

**LEWIS & CLARK COUNTY  
HELENA VALLEY GROUNDWATER  
VULNERABILITY PROJECT  
FINAL PROJECT REPORT**

---

**June 18, 2008  
Revised June 27, 2008  
Project #: 944-001-001**

---

**SUBMITTED BY:** Trihydro Corporation  
1252 Commerce Drive, Laramie, WY 82070

---



**ENGINEERING SOLUTIONS. ADVANCING BUSINESS.**

**Home Office** | 1252 Commerce Drive | Laramie, WY 82070 | phone 307/745.7474 | fax 307/745.7729 | [www.trihydro.com](http://www.trihydro.com)

# Table of Contents

<b>1.0</b>	<b>INTRODUCTION.....</b>	<b>1-1</b>
1.1	Purpose.....	1-1
1.2	Organization of this Report .....	1-1
<b>2.0</b>	<b>AQUIFER SENSITIVITY ASSESSMENT .....</b>	<b>2-1</b>
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
<b>3.0</b>	<b>SOURCES OF DATA.....</b>	<b>3-1</b>
<b>4.0</b>	<b>MODEL METHODOLOGY .....</b>	<b>4-1</b>
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
<b>5.0</b>	<b>PROJECT SUMMARY.....</b>	<b>5-1</b>
5.1	Public Involvement.....	5-1
5.2	GIS Tool for Sensitivity Mapping Applications.....	5-1
5.3	Future Recommendations.....	5-1
<b>6.0</b>	<b>REFERENCES.....</b>	<b>6-1</b>

## 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:

- **D**epth to Initial Groundwater
- **R**echarge (net annual from natural sources)
- **A**quifer Media
- **S**oil Media
- **T**opography (slope)
- **I**mpact of the Vadose Zone
- **C**onductivity (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

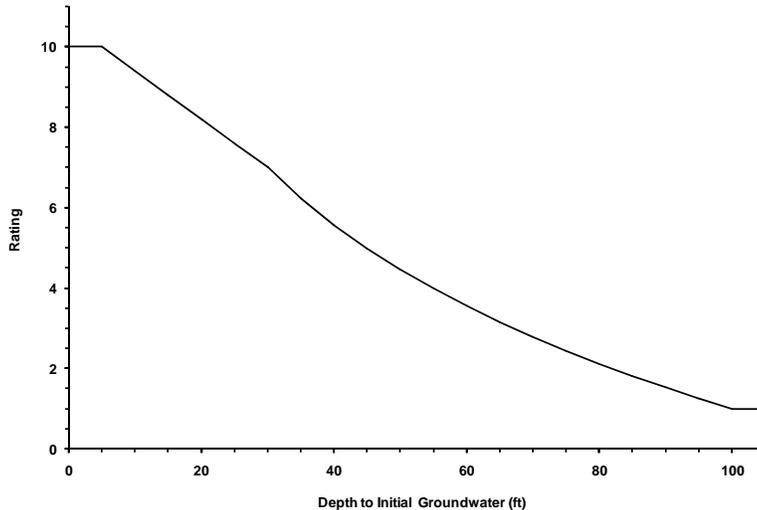
Depth to water calculations for the study area were developed based on groundwater sampling data maintained by the Montana Ground-Water Information Center in Butte (<http://mbmaggwic.mtech.edu>). GWIC staff provided 2007 sampling information for the county, complete with geographic coordinates for each 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 4-1. GROUNDWATER DEPTH RATINGS**

Range of Depth (feet)	Rating Equation
0 – 5	10
5 – 30	$10.60 - 0.12 (\text{depth})$
30 – 100	$23.94 - [4.98 \times \ln (\text{depth})]$
> 100	1



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

```
con ([DTW_Final] < 5, 10, con([DTW_Final] < 30,(10.6 - ([DTW_Final] * 0.12)), con([DTW_Final] < 100,(23.94 - (ln([DTW_Final]) * 4.98)), 1 )))
```

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 Quarternary-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 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**

<b>Surficial Geologic Unit</b>	<b>Unit Code</b>	<b>Rating</b>
Alluvium	Qal	8
Pediments	QTp	7
Undifferentiated Tertiary Sediments	Tsu	7

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**

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

#### 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 ( $\mu\text{m/s}$ ) and 3  $\mu\text{m/s}$ . 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**

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

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.

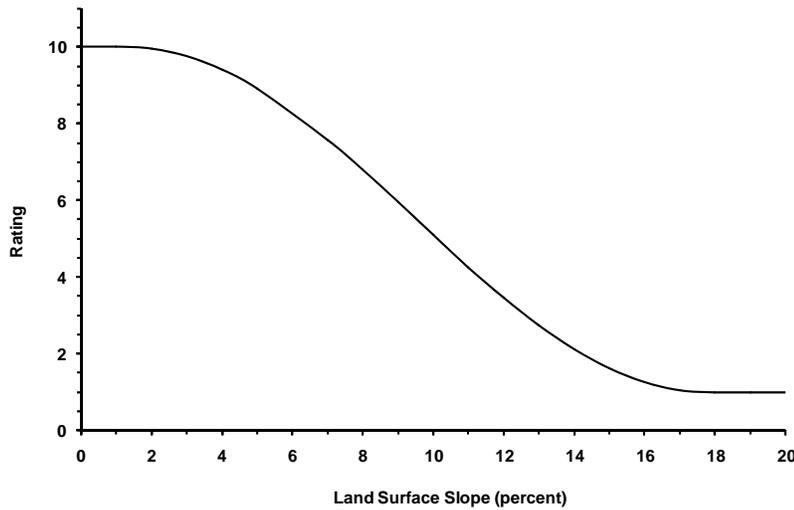
Land surface slope refers to the steepness of the land surface and can be represented as a degree or as a percentage (45 degrees = 100 percent). Land surface slopes have been expressed as a percentage on Figure 9. The flatter the slope, the longer water resides in one place on the land surface, which 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:

**TABLE 4-5. LAND SURFACE SLOPE RATINGS**

Percent Slope	Rating Equation
0 – 1	10
1 – 18	$5.5 + 4.5 \{ \sin [(slope + 7) \times 0.19] \}$
> 18	1



