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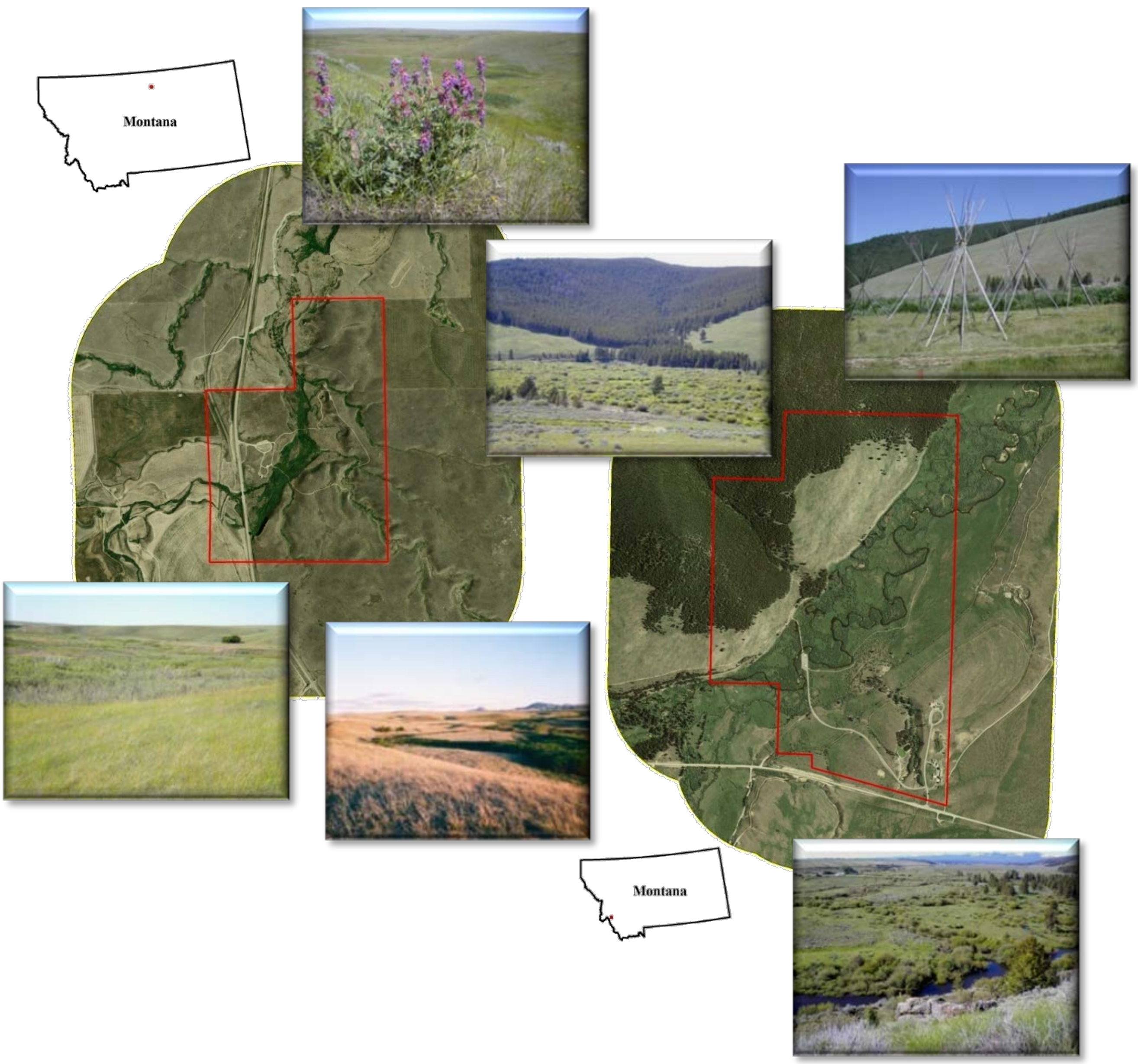
Natural Resource Stewardship and Science

Natural Resource Condition Assessment

Big Hole and Bear Paw National Battlefields of the Nez Perce National Historical Park

Natural Resource Report NPS/UCBN/NRR—2011/471



ON THE COVER

Map of Big Hole National Battlefield located in south-west Montana and Bear Paw Battlefield located in north-central Montana with insets of pictures from the Big Hole National Battlefield and Nez Perce National Historical Park websites and Northwest Management, Inc.

Natural Resource Condition Assessment

Big Hole and Bear Paw National Battlefields of the Nez Perce National Historical Park

Natural Resource Report NPS/UCBN/NRR—2011/471

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado publishes a range of reports that address natural resource topics of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate high-priority, current natural resource management information with managerial application. The series targets a general, diverse audience, and may contain NPS policy considerations or address sensitive issues of management applicability.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

This report is available from the Upper Columbia Basin Network website (http://science.nature.nps.gov/im/units/ucbn/reports/) and the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/nrpm/).

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Executive Summary

This Natural Resource Condition Assessment (NRCA) report and accompanying geodatabase is designed to give the resource managers of Big Hole National Battlefield (BIHO) and the Bear Paw Battlefield (BEPA) unit of Nez Perce National Historical Park a better understanding of the condition of natural resources within and adjacent to these park units. Assessment of the natural resources was accomplished through an extensive literature review, evaluating existing data, and collection of new data on areas of each park unit where sufficient, reliable data for an assessment was not available. Aquatic and upland habitats were assessed and treated separately as there were different methods of evaluation for each. Selected threats and stressors to BIHO and BEPA natural resources have been evaluated and presented for park-wide consideration. Information gained from this report will form the basis for development of actions to reduce and prevent impairment of the natural resources at these sites and assist in the development of desired future conditions through park planning processes.

The study is based on two management areas composed of 6th level Hydrologic Unit Codes (HUC) (USGS 2009) surrounding each National Park Service (NPS) unit. An additional two km buffer was included for clarification and mapping purposes. All available geographical information system references were acquired for the project areas to create ArcGIS map project files and geodatabases. These products were used to develop all maps presented in the report and for analysis of geographically based data. All site-specific data was compiled in GIS 9.3. Upland data is available in the digital database and riparian/aquatic assessment data is attached to this report. Maps and pictures were provided for each upland and aquatic assessment site along with a description of the site and current observed condition.

BIHO upland communities were sampled at seven sites distributed across two park ecotones (range uplands and forested uplands). All sites were evaluated based on the Natural Resource Conservation Service (NRCS) ecological site description, as defined by soil type, and an established reference condition (Pellant et al. 2005). Each ecological site received a five-level rating for condition in three landscape attributes: soil stability, hydrologic function, and biotic integrity. All but one plot had a soil stability attribute rating of none to slight departure from reference condition, indicating soil processes were generally in good condition and functioning properly in all units. The hydrologic function attribute echoed that of the soil stability attribute with a rating of none to slight for all sites within the park. This suggests that the water quality of the area is in generally good condition. Although some erosion may be localized in very small areas, the majority of the area is functioning properly within its respective watershed. The biotic integrity attribute ratings indicated all seven plots were functioning properly with a rating of none to slight for each. Site one in the rangeland area had a departure of 2.9% whereas the remaining plots showed 0% departure.

BEPA upland communities were sampled at seven sites throughout the park. All plots had a soil stability attribute rating of none to slight departure from reference condition, indicating soil processes were generally in good condition and functioning properly. The hydrologic function attributes had very similar results to that of the soil stability with a rating of none to slight for all assessment sites. Both attributes indicate the Park land is in excellent condition and is

functioning properly. The biotic integrity attributes indicated that most all of the BEPA park area is in excellent to good condition.

Aquatic resource assessments were conducted at BIHO in four locations on the North Fork of the Big Hole River starting at the southern end of the park where the river enters and ending near the northern end of BIHO as the river exits. Sites were assessed using the "Montana Wetland Rapid Assessment Method" (MRAM) riparian assessment methodology developed by the Montana Department of Environmental Quality (MDEQ) for riparian/wetland/riverine habitats (Apfelbeck and Farris 2005). All three aquatic site assessments were considered to be functioning properly. The fourth site nearest the northern end of the park was noted to have some stream bank instability and causes were attributed to the possibility of natural stream channel migration or recent spring high water of the 2008-09 winter runoff (USGS 2010). Aquatic resource assessments were not completed within BEPA due to the presence of seasonal water pathways and general lack of areas dominated by riparian/wetland vegetation.

A total of 48 taxa that occur in the park are listed as non-native plant species within Montana. Previous studies have identified 34 noxious or invasive species as either potentially or physically existing in BIHO Park unit. Of these 34 species, six are listed as noxious weeds by the State of Montana. Within the boundaries of BEPA there have been four non-native plant species identified by the State of Montana to be noxious weeds, and spotted knapweed appears to be the most widespread and threatening of the four. An accurate mapping of weeds currently existing on BIHO and BEPA lands would allow management to be more strategic in their control of these undesirable species through preparation and cooperation with other landowners. Cooperation with adjacent owners of both private and public lands is known to be the most effective method to prevent and manage noxious weeds. The management of these invasive species will further help in maintaining the sensitive population of Lemhi penstemon (*Penstemon lemhiensis*) (Stucki and Rodhouse 2009) and other species of management concern within BIHO and BEPA.

The climate of the region is predicted to have warmer, wetter winters with a temperature increase of 3.1° F by 2030 and a 5% overall increase in precipitation (Mote et al. 2005). Precipitation is predicted to come more in the form of rain with smaller snow pack and altered seasonal stream flow patterns shifting markedly toward larger winter and spring flows and smaller summer and autumn base flows (Mote et al. 2005). The upper Big Hole River watershed provides some of the last remaining habitat of the native fluvial Arctic grayling population that once inhabited other areas of the Missouri River Watershed (Rens and Magee 2006). Arctic grayling may encounter further loss of habitat and spawning areas under accelerated climate change. This issue might be addressed through future natural resource planning and enhanced monitoring.

Results of this report should assist park managers in identifying when, where, and how to improve management practices, justify additional resources, and prepare for the changes in the environment that would directly impact BIHO and BEPA natural and cultural resources if climate change scenarios unfold as projected.

Acknowledgments

This project was completed through the effort and dedication of numerous individuals and organizations. We are thankful for all the support and help from Lisa Garrett, Coordinator for the NPS Upper Columbia Basin Network. She had the vision to develop and implement this project and the professionalism and dedication to guide it to completion. We owe a great deal of appreciation to our dedicated staff, including Vaiden Bloch, GIS Specialist, from Northwest Management, Incorporated. Finally, we are very thankful for all the support and help from Lisa Garrett, Gordon Dicus, Eric Starkey, and Tom Rodhouse National Park Service - Upper Columbia Basin Network, and Jason Lyon and Jannis Jocius from Nez Perce National Historical Park for data and editorial assistance. A special thanks to Dan Cogen and James Von Loh of Cogen Technologies Inc for their efforts in technical review and editing.

The staff at Big Hole National Battlefield (BIHO) went out of their way to assist field crews in every way possible. They were very professional and extremely helpful throughout the process.

Introduction

Purpose and Scope

The mission of the National Park Service (NPS) is "to conserve unimpaired the natural and cultural resources and values of the National Park system for the enjoyment of this and future generations" (NPS 1999). To uphold this goal, the Director of the NPS approved the Natural Resource Challenge to encourage national Parks to focus on the preservation of the Nation's natural heritage through science, natural resource inventories, and expanded resource monitoring (NPS 1999). Through the challenge, 270 Parks in the national Park system were organized into 32 inventory and monitoring networks.

The Upper Columbia Basin Network (UCBN) consists of nine widely separated NPS units located in western Montana, Idaho, eastern Washington, and central Oregon. Parks of the UCBN include: Big Hole National Battlefield, City of Rocks National Reserve, Craters of the Moon National Monument and Preserve, Hagerman Fossil Beds National Monument, John Day Fossil Beds National Monument, Lake Roosevelt National Recreation Area, Minidoka Internment National Monument, Nez Perce National Historical Park, and Whitman Mission National Historic Site.

As part of the Natural Resource Challenge, the NPS Water Resources Division received funding to assess natural resource conditions in national park units. Management oversight and technical support for this effort is provided by the division's Watershed Condition Assessment (WCA) Program. The WCA Program partnered with the Pacific West Region to fund and oversee an assessment at each Park in the UCBN. This report documents the results of the Natural Resource Condition Assessment (NRCA) completed for Big Hole National Battlefield and the Bear Paw Battlefield unit of Nez Perce National Historical Park.

Natural Resource Condition Assessments are broad-scope ecological assessments intended to develop synthesis "information products" readily usable by Park managers for: a) resource stewardship planning and b) reporting to performance measures such as the Department of Interior (DOI) Strategic Plan's "land health" goals. Three elements are key to making these assessments useful for both planning and performance reporting:

- Build on data, information, and knowledge already assembled through efforts of the NPS inventory and Monitoring Program (I&M), other NPS science support programs, and from partner collaborators working in and near Parks;
- Emphasize a strong geospatial component for how the assessment is conducted and in the resulting information products;
- Provide narrative and/or semi-quantitative descriptions of science-based reference conditions for park resources that will assist park managers as they work to define Desired Future Conditions through park planning processes. These reference conditions will become more refined and quantitative over time.

This report is designed to give NPS staff a moment-in-time assessment of park resources. Information gained from this report will form the basis for development of actions to reduce and prevent impairment of park resources through park and partnership efforts. The goals of the Natural Resource Condition Assessment are to:

- Determine the state of knowledge concerning overall natural resource conditions;
- Identify information gaps and resource threats;
- Assess overall ecosystem health;
- Establish the context for management actions and collaboration.

Study Area

This project encompasses two NPS sites located in southwestern and north-central Montana (Figure 1). The first of these is the Big Hole National Battlefield (BIHO) located near Wisdom, Montana, and the second is the Bear Paw Battlefield unit of the Nez Perce National Historical Park (BEPA) located south of Chinook, Montana.

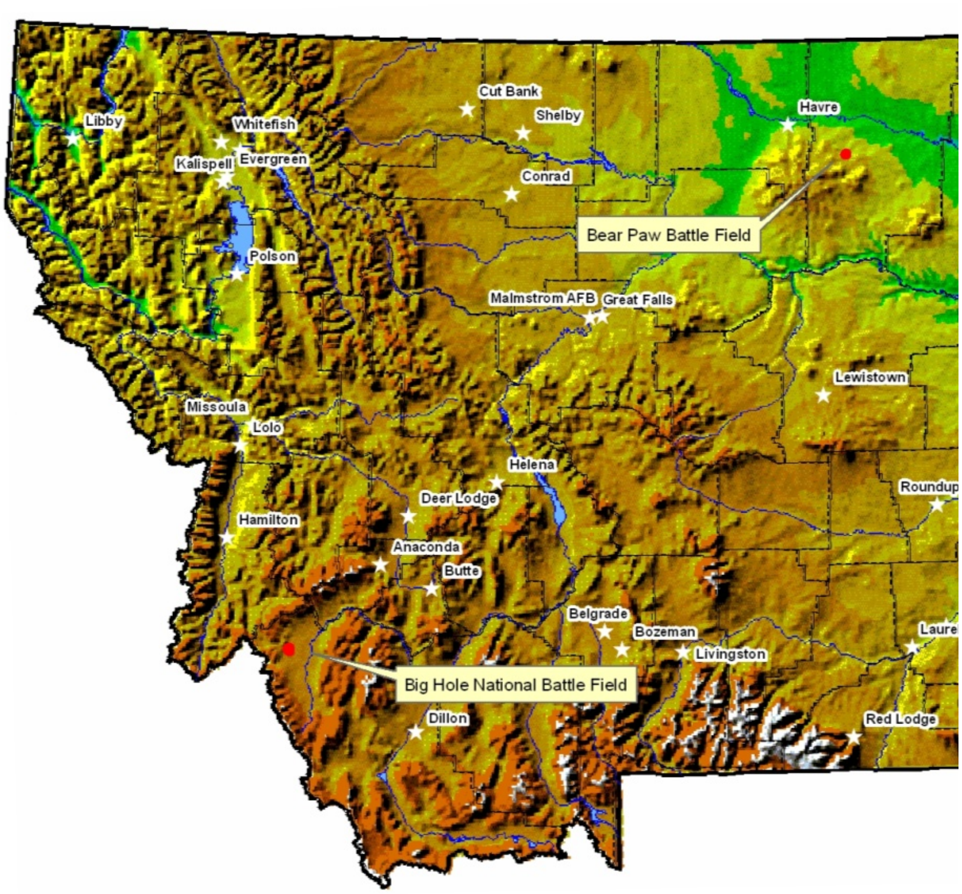

Figure 1. Map of Montana showing both park unit locations.

Historical Setting

The Big Hole area was well known to the Nez Perce as a summer hunting, gathering, and camping area along the route between their homeland in central Idaho and buffalo hunting grounds east of the Rocky Mountains. Used for generations, the Nez Perce traveled to the Big Hole in early August of 1877 after engaging the military in several conflicts in Idaho. The Nez

Perce eventually made camp along the North Fork of the Big Hole River on August 7, 1877. Unbeknownst to them, they were being pursued by U.S. Army forces under the command of Colonel John Gibbon. Gibbon and his men staged a pre-dawn surprise attack on the Nez Perce camp on August 9th. By that afternoon, the Nez Perce were able to force the soldiers into a retreat and siege position on a small point of timber near the center of the current battlefield. After successfully repulsing the military attack and suffering heavy losses, the Nez Perce withdrew from the site on the 10th of August.

The battle was part of a five-month conflict in which the army, intent on moving the Nez Perce to the Lapwai Reservation in Idaho, pursued roughly 750 men, women, and children across 1,170 miles from the Wallowa Valley in Oregon to the Bear Paw Mountains, just 40 miles from the Canadian border in northern Montana. Along the way, the two sides fought a series of confrontations during which scores of people were killed, including soldiers, citizen volunteers, and Nez Perce men, women, and children. The remaining Nez Perce eventually made their way north through Montana in late September 1877 (NPS 2008b).

Immediately north of the Bear Paw Mountains a hunting party, in advance of the main body of Nez Perce, successfully killed a buffalo along Snake Creek, roughly 40 miles south of the Canadian border. Again feeling they were well ahead of their military pursuers, the Nez Perce set up camp on September 29, 1877 adjacent to the kill site. The Nez Perce camp was quickly discovered by Indian scouts working for the U.S. Army early on the morning of September 30, 1877 and, under the command of Colonel Nelson A. Miles, the military attacked the Nez Perce camp later that morning. Miles and his troops had been traveling rapidly in a northwesterly direction in an attempt to intercept the Nez Perce before they made it to Canada. The ensuing battle of the Bear Paw lasted five days until the exhausted, cold, and hungry Nez Perce surrendered on October 5, 1877. In the course of events a group of Nez Perce under the direction of Chief White Bird succeeded in escaping to Canada, but with Chief Joseph's surrender, the rest of the non-treaty Nez Perce were exiled first to Kansas and later to Indian Territory in Oklahoma. In 1885, Chief Joseph and the remaining Nez Perce held in Oklahoma, were allowed to return to the Northwest but were forced to settle on the Colville Indian Reservation in central Washington State.

Administration

The two NPS managed sites examined as components of this study were included in the national park system primarily because of their nationally significant cultural resources. Each unit had a different path to becoming a part of the NPS system. Even though neither was recognized for their natural resource potential at the time of designation, today they serve as federally protected natural areas important to the maintenance and existence of numerous plant and animal species.

Big Hole

The BIHO site was set aside from development as a five acre national monument through a June 23, 1910 executive order signed by President Taft. Originally administered by the War Department and later the U.S. Forest Service, jurisdiction over the site was transferred to the NPS in July of 1933 by President Franklin D. Roosevelt. Passage of Public Law 88-24 on May 17, 1963 allowed for expansion of the now 200 acre site to include roughly 455 additional acres, and conversion of the site from a national monument to a national battlefield (Catton and Huber

1999). Acquisition of these additional lands was not fully completed by the NPS until 1972 at which time the Big Hole National Battlefield totaled 655 acres.

Located ten miles west of Wisdom, Montana, the battlefield encompasses much of the zone of conflict from the 1877 battle. There are two self-guided trails at the site leading from the lower parking area to the location of the Nez Perce encampment and the siege area where U.S. soldiers were held at bay during the second half of the battle (NPS 1997). A third self-guided trail leads to a site on the hill to the west where the howitzer was captured by Nez Perce warriors. Trail guides, waysides, and battlefield markers account in brief detail the events that transpired across the landscape.

The battlefield continues to draw a steady flow of visitors. Day-use areas are available for picnicking; however, there are no over-night facilities. Throughout the past decade, visitation has averaged 55,168 visitors annually according to NPS records from 2009 (Figure 2) represents fluctuations in visitation at BIHO since 1938 (NPS 2010b).

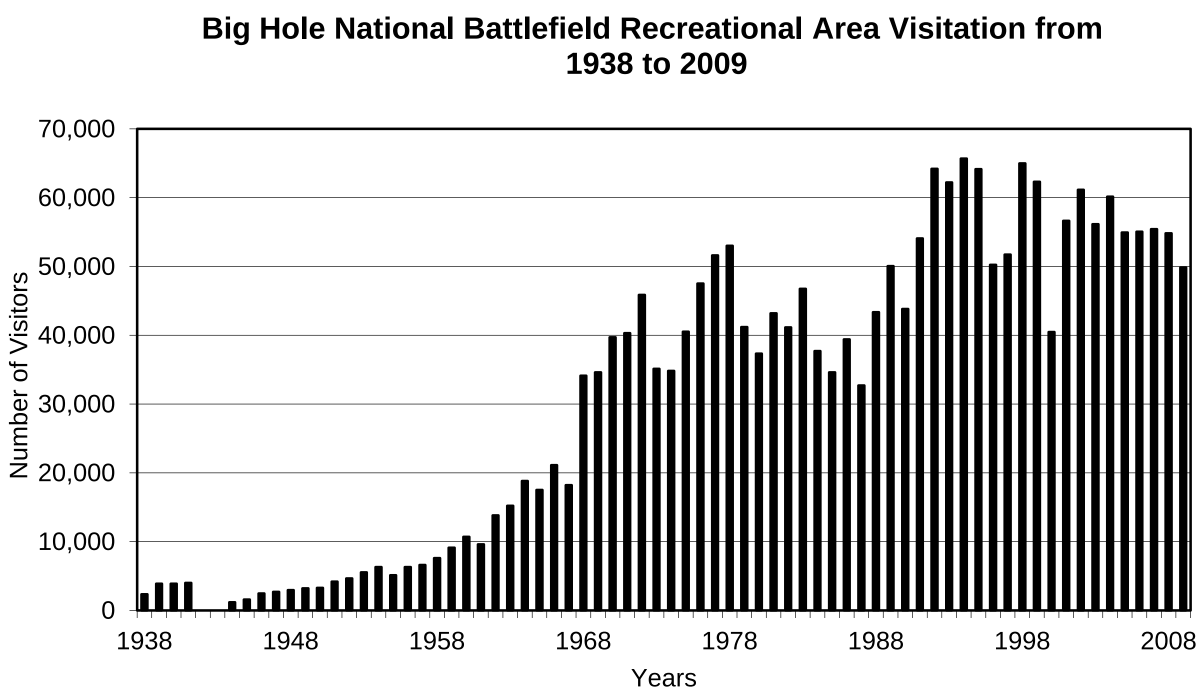

Figure 2. Recreational use from 1938-2009 at BIHO (NPS 2010b).

Bear Paw

The BEPA unit was initially set aside from development through an act of Congress in 1928 to be managed by the Bureau of Land Management (BLM). In the 1960s the original 150 acre site, and an additional 40 acres of private property, were transferred to the Montana Department of Fish Wildlife and Parks for management as the Chief Joseph's Battleground of the Bear Paw State Monument. In 1992, the site was added to Nez Perce National Historical Park (NEPE) and the NPS began leasing the property from the state to facilitate establishment, development, administration, and public use of BEPA (Scott 2010). The NPS acquired the 190 acre property from the State of Montana in 2005.

All the visitor facilities, consisting of a vault toilet, covered picnic shelter, and upper and lower parking areas, currently present at the BEPA site were created prior to NPS acquisition. A loop trail which leads visitors across the site from the upper parking lot to the Nez Perce encampment area, south to the location of Colonel Mile's first charge on the camp, and eventually to the Chief Joseph surrender site is maintained as a mowed path. Also present are a wooden bridge crossing Snake Creek, several interpretive waysides, and various commemorative monuments and plaques.

According to NPS records just under 9,000 people visited the BEPA site in 2009. This number was up slightly from previous years and may be reflective of more local, day-use visitation of the site.

Current Administration

Today, both BIHO and BEPA are part of NEPE. Originally established by Public Law 89-19 on May 15th, 1965, NEPE was created to facilitate protection and provide interpretation of sites in the "Nez Perce Country" that have exceptional value in commemorating the history of the nation (NPS 1997). The park is non-traditional because it is not a contiguous tract of land but rather a conglomerate of small sites. These sites depict the historic role of the Nez Perce people in the westward expansion of the United States and include, but are not limited to, historic buildings, missions, battlefields, cemeteries, archeological sites, geological formations and trails. The initial law established 24 sites all located within the state of Idaho.

On October 30th, 1992 further legislation was passed in the form of Public Law 102-576 allowing for the addition of 14 new sites in the states of Oregon, Washington, Montana, Idaho and Wyoming. This increased the NEPE administered units to the 38 sites existing today. It is through this 1992 act that BIHO came under the jurisdiction of NEPE and BEPA was officially included in the NPS system. On the basis of provisions in the NEPE enabling legislation, the purpose of all 38 units of NEPE are to (NPS 1997):

- Facilitate protection and offer interpretation of Nez Perce sites in Idaho, Oregon, Washington, Montana, and Wyoming that have exceptional value in commemorating the history of the United States.
- Protect and preserve tangible resources that document the history of the Nez Perce people and the significant role of the Nez Perce in North American history.
- Interpret the culture and history of the Nez Perce people and promote documentation to enhance that interpretation.

Natural Resources

The UCBN Monitoring Plan has identified a suite of 14 vital signs chosen for monitoring implementation throughout the UCBN park units over the next five years (Garrett et al. 2007). Vital signs are "a subset of physical, chemical, and biological elements and processes of park ecosystems that are selected to represent the overall health or condition of park resources, known or hypothesized effects of stressors, or elements that have important human values" (NPS 2009).

There are eight vital signs established for monitoring in BIHO and BEPA to assist managers with future monitoring and management plan development (Garrett et al. 2007, NPS 2009). These vital signs are aspects of the natural environment including; geology and soils, water biological integrity, human use, and ecosystem patterns. These aspects are broken down by their specific attributes briefly below and throughout the results.

The air, water, soils, and geology in a watershed combine to create the physical environment, which is the foundation of all ecosystems. Air quality is fundamentally important to the preservation of healthy natural areas, and currently BIHO and BEPA receive generally low levels of atmospheric pollutants. Water resources in BIHO and BEPA include major rivers, surface water, and groundwater.

