Natural Resources, Environment and Hazards

Community Technical Assistance Program

Memo Issued by WGM Group

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COMMERCE

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Community Technical Assistance Program
Community MT
Montana Department of Commerce
301 S. Park Ave
Helena, MT 59620

Re: Processes for Physical Natural Resource and Environmental Hazard Identification and Resources Related to Land Development

The Community Technical Assistance Program has contracted WGM Group to create step by step processes for identifying physical hazards and resources prior to land development. The intentions of this memo are to provide a guiding resource for communities, making it easier to find required information for land development applications including maps, data, and analysis. The Montana Department of Commerce has been tasked with supporting communities implementing the Montana Land Use Planning Act (SB382) through the development of a Land Use Plan. Section 13 of the bill, as drafted, includes the “Natural Resources, Environment and Hazards” portion of the Land Use Plan. This document is presented as a tool to assist communities in developing this section of their Land Use Plans as a resource guide for data, considerations and best practices.

The Montana Land Use Planning Act can be accessed from the following link:
https://leg.mt.gov/bills/2023/billpdf/SB0382.pdf

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Wildfires

Identifying wildfire-prone areas in Montana is crucial when determining development sites for the following reasons:

Long-Term Sustainability:
Sustainable development involves considering the long-term impacts of development on both human communities and the natural environment. By avoiding or responsibly mitigating development in wildfire-prone areas, developers and the community can contribute to the resiliency and sustainability of communities over time. This includes reducing the risk of catastrophic wildfire events and promoting safer, more resilient development practices.

Risk Mitigation:
Montana is known for its vast forests and grasslands, which are susceptible to wildfires, especially during dry seasons or periods of drought. Identifying wildfire-prone areas allows developers to assess and mitigate the risks associated with potential wildfires. This may include implementing building codes or tightening existing building codes, establishing building buffer zones, or even avoiding development in high-risk areas altogether.

Safety of Residents and Property:
Developing in wildfire-prone areas without proper precautions can put residents and properties at risk. Identifying these areas prior to development enables developers and the community to take necessary measures to enhance the safety of future residents and protect their homes from the threat of wildfires. Precautionary measures may involve incorporating fire-resistant building materials, creating defensible spaces around structures, and ensuring access for emergency evacuation routes.

Environmental Conservation:
Wildfires not only pose risks to human lives and property but also have significant environmental impacts. Wildfires can destroy habitats, disrupt ecosystems, and contribute to air and water pollution. By mitigating development in wildfire prone areas, developers and the community can help preserve the natural environment and reduce the likelihood of major destruction.

Insurance and Liability Considerations:
Insurance companies often consider the wildfire risk when determining premiums for properties located in high-risk areas. Identifying wildfire prone areas allows the community to anticipate potential insurance costs.

Wildfire Resources in Montana

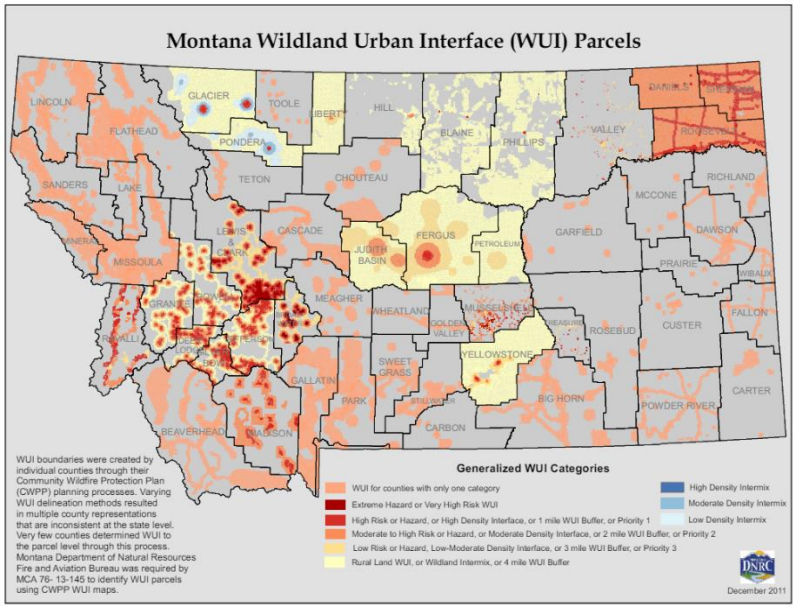
Wildland Urban Interface boundaries are created by individual Montana counties through their Community Wildfire Protection Plan planning processes. The Montana Department of Natural Resources and Conservation has created a Generalized Map with WUI categories ranging from low to extremely high risk for wildfire hazards. These ranges are based on WUI buffers from one to four miles. The DNRC has provided separate maps representing each county in the state in one document.

The links for these maps are found here:
https://leg.mt.gov/content/Services%20Division/Lepo/statreports/wildland-urban-parcels/2012-wildland-urban-parcels.pdf

CWPP Montana WUI | CWPP Montana WUI | Open Data (arcgis.com)

Headwaters Economics provides a Wildfire Risk to Communities website that offers maps and data about community wildfire risk nationwide:
https://headwaterseconomics.org/natural-hazards/wildfire-risk-to-communities/

Additionally, the United States Forest Service provides a website with interactive maps, charts, and resources to help communities understand, explore, and reduce wildfire risk:
https://wildfirerisk.org/



Flooding

An important aspect of determining development feasibility is to factor in the risk of flooding for sites near bodies of water. Communities impacted by potential flood hazards oftentimes have a Floodplain Administrator or Manager either directly on staff or by consultation to assist with floodplain services.

The Federal Emergency Management Agency has created floodplain maps nationally for citizens and emergency personnel to improve the nation's capability to prepare for, protect against, respond to, recover from and mitigate hazards.

FEMA floodplain maps, including Flood Insurance Rate Maps, are created through a comprehensive process that involves collecting various types of data. An overview of the key steps involved in the mapping process are described below:

Hydrological Analysis:
This step involves studying the watershed and hydrological characteristics of the area. It includes analyzing snow and rainfall data, river and stream flow rates, soil permeability, and other factors that contribute to flooding.

Topographic Mapping:
Detailed topographic maps are created using various methods such as aerial photography, Light Detection and Ranging, and ground surveys. These maps provide elevation data which is crucial for understanding the terrain and identifying low-lying areas prone to flooding.

Hydraulic Modeling:
Hydraulic models simulate how water flows through the landscape during different flood scenarios. These models take into account factors such as rainfall intensity, river flow rates, and terrain characteristics. These models may help predict flood extents, water depths, velocities, and other potential flood impacts.

Floodplain Mapping:
Using the data from the hydraulic models and topographic maps, floodplain boundaries are delineated. These boundaries indicate areas that are likely to be inundated during various flood events, such as the 100-year flood (a flood with a 1% chance of occurring in any given year).

Field Verification:
Field surveys are conducted to validate the accuracy of the data and models used in the mapping process. This may involve "ground-truthing" (information known to be real or true, provided by direct observation and measurement), floodplain boundaries, confirming elevations, and verifying other relevant information.

Community Input:
FEMA engages with local communities, government agencies, and stakeholders to gather additional information and incorporate local knowledge into the mapping process. This helps ensure that the maps accurately reflect local conditions and concerns.

Map Production:
Once all the data has been collected, analyzed, and verified, FEMA produces the final floodplain maps. These maps typically include various flood zones (ex: Special Flood Hazard Areas), base flood elevations, floodways, and other relevant information.

Map Adoption and Updates:
After FEMA completes the maps, they are typically reviewed and adopted by local governments. Periodically, FEMA revisits and updates the maps to account for changes in factors such as land use, development, climate patterns, and local infrastructure.

Overall, FEMA floodplain maps are the result of a thorough and collaborative process that integrates scientific data, modeling techniques, field surveys, and community input to accurately depict future flood risks and inform floodplain management and mitigation efforts.

Floodplain Resources in Montana

The FEMA Flood Map Service Center is the official public source for flood hazard information produced in support of the National Flood Insurance Program. Utilizing the MSC can help find your community's official flood map and provide tools for better understanding flood risk.

FEMA MSC link: https://msc.fema.gov/portal/home

The MSC home page allows you to search by address, a place, or latitude/longitude coordinates. To view an interactive map of the searched area, click the "Go to NFHL Viewer" button.

FEMA

Navigation

Search

MSC Home
MSC Search by Address
MSC Search All Products
MSC Products and Tools
Hazus
LOMC Batch Files
Product Availability
MSC Frequently Asked Questions (FAQs)
MSC Email Subscriptions
Contact MSC Help

FEMA Flood Map Service Center: Search By Address

Enter an address, place, or coordinates:

missoula montana

Search

Whether you are in a high risk zone or not, you may need flood insurance because most homeowners insurance doesn't cover flood damage. If you live in an area with low or moderate flood risk, you are 5 times more likely to experience flood than a fire in your home over the next 30 years. For many, a National Flood Insurance Program's flood insurance policy could cost less than $400 per year. Call your insurance agent today and protect what you've built.

Learn more about steps you can take to reduce flood risk damage.

Search Results—Products for **MISSOULA COUNTY ALL JURISDICTIONS**

Show ALL Products »

The flood map for the selected area is number **30063C1480E**, effective on **7/6/2015**

DYNAMIC MAP

PRINT MAP/ FIRMette

MAP IMAGE

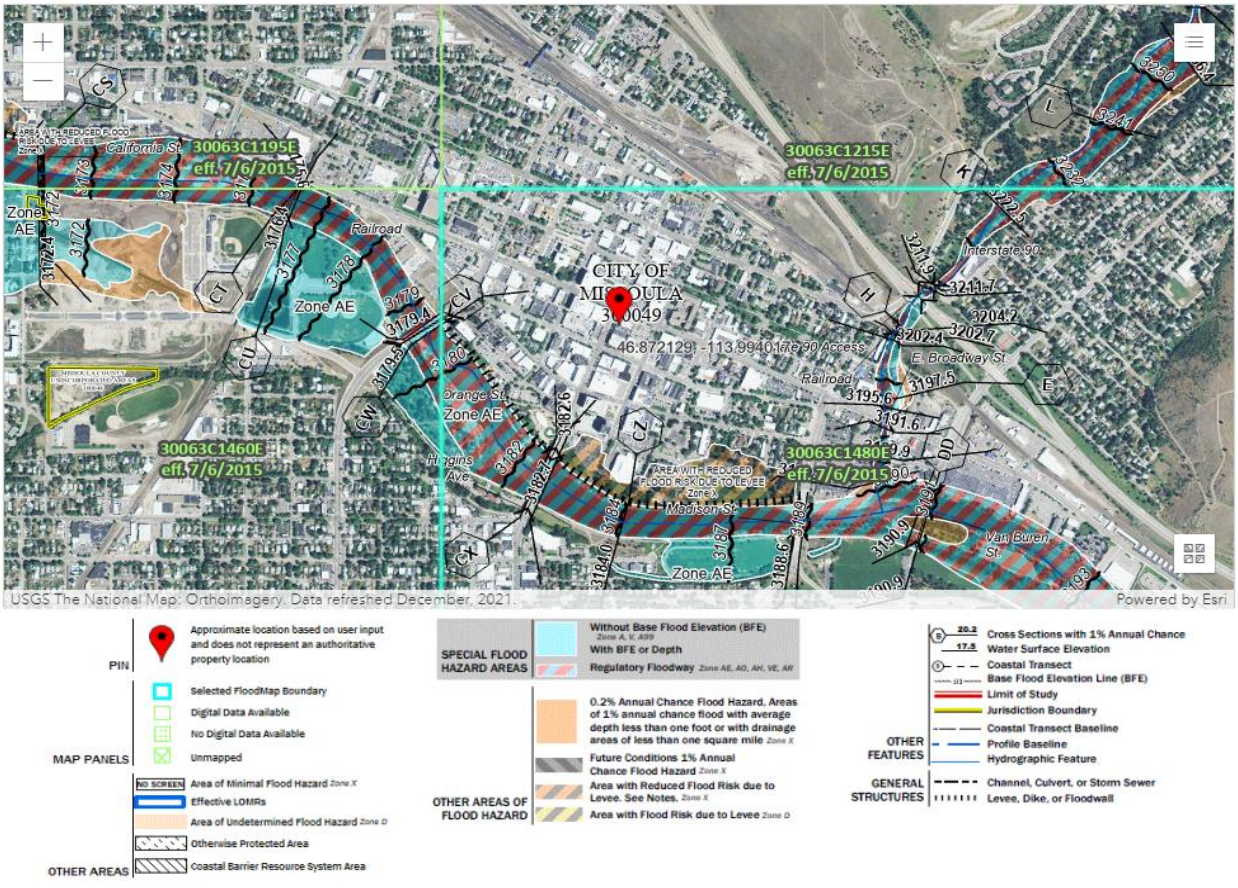
DOWNLOAD FIRM PANEL

Changes to this FIRM
Revisions (0)
Amendments (8)
Revalidations (3)