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

```
con ([Slope] < 1,10, con([Slope] < 18, (5.5 + (4.5 *(Sin([Slope] + 7) * 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 4-6. VADOSE ZONE RATINGS FOR SURFICIAL MATERIALS**

<b>Surficial Geologic Unit</b>	<b>Unit Code</b>	<b>Rating</b>
Alluvium	Qal	6
Pediments	QTp	7
Undifferentiated Tertiary Sediments	Tsu	5

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 4-7. VADOSE ZONE RATINGS FOR BEDROCK FORMATIONS**

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

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 8<sup>th</sup>, 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 9<sup>th</sup>, 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 24<sup>th</sup> 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

- Aller, L., T. Bennett, J. H. Lehr, R. J. Petty, and G. Hackett. 1987. *DRASTIC: A Standardized System for Evaluating Groundwater Pollution Potential using Hydrogeologic Settings*. U.S. Environmental Protection Agency, Ada, OK. EPA/600/2-87/035. 622 pp.
- Briar, D.W. and J.P. Madison, 1992. *Hydrogeology of the Helena Valley-Fill Aquifer System, West-Central Montana*: U.S. Geological Survey, Water-Resources Investigations Report 92-4023, 49 p.
- Focazio, M.J. 2002. *Assessing Ground-water Vulnerability to Contamination: Providing Scientifically Defensible Information for Decision Makers*. U.S. Geological Survey Circular 1224.
- Hamerlinck, J.D., and C.S. Arneson, editors, 1998a, *Wyoming Ground-Water Vulnerability Assessment Handbook: Volume 1. Background, Model Development, and Aquifer Sensitivity Analysis: Spatial Data and Visualization* Center Publication SDVC 98-01-1, University of Wyoming, Laramie, WY.
- Hamerlinck, J.D., and C.S. Arneson, editors, 1998b, *Wyoming Ground-Water Vulnerability Assessment Handbook: Volume 2. Assessing Ground-Water Vulnerability to Pesticides: Spatial Data and Visualization* Center Publication SDVC 98-01-2, University of Wyoming, Laramie, WY.
- Merchant, J.W., D.O. Whittemore, J.L. Whistler, C.D. McElwee, and J.J. Woods. 1987. *Groundwater pollution hazard assessment: A GIS approach*. From: Proceedings of the International Geographic Information Systems (IGIS) Symposium, Association of American Geographers. Washington, D.C., v. 3, pp. 103-115.
- National Research Council (NRC). 1993. *Groundwater Vulnerability Assessment: Contamination Potential under Conditions of Uncertainty*. National Academy Press, Washington, D.C.
- Natural Resources Conservation Service (NRCS), US Department of Agriculture, 2007. *Soil Survey Geographic (SSURGO) Database for Lewis and Clark County Area, Montana*.
- Reynolds, M.W. and T.R. Brandt. 2000. *Generalized Bedrock Geologic Map of the Helena Area, West-Central Montana*. U.S. Geological Survey Water-Resources Investigations Report 00-4212.

Thamke, J. N. and M. W. Reynolds, 2000. *Hydrology of the Helena Area Bedrock, West-Central Montana, 1993-98*: U.S. Geological Survey, Water-Resources Investigations Report 00-4212, 119 p.

U.S. Environmental Protection Agency (USEPA). 1993a. *Groundwater Resource Assessment*. EPA/813/R-93/003.

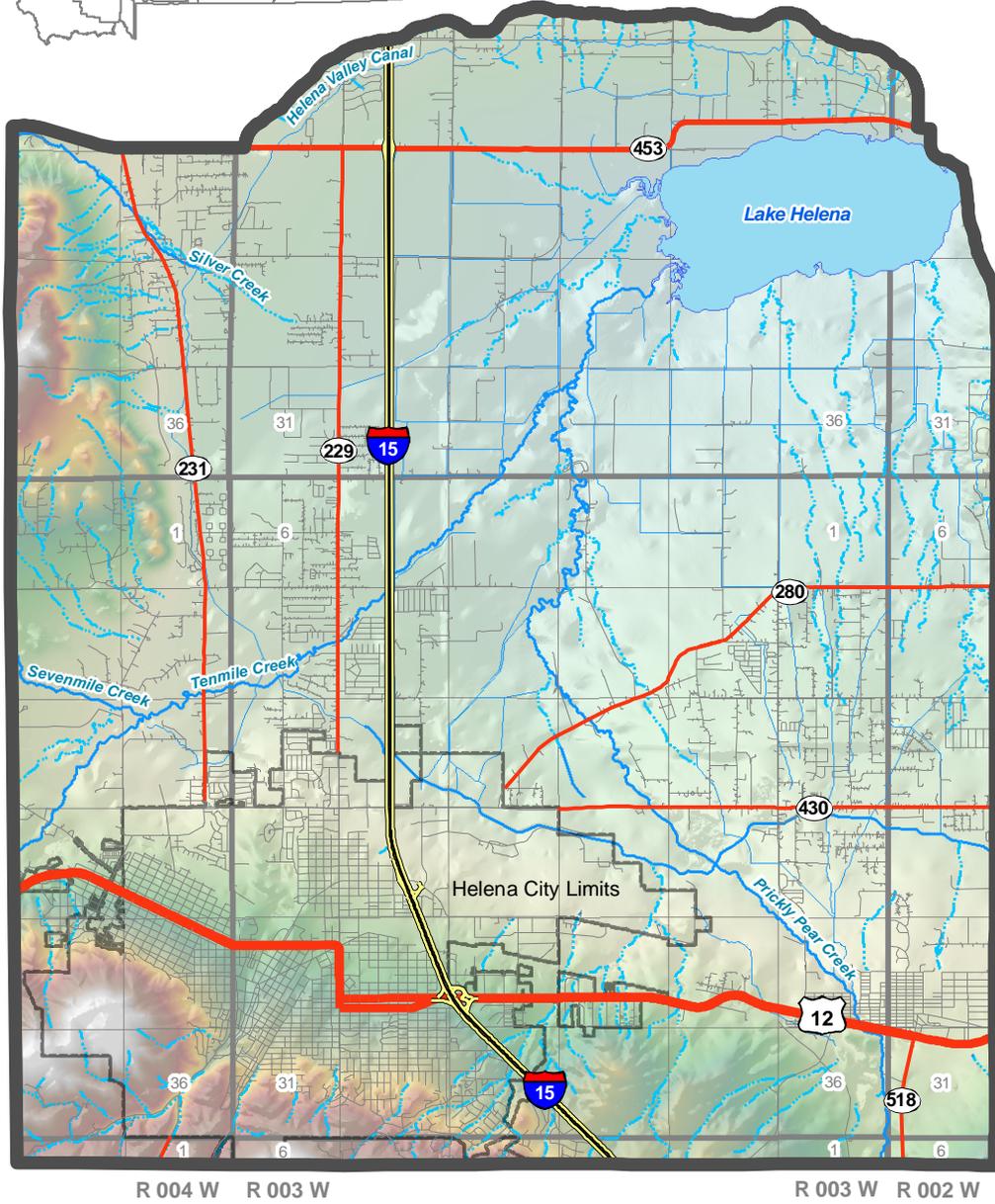
U.S. Environmental Protection Agency (USEPA). 1993b. *A Review of Methods for Assessing Aquifer Sensitivity and Groundwater Vulnerability to Pesticide Contamination*. EPA/813/R-93/002. 147 pp.



## FIGURES



**STUDY AREA LOCATION**



0 2 Miles



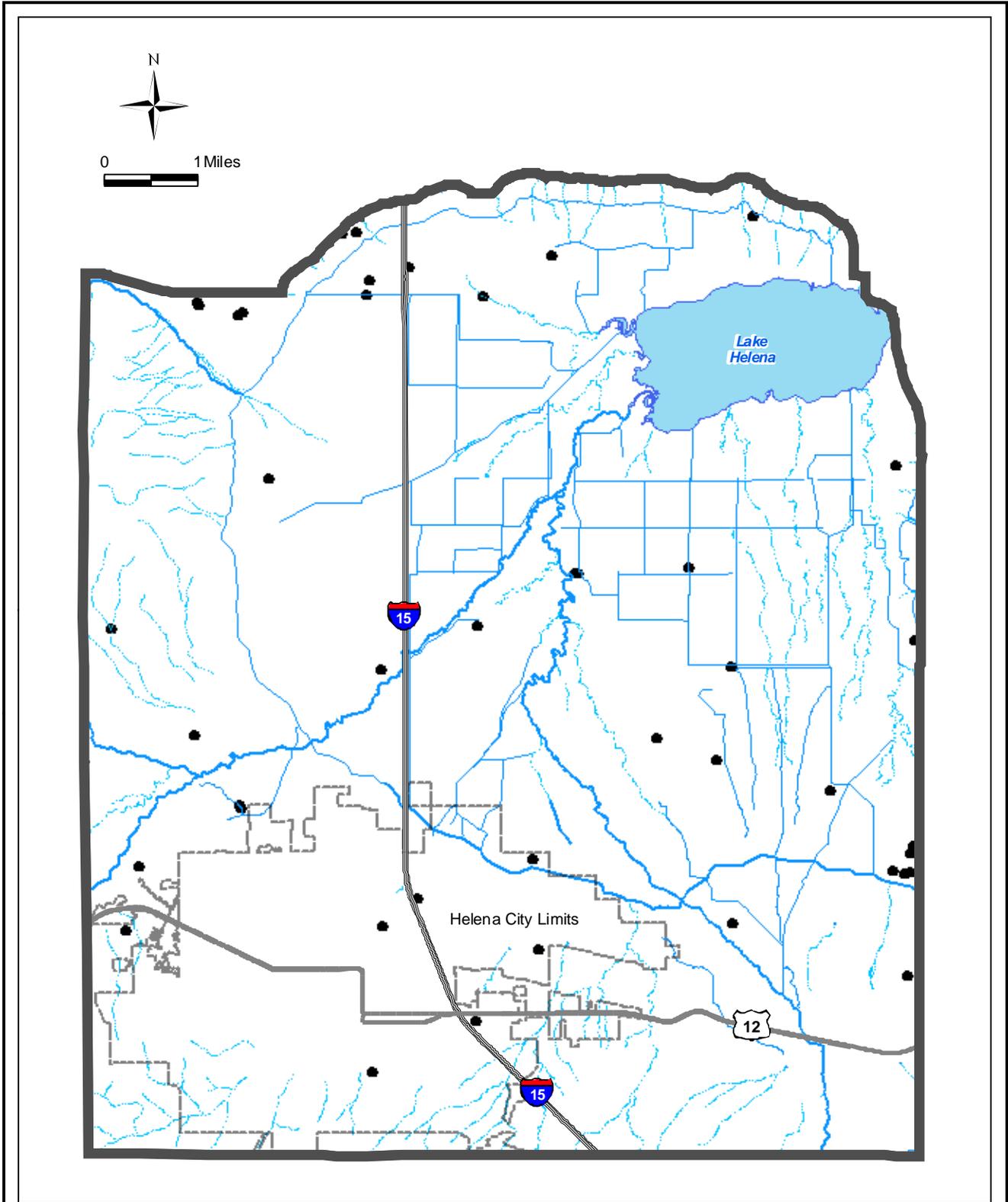
Trihydro  
CORPORATION  
1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307/745.7474 (F) 307/745.7729

**FIGURE 1**

**STUDY AREA LOCATION**

**HELENA VALLEY GROUND WATER  
VULNERABILITY STUDY  
LEWIS AND CLARK COUNTY, MONTANA**

Drawn By: BR	Checked By: CSA	Scale: 1:110,000	Date: 4/22/08	File: Site_Loc.mxd
--------------	-----------------	------------------	---------------	--------------------



**EXPLANATION**

- GWIC 2007 STATIC WATER LEVEL GAGING LOCATION



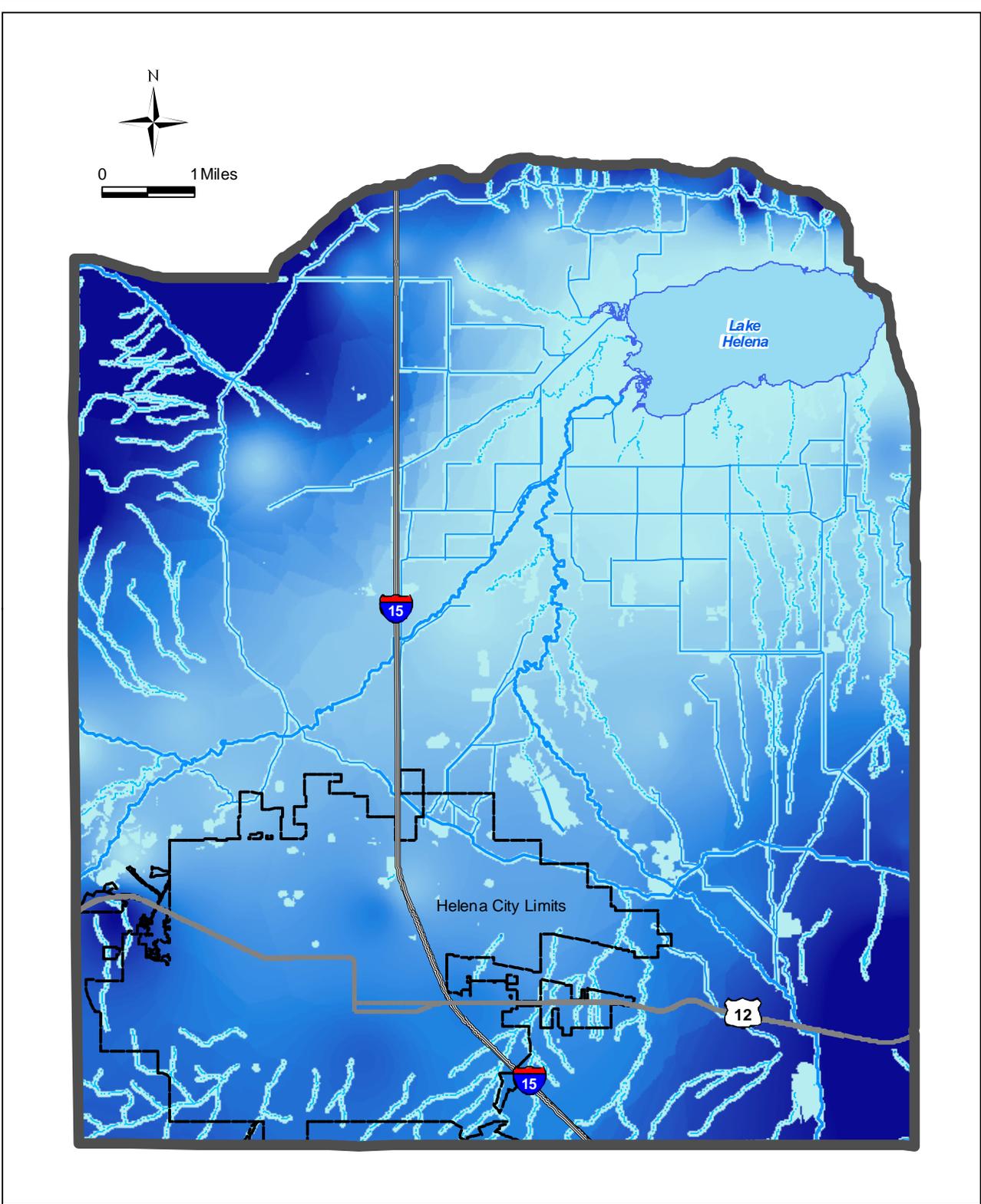
1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307.745.7474 (F) 307.745.7729

**FIGURE 2**

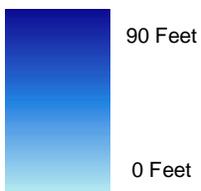
**AVAILABLE WATER DEPTH LOCATIONS**

**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: Well\_Locations.mxd



**DEPTH SCALE**




**Trihydro**  
CORPORATION

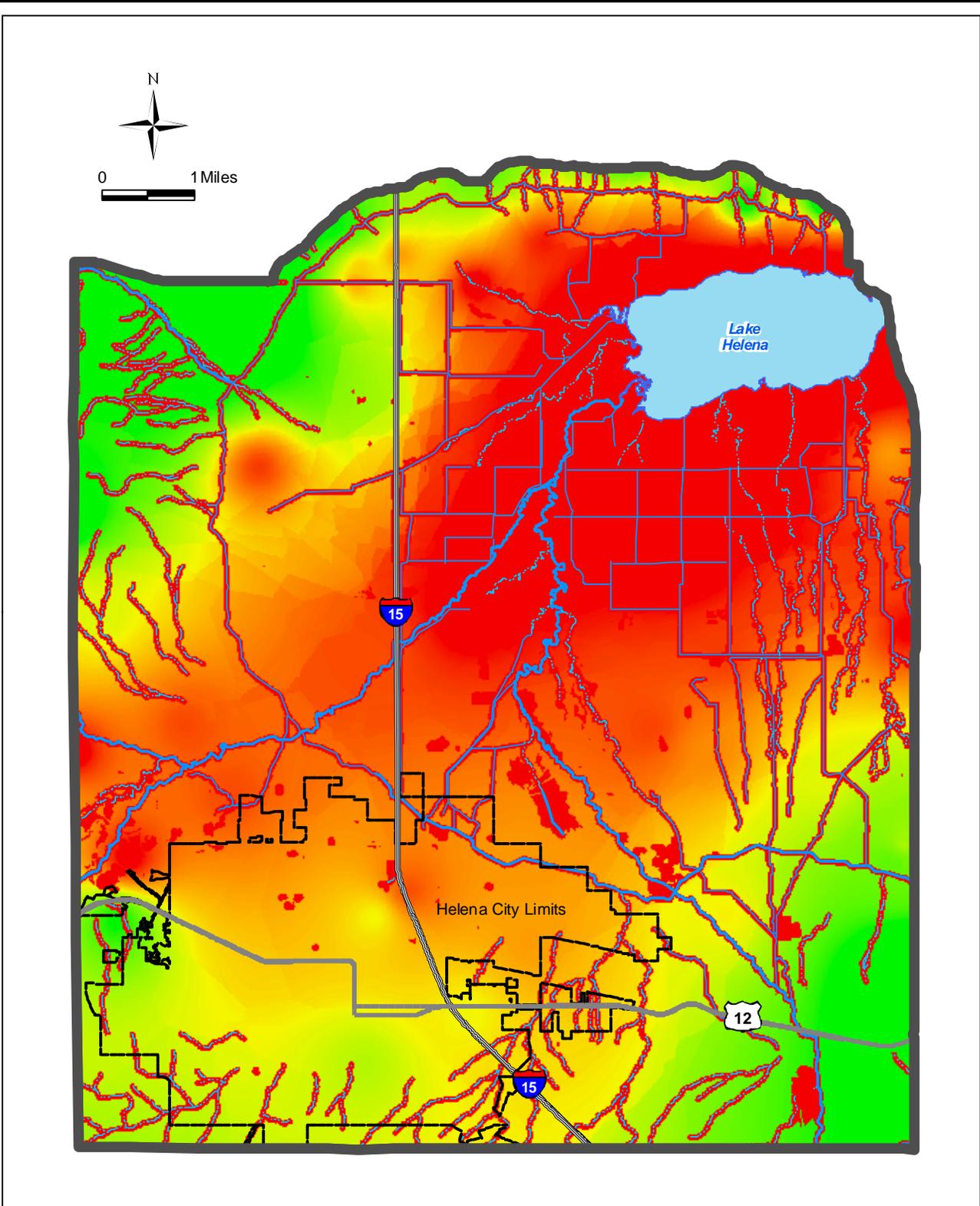
1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307.745.7474 (F) 307.745.7729

**FIGURE 3**

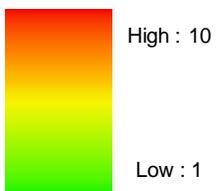
**DEPTH TO INITIAL GROUNDWATER**

**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



**RATING SCALE**




**Trihydro**  
CORPORATION

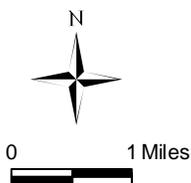
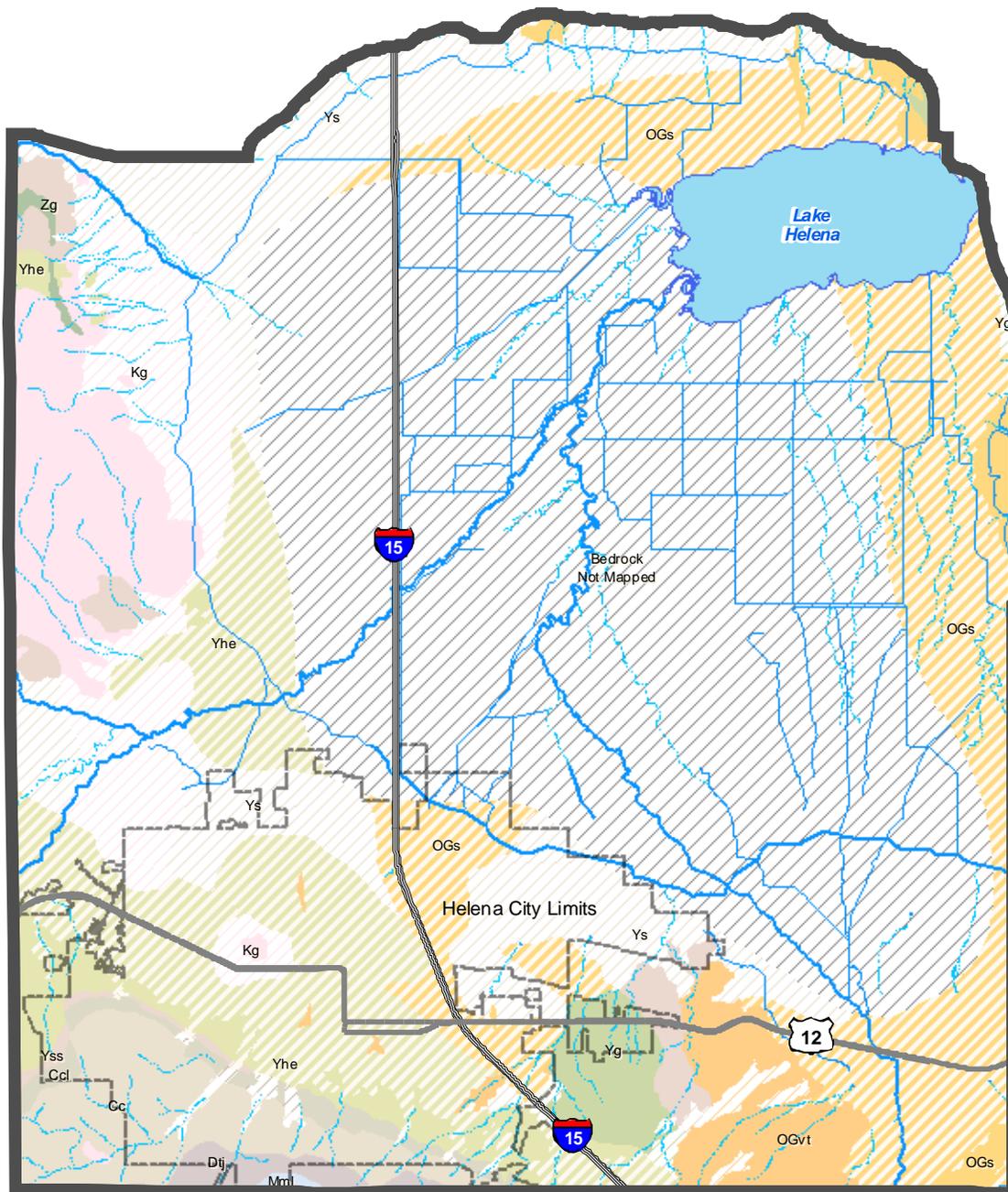
1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307.745.7474 (F) 307.745.7729

**FIGURE 4**

**DEPTH TO INITIAL GROUNDWATER RATINGS**

**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\_Ratings.mxd



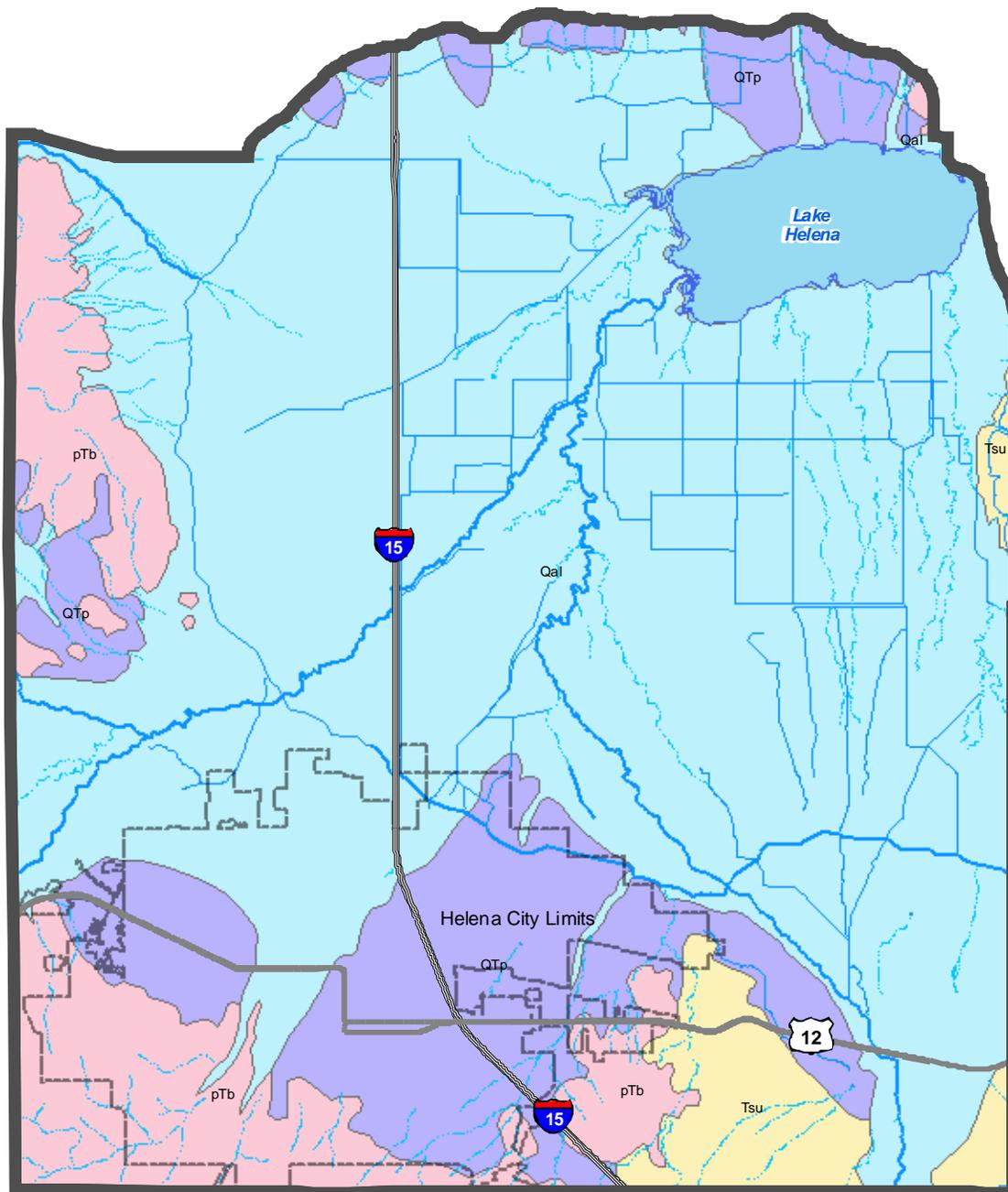
**Trihydro**  
 CORPORATION  
 1252 Commerce Drive  
 Laramie, WY 82070  
 www.trihydro.com  
 (P) 307.745.7474 (F) 307.745.7729

**FIGURE 5**

**BEDROCK GEOLOGY**

**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: Bedrock.mxd



0 1 Miles



1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307.745.7474 (F) 307.745.7729

**FIGURE 6**

**SURFICIAL GEOLOGY**

**HELENA VALLEY GROUNDWATER  
VULNERABILITY STUDY  
LEWIS AND CLARK COUNTY, MONTANA**

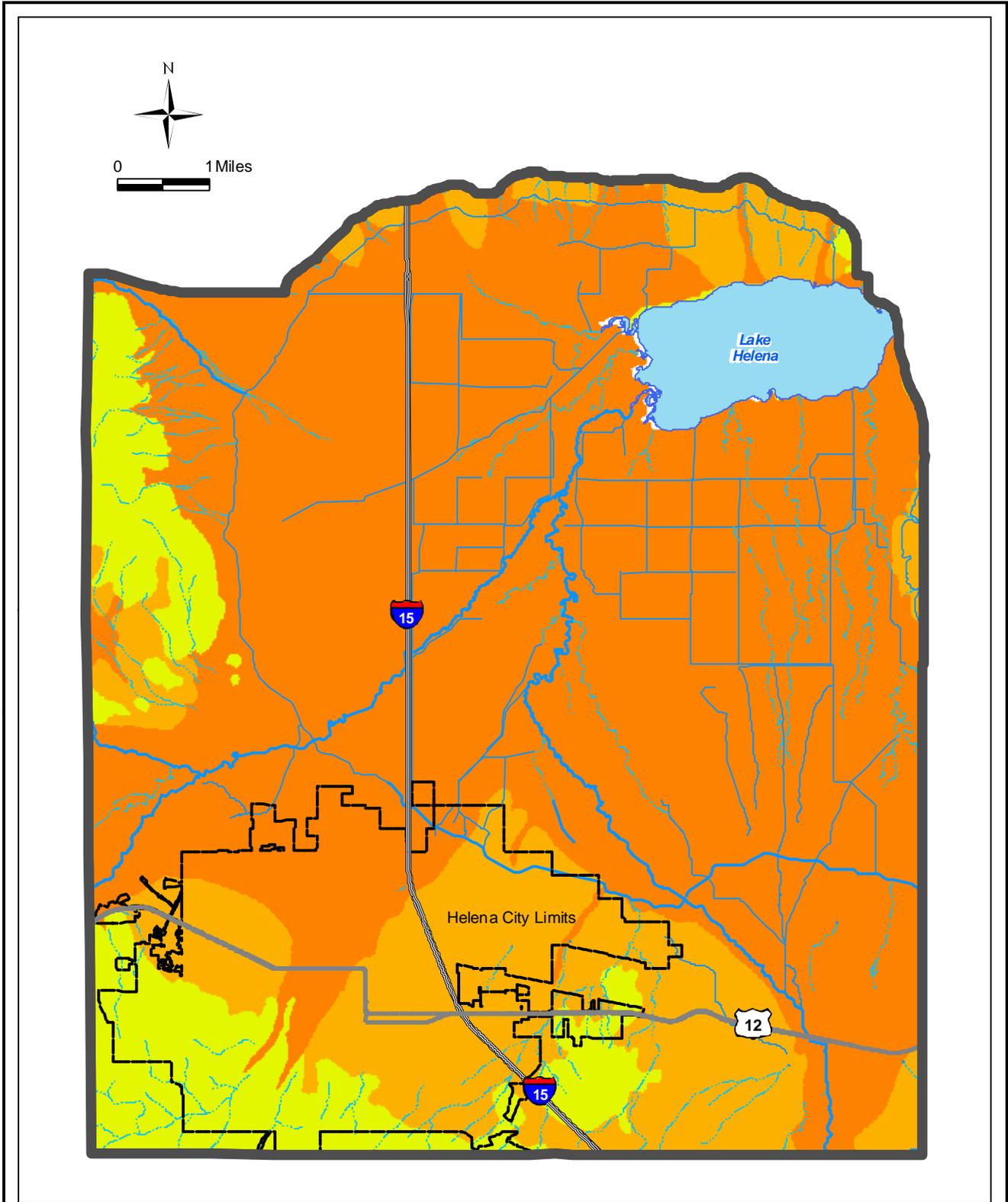
Drawn By: BR

Checked By: CSA

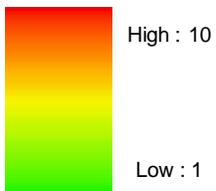
Scale: 1:100,000

Date: 4/18/08

File: Surficial.mxd



**RATING SCALE**




**Trihydro**  
CORPORATION

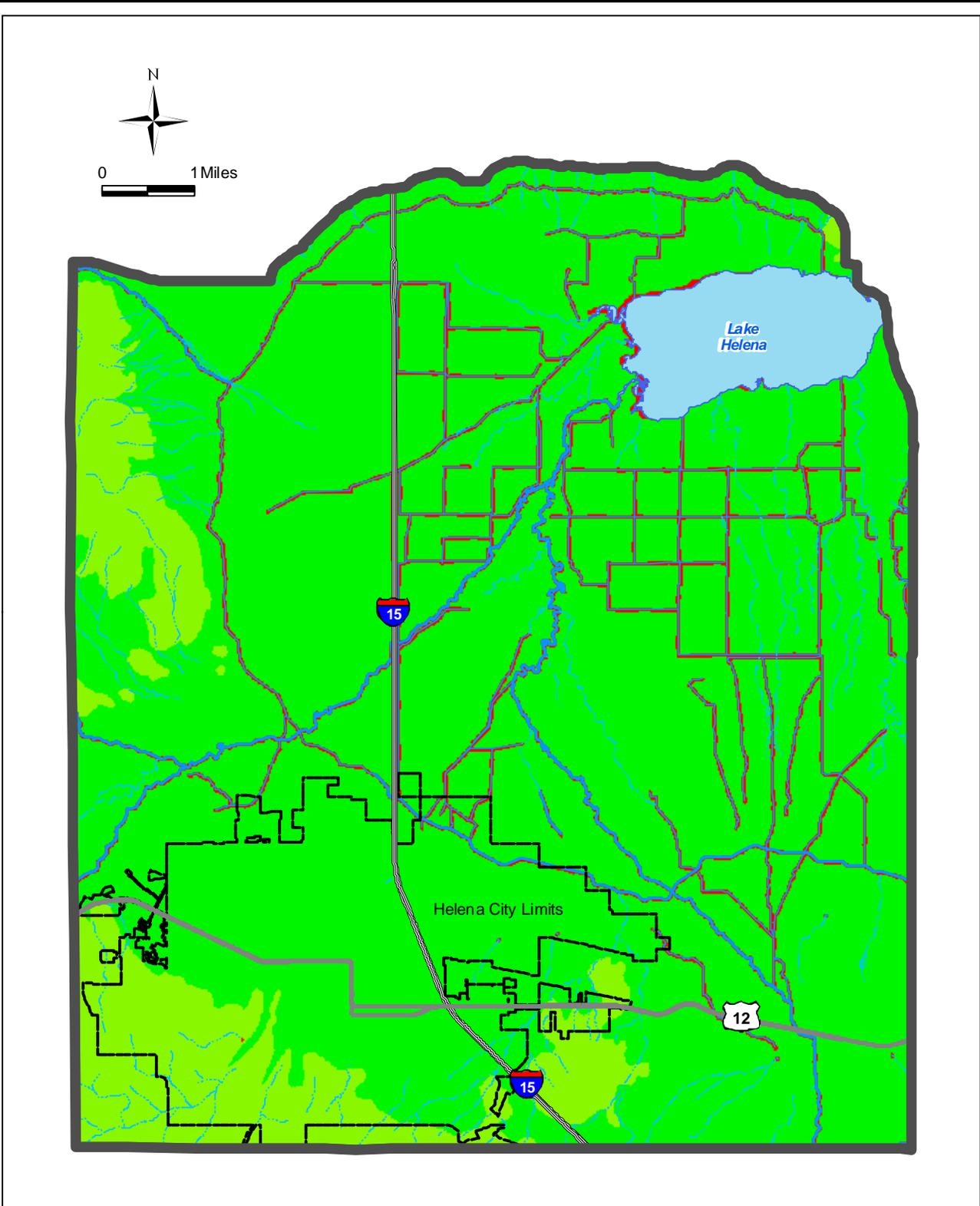
1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307.745.7474 (F) 307.745.7729

**FIGURE 7**

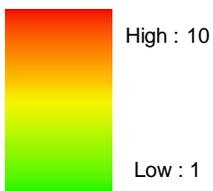
**GEOHYDROLOGIC SETTING RATINGS**

**HELENA VALLEY GROUNDWATER  
VULNERABILITY STUDY  
LEWIS AND CLARK COUNTY, MONTANA**

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



**RATING SCALE**




**Trihydro**  
CORPORATION

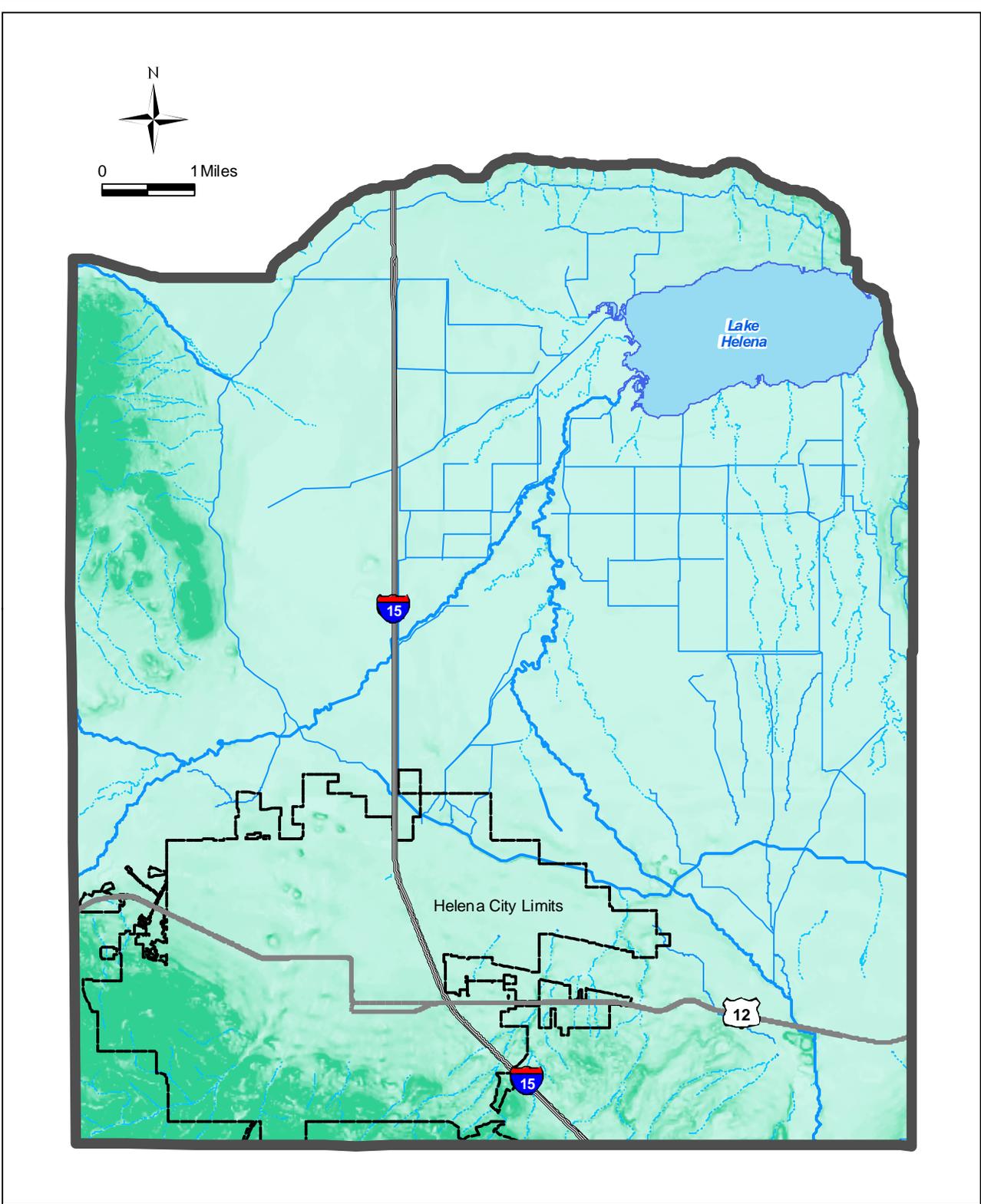
1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307.745.7474 (F) 307.745.7729

**FIGURE 8**

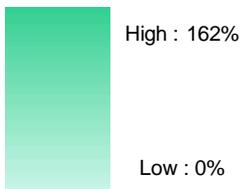
**AQUIFER RECHARGE RATINGS**

**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: Recharge.mxd
--------------	-----------------	------------------	---------------	--------------------



**SLOPE SCALE**



**Trihydro**  
CORPORATION

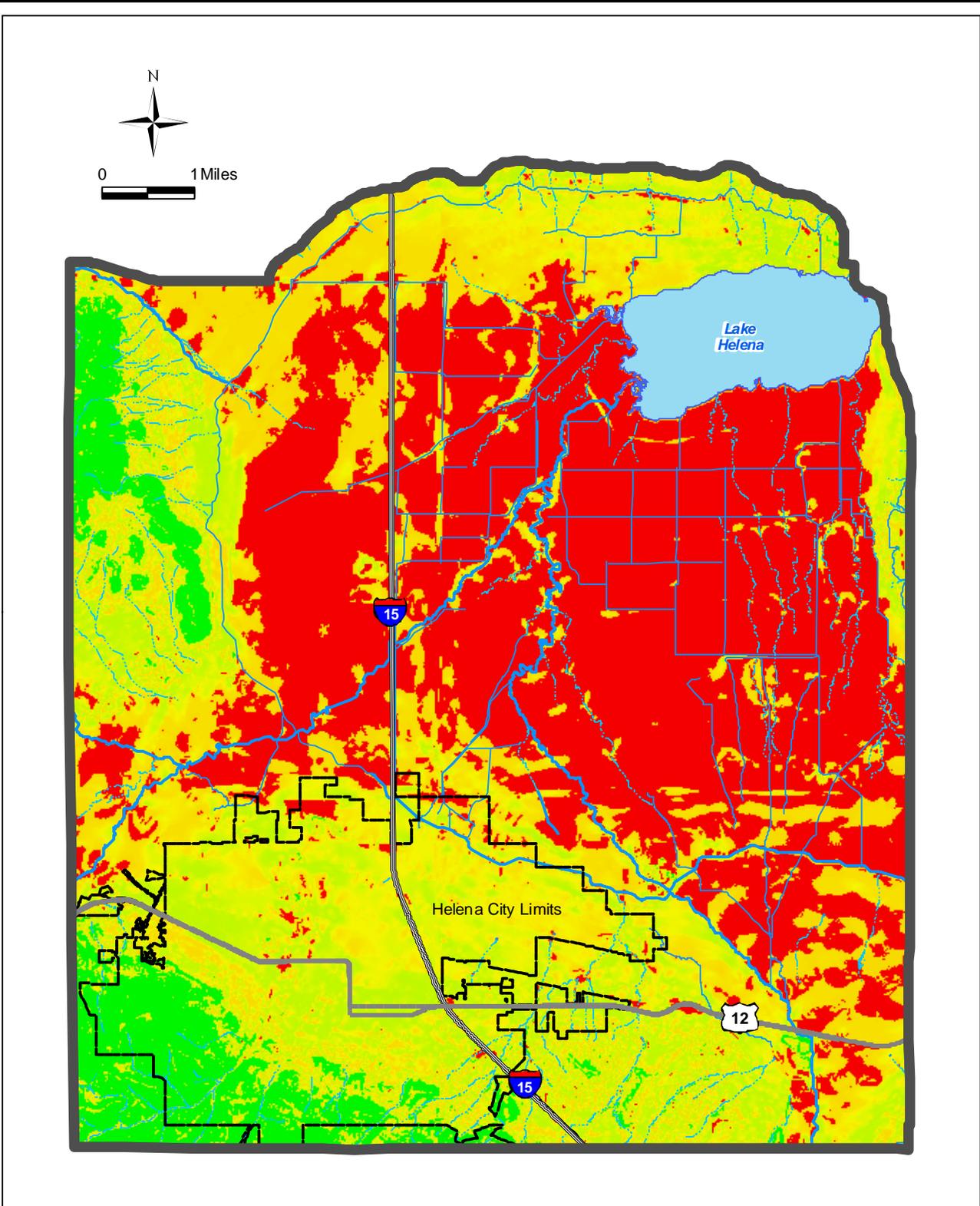
1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307.745.7474 (F) 307.745.7729

**FIGURE 9**

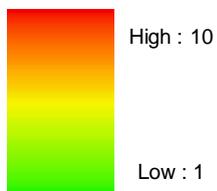
**LAND SURFACE SLOPE**

**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.mxd



**RATING SCALE**



**Trihydro**  
CORPORATION

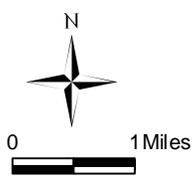
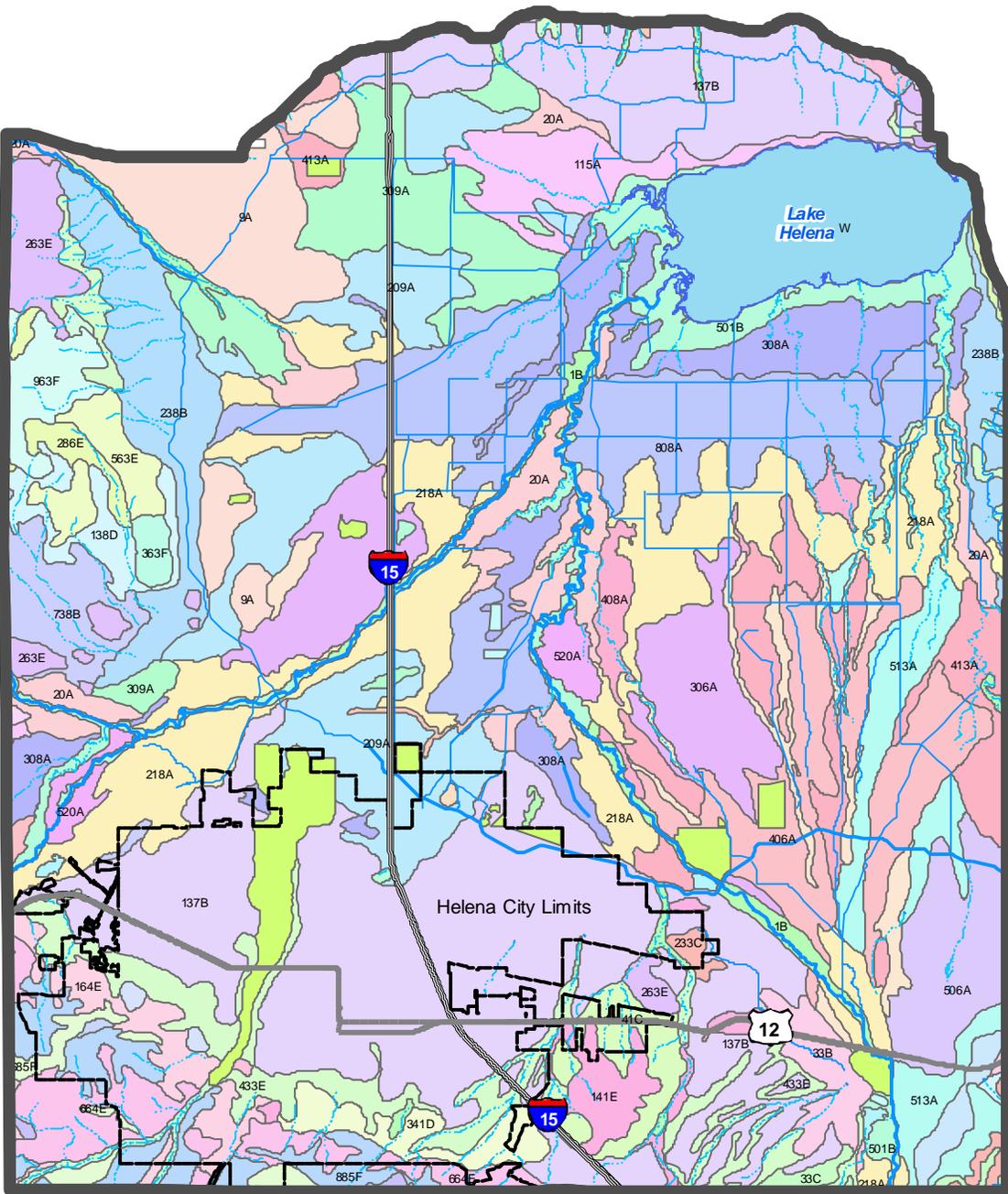
1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307.745.7474 (F) 307.745.7729

**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
--------------	-----------------	------------------	---------------	-------------------------



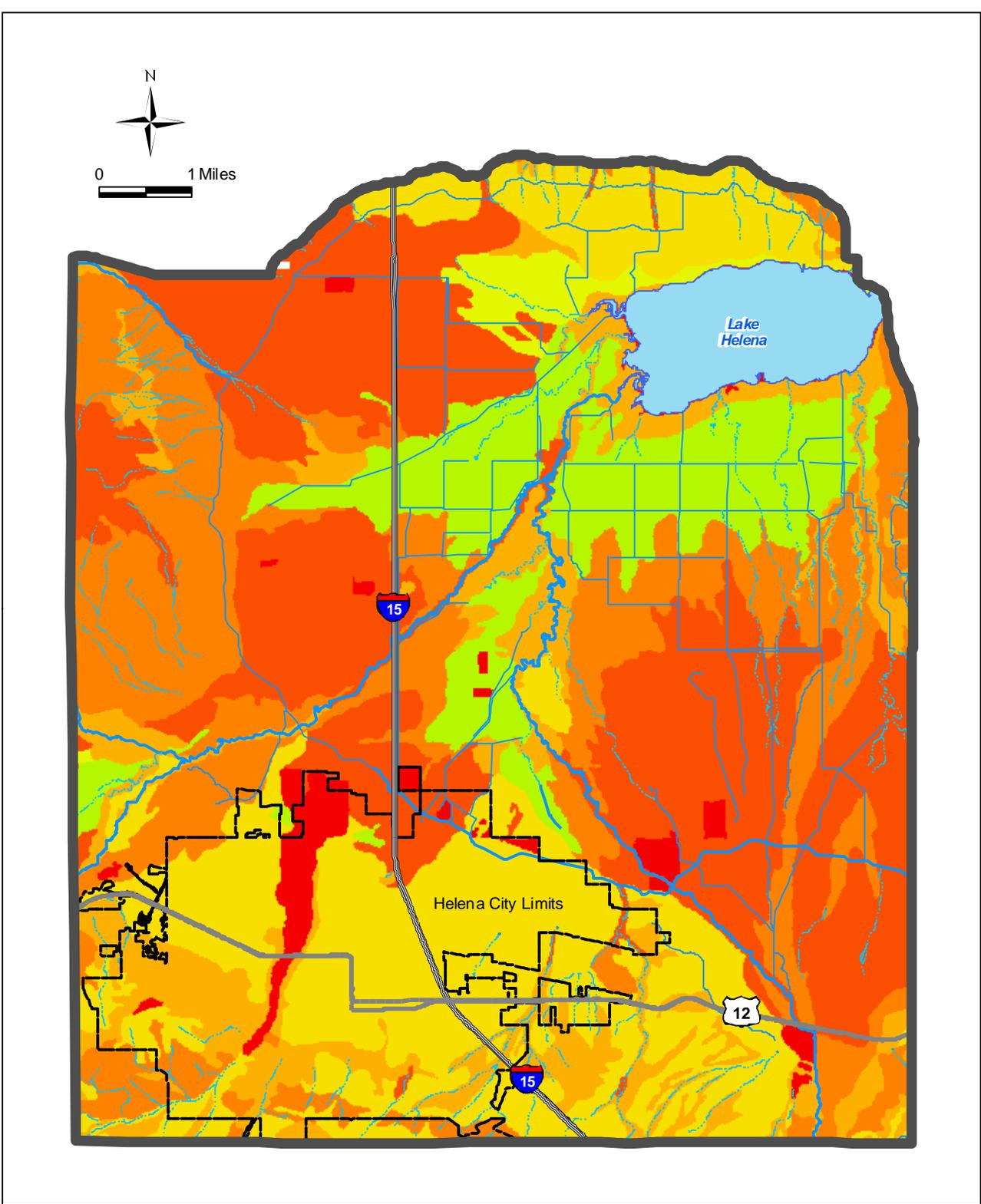
**Trihydro**  
 CORPORATION  
 1252 Commerce Drive  
 Laramie, WY 82070  
 www.trihydro.com  
 (P) 307/745.7474 (F) 307/745.7729

**FIGURE 11**

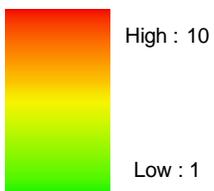
**SOIL UNITS**

**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: Soi\_units.mxd



**RATING SCALE**




**Trihydro**  
CORPORATION

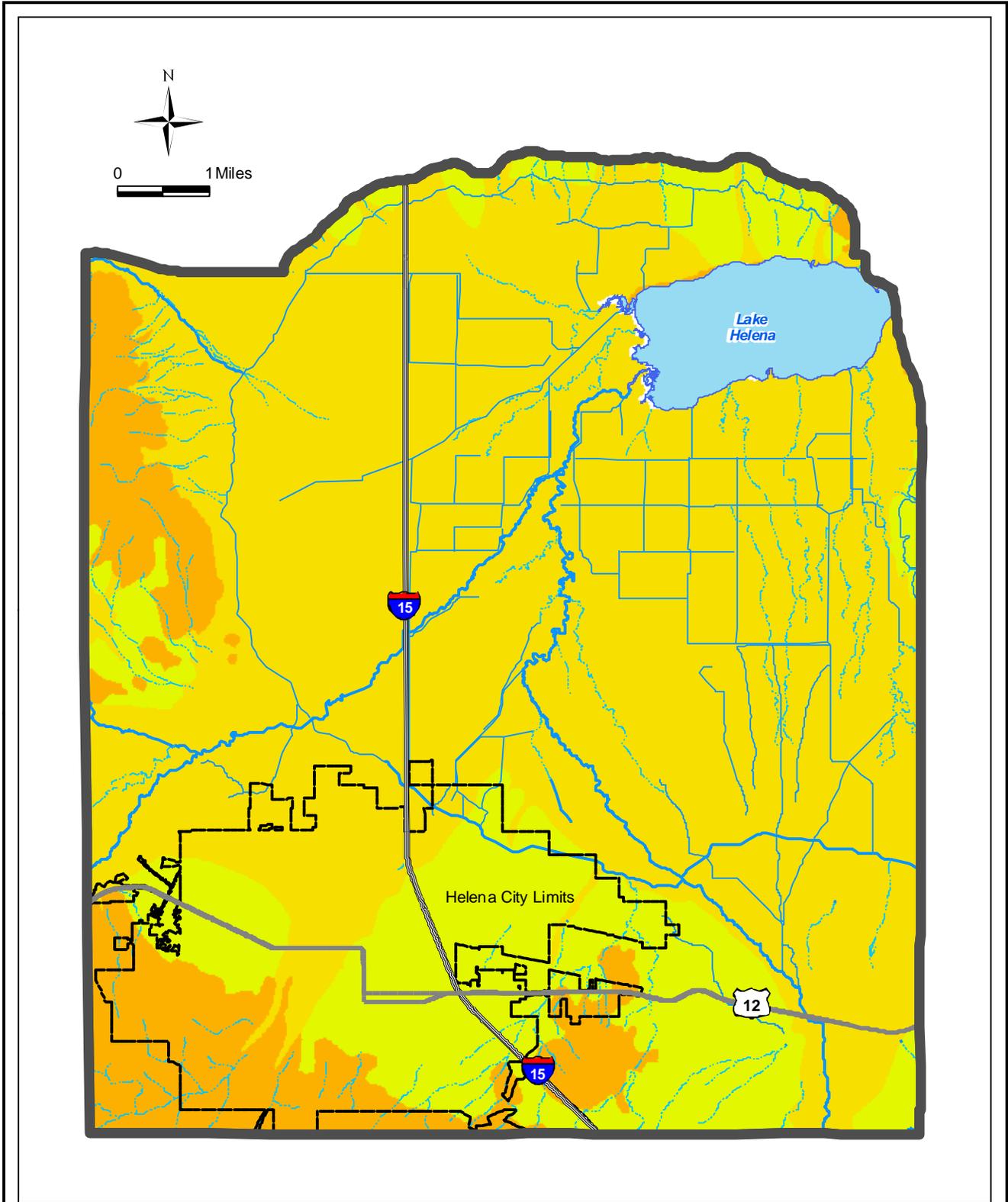
1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307.745.7474 (F) 307.745.7729

**FIGURE 12**

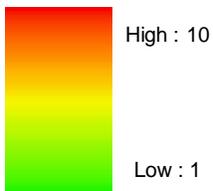
**SOILS RATINGS**

**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**




**Trihydro**  
CORPORATION

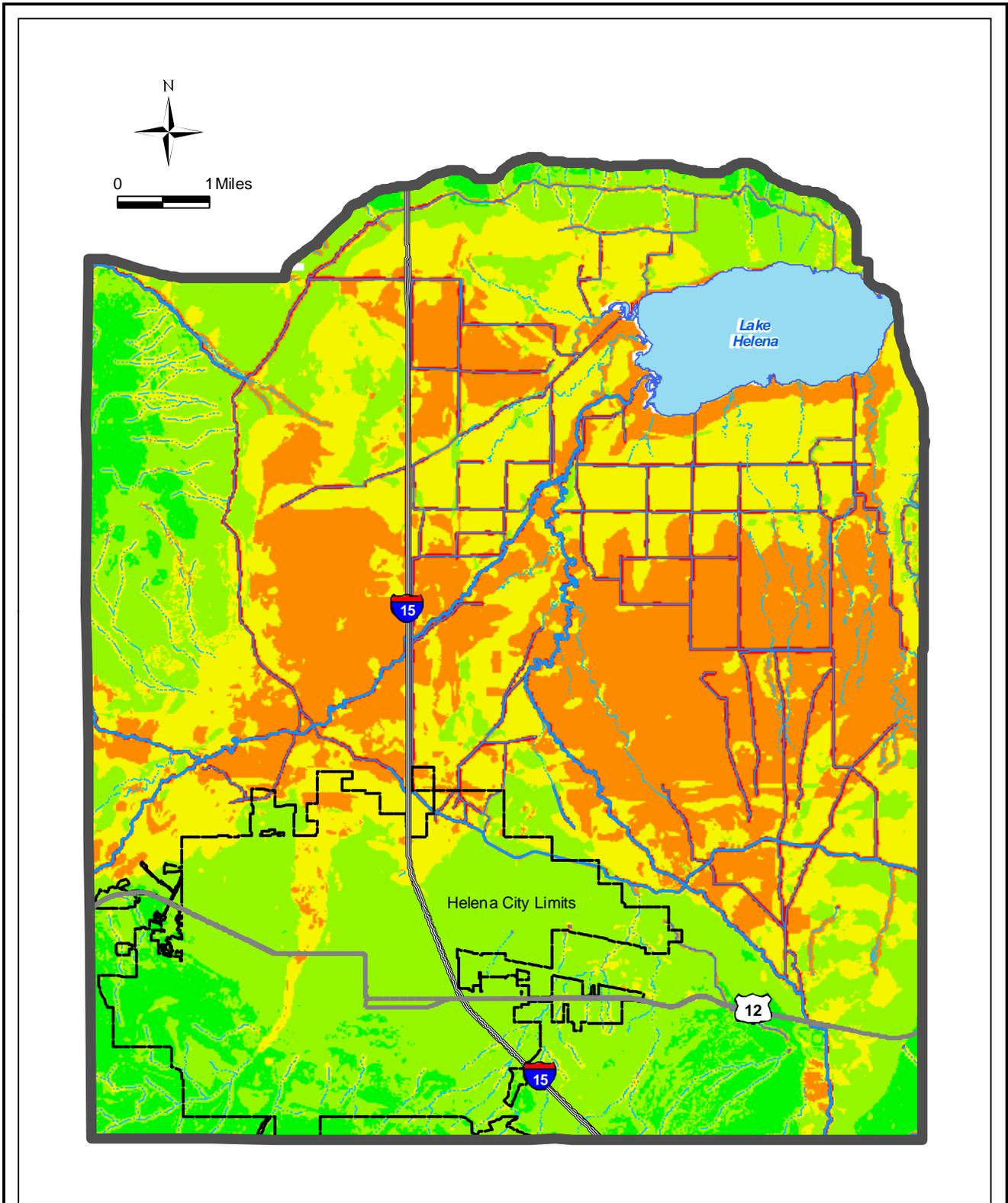
1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307.745.7474 (F) 307.745.7729

**FIGURE 13**

**VADOSE ZONE RATINGS**

**HELENA VALLEY GROUNDWATER  
VULNERABILITY STUDY  
LEWIS AND CLARK COUNTY, MONTANA**

Drawn By: BR	Checked By: CSA	Scale: 1:100,000	Date: 4/22/08	File: Vadose_zone.mxd
--------------	-----------------	------------------	---------------	-----------------------



**SENSITIVITY SCALE**

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



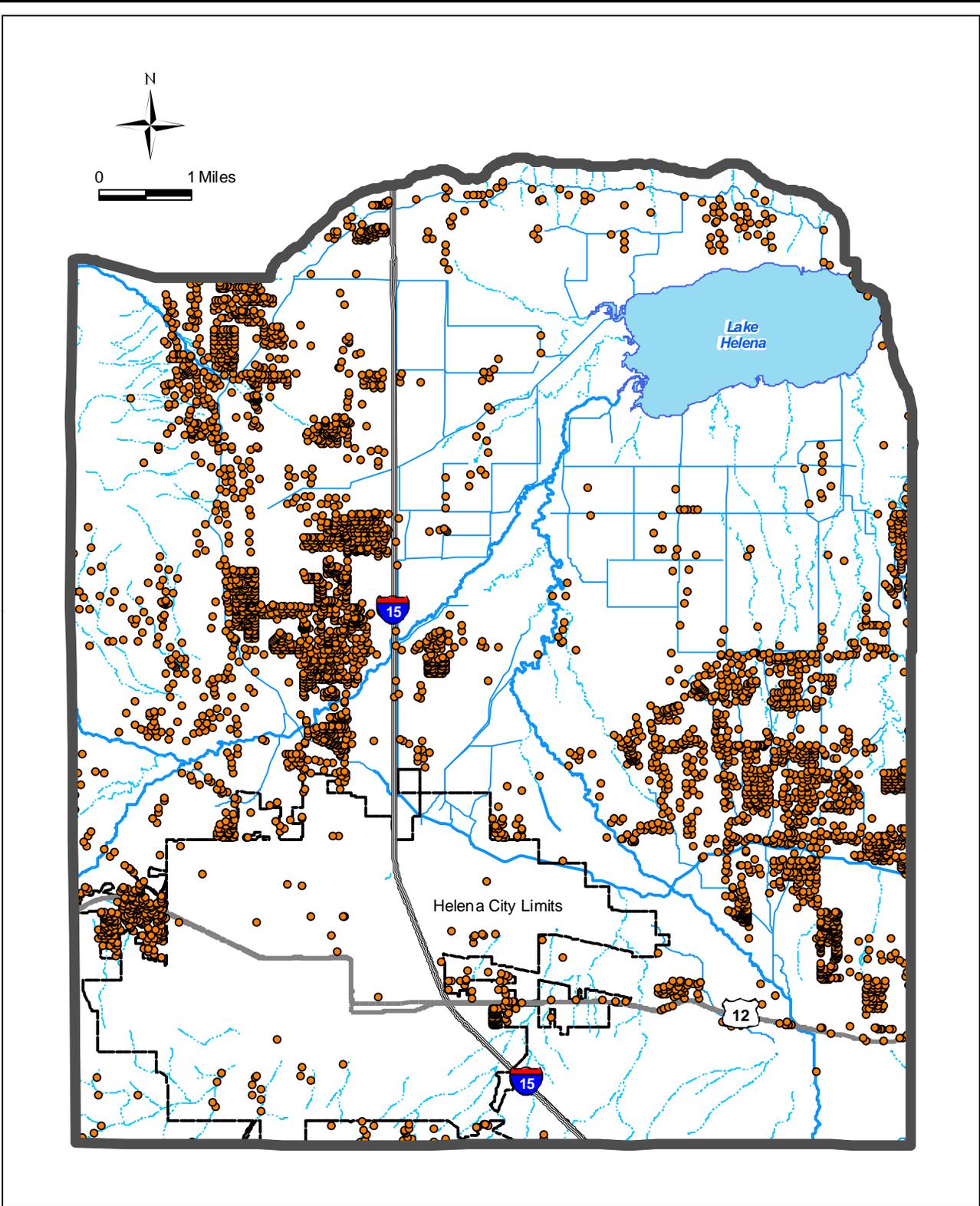
1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307.745.7474 (F) 307.745.7729

**FIGURE 14**

**AQUIFER SENSITIVITY**

**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: Aquifer_sensitivity.mxd
--------------	-----------------	------------------	---------------	-------------------------------



**EXPLANATION**

- SEPTIC SYSTEM LOCATION



1252 Commerce Drive  
Laramie, WY 82070  
www.trihydro.com  
(P) 307.745.7474 (F) 307.745.7729

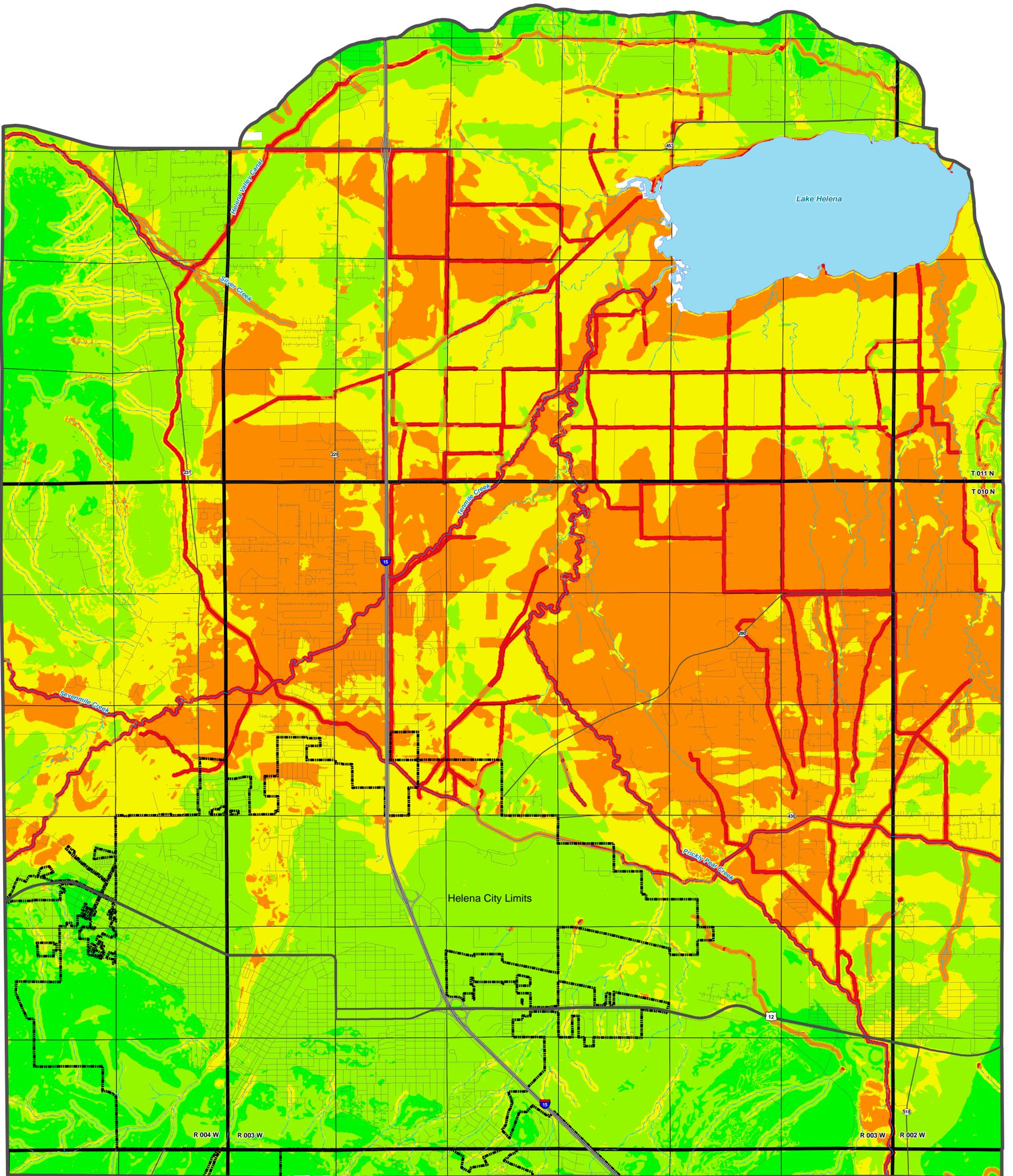
**FIGURE 15**

**SEPTIC SYSTEM LOCATIONS**

**HELENA VALLEY GROUNDWATER  
VULNERABILITY STUDY  
LEWIS AND CLARK COUNTY, MONTANA**

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

**PLATES**



**SENSITIVITY SCALE**



PLATE 1

AQUIFER SENSITIVITY

**HELENA VALLEY GROUNDWATER  
VULNERABILITY STUDY  
LEWIS AND CLARK COUNTY, MONTANA**

Drawn By: BR | Checked By: CSA | Scale: 1:27,000 | Date: 4/24/08 | File: Vulnerability\_Dsize.mxd

**APPENDIX A**

**BEDROCK GEOLOGY DESCRIPTIONS**



Table 2.--Generalized geologic units and water-yielding properties  
[gal/min, gallons per minute]

Erathem	System or series		Formation	Approximate thickness (feet)	General character	Water-yielding properties
Cenozoic	Quaternary	Holocene	Alluvium (Qal)	0-100	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.	Deposits yield abundant water to wells at all locations in the valley. Yields are commonly 20 to 300 gal/min.
		Pleistocene				
			Pediments (QTp)	0-50	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.	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.
	Tertiary	Pliocene to Eocene (?)	Sediments (undifferentiated) (Tsu)	0-6,000	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 "lake beds" 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.	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.
pre-Tertiary			Bedrock (pTb)	--	Cretaceous to Precambrian sedimentary rocks and Cretaceous plutonic and volcanic rocks surrounding the valley.	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 5 to 15 gal/min.

(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, 1989; 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]

Geologic characteristics			Inferred hydrologic characteristics				Inferred hydrologic responses in study area to		
Geologic map unit and map symbol (pl. 1)	Generalized distribution in study area	Generalized rock type	Parallel to stratification	Perpendicular to stratification	Where fractured or faulted	Recharge	Protracted withdrawal of ground water	Protracted fluid waste disposal	
Pliocene(?) and Miocene sedimentary rocks	Northern part of western mountains and possible thin remnants in southern part of North Hills area	Interbedded conglomerate, sandstone, siltstone, and tuff; minor mudstone	Low to moderate porosity and permeability, but highly variable within conglomerate and sandstone intervals; low permeability across tuff beds and alternating rock types	Low to moderate porosity and permeability, but vertically variable within conglomerate and sandstone intervals; low permeability across tuff beds and alternating rock types	Locally moderate hydraulic conductivity in fractured conglomerate and sandstone intervals; clay derived from alteration of tuff can seal fractures and faults; low to moderate hydraulic conductivity in fractured tuff	Moderate to rapid recharge by episodic influent seepage or seasonal canal leakage where conglomerate and sandstone beds are exposed at the surface; limited episodic recharge through fractures in tuff sequences	Moderate to rapid drawdown if water is not sustained by recharge; possible reduction of porosity and permeability by secondary growth and movement of clay in interstices; overall water-level decline likely on a secular basis with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; adsorption and retention of contaminants by clays and on fracture faces; swelling of some clays by wetting; once contaminated, likely slow to recover by flushing with fresh water	
Oligocene volcanic rocks; may include some rocks of possible late Eocene age in the southwest part of the map area	South Hills, Montana City area; southern part of western mountains	Rhyolite flows and intrusive bodies, minor tuff, breccia, and tuffaceous sandstone; unit O <sub>5</sub> Vt is mainly stratified tuff and thin interbeds of sandstone and pebble conglomerate	Low porosity and permeability in rhyolite where not fractured; moderate porosity and low permeability in breccia and tuffaceous sandstone	Low porosity and permeability in rhyolite where not fractured; moderate porosity but low permeability in breccia and tuffaceous sandstone	Fluid flow and storage primarily in fractures and faults; low to moderate fluid flow through fractures	Limited episodic recharge through fractures; slow recovery after withdrawal	Moderate to rapid drawdown, water production likely seasonal and cyclic; overall water-level decline likely on a secular basis with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fracture openings can be reduced or sealed by accumulation of particulate waste	

**Table 2a.** Geologic and inferred hydrologic characteristics of Helena area bedrock (Continued)

Geologic characteristics		Inferred hydrologic characteristics			Inferred hydrologic responses in study area to			