Vegetation, terrestrial wildlife, aquatic wildlife and fisheries in a watershed combine to create the biological environment. Both BIHO and BEPA intersect different ecological systems which support biologically diverse sets of wildlife and vegetative species. Additionally, past and present park development (Chambers et al. 2008) and the suppression of wildfire (Stucki and Rodhouse 2009) have fragmented areas dominated by native vegetation and in some cases have caused a shift in species composition to more weedy vegetative types.

Big Hole

The BIHO area map is shown in
Figure **3** below. Elevation within BIHO ranges from approximately 6,100 feet above sea level to over 7,000 at the top of Battle Mountain. This makes the Big Hole Valley the highest and broadest mountain valley in western Montana. In fact, much of the valley floor is above 6,000 feet in elevation. As a result of its elevation and location, the four seasons are distinct at BIHO, spring is late (often beginning in May), and winters can be early (often beginning at the end of September) (WRCC 2010). Weather data from the Wisdom, Montana gauging station provides mean, minimum, and maximum measures of weather near BIHO (WRCC 2010). The climate of BIHO, based upon these long-term weather patterns, is best described as a semi-arid continental climate; one which has warm dry summers and cold, harsh winters. Annual average precipitation is less than 12 inches distributed between snowfall in the winter and seasonal rain showers, and average temperatures range from -17°C to 26°C.

The snowmelt and rain runoff from the surrounding mountains and hillsides combine to form major creeks, surface water, and groundwater. Trail and Ruby Creeks are perennial and come together to form the North Fork of the Big Hole River to the immediate west of the park boundary. The resulting two mile portion of the river bisects the site, meandering in a northeasterly course through wet meadow bottomland.

Drainage areas within BIHO typically range from upland areas comprised of swales, which may seasonally exhibit saturated soils to riparian/wetland areas bordering the North Fork of the Big Hole River. These areas exhibit vegetation consisting of willow, sedge, rush and grass species. The river is nationally known as one of the premiere blue-ribbon trout waters in Montana and is well-known for its rich variety of fish. Brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), and rainbow trout (*Oncorhynchus clarkii*) are all non-native fish species. Population studies of fluvial Arctic grayling (*Thymallus arcticus*) within these areas have suggested the potential for this species to exist in the North Fork of the Big Hole River. As of the date of this publication there have been no Arctic graylings observed in the river at the battlefield, although habitat capable of supporting this species is thought to exist.

Water quality and quantity are important for healthy habitats. At BIHO water quality was evaluated in 1997 during the NPS *Baseline Water Quality Inventory and Analysis* (NPS 1997b) as well as in the 2009 NPS *Upper Columbia Basin Network Integrated Water Quality Annual Report* (Starkey 2010). Water use outside the park consists predominately of irrigation for area crops and livestock. Most of the water resource monitoring throughout the BIHO study area prior to 1997 is represented by one-time or intensive single-year sampling efforts by the collecting organizations (NPS 1997b).

Not only are aquatic and riparian areas important at BIHO, but upland steppe and forests also contribute to the natural biodiversity of the site. The sagebrush steppe and grasslands meet mixed conifer forests creating transition zones or “ecotonal habitats” throughout the battlefield. The site is roughly rectangular in shape; it is bounded by the two-lane State Highway 43 on the south, Beaverhead National Forest lands on the north, and private ranch land on the west and east. Battle Mountain rises on the northwest side of this river valley and Ruby Bench is on the southeast side. Battle Mountain is backed by the forest-covered Anaconda Mountain Range (NPS 2000). The lower slope of Battle Mountain is marked by a treeless, grassy, open area now known as the “Horse Pasture” (NPS 2000). To the west of the Horse Pasture, is a draw known as Battle Gulch. Below Battle Gulch the forest extends down to the valley floor over a low alluvial fan promontory known as the “Siege Area” (NPS 2000).

In addition to the steppe and forests, BIHO supports one of the largest populations of Lemhi penstemon (*Penstemon lemhiensis*) in Montana (Stucki and Rodhouse 2009) and a considerable population of camas (*Camassia quamash*). The occurrence of camas in BIHO has afforded park managers the opportunity to focus research on the development of desired future conditions through the use of this species as an indicator of biological diversity (Garrett et al. 2007, Rodhouse 2009).

Other species present at BIHO, such as quaking aspen (*Populous tremuloides*) and ponderosa pine (*Pinus ponderosa*), can be used as air quality monitoring bioindicators for detecting high levels of ozone (NPS 2001, NPS 2004). In 2001 an assessment of ozone at BIHO was performed through the use of kriging data collected from 1995 to 1999 and the results confirmed that the risk of ozone foliar injury at BIHO is low (UCBN 2001). Furthermore, the airshed of BIHO is classified under the umbrella of NEPE as a Class II airshed by National Environmental Protection Agency (EPA) standards and by the State of Montana Department of Environmental Quality (MTDEQ) and is regarded as an “unclassified area assumed to be in attainment” (MTDEQ 2011).

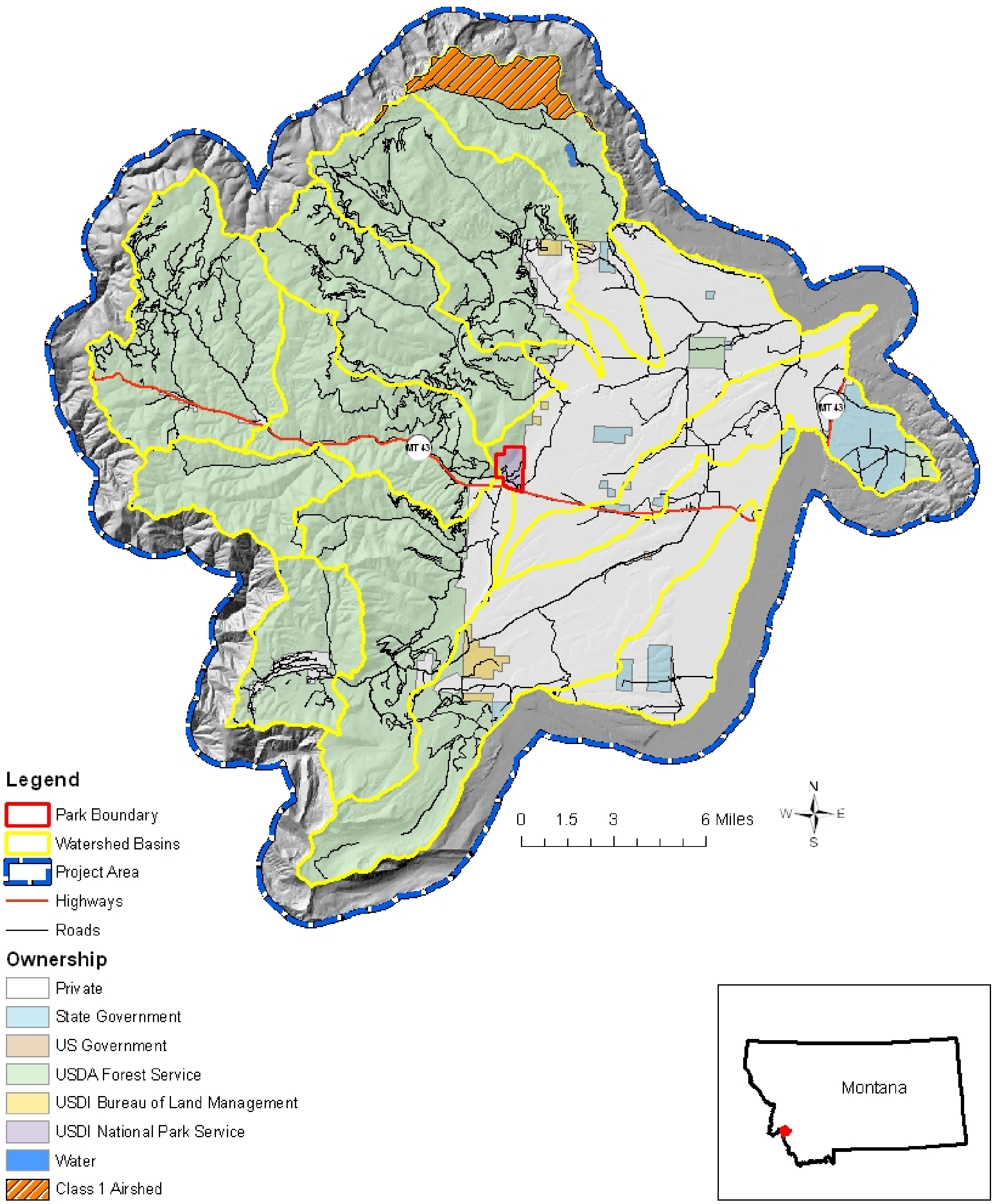

Figure 3. BIHO Area Map.

Bear Paw

The BEPA area map is shown in
Figure **4** below. Located 16 miles south of Chinook, Montana, the BEPA site is situated in the foothills of the north slope of the Bear Paw Mountains encompassing a relic of the open, moderately rolling short grass prairie once common to northern Montana. Two key topographic features constitute a majority of the site, the primary creek-side terrace and the rolling prairie (NPS 1997). The landscape of gently rolling hills is bisected from the southwest to the north by Snake Creek, a tributary of the Milk River, and by several ephemeral gullies that drain the site toward the creek (NPS 1997). The site is bounded by County Highway 240 on the west and private ranch lands to the north, east, and south.

Although water is occasionally present, Snake Creek generally appears as a marsh rather than a creek across much of BEPA, except during spring runoff and following significant precipitation events. Weather data, including precipitation, from the Chinook, Montana gauging station provides mean, minimum, and maximum measures of weather near BEPA (WRCC 2010). In BEPA grassland vegetation dominates the majority of the area with forbs such as lupine, cactus and penstemon prevalent throughout the upland areas bordering Snake Creek (NPS 2002). Weather and moisture greatly affect the riparian area habitats of the park site and contain species such as willows, currants, and grasses. There are currently no known water quality or quantity monitoring efforts at BEPA in the riparian waterway, or within the Snake Creek drainage upstream of the site.

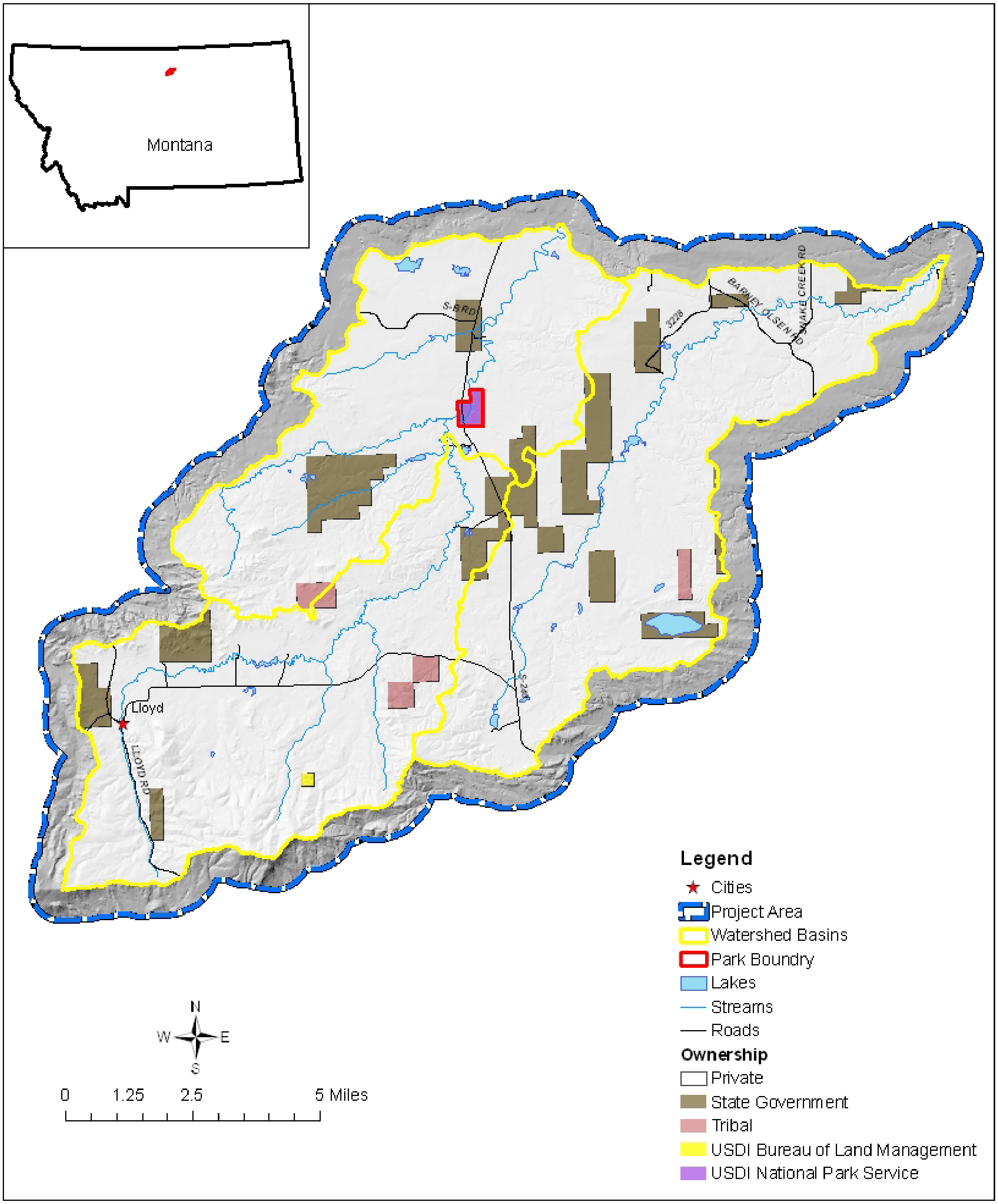

Figure 4. BEPA Area Map.

Methods

GIS and Geodatabases

The majority of data used in this report is Geographical Information System (GIS) data in tabular form tied to spatial features, such as points, lines, and/or polygons. GIS software provides spatial analysis capabilities such as overlay, buffer, extraction, and modeling. The ArcMap Version 9.3 software was used to assess, store, edit, and display all available GIS attribute data for BIHO and BEPA. GIS layers were organized into categories based on general theme type and evaluated by HUC unit. In some cases the HUC units extend well beyond the boundaries of the park due to the areal extent of GIS data available. Although data was not available for each theme type, the category directory is included to incorporate data that may become available in the future. The general themes used for both BIHO and BEPA consisted of: Air Resources, Animal, Geography, Geology, Land Process, Land Use, Plant, Stressors, Water Resources, and Climate.

A map project file, using the NPS ArcMap 11”x8.5” template, was developed for BIHO and BEPA using ArcMap software following the behavioral rules for data in a single Microsoft Access database (Figure 5). Many types of geographic datasets can be collected within a map project file, including feature classes, attribute tables, and raster data sets. From the map project files a geographically defined project area was created by selecting the park boundary and adding a two kilometer buffer. General base-map layers and aerial photography were applied to the full project area extent. Most layers were also clipped to the project extent for analysis and summarization of attributes.

The map project file was populated with GIS data through an extensive search of NPS sources and a multitude of local, state, and federal websites. Data determined to be useful and accurate were re-projected into the North American Datum 1983 (NAD83) and the Universal Transverse Mercator (UTM) zone 12 projection. Metadata was generated for each layer in Federal Geographic Data Committee (FGDC) compliant format. The metadata describes the source, accuracy, data dictionary, projection, datum, and other details of individual layers.

Aerial photography was also gathered and clipped to the project area using LizardTech GeoExpress software and converted into a MrSid Generation 3 (MG3) format file. Attribute information on the specific data layers clipped to the area extent were summarized in a spreadsheet. The attribute information includes various attribute parts, lengths, acreage etc. of the data layers in the map project file.

All GIS data layers were imported into an ArcGIS File Geodatabase using ArcCatalog version 9.3 (ESRI 2006). A geodatabase is an ArcMap file structure that stores geometry, spatial reference systems, attribute datasets, network datasets, topologies, and others features. This GIS format provides a uniform method for storing and using GIS data while providing flexibility for additions of new information. Feature data sets within the geodatabase were created based on theme type.

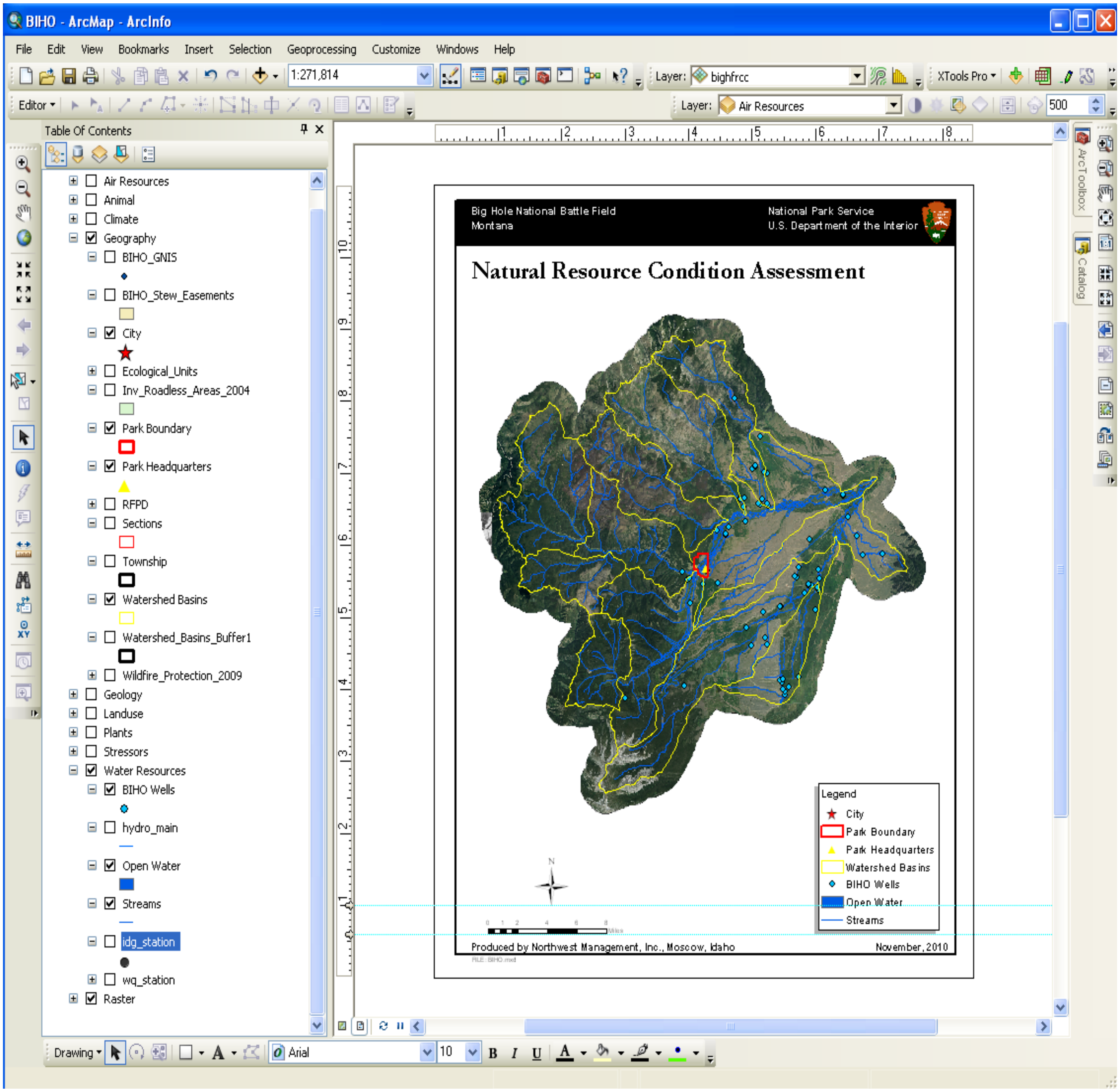

Figure 5. Screenshot of ArcGIS BIHO Map Project.

Aerial photography was not included in the geodatabase due to limitation of processing MG3 file formats. Aerials are included in a separate directory outside the geodatabase. All the data, project file and summary tables are included on a DVD disk for distribution with this report. As a by-product of this research, a Microsoft Access database (included on DVD) was created for websites with documented GIS data that could be downloaded in various formats compatible with ESRI's ArcMap software.

Literature Review

In order to conduct the assessment of natural resources at BIHO and BEPA, all currently available and relevant reports and publications were identified and reviewed. Data were acquired from information storehouses such as the NPS NatureBib, the U.S. Geological Survey (USGS), the Nature Conservancy (TNC), and LANDFIRE website: http://www.landfire.gov/index.php. Other information was gained through the UCBN website: http://science.nature.nps.gov/im/units/ucbn/ reports/reports.cfm#InvRpt_BIHO, interviews with park staff, NPS or BLM *General Technical* reports, as well as peer reviewed literature such as *Journal of Mammalogy*, *Journal of the American Water Resource Association* (AWRA) and *Transactions of the American Fisheries Society*.

After review of the available literature, and a meeting with park resource managers, general natural resource topics of particular relevance to BIHO and BEPA were identified. These topics were animal resources (terrestrial and aquatic), vegetation resources (including invasive plants, upland vegetation, and riparian vegetation), water resources (including hydrology and water quality), air resources (including weather and climate), geological resources (including geologic and soils) and human use. The information contained in the reports and publications were then consolidated, summarized, and synthesized in a manner to portray the historic and existing park ecosystems and guide development of site specific assessments. The summation of this information is reflected in the Introduction section of this report.

The literature review process also revealed a few areas of general need or data gaps. Of primary concern was the lack of condition and synthesis information for the ecosystems of both sites. In the case of BIHO the park has adequate inventory data for most significant resources as indicated in Table 1, whereas very little baseline inventory data exists for the BEPA site. In general, what is lacking are assessment and condition studies that move beyond basic inventories to assess the nature, extent, and/or condition of resources at these particular park sites. This lack of synthesis data and resource condition information for both study sites was somewhat expected and is primarily the result of the small size of both sites and the fact that one of the units (BEPA) has only been NPS-owned since 2005.

Table 1. Available Inventories for BIHO and BEPA maintained by the UCBN.

Dataset Type	Species Taxa	BIHOYear	BEPA Year
Animal Resources			
	Mammals	2002	N/A
	Birds	2005	2005
	Amphibians	2002	N/A
	Reptiles	2002	N/A
	Fish	2005	N/A
	Invertebrates	N/A	N/A
Veg. Resources			
	Vascular Plants	2001/2005	2001
	Rare Plants	1997/2009	N/A
	Invasive Plants	2011*	2011*
	Veg Map	2011*	2011*
Air Resources			
	Air Quality / Emissions	Unknown	N/A

Dataset Type	Species Taxa	BIHOYear	BEPA Year
	Ozone Risk	2001	N/A
Water Resources			
	Water Quality	1997	N/A
Geo. Resources			
	Paleo Resources	2005	2005
	Geology	2012*	2012*
	Soils	2006	Unknown
Human Use			
	Landcover	2006	N/A
	Cultural Landscapes	2008	N/A

* = These are projects currently underway and final reports or documents are anticipated in the year indicated.

The key area for synthesis, identified by NPS staff and confirmed through the literature review, was the condition of vegetative resources across both study sites. While vegetation inventory information is available (or scheduled for completion) at both BIHO and BEPA, neither site had adequate information on the current condition of those resources based on established reference conditions. This led to the selection of several on-the-ground, rapid assessment tools utilized to assess the condition of aquatic and upland vegetative resources.

Site Specific Assessment

Site specific assessments were completed at both BIHO and BEPA as a component of this study. These on-the-ground assessments were conducted using standard methodologies allowing for a quick evaluation of the current condition of aquatic and upland environments present at these two park units.

Aquatic Resource Assessment

Aquatic assessment sites were evaluated using aerial photography and the Montana Wetland Rapid Assessment Method (MRAM) riparian assessment methodology developed by the Department of Environmental Quality for riparian/lotic (i.e., flowing water) sites (Apfelbeck and Farris 2005). All assessment locations were evaluated as riverine/wetland environments due to the predominate attributes of stream flow and spring runoff events affecting the North Fork of the Big Hole River in BIHO and the ephemeral nature of Snake Creek in BEPA. There were three aquatic assessments completed for BIHO and no aquatic assessments completed in BEPA. The low lying seasonally wet areas of Snake Creek within BEPA did not conform to the "wetland" or "riverine" conditions as explained within the MRAM method. Therefore, within BEPA these seasonally wetted areas were evaluated with an upland assessment method which is described in further detail in the *Upland Resource Assessment* section.

The MRAM method evaluates eight hydrologic, vegetative, and stream geomorphology indicators of riparian condition or "health" and subsequently assigns a functionality rating to each site. The condition of an MRAM area refers to the stability of the physical system, which in turn is dictated by the interaction of geology, soil, water, and vegetation. Properly functioning riparian areas are in dynamic equilibrium with the streamflow forces and channel processes. The channel adjusts in slope and form to handle larger runoff events with limited perturbation of channel characteristics and associated riparian plant communities. Because of this stability, properly functioning riparian areas can maintain fish and wildlife habitat, water quality, and other important ecosystem attributes amidst larger storm events. In contrast, nonfunctional systems subjected to the same storm events may exhibit excessive erosion and sediment loading, loss of fish habitat, loss of associated wetland habitat, and other detrimental effects to the riparian area.

Based on the hydrologic, vegetative, and geomorphology elements of BIHO's riparian area, one of the following three condition ratings was assigned to each site. The condition rating incorporates site impact, stressors, and restorability:

<u>Excellent Condition (>0.9 – 1.0)</u>: Streams and associated riparian areas are functioning properly when adequate vegetation, landform, or large woody debris is present to: dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid floodplain development; improve floodwater retention and groundwater recharge; develop root masses that stabilize stream banks against cutting action; develop diverse ponding and channel characteristics to provide habitat and the water depths, durations, temperature regimes, and substrates necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity.

<u>Good Condition (>0.7 – 0.9)</u>: These riparian areas are in functional condition, but an existing soil, water, vegetation, or related attribute makes it susceptible to degradation or puts the area "at-risk". For example, a stream reach may exhibit attributes of a stable system, but may be vulnerable to severe erosion during a large storm in the future due to likely migration of a headcut or increased runoff associated with grazing. When this rating is assigned to a stream reach, its "trend" toward or away from excellent condition is assessed.

<u>Fair Condition (>0.5 – 0.7)</u>: These are riparian areas with some adequate vegetation, landform, or large woody debris but not in sufficient density to adequately dissipate stream energy associated with high flows. These areas are currently not reducing erosion, improving water quality, or sustaining desirable channel and riparian habitat characteristics. Restoration efforts beyond simple removal of a deleterious aspect such as over grazing or recreation would be needed to restore the riparian area to proper functioning condition.

<u>Poor Condition (0 – 0.5)</u>: These are riparian areas that clearly are not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows. Riparian areas in poor condition are not reducing erosion, improving water quality, or sustaining desirable channel and riparian habitat characteristics by classification definition. The absence of certain physical attributes such as a floodplain where one should exist is an indicator of nonfunctioning poor conditions.

