## Reach #1 - Lotic Checklist

| Name of Riparian-Wetland Area: | | **Missouri River** | |
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| Date: | **5/14/2010, 5/20/2010 & 7/16/2010** | Segment/Reach ID: | **Reach #1 - River Mile 0 (Fort Benton) to 22 (Marias River)** |
| ID Team Observers: | **X** C. Krause, Hydrologist **X** V. Shea, Rangeland Management Specialist **X** A. Northerner, Range Technician (Riparian) **X** M. Forsyth, Rangeland Management Specialist **X** J. Peters, Wildlife Biologist **X** A. Ehlert, Range Technician __ M. Philbin, Hydrologist **X** J. Sorlie, Soil Scientist __C. Meier, Soil Scientist **X** W. Elmore, Ecologist **X** S. Smith, Riparian/Rangeland Management Specialist & National Riparian Service Team Leader | | |
| Assessment Procedures: | During February 2-4, 2010, interdisciplinary (ID) Team members met with National Riparian Service Team staff, former BLM National Operations Center surface water specialist, USGS scientist, and University of Montana scientist to gain a common understanding of what is already known and review existing information. Preliminary reach breaks were agreed upon, potential and capability descriptions were discussed, and written descriptions were developed.<br><br>Predetermined stops were chosen for each reach based upon sites that were representative of larger reaches of river based upon geomorphic and vegetative characteristics, unique or critical areas, grazing allotments, and reach breaks. BLM staff has been monitoring sites on the Upper Missouri since 1990 using the Upper Missouri National Wild and Scenic River (UMNWSR) monitoring form. Depending on site location, sites are monitored on a one, three, or five year cycle. In some instances over 20 years of photographs and documentation exist and this information was heavily used in stop location selection because of the reference material available.<br><br>Interested parties, grazing permittees, and stakeholders were invited to participate every day of the assessment in July. Each day began with a review of the potential descriptions for the reach. The entire reach was examined by the ID Team by boat with stops at the predetermined locations. At each stop the inundating discharges, flood frequency curves and zone locations were reviewed as necessary. Photograph and GPS documentation of the site was completed and soil pits were dug and documented. Vegetation lists were completed for each zone. At the completion of each stop the ID Team discussed their individual notes and observations. Once each reach was looked at from top to bottom the checklist was completed.<br><br>On May 14, 2010, an ID Team consisting of Vinita Shea (Range Specialist), Chad Krause (Hydrologist), Aurora Northerner (Range Technician), Jody Peters (Wildlife Biologist), Abby Ehlert (Range Technician) and Mitch Forsyth (Range Specialist), began a Proper Functioning Condition (PFC) assessment for the Missouri River. Starting at the mouth of the Marias River (reach break), about River Mile 21.5, working up river toward Fort Benton, the ID Team stopped at three locations on public land along the north side of the river. These sites were determined to be representative of the riparian-wetland plant communities occurring within Reach #1. Sites included both woody and herbaceous community types. A photo point was established and species diversity information (plant list) was collected at all three stops. In addition, information was collected for older river terraces, back channels and relic, mature cottonwood stands.<br><br>On May 20, 2010, an ID Team consisting of Vinita Shea (Range Specialist), Chad Krause (Hydrologist), Aurora Northerner (Range Technician), Jody Peters (Wildlife Biologist), Abby Ehlert (Range Technician), Josh Sorlie (Soil Scientist) and Mitch Forsyth (Range Specialist) completed a PFC assessment covering the south side of the Missouri River. Four sites were visited following the same procedure as described above.<br><br>On July 16, 2010, an ID Team consisting of Wayne Elmore (Riparian Ecologist), Steve Smith (Team Leader, NRST), Vinita Shea (Range Specialist), Chad Krause (Hydrologist), Aurora Northerner (Range Technician), Jody Peters (Wildlife Biologist), Abby Ehlert (Range Technician), Josh Sorlie (Soil Scientist) and Mitch Forsyth (Range Specialist) reviewed the field information collected on May 14, 2010 and May 20, 2010 in Reach #1 (Fort Benton to Marias River). This allowed Steve Smith and Wayne Elmore, who were not present on the earlier field visits, an opportunity to see the entire reach, look at the stops made in May, | | |

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| | review the notes and plant lists and discuss the functional rating.<br><br>Common names for plants will be used throughout this document. For scientific names refer to the plant lists or Appendix A.<br><br>The following 17 questions were answered using the methodology described in Technical Reference 1737-15. |

**Definitions:**
Zone 1 - from the scour line (the lower limit of sod-forming or perennial vegetation on depositional banks) to bankfull discharge (the stream discharge generally considered to be the single discharge that is most effective for moving sediment, forming or removing bars, and forming or changing bends and meanders, all of which result in the average morphological characteristics of channels). Bankfull on this reach of the Missouri River roughly coincides with the 2-year return interval discharge, approximately 23,000 cubic feet per second (cfs) (flood frequency analysis based on period of record at Fort Benton gage since beginning of flow regulation (total period of record is 1890-2010)).

Zone 2 - from bankfull to approximately the 10-year return interval discharge, approximately 45,000 cfs (flood frequency analysis based on period of record at Fort Benton gage since beginning of flow regulation (total period of record is 1890-2010)). This intermediate zone is between the frequently wetted area along the river and upland areas found on older, more elevated river terraces. This zone is dominated by plants that are equally likely to occur in wetlands or non-wetlands.

Zone 3 – from approximately the 10-year return interval discharge, approximately 45,000 cfs to the uplands (flood frequency analysis based on period of record at Fort Benton gage since beginning of flow regulation (total period of record is 1890-2010)). This zone is very infrequently flooded but may contain relic riparian species such as mature cottonwoods that were established at lower elevations before the surface was moved higher through sediment accretion.

It is important to note that because the function of the river is dictated largely by attributes and process in Zones 1 and 2, the assessment was focused on conditions observed in these zones.

Wetland Indicator Status Categories:
OBL (Obligate Wetland) - Occurs almost always under natural conditions in wetlands.
FACW (Facultative Wetland) - Usually occur in wetland but occasionally found in non-wetlands.
FAC (Facultative) - Equally likely to occur in wetlands or non-wetlands.
FACU (Facultative Upland) - Usually occur in non-wetlands but occasionally found on wetlands.
UPL (Obligate Upland) - Occur almost always under natural conditions in non-wetlands.