Geologic map unit and map symbol (pl. 1)	Generalized distribution in study area	Generalized rock type	Parallel to stratification	Perpendicular to stratification	Where fractured or faulted	Recharge	Protracted withdrawal of ground water	Protracted fluid waste disposal
Oligocene sedimentary rocks; may include some rocks of possible Eocene age at base	Spokane Bench, South Hills, and East Helena area	Interbedded sandstone, conglomerate, and tuff; minor carbonaceous siltstone and mudstone	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	Low to moderate porosity and permeability within sandstone and some conglomerate intervals; low permeability across tuff beds and interbedded rock types that contain silt, clay, and tuff	Locally 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	Low to moderate, locally high, recharge by episodic influent seepage or seasonal canal leakage where sandstone and conglomerate beds are exposed at the surface	Moderate to rapid drawdown; possible reduction of porosity and permeability by swelling and movement of clay; overall water-level decline likely on a secular basis with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; adsorption and retention of contaminants by clays and on fracture faces; swelling of some clays by wettings; once contaminated, likely slow to recover by flushing with fresh water
O&S								
Eocene volcanic rocks	Western mountains, including Mullian Pass areas and Dreadnought Hill	Andesitic and basaltic flows, breccia, and intrusive bodies	Low porosity and permeability where not fractured; can have intervals of moderate permeability at bases or tops of volcanic flows	Low porosity and permeability where not fractured	Fluid flow and storage primarily in fractures and faults; low to moderate fluid flow through fractures	Limited episodic recharge through fractures; slow recovery after withdrawal	Moderate to rapid drawdown in fractures; water production likely seasonal and cyclic; overall water-level decline likely on a secular basis with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fracture openings can be reduced or sealed by accumulation of particulate waste
EoV								
Cretaceous intrusive rocks, mainly granitic	Western mountains, Scratch-gravel Hills, and South Hills	Quartz monzonite, monzonite, granite and some mafic intrusive rocks	Not stratified; local alignment of minerals can produce planar and linear fabrics; low porosity and permeability unless weathered and fractured	Not stratified; local alignment of minerals can produce planar and linear fabrics; low porosity and permeability unless weathered and fractured	Fluid flow and storage primarily in fractures and faults; low to moderate fluid flow through fractures	Limited episodic recharge through fractures; slow recovery after withdrawal	Moderate drawdown; water production seasonal and cyclic; overall water-level decline likely on a secular basis with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fracture openings can be reduced or sealed by accumulation of particulate waste
Kg								

Table 2a. Geologic and inferred hydrologic characteristics of Helena area bedrock (Continued)

Geologic characteristics			Inferred hydrologic characteristics			Inferred hydrologic responses in study area to		
Geologic map unit and map symbol (pl. 1)	Generalized distribution in study area	Generalized rock type	Parallel to stratification	Perpendicular to stratification	Where fractured or faulted	Recharge	Protracted withdrawal of ground water	Protracted fluid waste disposal
Elkhorn Mountains Volcanics	Western mountains; South Hills, including Prickly Pear Creek and Clancy Creek drainages	Andesitic volcanic rocks; ash flow tuffs; shallow intrusive rocks, and minor sedimentary rocks; mainly well indurated and locally metamorphosed	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	Generally low permeability across interbedded units and within volcanic flows and shallow intrusive rocks	Fluid flow and storage primarily in fractures and faults; low to moderate fluid flow through fractures	Limited episodic recharge through fractures; slow recovery after withdrawal	Moderate to rapid drawdown; water production seasonal and cyclic; overall water-level decline likely on a secular basis with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fracture openings can be reduced or sealed by accumulation of particulate contaminants
Upper and Lower Cretaceous sedimentary rocks: Colorado Group and Kootenai Formation; locally includes Slim Sam Formation	Western mountains, including Dog Creek, Uncle George Creek, and tributaries of Tenmile Creek; North Hills, north-east part; and South Hills	Mudstone, siltstone, thin sandstone units; some conglomerate and very thin tuff beds; locally metamorphosed adjacent to younger intrusive bodies	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	Low permeability and hydraulic conductivity across interbedded mudstone and sandstone	Fractures and faults increase permeability and hydraulic conductivity	Limited episodic recharge mainly through fractures; slow recovery after protracted withdrawal	Moderate drawdown if well is completed in sandstone or conglomerate; moderate to rapid drawdown if completion is in fractured mudstone; precipitation of carbonate and authigenic growth or movement of clay during withdrawal can reduce porosity and permeability in pores; overall water-level decline likely on a secular basis with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste
Kck								

**Table 2a.** Geologic and inferred hydrologic characteristics of Helena area bedrock (Continued)

Geologic characteristics			Inferred hydrologic characteristics			Inferred hydrologic responses in study area to		
Geologic map unit and map symbol (pl. 1)	Generalized distribution in study area	Generalized rock type	Parallel to stratification	Perpendicular to stratification	Where fractured or faulted	Recharge	Protracted withdrawal of ground water	Protracted fluid waste disposal
Jurassic sedimentary rocks: Morrison Formation and Ellis Group	Western mountains, South Hills, and northeast part of North Hills	Mudstone, siltstone, and thin units of fine-grained sandstone with minor carbonaceous shale and limestone beds; locally metamorphosed where intruded by igneous rocks	Generally low porosity and permeability; low permeability where metamorphosed	Low to moderate porosity and permeability within sandstone; low permeability across mudstone and interbedded rock types	Fractures enhance dissolution, hydraulic conductivity, and reservoir storage within some carbonate beds and in some mudstone intervals	Limited episodic recharge mainly through fractures; slow recovery after withdrawal	Moderate drawdown in sandstone units and in fractured mudstone; precipitation of carbonate and authigenic growth or movement of clay in pores during withdrawal can reduce porosity and permeability; overall water-level decline likely on a secular basis with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste
Jme								
Permian and Pennsylvanian sedimentary rocks: Phosphoria, Quadrant, and Amsden Formations	South Hills and northeast part of North Hills	Silica- and calcium carbonate-cemented sandstone; thin limestone, siltstone, and dolostone beds; some thin chert in upper part	Generally low porosity and permeability; locally moderate porosity in intervals of dissolution in limestone and calcareous sandstone beds	Low to locally moderate porosity and permeability within carbonate and sandstone intervals; low permeability across mudstone and quartz-cemented sandstone intervals	Fractures enhance dissolution, hydraulic conductivity, and reservoir storage within some carbonate beds and in mudstone intervals	Limited episodic recharge mainly through fractures; slow recovery after withdrawal	Moderate to slow drawdown; withdrawal may induce reduction of porosity and permeability by precipitation of calcium carbonate; overall water-level decline likely on a secular basis with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste
PPqa								

**Table 2a.** Geologic and inferred hydrologic characteristics of Helena area bedrock (Continued)

Geologic characteristics			Inferred hydrologic characteristics				Inferred hydrologic responses in study area to		
Geologic map unit and map symbol (pl. 1)	Generalized distribution in study area	Generalized rock type	Parallel to stratification	Perpendicular to stratification	Where fractured or faulted	Recharge	Protracted withdrawal of ground water	Protracted fluid waste disposal	
Big Snowy Group: Heath, Otter, and Kibbey Formations Mb	Northeast part of North Hills	Mudstone, siltstone, and thin limestone beds; calcareous sandstone; local dolostone breccia near base	Generally low porosity and permeability; locally moderate porosity and permeability in breccia near base	Low permeability across mudstone intervals except where fractured, and then moderate at boundaries with sandstone or limestone	Permeability is increased by fractures in all rock types but particularly in mudstone intervals	Limited episodic recharge mainly through fractures; recovery slow in mudstone intervals where not densely fractured; slow recovery after withdrawal	Moderate drawdown if completion is in fractured mudstone; or carbonate beds with secondary dissolution porosity; overall water-level decline on a secular basis likely in mudstone units with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste	
Madison Group: Mission Canyon Limestone and Lodgepole Limestone Mml	South Hills, northeast part of North Hills, and locally in central part of western mountains	Thick bedded limestone; thin bedded limestone with some calcareous siltstone in lower part; metamorphosed to calc-silicate rock where intruded by Cretaceous igneous rocks	Moderate porosity, permeability, and hydraulic conductivity in intervals of dissolution; low porosity and permeability where metamorphosed	Discontinuous low to moderate porosity and permeability; locally moderate to high permeability and hydraulic conductivity in areas of dissolution	Fractures significantly enhance dissolution, permeability, and hydraulic conductivity throughout the rocks; fractures are likely the main source of permeability where unit is metamorphosed	Moderate to rapid recovery, but strongly episodic; slow recovery after protracted withdrawal	Moderate drawdown; can be rapid in intervals of dissolution; moderate to rapid drawdown where metamorphosed and fractured	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste; waste water of low pH can induce dissolution of the carbonate minerals	

Table 2a. Geologic and inferred hydrologic characteristics of Helena area bedrock (Continued)

Geologic characteristics			Inferred hydrologic characteristics			Inferred hydrologic responses in study area to		
Geologic map unit and map symbol (pl. 1)	Generalized distribution in study area	Generalized rock type	Parallel to stratification	Perpendicular to stratification	Where fractured or faulted	Recharge	Protracted withdrawal of ground water	Protracted fluid waste disposal
Three Forks and Jefferson Formations, undivided; as mapped includes some Mississippi strata at the top	Northeast part of North Hills; locally in central part of western mountains; South Hills	Thick bedded to laminated dolostone and minor very thin limestone; mudstone and carbonaceous mudstone in uppermost part; locally metamorphosed to calc-silicate rock adjacent to Cretaceous intrusive rocks	Low porosity and permeability with low hydraulic conductivity; parting parallel to stratification can locally have moderate hydraulic conductivity; low porosity and permeability where metamorphosed	Discontinuous low porosity and permeability; can be enhanced across bedding by dissolution of carbonate minerals	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	Moderate recovery mainly through fractures; episodic; slow recovery after protracted withdrawal	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	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste; infiltrating fluids of low pH can induce dissolution of the carbonate minerals
Dtj								
Upper and Middle Cambrian carbonate rocks: Hasmark, Pilgrim, Park, and Meagher Formations	Western mountains in northern tributaries of Tennessee Creek; South Hills; east of North Hills	Thick to thin bedded limestone, with pebble conglomerate and dolomite at top; mudstone at center and as partings in lower part; locally metamorphosed to calc-silicate rock	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	Discontinuous low porosity and permeability; can be increased across bedding by dissolution of carbonate minerals	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	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	Moderate drawdown in intervals of dissolution; moderate to rapid drawdown where fractured; overall water-level decline likely on a secular basis with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste; infiltrating fluids of low pH can induce dissolution of the carbonate minerals
CC								

**Table 2a.** Geologic and inferred hydrologic characteristics of Helena area bedrock (Continued)

Geologic characteristics			Inferred hydrologic characteristics				Inferred hydrologic responses in study area to		
Geologic map unit and map symbol (pl. 1)	Generalized distribution in study area	Generalized rock type	Parallel to stratification	Perpendicular to stratification	Where fractured or faulted	Recharge	Protracted withdrawal of ground water	Protracted fluid waste disposal	
