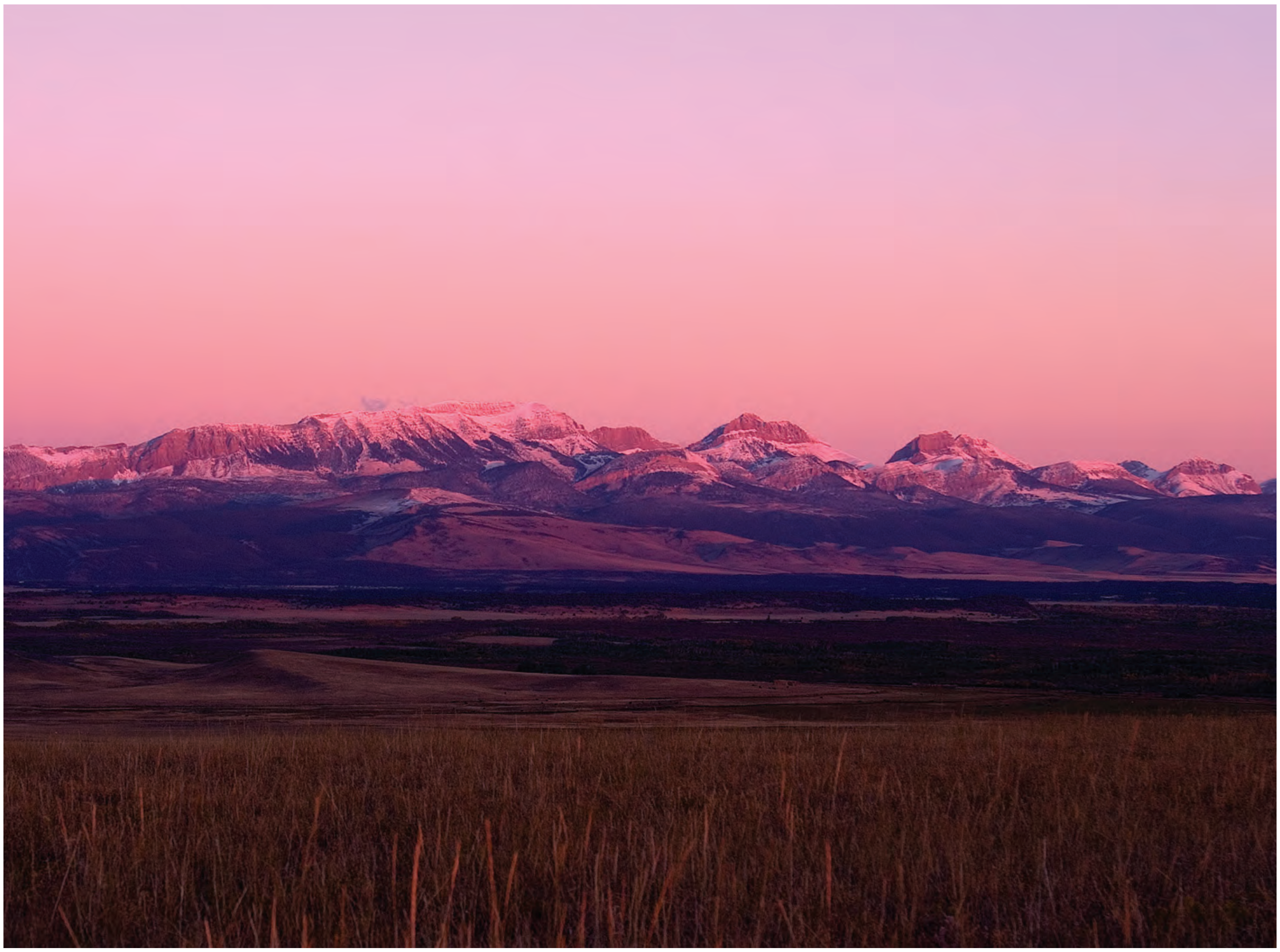
CHAPTER 3–Refuge Resources and Description



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Rocky Mountain Front Conservation Area

This chapter describes the characteristics and resources of the Benton Lake National Wildlife Refuge Complex and how existing or past management or other influences have affected these resources. The affected environment addresses the physical, biological, and social aspects that could be affected by management under this CCP. The Service used published and unpublished data, as noted in the bibliography, to quantify what is known about it.

3.1 Physical Environment

The following sections describe the physical characteristics of the refuge complex. Physical characteristics include climate, climate change, geography and physiography, soils, water resources, water quality, water rights, and air quality.

Climate

The refuge complex covers more than 2,700 square miles and spans the Continental Divide in northwestern and north-central Montana. The Continental Divide exerts a marked influence on the climate of adjacent areas. West of the Divide, the climate might be termed a modified, north Pacific Coast type, while to the east, climatic characteristics are decidedly continental. On the west of the mountain barrier, winters are milder, precipitation is more evenly distributed throughout the year, summers are cooler in general, and winds are lighter than on the eastern side. According to the National Oceanic and Atmospheric Administration (NOAA), there is more cloudiness in the west in all seasons, humidity runs a bit higher, and the growing season is shorter than in the eastern plains areas (NOAA 2011b).

Cold waves, which cover parts of Montana on the average of 6–12 times a winter, are confined mostly to the eastern part of the refuge complex. The coldest temperature ever observed in this area was –70 °F at Rogers Pass, 40 miles northwest of Helena, on January 20, 1954. Between cold waves, there are periods, sometimes longer than 10 days, of mild, but often windy, weather along the eastern slopes of the Divide. These warm, windy winter periods are popularly known as "Chinook" weather. Chinook winds frequently reach speeds of 25–50 miles per hour or more and can persist, with little interruption, for several days. Most refuge complex lakes and wetlands freeze over every winter. All rivers carry floating ice during the late winter or early spring. Few streams freeze solid; water generally continues to flow beneath the ice. During the coldest winters, anchor ice that builds from the bottom of shallow streams on rare occasions causes some flooding (NOAA 2011b).

During the summer months, hot weather occurs often in the eastern parts of the refuge complex. Temperatures higher than 100 °F sometimes occur in the lower elevation areas west of the Continental Divide during the summer, but hot spells are less frequent and of shorter duration than in some sections of the Great Plains. Summer nights are almost invariably cool and pleasant. In the areas with elevations above 4,000 feet, extremely hot weather is almost unknown. Much of the State has average freeze-free periods longer than 130 days, allowing plenty of time for growing a wide variety of crops. There is no freeze-free period in many higher valleys of the western mountains, but hardy and nourishing grasses thrive in such places, producing large amounts of quality grazing for stock (NOAA 2011b).

Precipitation varies widely across the refuge complex and depends largely on topographic influences. Generally, nearly half the annual long-term average total falls from May through June (NOAA 2011a). The western part of the refuge complex is the wettest, and the east side is the driest. Average annual precipitation in the intermountain valleys west of the Continental Divide is 16–22 inches, while most of the eastern part of the refuge complex only receives an average of 8–14 inches (NRIS 2011a).

Drought in its most severe form is practically unknown, but dry years do occur in some areas. All parts of the State rarely suffer from dryness at the same time. The only exceptions on record occurred during the 1930 decade (NOAA 2011a). In eastern parts of the refuge complex, the last 100 years of weather data show a long-term "boom and bust" cycle of 10–20 years of alternating wet and dry periods (NOAA 2009).

Annual snowfall varies from quite heavy—300 inches in some parts of the mountains in the western half of the refuge complex—to around 20 inches east of the Continental Divide. Most of the larger cities have annual snowfall within the 30- to 50-inch range. Most snow falls during the November–March period, but heavy snowstorms can occur as early as mid-September or as late as May 1. Mountain snowpacks in the wetter areas often exceed 100 inches in depth as the annual snow season approaches its end, around April 1–15. The greatest volume of flow in Montana's rivers occurs during the spring and early summer months with the melting of the winter snowpack (NOAA 2011b). Table 4 summarizes precipitation and temperature throughout the refuge complex.

Table 4. Weather information for units of the Benton Lake National Wildlife Refuge Complex, Montana.

Unit	*Average annual precipitation (inches)*	*Highest precipitation months*	*Average snowfall (inches)*	*Average annual temperature (°F)*	*Average low temperature (°F)*	*Average high temperature (°F)*
Benton Lake National Wildlife Refuge (Great Falls)	15	May, June	61	45	33	57
Benton Lake Wetland Management District	6–22	May, June	41–80	39–44	24–33	54–55
Blackfoot Valley Conservation Area (Ovando)	17	May, June	79	39	25	54
Rocky Mountain Front Conservation Area (Augusta)	14	May, June	41	43	29	57
Swan River National Wildlife Refuge and Swan Valley Conservation Area (Seeley Lake)	21	December, January	120	41	27	55

Trumpeter swans are released in the Blackfoot Valley Conservation Area.

Benton Lake National Wildlife Refuge and Benton Lake Wetland Management District

The climate of the district to the east of the Blackfoot Valley and the Rocky Mountain Front is semiarid continental, which is characterized by cold, dry winters and warm, dry summers. Subzero weather normally occurs several times during a winter, but the duration of cold spells typically lasts only several days to a week, after which it can be abruptly terminated by strong southwesterly Chinook winds. The sudden warming associated with these winds can produce temperature rises of nearly 40 °F in less than a day. Conversely, strong intrusions of bitterly cold arctic air move south from Canada several times each winter and can drop temperatures 30–40 °F within 24 hours. The dynamic Chinook winds prohibit the large accumulation of snow over winter and reduce large spring runoffs, because snow melts in small increments throughout winter and is mostly absorbed into the ground.

Average annual precipitation across the district varies from a high of 22 inches near the foothills of the Rocky Mountains and Sweet Grass Hills to a low of 6 inches in the center of the district, around the towns of Shelby and Chester. At Benton Lake Refuge, the average annual precipitation is 14.98 inches. During the period of record at Great Falls, yearly precipitation extremes have ranged from 6.68 inches in 1904 to 25.24 inches in 1975. Precipitation generally falls as snow during the winter, late fall, and early spring, whereas, the highest rainfall months are May and June.

Long-term temperature and precipitation data show dynamic patterns of recurring peaks and lows on a 10–20 year cycle. Regional precipitation decreased and temperatures rose from the late 1910s to the late 1930s (NOAA 2009). A steady rise in precipitation and declining temperatures occurred from the early 1940s to the mid-1950s followed by another decline in precipitation and local runoff in the 1960s. Precipitation rose again during the late 1970s and early 1990s, and remained about average during the 1980s and late 1990s to early 2000s. Currently, precipitation appears to be gradually increasing.

Blackfoot Valley Conservation Area

In the Blackfoot Valley, the climate is generally cool and dry, but there is considerable variability. July and August are the warmest months with an average high around 81 ºF and a low near 40 ºF. On average, the warmest month is July. The highest recorded temperature was 99 °F in 2003. January is the average coldest month. The lowest recorded temperature was –48 °F in 1982.

Rocky Mountain Front Conservation Area

Along the Rocky Mountain Front, the climate is generally cool and dry, but there is considerable variability corresponding to the east–west elevational gradient that greatly influences vegetation and habitat. July and August are the warmest months, with an average high around 77 ºF and a low near 45 ºF. The Augusta climatic station at the eastern boundary of the Front has similar above-freezing winter average highs, but is colder at night, with January having average lows of 10 ºF. Average summer temperatures are also warmer in Augusta, with July and August having highs slightly greater than 80 ºF and lows around 47 ºF. Gibson Dam receives almost 18 inches of precipitation annually. May and June are the wettest months, with about 3 inches per month, and the winter months receive less than 1 inch of precipitation per month. Augusta has a similar pattern with relatively wet springs and dry winters although the total precipitation annually averages only about 14 inches. This precipitation gradient (along with soils) is vital in structuring vegetation communities across the Front (Kudray and Cooper 2006).

Swan River National Wildlife Refuge and Swan Valley Conservation Area

The upper Swan Valley is at the eastern limit of the Pacific maritime climatic influence, common to northern Idaho and northwestern Montana. The Mission Range experiences more of the maritime influence than the Swan Range. The climate is generally cool and dry, with precipitation increasing from south to north in the valley. Precipitation in the form of snow and rain varies between an average of 30 inches on the valley floor to more than 100 inches along the Swan and Mission divides. The highest precipitation usually comes from late October to mid-February and again from mid-May to early July. The highest precipitation intensity occurs when a moist weather front from the Pacific collides with cool continental weather.

Occasionally, cold arctic air from a continental weather system slips over the Continental Divide from the northeast and down the valley, bringing extreme subzero temperatures. Summer temperatures average in the 80s at lower elevations. Extremes of 90–100 °F are reached during drought years. The relatively short growing season (2–3 months) limits widespread agricultural development. Frosts can occur any month of the year. Therefore, conversion of forest types to cultivated crops has been limited relative to other western Montana valleys.

Climate Change

Warming of the global climate is considered by the Intergovernmental Panel on Climate Change (2007) to be unequivocal. Over the last 100 years, the average global temperature has risen 1.3 °F. In the Northern Hemisphere, the temperature rise over the last 50 years is very likely higher than any other 50-year period in the last 500 years. In Montana, average spring temperatures have risen by almost 4 °F over the last 55 years and winter temperatures have increased 3 °F (TNC 2009).

Increases in temperature have been associated with decreases in mountain glacier and snow cover, earlier spring melt, higher runoff, and warmer lakes and rivers. In Montana, precipitation changes have varied across the State. In general, the northern Rockies are now seeing less winter snow while the southeastern plains are receiving slightly more spring and fall rain. However, that added rain is coming in fewer, more severe, storms (TNC 2009).

Climate change adaptation is the emerging discipline that focuses on helping people and natural systems prepare for, and cope with, the effects. Adaptation refers to measures designed to reduce the vulnerability of systems to the effects of climate change (Glick et al. 2011). Efforts generally include (1) building resistance, which is the ability of an ecosystem, species, or population to withstand change without significant ecological loss; (2) building resilience, which is the ability of a system to recover from a disturbance or change without significant loss and return to a given ecological state; and (3) facilitation of ecological transitions. Promoting and supporting resilience is the most commonly recommended approach, but related to the success of this is the ability to reduce existing stressors that would be magnified with climate change, protect refugia and habitat connectivity and implementing proactive management and restoration (Glick et al. 2011).

The refuge complex is part of the GNLCC and the PPPLCC. The LCCs work with a variety of science partners to address existing and future issues related to climate change and landscape-scale conservation. These partnerships have the potential to be major conduits for stepping down global and regional climate change models and helping to target this work to the highest priority needs for land managers and conservation within the refuge complex.

Geology And Physiography

The landscape of the refuge complex is extremely diverse. Elevations across the refuge complex range from as little as 3,000 to more than 10,000 feet above mean sea level (amsl). Changes in elevation are especially significant along the Rocky Mountain Front CA, which encompasses up to 4,000 feet of topographic relief over a few miles. The landscape features vary from large rivers to intermittent prairie streams, small temporary wetlands to large lakes, intermountain valleys to alpine peaks, and prairie grasslands to conifer forests.

The geology that underlies the visible topography within the refuge complex is also diverse. Up until approximately 175 million years ago, the landscape of the modern day complex was fairly uniform. Most of Montana was below sea level and vast areas were shallowly flooded. This changed with the shifting of the tectonic plates that form the earth's crust that led to the collision of the continental plate bearing North America with the floor of the Pacific Ocean. That collision led to the literal crumpling of the continent along deep fault lines. As the earth's surface continued to bulge, it eventually became unstable and the top sedimentary layers peeled off and came to rest to the east, piling on top of each other to form the eastern front of the Rocky Mountains. The mountains in northwest Montana are comprised of the older formations that were exposed when the veneer slipped off.

Around 65 million years ago, the crust beneath central Montana rose sufficiently so that the inland sea retreated. Subsequent to this, volcanic activity led to igneous intrusions into the older, surrounding sedimentary rocks and the formation of the island mountain chains in north-central Montana, including the Sweet Grass Hills. This was followed by a relatively calm geologic period in Montana where crustal movements subsided. Alternating dry and warm, tropical periods from the Oligocene to the Pliocene (35 to 2.5 million years ago) led to the deposition of


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Rocky Mountain Front Conservation Area sedimentary layers, including gravel, sand, mud, volcanic ash, limestone, coal, and laterite.

Today, these earlier sedimentary layers are buried throughout most of the refuge complex by glacial till and debris left by the enormous glaciers that covered northern Montana during the last ice ages. The glaciers had a profound effect on the landscape within the refuge complex by sculpting mountains, changing riverflows and leaving behind many wetlands. The first, and largest, of these recent ice ages was the Bull Lake Ice Age, approximately 70,000–130,000 years ago. This was followed by a less extensive ice age, the Pinedale, approximately 10,000–15,000 years ago (Alt and Hyndman 1986).

Benton Lake National Wildlife Refuge

The Benton Lake basin is characterized by gently dipping sedimentary bedrock formed during the Cretaceous Period (145–65 million years ago) overlain in many places by glacial and alluvial deposits from the last ice ages (Maughan 1961). Bedrock in most of the Benton Lake basin is seleniferous marine shale of the Cretaceous Colorado Group, often referred to as Colorado Shale (Maughan 1961). The ancient sedimentary bedrock that lies beneath the Benton Lake basin is important because of the effect it has on water quality today as a source of selenium.

During the last Pleistocene ice sheet, Glacial Lake Great Falls covered low-lying parts of the Benton Lake region. Glacial lake deposits near Benton Lake are primarily clay and silty clay and are up to 100 feet thick (Lemke 1977). Glacial drift associated with the last ice sheet was deposited northeast of Benton Lake and east of Priest Butte Lakes and formed the closed Benton Lake basin. Glacial drift deposits are primarily glacial till consisting of unsorted and unstratified clay, silt, sand, and some coarser material. Locally, glacial drift may include stratified sand and gravel alluvial deposits (Mudge et al. 1982, Lemke 1977).

The topography of the refuge reflects the dominant geological surfaces and features of the region. Within Benton Lake proper, elevation gradients are relatively subtle, ranging from about 3,614 feet amsl in the lowest depressions in the middle of the historical lakebed to about 3,622 feet amsl on the edge of the lake that defines its full-pool water level.

Benton Lake Wetland Management District

The glaciers that covered the Plains of the district originated in the northeast near Hudson Bay and reached central Montana at the end of the ice ages. Consequently, the glacial imprint on this area is relatively light as glaciers were thinner and present for a relatively brief time. The inland mountain ranges, such as the Sweet Grass Hills, were surrounded, but not covered, by these glaciers. Nevertheless, as the glaciers retreated they left a layer of glacial till and debris covering northern Montana. The classic hummocky landscape left behind by this debris can be seen on the Furnell WPA at the base of the Sweet Grass Hills.

The southern edge of the glaciers approximated the modern-day Missouri River. The edges of the glaciers dammed rivers and created lakes in central Montana. The largest was Glacial Lake Great Falls, which was 600 feet deep in Great Falls and extended all the way to Cut Bank. As Glacial Lake Great Falls rose, it formed a spillway north of the Highwood Mountains washing out a large valley known today as the Shonkin Sag. The repeated flooding and spilling by Glacial Lake Great Falls through the Shonkin Sag left behind several depressions that are now shallow, brackish lakes including those found on the Kingsbury Lake and Big Sag WPAs. Similarly, the Milk River may have been diverted during the last ice age, forming the Sweetgrass Sag and leaving behind depressions that created wetlands on the waterfowl production areas in northern Toole County.

Most of the district lies within the Great Plains, a relatively flat landscape sloping slightly to the east. The area is punctuated by large rivers including the Missouri and Milk and their associated tributaries as well as isolated mountain groups such as the Highwood Mountains and Sweet Grass Hills. The Sweet Grass Hills consist of three distinct buttes with scattered hills connecting them. The three buttes are West Butte (elevation of 6,983 feet), Gold Butte (elevation of 6,512 feet), and East Butte (elevation of 6,958 feet). The three buttes, and the hills between them, run for about 50 miles east to west and are about 10 miles in distance from north to south.

The sedimentary rocks of north-central Montana are also of particular interest because some harbor oil and gas or coal. A large structural warp in the bedrock between Shelby and Cut Bank, known as the Sweetgrass arch, has trapped several oil and gas fields. Crude oil production peaked in 1960 in central Montana but has declined since then, as new discoveries did not keep up with depletion. The Cut Bank Field, Pondera Field west of Conrad, and a large reservoir near Kevin and Sunburst are some of the largest resources, but many of these wells produce only a few barrels per day (Alt and Hyndman 1986).

Blackfoot Valley Conservation Area

The Blackfoot Valley was strongly influenced by large continuous ice sheets that extended from the mountains southward into the Blackfoot and Clearwater River Valleys (Witkind and Weber 1982) during the Bull Lake and Pinedale ice ages. When the glaciers receded, large deposits of glacial till, glacial outwash, and glacial lakebed sediments were left behind. These deposits cover much of the Blackfoot Valley floor, shaping the topography of the valley and the geomorphology of the Blackfoot River and the lower reaches of most tributaries. Glacial features evident on the landscape today include moraines, outwash plains, kame terraces, and glacial potholes (Whipple et al. 1987, Cox et al. 1998). The Blackfoot and Kleinschmidt Lake WPAs, in particular, reflect this glacial influence in the pothole wetlands present on these parcels. The landscape between Clearwater Junction and Lincoln is characterized by alternating areas of glacial moraines and their associated outwash plains. In this area, ice pouring down from the mountains to the north spread out to form large ponds of ice several miles across, known as piedmont glaciers. Muddy meltwater draining from these piedmont glaciers spread sand and gravel across the ice-free parts of the valley floor to create large outwash plains. The town of Ovando sits on one of these smooth outwash plains (Alt and Hyndman 1986). In addition, during the latter part of the Pleistocene Era, the Blackfoot Valley was further shaped by the repeated filling and catastrophic draining of Glacial Lake Missoula, which extended upstream as far as Clearwater Junction (Alt and Hyndman 1986).

The Blackfoot River watershed totals nearly 1.5 million acres. The 132-mile-long Blackfoot River drains 2,320 square miles and hosts a 3,700-mile stream network. The headwaters of the Blackfoot begin atop Roger's Pass at the Continental Divide and flow west to its confluence with the Clark Fork River near Missoula. The Blackfoot Valley floodplain varies in width from several hundred feet to several miles and has many tributaries. Historically, the river meandered back and forth across the valley floor. The remnants of these old oxbows formed the wetland basins managed today on the H2–O WPA.

Rocky Mountain Front Conservation Area

The highest-elevation landforms are located in the most western section of the Front and are Paleozoic Era sedimentary rock composed of sandstone, shale, and limestone (including dolomite). These relatively hard materials kept their shape during formation and are not as prone to erosion. The Kootenai Formation from the Mesozoic Era is found adjacent at lower elevations and is also sedimentary rock but is composed of conglomerate, sandstone, shale, and mudstone. These materials formed tight folds and are prone to erosion, resulting in low hills that look more like the Plains to the east than the craggy mountains to the west. The Colorado Shale Formation of shale and siltstone is typically found at the next lowest topographic level. At lower elevations, alluvial deposits are common, with layers of gravel, sand, and silt. There are also significant low-elevation glacial deposits from the Pleistocene Age that have variable, mostly coarse, textures. These have left behind hummocky pothole wetlands in some areas. The Two Medicine Formation from the Cretaceous Era is one of the most common lower elevation types and is sedimentary, with clay, limestone, and sandstone. There is also a prominent area of Cretaceous volcanic rock in the far southern part of the Front (Kudray and Cooper 2006).

The Rocky Mountain Front in Montana transitions from eastern foothill grasslands, between 3,500 and 5,500 feet in elevation, to mountain peaks at nearly 9,000 feet in elevation. The area is drained by several rivers, including the Sun, Teton, and Marias, which eventually drain into the Missouri River.

Although, geologically speaking, the Front has the potential for oil and gas reserves, the complexity of the formation suggests that any fields are likely to be small (Alt and Hyndman 1986).

Swan River National Wildlife Refuge and Swan Valley Conservation Area

During the shifting of tectonic plates that led to the formation of the Rocky Mountains, the Swan Valley was created along a fault when a large block of rock was pushed up on the east side of the valley, forming the Swan Range, and the west side of the fault dipped down, forming the Mission Range. The general direction of the faulting was northwest to southeast, with the mountain ranges tilted in an easterly direction. This faulting history generally left steeper and more rugged mountains in the Swan Range. Both the Mission Range and the Swan Range are Precambrian sedimentary formations.

Further alteration of the geological landscape in the Swan Valley resulted from the Bull Lake Ice Age when the northern end of the Mission Range split a glacier, which flowed south from British Columbia. One lobe of the glacier went through the Swan Valley south to the Blackfoot River, forming a continuous sheet over the mountains, especially the northern part of the Mission Range. Only the highest peaks and ridges remained uncovered.

Ice again advanced through the valley to the lower end of Salmon Lake during the Pinedale Ice Age. Additionally, long tongues of ice thrust out of the mountains into the valley, depositing moraines at their edges. The last fingers of ice formed the high ridges or high moraines that now enclose glacial lakes such as Holland and Lindbergh Lakes, as well as others at the mouths of canyons in the Mission Range and Swan Range. As the valley glacier melted, dirt and debris were left behind. Large piles of these sediments remained as humps on the valley floor or were pushed into ridges or eskers as the glaciers moved. In other areas, pockets of ice were left behind. When they melted, they left depressions that became lakes, ponds, potholes, or wetlands. This complex of wetlands intermingled with upland terrain is unique (Swan Ecosystem Center 2004).

The Swan River basin, a tributary to Flathead Lake and the Flathead River in the headwaters of the Columbia River, is around 1,286 square miles in area. A wide diversity of lakes, riparian areas, rivers, creeks, alpine and subalpine glacial lakes, and springs feed the basin (Friessell et al. 1995). The Swan and Mission Ranges reach peak elevations higher than 9,000 feet. The Swan River flows through these mountains, winds across the morainal foothills and through valleys forming braided delta areas. The river travels over a dense forest floor comprised of variously graded, porous glacial till and alluvium, averaging 6.2 miles wide at an elevational range of 2,500–9,000 feet. (Friessell et al. 1995). Several large lakes (250 to 2,700 acres) lie along the course of the river and its main tributaries. Hundreds of kettle lakes, fens, bogs, and other lake-like systems and small, shallow and vegetated wetlands, many with perched aquifers not directly connected to surface streams, lie scattered across the glacial and alluvial valley floors and foothills (Frissell et al. 1995). Forested riverine and small, shallow and vegetated wetlands fringe the river channel and dominate its extensive floodplains and relict paleochannels (an ancient inactive stream channel filled by the sediments of younger overlying rock).

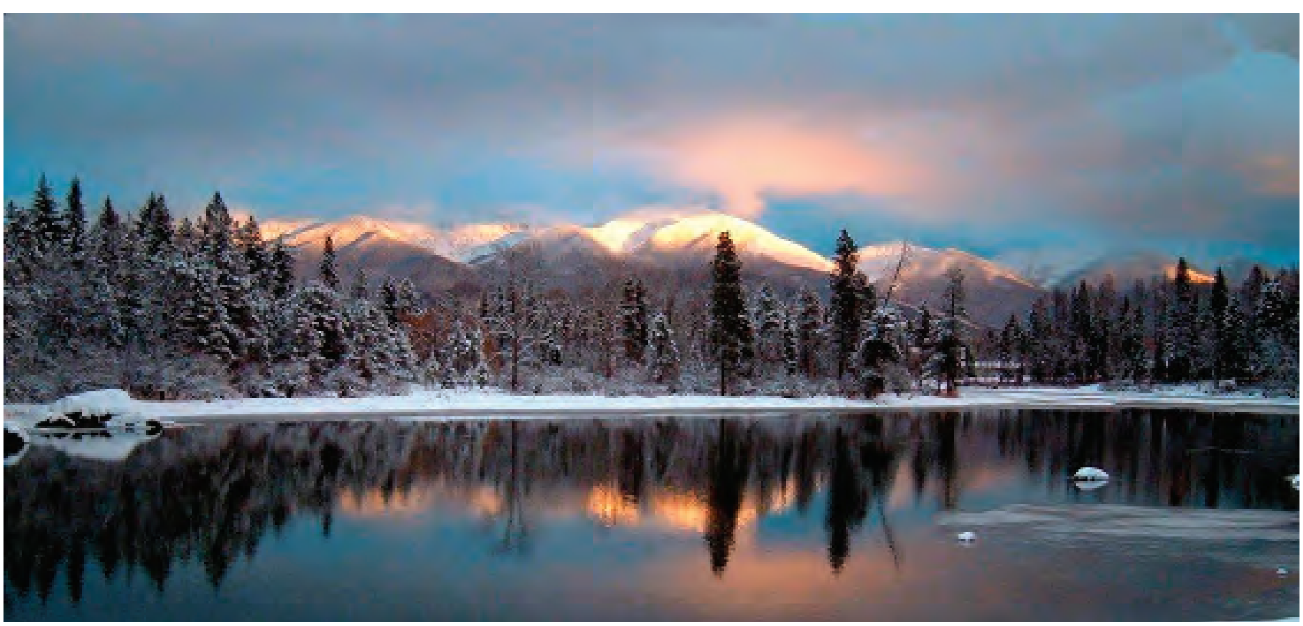
The Swan River Refuge lies within the floodplain of the Swan River on the southern edge of Swan Lake between the Swan Mountain Range to the east and the Mission Mountain Range to the west. The valley floor is generally flat but rises steeply to adjacent forested mountain sides. Eighty percent of the floodplain is comprised of wetlands and the other 20 percent consists of forests of old growth fir, spruce, cedar, and larch. The Swan River, which once meandered through the floodplain, has been forced to the west side of the refuge by deposits of silt, leaving a series of oxbow sloughs within the refuge floodplain.

Soils

Soils in the refuge complex are extremely variable due to the diverse influences of climate, topography, and geology. In general, the soils are strongly related to the geologic substrates and landforms. The State soil geographic database provides a consistent method of assessing generalized soil characteristics on a regional scale (NRCS 2006). This has been used in conjunction with the Ecoregions of Montana (Woods et al. 2002) to provide a generalized description of the common soil characteristics within the refuge complex. More detailed soils data are available from the county soil survey geographic databases that will be used as stepdown management plans are developed for individual units. Information on the soil geographic databases is available from the USDA Natural Resources Conservation Service (NRCS) (NRCS 2011c).

Benton Lake National Wildlife Refuge

Surface soils are predominantly clays and silty clays (Vertisols) deposited in the lake-system environ-



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Swan River

ments of Glacial Lake Great Falls and Benton Lake. The Benton Lake bed and surrounding lower elevations are mostly plastic clays and exceed 100 feet deep under parts of Benton Lake. These are Pendroy, Thebo Vanda, and Marvan clays (NRCS 2011c). Where Lake Creek enters Benton Lake, soils are mostly silt and sand with minor clay and gravel present in soil stratigraphy. These soils range from 10 to 40 feet thick where they become intermixed with underlying lake-system-type deposits. Higher elevation terrace-type soils along the western and southern edges of Benton Lake are mostly 10 to 30-feet-thick silty clay loam types overlying reddish-brown, poorly sorted sand and gravel dominated by subangular-to-slabby sandstone and subrounded quartzite, shale, granite, and argillite (Maughan and Lemke 1991). Some of these surfaces have interesting, stratified soils indicating various depositions from historical marine environments, Lake Great Falls, and underlying Colorado Shale (Condon 2000).

Benton Lake Wetland Management District

The materials left by the glaciers during the last ice ages are the most widely distributed parent material of soils in the district today. The thickness of these deposits varies widely from more than 100 feet deep in preglacial valleys and depressions to very thin on higher divides and benches. Mollisols—dark, base-rich mineral soils typically formed under perennial grasses—cover much of the area (NRCS 2011a). Common mollisol soils series include Scobey, Telstad, Vida, Joplin, Bearpaw, and Kevin, which are very deep, well drained soils formed in glacial till across the Plains, and in the case of Kevin soils, are typical of glacial moraines and hummocky areas (Woods et al. 2002, NRCS 2011b). Native vegetation on these soils is typically western wheatgrass–needlegrass (Woods et al. 2002). In areas where there are steep, actively eroding slopes, floodplains, or glacial outwash plains, Entisols are common (Woods et al. 2002). Entisols show little or no soil horizons as deposition or erosion rates are often faster than soil development (NRCS 2011a). The Hillon soil series is found on several waterfowl production areas and is a common Entisol across the district (Woods et al. 2002, NRCS 2011b). The third common soil order in the northern glaciated plains is vertisols. Vertisols are clayey soils that have deep, wide cracks for some time during the year. Vertisols generally have gentle slopes and are associated with grass cover (NRCS 2011a). The Pendroy series are common vertisols in the district (Woods et al. 2002). The Pendroy series consists of deep, well drained soils formed in clayey glacial river or lake material or in alluvium from shale uplands (NRCS 2011b). These soils are on alluvial fans, floodplains, stream terraces, and lake plains. Because the permeability of these soils is slow, irrigation can result in the buildup of salinity and nearly all mature soils in the area carry a constituent of alkali salts (Gieseker et al. 1933).

