attribute:
  Attribute_Label: MAZIP
Attribute:
Attribute Label: LGLDSC
Attribute:
Attribute Label: TOACRG
Attribute:
Attribute Label: TOSQFT
Attribute:
Attribute Label: TATXYR
Attribute:
Attribute Label: TAXAMT
Attribute:
Attribute Label: ASYEAR
Attribute:
Attribute Label: MKTVAL
Attribute:
Attribute Label: TXBVAL
Attribute:
Attribute Label: area
Attribute:
Attribute Label: OBJECTID
Attribute Definition: Internal feature number.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute Label: Shape_Length
Attribute Definition: Length of feature in internal units.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Positive real numbers that are automatically generated.
Attribute:
Attribute Label: Shape_Area
Attribute Definition: Area of feature in internal units squared.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Positive real numbers that are automatically generated.
Distribution Information:
Resource Description: Downloadable Data
Standard Order Process:
Digital Form:
Digital Transfer Information:
Transfer Size: 12.758
Digital Transfer Option:
Online Option:
Computer Contact Information:
Network Address:
Network Resource Name: http://www.co.lewis-clark.mt.us/index.php?id=52
Metadata Reference Information:
Metadata Date: 20080420
Metadata Contact:
Contact Information:
Contact Organization Primary:
Contact Address:
Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Time Convention: local time
Metadata Extensions:
Online Linkage: http://www.esri.com/metadata/esriprof80.html
Profile Name: ESRI Metadata Profile
D.19  MONTANA AVERAGE ANNUAL PRECIPITATION, 1971-2000

Identification_Information:
Citation:
  Originator: PRISM Group, Oregon Climate Service, Oregon State University
  Publication_Date: 20060621
  Title: Montana Average Annual Precipitation, 1971-2000
  Geospatial_Data_Presentation_Form: vector digital data

Publication_Information:
  Publication_Price: Helena, MT
  Publisher: Montana State Library
  Online_Linkage: http://nris.mt.gov/nsdi/nris/shape/precip71_00.zip
  Online_Linkage: http://nris.mt.gov/nsdi/nris/e00/precip71_00.zip

Larger_Work_Citation:
  Originator: PRISM Group, Oregon Climate Service, Oregon State University
  Publication_Date: 200402
  Title: United States Average Annual Precipitation, 1971-2000
  Geospatial_Data_Presentation_Form: raster digital data
  Publication_Price: Corvallis, Oregon
  Publisher: PRISM Group, Oregon Climate Service, Oregon State University
  Online_Linkage: http://www.ocs.orst.edu/prism/

Description:
  Abstract:
  These data are estimates of average annual precipitation, in inches, for the climatological period 1971-2000. Parameter-elevation Regressions on Independent Slopes Model (PRISM) derived raster data is the underlying data set from which the data were created. PRISM is an analytical model that uses point data and a digital elevation model (DEM) to generate gridded estimates of annual, monthly and event-based climatic parameters. For further information, the online PRISM homepage can be found at http://www.ocs.orst.edu/prism/.

  The data is available as an ESRI GridASCII export file, in latitude/longitude coordinates with a horizontal resolution of 0.00833 degrees, for the entire United States from the Oregon Climate Service web site. The data for Montana is available in Montana State Plane Coordinates, resampled to a resolution of 600 meters, in either GridASCII export format or as a shapefile with polygons representing 27 precipitation ranges.

  Purpose: Display and/or analyses requiring spatially distributed monthly or annual precipitation for the climatological period 1971-2000. Supplemental_Information: There are many methods of interpolating precipitation from monitoring stations to grid points. Some provide estimates of acceptable accuracy in flat terrain, but few have been able to adequately explain the extreme, complex variations in precipitation that occur in mountainous regions. Significant progress in this area has been achieved through the development of PRISM (Parameter-elevation Regressions on Independent Slopes Model). PRISM is an analytical model that uses point data and a digital elevation model (DEM) to generate gridded estimates of monthly and annual precipitation (as well as other climatic parameters). PRISM is well suited to regions with mountainous terrain, because it incorporates a conceptual framework that addresses the spatial scale and pattern of orographic precipitation.

  Time_Period_of_Content:
  Time_Period_Information:
    Single_Date/Time:
      Calendar_Date: REQUIRED: The year (and optionally month, or month and day) for which the data set corresponds to the ground.
      Range_of_Dates/Times:
        Beginning_Date: 1971
        Ending_Date: 2000
  Currentness_Reference: Climatological period from which the point observations were taken.

  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: None planned
  Spatial_Domain:
    Bounding_Coordinates:
West_Bounding_Coordinate: -116.178337
East_Bounding_Coordinate: -103.611160
North_Bounding_Coordinate: 49.180943
South_Bounding_Coordinate: 44.238013

Keywords:
Theme:
  Theme_Keyword_Thesaurus: ISO 19115 Topic Category
  Theme_Keyword: climatologyMeteorologyAtmosphere
Theme:
  Theme_Keyword_Thesaurus: none
  Theme_Keyword: precipitation
Place:
  Place_Keyword_Thesaurus: none
  Place_Keyword: Montana, USA

Access_Constraints: REQUIRED: Restrictions and legal prerequisites for accessing the data set.
Use_Constraints: This data is copyright 2004, PRISM Group, Oregon State University, http://www.prismclimate.org. A statement of this copyright must accompany any transfer or display of this data.

Point_of_Contact:
  Contact_Information:
    Contact_Organization_Primary:
      Contact_Organization: Oregon Climate Service at Oregon State University
    Contact_Address:
      Address_Type: mailing address
      Address: Strand Ag Hall 326, Oregon Climate Service, Oregon State University
      City: Corvallis
      State_or_Province: OR
      Postal_Code: 97331-2209
      Country: USA
    Contact_Voice_Telephone: 541-737-5710
    Contact_Electronic_Mail_Address: oregon@oce.orst.edu
  Browse_Graphic:
    Browse_Graphic_File_Name: http://nris.mt.gov/nsdi/nris/precip71_00.gif
    Browse_Graphic_File_Type: GIF
  Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:
  Completeness_Report: Point estimates of monthly precipitation originated from the following sources: 1) National Weather Service Cooperative (COOP) stations, 2) Natural Resources Conservation Service (NRCS) SNOTEL, 3) local networks, and 4) statistically in-filled missing monthly data to produce a serially complete station data set, generated by the National Center for Atmospheric Research (NCAR).

Lineage:
Source_Information:
  Source_Citation:
    Originator: National Climatic Data Center (NCDC)
    Publication_Date: 2001
    Title: U.S. National 1971-2000 Climate Normals, Climatography of the United States
    Publication_Information:
      Publication_Place: Asheville, NC, USA
      Publisher: National Climatic Data Center (NCDC)

Source_Information:
  Source_Citation:
    Originator: Natural Resources Conservation Service
    Publication_Date: 2001
    Title: Cooperative Snow Survey Data of Federal - State - Private Cooperative Snow Surveys
    Publication_Information:
      Publication_Place: Portland, OR, USA
      Publisher: Natural Resources Conservation Service, Water and Climate Center

Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
  Beginning_Date: 1971
  Ending_Date: 2000
Source_Currentness_Reference: ground condition
Source_Contribution: Location and values of known average monthly and annual precipitation

Source_Citation:
  Citation_Information:
    Originator: Natural Resources Conservation Service, Water and Climate Center
    Publication_Date: Unpublished Material
    Title: Local Precipitation monitoring networks
Source_Time_Period_of_Content:
  Time_Period_Information:
    Range_of_Dates/Times:
      Beginning_Date: 1971
      Ending_Date: 2000
    Source_Currentness_Reference: ground condition
Source_Citation:
  Citation_Information:
    Originator: Defense Mapping Agency
    Publication_Date: 1985
    Title: 1:250,000-scale Digital Elevation Models (DEM) also known as 1-Degree DEM's
    Publication_Information:
      Publication_Place: Washington, DC
      Publisher: U.S. Geological Survey
Source_Time_Period_of_Content:
  Time_Period_Information:
    Single_Date/Time:
      Calendar_Date: 1985
    Source_Currentness_Reference: publication date
Source_Contribution: Terrain surface input to PRISM model for estimation of precipitation between known points.

Source_Citation:
  Citation_Information:
    Originator: National Center for Atmospheric Research (NCAR)
    Publication_Date: Unpublished material
    Title: Serially complete station data set
Source_Time_Period_of_Content:
  Time_Period_Information:
    Range_of_Dates/Times:
      Beginning_Date: 1971
      Ending_Date: 2000
    Source_Currentness_Reference: ground condition
Source_Contribution: Serially in-filled data set in which missing monthly values are replaced with reasonable values generated by a statistical process (kriging).

  Process_Step:
    Process_Description: The process used by the Oregon Climate Service to create this data is described at http://www.ocs.oregonstate.edu/prism.
    Process_Date: 2002
  Process_Step:
    Process_Description: The 1971-2000 average annual precipitation data for the United States was downloaded from the Oregon Climate Service web site. This data was clipped to the area of Montana, projected from latitude/longitude coordinates to Montana State Plane Coordinates (and resampled from a resolution of 0.0083 degrees to 600 meters), and the precipitation units were converted from 100ths of a millimeter to inches. The grid data was classified into 27 classes and converted to shapefile format.
    Process_Date: 20060621
Process Step: Metadata imported.
Source Used Citation Abbreviation: H:\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\precip71_00\precip71_00.xml

Process Step: Dataset copied.
Source Used Citation Abbreviation: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_County.gdb

Spatial Data Organization Information:
Direct Spatial Reference Method: Vector
Point and Vector Object Information:
SDTS Terms Description:
   SDTS Point and Vector Object Type: G-polygon
   Point and Vector Object Count: 12937

Spatial Reference Information:
Horizontal Coordinate System Definition:
Planar:
   Grid Coordinate System:
      Grid Coordinate System Name: State Plane Coordinate System 1983
   State Plane Coordinate System:
      SPCS Zone Identifier: 2500
      Lambert Conformal Conic:
         Standard Parallel: 45.000000
         Standard Parallel: 49.000000
         Longitude of Central Meridian: -109.500000
         Latitude of Projection Origin: 44.250000
         False Easting: 600000.000000
         False Northing: 0.000000

   Planar Coordinate Encoding Method: coordinate pair
   Coordinate Representation:
      Abscissa Resolution: 600
      Ordinate Resolution: 600
   Planar Distance Units: meters

Geodetic Model:
   Horizontal Datum Name: North American Datum of 1983
   Ellipsoid Name: Geodetic Reference System 80
   Semi-major Axis: 6378137.000000
   Denominator of Flattening Ratio: 298.257222

Entity and Attribute Information:
Detailed Description:
   Entity Type:
      Entity Type Label: precip71_00

Attribute:
   Attribute Label: Inches
   Attribute Definition: Range of average annual precipitation within the polygon, inches.
   Attribute Domain Values:
      Enumerated Domain:
         Enumerated Domain Value: 6-7
      Enumerated Domain:
         Enumerated Domain Value: 7-8
      Enumerated Domain:
         Enumerated Domain Value: 8-9
      Enumerated Domain:
         Enumerated Domain Value: 9-10
      Enumerated Domain:
         Enumerated Domain Value: 10-11
      Enumerated Domain:
         Enumerated Domain Value: 11-12
      Enumerated Domain:
Enumerated_Domain_Value: 12-13
Enumerated_Domain:
  Enumerated_Domain_Value: 13-14
Enumerated_Domain:
  Enumerated_Domain_Value: 14-16
Enumerated_Domain:
  Enumerated_Domain_Value: 16-18
Enumerated_Domain:
  Enumerated_Domain_Value: 18-20
Enumerated_Domain:
  Enumerated_Domain_Value: 20-22
Enumerated_Domain:
  Enumerated_Domain_Value: 22-24
Enumerated_Domain:
  Enumerated_Domain_Value: 24-26
Enumerated_Domain:
  Enumerated_Domain_Value: 26-28
Enumerated_Domain:
  Enumerated_Domain_Value: 28-30
Enumerated_Domain:
  Enumerated_Domain_Value: 30-34
Enumerated_Domain:
  Enumerated_Domain_Value: 34-38
Enumerated_Domain:
  Enumerated_Domain_Value: 38-42
Enumerated_Domain:
  Enumerated_Domain_Value: 42-46
Enumerated_Domain:
  Enumerated_Domain_Value: 46-50
Enumerated_Domain:
  Enumerated_Domain_Value: 50-55
Enumerated_Domain:
  Enumerated_Domain_Value: 55-60
Enumerated_Domain:
  Enumerated_Domain_Value: 60-70
Enumerated_Domain:
  Enumerated_Domain_Value: 70-85
Enumerated_Domain:
  Enumerated_Domain_Value: 85-100
Enumerated_Domain:
  Enumerated_Domain_Value: 100-114

Attribute:
  Attribute_Label: Shape
  Attribute_Definition: Feature geometry.

Attribute:
  Attribute_Label: GRIDCODE
  Attribute_Definition: Upper limit of average annual precipitation within the polygon, inches.
  Attribute_Domain_Values:
    Range_Domain:
      Range_Domain_Minimum: 7
      Range_Domain_Maximum: 114

Attribute:
  Attribute_Label: OBJECTID
  Attribute_Definition: Internal feature number.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
Attribute Label: Shape_Length
Attribute Definition: Length of feature in internal units.
Attribute Definition Source: ESRI
Attribute Domain Values:
  Unrepresentable Domain: Positive real numbers that are automatically generated.
Attribute:
  Attribute Label: Shape_Area
Attribute Definition: Area of feature in internal units squared.
Attribute Definition Source: ESRI
Attribute Domain Values:
  Unrepresentable Domain: Positive real numbers that are automatically generated.
Overview Description:
Distribution Information:
Distributor:
  Contact Information:
    Contact Organization Primary:
      ContactOrganization: Montana State Library
    Contact Address:
      Address Type: mailing address
      Address: PO Box 201800
      City: Helena
      State or Province: MT
      Postal Code: 59620-1800
    Contact Voice Telephone: 406-444-6910
    Contact Electronic Mail Address: nris@mt.gov
Resource Description: Downloadable data
Distribution Liability: Neither the United States Government nor any agency thereof, nor any of their employees, make any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or misuse of the data, or for damage, transmission of viruses or computer contamination through the distribution of these data sets or for the usefulness of any information, apparatus, product, or process disclosed in this report, or represents that its use would not infringe privately owned rights. Reference therein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. Any views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
Standard Order Process:
  Digital Form:
    Digital Transfer Information:
      Format Name: ESRI GridASCII
    Digital Transfer Option:
      Online Option:
        Computer Contact Information:
          Network Address:
            Network Resource Name: http://nris.mt.gov/nsdi/nris/e00/precip71_00.zip
  Digital Form:
    Digital Transfer Information:
      Format Name: ESRI Shape file
    Digital Transfer Option:
      Online Option:
        Computer Contact Information:
          Network Address:
            Network Resource Name: http://nris.mt.gov/nsdi/nris/shape/precip71_00.zip
Fees: none
Technical Prerequisites: Geographic data are intended for use in a Geographic Information System (GIS).
Metadata Reference Information:
Metadata Date: 20060621
Metadata Contact:
  Contact Information:
    Contact Organization Primary:
      Contact Organization: Montana State Library
Contact Person: Gerry Daumiller
Contact Address:
  Address_Type: mailing address
  Address: PO Box 201800
  City: Helena
  State_orProvince: MT
  Postal_Code: 59620-1800
  Contact_Voice_Telephone: 406-444-5358
  Contact_Electronic_Mail_Address: gdaumiller@mt.gov
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time
Metadata_Extensions:
  Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile
D.20 HELENA VALLEY MONTANA PRECIPITATION ISOHYETS