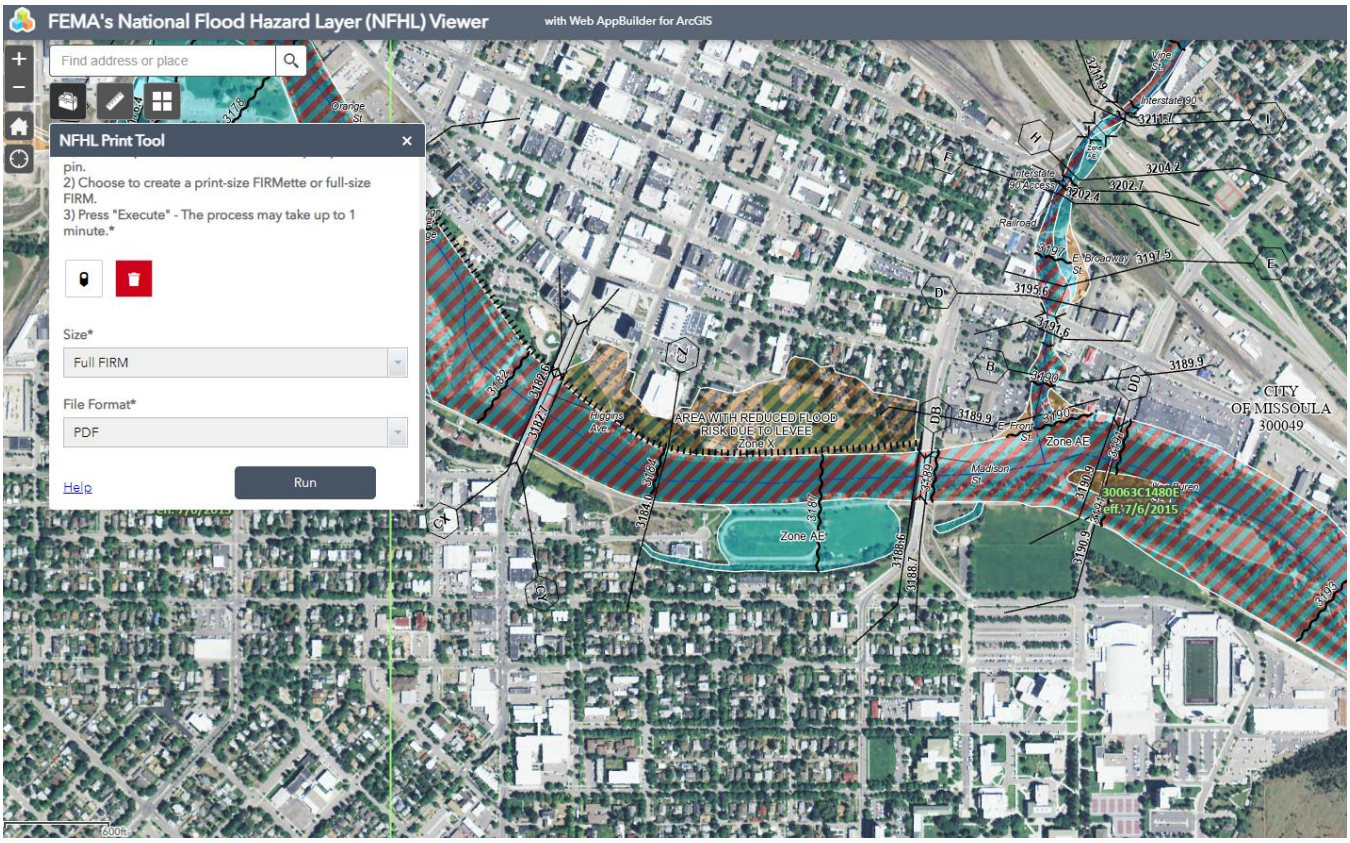
You can choose a new flood map or move the location pin by selecting a different location on the locator map below or by entering a new location in the search field above. It may take a minute or more during peak hours to generate a dynamic FIRMette.

Go To NFHL Viewer »

Example Floodplain Map:



FEMA's National Flood Hazard Layer Viewer:



The NFHL Viewer also gives an option to print the full Flood Insurance Rate Map based on a dropped pin location. This can be a helpful tool if local government agencies require proof that a development site is located outside of hazard areas prone to flooding.

The Montana DNRC provides a quick guide that helps local officials and citizens understand why and how Montana communities must manage development in floodplains to protect people and property. Communities that participate in the National Flood Insurance Program adopt and enforce the floodplain management regulations based on federal and State requirements in Montana Code Annotated Title 76, Chapter 5 and Administrative Rules of Montana Chapter 15.

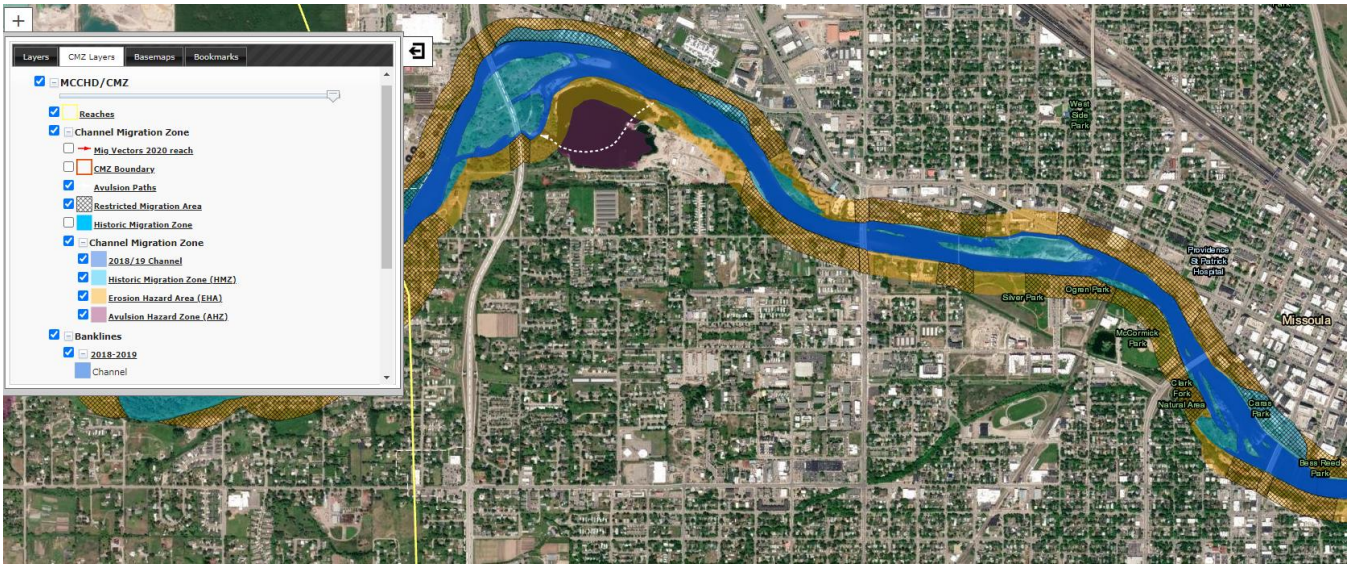
The National Flood Insurance Program in Montana Quick Guide can be found from the following link:
https://dnrc.mt.gov/_docs/water/Floodplains/Permits-Regulations/2023_MTQG_INTERACTIVE.pdf

The Montana National Resource Information System, a program of the Montana State Library, provides natural resource information through searchable links, data, and maps. The NRIS website can be found from the following link: https://nris.msl.mt.gov/

Channel Migration Zones (Not FEMA Designated)

Some jurisdictions in Montana may have conducted studies of local water bodies and provide their own maps along with or aside from FEMA's data collection. These local studies could provide more up to date assessments of flood prone areas and water bodies as the information will show historic rates of change, erosion, and are site specific. For example, Missoula County provides a GIS map showing Channel Migration Zones with several layers including historic migration zones, erosion hazard areas, avulsion hazard zones (floodplain areas geomorphically susceptible to abrupt channel relocation), CMZ boundaries, restricted migration areas, and banklines. These map layers show viewers the progression of how flood prone areas have changed over time.

Missoula City/County Health Department - Channel Migration Zone Map:



Depending on specific jurisdictions, there may be additional maps and data. Please reach out to site specific jurisdictions when researching potential flood prone areas to determine if they have other resources to factor prior to development.

Unsuitable Soils/Ground Subsidence

Development on suitable soils provides a stable foundation for buildings, roads and other structures. Suitable soils are often more resilient to natural hazards such as earthquakes, floods, and landslides. Building on stable ground reduces the susceptibility of structures to damage or collapse during extreme events, enhancing overall resilience. Unsuitable soils including expansive clay or loose sand can pose significant risks to structures due to their tendency to swell, shrink, or shift over time.

The United States Department of Agriculture collects soils data primarily through its agency, the Natural Resources Conservation Service. The process for data collection of soils includes the following steps:

Soil Surveys:
The NRCS conducts soil surveys to systematically examine, describe, classify, and map soils in a particular area. These soil surveys are typically carried out at various scales that range from national to local levels. The surveys include fieldwork where soil scientists physically examine and sample soils across landscapes.

Field Data Collection:
Soil scientists visit sites within the area of interest and collect soil samples using various methods. They assess soil properties such as texture, color, structure, depth, and chemical composition. This data is crucial for understanding soil characteristics and behavior.

Laboratory Analysis:
After collecting soil samples, they are sent to laboratories for detailed analysis. Laboratory tests provide information about soil fertility, pH, nutrient levels, organic matter content, and other important parameters. This data helps in assessing soil quality and its suitability for various land uses such as agriculture, forestry, and building construction.

Remote Sensing:
In addition to fieldwork, the USDA utilizes remote sensing technologies such as satellite imagery and aerial photography to gather information about soil characteristics over larger areas. Remote sensing can provide valuable data on soil moisture, erosion, and land cover, which complement ground-based surveys.