The vegetation section of the PFC checklist focuses on the age class, diversity and amount of *"riparian-wetland"* vegetation present along a reach within Zone 1 and 2. The term "*riparian-wetland"* refers primarily to facultative wetland and obligate wetland plants or those that usually or almost always occur in wetland areas. It is important to note that even though plains cottonwood and green ash are considered facultative plants, meaning they are equally likely to occur in wetland or non-wetland areas, for this assessment they were considered together with other riparian-wetland vegetation and used by the ID Team for completing the PFC checklist. Both plants, and especially plains cottonwood, were found within Zone 1 and 2 and are important in determining the processes and functionality of the Upper Missouri River.

Plant Composition:
Dominant - this term was used to describe plants having a canopy cover greater than 25% or when only a single plant occurred within an assessment area. If the canopy cover of two or more plants made up most of the assessment area, and they were of about equal value, each was noted as a dominant plant.

Vegetation Stability Class Rating:
1 to 3 = Low; 4 to 6 = Medium; 7 to 10 = High
(taken from Appendix H, Monitoring Stream Channels and Riparian Vegetation-Multiple Indicators, Interagency Technical Bulletin, Version 5.0, April 2008)

Soils

Redoximorphic (redox) features – include gray layers and gray mottles, both of which occur when iron compounds are reduced by soil microbes in anaerobic soils. Iron, in its reduced form, is mobile and can be carried in the ground-water solution. When the iron and its brown color are thus removed, the soils show the gray color of their sand particles. The anaerobic, reduced zones can be recognized by their gray, blue, or blue-gray color. The mobilized iron tends to collect in aerobic zones within the soil where it oxidizes, or combines with additional oxygen, to form splotches of bright red-orange color called mottles. The mottles are most prevalent in the zones of fluctuating water and help mark the seasonal high water table (BLM Technical Reference 1737-19 – Riparian-Wetland Soils).

POTENTIAL: Reach #1 - River Mile 0(Fort Benton) to 22(Marias River), is located within the older, preglacial Missouri River valley. Relative to the constrained, postglacial river channel, the Upper Missouri River upstream of Coal Banks has relatively high sinuosities, wide valleys, and more rapid channel migrations (Scott et al., 1997). See Figure 1- Reach #1 - River Mile 0(Fort Benton) to 22(Marias River).

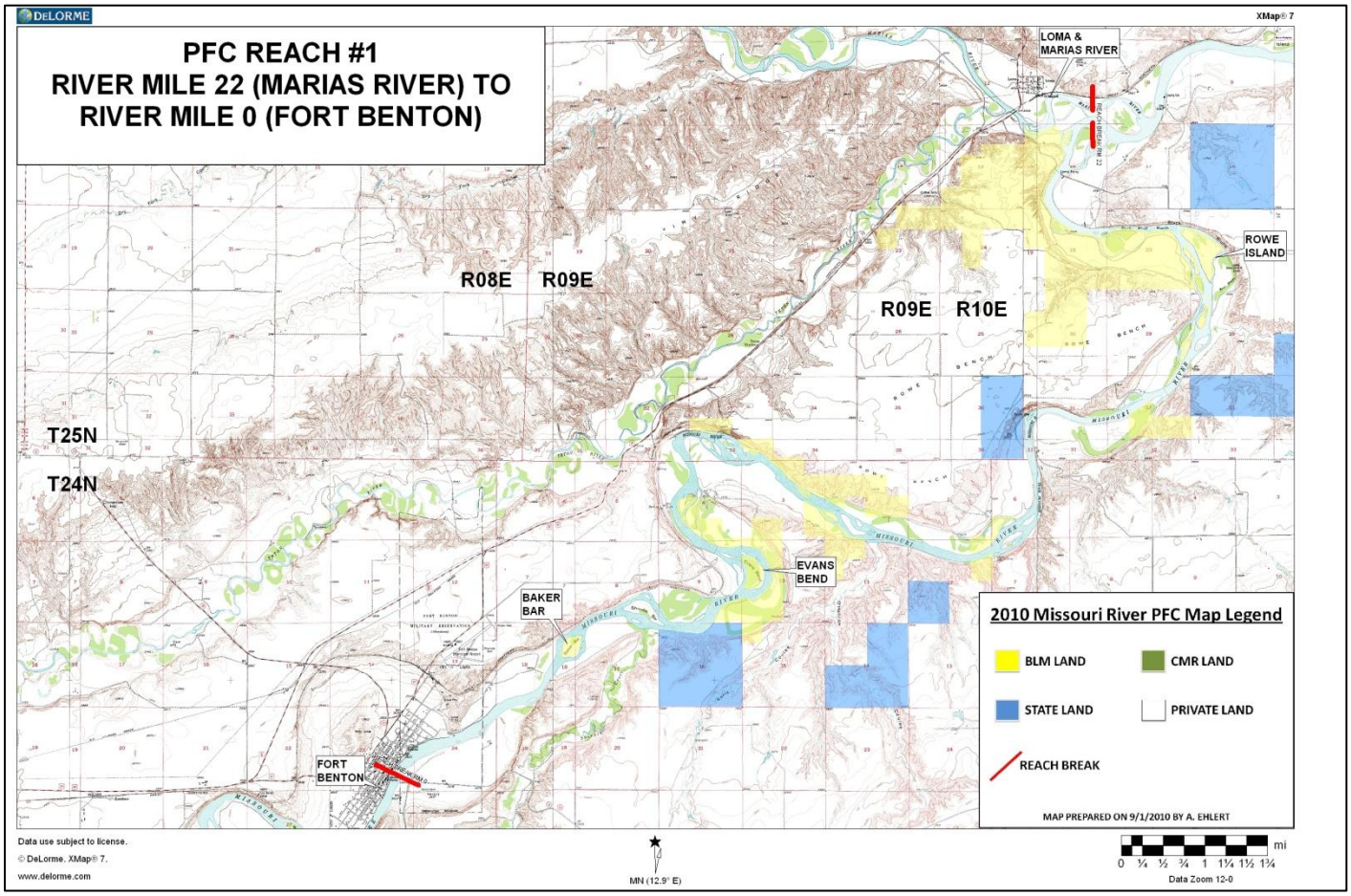


Figure 1 - Reach #1 - River Mile 0(Fort Benton) to 22(Marias River)

At potential, the channel would be broadly characterized as Rosgen C and F-type channels (Rosgen, 1996). Channel classification could vary from C and F-type channels to small portions of C-type channels with flood prone areas within an F- type channel. Rosgen C channels are often found in broad valleys with terraces, in association with floodplains and alluvial soils. They can be slightly entrenched with well-defined meandering channel. Rosgen C channels are low gradient, meandering, point-bar with riffle/pool morphology (Rosgen, 1996). Entrenchment ratios, which is the flood prone width divided by the bankfull width, are generally greater than 2.2, width/depth ratios greater than 12, and slopes less than 0.02.