Identification Information:
Citation:
  Originator: Trihydro Corporation
  Publication_Date: 1998
  Title: Helena Valley Montana Precipitation Isohyets
  Geospatial Data Presentation Form: vector digital data
  Online_Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Lewis_Clark_FINAL.gdb
  LARGER_WORK_Citation:
  Citation Information:
  Description:
  Abstract: This data set represent precipitation isohyets for Helena Valley Montana. It was digitized from: "Hydrology of Helena Area Bedrock, West-Central Montana, 1993-98" USGS Water-Resources Investigations Report 00-4212."
  Purpose: To fulfill the need for precipitation information.
  Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: 1998
  Currentness_Reference: publication date
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: None planned
  Spatial_Domain:
    Bounding_Coordinates:
      West_BoundingCoordinate: -112.382134
      East_BoundingCoordinate: -111.773058
      North_BoundingCoordinate: 46.801439
      South_BoundingCoordinate: 46.389179
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Climate
      Theme_Keyword: Precipitation
      Theme_Keyword: Isohyet
    Place:
      Place_Keyword: United States
      Place_Keyword: Montana
      Place_Keyword: Lewis & Clark County
      Place_Keyword: Helena
      Place_Keyword: Helena Valley
    Access_Constraints: None
    Use_Constraints: None
  Point_of_Contact:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: Trihydro Corporation
        Contact_Position: GIS Analyst
        Contact_Address:
          Address_Type: mailing and physical address
          Address: 1252 Commerce Dr.
          City: Laramie
          State_or_Province: WY
          Postal_Code: 82070
        Contact_Voice_Telephone: 307 745-7474
        Contact_Facsimile_Telephone: 307 745-7729
Contact Electronic Mail Address: GISSupport@trihydro.com
Native Data Set Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350
Data Quality Information:
  Attribute Accuracy:
    Attribute Accuracy Report: 100% Verified by comparison to original figure.
  Logical Consistency Report: These data are topologically consistent.
  Completeness Report: These data are as complete as the figure from which it was digitized.
Positional Accuracy:
  Horizontal Positional Accuracy:
    Horizontal Positional Accuracy Report: Unknown
Lineage:
  Source Information:
    Source Citation:
      Originator: USGS
      Publication Date: 1998
      Title: "Hydrology of Helena Area Bedrock, West-Central Montana, 1993-98" USGS Water-Resources Investigations Report 00-4212.
      Source Scale Denominator: Unknown
      Type of Source Media: paper
      Source Contribution: Precipitation contours.
      Process Step:
        Process Date: 20071128
      Source Used Citation Abbreviation: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_County.gdb
Spatial Data Organization Information:
  Direct Spatial Reference Method: Vector
  Point and Vector Object Information:
    SDTS Terms Description:
      SDTS Point and Vector Object Type: String
      Point and Vector Object Count: 19
  Spatial Reference Information:
    Horizontal Coordinate System Definition:
      Planar:
        Grid Coordinate System:
          Grid Coordinate System Name: State Plane Coordinate System
          State Plane Coordinate System:
            SPCS Zone Identifier: 2500
            Lambert Conformal Conic:
              Standard Parallel: 45.000000
              Standard Parallel: 49.000000
              Longitude of Central Meridian: -109.500000
              Latitude of Projection Origin: 44.250000
              False Easting: 600000.000000
              False Northing: 0.000000
      Planar Coordinate Information:
        Planar Coordinate Encoding Method: coordinate pair
        Coordinate Representation:
          Abscissa Resolution: 0.000100
          Ordinate Resolution: 0.000100
          Planar Distance Units: meters
  Geodetic Model:
    Horizontal Datum Name: North American Datum of 1983
    Ellipsoid Name: Geodetic Reference System 80
    Semi-major Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222
Vertical_Coordinate_System_Definition:
Altitude_System_Definition:
Altitude_Resolution: 0.000100
Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates
Entity_and_Attribute_Information:
Detailed_Description:
   Entity_Type:
      Entity_Type_Label: Helena_precip_isohyet
   Attribute:
      Attribute_Label: OBJECTID
      Attribute_Definition: Internal feature number.
      Attribute_Definition_Source: ESRI
      Attribute_Domain_Values:
         Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
   Attribute:
      Attribute_Label: SHAPE
      Attribute_Definition: Feature geometry.
      Attribute_Definition_Source: ESRI
      Attribute_Domain_Values:
         Unrepresentable_Domain: Coordinates defining the features.
   Attribute:
      Attribute_Label: Value
   Attribute:
      Attribute_Label: SHAPE_Length
      Attribute_Definition: Length of feature in internal units.
      Attribute_Definition_Source: ESRI
      Attribute_Domain_Values:
         Unrepresentable_Domain: Positive real numbers that are automatically generated.
Distribution_Information:
Distributor:
Contact_Information:
   Contact_Organization_Primary:
      Contact_Organization: City of Helena and Lewis & Clark County
      Contact_Position: GIS Center
      Contact_Address:
         Address_Type: physical address
         Address: 316 N. Park Avenue, Room 147
         City: Helena
         State_or_Province: MT
         Postal_Code: 59624
      Contact_Voice_Telephone: 406-447-8389
      Contact_Facsimile_Telephone: 406-477-8386
      Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us
Resource_Description: Downloadable Data
Metadata_Reference_Information:
Metadata_Date: 20080420
Metadata_Contact:
Contact_Information:
   Contact_Organization_Primary:
      Contact_Organization: Trihydro Corporation
      Contact_Position: GIS Analyst
      Contact_Address:
         Address_Type: mailing and physical address
         Address: 1252 Commerce Dr.
         City: Laramie
         State_or_Province: WY
Postal Code: 82070
Contact Voice Telephone: 307 745-7474
Contact Facsimile Telephone: 307 745-7729
Contact Electronic Mail Address: GISSupport@trihydro.com
Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Time Convention: local time
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
D.21 LEWIS & CLARK COUNTY ROADS

Identification Information:
Citation:
   Originator: City of Helena and Lewis & Clark County GIS
   Publication Date: January 1, 2002
   Title: Roads
   Geospatial Data Presentation Form: vector digital data
   Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_FINAL.gdb

Description:
Abstract: Roadways in Lewis & Clark County derived from GPS field surveys during the summers of 1997 & 1998. The intent was to map every roadway, including state hwys and private drives, along which a residence or structure is located. This data set has been updated to included most driveways and new roads as of December 10, 2003. Continues to be updated each year as per addressing coordinator's road naming, and new subdivision additions

Purpose: Base map data for rural addressing and county GIS mapping.
Supplemental Information:
*IMPORTANT* These data are NOT the official record *IMPORTANT*
The data contained herein are NOT the official records and may be inaccurate and incomplete! By using this GIS information, the user acknowledges and accepts full responsibility for verifying the correctness and the completeness of any of the information provided here.

The City of Helena and Lewis & Clark County do not warrant, either explicit or implied, the completeness or accuracy of the information provided. Additionally, the city and county accept no liability of any kind, including but not limited to any losses or damages that may result from the wrongful reliance on this information, and the user also accepts full responsibility for any subsequent use or reuse of the data, and shall be solely responsible for results or any damages which may result from the use of any of these data.

Time_Period_of_Content:
Time_Period_Information:
   Single_Date/Time:
      Calendar_Date: 2/27/2004
   Currentness_Reference: publication date

Status:
Progress: Complete
Maintenance_and_Update_Frequency: As needed

Spatial Domain:
Bounding_Coordinates:
   West_Bounding_Coordinate: -112.895253
   East_Bounding_Coordinate: -111.632830
   North_Bounding_Coordinate: 47.644821
   South_Bounding_Coordinate: 46.423151

Keywords:
Theme:
   Theme_Keyword_Thesaurus: REQUIRED: Reference to a formally registered thesaurus or a similar authoritative source of theme keywords.
   Theme_Keyword: Roads and streets

Access_Constraints: This data set is public record and subject to public right to know laws.
Use_Constraints:
USES PROHIBITED: The following uses are prohibited except with the express written consent of the City of Helena and Lewis & Clark County:

1. Giving the Data to third parties or using the Data for the benefit of third parties except authorized agents of the Licensee;
2. Making copies or reproducing the Data, or any part thereof, except for making backup and archival copies solely for the Licensee;
3. Selling, distributing, loaning, or offering for use of the Data, in whole or in part, to others; and
4. Reproducing hardcopy products as provided by the Owner with the intent to sell for a profit.

Point_of_Contact:

Contact_Organization_Primary:
  Contact_Organization: City of Helena and Lewis & Clark County
  Contact_Person: GIS Staff
  Contact_Address:
    Address_Type: mailing and physical address
    Address: 316 N. Park Avenue, Room 147
    City: Helena
    State_or_Province: Montana
    Postal_Code: 59624
    Country: USA
  Contact_VoiceTelefono: (406) 447-8389
  Contact_VoiceTelefono: 406-447-8389
  Contact_FacsimileTelefono: (406) 447-8386
  Contact_ElectronicMailAddress: giscenter@co.lewis-clark.mt.us
  Hours_of_Service: Mon-Fri 8-5

Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:

Logical_Consistency_Report: Most streets and roads have been GPS'ed and are within 3 to 5 meters.

Lineage:

Process_Step:
  Process_Description: Metadata imported.
  Source_Used_Citation_Abbreviation: C:\contactinfo.xml

Process_Step:
  Process_Description: Dataset copied.
  Source_Used_Citation_Abbreviation: G:\Infrastructure\ROADS\COUNTY\gpsroad-cl

Process_Step:
  Process_Description: Metadata imported.
  Source_Used_Citation_Abbreviation: c:\ArcTemp\xml8.tmp

Process_Step:
  Process_Description: Dataset copied.
  Source_Used_Citation_Abbreviation: G:\Infrastructure\ROADS\COUNTY\gpsroad-cl

Process_Step:
  Process_Description: Metadata imported.
  Source_Used_Citation_Abbreviation: c:\ArcTemp\xml52.tmp
Process Step:
Process Description: Dataset copied.
Source Used Citation Abbreviation: G:\Infrastructure\ROADS\COUNTY\gpsroad-cl

Process Step:
Process Description: Metadata imported.
Source Used Citation Abbreviation: c:\ArcTemp\xml1E.tmp

Process Step:
Process Description: Dataset copied.
Source Used Citation Abbreviation: G:\Infrastructure\ROADS\COUNTY\gpsroad-cl

Process Step:
Process Description: Metadata imported.
Source Used Citation Abbreviation: c:\ArcTemp\xml20.tmp

Process Step:
Process Description: Dataset copied.
Source Used Citation Abbreviation: G:\Infrastructure\ROADS\COUNTY\gpsroad-cl

Process Step:
Process Description: Metadata imported.
Source Used Citation Abbreviation: c:\ArcTemp\xml22.tmp

Process Step:
Process Description: Dataset copied.
Source Used Citation Abbreviation: G:\Infrastructure\ROADS\COUNTY\gpsroad-cl

Process Step:
Process Description: Metadata imported.
Source Used Citation Abbreviation: c:\ArcTemp\xml3.tmp

Process Step:
Process Description: Dataset copied.
Source Used Citation Abbreviation: G:\Infrastructure\ROADS\COUNTY\gpsroad-cl

Process Step:
Process Description: Metadata imported.
Source Used Citation Abbreviation: c:\ArcTemp\xml1A.tmp

Process Step:
Process Description: Dataset copied.
Source Used Citation Abbreviation: c:\ArcTemp\xml7.tmp

Process Step:
Process Description: Metadata imported.
Source Used Citation Abbreviation: c:\ArcTemp\xml1A.tmp

Process Step:
Process Description: Dataset copied.
Source Used Citation Abbreviation: Server=206.127.88.50; Service=5151; Database=GIS; User=GISOwner; Version=sde.DEFAULT

Process Step:
Process Description: Dataset copied.
Source Used Citation Abbreviation: \LC_MAIN\GIS\SDE_updates_changes\Lewis Clark County Roads Geodatabase.mdb

Process Step:
Process Description: Dataset copied.
Source Used Citation Abbreviation: Server=172.18.2.25; Service=5151; Database=GIS; User=gisowner; Version=sde.DEFAULT

Spatial Data Organization Information:
Direct Spatial Reference Method: Vector

Point and Vector Object Information:
SDTS Terms Description:
SDTS Point and Vector Object Type: String
Point and Vector Object Count: 0

Spatial Reference Information:
Horizontal Coordinate System Definition:
Planar:

Map Projection:
Map Projection Name: Lambert Conformal Conic
Lambert Conformal Conic:
Standard Parallel: 45.000000
Standard Parallel: 49.000000
Longitude of Central Meridian: -109.500000
Latitude of Projection Origin: 44.250000
False_Easting: 600000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
  Planar_Coordinate_Encoding_Method: coordinate pair
  Coordinate_Representation:
    Abscissa_Resolution: 0.000100
    Ordinate_Resolution: 0.000100
  Planar_Distance_Units: meters
Geodetic_Model:
  Horizontal_Datum_Name: D_North_American_1983_HARN
  Ellipsoid_Name: Geodetic Reference System 80
  Semi-major_Axis: 6378137.000000
  Denominator_of_Flattening_Ratio: 298.257222
Vertical_Coordinate_System_Definition:
  Altitude_System_Definition:
    Altitude_Resolution: 0.000100
    Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates
Entity_and_Attribute_Information:
Detailed_Description:
  Entity_Type:
    Entity_Type_Label: Roads
  Attribute:
    Attribute_Label: len
  Attribute:
    Attribute_Label: BASENAME
    Attribute_Definition: Basic road name
  Attribute:
    Attribute_Label: PREFIX
    Attribute_Definition: Road name prefix (N, S...)
    Attribute_Definition_Source: addressing
    Unrepresentable_Domain: Coordinates defining the features.
  Attribute:
    Attribute_Label: SUFFIX
    Attribute_Definition_Source: addressing office
  Attribute:
    Attribute_Label: STREETTYPE
    Attribute_Definition: Road type...Rd. St. Ave.
    Attribute_Definition_Source: addressing center
  Attribute:
    Attribute_Label: FULLNAME
    Attribute_Definition: Concatenation of Prefix, Streetname, Suffix and Streettype
    Attribute_Definition_Source: addressing center
  Attribute:
    Attribute_Label: SURFACE
    Attribute_Definition: road surface type (paved...)
    Attribute_Definition_Source: addressing center
  Attribute:
    Attribute_Label: FROMLEFT
    Attribute_Definition: Lowest address on left side of primary road direction segment
    Attribute_Definition_Source: addressing center
  Attribute:
    Attribute_Label: TOLEFT
    Attribute_Definition: Highest address on left side of primary road direction segment
  Attribute:
    Attribute_Label: FROMRIGHT
    Attribute_Definition: Lowest address on right side of primary road direction segment
Attribute:
  Attribute_Label: TORIGHT
  Attribute_Definition: Highest address on right side of primary road direction segment
Attribute:
  Attribute_Label: L_PO
  Attribute_Definition: Post office zip code left of road segment
  Attribute_Definition_Source: addressing center
Attribute:
  Attribute_Label: R_PO
  Attribute_Definition: Post office city on right side of primary road direction segment
  Attribute_Definition_Source: addressing center
Attribute:
  Attribute_Label: ALIAS
  Attribute_Definition: street or road alias
Attribute:
  Attribute_Label: L_ZIP
  Attribute_Definition: Zipcode on left side of primary road direction segment
Attribute:
  Attribute_Label: R_ZIP
  Attribute_Definition: Zipcode on right side of primary road direction segment
Attribute:
  Attribute_Label: L_ESZ
  Attribute_Definition: Emergency Service Zone on left side of primary road direction segment
  Attribute_Definition_Source: addressing center
Attribute:
  Attribute_Label: R_ESZ
  Attribute_Definition: Emergency Service Zone on right side of primary road direction segment
  Attribute_Definition_Source: addressing
Attribute:
  Attribute_Label: L_EXCH
  Attribute_Definition: Telephone Exchange on left side of primary road direction segment
Attribute:
  Attribute_Label: R_EXCH
  Attribute_Definition: Telephone Exchange on right side of primary road direction segment
Attribute:
  Attribute_Label: MILES
  Attribute_Definition: length of road segment in miles
  Attribute_Definition_Source: addressing
Attribute:
  Attribute_Label: CLASS
Attribute:
  Attribute_Label: R_ESN
  Attribute_Definition: Emergency Service Number on right side of primary road direction segment
Attribute:
  Attribute_Label: EDITOR
  Attribute_Definition: initials of last editor
  Attribute_Definition_Source: addressing center
Attribute:
  Attribute_Label: EDITDATE
  Attribute_Definition: edit date
Attribute:
  Attribute_Label: DIRECTION
  Attribute_Definition: road segment direction
Attribute:
  Attribute_Label: E_SPEED
  Attribute_Definition: Estimated Street or Road speed for emergency travel
Attribute:
  Attribute_Label: L_ESN
Attribute_Definition: Emergency Service Number on right side of primary road direction segment
Attribute:
Attribute_Label: LOCATION
Attribute:
Attribute_Label: HWYTYPE
Attribute_Definition: Type of Highway, such as US or Montana
Attribute:
Attribute_Label: RTENUM
Attribute_Definition: Federal or state route designation
Attribute:
Attribute_Label: ALTRTENUM
Attribute_Definition: Federal or state route designation
Attribute:
Attribute_Label: LOGCODE
Attribute:
Attribute_Label: SHAPE
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.
Attribute:
Attribute_Label: STATUS
Attribute:
Attribute_Label: OBJECTID
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: Shape
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.
Attribute:
Attribute_Label: Shape_Length
Attribute_Definition: Length of feature in internal units.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.

Distribution_Information:
Resource_Description:
Downloadable Data
http://www.co.lewis-clark.mt.us/index.php?id=102
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Transfer_Size: 0.000
Metadata_Reference_Information:
Metadata_Date: 20080307
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: City of Helena and Lewis & Clark County
Contact_Person: GIS Staff
Contact_Position: GIS Center
Contact_Address:
Address_Type: physical address
Address: 316 N. Park Avenue, Room 147
City: Helena
State_or_Province: Montana
Postal_Code: 59624
Country: USA
Contact_Voice_Telephone: (406) 447-8367
Contact_Voice_Telephone: 406-447-8389
Contact_Facsimile_Telephone: (406) 447-8386
Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us
Hours_of_Service: Mon-Fri 8-5
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time
Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile
Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile
Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile
D.22 EXTENDED STUDY AREA SEPTIC SYSTEM LOCATIONS IN LEWIS & CLARK COUNTY MONTANA

Identification Information:

Citation:
Originator: Trihydro Corporation
Publication Date: 20080129
Title: Extended Study Area Septic System Locations in Lewis & Clark County Montana
Geospatial Data Presentation Form: vector digital data
Online Linkage: M:\fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_FINAL.gdb

Description:
Abstract: This data set represent a complete list of addresses in Lewis & Clark County, Montana. It is a combination of geocoded address points and address points downloaded from the Lewis & Clark County website.
Purpose: This data set is intended to assist in a groundwater vulnerability project

Time Period of Content:
Single Date/Time:
Calendar Date: 2007
Currentness Reference: publication date

Status:
Progress: Complete
Maintenance and Update Frequency: None planned

Spatial Domain:
Bounding Coordinates:
West Bounding Coordinate: -112.088413
East Bounding Coordinate: -111.889448
North Bounding Coordinate: 46.721507
South Bounding Coordinate: 46.567537

Keywords:
Theme:
Theme Keyword Thesaurus: None
Theme Keyword: Septic System

Access Constraints: Access is limited to Trihydro employees and Lewis & Clark County Montana employees.
Use Constraints: None.