Blackfoot Valley Conservation Area

The floor of the Blackfoot Valley was shaped by the glaciers and is characterized by hummocky moraines, outwash plains, terraces, fans, poorly developed drainage networks, and many wetlands (Woods et al. 2002). Most soil types present in the watershed have similar surface textures, are moderately well to well drained, and have a depth to water table between 3 and 6 feet. These dominant soils are neither prime farmland nor hydric soils supporting wetlands. Fescue grasslands within the valley are commonly underlain by Mollisols soils including Quigley, Perma, Raynesford, Leavitt, Burnette, and Winspect (Woods et al. 2002). These soils are very deep, well drained and were formed by alluvium, colluvium, alpine till, or slide deposits derived from limestone, shale, sandstone, limestone and calcareous sedimentary rock. They are typically found on alluvial fans, stream terraces, hills, outwash plains, and moraines (NRCS 2011b). In areas that support timber, such as ponderosa pine and Douglas-fir, Inceptisol series such as Totelake and Winfall are common (Woods et al. 2002). These soils are very deep, well drained and formed either by glacial outwash (Totelake) or loamy till (Winfall). The Totelake soils are found on alluvial fans and stream terraces whereas the Winfall soils are found on moraines and mountains (NRCS 2011b).

Rocky Mountain Front Conservation Area

At the foot slopes of the Rocky Mountains and the smaller mountain chains, such as the Sweet Grass Hills, Mollisols, and Entisols are the prevalent soil orders. Within these, there is a wide variety of common soils series. Mollisols soil types that support western wheatgrass–needlegrass prairies include Farnuf, Fairfield, Delpoint, Marmarth, Reeder, and Regent (Woods et al. 2002). These are very-deep to moderately deep, well-drained soils formed from either glacial deposits (Farnuf, Fairfield, Delpoint) or weathered sedimentary materials like sandstone, siltstone, mudstone or shale (Marmarth, Reeder, Regent) (NRCS 2011b). Fescue grasslands are commonly found on Mollisols series such as Castner, Work, Absarokee, Michelson, and Redchief. These are shallow to very-deep, well-drained soils formed from alluvium or colluvium over bedrock, or, in case of Redchief soils, from glacial deposits. Redchief soils can also support scattered lodgepole, aspen and alpine fir as elevations increase (NRCS 2011b). Entisols soil series common to the Front include Cabbart and Cabba (Woods et al. 2002). Both are shallow, well-drained soils from semiconsolidated, loamy sedimentary beds. Found on escarpments, hills, and sedimentary plains, they typically support wheatgrass–needlegrass prairies (NRCS 2011b).

Swan River National Wildlife Refuge and Swan Valley Conservation Area

Soils in the Swan Valley range from steep mountain formations that are minimally developed and consist mainly of bedrock of various belt supergroup formations to the deep fertile soils of the valley floor consisting of recent alluvium along the floodplains.

Valley soils consist of glacial moraine, outwash, lakebeds, or other sediments associated with the last glacial activity and its associated lake and flood sediments. Parent materials are sands, silts, and gravels underlain by siltstones or glacial deposits. The valley floor is generally flat with slopes from 2 to 20 percent. Steep slopes occur at the front edge of some terraces. Soils in the valley bottom consist of two broad types. One is rocky and poorly drained and is underlain by unsorted glacial till. These soils generally support timber production. The second consists of deep, well-drained, and well-structured silty substrate with thick, dark nutrient-rich surface horizons up to 1 foot thick.

The soils of the Swan River Refuge were largely formed by the Swan River moving back and forth across the floodplain over time. Nearly 30 percent are Aquepts formed by alluvium deposited in the floodplain. The soils in the valley bottom are gravelly or silty loams that typically support shrub and forest vegetation. The edges of the refuge that transition from the floodplain to the forested uplands are Andeptic Cryoboralfs formed by glacial till and also typically support forested vegetation (NRCS 2011c).

Water Resources

Water resources for the refuge complex consist of precipitation, runoff, ground water flows, and established water rights. On fee-title lands within the refuge complex, just more than half of the approximately 12,000 acres of wetlands are subject to natural flooding and drying cycles. In Montana, precipitation is cyclical, causing a series of wet and dry years, often in 10–20 year cycles (Hansen et al. 1995, Heitmeyer et al. 2009). Therefore, whether or not most of those wetlands are flooded or dry in any given year depends on natural climatic cycles. For the remaining wetlands, water resources may be augmented by water rights tied to diversions from streams, irrigation return flows and impoundments.

Benton Lake National Wildlife Refuge

Benton Lake lies within a closed basin where natural water inputs to the lake come primarily—an average of 65–70 percent—from the 137-square mile Lake Creek watershed. Lake Creek, the largest tributary to Benton Lake, is an intermittent, ephemeral stream with greatest flows during spring and early summer due to snowmelt and increased spring rains. Although ground water discharge maintains a small base flow in Lake Creek and some of its tributaries during spring and fall and, sometimes, in wet summers, most ground water discharged to seeps and tributaries does not reach Benton Lake (Nimick 1997).

Natural runoff from Lake Creek into Benton Lake is strongly correlated with seasonal and annual precipitation in the region. During periods of greater regional precipitation and snowmelt runoff, water flowing from Lake Creek can create very high water levels. Typically, regional precipitation and runoff decline for several years following precipitation peaks, and annual water levels in Benton Lake gradually decline to lower levels due to evapotranspiration, which averages about 40-41 inches per year (Soil Conservation Service 1970). Consequently, water levels in the Benton Lake basin can be highly dynamic, and inputs from natural sources exhibit a strong seasonal pattern of increased inputs and rising water levels in spring and early summer followed by gradual declines during summer and fall.

Other natural water inputs are derived from onsite precipitation and runoff from several small local drainages and surrounding uplands. Outflows are minimal due to the thick lacustrine-type clay surfaces in Benton Lake that prohibit water movement, or recharge, from the lake into ground water (Nimick et al. 1996, Nimick 1997). Other ground water in the Benton Lake basin appears to move slowly to the east and discharges to some shallow wetland depressions between Benton Lake and the Missouri River (Nimick 1997).

In 1957 the Cascade County Wildlife Association prompted a major effort to construct pumping and water delivery structures from Muddy Creek to the refuge. A pump station and pipeline were constructed from 1958 to 1962 to send irrigation return flow in Muddy Creek from the central and northeast parts of the Greenfields Bench to the refuge. In 1961, full-time Service staff were assigned to, and housed on, the refuge. The first water pumped to Benton Lake from Muddy Creek occurred in 1962. Water from the Muddy Creek pump station is moved 4 miles through an underground pipeline over a low-drainage divide and then is discharged into the natural Lake Creek channel where it flows for about 12 miles to its mouth in Benton Lake. Pumping from Muddy Creek corresponds to times of irrigation return flow in the Greenfields irrigation system, which is generally from May until mid-October. The refuge has rights for up to 14,600 acre-feet of water from Muddy Creek each year depending on adequate flows in the creek (Palawski and Martin 1991). Water from Muddy Creek is free, but the refuge must pay electrical costs for the two 350-horsepower pumps and one 250-horsepower pump.

Benton Lake Wetland Management District, Blackfoot Valley Conservation Area, and Rocky Mountain Front Conservation Area

Within the 10-county district, there are approximately 500,000 acres of wetlands (MNHP 2010b). Areas with particularly high densities include the Rocky Mountain Front, the Sweet Grass Hills, and the Blackfoot Valley. In the Blackfoot Valley, wetland densities exceed 100 basins per square mile.

The Service currently holds conservation, grassland, and wetland easements on 132,858 acres of land in the district. Wetlands associated with lands in all of these easement programs are protected. The Service is currently conducting landscape-level analysis to rank wetland resources based on their importance to breeding waterfowl, which may be expanded to other priority wetland-dependent birds in the future. This prioritization will help identify the highest priority wetland resources in the district.

Currently, there are approximately 4,300 acres of wetlands protected and managed on waterfowl production areas within the district (MNHP 2010b). Roughly one-third of these wetland acres are permanent or semipermanent, one-third are seasonal and the remaining third are temporary (MNHP 2010b). Most of these wetlands receive water primarily through precipitation and runoff from snow or rain events. The catchment area for most waterfowl production area wetlands is generally small and limited to the area immediately surrounding the basin. One exception is Kingsbury Lake WPA, where the main wetland basin receives runoff from the nearby Highwood Mountains via Alder Creek.

On approximately 400 acres of waterfowl production area wetlands, the basins have been impounded to hold precipitation and runoff higher or longer than would otherwise occur, thus extending the period of flooding. These include some or all of the wetlands on the Blackfoot, Hartelius, Arod Lakes, Kingsbury Lake, and Sands and Furnell WPAs. On the H2–O WPA in the Blackfoot Valley, water is diverted from the Blackfoot River to flood oxbow wetlands on the waterfowl production area.

H2–O WPA

The H2–O WPA is located next to the Blackfoot River and near the mouth of Nevada Creek. The 630-acre parcel south of the Blackfoot River supports 35 wetlands totaling approximately 229 acres within and immediately next to the property. The Montana Department of Natural Resources and Conservation described the hydrology of the H2–O in 2005 based on 2 years of monitoring on the waterfowl production area (Roberts and Levens 2005). Inflows into the H2–O are supplied by surface water (McCormick ditch), shallow ground water, and precipitation. Outflows were made up of evapotranspiration, and surface and ground water returns to the Blackfoot River and Nevada Creek.

Water is delivered to the wetlands by an irrigation ditch that conveys water from a head gate located 1.1 miles below the Highway 141 crossing on the Blackfoot River, through four neighboring properties, to the H2–O WPA. The ditch, referred to as the McCormick ditch, enters the waterfowl production area in two locations. After traveling 3.24 miles in a southwestern direction the ditch splits, sending water 0.95 miles west to the H2–O WPA near Pond #4. The other branch of McCormick ditch flows 1.95 miles south before entering the eastern edge of the waterfowl production area near Alkali Lake. The total water right in the ditch for all users is 122.5 cubic feet per second (cfs). The H2–O WPA part of this is 75 cfs. The Service currently supports the ditch. The percent of water diverted from the Blackfoot River that actually reaches the H2–O ranges from 6 percent to more than 200 percent. The wide range in values is due to adjacent irrigation. For example, when the McCormick turnout is pulling water from the ditch, the deliverable part is much lower. Conversely, on those days when the McCormick turnout is not pulling water, and there is substantial tail water runoff from adjacent flood irrigation, the deliverable part exceeds 100 percent (ditch is gaining).

Swan River National Wildlife Refuge and Swan Valley Conservation Area

Within the refuge, wetlands are mostly meandered loops of the Swan River that have been cut off from the main channel. Under natural conditions, floodwater and ground water would be the dominant inputs. Currently, the hydrology of the refuge is not well understood. It is possible that there have been significant modifications to the water resources that are hidden by thick vegetation. A detailed hydrogeomorphic analysis of the refuge would help to understand and manage the hydrology more effectively.

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White-tailed Jackrabbit

Water Quality

A comprehensive evaluation of water quality across the refuge complex has not been conducted. Given the significant land use changes in parts of the refuge complex (for example, conversion of grasslands to agriculture in the district) water quality problems may be undiscovered.

Benton Lake National Wildlife Refuge

In the late 1980s, it was discovered that the refuge had concentrations of selenium in water, bottom sediment, and biota that were moderately to considerably higher than regional background values or reference concentrations associated with biological risk (Knapton et al. 1988). Since that time, much work has been undertaken to understand and characterize the selenium contamination issues at Benton Lake Refuge (Nimick et al. 1996; USFWS 1991; Zhang and Moore 1997; Henney et al. 2000; unpublished data on file at Benton Lake Refuge 2006, 2008, 2011). Concerns have focused on reducing the selenium levels on the refuge and in the Lake Creek watershed to prevent concentrations that would cause reproductive failure in sensitive birds.

Selenium (Se) is a semimetallic trace element that is an essential nutrient for animals. However, there is a very narrow margin between nutritionally optimal and potentially toxic dietary exposure for vertebrates. Based on the known margins of safety between normal and toxic dietary exposures, selenium is more poisonous than either arsenic or mercury (DOI 1998). Relatively small increases in the dietary exposure of animals is potentially harmful. A general rule of thumb for selenium is that thresholds for adverse effects in vertebrate animals begin at concentrations less than ten times above normal, although immunotoxic effects have been documented at concentrations less than 5 times above normal levels. Reproduction in vertebrates is particularly sensitive to selenium toxicity, especially in egg-laying vertebrates such as birds (DOI 1998). Birds are also vulnerable because selenium bioaccumulates through the food chain (Lemly 1995, 2002).

The underlying geology, land use changes in the landscape surrounding the refuge, and alterations to natural hydrology (water source, timing, and duration of flooding) have all contributed to the increased selenium levels on the refuge (Lemly and Smith 1987, Lambing et al. 1994, Nimick et al. 1996). Bedrock in most of the Benton Lake basin is seleniferous marine shale of the Cretaceous Colorado Group, often referred to as Colorado Shale (Maughan 1961). Selenium in these formations is highly mobile and biologically available in arid regions with alkaline soils, as is the case in much of north-central Montana.

The crop–fallow method of wheat farming occurring around the refuge is the primary contributor to saline seep development in the Lake Creek watershed. Seeps are formed during fallow periods when precipitation exceeds the storage capacity of the soil. Excess water percolates through salt-laden soil layers, dissolving salts and eventually forming a saline water table above a deeper, impermeable layer, such as shale. The saline water then moves horizontally downslope until it discharges at the surface, where it evaporates and concentrates salts, including selenite (Se4+) and selenate (Se+6), in the immediate area (Brown et al. 1982). Runoff that flows through these areas in the watershed washes selenium and other concentrated salts into Benton Lake at the bottom of the watershed, where it accumulates (figure 12).

Construction of the multiple units and the introduction of Muddy Creek water via pumping has also increased total selenium accumulation on the refuge (Zhang and Moore 1997, Heitmeyer et al. 2009). Before 1961, Benton Lake was one large wetland and no water was pumped into the basin. In most years, pooled water from spring runoff was lost to evaporation during the following summer. Selenium concentration in pre-1961 sediment collected in cores from the Unit 3 inlet area was approximately 0.2–0.3

micrograms per gram. This low concentration of selenium in older sediment suggests that equilibrium concentrations were very low before the construction of the unit system.

After the unit system was constructed in 1961 and Muddy Creek water was pumped into the refuge, inputs of selenium increased and outputs decreased. The pounds of selenium that enter the refuge annually in natural runoff and pumped water is highly variable among years (table 5). From 1970–2010, the total selenium load in the refuge from natural runoff was around 3,785 pounds. Pumping from Muddy Creek added another 2,417 pounds.

Although selenium is transported to the refuge in the surface and ground water that flows to the refuge, almost all of the selenium that enters the refuge accumulates in wetland sediment. Selenium is not evenly distributed among or within the units, but rather accumulates more rapidly near the locations of primary selenium inputs and more permanently flooded units (Zhang and Moore 1997). In general, selenium concentrations in sediments are highest where Lake Creek enters Unit 1 and 2 and in Unit 4c near a large seep. The remaining units in the refuge receive less selenium inputs, because they are further from the mouth of Lake Creek (Knapton et al. 1988, Nimick et al. 1996, Zhang and Moore 1997).

The natural dry cycle, which is important for removing selenium from the system, also has been significantly reduced since pumping began. Selenium is removed from the refuge primarily by transferring directly to the air from water or sediment (volatilization). The rate of selenium volatilization depends on the form of selenium, microbial activity, and various environmental conditions, but is much higher from exposed sediment than open water (Zhang and Moore 1997). Selenium now enters the refuge in Unit 1, which is rarely dried. Consequently, the average selenium concentration in sediment there is 2.7 micrograms per gram, with some values reaching above the toxic threshold of 4 micrograms per gram.

High salinity was once a concern. However, a review of long-term salinity data on the refuge found that, while salinity may increase within a season as wetlands dry, there were no detectable increasing trends over a 10-year period (Nimick 1997).

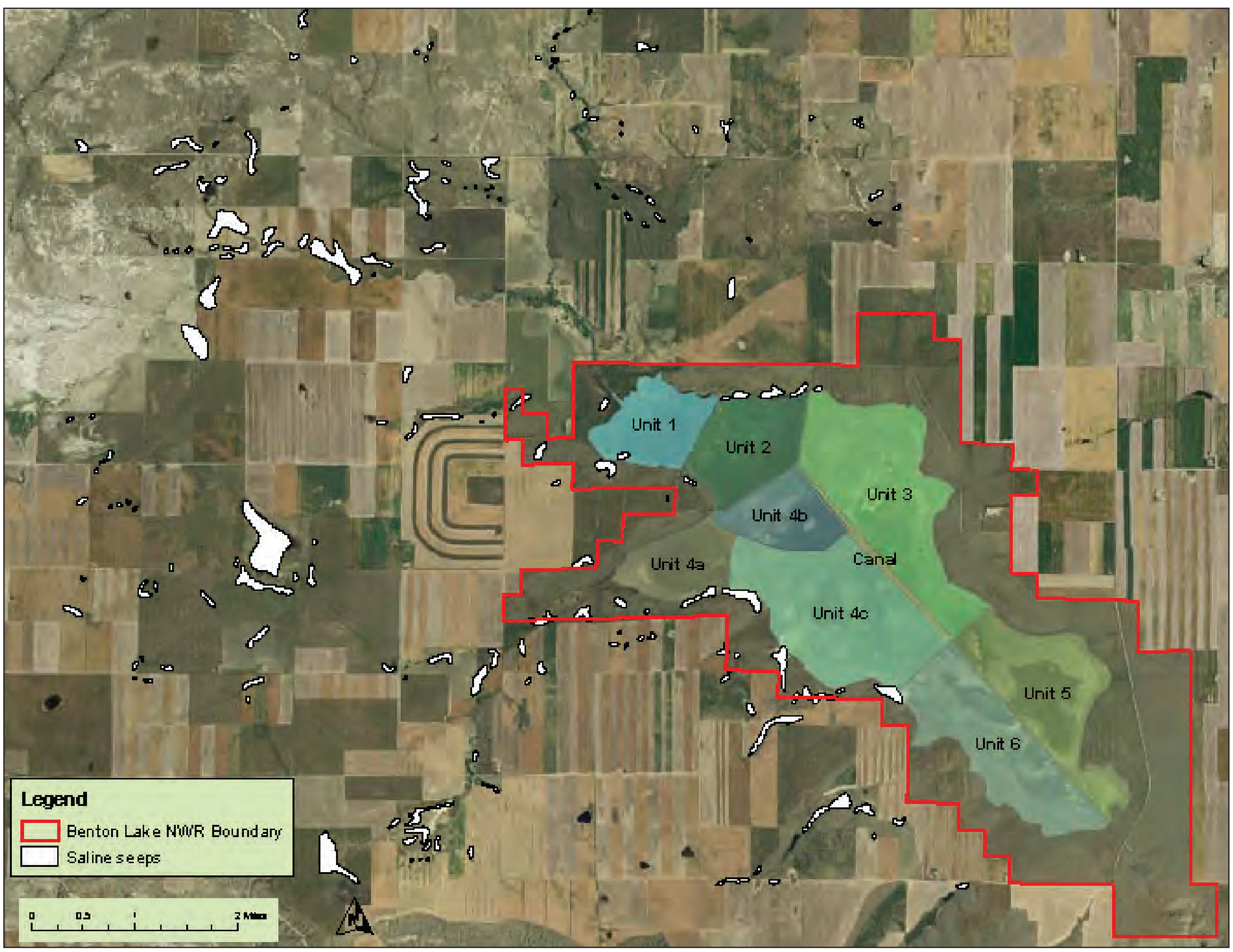


Figure 12. Map of saline seeps in the region of Benton Lake National Wildlife Refuge (NWR), Montana.

Table 5. Annual amounts of pumped water, natural runoff, and selenium entering Benton Lake, 1970–2012.

Year	Pumped water (acre-feet)	Runoff (acre-feet)	Estimated pumped selenium (pounds)	Estimated natural selenium (pounds)	Total estimated selenium (pounds)
1970	3,670	3,000	50	122	172
1971	6,371	0	87	0	87
1972	9,079	990	123	40	164
1973	6,643	0	90	0	90
1974	5,897	334	80	14	94
1975	0	13,933	0	568	568
1976	2,978	400	40	16	57
1977	4,167	0	57	0	57
1978	0	19,200	0	783	783
1979	68	12,100	1	493	494
1980	2,000	1,100	27	45	72
1981	3,650	500	50	20	70
1982	3,037	4,132	41	168	210
1983	2,822	1,763	38	72	110
1984	4,790	1,947	65	79	144
1985	6,380	1,157	87	47	134
1986	3,376	4,759	46	194	240
1987	7,987	350	109	14	123
1988	7,517	208	102	8	111
1989	212	9,710	3	396	399
1990	4,797	1,056	65	43	108
1991	8,028	943	109	38	148
1992	7,276	21	99	1	100
1993	1,932	3,049	26	124	151
1994	5,800	227	79	9	88
1995	5,555	344	76	14	90
1996	3,969	846	54	34	88
1997	4,430	2,245	60	92	152
1998	5,693	622	77	25	103
1999	5,033	122	68	5	73
2000	5,385	54	73	2	75
2001	5,082	51	69	2	71
2002	3,975	610	54	25	79
2003	3,868	4	53	0	53
2004	3,985	73	54	3	57
2005	2,730	422	37	17	54
2006	3,951	827	54	34	87
2007	3,542	486	48	20	68
2008	4,204	673	57	27	85
2009	4,866	1,730	66	71	137

Table 5. Annual amounts of pumped water, natural runoff, and selenium entering Benton Lake, 1970–2012.

Year	*Pumped water (acre-feet)*	*Runoff (acre-feet)*	*Estimated pumped selenium (pounds)*	*Estimated natural selenium (pounds)*	*Total estimated selenium (pounds)*
2010	3,069	3,433	42	140	182
2011	1,554	10,282	21	419	440
2012	2,550	83	35	3	38
Mean	4,231	2,414	58	98	156
Median	4,076	750	57	31	100
Total	179,368	103,703	2,438	4,228	6,666

Source: unpublished records on file at Benton Lake Refuge; Nimick et al. 1996.

Benton Lake Wetland Management District

In 1995, a survey of contaminants from 10 sites within the district was conducted to find out if trace elements were accumulating in either sediment or the aquatic food chain of wetlands (Gilbert et al. 1995). Elevated levels of lead, boron, and selenium were detected in several locations. The concentrations did not appear to pose an immediate threat to wildlife resources but continued monitoring was recommended. Given the alkaline nature of many of the soils in the district and the fact that evaporation rates can exceed precipitation, the potential for accumulation of toxins in wetland basins, particularly impoundments that do not dry out, deserves further attention.

Blackfoot Valley Conservation Area

The Blackfoot River, from the headwaters downstream to Landers Fork, shows varying levels of metals-related impairment. Water quality data show that the upstream part of this stream segment routinely exceeds numeric water quality criteria for the metals cadmium, copper, iron, lead, and zinc. Metals concentrations decrease in the downstream direction to the point where exceedences of metals-related numeric water quality criteria typically occur only during high flows. Water quality data from Blackfoot River, from Landers Fork to Nevada Creek, occasionally exceed numeric water quality criteria during high flows for cadmium, iron, aluminum, and zinc. Sources of metals-related impairment and acidity from the upper river segments are associated with the Upper Blackfoot Mining Complex. Reclamation activities, including restoration strategies for metals-listed segments of the Blackfoot River, rely on the completion of water quality restoration commitments from the Upper Blackfoot Mining Complex.

In 2005, a basin-wide restoration action plan for the Blackfoot River watershed was completed. This action plan serves as a guiding document to identify, rank, and plan for the implementation of restoration projects in the Blackfoot River watershed.

Rocky Mountain Front Conservation Area

Watersheds in the Rocky Mountain Front include the Sun River, Teton River, and Dearborn River. The Sun River watershed is connected to the Teton River watershed via human-built canals and irrigation works.

Sun River Watershed

The Sun River watershed spans several land types, from the forested headwaters in the Rocky Mountain wilderness to the prairies at its confluence with the Missouri River near the city of Great Falls, Montana. Agricultural land use dominates the watershed. The links between water quality, land use, and the natural variability of land types in the watershed are complex. Potentially impaired waters identified by the State of Montana in the Sun River watershed are Ford Creek, Gibson Reservoir, Willow Creek Reservoir, upper Sun River, lower Sun River, Freezeout Lake, and Muddy Creek.

The upper Sun River was identified as impaired on Montana's 2000 and 2002 lists of impaired waterbodies because of excess nutrients. This segment is approximately 80 miles long and runs from Gibson Dam to Muddy Creek. Landowners, local watershed organizations, and many Federal, State, and local government agencies collaborated to carry out agricultural best management practices in the upper Sun River and its tributaries. Water quality improved as a result, allowing the Montana Department of Environmental Quality to remove the upper Sun River from the list for nutrients in 2006. The Sun River watershed project is a classic example of using the watershed approach to address nonpoint source pollution (EPA 2012).

Teton River Watershed

The Teton River watershed is located on the eastern side of the Rocky Mountain Front in west-central Montana. Recorded conditions in the Teton basin begin with the Lewis and Clark expedition of 1804–1806. The expedition journals, as translated by Moulton (1999), documented several points of interest that can be used today to gain an understanding of the historical landscape and riparian vegetation. On June 3, 1805, the Fields brothers noted the Teton's riparian areas as "containing much timber in its bottom, consisting of the narrow and wide leafed cottonwood with some birch and box alder undergrowth, willows, rosebushes, and currents."

White settlers soon followed, using the expansive lands to raise large herds of cattle and horses. Where possible, rich, river bottoms were cleared to increase forage production. Irrigation soon followed to increase the amount of hay that could be produced and stored for winter. Land use along the river bottoms and floodplain has changed significantly. Some reaches of the river were channelized (straightened), permanent bridges for transportation were installed, and riparian areas were heavily used, which reduced bank-stabilizing vegetation.

The Teton River flows into the Marias River near Loma, in west-central Montana, and then into the Missouri River. In 1996, 13 stream segments or waterbodies in the Teton River watershed were listed with threatened or impaired beneficial use. In 2002, 9 stream segments or waterbodies have impaired status, and 5 have been found to fully support all beneficial uses. The type and magnitude of water quality impairments vary across the watershed. Primary causes of water quality impairments include salinity, total dissolved solids and chlorides or sulfides, selenium, organic enrichment (dissolved oxygen), siltation (suspended solids), temperature, and nutrients. Other listed causes include stream flow alteration (dewatering), bank erosion, riparian degradation, fish habitat alteration, and other habitat alteration. Sources are varied, but predominantly result from the effects of a 1964 flood or relate to agricultural land uses and associated practices. Agricultural activities dominate the watershed, with 84 percent of the land cover and land use identified as cropland, rangeland, or pasture. Irrigated and dryland agriculture practices have a cumulative effect on the river system and resultant water quality either by altering stream flows or by raising ground water levels and augmenting flows that contribute to saline seeps. Riparian grazing activities also have an effect on the health of the riparian zones, stability of stream banks, and ultimately, water quality (MDEQ 2003).

Dearborn River Watershed

In 1996, 2002, and 2004 the State of Montana reported that several stream segments in the Dearborn River watershed in west-central Montana have impaired beneficial uses. The segments of concern are the Dearborn River, middle fork Dearborn River, south fork Dearborn River, and Flat Creek. Causes of impairment in these stream segments include flow alteration, thermal modifications, other habitat alterations, and siltation (MDEQ 2005).

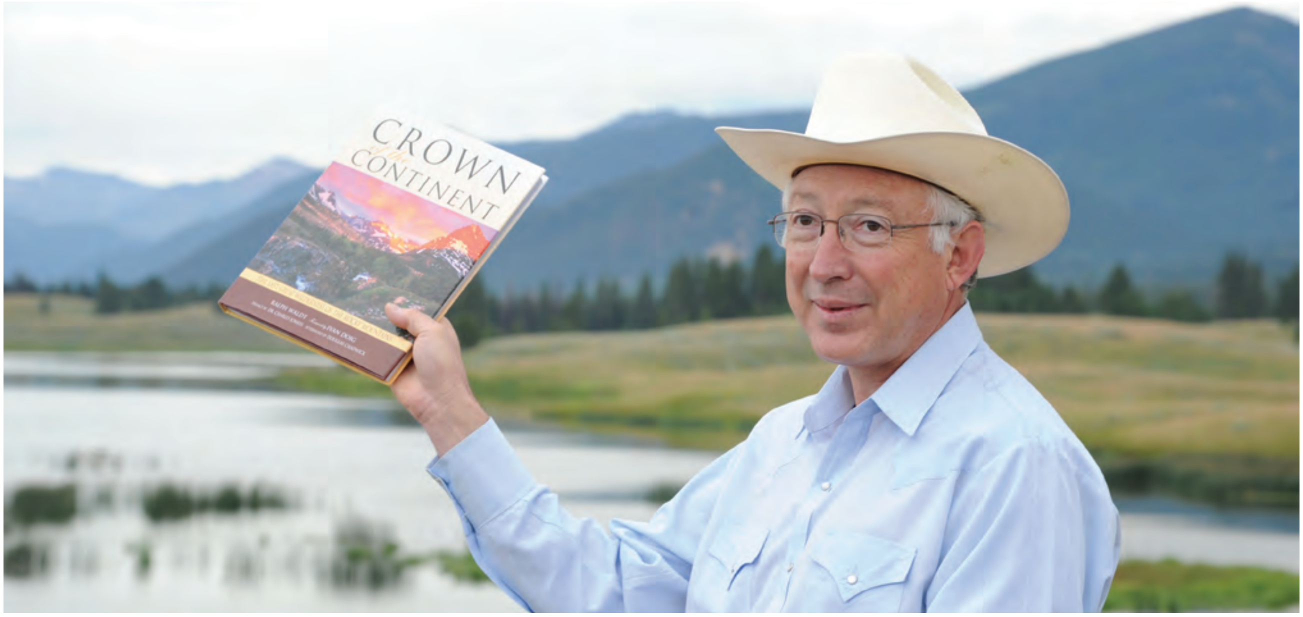
Swan River National Wildlife Refuge and Swan Valley Conservation Area

Clear, cold waters emerge from the Mission Range and Swan Range and flow through the 410,000-acre Swan River watershed joining the Flathead River and eventually reaching the Pacific Ocean by way of the Columbia River. The Swan Valley holds more surface water than any other Montana watershed; 16 percent of the land is wet. Water collects in more than 4,000 potholes, ponds, lakes, marshes, and wetlands, and a 1,300-mile network of streams transports water throughout the valley. Two key water quality problems facing the Swan Lake watershed include (1) sediment from past activities; and (2) converted forest land for residential use. The development of roads and homesites has created water quality problems in the Swan Valley. Water quality in Swan Lake is generally excellent, however, dissolved oxygen levels in two deep basins reach unexpected low levels in the fall of each year. Low dissolved oxygen levels are of concern due to their potential harm to aquatic life and as an indication that basin-wide increases in pollutants may be reaching Swan Lake (Swan Ecosystem Center 2011).

Water Rights

Montana waters, in all their varied forms and locations, belong to the State. The Montana constitution states that all surface, underground, flood, and atmospheric waters within the boundaries of the State are the property of the State for the use of its people. (Article IX, section 3[3]). Since water belongs to the State, anyone who holds a water right does not own the water itself, instead, they possess a right to use the water within State guidelines.

Water rights in Montana are guided by the prior appropriation doctrine, that is, first in time is first in right. A person's right to use a specific quantity of water depends on when the use of water began. The first person to use water from a source established the first right; the second person could establish a right to the water that was left, and so on. During



USFWS

United States Secretary of the Interior Ken Salazar visits the refuge complex.

dry years, the person with the first right has the first chance to use the available water to fulfill that right. The holder of the second right has the next chance. Water users are limited to the amount of water that can be beneficially used. In Montana, the term "beneficial use" means, generally, a use of the water for the benefit of the appropriator, other persons, or the public, including, but not limited to, agricultural (including stock water), domestic, fish and wildlife, industrial, irrigation, mining, municipal, power, and recreational uses.

Water rights are appurtenant to the land on which they are used and may, but do not have to, transfer with sale of the land. Water rights are summarized in table 6 and described in this section for the units of the refuge complex.

Table 6. Water rights and use on Benton Lake National Wildlife Refuge Complex, Montana.