At each identified site, the research team assessed lotic riparian functional condition along the shoreline of the North Fork of the Big Hole River within the BIHO unit. The MRAM assessments evaluated the physical characteristics of the stream/wetland site to establish an overall rating of functionality. The aquatic resource assessments using the MRAM did not evaluate macroinvertebrate populations because the UCBN's water quality monitoring program already assesses aquatic macroinvertebrates within BIHO. In addition, insufficient riverine/wetland conditions exist for Snake Creek within BEPA. The collected assessment results are discussed individually in the *Results* section. Additional information regarding a detailed guide for administering the MRAM assessments can be found in Apfelbeck and Farris (2005).

Upland Resource Assessment

Ecological assessments were completed in both the BIHO and BEPA park units during the 2009 field season. Ecological sites are recognized as the basis for evaluation of upland habitats using an assessment method co-developed by the Natural Resources Conservation Service (NRCS), Agricultural Research Service (ARS), Bureau of Land Management (BLM), and the USGS. The method is described in the publication “Interpreting Indicators of Rangeland Health” (Pellant et al. 2005). An ecological site is a land classification system based on the potential of land to produce distinctive kinds, amounts, and proportions of vegetation and is used as the sample unit within each park unit.

A combination of soils mapping and differences in vegetative cover was used to distinguish between differences in ecological areas sampled within BIHO and BEPA. A total of seven sample sites within each park unit were identified and assessed across all distinguishable upland environs. For BIHO, three rangeland areas and four forested areas were sampled and within BEPA two sites were located in the “Overflow” ecological site, one in the “Thin Clayey” ecological site and four in the “Silty 13-19 inch” ecological site.

<u>Rangeland Areas</u>: The rangeland health rapid assessment methodology is designed to provide a preliminary evaluation of three landscape attributes; soil/site stability, hydrologic function, and integrity of the biotic community at the ecological site level. It was developed to assist land managers in identifying areas potentially at risk of degradation and assist in the selection of sites for developing monitoring programs. Definitions of these three closely interrelated attributes are:

Soil Site Stability: The capacity of the site to limit redistribution and loss of soil resources including nutrients and organic matter by wind and water.

Hydrologic Function: The capacity of the site to capture, store, and safely release water from rainfall, run-on (inflow), and snowmelt (where relevant), to resist a reduction in this capacity, and to recover this capacity following degradation.

Integrity of the Biotic Community: The capacity of the site to support characteristic functional and structural communities in the context of normal variability, to resist loss of this function and structure due to disturbance, and to recover following disturbance.

This technique was developed as a tool for conducting a moment-in-time qualitative assessment of rangeland status. It is also used as a communication and training tool for assisting land managers and other interested people in better understanding rangeland ecological processes and their relationship to 17 key indicators (Pyke et al. 2002). This method uses soil survey information, ecological site descriptions, and appropriate ecological reference areas to qualitatively assess the health of uplands. As part of the assessment process, 17 indicators relating to these attributes are evaluated and the category descriptor or narrative that most closely describes the site is recorded. “Optional Indicators” may also be developed to meet local needs. The critical link between observations of indicators and determining the degree of departure from the ecological site description and/or ecological reference area is part of the interpretation process.

This technique does not provide for just one rating of upland health, but based upon a “preponderance of evidence” approach, it provides the departure from the ecological site description/ecological reference area(s) for the three attributes. There are five categories of departure recognized: “none to slight”, “slight to moderate”, “moderate”, “moderate to extreme”, and “extreme”.

A slight modification of the methodology was implemented so multiple assessments in each ecological site could be combined for analysis. A rating from 1 (none to slight) to 5 (extreme) was assigned to each category. In the case of an ecological site or unit with more than one sample, an average would be calculated for each indicator and then summed for each landscape attribute. There are ten indicators for soil site stability and hydrologic function and nine for biotic integrity. The score for each landscape attribute is the sum of the indicators, minus the reference conditions. Reference condition was determined to be ten for soil site stability and hydrologic function and nine for biotic integrity (based on a score of 1 for each indicator per attribute). Percent departure for each attribute was a proportion calculated by dividing the score by the maximum departure value; 40 for soil stability and hydrologic function and 35 for biotic integrity. The results can then be displayed graphically as a percent departure from the reference condition. For narrative purposes, the percent departure values are re-converted into the associated qualitative categories: none to slight (<21%), slight to moderate (21-40%), moderate (41-60%), moderate to extreme (61-80%), and extreme (>80%).

<u>Forested Areas</u>: The forested area at BIHO was evaluated using a stand exam to assess health and vigor and to provide insight into potential risks to these areas. The forested area was subdivided into four stands and each stand had five temporary inventory plots. Data collection included tree diameter at breast height (DBH), total height, defect, crown ratio as a percent of total height and age. Data was also collected for small trees (less than four and one half feet tall) to assess the presence and quality of stand regeneration under the main tree canopy. A brief description and health assessment for each stand is included in the *Upland Resource Assessments* section.

A Microsoft Access (Access) database was developed for digitally storing site data, comments, and the 17 indicator values. The 17 indicators are a set of environmental aspects that can be assigned a rating for the characterization of ecosystem health or departure from expected conditions. These indicators are presented in Table 2 below. Additionally, a GPS point was collected at the center of each sample site. Sample sites varied from one to 20 acres in size due to continuous similarities in soil and vegetation types over areas surveyed, these variations in size are displayed in the database. Maps were generated for each ecological site sampled that display the sample site(s) and other land features.

Table 2. The 17 indicators for the ecological site assessments completed in both BIHO and BEPA.

Upland Site Ecological Assessment Indicators	
1	Rills
2	Water-flow Patterns
3	Pedestals and/or Terracettes
4	Bare Ground ____%
5	Gullies
6	Wind-scoured, blowouts, and/or deposition areas
7	Litter movement
8	Soil surface resistance to erosion
9	Soils surface loss or degradation
10	Plant community composition and distribution relative to infiltration
11	Compaction layer
12	Functional/structural groups
13	Plant mortality/decadence
14	Litter amount
15	Annual production
16	Invasive plants
17	Reproductive capability of perennial plants

Results

GIS and Geodatabase

The ArcMap Version 9.3 software was used to assess, store, edit, and display all available GIS attribute data for BIHO and BEPA in the geodatabase. The geodatabase format of the GIS data provides a uniform method for storing and using the data while providing flexibility for additions of new information. GIS data relating to the identified general themes is presented here for both BIHO and BEPA.

Big Hole

The Plant feature dataset in the BIHO geodatabase contains two point feature classes showing plot locations collected with GPS equipment for two vegetation studies conducted in July 2010. Table 3 lists the theme, geodatabase file name and number of plots within each study.

Table 3. Theme, geodatabase file name and number of plots within each study for the Plant Feature dataset.

Themes	Geodatabase File Name	Number Parts
Plant		
Vegetation Plots 1	BIHO_veg_Plots_1	875
Vegetation Plots 2	BIHO_veg_Plots_2	37

The BIHO geodatabase also includes two vegetation raster data sets covering the project area. Raster data is a geospatial image formed by a matrix of cells (pixels) organized into a grid where each pixel contains a value representing information. Resolution of raster data increases as pixel size decreases giving a high resolution data layer more precise geographic location accuracy. Raster data can be discrete, representing features or continuous, showing gradations such as temperature or elevation. These are public domain layers developed by different agencies based on classification of satellite imagery. Existing vegetation cover is a Landscape Fire and Resource Management Planning Tools Project (LANDFIRE) predictive model representing the percent of average canopy cover of current vegetation for a 30-m grid cell. The bihoevt layer's attribute table contains multiple vegetation classifications including name, order, class and subclass. This provides an opportunity to display the data in a variety of ways from general cover classes to specific predominant species types. Table 4 lists the various cover types, acres of each and percent of total area depicted using the nvcsclass column in the file's attribute table.

Table 4. Various cover types, acres of each and percent of total area depicted using the nvcsclass dataset.

Attribute (nvcsclass)	GIS Acres	% Total Area
ClosedTtree Canopy	107,212.5	44.182%
Dwarf-Shrubland	624.4	0.257%
Herbaceous - Grassland	34,904.9	14.384%
Herbaceous - Shrub-steppe	21,438.3	8.835%
No Dominant Lifeform	3.3	0.001%
Non-vegetated	208.7	0.086%
Open Tree Canopy	40,953.4	16.877%
Shrubland	37,257.2	15.353%
Sparsely Vegetated	60.3	0.025%

One feature data set pertaining to air resources is included in the BIHO geodatabase. This file identifies a primarily USFS managed area on the far north side of the BIHO project area, the Anaconda Pintler Wilderness Area, which is in a Class 1 airshed zone. Airshed zones are used by the smoke monitoring unit at the aerial fire depot in Missoula, MT to issue restrictions on prescribed fires in each airshed based on air quality and atmospheric dispersion conditions.

Geographical data pertaining to animals is somewhat limited for the BIHO project area. Animal feature data included in the BIHO geodatabase pertain to elk winter and summer range. The data represents the 2006 elk seasonal range boundaries based on long term observation data, specific research data, and professional judgment. The data was compiled by the Montana Game and Fish Department. Table 5 lists the general characteristics of the data layers.

Table 5. General characteristics of the data layers within the animal feature dataset.

Themes	Geodatabase File Name	GIS Acres	Number Parts
Animal			
Elk Summer Range	RMEF_Elk_summer_rng_2006	222,337.8	1
Elk Winter Range	RMEF_Elk_winter_rng_2006	7,442.0	2

Climate features included in the BIHO Geodatabase include data layers showing the average precipitation and temperature within the project area. Precipitation averages ranges from 17-45 inches annually, and temperature averages ranges from 29-39 degrees Fahrenheit annually. The data layers show the average temperature and precipitation gradient across the project area.

GIS data found within the BIHO project area includes features on past fire point location and fire perimeter polygons. Fire data is often recorded by multiple agencies and a single fire incident can be present in more than one data file with varying characteristics. Wildfire is a threat to resources at BIHO from fire ignitions on or adjacent to the park site. Fire history in this area is well documented by various federal agencies with some overlap between land ownership. Wildfire data in these files were compiled by USDA Region 1 Forest Service covering the period 1985 through 2005. The data records fires that have occurred in the project area and are representative of ignition sources and the type of fires common to southwestern Montana. According to the Fire_Polygons_85-05 data set, approximately 258,084 acres burned as a result of wildfire ignitions during the period 1985-2005 within the BIHO basin area.

Water Resources feature data sets within the BIHO geodatabase include features pertaining to natural and developed water sources in addition to wells and water quality monitoring stations. Table 6 lists the various feature classes and their general characteristics included in each feature data set.

Table 6. Various feature classes and their general characteristics included in each feature dataset.

Themes	Geodatabase File Name	GIS Acres	Number Parts	Length Ft
Water Resources				
Wells	BIHO_wells		69	
Major Streams	Hydro_main		51	

Themes	Geodatabase File Name	GIS Acres	Number Parts	Length Ft
IDG Station	idg_stations		15	
Open Water	Open_Water	212.7	99	
Streams	Streams			2,933,946.8
Water Quality Stations	wq_station		18	

Many raster feature data sets are included in the BIHO geodatabase. Several of these raster files are from the LANDFIRE program which is a multi-agency, vegetation, fire and fuel characteristics mapping project. LANDFIRE layers are derived from modeling and high level classification. Table 7 lists the raster data files included in the BIHO geodatabase.

Table 7. Raster data files included in the BIHO geodatabase.

Themes	Geodatabase File Name	Number Parts
Raster Data		
Andersons 13 Fire Behavior Fuel Model	biho13fbfm	12
Digital Raster Graphic	BIHO_DRG	1
Existing Vegetation Type	bihoevt	9
Fire Regime Condition Class	bihofrcc	8
Fire Regime Group	bihofrg	9
Mean Fire Return Interval	bihomfri	21
National Land Cover Data	bihonlcd	14
Digital Elevation Model	dem	1
Hill Shade Relief Model	hishd	1
National Agriculture Statistic Data	mt_nass_09	16
NAIP Aerial Mosaic	biho_1.sid	1

Two raster themes from Table 7 pertain to cover vegetation, one to agricultural land use and five are modeled layers from the LANDFIRE program. The remaining raster data layers are base maps which include a hillshade terrain model derived from the digital elevation model (DEM), a clipped USGS 7.5 minute quadrangle digital raster graphic (DRG) (BIHO_drg) and aerial photo mosaics of the project area from 2009 NAIP imagery (biho_1.sid). A detailed description of the raster data and figures created from this data is presented in Appendix C and available in totality on the included CD.

Bear Paw

The BEPA geodatabase includes two vegetation raster data sets covering the BEPA project area. Raster data is a geospatial image formed by a matrix of cells (pixels) organized into a grid where each pixel contains a value representing information. Resolution of raster data increases as pixel size decreases giving a high resolution data layer more precise geographic location accuracy. Raster data can be discrete, representing features or continuous, showing gradations such as temperature or elevation. These are public domain layers developed by different agencies based on classification of satellite imagery. These are public domain layers developed by different federal agencies based on classification of satellite imagery. Table 8, Table 9, and Table 10 list the general vegetation cover types depicted in each raster dataset as well as total acres and percent of total area covered by each vegetation type identified in the attribute table of the file.

Table 8. National Land Cover Vegetation (bepa_nlcd), total acres and % of total area covered.

Attribute (Class_Name)	GIS Acres	% Total Area
Cultivated Crops	8,558.7	11.863%
Deciduous Forest	20.0	0.028%
Developed, Open Space	207.9	0.288%
Emergent Herbaceous Wetlands	476.0	0.660%
Evergreen Forest	517.3	0.717%
Grasslands/Herbaceous	47,756.2	66.193%
Open Water	139.4	0.193%
Pasture/Hay	2,118.8	2.937%
Shrub/Scrub	11,216.8	15.547%
Woody Wetlands	1,136.0	1.575%

There was no specific geographical data related to air resources, animals, or stressors found for the BEPA project area at the time the data was compiled.

Climate features included in the BEPA geodatabase include data layers showing the average precipitation and temperature within the project area. Precipitation averages range from 13-23 inches annually, and temperature averages ranges from 39-43 degrees Fahrenheit annually. The data layers show the average temperature and precipitation gradient across the project area.

Water Resources feature datasets within the BEPA geodatabase include features pertaining to natural and developed water sources and water quality monitoring stations. The following table lists the various feature classes and their general features.

Table 9. Water Resources feature classes and their general features.

Themes	Geodatabase File Name	GIS Acres	Number Parts	Length Ft
Water Resources				
Water Gages	idg_stations		14	
Lakes	lakes	501.0	26	
Streams	streams		9	375,644.5

Several of the feature data sets in the BEPA geodatabase are raster files developed from the LANDFIRE program. The following table lists the raster data files included in the BEPA geodatabase.

Table 10. Raster data files of the BEPA geodatabase.

Themes	Geodatabase File Name	Number Parts
Raster Data		
Andersons 13 Fire Behavior Model	bepa_13fbfm	12
Elevation	bepa_dem	815-1687'
Digital Raster Graphic (DRG) USGS Topo	bepa_drg.sid	1 map
Existing Vegetation Type	bepa_evt	12
Fire Regime Condition Class	bepa_frcc	3

Themes	Geodatabase File Name	Number Parts
Fire Regime Group (HFR)	bepa_frg	4
Hillshade	bepa_hlsd	1
Mean Fire Return Interval	bepa_mfri	11
National Land Cover Vegetation	bepa_nlcd	10
National Agriculture Statisticts	nass_09	21
Aerial Mosaic	bepa.NAIP.sid	1 mosaic

Considering the raster themes listed in the table above, two pertain to cover vegetation, one to agricultural land use and four are modeled layers from the LANDFIRE program. The other raster data layers are base maps which include a hillshade terrain model derived from the digital elevation model (DEM), a clipped USGS 7.5 minute quadrangle digital raster graphic (DRG) and aerial photo mosaics of the project area from 2009 NAIP imagery. A detailed description of the raster data and figures created from this data are presented in Appendix C and available in totality on the included CD.

Site Specific Assessment

Site specific assessments were completed in both BIHO and BEPA during the 2009 field season. The goal of each assessment was to gather information regarding the current status of specific Park resources in order to identify trends in resource health or degradation. The details of each upland assessment are presented below. The two types of field assessments performed were aquatic and upland.

Aquatic Resource Assessment

The primary objective in evaluating riparian wetland habitat was to provide the NPS with a starting point for managing land within its control. Three goals were developed to achieve these objectives: 1) identify existing riparian and shoreline condition; 2) identify specific threats and stressors impacting riparian/shoreline functions and values (e.g., wildlife habitat, water quality improvement, and aquatic species protection; and 3) recommend solutions to minimize or eliminate threats and stressors to riparian/shoreline areas and associated aquatic resources.

During the aquatic resource assessments, three ecological sites were identified and assessed on the North Fork of the Big Hole River within the BIHO site. The aquatic resource assessment consisted solely of lotic riparian/riverine characteristics. A summary of each aquatic site is presented below with maps and photographs for reference.

<u>Big Hole</u>

The three BIHO sites selected for evaluation were assessed using MRAM, developed for the Montana Department of Environmental Quality (Apfelbeck and Farris 2005). The MRAM uses relatively simple metrics for collecting data at specific wetland sites. The method provides a single rating or score that shows where a wetland falls on a condition continuum, ranging from full ecological integrity (i.e., Excellent condition) to highly degraded (i.e., poor condition). Prior to the August 2009 site visit, field personnel used aerial photography and topographic maps to identify three riparian/wetland sites that represent the range of aquatic conditions occurring within the park unit. Each site was selected to be approximately 200 meters long and as wide as the outermost meanders of the North Fork of the Big Hole River (Figure 6). Each site included assessment of the river and both shorelines.

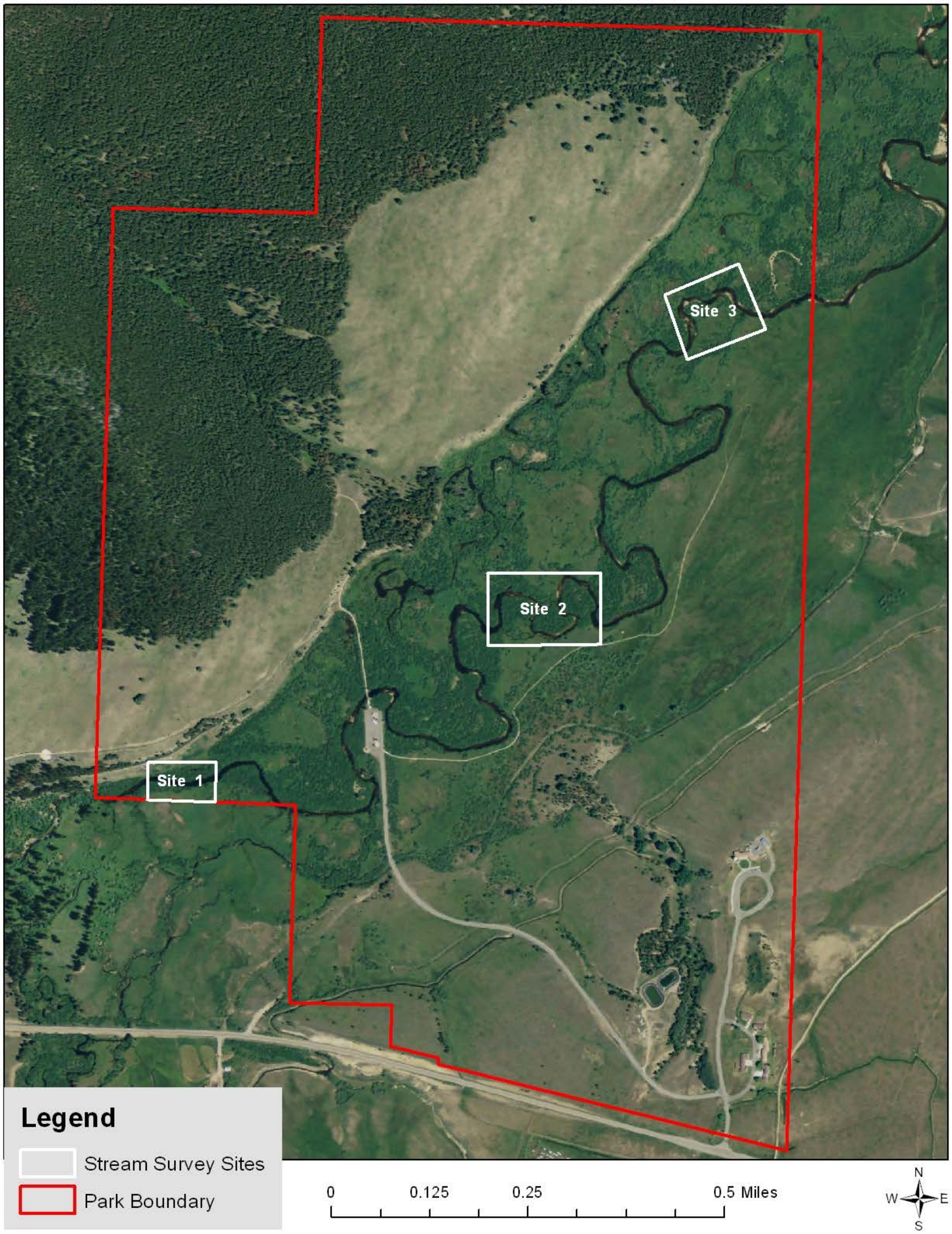

Figure 6. Map of BIHO aquatic assessment sites.

The MRAM assessment classifies wetland areas through a Hydrogeomorphic (HGM) wetland classification system (Brinson 1993) as well as a hierarchical set of systems, subsystems, and classes from Cowardin et al. (1979).

The Hydrogeomorphic Wetland Classification System

The hydrogeomorphic (HGM) wetland classification system was developed to be used for wetland functional assessments. The foundations behind HGM are that hydrology and geomorphic principals define wetlands; whereas, other wetland characteristics, such as vegetation, are the result of the HGM conditions (Brinson 1993). HGM classification provides an insight into why a particular wetland occurs on the landscape, whereas past wetland classification systems described habitat types. Brinson (1993) recognized that other physical properties of wetlands (e.g., vegetation, soil texture, soil pH) can have a pronounced impact on the level of all functions. By coupling HGM classification with non- HGM-based modifiers, such as *forested* and/or *calcareous*, users will be able to obtain greater insight into why the wetland occurs on the site being assessed, what hydrology and geomorphic limitations and potentials are unique to the site, and what plant community occurs (or will) occur on the site (Brinson 1993). The classifications with the HGM process are indicators of where the wetland occurs on the landscape. The seven approved HGM classes are:

- Riverine
- Depressional
- Slope
- Mineral Soil Flats
- Organic Soil Flats
- Estuarine Fringe
- Lacustrine Fringe

The Cowardin Wetland Classification System

The Cowardin system was designed for classification of wetlands and deepwater habitats over an extremely wide geographic area and for use by individuals and organizations with varied interests and objectives. The classification employs a number of system, subsystem, class, subclass and dominance types. It is a complex system when viewed in its entirety, but used for specific purpose at a local site the system is intended to be simple and straightforward (Cowardin et al. 1979). The structure of the Cowardin classification is hierarchical, progressing from systems and subsystems, at the most general levels, to classes, subclasses, and dominance types. The characteristics of the five major systems similar but not the same as the HGM method are:

- Marine
- Estuarine
- Riverine
- Lacustrine
- Palustrine

These systems have all been discussed at length in the scientific literature (Cowardin et al. 1979) and the concepts are well recognized; however, there is frequent disagreement as to the applicability of the Cowardin system. The disagreements are due to the bounds of major classification systems under the Cowardin method in comparison to the HGM method. For example: the Cowardin method can classify a seasonally ponded herbaceous wetland in a flood plain in Mississippi the same as a seasonally ponded herbaceous playa in the Texas Panhandle or a herbaceous wetland associated with spring flow in the foothills of Wyoming's eastern slope of the Rocky Mountains (Brinson 1993). This point of contention presented within the Cowardin method is addressed by the HGM system therefore the wetland assessment method employed here using the MRAM is intended to include the accuracies of both systems.

In August 2009, field personnel visited each pre-selected field site to conduct the MRAM for classification of the wetland environments. Following the characterization of each wetland site, field personnel further assessed the condition of each area considering the four remaining components of the field form:

- The assessment of wetland stressors (buffer condition)
- Stressors that occur in adjacent area surrounding the wetland
- The assessment of wetland restorability
- Summary of ratings and overall score

Table 11 provides a summary of MRAM assessment results at BIHO for the three assessment sites. All three sites within BIHO received an overall score > 0.9, which corresponds to an "Excellent" condition description as shown in Table 12.

Table 11. Montana Wetland Rapid Assessment Method overall condition index.

MRAM Overall Condition Score	Overall Condition Description
> 0.9 – 1.0	Excellent Condition
> 0.7 – 0.9	Good Condition
> 0.5 – 0.7	Fair Condition
0.0 – 0.5	Poor Condition

Table 12. Summary results of the BIHO Montana Wetland Rapid Assessment Method assessments.

Site	Overall Condition Score	Overall Condition Description
Big Hole 1	0.985	Excellent
Big Hole 2	0.979	Excellent
Big Hole 3	0.961	Excellent

Big Hole 1 Assessment Site

The Big Hole 1 (BH1) site was the upstream-most site assessed during the August 2009 site visit (Figure 7) and was located immediately downstream of the BIHO Park boundary (i.e., barbwire fence) near the confluence of Ruby Creek and Trail Creek. This site was selected to identify potential impacts from land uses upstream of the BIHO unit and to highlight any potential effects of the converging streams.

The BH1 assessment site was HGM classified as a lower perennial riverine system. Based on the Cowardin wetland classification system, the site included both riverine and palustrine wetland systems. The riverine portion of the site consisted of a lower perennial subsystem dominated by rocky bottom and unconsolidated bottom classes (45% cover each), with smaller percentages of aquatic bed and emergent wetland classes present (2% and 8% cover, respectively). The palustrine portion of the site contained seasonally flooded scrub-shrub wetland (65% cover) and emergent wetland (35% cover). Outside of the bankfull width of the North Fork of the Big Hole River, a few small depressions containing standing water < 50 cm depth were observed, which could potentially provide amphibian habitat. Fish were visually observed surface feeding within the river at the BH1 site but could not be identified to species.

Amphibian and aquatic reptile species were not observed onsite, nor were threatened or endangered species encountered. Of the vegetation present at the site, willow (*Salix* spp.) shrub species dominated, followed by moderate sedge (*Carex* spp.) cover and lesser amounts of grasses and rushes (*Juncus* spp.).

Figure 7. Map of BIHO aquatic assessment site 1 (BH1).

The HGM condition of the BH1 assessment appeared to be unaffected by potential hydrologic disturbances, including roads, irrigation withdrawals, dredge or filling, and animal pugging or hummocking. The onsite stream channel was observed to be stable and showed no visible signs of downcutting or incisement (Figure 8). Excessive bank erosion resulting from lateral stream movement was not observed. In addition, there was no evidence of excessive sediment removal or deposition within the North Fork of the Big Hole River, nor within the River's floodplain at the BH1 site. As indicated above, stream bank vegetation consisted of willows, sedges, and rushes, which contain deep binding root masses capable of protecting the banks from excessive erosion during high stream flow periods.