Point of Contact:
Contact Information:
Contact Person Primary:
Contact Person: Brian Robeson
Contact Organization: Trihydro Corporation
Contact Position: GIS Analyst
Contact Address:
Address Type: mailing and physical address
Address: 1252 Commerce Dr
City: Laramie
State or Province: WY
Postal Code: 82070
Contact Voice Telephone: 307 745-7474
Contact Electronic Mail Address: brobeson@trihydro.com

Native Data Set Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data Quality Information:
Completeness Report: While there are potentially other addresses with septic systems, these data are as complete as practical with respect to the current groundwater vulnerability project.
Lineage:
Process Step:
Process_Description: Merged address points matched with address points downloaded from Lewis & Clark County website and geocoded address points.
Process_Date: 20080129
Process_Step:
  Process_Description: Metadata imported.
  Source_Used_Citation_Abbreviation: C:\Workspace\septic.xml
Process_Step:
  Process_Description: Clipped to Extended Study Area boundary
  Process_Date: 20080129
Process_Step:
  Process_Description: Dataset copied.
  Source_Used_Citation_Abbreviation: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_County.gdb
Process_Step:
  Process_Description: Dataset copied.
  Source_Used_Citation_Abbreviation: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_County.gdb
Spatial_Data_Organization_Information:
  Direct_Spatial_Reference_Method: Vector
  Point_and_Vector_Object_Information:
    SDTS_Terms_Description:
      SDTS_Point_and_Vector_Object_Type: Entity point
      Point_and_Vector_Object_Count: 4270
  Spatial_Reference_Information:
    Horizontal_Coordinate_System_Definition:
      Planar:
        Map_Projection:
          Map_Projection_Name: Lambert Conformal Conic
          Lambert_Conformal_Conic:
            Standard_Parallel: 45.000000
            Standard_Parallel: 49.000000
            Longitude_of_Central_Meridian: -109.500000
            Latitude_of_Projection_Origin: 44.250000
            False_Easting: 600000.000000
            False_Northing: 0.000000
        Planar_Coordinate_Encoding_Method: coordinate pair
        Coordinate_Representation:
          Abscissa_Resolution: 0.000100
          Ordinate_Resolution: 0.000100
        Planar_Distance_Units: meters
    Geodetic_Model:
      Horizontal_Datum_Name: D_North_American_1983_HARN
      Ellipsoid_Name: Geodetic Reference System 80
      Semi-major_Axis: 6378137.000000
      Denominator_of_Flattening_Ratio: 298.257222
    Vertical_Coordinate_System_Definition:
      Altitude_System_Definition:
        Altitude_Resolution: 0.000100
        Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates
Entity_and_Attribute_Information:
  Detailed_Description:
    Entity_Type:
      Entity_Type_Label: septic_Clip
    Attribute:
      Attribute_Label: OBJECTID
      Attribute_Definition: Internal feature number.
      Attribute_Definition_Source: ESRI
      Attribute_Domain_Values:
        Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
  Attribute_Label: Shape
  Attribute_Definition: Feature geometry.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Coordinates defining the features.
Attribute:
  Attribute_Label: septic_Match_addr
Attribute:
  Attribute_Label: septic_HOUSE_NO
Attribute:
  Attribute_Label: septic_STREET
Attribute:
  Attribute_Label: septic_CSZ
Attribute:
  Attribute_Label: Sum_Output_septic_Match_addr
Attribute:
  Attribute_Label: Sum_Output_septic_Cnt_Match_addr
Distribution_Information:
  Resource_Description: Downloadable Data
Metadata_Reference_Information:
  Metadata_Date: 20080129
Metadata_Contact:
  Contact_Information:
    Contact_Organization_Primary:
      Contact_Organization: Trihydro Corporation
      Contact_Person: Brian Robeson
      Contact_Position: GIS Analyst
    Contact_Address:
      Address_Type: mailing and physical address
      Address: 1252 Commerce Dr.
      City: Laramie
      State_or_Province: WY
      Postal_Code: 82070
      Contact_Voice_Telephone: 307 745-7474
      Contact_Electronic_Mail_Address: brobeson@trihydro.com
  Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
  Metadata_Time_Convention: local time
  Metadata_Extensions:
    Online_Linkage: http://www.esri.com/metadata/esriprof80.html
    Profile_Name: ESRI Metadata Profile
D.23 HELENA VALLEY MONTANA SLOPE

Identification_Information:

Citation:

Originator: U.S. Geological Survey (USGS), EROS Data Center
Publication_Date: 1999
Title: Helena Valley Montana Slope
Edition: 1
Geospatial_Data_Presentation_Form: raster digital data

Publication_Information:

Publication_Place: Sioux Falls, SD
Publisher: U.S. Geological Survey
Online_Inline: H:\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Grids\slop
d

Description:

Abstract: The U.S. Geological Survey has developed a National Elevation Dataset (NED). The NED is a seamless mosaic of best-available elevation data. The 7.5-minute elevation data for the conterminous United States are the primary initial source data. In addition to the availability of complete 7.5-minute data, efficient processing methods were developed to filter production artifacts in the existing data, convert to the NAD83 datum, edge-match, and fill slivers of missing data at quadrangle seams. One of the effects of the NED processing steps is a much-improved base of elevation data for calculating slope and hydrologic derivatives. The specifications for the NED 1 arc second and 1/3 arc second data are: Geographic coordinate system: Horizontal datum of NAD83, except for AK which is NAD27 Vertical datum of NAVD88, except for AK which is NAVD29 Z units of meters

Purpose: Geospatial elevation data are utilized by the scientific and resource management communities for global change research, hydrologic modeling, resource monitoring, mapping, and visualization applications.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:
Beginning_Date: 19990201
Ending_Date: unknown

Currentness_Reference: publication date

Status:
Progress: In work
Maintenance_and_Update_Frequency: As needed

Spatial_Domain:

Bounding_Coordinates:
West_BoundingCoordinate: -112.187972
East_BoundingCoordinate: -111.778344
North_BoundingCoordinate: 46.839100
South_BoundingCoordinate: 46.494300

Keywords:

Theme:
Theme_Keyword_Thesaurus: GCMD Parameter Keywords
Theme_Keyword: EARTH SCIENCE
Theme_Keyword: LAND SURFACE
Theme_Keyword: TOPOGRAPHY
Theme_Keyword: LANDFORMS
Theme_Keyword: TERRAIN ELEVATION
Theme_Keyword: 1-DEGREE DEM
Theme_Keyword: 2-ARC-SECOND DEM
Theme_Keyword: 7.5-MINUTE DEM
Theme_Keyword: CARTOGRAPHY
Theme_Keyword: DEM
Theme_Keyword: DIGITAL ELEVATION MODEL
Theme_Keyword: DIGITAL MAPPING
Theme_Keyword: EDC
Theme_Keyword: EROS

Trihydro
Theme_Keyword: GEODATA
Theme_Keyword: GIS
Theme_Keyword: MAPPING
Theme_Keyword: RASTER
Theme_Keyword: USGS

Place:
Place_Keyword_Thesaurus: GCMD Location Keywords
Place_Keyword: NORTH AMERICA
Place_Keyword: UNITED STATES
Place_Keyword: UNITED STATES OF AMERICA

Access_Constraints: None

Use_Constraints: None. Acknowledgement of the originating agencies would be appreciated in products derived from these data.

Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:
Lineage:
Process_Step:
Process_Description: Metadata imported.
Source_Used_Citation_Abbreviation: C:\DOCUME~1\brobeson\LOCALS~1\Temp\xml302A.tmp

Process_Step:
Process_Description: Calculated slope from USGS 10 meter DEM.

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster

Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 3737
Column_Count: 3016
Vertical_Count: 1

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Lambert Conformal Conic
Lambert_Conformal_Conic:
Standard_Parallel: 45.000000
Standard_Parallel: 49.000000
Longitude_of_Central_Meridian: -109.500000
Latitude_of_Projection_Origin: 44.250000
False_Easting: 600000.000000
False_Northing: 0.000000
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 10.000000
Ordinate_Resolution: 10.000000
Planar_Distance_Units: meters

Geodetic_Model:
Horizontal Datum_Name: D North American 1983_HARN
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Customer Services Representative
Contact_Organization: EROS Data Center
Contact_Address:
Address_Type: mailing and physical address
Address: U.S. Geological Survey EROS Data Center
City: Sioux Falls
State or Province: SD
Postal Code: 57198
Country: USA
Contact_Voice Telephone: 605-594-6151
Contact_Facsimile Telephone: 605-594-6589
Contact_ElectronicMail Address: custserv@edcmail.cr.usgs.gov
Resource_Description: National Elevation Dataset (NED)
Distribution_Liability: Although these data have been processed successfully on a computer system at the U.S. Geological Survey, EROS Data Center, no warranty expressed or implied is made by either regarding the utility of the data on any system, nor shall the act of distribution constitute any such warranty. The USGS will warrant the delivery of this product in computer-readable format and will offer appropriate adjustment of credit when the product is determined unreadable by correctly adjusted computer peripherals, or when the physical medium is delivered damaged condition. Requests for adjustments of credit must be made within 90 days from the date of this shipment from the ordering site.
Standard_Order_Process:
  Digital Form:
    Digital Transfer Information:
      Transfer Size: 43.897
Metadata_Reference Information:
  Metadata Date: 20080420
Metadata_Contact:
  Contact Information:
    Contact_Person_Primary:
      Contact Person: Customer Services Representative
    Contact_Organization: EROS Data Center
    Contact_Address:
      Address_Type: mailing and physical address
      Address: U.S. Geological Survey EROS Data Center
      City: Sioux Falls
      State or Province: SD
      Postal Code: 57198
      Country: USA
    Contact_Voice Telephone: 605-594-6151
    Contact_Facsimile Telephone: 605-594-6589
    Contact_ElectronicMail Address: custserv@edcmail.cr.usgs.gov
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time
Metadata_Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile
SOIL SURVEY GEOGRAPHIC (SSURGO) DATABASE FOR LEWIS AND CLARK COUNTY AREA, MONTANA

Identification Information:
Citation:
Originator:
   U.S. Department of Agriculture, Natural Resources Conservation Service
Publication_Date: 20070502
Title:
   Soil Survey Geographic (SSURGO) database for Lewis and Clark County Area, Montana
Geospatial_Data_Presentation_Form: vector digital data
Publication_Information:
   PublicationPlace: Fort Worth, Texas
Publisher:
   U.S. Department of Agriculture, Natural Resources Conservation Service
Other_Citation_Details: mt630
Online_Linkage: URL:http://SoilDataMart.nrcs.usda.gov/
Description:
Abstract:
This data set is a digital soil survey and generally is the most detailed level of soil geographic data developed by the National Cooperative Soil Survey. The information was prepared by digitizing maps, by compiling information onto a planimetric correct base and digitizing, or by revising digitized maps using remotely sensed and other information.

This data set consists of georeferenced digital map data and computerized attribute data. The map data are in a soil survey area extent format and include a detailed, field verified inventory of soils and nonsoil areas that normally occur in a repeatable pattern on the landscape and that can be cartographically shown at the scale mapped. A special soil features layer (point and line features) is optional. This layer displays the location of features too small to delineate at the mapping scale, but they are large enough and contrasting enough to significantly influence use and management. The soil map units are linked to attributes in the National Soil Information System relational database, which gives the proportionate extent of the component soils and their properties.

Purpose:
SSURGO depicts information about the kinds and distribution of soils on the landscape. The soil map and data used in the SSURGO product were prepared by soil scientists as part of the National Cooperative Soil Survey.

Supplemental Information:
Digital versions of hydrography, cultural features, and other associated layers that are not part of the SSURGO data set may be available from the primary organization listed in the Point of Contact.

Time_Period_of_Content:
Time_Period_Information:
   Single_Date/Time:
      Calendar_Date: REQUIRED: The year (and optionally month, or month and day) for which the data set corresponds to the ground.
Range_of_Dates/Times:
   Beginning_Date: 20001215
   Ending_Date: 20070502
Currentness_Reference: publication date
Status:
   Progress: Complete
   Maintenance_and_Update_Frequency: As needed
Spatial_Domain:
   Bounding_Coordinates:
      West_Bounding_Coordinate: -112.796
      East_Bounding_Coordinate: -111.632
      North_Bounding_Coordinate: 47.652
      South_Bounding_Coordinate: 46.515
Keywords:
   Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: soil survey
      Theme_Keyword: soils
      Theme_Keyword: Soil Survey Geographic
      Theme_Keyword: SSURGO
   Place:
      Place_Keyword_Thesaurus: Counties and County Equivalents of the States of the United
      States and the District of Columbia (FIPS Pub 6-3)
      Place_Keyword: Montana
      Place:
      Place_Keyword_Thesaurus: Counties and County Equivalents of the States of the United
      States and the District of Columbia (FIPS Pub 6-3)
      Place_Keyword: Lewis and Clark County
      Place:
      Place_Keyword_Thesaurus: USGS Topographic Map Names Data Base
      Place_Keyword: Castle Reef Quadrangle
      Place_Keyword: Split Rock Lake Quadrangle
      Place_Keyword: Sawtooth Ridge Quadrangle
      Place_Keyword: Barr Creek Quadrangle
      Place_Keyword: Split Rock Junction Quadrangle
      Place_Keyword: Gilman Quadrangle
      Place_Keyword: Golden Ridge Quadrangle
      Place_Keyword: Lowry Quadrangle
      Place_Keyword: Double Falls Quadrangle
      Place_Keyword: Nilan Reservoir Quadrangle
      Place_Keyword: Augusta Quadrangle
      Place_Keyword: Gouchnour Ranch Quadrangle
      Place_Keyword: Bowmans Corners NW Quadrangle
      Place_Keyword: Bowmans Corners NE Quadrangle
      Place_Keyword: Jakie Creek Quadrangle
      Place_Keyword: Steamboat Mountain Quadrangle
      Place_Keyword: Bean Lake Quadrangle
      Place_Keyword: Krone Ranch Quadrangle
      Place_Keyword: Bowmans Corners Quadrangle
      Place_Keyword: Henry Creek Quadrangle
      Place_Keyword: Blowout Mountain Quadrangle
      Place_Keyword: Johnson Mountain Quadrangle
      Place_Keyword: Comb Rock Quadrangle
      Place_Keyword: Coburn Mountain Quadrangle
      Place_Keyword: Mid Canon Quadrangle
      Place_Keyword: Hardy Quadrangle
Access Constraints: None

Use Constraints:
The U.S. Department of Agriculture, Natural Resources Conservation Service, should be acknowledged as the data source in products derived from these data.

This data set is not designed for use as a primary regulatory tool in permitting or citing decisions, but may be used as a reference source. This is public information and may be interpreted by organizations, agencies, units of government, or others based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions that they make. The Natural Resources Conservation Service will not perform any evaluations of these maps for purposes related solely to State or local regulatory programs.

Photographic or digital enlargement of these maps to scales greater than at which they were originally mapped can cause misinterpretation of the data. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale. The depicted soil boundaries, interpretations, and analysis derived from
them do not eliminate the need for onsite sampling, testing, and
detailed study of specific sites for intensive uses. Thus, these data
and their interpretations are intended for planning purposes only.
Digital data files are periodically updated. Files are dated, and
users are responsible for obtaining the latest version of the data.

Point_of_Contact:

Contact_Information:
  Contact_Organization_Primary:
  Contact_Organization: U.S. Department of Agriculture, Natural Resources Conservation Service
  Contact_Position: State Soil Scientist
  Contact_Address:
  Address_Type: mailing address
  Address: ...not supplied...
  City: Bozeman
  State_orProvince: MT
  Postal_Code: 59715
  Contact_Voice_Telephone: 406-587-6818
  Contact_Electronic_Mail_Address: charles.gordon@mt.usda.gov

Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Cross_Reference:

Citation_Information:
  Originator:
  U.S. Department of Agriculture, Natural Resources Conservation Service
  Publication_Date: unpublished material
  Title: Soil Survey of Lewis and Clark County Area, Montana
  Geospatial_Data_Presentation_Form: atlas
  Other_Citation_Details:
  This soil survey contains information that can be applied in
managing farms and wetlands; in selecting sites for roads, ponds,
buildings, and other structures; and in judging the suitability
of tracts of land for farming, industry, and recreation.

  This soil survey depicts information about the kinds and
distribution of soils on the landscape. The soil map and data
used in the SSURGO product were prepared by soil scientists as
part of the National Cooperative Soil Survey.

Data_Quality_Information:
  Attribute_Accuracy:
  Attribute_Accuracy_Report:
  Attribute accuracy is tested by manual
  comparison of the source with hard copy plots and/or symbolized
display of the map data on an interactive computer graphic system.
  Selected attributes that cannot be visually verified on plots or
  on screen are interactively queried and verified on screen. In
  addition, the attributes are tested against a master set of valid
  attributes. All attribute data conform to the attribute codes in
  the signed classification and correlation document and amendment(s).

  Logical_Consistency_Report:
  Certain node/geometry and topology GT- polygon/chain relationships
are collected or generated to satisfy topological requirements
(the GT-polygon corresponds to the soil delineation). Some of these
requirements include: chains must begin and end at nodes, chains
must connect to each other at nodes, chains do not extend through
nodes, left and right GT-polygons are defined for each chain
element and are consistent throughout, and the chains representing
the limits of the file are free of gaps. The tests of logical
consistency are performed using vendor software. All internal
polygons are tested for closure with vendor software and are checked on hard copy plots. All data are checked for common soil lines (i.e., adjacent polygons with the same label). Edge locations generally do not deviate from centerline to centerline by more than 0.01 inch.

The soil survey areas in Montana of the Broadwater County Area, the Cascade County Area, and the Choteau - Conrad Area, Parts of Teton and Pondera Counties, the Jefferson County Area and Part of Silver Bow County, and the Powell County Area, Montana have an acceptable join to this soil survey.

Completeness Report:
A map unit is a collection of areas defined and named the same in terms of their soil and/or nonsoil areas. Each map unit differs in some respect from all others in a survey area and is uniquely identified. Each individual area is a delineation. Each map unit consists of one or more components.

Soil scientists identify small areas of soils or miscellaneous (nonsoil) areas that have properties and behavior significantly different than the named soils in the surrounding map unit. These minor components may be indicated as special features. If they have a minimal effect on use and management, or could not be precisely located, they may not be indicated on the map.