Claim, permit, certificate number, or compact	*Priority date, use period*	*Source, use*	*Diversion means*	*Flow rate**	*Allowed volume per year (acre-feet)*	*Other information*
Benton Lake National Wildlife Refuge						
41K–W–188174	4/28/1958, January 1–December 31	Muddy Creek, USFWS	Pumps	50 cfs	14,600	Associated with UFWS and Bureau of Reclamation Sun River Irrigation Project
Compact	11/21/1929, January 1–December 31	Ground water and natural flow, groundwater is to be used at refuge headquarters and natural flow is for Wildlife Habitat Maintenance and Enhancement	Wells and Lake Creek drainage including unnamed tributaries to Benton Lake		2 at a rate of 45 gpm for ground water, and no volume associated with natural flow	Natural flow when it enters the refuge is subordinate to other rights as indicated in Compact Article II, Section 2.b. Not subject to change

Table 6. Water rights and use on Benton Lake National Wildlife Refuge Complex, Montana.

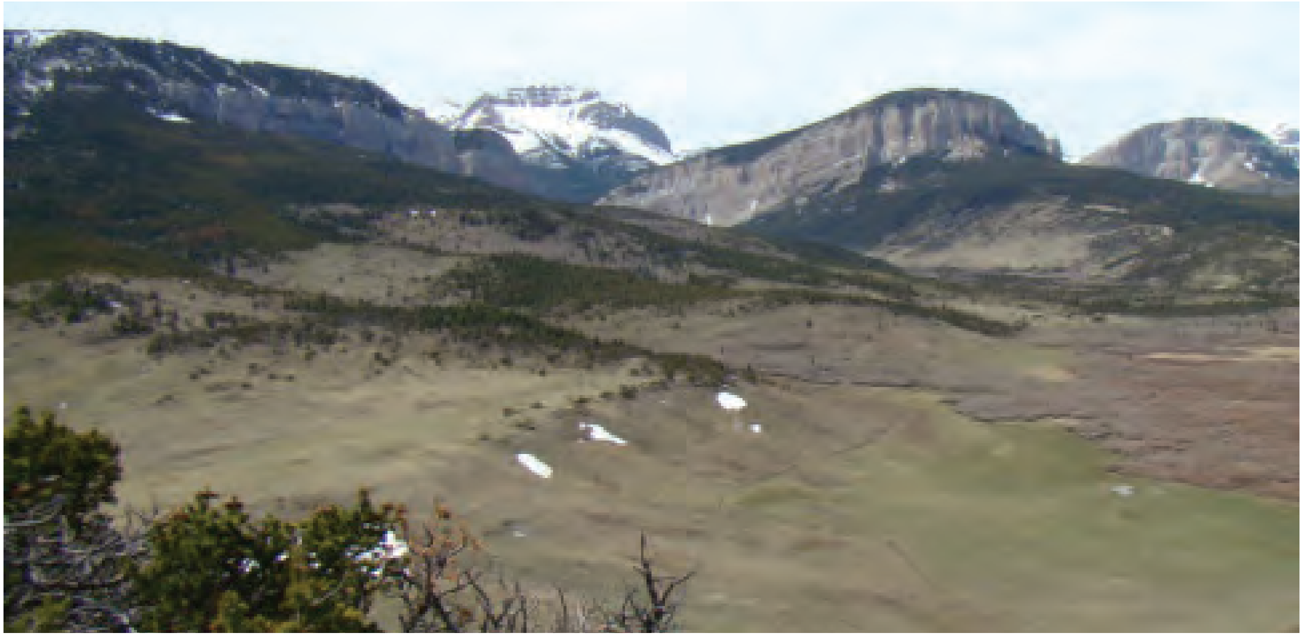
Claim, permit, certificate number, or compact	*Priority date, use period*	*Source, use*	*Diversion means*	*Flow rate**	*Allowed volume per year (acre-feet)*	*Other information*
Blackfoot Waterfowl Production Area						
76F–W–33714	7/2/1888, April 15–October 15	Spring, irrigation	Headgate	6.1 cfs	479	Combined with 76F–P–78265
76F–P–78265	6/6/1991, January 1–December 31	Unnamed tributary of the Blackfoot River, wildlife and waterfowl	Dams and headgates		479	Combined with 76F–W–33714. Not subject to change
76F–P–3472	8/29/1974, April 1–October 15	Blackfoot River, irrigation	Pump	700 gpm	370	Not subject to change
76F–W–116248	6/3/1946, June 1–October 15	Unnamed tributary of Interior Drainage, stock	Direct from source		30 gallons per day per animal unit	
Ehli Waterfowl Production Area						
40F–W–159045	12/31/1900, April 1–October 1	Willshaw Coulee, stock	Direct from source		30 gallons per day per animal unit	
40F–W–214983	6/30/1973, January 1–December 31	Willshaw Coulee, USFWS	Ehli Dam		770.6	
Furnell Waterfowl Production Area						
41N–W–183215	7/10/1902, January 1–December 31	Trail Creek, USFWS	Headgate	2 cfs	480.80	
H2–O Ranch Waterfowl Production Area						
76F–W–98036	6/25/1896, April 14–October 31	Blackfoot River, irrigation	Headgate (McCormick/Coughlin Ditch)	11.55 gpm		Acquired a portion of water right claim
76F–W–98046	6/4/1889, April 14–October 31	Blackfoot River, irrigation	Headgate (McCormick/Coughlin Ditch)	15 gpm		Acquired a portion of water right claim
76F–W–98034	6/8/1892, April 14–October 31	Blackfoot River, irrigation	Headgate (McCormick/Coughlin Ditch)	12.5 gpm		Acquired a portion of water right claim
76F–W–98041	4/15/1910, April 15–October 31	Blackfoot River, stock	Direct from source and headgate (McCormick/Coughlin Ditch)		30 gallons per day per animal unit	Acquired a portion of water right claim

Table 6. Water rights and use on Benton Lake National Wildlife Refuge Complex, Montana.

Claim, permit, certificate number, or compact	*Priority date, use period*	*Source, use*	*Diversion means*	*Flow rate**	*Allowed volume per year (acre-feet)*	*Other information*
76F–W–98033	4/15/1910, April 14–October 31	Blackfoot River, irrigation	Headgate (McCormick/Coughlin Ditch)	15.23 cfs		Acquired a portion of water right claim
76F–W–117702	12/31/1938, January 1–December 31	Ground water, domestic and lawn irrigation	Well	35 gpm	4	
76F–W–117703	12/31/1938, January 1–December 31	Ground water, stock	Well	35 gpm	30 gallons per day per animal unit	
76F–W–117704	2/3/1960, May 1–December 1	Ground water, stock	Well	20 gpm	30 gallons per day per animal unit	
76F–W–117705	12/31/1950, January 1–December 31	Ground water, stock	Well	35 gpm	30 gallons per day per animal unit	
76F–W–117707	8/7/1962, January 1–December 31	Ground water, stock	Well	35 gpm	30 gallons per day per animal unit	
76F–W–117710	6/26/1888, April 1–November 1	Blackfoot River, irrigation	Headgate (McCormick Ditch)	19.51 cfs		
76F–W–117711	6/15/1889, April 1–November 1	Blackfoot River, irrigation	Headgate (McCormick Ditch)	19.51 cfs		
76F–C–69182	9/14/1988, January 1–December 31	Ground water, stock	Well	25 gpm	5.95	Not subject to change
76F–P–17006	1/18/1978, April 15–October 15	Blackfoot River, irrigation	Pump	1500 gpm	375	Not subject to change
76F–W–214346	12/31/1938, January 1–December 31	Groundwater, USFWS	Well	66 gpm	106	Claim was filed late
76F–W–214347	6/26/1888, January 1–December 31	Blackfoot River, USFWS	Headgate (McCormick Ditch)	25 cfs	88	Claim was filed late
76F–W–214348	5/27/1892, April 1–November 1	Waste and seepage unnamed tributary of Blackfoot River, irrigation	McCormick Ditch	12.5 cfs		Associated with 76F-W-117710 and 117711 and claim was filed late
76F–W–214349	12/31/1950, January 1–December 31	Ground water, USFWS	Well	75 gpm	120	Claim was filed late

Table 6. Water rights and use on Benton Lake National Wildlife Refuge Complex, Montana.

Claim, permit, certificate number, or compact	*Priority date, use period*	*Source, use*	*Diversion means*	*Flow rate**	*Allowed volume per year (acre-feet)*	*Other information*
76F–W–214350	12/31/1963, January 1–December 31	Waste and seepage unnamed tributary of Blackfoot River, USFWS	McCormick Ditch	12.5 cfs	88	Claim was filed late
Kingsbury Lake Waterfowl Production Area						
41R–W–188250	9/20/1911, January 1–December 31	Unnamed tributary to Kingsbury Lake, USFWS	Dam	1 gpm		
41R–W–188251	9/20/1911, January 1–December 31	Kingsbury Lake, USFWS	Dam		2.5	
41R–W–188252	9/20/1911, January 1–December 31	Kingsbury Lake, USFWS	Dam		2.5	
41R–P–98648	1/8/1997, January 1–December 31	Alder Creek, stock	Dam		0.4	
41R–W–211490	12/31/1945, January 1–December 31	Alder Creek, USFWS	Dam		6	
41R–W–011806	5/31/1947, April 1–November 1	Kingsbury Lake, stock	Dam		2	
41R–W–011807	4/30/1947, April 1–November 1	Kingsbury Lake, stock	Dam		2	
41R–W–011808	4/30/1947, April 1–November 1	Kingsbury Lake, stock	Dam		2	
41R–W–011809	4/30/1947, April 1–November 1	Kingsbury Lake, stock	Pit		2	
41R–W–011810	6/30/1930, June 1–February 1	Alder Creek, stock	Direct from source		30 gallons per day per animal unit	
41R–W–011811	4/1/1947, April 1–November 1	Kingsbury Lake, stock	Pit		2	
41R–W–011812	9/30/1948, April 1–November 1	Ground water, stock	Well	0.5 gpm	30 gallons per day per animal unit	


USFWS

Rocky Mountain Front Conservation Area

Table 6. Water rights and use on Benton Lake National Wildlife Refuge Complex, Montana.

Claim, permit, certificate number, or compact	*Priority date, use period*	*Source, use*	*Diversion means*	*Flow rate**	*Allowed volume per year (acre-feet)*	*Other information*
Kleinschmidt Waterfowl Production Area						
76F–W–97791	4/1/1919, April 1–December 31	Kleinschmidt Lake, stock	Direct from source		30 gallons per day per animal unit	
Powell County Waterfowl Production Area						
76F–W–150350	12/31/1900, January 1–December 31	Upsata Lake, domestic	Surface water	1.25 cfs	5	Ownership pending
76F–W–150351	12/31/1900, April 1–October 31	Upsata Lake, irrigation	Headgate	2.5 cfs		Ownership pending
76F–W–150352	12/31/1900, January 1–December 31	Unnamed tributary of Interior Drainage, stock	Direct from source		30 gallons per day per animal unit	Ownership pending
76F–W–150353	12/31/1900, January 1–December 31	Unnamed tributary of Interior Drainage, stock	Direct from source		30 gallons per day per animal unit	Ownership pending
76F–W–150354	12/31/1900, January 1–December 31	Unnamed tributary of Interior Drainage, stock	Direct from source		30 gallons per day per animal unit	Ownership pending
76F–W–150356	12/31/1900, January 1–December 31	Upsata Lake, stock	Direct from source		30 gallons per day per animal unit	Ownership pending

Table 6. Water rights and use on Benton Lake National Wildlife Refuge Complex, Montana.

Claim, permit, certificate number, or compact	*Priority date, use period*	*Source, use*	*Diversion means*	*Flow rate**	*Allowed volume per year (acre-feet)*	*Other information*
Sands Waterfowl Production Area						
40J–W–118716	12/31/1945, April 1–November 1	Indian Woman Coulee, stock	Dam		0.66	Transferred incorrectly, acquired a portion of the water right claim
40J–W–118717	4/30/1953, April 1–October 31	Indian Woman Coulee, irrigation	Headgate	2.92 cfs		Transferred incorrectly, acquired a portion of the water right claim
40J–P–11694	3/14/1977, January 1–December 31	Halfway Lake, stock	Pit		0.95	Not subject to change
40J–P–30042409	6/12/2008, May 15–September 30	Indian Woman Coulee, stock	Pit		0.25	Not subject to change
Savik Waterfowl Production Area						
41O–P–30022505	5/26/2006, May 1–October 31	Foster Creek, stock	Pit		0.14	Not subject to change
41O–P–30025677	11/20/2006, May 1–October 31	Foster Creek, stock	Pit		0.14	Not subject to change
Swan River National Wildlife Refuge						
76K–W–188247	2/10/1925, January 1–December 31	Swan River, USFWS	Dike		3395	
76K–W–188248	4/21/1927, January 1–December 31	Spring Creek, USFWS	Dike	135 cfs	8,260	7,240 acre-feet is for nonconsumptive use
76K–W–188249	4/21/1927, January 1–December 31	Bond Creek, USFWS	Dike		268	
76K–W–190563	2/10/1925, April 15–October 19	Swan River, irrigation	Dike	52.95 cfs	3,395	
76K–W–190564	5/3/1923, January 1–December 31	Lime Creek, USFWS	Pipeline		1,793	
76K–W–190565	10/22/1919, January 1–December 31	Stopher Creek, USFWS	Pipeline		1,900	
76K–W–190566	9/20/1926, January 1–December 31	Lime Creek, USFWS	Pipeline		1,807	

*Note: permits, certificates, and compacts are subject to change due to Montana Statewide Adjudication except where noted as not subject to change. *Flow rate measures: cfs=cubic feet per second, gpm=gallons per minute.*

Benton Lake National Wildlife Refuge

The "Montana House bill 717–Bill to Ratify Water Rights Compact" (compact) is a water rights compact between the State of Montana and the Service signed July 17, 1997. The parties to this agreement recognize that the water rights described in the compact are junior to any tribal water rights with a priority date before the effective date of the compact, including aboriginal rights, if any, in the basins affected.

The refuge has two primary water rights. One is for 14,600 acre-feet of surface water from Muddy Creek (41K–W–188174) with a priority date of April 28, 1958. The other is for the natural flow in the Lake Creek drainage, including the unnamed tributaries to Benton Lake, where the drainage enters the refuge in the amount of natural flow remaining after the satisfaction of the following rights:

- all rights recognized under State law with a priority date before the effective date of the compact
- any rights for stock watering ponds with a priority date after the effective date of the compact and a maximum capacity of the impoundment or pit of less than 15 acre-feet and an appropriation of less than 30 acre-feet per year from a source other than a perennial flowing stream
- any right to appropriate ground water with a priority date after the effective date of the compact by means of a well or developed spring with a maximum appropriation of 35 gallons per minute (gpm) or less that does not exceed a total appropriation of 10 acre-feet per year

The refuge also has a ground water right to 2 acre-feet per year diverted at a maximum rate of 45 gpm from ground water beneath the Benton Lake Refuge.

Benton Lake Wetland Management District

Water rights in the district exist for eight waterfowl production areas and include stock water, irrigation, domestic use, fish, and wildlife. The rights cover natural runoff, instream flows, artesian wells, and springs. Table 6 includes all district water rights.

The Blackfoot River watershed is currently going through the adjudication process.

Blackfoot Valley, Rocky Mountain Front, and Swan Valley Conservation Areas

All water rights associated with the conservation areas in the refuge complex remain under the control of the landowner.

Swan River National Wildlife Refuge

The refuge has seven water rights for irrigation and fish and wildlife purposes and all are associated with instream flows (table 6).

Air Quality

Air quality is a global concern. The U.S. Environmental Protection Agency (EPA) has lead responsibility for the quality of air in the United States. Through the 1990 Clean Air Act, the agency sets limits on the amount of pollutants that can be discharged into the air. More than 170 million tons of pollution is emitted annually within the United States, through either stationary sources (such as industrial and power plants) or mobile sources (such as automobiles, airplanes, trucks, buses, and trains). There are also natural sources of air pollution such as fires, dust storms, volcanic activity, and other natural processes. The EPA has identified six principal pollutants that are the focus of its national regulatory program: carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide.

Air quality problems in Montana are usually found in more urban areas and in mountains or river valleys that are sensitive to temperature inversions. Carbon monoxide and particulate matter are the air pollutants that have the greatest adverse effect on Montana's air quality. Particulate matter is tiny liquid or solid particles in the air that can be breathed in through the lungs.

Most of the refuge complex is located in rural settings where soot from slash burning, forest fires, wood burning fireplaces and stoves and dust associated with windblown sand and dirt from roadways, fields and construction sites are the main factors that contribute to particulate matter. The major sources of carbon monoxide in Montana are motor vehicles and residential wood burning.

Air quality for the refuge complex is considered to be good with few manufacturing sites or major air pollution sources.

The Federal Clean Air Act requirements provided the framework for Montana's air quality program. However, the State has exceeded the Federal requirements in many areas by:

- adopting tougher ambient air quality standards for certain pollutants;
- requiring a permitting program for smaller sources of pollution;
- providing emission control analyses to the regulated public to make sure that smaller sources of air pollution have the best emission control technology available;
- developing local air quality programs to regulate residential wood burning and road dust (the primary sources of particulate air pollution in Montana), as well as smaller sources of air pollution;
- developing the Montana Smoke Management Plan and Open Burning Program to control the amount of harmful particulate matter that is released with smoke from prescribed fires.

The State of Montana, through the Department of Environmental Quality and local governments, continues to actively address air quality problems throughout the State. At present, urban development is more of a threat to Montana's air quality than industrial activities (MDEQ 2011).

Areas that violate Federal air quality standards are designated nonattainment areas. The EPA declares each area nonattainment for a specific pollutant such as carbon monoxide or particulate matter. The only area designated to have attainment problems in the refuge complex was Great Falls (carbon monoxide). Great Falls met attainment standards for carbon monoxide in 2002.

3.2 Biological Resources

The following sections describe the biological resources and habitat management activities that may be affected by the implementation of the CCP. The biological features detailed below are vegetative habitat types and associated species of concern, birds, mammals, amphibians, reptiles, fishes and insects. The quality of these habitats varies throughout the refuge complex due to water quality and quantity, the presence of invasive and nonnative species, effects from surrounding land uses, and the Service's ability to properly manage and protect particular areas.

The major habitat types that occur on the refuge complex are as follows:

- grasslands—comprised primarily of mixed-grass prairie with limited tame grasslands consisting of dense nesting cover (DNC) scattered throughout the refuge complex on fee-title land
- wetlands and riparian areas—natural and enhanced freshwater and saline wetlands including lakes, rivers, and ponds
- forests and woodlands
- sagebrush-steppe

Habitat management activities include cooperative farming, prescribed fire and haying, and prescriptive grazing.

Grasslands

Each unit of the refuge complex has its own, varied grassland habitat.

Benton Lake National Wildlife Refuge and Benton Lake Wetland Management District

The district is the largest geographical district in the country encompassing ten counties, with

Larry Allain / USDA–NRCS PLANTS Database

Blue Grama Prairie Grass

nine counties on the east side of the Continental Divide and one on the west side. Historically, the northern mixed-grass prairie system stretched from northern Nebraska into southern Canada and westward through the Dakotas to the Rocky Mountain Front in Montana, now it covers only approximately 104,000 square miles. Dominant grass species include rough fescue, Idaho fescue, western wheatgrass, and green needlegrasses. Other common species include blue grama, needle and thread grass, and threadleaf sedge. Shrub species such as snowberry and prairie sagewort also occur. Fire and grazing, along with drought, constitute the primary dynamics affecting this system.

The northern mixed-grass prairie is one of the most disturbed grassland systems. An estimated 75 percent of the region has been heavily altered. Agricultural crops are common in the central part of the district, also known as the Golden Triangle. This agricultural designation includes Great Falls as its apex and then roughly runs northeast through Havre, west to Cut Bank, and back to Great Falls. The area produces approximately half of Montana's wheat, primarily winter and spring wheat, and is the most productive of the State's farming areas that are not irrigated. Only a few remaining areas have escaped conversion to agriculture (NatureServe 2008). These grasslands are prominently represented in the district along the Rocky Mountain Front, surrounding the Sweet Grass Hills and in Glacier County on the Blackfeet Indian Reservation.

Benton Lake Refuge also has nearly 6,000 acres of intact, northern mixed-grass prairie. The dominant plant community is represented by green needlegrass, western wheatgrass, thickspike wheatgrass, prairie Junegrass and bluebunch wheatgrass. Other grasses and sedges include plains reedgrass, threadleaf sedge and needleleaf sedge. Blue grama is the only common warm-season grass. Grasses represent about 80 percent of the total annual production in this community (NRCS 2005).

Common forbs on Benton Lake's clayey soils include dotted gayfeather, American vetch, white prairie clover and purple prairie clover. American vetch and the prairie clover are nitrogen-fixing species and are valuable forage-producing plants. Groundplum milkvetch, scurfpea and prairie thermopsis are lower successional forbs that have the ability to fix nitrogen. White milkwort, biscuitroot, wild onion and western yarrow may be present as minor components of the plant community. Forbs represent about 15 percent of the total annual production (NRCS 2005).

Winterfat and Nuttall's saltbush are common warm and cool-season shrubs, respectively, on Benton Lake Refuge. They are valuable forage for wildlife and livestock. Silver sagebrush, fringed sagewort, broom snakeweed and prickly pear cactus may also represent minor shrub components. Overall, shrubs account for about 5 percent of the annual plant production (NRCS 2005).

There are approximately 4,516 acres of tame grasslands existing on fee-title lands scattered throughout the refuge complex. Most of the tame grasslands were inherited as former farmland when the waterfowl production areas or refuges were bought. However, there were some limited areas of native prairie on Benton Lake Refuge that were broken and seeded to tame grass in the 1960s and early 1970s. The predominant herbaceous cool-season species used were varying combinations of intermediate wheatgrass, tall wheatgrass, slender wheatgrass, pubescent wheatgrass, western wheatgrass, and crested wheatgrass; the legumes were alfalfa and sweetclover. The basic seeding rates were comprised of 75 percent wheatgrass and 25 percent legumes. These species, commonly referred to as DNC, were chosen based on research that showed they are highly attractive and beneficial to waterfowl (Duebbert 1969). DNC fields throughout the refuge complex vary from excellent to poor condition. Most stands are in some type of rotational management scheme to rejuvenate and extend the longevity of the planting.

Associated Wildlife

Grassland bird species on refuge complex lands are priority species due to the loss of grasslands in the surrounding areas and because their population trend is declining. During the past quarter-century, grassland birds have experienced steeper, more consistent, and more widespread population declines than any other avian guild in North America (Vickery et al. 2000). A 6-year study done in northwest Montana showed that grasslands in the northern Great Plains represent unique characteristics that support all of the species that are endemic to the landscape (Hendricks et al. 2007). On the refuge complex, priority grassland bird species include the Federal candidate species, Sprague's pipit. Other grassland priority species include ferruginous hawk, upland sandpiper, long-billed curlew, marbled godwit, burrowing owl, short-eared owl, grasshopper sparrow, chestnut-collared longspur, Baird's sparrow, and bobolink.

Grassland bird point counts were conducted for 4 years (1994–1997) consecutively at the Benton Lake Refuge. More than 800 individuals and 41 species of grassland birds were detected. Over the course of these surveys, there was a steady decline of the chestnut-collared longspurs, grasshopper sparrows, and horned larks.

Grassland-bird point counts were also conducted for 3 years (1995–1997) at the Kingsbury Lake and

Furnell WPAs. There was high species richness, and grasshopper sparrow, Baird's sparrow and Sprague's pipits were the most abundant species (Benton Lake Refuge Non-game Monitoring Program, Piercy 1997).

Grassland bird conservation and management recognizes the historical dynamics under which these habitats have evolved and, where feasible, incorporate the ecological processes that have generated and supported these distinctive grassland biotas (Vickery et al. 2000). Further management and conservation of these lands by refuge managers will support a diversity in grassland bird species.

Blackfoot Valley Conservation Area

Sweeping expanses of native bunchgrass prairie are one of the most striking visual elements of the Blackfoot River watershed. Grassland areas here were targeted by early European settlers for grazing and farm lands. Today, most of the grassland areas are located on private land. Some have been converted to irrigated and dryland pastures or used for hay production. Nonnative species include creeping foxtail, orchard grass, timothy, tall wheatgrass, meadow brome, smooth brome, alfalfa and sainfoin. Large bunchgrass prairies occur throughout the valley bottoms. The dominant bunchgrass is rough fescue; other common native grasses include bluebunch wheatgrass, Idaho fescue, prairie Junegrass, and several species of needlegrass. Native grassland often occurs in a matrix throughout the watershed.

Associated Wildlife

Grasslands support a variety of wildlife, including reptiles such as eastern racer, northern alligator lizard, rubber boa, and terrestrial garter snake (MNHP 2009). A variety of small mammals use grasslands in the Blackfoot Valley including shrews, voles, gophers, squirrels and rabbits. Large mammals include grizzly bears, white-tailed and mule deer, and elk.

In addition to grassland birds such as vesper sparrows and western meadowlarks, the Blackfoot Valley is perhaps also the best breeding and nesting area for the long-billed curlew in western Montana. This species is declining nationally and has been identified as a priority in both the shorebird and PIF conservation plans. Local surveys on Kleinschmidt Flat in 1997 found 31 pairs on 3,840 acres or more than 8 pairs per 1,000 acres. Production was not monitored, but many broods were noted. This species is highly reliant on grassland-nesting habitat, but will also nest in sagebrush-steppe, and relies more heavily on wetlands during migration.

Rocky Mountain Front Conservation Area

The Front contains the largest intact expanse of fescue grasslands left in the northern Great Plains (Lesica 1994). Higher elevations include fescue grasslands and a large acreage recently changed by a wildfire that is now a mix of mostly Douglas-fir regeneration among burned tree trunks over relatively lush fescue grasslands. The fescue is often mixed with shrubs. Creeping juniper and kinnikinnick occur on somewhat drier sites, and shrubby cinquefoil is common in more mesic areas. Shrubby cinquefoil is particularly common in the northern extreme of the Front, but also follows the greater eastward expansion of the fescue-type habitat in the southern end, where it is more closely associated with stream terraces. The fescue grasslands at higher elevation (and with correspondingly greater precipitation) transition at lower elevations to grasslands dominated by various grass species in response to soil and topography. Western wheatgrass is the dominant species in swales (lower elevation land that remains moist) with heavier soils. Needle and thread is the most common species on sandier soils, which tend to occur somewhat higher in the local landscape. Bluebunch wheatgrass is associated with steeper slopes; mixtures of any or all these grasses can occur with the variable conditions found in this diverse landscape. Blue grama can become very common with sustained heavy grazing. The absence of sagebrush is notable and currently unexplained.

Associated Wildlife

Lying next to Bob Marshall Wilderness, the diverse habitats of the Rocky Mountain Front play a critical role in sustaining the Northern Continental Divide Ecosystem's (NCDE) free-ranging wildlife populations. It is one of the last remaining areas in the lower 48 United States with an intact assemblage of large mammalian carnivores, and it is the only place in the world where grizzly bears still roam from the mountains onto the prairies as they did nearly 200 years ago. An estimated 100–150 bears frequent the project area, which is included in much of the recovery plan for the NCDE grizzly bear population. There are estimated to be 835 individual gray wolves making up approximately 110 packs in the Montana portion of the NCDE. The Front once supported a large concentration of swift fox, which were nearly extirpated from the State. Swift fox are now being reintroduced just north of the project area through a partnership between Defenders of Wildlife and the Blackfeet Indian Nation and may eventually move back into the project area.

The Rocky Mountain Front provides essential habitat for many grassland birds, many, of which, are experiencing significant population declines. These include chestnut-collared longspurs, Sprague's pipits, ferruginous hawks, long-billed curlews, and McCown's longspur. In addition, the most common birds found on grasslands along the Front during an inventory in 2004 include vesper sparrows, western meadowlarks, horned larks, Brewer's blackbirds, Savannah sparrows, and upland sandpipers (Lenard and Hendricks 2005).

The grasslands provide critical winter range for all large ungulates found within the eastern Bob Marshall Wilderness. Thousands of elk and mule deer winter primarily on State wildlife management areas along the Front. Shiras moose, a subspecies found in the central Rocky Mountains, occasionally frequent the project area. The grasslands along the eastern part of the project boundary also sustain small populations of pronghorn.

Swan River National Wildlife Refuge and Swan Valley Conservation Area

The current grasslands of the Swan Valley and the Swan River Refuge are the result of conversions of other habitat types. Settlers to the valley often converted forested areas and wet meadows and seasonal wetland habitats to haying and grazing areas. Trees were removed and fields destumped and attempts were made to drain wetlands and plant timothy and reed canarygrass for forage. These areas remain today as grasslands awaiting restoration to forested habitat or wetlands (personal communication, Mike Pallidinie, October 2011).

Wetlands And Riparian Areas

The diversity of wetland and riparian types within the refuge complex is exceptional. They include major riparian areas (including the Missouri River, Blackfoot River, and the Swan River), smaller riparian tributaries, glacial prairie potholes, depressional wetlands, emergent marshes, lakes, bogs, fens, and swamps. Many systems have been developed to classify and describe wetland types. The Service has adopted as its national standard the "Classification of Wetlands and Deepwater Habitats of the United States" (Cowardin et al. 1979). Added hydrologic and vegetation characteristics for the refuge complex wetlands that are also specific to Montana are described here by crossing the Cowardin classification system with the Ecological Systems described by Comer and others (2003) and produced by the Montana Natural Heritage Program (MNHP) (MNHP 2011b).

Wet–dry climatic cycles in Montana, often in 10- to 20-year periods, exert a strong influence on the wetlands and riparian systems in the refuge complex (Hansen et al. 1995). During this climatic cycle, wetlands go through a dry marsh, regenerating marsh, degenerating marsh, and a lake phase that is regulated by periodic drought and deluge (van der Valk 1981, Mitsch and Gosselink 2000, Euliss et al. 2004). During drought periods, seeds from annuals and perennials germinate and cover exposed mudflats. When precipitation floods the depressions, the annuals drown and the perennials survive, regenerating the marsh. Over a series of years, perennials dominate and submersed and floating-leaved hydrophytes return. After a few years of the regenerating phase, emergent vegetation begins to decline and eventually the marsh reverts to an open-water system. Muskrats may play an important role in the decline of emergent vegetation in some of these systems. During drought, the drawdown to mudflats is necessary so that emergent vegetation can become reestablished. Flooding, drawdown, and the eventual exposure of mudflats drive the water-level vegetation cycle.

Wet–dry cycles are important for supporting water quality for vegetation and wildlife in wetlands. During wet cycles, contaminants such as salts, metals, and nutrients are washed into wetlands. Agriculture and forestry operations, when adjacent, may cause nutrient and herbicide runoff. In saline soil marshes, an increase in precipitation during exceptionally wet years can dilute the salt concentration in the soils, allowing less salt-tolerant species to occur. The dry cycles create periods where these toxins can be neutralized by wind, the sun, and chemical transformation to remove them from wetlands (Zhang and Moore 1997, Smith et al. 2008, Heitmeyer et al. 2009).

Similar to wetlands, healthy, productive riparian areas are supported by dynamic processes (MNHP 2011b). Random and variable flood events scour and redistribute sediments which create new locations for vegetation to become established, which can further trap sediments, elevate gravel bars, and create backwater channels. This variability creates a variety of vegetation communities at different successional stages.

Benton Lake National Wildlife Refuge

Benton Lake historically was a large, seasonally flooded marsh that likely supported emergent vegetation during some years. Currently, portions of the wetland are permanently flooded and are more like a lake with relatively large areas of open water. The wetland is completely isolated from the regional ground water system by the presence of an impermeable layer of clay. Subsurface soil layers restrict water movement and root penetration. The

Broadleaf cattail is an emergent plant species in wetland habitat.

water can have increased salinity and be somewhat brackish. The historical gradation of vegetation zones within Benton Lake, from robust emergents in deeper depressions to grasslands on uplands, has been altered. Most historical vegetation communities are still present on the refuge, but their distribution and extent have changed. Developments for water management and a subsequent alteration in hydrology and water chemistry in Benton Lake pools are responsible for most changes. Generally, communities have shifted from drier wetland vegetation, such as western wheatgrass, foxtail barley and sedges, to a more extensive distribution of wetter and more alkaline-tolerant species (for example, alkali bulrush and cattails). Increasing amounts of exotic and invasive species also occur on the refuge (Heitmeyer et al. 2009).

Associated Wildlife

A rich diversity of wildlife species use the Benton Lake basin (see Appendix G–Species Lists). Aquatic invertebrates include a variety of Crustacea, such as *Daphnia* sp., *Gammarus* sp., and *Hyalella azteca*, and insects such as Corixid beetles, damselflies and dragonflies, Notonectid backswimmers, and Chironomids (Heitmeyer et al. 2009).

Several amphibian and reptile species also use Benton Lake, including tiger salamanders, boreal chorus frogs, painted turtles, and common, western and plains garter snakes. There is one historical record of northern leopard frog on the refuge, but no recent occurrences. Fathead minnows are the only fish species occasionally present on the refuge.