Vegetation at the BH1 assessment was not observed to be impacted by trampling or other human-caused disturbance during the field assessments. Noxious weeds, invasive plants, and disturbance-caused undesirable plants were not observed within the riverine areas; however, timothy grass (*Phleum pratense*) was apparent within the upland buffer of the BH1 site. Onsite woody vegetation consisted of dense willows with a diverse age class distribution and very little browsing of second year and older stems. (A list of noxious weeds in Beaverhead County, Montana can be found in Appendix B of this document).

The 100 m buffer surrounding the BH1 assessment site was in very good condition during the August 2009 site visit. The buffer did not appear to be impacted by hayfields, crops, forestry, concentrated livestock watering, or any kind of development pressure. All roads are farther than 100 m from the BH1 site. Bare ground, noxious weeds, and undesirable plants were very sparse (i.e., timothy grass present in small patches). Since a portion of the 100 m buffer for BH1 was outside of the park unit (outside portion of south side of site), grazing of buffer vegetation does occur. Grazing occurs on flat slopes, which reduces the potential for site disturbance caused by erosion or runoff. Although recreational activities occur within the BIHO park unit, users typically stay on designated trails and so no observable impacts were present within the BH1 buffer.

The BH1 assessment condition rated at overall value of 0.985, which corresponds with "excellent" onsite conditions (Table 12). The site appears to be functioning at an ecologically efficient level. Restoration of the site is not necessary due to limited onsite impacts and stable wetland and stream characteristics. Although impacts are minimal, potential stressors include grazing, human recreation, nearby roads, and potential negative impacts from excessive irrigation.

Figure 8. Photo of the Big Hole 1 assessment site taken from the slope north of the site.

Big Hole 2 Assessment Site

The Big Hole 2 (BH2) assessment site was located in the center of the BIHO Park unit (Figure 9). This site was selected due to its location of approximately one quarter of a mile downstream of the lower parking area and walking bridge, which receives significant hiking and fishing recreational use throughout the year.

Figure 9. Map of BIHO aquatic assessment site 2 (BH2).

The BH2 assessment site was HGM classified as a lower perennial riverine system. Based on the Cowardin wetland classification structure, the site includes both riverine and palustrine wetland systems. The riverine portion of the site consisted of a lower perennial subsystem dominated by unconsolidated bottom and aquatic bed classes (38% and 35% cover, respectively), with smaller percentages of emergent wetland and unconsolidated shore classes present (25% and 2% cover, respectively). The palustrine portion of the site contained seasonally flooded scrub-shrub wetland (60% cover) and emergent wetland (40% cover). Juvenile brook trout (*Salvelinus fontinalis*) and rainbow trout (*Oncorhynchus mykiss*) were visually observed within the River at the BH2 site. In addition, an adult western toad (*Anaxyrus boreas*) and several adult Columbia spotted frogs (*Rana luteiventris*) were observed. Other observations included beaver activity, deer tracks, and a muskrat (*Ondatra zibethicus*). Threatened or endangered species were not identified onsite during the site visit. Of the vegetation present at the site, willows dominated, followed by moderate sedge cover and lesser amounts of grasses and rushes.

The HGM condition of the BH2 assessment site appeared to be unaffected by potential hydrologic disturbances, including roads, irrigation withdrawals, dredge or filling, and animal pugging or hummocking. The onsite stream channel was stable and showed no visible signs of downcutting or incisement (Figure 10). Excessive bank erosion resulting from lateral stream movement was not observed. In addition, there was no evidence of excessive sediment removal or deposition within the North Fork of the Big Hole River, nor within the river's floodplain at the BH2 site. The presence of willow, sedge, and rush stream bank vegetation is expected to contain deep binding root masses capable of protecting the stream banks from excessive erosion during periods of high water.

Vegetation at the BH2 assessment site was not impacted by trampling or other human-caused disturbance. One invasive or disturbance-caused undesirable plant, Canada thistle (*Cirsium arvense*) was the only observed noxious weed at the site and was identified in very minimal densities. Similar to BH1, timothy grass was noted in the upland buffer of the BH2 site. Onsite woody vegetation consisted of dense willows with a diverse age class distribution and very little observed browsing of second year and older stems similar to BH1.

The 100 m buffer surrounding the BH2 assessment site was observed to be in very good condition during the August 2009 field work. The buffer did not appear to be impacted by hayfields, crops, forestry, concentrated livestock watering, or any kind of development pressure. All roads were greater than 100 m from the assessment site. Recreational activities within the area have not caused significant impacts to the BH2 buffer.

The BH2 assessment site resulted in a total condition score of 0.979, which also corresponds to a rating of "excellent" similar to BH1. The wetland site appears to be functioning at an ecologically efficient level. Restoration of the site is not necessary due to limited onsite impacts and stable wetland and stream characteristics. Although impacts are minimal, potential stressors include nearby grazing, wildlife browsing, human recreation, nearby roads, and potential negative impacts from excessive irrigation.

Figure 10. Photo of the Big Hole 2 assessment site.

Big Hole 3 Assessment Site

The Big Hole 3 (BH3) assessment site was the furthest downstream site assessed during the August 2009 fieldwork and was located immediately upstream of the eastern BIHO boundary (Figure 11). This site was selected to determine if uses throughout the BIHO park unit are affecting aquatic resources.

Figure 11. Map of BIHO aquatic assessment site 3 (BH3).

The BH3 assessment site was HGM classified as a lower perennial riverine system. Based on the Cowardin wetland classification system, the site includes both riverine and palustrine wetland systems. The riverine portion of the site consisted of a lower perennial subsystem dominated by rocky bottom (25% cover), unconsolidated bottom (20% cover), emergent wetland (20%), and rocky shore (20%), with smaller percentages of unconsolidated shore (10%) and aquatic bed (5%). The palustrine portion of the site contained seasonally flooded scrub-shrub wetland (50% cover) and emergent wetland (50% cover).

Juvenile brook trout and rainbow trout were visually observed within the river at the BH3 assessment. Several adult Columbia spotted frogs were also observed at the site. Other observations included a cow elk (*Cervus elaphus*) and deer tracks. Threatened or endangered species were not encountered onsite. Of the vegetation present at the site, willows and sedge species co-dominated, followed by lesser amounts of grasses and rushes.

The HGM condition of the BH3 assessment site appeared to be unaffected by potential hydrologic disturbances, including roads, irrigation withdrawals, dredge or filling, and animal pugging or hummocking. The onsite stream channel showed signs of widening and failure in areas where stream bank vegetation was dominated by grasses (Figure 12). A minimal amount of bank erosion resulting from lateral stream movement was observed; however, the erosion did not appear to be human-induced. The river at the BH3 site was observed to be wider than other areas and reasonably shallow. This was potentially due to lateral stream migration as there was no evidence of floodplain erosion due to overbank flooding. The presence of willow, sedge, and rush stream bank vegetation is expected to contain deep binding root masses capable of protecting the stream banks from excessive erosion during periods of high water. Lateral stream movement and subsequent bank failure was observed suggesting these species may not exhibit densities along the shoreline sufficient enough to provide this level of protection.

Vegetation at the BH3 site was not impacted by trampling or other human-caused disturbance. Noxious and invasive plant species and disturbance-caused undesirable plants were not observed within the study site; however, timothy grass and Canada thistle were present within the upland buffer. Onsite woody vegetation consisted of patches of dense willows with a diverse age class distribution and very little, if any, browsing of second year and older stems similar to BH1 and BH2.

The 100 m buffer surrounding the BH3 assessment was in very good condition and did not appear to be impacted by hayfields, crops, forestry, concentrated livestock watering, or any kind of development pressure. All roads are further than 100 m from the BH3 site. Bare ground, noxious weeds, and undesirable plant occurrence was limited to occasional timothy grass and Canada thistle in highly localized areas. Recreational activities occurring within BIHO did not appear to be impacting the BH3 buffer.

The BH3 assessment site condition score was 0.961, which corresponds to a rating of “excellent” for onsite conditions. Some channel instability and bank erosion was observed at the site; however, the instability did not appear to be human-induced nor effecting the proper functioning conditions of the riverine ecosystem. The North Fork of the Big Hole River continues to actively migrate across its floodplain and it is likely that much of the lateral movement at the BH3 assessment site is due to natural synchronization of the channel within its geographically defined floodplain. Restoration is not necessary at this site. Although existing impacts at the BH3 site were observed to be minimal, potential stressors include grazing, human recreation, nearby roads, and potential negative impacts from excessive irrigation.

Figure 12. Photo of the Big Hole 3 assessment site.

<u>Bear Paw</u>
No specific aquatic resource assessments were completed within BEPA. Two of the upland assessments evaluated low-land/wetland type vegetation and are presented below as upland assessments 12 and 14.

Upland Resource Assessment
During the upland resource assessments, seven ecological sites were identified and assessed within both BIHO and BEPA. Ecological sites are the basis for evaluation of upland habitats using the BLM rapid assessment for rangeland health methodology. The method is described in the publication *Interpreting Indicators of Rangeland Health* (Pellant et al. 2005). An Access database was developed for digitally storing site data, field comments, and the 17 indicator values. A GPS point was collected at the center of each sample site. Sample sites varied from one to 20 acres in size as noted in the database and maps were generated to show the sample

site(s) and other land features. A summary of the upland assessment results are included below and the detailed information for each specific assessment is available in Appendix D.

Big Hole

The seven ecological sites sampled at BIHO represented a range of habitat types across the site (Figure 13). A summary of the departure values by plot for each landscape attribute along with site physiographic information such as slope, aspect, and elevation can be found in Table 13.

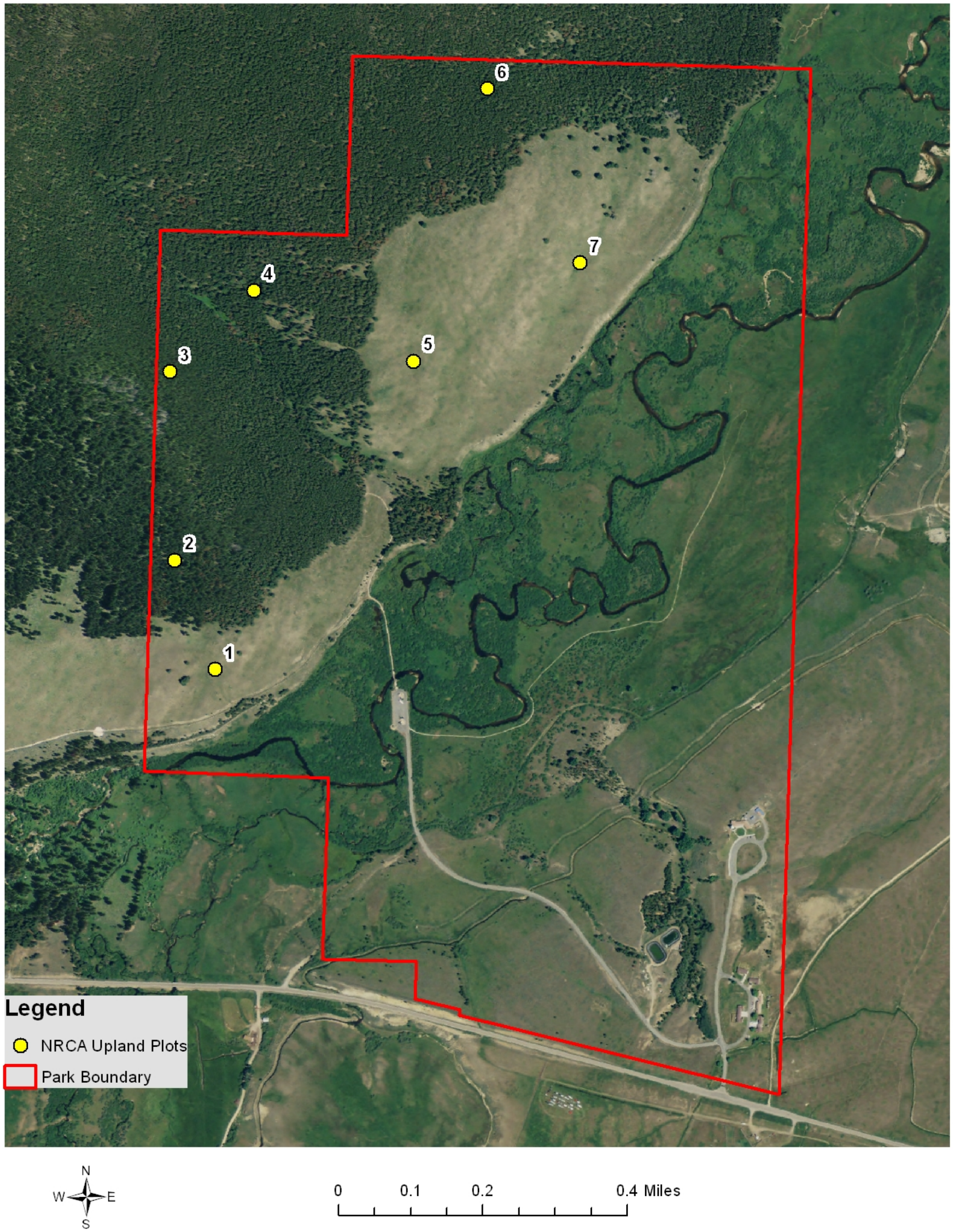

Figure 13. All locations of upland assessments for BIHO.

The soil stability attribute rating indicates much of the park area within the assessment sites is functioning properly with reference to the ratings described previously using the percent departure values according to their respective qualitative categories; none to slight (<21%), slight to moderate (21-40%), moderate (41-60%), moderate to extreme (61-80%), and extreme (>80%). None of the seven plots had a rating outside the none to slight departure (<21% departure) from reference condition for soil stability attribute or hydrologic function. Both attributes indicate the park land is in excellent condition and is functioning properly. The lands within the park are expected to remain stable in the future with similar land use patterns as are currently occurring. The lack of grazing use and the minimal impact of recreation in the area indicate a small potential for increased soil erosion or water quality degradation. Based on current soil stability and hydrologic function ratings through present Park management, these two processes are expected to remain stable into the future with minimal potential for decline.

The biotic integrity attribute indicated, similar to the soil stability and hydrologic function, most of the park area is in excellent to good condition. All seven sites were rated in the none to slight departure category (<21%). In light of this, visual observations indicate that the forested areas are at some risk to experience significant mortality of lodgepole pine (*Pinus contorta*). Over time and without cultural treatments to control the mountain pine beetle infestation or stocking control, the tree species composition will shift to Douglas fir (*Pseudotsuga menziesii*) and the lodgepole will gradually die out and be replaced.

Table 13. Summary of departure ratings for landscape attributes and physiographic attributes for BIHO upland sample plots.

Park Unit	Plot No.	Soil Stability % Departure	Hydrologic Function % Departure	Biotic Integrity % Departure	Slope	Aspect (degrees)	Elevation (ft)	Topographic Position
Forest Area	2	0.0%	0.0%	0.0%	15%	140	6,720	Footslope
Forest Area	3	0.0%	0.0%	0.0%	30%	100	6,606	Footslope
Forest Area	4	0.0%	0.0%	0.0%	40%	90	6,660	Footslope
Forest Area	6	0.0%	0.0%	0.0%	40%	40	6,950	Footslope
Range Area	1	0.0%	0.0%	2.9%	30%	145	6,390	Footslope
Range Area	5	0.0%	0.0%	0.0%	30%	150	6,510	Footslope
Range Area	7	0.0%	0.0%	0.0%	40%	120	6,385	Toeslope

Bear Paw

Five of the seven ecological sites sampled at the BEPA unit were in upland areas and two were located in low-lying riparian/wetland type environments (Figure 14). A summary of the departure values by plot for each landscape attribute along with site physiographic information such as slope, aspect, and elevation can be found in Table 14.

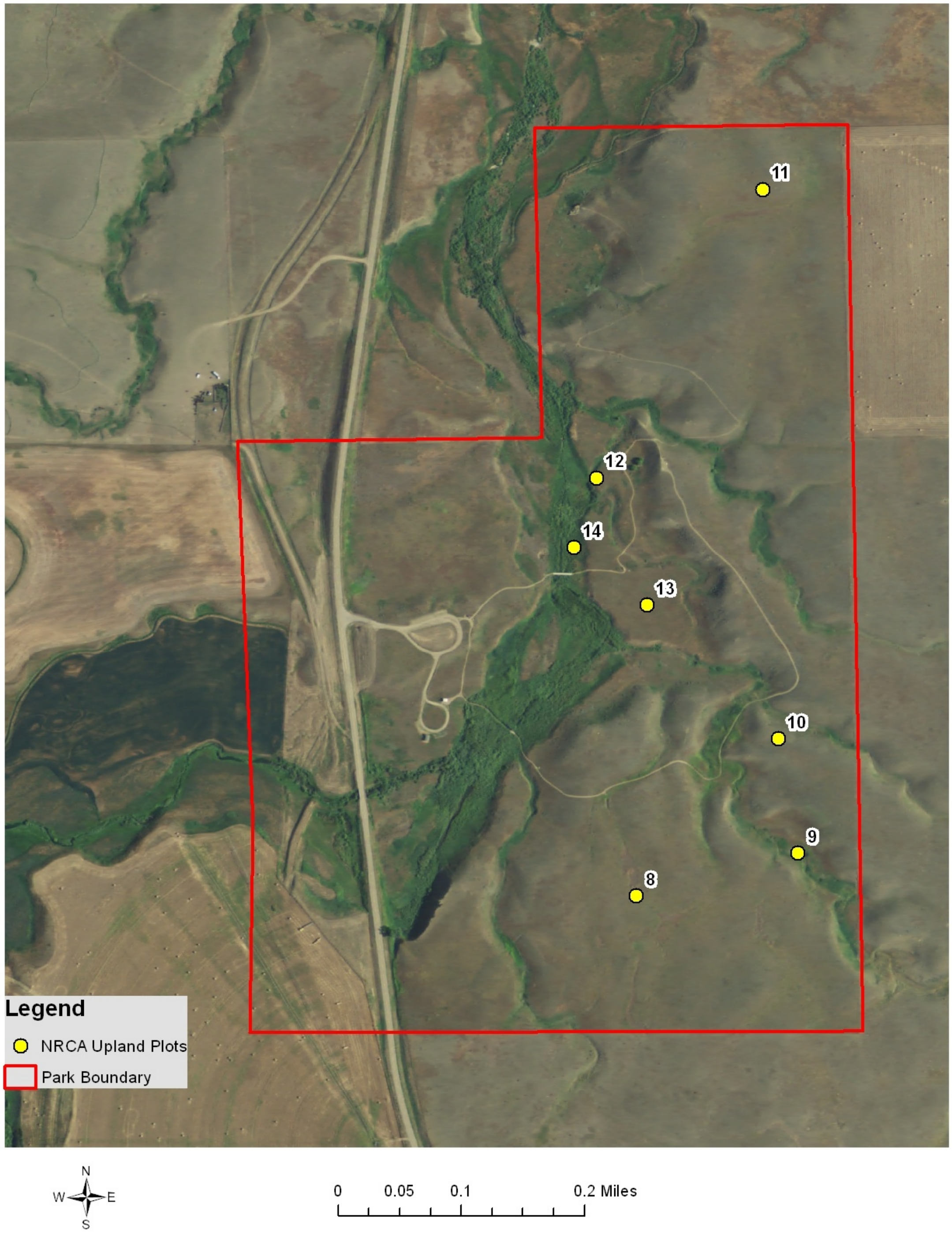

Figure 14. This figure shows all the locations of upland assessments for BEPA.

The soil stability attribute rating indicates much of the Park area within the assessment sites is in good to excellent condition. None of the seven plots have a rating outside the none to slight departure (<21% departure) from reference condition. The hydrologic function attribute had very similar results with all seven plots having a none to slight departure rating (<21% departure). Both attributes indicate the Park land is in excellent condition and is functioning properly. The lands within BEPA are expected to remain stable in the future with similar land use patterns as are currently occurring. The lack of grazing use and the minimal impact of recreation in the area indicate a small potential for increased soil erosion or water quality degradation. Based on current soil stability and hydrologic function ratings through present park management, these two processes are expected to remain stable

The biotic integrity attribute indicated, similar to the soil stability and hydrologic function, most of the Park area is in excellent to good condition. All seven sites were rated in the none to slight departure category (<21%).

Table 14. Summary of departure ratings for landscape attributes and physiographic attributes for BEPA upland sample plots.

Park Unit	Plot No.	Soil Stability % Departure	Hydrologic Function % Departure	Biotic Integrity % Departure	Slope	Aspect (degrees)	Elevation (ft)	Topographic Position
BEPA	8	2.5%	7.5%	20.0%	1%	350	3,050	Valley Floor
BEPA	9	0.0%	2.5%	14.3%	2%	290	3,025	Valley Floor
BEPA	10	0.0%	0.0%	2.9%	15%	190	3,040	Toeslope
BEPA	11	0.0%	2.5%	11.4%	4%	235	3,035	Shoulder
BEPA	12	0.0%	5.0%	14.3%	1%	270	3,260	Valley Floor
BEPA	13	2.5%	5.0%	11.4%	1%	300	2.990	Valley Floor
BEPA	14	0.0%	0.0%	5.7%	1%	290	2,995	Valley Floor

Summary and Recommendations

This NRCA used GIS databases for primary analyses of upland and aquatic plant communities. All GIS data layers were imported into an ArcGIS File Geodatabase using ArcCatalog version 9.3. In addition, all currently available and relevant reports and publications were identified and reviewed to inform the introduction, results, natural resources analyses and these summary and recommendation statements. The vegetation inventory information is available for both BIHO and BEPA; however, neither site has adequate information on the current condition based on established reference conditions. Therefore, selection and application of several on-the-ground, rapid assessment tools were used to assess the condition of upland and aquatic/riparian vegetation resources that have become established within the two study sites using 17 indicator values.

Site specific assessments were completed in both BIHO and BEPA during the 2009 field season. The goal of each assessment was to gather information regarding the current status of specific Park unit resources to identify trends in resource health or degradation. The details of each upland and aquatic assessment are presented herein.

Upland Assessment

Ecological assessments were completed in both the BIHO and BEPApark units during the 2009 field season; seven sample sites within each park unit were identified and assessed across all distinguishable upland environs. Evaluated under the rangeland health rapid assessment methodology were the three landscape attributes of soil/site stability, hydrologic function, and integrity of the biotic community at the ecological site level. The seven sites sampled at BIHO represented a range of upland habitat types, while five of the seven sites sampled at BEPA were located on upland sites and two were located on lowland sites characterized by vegetation with mesic water requirements.

Within BIHO and BEPA, the attributes of soil stability, hydrologic function, and biotic integrity were rated with none to slight departure (<21%) from reference conditions. The findings for each site are reported in the Results section of this NRCA. There is no grazing and little recreation impact on either park unit resulting in small potential for soil erosion or water quality degradation. Therefore, the land is in excellent condition, functioning properly, and not contributing to soil erosion in respective watersheds for these two attributes. Based on current soil stability and hydrologic function, ratings should be stable in the future.

The biotic integrity within BEPA was also rated in excellent condition and was functioning properly, rated at <21% departure from reference conditions. At risk under the BIHO biotic integrity attribute are forests characterized by lodgepole pine due to mountain pine beetle infestation or stocking control (thinning, selective cutting of weakened trees, salvage logging, etc.). Should lodgepole pine forest stands within BIHO succumb, the species composition would likely shift to Douglas-fir dominance.

Future research projects, including vegetation classification and mapping and vital signs monitoring, would provide geographically-based information allowing for detailed analyses of vegetation succession and distribution. This detailed vegetation information would allow managers to compare physiographic and other landscape attribute relationships to vegetation patterns resulting in the preparation of vegetation management plans. Implementation of these plans would begin the process of reducing non-native and noxious plants thus increasing native plant distribution, diversity, and cover and related ecosystem processes.

Aquatic/Riparian Assessment

Three goals were established to achieve the primary objective of providing baseline conditions of aquatic and riparian habitats for park managers. During the aquatic/riparian resource assessments, three ecological sites were identified and assessed on the North Fork of the Big Hole River within BIHO using MRAM (Apfelbeck and Farris 2005) methodology. The aquatic resource assessments examined and rated lotic riparian/riverine characteristics. A summary of the BIHO aquatic sites is presented below (please see the Results section for site/habitat maps and photographs). No specific aquatic/riparian resource assessments were completed within BEPA; two upland assessments evaluated low-land plant communities including emergent wetland vegetation (upland assessments 12 and 14 described in the Results section).

Each BIHO site was selected to be approximately 200 m long and as wide as the outermost meanders of the North Fork of the Big Hole River. Assessments included the river and both shorelines with the following classifications and data in common to all three sites: (1) HGM (Brinson 1993) lower perennial riverine system; (2) Cowardin et al. (1979) riverine and palustrine wetland systems; (3) lower perennial subsystem (riverine system); and (4) seasonally flooded scrub-shrub and emergent wetlands (palustrine system). Assessment sites BH1, BH2, and BH3 bottom classifications were predominantly: rocky bottom and unconsolidated bottom; unconsolidated bottom and aquatic bed; and rocky bottom, unconsolidated bottom, emergent wetland, and rocky shore, respectively. Seasonally flooded scrub-shrub wetland communities (predominantly willows) of BH1, BH2, and BH3 contributed 65%, 60%, and 50% site cover, respectively, while emergent wetland communities (predominantly sedges, rushes, and grasses) contributed 35%, 40%, and 50% cover, respectively. Brook and rainbow trout; western toad and Columbia spotted frog; and muskrat, beaver, deer, and elk individuals or sign were observed along the river within assessed sites.

The BH1, BH2, and BH3 lotic riparian/riverine assessment site condition scores (0.985, 0.979, and 0.961, respectively) correspond to an excellent rating for onsite conditions. Naturally occurring channel instability and bank erosion (channel widening and failure where grass species comprised the dominant vegetation) was observed at assessment site BH3. While assessment sites BH1 and BH2 appeared to have stable stream channels and were functioning at ecologically efficient levels. No restoration is recommended for any of the assessment sites. Existing impacts were minimal at each assessment site, although potential stressors exist in the form of nearby grazing, wildlife browsing, human recreation, nearby roads, and excessive irrigation. The noxious weed Canada thistle occurred as scattered patches in the BH2 assessment site and in the 100 m wide buffer zone around assessment sites BH2 and BH3. The buffer zone around each assessment site supported the undesirable timothy grass.

Future research projects, including vegetation classification and mapping within the buffer zones, monitoring water quantity and quality within and adjacent to the park units would provide managers with geographically-based data for future analysis and monitoring. This detailed information would allow managers to identify changes in the resource by comparing the baseline data to the future condition over a period of time.

Threats and Stressors

Threats and stressors thought to be the most important to management of the BIHO and BEPA natural resources were examined using available information and a summary of existing information. The conclusions and recommendations are provided in the following subsections.