Database Management:
All collected data, including field observations, laboratory analyses, and remote sensing imagery, are compiled into databases maintained by the NRCS. These databases are accessible to the public and researchers, serving as valuable resources for land management, environmental planning, and scientific research.

Publication and Dissemination:
The USDA publishes soil survey reports and maps, which provide detailed information about the soils in a particular area. These publications are widely used by farmers, ranchers, land planners, engineers, educators, and policy makers for making informed decisions about land use, conservation practices, and sustainable development.

Soil Resources in Montana

The Natural Resources Conservation Service is the official public source for soils information. Soils reports can be found through utilizing the following web soil survey website from the USDA:

USDA NRCS link: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

The Web Soil Survey map is an interactive map that allows the user to search by address, state and county, latitude/longitude coordinates, or by importing an Area of Interest from a shapefile. Specific parcels of land can be “zoomed in” and separate polygons drawn to create an individual Area of Interest.

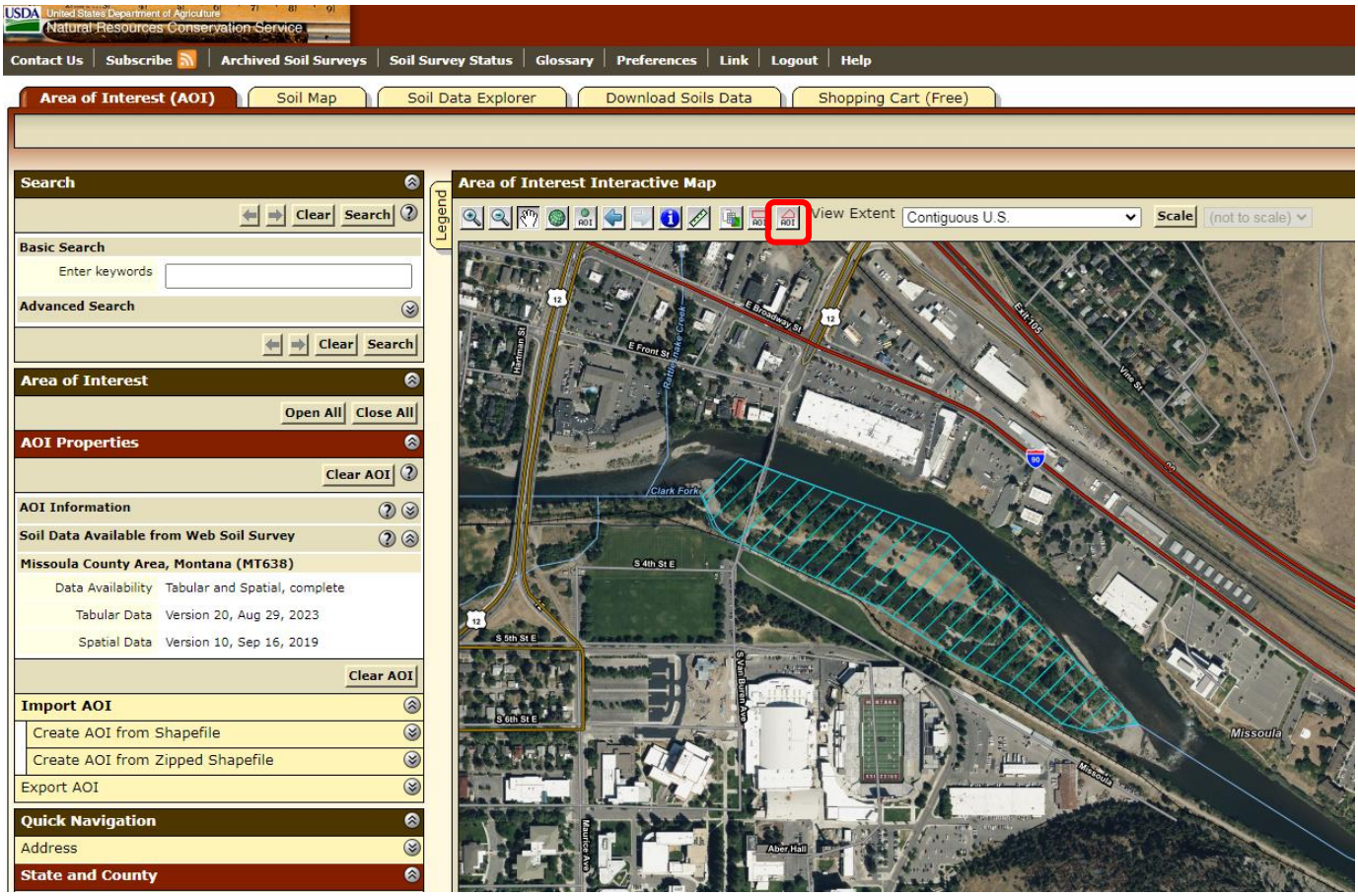
There are four steps to access soil data within the Web Soil Survey:

Define

Use the “Area of Interest” tab to define an area of interest. Next, navigate to an area by zooming in on a map or by selecting from a Quick Navigation choice list. After finding the area, define it as the Area of Interest by drawing a rectangle or a polygon around it using a map tool. This step must be completed before proceeding to the next three steps.

- Click on the “Define AOI by Polygon” Tool (highlighted red in the map below) to start drawing the Area of Interest. Double click to close the polygon. The Area of Interest will show up on the map by having blue dashed lines as the fill symbol within the drawing boundary.

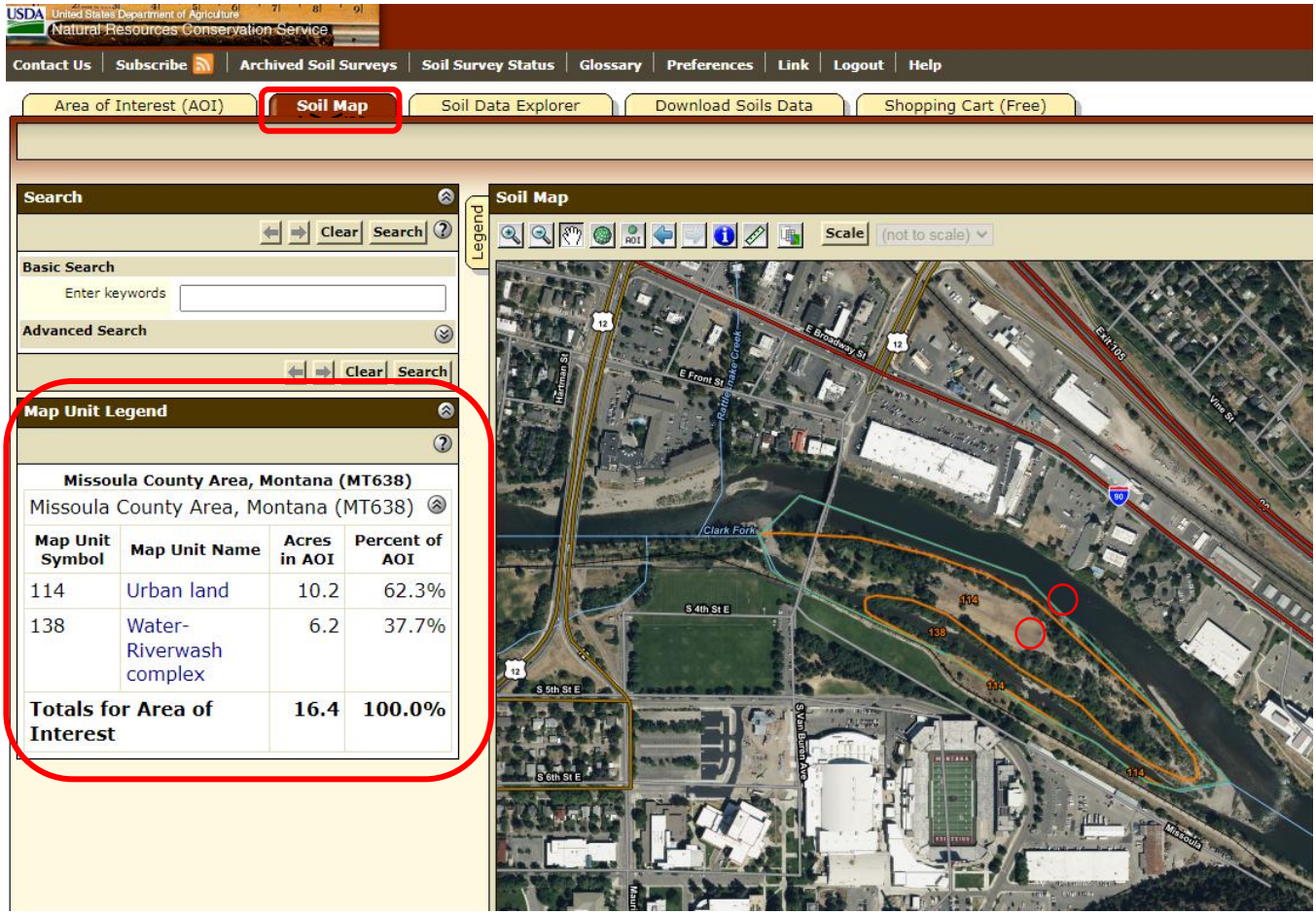
*The maps provided below are included as examples of a specific Area of Interest.



View

Click the “Soil Map” tab to view or print a map of the soils in the desired area and view a description of the soils.

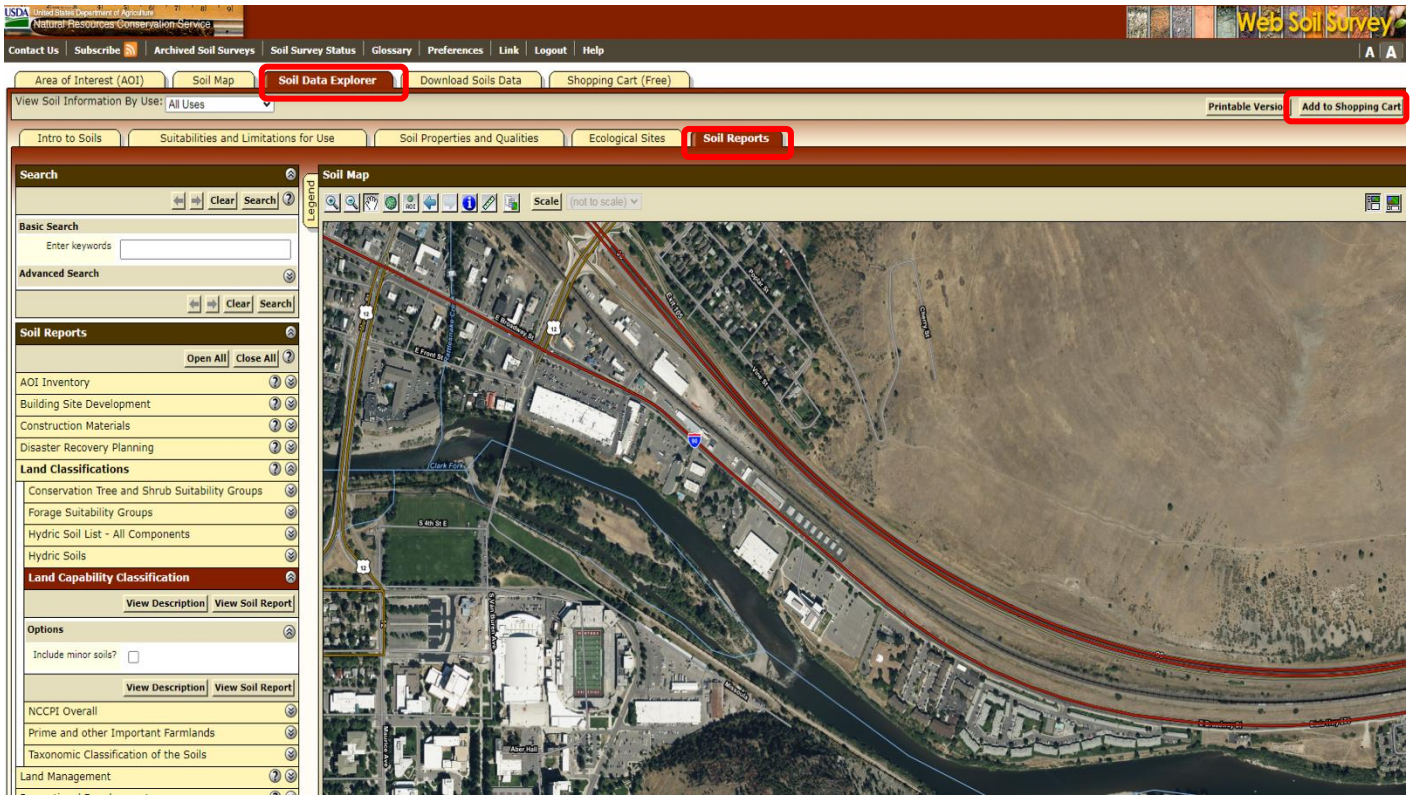
- The map will display unit symbols with numbers within the Area of Interest which correspond to the map unit legend defining the soil name, boundaries, acres, and the percent of the AOI.