Mammal species diversity and abundance in the Benton Lake wetland basin is relatively low, except for many small rodents such as mice and voles. Several species of bats likely use wetlands as foraging areas, but no formal surveys have been conducted. Muskrat often create openings in wetland vegetation with den building, but shallow water that freezes completely every year may be limiting their numbers. Additionally, many mammal species found mostly in the uplands, such as coyote, white-tailed deer, mule deer, and pronghorn, use dry parts of the wetlands to forage and breed.

Many waterbirds breed in the Benton Lake area. The most common breeding species include eared grebe, mallard, northern pintail, gadwall, blue-winged teal, cinnamon teal, American wigeon, northern shoveler, redhead, lesser scaup, ruddy duck, Canada goose, American coot, American avocet, Wilson's phalarope, marbled godwit, willet, Franklin's gull, white-faced ibis, black-necked stilt, and black-crowned night-heron.

Benton Lake Wetland Management District

Wetlands within the district, both on Service lands and throughout the landscape, are typically located in shallow depressions created by glacial activity during the last ice age. They are often found in complexes. In Montana, depressional wetlands are most concentrated to the north of Montana State Highway 2, from Glacier National Park to the North Dakota border. Individual depressions can also be found across the Northwestern Glaciated Plains north of the Missouri River.

Small, Shallow And Vegetated Wetlands

Most wetlands within the district are relatively small, shallow, and vegetated and are typically known as marshes, swamps, bogs, fens and wet meadows (Cowardin et al. 1979). The underlying soils, hydrology, and water chemistry strongly influence the vegetation found in these wetlands in any given year.

Some of these small, shallow, and vegetated wetlands are isolated from both ground water and other wetlands by an impermeable layer such as dense clay. The major sources of inputs are precipitation and snowmelt, and water loss occurs through evapotranspiration. These wetlands are temporarily or seasonally flooded, with most filling with water only occasionally and drying quickly, which affects the plant communities that are present. The drawdown zone is typically dominated by western wheatgrass, foxtail barley, povertyweed, common spikerush, hardstem bulrush or willow dock. Species richness can vary considerably among individual wetlands, and it is especially influenced by adjacent land use such as agriculture and grazing (MNHP 2011b).

Wetlands like these with more consistent water (for example, seasonal, semipermanent, and permanent wetlands) usually have a larger watershed and a significant connection to ground water. Species diversity can often be high. These wetlands usually contain emergent vegetation, such as cattails, sedges, spikerushes, rushes and bulrushes, as well as floating vegetation such as pondweeds, arrowhead, or common hornwort. When water recedes along the edges or during drought years, annuals and perennials, such as sedges, will germinate in exposed mudflats (MNHP 2011b).

Some of the small, shallow, and vegetated wetlands within the district have increased soil salinity due to high evaporation and the accumulation of minerals dissolved in the water. Salt-tolerant plants such as alkali bulrush, common three square, inland saltgrass, Nuttall's alkali grass, foxtail barley, red swampfire and freshwater cordgrass, and shrubs such as black greasewood are typical of these wetlands. Less salt-tolerate plants may occur in wet years when the salts are diluted (MNHP 2011b).

Prairie potholes occur in shallow depressions scraped out by glaciers in the northern Great Plains of Montana. The concentration of dissolved solids can vary considerably, even within the same year, although most prairie potholes contain alkaline water. Vegetation within these wetlands is highly influenced by hydrology and salinity. If water persists through the summer, monotypic stands of hardstem bulrush may occur with minor components of softstem bulrush or common threesquare along slightly drier margins. In permanently flooded sites, aquatic buttercups, aquatic smartweeds, pondweeds, or duckweeds are common. In seasonal and temporary wetlands, vegetation generally occurs in bands from a wetter middle dominated by spikerush through a drier ring of foxtail barley and an outer margin of western wheatgrass or thickspike wheatgrass (MNHP 2011b). Potholes are most common in the district around the Sweet Grass Hills and the northern end of the Front.

Wetlands with mineral soils that are subjected to long periods of anaerobic conditions can be found in the district as fringes around lakes or oxbows, and along slow-flowing streams and rivers as riparian marshes. The wetlands are typically seasonal or semipermanent. Seasonal wetlands typically have a central shallow marsh zone dominated by graminoids and sedges, while the deeper central marsh zone of semipermanent wetlands are dominated by cattails and bulrushes. Dominant vegetation often includes western wheatgrass, Northwest Territory sedge, Nebraska sedge, broadleaf cattail, and hardstem bulrush. Alkaline communities include western wheatgrass, freshwater cordgrass, and seashore saltgrass (MNHP 2011b).

More than 30 wetland basins of this type now exist on the H2–O WPA. These wetlands are primarily the remnants of natural oxbow basins that were created as the Blackfoot River meandered back and forth across the valley. Many of these wetlands were drained under earlier ownership, but have since been restored. With the recent restoration of many of these wetlands, some of the wetter areas are beginning to revert to sedge and rush communities. However, quackgrass continues to dominate in many areas, and it will take active management practices to convert these areas back to a more native composition.

Lake-System Wetlands

Lake systems are less common on fee-title lands across the district. These wetlands typically have deeper, more permanent water with less than 30 percent emergent vegetation (typically restricted to the edges) (Cowardin et al. 1979). Species associated with lake-system wetlands include sedges, creeping spikerush, broadleaf cattail and bulrush. Floating-leaved hydrophytes may be present in shallower areas of lakes, ponds, and reservoirs or in river backwaters. These include water lilies, yellow pondlily, buttercup, pondweed, and duckweed. Submergents such as common hornwort, horned pondweed, mare's tail, and water milfoil are also found in warm, shallow areas of lakes, ponds, and reservoirs (MNHP 2011b). Examples of this type can be found on Arod Lakes WPA.

Riparian Areas

Riparian areas are associated with perennial to intermittent or ephemeral streams throughout the northwestern Great Plains. Flooding is important in riparian areas for seed dispersal, vegetation establishment, and creating a diversity of vegetation communities, such as forest, shrubland, and wet meadows, as well as gravel and sand flats. In the western part of Montana, the overstory is often dominated by species such as black cottonwood, with narrowleaf cottonwood and Plains cottonwood occurring as codominants. Further east, narrowleaf cottonwood and Plains cottonwood become dominant. In wetter systems, the understory is typically willow and redosier dogwood with graminoids like western wheatgrass and forbs like American licorice. Sagebrush may dominate in areas where the channel is incised. Overgrazing or agriculture can degrade riparian systems causing saltcedar and Russian olive to replace native woody vegetation (MNHP 2011b).

Riparian areas along the foothills and valleys of the mountains are generally comprised of a mosaic of trees and shrubs. Black cottonwood is the key indicator species. Other dominant trees may include boxelder maple, narrowleaf cottonwood, eastern cottonwood, Douglas-fir, peachleaf willow, or Rocky Mountain juniper. Dominant shrubs include Rocky Mountain maple, thinleaf alder, river birch, redosier dogwood, hawthorn, chokecherry, skunkbush sumac, willows, rose, silver buffaloberry, or snowberry. These riparian areas may be next to sagebrush-steppe in moderately high intermountain basins (MNHP 2011b).

Associated Wildlife

A rich diversity of animal species use the wetlands and riparian habitats of the district. The relative abundance of species and specific food and cover resources used by animals vary with the long-term dynamics of flooding and drying in the systems (Frederickson and Reed 1988, Batzer et al. 1999, Wrubleski 2005). Aquatic invertebrates reach high abundance and biomass during wet periods of long-term water cycles in Great Plains wetlands and include a rich diversity of Crustacea, such as *Daphnia* sp., *Gammarus* sp., and Hyalella azteca, and insects such as Corixid beetles, damselflies and dragonflies, Notonectid backswimmers, and Chironomids (Heitmeyer et al. 2009).

Several amphibian and reptile species use the district wetlands and riparian areas on the Plains. Amphibians include three species of frogs (boreal chorus, northern leopard, and Columbia spotted), four species of toads (plains spadefoot, Great Plains, Woodhouse's, and western) and tiger salamanders. Reptiles include the common garter snake, plains garter snake, terrestrial garter snake, painted turtle, and spiny softshell turtles (MNHP 2011b). In the Blackfoot Valley, the Rocky Mountain tailed frog and long-toed salamander have also been documented (MNHP 2011b). The presence and abundance of some common species like tiger salamanders, gartersnakes, and boreal chorus frogs varies among years as flooding and drying changes resource availability and these species' susceptibility to being prey for other species groups (Heitmeyer et al. 2009).

Smaller prairie streams support native fish such as fathead minnows, white suckers, and lake chubs (Holton and Johnson 1996). Several streams and rivers along the Front support pure strains of westslope cutthroat trout and are considered highly significant for the east slope population. The Sun River was historically a stronghold for fluvial Arctic grayling, which vanished from the system because of habitat degradation. In the spring of 1999, grayling were reintroduced above Gibson Dam into upper Sun River tributaries. A rare hybrid of the northern redbelly dace also occurs along the Front. There are currently 12 native fish species and 13 nonnative fish species in the Blackfoot River watershed, as well as several hybrid salmonids (MFWP 2010).

Gene Nieminen / USFWS

Mallard Pair

Donna Dewhurst / USFWS

Redheads feed in large, open areas.

Mammal species diversity and abundance in the district wetlands is relatively low, except for many small rodents such as mice and voles. The relative abundance and productivity of wetland-dependent species like muskrat and mink track long-term hydrological and vegetation dynamics. Several species of bats may use wetlands as foraging areas, especially when flooded. Additionally, many mammal species that mostly use the uplands surrounding wetlands, such as coyote, white-tailed deer, mule deer, pronghorn, and elk may move into wetlands during dry seasons and years to forage and breed.

Many waterbirds use the district wetlands, but species richness, abundance, and production vary with the extent and duration of flooding in the basins. The most common breeding species include eared grebe, mallard, northern pintail, gadwall, blue-winged teal, cinnamon teal, American wigeon, northern shoveler, redhead, lesser scaup, ruddy duck, Canada goose, American coot, American avocet, Wilson's phalarope, marbled godwit, willet, and black tern. During wetter periods of the long-term precipitation and flooding cycle, many waterfowl, shorebirds, wading birds, gulls, and terns,and other wetland-dependent species are present, and productivity is high. Breeding waterbird productivity here follows the long-term dynamics of production in other northern prairie systems as vegetation, invertebrate, and nutrient cycling changes when wetlands dry, reflood, reach peak flooding extent, and then begin drying again (Murkin et al. 2000).

Waterbird use across the district is high during the fall and spring migration periods, both in wet and dry periods. During drier periods, extensive mudflat areas can attract shorebirds that use rich benthic and terrestrial invertebrate resources, and drying wetlands concentrate aquatic prey that is used by wading birds, some terrestrial birds, and mammals. As water in the district rises during wetter periods, more of the basins are flooded in both the spring and fall and provide critical migration stopover areas for waterfowl, shorebirds, wading birds, and other species such as birds of prey, songbirds, rails, and blackbirds. Bald eagle and peregrine falcon, raptor species of concern, are attracted to the region when large numbers of waterfowl and waterbirds are present (Heitmeyer et al. 2009).

Blackfoot Valley Conservation Area

As with other areas of the refuge complex, the Blackfoot Valley CA includes a rich diversity of wetland and riparian systems. Approximately 5 percent of the area is made up of wetland and riparian areas. The dominant riparian feature is the Blackfoot River and its associated tributaries. This is a cool to coldwater system with strong seasonal variability due to melting snow pack from higher-elevation mountainous areas. The Blackfoot is a classic freestone trout river with boulder and cobble riffles, cobble and gravel runs and pools, and silt on the margins or in the deepest pools. Deep runs and pools with undercut banks and large woody debris provide the best fish habitats, while the riffles harbor diverse macroinvertebrate communities. The Blackfoot is a clear-running river, except during spring runoff or where heavy livestock use, bank erosion, or stream incisement has occurred (MNHP 2011b).

As with other parts of the district, the Blackfoot Valley contains small, shallow, and vegetated wetlands and lake-system wetlands that have already been described, however, it is more likely in these higher-elevation areas that wetlands may be dominated by woodland and forest vegetation.

In northwestern Montana, wooded small and shallow wetlands, or vernal pools, occur on valley bottoms, lower benches, toe slopes, and flat sites from elevations of 2,840–5,200 feet. Wooded vernal pools are glacially created small, shallow, freshwater wetlands that partially or totally dry up by fall. Wooded vernal pools are often surrounded by grand fir, subalpine fir, western larch, Engelmann spruce, lodgepole pine, Douglas-fir, black cottonwood, and, to a lesser extent, quaking aspen and paper birch. Other common species include water starwort, inflated sedge, common spikerush, and reed canarygrass (MNHP 2011b).

In northwestern Montana, small, shallow, and vegetated wetlands dominated by conifers with permanent or seasonal flooding are also known as conifer swamps. This is an uncommon wetland type often next to lakes, fens, or wet meadows with areas of moving and stagnant water. Vegetation includes western red cedar, western hemlock, subalpine fir, and Engelmann spruce forests. Some of the most typical understory species include American ladyfern, woodfern, skunk cabbage, field horsetail, arrowleaf groundsel, and bluejoint reedgrass. This system frequently borders fens and wet to mesic coniferous forests (MNHP 2011b).

Associated Wildlife

Five amphibians have been documented in the Blackfoot Valley: Columbia spotted frog, long-toed salamander, Pacific tree frog, Rocky Mountain tailed frog, and western toad.

There are 12 native fish species and 13 nonnative fish species in the Blackfoot River watershed, as well as several hybrid salmonids (MFWP 2010).

The Blackfoot River watershed also provides quality breeding, nesting, migratory, and wintering habitat for a diversity of wetland-dependent bird species. Wetland complexes here provide important breeding habitat for 22 species of waterfowl:

- northern pintail
- mallard
- lesser scaup
- wood duck
- redhead
- ring-necked duck
- canvasback
- American wigeon
- Canada goose
- green-winged teal
- blue-winged teal
- cinnamon teal
- northern shoveler
- gadwall
- common goldeneye
- Barrow’s goldeneye
- harlequin duck
- bufflehead
- hooded merganser
- common merganser
- red-breasted merganser
- ruddy duck

During the nesting season in 1995, 1996, and 1997, the University of Montana Wildlife Cooperative Unit and the Service conducted breeding bird productivity studies in three separate properties within the Blackfoot River watershed, including the Blackfoot WPA. Nest success for upland nesting waterfowl (measured by the Mayfield method), including pintail, mallard, and lesser scaup, was found to be 49, 30, and 45 percent, respectively (Fondell and Ball 1997). These nest success estimates are some of the highest in North America for upland nesting ducks. Fondell and Ball (1997) stated that "Because the [Ovando] Valley is relatively undisturbed these estimates may reflect nest success over large areas of the watershed."

Brood surveys of northern shoveler, gadwall, American wigeon, cinnamon and blue-winged teal, canvasback, redhead, ring-necked, ruddy, and Barrow's goldeneye ducks in 1995 and 1996 on the WPAs in the Blackfoot Valley averaged 63 broods on 5 wetlands totaling 104 acres, or 0.62 broods per acre, with prefledge brood sizes of 5.2 in 1995 and 5.9 in 1996, which were higher than brood sizes reported in studies conducted at Freezeout Lake Wildlife Management Area and at Benton Lake Refuge on the east side of the Continental Divide (Fondell and Ball 1997). This high productivity is due to the large expanses of relatively undisturbed native grassland in association with wetland habitat, a coyote-dominated predator base, and a high concentration of glaciated wetlands. Breeding waterfowl pair counts have shown relatively high pair densities per square section for redhead and canvasback ducks. Redhead duck numbers over the past 15 years have averaged 12 pairs per section and canvasback ducks have averaged 9 pairs per section.

The Blackfoot Valley CA has also had a successful trumpeter swan reintroduction project for the last several years. Please see the Species of Concern section in this chapter for more details.

Rocky Mountain Front Conservation Area

This CA lies within the district and has a similar diversity of wetlands and riparian types as already described for the district. The Dearborn, Sun, and Teton Rivers form major riparian corridors running from the mountains eastward onto the prairies. Approximately 30 percent of the 700-plus plant species documented on the Front are associated exclusively with wetland or riparian habitats, including some of the largest remaining fens in the Pacific Northwest.

Fens are confined to specific environments defined by ground water discharge, soil chemistry, and peat accumulation. Fens form at low points in the landscape where ground water supports a constant water level at, or near, the surface most of the time. Constant high-water levels typically lead to a relatively deep accumulation of organic material. Fens can be very diverse, with a large number of rare and uncommon bryophytes and vascular plant species, and provide habitat for uncommon mammals, mollusks, and insects.

Fens usually occur as a mosaic of herbaceous communities dominated by sedges, spikerushes, and rushes and woody plant communities of willow and birch carr shrubland. Forb diversity is especially high in fens. Fens are often found in association with other wetlands such as marshes, wet meadows, riparian shrublands, conifer swamps, or wet to mesic coniferous forests (MNHP 2011b).

Associated Wildlife

Several amphibians occur along the Front, including three species of frogs (boreal chorus, northern leopard, and Columbia spotted), two species of toads (plains spadefoot and western), and two species of salamanders (tiger and long-toed). The common garter snake, plains garter snake, terrestrial garter snake, and painted turtle are reptiles known to occur along the Front (Maxell et al. 2003).

Several streams and rivers along the Front support pure strains of westslope cutthroat trout and are considered highly significant for the east slope population. The Sun River was historically a stronghold for fluvial Arctic grayling, which vanished from the system because of habitat degradation. In the spring of 1999, grayling were reintroduced above Gibson Dam into the upper Sun River tributaries. A rare hybrid of the northern redbelly dace also occurs within the project area.

Lying at the western end of the PPPLCC's Prairie Pothole Region within the refuge complex, the Front provides habitat for a significant diversity of wetland-dependent bird species. Seventeen species of waterfowl breed within the project area, including the harlequin duck, which is found along several mountain streams. Three nesting pairs of rare trumpeter swans have been documented in the Bean Lake–Nylan Reservoir complex, one of the few breeding occurrences outside of the Centennial Valley in southwest Montana. Hundreds of thousands of snow geese migrate along the Front, including 40,000 Wrangel Island snow geese, representing 50 percent of the entire known population. Peak flights of waterfowl along the Front during the spring and fall migrations often exceed several million birds. Six species of grebes are known to nest, including the red-necked grebe, a species in serious decline in many other areas. Eleven different species of shorebirds breed in the wetlands and adjacent grasslands scattered throughout the area. Several thousand sandhill cranes from the Rocky Mountain population use the river corridors during their spring and fall migrations, and some of the cranes breed in these areas as well.

Swan River National Wildlife Refuge and Swan Valley Conservation Area

Most wetlands on the Swan River refuge are seasonal or semipermanent emergent or scrub–shrub wetlands (Cowardin et al. 1979, MNHP 2011b) that occur around Swan Lake or in oxbows of the Swan River. Historically, dominant vegetation in the Swan River wetlands may have included western wheatgrass, Northwest Territory sedge, Nebraska sedge, broadleaf cattail, and hardstem bulrush, however, today reed canarygrass is common (MNHP 2011b). The federally threatened wetland plant, water howellia, can be found on TNC Preserve that borders the southern edge of the refuge, but the plant has not been confirmed to exist on the refuge to date. The Swan River also flows through the refuge. Historically, the river corridor would have been prone to annual to episodic flooding, which would create a mosaic of multiple communities that are tree-dominated with a diverse shrub component. However, the extent to which modifications to the hydrology may be disrupting these processes is unknown.

The Swan Valley is unique among Montana's spectacular valleys in that it contains more than 4,000 glacially derived wetlands. In fact, approximately 16 percent of the land in Swan Valley is considered wetland habitat (lakes, rivers, ponds, marshes, wet meadows, peatlands, and riparian areas). By comparison, the remainder of Montana averages 1-percent wetland habitat. As with other parts of the district and the Blackfoot Valley, the Swan Valley contains small, shallow, and vegetated wetlands, fens, and foothill and valley riparian areas and conifer swamps. In addition, Rocky Mountain wooded vernal pools are particularly well represented in the Swan Valley (MNHP 2011b).

Associated Wildlife

Seventeen species of waterfowl breed on the refuge including common waterfowl species such as Canada geese, mallards, cinnamon teal, and common goldeneye. Red-necked grebes, horned grebes, eared grebes, sora, Virginia rails, and marsh wrens are also common breeders. In addition, the refuge provides nesting sites for bald eagles. Yellow-headed blackbirds nest and forage on the refuge. White-tailed deer are the most common large mammal seen. Elk, moose, beaver, bobcat, and grizzly and black bear are known to inhabit the area. Other resident wildlife include coyote, muskrat and raccoon. Game fish include yellow perch, bull trout, northern pike, kokanee salmon, largemouth bass, cutthroat trout, brook trout, and mountain whitefish.

Sixteen species of amphibians and reptiles are known to inhabit the diverse habitats within the Swan Valley. Many of the documented species include S4 Status Species (apparently secure, though it may be quite rare in parts of its range or is suspected to be declining) such as common garter snake, painted turtle, rubber boa, Columbia spotted frog, long-toed salamander, and Rocky Mountain tailed frog (MNHP 2011b). The western toad is listed as an S2 Status Species (species at risk because of very limited or potentially declining population numbers, range, or habitat, making it vulnerable to global extinction or extirpation in Montana). The northern leopard frog is listed as an S1 Status Species (at high risk because of extremely limited or rapidly declining population numbers, range, or habitat, making it highly vulnerable to global extinction or extirpation in Montana). Species not listed in the Natural Heritage Database, but known to occur in the Swan Valley are Pacific tree frog, western skink, eastern racer, gopher snake, terrestrial garter snake, and western rattlesnake (Werner et al. 2004).

Common fish species in the Swan Valley include longnose sucker, largescale sucker, and slimy sculpin. In addition, potential species of concern within the project area include the brook stickleback and pygmy whitefish. Westslope cutthroat trout are currently a species of special concern and use clear, cold lakes and streams found here. Swan Valley CA is within the designated recovery area for the federally threatened bull trout. Critical habitat has been designated for bull trout within the CA.

Wetland complexes here provide important breeding habitat for 21 species of waterfowl:

- mallard
- lesser scaup
- wood duck
- redhead
- ring-necked duck
- canvasback
- American wigeon
- Canada goose
- green-winged teal
- blue-winged teal
- cinnamon teal
- northern shoveler
- gadwall
- common goldeneye
- Barrow's goldeneye
- harlequin duck
- bufflehead
- hooded merganser
- common merganser
- red-breasted merganser
- ruddy duck

The Swan Valley is one of the only watersheds in the western continental United States that supports breeding common loons. Currently, there are six breeding pairs in the Swan Valley on the Van, Loon, Summit, Lindbergh, Swan, and Holland Lakes. Historical records show that Shey and Peck Lakes were also once occupied by common loons.

Forests and Woodlands

Large parts of the Blackfoot Valley and Swan Valley CAs include forested lands. Healthy forests and wetland systems provide a host of watershed services, including water purification, ground water and surface flow regulation, erosion control, and stream bank stabilization. Carbon sequestration is the process by which atmospheric carbon dioxide is taken up by trees, grasses, and other plants through photosynthesis and stored as carbon in biomass (trunks, branches, foliage, and roots) and soils. The sink of carbon sequestration into forests and wood products helps to offset that sources of carbon dioxide that add to the atmosphere and mitigate climate change.

Blackfoot Valley Conservation Area and Blackfoot Waterfowl Production Area

There are approximately 260 acres of fee-title forest lands on the Blackfoot WPA. Management of the forest has consisted mainly of invasive plant control; there has been no logging or burning since the waterfowl production area was added to the Refuge System in the 1970s.

Stands of large ponderosa pine historically dominated most dry forest sites in western Montana. These are also comprised of a mix of ponderosa pine and Douglas-fir. Logging and fire suppression have altered age-class structure, physical structure, tree density, and tree species composition (Barrett 1979, Sheppard et al. 1983). Large, old-growth trees in more open settings have been replaced with dense stands of younger trees.

Swan River National Wildlife Refuge and Swan Valley Conservation Area

There are approximately 300 acres of fee-title forest lands on the Swan River Refuge. Management has consisted mainly of invasive plant control; there has been no logging or burning since the refuge was added to the Refuge System.

The Swan Valley lies at the border of the maritime and continental climates and thus has a mixture of Pacific coastal forest and intermountain tree species. Western red cedar, grand fir, western hemlock, and western larch grow in the valleys along with more familiar species such as Douglas-fir, Engelmann spruce, ponderosa pine, and lodgepole pine.

Cottonwood and spruce also dominate much of the Swan River's floodplain. Most of the lower elevation uplands consist of mixed conifers dominated by Douglas-fir, western larch, ponderosa pine, and lodgepole pine. Other common species include grand fir and subalpine fir. Stand types at most of the low-

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Restoration in the Swan Valley Conservation Area.

elevation lands range from regenerated seedling and pole stands, to mixed-aged stands of mature timber. For the lower elevations, typical forest rotations for saw timber range from 50–75 years. Forest types on the higher lands consist primarily of subalpine fir and lodgepole pine, with components of western larch, Douglas-fir, whitebark pine, and other species.

Associated Wildlife

Many priority bird species are closely associated with old forest stages and snags, such as the Lewis's woodpecker, pileated woodpecker, olive-sided flycatcher, flammulated owl, white-breasted nuthatch, and Williamson's sapsucker. Regional populations of these species have decreased due to the reduction of old forest stages. Olive-sided flycatchers, flammulated owls, and black-backed woodpeckers are all level one priority species for the Montana PIF program. They are found in open canopy woodlands, open-canopy ponderosa pine, and closed-canopy lodgepole pine, respectively.

Sixty-nine species of mammals are known to inhabit the diverse habitats within the Swan Valley. Many of the species documented include S2 Status Species such as the grizzly bear and Townsend's bat. Other species include S3 Status Species such as the wolverine, fisher, hoary bat, fringed myotis, hoary marmot, and Canada lynx, a federally threatened species. The refuge complex does not have enough fee-title forested habitat to provide all life needs for species such as lynx, gray wolf, and grizzly bear. However, complex fee-title and easement lands secure important linkages and connectivity between critical habitats on adjacent forested lands.

Game species known to occur in the valley are moose, elk, white-tailed deer, mule deer, bighorn sheep, gray wolf, and mountain goat (Foresman 2001). The forest units are located in areas with robust deer and elk populations. A diverse forest with varying age classes and stand types is important for ungulate survival. Early successional forests provide abundant shrubs and forbs that are forage for species of elk and deer. Older forests with dense canopy cover offer thermal regulation. Forests also provide important hiding and escape cover.

Other species documented to occur within the valley follow (Foresman 2001):

- northern pocket gopher
- southern red-backed vole
- long-tailed vole
- montane vole
- heather vole
- northern grasshopper mouse
- house mouse
- Norway rat
- northern bog lemming
- yellow-bellied marmot
- northern flying squirrel
- coyote
- red fox
- striped skunk
- long-tailed weasel
- mink
- badger
- raccoon
- white-tailed jackrabbit
- mountain cottontail
- porcupine

Sagebrush-Steppe

In the refuge complex, most of this system is dominated by mountain big sagebrush. Three-tip sagebrush is found where it functions primarily as a seral component, increasing in frequency following fire. Antelope bitterbrush may codominate, but, as a codominant, its occurrence is limited, being found primarily on intrusive volcanics in western and west-central Montana. Other shrubs may be present, but usually at low cover values (5–10 percent). Species include rubber rabbitbrush, and green rabbitbrush, wax currant, Woods' rose, deerbrush ceanothus, snowberry and serviceberry (MNHP 2010a).

The herbaceous layer is usually well represented. Graminoids that can be abundant include rough fescue, Idaho fescue, bottlebrush squirreltail, pinegrass, needlegrass, spike fescue, poverty oatgrass, western wheatgrass, mountain brome, slender wheatgrass, prairie Junegrass, bluebunch wheatgrass, Sandberg's bluegrass, and are variety of dry, upland sedges such as threadleaf sedge and Geyer's sedge (MNHP 2010a).

Forb diversity is moderate to high, commonly exceeding 30 species in a 400-square meter macroplot. Species may include arrowleaf balsamroot, Indian paintbrush, cinquefoil, fleabane, phlox, milkvetch, prairie smoke, lupine, buckwheat, yarrow, rosy pussytoes, wild strawberry, and western sagewort (MNHP 2010a).

Fire is critical to supporting native grassland–sagebrush communities. The historical fire regime in rough fescue communities, for example, was characterized by frequent return-interval (5–10 years), low-severity fires. The historical fire regime in sagebrush communities was characterized by longer return-interval (more than 25 years), stand-replacement fires.

Sagebrush-steppe areas in the refuge complex were targeted by early European settlers for grazing and farm lands. Today, most of the native grassland–sagebrush communities are located on private land. The big sagebrush-dominated plant community type is most prevalent in the middle Blackfoot Valley south of the Blackfoot River. The big sagebrush–rough fescue plant association, endemic to west and north-central Montana, is common in the Kleinschmidt Flat area. The three-tip sagebrush–rough fescue plant association is common in the Ovando area, yet found nowhere else in the world.

Sagebrush-steppe habitat occurs in the Blackfoot River watershed on approximately 56,000 acres (4 percent of total watershed acres). The Service owns 2,585 acres of sagebrush–steppe in fee title and has 12,750 acres of sagebrush-steppe under Western Montana conservation easements.

Associated Wildlife

High-priority species such as the Brewer's sparrow and loggerhead shrike build nests aboveground in shrubs or rely specifically on shrubs for cover. Brewer's sparrows, in particular, have experienced significant declines in the last 10–20 years and are good habitat indicator species because they appear to be sensitive to habitat changes at multiple scales (Knick et al. 2003). Brewer's sparrow is strongly associated with sagebrush, preferring sites with more than 13-percent sagebrush cover, with an average canopy height less than 5 feet and more than 25 percent of cover in native climax species (Bock and Bock 1987, Rotenberry et al. 1999). This sagebrush obligate was the most abundant breeding species found at sagebrush sites on the Blackfoot and Kleinschmidt Lake WPAs during Service productivity surveys in 1996 (Fondell and Ball 1997). The long-term viability of Brewer's sparrows in Montana depends on keeping large stands of sagebrush in robust condition (PIF 2000).

Invasive And Nonnative Plants

Invasive and nonnative plants occur on the refuge complex to varying degrees.

Benton Lake National Wildlife Refuge

The refuge is generally free from highly invasive, noxious weeds. Through early detection, rapid response (EDRR), early colonizing plants of spotted knapweed and leafy spurge, in particular, have been eradicated every year and prevented from spreading. Canada thistle has been present for many years on the refuge; thistle patches are found near many roads, dikes, wetland edges and other disturbed areas. Some dense stands have been treated with success, but most areas go untreated.

Across the wetland and grassland habitats on the refuge, however, several nonnative species are of concern for their effect in changing the native habitat, even if they are not on the State's noxious weed list.

Crested Wheatgrass

Crested wheatgrass has been the most commonly planted exotic grass in western North America since the early 1900s. Invasion of this species into native rangeland can have a negative effect on plant and wildlife diversity (Reynolds and Trost 1981, Christian and Wilson 1999, Davis and Duncan 1999). Crested wheatgrass was used to landscape areas around the refuge headquarters area in the 1960s and to revegetate roadsides and other areas of disturbance. Since then, it has spread throughout the refuge to varying degrees and covers approximately 400 acres. The refuge has begun a pilot program to find the most effective methods for controlling crested wheatgrass and restoring native vegetation.

Russian Olive

This species is adaptable in semiarid and saline environments and has been promoted as a source of food and cover for some wildlife species (NRCS 2002), particularly ring-necked pheasant. With this in mind, refuge staff planted Russian olive trees on the

Cassondra Skinner / USDA–NRCS PLANTS Database

Crested wheatgrass is a nonnative species that can have a negative effect on plant and wildlife diversity.

refuge until the 1970s. Since that time, research has shown that Russian olive and other nonnative trees fragment native prairie by causing some nesting grassland birds to avoid these areas and by increasing the predation of adult and juvenile grassland-dependent birds and their nests (Delisle and Savidge 1996, Gazda et al. 2002, Helzer 1996, Johnson and Temple 1990). Fortunately at Benton Lake Refuge, Russian olive trees have not spread and are generally confined to the shelterbelts where they were planted or to single, scattered individuals.

Japanese Brome

This grass has been present on the refuge for many years with almost no attention given to its treatment. Efforts are currently underway to map and estimate the extent and density of the infestation on the refuge. The degree to which this species affects wildlife use of native prairie is unknown. It is possible that Japanese brome decreases naturally during wetter periods (NRCS 2005), making aggressive control unnecessary.

Kentucky Bluegrass

This grass has been present in the refuge for many years with almost no attention given to its treatment. Efforts are underway to map and estimate the extent and density of the infestation. Recent inventories in the Dakotas have shown that many areas of native sod on fee-title lands in the northern Great Plains have become heavily invaded with Kentucky bluegrass, which is associated with the loss of floristic and avian diversity as well as negatively affected nutrient pools, energy flows, soil invertebrate and mycorrhizal relationships, and water cycles (Murphy and Grant 2005, Grant et al. 2009).