Rosgen F channels are often found on entrenched landforms in highly weathered material (Rosgen, 1996). Rosgen F-type channels can be described as entrenched, meandering, riffle/pool channel on low gradients with high width/depth ratios (Rosgen, 1996). Entrenchment ratios are typically less than 1.4, which means that the flood prone width/bankfull width is less than 1.4. Channel slopes are generally less than 0.02, and bankfull width/depth ratios are greater than 12.

Evidence exists that the fore mentioned channel types would exist at potential. Comparisons of detailed maps from the 1890s do indicate a decrease in channel width as a result of channel narrowing. However, the decrease in channel width versus flood prone width would not have been large enough to change channel classifications. The channel has also been vertically stable during that time period. Scott et al. (1997) plotted stage at peak discharge for the Fort Benton gage prior to and after the construction of Canyon Ferry Dam. The period of record at the Fort Benton gage goes back to 1890, and Canyon Ferry Dam was completed in 1953. There was no downward shift in the stage-peak discharge relation. Although a stable stage-discharge relation associated with channel narrowing would generally indicate a deeper channel, it is not necessarily an indicator of vertical instability. See Figure 2 - Reach #1 - River Mile 0(Fort Benton) to 22(Marias River) – Aerial View.

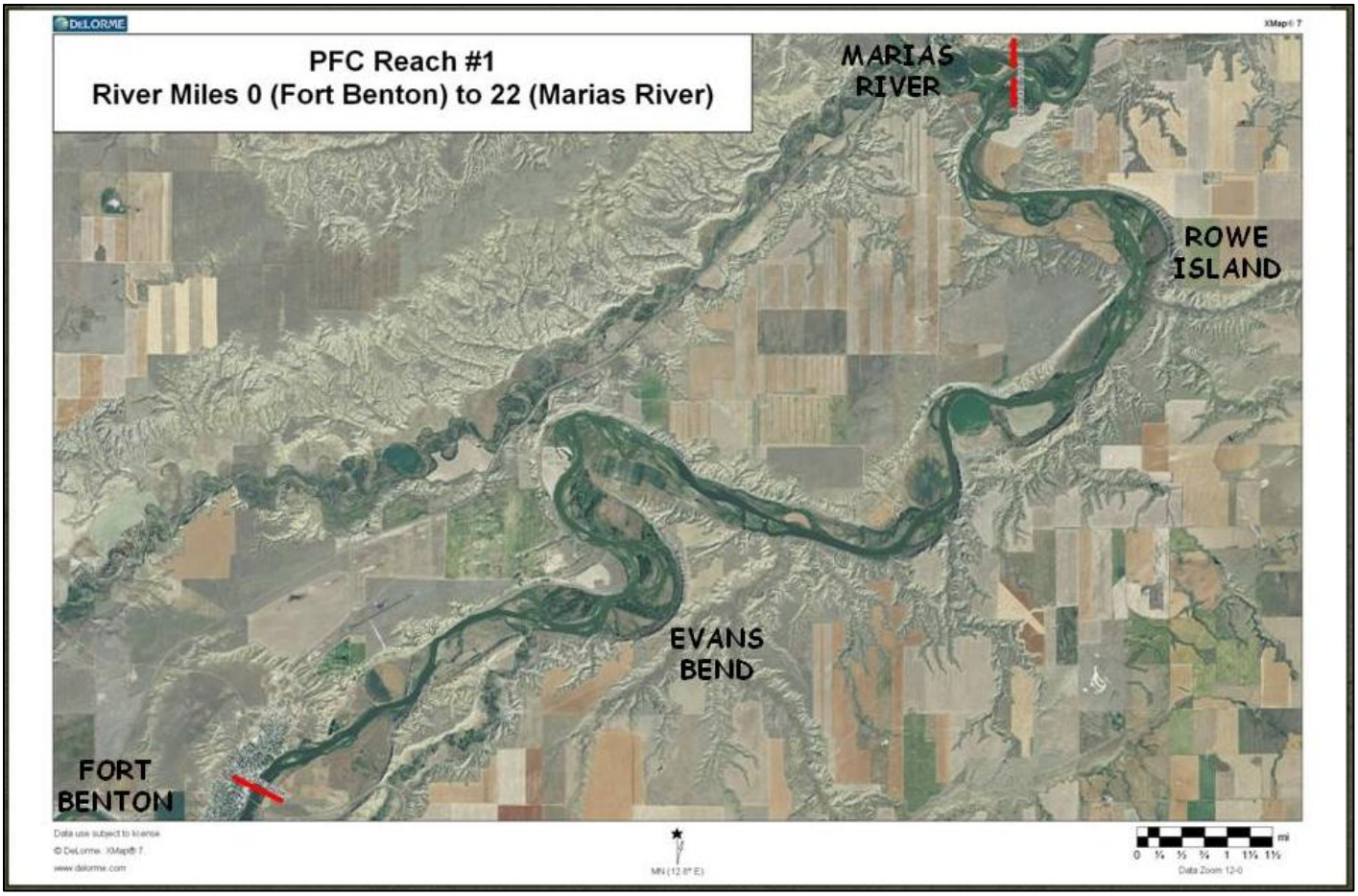


Figure 2 - Reach #1 - River Mile 0(Fort Benton) to 22(Marias River) – Aerial View

Bare moist sites suitable for cottonwood recruitment are most often met through flow induced channel change (Auble et al., 2005). Hansen (1989) describes four depositional sites which are suitable for the recruitment of pioneering species such as plains cottonwood and willow species. They are point bars, side bars, mid-channel bars, and delta bars. Through this unconstrained reach, all of the fore mentioned features exist. Meandering and channel narrowing are important processes for the establishment of woody vegetation. This results in vegetation community patterns that are spatially variable, usually not even-aged, establishment surface of mature trees often well below present ground surface and near channel bed elevation, and strong left-bank, right-bank asymmetry in ages corresponding to meander pattern (Scott et al., 1997). Small portions of constrained channels would result in vegetation community patterns of small numbers of linear, even–aged stands and establishment surface of mature trees well above channel bed elevation (Scott et al., 1997). More diverse representation of woody riparian vegetation, in terms of age-class and distribution, would be evident in back

channels, mid-channel bars, and depositional zones.