Fire

Fire is a major event with the potential to alter woodland and shrubland vegetation cover of BIHO and to somewhat alter the herbaceous types of BEPA (NPS 2011c). However, historic fire regime mapping within BEPA has not been specifically assessed as of the date of this publication making it challenging to infer effects over time. The presence or absence of natural fires within a given ecosystem is recognized as an important factor promoting, slowing, or eliminating various components of the ecosystem. Most natural fires in this portion of Montana are lightning caused and are recognized as natural events which must be permitted to continue to influence the ecosystem if truly natural systems are to be perpetuated (fire may contribute to or hinder the achievement of Park objectives). BIHO and BEPA fire management programs are designed around resource management objectives and the management zones of the park units (historic, development, and/or special use).

Historically and prehistorically, fire was the most prevalent natural and human-ignited disturbance process in the extant ecosystems. Fire is the dominant process influencing composition, diversity, energy, and nutrient cycles (Kauffman et al. 1997) and the Nez Perce people periodically burned vegetation of the BIHO and BEPA region to enhance food production for themselves and area wildlife (NPS BIHO 2011). Wildfire originating within or adjacent to park unit lands may pose a threat to the upland resources, particularly forested areas within BIHO, and less so at BEPA which supports grasslands and stands of graminoids, predominantly. Depending on the fire intensity and extent, effects could range from forest, woodland, or shrubland stand removal and replacement to combustion of fine fuels or thinning of understory shrubs and saplings. The former scenario would reduce the overall wildlife habitat structure for many species, although there may be increased use by grazing species; ground surface cover would be removed (increasing soil erosion potential and potential for non-native plant species invasion/establishment). The latter scenario would likely improve wildlife habitat quality due to stand maintenance for species that currently use BIHO and BEPA habitats.

Recent fire history in the BIHO and BEPA region is well documented by various federal agencies with some overlap between land ownership. Wildfire data on file were compiled by USDA Forest Service, Region 1 including the 20-year period of 1985 through 2005. The data records fires that have occurred in the area of the park units and are representative of ignition sources and the type of fires common to southwestern Montana. According to the Fire_Polygons_85-05 dataset, approximately 258,084 acres burned as a result of wildfire ignitions during the period 1985-2005 within the BIHO basin area.
Fire Regime Group (FRG) or historical fire regime can be employed as a coarse scale indicator of ecosystem sustainability to explain processes in terrestrial systems that constrain vegetation patterns, habitats, and ultimately, species composition. Land managers need to understand historical fire regimes, the fire return interval (frequency), and fire severity prior to settlement by

Euro-Americans, to be able to define ecologically appropriate goals and objectives for the managed area. FRGs are a critical component for characterizing the historical range of variability in fire-adapted ecosystems. Furthermore, understanding ecosystem/community departures provides the necessary context for managing sustainable ecosystems/communities. This information could be incorporated into an updated fire management plan that is aimed at curtailing the spread of noxious and invasive species for both BIHO and BEPA. For example, in the event of a wildfire where an invasive species not presently abundant at BIHO such as cheatgrass may become more widely established, managers may want to focus their efforts on fire tolerant native species that can adapt to a changed ecosystem/community and out-compete cheatgrass thus reducing its cover or eliminating its establishment.

The documented history of fire in the vicinity of BIHO indicates fire has occurred outside the boundary but not within BIHO for over 25 years. Observations of the current vegetation types and distribution indicate that fire may not have occurred within BIHO for a much longer period of time. Records of fire occurrence and size are maintained by the USFS and are presented in Table 15. Figure 15 is a map of the historic fire occurrence near BIHO from 1985 to 2005. Additionally, data in Table 16. Mean Fire Return Interval for BIHO. (Source See Appendix D) shows that nearly 75% of the vegetation within BIHO is in a moderate risk category for fire (81-300 years return interval).

Table 15. USFS Region 1 (Northern Region) recorded burned acres by year and cause for the project area, 1985-2005 (Source See Appendix D).

Region 1 Fire History 85-05	Campfire	Equipment Use	Lightning	Miscellaneous	Grand Total
1985	0.2		1,000.1		1,000.3
1986			20.2		20.2
1987	0.2		0.4		0.6
1988			5.3		5.3
1989	0.1	0.5	0.1		0.7
1990	0.1		2.5		2.6
1991			0.8		0.8
1992	0.1		0.1		0.2
1994			2.3		2.3
1995			0.1		0.1
1996			7.1		7.1
1997	0.1		0.1		0.2
1998	0.2		200.9		201.1
1999	0.5		185.3		185.8
2000			671.5		671.5
2001	0.3		0.1	0.1	0.5
2002	0.1		2,016.0	1.0	2,017.1
Grand Total	1.9	0.5	4,112.9	1.1	4,116.4

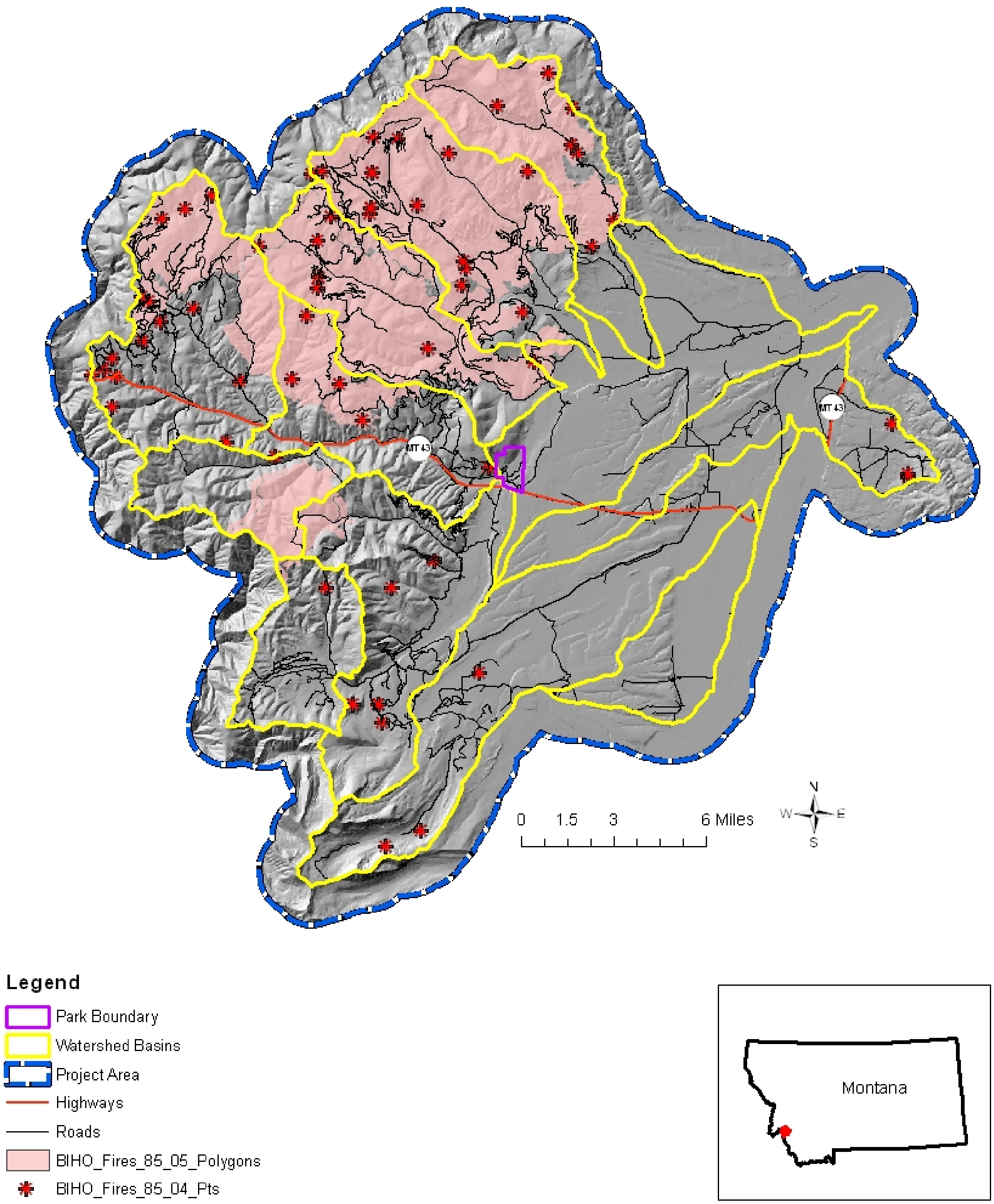

Figure 15. Historic fire occurrence near BIHO from 1985 to 2005 (USDA 2010).

The age of lodgepole pine stands within BIHO suggest fire has been successfully limited; the effects of fire suppression and changes in species composition have increased the fire-free interval within BIHO as larger woody species have replaced herbaceous species (Miller et al. 2008). In general, exclusion of fire may affect plant communities by decreasing species composition, thereby increasing the intensity of future fires (Rodhouse 2009). Furthermore, exclusion of fire in lodgepole pine stands can make them susceptible to mountain pine beetle infestations (Alexson et al. 2010). These mature stands tend to have sparse understory vegetation with relatively few species present. The stand structure trend toward single-aged stands. The fire return intervals for BIHO are presented in Table 16 as derived from the geodatabase information presented in Appendix C. Fire-adapted grasses, such as cheatgrass (which increase fine fuels, the rate of fire spread, and thrive in fire dominated ecosystems) represent a concern within BIHO. These herbaceous species can decrease the return interval of fire (Link et al. 2006) in ecosystems that historically supported fire regimes of 60 to 110 years to as little as three to five years (Whisenant 1990).

Table 16. Mean Fire Return Interval for BIHO. (Source See Appendix D)

Attribute (Label)	GIS Acres	% Total Area
26-30 Years	22.9	0.009%
31-35 Years	74.7	0.031%
36-40 Years	156.4	0.064%
41-45 Years	309.9	0.128%
46-50 Years	711.2	0.293%
51-60 Years	3,496.3	1.441%
61-70 Years	6,860.9	2.827%
71-80 Years	13,763.2	5.672%
81-90 Years	20,353.6	8.388%
91-100 Years	20,753.1	8.552%
101-125 Years	49,650.5	20.461%
126-150 Years	34,579.5	14.250%
151-200 Years	46,969.7	19.356%
201-300 Years	34,166.4	14.080%
301-500 Years	9,215.4	3.798%
501-1000 Years	701.6	0.289%
>1000 Years	33.4	0.014%
Water	130.6	0.054%
Barren	78.1	0.032%
Sparsely Vegetated	635.3	0.262%
Indeterminate Fire Regime	0.4	0.000%

The FRCC and FRG data may aid in mapping and planning to address the cheatgrass issue. Additionally, according to Hull and Stewart (1948) some species of alien bunchgrass have been used in the Great Basin to seed post-fire landscapes to suppress the growth of cheatgrass and reduce fuel continuity and flammability. Such practices could afford managers alternative options when addressing aggressive invasive plant species; however, monitoring and ecosystem function need to be fully understood in order to avoid unintended negative effects. Furthermore, when comparing historical fire data for BIHO and BEPA it is clear there are discrepancies in both the number of fires and acres burned suggesting a process of consistency for recording fire occurrence and burned acres is desired. The Fire Management Plan outline published in 2007 for the City of Rocks National Monument (CIRO) (NPS 2007) would provide a good template for a fire management plan encompassing both BIHO and BEPA.

Wildfire originating within or adjacent to BIHO or BEPA is a threat to the upland resources. Prescribed fires may reduce the possibility of stand-replacing fires within the Douglas-fir and lodgepole pine forests and woodlands adjacent to BIHO and could be used to curtail invasive plant species abundance and distribution around the BEPA boundary. The risk of negative impacts to natural vegetation and biotic integrity on BIHO and BEPA lands from fire is a concern for managers due to the time (>20 years) required for sagebrush shrubland communities to recover (Kitchen and McArthur 2008, Bollinger and Perryman 2008). It is unclear how the presence of an invasive perennial forb such as spotted knapweed (*Cenaurea biebersteinii*) might affect present fire regimes, though it has been observed that spotted knapweed does not carry fire as readily as grasses and it does survive fires due to a large perennial taproot and/or many viable seeds. Therefore, dense spotted knapweed infestations can change the fire regime by changing the fuel characteristics and thus reducing the fire return interval at a given site (McGowen-Stinski 2001; Xanthopoulos 1988). Following fire that exposes mineral soils, a number of annual and biennial forbs and grasses including mustards, sweet clovers, thistles, and brome grasses may become established with dense cover. These stands would provide fine fuels and would likely prevent reestablishment of native grasses and forbs in the short term.

Water Resources and Aquatic Habitat

The North Fork of the Big Hole River is the primary drainage flowing through BIHO; it flows into the Big Hole River mainstem near Wisdom, Montana. The primary drainage within BEPA is Snake Creek which originates in the Bear Paw Mountains flowing east to join Box Elder Creek and eventually emptying into the Milk River east of Fort Belknap Agency. Upstream of BEPA cattle grazing is common in the Snake Creek drainage. Limited research and information was available at the time of this report concerning the effects of the land use on water quality of Snake Creek at BEPA.

The Big Hole River originates in the Beaverhead National Forest with headwaters at Skinner Lake and is a tributary to the Jefferson River. Irrigation and recreation issues are managed by the Big Hole River Watershed Committee. The population of the rare fluvial Arctic grayling, which occurs entirely within the Big Hole River, continues to decline even with focused management efforts. Fluvial Arctic grayling have been officially identified downstream of BIHO but not within the North Fork inside BIHO boundaries (Jocius, pers. comm. 2011). More studies need to be conducted for this species.

The Big Hole River mainstem was sampled in two locations in the BIHO region using the methods of the Environmental Monitoring and Assessment Program (Bollman and Bowman 2008). The upper sample site had good water quality determined by high mayfly taxa richness (16 taxa), a low Hilsenhoff's Biotic Index (HBI) value (3.54), and the presence of five sensitive taxa. Caddisfly taxa were exceptionally diverse; 15 caddisfly taxa were collected. The Fine Sediment Bioassessment Index (FSBI) value was 4.7, which is near the median value for similar systems and sediment deposition probably did not influence the fauna in the reach. Overall taxa richness was very high; instream habitats were probably undisrupted and diverse. Surface flow apparently persisted year-round and other catastrophes including scouring sediment pulses are unlikely, since many long-lived semivoltine taxa (require more than one year in the aquatic larval development phase) were present. The functional composition of the assemblage included all expected components, and the proportional representation of each was appropriate.

The lower sample site had good water quality determined by moderately high mayfly taxa richness (13 taxa) and a moderately low HBI value (4.66) (Bollman and Bowman 2008). Hypoxic sediments may have been present in some areas; the warm-water mayfly *Tricorythodes* sp. was dominant in the assemblage. Caddisflies were represented by an expected number of taxa. The FSBI value (4.55) indicated that the community was moderately sensitive to sediment deposition, but sediment did not influence the composition of the aquatic fauna. Overall taxa richness was somewhat blunted compared to other large rivers in the region; instream habitats may have been monotonous. Semivoltine taxa were well-represented, suggesting that surface flow persisted year-round in this reach and that thermal extremes did not interrupt long life cycles. The dominance of gatherers and filter-feeders and the presence of other expected functional groups appeared to be appropriate for a riverine environment. Sampling this site in September resulted in the following assessment: (1) impairment by sediment, nutrients, and metals were indicated by the diatom assemblages; (2) the dominant taxon for both sampling events was *Epithemia sorex*, which increases in abundance in the presence of various stressors (*E. sorex* accounted for 49% of the diatoms identified in the sample); (3) indicators of metals contamination, including *Staurosira construens, Staurosirella pinnata,* and *Nitzschia fonticola* were among the dominant taxa collected; (4) *Diatoma moniliformis* and *Cocconeis placentula*, which prefer nutrient-enriched environs, were abundant; and (5) sediment indicators included *Navicula capitatoradiata*.

Water resources in BIHO are affected by cattle grazing and agricultural processes within relatively close proximity to its borders to the east and upstream, recreational use from fishermen and tourism use of the trail network, as well as natural stream processes of channel shifting and spring high water. During field investigations of 1982 and 1983 completed by Montana Bureau of Mines and Geology, it was noted that there were no active stream flow gauging stations within the BIHO area (Levings 1986). During 1988 a stream gage was installed by the USGS south of Wisdom, Montana on Big Lake Creek (USGS 2010); this station (No. 06024450) has recorded water temperature (°C) and discharge (cfs) on an hourly and daily scale through 2011. A second stream gauging station (No. 06024540) was installed during the fall of 1997 on Mudd Creek near Wisdom, Montana (USGS 2010); this station records discharge in cfs and has operated continuously to present. The gauges recorded high spring runoff induced by snowmelt and precipitation (possibly exacerbated by area fires removing vegetation cover and increasing runoff) during the spring seasons of 1996-97 and 2008-09 (USGS 2010). These high flow events could be related to the stream channel erosion and bank instability noted during the summer 2009 field surveys of the North Fork of the Big Hole River.

The primary concerns for BIHO and BEPA managers regarding water resources focus on preservation of water quality, riparian areas, recreation, and habitat for the fluvial Arctic grayling (BIHO). Water quality concerns include temperature, specific conductance, pH, dissolved oxygen, and turbidity resulting from streambank erosion and spring-season runoff (NPS 1997b). Additionally, low water levels during the late summer which result from diverting irrigation water, primarily tend to cause increased water temperatures. This has, in turn, become a management focus over the past two decades (Rens and Magee 2006). Direct impacts due to pronounced streambank erosion and increased turbidity, include the filling of spaces in-between the substrate (interstitial space) can inhibit the reproductive cycles of sensitive aquatic species by covering spawning beds and decreasing water quality. Increased temperatures and decreased water quality can further degrade aquatic ecosystems by supporting growth of algae, potentially leading to a decrease in dissolved oxygen, an increase in the pH, homogeneity of streambed substrate, and a subsequent shift in benthic macroinvertebrate communities (Chambers and Wisdom 2009). Human effects including river impoundments on private property upstream and NPS developments within the lower parking area of BIHO have the potential to affect flooding patterns, sediment deposition, and stream channel characteristics.

Riparian and aquatic invasive species, including American milfoil, dydimo (*Didymospheria geminata*), brook trout, rainbow trout, and zebra mussel (*Dreissena polymorpha*), will become a much greater concern for BIHO managers if not controlled through constant noxious weed, invasive algae, non-native fish, and non-native aquatic invertebrate management. Prevention that includes education of visitors and anglers is an important and cost effective management tool. Additionally, prevention of new and spreading colonies of Canada thistle on riparian and emergent wetland habitats is the most efficient and cost effective method of management and control. Prevention can be approached by maintaining complex native overstory canopies; a healthy overstory component will reduce the chances of establishment and spread of non-native and noxious plant species. Additional means of control can include jute matting with an additional three to four inches of mulch that will prevent sunlight from accessing invasive plants and allow overstory vegetation to mature. Managers must be persistent in control efforts over time because once established, invasive species will likely never be fully eradicated from BIHO and BEPA rivers, streams, and wetlands.

Fine sediment deposited on streambeds after grayling have spawned will reduce the survival from egg to fry if levels are excessive (Rens and Maggie 2007). Fine sediment also affects the number and diversity of invertebrates, which provides an important food resource for the fish. It is difficult to manage sediment loading found in streams within the park resulting from upstream land use activities. However, it is possible to help control and prevent fine sediments from entering the BIHO river and streams from onsite sources. In smaller streams, wood can be used to retain sediment by creating step pools along steeper gradient reaches. Wood debris also promotes bed and bank stability. Another effective method for reducing non-point sources of sediment within BIHO is to maintain densely vegetated riparian buffers that trap sediments prior to delivery into streams.

Animal Resources

The NPS lists 57 mammal, 204 bird, four reptile, two amphibian, and seven fish species as probably present or present at BIHO (NPSpecies 2011). Of these, the ring-necked pheasant (*Phasianus colchicus*), gray partridge (*Perdix perdix*), wild turkey (*Meleagris gallopavo*), and brook trout (*Salvelinus fontinalis*) are non-native and introduced for hunting or fishing recreation. Common big game mammals include the moose (*Alces alces*), elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), pronghorn (*Antilocapra americana*), and American black bear (*Ursus americanus*) (also the coyote (*Canis latrans*) may be hunted and is considered abundant), which may use the available habitats within BIHO. Abundant waterfowl hunted regionally and occupying BIHO aquatic, riparian, and wetland habitat includes the sandhill crane (*Grus canadensis*), Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), and American wigeon (*Anas americana*). The animal resources within the BEPA unit have not been specifically assessed as of the date of this publication and are anticipated to be incorporated in the NPS "State of the Parks" reports in the future.

The 2009 certified species list details the number of species known to exist in BIHO as well as a number of species that are considered to be "possibly present" due to the existence of specifically observed habitat conditions (NPS 2009b). The NPSpecies database provides a complete list of vertebrate species identified within BIHO which is presented by fauna type in Appendix A.

While adequate habitat for bat species exists at BIHO, no bats were observed by Rodhouse et al. (2009) during the inventory work completed in 2002. Three bat species are listed as probably present within BIHO (NPSpecies 2011), they are: the spotted bat (*Euderma maculatum*), small-footed myotis (*Myotis leibii*), and northern long-eared bat (*Myotis septentrionalis*). Because habitats occur in BIHO and BEPA that could support bat species during stages of their life cycle, future research on bat presence and habitat use is warranted.

Vegetation Classification and Mapping

BIHO and BEPA support a variety of plant communities serving as wildlife habitats varying from sagebrush-steppe and coniferous forest ecotones to rolling prairie grasslands and stands of wetland and riparian vegetation (NPS 1997). BIHO is characterized by sagebrush shrublands on benches, riparian and wetland grassland and willow stands, sandy hillside grasslands, and coniferous forest stands (NPS 2002). BEPA is characterized by sagebrush shrublands and grasslands on hillsides and willow, currant, snowberry, cattail, and horsetail wetland and riparian stands adjacent to Snake Creek (NPS 2002). A complete list of plant species is presented in NPSpecies (2011) and in NPS (2002).

To further understand the distribution of plant assemblages within BIHO, the NPS Vegetation Mapping (Inventory) Program funded the task to classify and map vegetation types in BIHO and BEPA commencing in 2009 under the UCBN Inventory and Monitoring program oversight. The initial phase of the project was directed by BIHO and UCBN staff in conjunction with Northwest Management, Inc. and the Idaho Conservation Data Center to develop a vegetation classification using the National Vegetation Classification System (NVCS). The report detailing the four-step approach for the development of the vegetation mapping methods was completed in April 2010 and is available on the UCBN website (Aho and Forman 2010). Currently the "Planning/Scoping", "List of Plant Associations", "NAIP Imagery" and "Field Data Collection" have been completed for this project (NAIP 2008, UCBN 2010). However, at the time of this publication the vegetation mapping final report was not available for incorporation; the "Classification and Field Key" and "Photo Interpretation - Vegetation Map Preparation" will be completed in spring of 2011 with the "Accuracy Assessment" phase scheduled for May-June 2011. The Final Report is scheduled for completion in winter 2011.

These vegetation products and GIS databases are integral in conducting threat and stressor analyses for both plant and animal species and habitats. Particularly important is the use of accurate vegetation mapping to inform fire fuels potential and various monitoring plans.

Threatened, Endangered, Sensitive, and Species of Special Concern (TESS)
Rare species within natural to urbanized habitats often become classified by federal agencies as sensitive, threatened, or endangered or are given a status rank by state agencies, typically heritage programs. TESS species within BIHO and BEPA were determined using the BIHO species list (NPSpecies 2011) and MNHP (2011) lists of rare animal and plant species. Invertebrates, bryophytes, and lichens were not included due to lack of survey information within BIHO and BEPA. Three TESS bird taxa within BEPA have been identified by the NPS as of the date of this publication, but a complete species list was not available.

Of the 40 TESS taxa identified as present or possibly present within BIHO, there are four federally threatened, three federal T&E candidates, and 20 federally sensitive species (13 species had no federal designation). The three TESS taxa identified as present in BEPA included one federal T&E candidate. Under the Montana status provided by the MNHP, there were two S1, eight S2, sixteen S3, and fourteen S3B TESS taxa in BIHO and one S2 and two S3 TESS taxa in BEPA. Three species (grizzly bear (*Ursus arctos horribilis*), fluvial Arctic grayling (*Thymallus arcticus*), and Ute ladies' tresses (*Spiranthes diluvialis*) have not been observed in BIHO (NPSpecies 2011), but may be significant because of range and habits/habitats (grizzly bear - meadows, mixed shrublands, forest stands, sidehill Parks, and alpine habitats), presence in mainstem rivers (fluvial Arctic grayling – Big Hole River), and presence in wetland and floodplain habitats in Beaverhead County (Ute ladies' tresses).

Climate change or increased land use within the Big Hole River drainage basin resulting in drought, vegetation cover conversion to other land uses, water diversion to irrigate crops, and more rapid runoff would negatively affect aquatic, riparian, and wetland TESS taxa, including the fluvial Arctic grayling, westslope cutthroat trout (*Onchorhynchus clarkii lewisi*), western toad (*Bufo boreas*), and Ute ladies' tresses. Stressors would include changes in flow periodicity, reduced flows, decreased water quality, reduction of favorable habitat, and increased water temperatures, among other effects. Reductions in riparian and wetland habitats associated with the North Fork of the Big Hole River within BIHO would negatively affect sixteen TESS taxa.

TESS plant species of the BIHO vicinity include Ute ladies' tresses, and Lemhi penstemon (*Penstemon lemhiensis*), and whitebark pine (*Pinus albicaulis*) (Table 17). Ute ladies' tresses (Figure 16) are sensitive to changes in hydrology and invasion by non-native plant species; populations currently are affected by heavy livestock grazing, conversion of floodplain areas to agriculture, and highway construction and maintenance (MNHP 2011). Additionally, most populations occur on private lands and no occurrences are currently protected or managed for conservation values (MTFWP 2010). Lemhi penstemon (Figure 17) is a relatively short-lived perennial forb (the largest known population with approximately 1,580 individuals observed in 2009 and 1,618 individuals in 2010 occurring within BIHO) (Stucki and Rodhouse 2009, UCBN 2010). Populations decline in response to drought and fire suppression and are negatively affected by invasive plant species, heavy livestock grazing, and road construction and maintenance (MNHP 2011). Whitebark pines (Figure 18) are currently in decline due to mountain pine beetle and white pine blister rust infestations within the species range (MNHP 2011). Suppression of wildfire and limited use of prescribed fire negatively affect whitebark pine due to subalpine fir and other conifer encroachment.

Table 17. BIHO Sensitive plants and Montana State Status.

Scientific Name	Common Name	State/Global Rank
Spiranthes diluvialis	Ute Ladies' Tresses	S1/G2
Penstemon lemhiensis	Lemhi penstemon	S1/G3
Pinus ablicaulis	Whitebark pine	S2/G4

Figure 16. Ute Ladies'Tresses, a perennial orchid known within Beaverhead County.

Figure 17. Lemhi penstemon, a showy, perennial forb within Beaverhead County.