Garrison Creeping Foxtail

Creeping foxtail is an introduced rhizomatous perennial species. It has a regenerative advantage on sites where the conditions are transitional between the more regularly flooded alkaline communities, such as alkali bulrush, and areas formerly dominated by foxtail barley at higher elevations. Its distribution has expanded significantly through the Benton Lake Refuge in recent years and generally occurs in bands lying immediately above areas occupied by cattail.

Cheatgrass

This grass has been present in the refuge complex for many years with almost no attention given to its treatment. It is mostly restricted to the southeast part of the refuge east of the Bootlegger Road. It is of concern because of its interaction with fire. Prescribed fire is the primary management tool at Benton Lake Refuge, however, cheatgrass can readily spread after burning. Work to map the infestations and to develop a preburn treatment plan is in progress.

Other nonnative species that occur in low numbers, or to a limited extent but could become an invasive problem, include smooth brome, reed canarygrass, salsify, alfalfa, and yellow sweetclover.

Benton Lake Wetland Management District

All 23 waterfowl production areas have been surveyed for noxious weeds at least once over the past 5 years by the Invasive Species Strike Team. Most of the waterfowl production areas have relatively small and annually variable infestations of Canada thistle, houndstongue, and a few other noxious weeds. Known infestations are treated on an annual basis as time allows. High priority noxious weed infestations are described below:

- Jarina WPA has one known patch of leafy spurge approximately 0.1 acre in size and scattered patches of spotted knapweed that collectively amount to approximately 2 acres.
- Arod Lakes WPA has scattered patches of Russian knapweed over approximately 5 acres.
- Schrammeck Lake WPA has scattered patches of Dalmatian toadflax which collectively cover approximately 1 acre.

On WPAs in the Blackfoot Valley, the local manager and Invasive Species Strike Team have mapped infestations and are actively managing them through biocontrol, chemical control, and monitoring. The species of most concern are leafy spurge, yellow toadflax, Russian and spotted knapweed, common tansy, houndstongue, oxeye daisy, and Canada thistle.

Cool-season exotic invasive grasses in the district are primarily Kentucky bluegrass, smooth brome, and crested wheatgrass. Prescribed grazing and fire are the management tools currently used to combat these species on native prairie. The district is part of the collaborative Native Prairie Adaptive Management Project within the Service's Region 6 designed to find management scenarios to reverse Kentucky bluegrass and smooth brome infestations.

Blackfoot Valley Conservation Area

Since 1994, the Blackfoot Challenge Weeds Committee, of which the Service is a participant, has coordinated and implemented a holistic strategy for managing undesirable invasive and noxious weeds in the watershed. Combining action with education, the core of the program is the locally led Vegetation Management Areas program, where neighbors work across property boundaries to manage weeds. Almost 475,000 acres are under active weed management, with 380 private landowners participating in the project. Integrated weed management strategies include herbicides, biocontrol, revegetation, multispecies grazing, hand pulling, plowing, mowing, prevention, and EDRR (Blackfoot Challenge et al. 2005).

Rocky Mountain Front Conservation Area

The Service recognizes the Front as one of the Nation's most significant wildlife areas and identifies invasive weeds as one of three primary threats to the Front's ecological integrity. Of the 2 million acres on the Front, noxious weeds infest an estimated 32,000 acres. Weeds have negative economic effects by reducing the productivity of farms and ranches; degrading water quality; reducing the quality and quantity of forage for elk, deer, pronghorn, and other wildlife; and adversely affecting outdoor recreation.

Concerned private landowners, nongovernmental organizations, State agencies, Federal agencies and the Service have active partnerships along the Front to address noxious weed issues. In general, these groups have organized along major watersheds to map and treat weeds as well as to educate others on prevention and control. Spotted knapweed and leafy spurge are currently the primary noxious weed infestations along the Front.

Swan River National Wildlife Refuge

Much of the native vegetation in the wetlands of the refuge has been replaced with reed canarygrass. A complete inventory of this and other invasives has not been done on the refuge.

Swan Valley Conservation Area

The most common noxious weeds in the Swan Valley are spotted knapweed and oxeye daisy. The noxious orange and yellow hawkweeds are relatively new but are rapidly spreading. The possibility that purple loosestrife, tansy ragwort, and yellow flag iris could become new invaders is also of concern in the Swan Valley.

Threats

Primary threats to native habitats and wildlife within the complex include energy development, housing development, and agricultural conversion. Oil, gas, and wind development activity has increased recently in the district. Loss and fragmentation of habitat are among the significant ecological impacts from access roads, drill pads, pipelines, waste pits, and other components of oil and gas project infrastructure. These impacts extend beyond the physical structures. Studies show that the actual ecological footprint of oil and gas extraction stretches across rangelands and forested lands for a considerable distance (Weller et al. 2002).

During strong markets for scenic western properties, especially when cattle prices are low, there is concern that ranches, particularly in the Blackfoot Valley and the Rocky Mountain Front, will be vulnerable to sale and subdivision for residential and commercial development. Housing development, and its associated infrastructure, can disrupt wildlife migration patterns. Nesting raptors and grassland bird species may be especially vulnerable to habitat fragmentation in the Blackfoot Valley. Riparian habitat loss due to development is also a key concern. Riparian habitat is a key component to grizzly bear movement between the mountains, valleys, and prairies. Livestock grazing and ranching practices tend to be compatible with grizzly bears, which move unimpeded up and down riparian corridors. Riparian areas also provide nest sites for many species of migratory birds that may be negatively impacted by development. In addition, housing developments can add sewage-derived nutrients to streams and lakes, increase wetland drainage and water diversion, and introduce invasive species that can affect threatened species, such as the bull trout.

Historically, the northern mixed-grass prairie system stretched from northern Nebraska into southern Canada and westward through the Dakotas to the Rocky Mountain Front in Montana. Now it covers only about 104,000 square miles. This is one of the most disturbed grassland systems, where an estimated 75 percent of the region has been heavily altered. Much of the conversion, and continued threat, within the complex is in the central part of the district, also known as the "Golden Triangle." This agricultural designation includes Great Falls at its apex and then roughly runs northeast through Havre, west to Cut Bank, and back to Great Falls. The area produces approximately half of Montana's wheat, primarily winter and spring wheat, and is the most productive of the State's farming areas that are not irrigated. Only a few remaining areas of mixed-grass prairie in the complex have escaped conversion to agriculture (NatureServe 2008). These grasslands are prominently represented in the district along the Rocky Mountain Front, surrounding the Sweet Grass Hills, and in Glacier County on the Blackfeet Indian Reservation.

Wildlife Disease

Regular surveillance and response preparedness for wildlife diseases are ongoing within the refuge complex. Currently, the high-priority wildlife diseases are botulism, West Nile virus, and chronic wasting disease.

Botulism

Avian botulism outbreaks, caused by the ingestion of a toxin produced by the bacterium, *Clostridium botulinum*, have occurred at Benton Lake at least since the mid-1960s (USFWS 1961–99). Occurrence of botulism at Benton Lake Refuge before the 1960s is unknown (no records or monitoring data are available), but documentation of historical outbreaks in other large wetland basins in the western U.S. suggest it probably occurred at least in some years (Wetmore 1915, Giltner and Couch 1930, Kalmbach and Gunderson 1934). Arod Lakes WPA also has a history of botulism outbreaks. District staff conduct periodic checks during late summer in this area.

West Nile Virus

A surveillance program for West Nile virus is ongoing at the Benton Lake Refuge. Cascade County conducts annual mosquito trapping in conjunction with weekly surveillance routes for avian mortality conducted by refuge staff.

Chronic Wasting Disease

Weekly surveillance and opportunistic sampling for chronic wasting disease has occurred on the refuge complex since 2004. To date, no occurrences of chronic wasting disease have been detected in wild ungulates in Montana.

Habitat Management Activities

The Service manages habitats through several refuge management activities under specific, prescribed conditions to meet habitat demands for a diverse suite of species—cooperative farming, prescribed fire and haying, and prescriptive grazing.

Cooperative Farming

When lands are included into the Refuge System as WPAs they often contain croplands or degraded stands of tame grasses instead of native habitat. In these cases, the cropland is usually seeded back to native cover or DNC for waterfowl. Native grass seed is generally more expensive, and native grass stands are often more difficult to establish.

If tame grass stands are in poor condition or have serious weed problems, farming to create a clean seedbed may be required for 2–4 years. Farming and seeding is used only to reestablish grassland or nesting cover and to return an altered landscape to a more native condition. The interim crops, such as grain, can provide some short-term, immediate benefits to local and migrating wildlife and be an erosion

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Highway 200 near Ovando, Montana, in the Blackfoot Valley Conservation Area.

control measure. In the long term, the real benefit from this activity is an increase in nesting habitat.

Often the Service conducts farming and seeding operations in cooperation with local farmers. Benefits to the local economy are limited, but the farming permittee should experience some economic gain. However, finding a cooperator willing to farm can be a limiting factor.

Prescribed Fire

Prescribed fires have been used in the northern Great Plains and Rocky Mountains for native species management by both the public and private agencies. Fire is used to remove litter and ladder fuel, control noxious weeds, reduce woody vegetation, or to improve the height and density of planted cover. Prescribed fire has been used as a tool to manage grasslands in the refuge complex since 1975.

Fire can be very important to the natural health and vigor of grasslands and shrublands. Fire releases nutrients tied up in vegetative matter, and removes dead vegetation that inhibits new growth. Fire can suppress exotic plant species and prevent the invasion of woody species, such as juniper, into native grasslands. However, fire may also allow the invasion of fire-tolerant species such as cheatgrass and spotted knapweed.

Burning grasslands that have evolved with fire can enhance vegetative growth, improve plant reproduction, and attract or concentrate wildlife. Regrowth following fire can be especially attractive to wildlife because of increased nutrition and palatability, and plants are often larger and more vigorous after a short recovery period. Blackened soil warms more quickly in the spring, resulting in more rapid plant growth and seed germination and can make soil invertebrates more available for wildlife. Nutrients are released from dead vegetation and are more readily available for new plant growth. Prescribed fires, when done properly, can increase habitat diversity by creating edges between habitat associations, which makes the area more attractive to wildlife. However, the burning of upland vegetation results in the intense removal of cover and the temporary loss of fire-sensitive species such as sagebrush.

Haying and Mowing

Haying and mowing management strategies are generally used to enhance tame grass or tame grass–legume stands and to control the spread of invasive weeds. Haying temporarily removes residual, dead, and matted vegetation, and stimulates new growth, which improves habitat structure and diversity. Seed production, seed germination, and the growth of desirable plants can result from properly timed haying. The duration of the treatment period is relatively short and manageable. Haying is very selective relative to the location of treatment. The removal of vegetation allows for the early warming of soils in the spring, which stimulates and earlier green up and invertebrate production.

Proper management of DNC may provide quality habitat up to 8 years without disturbance, it is the periodic vegetation treatments such as haying that capitalize on the relationship between young, vigorous stands of vegetation and higher wildlife production (Duebbert et al. 1981). With a rotational management plan that periodically rejuvenates the tame grass stand, productivity can be greatly increased.

Prescriptive Grazing

Grazing effects on grassland communities and woody riparian habitats have also been the subject of many studies. The effects of grazing on plant diversity depend on grazing intensity, the evolutionary history of the site, and climatic regimes. Hoof impact by grazing animals can break up capped soils, improve the water cycle, stimulate vegetative reproduction of stoloniferous grasses, and enhance the decomposition of old plant material by breaking up plant litter. Hoof action can also distribute and trample seeds into soils, increasing the chances of successful germination (Laylock 1967). Nutrients are returned to the soil in the form of urine and feces. Cattle may return 80–85 percent of the nitrogen ingested in plant tissue.

Grazing intensity and frequency can be regulated to enhance the species diversity of both plants and animals. For example, summer grazing can create fresh fall and winter regrowth as forage for elk and mule deer. Certain levels of grazing can pro-


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The Service uses prescribed fire to rejuvenate grasses and reduce vegetative litter.

vide habitat diversity and patchiness, particularly in areas of higher precipitation. Cattle dung hosts invertebrate production, undigested plant parts, and newly germinated seedlings, which in turn can be used by wildlife as food. Grazing can be much more species selective than mowing, burning, or chemical treatments. For example, grazing in uplands can stimulate the germination and production of grasses without affecting the sagebrush and other species that are important elements of the habitat, while fire removes all flammable material in which it comes in contact.

Grazing is a tool that, when used properly, removes old vegetation, stimulates new plant growth, restructures vegetation, affects plant species composition, and enhances animal diversity. The development of proper grazing strategies is essential for using this tool properly. The objectives of grazing are to help wildlife species first and foremost, as the needs of wildlife and their habitats are the primary determining factors of any habitat management strategy. Economic benefits are a secondary consideration. Determining the proper number of animals to be placed on an area is the principal factor affecting the relative success of any grazing management strategy (Heitschmidt and Sluth 1991). The timing, frequency, and intensity of grazing are the three main variables available to managers when designing a grazing plan:

- Timing refers to the period when livestock will be placed on a parcel of land. It is generally related to the plant phenology. Spring is a growth period, summer is an active growth and reproduction period, fall sees reproduction and carbohydrate storage, and with winter comes dormancy.

- Frequency is the time interval between applications of active treatment strategies. These can range from more than one treatment per year to annual, alternate year, or greater than 1 year (periodic).

- Intensity has been defined as the proportion of a year's forage production that is consumed or destroyed by grazing animals. This classical definition refers to the amount of palatable plant matter physically removed by cattle from a parcel of land, and this is generally expressed in animal unit months (AUMs). AUMs are determined by multiplying the number of animals by the number of days spent on the grazed area, divided by 30.4 (the average number of days in a month). The amount of forage in an AUM is approximately 794 pounds. For example, when 55 cows graze an area for 21 days, that would be (55×21)/30.4) 38 AUMs. This is approximately 30,172 pounds of forage, or 15 tons (38×94=30,172 pounds).

Grazing intensity as it relates to wildlife habitat and cover may be more accurately defined as the amount of standing residual and current vegetation (cover) that is removed or destroyed by grazing animals in relation to the pretreatment standing cover. This definition is different because it addresses the factor of cover in the management of uplands and other areas where the objective is to provide nesting cover. In areas where grazing is to be used to reinvigorate and restore cover, the measure of cover removal will be more meaningful. This can be expressed in a percentage figure of removal of aboveground biomass for planning purposes, and then, after monitoring, it can be converted into an AUM figure for the ease of developing future grazing prescriptions for that specific field.

Specific management plans can be prepared for each unit (where grazing is used) to address the timing, frequency and intensity of treatment and to make sure that wildlife objectives are being met. Short-duration, high-intensity grazing will be the most commonly used form of grazing. A sufficient number of animals will be placed on a given parcel of land to remove the desired amount of standing vegetation within a short period. Under this system, the animals are forced to consume available vegetation instead of being allowed to be so selective that they repeatedly graze only the more palatable plants. Ideally, the plants should be grazed only once during the growing period, and even longer periods of rest will be used to make sure that there is enough vegetation regrowth and accumulation for proper wildlife cover.

3.3 Species of Concern

For the purposes of this planning document, species of concern are defined as follows:

- those species listed under the ESA as endangered, threatened, or candidate species

- bald and golden eagles as protected under the Bald and Golden Eagle Protection Act

- native species that are considered to be at risk in Montana due to declining population trends, threats to their habitat, or restricted distribution as defined by the MNHP (2009)

Federally Listed Species

The ESA requires Federal agencies to carry out conservation (recovery) programs for listed species and to make sure that agency actions are not likely to jeopardize the continued existence of listed species or adversely change or destroy their critical habitat. Section 7(a) of the act requires Federal agencies to evaluate their actions with respect to any species that is listed as endangered or threatened and, with respect to its critical habitat, if any is being designated. Further, regulations implementing the interagency cooperation provision of the act codified at 50 CFR part 402. Section 7(a)(2) requires Federal agencies to make sure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of any species listed as endangered or threatened, or to destroy or adversely change its critical habitat.

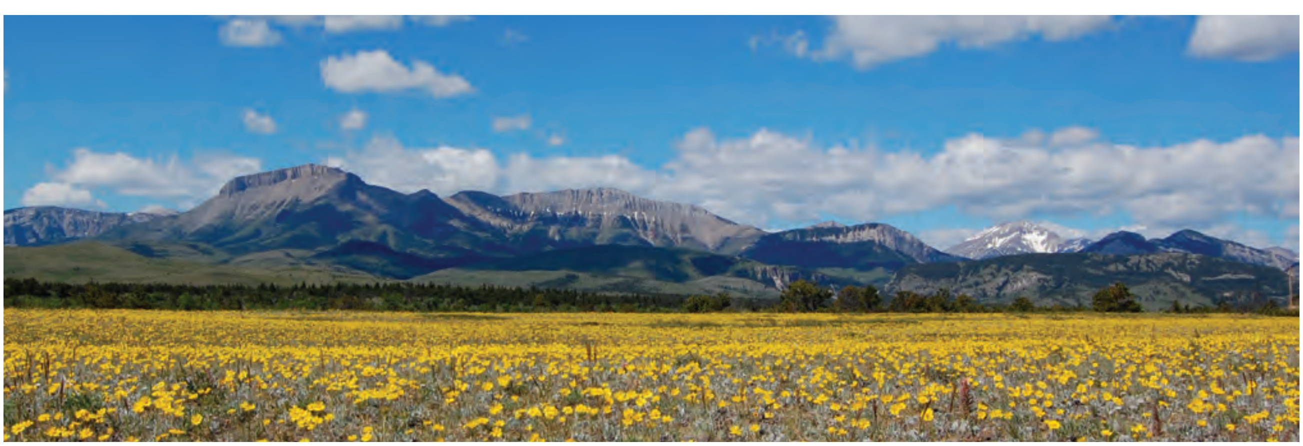
Key federally listed species that occur in the refuge complex include the threatened bull trout, grizzly bear, water howellia, and Canada lynx (table 7). Candidate species that occur on the refuge complex include greater sage-grouse, Sprague's pipit, and wolverine. The piping plover, pallid sturgeon, black-footed ferret, and arctic grayling are all listed under the ESA but are either no longer present on refuge complex lands or the Service's management strategies are not expected to affect them.

Bull Trout

Bull trout are a cold-water fish of relatively pristine stream and lake habitat in the Pacific Northwest. Bull trout need the coldest water temperatures of any northwest salmonid, and they need the cleanest stream substrates for spawning and rearing. These trout need complex habitats: streams with riffles and deep pools, undercut banks, and lots of large logs. In addition, bull trout need connections from main river, lake, and even ocean habitats to headwater streams for annual spawning and feeding migrations.

For listing purposes, the Service divided the range of bull trout into distinct population segments consisting of 27 recovery units. The Blackfoot River and Swan River watersheds lie within the Clark Fork River Recovery Unit and the Upper Clark Fork Recovery Subunit. Within this subunit, both the Swan River and Blackfoot River watersheds have been identified as core recovery areas (USFWS 2002a). The watersheds also have multiple stream reaches identified as critical habitat within the Clark Fork River Basin (USFWS 2010c).

Within the Blackfoot River watershed, bull trout densities are low in the upper Blackfoot River but increase downstream of the North Fork. Streams that appear to be particularly important for the spawning of migratory bull trout include Monture Creek, the north fork Blackfoot River, Copper Creek, Gold Creek, Dunham Creek, Morrell Creek, the west fork Clearwater River, and the east fork Clearwater River. Bull trout spawner abundance is indexed by the number of identifiable female bull trout nesting areas (redds). Data show that Monture Creek has an upward trend from 10 redds in 1989 to an average of 51 redds in subsequent years (Pierce et al. 2008). The North Fork also shows an upward trend from 8 redds in 1989 to an average of 58 redds between 1989 and 2008. The Copper Creek drainage (including Snowbank Creek) has experienced a resurgence of bull trout redds—from 18 in 2003 to 117 in 2008—since the 2003 Snow Talon Fire. The total number of redds counted in these three streams (Monture Creek, North Fork, and Copper Creek) increased from 39 in 1989 to 217 in 2000. With the onset of drought, bull trout redd counts then declined to 147 in 2008. These changes are attributed to protective regulations first enacted in 1990, restoration actions in spawning streams during the 1990s, and a period of sustained drought between 2000 and the present (Pierce et al. 2008).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Rocky Mountain Front Conservation Area

Table 7. Federally listed endangered, threatened, and candidate animal species within the Benton Lake National Wildlife Refuge Complex, Montana.

	Status	*National wildlife refuges*		*Wetland management district*	*Conservation areas*		
		Benton Lake	Swan River	Benton Lake	Blackfoot Valley	Rocky Mountain Front	Swan Valley
Pallid sturgeon	LE			x			
Black-footed ferret	LE			x		x	
Bull trout	LT, CH		x	x	x		x
Arctic grayling	C			x	x	x	x
Grizzly bear	LT		x	x	x	x	x
Canada lynx	LT, CH		x	x	x	x	x
Piping plover	LT			x			
Water howellia	LT						x
Sprague's pipit	C	x		x		x	
Greater sage-grouse	C			x			
Wolverine	C		x	x	x	x	x

(C = Candidate species, LE = Listed endangered, LT = Listed threatened, CH =Critical habitat identified)
Note: The gray wolf was delisted in May, 2011. Management of the species has been turned over to individual states with oversight by the Service. On June 30, 2011, the Service found that listing the fisher in the U.S. northern Rocky Mountains as threatened or endangered is not warranted at this time.

Within the Swan watershed, the bull trout population has remained strong. The Swan Lake population is stable because fish can access about 150 miles of quality tributary spawning habitat. Most other bull trout populations are declining because of habitat degradation, but many of the Swan Valley's tributary streams are in good-to-excellent condition.

Continuous, identifiable female bull trout nesting area (redd) count history dating to 1982 is available for bull trout for four index streams in the Swan River watershed (MFWP 2009). Bull trout may have reached equilibrium in this system at a population level of about 2,000 adults, and the current trend appears stable. The total redd count was 598 in 2008, representing roughly 2,000 adults in the spawning run. Given that some adults do not spawn every year, the total adult population is likely more than 2,500 adult bull trout.

One of the biggest threats to bull trout survival is increased development, which exacerbates temperature problems, increases nutrient loads, decreases bank stability, alters instream and riparian habitat, and changes the hydrologic response of affected watersheds.

Canada Lynx

The Canada Lynx Recovery Outline categorized lynx habitat and occurrence within the contiguous United States as (1) core areas; (2) secondary areas; and (3) peripheral areas. Core areas are defined as those with the strongest long-term evidence of the persistence of lynx populations. Core areas have both persistent verified records of lynx occurrence over time and recent evidence of reproduction. Six core areas and one provisional core area are identified within the contiguous United States (Nordstrom et al. 2005). The Blackfoot and Swan watersheds contain lands designated in the Northern Rocky Mountain–Northeastern Idaho Core Area, which supports the highest density lynx population in the northern Rocky Mountain region of the lynx's range. It acts as a source for lynx and provides connectivity to other parts of the lynx's range in the Rocky Mountains, particularly in the Yellowstone area (USFWS 2009a).

The Swan River and Blackfoot River watersheds are a stronghold for the Canada lynx in the northern Rocky Mountains. Based on ongoing research in these watersheds, lynx populations appear stable, although low reproductive rates are characteristic of this population. Since 1998, more than 80 lynx have been monitored in this area, providing information on habitat use, reproduction, mortality, and movement. This research has shown that these watersheds contain some of the best remaining habitat for lynx in the continental United States. Large, intact spruce–subalpine fir forests above 4,000 feet in this area provide quality habitat for lynx and for snowshoe hares, the primary lynx food source. Regenerating forest stands are often used as foraging habitat during the snow-free months while older, multistoried stands serve as denning and year-round habitat (Blackfoot Challenge et al. 2005).

Grizzly Bear

Grizzly bears are currently listed as a federally threatened species in the NCDE (USFWS 2011a). This ecosystem is an area of the northern Rocky Mountains with large blocks of protected public land containing some of the most pristine and intact environments found in the contiguous United States. Despite dramatic losses of habitat throughout North America, the grizzly bear has persisted in Montana and occurs in the Blackfoot and Swan watersheds and along the Front.

The NCDE supports the largest population (900 individuals) of grizzly bears in the lower 48 States. In 2003 and 2004, 29 individual grizzly bears were confirmed in the Blackfoot River watershed, 45 grizzly bears were confirmed in the Swan Valley watershed, and 100–150 on the Front. The USGS estimates that at least 40 bears are present during all or part of the year in the Blackfoot River watershed (USGS 2004) with 61 present in the Swan Valley.

Lakes, ponds, fens, and spring-fed creeks, common in parts of the Swan River and Blackfoot River valley floors, provide excellent bear habitat. Additionally, the vegetation found along certain reaches of both rivers and their tributaries provide bears with cover, food, and natural movement corridors. Riparian corridors along the Front are also important to grizzly bears.

Supporting linkage areas is important to the continued survival of the grizzly bear. It has an increased risk of extinction because the population consists of a limited number of individuals that live in several distinct populations geographically isolated from one another. Small populations are less able to absorb losses caused by random environmental, genetic, and demographic changes (Servheen et al. 2001). Linkage zones are areas between separated populations that provide adequate habitat for low densities of individuals to exist and move between isolated populations. The resulting exchange of genetic material helps support demographic vigor and diversity, increasing the viability of individual populations. For the grizzly bear, preserving the linkage between populations is as critical to the long-term conservation of the species as managing the individual populations.

The Blackfoot River watershed contains important habitat links for grizzly bears that are recolonizing historical ranges to the south. Grizzly bears breed, forage, and migrate throughout the watershed and den above 6,500 feet. They move from high mountain elevations to lower valley bottoms to forage seasonally for available food.

The Swan Valley area has been identified as an important habitat link for grizzlies moving between the Glacier National Park–Bob Marshall Wilderness Complex and the Mission Mountains Wilderness. It is also believed to be the key linkage zone to the large and important Selway–Bitterroot Wilderness to the southwest. As such, it provides an avenue of connectivity between the Canadian Rockies and the central Rockies of Idaho and Wyoming.

Water Howellia

Water howellia is a federally listed threatened plant restricted in Montana to depressional wetlands in the Swan Valley, typically occupying small basins where the water level recedes partially or completely by the fall. Montana contains the largest number of occupied ponds and wetlands, though population numbers are generally small and the occupied habitat is clustered in a very small part of the State. Reed canarygrass has invaded some wetlands in the Swan Valley, and it has the potential to form dense monocultures, thereby decreasing the amount of available habitat. Additionally, water howellia is an annual species that is solely dependent on recruitment from seed, it has very narrow habitat and moisture requirements, which leaves it vulnerable to extirpation as a result of consecutive years of unfavorable growing conditions (MFWP 2012). Water howellia is on land owned by TNC next to the Swan River Refuge and on other sites in the Swan Valley. Similar habitat is found on the Swan River Refuge, but it has not been documented on the refuge.

Candidate Species

Candidate species are plants and animals for which the Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities. A candidate species status is reviewed annually.

Candidate species receive no statutory protection under the ESA. However, the Service encourages the formation of partnerships to conserve these species because they are, by definition, species that may warrant future protection under the act. Since they do not receive regulatory protection under the ESA, the definition of "take," as identified in the act, does not apply to these species. However, Service policy requires that candidate species be treated as "proposed for listing" for purposes of intra-Service section 7 conference procedures (USFWS 1998).

Sprague's Pipit

Sprague's pipit is a candidate for listing as endangered or threatened under the ESA (USFWS 2008b) Sprague's pipits have been documented on the Benton Lake Refuge and in the district.

Sprague's Pipits breed in the northern Great Plains, with the highest density occurring in north-central and eastern Montana to North Dakota. (Stewart 1975, American Ornithologists' Union 1998, Robbins and Dale 1999, Tallman et al. 2002 as cited in Jones 2010).

Sprague's Pipits are closely associated with native grassland throughout their range (Sutter 1996, 1997; Sutter and Brigham 1998; Madden et al. 2000; Grant et al. 2004 as cited in Jones 2010) and are less abundant (or absent) in areas of introduced grasses than in areas of native prairie (Kantrud 1981, Johnson and Schwartz 1993, Dale et al. 1997, Madden et al. 2000, Grant et al. 2004 as cited in Jones 2010). Generally, pipits prefer to breed in well-drained native grasslands with high plant species richness and diversity. They prefer higher grass and sedge cover, less bare ground, and an intermediate average grass height when compared to the surrounding landscape, less than 5- to 20-percent shrub and brush cover, no trees at the territory scale, and litter cover less than 4.7 inches (Sutter 1996, Madden et al. 2000, Dechant et al. 2003, Dieni and Jones 2003, Grant et al. 2004 as cited in Jones 2010). The amount of residual vegetation remaining from the prior years' growth also appears to be a strong positive predictor of Sprague's Pipit occurrence (Madden 1996, Sutter 1996, Prescott and Davis 1998, Sutter and Brigham 1998 as cited in Jones 2010) and where they put their nests (Dieni and Jones 2003, Davis 2005).

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Sprague's Pipit

Sprague's Pipits rarely occur in cultivated lands and are uncommon on nonnative planted pastures (Owens and Myres 1973, Sutter 1996, Davis et al. 1999, McMaster and Davis 2001 as cited in Jones 2010). They have not been documented to nest in cropland (Owens and Myres 1973, Koper et al. 2009), in land in the CRP (Higgins et al. 2002) or in DNC planted for waterfowl habitat (Prescott 1997).

Projects that alter grassland habitat with permanent structures, such as wind towers, oil wells, roads, and buildings, can make an area unsuitable for Sprague's pipit use. The effective impact of a disturbance is much greater than its actual footprint because the birds avoid not only the structure but an area around it. While the grassland habitat on which Sprague's pipits breed can be disturbance dependent, negative effects on the pipit can largely be avoided by doing habitat manipulation, such as mowing or prescribed fire, outside of the breeding season. These actions may make an area unsuitable for several years until the grassland plant association has partially returned. However, adverse effects can be avoided by performing management actions on a subunit of the grassland area in any given year, so that some suitable habitat is available at all times.

Wolverine

Suitable wolverine habitat in the contiguous United States is limited to high-elevation, alpine areas that occur in an island-like fashion. One of the last strongholds for wolverines here is the northern Continental Divide region of Montana.

On December 13, 2010, the Service found that the North American wolverine in the contiguous United States is a distinct population segment that warrants protection under the ESA, but that listing the distinct population segment under the act is precluded by the need to address other listing actions of higher priority. The wolverine was listed as a candidate species under the act (USFWS 2010b).

Wolverines are indigenous to high mountain habitats that are separated from like habitats, thus isolated populations have formed. Since wolverines naturally occur at low densities and reproduce infrequently, protected linkage areas are crucial for dispersal, genetic flow, and the survival of the species. While most core wolverine habitat is in public ownership, many areas inbetween these islands are subject to rapidly increasing pressure from urban development and roads.

Arctic Grayling, Black-Footed Ferret, Greater Sage-Grouse, Pallid Sturgeon, and Piping Plover

These species have historical records of occurrence on the refuge complex but are either no longer present on the refuge complex or the Service's management strategies are not expected to affect them.

Arctic Grayling

On September 8, 2010, the upper Missouri River basin's "distinct population segment" of Arctic grayling was listed as a candidate species under the ESA. Fluvial Arctic grayling currently occupy only a fraction (about 5 percent) of their historical range within the Missouri River watershed upstream of the Great Falls. Kaya (1992) concluded that the major factors causing the range-wide decline of fluvial Arctic grayling in the upper Missouri River system include habitat degradation, angling exploitation and overfishing, and interactions with introduced nonnative salmonid fishes. Fluvial Arctic grayling in Montana are presently restricted to an approximately 80-mile-long segment of the upper Big Hole River.

Reintroduction efforts began in 1997 in the upper Ruby River and expanded to the north and south forks of the Sun River in 1999, the lower Beaverhead River in 1999, and the Missouri River headwaters near Three Forks, Montana, in 2000. Due to drought conditions and limited resources, the Montana Arctic Grayling Workgroup in 2002 recommended focusing reintroduction efforts on the upper Ruby River, and to continue with other sites as money, workload, and resources allow. Reintroduction efforts in 2008 took place in the upper Ruby River and the north fork of the Sun River. At both of these locations, remote site incubators were used to introduce grayling fry into the restoration reach (Magee and McCullough 2008).

Black-Footed Ferret

Black-footed ferrets are listed in several counties in the district and likely occurred here historically. However, no known populations currently exist within the district.

Greater Sage-Grouse

On March 5, 2010, the Service found that the greater sage-grouse warrants protection under the ESA, but that listing the species under the act is precluded by the need to address other listing actions of a higher priority. Evidence suggests that habitat fragmentation and destruction across much of the species' range has contributed to significant population declines over the past century. If current trends persist, many local populations may disappear in the next several decades, with the remaining fragmented population vulnerable to extinction. Greater sage-grouse may be present in Chouteau, Hill, and Liberty Counties in the district.