Middle Cambrian clastic rocks; Wolsey Shale and Flathead Formation	Western mountains in northern tributaries of Tennessee Creek; South Hills; east of North Hills	Upper part: micaceous mudstone and siltstone beds with local thin limestone beds. Lower part: quartz-cemented sandstone and thin conglomerate with mudstone partings	Low porosity and permeability; where not fractured low hydraulic conductivity	Low porosity and permeability; where not fractured low hydraulic conductivity	Fluid flow and storage primarily in fractures and faults; low to moderate fluid flow through fractures	Likely slow recharge through fractures; episodic; slow recovery after withdrawal	Moderate drawdown of water in fractures; withdrawal can produce elevated precipitation of iron oxides; overall water-level decline likely on a secular basis with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste	
Intrusive rocks: Late Proterozoic Z9	Scratchgravel Hills; western mountains in lower reach of Sevenmile Creek	Medium to coarsely crystalline gabbro and diorite	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	Generally low porosity and permeability; low hydraulic conductivity; may have moderate permeability where deeply weathered	Fluid flow and storage primarily in fractures; generally low fluid flow through fractures	Areally limited outcrop area; likely very slow recharge through fractures; episodic; slow recovery after withdrawal	Moderate drawdown of water in fractures; overall decline on a secular basis with protracted withdrawal; withdrawal can induce elevated precipitation of iron oxides	Interconnected fractures can serve as conduits for limited contaminant flow	

Table 2a. Geologic and inferred hydrologic characteristics of Helena area bedrock (Continued)

Geologic characteristics			Inferred hydrologic characteristics			Inferred hydrologic responses in study area to		
Geologic map unit and map symbol (pl. 1)	Generalized distribution in study area	Generalized rock type	Parallel to stratification	Perpendicular to stratification	Where fractured or faulted	Recharge	Protracted withdrawal of ground water	Protracted fluid waste disposal
Bonner Quartzite	Western mountains including upper tributaries of Dog Creek and Greenhorn Mountain area	Medium- and coarse-grained quartzite; some fine pebbles; argillite partings	Low porosity and permeability where not fractured; local moderate porosity where cement has dissolved; low hydraulic conductivity	Low porosity and permeability where not fractured; low hydraulic conductivity	Fluid flow and storage primarily in fractures and faults; low to moderate fluid flow through fractures	Recharge episodic, mainly through fractures; likely slow recharge	Moderate drawdown of water in fractures; overall water-level decline likely on a secular basis with protracted withdrawal; induce elevated precipitation of iron oxides	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste
Mount Shields Formation	Western mountains, north-central part	Interbedded argillite and siltite with thin intervals of quartzite; quartzite beds fine upward into argillite	Low porosity and permeability where not fractured; low hydraulic conductivity	Low porosity and permeability where not fractured; low to no hydraulic conductivity across stratification	Hydraulic conductivity, fluid flow, and storage mainly in fractures and some faults	Recharge episodic, mainly through fractures; likely slow recharge after withdrawal	Moderate drawdown; overall water-level decline likely on a secular basis with protracted withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste
Yms								
Shepard and Snowship Formations, undivided	Western mountains, east-central and north-central parts	Quartzite; argillite and siltite; some calcareous argillite and limestone in Shepard Formation	Low porosity and permeability where not fractured; low hydraulic conductivity	Limited porosity and permeability where not fractured; low to no hydraulic conductivity across stratification	Fluid flow and storage mainly in fractures and some faults	Recharge episodic, mainly through fractures; likely slow recharge	Moderate drawdown; overall water-level decline likely on a secular basis with protracted withdrawal; can induce precipitation of iron oxides	Interconnected fractures can provide conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste
Yss								

**Table 2a.** Geologic and inferred hydrologic characteristics of Helena area bedrock (Continued)

Geologic characteristics		Inferred hydrologic characteristics				Inferred hydrologic responses in study area to		
Geologic map unit and map symbol (pl. 1)	Generalized distribution in study area	Generalized rock type	Parallel to stratification	Perpendicular to stratification	Where fractured or faulted	Recharge	Protracted withdrawal of ground water	Protracted fluid waste disposal
Helena and Empire Formations, undivided	Western mountains, east-central and northern parts;	Dolomitic argillite and siltite; limestone and dolostone; argillite and very thin quartzite beds in lowest parts; locally metamorphosed to calc-silicate rock	Generally low porosity and permeability	Porosity enhanced in carbonate beds and some sandstone beds by dissolution of carbonate and silica; generally low permeability across beds	Fluid flow and storage mainly in fractures and some faults; some dissolution of carbonate beds adjacent to fractures	Slow to moderate recovery; episodic recharge mainly through fractures; slow recovery after withdrawal	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	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste; infiltrating fluids of low pH can induce dissolution of the carbonate minerals
Spokane Formation	North Hills; South Hills east of Helena	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	Low porosity, permeability and hydraulic conductivity where not fractured; no porosity and permeability where strongly metamorphosed	Generally low hydraulic conductivity where not fractured	Porosity, fluid storage, and fluid flow mainly in fractures and some faults	Recharge episodic, mainly through fractures; likely slow recharge; slow recovery after withdrawal	Slow to moderate drawdown; can be rapid where unit is strongly fractured; overall water-level decline likely on a secular basis with protracted withdrawal; withdrawal can induce precipitation of iron oxides and some carbonate	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste; infiltration of fluids of low pH can induce dissolution of the carbonate minerals

Table 2a. Geologic and inferred hydrologic characteristics of Helena area bedrock (Continued)

Geologic characteristics			Inferred hydrologic characteristics			Inferred hydrologic responses in study area to		
Geologic map unit and map symbol (pl. 1)	Generalized distribution in study area	Generalized rock type	Parallel to stratification	Perpendicular to stratification	Where fractured or faulted	Recharge	Protracted withdrawal of ground water	Protracted fluid waste disposal
Greyson Formation Y9	North Hills; South Hills east of Helena	Siltite and argillite with quartzite in uppermost part	Low porosity, permeability, and hydraulic conductivity where not fractured; can have moderate porosity and permeability in some quartzite beds in uppermost part	Generally low hydraulic conductivity where not fractured	Porosity, fluid flow, and fluid storage mainly in fractures and some faults; dissolution of silica along fractures and faults in quartzite beds at the top can locally increase porosity, permeability, and hydraulic conductivity	Recharge episodic, mainly through fractures; likely slow recharge	Slow to moderate drawdown; can be rapid where unit is strongly fractured or in porous quartzite beds in upper part; overall decline likely on a secular basis with protracted withdrawal; withdrawal can induce precipitation of iron oxides and some carbonate; slow recovery after withdrawal	Interconnected fractures can serve as conduits for unimpeded contaminant flow; fractures and intergranular pore space can be reduced or sealed by accumulation of particulate waste

**APPENDIX B**

**SOIL UNITS DATA AND RATINGS**



**APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY**

Soil Unit Description	Unit Symbol	% Clay, Soil Unit	% Sand, Soil Unit	Ksat, Soil Unit	USDA Texture	Rock Fragments				Rating
						Top Depth, inches	Bottom Depth, Inches	% Fragments, Estimated Range		
Aridic Ustifluvents, 0 to 4 percent slopes	1B	9.5	64.1	58.1	sandy loam					<b>9</b>
						0	5	0	25	
						5	25	15	45	
						25	60	65	80	
Scravo gravelly loam, 0 to 2 percent slopes	9A	7.4	83.6	72.1	loamy sand					<b>9</b>
						0	6	25	45	
						6	17	70	85	
						17	60	70	85	
Fairway silt loam, 0 to 2 percent slopes	20A	19.3	39.9	29.1	loam					<b>7</b>
						0	45	0	0	
						45	60	0	70	
Sappington-Amesha loams, 1 to 4 percent slopes	33B	14.8	48.2	9.2	loam					<b>6</b>
	Sappington		60%			0	4	0	25	
						4	60	0	35	
	Amesha		35%			0	4	0	20	
						4	32	0	10	
						32	60	0	45	
Sappington-Amesha loams, 4 to 8 percent slopes	33C	15.0	48.8	9.0	loam					<b>6</b>
	Sappington		50%			0	4	0	25	
						4	60	0	35	
	Amesha		40%			0	4	0	20	
						4	32	0	10	
						32	60	0	45	
Chinook sandy loam, 2 to 8 percent slopes	39B	10.8	65.6	27.1	sandy loam					<b>7</b>
			90%			0	60	0	25	
Rock outcrop-Rubble land	40D	21.9	39.1	48.6	loam					<b>10</b>
	No data									

**APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY**

Soil Unit Description	Unit Symbol	% Clay, Soil Unit	% Sand, Soil Unit	Ksat, Soil Unit	USDA Texture	Rock Fragments			Rating
						Top Depth, inches	Bottom Depth, Inches	% Fragments, Estimated Range	
Rootel-Musselshell loams, 2 to 8 percent slopes	41C	19.8	37.0	12.1	loam				<b>6</b>
	Rootel		55%			0	4	0	0
						4	36	15	45
						36	60	Unw Bdx	
	Musselshell		35%			0	4	0	15
						4	34	0	40
						34	60	45	70
Holter-Castner channery loams, 8 to 45 percent slopes	61E	21.3	39.9	15.1	loam				<b>7</b>
	Holter		60%			0	8	25	45
						8	12	50	70
						12	60	70	85
	Castner		25%			0	4	25	40
						4	14	45	80
						14	60	Unw Bdx	
Windham channery loam, 4 to 15 percent slopes	64D	25.9	38.2	9.0	loam				<b>6</b>
			95%			0	7	25	75
						7	30	15	65
						30	60	70	85
Geohrock channery loam, cool, 4 to 25 percent slopes	89D	19.6	41.8	23.0	loam				<b>7</b>
			85%			0	4	25	45
						4	10	30	65
						10	18	40	65
						18	60	75	90
Neen silt loam, 0 to 2 percent slopes	115A	26.2	6.9	3.5	silt loam				<b>5</b>
			97%			0	60	0	0
Amesha silt loam, 1 to 3 percent slopes	136B	14.5	51.6	12.8	loam				<b>6</b>
			90%			0	7	0	10
						7	40	0	10
						40	60	0	45

**APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY**

Soil Unit Description	Unit Symbol	% Clay, Soil Unit	% Sand, Soil Unit	Ksat, Soil Unit	USDA Texture	Rock Fragments			Rating
						Top Depth, inches	Bottom Depth, Inches	% Fragments, Estimated Range	
Musselshell-Crago complex, 2 to 8 percent slopes	137B	19.2	48.7	14.8	loam				<b>6</b>
	Musselshell		70%			0	4	0	15
						4	34	0	40
						34	60	45	70
	Crago		25%			0	4	30	45
						4	32	40	65
						32	60	65	85
Crittenden-Tolman complex, 4 to 35 percent slopes	138D	17.4	53.4	35.8	sandy loam				<b>8</b>
	Crittenden		70%			0	20	0	25
						20	31	15	40
						31	50	50	70
	Tolman		25%			0	10	5	15
						10	19	50	60
						19	60	Unw Bdx	
Crago-Pensore channery loams, 15 to 45 percent slopes	141E	22.4	40.4	9.2	loam				<b>7</b>
	Crago		55%			0	4	30	45
						4	32	40	65
						32	60	65	85
	Pensore		35%			0	4	15	40
						4	15	45	65
						15	60	Unw Bdx	
Geohrock-Tolman channery loams, 4 to 35 percent slopes	163D	22.1	39.8	16.1	loam				<b>8</b>
	Geohrock		55%			0	4	25	45
						4	10	30	65
						10	18	40	65
						18	60	75	90
	Tolman		40%			0	5	40	45
						5	19	50	60
						19	60	Unw Bdx	

**APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY**

Soil Unit Description	Unit Symbol	% Clay, Soil Unit	% Sand, Soil Unit	Ksat, Soil Unit	USDA Texture	Rock Fragments			Rating
						Top Depth, inches	Bottom Depth, Inches	% Fragments, Estimated Range	
Windham-Lap channery loams, 8 to 45 percent slopes	164E	25.2	38.6	9.1	loam				<b>7</b>
	Windham		75%			0	7	25	75
						7	30	15	65
						30	60	70	85
	Lap		20%			0	6	30	50
						6	8	45	70
						8	14	65	80
						14	60	Unw Bdx	
Nippt very cobbly loam, 0 to 4 percent slopes	206A	7.0	84.3	73.5	loamy sand				<b>9</b>
			95%			0	3	35	55
						3	9	25	65
						9	15	55	70
						15	60	65	80
Thess loam, 0 to 2 percent slopes	209A	9.8	73.8	84.8	sandy loam				<b>9</b>
			90%			0	25	0	10
						25	60	70	85
Meadowcreek-Fairway complex, 0 to 2 percent slopes	218A	16.1	55.4	38.8	sandy loam				<b>8</b>
	Meadowcreek		70%			0	35	0	10
						35	60	65	85
	Fairway		25%			0	45	0	0
						45	60	0	70
Geohrock-Crago very cobbly loams, 2 to 8 percent slopes	233C	19.8	46.5	20.8	loam				<b>7</b>
	Geohrock		60%			0	4	60	55
						4	10	40	60
						10	18	45	60
						18	60	75	90
	Crago		30%			0	4	35	55
						4	32	25	55
						32	60	55	75

**APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY**

Soil Unit Description	Unit Symbol	% Clay, Soil Unit	% Sand, Soil Unit	Ksat, Soil Unit	USDA Texture	Rock Fragments			Rating
						Top Depth, inches	Bottom Depth, Inches	% Fragments, Estimated Range	
Assinniboine-Chinook sandy loams, 2 to 8 percent slopes	238B	14.3	65.8	23.8	sandy loam				<b>8</b>
	Assinniboine		45%			0	60	0 25	
	Chinook		40%			0	60	0 25	
Hauz-Sieben-Tolman channery loams, 8 to 45 percent slopes	263E	22.3	39.7	11.8	loam				<b>8</b>
	Hauz		35%			0	5	25 45	
						5	15	60 80	
						15	24	70 80	
						24	60	Unw Bdx	
	Sieben		30%			0	9	25 45	
						9	17	50 65	
						17	21	65 70	
						21	41	60 80	
						41	60	65 80	
	Tolman		25%			0	5	40 45	
						5	19	50 60	
						19	60	Unw Bdx	
Woodgulch-Elbeth-Rock outcrop complex, 8 to 35 percent slopes	286E	8.6	79.5	80.5	loamy sand				<b>9</b>