Explore

Click the “Soil Data Explorer” tab to access soil data for the desired area and determine the suitability of the soils for a particular use. Descriptions and soil reports for these particular uses and the items to be saved in a report can be added to the “shopping cart”.

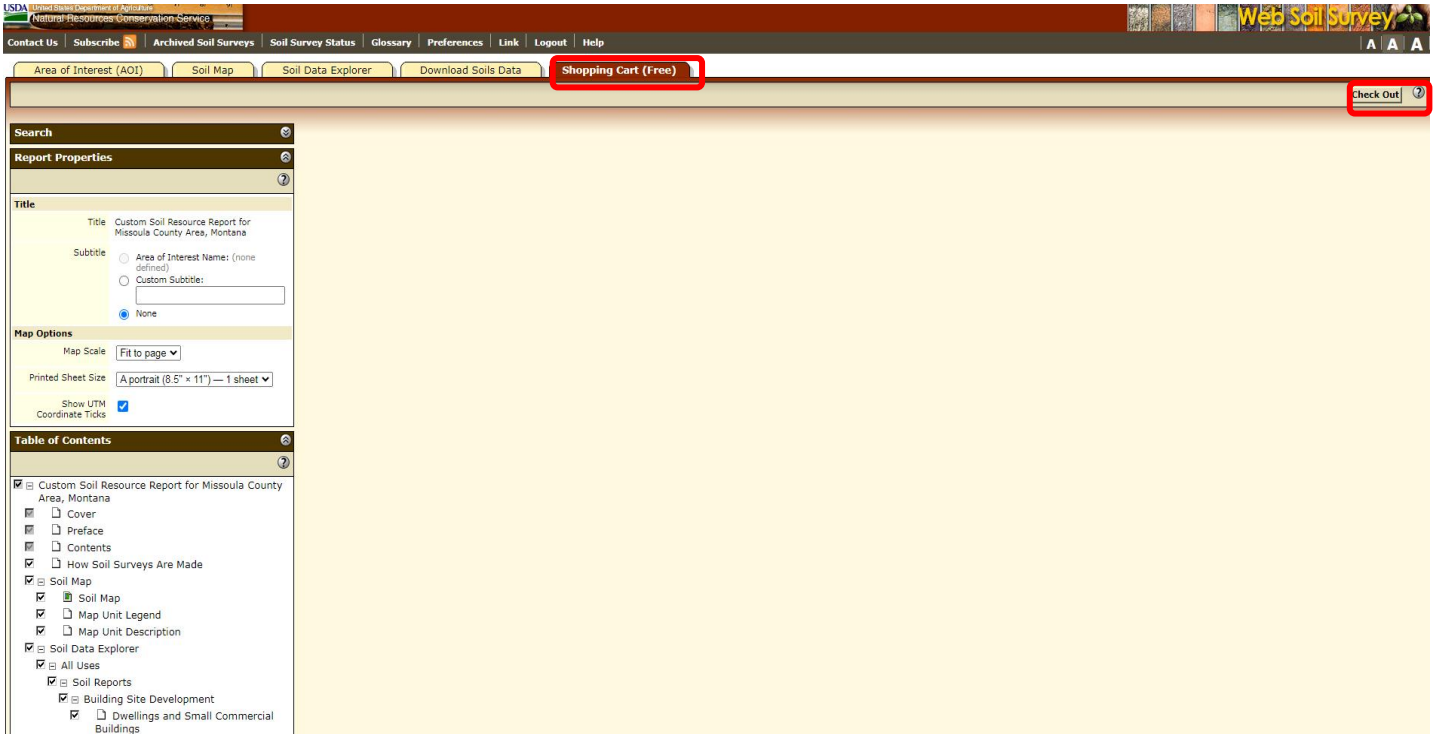
- Click on the desired soil report category from the legend and then click “Add to Shopping Cart” to create the custom soils report.



Check Out

Use the “Shopping Cart” tab to get your custom report immediately or download it later.

- Click on the Shopping Cart (Free) tab at the top, review the desired soil map categories from the Table of Contents and click on the “Check Out” button in the top right corner.



* Custom soil report will be generated, which can be downloaded to a desired file.

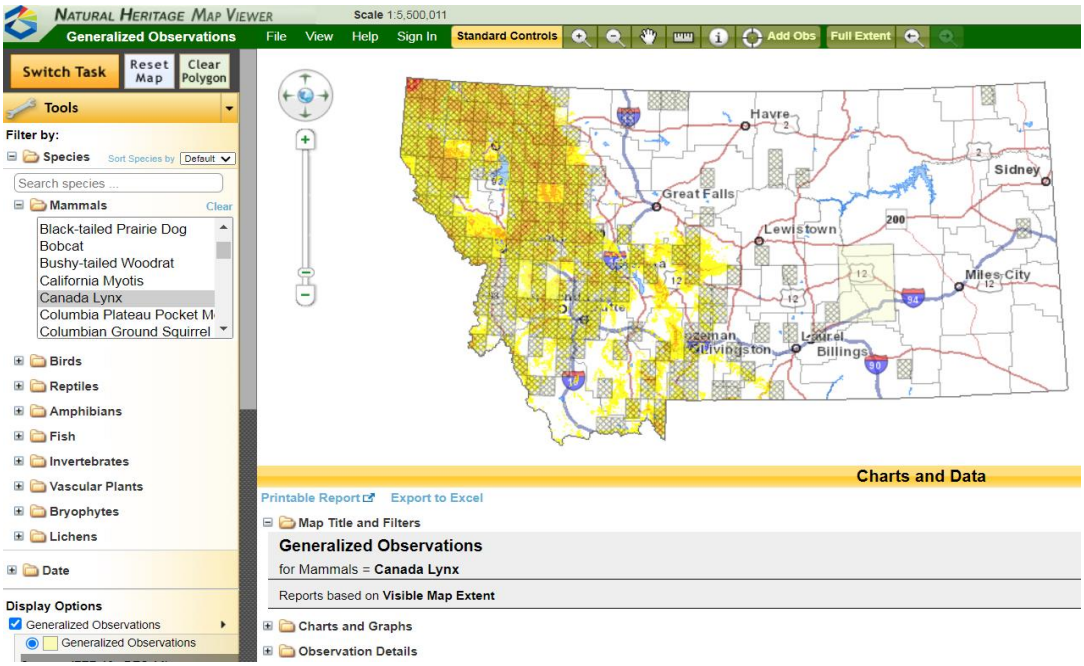
Wildlife Habitats/Environment

The Montana Natural Heritage Program is the state's source for reliable, objective information and expertise to support stewardship of our native species and habitats, emphasizing those of conservation concern. Data source agencies include Montana Fish, Wildlife and Parks, the Montana Department of Environmental Quality, the Montana Department of Natural Resources and Conservation, the Montana University System, the U.S. Forest Service, the Natural Resources Conservation Service, and the Bureau of Land Management.

Montana Natural Heritage Program: https://mtnhp.org/MapViewer/

Upon entry to the provided link a task panel will pop up.

Generalized Observations view the spatial distribution of one or more species by quarter-quarter latitude and longitude blocs as well as associated tabular information. Views can be filtered by; one or more species, year and month, geography by zooming in to an area of interest.



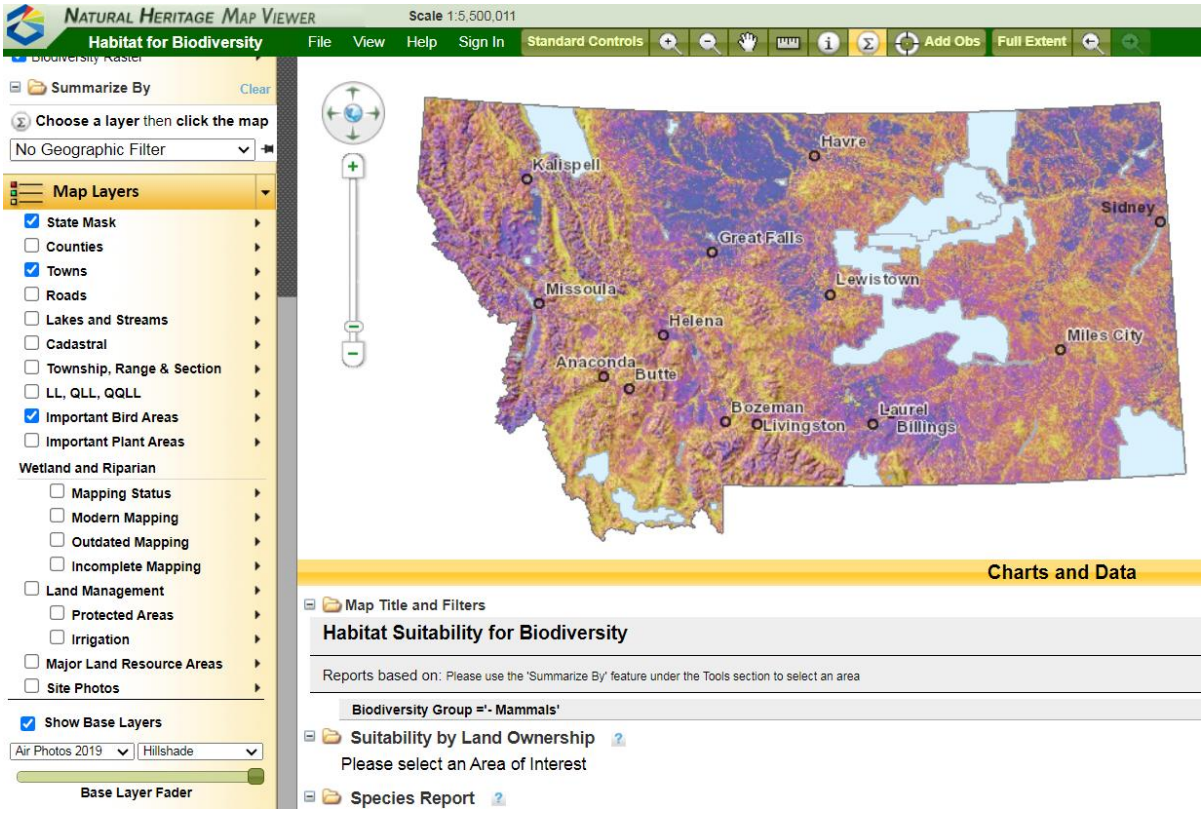
Provided below is a link with a step-by-step guide for using the “Generalized Observations Task” layer.