Specific National Cooperative Soil Survey standards and procedures were used in the classification of soils, design and name of map units, and location of special soil features. These standards are outlined in Agricultural Handbook 18, Soil Survey Manual, 1993, USDA, SCS; Agricultural Handbook 436, Soil Taxonomy, Soil Survey Staff, 1975, USDA, SCS; and all Amendments; Keys to Soil Taxonomy, Soil Survey Staff, (current issue); National Soil Survey Handbook, title 430-VI,(current issue).

The actual composition and interpretive purity of the map unit delineations were based on data collected by scientists during the course of preparing the soil maps. Adherence to National Cooperative Soil Survey standards and procedures is based on peer review, quality control, and quality assurance. Quality control is outlined in the memorandum of understanding for the soil survey area and in documents that reside with the Natural Resources Conservation Service state soil scientist. Four kinds of map units are used in soil surveys: consociations, complexes, associations, and undifferentiated groups.

Consociations - Consociations are named for the dominant soil. In a consociation, delineated areas are dominated by a single soil taxon and similar soils. At least one half of the pedons in each delineation are of the same soil component so similar to the named soil that major interpretations are not affected significantly. The total amount of dissimilar inclusions of other components in a map unit generally does not exceed about 15 percent if limiting and 25 percent if nonlimiting. A single component of a dissimilar limiting inclusion generally does not exceed 10 percent if very contrasting.

Complexes and associations - Complexes and associations are named for two or more dissimilar components with the dominant component listed first. They occur in a regularly repeating pattern. The major components of a complex cannot be mapped separately at a scale of
about 1:24,000. The major components of an association can be separated at a scale of about 1:24,000. In each delineation of either a complex or an association, each major component is normally present, though their proportions may vary appreciably from one delineation to another. The total amount of inclusions in a map unit that are dissimilar to any of the major components does not exceed 15 percent if limiting and 25 percent if nonlimiting. A single kind of dissimilar limiting inclusion usually does not exceed 10 percent.

Undifferentiated groups - Undifferentiated groups consist of two or more components that do not always occur together in the same delineation, but are included in the same named map unit because use and management are the same or similar for common uses. Every delineation has at least one of the major components and some may have all of them. The same principles regarding proportion of inclusions apply to undifferentiated groups as to consociations.

Minimum documentation consists of three complete soil profile descriptions that are collected for each soil added to the legend, one additional per 3,000 acres mapped; three 10 observation transects for each map unit, one additional 10 point transect per 3,000 acres.

A defined standard or level of confidence in the interpretive purity of the map unit delineations is attained by adjusting the kind and intensity of field investigations. Field investigations and data collection are carried out in sufficient detail to name map units and to identify accurately and consistently areas of about 4 acres.

Positional_Accuracy:

Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
The accuracy of these digital data is based upon their compilation to base maps that meet National Map Accuracy Standards. The difference in positional accuracy between the soil boundaries and special soil features locations in the field and their digitized map locations is unknown. The locational accuracy of soil delineations on the ground varies with the transition between map units.

For example, on long gently sloping landscapes the transition occurs gradually over many feet. Where landscapes change abruptly from steep to level, the transition will be very narrow. Soil delineation boundaries and special soil features generally were digitized within 0.01 inch of their locations on the digitizing source. The digital map elements are edge matched between data sets. The data along each quadrangle edge are matched against the data for the adjacent quadrangle. Edge locations generally do not deviate from centerline to centerline by more than 0.01 inch.

Lineage:
Source_Information:
Source_Citation:
Citation_Information:
  Originator: U.S. Geological Survey
  Publication_Date: unpublished material
  Title: quad centered photography
  Geospatial_Data_Presentation_Form: remote sensing image
Source Scale Denominator: 24000
Type of Source Media: paper
Source Time Period of Content:
  Time Period Information:
    Range of Dates/Times:
      Beginning Date: 1976
      Ending Date: 1987
  Source Currentness Reference: 1976
Source Citation Abbreviation: USGS1
Source Contribution: mapping base
Source Information:
  Source Citation:
    Citation Information:
      Originator: U.S. Geological Survey
      Publication Date: 1977
      Title: multiple 2.5 X 7.5 minute orthophotos
Geospatial Data Presentation Form: map
Publication Information:
  Publication Place: Denver, Colorado
  Publisher: U.S. Geological Survey
Source Scale Denominator: 24000
Type of Source Media: stable-base material
Source Time Period of Content:
  Time Period Information:
    Range of Dates/Times:
      Beginning Date: 1981
      Ending Date: 2000
  Source Currentness Reference: publication date
Source Citation Abbreviation: USGS2
Source Contribution:
  compilation base for 70 percent of the soil survey area
Source Information:
  Source Citation:
    Citation Information:
      Originator: U.S. Geological Survey
      Publication Date: 1977
      Title: multiple 7.5 minute orthophotos
Geospatial Data Presentation Form: map
Publication Information:
  Publication Place: Denver, Colorado
  Publisher: U.S. Geological Survey
Source Scale Denominator: 24000
Type of Source Media: stable-base material
Source Time Period of Content:
  Time Period Information:
    Range of Dates/Times:
      Beginning Date: 1981
      Ending Date: 2000
  Source Currentness Reference: publication date
Source Citation Abbreviation: USGS3
Source Contribution:
  compilation base for 30 percent of the soil survey area
Source Information:
  Source Citation:
    Citation Information:
      Originator: U.S. Geological Survey
Publication_Date: 1972-1991
Title: multiple 7.5 minute topographic quadrangles
Geospatial_Data_Presentation_Form: map
Publication_Information:
PublicationPlace: Reston, Virginia
Publisher: U.S. Geological Survey
Source_Scale_Denominator: 24000
Type_of_Source_Media: paper
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 2000
Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: USGS4
Source_Contribution: source used to digitize cultural boundaries
Source_Information:
Source_Citation:
Citation_Information:
Originator:
U.S. Department of Agriculture,
Natural Resources Conservation Service
Publication_Date: unpublished material
Title: annotation overlays
Geospatial_Data_Presentation_Form: map
Source_Scale_Denominator: 24000
Type_of_Source_Media: stable-base material
Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 1999
Ending_Date: 2000
Source_Currentness_Reference: 2000
Source_Citation_Abbreviation: NRCS1
Source_Contribution: scan source
Source_Information:
Source_Citation:
Citation_Information:
Originator:
U.S. Department of Agriculture,
Natural Resources Conservation Service
Publication_Date: unpublished material
Title: DLG DOC TAB directories of the soil survey of
Lewis and Clark County Area, Montana
Geospatial_Data_Presentation_Form: map
Source_Scale_Denominator: 24000
Type_of_Source_Media: magnetic tape
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 2000
Source_Currentness_Reference: 2000
Source_Citation_Abbreviation: NRCS2
Source_Contribution:
digital information containing area and
special features, tabular data and metadata for SSURGO
Source_Information:
Source_Citation:
Geospatial_Data_Presentation_Form: map
Publication_Information:
Publication_Place: Ft. Worth, Texas
Publisher:
U.S. Department of Agriculture, Natural Resources
Conservation Service, National Cartography and
Geospatial Center
Source_Scale_Denominator: 24000
Type_of_Source_Media: online
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 2003
Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: NRCS5
Source_Contribution: source used to apply revisions
Source_Information:
Source_Citation:
Citation_Information:
Originator:
U.S. Department of Agriculture,
Natural Resources Conservation Service
Publication_Date: unpublished material
Title:
MrSID compressed image for Lewis and Clark County Area,
Montana
Geospatial_Data_Presentation_Form: map
Source_Scale_Denominator: 24000
Type_of_Source_Media: CD-ROM
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 2003
Source_Currentness_Reference: 2003
Source_Citation_Abbreviation: NRCS6
Source_Contribution: NAD83 ortho imagery used for quality control
Source_Information:
Source_Citation:
Citation_Information:
Originator:
U.S. Department of Agriculture,
Natural Resources Conservation Service
Publication_Date: unpublished material
Title:
ARC INTERCHANGE files for the survey of Lewis and Clark
County Area, Montana
Geospatial_Data_Presentation_Form: map
Source_Scale_Denominator: 24000
Type_of_Source_Media: CD-ROM
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 2003
Source_Currentness_Reference: 2003
Source_Citation_Abbreviation: NRCS7
Source_Contribution:
digital information containing area and special
soil features for evaluation for SSURGO
Source Information:
Citation Information:
  Originator:
    U.S. Department of Agriculture, Natural Resources Conservation Service
  Publication Date: 2003
  Title: National Soil Information System (NASIS) data base
  Geospatial Data Presentation Form: unknown
  Source Scale Denominator: 24000
  Type of Source Media: database
  Source Time Period of Content:
  Time Period Information:
    Single Date/Time:
      Calendar Date: 2003
  Source Currentness Reference: publication date
  Source Citation Abbreviation: NASIS
  Source Contribution: attribute (tabular) information

Process Step:
  Process Description:
    Field procedures for the second order soil survey included plotting of soil boundaries determined by field observation and by interpretation of remotely sensed data. Boundaries were verified at closely spaced intervals, and the soils in each delineation were identified by traversing and transecting the landscape. Soil scientists described and sampled the soils, analyzed samples in the laboratory, and statistically analyzed the data. The classification and map unit names were finalized at the final correlation in 1992.
  Source Used Citation Abbreviation: USGS1
  Process Date: 1997

Process Step:
  Process Description:
    Map compilation was accomplished by transferring soil delineations, special soil features and map unit labels from the quad centered photography to stable-base orthophotos. Four control points corresponding to the four corners of the 7.5 minute orthophotos were used during data collection onto the annotated overlays. Materials necessary for digitizing and certification were sent to the Montana Digitizing Unit in Bozeman, Montana.
  Source Used Citation Abbreviation: USGS1, USGS2, USGS3, NRCS1
  Process Date: 2000

Process Step:
  Process Description:
    The annotated overlays were scanned on an Anatek Eagle 4050 scanner at 300 dots per inch at Midwest Graphics in Kenosha, Wisconsin. The LT4X, Version 4.11 maps were created in North American Datum of 1927 by cartographic technicians at the Montana Digitizing Unit in Bozeman, Montana. Four control points corresponding to the 7.5 minute quadrangle were used during data collection. Raster editing and conversion, vector editing, labeling, and edge matching were accomplished. The special soil features were manually digitized on screen in LT4X, Version 4.11. The cultural boundaries were manually digitized from the 7.5 minute topographic quadrangles. Plots were generated of the entire soil survey area, and author errors were noted and sent to the state for edits.
    Soil scientists on staff at the Natural Resources Conservation

Source Information:
Citation Information:
  Originator:
    U.S. Department of Agriculture, Natural Resources Conservation Service
  Publication Date: 2003
  Title: National Soil Information System (NASIS) data base
  Geospatial Data Presentation Form: unknown
  Source Scale Denominator: 24000
  Type of Source Media: database
  Source Time Period of Content:
  Time Period Information:
    Single Date/Time:
      Calendar Date: 2003
  Source Currentness Reference: publication date
  Source Citation Abbreviation: NASIS
  Source Contribution: attribute (tabular) information

Process Step:
  Process Description:
    Field procedures for the second order soil survey included plotting of soil boundaries determined by field observation and by interpretation of remotely sensed data. Boundaries were verified at closely spaced intervals, and the soils in each delineation were identified by traversing and transecting the landscape. Soil scientists described and sampled the soils, analyzed samples in the laboratory, and statistically analyzed the data. The classification and map unit names were finalized at the final correlation in 1992.
  Source Used Citation Abbreviation: USGS1
  Process Date: 1997

Process Step:
  Process Description:
    Map compilation was accomplished by transferring soil delineations, special soil features and map unit labels from the quad centered photography to stable-base orthophotos. Four control points corresponding to the four corners of the 7.5 minute orthophotos were used during data collection onto the annotated overlays. Materials necessary for digitizing and certification were sent to the Montana Digitizing Unit in Bozeman, Montana.
  Source Used Citation Abbreviation: USGS1, USGS2, USGS3, NRCS1
  Process Date: 2000

Process Step:
  Process Description:
    The annotated overlays were scanned on an Anatek Eagle 4050 scanner at 300 dots per inch at Midwest Graphics in Kenosha, Wisconsin. The LT4X, Version 4.11 maps were created in North American Datum of 1927 by cartographic technicians at the Montana Digitizing Unit in Bozeman, Montana. Four control points corresponding to the 7.5 minute quadrangle were used during data collection. Raster editing and conversion, vector editing, labeling, and edge matching were accomplished. The special soil features were manually digitized on screen in LT4X, Version 4.11. The cultural boundaries were manually digitized from the 7.5 minute topographic quadrangles. Plots were generated of the entire soil survey area, and author errors were noted and sent to the state for edits.
    Soil scientists on staff at the Natural Resources Conservation
Service state office in Bozeman, Montana completed quality control routines. The soil scientist edits were digitally applied in LT4X, Version 4.11. New plots were generated of ten percent of the soil survey area and sent to the Major Land Resource Area in Bozeman, Montana for a digitizing review. Digital line graphs, optional format (DLG-3) files were written using export area_SSRGO and export spec_SSRGO options in LT4X.

Source_Used_Citation_Abbreviation: USGS1, USGS2, USGS3, USGS4, NRCS1
Process_Date: 2000

Process_Description:
The DLG DOC and TAB directories were imported into ARC/INFO, Version 7.21 by certification staff at the Montana Digitizing Unit. ARCEdit was used to correct node and label mismatches, pseudo nodes and to remove extra vertices. New DLG-3's were written. The data were forwarded to the National Cartography and Geospatial Center in Ft. Worth, Texas for archiving and distribution.

Source_Used_Citation_Abbreviation: NRCS1, NRCS2, NRCS4
Process_Date: 2000

Process_Description:
The Map Unit Interpretations Record data base was developed by Natural Resources Conservation Service soil scientists according to national standards.

Source_Used_Citation_Abbreviation: USGS1
Process_Date: 1996

Process_Description:
The online SSURGO data were imported to ARC/INFO, Version 7.2.1 at the Natural Resources Conservation Service, Montana Digitizing Unit. The SSURGO data were processed through revised evaluation program macros dated October 1998. ARCEdit was used to join to adjacent survey boundaries. Minor codes were renamed to link spatial data map unit labels to the National Soil Information System data base. New DLG-3's were written. The data were forwarded to the National Cartography and Geospatial Center in Ft. Worth, Texas for archiving and distribution.

Source_Used_Citation_Abbreviation: NRCS3
Process_Date: 2002

Process_Description:
The National Soil Information System data base was developed by Natural Resources Conservation Service soil scientists according to national standards. A map unit label M-W (miscellaneous water) was added to the NASIS tabular data.

Source_Used_Citation_Abbreviation: USGS1
Process_Date: 2002

Process_Description:
The SSURGO survey-wide coverages and MrSID compressed imagery were imported to in ARC 8.3 ArcMap by a soil scientist on staff at the Natural Resources Conservation Service state office. Topology tools were used to revise temporal areas. Small water areas were considered for special spot features labeled WAT. The data were compared to the NASIS tabular information. ARC INTERCHANGE files were written, then forwarded to certification staff at the Montana Digitizing Unit for verification for SSURGO.
Source_Used_Citation_Abbreviation: NRCS4, NRCS5, NRCS6, NRCS7  
Process_Date: 2003  
Process_Description:  
The ARC INTERCHANGE files and NASIS information were imported to ARC/INFO, Version 8.2 by certification staff at the Montana Digitizing Unit. The data were processed through evaluation macros dated June 2003. Boundaries were validated to adjacent soil survey areas. The data were forwarded to the National Cartography and Geospatial Center in Ft. Worth, Texas for archiving and distribution.
Source_Used_Citation_Abbreviation: NRCS4, NRCS7  
Process_Date: 2003  
Process_Description:  
The National Soil Information System data base was developed by Natural Resources Conservation Service soil scientists according to national standards. A map unit label M-W (miscellaneous water) was added to the NASIS tabular data.
Source_Used_Citation_Abbreviation: USGS1  
Process_Date: 2003  
Process_Description:  
The Natural Resources Conservation Service State Soil Scientist or delegate, upon completion of data quality verification, determined that the tabular data should be released for official use. A selected set of map units and components in the soil survey legend was copied to a staging database, and rating values for selected interpretations were generated. The list of selected interpretations is stored in the database table named sainterp.
Source_Used_Citation_Abbreviation: NASIS  
Process_Date: 20040115  
Process_Description:  
The Natural Resources Conservation Service State Soil Scientist or delegate verified that the labels on the digitized soil map units link to map units in the tabular database, and certified the joined data sets for release to the Soil Data Warehouse. A system assigned version number and date stamp were added and the data were copied to the data warehouse. The tabular data for the map units and components were extracted from the data warehouse and reformatted into the soil data delivery data model, then stored in the Soil Data Mart. The spatial data were copied to the Soil Data Mart without change.
Source_Used_Citation_Abbreviation: NASIS  
Process_Date: 20040115  
Process_Description:  
The Natural Resources Conservation Service State Soil Scientist or delegate, upon completion of data quality verification, determined that the tabular data should be released for official use. A selected set of map units and components in the soil survey legend was copied to a staging database, and rating values for selected interpretations were generated. The list of selected interpretations is stored in the database table named sainterp.
Source_Used_Citation_Abbreviation: NASIS  
Process_Date: 20070125  
Process_Description:  


The Natural Resources Conservation Service State Soil Scientist or delegate verified that the labels on the digitized soil map units link to map units in the tabular database, and certified the joined data sets for release to the Soil Data Warehouse. A system assigned version number and date stamp were added and the data were copied to the data warehouse. The tabular data for the map units and components were extracted from the data warehouse and reformatted into the soil data delivery data model, then stored in the Soil Data Mart. The spatial data were copied to the Soil Data Mart without change.