Pallid Sturgeon

Records show that pallid sturgeon have been documented in the district in the Missouri River in Chouteau County, however, management actions within the refuge complex are not expected to have any effects on the Missouri River or the pallid sturgeon.

Piping Plover

A 5-year review of the piping plover's ESA listing was completed in September 2009. The current recovery plan was completed in 1988. The northern Great Plains population of piping plovers nest on the shorelines and islands of alkali (salty) lakes in North Dakota and Montana. They nest on sandbar islands and reservoir shorelines along the Missouri River and reservoirs in Montana, North Dakota, South Dakota, and Nebraska.

The only records of piping plover on the refuge complex are in Pondera county in the district where one to four pair of were observed at Alkali Lake from 1990 until 2007.

Other Species of Concern

The MNHP serves as the State's information source for animals and plants with a focus on species and communities that are rare, threatened, or have declining trends and, as a result, are at risk of extinction in Montana. The MNHP assesses species' status based on methods developed by NatureServe (Regan et al. 2004). These criteria include population size, area of occupancy in Montana, short- and long-term trends, threats, inherent vulnerability, and specificity to environment. Based on these factors, a preliminary rank is calculated and is reviewed by key experts.

According to the MNHP database (MNHP 2011a), there are 126 animal species of concern that could occur on lands administered by the refuge complex. These include 15 mammal, 55 birds, 19 fish, 9 amphibian and 28 invertebrate species (see appendix G).

Trumpeter swans were endemic to the Blackfoot Valley but have been absent for 200 years. Meriwether Lewis first documented trumpeter swans in the Blackfoot Valley in 1806. A pair of trumpeter swan naturally returned to the valley in 2000. This pair eventually bred but the female was killed. The male raised the 3 cygnets through the fall but none of the swans returned the following spring. A partnership of private landowners, foundations, conservation groups, and State and Federal agencies was formed to restore the swan to the Blackfoot Valley. Eggs from trumpeter swans in Canada were collected and transported to a facility in Jackson, Wyoming, where they were raised to a suitable age for release. The cygnets were then trucked to the Blackfoot Valley and released on suitable habitat. Since 2005, 83 trumpeter swans have been released. In 2011, swans that were part of the reintroduction effort successfully bred, producing seven cygnets.

Black terns are considered a species of special concern by the Service in Region 6. They are listed at a Level II on the Montana Priority Bird Species List, which dictates that Montana has a high responsibility to watch the status of this species and design conservation actions. Black terns are found throughout the district, and the Blackfoot River watershed hosts the largest black tern colony documented in Montana.

The Blackfoot Valley supports western Montana's largest population of Brewer's sparrow, one of the highest priority songbirds in Montana (Casey 2000). This sagebrush obligate was the most abundant breeding species found at sagebrush sites on the Blackfoot and Kleinschmidt Lake WPAs during Service productivity surveys in 1996 (Fondell and Ball 1997). The long-term viability of Brewer's sparrows in Montana depends on keeping large stands of sagebrush in robust condition (PIF 2000).

The Blackfoot Valley is perhaps also the best breeding and nesting area for the long-billed curlew in western Montana. This species is declining nationally and has been identified as a priority in both the shorebird and PIF conservation plans. Local surveys on Kleinschmidt Flat in 1997 found 31 pairs on 3,840 acres, or greater than 8 pairs per 1,000 acres. Production was not monitored, but many broods were noted. This species is highly reliant on grassland-nesting habitat, also nests in sagebrush-steppe, and relies more heavily on wetlands during migration. Small population size and negative population trends, combined with threats of habitat degradation on both breeding and wintering grounds, make the long-billed curlew a high conservation priority (National Audubon Society 2007).

One of the Nation's densest populations of golden eagles and prairie falcons lives in the rock escarpments along the Rocky Mountain Front. The Front also hosts relatively robust populations of bald eagles, peregrine falcons, ferruginous hawks, and goshawks.

Montana supports the largest breeding population of common loons in the western United States, with a 10-year average summer count of 216 individuals. This population consists of an average of 62

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A long-billed curlew finds a wide-prairie view. The Blackfoot Valley in Montana is a favorite breeding and nesting spot.

territorial pairs, 52 nonbreeding single adults, and 41 chicks. Since surveys began in the late 1980s, the population has remained remarkably stable. Fecundity in Montana appears to be above average in comparison to many other States, ranging between 0.66 and 0.70 chicks fledged per territorial pair. Most loon observations range from the Rocky Mountain Front west to the Idaho–Montana border, with breeding limited to the northwest corner. As of 2009, there were 12 breeding pairs in the Swan Valley and 5 in the Blackfoot Valley (Hammond 2009).

The refuge complex includes one of the largest remaining expanses of native prairie left in the northern Great Plains. This sea of grass provides essential habitat for many grassland birds, many of which are experiencing significant population declines. These include chestnut-collared longspurs, bobolinks, Sprague's pipit, burrowing owls, marbled godwits, long-billed curlews, and lark buntings.

3.4 Cultural Resources

Cultural resources for the refuge complex are described in terms of the area's prehistoric occupation and historic period and the refuge complex-specific history and archaeology.

Prehistoric Occupation

The cultural sequence for prehistoric occupation in this area is often split into three major subdivisions based on these phases—early, middle, and late prehistoric.

Early Prehistoric

The Early Prehistoric Period dates from 12,000 years before Christ (B.C.) to 6,500 B.C. in the region surrounding Benton Lake Refuge. Paleo-Indian people had an economy based primarily on communal big game hunting with distinctive Clovis and Folsum fluted projectile points (spear points). The period is associated with the end of glaciation in North America. The climate was cooler and drier than today, supporting several now-extinct large mammal species. Based on archaeological bones excavated in sites of this period, these hunters subsisted primarily on giant bison, mastodon, camel, horse, and mammoth.

Middle Prehistoric

The Middle Prehistoric Period ranges from 6,500 B.C. to Anno Domini (A.D.) 200, depending on location. Archaeologically it appears that these people were largely focused on exploiting bison, but the tool kit expanded from paleo-Indian times suggesting a dependence on a broader spectrum of plant and animal resources in more varied habitats. Climatologically it was becoming drier and Plains Archaic populations tended to inhabit areas with protected water sources. Sites typically occur in basin and foothill regions, river valleys, and in open prairie. There is a wide variation of projectile point (spear or atlatl) types associated with this period, no doubt due to the varied species, environments, and hunting techniques used to get game in this fluctuating climatic regime. The atlatl, or spear thrower, was introduced, allowing greater range than spear throwing and necessitating smaller projectile points. Communal hunting continued, but researchers have suggested that smaller hunting groups were used at various times of the year. There is also more evidence of processing of vegetal resources suggesting a reliance on a broader spectrum of resources.

Late Prehistoric

Late Prehistoric Period ranges from A.D. 200–1750. During this phase prehistoric people moved out onto the prairies, and new technologies were introduced, including the bow and arrow and pottery. Complexes included in this tradition include Besant, Avalonea, Benson's, Butte–Beehive, and Old Women's. The Besant complex represents the earliest adoption of pottery and bow and arrow use in this area of the northern Great Plains.

Horses were not in widespread use in the northern plains until A.D. 1725–1750. Bison continued to be the primary resource exploited by Protohistoric groups, but the addition of the horse to hunting techniques drastically affected social organization, settlement patterns, and the effectiveness of bison hunting. Protohistoric people were able to react more quickly to the movements of the bison herds, were able to hunt further away from base camps, and began to leave women and children in camps while hunting.

Historic Period

During this period, trade goods and interaction between European settlers and tribal people began to directly affect aboriginal lifeways. This process started well before European settlers arrived. Trade goods and the desire for them changed Native American lifeways by shifting hunting activities for household consumption to a means to obtain trade goods. As more aboriginal people were being pushed into the northern Great Plains, conflict between tribes in search of bison became more frequent. Taking control of territories for hunting grounds and high mobility became increasingly important.

Native American History

The origin of aboriginal groups in Montana before 1500 is debated by archaeologists and linguists. In eastern Montana, by the 1600s, it is generally accepted that the River Crow were situated on the Missouri River and the Mountain Crow along the Yellowstone. The Blackfeet were situated northwest of the River Crow into Canada and the Assiniboine to the northeast of the River Crow into Canada. Western and northwestern Montana were inhabited by the Bitterroot Salish, upper Pend d'Oreilles, and Kootenai, who are now known as the Confederated Kootenai and Salish Tribes (CKST).

In the late 18th century, increased movement of European settlers in the northern plains caused the first outbreaks of smallpox among Montana's native people (Fandrich and Peterson 2005). By 1781 reports in Saskatchewan, Canada, relate that 30–60 percent of the native population was lost. Diseases introduced by European settlers would greatly affect tribal politics and warfare because the loss of population forced certain tribes to create partnerships that would allow them to defend themselves against native enemies. Anglo contacts grew more frequent with the ongoing movement of riverboats associated with the fur trade and the discovery of gold in western Montana. This increased opportunities for diseases to spread through the native populations. With the introduction of the steam-powered riverboats using the Missouri River to ship supplies, diseases were able to move faster across the region. In 1837 the riverboat St. Peter carried smallpox to Fort Union (Fandrich and Peterson 2005). The Captain, Alexander Culbertson, wanted to halt the progress of the riverboat until the outbreak of smallpox had ended. However, the Piegan and Bloods were awaiting supplies and the boat continued to Fort McKenzie, spreading smallpox. The Gros Ventre, Sioux, and Plains Cree did not experience radical population losses from the outbreak.

In the 1880s the climate and conditions for native people in Montana were at their worst. The bison were gone from the area and a series of harsh winters left most tribal populations without adequate food. Government supplies were not sufficient to feed the tribal populations and, without bison hunting for supplemental nutrition, starvation ensued.

Lewis and Clark

In 1802, Thomas Jefferson organized the Corps of Discovery after the Louisiana Purchase from the French ended any European claim to the land. At this time, this part of the western United States was largely undocumented. Jefferson realized the need to survey the area in preparation for settlement and was in search of a Northwest Passage to the Orient. At that time there was no navigable route that connected Eastern and Western North America, requiring ships to sail around South America and Africa. Ultimately this goal of the Corps was not realized because the route was difficult to navigate and required several portages, making movement of large watercraft unpractical. When the Corps of Discovery returned to Saint Louis, they brought with them field maps documenting the locations of waterways and resources they had encountered. The Corps found that large numbers of wildlife inhabited the region, which would later spur the fur trade. Several Lewis and Clark campsites are known along the upper Missouri River, and Meriwether Lewis is known to have camped in Lincoln Gulch in the Blackfoot Valley.

Although the Lewis and Clark expeditions of the region are generally thought of as the first Anglo visitors to the Upper Missouri, they were predated by French Canadian trappers and traders in the 18th century working with the Hudson's Bay Company. Historians believe that one major reason for the Corps of Discovery expedition was to thwart the Hudson's Bay Company's interest in the area. This is suggested by the 1816 amendments to trade laws preventing foreign agents from doing business on American soil without obtaining a license.

Historic Euro-Americans

The post-Lewis and Clark historic period in central and northern Montana can be divided into three generalized periods based on major types of economic activity—fur trade, ranching, and railroad.

Fur Trade Era

With the rise of beaverpelt prices in the 19th century, more European settlers came to the upper Missouri River to trap and trade furs. Once the beaver were trapped out of the region, the fur trade shifted to the bison robe. Fort Benton was constructed to support these industries as the furthest inland port in the continental United States. Fort Lewis was constructed in 1831 and was abandoned after the Blackfeet requested that the fort be moved to the north side of the river in 1846. Several smaller forts were established downstream on the Missouri River from Fort Benton to the North Dakota border for two reasons: (1) forts allowed the tribes easy access to traders for their furs; and (2) the riverboats coming from Saint Louis often could not get further up river from Fort Benton because it became shallower upstream. Fort Benton served as a hub of transport for supplies and people because the town was connected by a road network leading to gold mining communities, which were becoming established in the mountainous areas of western Montana.

By the 1820s, the American Fur Company began to sponsor small forts along the river to secure a share of the trade in animal products from native and white trappers. This company was owned by John Jacob Aster who was later to become one of the wealthiest men in the country by taking the money made in this enterprise and buying real estate. Several forts were established to compete with the American Fur Company, but most failed due to the fierce competition with the company or to frequent attacks by native people. One reason so many forts, trading posts, and riverboat landings were constructed was due to the difficulty of getting up river from the area of modern-day Fred Robinson bridge (at the boundary of Phillips and Fergus Counties) to Fort Benton. The stretch of river from Cow Island to Fort Benton was known as Rocky River, marking the point where elevation increased approximately 2 foot per mile as one went upstream (Davy 1992). From the area downstream of Rocky River, riverboats could be unloaded and freight put on wagons to be hauled to Helena, Fort Benton, or the Judith Mountains. In sum, 31 trading posts were built on the Missouri River between the North Dakota boundary and Fort Benton between 1828 and 1885 (Davy 1992).

Throughout the 19th century, the fur trade in Montana depended on riverboats to move the goods to and from the region. The tribes, as well as Anglo trappers, were involved in the trade, and there were frequent conflicts between the two groups. Some of the aboriginal groups opposed trading with European settlers altogether. The Assiniboine supported the establishment of Fort Union while the Blackfeet and Gros Ventre did not. Originally the trade consisted of beaverpelts, but, in the 1840s, the animals had been overexploited and fur prices dropped, changing the focus of trade to bison robes. Growth of this industry was rapid, as 2,600 bison robes were sent east annually in the early 1800s, whereas approximately 90,000 or more would be shipped annually from Saint Louis by the 1850s. By 1850, the tribes depended on trade goods, which they obtained through the bison robe trade. Tribal involvement increased conflict between aboriginal groups because the tribal hunting grounds were the key to supporting trade.

With the discovery of gold in western Montana in the 1860s and the development of the fur trade, steamboat travel was a vital supply line to towns such as Fort Benton and Helena that had few other choices for travel because of the lack of well-established roads or railways. Food, supplies, and trade goods required for miners and trappers would be hauled up from St. Louis, and goods such as furs, bison robes, and gold, would be sent downstream to the markets. Steamboat traffic was common on the river from 1859 until 1888, averaging about 20 boats a year. In the years between 1860 and 1869, the river averaged 34 boats per year, making this the highlight of riverboat use on the Upper Missouri.

A pronghorn roams on the grasslands of Benton Lake National Wildlife Refuge Complex.

Mullan Road was constructed from 1858 to 1862 by the Federal Government to connect Fort Walla Walla in Washington State to Fort Benton. It was designed to bring settlers into the region and make military expeditions possible due to the rising conflicts between European settlers and native people. The road also provided a route to carry supplies into western Montana for the early mining operations and link the west coast to the Missouri River. Before the introduction of railways to Montana, this route was the first established passageway from the Rocky Mountains to the inland Northwest. During its active life, the road is estimated to have brought 20,000 civilians to the region. Mullan Road was listed on the National Register of Historic places in 1975. A section of the road is thought to occur on the Benton Lake Refuge, however, documentation confirming this is currently lacking.

Ranching Era

Because of the difficulty in transporting locally produced products from Montana, ranching began as small operations that provided beef to miners mostly in the western part of the State. Early mining was focused on deposits of placer gold. This work began in 1862–1864 and was situated at Bannack, Virginia City, Helena, and Confederate Gulch. Because the railroads had not been constructed, goods were transported between Saint Louis and Fort Benton by keel boat, which added cost to food (as well as other products) and allowed small, local ranching outfits to make profits on these developing local markets. Because agriculture was difficult, ranching was the preferred mode of food production at this time.

Eventually steam-powered riverboats were used to move the goods. In 1866 the first cattle drive from Texas took place, which started open-range ranching in the grasslands that were vacant after the destruction of the bison herds. Mid-nineteenth century ranching operations in Montana were fairly unorganized and consisted of both corporate interests and small ranches. Cattle depended on open range for grazing because there was little hay production due to the cost of irrigation. The management styles of the different operations and the lack of fencing caused difficulties from many sources, including overstocking, loss of cattle from mavericking, and outright theft. Mavericking was the process of branding unbranded calves (calves that lacked a branded mother by which to identify the owner).

Because cattle were left on the open range, there were two roundups held in the fall and spring used to manage the cattle. By the early 1880s, 17 districts statewide had been established to make rules for the roundups. These districts were based on natural boundaries. In each of the districts, the ranches worked communally during the roundup to gather the free-ranging cattle in their district. The cattle were sorted by brand and rules were established among the districts to encourage fairness in branding. For instance, the use of branding irons was prohibited at any time except during the roundups (Malone et al. 1976). Decisions were also made about unbranded calves at the roundup. In some cases, the calves would be branded with the brand in the area managed by the ranch in which they were found. Some districts considered unbranded calves as district property and sold them to help the district. Mavericking was common and was a way to quickly increase the size of the owner's herd at no cost.

Also during the 1880s, railways had been constructed across the State linking it more directly with large cattle markets in the east and west, making the business of ranching cattle more profitable. The long drives, used before the railroad, reduced the value of the herd and were more expensive than loading the cattle onto a train.

This system of ranching was successful until the winter of 1886–1887 when particularly severe weather and overstocking caused the loss of a great deal of the State's cattle. Overgrazing on the ranges and a very hot, dry summer left the forage in poor condition that fall. Low temperatures and precipitation kept the forage covered for most of the winter, which resulted in a massive die-off because the storage of hay had not become common practice and there was no reserves of food for the cattle in winter. Although losses varied in different parts of the State, overall about 60 percent of the cattle were lost (Davy 1992). Of the 220 cattle operations statewide before that winter, only 120 survived.

The winter of 1886–1887 significantly changed cattle ranching in Montana. Open range grazing was decreased during the following decades because of the risk of a similar catastrophe. Large operators, who were financed with money from the east, lost support from their investors and downsized or ceased operations completely. Many of the small operators fared the winter better because they were more prone to store up hay to feed their cattle. Between 1887 and 1889 the number of ranches increased significantly, and, by 1890, the ranges carried more cattle than before the 1886–1887 winter. The amount of land devoted to hay cropping tripled during this period. Sheep, which are more able to withstand the severe weather, were less affected by the 1886–1887 winter, and many ranchers converted to sheep ranching in the 1890s. This change was so profound that, by 1900, Montana was the Nation's largest wool producer, with 6 million head.

Railroad Era

During the 1880s, railroads were established, linking eastern Montana to large cities and markets for the natural resources that were available for exploitation at the time. With the establishment of the railways, movement of goods was faster, more predictable, and cheaper than riverboat travel along the Missouri. The addition of the railroad to the State's transportation system ensured the reliable movement of cattle to large markets in the east.

By 1900, a homestead boom began that would last until 1918. Initial settlement of the region occurred in river bottoms that were readily cultivated. Settlement was spurred by the cheap transportation offered by railways, the profitable shipment of grain to market, and advertisement campaigns devised by the railroad companies to sell their free land. The Federal Government had given the railways land along tracks to pay them for the construction costs. When an area was settled, the railroads would not only be able to sell the land, but would also create more traffic for freight as the settlers would need to move their products to market. The homestead boom was so intense that Montana had more homestead entries than any other State. The boom continued successfully, as high moisture during the period of 1909–1916 allowed for the dry farming of cereal grains. Shipping grain by rail made moving it to large eastern markets financially profitable and reliable. When conditions became drier, however, the farming boom ended as farmers began to understand that there was a lack of predictable moisture in the eastern part of the State, limiting dryland farming. This, in combination with the Great Depression, caused a mass exodus from Montana, in which half of the State's farmers lost their farms between 1921 and 1925. Predictable water for farming in most of Montana would be addressed at this time by large-scale, Federal Government-supported irrigation.

History and Archaeology of the Refuge Complex

The refuge complex has a rich history, including several cultural resource sites.

Benton Lake National Wildlife Refuge

Originally Benton Lake was known as Alkali pond. In 1887, local farmers attempted to use the lake's water for irrigation and constructed Benton Lake Canal. Promoters of the project believed it would open a million acres for settlement by farmers. Unfortunately the promoters did not anticipate the shallow nature of the lake and its vulnerability to drought. At the urging of local sportsman in 1929, Montana Congressman Scott Leavitt proposed having several thousand acres of the project set aside for a refuge. The county commissioners did not initially support the idea because they believed the land would be best used for settlement by farmers. In the fall of 1929, President Hoover established the refuge by Executive order. In 1931, the lake dried up and a canal project was started by sportsmen and women to bring water back into the lake. The proposed canal would have to be 30 miles long, connecting the lake to the Sun River. This project was cancelled, and the issue was not revisited until 1957 when the U.S. Congress appropriated $90,000 for a pump station and ditches to divert water from Muddy Creek.

The main county road bisecting the refuge to the north, called Bootlegger Trail, received its name during the Prohibition Era (1916–1933). The road existed in the 19th century as a thoroughfare connecting farms to Great Falls. During Prohibition, it became the major route in the area for obtaining legally produced alcohol from Canada. This alcohol would be resold illegally to northwestern Montana residents.

Archaeology

Limited archaeological surveys have taken place on the refuge and were associated with the construction of dikes, a prescribed fire survey, and several canal segment constructions. The refuge supports a section of both Mullan Road and Benton Lake Canal. The section of Mullan Road on the refuge was listed on the National Register in 1975. It is located in native prairie, and the refuge has no immediate plans for disturbing the area.

The most substantial cultural resources survey conducted on the refuge is a 560-acre survey of Bootlegger Trail for a Montana Department of Transportation road improvement. During this project, three sites were identified on Service land, including Benton Lake Canal 24CA974, Bootlegger Ponds 24CA975, and Slate Pit 24CA976. The Benton Lake Canal was found eligible for the National Register, while Bootlegger Ponds and Slate Pit were found not eligible (Frontier Historical Consultants 2004). Benton Lake Canal was conceived in 1887 when local farmers cut a 1.25-mile-long canal 26-feet deep to obtain Benton Lake's water for irrigation. Slate pit was a historic and modern mining operation, which was mostly removed at the time of recording in 2004. Bootlegger Ponds consist of two erosion check dams and one stock water pond presumed to have been built during the 1931 road construction project.

Recently, miscellaneous small surveys have been conducted for refuge projects. Loflin (2006) conducted a survey on 180 acres for a control burn next to Benton Lake. No cultural resources were observed. In 2005 Loflin surveyed 6.5 acres near the

Lake Creek ditch next to Benton Lake in preparation for an upgrade of the ditch. Although no sites were found, the researcher observed an isolated lithic flake suggesting that there was some prehistoric occupation of the lake margin, but, because the lake size has been altered, it is likely that the sites may have been inundated (Loflin 2005b).

In 2008, Alberta Tie, LTD, contracted with the University of Arizona to conduct a traditional use study along a corridor just east of the refuge with the Blackfeet and Piegan tribes (Zedeno and Murray 2008). This study was in preparation for a 120-mile-long electrical transmission line connecting Great Falls to Canada. Four traditional use areas, including locations of burials, plant gathering areas, and ceremonial locations, were identified, suggesting that the Blackfeet have traditional use and ongoing interest in the area.

Benton Lake Wetland Management District

Beginning in the early 1900s, efforts to increase opportunities for small grain farming in the region began with the initiation of the Sun River Reclamation Project, later known as the Sun River Irrigation Project. This project was authorized by the Secretary of the Interior in 1906 and contains more than 100,000 acres of potentially irrigated land along the Sun River and its tributaries west of Benton Lake (Knapton et al. 1988). The Sun River project contains two major divisions. The Fort Shaw Irrigation Division that borders the Sun River contains about 10,000 acres and the Greenfields Irrigation Division contains about 83,000 acres.

Construction of the Fort Shaw Division began in 1907, and the first water was delivered to Division farmlands in 1909 (Knapton et al. 1988). Construction of facilities within the Greenfields Irrigation Division began in 1913, and the first water was delivered to area grain farmers in 1920. The main storage structure, Gibson Reservoir, was constructed on the upper Sun River from 1922 to 1929. Approximately 300 miles of canals and lateral distribution ditches send water across the Greenfields Bench.

The development of the Greenfields Irrigation Division dramatically changed the landscape within large parts of the district and influenced land use near Benton Lake Refuge. Native grassland was converted to irrigated cropland, mostly wheat and barley, and pasture–hayland. The advent of increased small grain production in the region and accompanying storage, transportation, and milling facilities also encouraged grain production outside of the irrigation division. Much of the native grassland in the district was converted to dry cropland. The predominant crops grown in this area until the 1980s were wheat, barley, oats, and flax using crop–fallow rotations where alternating linear fields were either cropped or kept fallow (free of vegetation using tillage or chemical treatments) for 1–2 years. Since the mid-1980s, more than 60 percent of the cropland in the Greenfields Division has been contracted for growing malting barley, which has improved the financial sustainability of croplands in the area and has provided a more than $20 million annual return.

Archaeology

Three of the district's waterfowl production areas have documented prehistoric and historic sites.

Blackfoot WPA

Based on the limited amount of field inventory conducted on Service land, seven cultural resource sites have been recorded: six are prehistoric and one is historic. The prehistoric sites consist of lithic scatters, and their ages are unknown. The historic site consists of an old road that was the main road to the area. None of the sites have been formally evaluated for eligibility to the National Register of Historic Places. A cultural resource survey on timbered parts of the Blackfoot WPA is planned.

Three areas on lands next to the Blackfoot WPA have been identified as containing culturally significant ponderosa pine peeled trees and vegetatively significant ponderosa pine trees (BLM 2010).

Pine peeled trees have also been documented in Colorado and Utah, and are referred to as culturally modified trees. It is believed the peeled trees were used occasionally by native people as a sealant, glue, medicine, or sweetener (Loosle 2003). The bark was usually collected in the spring when the sugary sap ran. Bark sheets were cut from trees using wooden sticks or rib bones from elk. The inner and outer bark were separated and could either be eaten fresh or rolled into balls that could be stored for later use. Harvesting methods did not kill the tree (Ostlund et al. 2005). Surviving trees exhibit distinctive peeling scars. These trees are found throughout northwestern Montana and can now be used to interpret native peoples' land use and movements.

Ehli WPA

A single, historic, late-nineteenth to mid-twentieth century farmstead has been recorded at Ehli WPA (Loflin 2007). This work was done to prepare for the debris removal for a farmstead on the WPA, and no other survey was conducted. At the time of recordation, all of the buildings except a recycled rail car had collapsed. The site was found not to be eligible for the National Register and the debris associated with the farmstead has been removed. The Montana State Historic Preservation Office concurred with the findings.

H2–O WPA

About 470 acres of archaeological survey have been conducted at H2–O WPA (Schwab 1994). During this survey for wetland repairs, four prehistoric lithic scatters and two historic sites were found. The two historic sites (McCormick ditch 24PW623 and McCormick farmstead 24PW618) were found potentially eligible for the National Register and need further investigation if work is proposed near them. The McCormick farmstead (24PW618) was found not eligible by the contractor, but the Montana State Historic Preservation Office did not concur. The unresolved National Register eligibility of 24PW618 is an ongoing issue for the WPA. In 2005, the Service proposed building a new office at the H2–O headquarters. Service staff again found that 24PW618 was not eligible for the National Register due to the loss of integrity of the farmstead (Loflin 2005a). The Montana State Historic Preservation Office disagreed, stating that not enough historic research had been conducted. The Service forwarded the project to the Advisory Council on Historic Preservation who has requested more information. This issue will be revisited when the refuge decides to pursue the project again.

Blackfoot Valley, Rocky Mountain Front, and Swan Valley Conservation Areas

These lands remain in private ownership. Therefore, Federal laws on the protection and management of cultural resources do not apply to these units.

Swan River National Wildlife Refuge

Although no formal survey has been conducted, refuge cultural resources staff recorded a historic muskrat farm on the refuge in 2009 (Loflin 2010a). This work was done to prepare for the disposal of a small log building known as Trapper's Cabin. The cabin is on the river's edge, and staff were concerned that it would fall into the river. The residence associated with this building has completely collapsed, and Service cultural resources staff documented that the building had lost too much integrity to be considered eligible for the National Register. The Montana State Historic Preservation Office concurred (Brown 2011), and the cabin is being transferred.

3.5 Special Management Areas

Management of these areas takes into consideration the special features that led to their designation.

Wilderness Review

A wilderness review is the process used for deciding whether to recommend Service lands or waters to the U.S. Congress for designation as wilderness. The Service is required to conduct a wilderness review for each refuge as part of the CCP process. Lands or waters that meet the minimum criteria for wilderness would be identified in a CCP and further evaluated to decide whether or not they merit recommendation for inclusion in the Wilderness System. To be designated a wilderness, lands must meet the criteria outlined in the Wilderness Act of 1964:

- Generally appears to have been affected primarily by the forces of nature, with the imprint of human work substantially unnoticeable.
- Has outstanding opportunities for solitude or a primitive and unconfined type of recreation.
- Has at least 5,000 acres of land or is of sufficient size to make practicable its preservation and use in an unimpaired condition.
- May also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

The Benton Lake Refuge meets the wilderness criteria for size and for scientific, scenic, and ecological value, but is affected by roads, fences, and extensive human effects from livestock grazing and wetland modifications, which preclude it from being designated as a wilderness.

Important Bird Areas

The Benton Lake Refuge and approximately 13,284 acres of the Blackfoot Valley have been designated as an important bird area through a program administered by the National Audubon Society. Important bird areas provide essential habitat for one or more species of birds. They include sites for breeding, wintering, or migrating birds and may be a few acres or thousands of acres. Usually they are discrete sites that stand out from the surrounding landscape. They may include public or private lands, and may be protected or unprotected (National Audubon Society 2010). To qualify as important bird areas, sites must satisfy at least one of the following criteria to support the following types of bird species:

- species of conservation concern (for example, threatened and endangered species)


© Bob Gress

Baird's Sparrow

- restricted-range species (species vulnerable because they are not widely distributed)
- species that are vulnerable because their populations are concentrated in one general habitat type or biome
- species or groups of similar species (such as waterfowl or shorebirds) that are vulnerable because they occur at high densities due to their behavior of congregating in groups
- global concern species—ferruginous hawk, piping plover, long-billed curlew, Sprague's pipit, Brewer's sparrow, chestnut-collared longspur
- continental concern species—northern harrier, Swainson's hawk, upland sandpiper, marbled godwit, Wilson's phalarope, common tern, burrowing owl, short-eared owl, loggerhead shrike, Baird's sparrow, McCown's longspur

Of the more than 240 species of birds documented on the Benton Lake Refuge, 17 species of global and continental concern breed on the refuge.

Western Hemisphere Shorebird Reserve Network

Because of the concentrations of migrating shorebirds that have been observed in some years, the Western Hemisphere Shorebird Reserve Network recognizes the Benton Lake Refuge as a site of regional importance.

3.6 Visitor Services

Visitors to the refuge complex enjoy a variety of wildlife-dependent public use activities such as hunting, fishing, wildlife observation, photography, environmental education, and interpretation. Figures 13 and 14 highlight public use areas on the Benton Lake and Swan River Refuges. Brochures containing area maps, public use regulations, bird species, and general information are available for the units in the refuge complex. Table 8 shows the number of visitors participating in various wildlife-dependent activities and volunteer hours for each unit of the refuge complex.

Appropriateness and Compatibility

In general, national wildlife refuges are closed to all public use until specifically opened. WPAs are inherently open to migratory gamebird hunting, upland gamebird hunting, big game hunting, fishing, and trapping and are closed to all other uses unless specifically opened.

Existing and proposed uses of national wildlife refuges where the Service has jurisdiction over the use need to be screened for appropriateness before compatibility. For a use on a refuge to be found appropriate, it must meet one of the following criteria: (1) be a priority public use; (2) be described in a refuge management plan approved after October 9, 1997; (3) is take of fish and wildlife under State regulations; and (4) be found appropriate as specified in 603 FW 1 Sec 1.11. Uses that are not appropriate are to be denied without determining compatibility.

One use deemed not appropriate came up during public scoping. A commercial outfitter requested to conduct guided hunting on the Swan River Refuge. A formal evaluation was conducted using the criteria noted above, and guided waterfowl hunting was found to be "Not Appropriate" on the Swan River Refuge for the following reasons. To be permitted on a national wildlife refuge, an economic use must contribute to "the achievement of the national wildlife refuge purposes or the National Wildlife Refuge System mission" (50 CFR 29.1). Guided waterfowl hunting would not contribute to the purpose of the Swan River Refuge, which is "for use as an inviolate sanctuary…for migratory birds." Additionally, this use was found to be "not appropriate" because it would not further enhance public understanding or be beneficial to the refuge's natural or cultural resources.