https://mtnhp.org/Help/MapViewer/Tasks/How_To_Use_Generalized_Observations_Task_20200331.pdf

Habitat Suitability for Biodiversity views maps of overall predicted habitat suitability for various biodiversity groups including;

- Species of Concern vertebrate animals
- Species of Concern vascular plants
- Noxious weeds (cumulative risk of invasion)
- Native vertebrate animals - mammals, birds, reptiles, amphibians, and fish
- Non-native fish

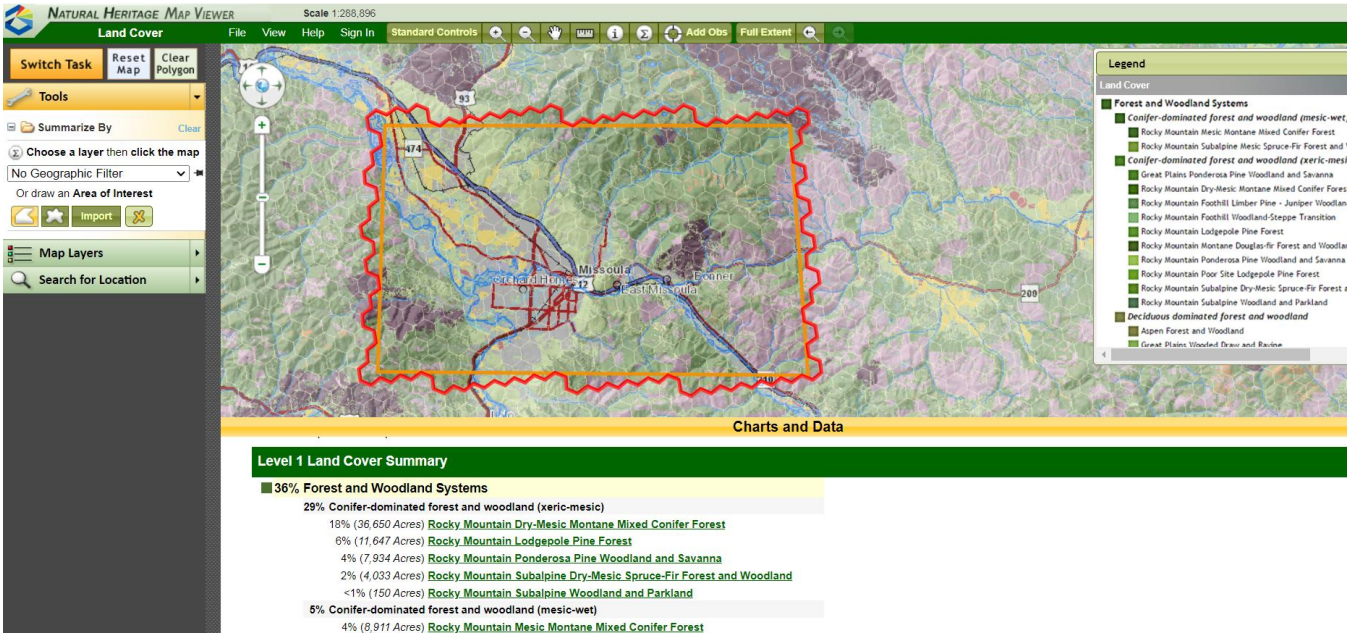
For geographic areas of interest, view numbers and list of species, turn on individual species models, and see summaries by land stewardship. Maps are 10 color classes with hotter colors indicating high predicted habitat suitability for the biodiversity group selected.



Provided below is a link with a step-by-step guide for using the “Habitat Suitability for Biodiversity” map layer.

https://mtnhp.org/Help/MapViewer/Tasks/How_To_Use_Habitat_Suitability_For_Biodiversity_Task_20221211.pdf

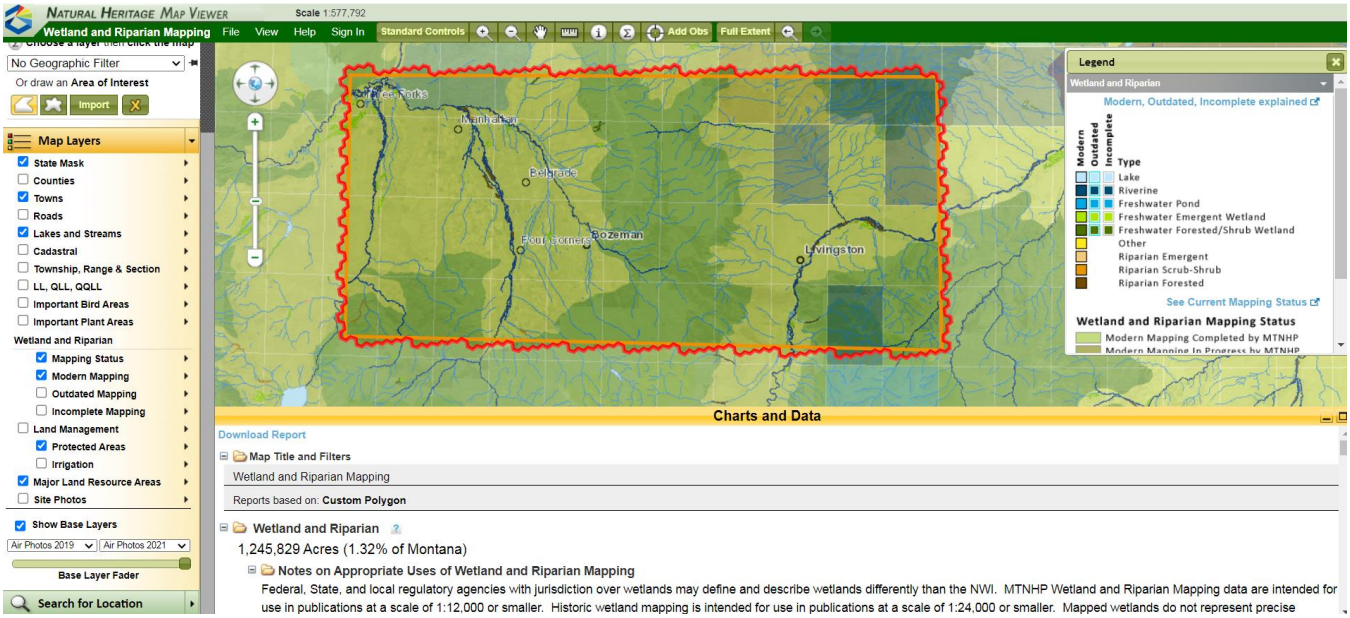
Land Cover layer is comprised of three levels of ecological systems representing Montana's vegetation communities as well as various human land use categories Select a geographic area of interest to get a percentage and acreage summary of the land cover classes in the area. Areas of interest can be customized by drawing polygons for specific parcels, counties or regions. Land cover summaries are provided below the map, including charts and data with a representative color-coded legend located on the right of the map.



Provided below is a link with a step-by-step guide for using the "Land Cover" map layer.

https://mtnhp.org/Help/MapViewer/Tasks/How_To_Use_Land_Cover_Task_20200331.pdf

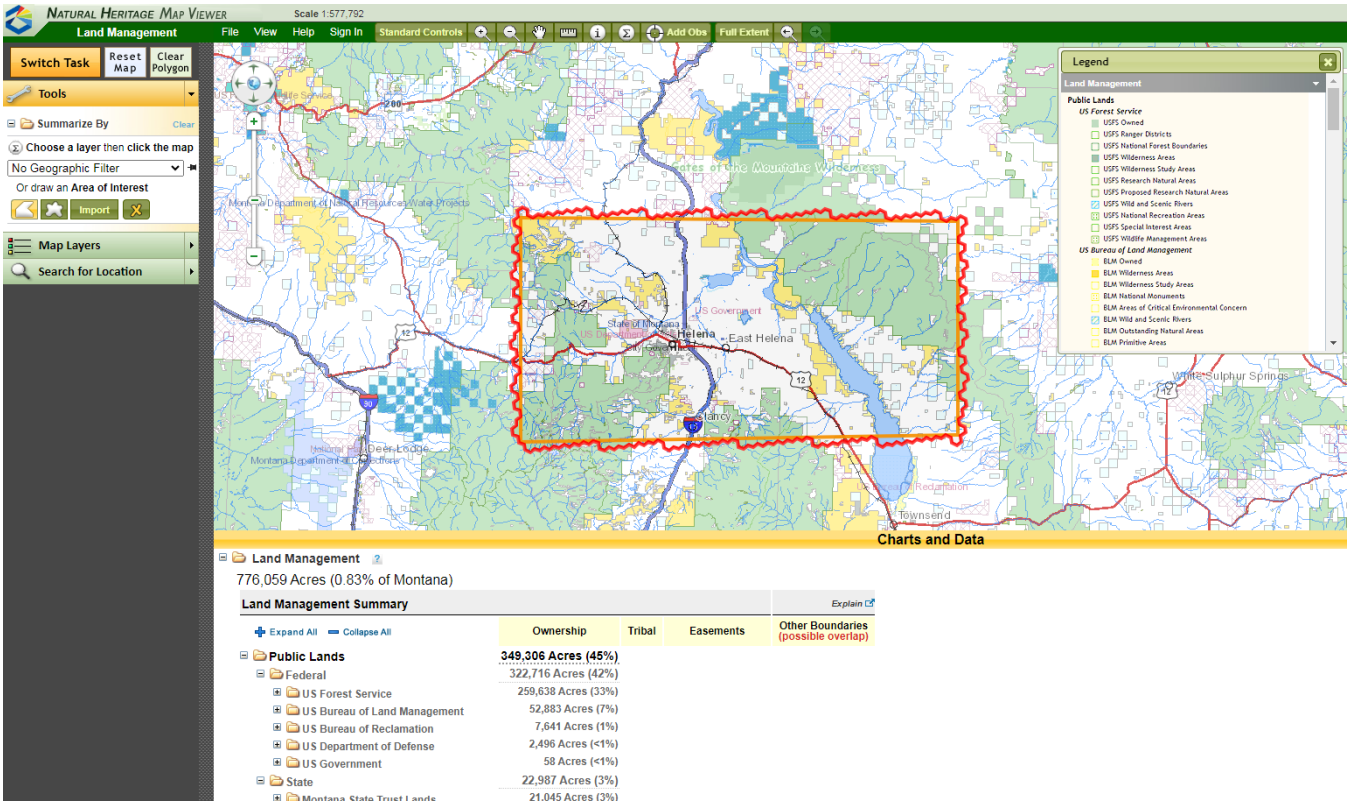
Wetland and Riparian Mapping layer classifies wetlands according to the Cowardin classification system of the National Wetland Inventory and riparian areas according to the U.S. Fish and Wildlife Service's System for mapping riparian areas. Select a geographic area of interest to get a summary of the acreage of each wetland and riparian type in the area. Mapping is completed through photointerpretation of one-meter resolution, color infrared aerial photography taken since 2005 as well as topographic maps, digital elevation models, soils data, and other sources of aerial imagery. Charts and data are provided below the map for selected or customized Areas of Interest.