Because of the climate of northcentral Montana, which includes very cold temperatures, snow, and rapid warm up from "Chinook" winds, mechanical ice drives occur. The influence of this process on riparian vegetation is substantial. However, the effect is less noticeable in the unconstrained portion of the river relative to the constrained reaches. In these unconstrained portions, recruitment of trees is less dependent on the large flood pulses because with the lateral movement and sediment aggradation, established trees are removed from the zone where they receive more frequent physical disturbance (Scott and Auble, 2002). See Figure 3 - Decision Point – Mouth of the Marias River.

Figure 3 - Decision Point – Mouth of the Marias River

As sediment aggrades and depositional features mature, the potential exists for more mesic riparian species. According to Hansen (1989), as the alluvial material matures, there is a corresponding change in soil parameters, which provides a more suitable environment for tree species such as green ash and boxelder. Hansen (1989) describes a successional path of pioneer species such as plains cottonwood and sandbar willow followed by an understory of green ash, boxelder, chokecherry, and red-osier dogwood. Rivers which are free to move back and forth across their floodplain result in stands of vegetation in various stages of succession (Hansen, 1989). Suitable conditions for understory development would be met more frequently in the unconstrained reach than the constrained reaches of the Upper Missouri River.

Although typical C-type stream characteristics, such as point bars and cutbanks and their associated patterns of woody riparian species are common, many streambank miles through the reach would be dominated by herbaceous vegetation. Species would include a variety of Carex, Juncus, Scirpus, and Eleocharis species. The fore mentioned species would be located within Zone 1, would be frequently inundated and subject to ice, and be within close proximity of summer low water levels. These species tend to be located between the mean annual flood stage and the low water level (personal observation). During periods of low flow, they are very effective at capturing sediment. However, they can be vulnerable to high shear stress, buried by sediment, or completely removed by high flow or ice depending on conditions that year.

Historical accounts also contribute to the description of potential within this reach including the 1890s map by the Missouri River Commission and accounts from the Lewis and Clark expedition from 1804 to 1806. Above Coal Banks Landing, which is within this river reach, they state "timber increases in quantity, the low grounds become more level and extensive." They also note "came-to for the night in a handsome, low cottonwood plain on the south."

LIMITING FACTORS INFLUENCING POTENTIAL: Reach #1 - River Mile 0 (Fort Benton) to 22 (Marias River) is above the confluence of the Marias River and the influence of Tiber Dam. However, flow is still regulated through this reach by Canyon Ferry Dam on the Missouri. Flow releases out of Canyon Ferry Dam are also limited by urban encroachment by the city of Great Falls and by housing developments on the Missouri River between Great Falls and Helena. A generalized channel narrowing has occurred on this reach, and riparian forest has actually increased from Fort Benton to Coal Banks (personal communication, G. Auble (USGS)). However, much of the non-cottonwood forest is Russian olive. See Figure 4 - Typical Existing Conditions on Reach #1 - River Mile 0 (Fort Benton) to 22 (Marias River).

Figure 4 - Typical Existing Conditions on Reach #1 - River Mile 0 (Fort Benton) to 22 (Marias River)

A key factor affecting potential is the decrease in the magnitude of fluvial disturbances on the Upper Missouri River associated with both climatic shift and dams. A shift from wetter conditions in the mid to late 1800s combined with the effect of flow regulation has resulted in a process of channel narrowing (Scott and Auble, 2002). This affect has resulted in the establishment of cottonwood trees in existing back channels as they have become filled in with sediment and are no longer part of the active channel. Currently, this increase in trees has mitigated the effects of the loss of trees from higher surfaces, and current amounts of cottonwood forest are similar to amounts in 1890 (personal communication, G. Auble (USGS) and M. Scott (USGS)). However, this is a one-time response as the channel would not be capable of narrowing indefinitely.

Vegetation potential on the Upper Missouri River is also influenced by non-native plants and invasive weed species. Evidence exists that direct competition between native plants and areas dominated by exotic plants (non-native and invasive weeds) can result in the disappearance of native species. Kudray (2004) found reduced species richness was most strongly correlated with greater exotic herbaceous cover and also had a negative correlation with native woody species richness.

Five invasive weed species were documented by Kudray (2004) within the Upper Missouri River including: leafy spurge, Canada thistle, spotted knapweed, diffuse knapweed, and houndstongue. If control methods are found for the above listed weeds, particularly leafy spurge and knapweed, the capability could change. However, even with aggressive control strategies, it is highly unlikely that these weeds would be removed from the Missouri River ecosystem.

The history of the establishment and spread of invasive weed species along the Missouri River within the Monument is very similar to other western rivers although probably more recent. Vegetation inventories completed in 1975 and 1976, which included the river corridor, major tributaries and adjacent upland areas, did not document any infestations of invasive weed species on public land (George Hirschenberger, retired BLM, personal communication). However, by 1983 the BLM had identified areas between Coal Banks Landing and the Fred Robinson Bridge where invasive weed species, mainly leafy spurge, were becoming established along the river corridor. These areas were widely dispersed and small in size and density. In that year BLM personnel chemically treated an estimated 20 acres of leafy spurge and Canada thistle on public land (John Fahlgren, retired BLM, personal communication). By 2001, compiling information collected from surveys conducted over several years, the size of infested acres on public land had grown to 615 acres. The number of new invasive weed species had also grown considerably, from two in 1983 to over 10 in 2001. Again in 2010 the BLM completed a survey for invasive weed species along the entire river corridor from Fort Benton to the boundary of the Charles M. Russell Wildlife Refuge. As Table 1 below indicates, the acres infested on public land (Zones 1 - 3) more than doubled, increasing from 615 acres in 2001 to 1,363 acres in 2010.