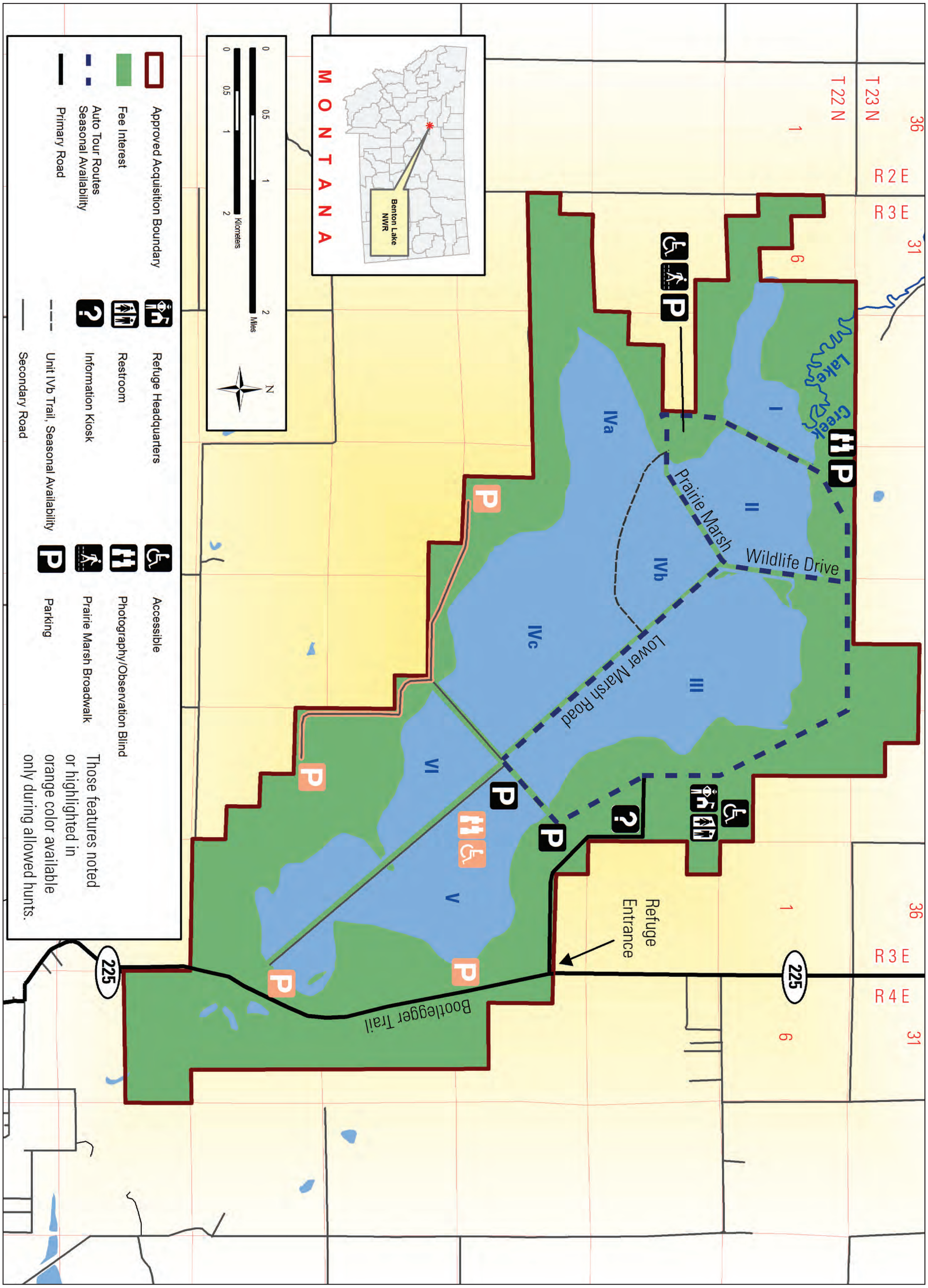


Figure 13. Map of public use at Benton Lake National Wildlife Refuge, Montana.

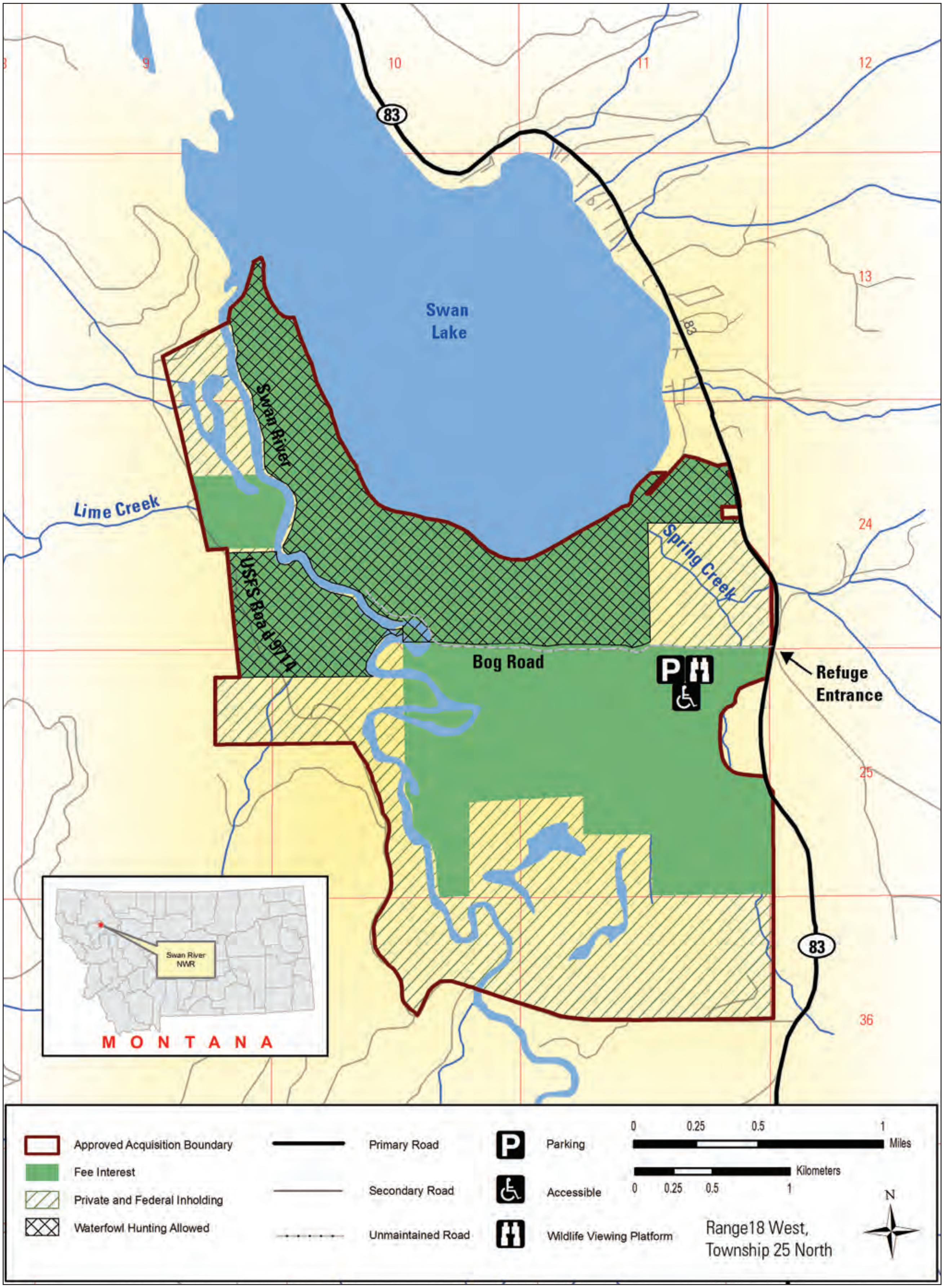


Figure 14. Map of public use at Swan River National Wildlife Refuge, Montana.

Table 8. Actual Annual Performance Plan for 2011 for Benton Lake National Wildlife Refuge Complex, Montana.

	Refuge complex total	*Benton Lake Refuge*	*Benton Lake Wetland Management District*	*Swan River Refuge*
Total number of visitors	13,280	10,000	2,780	500
Number of Special Events hosted on- and off-site	10	3	7	0
Number of participants in special events onsite	525	75	450	0
Visitors to Visitor Center or Contact Station	1,000	1,000	n/a	0
Waterfowl hunt visits	555	300	155	100
Other migratory bird hunt visits	12	0	12	0
Upland game hunt visits	825	75	750	0
Big game hunt visits	455	0	455	0
Total hunting visits	1,847	375	1,372	100
Fishing visits	425	50	350	25
Number of foot trail and pedestrian visits	1,420	750	270	400
Number of Auto Tour visits	6,810	6,500	310	n/a
Number of boat trail and launch visits	0	0	0	0
Total wildlife observation visits	8,230	7,250	580	400
Number of photography participants	490	400	50	40
Number of education participants involved in on- and off-site environmental education programs	1,765	1,700	55	10
Number of interpretation participants in on- and off-site talks andprograms	120	75	45	0
Total other recreational participants	205	75	30	100
Number of volunteers	4	1	0	3

The hunting program on the refuge provides relatively easy access to a quality recreational hunting experience, and the refuge complex has not received any public comments or requests from hunters indicating the need for a guided hunt. There is also concern that competition from a commercial operation for the “best” hunting locations could impair quality hunts for nonguided hunters.

Uses that are found appropriate must still have a compatibility determination. A compatible use is one that will not materially interfere with, or detract from, the fulfillment of the Refuge System mission or the purposes of the refuge. A compatibility determination is written documentation by the refuge manager of a proposed, or existing, use of a refuge to decide if it is, or is not, compatible with the purpose the refuge was established. Refuge management activities are not subject to compatibility, unless that activity produces a commodity (for example, haying, grazing, timber harvest, and trapping).

A use that is found compatible does not necessarily mean that it is approved. For administrative reasons, the refuge manager may deny a compatible use. This process includes a public comment period, and concurrence is required from the refuge’s regional chief. The policy has no administrative mechanism to appeal a compatibility determination.

All existing and proposed uses will go through this screening process. These policies make sure that each approved use will be conducted in accordance with the legal mandates and policies for which each refuge was established and that each use complies with station budget and staff levels.

Economic uses are only allowed on national wildlife refuges as described in 50 CFR 29.1 in accordance with 16 U.S.C. 715s. A use must contribute to the achievement of the national wildlife refuge purposes or the Refuge System mission. Uses must be compatible and can only be authorized with the proper permit. 50 CFR 29.1 states, “Economic use in this section includes but is not limited to grazing livestock, or engaging in operations that facilitate approved programs on national wildlife refuges.”

See appendix B for approved compatibility determinations.

Hunting

Hunting is one of six priority recreational uses identified in the Improvement Act. All recreational activities are secondary to the primary purpose for which a refuge unit was established and must be compatible. Hunting provides traditional recreational activities throughout the refuge complex and local areas with no definable adverse effects on the biological integrity or habitat sustainability of the refuge complex resources, as defined in the act. Service policy states that no more than 40 percent of a national wildlife refuge may be open to migratory bird hunting. This restriction makes sure that habitat without disturbance is available for migrating birds, including waterfowl.

In FY 2011, hunting accounted for 1,847 recreational visits to the refuge complex, which is 14 percent of total visitor use. Most hunting occurs on the district.

In addition to the site-specific regulations mentioned below, all State hunting regulations apply to Service lands in the refuge complex. Shotgun hunters may only possess and use nontoxic shot on fee-title lands within the refuge complex, and vehicle travel and parking is restricted to roads, pullouts, and parking areas.

Benton Lake National Wildlife Refuge

Hunting on the refuge begins with the opening of the State waterfowl season and runs through November 30. Benton Lake Refuge is open for the youth waterfowl season, which typically occurs the weekend before the opening of the general waterfowl season. Ducks, geese, coots, swans (by permit), sharp-tailed grouse, gray partridge, and ring-necked pheasants can be hunted on the refuge. Hunting of all other species is prohibited. State seasons apply within the refuge framework. Hunting is on a first-come, first-served basis. One disability accessible hunting blind is available in Unit 5.

Benton Lake Wetland Management District

All WPAs in the district, except the Sands and H2–O WPAs, are open to migratory gamebird hunting, upland gamebird hunting, big game hunting, fishing, and trapping in accordance with Montana State law. The Sands and H2-O WPAs were donated to the Service with deed restrictions that prohibit hunting. Travel on the WPAs is by foot or nonmotorized boats. No camping, overnight parking, or fires are permitted on WPAs. One exception is at Arod Lakes WPA, which is cooperatively managed with MFWP. State-provided facilities there include a boat ramp for motorized boats, a small, designated camping area, and limited motorized vehicle access for ice fishing three months of the year.

Blackfoot Valley, Rocky Mountain Front, and Swan Valley Conservation Areas

Hunting is popular throughout the project areas. Hunted wildlife include waterfowl, upland gamebirds, elk, moose, deer, black bear, bighorn sheep, mountain lion, and furbearers. Public access to conservation easement lands is under the control of the landowner.

Swan River National Wildlife Refuge

On the refuge, approximately 100 annual hunter visits occur. The area of the refuge north of Bog Road is open for waterfowl hunting and closed for all other species. Big game and upland game hunting is not authorized on the refuge. Guided hunting opportunities are not authorized on the refuge.

Fishing

National wildlife refuges may be opened to sportfishing only after a determination is made that this activity is compatible with the purposes for which the refuge was established. In addition, the sportfishing program must be consistent with principles of sound fishery management and otherwise be in the public interest. Lands acquired as WPAs are open to sportfishing, subject to State laws and regulations. Fishing or entry on all, or any part of, individual areas may be temporarily suspended by the posting, on occasion, of unusual or critical conditions affecting, land, water, vegetation, or fish and wildlife populations. In fiscal year 2011, fishing accounted for 425 recreational visits to the refuge complex, which is 3 percent of the total visitor use.

Benton Lake National Wildlife Refuge

The refuge offers no fishing opportunities due to a lack of sport fish on the refuge. The Pumphouse Unit (147 acres) is open for walk-in access to Muddy Creek, which provides trout-fishing opportunities.

Benton Lake Wetland Management District

The Arod Lakes and Blackfoot WPAs are open to fishing. Arod Lakes WPA, where yellow perch and northern pike are plentiful, receives the bulk of fishing visits in the refuge complex.

Blackfoot Valley, Rocky Mountain Front and Swan Valley Conservation Areas

Public access to conservation easement lands is under the control of the landowner and subject to State stream access laws.

Swan River National Wildlife Refuge

The refuge is open to fishing in accordance with State regulations on Swan Lake and Swan River.

Trapping

There are limited trapping opportunities on the refuge complex.

Benton Lake National Wildlife Refuge

Recreational trapping is prohibited on the refuge. Trapping by special use permit occurs for wildlife and infrastructure management purposes only.

Benton Lake Wetland Management District

With the exception of Sands and H2-O WPAs, recreational trapping is permitted on WPAs according to State regulations.

Blackfoot Valley, Rocky Mountain Front, and Swan Valley Conservation Areas

Public access to conservation easement lands is under the control of the landowner.

Swan River National Wildlife Refuge

Recreational trapping is prohibited on the refuge. Trapping by special use permit occurs for wildlife and infrastructure management purposes only.

Wildlife Observation and Photography

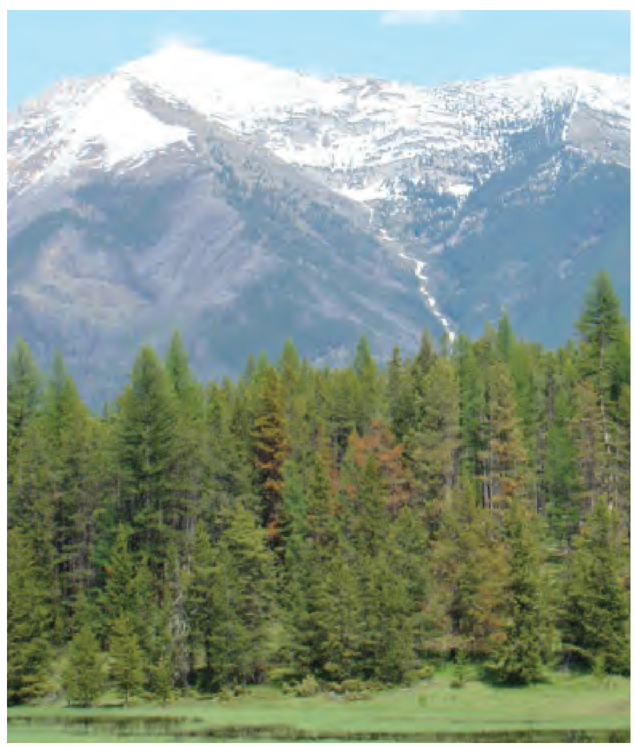
These are popular wildlife-dependent recreational activities at the refuge complex. A variety of habitats and many species of wildlife provide many observation and photography opportunities year round. In FY 2011, wildlife observation and photography accounted for 8,230 and 490 recreational visits, respectively, which is 62 percent and 4 percent of the total visitor use to the refuge complex. The Benton Lake Refuge received most of the visitation.

To protect nesting birds and other wildlife, pets are required to be leashed and remain on designated roads and trails, except during the hunting season in hunt areas. Vehicles (both motorized and nonmotorized) must stay on designated roads. Off-road vehicle travel is strictly prohibited due to negative impacts to biological resources and disturbance to wildlife.

Commercial filmmakers and still photographers must acquire a special use permit to work on Service lands. The permit specifies regulations and conditions that the permittee must follow to protect the wildlife and habitats they have come to capture on film and to prevent the unreasonable disruption of other visitors' enjoyment of the refuge complex. Commercial filming and photography on Service lands must also show a means (1) to generate the public's appreciation and understanding of the refuge's wildlife and their habitats and the value and mission of the Refuge System; or (2) to facilitate the outreach and education goals of the refuge complex.

Benton Lake National Wildlife Refuge

The refuge offers the Prairie Marsh Wildlife Drive, a 9-mile, self-guided auto tour route, as well as a Visitor Center, informational kiosk, the Prairie Marsh Boardwalk with a spotting scope, a sharp-tailed grouse observation blind, and a photography blind that is available on a first-come, first-served basis. The observation blind is available by reservation in April and May for viewing the courting rituals of



USFWS

Swan Valley Conservation Area

sharp-tailed grouse. The refuge also permits visitors to use their own temporary photography blinds along Prairie Marsh Wildlife Drive. Most visitors view wildlife from the auto tour route. Lower Marsh Road is also a popular observation area.

Benton Lake Wetland Management District

Currently, noncommercial wildlife observation and photography have been determined to be compatible, and WPAs are open to these uses. Commercial filmmakers and photographers still must acquire a special use permit.

WPAs are open to foot traffic: hiking, snowshoeing, and cross-country skiing. Bicycle use is permitted only on roads open to vehicular traffic. Equestrian use is prohibited. Impacts to biological resources, such as the introduction of invasive species and disturbances to wildlife during periods of nesting and migration, are of concern.

Blackfoot Valley, Rocky Mountain Front, and Swan Valley Conservation Areas

Public access to conservation easement lands is under the control of the landowner.

Swan River National Wildlife Refuge

Bog Road provides wildlife-viewing and photography opportunities and access to the interior of the refuge. The existing observation platform, kiosk, and interpretive panel and associated parking area also provide opportunity for wildlife observation and photography and are popular destination point while traveling through the Swan Valley.

Foot traffic, including hiking, cross-country skiing, and snowshoeing is permitted on Bog Road year round and in the hunt area during waterfowl hunting season. Bog Road is not maintained and is typically covered with several feet of snow. Parking is very limited on the refuge, therefore access is primarily from Swan Lake. Visitors cross-country skiing and snowshoeing are few, likely less than ten visitors per year.

Equestrian use is prohibited on Swan River Refuge to limit impacts to biological resources, such as the introduction of invasive species and disturbances to wildlife during periods of nesting and migration. Bicycles are permitted on Bog Road and on roads open to motorized vehicles.

Boating is permitted on the Swan River in accordance with State regulations. Many visitors to the refuge use canoes or kayaks to travel the river and enjoy the sights and sounds. Use of motor boats is controlled by the State “no wake” regulation, which has reduced impacts to the river shoreline.

“No-wake” is a State regulation that was adopted to curb motorboaters, and personal water craft users from running at top speed up the Swan River. The regulation is followed by most visitors and has increased use of the river by canoeists and kayakers. The “no-wake” regulation has reduced signs of erosion along the riverbanks, which should help native bull trout.

Environmental Education and Interpretation

Opportunities for environmental education and interpretation are abundant within the refuge complex. In FY 2011, for programs on and off of the refuge complex, environmental education accounted for 1,765 visits and interpretation accounted for 120 visits, which is 13 percent and 1 percent, respectively, of the total visitor use. In addition, 525 participants attended 10 special events on and off the refuge complex.

Benton Lake National Wildlife Refuge

The Benton Lake Refuge has the potential to provide an extraordinary environmental education and interpretation program. The refuge is located 12 miles from Great Falls, a city of 60,000 people. The population of Cascade County, where the refuge is located, is 82,000. The refuge staff has never included an environmental education position. Management staff has given occasional tours to school groups and nongovernmental organizations. The environmental science department of the Great Falls Public Schools (GFPS) brings all third graders (800–900 students) to the refuge each year in May and June for a basic introduction to prairie grasslands and wetlands. Refuge staff greet the buses and give a very brief overview of the Refuge System and provide refuge-specific information. Occasional youth hunting clinics are held at the refuge with help from MFWP staff. Becoming an Outdoor Woman workshops have also been occasionally held on the refuge. Refuge staff also take part in the Science, Technology, Engineering, and Math Exposition (STEM Expo) to help foster community-based participation by youth in the career fields of science and mathematics. The program includes both a community expo and a mentoring program.

Interpretive panels have been updated and are displayed in the visitor kiosk located on the office entrance road. More panels are being developed for display on the Prairie Marsh Boardwalk.

Benton Lake Wetland Management District

WPAs are open for environmental education and interpretation if they are found to be compatible. All WPAs in the district have the potential to be part of a structured environmental education and interpretation program. Currently, no such program exists due to the lack of environmental education staff in the refuge complex. Occasional environmental education events are held at the H2–O WPA. These usually involve wetland education themes with grade school children from around the Blackfoot Valley.

Blackfoot Valley, Rocky Mountain Front, and Swan Valley Conservation Areas

Public access to conservation easement lands is under the control of the landowner and no active interpretive or educational programming occurs on them.

Swan River National Wildlife Refuge

Currently, no formal environmental education or interpretation program exists at the refuge due to the lack of environmental education staff. The kiosk panels at the refuge, which are regulatory and informational, have been revised. Concrete work that provided a parking area, trail, and observation deck—all, of which, are accessible to people with disabilities—was completed in 2009 and construction of a new kiosk was completed in 2011. Interpretive panels on the viewing platform discuss the biology of the marsh. There is currently very limited potential for staff-led environmental education at the refuge due to the difficult access conditions on Bog Road and the lack of parking space. Bog Road provides access to the interior of the refuge. It is a two track road that is impassable in high water conditions or wet weather.

3.7 Operations

Operations consist of the staff, facilities, equipment, and supplies needed to administer resource management and public use programs throughout the refuge complex, which is located across a 12-county area covering more than 2,700 square miles. Within this area, the Service is responsible for the protection of 163,304 acres of lands and waters.

Staff

Currently, the refuge complex staff is comprised of 9.5 permanent full-time employees (table 9). Since 1998, the refuge complex has lost three positions—one full-time law enforcement position, one permanent biological science technician and a permanent maintenance worker. The current staff level remains well below the minimum prescribed in the June 2008 Final Report—Staffing Model for Field Stations (USFWS 2008e), which recommended adding 8 staff members, including a general schedule (GS)–13 refuge manager, GS–12 wildlife refuge specialist, GS–9 park ranger (visitor services specialist), GS–9 park ranger (law enforcement), GS–12 wildlife biologist, wage grade (WG)–8 maintenance worker, and GS–6 biological science technician (0.5 full-time equivalent employee).

Table 9. Staff funded in fiscal year 2011 at the Benton Lake National Wildlife Refuge Complex, Montana.

Official title	*Working title*	*Series and grade*	*FTE*	*Assignment*	*Station*
Permanent staff					
Wildlife refuge manager	Complex manager	GS-0485–14	1	Refuge complex	Benton Lake Refuge
Wildlife refuge manager	Deputy refuge manager	GS-0485–12	1	Refuge complex	Benton Lake Refuge
Wildlife biologist	Refuge complex biologist	GS-0486–12	1	Refuge complex	Benton Lake Refuge
Supervisory wildlife refuge specialist	Wetland district manager	GS-0485–12	1	District—all	Benton Lake Refuge
Wildlife refuge specialist	Wildlife refuge specialist	GS-0485–11	0.5	District—Blackfoot	H2-O WPA
Wildlife refuge specialist	Wildlife refuge specialist	GS-0485–09	1	District—Rocky Mountain Front	Benton Lake Refuge

Table 9. Staff funded in fiscal year 2011 at the Benton Lake National Wildlife Refuge Complex, Montana.

Official title	*Working title*	*Series and grade*	*FTE*	*Assignment*	*Station*
Maintenance worker	Maintenance worker	WG-4749–08	1	Benton Lake Refuge	Benton Lake Refuge
Administrative officer	Budget specialist	GS-0341–11	1	Refuge complex	Benton Lake Refuge
Budget analyst	Regional PCS and travel coordinator	GS-0560–09	1	Refuge complex	Benton Lake Refuge
Temporary, term, and seasonal staff (as money allows)					
Biological science technologist (term)	Biological science technologist (term)	GS-0404–06	0.8	Benton Lake Refuge	Benton Lake Refuge
Biological Science technologist (temporary)	Biological science technologist (temporary)	GS-0404–06	0.5	Benton Lake Refuge	Benton Lake Refuge
Administrative office assistant	Generalist	GS-0303–04	0.5	Refuge complex	Benton Lake Refuge

Facilities

Facilities are used to support habitat and wildlife management programs and wildlife-dependent public use activities. Facilities and real property assets are generally well supported throughout the refuge complex. The condition of real property assets affects the efficiency of staff to manage biological and visitor resources. The refuge complex has one full-time maintenance worker to support buildings, fences, and roads.

Poorly functioning facilities and infrastructure (for example, pump house, water delivery ditches, levees, and water control structures) can affect wetland, grassland, and forest management activities throughout the refuge complex. Water delivery, storage, and release are fundamental for accomplishing some management objectives. Poorly functioning levees, water control structures, pump house, and delivery ditches would significantly reduce management effectiveness. Interior and exterior fencing and boundary signing within the refuge complex are in need of further maintenance because they can reduce the efficiency and effectiveness of grassland and wetland management and resource protection.

The condition of real property assets affects the efficiency of staff to manage visitor services. Visitors to the refuge complex expect facilities and real property assets such as offices, comfort stations, roadways, boardwalks, and kiosks to be in good condition, accessible, and to contain correct information. Accessible facilities exist, but may not be strategically located to meet the needs of the users.

Visitor And Employee Safety And Resource Protection

Until the end of FY 2011, the Benton Lake Refuge had at least one dual-function, law enforcement-commissioned officer position. A full-time law enforcement officer is critical to protect fish and wildlife resources and provide staff and visitor safety. Within the last 4 years, the refuge complex has had a permanent, full-time law enforcement position and up to 2 collateral duty positions. Now, only 1 collateral duty officer serves the refuge complex.

Past violations on fee-title lands have primarily involved hunting. Vandalism, trespassing, dumping, and general littering exist, but violators are not often apprehended by law enforcement. Seasonal closures are implemented throughout the refuge complex to protect sensitive wildlife resources. Minimizing disturbances to nesting migratory birds is of particular concern. Law enforcement officers on the refuge complex are also responsible for monitoring and enforcing easement contracts, which is a critical aspect of protecting wetland and grassland habitats.

Current management routinely emphasizes analyses of safe work habits, use of personal protective equipment, and job hazards in all work situations, including those that seem relatively free of hazards. In FY 2009, the Regional Safety Office conducted an inspection at Benton Lake Refuge headquarters and compound that resulted in the correction of a small number of minor unsafe situations (for example, handrails need to connect to walls). In 2009, there was only one employee on-the-job injury. Overall employee and visitor safety is at acceptable levels.

3.8 Partnerships

The primary objectives of partnerships for conservation between the Service, private partners, nongovernmental organizations and others are to:

- support wildlife biological diversity;
- link together existing protected areas;
- preserve existing wildlife corridors;
- protect large, intact, functioning ecosystems;
- support the rural character and agricultural lifestyle of western Montana.

The Partners for Fish and Wildlife Program continues to develop strong partnerships with private landowners along the Front and within the Blackfoot and Swan Valleys through of habitat restoration and management projects on private lands. Strong partnerships have also developed among a variety of agencies and organizations, such as Trout Unlimited, TNC, The Conservation Fund, Ducks Unlimited, Natural Resource Conservation Service, MFWP, and the Montana Department of Natural Resources and Conservation, to accomplish similar objectives through restoration and protection projects.

Habitat restoration efforts focus on invasive weed treatment, wetlands, streams, native grasslands, and riparian areas. Typical projects include wetland restoration, riparian corridor enhancement (revegetation), instream restoration, invasive weed treatment programs, and the development of grazing systems to rejuvenate native grasslands.

The Blackfoot River watershed has a history of pioneering innovative land management strategies to support working landscapes and fish and wildlife. Recognizing the strong tie between land and livelihood, private landowners have played a key role in conservation projects for more than three decades. One of the earliest efforts involved developing Montana's enabling legislation for conservation easements, with the first conservation easement in Montana signed in the Blackfoot Valley in 1976.

The mission of the Blackfoot Challenge, a private nonprofit organization that came out of this rich tradition, is to coordinate efforts that conserve and enhance the natural resources and rural way of life in the Blackfoot Valley for present and future generations. Their contributions are a cornerstone for the successes within the valley. In 2006, the Blackfoot Challenge won the Innovations in American Government Award sponsored by the Ash Institute for Democratic Governance and Innovation at Harvard University's Kennedy School of Government.

Innovative partnerships continue to develop within northwest Montana. As part of the Blackfoot Community Project, for example, partners developed the 41,000-acre Blackfoot Community Conservation Area that involves community forest ownership of 5,609 acres and cooperative ecosystem management across public and private lands. As a multiple-use demonstration area, this project shows innovative access, land stewardship, and restoration practices and is management by a 15-member community-based council.

TNC has been a leading influence on the acquisition of conservation easements along the Front, protecting more than 79,000 acres at a cost of $15.8 million over the past 30 years. In the past 5 years, TNC has provided $2.1 million in private money to the Service's easement program within the project area. In addition, this partnership recently expanded to include the Conservation Fund and Richard King Mellon Foundation, both of whom have committed an added $15 million dollars in private money to buy conservation easements along the Front.

In addition there are several grant programs administered by the Division of Ecological Services, available to tribes, States, and private landowners for projects that help federally listed, proposed, or candidate species along the Rocky Mountain Front, Blackfoot Valley, and Swan Valley CAs.

3.9 Socioeconomic Environment

Most of the complex is open to public use, including the compatible, wildlife-dependent uses of hunting, fishing, wildlife observation, photography, environmental education and interpretation. These recreational opportunities attract outside visitors and bring dollars to the community. Associated visitor activity—such as spending on food, gasoline, and overnight lodging in the area—provides local businesses with supplemental income and increases the local tax base. Management decisions for the refuge complex about public use, expansion of services, and habitat improvement may either increase or decrease refuge complex visitation and, thus, affect the amount of visitor spending in the local economy.

For this CCP, the Service had a contractor prepare a socioeconomic study for the complex (USGS 2011), which is the basis for the following sections: population and employment, public use of the refuge complex, and baseline economic activity.

Regional Economic Setting

For economic impact analysis, a region (and its economy) is typically defined as all counties within a 30–60 mile radius of the impact area. Only spending that takes place within this regional area is considered to stimulate economic activity. The size of the region influences both the amount of spending captured and multiplier effects. Most of the economic activity related to the refuge complex is located within a 12-county region in northwestern Montana: Cascade, Chouteau, Glacier, Hill, Lake, Lewis and Clark, Liberty, Missoula, Pondera, Powell, Teton, and Toole. These counties compose the local economic region.

During the last century, ranching, farming, mining, oil and natural gas development, and the railroad have been important factors in the social and economic history of the area. More recently, outdoor recreation and tourism have been increasingly important contributors to the local economies. The next sections describe the socioeconomic characteristics and trends in the 12-county region.

Population and Density

Table 10 summarizes the population characteristics of Montana and the local economic region. In 2009, the U.S. Census Bureau estimated the total population for the 12 counties to be 342,587 residents, or 35.1 percent of Montana's total population. Three counties (Cascade, Lewis and Clark, and Missoula) accounted for 252,743 residents, or 74 percent of the region. Missoula was the most heavily populated with 108,623 residents, while Liberty was the least populated with 1,748 residents (U.S. Census Bureau 2011a). Three counties had populations greater than 60,000 and 6 had populations less than 8,000. Montana's population experienced an in-migration of residents from 2000–2009 (nearly 8 percent) (U.S. Census Bureau 2011a). Counties with larger populations grew more quickly than less-populated counties. Cascade, Glacier, Hill, Lake, Lewis and Clark, and Missoula counties recorded population gains over the past decade, while Chouteau, Liberty, Pondera, Powell, Toole, and Teton counties recorded population losses (U.S. Census Bureau 2011a). Missoula County experienced the largest gain (13 percent) while Liberty County experienced the largest loss (19 percent) (U.S. Census Bureau 2011a).