Provided below is a link to a step-by-step guide for using the "Wetland and Riparian Mapping" layer.

https://mtnhp.org/Help/MapViewer/Tasks/How_To_Use_Wetland_and_Riparian_Mapping_Task_20200331.pdf

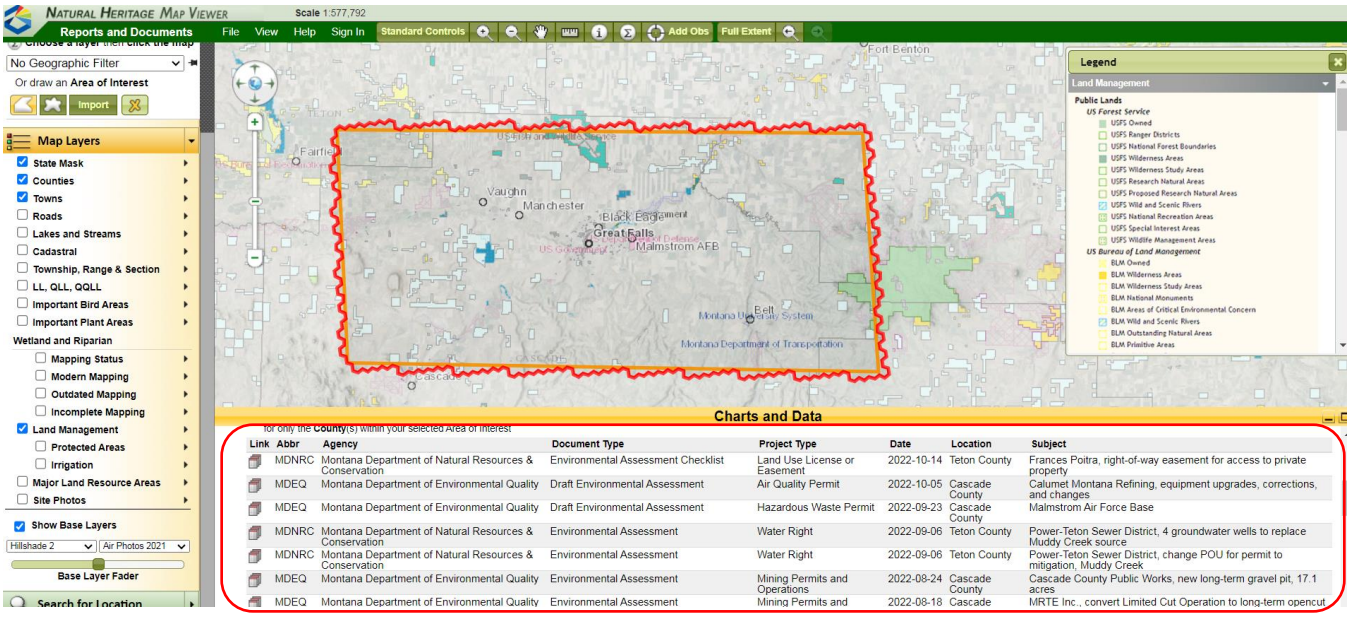
Land Management provides ownership/management information for public lands, tribal lands, conservation easements, and other administrative boundaries. Select a geographic area of interest to get a summary of the percentage and acreage of each ownership/management type in the area.



Provided below is a link with a step-by-step guide for using the “Land Management” map layer.

https://mtnhp.org/Help/MapViewer/Tasks/How_To_Use_Land_Management_Task_20200331.pdf

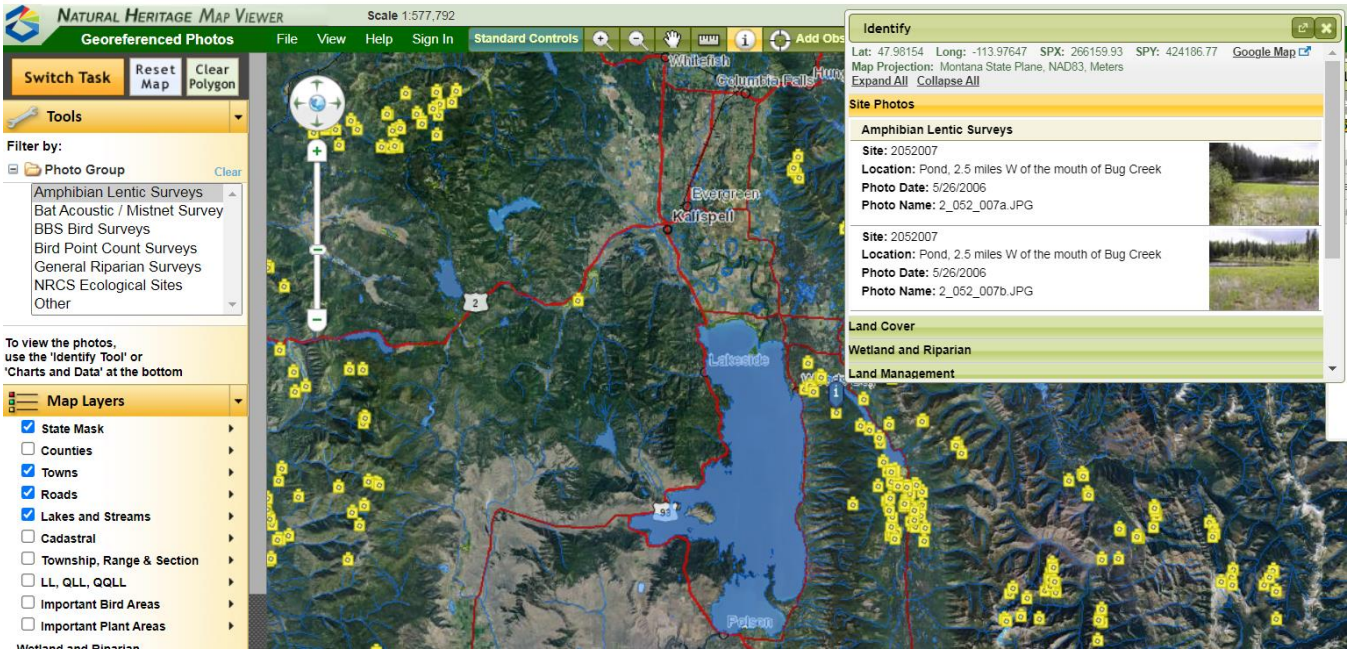
Reports and Documents provide biological reports and Montana Environmental Policy Act documents associated with an area of interest. Select a geographic area of interest to see reports and documents by agency, project type, document type, year received, and subject. Links are also provided to look for National Environmental Policy Act documents on federal agency websites.



Provided below is a link to a step-by-step guide for using the “Reports and Documents” layer.

https://mtnhp.org/Help/MapViewer/Tasks/How_To_Use_Reports_and_Documents_Task_20221206.pdf

Photos or Georeferenced Photos provide site photos from surveys conducted across Montana with an emphasis on wetland surveys. Click on a photo location to open the “Identify” box which will display site photos from surveys.



Provided below is a link to a step-by-step guide for using the “Photos” map layer.

https://mtnhp.org/Help/MapViewer/Tasks/How_To_Use_Georeferenced_Photos_Task_20200331.pdf

Earthquakes

Montana is prone to seismic activity, making it imperative to consider earthquakes when developing. An earthquake is ground shaking from radiated seismic energy caused by a sudden slip on a fault in the earth’s crust, volcanic or magmatic activity, or other sudden stress changes in the earth. Magnitude and intensity are used to describe the size and effects of earthquakes. Western Montana is more prevalent in seeing seismic activity; however, an earthquake has occurred in all corners of the state. A belt of seismicity known as the Intermountain Seismic Belt extends through western Montana, from the Flathead Lake region to the Yellowstone National Park region. Earthquakes in Montana have demonstrated their destructive effects which include landslides and uneven ground settling, flooding, and damage to homes and buildings, dams, irrigation systems, the power grid, communications systems, and transportation systems.

Considering earthquakes is crucial for several reasons including the following:

Safety of Structures:
Understanding the potential risks associated with earthquakes is vital for ensuring the safety and stability of structures built in the area. Assessing the seismic hazards can help engineers design buildings and infrastructure that can withstand the forces generated by earthquakes, reducing the risk of collapse or damage during a seismic event.

Protecting Lives:
Earthquakes can pose a significant threat to human life, particularly if buildings and infrastructure are not adequately designed to withstand seismic forces. Considering seismic hazards when selecting a development site can help mitigate the risk to human life by avoiding specific areas with high seismic activity or implementing appropriate engineering measures to enhance structural resilience.

Infrastructure Resilience:
Infrastructure such as roads, bridges, and utilities are also vulnerable to earthquake damage. Developing in areas prone to seismic activity without considering earthquake hazards can result in increased maintenance costs, disruptions to services, and potential hazards to public safety. By evaluating seismic risks during the site selection process, developers can plan and design infrastructure to be more resilient to earthquakes, minimizing damage and facilitating faster recovery in the case of a seismic event.

Insurance and Liability:
Ignoring seismic hazards can have financial implications in terms of insurance premiums and potential liability in the event of earthquake related damage or loss of life. Insurance companies may require higher premiums for properties located in earthquake prone areas, and developers could face legal repercussions if inadequate precautions were taken to mitigate seismic risks.

Long-Term Sustainability:
Considering seismic hazards in site selection promotes long-term sustainability by reducing the vulnerability of developments to natural disasters. Building resilient structures or infrastructure not only protects life and property during earthquakes but also enhances the overall resilience of communities, contributing to their ability to withstand and recover from other types of disasters.

Earthquake Information Resources in Montana:

Earthquakes will continue to occur in Montana; however, the precise time, location, and magnitude of future events cannot be predicted. Many factors contribute to determining areas of vulnerability: historical earthquake occurrence, proximity to faults, soil characteristics, building construction, and population density. Western Montana has a history of large, damaging earthquakes and is seismically active. Most earthquakes occur along fault lines that do not extend to the earth's surface and are unmapped and unknown.

The Montana Bureau of Mines and Geology Earthquake Studies Office, located on the Montana Tech Campus at Butte is the most reputable source for earthquake data in Montana. The Earthquakes Studies Office provides data and maps on past and most recent earthquakes, seismicity data, webcams from seismic stations, earthquake patterns in history, earthquake safety and other seismic resources. The Office operates the Montana Regional Seismic Network, a network of 42 permanent seismic stations located throughout western Montana. The data from these 42 sensors are continuously sent to the ESO using radio, satellite, cell phone links, and the internet for recording and analysis. Using data from these stations and other data sources from other institutions, MBMG personnel determine the locations and magnitudes of local and regional seismic events and determine whether they are earthquakes or man-made blasts at surrounding quarries, mines, or construction sites. Local and regional earthquakes data are contributed to the U.S USGS Comprehensive Catalog. All seismograph station data are archived at Data Services. The ESO typically records and locates roughly 10 earthquakes (usually small) each day in the northern Rocky Mountain region, but the number can be higher during earthquake swarms or aftershock sequences.