Figure 18. Whitebark Pine.

TESS bird species using the BEPA grassland habitat include the Sprague's pipit (*Anthus spraguei*), Baird's sparrow (*Ammodramus bairdii*), and mountain plover (*Charadrius montanus*) (Figure 19, 20, 21); little is known about these species for this document. They occur during the breeding season and may nest in BEPA grassland habitat. Suppression of wildfire and limited use of prescribed fire can negatively affect grassland habitat due to shrub and tree encroachment and build-up of litter. Grassland birds are likely also affected by invasion by non-native plant species, heavy livestock grazing, conversion of grasslands to agriculture, and development fragmenting habitat.

Table 18. BEPA TESS Species Montana Status.

Scientific Name	Common Name	State/Global Rank
Anthus spraguei	Sprague's pipit	S3B/G4
Ammodramus bairdii	Baird's sparrow	S3B/G4
Charadrius montanus	mountain plover	S2B/G3

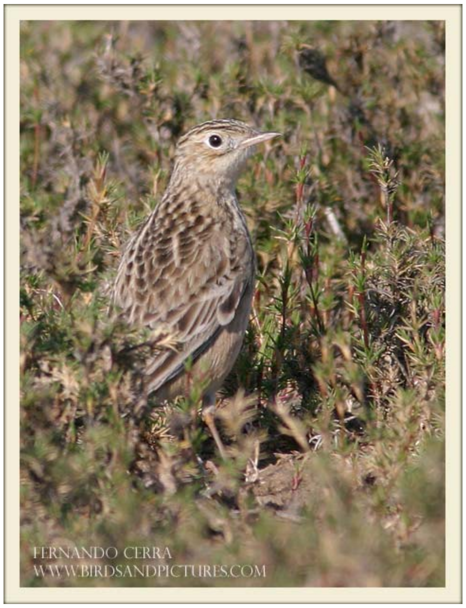

Figure 19. Sprague's pipit (Picsearch 2011).

Figure 20. Baird's Sparrow (Picsearch 2011).

Figure 21. Mountain Plover (Picsearch 2011).

Non-native Plant Species, Invasive Plant Species, and/or Noxious Weeds

The management and control of invasive non-native plant species has been identified as a high priority issue within the NPS and is a primary (accountable) goal under the Government Performance Results Act of 1993 (USDA 2011). Prevention and early detection of invasive plants and noxious weeds within BIHO and BEPA is critical to effective management. Monitoring status and trend detection of a prioritized list of target invasive species would be accomplished in a cost-effective approach that would rely on integration with other terrestrial vegetation monitoring efforts. BIHO and BEPA staffs are making a concerted effort to locate, identify, and treat non-native plant species with proven Integrated Pest Management (IPM) procedures to guarantee that federally and state listed noxious weeds and other non-native plant species do not become established and replace native plant communities (NPS 1997). An invasive plant management plan including BIHO and BEPA has been drafted and is currently being evaluated in an environmental assessment.

Of the 393 plant taxa listed for BIHO, 12% or 48 taxa are non-native (NPSpecies Database 2011). Six of the BIHO non-native taxa are listed as noxious by Montana (USDA Plants Database 2011), they are: Canada thistle (*Cirsium arvense*), common tansy (*Tanacetum vulgare*), field bindweed (*Convolvulus arvensis*), spotted knapweed (*Centaurea stoebe*), leafy spurge (*Euphorbia esula*), and tamarisk (*Tamarix* sp.) (tamarisk is not listed by NPSpecies 2011 for BIHO) (NPS In Process). Montana-listed noxious plant species identified and managed within BEPA include Canada thistle, field bindweed, and spotted knapweed (NPS In Process). Approximately two acres (0.8 hectares) of BIHO and one-tenth acre (0.04 hectares) of BEPA are considered infested by non-native plant species. In addition to the noxious plant species, top priority non-native plant species for management in BIHO and/or BEPA include oxeye daisy (*Leucanthemum vulgare*), hoary false alyssum (*Berteroa incana*), bull thistle (*Cirsium vulgare*), yellow sweetclover (*Melilotus officinalis*), common mallow (*Malva neglecta*), common mullein (*Verbascum thapsus*), prostrate knotweed (*Polygonum aviculare*), and dandelion (*Taraxacum officinale*).

Management of all species of non-native and/or noxious invasive plant species is important for good stewardship of natural resources; however, some species pose greater threats to the natural resources of BIHO and BEPA but are not currently the most abundant. Invasive plant species including cheatgrass and knapweeds are low in terms of abundance, but pose a threat to ecosystems and plant communities of BIHO and BEPA. The NPS (2002) vegetation management plan identified threats due to the spread of invasive plant species into native plant communities or establishment on newly disturbed soils. Protection of the largest known population of Lemhi penstemon within the BIHO area is extremely important relative to invasive plant species management (Stucki and Rodhouse 2009).

The Pacific Northwest Weed Management Handbook (Peachey 2008) describes five major options for land managers, summarized as follows:

(1) Prevention is the most cost effective method for management of noxious species.
(2) Biological management is the use of other organisms against noxious or invasive weeds.

(3) Cultural management techniques integrate numerous components to minimize the impact of noxious weeds.
(4) Mechanical management physically manipulates the noxious weed directly or the ground to kill or prevent sprouting.
(5) Herbicides are chemicals used in many forms (liquid or solids) to directly kill or prevent germination of noxious weeds.

Mapping and inventorying invasive plants at BIHO and BEPA should be a top priority for managers. Maintaining updated maps of occurrences and status of invasive plant species is a key element to an efficient strategic management program and will help ensure that park unit resources are used as effectively and efficiently as possible. A database comparing descriptions of status and maps that show the locations, sizes of invasive plant species occurrences, the invasive plant species present and their abundance, as well as treatment information would be invaluable. It is recognized that developing and maintaining databases and maps requires significant resources that BIHO and BEPA managers must acquire. The data collected from inventorying and mapping would provide fundamental information used for assessing and prioritizing invasive plant management efforts. BIHO and BEPA managers have prepared a draft invasive species management plan which must be vetted through the NEPA process using an environmental assessment (EA) (NPS In Process). The Finding of No Significant Impact for the draft EA will be soon forthcoming and the plan completed and adopted on the date of signature. This invasive species management plan will serve the following purposes:

- Decrease invasive plant species cover and increase native plant species cover.
- Document and standardize best management practices to more effectively meet BIHO and BEPA goals and objectives relative to invasive plant species management.
- Provide options or tools to managers in reducing the threat to natural and cultural resources.
- Use monitoring to more effectively implement and adapt management practices.
- Determine the minimum tool/treatment or combinations of treatments needed to restore functioning native plant communities.
- Develop a document that will meet required federal and state environmental compliance.
- Develop a document that will provide future direction for invasive plant species management projects that fall under its scope.
- Assist in restoring native plant communities and wildlife habitat to reduce the BIHO and BEPA resources dedicated to invasive plant species control and removal.

Cooperation with adjacent landowners, private and public, is the most effective method to prevent and control noxious weeds. To this end, BIHO participates in the Beaverhead County Weed District. The Beaverhead County Weed District mission is to bring together those responsible for weed management to develop common management objectives and facilitate effective treatment and coordination efforts along logical geographic boundaries with similar land types, use patterns, and problem species (BCWD 2011). Cooperators include private landowners, county government, state agencies, federal land management agencies, other interested agencies and individuals.

Climate Change

Accelerated global climate change may be the most far-reaching and consequential challenge facing NPS natural resource managers (UCBN 2011). The Intergovernmental Panel on Climate Change (IPCC), a scientific intergovernmental body formed from the World Meteorological Organization and the United Nations Environment Program, focuses on climate change impacts, adaptation, and vulnerability (Parry et al. 2007). The IPCC has generally noted climates in the BIHO and BEPA region becoming warmer and drier and has also identified affects between climate change and terrestrial ecosystems in North America (Field et al. 2007, Parry et al. 2007). Reported changes included variations in seasonal precipitation and temperature, timing of life-cycle events, plant growth or primary production, and biogeographic distribution. Increased temperatures and variations in precipitation also support wildfires through extended summer seasons that cause a reduction in fuel moisture levels (Running 2006). In the last three decades burn duration of large wildfires has increased and the wildfire seasons in the western U.S. are estimated to have lengthened by approximately 78 days in response to spring/summer warming of 1.6 °F (0.87 °C) over average temperatures (Westerling et al. 2006).

The UCBN is committed to tracking changes in park natural resources that may be influenced or caused by accelerated climate change and monitoring activities would contribute to fulfill this commitment. The direct and indirect impact of predicted changes in climate on natural resources within BIHO and BEPA is complex and difficult to manage. Climate is an additional factor which contributes to the diversity of the Park units and also presents a potential stress to many ecosystem components. Climate changes could be positive or negative depending on the ecosystem processes, communities, and/or species under consideration. Plant and animal species dependent upon existing conditions, including amphibians, aquatic reptiles, and fish, could experience possible habitat disruption. Warming temperatures may also alter the composition of plant communities and allow exotic plant species to invade from warmer regions.

Listed below are specific effects on species and ecosystems attributed to global climate change (Mawdsley et al. 2009).

- Shifts in species distributions, often along elevation gradients.
- Changes in the timing of life-history events or phenology for particular species.
- Decoupling of coevolved interactions, such as plant-pollinator relationships.
- Effects on demographic rates, such as survival and fecundity.
- Reductions in population size.
- Extinction or extirpation of range-restricted or isolated species and populations.
- Direct loss of inland habitat due to increased fire frequency, bark beetle outbreaks, altered weather patterns, and direct warming of habitats.
- Increased spread of wildlife diseases, parasites, and zoonoses.
- Increased populations of species that are direct competitors of focal species for conservation efforts.
- Increased spread of invasive or non-native species, including plants, animals, and pathogens.

Mawdsley et al. (2009) identified 16 adaptation strategies in the four major adaptive strategy categories to conserve species and ecosystems from the effects of global climate change. Many of the strategies are focused at the national and regional level and would not be applicable to individual park units. The major category titled "Strategies Related to Monitoring and Planning" identifies four adaptation strategies that could be implemented at the park-level: (1) evaluate and enhance monitoring programs for wildlife and ecosystems; (2) incorporate predicted climate-change impacts into species and land management plans, programs, and activities; (3) develop dynamic landscape conservation plans; and (4) ensure wildlife and biodiversity needs are considered as part of the broader societal adaptation process.

The threats to BIHO and BEPA resources from climate change include altered precipitation patterns, seasonal weather patterns, and temperature that could lead to degradation of habitats, loss of or shifts in biodiversity, and species composition changes. Climate change could alter stream flow regimes through alteration of precipitation patterns; alteration could result in larger spring-season flows, increased flood stage, and induce hotter, drier summers. These climate change effects would pose a threat to the Lemhi penstemon and stream flows within BIHO. Local or regional changes on a large scale would impact natural resources of BIHO and BEPA, including water availability, possible migration patterns of animals (may lose seasonal benefits the area previously provided and competition from species capable of using the altered environment), encroachment of invasive, non-native, noxious, and otherwise undesirable plant species, and overall diversity of local species composition.

General Threats and Stressors

Due to the lack of consistent quantitative information on many threats and stressors, impacts were evaluated in a qualitative manner. Table 19 and Table 20 are an overall estimate of the potential impact to the major landscape attributes from the threats and stressors reported previously, including wildfire, noxious weeds, wood-boring insects, climate change, and land use changes for upland habitats. For aquatic habitats, five principle attributes were also identified, including invasive riparian plant species, non-native fish species, riverbank erosion on grass-dominated sites, land use practices for aquatic habitats, and climate change. The actual impact from these threats and stressors to any specific site will vary depending on the existing natural resource and landscape setting.

Table 19. Matrix of potential impact from threats/stressors examined in this report to the major resources/processes at BIHO.

	Major Resources/Processes		
Threats/Stressors	Soils	Hydrologic	Biotic
Upland Habitats			
Wildfire	Moderate	High	High
Noxious Weeds	Low	Moderate	High
Land Use Change	Moderate	High	High
Aquatic Habitats			
Invasive Riparian Species	Low	High	High
Recreational Land Use	Moderate	High	Moderate
Fine Sediments	Moderate	High	Moderate
Land Use Practices	Moderate	Moderate	High
All Habitats			
Climate Change	Low	High	Moderate
Key to Rating for Threats/Stressors			
Potential impact to resource	High	Moderate	Low

Table 20. Matrix of potential impact from threats/stressors examined in this report to the major resources/processes at BEPA.

Threats/Stressors	Major Resources/Processes: Soils	Hydrologic	Biotic
Upland Habitats			
Wildfire	Moderate	High	High
Noxious Weeds	Low	Moderate	High
Land Use Change	Moderate	High	High
Aquatic Habitats			
Invasive Riparian Species	Low	High	High
Recreational Land Use	Moderate	High	Moderate
Fine Sediments	Moderate	Moderate	Moderate
Land Use Practices	Moderate	Moderate	High
All Habitats			
Climate Change	Low	High	Moderate
Key to Rating for Threats/Stressors			
Potential impact to resource	High	Moderate	Low

Data Gaps

Several types of information were not available or were too outdated to inform this NRCA. Summarized herein are the important data which would improve natural resource management by BIHO and BEPA staff. We did not estimate cost or indicate agency responsibility due to the extensive nature of the data. This summary should provide guidance to BIHO and BEPA staff on future research/data collection efforts within and outside the park units:

(1) Accurate and standardized land cover/use mapping for the project area that meets National Map Accuracy Standards (+ 40 ft) and is repeatable over time. This information is very important for watershed modeling of water quality attributes, wildfire risk assessment, wildlife habitat structure, soils, and other resource values.

(2) Invasive plant species and noxious weed and land use maps in digital format focused on adjacent private (cattle ranches) and public lands (Beaverhead National Forest) within the HUC or other established buffer zone. Information collected by Exotic Plant Management Teams (EPMT) and the County Weed Management Associations (CWMAs) may provide foundation work for the development of this type of project. Currently, there are multiple sources of information regarding invasive plant species in BIHO and BEPA at a county scale, however there are inconsistencies including differing lists of invasive, native, and non-native plant species. Managers would be more aware of possible new invasive plant species and could develop better management strategies for existing non-native and noxious plant species with this information. The newly prepared invasive plant species management plan, when adopted, will further inform this data gap.

(3) An updated fire management plan is needed for BIHO and BEPA to advance the plan prepared in 1999. Additionally, the published vegetation survey completed in 2002 and the newly proposed *Vegetation Inventory Report* proposed for completion in 2011 will aid in updating the comprehensive Fire Management Plan based on present conditions of vegetation and ecosystem composition. Mapping of invasive, noxious, and undesirable plant species would also provide needed information on the influences of fire and management of species of concern.

(4) Erosion along the stream banks of the North Fork of the Big Hole River within BIHO is important to monitor due to possible effects of disturbing cultural resources near the encampment area (Rodhouse 2010). Rodhouse (2010) stated that a specific objective in the NPS stream channel protocol has been aimed at addressing riverbank erosion; however a protocol was not available for review for this NRCA.

(5) There is a need for BEPA managers to design and conduct field assessments of existing resource conditions for water resources (including water quality), animal resources, air quality monitoring, species of concern, and wildfire in addition to the current vegetation inventory work because these data are important to inform BEPA management. Much of the available research and information in this area is presently available at a county or regional scale.

(6) Studies focused on bat species were lacking for BIHO and BEPA; many bat species within Montana are species of concern and further research on population distribution and occurrence would aid efforts to provide species conservation and possibly provide insight into climate variations based on bat behavioral patterns.

Management Action Recommendations

This NRCA examined the literature, GIS databases, and field observations of four riparian ecosystems and seven upland sites within BIHO and seven upland and bottomland sites within BEPA using a rapid resource assessment methodology (Apfelbeck and Farris 2005). Management practices structured toward attaining proper functioning condition of ecosystems through suggested recommendations and the use of additional resources is expected to accomplish the NPS goals and objectives for conservation for future generations. Recommended management actions include but are not limited to: (1) acquire subsurface mineral rights for the entire BIHO and BEPA units; (2) acquire the non-NPS water right for BIHO; (3) monitor private irrigation facilities and associated access roads within BIHO; (4) acquire an additional 355 acres along the east boundary, inventory the resources, and assess condition for future management; (5) account for visitor access by updating all trails to meet Americans with Disability Act standards; (6) monitor for social trailing and enact deterrents; (7) determine the potential for oil and gas developments; (8) determine control methods for invasive and noxious plant species in accordance with neighboring land managers; and (9) monitor plant communities and wildlife species to determine climate change effects within BIHO and BEPA.

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Appendix A: 2009 Species List for BIHO

Fauna	Scientific Name	Common Name	Occurrence
Birds	Aix sponsa	Wood Duck	Probably Present
	Anas acuta	Northern pintail	Present in Park
	Anas americana	American wigeon	Present in Park
	Anas clypeata	Northern Shoveler	Unconfirmed
	Anas crecca	Green-winged teal	Present in Park
	Anas cyanoptera	Cinnamon Teal	Unconfirmed
	Anas discors	Blue-winged Teal	Unconfirmed
	Anas platyrhynchos	Mallard	Present in Park
	Anas rubripes	American Black Duck	Unconfirmed
	Anas strepera	Gadwall	Unconfirmed
	Anser albifrons	Greater White-fronted Goose	Probably Present
	Aythya affinis	Lesser Scaup	Probably Present
	Aythya americana	redhead	Unconfirmed
	Aythya collaris	Ring-necked Duck	Probably Present
	Aythya marila	Greater Scaup	Probably Present
	Aythya valisineria	canvasback	Probably Present
	Branta canadensis	Canada Goose	Present in Park
	Bucephala albeola	bufflehead	Probably Present
	Bucephala clangula	Common Goldeneye	Probably Present
	Bucephala islandica	Barrow's Goldeneye	Probably Present
	Chen caerulescens	Blue Goose, Snow Goose	Probably Present
	Chen rossii	Ross' Goose, Ross's Goose	Probably Present
	Cygnus buccinator	Trumpeter Swan	Probably Present
	Cygnus columbianus	Tundra Swan	Probably Present
	Histrionicus histrionicus	Harlequin Duck	Probably Present
	Lophodytes cucullatus	Hooded Merganser	Probably Present
	Melanitta fusca	Velvet Scoter, White-winged Scoter	Unconfirmed
	Mergus merganser	Common Merganser	Present in Park
	Mergus serrator	Red-breasted Merganser	Probably Present
	Oxyura jamaicensis	ruddy duck	Unconfirmed
	Aeronautes saxatalis	White-throated Swift	Probably Present
	Chaetura vauxi	Vaux's Swift	Probably Present
	Cypseloides niger	American Black Swift, black swift	Unconfirmed
	Selasphorus rufus	Rufous hummingbird	Present in Park
	Stellula calliope	Calliope Hummingbird	Present in Park
	Accipiter cooperii	Cooper's hawk	Present in Park
	Accipiter gentilis	Northern goshawk	Present in Park

Fauna	Scientific Name	Common Name	Occurrence
	Accipiter striatus	Sharp-shinned hawk	Present in Park
	Aquila chrysaetos	Golden eagle	Present in Park
	Buteo jamaicensis	Red-tailed hawk	Present in Park
	Buteo lagopus	Roughleg, Rough-legged Hawk	Present in Park
	Buteo regalis	Ferruginous hawk	Present in Park
	Buteo swainsoni	Swainson's Hawk	Present in Park
	Circus cyaneus	Northern harrier	Present in Park
	Haliaeetus leucocephalus	Bald Eagle	Present in Park
	Pandion haliaetus	Osprey	Unconfirmed
	Ardea herodias	Great blue heron	Present in Park
	Botaurus lentiginosus	American Bittern	Probably Present
	Casmerodius albus	Great Egret	Probably Present
	Nycticorax nycticorax	Black-crowned Night Heron, Black-crowned Night-Heron	Probably Present
	Charadrius semipalmatus	Semipalmated Plover	Probably Present
	Charadrius vociferus	killdeer	Present in Park
	Himantopus mexicanus	ae'o, Black-necked Stilt, Hawaiian Stilt	Probably Present
	Pluvialis dominica	American Golden Plover, American Golden-Plover, Lesser Golden-Plover	Unconfirmed
	Pluvialis squatarola	Black-bellied Plover, Grey Plover	Unconfirmed
	Recurvirostra americana	American Avocet	Probably Present
	Cathartes aura	Turkey vulture	Present in Park
	Falco columbarius	Merlin	Probably Present
	Falco mexicanus	Prairie falcon	Present in Park
	Falco peregrinus	Peregrine Falcon	Probably Present
	Falco rusticolus	Gyrfalcon	Probably Present
	Falco sparverius	American Kestrel	Present in Park
	Gavia immer	Common Loon, Great Northern Loon	Probably Present
	Chlidonias niger	Black Tern	Probably Present
	Larus argentatus	Herring Gull	Probably Present
	Larus californicus	California Gull	Probably Present
	Larus delawarensis	Ring-billed Gull	Probably Present
	Larus philadelphia	Bonaparte's Gull	Probably Present
	Larus pipixcan	Franklin's Gull	Probably Present
	Sterna caspia	Caspian Tern	Probably Present
	Sterna forsteri	Forster's Tern	Unconfirmed
	Sterna hirundo	Common Tern	Unconfirmed
	Pelecanus erythrorhynchos	American White Pelican	Present in Park

Fauna	Scientific Name	Common Name	Occurrence
	Phalacrocorax auritus	Double-crested Cormorant	Probably Present
	Aechmophorus occidentalis	Western Grebe	Probably Present
	Podiceps auritus	Horned Grebe	Probably Present
	Podiceps grisegena	Red-necked Grebe	Probably Present
	Podilymbus podiceps	pied-billed grebe	Unconfirmed
	Actitis macularia	Spotted sandpiper	Present in Park
	Bartramia longicauda	Upland Sandpiper	Probably Present
	Calidris alba	Sanderling	Unconfirmed
	Calidris alpina	dunlin	Unconfirmed
	Calidris bairdii	Baird's Sandpiper	Probably Present
	Calidris mauri	western sandpiper	Unconfirmed
	Calidris melanotos	Pectoral Sandpiper	Probably Present
	Calidris minutilla	least sandpiper	Probably Present
	Calidris pusilla	Semipalmated Sandpiper	Unconfirmed
	Gallinago gallinago	common snipe	Present in Park
	Limnodromus scolopaceus	Long-billed Dowitcher	Probably Present
	Limosa fedoa	Marbled Godwit	Unconfirmed
	Numenius americanus	long-billed curlew	Present in Park
	Phalaropus lobatus	Red-necked Phalarope	Probably Present
	Phalaropus tricolor	Wilson's phalarope	Present in Park
	Tringa flavipes	lesser yellowlegs	Probably Present
	Tringa melanoleuca	Greater Yellowlegs	Probably Present
	Tringa solitaria	Solitary sandpiper	Present in Park
	Plegadis chihi	White Faced Ibis	Unconfirmed
	Columba fasciata	band-tailed pigeon	Unconfirmed
	Columba livia	Common Pigeon, Rock Dove, Rock Pigeon	Encroaching
	Zenaida macroura	Mourning Dove	Present in Park
	Ceryle alcyon	Belted Kingfisher	Present in Park
	Coccyzus americanus	Yellow-billed Cuckoo	Unconfirmed
	Alectoris chukar	Chukar, Chukar Partridge	Encroaching
	Bonasa umbellus	Ruffed grouse	Present in Park
	Dendragapus obscurus	Blue Grouse	Probably Present
	Falcipennis canadensis	Spruce Grouse	Present in Park
	Lagopus leucura	White-tailed Ptarmigan	Unconfirmed
	Meleagris gallopavo	Wild Turkey	Probably Present
	Perdix perdix	Gray Partridge, Grey Partridge	Probably Present
	Phasianus colchicus	Common Pheasant, ring-necked pheasant	Probably Present
	Tympanuchus phasianellus	Sharp-tailed Grouse	Unconfirmed
	Grus canadensis	Sandhill crane	Present in Park

Fauna	Scientific Name	Common Name	Occurrence
	Fulica americana	American Coot	Unconfirmed
	Porzana carolina	Sora	Probably Present
	Rallus limicola	Virginia Rail	Probably Present
	Eremophila alpestris	Horned Lark	Probably Present
	Bombycilla cedrorum	Cedar Waxwing	Present in Park
	Bombycilla garrulus	Bohemian Waxwing	Probably Present
	Passerina amoena	Lazuli bunting	Present in Park
	Pheucticus melanocephalus	black-headed grosbeak	Present in Park
	Certhia americana	brown creeper	Present in Park
	Cinclus mexicanus	American Dipper	Present in Park
	Corvus brachyrhynchos	American crow	Present in Park
	Corvus corax	Common raven	Present in Park
	Cyanocitta cristata	Blue Jay	Probably Present
	Cyanocitta stelleri	Steller's Jay	Present in Park
	Gymnorhinus cyanocephalus	Pinyon Jay	Probably Present
	Nucifraga columbiana	Clark's nutcracker	Present in Park
	Perisoreus canadensis	Gray jay, scrub jay	Present in Park
	Pica hudsonia	American magpie, black-billed magpie	Present in Park
	Ammodramus savannarum	grasshopper sparrow	Unconfirmed
	Calamospiza melanocorys	Lark Bunting	Probably Present
	Calcarius lapponicus	Lapland Longspur	Probably Present
	Chondestes grammacus	Lark Sparrow	Probably Present
	Junco hyemalis	Dark-eyed junco	Present in Park
	Melospiza georgiana	Swamp Sparrow	Unconfirmed
	Melospiza lincolnii	Lincoln's sparrow	Present in Park
	Melospiza melodia	Song sparrow	Present in Park
	Passerculus sandwichensis	Savannah sparrow	Present in Park
	Passerella iliaca	Fox sparrow	Present in Park
	Pipilo chlorurus	green-tailed towhee	Unconfirmed
	Pipilo erythrophthalmus	Eastern Towhee, Rufous-sided Towhee	Unconfirmed
	Plectrophenax nivalis	Snow Bunting	Present in Park
	Pooecetes gramineus	Vesper sparrow	Present in Park
	Spizella arborea	American Tree Sparrow	Present in Park
	Spizella breweri	Brewer's sparrow	Present in Park
	Spizella pallida	Clay-colored Sparrow	Probably Present
	Spizella passerina	Chipping sparrow	Present in Park
	Zonotrichia albicollis	White-throated Sparrow	Probably Present
	Zonotrichia leucophrys	White-crowned sparrow	Present in Park
	Zonotrichia querula	Harris' Sparrow, Harris's	Probably Present