USFWS

Conducting vegetation sampling on the Benton Lake National Wildlife Refuge.

To better understand the demographic profiles of these counties, it is useful to examine their population densities and compare these to the same figures for the major communities in the region. Generally, counties with larger populations tend to be more densely populated. Missoula County, the most populated county in the region, has a population density of 42 persons per square mile. Cascade, Lake, and Lewis and Clark Counties (all heavily populated) follow similar patterns. Liberty County, the least populated in the 12-county region, has a population density of only 1 person per square mile. Chouteau, Pondera, Powell, Teton and Toole Counties (all sparsely populated) follow similar patterns.

The 2010 census reports the population of the city of Missoula to be 66,788, which is over 60 percent of the population of Missoula County. Similarly, the city of Great Falls has approximately 72 percent of Cascade County's population (U.S. Census Bureau 2011a). Higher local densities in these large communities show that rural areas may be more sparsely populated than what is shown in table 10.

Population projections may help show the expected economic conditions and demand for recreation near the complex. Montana's population is projected to increase 24 percent from 2009 to 2030, with a steady increase of approximately 11 percent each decade. The 12-county region is also predicted to grow, with the population increasing by 18 percent from 2009 to 2030 (NPA Data Services, Inc. 2011). Toole County, the second smallest county in the region, and Cascade County, the second largest, are predicted to lose the highest proportion of residents (-8.37 percent and -7.69 percent, respectively) while Lake County, currently the fourth largest in the complex, is predicted to gain the largest proportion (47 percent) (NPA Data Services, Inc. 2011).

Communities Near the Refuge Complex

The following narrative describes the communities near each of the units.

Benton Lake National Wildlife Refuge

Benton Lake Refuge is mostly located in north-central Cascade County, with portions located in Chouteau and Teton. Visitors come to the refuge for wildlife observation, photography, and waterfowl and upland game hunting. Great Falls, located about 12 miles to the south, is the closest city to the refuge. Despite a history of boom-and-bust mining cycles, Great Falls is a well-planned city. By the late 1800s, connections to the railroad allowed for a growing number of businesses and a vibrant agricultural sector. Throughout the 1900s, the city experienced steady growth due to the diversity of the local economy. By 1939, when Malmstrom Air Force Base was established here, the city had several well-developed sectors in the local economy, including manufacturing, agriculture, military, and retail (Big Sky Fishing 2011). Great Falls is a growing tourist destination, as it provides access to a wide variety of outdoor recreation opportunities. Visitors come for its rich Western history and impressive parks and open spaces (Great Falls Visitor Information Center 2011). Great Falls is also one of the many gateways to Glacier, Yellowstone, and Grand Teton National Parks, as well as to Showdown, Teton Pass, and Great Divide ski resorts (Great Falls Visitor Information Center 2011).

Table 10. Regional population estimates and characteristics for Montana, 2000–2030.

	Resident population in 2009	*Persons per square mile*	*Percent population change 2000–2009*	*Projected percent population change 2009–2030*
Montana	974,989	7	7.9	24
Cascade County	82,178	30	2.5	–8
Chouteau County	5,167	1	–13.5	–3
Glacier County	13,550	5	2.7	7
Hill County	16,632	6	0.02	-7
Lake County	28,605	19	7.5	47
Lewis and Clark County	61,942	18	10.9	38
Liberty County	1,748	1	–18.8	–2
Missoula County	108,623	42	13	30
Pondera County	5,814	4	–8.8	–4
Powell County	7,089	3	–1.2	15
Teton County	6,088	3	–5.4	–2
Toole County	5,151	3	-2.1	-8

Source: U.S. Census Bureau (2011a) and NPA Data Services, Inc. (2011).

Benton Lake Wetland Management District

The district is the largest in the country, covering ten counties. The Service has acquired 23 waterfowl production areas within the district, most of which lie in north-central Montana's Glacier and Toole Counties. More than 7,000 acres of wetland easements and 4,294 acres of grassland easements in northern Montana have been purchased for waterfowl production. Although these easements are spread throughout the district, the small town of Shelby is near to a cluster of wetland easements. Shelby is dependent on agriculture and tourism. The agricultural industry accounts for 10 percent of the 3,525 jobs in Toole County (Bureau of Economic Analysis 2011). Wildlife living on the conservation easements and waterfowl production areas also attract visitors to the area. Opportunities for viewing wildlife are abundant, and hunting, trapping, and fishing are available in many of the WPAs.

Blackfoot Valley Conservation Area

The Blackfoot Valley CA includes parts of Missoula, Powell, and Lewis and Clark Counties. The town of Ovando, which was home to only 81 residents in 2010, is located near the center of the conservation area (U.S. Census Bureau 2011b). This sleepy town is located along Highway 200 between Helena and Missoula. Historically, it has played several significant roles including, for example, a thoroughfare for the Blackfoot Indian Tribe, a camp for the Lewis and Clark party, a forerunner in the establishment of a United States Post Office system in Montana, and a regional hub for cattle and sheep ranching in late 19th century (Ovando, Montana 2011). The Blackfoot River Valley is a 1.5-million-acre watershed that is the central focus of the Blackfoot Community Project, a partnership with TNC, the Blackfoot Challenge, seven local communities, and private landowners (Blackfoot Challenge et al. 2005).

The Blackfoot Valley CA encompasses an 824,024-acre ecosystem. To date, a total of 43,991 acres of wetland, grassland, and conservation easements have been obtained within the project area. The Blackfoot River watershed includes the Ovando Valley and Helmville Valley. The watershed is bordered on the east by the Continental Divide, on the south by the Garnet Mountains, on the north by the Bob Marshall Wilderness Complex, and on the west by the Rattlesnake Wilderness. The center of the project area lies about 55 miles east of Missoula. The Blackfoot Valley CA is part of a conservation strategy to protect one of the last undeveloped, low-elevation river valley ecosystems in western Montana. The area compliments other components of a broad partnership known as the Blackfoot Challenge. The Service's Partners for Fish and Wildlife Program also works with private landowners to restore and enhance habitat on private lands and coordinate management activities on public lands throughout the entire Blackfoot Valley.

Rocky Mountain Front Conservation Area

The Rocky Mountain Front CA stretches from Pondera County south through Teton County and into Lewis and Clark County. The town of Choteau is located near the center of the CA in Teton County, 53 miles northwest of Great Falls. In 2010, Choteau, the county seat of Teton County, was home to 1,684 people. Located on regional trucking routes as well as on Burlington Northern Railroad routes, the city serves as an important commercial hub (U.S. Census Bureau 2011b; Choteau Chamber of Commerce date unknown). The town is also a home base from which tourists and recreationists enjoy the Rocky Mountain Front, located just 20 miles to the east. This area, which is known for its many wide open spaces and pristine wildlife habitats, allows visitors to enjoy the "…culture and traditions [that] are steeped in the fertile soil and in the wheat, barley and livestock" (Choteau Chamber of Commerce date unknown). Tourists also enjoy the Old Trail Museum, which takes visitors back to prehistoric times. Hiking through the mountains, viewing wildlife, and fishing the streams and lakes are some of the major recreational highlights of the area surrounding the Rocky Mountain Front CA (Teton County History 2011). Nearly 80,000 acres of conservation easements have been acquired to date.

Swan River National Wildlife Refuge

Swan River Refuge covers 1,569 acres in northern Lake County. Visitors are attracted to the refuge for opportunities to fish, hunt waterfowl, and view wildlife. The refuge is near the city of Kalispell, which is the 7th largest city in Montana and the Flathead County seat. Colorado College recently named Kalispell the "most diverse, balanced economy in the Rocky Mountain West" in its State of the Rockies report (Kalispell Chamber of Commerce 2011). Kalispell has a small business-oriented economy that is growing fast due to train traffic and increasing interest in outdoor recreation. The city provides easy access to the Canadian border as well as to public lands, which makes up 94 percent of the county's total land area (Kalispell Chamber of Commerce 2011).

Swan Valley Conservation Area

Swan Valley CA, which is part of the Interior Columbia River Basin, is located in Lake and northern Missoula Counties on the western side of the 12-county region. The establishment of the Swan Valley CA authorized the purchase of up to 10,000 acres of conservation easements and up to 1,000 acres of fee-title land next to the Swan River Ref-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Prescribed fire is a managment tool used at Benton Lake National Wildlife Refuge Complex.

uge. The conservation area lies about 30 miles southeast of Kalispell, near the small town of Seeley Lake, which was home to 1,436 residents in 2000 and relies on tourist traffic to and from Yellowstone and Glacier National Parks to sustain its local economy.

Gender, Age and Racial Composition

In the 2009 Census estimate, Montana had about an equal proportion of males (49.9 percent) and females (50.1 percent). This is also true of most of the counties in the refuge complex. The largest disparity, however, is in Powell County, where 61.4 percent of the population is male (U.S. Census Bureau 2011a). Median ages of the 12 counties ranged between 31 years (Glacier County) and 48.8 years (Liberty County). Only 4 of the 12 counties reported median ages below the State median (39.0 years). In general, the age distribution of the 12-county region mimics the distribution of the State as a whole (U.S. Census Bureau 2011a). Counties with higher populations tend to follow the State pattern more closely, and there is more variation in the median age in counties with considerably lower populations.

In 2009, Montana's population was mostly Caucasian (90.3 percent of all residents). American Indian and Alaska Natives had the second largest representation with 6.5 percent of residents. Generally, this distribution is also representative of the racial demographics in the 12-county region (U.S. Census Bureau 2011a). The demographics of the region, however, do differ slightly from statewide trends in the following ways:

- The regional Caucasian population represents 2.7-percent less of the total population than indicated by statewide demographics.

- The regional American Indian and Alaska Native population represents 2-percent more of the total population than indicated by statewide demographics.

The latter of these differences is due in large part to the American Indian and Alaska Native population of Glacier County, which represents the highest proportion of American Indian and Alaska Natives (60.9 percent) in both the region and the state. All counties are within 2 percentage points of the state proportion of residents of Hispanic or Latino origin (U.S. Census Bureau 2011a).

Economic Conditions and Trends

This section discusses conditions and trends in unemployment and social welfare. Many of the counties responded to the recent recession with below-average increases in unemployment, oftentimes reporting unemployment figures lower than the state and national rates. In contrast, many of the counties reported poverty figures much higher than the state and national averages (U.S. Census Bureau 2011a; Bureau of Labor Statistics, 2011). This section also discusses income and employment by industry.

Unemployment and Poverty

Table 11 summarizes unemployment rates, poverty levels, and household incomes. From 2007–2010, many of the counties in the refuge complex proved to have job markets that were less impacted by the recent recession than the rest of the country. The largest increase in nationwide unemployment occurred between 2008 and 2009, during which time unemployment increased by 3.5 percent (U.S. Census Bureau 2011a). By contrast, the average increase in unemployment for the 12-county region during the same period was 0.9 percent. Glacier County had the smallest change in its unemployment rate from 2008–2009, an increase of 0.4 percent (U.S. Census Bureau 2011a).

In 2009, most of the counties in the region reported median household incomes below the national median ($50,221). The exception was Lewis and Clark County ($52,317), which had the highest median household income in the 12-county region. Lewis and Clark was the only county in the region to report a figure greater than the state median ($42,222). After Lewis and Clark County, Hill ($40,778), Cascade ($40,434), and Missoula ($40,130) were the only other counties to report a median household income greater than $40,000. Glacier County ($29,941) reported the lowest median income in the region (U.S. Census Bureau 2011a).

Poverty levels in the region tended to be higher than state (15 percent) and national (14.3 percent) averages in 2009. Glacier, Lake, and Powell Counties reported the highest poverty rates among individuals at 30.5 percent, 20.9 percent, and 20.3 percent, respectively. Lewis and Clark, Cascade, and Teton Counties reported the lowest poverty rates among individuals at 10.1 percent, 15.1 percent, and 15.3 percent, respectively (U.S. Census Bureau 2011a).

In 2010, all of the counties in the 12-county region had median household incomes below the national median ($51,425), and many of the counties had median incomes below the State median ($43,089). The largest median household income, $50,245, was reported in Lewis and Clark County. The lowest median household income, $32,790, was reported in Pondera County (U.S. Census Bureau 2011a). Only Hill ($44,833), Flathead ($45,258), and Lewis and Clark ($50,245) Counties reported median household incomes above the state median.

Although unemployment seemed to show a rather strong economy, poverty levels in the 12-county region tended to be higher than the state (14.7 percent) and national (13.5 percent) averages. Glacier, Pondera, Liberty, and Lake Counties reported the highest poverty rates among individuals, with 24, 23.6, 22.8, and 21.3 percent, respectively. Lewis and Clark, Flathead, Powell, and Teton Counties reported the lowest poverty rates among individuals, with 10.4, 11.6, 12.8, and 13 percent, respectively (U.S. Census Bureau 2011a).

Table 11. Unemployment, poverty and household income in the counties surrounding the Benton Lake National Wildlife Refuge Complex, Montana.

	Median household income in dollars in 2009	*Unemployment percentage in 2010*	*Net change in unemployment percentage from 2007–1010*	*Percent of persons below poverty in 2009*
United States	50,221	9.6	5	14.3
Montana	42,222	7.2	3.9	15
Cascade County	40,434	6.1	2.8	15.1
Chouteau County	37,945	4.4	1.5	18.1
Glacier County	29,941	10.1	2.2	30.5
Hill County	40,778	5.6	1.7	19.1
Lake County	35,888	10.1	5	20.9
Lewis and Clark County	52,317	5.5	2.7	10.1
Liberty County	36,106	5	2.2	18.3
Missoula County	40,130	7.3	4.1	16.9
Pondera County	34,813	6.6	2.9	19.1
Powell County	35,848	8.9	3.9	20.3
Teton County	36,834	5.9	3	15.3
Toole County	37,238	4.7	2.4	16.5

Source: (U.S. Census Bureau 2011a,b).

Employment and Income by Industry

Table 12 summarizes employment by industry for the entire region. In 2009, about half of the regional employment (49 percent) fell into four main sectors (Bureau of Labor Statistics 2011):

- public administration
- educational, health, and social services
- retail trade
- arts, entertainment, recreation, accommodation, and food services

The Census data show that there is a tradeoff between population levels and employment in certain sectors. Namely, counties in the region with smaller populations tend to have both high employment in the agriculture and mining sectors and low employment in the retail trade industry. The opposite is true of regional counties with relative large populations. For example, Liberty County, the least populous in the 12-county region, reported that the agriculture industry alone accounted for 23 percent of its total employment in 2009, while retail trade accounted for 9 percent. By contrast, Missoula County, the most populous county, reported that the retail trade industry accounted for 13 percent of its total employment in the same year, while agriculture and mining accounted for only 1 percent of total employment (Bureau of Labor Statistics 2011).

Liberty County had the highest dependence on farm earnings, which accounted for more than 45 percent of its total earnings for 2009. Chouteau, Pondera, and Teton Counties also showed a high dependence on their farming industries, which accounted for 29 percent, 21 percent and 20 percent of total county earnings, respectively (Bureau of Economic Analysis 2011). These counties have an average population of around 4,700 residents, and an average population density of 2.3 persons per square mile (U.S. Census Bureau 2011a).

Key Activities that Affect the Local Economy

The ability of the complex to affect local economic activity and desired economic conditions is related to Service land use decisions and associated land uses. Recreation and tourism are the prominent resource-based industries with ties to the refuge complex.

Tourism and Outdoor Recreation in Montana

Montana residents and visitors to the state take part in a variety of outdoor recreation activities. According to the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, approximately 950,000 residents and nonresidents took part in wildlife-associated activities in Montana (USFWS 2008a). Of all participants,31 percent took part in fishing for a total of 2.9 million fishing days, 21 percent took part in hunting for a total of 2.1 million hunting days, and 79 percent took part in wildlife-watching for a total of 3.1 million activity days.

Table 12. Employment by industry for the 12-county region surrounding Benton Lake National Wildlife Refuge Complex, Montana.

Industry	*Percent employment by industry for the 12-county region*
Educational, health and social services	13
Retail trade	12
Arts, entertainment, recreation, accommodation, and food services	10
Construction	6
Public administration	14
Professional, scientific, management, administration, and waste services	9
Manufacturing	2
Finance, insurance, real estate, and rental and leasing	8
Agriculture, forestry, fishing and hunting, and mining	5
Other services (except public administration)	6
Transportation and warehousing	2
Wholesale trade	2
Information services	2
Total employment (jobs) = 221,513	

Source: U.S. Census Bureau (2011a).

Montana residents had the highest per capita hunting participation in the country at 20 percent, and fishing participation was also high at 23 percent. Most of all anglers (59 percent) and hunters (74 percent) in Montana were state residents, while most of the away-from-home wildlife watching participants in Montana were nonresidents (67 percent). The in-state spending associated with these activities totaled $1.1 billion in 2006, with $585 million spent on trip-related expenditures, $472 million on equipment purchases, and $72 million on licenses (USFWS 2008a).

Hunting and Fishing

Much of the Service's fee-owned land in the refuge complex is open to hunting. In 2006, the number of people who reported participating in fishing, hunting, or both as a primary form of recreation in Montana totaled 378,000 (USFWS 2008a). The spending associated with fishing and hunting in Montana totaled $753 million, of which 55 percent ($417 million) was spent on equipment, 38 percent ($283 million) was spent on trip-related expenditures, and 7 percent ($53 million) was spent on other expenses such as magazines, membership dues, and land leasing (USFWS 2008a). Waterfowl hunting is a popular recreation activity in the area surrounding the refuge complex. Although popular, the number of waterfowl hunters have declined in recent years. In 2001, there were 23,675 waterfowl stamps sold to in-state residents. Fewer stamps were sold in 2005 (17,474) and fewer still in 2010 (16,428) (MFWP 2011). During the same period, upland game hunting, comprised of turkey and bird hunting, has seen an increase from 44,000 licenses in 2001 to 52,000 in 2010. In 2006, migratory bird hunters made up only 8 percent of all hunters in Montana (MFWP 2011).

Wildlife Viewing

Wildlife viewing opportunities are abundant throughout the State of Montana. Wildlife viewing can include the activities of observing, identifying, or photographing wildlife. In 2006, the number of people that reported participating in wildlife viewing as a primary form of recreation totaled 755,000 in Montana (USFWS 2008a). The spending associated with wildlife viewing in Montana totaled $376 million, of which 80 percent ($303 million) was spent on trip-related expenditures, 15 percent ($55 million) was spent on equipment, and 5 percent ($19 million) was spent on other expenses such as magazines, membership dues, and land leasing (USFWS 2008a). According to a Service report on the national and state economic impacts of wildlife watching, spending by resident and nonresident wildlife watchers in Montana in 2006 generated economic impacts of $376 million in retail sales, $213 million in wages, 9,772 jobs, and $50 million in state and local sales tax revenue, totaling $639 million in total economic effects (USFWS 2008c).

Land Use and Ownership Changes Surrounding Refuge Complex Lands

Divided by the Rocky Mountains, the 12-county area surrounding the refuge complex contains a diverse variety of land uses and vegetative covers. Lake, Missoula, and Powell Counties lie to the west of the Continental Divide, and Cascade, Chouteau, Glacier, Hill, Lewis and Clark, Liberty, Pondera, Teton, and Toole lie to the east. The western region is largely forested and includes some of the best water, wildlife and working forests in the country (TNC 2011). Land cover in the western counties is comprised of 58 percent forestland, 19.7 percent grassland, 9.3 percent shrubland, 7.0 percent mixed cropland, 0.3 percent urban, and 3.3 percent other lands and water. Refuge complex units lying to the west of the Divide include Swan River Refuge, the Blackfoot Valley CA, and the Swan Valley CA. The eastern region is more arid and is largely comprised of planted grasslands and native prairie. The area also includes croplands, primarily located in the northeastern counties of Chouteau, Hill, Liberty, Pondera, Teton, and Toole. Land cover in the eastern counties is comprised of 9.9 percent forestland, 74.8 percent grassland, 6.6 percent shrubland, 6.2 percent mixed cropland, 0.1 percent urban, and 0.8 percent other lands and water (Headwaters Economics 2011a). Refuge complex units lying to the east of the divide include Benton Lake Refuge, the district, and the Rocky Mountain Front CA.

Land ownership within the 12-county area is comprised of 63.5 percent private ownership, 20.7 percent Federal ownership, 6.9 percent State ownership, and 7.6 percent tribal ownership (Headwaters Economics 2011a). Of the federally owned land, 77 percent is owned by the USDA Forest Service , 9 percent by the National Park Service, 10 percent by the BLM, and 4 percent by other Federal agencies including the Service (Headwaters Economics 2011a).

Changes in Land Use

The lands and waters of the refuge complex are unique landscapes with high conservation values. Some of the largest tracts of pristine wildlife habitat remaining in the U.S. are located within the Rocky Mountain Front, Blackfoot Valley, and Swan Valley CAs. These areas include large expanses of intact habitat and historic wildlife corridors that help federal trust species, such as grizzly bear, gray wolf, wolverine, pine martin, and Canada lynx, as well as migratory bird species, fish species, and rare plant species. The conservation areas in the refuge complex are primarily comprised of a mix of public lands and large tracts of privately owned ranchlands and forestlands. Private ranchlands and forestlands provide dual benefits by supplying wildlife habitat on working landscapes. These valuable landscapes are threatened by residential development. In 2000, the American Farmland Trust identified 5.1 million acres of prime ranchlands in Montana as being vulnerable to low-density residential development by the year 2020, with ranchlands located in high mountain valleys and mixed grassland areas surrounding the Rocky Mountains at highest risk of conversion. Among the counties in the Rocky Mountain Region (which includes 263 counties in Idaho, Montana, Wyoming, Utah, Colorado, Arizona, and New Mexico) Lewis and Clark and Missoula ranked in the top ten for acres of strategic ranchland at risk (American Farmland Trust 2000).

Development risk for ranchlands is largely driven by population growth and housing demand. Northwestern Montana has seen a boom in population and residential development in recent years. Within the 12-county area, Missoula County has seen the fastest growth in population, with an increase of 12.95 percent between 2000 and 2009. Lewis and Clark and Lake Counties have also seen large increases in population of 10.85 percent and 7.45 percent, respectively, during the same time period (U.S. Census Bureau 2011a). In addition to increases in population, second homes have become very popular in the state. As of 2011, there were more than 38,000 vacation homes in Montana, up 59 percent from those reported in the 2000 Census (Great Falls Tribune, 2011). Increases in population and second homes have led to increases in residential development in the region. Within the 12-county area, acres of private land developed for residential use increased by 29.9 percent from 1980 to 2000. As of 2000, residential development accounted for 2.8 percent of private lands in the 12-county area, up from 2.1 percent in 1980 (Headwaters Economics 2011a). Among the 12 counties, residential development accounted for the largest percent of private acreage in Lake and Missoula. Between 1980 and 2000, residential development in Lake County increased by 101.1 percent from 9.2 percent to 18.4 percent, and residential development in Missoula County increased by 10.1 percent from 11.4 percent to 12.5 percent (Headwaters Economics 2011a).

Residential development is not the only threat to wildlife in the region. The conversion of grasslands and wetlands to croplands can degrade water quality and diminish valuable habitat. Wetlands cover a relatively small area of Montana, but they have high ecological value as stopovers and breeding grounds for migratory birds and waterfowl. Montana wetlands are at risk of cropland conversion. About 27 percent of the wetlands present before 1800 have been converted to other land uses, primarily cropland (Dahl 1990). In addition to the filling, leveling, and draining of wetlands, the conversion of grassland to cropland has threatened upland habitat next to wetlands. Upland habitats provide nesting cover for migratory birds and for waterfowl and their broods. The district play a key role in protecting Montana's wetland and grassland resources.

CRP lands also affect wildlife habitat and water quality near the refuge complex. The CRP program pays landowners to take highly erodible croplands out of production and plant them to native grasses. CRP grasslands reduce erosion and help keep contaminates, sediments, and nutrients out of streams and lakes (USDA FSA 2008). CRP lands also help wildlife and have been found to increase nest abundance and population growth for waterfowl and migratory birds (Ryan et al. 1998). As of 2011, CRP lands in Montana make up more than 2.8 million acres, or about 3 percent, of the Montana land base (USDA FSA 2011). The U.S. Department of Agriculture's Farm Service Agency enters into 10- or 15-year CRP contracts with farmers. More than 59 percent of these contracts are scheduled to expire in the next 3 years: 497,194 acres in 2011, 694,004 acres in 2012, and 365,537 acres in 2013 (USDA FSA 2011). Depending on market conditions, commodity prices, and farm policy, these expirations could result in a large conversion of grasslands to croplands (Smith 2010), however, it is not likely that all of the expiring contracts will be converted (Roberts and Lybowski 2007).

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A spotting scope is on hand for educational use and wildlife observation at the visitor center at Benton Lake National Wildlife Refuge.

Conservation Easements

The Service has identified conservation easements as a key strategy for conserving important wildlife habitat in Northwestern Montana. Conservation easements leave land in private ownership, protecting private property rights while providing the Service with a cost-effective conservation strategy for large blocks of habitat. Within the Rocky Mountain Front, Blackfoot Valley, and Swan Valley CAs, the Service proposes to conserve a total of 408,500 acres of wildlife habitat through the acquisition of conservation easements from willing sellers. To date, the Service has protected 76,847 acres in Lewis and Clark, Pondera, and Teton Counties through conservation easements within the Rocky Mountain Front CA, and 43,991 acres in Lewis and Clark and Powell counties through wetland, grassland, and conservation easements within the Blackfoot Valley CA. The Service has protected an added 11,392 acres in wetland and grassland easements in the district.

A conservation easement is a voluntary, legal agreement entered into between a landowner and a conservation entity. Conservation easements are binding in perpetuity. The landowner reserves the right to sell or bequeath the property, but the easement and its associated restrictions remain with the property. Under a conservation easement, a landowner supports ownership of their property, but transfers some of their ownership rights to the conservation entity. Landowners have a set of rights associated with their land. For example, they have the right to run cattle, grow crops, harvest trees, build structures, and subdivide and sell portions of their land. Under a conservation easement, the landowner transfers several of these rights to a conservation entity. The most common right transferred is the right to develop or subdivide the land. Some conservation easements include more land use restrictions. The terms of a conservation easement must be mutually agreed upon by the landowner and the easement holder. There are three primary types of conservation easements offered in the refuge complex: perpetual wetland easements, perpetual grassland easements, and perpetual conservation easements. Perpetual wetland easements protect privately owned wetlands from being drained, filled, or leveled. Perpetual grassland easements protect privately owned rangeland and hayland from conversion to cropland. Perpetual conservation easements include the wetland and grassland restrictions and also protect land from being subdivided for residential development. For all refuge complex easements, landowners support the right to allow or disallow public access to their land. Hunting on many private lands is available for a fee through outfitters and guides. Although conservation easements do prohibit game farms, refuge complex easements do not preclude commercial hunting on private lands. Private landowners can also grant permission for hunters to hunt on their land at no cost. Montana facilitates private land hunting through their Block Management program, which helps landowners manage hunting activities and provides the public with free hunting access to private land (Personal conversation with Neal Whitney, MFWP, on June 14, 2011.).

Social and Economic Impacts of Conservation Easements

Conservation easements are public goods that generate many benefits for local residents, communities, and governments. Unlike goods derived from natural resources that are traded in a market, many of the benefits from conservation, such as ecosystem services and intrinsic worth, can be difficult to monetarily quantify. Conservation easements can protect values associated with biodiversity and wildlife abundance, support aesthetic beauty, and protect socially and culturally significant features of landscapes and livelihoods (Holdren and Ehrlich 1974, Ehrlich and Ehrlich 1992, Daily 1997, MEA 2005). Ecosystem services, such as water purification, oxygen production, pollination, and waste breakdown, are also supported for local residents through conservation easements (MEA 2005). A primary public benefit of Service conservation easements is enhanced and preserved wildlife habitat. As development stressors increase over time, many key habitat areas off of the refuge complex may become less available due to their conversion to nonwildlife habitat uses. Habitat preservation has been shown to stabilize and increase wildlife populations, especially for migratory bird species (Reynolds et al. 2001). Conservation easements on private lands strengthen the resiliency of species habitats and provide opportunities for wildlife movement and adaptation for years to come. Although the public may not be able to explicitly use or access land that is protected by conservation easements, these lands do help residents by increasing biodiversity, recreational quality, and hunting opportunities on publicly accessible national wildlife refuges and on some private lands (Rissman et al. 2007). In addition to preserving wildlife habitat and ecosystem services, conservation easements can protect traditional and historic ways of life that are associated with the working landscape. Land with historic commercial use, such as ranching, forestry, and farming, is often compatible with, or beneficial to, national wildlife refuge objectives (Jordan et al. 2007, Rissman et al. 2007). Conservation easements can also provide financial benefits for landowners that can enable them to preserve the natural and historic value of their farm, ranch, and open space lands, and to pass this legacy on to their children and grandchildren.

The Service proposes to buy conservation easements from willing sellers at fair market value, as determined by an appraisal process. An appraiser estimates for how much the land would sell unencumbered by the conservation easement (the before value) and for how much the land would sell with the conservation easement in place (the after value). The value of the conservation easement is equal to the before value minus the after value, or the difference in the fair market value of the property with and without the easement. Landowners may also choose to donate conservation easements to the Service. The donation of a conservation easement may qualify as a tax-deductible, charitable donation, which may result in federal income tax benefits. The sale of a conservation easement for less than its fair market value (called a bargain sale) may also qualify for tax deductions. Landowners may be able to claim a charitable income tax donation equal to the difference between the fair market value and the bargain sale price of their easement. Income from the sale of a conservation easement may be taxable. Please note that the Service does not give tax advice. Landowners considering entering into a conservation agreement should consult a tax advisor or attorney for advice on how a conservation easement would affect their taxes and estate.

Conservation easements affect the value of the encumbered property, and may affect the value of neighboring properties. They reduce the fair market value of an estate, because the easement permanently removes some of it's development potential. The reduction in value depends on the potential development value of the land and the level of restriction agreed-upon in the easement. In general, an easement on land located in an area with high development pressure will have a greater effect on value than an easement on land located in an area with low pressure, and an easement that is more restrictive will have a greater effect on the value of the land than an easement that is less restrictive. Changing the status of a parcel of land from developable pastureland to privately owned conservation land can increase the residential value of adjacent properties because they would be in proximity to permanently preserved open spaces (Irwin 2002). Evidence suggests that increases in residential property values as a result of open space proximity is most significantly due to the preclusion of development and not necessarily the type of open space preserved. In other words, preserved farm and ranchland could increase residential property values in a similar way that preserved forestland could (Irwin 2002).

The conservation easements acquired by the refuge complex are expected to have minimal impacts to local government revenue. Local governments collect revenue through intergovernmental transfers, property taxes, sales taxes, personal income taxes, and other charges such as permitting. Property taxes constitute the largest source of local governments' own revenue (Urban Institute and Brookings Institution 2008) and are expected to remain unchanged. Property taxes are assessed based on the value of property. For most types of property, county assessors use fair market value to determine property tax liabilities, however, agricultural and forest lands are often assessed differently. In many states, the assessed value of agricultural land and forestland are decided based on the productive value of the land rather than on the fair market value of the property. The fair market value of land is the amount for which a property is estimated to sell. This value includes both the productive value of the land and any speculative value associated with the possibility of developing the land. Conservation easements reduce the fair market value of property by removing the speculative value associated with possible development, however, conservation easements generally do not affect the productive value of agricultural land or forestland. In Montana, agricultural lands and forestlands are valued on the basis of land productivity, and are not influenced by the pressures of urban influences or land speculation (Montana Department of Revenue 2011). Most of the properties that enter into conservation easement agreements with the Service are classified as agricultural land or forestland, thus there will be little to no impact to the current property tax base for the 12-county area. Local government revenue associated with personal income is also expected to remain relatively constant. The proposed easements would affect the location and distribution of development, but are not expected to change the rate or density of human population growth. Redistribution of population growth could affect personal income-related revenues, but is expected to have little effect on total revenues within the 12-county area. Land protection through conservation easements could result in a reduction in future expenditures for local governments and municipalities. New residential developments require local governments to provide services such as fire protection, police services, and schools, and to construct new infrastructure such as roads, parks, and water and electrical delivery systems. A 2009 study to assess the effect of the Montana Legacy Project on net government revenues in Lake and Mineral Counties found that the costs of residential development of Legacy Project lands outweighed expected new revenues (Headwaters Economics 2011b, 2011c). The effect of conservation easements on local government revenues is complex and speculative, but evidence suggests that the effects of the refuge complex conservation easement programs on net revenues will be marginal.