Resource Links:

MBMG Earthquake Studies Office:
https://www.mbmg.mtech.edu/MontanaGeology/geohazards/Earthquakes/main.asp#gsc.tab=0

USGS Comprehensive Catalog: https://earthquake.usgs.gov/earthquakes/search/

Data Services: https://ds.iris.edu/ds/

Landslides/Slope Instability

Landslides are defined as the movement of a mass of earth, debris, or rock down a slope from a mountain or cliff. Landslides are serious geologic hazards that can be found in any State in the U.S but are more prevalent in mountain states. As development occurs and people move into new areas of hilly or mountainous terrain, it is important to understand the nature of their potential exposure to landslide and rockslide hazards. Planning for these hazards includes identifying areas prone to landslides and adapting by incorporating land use plans and appropriate management regulations, as well as using thoughtful engineering practices for infrastructure and new construction of buildings.

Oftentimes, human activities can be a contributing factor in causing landslides. Some examples of how humans can generate landslides include the following:

Deforestation:
Removing trees and vegetation destabilizes slopes by reducing root cohesion and increasing surface runoff, which can lead to soil erosion and slope failure. Deforestation can also lead to increased fire risk, as reducing tree cover and ground vegetation dries out forests.

Construction and Excavation:
Activities such as road construction, mining, and excavation for buildings can alter the natural slope stability. Excavation can weaken slopes, alter drainage patterns and increase the weight on the lower parts of slopes, all of which can trigger landslides.

Irrigation and Land Use Changes:
Changing land use patterns, especially converting natural landscapes to agricultural or urban areas, can modify natural drainage patterns and increase water infiltration, which can saturate slopes and trigger landslides.

Water Management:
Poorly designed drainage systems, leaking water pipes, or improper irrigation techniques can saturate slopes or alter groundwater levels, which can contribute to landslide occurrence. Downslope locations below irrigation infrastructure such as ditches or canals are also at risk for slope instability.

Logging and Mining:
These activities can directly disturb slopes, reduce vegetation cover, and alter soil properties, all of which can increase landslide susceptibility.

Earthquakes and Blasting:
Earthquakes and blasting for construction or mining can trigger landslides by shaking or fracturing slopes, destabilizing them.

Landfill and Waste Dumping:
Improperly managed landfills or dumping of waste on slopes can increase weight and change slope geometry, potentially triggering landslides.

Climate Change:
While not a direct human activity, climate change induced factors like increased rainfall or snowfall intensity, prolonged droughts followed by intense rainfall, and melting of permafrost can all influence landslide occurrence, exacerbating risks in vulnerable areas affected by human activities.

Many of these human-initiated landslides can be avoided or mitigated altogether. Mitigating these risks involves careful planning, proper engineering practices, and land-use management that takes into account natural slope stability and the potential impacts of human activities on slopes.

Landslides Information Resources in Montana:

The Montana Bureau of Mines and Geology at Butte runs a Landslide Hazards Program that aims to identify, map, and categorize landslide areas across the State of Montana to better understand spatial distribution and causes of ground failure to help mitigate against landslide hazards. The new and ongoing deployment of Light Detection and Ranging techniques provides means to create high resolution imagery through technology and remove vegetation cover to identify landslide processes. Landslide location maps and slide prone areas are identified through reports and studies conducted by the MBMG Landslide Hazards Program and found on their website. Nationally, the United

States Geological Survey provides a Landslide Hazards Program whose objective is to reduce long-term losses from landslide hazards by improving the understanding of the causes of ground failure and suggesting mitigation strategies. The USGS website has resources explaining the science, monitoring and education of landslides and provides data, maps publications and web tools regarding the subject.

Resource Links:

MBMG Landslide Hazards Program:
https://www.mbmg.mtech.edu/MontanaGeology/geohazards/landslides/main.asp#gsc.tab=0

USGS Landslide Hazards Program:
https://www.usgs.gov/programs/landslide-hazards

Avalanches

An avalanche is a mass of loosened snow, ice, and/or earth that happens suddenly and swiftly sliding down a mountain. They often occur as the result of severe winter weather and temperature fluctuations. Avalanches primarily occur throughout western Montana in the mountainous regions, with about 90% occurring on moderate slopes of 30 to 45 degrees. They are an immediate threat to winter recreationists and communication and transportation networks.

Avalanches occur in two general forms, or a combination of both, including slab avalanches and loose snow avalanches. Slab avalanches are made of tightly packed snow at the top layer and are triggered by a collapse of an underlying weak snow layer. Additional weight from snowfall or skiers/snowboarders applies pressure to the top layer and the weaker layer underneath has the potential to collapse or wash out, causing large volumes of fast-moving snow. Slab avalanches are the most common type of avalanches in which people can get caught up and die from.

Loose snow avalanches are less dangerous than slab avalanches but still have the potential to impact winter enthusiasts and communication infrastructure. Loose snow avalanches are powdery surface slides that vary in size, depending on how much snow is entrained and on the size of the terrain feature where they occur. Loose snow avalanches release immediately below their trigger point and are typically smaller and more predictable than slab avalanches.

It is important for winter enthusiasts in Montana to monitor snow reports and avalanche data when exploring the backcountry and rely on forecasters' condition reports in order to receive warnings and stay safe. Similarly, when building long term structures in mountainous regions and on steep slopes, developers should assess the terrain, snowpack stability, and historical avalanche data prior to construction.

Avalanche Resources in Montana:

There are several resources available for identifying avalanche prone areas in Montana through local organizations and at a national level. These organizations provide educational resources, forecasts, maps, snowfall data, accident reports, and recent observations.

Gallatin National Forest Avalanche Center: https://www.mtavalanche.com/

Flathead Avalanche Center: https://flatheadavalanche.org/

West Central Montana Avalanche Center: https://missoulaavalanche.org/

US Forest Service National Avalanche Center: https://avalanche.org/national-avalanche-center/

High Groundwater

In Montana, where many areas depend on well water and have significant agricultural activities, monitoring groundwater levels is particularly important to ensure sustainable development and protect natural resources. High groundwater levels can also pose several challenges and risks for development in Montana including the following:

Flooding Risk:
High groundwater levels increase the risk of flooding, especially during heavy rainfall or snowmelt. This can damage buildings, infrastructure, and agricultural land.

Foundation Issues:
High groundwater can cause instability in soils, leading to settling or shifting of foundations. This can result in structural damage to buildings, making them unsafe or requiring costly repairs.

Basement Water Intrusion:
Buildings that have basements are particularly vulnerable to water intrusion from high groundwater. This can lead to mold growth, structural damage, and unhealthy living conditions.

Septic System Failures:
High groundwater can impede the proper functioning of septic systems, leading to contamination of the groundwater with untreated sewage. This can pose significant health risks and environmental hazards.

Soil Saturation:
Soils that are constantly saturated with water can lose their load-bearing capacity. This makes construction more difficult and expensive, as it may require special engineering solutions such as pilings or extensive draining systems.

Agricultural Impacts:
High groundwater can negatively impact agriculture by waterlogging crops, leading to reduced yields and damaged plants. It can also make it difficult to work the land with heavy machinery.

Increased Construction Costs:
Developing on land with high groundwater often requires additional measures to manage water levels, such as installing sump pumps, drainage systems, or waterproofing foundations. These measures increase the overall cost of construction and maintenance.

Environmental Concerns:
Development in areas with high groundwater can disrupt local ecosystems. Changes in water flow and quality can affect wetlands, streams, and other natural habitats, potentially leading to negative environmental impacts.

High Groundwater Resources in Montana:

Montana Bureau of Mines and Geology in Butte holds a database called the Ground Water Information Center that is the central repository for information on the groundwater resources of Montana. The data includes well-completion reports from drillers, measurements of well performance and water quality based on site visits, water-level measurements at various wells for periods of up to 60 years, and water-quality reports for thousands of samples. The databases at GWIC are continually updated with new data from driller's logs, MBMG research projects, and research projects from other agencies.

Ground Water Information Center: https://mbmggwic.mtech.edu/

The USGS has a National Water Dashboard which is a map that provides depth-to-water measurements made in the past and present:
https://dashboard.waterdata.usgs.gov/app/nwd/en/

The National Groundwater Monitoring Network is a compilation of groundwater monitoring wells from federal, state, and local groundwater networks across the nation:
https://cida.usgs.gov/ngwmn/

For specific development sites it is important to complete a water table test for high groundwater, as water table levels can fluctuate seasonally, yearly, and by area.

Polluted Water

Polluted water poses a multifaceted threat to development in Montana, affecting public health, increasing costs, complicating regulatory compliance, and harming the environment and economy. Addressing water pollution is essential for sustainable development and the well-being of communities in the state.

Polluted water can have several significant negative effects on development in Montana including:

Health Hazards:
Polluted water can contain harmful pathogens, chemicals, and heavy metals that pose serious health risks to humans. Contaminated drinking water can lead to outbreaks of diseases such as cholera, dysentery, and other waterborne illnesses.

Increased Treatment Costs:
Development in areas with polluted water requires additional investment in water treatment infrastructure. This includes advanced filtration systems and chemical treatments to ensure water quality meets safety standards, leading to higher costs for developers and municipalities.

Regulatory Challenges:
Development in areas with known water pollution issues may face stricter regulatory scrutiny and more stringent environmental compliance requirements. This can delay projects and increase the costs associated with obtaining necessary permits and approvals.

Agricultural Impacts:
Polluted water used for irrigation can harm crops and livestock. Contaminants can accumulate in the soil and enter the food chain, potentially affecting agricultural productivity and food safety. This can have economic repercussions for local farmers and the broader agricultural industry in Montana.

Decreased Property Values:
Properties in areas with polluted water sources may have reduced market values due to the perceived health risks and potential costs associated with water treatment. This can make it more difficult to attract buyers, affecting the viability of development projects.

Damage to Ecosystems:
Polluted water can harm local ecosystems, affecting fish and wildlife populations and degrading natural habitats. This can lead to a loss of biodiversity and negatively impact tourism and recreational activities that rely on a healthy environment.

Public Opposition:
Awareness of water pollution issues can lead to public opposition to development projects. Community resistance can result in legal challenges, protests, and negative publicity, further complicating development efforts.

Long Term Sustainability:
Ensuring a sustainable water supply is crucial for long-term development. Pollution can compromise the availability and quality of water resources, making it challenging to

support ongoing growth and development. This is especially critical in Montana, where many communities rely on groundwater for drinking water and agricultural uses.

Polluted Water – Information Resources in Montana:

Water quality is an important topic for all Montanans. The Montana Department of Environmental Quality is charged with maintaining and improving clean water in Montana's rivers, lakes, and below the surface - the groundwater. Montana's waters are a vital resource providing recreation, fishing, tourism, and drinking water. Water permitting is essential in the review process for DEQ to determine that water is safe and free of pollutants.