**Table 1 - Invasive Weed Species of Concern Found Along the Missouri River**

| Common Name | 2001 BLM Infested Acres | 2010 BLM Infested Acres | Difference |
|---|---|---|---|
| Russian Knapweed | 370 | 322 | -48 |
| Common Burdock | Not Mapped | 2 | |
| Hoary Cress | 2 | Trace Amount | -2 |
| Spotted Knapweed | 19 | 46 | 27 |
| Canada Thistle*** | 14 | 280 | 266 |
| Field Bindweed*** | Trace Amount | 9 | 9 |
| Poison Hemlock*** | Trace Amount | 11 | 11 |
| Houndstongue*** | Trace Amount | 40 | 40 |
| Russian Olive | Not Mapped | 62 | |
| Leafy Spurge | 198 | 586 | 388 |
| Perennial Pepperweed | 12 | 5 | -7 |
| Dalmatian Toadflax | Trace Amount | Trace Amount | 0 |
| Salt Cedar | Trace Amount | Trace Amount | 0 |
| **Total Acres** | **615** | **1363** | **748** |
| ******* *Species were not completely documented in earlier surveys* | | | |

In evaluating the health and functionality of riparian ecosystems, the kind, amount and density of vegetation plays an important role. Healthy native plant communities capture sediment aiding in floodplain development and provide a deep-binding root mass protecting banks against ice damage and water erosion. These areas are also very prone to establishment of invasive weeds and non-native plants. Invasive weeds prefer highly disturbed sites such as river banks, roadsides and camping areas. Once established, invasive weeds often out-compete and displace native vegetation creating a single species plant community often resulting in increased soil erosion, an altered nutrient cycle, and reduced biological diversity (Sheley et al., 1999).

Non-native grass species are common and abundant, especially in Zone 2 (personal observation). These include smooth brome, Kentucky bluegrass, quackgrass, crested wheatgrass, and annual bromes. Smooth brome is aggressive, competitive and can exclude all other species (Kudray, 2004). Smooth brome occurred in 69 percent of Kudray's plots. Control methods and the capability of the BLM to economically control non-native grasses are limited.

Russian olive can affect vegetation composition and structure changing the site's potential. Russian olive has significant affects on riparian forests. According to Lesica and Miles (2001), Russian olive can displace native trees and shrubs and form monotypic stands that alter ecosystems. There is the possibility of Russian olive becoming the dominant or co-dominant tree on the Upper Missouri (personal communication, G. Auble (USGS)). Along the upper half of the Missouri River, which is mostly private land, it may be socially and economically impractical to control invasions of Russian olive. However, along the lower half of the Missouri River, which is largely public land, the opportunity to control Russian olive and limit its spread and establishment is still a viable option.

Agriculture and urban development has also increased substantially in this reach since 1890. As floodplain development increases, it may not allow for channel meandering processes, which created the cottonwood forests, to continue at the same rate or in equivalent amounts.

| Yes | No | N/A | HYDROLOGICAL |
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| X | | | 1) Floodplain above bankfull is inundated in "relatively frequent" events<br><br>**Rationale for Answer**<br><br>The river channel attributes and function are within a relative range of historic conditions both vertically and morphologically. So, relative to the potential channel morphology of Rosgen C and Rosgen F-channel types, no physical channel or floodplain characteristics prohibit access to the floodplain. Canyon Ferry Dam does regulate flows through this reach; however, the effect on "relatively frequent" events such as 2- to 5-year return-interval discharges is less than the shift in flooding frequency of much larger events, which may be important for ecological processes such as cottonwood recruitment.<br><br>A reach scale channel narrowing process has decreased the width of the active channel, which without a corresponding decrease in channel elevation would result in greater floodprone area. The channel has also been vertically stable. During the past century, the stage-peak discharge relation at the Fort Benton gage has not significantly changed, suggesting that the Missouri River has not downcut. Although a stable stage-discharge relation accompanied by channel narrowing would indicate a deeper channel, it may not be an indicator of vertical instability as much as the channel reaching a new equilibrium. The take home message is that flows of certain magnitudes inundate similar elevations as historically.<br><br>Redoximorphic (redox) features indicating that the soils undergo periodic saturation were prevalent in both Zones 1 and 2 except on the steep erosive bends of the river. Redox features were observed at a depth of 0 to 20 inches below the soil surface. The depth to these features increases as the distance from the active channel increases. The redox features observed were reduced soil matrices in Zone 1 and redox concentrations and depletions in both Zones 1 and 2. |
| | | X | 2) Where beaver dams are present are they active and stable<br><br>**Rationale for Answer**<br><br>Although beavers are present on the Missouri River, beavers on the Missouri do not build dams that affect channel morphology, floodplain hydrology, or alter water-table elevations. |
| X | | | 3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)<br><br>**Rationale for Answer**<br><br>Examination of the 1890 Missouri River Commission map, 1950s, 1980s and 2006 imagery has shown a decrease in channel width in all reaches of the Upper Missouri National Wild & Scenic River (UMNWSR). However, the ensuing change in width/depth ratios would not have changed the classification of the river channel. Furthermore, there have been no significant vertical shifts in the stage-discharge relation at the Fort Benton gage, which would indicate vertical changes in the river. The river channel attributes and function are within a relative range of historic conditions both vertically and morphologically. |
| X | | | 4) Riparian-wetland area is widening or has achieved potential extent<br><br>**Rationale for Answer**<br><br>A process of channel narrowing occurring over the last century has resulted in riparian species, |

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| | | | such as cottonwood, becoming established on sites that were previously within the active channel. Keep in mind that the channel will not be capable of narrowing indefinitely, and this may be a one-time response as the channel approaches a new equilibrium. As riparian-wetland vegetation establishes on zones that were at one time frequently flooded, subsequent sediment deposition moves them higher and drier, thereby decreasing the flooding frequency of these sites. Although there has been a net decrease in river channel, the amount of riparian-wetland area may be similar to past extents. |
| **X** | | | 5) Upland watershed is not contributing to riparian-wetland degradation<br><br>**Rationale for Answer**<br><br>Existing channel morphology and channel forming process did not indicate a large change in the amount of water or sediment supplied by the watershed. No evidence existed of excessive sediment deposition or scour/erosion from sediment "hungry" waters due to dam released waters. Substrate particle sizes ranged from cobble and gravel in higher shear stress zones to very fine in lower shear stress areas such as depositional zones. This indicates that the reach is capable of processing the water and sediment provided by the watershed. Conversely, homogeneity of the particle size distributions would indicate that the stream is no longer capable of moving its sediment load or that a change in stream energy has occurred and recent stream discharges are capable of moving a greater percentage of substrate materials. |