	Woodgulch		45%			0	1	0 0	
						1	5	10 20	
						5	51	0 10	
						51	60	10 45	
	Elbeth		30%			0	38	5 15	
						38	60	10 20	
	Rock outcrop		15%			No data			
Frenchcreek very gravelly loam, 2 to 15 percent slopes	288C	15.2	55.0	38.4	sandy loam				<b>8</b>
			90%			0	5	50 70	
						5	12	65 80	
						12	60	75 85	
Typic Ustifluvents, 0 to 4 percent slopes	301B	21.8	45.2	26.2	loam				<b>6</b>
			90%			No data			

**APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY**

Soil Unit Description	Unit Symbol	% Clay, Soil Unit	% Sand, Soil Unit	Ksat, Soil Unit	USDA Texture	Rock Fragments			Rating
						Top Depth, inches	Bottom Depth, Inches	% Fragments, Estimated Range	
Nippt-Attewan-Beaverell complex, 0 to 4 percent slopes	306A	7.9	78.1	79.9	loamy sand				9
	Nippt		55%			0	3	25	40
						3	9	30	70
						9	15	65	80
						15	60	75	90
	Attewan		20%			0	5	0	20
						5	10	0	30
						10	23	0	35
						23	60	50	85
	Beaverell		15%			0	3	25	40
						3	11	50	70
						11	60	45	75
Villy silt loam, 0 to 2 percent slopes	308A	27.6	8.0	3.7	silty clay loam				4
			95%			0	60	0	0
Thess-Scravo complex, 0 to 2 percent slopes	309A	8.7	78.5	78.8	sandy loam				9
	Thess		50%			0	25	0	10
						25	60	70	85
	Scravo		40%			0	6	25	45
						6	60	70	85
Musselshell-Crago-Pensore complex, 4 to 25 percent slopes	341D	19.7	44.8	12.4	loam				6
	Musselshell		40%			0	4	0	15
						4	34	0	40
						34	60	45	70
	Crago		25%			0	4	30	45
						4	32	40	65
						32	60	65	85
	Pensore		20%			0	4	25	40
						4	15	45	65
						15	60	Unw Bdx	

**APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY**

Soil Unit Description	Unit Symbol	% Clay, Soil Unit	% Sand, Soil Unit	Ksat, Soil Unit	USDA Texture	Rock Fragments			Rating
						Top Depth, inches	Bottom Depth, Inches	% Fragments, Estimated Range	
Tolman-Rock outcrop complex, 15 to 60 percent slopes	363F	25.1	37.0	10.0	loam				<b>8</b>
	Tolman		65%			0	5	40	45
						5	19	50	60
						19	60	Unw Bdx	
	Rock outcrop		25%					Unw Bdx	
Nippt gravelly loam, 0 to 2 percent slopes	406A	7.0	84.0	73.0	loamy sand				<b>9</b>
			95%			0	3	25	40
						3	9	40	70
						9	15	65	85
						15	60	75	90
Villard-Villy silt loams, 0 to 2 percent slopes	408A	18.6	46.0	60.3	loam				<b>8</b>
	Villard		70%			0	21	0	0
						21	32	0	5
						32	60	65	85
	Villy		20%			0	60	0	0
Attewan loam, 0 to 2 percent slopes	413A	11.1	65.0	63.7	sandy loam				<b>9</b>
			90%			0	5	0	20
						5	10	0	30
						10	23	0	35
						23	60	50	85
Crago-Musselshell gravelly loams, 4 to 35 percent slopes	433E	21.5	44.4	12.5	loam				<b>7</b>
	Crago		50%			0	4	30	45
						4	32	40	65
						32	60	65	85
	Musselshell		40%			0	4	20	40
						4	34	0	40
						34	60	45	70

**APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY**

Soil Unit Description	Unit Symbol	% Clay, Soil Unit	% Sand, Soil Unit	Ksat, Soil Unit	USDA Texture	Rock Fragments			Rating
						Top Depth, inches	Bottom Depth, Inches	% Fragments, Estimated Range	
Beaverell-Ashlo very cobbly loams, 0 to 2 percent slopes	465A	10.1	48.9	86.1	loam				<b>9</b>
	Beaverell		55%			0	3	30	55
						3	11	50	70
						11	60	45	75
	Ashlo		30%			0	6	35	60
						6	10	35	65
						10	60	70	85
Fluvaquents and Fluvaquentic Haplustolls soils, 0 to 4 percent slo	501B	20.9	38.6	21.7	loam				<b>7</b>
	Fluvaquents		60%			0	43	0	0
						43	60	55	70
	Fluvaquentic Haplus		40%			0	40	0	10
						40	60	65	85
Nippt-Attewan complex, 0 to 2 percent slopes	506A	7.7	80.7	104.1	loamy sand				<b>9</b>
	Nippt		70%			0	4	10	30
						4	10	25	65
						10	60	65	80
	Attewan		25%			0	5	0	20
						5	10	0	30
						10	23	0	35
						23	60	50	85
Attewan-Nippt complex, 0 to 2 percent slopes	513A	9.6	71.9	65.3	sandy loam				<b>8</b>
	Attewan		60%			0	5	0	20
						5	10	0	30
						10	23	0	35
						23	60	50	85
	Nippt		30%			0	3	25	40
						3	9	30	70
						9	15	65	80
						15	60	75	90

**APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY**

Soil Unit Description	Unit Symbol	% Clay, Soil Unit	% Sand, Soil Unit	Ksat, Soil Unit	USDA Texture	Rock Fragments			Rating
						Top Depth, inches	Bottom Depth, Inches	% Fragments, Estimated Range	
Fairway-Villy silt loams, 0 to 2 percent slopes	520A	22.7	26.8	18.6	silt loam				<b>6</b>
	Fairway		45%			0	45	0	0
						45	60	0	70
	Villy		40%			0	60	0	0
Geohrock gravelly loam, 2 to 8 percent slopes	532B	19.5	43.5	24.5	loam				<b>7</b>
			85%			0	4	25	45
						4	8	30	65
						8	17	40	65
						17	60	75	90
Tollex-Tolman-Hauz channery loams, 8 to 45 percent slopes	563E	23.4	38.4	25.7	loam				<b>8</b>
	Tollex		40%			0	2	0	0
						2	5	25	50
						5	18	75	90
						18	60	Unw Bdx	
	Tolman		35%			0	5	40	45
						5	19	50	60
						19	60	Unw Bdx	
	Hauz		20%			0	5	25	45
						5	15	60	80
						15	24	70	80
						24	60	Unw Bdx	
Yamacall-Attewan loams, 0 to 2 percent slopes	569A	18.0	49.7	33.3	loam				<b>7</b>
	Yamacall		50%			0	60	0	20
	Attewan		45%			0	5	0	20
						5	10	0	30
						10	23	0	40
						23	60	50	85
Crago gravelly loam, 0 to 8 percent slopes	637B	24.4	39.4	12.1	loam				<b>8</b>
			90%			0	4	30	45
						4	32	40	65
						32	60	65	85

**APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY**

Soil Unit Description	Unit Symbol	% Clay, Soil Unit	% Sand, Soil Unit	Ksat, Soil Unit	USDA Texture	Rock Fragments			Rating
						Top Depth, inches	Bottom Depth, Inches	% Fragments, Estimated Range	
Windham-Whitecow-Lap channery loams, 15 to 45 percent slopes	664E	25.4	38.4	10.0	loam				<b>8</b>
	Windham		45%			0	7	25	75
						7	30	15	65
						30	60	70	85
	Whitecrow		35%			0	1	0	0
						1	3	15	40
						3	25	40	75
						25	60	65	85
	Lap		15%			0	6	30	50
						6	8	45	70
						8	14	65	80
						14	60	Unw Bdx	
Whitecow channery loam, cool, 25 to 60 percent slopes	685F	25.8	38.0	11.6	loam				<b>7</b>
			95%			0	1	0	0
						1	3	15	40
						3	25	40	75
						25	60	65	85
Crittenden-Kalsted, bedrock substratum, sandy loams, 2 to 8 percent	738B	13.4	61.3	38.3	sandy loam				<b>8</b>
	Crittenden		50%			0	20	0	25
						20	31	15	40
						31	50	50	70
						50	60	Unw Bdx	
	Kalsted		40%			0	30	0	15
						30	50	15	45
						50	60	Unw Bdx	
Villy silt loam, 0 to 2 percent slopes, very rarely flooded	808A	27.8	7.0	2.9	silty clay loam				<b>4</b>
	Villy		95%			0	60	0	0

**APPENDIX B. SOIL UNITS DATA AND RATINGS, LEWIS AND CLARK GROUNDWATER VULNERABILITY**

Soil Unit Description	Unit Symbol	% Clay, Soil Unit	% Sand, Soil Unit	Ksat, Soil Unit	USDA Texture	Rock Fragments			Rating
						Top Depth, inches	Bottom Depth, Inches	% Fragments, Estimated Range	
Whitecow-Warneke channery loams, 15 to 45 percent slopes	885F	23.7	39.3	10.9	loam				<b>6</b>
	Whitecrow		70%			0	1	0	0
						1	3	15	40
						3	25	40	75
						25	60	65	85
	Warneke		20%			0	4	25	45
						4	16	60	80
						16	60	Unw Bdx	
Tolox-Mocmont-Rock outcrop complex, 25 to 60 percent slopes	963F	23.1	38.0	43.7	loam				<b>9</b>
	Tolox		45%			0	2	0	0
						2	5	25	50
						5	18	75	90
						18	60	Unw Bdx	
	Mocmont		35%			0	2	0	0
						2	16	45	70
						16	60	60	90
	Rock Outcrop		15%					Unw Bdx	

**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**

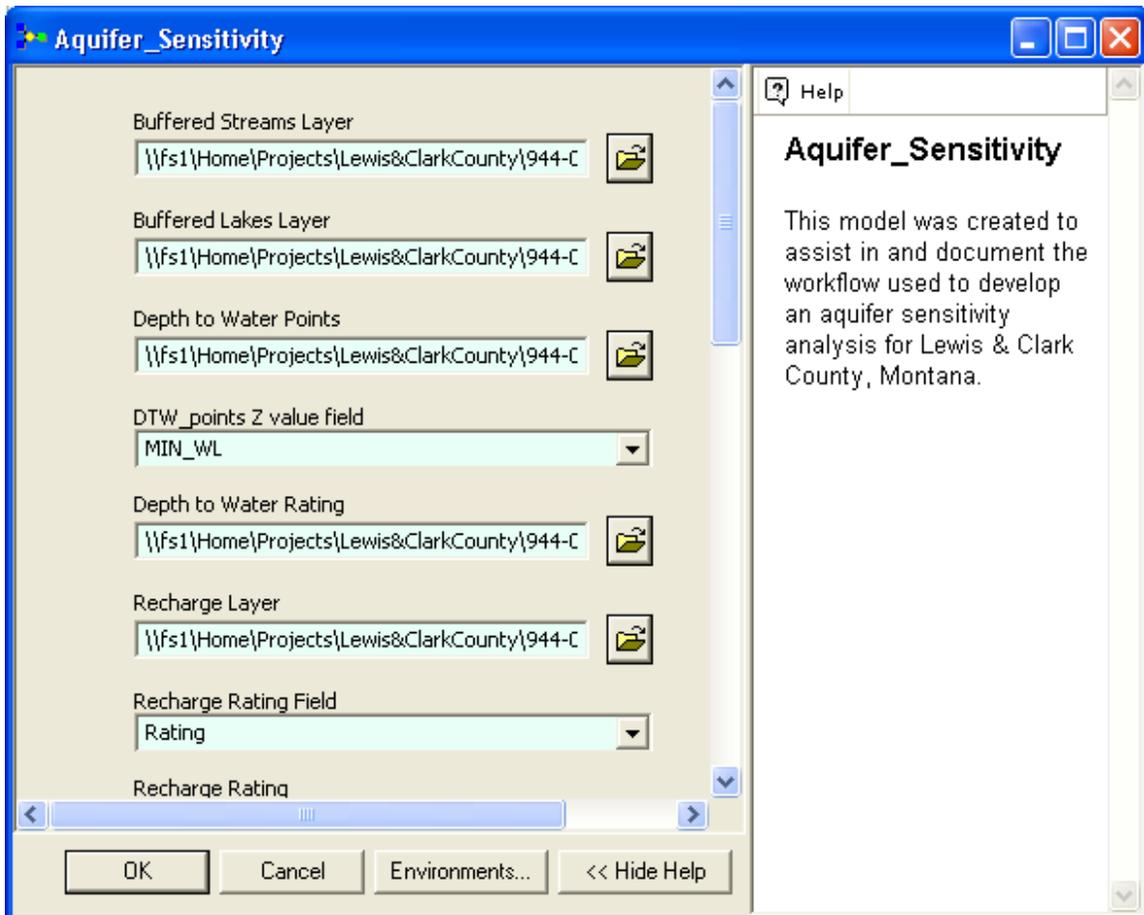


## Appendix C

### 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

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

## D.1 HELENA VALLEY MONTANA 2001 LAND SURFACE CONTOUR DEM

### Identification\_Information:

#### Citation:

##### 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:

##### Time\_Period\_Information:

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\_Standard\_Version: FGDC-STD-001-1998

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:

##### Citation\_Information:

Originator: Trihydro Corporation

Publication\_Date: 20080501

Title: Helena Valley Montana 2006 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\_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:

##### Time\_Period\_Information:

##### 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\_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: 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\_Standard\_Version: FGDC-STD-001-1998

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:  
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: Address\_pts  
 Attribute:  
 Attribute\_Label: HOUSENUMBE  
 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  
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](mailto:giscenter@co.lewis-clark.mt.us)  
Hours\_of\_Service: Mon-Fri 8-5  
Metadata\_Standard\_Name: FGDC Content Standards for Digital Geospatial Metadata  
Metadata\_Standard\_Version: FGDC-STD-001-1998  
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 veneers 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:

helena: geologic units, faults, and other line features

helenard: USGS DLG highways and roads

helenarr: USGS DLG railroads

helenact: USGS DLG county boundaries

helenahy: USGS DLG hydrography

helenapl: BLM PLSS boundaries

heltrlin: electric transmission lines

helctdiv: continental divide boundary

wpgcmykg.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\_Bounding\_Coordinate: -112.375

East\_Bounding\_Coordinate: -111.786

North\_Bounding\_Coordinate: 46.792

South\_Bounding\_Coordinate: 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: Jefferson County

Place\_Keyword: Lewis and Clark 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

Postal\_Code: 80225-0046

Country: USA

Contact\_Voice\_Telephone: 303-236-8007

Browse\_Graphic:

Browse\_Graphic\_File\_Name: [http://geology.cr.usgs.gov/pub/wri/wri-00-4212/wri-00-4212\\_print.pdf](http://geology.cr.usgs.gov/pub/wri/wri-00-4212/wri-00-4212_print.pdf)

Browse\_Graphic\_File\_Description: graphic representation of map layout

Browse\_Graphic\_File\_Type: PDF

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:

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:

Source\_Citation:



Citation\_Information:

Originator: Bregman, M.L.

Publication\_Date: 1981

Title: Structural geology of the Sheep Creek and Rattlesnake Mountain quadrangles, Lewis and Clark County, Montana

Series\_Information:

Series\_Name: Montana Bureau of Mines and Geology Geologic Map

Issue\_Identification: 26

Source\_Scale\_Denominator: 24000

Type\_of\_Source\_Media: paper

Source\_Time\_Period\_of\_Content:

Time\_Period\_Information:

Single\_Date/Time:

Calendar\_Date: 1981

Source\_Currentness\_Reference: publication date

Source\_Citation\_Abbreviation: Bregman (1981)

Source\_Contribution: geologic data source

Source\_Information:

Source\_Citation:

Citation\_Information:

Originator: Knopf, Adolf

Publication\_Date: 1963

Title: Geology of the northern part of the Boulder batholith and adjacent area, Montana

Series\_Information:

Series\_Name: U.S. Geological Survey Miscellaneous Investigations Map

Issue\_Identification: I-381

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: Knopf (1963)

Source\_Contribution: geologic data source

Source\_Information:

Source\_Citation:

Citation\_Information:

Originator: Reynolds, M.W.

Originator: Hays, W.H.

Publication\_Date: 2002

Title: Geologic map of the Nelson quadrangle, Lewis and Clark County, Montana

Series\_Information:

Series\_Name: U.S. Geological Survey Geologic Investigations Map

Issue\_Identification: I-2774

Type\_of\_Source\_Media: paper

Source\_Time\_Period\_of\_Content:

Time\_Period\_Information:

Single\_Date/Time:

Calendar\_Date: 2002

Source\_Currentness\_Reference: publication date

Source\_Citation\_Abbreviation: Reynolds and Hays (2002)

Source\_Contribution: geologic data source

Source\_Information:

Source\_Citation:

Citation\_Information:

Originator: Robinson, G.D.

Originator: McCallum, M.E.

Originator: Hays, W.H.

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:  
Time\_Period\_Information:  
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:  
Time\_Period\_Information:  
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:  
Time\_Period\_Information:  
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:  
Source\_Citation:  
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\brobesson\LOCALS~1\Temp\xml7F8.tmp

Process\_Step:  
 Process\_Description: Dataset copied.  
 Source\_Used\_Citation\_Abbreviation:

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

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: AREA

Attribute:

Attribute\_Label: PERIMETER

Attribute:

Attribute\_Label: HELENA\_

Attribute:

Attribute\_Label: HELENA\_ID

Attribute:

Attribute\_Label: UNIT

Attribute:

Attribute\_Label: SOURCE

Attribute:

Attribute\_Label: LABEL

Attribute:

Attribute\_Label: DESC\_

Attribute:

Attribute\_Label: SYMBOL

Attribute:

Attribute\_Label: PATTERN

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:

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 -
```



```

> 113 SYMBOL      3  3  I  -
> 116 SOURCE      3  3  I  -
>
>
>HELENA.REF
>COLUMN ITEM NAME  WIDTH OUTPUT TYPE N.DEC ALTERNATE NAME
>  1 SOURCE        4  4  I  -
>  5 SCALE         8  8  I  -
> 13 AUTHORS       200 200  C  -
> 213 YEAR         4  4  I  -
> 217 REFERENCE    250 250  C  -
>
>
>HELENA.RU:
>
>COLUMN ITEM NAME  WIDTH OUTPUT TYPE N.DEC ALTERNATE NAME
>  1 UNIT          4  4  I  -
>  5 DESC         100 100  C  -
> 105 DESC1       160 160  C  -
> 265 DESC2       160 160  C  -
> 425 DESC3       160 160  C  -
>
>
>HELCTDIV.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 HELCTDIV#     4  5  B  -
> 29 HELCTDIV-ID   4  5  B  -
> 33 SOURCE        4  4  I  -
>
>
>HELENACT.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 HELENACT#     4  5  B  -
> 29 HELENACT-ID   4  5  B  -
> 33 SOURCE        4  4  I  -
>
>
>HELENAHY.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 HELENAHY#     4  5  B  -