Fauna	Scientific Name	Common Name	Occurrence
		Sparrow	
	Carduelis flammea	Common Redpoll	Present in Park
	Carduelis hornemanni	Arctic Redpoll, Hoary Redpoll	Probably Present
	Carduelis pinus	Pine siskin	Present in Park
	Carduelis tristis	American goldfinch	Present in Park
	Carpodacus cassinii	Cassin's Finch	Present in Park
	Carpodacus mexicanus	House Finch	Probably Present
	Carpodacus purpureus	Purple Finch	Present in Park
	Coccothraustes vespertinus	Evening grosbeak	Present in Park
	Leucosticte atrata	Black rosy-finch	Unconfirmed
	Leucosticte tephrocotis	Grey-crowned rosy-finch	Unconfirmed
	Loxia curvirostra	Red Crossbill	Present in Park
	Loxia leucoptera	Two-barred Crossbill, White-winged Crossbill	Probably Present
	Pinicola enucleator	Pine Grosbeak	Probably Present
	Hirundo rustica	Barn swallow	Present in Park
	Petrochelidon pyrrhonota	cliff swallow	Present in Park
	Riparia riparia	Bank Swallow, Sand Martin	Present in Park
	Stelgidopteryx serripennis	Northern rough-winged swallow	Present in Park
	Tachycineta bicolor	Tree swallow	Present in Park
	Tachycineta thalassina	Violet-green Swallow	Present in Park
	Agelaius phoeniceus	Red-winged blackbird	Present in Park
	Dolichonyx oryzivorus	Bobolink	Probably Present
	Euphagus cyanocephalus	Brewer's blackbird	Present in Park
	Icterus bullockii	Bullock's Oriole	Unconfirmed
	Molothrus ater	Brown-headed cowbird	Present in Park
	Quiscalus quiscula	Common Grackle	Unconfirmed
	Sturnella neglecta	Western meadowlark	Present in Park
	Xanthocephalus xanthocephalus	Yellow-headed Blackbird	Present in Park
	Lanius excubitor	Great Grey Shrike, northern shrike	Probably Present
	Lanius ludovicianus	Loggerhead Shrike	Probably Present
	Dumetella carolinensis	Gray Catbird, Grey Catbird	Present in Park
	Oreoscoptes montanus	Sage Thrasher	Probably Present
	Anthus rubescens	American Pipit, Buff-bellied Pipit	Probably Present
	Poecile atricapillus	Black-capped Chickadee	Present in Park
	Poecile gambeli	Mountain Chickadee	Present in Park
	Poecile rufescens	Chestnut-backed chickadee	Unconfirmed
	Dendroica coronata	Yellow-rumped warbler	Present in Park
	Dendroica petechia	American Yellow Warbler, Yellow Warbler	Present in Park

Fauna	Scientific Name	Common Name	Occurrence
	Dendroica townsendi	Townsend's warbler	Present in Park
	Geothlypis trichas	Common yellowthroat	Present in Park
	Icteria virens	Yellow-breasted Chat	Unconfirmed
	Oporornis tolmiei	Macgillivray's warbler	Present in Park
	Seiurus noveboracensis	Northern waterthrush	Present in Park
	Setophaga ruticilla	American Redstart	Probably Present
	Vermivora celata	Orange-crowned Warbler	Probably Present
	Vermivora peregrina	Tennessee Warbler	Unconfirmed
	Vermivora ruficapilla	Nashville Warbler	Probably Present
	Wilsonia pusilla	Wilson's warbler	Present in Park
	Passer domesticus	House Sparrow	Encroaching
	Regulus calendula	Ruby-crowned kinglet	Present in Park
	Regulus satrapa	Golden-crowned Kinglet	Present in Park
	Sitta canadensis	Red-breasted nuthatch	Present in Park
	Sitta carolinensis	White-breasted Nuthatch	Probably Present
	Sitta pygmaea	Pygmy Nuthatch	Probably Present
	Sturnus vulgaris	European starling	Present in Park
	Piranga ludoviciana	Western tanager	Present in Park
	Catherpes mexicanus	Canyon Wren	Unconfirmed
	Cistothorus palustris	Marsh Wren	Probably Present
	Salpinctes obsoletus	Rock wren	Present in Park
	Troglodytes aedon	House Wren	Present in Park
	Troglodytes troglodytes	Winter Wren	Probably Present
	Catharus fuscescens	Veery	Present in Park
	Catharus guttatus	Hermit thrush	Present in Park
	Catharus ustulatus	Swainson's thrush	Present in Park
	Ixoreus naevius	Varied Thrush	Probably Present
	Myadestes townsendi	Townsend's solitaire	Present in Park
	Sialia currucoides	Mountain bluebird	Present in Park
	Sialia mexicana	Western Bluebird	Present in Park
	Turdus migratorius	American robin	Present in Park
	Contopus cooperi	Olive-sided Flycatcher	Present in Park
	Contopus sordidulus	Western wood-pewee	Present in Park
	Empidonax hammondii	Hammond's Flycatcher	Present in Park
	Empidonax minimus	Least Flycatcher	Probably Present
	Empidonax oberholseri	Dusky flycatcher	Present in Park
	Empidonax occidentalis	Cordilleran Flycatcher	Present in Park
	Empidonax traillii	Willow flycatcher	Present in Park
	Myiarchus cinerascens	Ash-throated Flycatcher	Unconfirmed
	Sayornis saya	Say's Phoebe	Present in Park

Fauna	Scientific Name	Common Name	Occurrence
	Tyrannus tyrannus	Eastern kingbird	Present in Park
	Tyrannus verticalis	Western Kingbird	Unconfirmed
	Vireo gilvus	Warbling vireo	Present in Park
	Vireo olivaceus	red-eyed vireo	Unconfirmed
	Vireo philadelphicus	Philadelphia Vireo	Unconfirmed
	Vireo plumbeus	Plumbeus vireo	Unconfirmed
	Colaptes auratus	Northern flicker	Present in Park
	Dryocopus pileatus	Pileated Woodpecker	Present in Park
	Melanerpes lewis	Lewis' Woodpecker, Lewis's Woodpecker	Unconfirmed
	Picoides arcticus	Black-backed Woodpecker	Probably Present
	Picoides pubescens	Downy woodpecker	Present in Park
	Picoides tridactylus	Eurasian Three-toed Woodpecker, Three-toed Woodpecker	Probably Present
	Picoides villosus	Hairy woodpecker	Present in Park
	Sphyrapicus nuchalis	Red-naped Sapsucker	Present in Park
	Sphyrapicus thyroideus	Williamson's sapsucker	Present in Park
	Chordeiles minor	Common nighthawk	Present in Park
	Phalaenoptilus nuttallii	Common Poorwill	Unconfirmed
	Aegolius acadicus	Northern Saw-whet Owl	Probably Present
	Asio flammeus	Short-eared owl	Present in Park
	Asio otus	Long-eared Owl	Present in Park
	Athene cunicularia	Burrowing Owl	Unconfirmed
	Bubo virginianus	Great horned owl	Present in Park
	Glaucidium gnoma	Mountain Pygmy Owl, Northern Pygmy-Owl	Present in Park
	Nyctea scandiaca	snowy owl	Unconfirmed
	Otus kennicottii	western screech-owl	Present in Park
	Strix nebulosa	Great Gray Owl, Great Grey Owl	Present in Park
	Strix varia	Barred Owl	Probably Present
Mammals	Alces alces	moose	Present in Park
	Antilocapra americana	pronghorn	Present in Park
	Brachylagus idahoensis	Pygmy Rabbit	Unconfirmed
	Canis latrans	Coyote	Present in Park
	Canis lupus	gray wolf, Wolf	Present in Park
	Castor canadensis	american beaver, beaver	Present in Park
	Cervus elaphus	elk, wapiti, wapiti or elk	Present in Park
	Clethrionomys gapperi	Southern red-backed vole	Present in Park

Fauna	Scientific Name	Common Name	Occurrence
	Corynorhinus townsendii	Townsend's Big-eared Bat, Western Big-eared Bat	Unconfirmed
	Eptesicus fuscus	big brown bat	Unconfirmed
	Erethizon dorsatum	common porcupine, porcupine	Present in Park
	Euderma maculatum	spotted bat	Probably Present
	Glaucomys sabrinus	Northern flying squirrel	Present in Park
	Gulo gulo	wolverine	Present in Park
	Lasionycteris noctivagans	silver-haired bat	Unconfirmed
	Lasiurus cinereus	hoary bat	Unconfirmed
	Lemmiscus curtatus	sagebrush vole	Present in Park
	Lepus americanus	snowshoe hare	Present in Park
	Lepus townsendii	white-tailed jack rabbit, White-tailed Jackrabbit	Present in Park
	Lontra canadensis	North American River Otter, northern river otter, river otter	Present in Park
	Lynx canadensis	Canada lynx, Canadian Lynx, lynx	Present in Park
	Lynx rufus	bobcat	Probably Present
	Marmota flaviventris	yellow-bellied marmot	Probably Present
	Martes americana	American marten, marten	Present in Park
	Martes pennanti	Fisher	Probably Present
	Mephitis mephitis	striped skunk	Present in Park
	Microtus longicaudus	Long-tailed vole	Present in Park
	Microtus montanus	Montane vole	Present in Park
	Microtus pennsylvanicus	meadow vole	Present in Park
	Microtus richardsoni	water vole	Probably Present
	Mustela erminea	Short-tailed Weasel	Present in Park
	Mustela frenata	long-tailed weasel	Present in Park
	Mustela vison	American Mink, mink	Present in Park
	Myotis californicus	California Bat	Unconfirmed
	Myotis evotis	long-eared myotis	Unconfirmed
	Myotis leibii	eastern small-footed myotis, small-footed myotis	Probably Present
	Myotis lucifugus	little brown bat, little brown myotis	Unconfirmed
	Myotis septentrionalis	northern long-eared bat, northern myotis	Probably Present
	Myotis thysanodes	Fringed Bat	Unconfirmed
	Myotis volans	Long-legged Bat	Unconfirmed

Fauna	Scientific Name	Common Name	Occurrence
	Myotis yumanensis	Yuma Bat	Unconfirmed
	Neotoma cinerea	bushy-tailed woodrat	Present in Park
	Odocoileus hemionus	mule deer	Present in Park
	Odocoileus virginianus	white-tailed deer	Present in Park
	Ondatra zibethicus	muskbeaver, muskrat	Present in Park
	Perognathus parvus	Great Basin pocket mouse	Probably Present
	Peromyscus maniculatus	Deer mouse	Present in Park
	Phenacomys intermedius	heather vole, western heather vole	Present in Park
	Procyon lotor	common raccoon, northern raccoon, Raccoon	Probably Present
	Puma concolor	Cougar, mountain lion, puma	Probably Present
	Sorex cinereus	SHREW	Present in Park
	Sorex hoyi	American Pygmy Shrew, pygmy shrew	Present in Park
	Sorex monticolus	dusky shrew, montane shrew	Present in Park
	Sorex palustris	Northern Water Shrew	Probably Present
	Sorex preblei	malheur shrew, Preble's Shrew	Present in Park
	Sorex vagrans	vagrant shrew, wandering shrew	Present in Park
	Spermophilus columbianus	Columbian ground squirrel	Present in Park
	Spermophilus lateralis	golden-mantled ground squirrel	Present in Park
	Spilogale gracilis	Western Spotted Skunk	Probably Present
	Sylvilagus nuttallii	Mountain Cottontail, Nuttall's cottontail	Present in Park
	Tamias amoenus	Yellow-pine chipmunk	Present in Park
	Tamias minimus	Least chipmunk	Present in Park
	Tamias ruficaudus	red-tailed chipmunk	Present in Park
	Tamiasciurus hudsonicus	red squirrel	Present in Park
	Taxidea taxus	American badger, badger	Present in Park
	Thomomys talpoides	northern pocket gopher	Present in Park
	Ursus americanus	American Black Bear, black bear	Present in Park
	Vulpes vulpes	Red Fox	Present in Park
	Zapus princeps	Western jumping mouse	Present in Park
Amphibians	Ambystoma macrodactylum	Long-toed Salamander	Encroaching

Fauna	Scientific Name	Common Name	Occurrence
	Ascaphus montanus	inland tailed frog, Rocky Mountain tailed frog	Encroaching
	Bufo boreas	Western Toad	Present in Park
	Rana luteiventris	Columbia Spotted Frog	Present in Park
Reptiles	Charina bottae	Rubber Boa	Unconfirmed
	Thamnophis elegans	Western Terrestrial Garter Snake	Present in Park
	Thamnophis elegans vagrans	wandering garter snake	Present in Park
	Thamnophis sirtalis	Common Garter Snake	Present in Park
	Thamnophis sirtalis parietalis	Red-sided Garter Snake	Present in Park
Fish	Catostomus catostomus	longnose sucker	Unconfirmed
	Catostomus commersonii	white sucker	Present in Park
	Catostomus platyrhynchus	mountain sucker	Unconfirmed
	Cottus bairdii	mottled sculpin	Present in Park
	Lota lota	burbot, eelpout	Present in Park
	Oncorhynchus clarkii lewisi		Probably Present
	Oncorhynchus mykiss	rainbow trout, redband trout, steelhead	Unconfirmed
	Prosopium williamsoni	mountain whitefish	Present in Park
	Rhinichthys cataractae	longnose dace	Present in Park
	Salmo trutta	brown trout	Unconfirmed
	Salvelinus fontinalis	brook trout, charr, salter	Present in Park
	Thymallus arcticus	Arctic grayling	Unconfirmed

Appendix B: List of Noxious Weeds Beaverhead County, MT.

Priority	Common Name	Scientific Name
1A	Yellow starthistle	Centaurea solstitialis
1B	Dyer's woad	Isatis tinctoria
	Flowering rush	Butomus umbellatus
	Japanese knotweed complex	Polygonum spp.
	Purple loosestrife	Lythrum spp.
	Rush skeletonweed	Chondrilla juncea
	Eurasian watermilfoil	Myriophyllum spicatum
	Scotch broom	Cytisus scoparius
	Curlyleaf pondweed	Potamageton crispus
2A	Tansy ragwort	Senecio jacobea
	Meadow hawkweed complex	Hieracium spp.
	Orange hawkweed	Hieracium aurantiacum
	Tall buttercup	Ranunculus acris
	Perennial pepperweed	Lepidium latifolium
	Yellowflag iris	Iris pseudacorus
	Blueweed	Echium vulgare
	Hoary alyssum	Berteroa incana
2B	Canada thistle	Cirsium arvense
	Field bindweed	Convolvulus arvensis
	Leafy spurge	Euphorbia esula
	Whitetop	
	Russian knapweed	Centaurea repens
	Spotted knapweed	Centauria stoebe or maculosa
	Diffuse knapweed	Centaurea diffusa
	Dalmatian toadflax	Linaria dalmatica
	St. John'swort	Hypericum perforatum
	Sulfur cinquefoil	Potentilla recta
	Common tansy	Tanacetum vulgare
	Oxeye daisy	Chrysanthemum leucanthemum
	Houndstongue	Cynoglossum officinale
	Yellow toadflax	Linaria vulgaris
	Saltcedar	Tamarix spp.

Priority	Common Name	Scientific Name
3	Cheatgrass	Bromus tectorum
	Hydrilla	Hydrilla verticillata
	Russian Olive	Elaeagnus angustifolia
4	Musk Thistle	Carduus nutans
	Common Teasel	Dipsacus fukkonum
	Field Scabious	Knautia arvensis
	Black Henbane	Hyoscyamus niger
	Common Mullein	Verbascum thapsus
	Scentless Chamomile	Tripleurospermum perforate
	Swainsonpea	Sphaerophysa salsula
	Cypress Spruge	Euphorbia cyparissias
	Myrtle Spurge	Euphorbia myrsinites

- **Priority 1A** weeds are not present in Montana. Management criteria will require eradication if detected; education; and prevention.
- **Priority 1B** weeds have limited presence in Montana. Management criteria will require eradication or containment and education.
- **Priority 2A** weeds are common in isolated areas of Montana. Management criteria will require eradication or containment where less abundant. Management shall be prioritized by local weed districts.
- **Priority 2B** weeds are abundant in Montana and widespread in many counties. Management criteria will require eradication or containment where less abundant. Management shall be prioritized by local weed districts.
- **Priority 3** Regulated Plants: (NOT MONTANA LISTED NOXIOUS WEEDS)
  These regulated plants have the potential to have significant negative impacts. The plant may not be intentionally spread or sold other than as a contaminant in agricultural products. The state recommends research, education and prevention to minimize the spread of the regulated plant.
- **Priority 4** County designated noxious weeds.

Appendix C: List of NRCA Geodatabase Feature Data Sets.

Data Type	File Name	Source	Graphic Example
Air Resources	N/A	N/A	
Climate			
Precipitation	Precipitation	US Dept of Agriculture NRCS PRISM	Yes
Temperature	Temperature_ave	US Dept of Agriculture NRCS PRISM	Yes
Geography			
Watershed Basins	BIHO_basins	US Dept of Agriculture NRCS	Yes
BIHO CRSP Boundary	BIHO_CRSP_bndy_NAD83_Z12_	UCBN-NPS	Yes
Geographic Feature Names	BIHO_idgnis	US Geological Survey	Yes
Project Area	BIHO_project_area	US Dept of Agriculture NRCS	Yes
Cities	cities	National Park Service Water Resources Division	Yes
City Municipal Boundary	city_boundary	National Park Service Water Resources Division	Yes
Counties	county	National Park Service Water Resources Division	
Flood Control Districts	Flood_Control_Dist	IdahoState Tax Commission	
MountainPeaks	Mountain_Peaks	National Park Service Water Resources Division	Yes
Park Boundary	park_polygon	National Park Service Water Resources Division	Yes
Park Headquarters	parkhead	National Park Service Water Resources Division	
Points of Interest	pt_of_interest	National Park Service Water Resources Division	
USGS Quadrangle Index	quad_index	US Geological Survey	
PLSS Sections	sections	Department of Interior, BLM	
PLSS Townships	Townships	Department of Interior, BLM	Yes
Wild Fire Districts	WildfireDist	Idaho Department of Lands	Yes
Geology			
Detailed Soils	BIHO_Soils_SSURGO	US Dept of Agriculture NRCS	
Fault Lines	fault_lines	US Geological Survey	Yes
Geology	geology _polygon	US Geological Survey	Yes
Groundwater Lithology	groundwater_lithology	Idaho Department of Water Resources	
General Soils ID	Id_statsgo	US Dept of Agriculture NRCS	
Seismic Hazard Rating	seismic_hazard	US Geological Survey	
Land Use			

Data Type	File Name	Source	Graphic Example
Campgrounds	campground	National Park Service Water Resources Division	
Fenceline	BIHO_CRSP_Fenceline UCBN_NAD83_Z12_2009	UCBN-NPS	
Ownership	BIHO_Ownership	Department of Interior, BLM	Yes
Dirt Roads	dirt_roads	National Park Service Water Resources Division	
Highways	highways	National Park Service Water Resources Division	Yes
Mine Locations	mines	National Park Service Water Resources Division	
Oil & Gas Wells	Oil_Gas_Wells	Idaho Bureau of Mines, Utah Division of Oil, Gas	
Roads	Roads	National Park Service Water Resources Division	Yes
General Land Use	strata_a_id	US Dept of Agriculture	
Trails	Trails	National Park Service Water Resources Division	Yes
Four Wheel Drive Roads	wd_roads	National Park Service Water Resources Division	Yes
Plant			
Aspen Stands	BIHO_Aspen2007 available-for-sampling	UCBN-NPS	Yes
Permanent Veg Plot Locations	PermanentPlotLocationsBIHO	UCBN-NPS	Yes
Stressors			
Fire Locations BLM	BLM_Fire_Pts_72_08	FAMWEB National Interagency FireCenter	Yes
Weeds BIHO From BLM	City_of_Rocks_Weeds_BLM	Department of Interior, BLM, Burley	Yes
Fire Locations NPS	NPS_Fire_Pts_72_08	FAMWEB National Interagency FireCenter	Yes
Sawtooth NF Fire Areas	Sawtooth_NF_Fire_Areas	United States Fores Service, Sawtooth NF	Yes
Sawtooth NF Fire Points	SNF_Fire_Points	United States Fores Service, Sawtooth NF	Yes
Sawtooth NF Invasive Inventory	SNF_Invasive_Inventory_BIHO	United States Fores Service, Sawtooth NF	Yes
USFS historic fire locations	USFS_famweb_Fire_Points	FAMWEB National Interagency FireCenter	Yes
Weed locations Idaho dept ag	Weed_Points_IDAG	Idaho Department of Agriculture	Yes
Wildfire Polygons BLM	wildfire_polygons_blm	Department of Interior, BLM,	Yes
Water Resources			
Aquifer	Aquifer	US Geological Survey	
Streams	BIHO_streams	Idaho Department of Water Resources	Yes
Geothermal Locations	geothermal	Idaho Department of Water Resources	Yes

Data Type	File Name	Source	Graphic Example
Municipal Water Locations	Municipal_Water	Idaho Department of Water Resources	Yes
River Reaches	rf3_hydro	National Park Service Water Resources Division	
Springs	Springs	National Park Service Water Resources Division	Yes
Water Quality Monitoring Site	wq_station	National Park Service Water Resources Division	Yes
Raster Data			
Andersons 13 Fire Behavior Model	BIHO13fbfm	United StatesForest Service	Yes
Elevation	BIHO_dem	USDANationalCartography & GeospatialCenter	Yes
Digital Raster Graphic (DRG) USGS Topo	BIHO_drg	US Dept of Agriculture NRCS	Yes
Existing Vegetation Type	BIHO_evt	United StatesForest Service	Yes
Fire Regime Condition Class	BIHO_frcc	United StatesForest Service	Yes
Fire Regime Group (HFR)	BIHO_frg	United StatesForest Service	Yes
Hillshade	BIHO_hlsd	Derived Product from DEM	Yes
Mean Fire Return Interval	BIHO_mfri	United StatesForest Service	Yes
Agricultural Land Use	BIHO_nass	United States Dept of Agriculture	Yes
NationalLand Cover Vegetation	BIHO_nlcd	US Dept of Agriculture NRCS	Yes
Aerial Mosaic 2006	BIHO_naip_2006.sid	USDA-FSA-Aerial Photo Field Office (APFO)	Yes
Aerial Mosaic 2009	BIHO_naip_mosaic_09.sid	USDA-FSA-Aerial Photo Field Office (APFO)	Yes

Appendix D: Upland Assessment for BIHO and BEPA.

Forested Uplands – Big Hole Battlefield

The forested areas at BIHO have been classified into habitat types as described in the USFS publication *Forest Habitat Types of Montana*, (Pfister et al. 1977). The area is a representative of the *Pseudotsuga menziesii/Calamagrostis rubescens* habitat type. This site is dominated by the Maciver-Philipsburg-Tiban complex, alluvial fan soils that are loams over a gravelly clay loam and gravelly loam subsurface. These soils formed from alluvium derived from limestone, sandstone and shale. Rooting depth is restricted to 60 inches and the soil is well drained. Four plots were sampled in this habitat type.

Plots, 2, 3, 4 and 6 are all located on footslopes with slopes above them ranging from 15% to 40% and elevations between 6,600 feet and 6,950 feet (Figure 22. Map of forested upland sample plots).

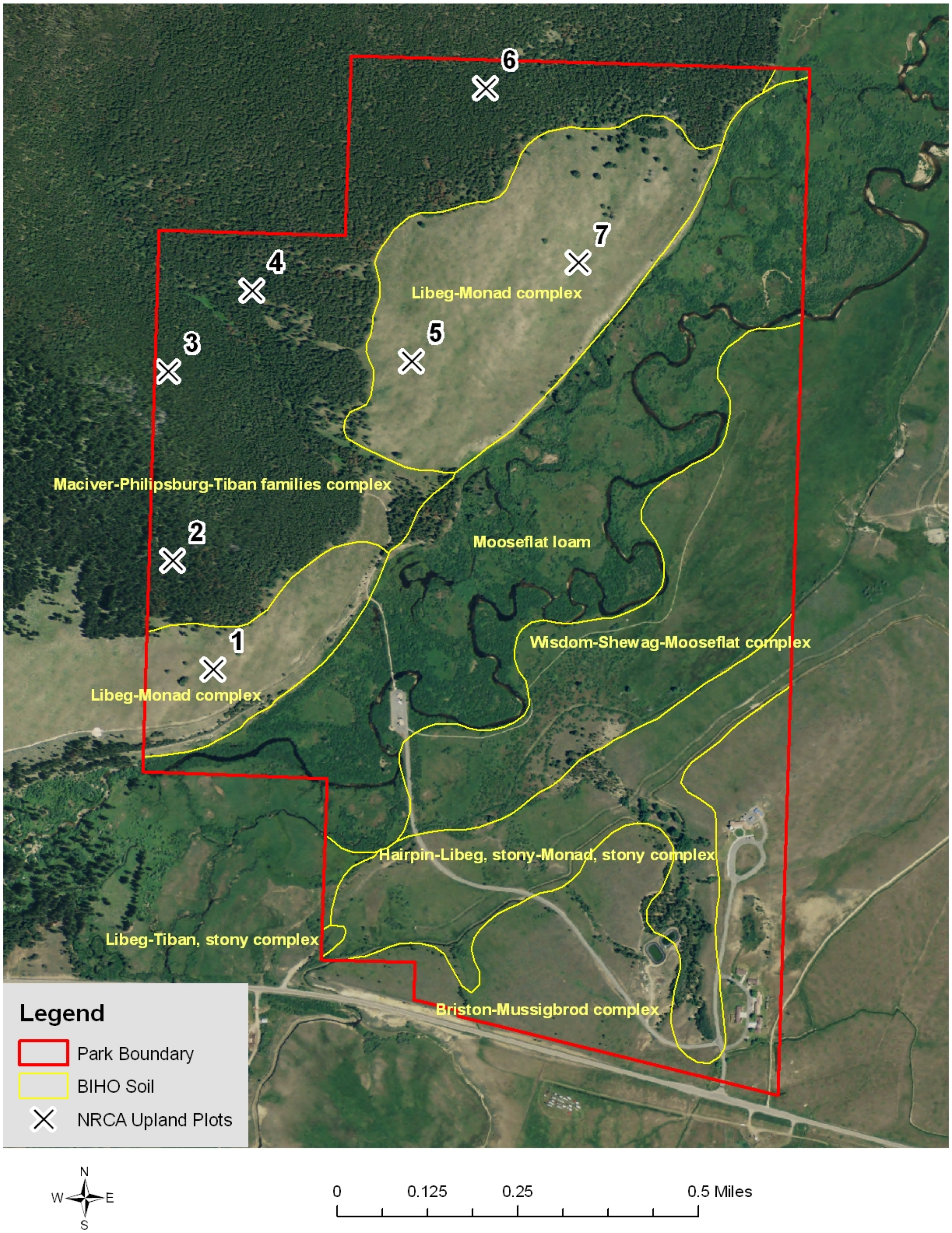

Figure 22. Map of forested upland sample plots 2, 8, 4 and 6, BIHO.

All four plots exhibit similar landscape attribute (soil stability, hydrologic function and biotic integrity) departure values (0%, 0%, and 0%, respectively) (Figure 23). The current vegetation on all plots is dominated by the tree species Douglas fir and lodgepole pine. The shrub component is dominated by mountain snowberry (*Symphoricarpos oreophilus)* and grouse whortleberry *(Vaccinium scoparium).* Pinegrass (*Calamagrostis rubescens*) and Geyer's sedge (*Carex geyeri*) are the predominant grass species. No noxious or invasive species were found during field data collection.