| Yes | No | N/A | VEGETATION |
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| **X** | | | 6) Diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)<br><br>**Rationale for Answer**<br><br>Herbaceous riparian-wetland plant communities were common and well represented on public land throughout the reach in Zone 1. Zone 1 was comprised of woolly sedge, hardstem bulrush, three-square bulrush, common spikesedge, reed canarygrass, alkali cordgrass and rough horsetail. At one site, where the back channel was filling in but was currently flooded, common cattail and small-fruit bulrush were present. Within Zone 1, dense communities of these rhizomatous herbaceous plants were common, indicating they are well established and expanding and thus exhibiting multiple "age-classes."<br><br>The most common shrub community type within Zone 1 and 2, occurring on the larger depositional surfaces of recent alluvium and also at gravelly sites, were dominated by sandbar willow. Sandbar willow ranged in height from two feet to greater than six feet and has completely colonized several areas (dense stands). Sandbar willow spreads by lateral root development, which on the colonized sites, provides examples of age-class diversity. Yellow willow was also present throughout the reach but infrequent and in much smaller amounts. Many of these were likely reproducing from very old, mature plants.<br><br>Within Zones 1 and 2, the dominant tree species included plains cottonwood seedlings and saplings, narrow-leaf cottonwood, green ash and peachleaf willow. For narrow-leaf cottonwood and green ash, a number of age classes were present ranging from sapling through pole and up to mature. Back channels that are filling in but are still periodically flooded, probably every two to five years, contained boxelder and plains cottonwood communities and have the highest potential for successful establishment and survival. Below bankfull seedling and sapling plains cottonwood trees dominated. However, these plants could be older and are actually re-sprouts or suckers from mature plants that have been damaged from beaver, flooding, and ice. |

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| | | |  <br>***South Stop #2 - back channel of island with well established community of common cattail and small-fruit bulrush.***<br><br>  <br>***South Stop #4 (Rowe Island) provides an example of a larger depositional area that is building and moving laterally. Note the dense sandbar willow and hardstem bulrush community (towards top) and narrowleaf cottonwood (center). The narrowleaf cottonwood has taken on a clump growth form after being sheared off by beaver.*** |
| **X** | | | 7) Diverse composition of riparian-wetland vegetation (for maintenance/recovery) (*species present*)<br><br>**Rationale for Answer**<br><br>The ID Team identified a variety of riparian-wetland plant species encountered at the seven sites visited on public land. Species noted included alkali cordgrass, reed canarygrass, common spikesedge, common cattail, hardstem bulrush, three-square bulrush, rough horsetail, small-fruit bulrush, woolly sedge and other sedge species, sandbar willow, red-osier dogwood, narrowleaf cottonwood, plains cottonwood, green ash and peachleaf willow. Herbaceous sites also contained a large percentage of invasive plants and noxious weeds; smooth brome, creeping meadow foxtail, Kentucky bluegrass, leafy spurge, Russian knapweed, spotted knapweed, perennial pepperweed, common mullein and Canada thistle. The number of species and density varied between sites making it difficult to determine what extent non-native plants may be having on plant diversity and what competitive advantage they may be having over native plants. |

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| | | |  <br>***The depositional surface at South Stop #1 (Evans Bend) is dominated by reed canarygrass.*** |
| **X** | | | 8) Species present indicate maintenance of riparian-wetland soil moisture characteristics<br><br>**Rationale for Answer**<br><br>Redoximorphic (redox) features indicating that the soils undergo periodic saturation were prevalent in both Zones 1 and 2 except on the steep erosive bends of the river. Redox features were observed from the soil surface to within 20 inches of the soil surface. The depth to these features increases as the distance from the active channel increases. The redox features observed were reduced soil matrices in Zone 1 and redox concentrations and depletions in both Zones 1 and 2.<br><br>Zone 1 is dominated by plants and plant communities consisting of obligate (OBL) and facultative wetland (FACW) plants. Plants noted included alkali cordgrass, reed canarygrass, common spikesedge, common cattail, hardstem bulrush, three-square bulrush, rough horsetail, small-fruit bulrush, woolly sedge and other sedge species, sandbar willow, red-osier dogwood, narrowleaf cottonwood, plains cottonwood, green ash and peachleaf willow. The back channel areas, which are prone to frequent flooding during the spring and early summer, also had riparian plant communities dominated by OBL and FACW plants. Moving away from the river into zones 2 and 3, (from the frequently wetted areas to sites less frequently flooded), there is a noticeable shift to facultative and facultative upland plants. |
| **X** | | | 9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events (*community types present*)<br><br>**Rationale for Answer**<br><br>Zone 1 is capturing sediment and is vegetated with riparian-wetland plants and plant communities with medium to high stability ratings. The OBL and FACW species noted along the reach with medium to high stability ratings include; hardstem bulrush, three-square bulrush, common cattail, small-fruit bulrush, common spikesedge and other sedges. These areas are slowly accreting and no unusual erosion activity was noted. Outside meander bends, with steep, high-walled banks are cutting but not at an accelerated rate. |
| **X** | | | 10) Riparian-wetland plants exhibit high vigor<br><br>**Rationale for Answer**<br><br>The reach was visited early in the growing season (May) at a time when OBL and FACW plants |

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| | | | were just beginning growth or in an early growth stage. The reach was visited again in July after water levels dropped allowing the ID Team another opportunity to look at recently exposed depositional surfaces. Herbaceous obligate wetland plants were emerging from depositional surfaces and along the scour line.<br><br>Tree and shrub species exhibited good vigor and growth considering most are re-sprouting from the base following removal by beaver. None showed a growth form typical of heavy browse use but were multi-stemmed from ice and beaver impacts. Impacts from beavers, girdling and complete removal, were noted in several areas. This was especially evident and common on narrow-leaf cottonwood where plants are resprouting from stumps of pole-sized trees.<br><br>Both herbaceous and shrub communities exhibited a high level of vigor based on growth form, height, leaf width and color, number of seed heads and the ability of plants to grow through layers of deposition. |
| **X** | | | 11) Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows (*enough*)<br><br>**Rationale for Answer**<br><br>The plants, plant groupings and community types observed in Zone 1 are well developed and the depositional surfaces well vegetated. Portions of this reach contain steep, vertical banks that are barren, have a high percentage of bare ground, few plants and a low potential for riparian development. However, these sites are naturally occurring with cutting/erosion from high flows along the outside of meander bends and scouring from ice events. Only a small percentage of the reach contained any areas of human-caused disturbances. The back channels were also well vegetated with high stability class plants. It was noted that many sites contained invasive weed species and non-native plants with the highest densities observed in the older, relic sites that are rarely, if ever, flooded. The team concluded that at least in Zones 1 and 2, non-native species have not reached a density affecting streambank stability as evidenced by slumping or cutting above natural levels.<br>  <br>***Looking upriver at North Stop #3 at a steep walled bank with a narrow depositional surface. These sites have low potential for riparian development and are subjected to intense scouring by water and ice.*** |
| | | **X** | 12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)<br><br>**Rationale for Answer**<br><br>Large woody material is present within the reach; however, it is not required for function. During the steamboat era, a significant amount of woody material was pulled from the Missouri River to aid in navigation. Nevertheless, not only did the river fail to degrade (downcut) as a result of this |