```

```

> 29 HELENAHY-ID      4  5  B  -
> 33 SOURCE           4  4  I  -
>
>
>HELENAPL.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 HELENAPL#        4  5  B  -
> 29 HELENAPL-ID      4  5  B  -
> 33 SOURCE           4  4  I  -
>
>
>HELENARD.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 HELENARD#        4  5  B  -
> 29 HELENARD-ID      4  5  B  -
> 33 SOURCE           4  4  I  -
>
>
>HELENARR.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 HELENARR#        4  5  B  -
> 29 HELENARR-ID      4  5  B  -
> 33 SOURCE           4  4  I  -

```

```

>Unique item values in helena.pat
>UNIT LABEL      DESC
>1  No bedrock   No bedrock data
>2  POMIs       Pliocene(?) and Miocene sedimentary rocks
>3  OGv         Oligocene volcanic rocks
>4  OGvt        Oligocene volcanic rocks (tuffaceous)
>5  OGs         Oligocene sedimentary rocks
>6  EOv         Eocene volcanic rocks
>7  Kg          Cretaceous intrusive rocks, mainly granitic
>8  Kev         Elkhorn Mountains Volcanics
>9  Kck         Upper and Lower Cretaceous sedimentary rocks
>10 Jme         Jurassic sedimentary rocks
>11 PIPqa       Permian and Pennsylvanian sedimentary rocks
>12 Mb          Big Snowy Group
>13 Mml         Madison Group
>14 Dtj         Three Forks Formation and Jefferson Formation, undivided