Note: 1/25/07 - The following edit tasks performed:
Component Name set to proper case
Strip "and similar soils" from comp name
Set and validate map unit name case
Flag minor components as "NO"
Ensure veg. production for all soil components

At component level (those named as series only)...
Populate Albedo
...horizon structure
...slope shape
...landform
...parent material
...horizon designations
...Representative textures
...Kf below the surface
...Ran all validations and resolve errors.
Source_Used_Citation_Abbreviation: NASIS
Process_Date: 20070126
Process_Type: The Natural Resources Conservation Service State Soil Scientist or delegate, generated new rating values for selected interpretations using current interpretation rules from the NASIS database. 5/2/07 update includes refreshed Montana Modeled non-irrigated small grain yields.
Source_Used_Citation_Abbreviation: NASIS
Process_Type: The tabular data were extracted from the data mart without change. The spatial data's coordinate system was transformed to UTM Zone 12, Northern Hemisphere (NAD 83) using ESRI ArcObjects 8.3 "ConvertFeatureClass" and exported to an ESRI shapefile.
Source_Used_Citation_Abbreviation: NASIS
Process_Type: Metadata imported.
Source_Used_Citation_Abbreviation: H:\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\soil_mt630\soil_mt630\soil_metadata_mt630.xml
Process_Type: Dataset copied.
Source_Used_Citation_Abbreviation: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_County.gdb
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS Terms_Description:
SDTS Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: 0
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 12
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -111.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
  Planar_Coordinate_Encoding_Method: coordinate pair
  Coordinate_Representation:
    Abscissa_Resolution: 0.000256
    Ordinate_Resolution: 0.000256
  Planar_Distance_Units: meters
Geodetic_Model:
  Horizontal_Datum_Name: North American Datum of 1983
  Ellipsoid_Name: Geodetic Reference System 80
  Semi-major_Axis: 6378137.000000
  Denominator_of_Flattening_Ratio: 298.257222
Vertical_Coordinate_System_Definition:
  Altitude_System_Definition:
    Altitude_Resolution: 0.000100
    Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates
Entity_and_Attribute_Information:
Detailed_Description:
  Entity_Type:
    Entity_Type_Label: Special Soil Features
    Entity_Type_Definition:
      Special Soil Features represent soil, nonsoil, or landform features that are too small to be digitized as soil delineations (area features).
    Entity_Type_Definition_Source:
  Attribute:
    Attribute_Label: OBJECTID
    Attribute_Definition: Internal feature number.
    Attribute_Definition_Source: ESRI
    Attribute_Domain_Values:
      Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
  Attribute:
    Attribute_Label: Shape
    Attribute_Definition: Feature geometry.
    Attribute_Definition_Source: ESRI
    Attribute_Domain_Values:
      Unrepresentable_Domain: Coordinates defining the features.
  Attribute:
    Attribute_Label: AREASYMBOL
  Attribute:
    Attribute_Label: SPATIALVER
  Attribute:
    Attribute_Label: MUSYM
  Attribute:
    Attribute_Label: MUKEY
  Attribute:
    Attribute_Label: Shape_Length
    Attribute_Definition: Length of feature in internal units.
    Attribute_Definition_Source: ESRI
    Attribute_Domain_Values:
      Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute_Label: Shape_Area
Attribute_Definition: Area of feature in internal units squared.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
  Unrepresentable_Domain: Positive real numbers that are automatically generated.
Overview_Description:
  Entity_and_Attribute_Overview:
    Map Unit Delineations are closed polygons that may be dominated by a single soil or nonsoil component plus allowable similar or dissimilar soils, or they can be geographic mixtures of groups of soils or soils and nonsoil areas.

    The map unit symbol uniquely identifies each closed delineation map unit. Each symbol corresponds to a map unit name. The map unit key is used to link to information in the National Soil Information System tables.

    Map Unit Delineations are described by the National Soil Information System database. This attribute database gives the proportionate extent of the component soils and the properties for each soil. The database contains both estimated and measured data on the physical and chemical soil properties and soil interpretations for engineering, water management, recreation, agronomic, woodland, range, and wildlife uses of the soil.

    The National Soil Information System database contains static metadata. It documents the data structure and includes such information as what tables, columns, indexes, and relationships are defined as well as a variety of attributes of each of these database objects. Attributes include table and column descriptions and detailed domain information.

    The National Soil Information System database also contains a distribution metadata. It records the criteria used for selecting map units and components for inclusion in the set of distributed data.

    Special features are described in the feature table. It includes a feature label, feature name, and feature description for each special and ad hoc feature in the survey area.
Entity_and_Attribute_Detail_Citation:


Distribution_Information:
  Distributor:
  Contact_Information:
    Contact_Organization_Primary:
Contact_Organization:
U.S. Department of Agriculture, Natural
Resources Conservation Service, National
Cartography and Geospatial Center

Contact_Address:
Address_Type: mailing address
Address: P.O. Box 6567
City: Fort Worth
State_or_Province: Texas
Postal_Code: 76115
Contact_Voice_Telephone: 800 672 5559
Contact_Facsimile_Telephone: 817 509 3469

Resource_Description: Lewis and Clark County Area, Montana SSURGO

Distribution_Liability:
Although these data have been processed successfully on a computer
system at the U.S. Department of Agriculture, no warranty expressed
or implied is made by the Agency regarding the utility of the data
on any other system, nor shall the act of distribution constitute
any such warranty. The U.S. Department of Agriculture will warrant
the delivery of this product in computer readable format, and will
offer appropriate adjustment of credit when the product is determined
unreadable by correctly adjusted computer input peripherals, or
when the physical medium is delivered in damaged condition. Request
for adjustment of credit must be made within 90 days from the date
of this shipment from the ordering site.

The U.S. Department of Agriculture, nor any of its agencies are
liable for misuse of the data, for damage, for transmission of
viruses, or for computer contamination through the distribution of
these data sets. The U.S. Department of Agriculture (USDA) prohibits
discrimination in all its programs and activities on the basis of race,
color, national origin, sex, religion, age, disability, political
beliefs, sexual orientation, or marital or family status. (Not all
prohibited bases apply to all programs.)

Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: ArcView shapefile
Format_Information_Content: spatial
File_Decompression_Technique: WinZip or equivalent
Transfer_Size: 28.4

Digital_Transfer_Option:

Online_Option:
Computer_Contact_Information:
Network_Address:
Network_Resource_Name: URL:http://SoilDataMart.nrcs.usda.gov/
Access_Instructions:
Select desired survey area at above Internet Web site. An email
address is required for receipt of instructions on retrieval via
anonymous FTP. Anticipate a delay between submission of request
at Web site and receipt of email message.

Digital_Form:
Digital_Transfer_Information:
Format_Name: ARC/INFO coverage
Format_Information_Content: spatial
File_Decompression_Technique: WinZip or equivalent
Transfer_Size: 28.4

Digital_Transfer_Option:
Online Option:
  Computer Contact Information:
    Network Address:
      Network Resource Name: URL:http://SoilDataMart.nrcs.usda.gov/
  Access Instructions:
    Select desired survey area at above Internet Web site. An email
    address is required for receipt of instructions on retrieval via
    anonymous FTP. Anticipate a delay between submission of request
    at Web site and receipt of email message.

Digital Form:
  Digital Transfer Information:
    Format Name: ARC/INFO interchange file
    Format Information Content: spatial
    File Decompression Technique: WinZip or equivalent
    Transfer Size: 28.4

Digital Transfer Option:
  Online Option:
    Computer Contact Information:
      Network Address:
        Network Resource Name: URL:http://SoilDataMart.nrcs.usda.gov/
    Access Instructions:
      Select desired survey area at above Internet Web site. An email
      address is required for receipt of instructions on retrieval via
      anonymous FTP. Anticipate a delay between submission of request
      at Web site and receipt of email message.

Digital Form:
  Digital Transfer Information:
    Format Name: ASCII
    Format Information Content: keys and attributes
    File Decompression Technique: WinZip or equivalent
    Transfer Size: 90.6

Digital Transfer Option:
  Online Option:
    Computer Contact Information:
      Network Address:
        Network Resource Name: URL:http://SoilDataMart.nrcs.usda.gov/
    Access Instructions:
      Select desired survey area at above Internet Web site. An email
      address is required for receipt of instructions on retrieval via
      anonymous FTP. Anticipate a delay between submission of request
      at Web site and receipt of email message.

Fees:

  There is currently no direct charge for requesting data or for
  retrieval via FTP.

Ordering Instructions:

  Visit the above mentioned Internet Web Site, select state or
  territory, then select individual soil survey area of interest.
  Spatial line data and locations of special feature symbols are in
  ESRI ArcGIS (ArcView, ArcInfo) shapefile, coverage and interchange
  (i.e., export) formats. The National Soil Information System
  attribute soil data are available in variable length, pipe
  delimited, ASCII file format.

  Turnaround: Typically within four hours

Metadata Reference Information:

  Metadata Date: 20071121
  Metadata Contact:
    Contact Information:
      Contact Organization Primary:
Contact_Organization: U.S. Department of Agriculture, Natural Resources Conservation Service
Contact_Person: REQUIRED: The person responsible for the metadata information.
Contact_Position: State Soil Scientist
Contact_Address:
  Address_Type: mailing address
  Address: ...not supplied...
  City: Bozeman
  State_orProvince: MT
  Postal_Code: 59715
Contact_Voice_Telephone: 406-587-6818
Contact_Electronic_Mail_Address: charles.gordon@mt.usda.gov
Metadata_Standard_Name: Content Standard for Digital Geospatial Metadata
Metadata_Time_Convention: local time

**Study Area Extent - Raster**

Identification_Information:
Citation:
  Citation_Information:
    Originator: Trihydro Corporation
    Publication_Date: 20080501
    Title: Study Area Extent
    Geospatial_Data_Presentation_Form: raster digital data
    Online_Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Grids\studyarea_ext
Description:
  Abstract: These data represent a raster version of the Extented Study Area boundary.
  Purpose: These data are intended to be used as an analysis mask, ensuring that cell corners match and that only cells within the study area are analyzed.
Time_Period_of_Content:
  Time_Period_Information:
    Single_Date/Time:
      Calendar_Date: 20080501
Currentness_Reference: publication date
Status:
  Progress: In work
  Maintenance_and_Update_Frequency: None planned
Spatial_Domain:
  Bounding_Coordinates:
    West_Bounding_Coordinate: -112.089922
    East_Bounding_Coordinate: -111.888999
    North_Bounding_Coordinate: 46.725313
    South_Bounding_Coordinate: 46.565163
Keywords:
  Theme:
    Theme_Keyword_Thesaurus: None
    Theme_Keyword: Boundary
Place:
  Place_Keyword: Helena
  Place_Keyword: Helena Valley
Access_Constraints: None
Use_Constraints: None
Point_of_Contact:
  Contact_Information:
    Contact_Organization_Primary:
      Contact_Organization: Trihydro Corporation
      Contact_Position: GIS Analyst
      Contact_Address:
        Address_Type: mailing and physical address
Address: 1252 Commerce Dr
City: Laramie
State_or_Province: WY
Postal_Code: 82070
Contact_Voice_Telephone: 307 745-7474
Contact_Facsimile_Telephone: 307 745-7729
Contact_Electronic_Mail_Address: GISSupport@trihydro.com
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350
Data_Quality_Information:
  Lineage:
    Process_Step:
      Process_Description: Dataset copied.
      Source_Used_Citation_Abbreviation: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Grids_Working\studyarea_ext
    Process_Step:
      Process_Description: Converted the Extended Study Area vector boundary to this raster using Spatial Analyst's Features to Raster tool.
Spatial_Data_Organization_Information:
  Direct_Spatial_Reference_Method: Raster
  Raster_Object_Information:
    Raster_Object_Type: Grid Cell
    Row_Count: 1733
    Column_Count: 1483
    Vertical_Count: 1
Spatial_Reference_Information:
  Horizontal_Coordinate_System_Definition:
    Planar:
      Map_Projection:
        Map_Projection_Name: Lambert Conformal Conic
        Lambert_Conformal_Conic:
          Standard_Parallel: 45.000000
          Standard_Parallel: 49.000000
          Longitude_of_Central_Meridian: -109.500000
          Latitude_of_Projection_Origin: 44.250000
          False_Easting: 600000.000000
          False_Northing: 0.000000
        Planar_Coordinate_Encoding_Method: row and column
        Coordinate_Representation:
          Abscissa_Resolution: 10.000000
          Ordinate_Resolution: 10.000000
        Planar_Distance_Units: meters
      Geodetic_Model:
        Horizontal_Datum_Name: D North American 1983_HARN
        Ellipsoid_Name: Geodetic Reference System 80
        Semi-major_Axis: 6378137.000000
        Denominator_of_Flattening_Ratio: 298.257222
  Distribution_Information:
    Resource_Description: Downloadable Data
    Standard_Order_Process:
      Digital_Form:
        Digital_Transfer_Information:
          Transfer_Size: 10.207
Metadata_Reference_Information:
  Metadata_Date: 20080420
  Metadata_Contact:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: Trihydro Corporation
        Contact_Person: Brian Robeson
Contact Position: GIS Analyst
Contact Address:
  Address Type: mailing and physical address
  Address: 1252 Commerce Dr
  City: Laramie
  State or Province: WY
  Postal Code: 82070
  Contact Voice Telephone: 307 745-7474
  Contact Facsimile Telephone: 307 745-7729
  Contact Electronic Mail Address: GISSupport@trihydro.com
Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Time Convention: local time
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
D.25  LEWIS & CLARK COUNTY ZONING

Identification Information:
Citation:
Citation Information:
  Originator: REQUIRED: The name of an organization or individual that developed the data set.
  Publication Date: REQUIRED: The date when the data set is published or otherwise made available for release.
  Title: LC_county_zoning
  Geospatial Data Presentation Form: vector digital data
  Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\Lewis_Clark_FINAL.gdb

Description:
  Abstract: Lewis & Clark County Zoning areas
  Purpose: Special Zoning district boundaries within the County
  Supplemental Information:
    *IMPORTANT* These data are NOT the official record *IMPORTANT*
    The data contained herein are NOT the official records and may be inaccurate and incomplete! By using this GIS information, the user acknowledges and accepts full responsibility for verifying the correctness and the completeness of any of the information provided here.

The City of Helena and Lewis & Clark County do not warrant, either explicit or implied, the completeness or accuracy of the information provided. Additionally, the city and county accept no liability of any kind, including but not limited to any losses or damages that may result from the wrongful reliance on this information, and the user also accepts full responsibility for any subsequent use or reuse of the data, and shall be solely responsible for results or any damages which may result from the use of any of these data.

Time Period of Content:
  Time Period Information:
    Single Date/Time:
      Calendar Date: REQUIRED: The year (and optionally month, or month and day) for which the data set corresponds to the ground.
      Currentness Reference: REQUIRED: The basis on which the time period of content information is determined.
      Status:
        Progress: Complete
        Maintenance and Update Frequency: As needed
      Spatial Domain:
        Bounding Coordinates:
          West Bounding Coordinate: -112.694393
          East Bounding Coordinate: -111.709170
          North Bounding Coordinate: 46.976592
          South Bounding Coordinate: 46.511992
      Keywords:
        Theme:
        Theme Keyword Thesaurus: REQUIRED: Reference to a formally registered thesaurus or a similar authoritative source of theme keywords.
        Theme Keyword: Zoning
      Access Constraints: This data set is public record and subject to public right to know laws.
      Use Constraints:
        USES PROHIBITED: The following uses are prohibited except with the express written consent of the City of Helena and Lewis & Clark County:
          1. Giving the Data to third parties or using the Data for the benefit of third parties except authorized agents of the Licensee; 2. Making copies or reproducing the Data, or any part thereof, except for making backup and archival copies solely for the Licensee; 3. Selling, distributing, loaning, or offering for use of the Data, in whole or in part, to others; and 4. Reproducing hardcopy products as provided by the Owner with the intent to sell for a profit.
      Point of Contact:
      Contact Information:
        Contact Organization Primary:
        Contact Organization: Lewis & Clark County / City of Helena
        Contact Position: GIS Center
        Contact Address:
        Address Type: mailing and physical address
        Address: 316 N. Park Ave., Rm 147
City: Helena  
State_or_Province: MT  
Postal_Code: 59623  
Country: USA  
Contact_Voice_Telephone: 406-447-8389  
Contact_Voice_Telephone: 406-447-8367  
Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us  
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350  
Spatial_Data_Organization_Information:  
Direct_Spatial_Reference_Method: Vector  
Point_and_Vector_Object_Information:  
SDTS_Terms_Description:  
SDTS_Point_and_Vector_Object_Type: G-polygon  
Point_and_Vector_Object_Count: 0  
Spatial_Reference_Information:  
Horizontal_Coordinate_System_Definition:  
Planar:  
Map_Projection:  
Map_Projection_Name: Lambert Conformal Conic  
Lambert_Conformal_Conic:  
Standard_Parallel: 45.000000  
Standard_Parallel: 49.000000  
Longitude_of_Central_Meridian: -109.500000  
Latitude_of_Projection_Origin: 44.250000  
False_Easting: 600000.000000  
False_Northing: 0.000000  
Planar_Coordinate_Information:  
Planar_Coordinate_Encoding_Method: coordinate pair  
Coordinate_Representation:  
Abscissa_Resolution: 0.000100  
Ordinate_Resolution: 0.000100  
Planar_Distance_Units: meters  
Geodetic_Model:  
Horizontal_Datum_Name: D_North_American_1983_HARN  
Ellipsoid_Name: Geodetic Reference System 80  
Semi-major_Axis: 6378137.000000  
Denominator_of_Flattening_Ratio: 298.257222  
Vertical_Coordinate_System_Definition:  
Altitude_System_Definition:  
Altitude_Resolution: 0.000100  
Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates  
Entity_and_Attribute_Information:  
Detailed_Description:  
Entity_Type:  
Entity_Type_Label: LC_county_zoning  
Attribute:  
Attribute_Label: len_1  
Attribute:  
Attribute_Label: ZONENAME  
Attribute_Definition: District Name  
Attribute_Definition_Source: County Planning  
Attribute:  
Attribute_Label: ZONETYPE  
Attribute_Definition: Specific sub-zoning type w/in area  
Attribute_Definition_Source: County Planning  
Attribute:  
Attribute_Label: EDITOR  
Attribute_Definition: GIS editor
Attribute:
Attribute_Label: LASTEDIT
Attribute_Definition: Last GIS edit
Attribute:
Attribute_Label: SHAPE
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.
Attribute:
Attribute_Label: CREATED
Attribute_Definition: Date GIS created
Attribute:
Attribute_Label: AREA
Attribute_Definition: Area of feature in internal units squared.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute:
Attribute_Label: LEN
Attribute_Definition: Length of feature in internal units.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute:
Attribute_Label: OBJECTID
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: Shape_Length
Attribute_Definition: Length of feature in internal units.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.
Attribute:
Attribute_Label: area_1
Attribute_Definition: Area of feature in internal units squared.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Positive real numbers that are automatically generated.
Distribution_Information:
Resource_Description: Downloadable Data
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Transfer_Size: 0.000
Metadata_Reference_Information:
Metadata_Date: 20080307
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Lewis & Clark County / City of Helena
Contact_Person: GIS staff
Contact_Position: GIS Center
Contact_Address:
Address_Type: REQUIRED: The mailing and/or physical address for the organization or individual.
City: REQUIRED: The city of the address.
State_or_Province: REQUIRED: The state or province of the address.
Postal_Code: REQUIRED: The ZIP or other postal code of the address.
Contact_Voice_Telephone: 406-447-8689
Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time
Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile
D.26 DEPTH TO WATER RATING

Identification Information:
Citation:
   Citation Information:
      Originator: Trihydro Corporation
      Publication_Date: 20080501
      Title: Depth to Water Rating
      Geospatial_Data_Presentation_Form: raster digital data
      Online_Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Analysis_output\dtw_rating

Description:
   Abstract: Depth to Water is an important factor contributing to aquifer sensitivity. These data combine wells gaging static water levels with streams, lakes, and perennial wetlands to model depth to water in the study area.
   Purpose: This layer is required input in the aquifer sensitivity model (modified DRASTIC).