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| | | | activity, but it also narrowed during the past century. Although woody material is not a driver for function on the Upper Missouri, it can play an important role in small areas for floodplain development, energy dissipation, and aquatic habitat. |
| **Yes** | **No** | **N/A** | **EROSION DEPOSITION** |
| **X** | | | 13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy<br><br>**Rationale for Answer**<br><br>The channel morphology and floodplain areas are as expected relative to potential; the river is unconstrained in this reach with numerous meanders, oxbows, overflow channels, and islands. Depositional areas on BLM lands were well vegetated with riparian vegetation. The increased roughness of these areas results in energy loss in the channel due to friction loss. Depositional zones were where expected (inside of point bars, islands, etc.), and eroding banks that were present were only located on the outside of meander bends where shear stress is high because of large changes in velocity over a short distance.<br><br>New depositional zones were vegetated with pioneer species such as cottonwood and sandbar willow, which provide a functional role. These species are generally the first to establish on depositional zones of coarser material. Because these species are currently established on low elevation surfaces that are subject to frequent disturbance from floods and ice, they may never become mature individuals. However, due to their stiffer stems relative to herbaceous plants, they are able to trap woody material and organic matter, and subsequently fine-grained sediments, which lead to more conducive environments for sedge/rush communities and maturation of the floodplain. The increase in organic material also leads to increased water-holding capacity of the floodplain. |
| **X** | | | 14) Point bars are revegetating with riparian-wetland vegetation<br><br>**Rationale for Answer**<br><br>All depositional areas within the reach including point bars, islands, lateral bars, and delta bars were well vegetated with riparian-wetland vegetation including sedges, rushes, and willow within frequently inundated areas. Zone 2 was dominated by invasive species such as smooth brome, quack grass, and leafy spurge.<br><br>New depositional zones were vegetated with pioneer species such as cottonwood and sandbar willow, which provide a functional role. These species are generally the first to establish on depositional zones of coarser material. Because these species are currently established on low elevation surfaces that are subject to frequent disturbance from floods and ice, they may never become mature individuals. However, due to their firm stems, they are able to trap woody material, organic matter, and fine-grained sediments, which lead to more conducive environments for sedge/rush communities and maturation of the floodplain. |
| **X** | | | 15) Lateral stream movement is associated with natural sinuosity<br><br>**Rationale for Answer**<br><br>Examination of the 1890 Missouri River Commission map, 1950s, 1980s and 2006 imagery has shown a decrease in channel width in all reaches of the UMNWSR. However, the ensuing change in width/depth ratios would not have changed the classification of the river channel. Lateral movement is not excessive, and point bars are moving at similar rates to cut banks on the |

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| | | | outside of meander bends. |
| **X** | | | 16) System is vertically stable (*not downcutting*)<br><br>**Rationale for Answer**<br><br>A reach scale channel narrowing process has decreased the width of the active channel, which without a corresponding decrease in channel elevation would result in greater floodprone area. The channel has also been vertically stable. During the past century, the stage-peak discharge relation at the Fort Benton gage has not significantly changed, suggesting that the Missouri River has not downcut. Although a stable stage-discharge relation accompanied by channel narrowing would indicate a deeper channel, it may not be an indicator of vertical instability as much as the channel reaching a new equilibrium. The take home message is that flows of certain magnitudes inundate similar areas as historically. |
| **X** | | | 17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)<br><br>**Rationale for Answer**<br><br>Existing channel morphology and channel forming process did not indicate a large change in the amount of water or sediment supplied by the watershed. No evidence existed of excessive sediment deposition or scour/erosion from sediment "hungry" waters due to dam released waters. Substrate particle sizes ranged from cobble and gravel in higher shear-stress zones to very fine in lower shear-stress areas such as depositional zones. This indicates that the reach is capable of processing the water and sediment provided by the watershed. Conversely, homogeneity of the particle size distributions may indicate that the stream is no longer capable of moving its sediment load or that a change in stream energy has occurred and recent stream discharges are capable of moving a greater percentage of substrate materials. Eroding banks were located where expected, on the outside of meander bends. |

**Remarks (Reach #1)**

General Comments

In the reach of the UMNWSR from Fort Benton to Coal Banks, approximately 2% of the canopy cover of cottonwood trees are less than 10 years old, 5% are 10 to 25 years old, 31% are 25 to 50, 44% are 50 to 114, and 18% are greater than 114 years old (unpublished USGS data, in review and subject to revision). Spatial and temporal variability in the recruitment of trees means that there is no reasonable expectation of constant total area or stable age distributions (unpublished USGS data, in review and subject to revision). The process of channel narrowing that has been occurring since the late 1800s has resulted in establishment of cottonwood trees as existing back channels have filled in. This increase in trees has mitigated the effects of the loss of trees from higher surfaces, and current amounts of cottonwood forest are similar to those documented in 1890 (unpublished USGS data, in review and subject to revision). However, without a change in flow regimes on the UMNWSR, the amount of cottonwood forest may decrease although this effect will be somewhat less noticeable in the unconstrained portions of the river, which includes this reach.

Soils Summary

Zone 1 is within the active channel that is saturated/flooded with a two-year return interval flow. Soils within this zone undergo continuous or periodic saturation. This zone is typically in a reduced state resulting from the soils being saturated and virtually free of elemental oxygen (anaerobic). The soil matrix is reduced and low chroma colors (gleyed/gray) are observed. When the water table drops and the soils dry out, prominent redoximorphic (redox) features

such as iron concentrations and depletions, are found to the surface of the soil profile.

Overall for the reach, fines are kept in suspension in this zone due to the higher stream energy, so gravel and cobble settle out. A series of depositional events have stratified soil textures in the upper 20 inches, ranging from loamy sand to sandy clay loam (approximately 12 to 25 percent clay) with much gravel and cobble. Below 20 inches depth sand, gravel, and cobble are the dominant sediments.