```



- >15 Cc Upper and Middle Cambrian carbonate rocks
- >16 Ccl 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
- >Unique item values in helena.aat
- >SYMBOL NAME
- >1 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:

Digital\_Transfer\_Information:

Format\_Name: ARCE, SHP

Format\_Version\_Number: created with ArcInfo v. 8.1.2

File-Decompression\_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\_Standard\_Version: FGDC-STD-001-1998

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:

#### Description:

Abstract: This data set represents the surficial geology of the Helena Valley, Montana. It was digitized from: "Briar, D.W. and J.P. Madison, 1992. Hydrogeology of the Helena Valley-Fill Aquifer System, West-Central Montana: U.S. Geological Survey, Water-Resources Investigations Report 92-4023, 49 p".

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  
Title: Hydrogeology of the Helena Valley-Fill Aquifer System, West-Central Montana: U.S. Geological Survey, Water-Resources Investigations Report 92-4023, 49 p  
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\_surfacial  
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:

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\_Standard\_Version: FGDC-STD-001-1998

Metadata\_Time\_Convention: local time

Metadata\_Extensions:

Online\_Linkage: <http://www.esri.com/metadata/esriprof80.html>

Profile\_Name: ESRI Metadata Profile



## D.6 BLM QUARTER-QUARTER SECTIONS

### Identification\_Information:

#### Citation:

##### Citation\_Information:

Originator: Bureau of Land Management

Originator: U.S. Forest Service

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

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](mailto: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:

Horizontal\_Positional\_Accuracy\_Report:

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, interestes, 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 conectivity 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 conectivity 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\_Clark\_County\lades.xml  
 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: 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: Indkey  
 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

Attribute\_Domain\_Values:

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:



Enumerated\_Domain\_Value: G  
Enumerated\_Domain\_Value\_Definition: SW 1/4 of NW 1/4 of  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: H  
Enumerated\_Domain\_Value\_Definition: SE 1/4 of NW 1/4 of  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: I  
Enumerated\_Domain\_Value\_Definition: NE 1/4 of SW 1/4 of  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: J  
Enumerated\_Domain\_Value\_Definition: NW 1/4 of SW 1/4 of  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: K  
Enumerated\_Domain\_Value\_Definition: SW 1/4 of SW 1/4 of  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: L  
Enumerated\_Domain\_Value\_Definition: SE 1/4 of SW 1/4 of  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: M  
Enumerated\_Domain\_Value\_Definition: NE 1/4 of SE 1/4 of  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: N  
Enumerated\_Domain\_Value\_Definition: NW 1/4 of SE 1/4 of  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: O  
Enumerated\_Domain\_Value\_Definition: SW 1/4 of SE 1/4 of  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: P  
Enumerated\_Domain\_Value\_Definition: SE 1/4 of SE 1/4 of  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: Q  
Enumerated\_Domain\_Value\_Definition: All existing nominal locations within this section.  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: Z  
Enumerated\_Domain\_Value\_Definition: Nominal location not relevant.  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Unrepresentable\_Domain: Sequential unique whole numbers that are automatically generated.  
Attribute:  
Attribute\_Label: ladescar  
Attribute\_Definition: Acreage of polygon  
Attribute\_Definition\_Source: BLM  
Attribute\_Domain\_Values:  
Unrepresentable\_Domain: Positive floating point number.  
Attribute:  
Attribute\_Label: ladunt  
Attribute\_Definition: Unit of measure for ladescar  
Attribute\_Definition\_Source: BLM

Attribute\_Domain\_Values:

Attribute:

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:

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.

Enumerated\_Domain\_Value\_Definition\_Source: BLM

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 NW1/4 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: 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 township  
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: Township  
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](http://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](mailto: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](mailto: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](mailto: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](mailto:regina.lefort@blm.gov)

Metadata\_Standard\_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata\_Standard\_Version: FGDC-STD-001-1998

Metadata\_Time\_Convention: local time



## D.7 BLM SECTIONS

### Identification\_Information:

#### Citation:

##### Citation\_Information:

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 (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

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](mailto: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:

Horizontal\_Positional\_Accuracy\_Report:

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, interestes, 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 conectivity 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 conectivity 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\_Clark\_County\first.xml  
 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: 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 twnftr and rngftr 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 ladesec 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](http://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](mailto: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](mailto: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](mailto: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](mailto:regina.lefort@blm.gov)

Metadata\_Standard\_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata\_Standard\_Version: FGDC-STD-001-1998

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.8 BLM TOWNSHIPS

### Identification\_Information:

#### Citation:

##### Citation\_Information:

Originator: Bureau of Land Management

Originator: U.S. Forest Service

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:

##### 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](mailto: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:

Horizontal\_Positional\_Accuracy\_Report:

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 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, interestes, 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 conectivity 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 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 conectivity 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\_Clark\_County\tnwshp.xml  
 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: 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\_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\_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 twnftr and rngftr 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

Attribute:

Attribute\_Label: primer  
Attribute\_Definition: Principal Meridian  
Attribute\_Definition\_Source: BLM  
Attribute\_Domain\_Values:  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 01  
Enumerated\_Domain\_Value\_Definition: First principal  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 02  
Enumerated\_Domain\_Value\_Definition: Second principal  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 03  
Enumerated\_Domain\_Value\_Definition: Third principal  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 04  
Enumerated\_Domain\_Value\_Definition: Fourth principal  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 05  
Enumerated\_Domain\_Value\_Definition: Fifth principal  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 06  
Enumerated\_Domain\_Value\_Definition: Sixth principal  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 07  
Enumerated\_Domain\_Value\_Definition: Black Hills  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 08  
Enumerated\_Domain\_Value\_Definition: Boise  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 09  
Enumerated\_Domain\_Value\_Definition: Chickasaw  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 10  
Enumerated\_Domain\_Value\_Definition: Choctaw  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 11  
Enumerated\_Domain\_Value\_Definition: Cimarron  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 12  
Enumerated\_Domain\_Value\_Definition: Copper River  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 13  
Enumerated\_Domain\_Value\_Definition: Fairbanks  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:



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: Uintah  
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.

Attribute\_Definition\_Source: BLM  
Attribute\_Domain\_Values:  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: N  
Enumerated\_Domain\_Value\_Definition: North of baseline  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: S  
Enumerated\_Domain\_Value\_Definition: South of baseline  
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: twnftr  
Attribute\_Definition: Numeric code identifying fractional tier  
Attribute\_Definition\_Source: BLM  
Attribute\_Domain\_Values:  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 0  
Enumerated\_Domain\_Value\_Definition: Not a fractional tier  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 1  
Enumerated\_Domain\_Value\_Definition: 1/4 tier  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 2  
Enumerated\_Domain\_Value\_Definition: 1/2 tier  
Enumerated\_Domain\_Value\_Definition\_Source: BLM  
Enumerated\_Domain:  
Enumerated\_Domain\_Value: 3  
Enumerated\_Domain\_Value\_Definition: 3/4  
Enumerated\_Domain\_Value\_Definition\_Source: BLM

Attribute:

Attribute\_Label: datemodifi

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 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](http://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](mailto: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](mailto:regina.lefort@blm.gov)

Metadata\_Standard\_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata\_Standard\_Version: FGDC-STD-001-1998

Metadata\_Time\_Convention: local time

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:

##### Citation\_Information:

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:

##### Time\_Period\_Information:

Single\_Date/Time:

Calendar\_Date: unknown

Currentness\_Reference: Unknown

#### 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:

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\_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: 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:

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\_Standard\_Version: FGDC-STD-001-1998  
 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:

##### Citation\_Information:

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\_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\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:

##### 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\brobesson\LOCALS~1\Temp\xml3028.tmp  
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 computersystem at the U.S. Geological Survey, EROS Data Center, no warrantyexpressed or implied is made by either regarding the utility of thedata on any system, nor shall the act of distribution constitute anysuch warranty. The USGS will warrant the delivery of this product incomputer-readable format and will offer appropriate adjustment ofcredit when the product is determined unreadable by correctly adjustedcomputer peripherals, or when the physical medium is delivered indamaged condition. Requests for adjustments of credit must be madewithin 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 SurveyEROS 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\_Standard\_Version: FGDC-STD-001-1998  
  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:

##### Citation\_Information:

Originator: Trihydro Corporation

Publication\_Date: 20080501

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:

##### 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\_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



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:

Logical\_Consistency\_Report: This dataset contains a single, closed and attributed polygon.

Completeness\_Report: This dataset is complete.

Positional\_Accuracy:

Horizontal\_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:

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\_Standard\_Version: FGDC-STD-001-1998  
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:

##### Citation\_Information:

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

Online\_Linkage: \\fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Lewis\_Clark\_FINAL.gdb

### Description:

#### Abstract:

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://mbmgwic.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:

##### Time\_Period\_Information:

Range\_of\_Dates/Times:

Beginning\_Date: 1860

Ending\_Date: 20070621

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://mbmggwic.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](mailto: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:

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://mbmggwic.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:

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.

-- SURGPS: 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://mbmggwic.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:

Process\_Step:

Process\_Description: Metadata imported.

Source\_Used\_Citation\_Abbreviation: C:\DOCUME~1\brobesson\LOCALS~1\Temp\xml2E5C.tmp

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:

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:

Enumerated\_Domain\_Value: NAV-GPS

Enumerated\_Domain\_Value\_Definition: uncorrected Global Positioning System locations

Enumerated\_Domain\_Value\_Definition\_Source: GWIC

Enumerated\_Domain:

Enumerated\_Domain\_Value: SUR-GPS

Enumerated\_Domain\_Value\_Definition: corrected Global Positioning System locations

Enumerated\_Domain\_Value\_Definition\_Source: GWIC

Enumerated\_Domain:

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\_Standard\_Version: FGDC-STD-001-1998  
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\_Bounding\_Coordinate: -112.084542

East\_Bounding\_Coordinate: -111.946822

North\_Bounding\_Coordinate: 46.628907

South\_Bounding\_Coordinate: 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\_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: 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  
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: 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

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\_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](mailto:giscenter@co.lewis-clark.mt.us)

Hours\_of\_Service: Mon-Fri 8-5

Metadata\_Standard\_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata\_Standard\_Version: FGDC-STD-001-1998

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:

##### Citation\_Information:

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 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\broberson\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\_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  
 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@edemail.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: 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@edemail.cr.usgs.gov

Metadata\_Standard\_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata\_Standard\_Version: FGDC-STD-001-1998

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:

##### Citation\_Information:

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\_Thesaurus: U.S. Department of the Interior, U.S. Geological Survey, 1999, Standards for National Hydrography Dataset (<http://mapping.usgs.gov/standards/>)

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\_Thesaurus: U.S. Department of Commerce, 1977, Countries, dependencies, areas of special sovereignty, and their principal administrative divisions (Federal Information Processing Standards 10-3): Washington, D.C., National Institute of Standards and Technology.

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

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](http://mapping.usgs.gov/esic/esic_index.html)

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\_Step:

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\_Step:

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\_Step:

Process\_Description: See dataset specific metadata.

Process\_Step:

Process\_Description: Dataset copied.

Source\_Used\_Citation\_Abbreviation: \\f880\oracle\_export\GDBExtractServer\Template\NHD\_Template\_High.mdb

Process\_Step:

Process\_Description: Dataset copied.



Source\_Used\_Citation\_Abbreviation: \\fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\NHD111229\NHD111229.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: 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\_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: Lakes\_24k  
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: 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/>.

Entity\_and\_Attribute\_Detail\_Citation: The names and definitions of all feature types, characteristics, and values are in U.S. Geological Survey, 1999, Standards for National Hydrography Dataset High Resolution: Reston, Virginia, U.S. Geological Survey. The document is 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 at: <http://erg.usgs.gov/isb/pubs/factsheets/fs06002.html>.

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](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](http://mapping.usgs.gov/esic/esic_index.html)

Metadata\_Standard\_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata\_Standard\_Version: FGDC-STD-001-1998

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:

##### Citation\_Information:

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:

Series\_Name: 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.