Surface water discharge permits through the Montana Pollutant Discharge Elimination System regulate wastewater discharges by limiting the quantities of pollutants to be discharged. The limits and requirements in this permit help ensure compliance with Montana's Water Quality Standards, and State and Federal Regulations, which are written to protect public health and the aquatic environment. Permits can be found through the following link: https://deq.mt.gov/water/assistance

The Montana Groundwater Pollution Control System (MGWPCS) program issues groundwater discharge permits to owners of potential sources of pollution to state groundwater. Typical permitted facilities include residential wastewater treatment systems, metal ore mills, lumber mills, wood product manufacturers, breweries, and community water treatment plants. Permits can be found on the water assistance page on the DEQ website through the following link: https://deq.mt.gov/water/assistance

Montana DEQ Water webpage: https://deq.mt.gov/water/index

Additional maps and information can be found on the Montana State Library website: https://msl.mt.gov/geoinfo/water_information_system/groundwater/groundwater_maps

Severe Toxic or Hazardous Waste Exposure

Being aware of toxic or hazardous waste exposure is essential for protecting human health, preserving the environment, complying with regulations, managing economic risks, maintaining community relations, and ensuring the long-term sustainability of development projects in Montana. These reasons are further explained below:

Health and Safety:
Exposure to toxic or hazardous waste can lead to serious health problems, including respiratory issues, skin irritations, neurological disorders, and cancers. Ensuring that

development sites are free from contamination protects workers, residents and the general public. Prolonged exposure to hazardous substances can result in chronic health issues, affecting the quality of life and increasing healthcare costs for the affected population.

Environmental Protection:
Toxic waste can leach into the soil and groundwater, contaminating drinking water supplies and agricultural land. This can lead to widespread environmental degradation and pose a risk to local ecosystems and wildlife. Contaminants can disrupt local ecosystems, harming plants and animals and leading to a loss of biodiversity. Maintaining a healthy environment is essential for the sustainability of natural resources and the well-being of communities.

Regulatory Compliance:
Developers must comply with state and federal environmental regulations, such as the Comprehensive Environmental Response, Compensation, and Liability Act, commonly known as Superfund. Non-compliance can result in legal penalties, fines, and costly remediation efforts. Conducting through environmental assessments and identifying hazardous waste sites is a critical part of due diligence for any development project. This helps avoid legal liabilities and ensures compliance with environmental laws.

Economic Implications:
Identifying and cleaning up hazardous waste sites can be extremely expensive. Developers need to be aware of these potential costs to budget appropriately and assess the financial viability of the project. Properties in contaminated areas may have lower market values, making them less attractive to buyers. Ensuring that developments sites are free from hazardous waste helps maintain property values and marketability.

Community Relations:
Transparency and proactive management of hazardous waste issues can build trust with the local community. Conversely, failure to address these issues can lead to public opposition, negative publicity, and damage to the developer's reputation. Ensuring that development projects do not expose communities to toxic substances demonstrates a commitment to public health and safety, promoting positive relationships with residents.

Severe Toxic or Hazardous Waste Exposure Resources in Montana:

The Montana Department of Environmental Quality's Hazardous Materials Section of the Waste Management and Remediation Division provides expertise in hazardous waste management and is responsible for permitting, compliance assurance, and technical assistance for hazardous waste and used oil management. The Hazardous Materials Section is responsible for regulating storage, treatment, transport, and disposal of hazardous waste and used oil for all hazardous waste handlers in Montana.

In addition, the unit provides technical assistance to, and conducts inspections of, hazardous waste generators of all sizes throughout Montana. Reports, regulations, permitting and general information can be found on the Montana DEQ Hazardous waste program's website: https://deq.mt.gov/twr/Programs/hazmat

Agriculture Lands/Agricultural Water User Facilities

Agricultural water user facilities play an integral role in water management and sustainability in Montana. Montana's agricultural sector heavily relies on irrigation systems, which are supported by various water user facilities such as canals, ditches, and reservoirs. These facilities ensure efficient water distribution to farms, ranches, and communities, supporting crop production and livestock operations across the state. Neglecting or improperly planning around these facilities during land development can disrupt water access, jeopardize agricultural productivity, and impact the overall ecosystem. Therefore, understanding and integrating these water user facilities into land development plans are essential to maintain water security, uphold agricultural livelihoods, and preserve Montana's natural resources.

Agricultural Water Facilities Resources in Montana

Determining agricultural water use in Montana is dependent on the water rights that a property holds. The State of Montana owns the waters within the state on behalf of its citizens. Citizens do not own the water but can possess a legal right to use the water within state guidelines. By law, a recorded water right is required for the majority of water uses to be valid, legal, and defensible against other water users.

More information on water rights can be found on the Montana Department of Natural Resources and Conservation website: https://dnrc.mt.gov/Water-Resources/Water-Rights/Understanding-Water-Rights/#:~:text=The%20State%20of%20Montana%20owns,defensible%20against%20other%20water%20users.

Montana DNRC uses the geocode of a property to track ownership of water rights. A geocode is a 17-digit number that can be found on property tax records or a search on Montana Cadastral (https://svc.mt.gov/msl/cadastral/?page=Map).

If a geocode has been identified on an active water right, that water right will come up as a result when searching by geocode in the Water Right Query System (https://gis.dnrc.mt.gov/apps/WRQS/).

The Montana Natural Resources Conservation Service, a division of the United States Department of Agriculture, provides an irrigation scheduling record book to assist in scheduling irrigations and maintain useful records by recording crop water use, irrigation applications, and soil water levels.

Irrigation Scheduling Record Book: https://www.nrcs.usda.gov/sites/default/files/2023-06/Montana-Irrigation-Scheduling-Recordbook.pdf

Minerals

Montana's mineral wealth plays a significant role in its economic and industrial landscape, marked by a rich history of mining activities and a diverse range of valuable materials. Montana is renowned for its substantial deposits of copper, gold, and silver, which have historically driven economic growth and continue to be significant contributors to the mining sector. Montana also boasts reserves of coal, platinum, palladium, and rare earth elements. These are essential for various industrial applications, including energy production, electronics, and manufacturing. The state's mineral resources not only provide jobs and stimulate local economies, but also contribute to national and global markets, underlining Montana's importance in the mining industry. Responsible mining practices and ongoing exploration efforts ensure that Montana remains a key contributor in the sustainable extraction and utilization of these vital resources.

Mineral Resources in Montana:

The National Minerals Information Center, a division of the United States Geological Survey, provides statistics and information on nonfuel mineral commodities produced in Montana. Production charts and maps show the areas where specific minerals are extracted, and the amount produced. The Montana Minerals page can be found in the following link:
https://www.usgs.gov/centers/national-minerals-information-center/mineral-industry-montana#:~:text=Leads%20in%20talc%20production%20%26%20is,%2C%20gold%2C%20lime%2C%20gemstones.

The Montana Department of Environmental Quality provides resources for coal mining, hard rock mining, and opencut mining. Annual reports show site specific numbers for production in these mining sectors.
https://deq.mt.gov/mining/index

Forestry Lands

Montana's forestry sector is a cornerstone of its economy and environmental stewardship, playing a vital role in both local communities and the broader ecological landscape. The state's vast forests cover approximately one-quarter of its total land area and are rich in diverse tree species. These forests support a robust timber industry that provides jobs, raw materials for construction, paper products, and biomass energy. Beyond economic benefits, Montana's forests are crucial for wildlife habitats, recreation, and water quality. Sustainable forest management practices are essential in Montana to balance timber production with conservation efforts, ensuring the health and resilience of these vital ecosystems for future generations.

Forestry Lands Resources in Montana

The Montana Natural Resource Conservation Service provides resources for forest management in the state. The NRCS emphasizes voluntary science-based assistance to help private forest landowners and managers improve their forest resource. NRCS conservationists work with private forest landowners and managers to plan and install forestry practices that can improve growth, reduce risk, and improve forest health. Publications and guides are available on the NRCS website for forest land treatments, conservation of trees and shrubs, and planting guidelines.

NRCS Forestry Resources: https://www.nrcs.usda.gov/resources/guides-and-instructions/forestry-montana-resources

The United States Forest Service, a division of the U.S Department of Agriculture, offers resources for the protection and management of National Forest Lands. The Forest Service sustains the health, diversity, and productivity of the Nation's forests to meet the needs of present and future generations. Through implementation of land and resource management plans, the agency ensures sustainable ecosystems by restoring and maintaining species diversity and ecological productivity that helps provide water recreation, water, timber, minerals, fish, wildlife, wilderness, and aesthetic values. Montana is located in the Northern Region (Region 1) which covers six states and is based in Missoula, MT.

U.S Forest Service: https://www.fs.usda.gov/

Agency Contact List

HAZARD	AGENCY	EMAIL	PHONE
Wildfires	Montana DNRC Forestry and Fire	Dnrc_publicinfo@mt.gov	406-542-4300
Flooding	Federal Emergency Management Agency (FEMA) Montana Department of Natural Resources	AskIA@fema.dhs.gov https://dnrc.mt.gov/Water-Resources/Floodplains/	303-235-4800
Unsuitable Soils	USDA NRCS	askusda@usda.gov	1-833-ONE-USDA
Wildlife Habitats	Montana Natural Heritage Program	mtnhp@mt.gov	406-444-3989
Earthquakes	Montana Bureau of Mines and Geology	pubsales@mtech.edu	406-496-4167
Landslides	Montana Bureau of Mines and Geology	pubsales@mtech.edu	406-496-4167
Avalanches	Gallatin National Forest Avalanche Center Flathead Avalanche Center	mtavalanche@gmail.com flatheadavalanche.org Missoulaavalanche.org	406-587-6981 406-387-3887

	West Central Montana Avalanche Center		406-530-9776
High Groundwater	Montana Bureau of Mines and Geology Groundwater Information Center Montana DNRC Water Sciences Bureau	pubsales@mtech.edu https://dnrc.mt.gov/Water-Resources/Water-Science-and-Data/	406-496-4336
Polluted Water	Montana Department of Environmental Quality	https://deq.mt.gov/about/ContactUs Online Email Submittal Form	406-444-2544
Toxic/Hazardous Waste	Montana Department of Environmental Quality	deqhazwaste@mt.gov	406-444-5300
Agricultural Water User Facilities	MT DNRC	https://dnrc.mt.gov/	406-444-2074
Minerals	MT Department of Environmental Quality National Minerals Information Center	https://deq.mt.gov/mining/index https://www.usgs.gov/centers/national-minerals-information-center	406-444-2544 1-888-392-8545
Forestry Lands	Natural Resources Conservation Service	https://www.nrcs.usda.gov/resources/guides-and-instructions/forestry-montana-resources	1-833-ONE-USDA

	United States Forest Service	https://www.fs.usda.gov/	800-832-1355

Additional Resources:

Montana DEQ prepares environmental review documents in accordance with requirements of the Montana Environmental Policy Act. These can be found in the form of Environmental Assessments (or Environmental Impact Statements. These environmental review documents give opportunities for the public to participate in the environmental review process. The MEPA documents webpage on the DEQ website provides links to specific MEPA projects currently under review at DEQ.

Montana Environmental Policy Act: https://deq.mt.gov/public/mepa

A Multi-Hazard Mitigation Plan was prepared for Montana Disaster and Emergency Services and the Montana Department of Military Affairs which is a long-form document that highlights proactive and preventative measures that can be implemented to minimize or eliminate detrimental effects of hazards. The preventative actions (mitigation) serve to safeguard human life, property, the economy, and other valuable assets. This mitigation plan addresses primary hazards and associated risks across the state.

Multi-Hazard Mitigation Plan:
https://des.mt.gov/Mitigation/FINAL_2023_MT_MHMP_20231003.pdf

Sincerely,
WGM Group, Inc.