Figure 23. Departure from reference condition of the three landscape attributes in the PSME/pinegrass habitat type, Big Hole forested area (Plot 6 in the background).

Forest Stand Assessment Summary - Big Hole Battlefield

The four forest stands are similar in composition, primarily comprised of lodgepole pine and Douglas-fir. Each stand was sampled with five plots evenly spaced throughout entailing a 28 BAF prism sweep and a 1/100th acre regeneration survey. Each stand had its own assigned plot spacing, based on the size of the stand. The sampled stands were designated 5, 58, 36 and 54 (Figure 24).

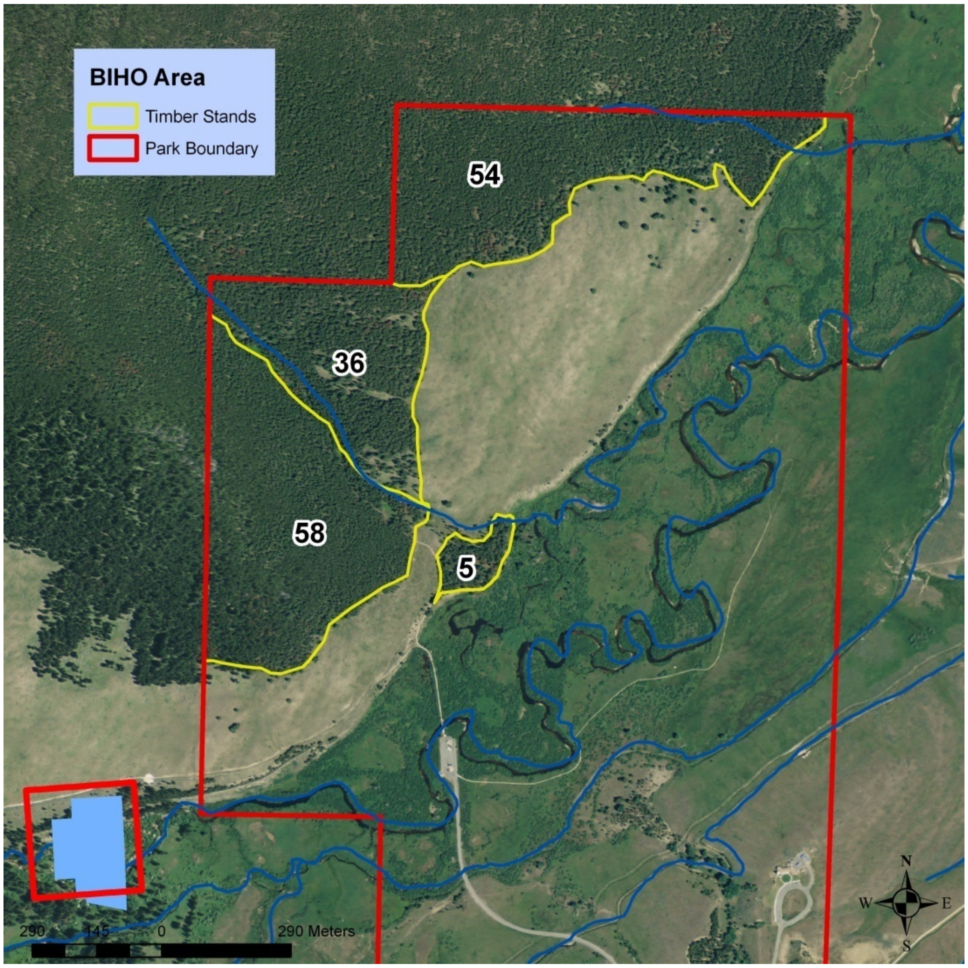

Figure 24. Map of sample stands 5, 36, 54, 58.

All four stands have active pockets of mountain pine beetle (*Dendroctonous ponderosae*) in them. Without treatment or proactive measures taken, it is likely that the majority of the lodgepole pine will become infected resulting in widespread mortality as a result of this insect infestation. Most of the other damage in the trees consisted of forked tops and physical damage from falling trees. This damage is not affecting the health of the trees. Dwarf mistletoe (*Arceuthobium douglasii*) was also noted in the Douglas fir, but the infection is not extensive, occurring only in the eastern portion of stand 54.

Stands 58, 36 and 54 are over stocked with trees which could eventually affect the health of these stands and could pose a high fire risk. The dead and dying trees falling to the ground will create a high fuel load increasing the risk of fire. The distribution of regeneration size trees is very patchy as the stands are essentially closed canopy preventing successful regeneration.

Stand 5

This is the smallest of the stands visited and is most visible to visitors to the park. This stand consists of over 90% lodgepole pine with a few scattered ponderosa pine (*Pinus ponderosa*) and Douglas-fir. The stand is moderately to heavily-stocked with mature lodgepole pine. An estimated 20% to 25% of the lodgepole pines having mountain pine beetle hits on their boles. Some of the trees have died, others showed signs of severe stress from the insects. The forest floor was very clean of litter and appeared to pose no risk for a ground fire or to act as a ladder fuel.

Stand 58

Stand 58 is a moderately to heavily stocked stand dominated by lodgepole pine. There are pockets of Douglas fir, ponderosa pine and Engelmann spruce (*Picea engelmannii*) scattered throughout the stand and make up about 25% of the stand. There are pockets of dead and dying lodgepole pine throughout the stand that have been infected with mountain pine beetle. The hardest hit areas are near the western boundary and along the stand boundary of stand 36. There is some evidence of trees being cut in an attempt to slow the spread of the beetle. It appears this effort was unsuccessful as there were numerous indications of fresh pitch tubes on the trees. An estimated 15% - 20 % of the lodgepole pines show some signs of mountain pine beetle activity.

Stand 36

Stand 36 is moderately stocked with a mix of ponderosa pine, lodgepole pine and Douglas fir. This stand is a much drier site with a south aspect. Many of the lodgepole pines have been attacked by the mountain pine beetle throughout the stand with the hardest hit areas near the north and eastern boundaries. Some of the ponderosa pines have been attacked. Some of the mountain pine beetle-affected trees had been cut and piled. There was also a small amount of mistletoe scattered throughout the Douglas fir in this stand.

Stand 54

This stand is a moderately to heavy stocked stand and predominantly composed of lodgepole pine. This stand has the heaviest infection of mountain pine beetle. An estimated 35% to 40% of the lodgepole pine show some sign of mountain pine beetle infection. Many have recently died and others show signs of stress. Approximately 10% of the affected lodgepole pines have already been cut down but not removed from the stand. The heaviest mountain pine beetle activity is in the eastern half of the stand and along the southern boundary. The Douglas fir throughout the stand is also infected with mistletoe.

Range Uplands – Big Hole Battlefield

The range uplands sampled for this assessment consisted solely of the droughty steep/loamy ecological site, which was sampled at three plot locations. The soils within this ecological site are comprised of the Libeg-Monad complex, 8% to 35%. The following is a summary of the finding so the field assessment**.**

Droughty Steep/Loamy Steep Ecological Sites

The range area is comprised of one ecological site and was sampled with three plots. Two of these sample sites were located on the Horse Pasture (plot 5 and 7) and one was located on the Howitzer Hill (plot 1). The soil type at all three sites is the Libeg-Monad complex, 8% to 35% slopes which is derived from loamy skeletal alluvium and or colluvium. The soils are gravelly loams and loams over the top of very gravelly sandy clay loams and/or gravelly clay loams with a rooting depth up to 60 inches. The soil is naturally well drained. These sites have slopes between 30% and 40% and are at an elevation of 6,400 feet.

The average soil stability and hydrologic function attributes for all the sample plots were rated as none to slight, 0% and 0%, respectively. The average biotic integrity attribute was also rated at none to slight departure (1.0%) and appears to have no livestock grazing (Figure 25).

The current vegetation is dominated by natives with only a trace of spotted knapweed (*Centaurea stoebe*) is present on plot 1. The shrub layer is composed predominantly of mountain big sagebrush (*Artemisia tridentata vaseyana*) with a few mountain snowberry. There is a diverse mix of grasses on all plots dominated by bluebunch wheatgrass (*Agropyron spicatum*) and Idaho fescue. The forb layer is rich and diverse and dominated by arrowleaf balsamroot (*Balsamorhiza sagittata*), foothill arnica (*Arnica fulgens*) and sulphur-flower buckwheat (*Eriogonum umbellatum*).

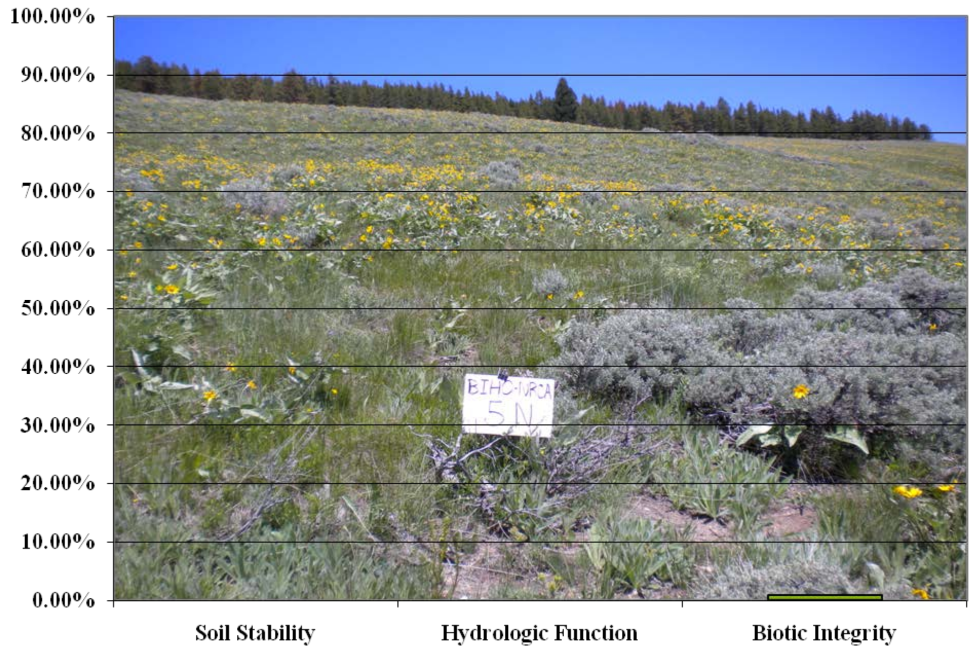

Figure 25. Departure from reference condition of the three landscape attributes in the Loamy Droughty Steep ecological site, Big Hole range area (Plot 5 in the background).

Overflow Site – Bear Paw Battlefield

The Overflow ecological site (R058AC045MT-ecological site code) is comprised of one soil map unit: the Typic Ustifluvents wet soil map unit, and was sampled with two plots (12 and 14). The Typic Ustifluvents wet soils typically occur in areas of infrequent flooding. The soil characteristics and properties as well as the characteristic vegetation have not been described in the literature and could provide additional information for upland resource assessments. Two plots, 12 and 14, were sampled in this ecological site located adjacent to the Snake Creek bottom in the central portion of the park. Both plots have slopes of less that 5% and elevations near 3,000 feet (Figure 26).

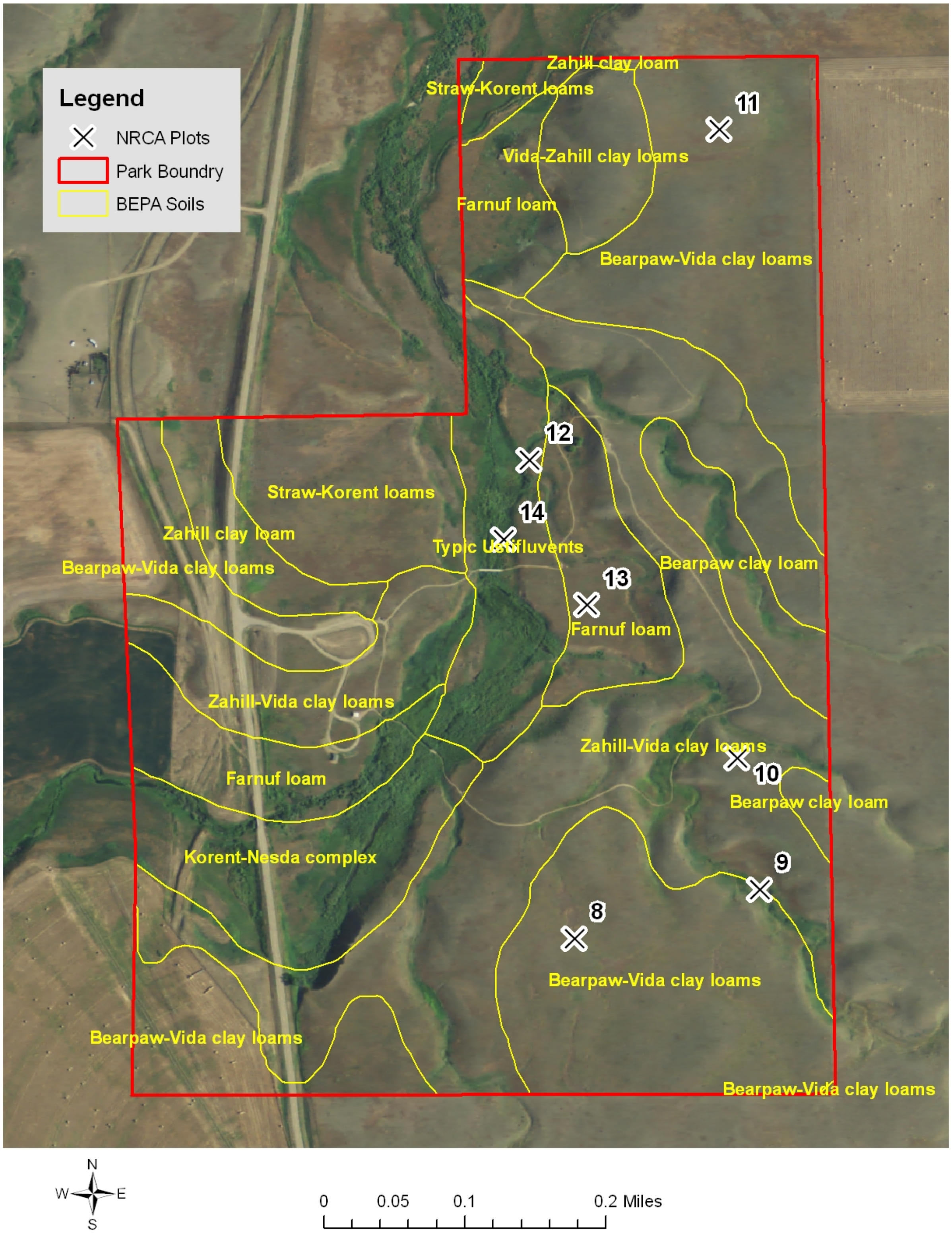

Figure 26. Map of Overflow Ecological Site (Typic Ustifluvents Soil Map Unit), sample plots 12 and 14, BEPA.

Both the average soil stability and hydrologic function attributes for the two sample plots were rated as none to slight, 0.0% and 2.5%, respectively. The average biotic integrity attribute was also rated at none to slight departure (10.0%) and appears to have suffered little impact from past livestock grazing. Both of these percentages would suggest the area is in excellent condition. The average plot landscape attribute values are displayed in Figure 27.

The current vegetation is relatively thick and lush and appears to be healthy with good reproductive success. Only a trace amount, <1%, of the non-native tree species box elder (*Acer negundo)* was found present on the sites. The shrub layer composed entirely of native plants and is predominantly western snowberry (*Symphoricarpos occidentalis*) and narrowleaf willow (*Salix exigua*) with lesser amounts of Woods' rose (*Rosa woodsii* var. *woodsii*) and silver sagebrush (*Artemisia cana*). The grasses are predominantly a mix of the native grass Pumpelly's brome (*Bromus inermis* var. *pumpellianus*) and non-native Kentucky bluegrass (*Poa pratensis*). Other invasive non-native grasses include cheatgrass (*Bromus tectorum*) and field brome (*Bromus japonicus*). There is a diverse mix of forbs in the two plots composed predominantly of native forbs with less than 2% of the cover composed on non-native species.

Figure 27. Departure from reference condition of the three landscape attributes in the Overflow ecological site (Plot 12 in the background).

Thin Clayey 9-15 – Bear Paw Battlefield

The Thin Clayey 9-15 ecological site was sampled with one plot, No. 10 (Figure 25). The soils within the ecological site are the Zahill Vida clay loams occurring on 15% to 25% slopes, are derived from till. The soils have a rooting depth up to 60 inches and are moderate to slow draining. Plot 10 is located in the southwest quadrant of the park on a toeslope with a slope of 15% and an elevation of 3,040 feet.

The soil stability and hydrologic function attributes for the sample plot was rated as none to slight, 0% and 0%, respectively. The average biotic integrity attribute was also rated at none to slight departure (2.9%) and appears to have little or no livestock grazing. The individual plot landscape attribute values are displayed below Figure 28.

The current vegetation is dominated by grass species with a scattering of native shrub species and a diverse and rich mixture of forbs. The grass layer is dominated by the native species threadleaf sedge (*Carex filifolia*), needle and thread grass (*Stipa comata*), prairie Junegrass (*Koeleria macrantha*) and the non- native Kentucky bluegrass. There are numerous forbs species, but the most abundant are Rocky Mountain spikemoss (*Selaginella densa* var. *scopulorum*) and white prairie aster (*Aster falcatus*).

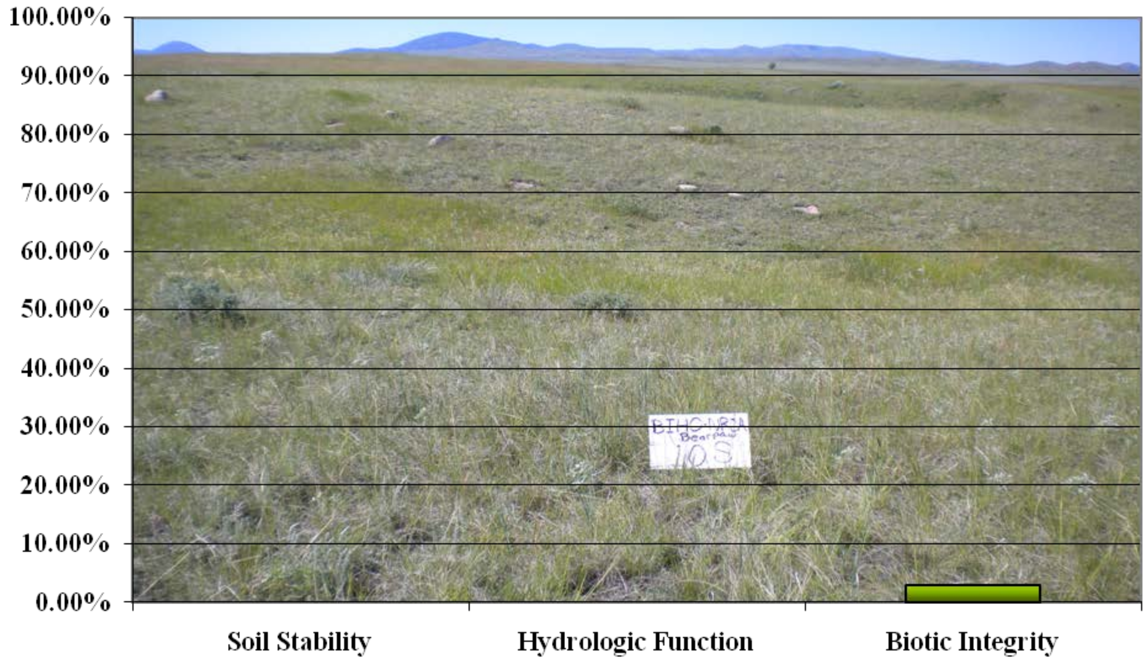

Figure 28. Departure from reference condition of the three landscape attributes in the Thin Clayey 9-15 ecological site (Plot 10 in the background).

Silty 13-19 – Bear Paw Battlefield

The Silty 13-19 ecological site comprised of two soil types within the BEPA, the Bearpaw-Vida clay loams and the Farnuf loams soils, and was sampled with four plots.

Bearpaw-Vida Clay Loams

The Bearpaw-Vida clay loams soil is derived from till. The soils are clay loams along the entire depth of the soil profile and are 39 inches to 60 inches deep. The soils exhibit naturally moderately slow to slow permeability and are well drained. Three plots (plots 8, 9 and 11) were sampled in this ecological site. All three plots had slopes of 4% or less, elevation of 3,035 feet and were located on the valley floor.

The average soil stability and hydrologic function attributes for all three of the sample plots were rated as none to slight, 0.8% and 4.2%, respectively. The average biotic integrity attribute was also rated at none to slight departure (10.0%) and appears to have no livestock grazing. The average plot landscape attribute values are displayed below Figure 29.

The current vegetation has a large component of non-native grasses which contributed to the slightly higher value for the biotic integrity landscape attribute. Kentucky bluegrass covers up to 55% of the three plots sampled. The only native grass with greater than 10% cover is needle and thread grass with the balance of the natives less than 5%. Western snowberry is the most common shrub on these plots.

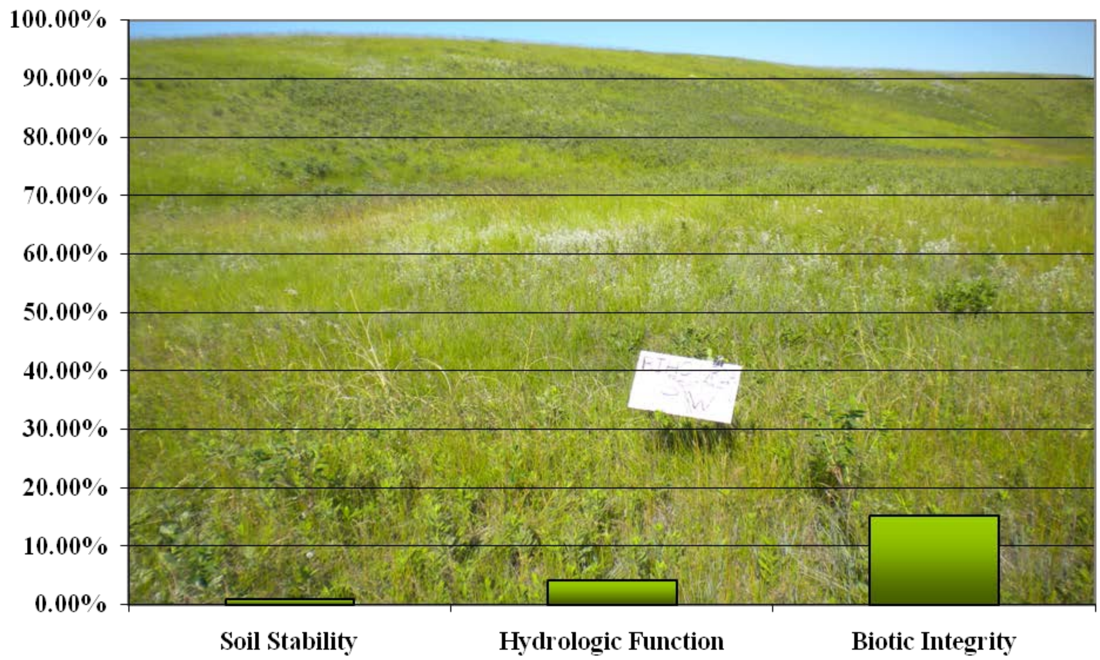

Figure 29. Departure from reference condition of the 3 landscape attributes in the Silty 13-19 ecological site (Plot 9 in the background).

Farnuf Loam – Bear Paw Battlefield

The Farnuf soil derived from alluvium is loam over the top of clay loam with a depth up to 60 inches. The soil is naturally well drained with a moderate permeability. One plot, 13, was sampled in this soil within this ecological site and is located near the center of the park (Figure 27). The site has a slope of 1%, at an elevation of 2,990 feet and in a valley floor topographic position.

The average soil stability and hydrologic function attributes for the sample plot were rated as none to slight, 2.5% and 5.0%, respectively. The average biotic integrity attribute was also rated at none to slight departure (11.4%) and appears to have had only minor livestock grazing in the past. The plot landscape attribute values are displayed in Figure 30.

The current vegetation is grass dominated with only a minor amount of shrubs and forbs present on the site. The grass component is predominantly composed (78%) of non-native grasses, Kentucky bluegrass, field brome and cheatgrass with only 10% of the area composed of the native species western wheatgrass (*Agropyron smithii*). The occurrence of non-native vegetation contributed to the slightly higher biotic integrity attribute rating.

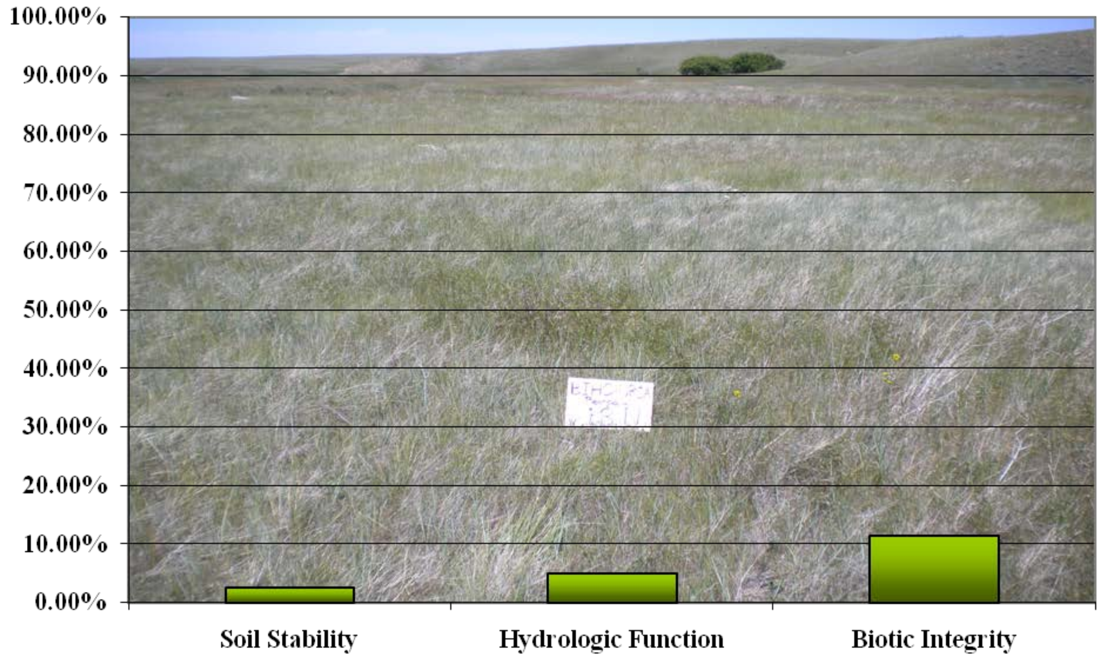

Figure 30. Departure from reference condition of the three landscape attributes in the Silty 13-19" ecological site (Plot 13 in the background).

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