##### 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 tubercid 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



Ending\_Date: present  
Currentness\_Reference: publication date  
Status:  
Progress: Ongoing  
Maintenance\_and\_Update\_Frequency: In Continuous Increments  
Spatial\_Domain:  
Bounding\_Coordinates:  
West\_Bounding\_Coordinate: -112.088295  
East\_Bounding\_Coordinate: -111.889211  
North\_Bounding\_Coordinate: 46.713366  
South\_Bounding\_Coordinate: 46.565776  
Keywords:  
Theme:  
Theme\_Keyword\_Thesaurus: None  
Theme\_Keyword: Wetlands  
Theme\_Keyword: Deepwater habitats  
Theme\_Keyword: Hydrography  
Theme\_Keyword: Surface water  
Theme\_Keyword: Swamps, marshes, bogs, fens  
Place:  
Place\_Keyword: United States  
Place\_Keyword: Montana  
Place\_Keyword: Lewis & Clark County  
Place\_Keyword: Helena  
Access\_Constraints: None  
Use\_Constraints: None. Acknowledgement of the U.S. Fish and Wildlife Service and (or) the National Wetlands Inventory would be appreciated in products derived from these data  
Point\_of\_Contact:  
Contact\_Information:  
Contact\_Organization\_Primary:  
Contact\_Organization: U.S. Fish and Wildlife Service  
Contact\_Person: Tom Dahl  
Contact\_Position: Divison of Habitat and Resouce Conservation  
Contact\_Address:  
Address\_Type: mailing 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  
Browse\_Graphic:  
Browse\_Graphic\_File\_Description: Topical overlay showing the extent and type of wetland and deepwater habitats.  
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. Fish and Wildlife Serivce, National Wetlands Inventory  
Publication\_Date: Various  
Title: Wetlands and Deepwater Habitats of the Conterminous United States  
Edition: Version 1.0  
Publication\_Information:  
Publication\_Place: Washington, D.C. USA  
Publisher: U.S. Fish and Wildlife Service  
Data\_Quality\_Information:  
Attribute\_Accuracy:

**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 of 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:**

**Publication\_Place:** 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:**

**Time\_Period\_Information:**

**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 where 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:  
Process\_Description: Dataset copied.

Process\_Step:  
Process\_Description: Metadata imported.

Process\_Step:  
Process\_Description: Dataset copied.  
Source\_Used\_Citation\_Abbreviation: Server=igsarchwdbgis01; Service=5151; User=NWIDBA; Version=SDE.DEFAULT

Process\_Step:  
Process\_Description: Metadata imported.  
Source\_Used\_Citation\_Abbreviation: C:\DOCUME~1\brobesson\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\_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

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\_Standard\_Version: FGDC-STD-001-1998

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:

##### Citation\_Information:

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: \\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\_Thesaurus: U.S. Department of the Interior, U.S. Geological Survey, 1999, Standards for National Hydrography Dataset (<http://mapping.usgs.gov/standards/>)

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\_Thesaurus: U.S. Department of Commerce, 1977, Countries, dependencies, areas of special sovereignty, and their principal administrative divisions (Federal Information Processing Standards 10-3): Washington, D.C., National Institute of Standards and Technology.

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

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](http://mapping.usgs.gov/esic/esic_index.html)

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\_Step:

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\_Step:

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\_Step:

Process\_Description: See dataset specific metadata.

Process\_Step:

Process\_Description: Dataset copied.

Source\_Used\_Citation\_Abbreviation: \\f880\oracle\_export\GDBExtractServer\Template\NHD\_Template\_High.mdb

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: 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, 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/>.

Entity\_and\_Attribute\_Detail\_Citation: The names and definitions of all feature types, characteristics, and values are in U.S. Geological Survey, 1999, Standards for National Hydrography Dataset High Resolution: Reston, Virginia, U.S. Geological Survey. The document is 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 at: <http://erg.usgs.gov/isb/pubs/factsheets/fs06002.html>.

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](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](mailto: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](http://mapping.usgs.gov/esic/esic_index.html)

Metadata\_Standard\_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata\_Standard\_Version: FGDC-STD-001-1998

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:

##### Time\_Period\_Information:

Single\_Date/Time:

#### Status:

#### Spatial\_Domain:

##### Bounding\_Coordinates:

West\_Bounding\_Coordinate: -113.181712

East\_Bounding\_Coordinate: -111.482000

North\_Bounding\_Coordinate: 47.988137

South\_Bounding\_Coordinate: 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:

##### 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: 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: DATEMOD  
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\_Standard\_Version: FGDC-STD-001-1998  
 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:

##### Citation\_Information:

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\_Place: Helena, MT

Publisher: Montana State Library

Online\_Linkage: [http://nris.mt.gov/nsdi/nris/shape/precip71\\_00.zip](http://nris.mt.gov/nsdi/nris/shape/precip71_00.zip)

Online\_Linkage: [http://nris.mt.gov/nsdi/nris/e00/precip71\\_00.zip](http://nris.mt.gov/nsdi/nris/e00/precip71_00.zip)

##### Larger\_Work\_Citation:

##### Citation\_Information:

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\_Information:

Publication\_Place: Corvallis, Oregon

Publisher: PRISM Group, Oregon Climate Service, Oregon State University

Online\_Linkage: <http://www.ocs.orst.edu/prism/>

Online\_Linkage: <ftp://ftp.ncdc.noaa.gov/pub/data/prism100/>

### 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](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:

Citation\_Information:

Originator: National Climatic Data Center (NCDC)  
Publication\_Date: 2001  
Title: U.S. National 1971-2000 Climate Normals, Climatology of the United States  
Publication\_Information:  
Publication\_Place: Asheville, NC, USA  
Publisher: National Climatic Data Center (NCDC)

Source\_Information:

Source\_Citation:

Citation\_Information:

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\_Information:

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\_Information:

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\_Information:

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:  
   Process\_Description: Metadata imported.  
   Source\_Used\_Citation\_Abbreviation: H:\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\precip71\_00\precip71\_00.xml  
 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: 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\_Information:  
           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:

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:

Contact\_Organization: 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](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](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\_or\_Province: 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\_Standard\_Version: FGDC-STD-001-1998  
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:

##### Citation\_Information:

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-Cental 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\_Bounding\_Coordinate: -112.382134

East\_Bounding\_Coordinate: -111.773058

North\_Bounding\_Coordinate: 46.801439

South\_Bounding\_Coordinate: 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:  
Citation\_Information:  
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\_Description: Screen digitized Helena, MT area isohyets from: "Hydrology of Helena Area Bedrock, West-Central Montana, 1993-98" USGS Water-Resources Investigations Report 00-4212.  
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  
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\_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\_Standard\_Version: FGDC-STD-001-1998  
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:

##### Citation\_Information:

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 hwy's and private drives, along which a residence or structure is located. This data set has been updated to include 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\_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: 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:

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\_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\_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\xml39.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\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: Metadata imported.  
 Source\_Used\_Citation\_Abbreviation: c:\ArcTemp\xml7.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  
       Attribute\_Domain\_Values:  
         Unrepresentable\_Domain: Coordinates defining the features.  
     Attribute:  
       Attribute\_Label: SUFFIX  
       Attribute\_Definition: Road suffix  
       Attribute\_Definition\_Source: addressing office  
     Attribute:  
       Attribute\_Label: STREETTYPE  
       Attribute\_Definition: Road type...Rd. St. Ave.  
       Attribute\_Definition\_Source: addressing office  
     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\_Standard\_Version: FGDC-STD-001-1998

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:

##### Citation\_Information:

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: \\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:

##### Time\_Period\_Information:

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: \\FAEF341\CS\Temp\LNC\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\_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: 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\_Standard\_Version: FGDC-STD-001-1998  
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:

##### Citation\_Information:

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\_Linkage: \\fs1\Home\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\DELIVERABLE\Grids\slope

### 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\_Bounding\_Coordinate: -112.187972

East\_Bounding\_Coordinate: -111.778344

North\_Bounding\_Coordinate: 46.839100

South\_Bounding\_Coordinate: 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

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\broberson\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\_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: 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\_Electronic\_Mail\_Address: custserv@edcmail.cr.usgs.gov

Metadata\_Standard\_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata\_Standard\_Version: FGDC-STD-001-1998

Metadata\_Time\_Convention: local time

Metadata\_Extensions:

Online\_Linkage: <http://www.esri.com/metadata/esriprof80.html>

Profile\_Name: ESRI Metadata Profile

## D.24 SOIL SURVEY GEOGRAPHIC (SSURGO) DATABASE FOR LEWIS AND CLARK COUNTY AREA, MONTANA

### Identification\_Information:

#### Citation:

##### Citation\_Information:

##### 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:

Publication\_Place: 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

Place\_Keyword: Arrastra Mountain Quadrangle  
Place\_Keyword: Stonewall Mountain Quadrangle  
Place\_Keyword: Silver King Mountain Quadrangle  
Place\_Keyword: Cadotte Creek Quadrangle  
Place\_Keyword: Rogers Pass Quadrangle  
Place\_Keyword: Roberts Mountain Quadrangle  
Place\_Keyword: Wolf Creek Quadrangle  
Place\_Keyword: Craig Quadrangle  
Place\_Keyword: The Sawteeth Quadrangle  
Place\_Keyword: Moose Creek Quadrangle  
Place\_Keyword: Lincoln Quadrangle  
Place\_Keyword: Swede Gulch Quadrangle  
Place\_Keyword: Stemple Pass Quadrangle  
Place\_Keyword: Wilborn Quadrangle  
Place\_Keyword: Mitchell Mountain Quadrangle  
Place\_Keyword: Sheep Creek Quadrangle  
Place\_Keyword: Beartooth Mountain Quadrangle  
Place\_Keyword: Candle Mountain Quadrangle  
Place\_Keyword: Granite Butte Quadrangle  
Place\_Keyword: Canyon Creek Quadrangle  
Place\_Keyword: Silver City Quadrangle  
Place\_Keyword: Rattlesnake Mountain Quadrangle  
Place\_Keyword: Upper Holter Lake Quadrangle  
Place\_Keyword: Esmeralda Hill Quadrangle  
Place\_Keyword: Greenhorn Mountain Quadrangle  
Place\_Keyword: Austin Quadrangle  
Place\_Keyword: Scratchgravel Hills Quadrangle  
Place\_Keyword: Lake Helena Quadrangle  
Place\_Keyword: Hauser Lake Quadrangle  
Place\_Keyword: Canyon Ferry Quadrangle  
Place\_Keyword: MacDonald Pass Quadrangle  
Place\_Keyword: Black Mountain Quadrangle  
Place\_Keyword: Helena Quadrangle  
Place\_Keyword: East Helena Quadrangle  
Place\_Keyword: Louisville Quadrangle  
Place\_Keyword: Canyon Ferry SW 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\_or\_Province: 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:  
     Publication\_Place: 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:

Citation\_Information:

Originator:

U.S. Department of Agriculture,  
Natural Resources Conservation Service

Publication\_Date: 2000

Title:

Soil Survey Geographic (SSURGO) database for Lewis and  
Clark County Area, Montana

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: 2002

Source\_Currentness\_Reference: publication date

Source\_Citation\_Abbreviation: NRCS3

Source\_Contribution: source used to apply digital revisions

Source\_Information:

Source\_Citation:

Citation\_Information:

Originator:

U.S. Department of Agriculture, Natural Resources  
Conservation Service

Publication\_Date: 2002

Title:

National Soil Information System (NASIS) database for  
Lewis and Clark County Area, Montana

Geospatial\_Data\_Presentation\_Form: map

Publication\_Information:

Publication\_Place: Fort Collins, Colorado

Publisher:

U.S. Department of Agriculture, Natural Resources  
Conservation Service, Information Technology Center

Type\_of\_Source\_Media: online

Source\_Time\_Period\_of\_Content:

Time\_Period\_Information:

Single\_Date/Time:

Calendar\_Date: 2002

Source\_Currentness\_Reference: export certification date

Source\_Citation\_Abbreviation: NRCS4

Source\_Contribution: tabular data linked to spatial soil data

Source\_Information:

Source\_Citation:

Citation\_Information:

Originator:

U.S. Department of Agriculture, Natural Resources  
Conservation Service

Publication\_Date: 2002

Title:

Soil Survey Geographic (SSURGO) database for Lewis and Clark  
County Area, Montana

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:

Source\_Citation:

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\_SSURGO and export spec\_SSURGO options in LT4X.

Source\_Used\_Citation\_Abbreviation: USGS1, USGS2, USGS3, USGS4, NRCS1

Process\_Date: 2000

Process\_Step:

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\_Step:

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\_Step:

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\_Step:

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\_Step:

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\_Step:

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\_Step:

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\_Step:

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\_Step:

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\_Step:

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\_Step:

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.

National Non-tech description generated and included. Military and Department of Homeland Security interpretations added.

Source\_Used\_Citation\_Abbreviation: NASIS

Process\_Date: 20070126

Process\_Step:

Process\_Description: 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\_Date: 20070502

Process\_Step:

Process\_Description: 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\_Date: 20071121

Process\_Step:

Process\_Description: Metadata imported.

Source\_Used\_Citation\_Abbreviation: H:\Projects\Lewis&ClarkCounty\944-001-001\GIS\Data\soil\_mt630\soil\_mt630\soil\_metadata\_mt630.xml

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: 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:

U.S. Department of Agriculture. 1993. Soil Survey Manual. Soil Surv. Staff, U.S. Dep. Agric. Handb. 18.

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:

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:

U.S. Department of Agriculture. 1999. Soil Taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436.

U.S. Department of Agriculture. (current issue). Keys to Soil Taxonomy. Soil Surv. Staff, Soil Conserv. Serv.

U.S. Department of Agriculture. (current issue). National Soil Survey Handbook, title 430-VI. Soil Surv. Staff, Natural Resources Conservation Service.

U.S. Department of Agriculture. 1993. Soil Survey Manual. Soil Surv. Staff, U.S. Dep. Agric. Handb. 18.

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\_or\_Province: 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\_Standard\_Version: FGDC-STD-001-1998  
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 Extended 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\_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:

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\_Standard\_Version: FGDC-STD-001-1998

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: 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:  
Attribute\_Label: LEN  
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:  
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: 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\_Standard\_Version: FGDC-STD-001-1998  
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

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:

Time\_Period\_Information:

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:

Time\_Period\_Information:

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:

Time\_Period\_Information:

Single\_Date/Time:

Calendar\_Date: 2004

Source\_Currentness\_Reference: publication date

Source\_Citation\_Abbreviation: NHD lakes

Source\_Contribution: Perennial lake information.

Source\_Information:

Source\_Citation:

Citation\_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\_Step:  
Process\_Description:  
The final Depth to Water Grid is rated using the following Raster Calculator expression:

con ([DTW\_Final] < 5, 10, con([DTW\_Final] < 30,(10.6 - ([DTW\_Final] \* 0.12)), con([DTW\_Final] < 100,(23.94 - (ln([DTW\_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\_Standard\_Version: FGDC-STD-001-1998

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 hcaracter 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

Title: Hydrogeology of the Helena Valley-Fill Aquifer System, West-Central Montana: U.S. Geological Survey, Water-Resources Investigations Report 92-4023

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.

Surficial Geology Code	Rating
Qal	8
QTp	7
Tsu	7

Bedrock Geology Code	Rating
OGvt	5
OGs	5
Kg	5
Mml	5
Dtj	5
Cc	5
Ccl	5
Zg	5
Yss	5
Yhe	5
Ys	5
Yg	5

Process\_Date: 20080402

Process\_Step:

Process\_Description: Dissolved the Geohydrologic Setting Layer based on the 'rating' field.

Process\_Date: 20080402

Process\_Step:

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

Process\_Date: 20080402

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: 74

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: 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\_Standard\_Version: FGDC-STD-001-1998  
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:

##### Citation\_Information:

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

#### Description:

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:  
 Originator: USGS: Briar, D.W. & Madison, J.P.  
 Publication\_Date: 1992  
 Title: Hydrogeology of the Helena Valley-Fill Aquifer System, West-Central Montana: U.S. Geological Survey, Water-Resources Investigations Report 92-4023, 49 p  
 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:  
SDTS\_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\_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: 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\_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: 0.175  
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\_Standard\_Version: FGDC-STD-001-1998  
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:

##### Citation\_Information:

Originator: Trihydro Corporation

Publication\_Date: 20080501

Title: Land Surface Slope Rating

Edition: 1

Geospatial\_Data\_Presentation\_Form: raster digital data

##### Publication\_Information:

Online\_Linkage: \\fs1\Home\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 Horizontal datum of NAD83, except for AK which is NAD27 Vertical datum of NAVD88, except for AK which is NAVD29 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\_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: 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:

```
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:

```
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:

```
con([Slope] < 1,10, con([Slope] < 18, (5.5 + (4.5 *(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\_Standard\_Version: FGDC-STD-001-1998  
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\_Step:  
 Process\_Description: Joined table with map unit descriptions.  
 Process\_Step:  
 Process\_Description:  
 Added a field called 'soils\_rati' and populated it based on geologist's guidance.

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

Process\_Date: 20080314  
 Process\_Step:  
 Process\_Description: Converted Soils Rating polygon layer to a raster using Feature to Raster tool in Spatial Analyst.  
 Process\_Date: 20080314

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\_Standard\_Version: FGDC-STD-001-1998  
Metadata\_Time\_Convention: local time

## D.31 VADOSE ZONE RATINGS

### Identification\_Information:

#### Citation:

##### 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\_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: 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\_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: 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

Title: Hydrogeology of the Helena Valley-Fill Aquifer System, West-Central Montana: USGS Water-Resources Investigations

Report 92-4023.

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

OGs7

Kg 7

Mml7

Dtj 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\_Standard\_Version: FGDC-STD-001-1998  
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:

##### Citation\_Information:

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:

##### 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: -112.089918

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\_Standard\_Version: FGDC-STD-001-1998  
Metadata\_Time\_Convention: local time  
Metadata\_Extensions:  
Online\_Linkage: <http://www.esri.com/metadata/esriprof80.html>  
Profile\_Name: ESRI Metadata Profile

**APPENDIX E**

**HERRERA REVIEW**





June 18, 2008

Ms. Kathy Moore  
Administrator of Environmental Services  
Lewis & Clark County  
316 North Park  
Helena, MT 59623

Subject: Geohydrologic Model Peer Review

2200 Sixth Avenue  
Suite 1100  
Seattle  
Washington  
98121

(206) 441-9080  
FAX 441-9108

101 E Broadway  
Suite 610  
Missoula  
Montana  
59802

(406) 721-4204  
FAX 721-4232

322 NW Fifth Avenue  
Suite 315  
Portland  
Oregon  
97209

(503) 228-4301  
FAX 228-3373

435 Holgerson Road  
Sequim  
Washington  
98382

(360) 683-9109  
FAX 683-3671

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



Ms. Kathy Moore  
June 18, 2008  
Page 2

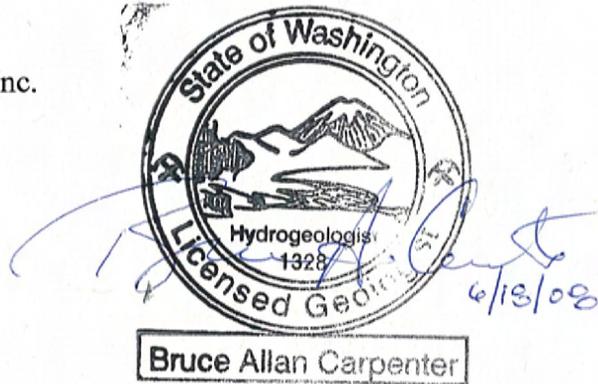
The sensitivity maps developed for each of the parameters and overall sensitivity map will provide useful information for future land-use planning. The methodology is clearly stated and the data used to produce each of the maps can be updated as conditions change. The maps may be georeferenced in a GIS format and ground-water-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