Time_Period_of_Content:
   Time_Period_Information:
      Single_Date/Time:
         Calendar_Date: 20080501
   Currentness_Reference: publication date

Status:
   Progress: Complete
   Maintenance_and_Update_Frequency: Irregular

Spatial_Domain:
   Bounding_Coordinates:
      West_Bounding_Coordinate: -112.090493
      East_Bounding_Coordinate: -111.888379
      North_Bounding_Coordinate: 46.725261
      South_Bounding_Coordinate: 46.564726

Keywords:
   Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Water
      Theme_Keyword: Hydrology
      Theme_Keyword: Ground Water
      Theme_Keyword: Aquifer

Place:
   Place_Keyword: United States
   Place_Keyword: Montana
   Place_Keyword: Lewis & Clark County
   Place_Keyword: Helena
   Place_Keyword: Helena Valley

Access_Constraints: None
Use_Constraints: None

Point_of_Contact:
   Contact_Information:
      Contact_Organization_Primary:
         Contact_Organization: Trihydro Corporation
         Contact_Position: GIS Analyst
         Contact_Address:
            Address_Type: mailing and physical address
            Address: 1252 Commerce Dr.
            City: Laramie
            State_or_Province: WY
            Postal_Code: 82070
         Contact_Voice_Telephone: 307 745-7474
         Contact_Facsimile_Telephone: 307 745-7729
         Contact_Electronic_Mail_Address: GISsupport@trihydro.com
164 of 191

Native Data Set Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data Quality Information:

Attribute Accuracy:
  Attribute Accuracy Report: Relies on source information.
Logical Consistency Report: These data are topologically consistent.
Completeness Report: These data are complete for the study area.

Positional Accuracy:
  Horizontal Positional Accuracy:
  Horizontal Positional Accuracy Report: Relies on source information.

Lineage:

Source Information:
  Source Citation:
    Citation Information:
      Originator: GWIC
      Publication Date: 2007
      Title: Montana Groundwater Information Center Water Well Data
    Source Scale Denominator: 24000
  Type of Source Media: vector digital data
  Source Time Period of Content:
    Single Date/Time:
      Calendar Date: 2007
  Source Currentness Reference: ground condition
  Source Citation Abbreviation: GWIC wells - 2007
  Source Contribution: Provided minimum depth to static water levels from gaging wells in the study area.

Source Information:
  Source Citation:
    Citation Information:
      Originator: USGS
      Publication Date: 2004
      Title: National Hydrography Dataset
    Source Scale Denominator: 24000
  Type of Source Media: vector digital data
  Source Time Period of Content:
    Single Date/Time:
      Calendar Date: 2004
  Source Currentness Reference: publication date
  Source Citation Abbreviation: NHD streams
  Source Contribution: Perennial stream information.

Source Information:
  Source Citation:
    Citation Information:
      Originator: USGS
      Publication Date: 2004
      Title: National Hydrography Dataset
    Source Scale Denominator: 24000
  Type of Source Media: vector digital data
  Source Time Period of Content:
    Single Date/Time:
      Calendar Date: 2004
  Source Currentness Reference: publication date
  Source Citation Abbreviation: NHD lakes
  Source Contribution: Perennial lake information.
Originator: USFWS
Publication_Date: 200707
Title: Helena Valley Montana National Wetlands Inventory
Source_Scale_Denominator: 24000
Type_of_Source_Media: vector digital data
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 200707
Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: NWI
Source_Contribution: Perennial wetlands information.

Process_Step:
Process_Description: Buffered streams and lakes by 50 meters.

Process_Step:
Process_Description: Merged buffered streams, lakes, and wetlands.

Process_Step:
Process_Description: Converted buffered water data to a raster using Feature to Raster in Spatial Analyst.

Process_Step:
Process_Description: Set values in the resulting raster using the Raster Calculator expression: `con ( isnull([water_grid]),1,0)`.

This sets all null values to 1 and all non-null values to 0. This is important when the interpolated static water level grid is multiplied by the perennial water grid.

Process_Step:
Process_Description: A static water level grid is created from the GWIC wells by using IDW interpolation with a variable search radius, a power of 2, and an output cell size of 10.

Process_Step:
Process_Description: The static water level grid is multiplied by the perennial water grid using Spatial Analyst's Raster Calculator.

Process_Description: The final Depth to Water Grid is rated using the following Raster Calculator expression:

\[
\text{con } ([\text{DTW}\_\text{Final}] < 5, 10, \text{con}([\text{DTW}\_\text{Final}] < 30,(10.6 - ([\text{DTW}\_\text{Final}] * 0.12)), \text{con}([\text{DTW}\_\text{Final}] < 100,(23.94 - (ln([\text{DTW}\_\text{Final}]) * 4.98)), 1))
\]

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: 310

Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 1737
Column_Count: 1492
Vertical_Count: 1

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Lambert Conformal Conic
Lambert_Conformal_Conic:
Standard_Parallel: 45.000000
Standard_Parallel: 49.000000
Longitude_of_Central_Meridian: -109.500000
Latitude_of_Projection-Origin: 44.250000
False_Easting: 600000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
  Planar_Coordinate_Encoding_Method: row and column
  Coordinate_Representation:
    Abscissa_Resolution: 10.000000
    Ordinate_Resolution: 10.000000
  Planar_Distance_Units: meters

Geodetic_Model:
  Horizontal_Datum_Name: D_North_American_1983_HARN
  Ellipsoid_Name: Geodetic Reference System 80
  Semi-major_Axis: 6378137.000000
  Denominator_of_Flattening_Ratio: 298.257222

Vertical_Coordinate_System_Definition:
  Altitude_System_Definition:
    Altitude_Resolution: 0.000100
    Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates

Entity_and_Attribute_Information:
  Detailed_Description:
    Entity_Type:
      Entity_Type_Label: DTW

Distribution_Information:
  Distributor:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: City of Helena and Lewis & Clark County
        Contact_Position: GIS Center
        Contact_Address:
          Address_Type: physical address
          Address: 316 N. Park Avenue, Room 147
          City: Helena
          State_or_Province: MT
          Postal_Code: 59624
        Contact_Voice_Telephone: 406-447-8367
        Contact_Facsimile_Telephone: 406-447-8386
        Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us

  Resource_Description: Downloadable Data

Standard_Order_Process:
  Digital_Form:
    Digital_Transfer_Information:
      Transfer_Size: 10.242

Metadata_Reference_Information:
  Metadata_Date: 20080421

Metadata_Contact:
  Contact_Information:
    Contact_Organization_Primary:
      Contact_Organization: Trihydro Corporation
      Contact_Person: Brian Robeson
      Contact_Position: GIS Analyst
      Contact_Address:
        Address_Type: mailing and physical address
        Address: 1252 Commerce Dr.
        City: Laramie
        State_or_Province: WY
        Postal_Code: 82070
      Contact_Voice_Telephone: 307 745-7474
      Contact_Facsimile_Telephone: 307 745-7729
      Contact_Electronic_Mail_Address: GISSupport@trihydro.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time
Metadata_Extensions:
  Online_Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile_Name: ESRI Metadata Profile
D.27 GEOHYDROLOGIC SETTING - RATING

Identification_Information:
Citation:
  Citation_Information:
    Originator: Trihydro Corporation
    Publication_Date: 20080501
    Title: Geohydrologic Setting - Rating
    Geospatial_Data_Presentation_Form: raster digital data
    Online_Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Analysis_output\Geohydro_rate

Description:
Abstract: The Geohydrologic layer represents the hydraulic character of the uppermost aquifer. This layer combines the aquifer media and saturated hydraulic conductivity layers of the DRASTIC model to produce a comprehensive rating system of the aquifer's ability to transmit and store water.
Purpose: This layer is required input in the aquifer sensitivity model (modified DRASTIC).
Time_Period_of_Content:
  Time_Period_Information:
    Single_Date/Time:
      Calendar_Date: 20080501
    Currentness_Reference: publication date

Status:
  Progress: Complete
  Maintenance_and_Update_Frequency: Irregular

Spatial_Domain:
  Bounding_Coordinates:
    West_Bounding_Coordinate: -112.089922
    East_Bounding_Coordinate: -111.888999
    North_Bounding_Coordinate: 46.725313
    South_Bounding_Coordinate: 46.565163

Keywords:
  Theme:
    Theme_Keyword_Thesaurus: None
    Theme_Keyword: Geology
    Theme_Keyword: Hydrology
    Theme_Keyword: Ground Water
    Theme_Keyword: Aquifer
    Theme_Keyword: Aquifer Media
    Theme_Keyword: Saturated Hydraulic Conductivity

Place:
  Place_Keyword: United States
  Place_Keyword: Montana
  Place_Keyword: Lewis & Clark County
  Place_Keyword: Helena
  Place_Keyword: Helena Valley

Access_Constraints: None
Use_Constraints: None

Point_of_Contact:
  Contact_Information:
    Contact_Organization_Primary:
      Contact_Organization: Trihydro Corporation
      Contact_Position: GIS Analyst
    Contact_Address:
      Address_Type: mailing and physical address
      Address: 1252 Commerce Dr.
      City: Laramie
      State_or_Province: WY
      Postal_Code: 82070
Contact Voice Telephone: 307 745-7474
Contact Facsimile Telephone: 307 745-7729
Contact Electronic Mail Address: GISSupport@trihydro.com
Native Data Set Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350
Data Quality Information:
  Attribute Accuracy:
    Attribute Accuracy Report: Attributes are accurate at 1:100,000 scale.
  Logical Consistency Report: These data contain no topological errors.
  Completeness Report: These data are complete.
Positional Accuracy:
  Horizontal Positional Accuracy:
    Horizontal Positional Accuracy Report: +/- 50 meters
Lineage:
Source Information:
  Source Citation:
    Citation Information:
      Originator: Mitchell W. Reynolds
      Originator: Theodore R. Brandt
      Publication Date: 2000
      Title: Generalized Bedrock Geologic Map of the Helena Area, West-Central Montana
      Edition: 1
      Series Information:
        Series Name: USGS Water-Resources Investigations Report
        Issue Identification: WRI-00-4212
      Publication Information:
        Publication Place: Denver, CO
        Publisher: US Geological Survey
      Source Scale Denominator: 100000
      Type of Source Media: vector digital data
      Source Time Period of Content:
        Time Period Information:
          Single Date/Time:
            Calendar Date: 2000
      Source Currentness Reference: publication date
      Source Citation Abbreviation: USGS Bedrock Geology
      Source Contribution: Provided bedrock geology.
  Source Information:
    Source Citation:
      Citation Information:
        Originator: Briar, D.W. & Madison, J.P.
        Publication Date: 1992
      Source Scale Denominator: Unknown
      Type of Source Media: vector digital data
      Source Time Period of Content:
        Time Period Information:
          Single Date/Time:
            Calendar Date: 1992
      Source Currentness Reference: publication date
      Source Citation Abbreviation: USGS Surficial Geology
      Source Contribution: Provided surficial geology.
  Process Step:
    Process Description: Unioned surficial and bedrock geology.
    Process Date: 20080402
  Process Step:
    Process Description:
      Added a field in the table called 'ratings' and populated it based on guidance from the project geologist.
Note: The following rating chart combines units from the surficial geologic map and the bedrock geologic map. Mapped surficial geologic units should supersede bedrock units, except for pTb surficial unit, which will be replaced by the ratings of the bedrock geologic map.

<table>
<thead>
<tr>
<th>Surficial Geology Code</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qal</td>
<td>8</td>
</tr>
<tr>
<td>QTp</td>
<td>7</td>
</tr>
<tr>
<td>Tsu</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bedrock Geology Code</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>OGvt</td>
<td>5</td>
</tr>
<tr>
<td>OGs</td>
<td>5</td>
</tr>
<tr>
<td>Kg</td>
<td>5</td>
</tr>
<tr>
<td>Mml</td>
<td>5</td>
</tr>
<tr>
<td>Dtj</td>
<td>5</td>
</tr>
<tr>
<td>Cc</td>
<td>5</td>
</tr>
<tr>
<td>Ccl</td>
<td>5</td>
</tr>
<tr>
<td>Zg</td>
<td>5</td>
</tr>
<tr>
<td>Yss</td>
<td>5</td>
</tr>
<tr>
<td>Yhe</td>
<td>5</td>
</tr>
<tr>
<td>Ys</td>
<td>5</td>
</tr>
<tr>
<td>Yg</td>
<td>5</td>
</tr>
</tbody>
</table>

Process_Description: Dissolved the Geohydrologic Setting Layer based on the 'rating' field.

Process_Description: Converted the dissolved Geohydrologic Setting layer to a raster using the Features to Raster tool in Spatial Analyst.

Direct_Spatial_Reference_Method: Raster
SDTS_Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: 74
Horizontal_Datum_Name: D_North_American_1983_HARN
Ellipsoid_Name: Geodetic Reference System 80
Semi-major Axis: 6378137.000000
Denominator of Flattening Ratio: 298.257222

Vertical Coordinate System Definition:
Altitude System Definition:
Altitude Resolution: 0.000100
Altitude Encoding Method: Explicit elevation coordinate included with horizontal coordinates

Entity and Attribute Information:
Detailed Description:
Entity Type:
Entity Type Label: geohydro_rate.vat
Attribute:
Attribute Label: Rowid
Attribute Definition: Internal feature number.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute Label: VALUE
Attribute:
Attribute Label: COUNT

Distribution Information:
Distributor:
Contact Information:
Contact Organization Primary:
Contact Organization: City of Helena and Lewis & Clark County
Contact Position: GIS Center
Contact Address:
Address Type: physical address
Address: 316 N. Park Avenue, Room 147
City: Helena
State or Province: MT
Postal Code: 59624
Contact Voice Telephone: 406-447-8367
Contact Facsimile Telephone: 406-447-8386
Contact Electronic Mail Address: giscenter@co.lewis-clark.mt.us

Resource Description: Downloadable Data
Standard Order Process:
Digital Form:
Digital Transfer Information:
Transfer Size: 0.114

Metadata Reference Information:
Metadata Date: 20080421
Metadata Contact:
Contact Information:
Contact Organization Primary:
Contact Organization: Trihydro Corporation
Contact Person: Brian Robeson
Contact Position: GIS Analyst
Contact Address:
Address Type: mailing and physical address
Address: 1252 Commerce Dr.
City: Laramie
State or Province: WY
Postal Code: 82070
Contact Voice Telephone: 307 745-7474
Contact Facsimile Telephone: 307 745-7729
Contact Electronic Mail Address: GISSupport@trihydro.com

Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Time Convention: local time
Metadata Extensions:
  Online Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile Name: ESRI Metadata Profile
D.28  AQUIFER RECHARGE - RATING

Identification Information:

Citation:
Originator: Trihydro Corporation
Publication_Date: 20080501
Title: Aquifer Recharge - Rating
Geospatial_Data_Presentation_Form: raster digital data
Online_Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Analysis_output\recharge_rate

Abstract: Recharge to the Helena valley-fill aquifer, which is the primary source for domestic drinking water in the study area, is from several sources which infiltrate through the overlying soil or recharge the aquifer as inflow. The primary sources of aquifer recharge in the valley are from inflow from fractures in the surrounding Pre-Tertiary bedrock and infiltration of streamflow and irrigation water (Briar and Madison, 1992). Recharge to the valley-fill aquifer from inflow through bedrock fractures is not considered in this model layer, only the potential for infiltrating recharge from the surface into the underlying bedrock units.

Purpose: This layer is required input in the aquifer sensitivity model (modified DRASTIC).

Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20080501
Currentness_Reference: publication date

Status:
Progress: Complete
Maintenance_and_Update_Frequency: Irregular

Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -112.089922
East_Bounding_Coordinate: -111.888999
North_Bounding_Coordinate: 46.725313
South_Bounding_Coordinate: 46.565163

Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Aquifer
Theme_Keyword: Recharge
Theme_Keyword: Ground Water

Place:
Place_Keyword: United States
Place_Keyword: Montana
Place_Keyword: Lewis & Clark County
Place_Keyword: Helena
Place_Keyword: Helena Valley
Access_Constraints: None
Use_Constraints: None

Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Trihydro Corporation
Contact_Position: GIS Analyst
Contact_Address:
Address_Type: mailing and physical address
Address: 1252 Commerce Dr.
City: Laramie
State_or_Province: WY
Postal_Code: 82070
Contact_Voice_Telephone: 307 745-7474
Contact Facsimile Telephone: 307 745-7729  
Contact Electronic Mail Address: GISSupport@trihydro.com  

Native Data Set Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350  

Data Quality Information:  
Attribute Accuracy:  
Attribute Accuracy Report: Attributes are as accurate as the source information and the geologist's guidance.  
Logical Consistency Report: There are no topological errors in these data.  
Completeness Report: 100%  
Positional Accuracy:  
Horizontal Positional Accuracy:  
Horizontal Positional Accuracy Report: Based on source data accuracy.  

Lineage:  
Source Information:  
Source Citation:  
Citation Information:  
  Publication Date: 1992  
Source Scale Denominator: Unknown  
Type of Source Media: vector digital data  
Source Time Period of Content:  
Time Period Information:  
  Single Date/Time:  
    Calendar Date: 1992  
Source Currentness Reference: publication date  
Source Citation Abbreviation: USGS Surficial Geology  
Source Contribution: Provided surficial geology information.  

Source Information:  
Source Citation:  
Citation Information:  
  Originator: USGS  
  Publication Date: 2004  
  Title: NHD 1:24,000 scale Streams  
Source Scale Denominator: 24000  
Type of Source Media: vector digital data  
Source Time Period of Content:  
Time Period Information:  
  Single Date/Time:  
    Calendar Date: 2004  
Source Currentness Reference: publication date  
Source Citation Abbreviation: USGS NHD  
Source Contribution: Provided perennial streams and irrigation canals.  

Process Step:  
Process Description: Buffered perennial streams and irrigation canals by 100 feet.  
Process Date: 20080403  

Process Step:  
Process Description: Unioned surficial geology and buffered streams.  
Process Date: 200890403  

Process Step:  
Process Description:  
  Added a field called 'rating' and populated it based on geologist's guidance.  

  100 foot buffers = 10  
  Pre-Tertiary Bedrock = 3  
  All other surficial geology units = 1  
Process Date: 20080403  
Process Step:
Process_Description: Dissolved Aquifer Recharge layer based on the 'rating' field.
Process_Date: 20080403
Process_Step:
  Process_Description: Converted the dissolved Aquifer Recharge layer to a raster using Feature to Raster in Spatial Analyst.
  Process_Date: 20080403
Spatial_Data_Organization_Information:
  Direct_Spatial_Reference_Method: Raster
  Point_and_Vector_Object_Information:
    SDTS_Terms_Description:
      Point_and_Vector_Object_Type: G-polygon
      Point_and_Vector_Object_Count: 3
  Spatial_Reference_Information:
    Horizontal_Coordinate_System_Definition:
      Planar:
        Map_Projection:
          Map_Projection_Name: Lambert Conformal Conic
          Lambert_Conformal_Conic:
            Standard_Parallel: 45.000000
            Standard_Parallel: 49.000000
            Longitude_of_Central_Meridian: -109.500000
            Latitude_of_Projection_Origin: 44.250000
            False_Easting: 600000.000000
            False_Northing: 0.000000
        Planar_Coordinate_Encoding_Method: row and column
        Coordinate_Representation:
          Abscissa_Resolution: 10.000000
          Ordinate_Resolution: 10.000000
        Planar_Distance_Units: meters
    Geodetic_Model:
      Horizontal_Datum_Name: D_North_American_1983_HARN
      Ellipsoid_Name: Geodetic Reference System 80
      Semi-major_Axis: 6378137.000000
      Denominator_of_Flattening_Ratio: 298.257222
    Vertical_Coordinate_System_Definition:
      Altitude_System_Definition:
        Altitude_Resolution: 0.000100
        Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates
  Entity_and_Attribute_Information:
    Detailed_Description:
      Entity_Type:
        Entity_Type_Label: recharge_rate.vat
      Attribute:
        Attribute_Label: Rowid
        Attribute_Definition: Internal feature number.
        Attribute_Definition_Source: ESRI
        Attribute_Domain_Values:
          Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
      Attribute:
        Attribute_Label: VALUE
      Attribute:
        Attribute_Label: COUNT
  Distribution_Information:
    Distributor:
      Contact_Organization_Primary:
        Contact_Organization: City of Helena and Lewis & Clark County
        Contact_Position: GIS Center
Contact_Address:
Address_Type: physical address
Address: 316 N. Park Avenue, Room 147
City: Helena
State_or_Province: MT
Postal_Code: 59624
Contact_Voice_Telephone: 406-447-8367
Contact_Facsimile_Telephone: 406-447-8386
Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us
Resource_Description: Downloadable Data
Standard_Order_Process:
Digital_Form:
  Digital_Transfer_Information:
    Transfer_Size: 0.175
Metadata_Reference_Information:
Metadata_Date: 20080421
Metadata_Contact:
  Contact_Information:
    Contact_Organization_Primary:
      Contact_Organization: Trihydro Corporation
      Contact_Person: Brian Robeson
      Contact_Position: GIS Analyst
    Contact_Address:
      Address_Type: mailing and physical address
      Address: 1252 Commerce Dr.
      City: Laramie
      State_or_Province: WY
      Postal_Code: 82070
      Contact_Voice_Telephone: 307 745-7474
      Contact_Facsimile_Telephone: 307 745-7729
    Contact_Electronic_Mail_Address: GISSupport@trihydro.com
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time
Metadata_Extensions:
  Online_Linkage: http://www.esri.com/metadata/esriprof80.html
Profile_Name: ESRI Metadata Profile
D.29 LAND SURFACE SLOPE RATING

Identification_Information:
Citation:
Originator: Trihydro Corporation
Publication_Date: 20080501
Title: Land Surface Slope Rating
Edition: 1
Geospatial_Data_Presentation_Form: raster digital data
Publication_Information:
Online_Linkage: H:\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Analysis_output\slope_rating
Description:
Abstract:
The U.S. Geological Survey has developed a National Elevation Dataset (NED). The NED is a seamless mosaic of best-available elevation data. The 7.5-minute elevation data for the conterminous United States are the primary initial source data. In addition to the availability of complete 7.5-minute data, efficient processing methods were developed to filter production artifacts in the existing data, convert to the NAD83 datum, edge-match, and fill slivers of missing data at quadrangle seams. One of the effects of the NED processing steps is a much-improved base of elevation data for calculating slope and hydrologic derivatives. The specifications for the NED 1 arc second and 1/3 arc second data are:
- Geographic coordinate system: NAD83
- Vertical datum: NAVD88
- Z units of: meters.

Land surface slope calculations for the study area were developed based on elevation data from several data sources. Initially the county-wide USGS 10 meter National Elevation Dataset was used (http://seamless.usgs.gov/). A standard GIS routine calculated percent slope from this layer. The county also provided detailed topographic contours from 2001 and 2006. This data contained more detail and was assumed to be more accurate.

Purpose: This layer is required input in the aquifer sensitivity model (modified DRASTIC).

Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20080501
Currentness_Reference: publication date
Status:
Progress: Complete
Maintenance_and_Update_Frequency: None planned
Spatial_Domain:
Bounding_Coordinates:
- West_BoundingCoordinate: -112.089922
- East_BoundingCoordinate: -111.888999
- North_BoundingCoordinate: 46.725313
- South_BoundingCoordinate: 46.565163
Keywords:
Theme:
- Theme_Keyword_Thesaurus: GCMD Parameter Keywords
- Theme_Keyword: LAND SURFACE
- Theme_Keyword: TOPOGRAPHY
- Theme_Keyword: LANDFORMS
- Theme_Keyword: TERRAIN ELEVATION
- Theme_Keyword: 7.5-MINUTE DEM
- Theme_Keyword: CARTOGRAPHY
- Theme_Keyword: DEM
- Theme_Keyword: DIGITAL ELEVATION MODEL
Place:
- Place_Keyword_Thesaurus: GCMD Location Keywords
- Place_Keyword: NORTH AMERICA
- Place_Keyword: UNITED STATES
Place_Keyword: UNITED STATES OF AMERICA
Place_Keyword: Montana
Place_Keyword: Lewis & Clark County
Place_Keyword: Helena
Access_Constraints: None
Use_Constraints: None. Acknowledgement of the originating agencies would be appreciated in products derived from these data.
Point_of_Contact:
Contact_Information:
  Contact_Organization_Primary:
  Contact_Organization: Trihydro Corporation
  Contact_Position: GIS Analyst
  Contact_Address:
  Address_Type: mailing and physical address
  Address: 1252 Commerce Dr.
  City: Laramie
  State_or_Province: WY
  Postal_Code: 82070
  Contact_Voice_Telephone: 307 745-7474
  Contact_Facsimile_Telephone: 307 745-7729
  Contact_Electronic_Mail_Address: GISSupport@trihydro.com
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350
Data_Quality_Information:
Lineage:
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: USGS, EROS Data Center
      Publication_Date: 1999
      Title: Helena Valley Montana 10 Meter DEM
    Source_Scale_Denominator: 24000
    Type_of_Source_Media: digital raster data
    Source_Time_Period_of_Content:
      Time_Period_Information:
        Single_Date/Time:
          Calendar_Date: 1999
      Source_Currentness_Reference: publication date
    Source_Citation_Abbreviation: USGS NED
    Source_Contribution: Provided DEM from which slope was calculated.
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: Lewis & Clark County, Montana
      Publication_Date: 2001
      Title: 2001 Land Surface Contours
    Type_of_Source_Media: vector digital data
    Source_Time_Period_of_Content:
      Time_Period_Information:
        Single_Date/Time:
          Calendar_Date: 2001
      Source_Currentness_Reference: ground condition
    Source_Citation_Abbreviation: 2001 contours
    Source_Contribution: More accurate elevation data.
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: Lewis & Clark County, Montana
      Publication_Date: 2006
      Title: 2006 Land Surface Contours
Type_of_Source_Media: vector digital data
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 2006
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: 2006 contours
Source_Contribution: More accurate elevation data.

Process_Step:
Process_Description: Calculated slope from USGS 10 meter DEM.

Process_Step:
Process_Description: Converted 2001 contours into a DEM using Topo to Raster (10 meter cell size, Enforce hydrologically correct drainage).

Process_Step:
Process_Description: Converted 2006 contours into a DEM using Topo to Raster (10 meter cell size, Enforce hydrologically correct drainage).

Process_Step:
Process_Description: Calculated percentage slope layer for 2001 and 2006 DEM.

Process_Step:
Process_Description: Combined the three slope layers with the following Raster Calculator expressions:

\[\text{con(isnull([slope_cont_01]), [slope_cont_06], [slope_cont_01])}\]

This expression uses 2001 values except where they don't exist and then it uses 2006 values.

Then:

\[\text{con(isnull([Calculation]), [slope_clip], [Calculation])}\]

This expression uses 2001 & 2006 values except where they don't exist and then it USGS slope values.

Process_Step:
Process_Description: Assigned ratings to the combined surface slope layer by using the following expression within the Raster Calculator:

\[\text{con(Slope < 1,10, con(Slope < 18, (5.5 + (4.5 * (\text{Sin(Slope + 7) * 0.19}))), 1))}\]

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 1733
Column_Count: 1483
Vertical_Count: 1

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Lambert Conformal Conic
Lambert_Conformal_Conic:
Standard_Parallel: 45.000000
Standard_Parallel: 49.000000
Longitude_of_Central_Meridian: -109.500000
Latitude_of_Projection_Origin: 44.250000
False_Easting: 600000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa Resolution: 10.000000
Ordinate Resolution: 10.000000
Planar Distance Units: meters
Geodetic Model:
   Horizontal Datum Name: D_North_American_1983_HARN
   Ellipsoid Name: Geodetic Reference System 80
   Semi-major Axis: 6378137.000000
   Denominator of Flattening Ratio: 298.257222
Distribution Information:
   Distributor:
      Contact Information:
         Contact Person Primary:
            Contact Person: Customer Services Representative
            Contact Organization: EROS Data Center
            Contact Address:
               Address Type: mailing and physical address
               Address: U.S. Geological Survey EROS Data Center
               City: Sioux Falls
               State or Province: SD
               Postal Code: 57198
               Country: USA
               Contact Voice Telephone: 605-594-6151
               Contact Facsimile Telephone: 605-594-6589
               Contact Electronic Mail Address: custserv@edcmail.cr.usgs.gov
      Resource Description: National Elevation Dataset (NED)
   Distribution Liability: Although these data have been processed successfully on a computer system at the U.S. Geological Survey, EROS Data Center, no warranty expressed or implied is made by either regarding the utility of the data on any system, nor shall the act of distribution constitute any such warranty. The USGS will warrant the delivery of this product in computer-readable format and will offer appropriate adjustment of credit when the product is determined unreadable by correctly adjusted computer peripherals, or when the physical medium is delivered in damaged condition. Requests for adjustments of credit must be made within 90 days from the date of this shipment from the ordering site.
   Standard Order Process:
      Digital Form:
         Digital Transfer Information:
            Transfer Size: 10.197
Metadata Reference Information:
   Metadata Date: 20080421
   Metadata Contact:
      Contact Information:
         Contact Person Primary:
            Contact Person: Customer Services Representative
            Contact Organization: EROS Data Center
            Contact Address:
               Address Type: mailing and physical address
               Address: U.S. Geological Survey EROS Data Center
               City: Sioux Falls
               State or Province: SD
               Postal Code: 57198
               Country: USA
               Contact Voice Telephone: 605-594-6151
               Contact Facsimile Telephone: 605-594-6589
               Contact Electronic Mail Address: custserv@edcmail.cr.usgs.gov
      Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
      Metadata Time Convention: local time
      Metadata Extensions:
         Online Linkage: http://www.esri.com/metadata/esriprof80.html
         Profile Name: ESRI Metadata Profile
D.30 SOILS RATING

Identification_Information:
Citation:
  Citation_Information:
    Originator: Trihydro Corporation
    Publication_Date: 20080501
    Title: Soils Rating
    Geospatial_Data_Presentation_Form: raster digital data
    Online_Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Analysis_output\soils_rate

Description:
Abstract: The soils layer evaluates the ability of contaminants to migrate through the soil and potentially move into the underlying groundwater.
Purpose: This layer is required input in the aquifer sensitivity model (modified DRASTIC).
Time_Period_of_Content:
  Time_Period_Information:
    Single_Date/Time:
      Calendar_Date: 20080501
    Currentness_Reference: publication date
Status:
  Progress: Complete
  Maintenance_and_Update_Frequency: Irregular
Spatial_Domain:
  Bounding_Coordinates:
    West_Bounding_Coordinate: -112.089922
    East_Bounding_Coordinate: -111.888999
    North_Bounding_Coordinate: 46.725313
    South_Bounding_Coordinate: 46.565163

Keywords:
  Theme: Theme_Keyword_Thesaurus: None
  Theme_Keyword: Soil
  Place: Place_Keyword: United States
  Place_Keyword: Montana
  Place_Keyword: Lewis & Clark County
  Place_Keyword: Helena
  Place_Keyword: Helena Valley
Access_Constraints: None
Use_Constraints: None
Point_of_Contact:
  Contact_Information:
    Contact_Organization_Primary:
      Contact_Organization: Trihydro Corporation
      Contact_Position: GIS Analyst
    Contact_Address:
      Address_Type: mailing and physical address
      Address: 1252 Commerce Dr.
      City: Laramie
      State_or_Province: WY
      Postal_Code: 82070
    Contact_Voice_Telephone: 307 745-7474
    Contact_Facsimile_Telephone: 307 745-7729
    Contact_Electronic_Mail_Address: GISSupport@trihydro.com

Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:
  Attribute_Accuracy:
Attribute_Accuracy_Report: Accuracy is based on source data and geologist's guidance.
Logical_Consistency_Report: There are no topological errors in these data.
Completeness_Report: These data are complete for all soils in the study area.
Positional_Accuracy:
  Horizontal_Positional_Accuracy:
    Horizontal_Positional_Accuracy_Report: Plus or minus 40 feet based upon source data scale of 1:24,000.
Lineage:
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: USDA, NRCS
      Publication_Date: 20070502
    Title: Soil Survey Geographic (SSURGO)
  Source_Scale_Denominator: 24000
  Type_of_Source_Media: vector digital data
  Source_Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: 20070502
      Source_Currentness_Reference: publication date
    Source_Citation_Abbreviation: NRCS Soils
    Source_Contribution: Provided soil units and descriptions.
  Process_Description: Joined table with map unit descriptions.
  Process_Description:
    Added a field called 'soils_rati' and populated it based on geologist's guidance.

<table>
<thead>
<tr>
<th>Particle Size</th>
<th>Other Characteristics</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedrock outcrop</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Sandy</td>
<td>Gravelly to very gravelly in most of horizon; high percentage of fragments; Permeability &gt;50 m/s</td>
<td>9</td>
</tr>
<tr>
<td>Sandy loam-skeletal</td>
<td>Greater than 35% fragments in appreciable portion of soil unit; permeability &gt; 30 m/s</td>
<td>8</td>
</tr>
<tr>
<td>Loamy-skeletal; coarse-loamy</td>
<td>Greater than 35% fragments in appreciable portion of soil unit; permeability &gt; 15 m/s</td>
<td>7</td>
</tr>
<tr>
<td>Loamy; fine loamy-skeletal</td>
<td>Permeability &lt; 15 m/s and &gt; 5 m/s</td>
<td>6</td>
</tr>
<tr>
<td>Fine loamy-skeletal</td>
<td>Permeability &lt; 5 m/s</td>
<td>5</td>
</tr>
<tr>
<td>Fine loamy</td>
<td>Permeability &lt; 5 m/s, few fragments</td>
<td>4</td>
</tr>
</tbody>
</table>

Process_Date: 20080314
Process_Description: Converted Soils Rating polygon layer to a raster using Feature to Raster tool in Spatial Analyst.

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Point_and_Vector_Object_Information:
  SDTS_Terms_Description:
    SDTS_Point_and_Vector_Object_Type: G-polygon
    Point_and_Vector_Object_Count: 310

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
  Map_Projection:
    Map_Projection_Name: Lambert Conformal Conic
Lambert_Conformal_Conic:
  Standard_Parallel: 45.000000
  Standard_Parallel: 49.000000
  Longitude_of_Central_Meridian: -109.500000
  Latitude_of_Projection_Origin: 44.250000
  False_Easting: 600000.000000
  False_Northing: 0.000000
Planar Coordinate Information:
Planar Coordinate Encoding Method: row and column
Coordinate Representation:
Abscissa Resolution: 10.000000
Ordinate Resolution: 10.000000
Planar Distance Units: meters
Geodetic Model:
Horizontal Datum Name: D_North_American_1983_HARN
Ellipsoid Name: Geodetic Reference System 80
Semi-major Axis: 6378137.000000
Denominator of Flattening Ratio: 298.257222
Vertical Coordinate System Definition:
Altitude System Definition:
Altitude Resolution: 0.000100
Altitude Encoding Method: Explicit elevation coordinate included with horizontal coordinates
Entity and Attribute Information:
Detailed Description:
Entity Type:
Entity Type Label: soils_rate.vat
Attribute:
Attribute Label: Rowid
Attribute Definition: Internal feature number.
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute Label: VALUE
Attribute:
Attribute Label: COUNT
Distribution Information:
Distributor:
Contact Information:
Contact Organization Primary:
Contact Organization: City of Helena and Lewis & Clark County
Contact Position: GIS Center
Contact Address:
Address Type: physical address
Address: 316 N. Park Avenue, Room 147
City: Helena
State or Province: MT
Postal Code: 59624
Contact Voice Telephone: 406-447-8367
Contact Facsimile Telephone: 406-447-8386
Contact Electronic Mail Address: giscenter@co.lewis-clark.mt.us
Resource Description: Downloadable Data
Standard Order Process:
Digital Form:
Digital Transfer Information:
Transfer Size: 0.189
Metadata Reference Information:
Metadata Date: 20080421
Metadata Contact:
Contact Information:
Contact Organization Primary:
Contact Organization: Trihydro Corporation
Contact Person: Brian Robeson
Contact Position: GIS Analyst
Contact Address:
Address Type: mailing and physical address
Address: 1252 Commerce Dr.
City: Laramie
State or Province: WY
Postal Code: 82070
Contact Voice Telephone: 307 745-7474
Contact Facsimile Telephone: 307 745-7729
Contact Electronic Mail Address: GISSupport@trihydro.com
Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Time Convention: local time
D.31 VADOSE ZONE RATINGS

Identification Information:
Citation Information:
Originator: Trihydro Corporation
Publication_Date: 20080501
Title: Vadose Zone Ratings
Geospatial Data Presentation Form: raster digital data
Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Analysis_output\vadose_rate

Description:
Abstract: The vadose zone comprises the unsaturated zone above the water table and below the soil horizon. For input into the DRASTIC model, the vadose zone ratings range between one to 10, where a value of one represents a confining layer and a value of 10 represents a highly fractured igneous or volcanic rock, or karst limestone, where secondary porosity creates preferential pathways for infiltrating water to quickly reach the groundwater table.

Purpose: This layer is required input in the aquifer sensitivity model (modified DRASTIC).

Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20080501

Currentness_Reference: publication date
Status:
Progress: Complete
Maintenance_and_Update_Frequency: Irregular

Spatial_Domain:
Bounding_Coordinates:
West_BoundingCoordinate: -112.089922
East_BoundingCoordinate: -111.888999
North_BoundingCoordinate: 46.725313
South_BoundingCoordinate: 46.565163

Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Geology
Theme_Keyword: Hydrology
Theme_Keyword: Soils
Theme_Keyword: Vadose Zone
Theme_Keyword: Aquifer
Theme_Keyword: Aquifer Recharge

Place:
Place_Keyword: United States
Place_Keyword: Montana
Place_Keyword: Lewis & Clark County
Place_Keyword: Helena
Place_Keyword: Helena Valley

Access_Constraints: None
Use_Constraints: None

Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Trihydro Corporation
Contact_Position: GIS Analyst
Contact_Address:
Address_Type: mailing and physical address
Address: 1252 Commerce Dr.
City: Laramie
State_orProvince: WY
Postal Code: 82070
Contact Voice Telephone: 307 745-7474
Contact Facsimile Telephone: 307 745-7729
Contact Electronic Mail Address: GISSupport@trihydro.com

Native Data Set Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data Quality Information:
Attribute Accuracy:
Attribute Accuracy Report: As accurate as the source data.
Logical Consistency Report: There are no topological errors in these data.
Completeness Report: These data are complete for the study area.
Positional Accuracy:
Horizontal Positional Accuracy:
Horizontal Positional Accuracy Report: Based on source data accuracy.

Lineage:
Source Information:
Source Citation:
Citation Information:
Originator: USGS
Publication Date: 2000
Title: Generalized Bedrock Geologic Map of the Helena Area, West-Central Montana
Source Scale Denominator: 100000
Type of Source Media: vector digital data
Source Time Period of Content:
Time Period Information:
Single Date/Time:
Calendar Date: 2000
Source Currentness Reference: publication date
Source Citation Abbreviation: USGS Bedrock
Source Contribution: Provided bedrock geology.
Source Information:
Source Citation:
Citation Information:
Originator: USGS
Publication Date: 1992
Source Scale Denominator: Unknown
Type of Source Media: vector digital data
Source Time Period of Content:
Time Period Information:
Single Date/Time:
Calendar Date: 1992
Source Currentness Reference: publication date
Source Citation Abbreviation: USGS Surficial Geology
Source Contribution: Provided surficial geology.

Process Step:
Process Description: Unioned bedrock and surficial geology layers.

Process Step:
Process Description:
Added a field in the table called 'rating' and populated the field based on geologist's guidance.

Note: The following rating chart combines units from the surficial geologic map and the bedrock geologic map. Mapped surficial geologic units should supersede bedrock units, except for pTb surficial unit, which will be replaced by the ratings of the bedrock geologic map.

Surficial Geology Code Rating
Qal 6
QTp 5
Tsu 5

Bedrock Geology Code  Rating
OGvt  7
OGs 7
Kg  7
Mnl7
Dij  7
Cc  7
Ccl  7
Zg  7
Yss  7
Yhe  7
Ys  7
Yg  7

Process_Date: 20080403
Process_Step:
  Process_Description: Dissolved vadose zone layer based on rating field.
Process_Date: 20080403
Process_Step:
  Process_Description: Converted Vadose Zone dissolve layer to a raster using Feature to Raster in Spatial Analyst.
Process_Date: 20080403

Spatial_Data_Organization_Information:
  Direct_Spatial_Reference_Method: Raster
  Point_and_Vector_Object_Information:
    SDTS_Terms_Description:
      SDTS_Point_and_Vector_Object_Type: G-polygon
      Point_and_Vector_Object_Count: 51
  Spatial_Reference_Information:
    Horizontal_Coordinate_System_Definition:
      Planar:
        Map_Projection:
          Map_Projection_Name: Lambert Conformal Conic
          Lambert_Conformal_Conic:
            Standard_Parallel: 45.000000
            Standard_Parallel: 49.000000
            Longitude_of_Central_Meridian: -109.500000
            Latitude_of_Projection_Origin: 44.250000
            False_Easting: 600000.000000
            False_Northing: 0.000000
          Planar_Coordinate_Information:
            Planar_Coordinate_Encoding_Method: row and column
            Coordinate_Representation:
              Abscissa_Resolution: 10.000000
              Ordinate_Resolution: 10.000000
              Planar_Distance_Units: meters
          Geodetic_Model:
            Horizontal_Datum_Name: D North American 1983_HARN
            Ellipsoid_Name: Geodetic Reference System 80
            Semi-major_Axis: 6378137.000000
            Denominator_of_Flattening_Ratio: 298.257222
        Vertical_Coordinate_System_Definition:
          Altitude_System_Definition:
            Altitude_Resolution: 0.000100
            Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates
      Entity_and_Attribute_Information:
        Detailed_Description:
        Entity_Type:
Entity_Type_Label: vadose_rate.vat
Attribute:
  Attribute_Label: Rowid
  Attribute_Definition: Internal feature number.
  Attribute_Definition_Source: ESRI
  Attribute_Domain_Values:
    Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
  Attribute:
  Attribute_Label: VALUE
  Attribute:
  Attribute_Label: COUNT
Distribution_Information:
  Distributor:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: City of Helena and Lewis & Clark County
        Contact_Position: GIS Center
        Contact_Address:
          Address_Type: physical address
          Address: 316 N. Park Avenue, Room 147
          City: Helena
          State_or_Province: MT
          Postal_Code: 59624
          Contact_Voice_Telephone: 406-447-8367
          Contact_Facsimile_Telephone: 406-447-8386
          Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us
    Resource_Description: Downloadable Data
  Standard_Order_Process:
    Digital_Form:
      Digital_Transfer_Information:
        Transfer_Size: 0.114
Metadata_Reference_Information:
  Metadata_Date: 20080421
  Metadata_Contact:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: Trihydro Corporation
        Contact_Person: Brian Robeson
        Contact_Position: GIS Analyst
        Contact_Address:
          Address_Type: mailing and physical address
          Address: 1252 Commerce Dr.
          City: Laramie
          State_or_Province: WY
          Postal_Code: 82070
          Contact_Voice_Telephone: 307 745-7474
          Contact_Facsimile_Telephone: 307 745-7729
          Contact_Electronic_Mail_Address: GISSupport@trihydro.com
  Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
  Metadata_Time_Convention: local time
  Metadata_Extensions:
    Online_Linkage: http://www.esri.com/metadata/esriprof80.html
    Profile_Name: ESRI Metadata Profile
D.32  AQUIFER SENSITIVITY FOR THE HELENA VALLEY AREA, MONTANA

Identification Information:
Citation:
  Originator: Trihydro Corporation
  Publication Date: 20080501
  Title: Aquifer Sensitivity for the Helena Valley Area, Montana
  Geospatial Data Presentation Form: raster digital data
  Online Linkage: \fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Analysis_output\final_sensit

Description:
Abstract: The final aquifer sensitivity model was created by simply "adding" the ratings from each of the six rated characteristic layers. The result was a possible range of values of six (assuming each layer had a rating of one for the particular area) up to 60 (if each layer were rated a 10).
Purpose: This is the output aquifer sensitivity layer. Further analysis can be conducted by using this layer in conjunction with human-influenced risk factors to create new products. Specific human-influenced factors could be former agricultural areas which might still contain nitrogen below the typical root zone, current septic system locations in the rural county, or even currently irrigated lawns and croplands.

Time Period of Content:
  Single Date/Time:
    Calendar Date: 20080501
  Currentness Reference: publication date

Status:
  Progress: Complete
  Maintenance and Update Frequency: Irregular

Spatial Domain:
  Bounding Coordinates:
    West Bounding Coordinate: -112.089918
    East Bounding Coordinate: -111.888999
    North Bounding Coordinate: 46.725238
    South Bounding Coordinate: 46.565178

Keywords:
  Theme:
    Theme_Keyword_Thesaurus: None
    Theme_Keyword: Hydrology
    Theme_Keyword: Geology
    Theme_Keyword: Soils
    Theme_Keyword: Topography
    Theme_Keyword: Precipitation
    Theme_Keyword: Ground Water
    Theme_Keyword: Aquifer
    Theme_Keyword: Aquifer Sensitivity
  Place:
    Place_Keyword: United States
    Place_Keyword: Montana
    Place_Keyword: Lewis & Clark County
    Place_Keyword: Helena
    Place_Keyword: Helena Valley

Access Constraints: None
Use Constraints: None
Point of Contact:
  Contact Information:
    Contact_Organization_Primary:
      Contact_Organization: Trihydro Corporation
      Contact_Position: GIS Analyst
      Contact_Address:
Address_Type: mailing and physical address
Address: 1252 Commerce Dr.
City: Laramie
State_or_Province: WY
Postal_Code: 82070
Contact_Voice_Telephone: 307 745-7474
Contact_Facsimile_Telephone: 307 745-7729
Contact_Electronic_Mail_Address: GISSupport@trihydro.com
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.2.1350

Data_Quality_Information:
Attribute_Accuracy:
  Attribute_Accuracy_Report: Depends on accuracy of source data.
Logical_Consistency_Report: These data are topologically correct.
Completeness_Report: These data are complete for the study area.
Positional_Accuracy:
  Horizontal_Positional_Accuracy:
    Horizontal_Positional_Accuracy_Report: Depends on accuracy of source data.

Lineage:
Process_Step:
  Process_Description:
    Sums the Depth to Water rating layer, Geohydrologic Setting rating layer, Aquifer Recharge rating layer, Slope rating layer, Soils rating layer, and Vadose Zone rating layer using Spatial Analyst's Raster Calculator.

This produces the unitless output ratings ranging from 6 - 60 that describe relative aquifer sensitivity within the study area.

Spatial_Data_Organization_Information:
  Direct_Spatial_Reference_Method: Raster
  Point_and_Vector_Object_Information:
    SDTS_Terms_Description:
      SDTS_Point_and_Vector_Object_Type: G-polygon
      Point_and_Vector_Object_Count: 310
  Spatial_Reference_Information:
    Horizontal_Coordinate_System_Definition:
      Planar:
        Map_Projection:
          Map_Projection_Name: Lambert Conformal Conic
          Lambert_Conformal_Conic:
            Standard_Parallel: 45.000000
            Standard_Parallel: 49.000000
            Longitude_of_Central_Meridian: -109.500000
            Latitude_of_Projection_Origin: 44.250000
            False_Easting: 600000.000000
            False_Northing: 0.000000
        Planar_Coordinate_Information:
          Planar_Coordinate_Encoding_Method: row and column
          Coordinate_Representation:
            Abscissa_Resolution: 10.000000
            Ordinate_Resolution: 10.000000
            Planar_Distance_Units: meters
        Geodetic_Model:
          Horizontal_Datum_Name: D North American 1983_HARN
          Ellipsoid_Name: Geodetic Reference System 80
          Semi-major_Axis: 6378137.000000
          Denominator_of_Flattening_Ratio: 298.257222
        Vertical_Coordinate_System_Definition:
          Altitude_System_Definition:
            Altitude_Resolution: 0.000100
            Altitude_Encoding_Method: Explicit elevation coordinate included with horizontal coordinates
    Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Final Sensit
Distribution_Information:
Distributor:
Contact_Information:
  Contact_Organization_Primary:
    Contact_Organization: City of Helena and Lewis & Clark County
    Contact_Position: GIS Center
    Contact_Address:
      Address_Type: physical address
      Address: 316 N. Park Avenue, Room 147
      City: Helena
      State_or_Province: MT
      Postal_Code: 59624
    Contact_Voice_Telephone: 406-447-8367
    Contact_Facsimile_Telephone: 406-447-8386
    Contact_Electronic_Mail_Address: giscenter@co.lewis-clark.mt.us
Resource_Description: Downloadable Data
Standard_Order_Process:
  Digital_Form:
  Digital_Transfer_Information:
    Transfer_Size: 10.195
Metadata_Reference_Information:
Metadata_Date: 20080421
Metadata_Contact:
Contact_Information:
  Contact_Organization_Primary:
    Contact_Organization: Trihydro Corporation
    Contact_Person: Brian Robeson
    Contact_Position: GIS Analyst
    Contact_Address:
      Address_Type: mailing and physical address
      Address: 1252 Commerce Dr.
      City: Laramie
      State_or_Province: WY
      Postal_Code: 82070
    Contact_Voice_Telephone: 307 745-7474
    Contact_Facsimile_Telephone: 307 745-7729
    Contact_Electronic_Mail_Address: GISSupport@trihydro.com
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Time_Convention: local time
Metadata_Extensions:
Online_Linkage: http://www.esri.com/metadata/esripof80.html
Profile_Name: ESRI Metadata Profile
June 18, 2008

Ms. Kathy Moore
Administrator of Environmental Services
Lewis & Clark County
316 North Park
Helena, MT 59623

Subject: Geohydrologic Model Peer Review

Dear Ms. Moore:

Herrera Environmental Consultants performed a peer review of the aquifer sensitivity assessment and model developed by Trihydro Corporation for the Helena Valley Groundwater Vulnerability Project in Lewis and Clark County, Montana. A modified version of the USEPA DRASTIC aquifer sensitivity model presented in the Wyoming Ground-Water Vulnerability Assessment Handbook was used by Trihydro to complete the assessment of aquifer sensitivity for the Helena Valley.

The aquifer sensitivity ratings and map prepared for this study were based on an assessment of six groundwater parameters:

- depth to ground water
- net annual aquifer recharge from precipitation and snowmelt
- geohydrologic environment of the aquifer
- soils
- land surface slope
- characteristics of the vadose zone

The equations used to develop the sensitivity ratings for each of the six parameters were consistent with the equations provided in the Wyoming Handbook. The sources of data for each of the parameters are based on current published information collected and compiled by nationally recognized scientific organizations, including the following:

- Montana Ground-Water Information Center
- U.S. Geological Survey
- National Resources Conservation Service
The sensitivity maps developed for each of the parameters and overall sensitivity map will provide useful information for future land-use planning. The methodology is clearly stated and the data used to produce each of the maps can be updated as conditions change. The maps may be georeferenced in a GIS format and groundwater-vulnerability maps can be produced by combining sensitivity maps with land use data.

Sincerely,

Herrera Environmental Consultants, Inc.

Bruce A. Carpenter, LHG
Senior Hydrogeologist

Michael Spillane, PE
Vice President, Principal Engineer

cc: Mr. Len Ballek