Zone 2 is on the floodplain above Zone 1 and extends to approximately the 10-year floodplain, which is periodically saturated during less frequent flood events. As the river and water-table levels rise and fall, the soil alternates between reduced and oxidized states. Reduction occurs during saturation with water, and oxidation occurs when the soil is not saturated (USDA-NRCS 2010). Evidence of fluctuation is indicated by the presence of redox features within the upper 20 inches of the soil profile, which commonly include rust colored iron concentrations in the matrix and along roots and pores, and gray colored iron depletions throughout the soil matrix. The soil matrix is not reduced. The depth to redox features increases as the distance from the active channel increases. Redox features are not always present on some outside meanders because they are eroding faster than the features can form.

As the river rises during flooding events and reaches the floodplain, stream energy is dissipated resulting in fine-textured material settling out of suspension in the inside bends of stream meanders (point bars), side bars, mid-channel bars and delta bars. Soil textures are stratified resulting from depositional events and predominately range from loamy sands to sandy clay loams (approximately 12 to 25 percent clay) with thin layers of fine-textured materials. Common to Zones 1 and 2 – Substrate sediments contained much larger percentages of gravel and cobble then Reaches 3 through 6. Fine-textured soils can be found below steep sided cliffs/hills where shale is the parent material. Either the material has washed or fallen off the cliffs/hillsides and accumulated at the base, or the river has laterally cut into the cliffs/hillsides.

Zone 3 is on terraces above Zone 2. This zone is not frequently flooded; therefore, indicators (redox features) of recent soil wetting are not observed. In the old mature tree galleries, relict faint redox features are found below 40 inches indicating the zone was periodically saturated in the past. Much of Zone 3 has been moved higher through sediment accretion and is therefore flooded with less frequency.

Although this zone is not frequently flooded by summer stages, it is frequently scoured by ice resulting from spring thaw ice jams resulting in areas of bare soil. Rock fragments ranging in size from gravel to stones can be deposited by ice at higher elevations than river summer flows are capable of depositing.

Soil textures in this zone range from loamy sand to clayey dependent on what type of material was deposited during past flood events and/or the parent material found on the adjacent uplands.

Vegetation

Reed canarygrass occurs on nearly all depositional areas in Zones 1 and 2, and was often the dominant herbaceous species present. This perennial grass spreads aggressively and can limit the spread and establishment of other more desirable riparian-wetland species.

Smooth brome, and in some areas quackgrass, are the most abundant grasses on Zone 2 terraces.

In Zone 3, several shrub community types were present. These were located in the understory of mature stands of plains cottonwood and boxelder. The most common included red-osier dogwood, golden currant, western snowberry, white-stem gooseberry and chokecherry.

The more developed tree communities (plains cottonwood, narrowleaf cottonwood, green ash, boxelder) occurred in Zone 3; the old river floodplains that are dry or drying out and will rarely if ever be flooded again, even during extreme high flows.

Several water birch trees were found, but only at one stop (Evans Bend). Most of the boxelder and peachleaf willow communities observed consisted entirely of mature and/or decadent trees with an understory of snowberry or herbaceous grasses indicating the sites were rarely flooded and gradually drying out. The latter were documented in Zone 3.

Invasive weed species and non-native plants were also common and widespread on the sites evaluated and throughout the reach.

With the exception of Russian olive, the woody species found were native.

Red-osier dogwood was observed to be the most heavily used browse species. Use appeared to be primarily by wildlife (mule or white-tail deer). See explanation of how determined under wildlife section.

A large proportion of the banks on public land can be characterized as steep and nearly vertical, reaching five to ten feet in height in some places along the outside meander bend. Some parts of the bank within this reach are gravelly but where deposition is occurring, small stringers of herbaceous communities have established. The floodplain is very narrow and discontinuous.

***View of steep walled banks with a narrow riparian zone characteristic of public land above Loma Bridge.***

North Stop #1, River Mile 18.2, in the very southwest corner of section 2, was selected as fairly representative for woody plant communities occurring on public land. This site is also being considered as a "Designated Monitoring Area". The site has both a developing depositional area adjacent the river and an old back channel that is periodically flooded. Zone 1, an area of current deposition in the active part of the channel, immediately adjacent the river, is herbaceous with three-square and hardstem bulrush, reed canarygrass and creeping meadow foxtail. Zone 2 is dominated by sandbar willow with an understory of smooth brome and reed canarygrass. The old river channel floodplain has scattered plains cottonwood, mature and decadent, shrub communities and open grassland areas. Narrowleaf cottonwood saplings are present in the old channel bottom. These are mostly resprouts from stumps (multi-stemmed) following removal by beavers. Beaver have made substantial use of narrowleaf cottonwood and other woody species. Moderate use was noted on willow and red-osier dogwood by deer. See explanation of how determined under wildlife section.

North Stop #3, River Mile 10.5, contains an old floodplain above the river with an overstory of plains cottonwood and boxelder trees, a dense shrub understory of chokecherry and golden currant and grass openings of crested wheatgrass and smooth brome. Narrowleaf cottonwood and green ash trees, primarily mature trees, are scattered throughout in small groups or pockets. These sites are often referred to as "perched water tables". Overland flow of water from adjacent upland areas is normally trapped and stored supporting diverse woody riparian communities.

***Site of perched water table at North Stop #3***

South Stop #4, Rowe Island, River Mile 18.5, contained a large, gravelly deposit at the lower end of the island with trace amounts of narrowleaf cottonwood. These trees, as with other sites containing narrowleaf cottonwood, exhibited a shrub-like growth form because of frequent beaver activity.

Additional comments included the frequency, amount and density of invasive weeds, especially leafy spurge and Russian knapweed in Zones 1 and 2. Other invasive weeds and non-native plants noted were perennial pepperweed, spotted knapweed, poison hemlock, Canada thistle, field bindweed and common mullein. Because invasive weeds and non-native plants compete with and often displace native riparian-wetland plants, they may reach a level where they affect the functional condition of the Missouri River through changes in vegetation composition, structure and streambank stability.

The banks in this reach, as compared to the other reaches, have more gravel and cobble in the active channel and are more steep and high walled.

Beavers are also active in this reach but their impacts are not as concentrated as in other areas along the river. This is probably due to the amount of habitat available and the quantity of gravel substrate.

Wildlife

All stops along this reach showed abundant use of habitat by wildlife. Bald eagles and ospreys are utilizing large cottonwoods for nesting near the river. There are abundant migratory bird species throughout the reach, with highest density in mature woodland sites with good understory, which are not located near public use sites (boat launch and campsites). There is heavy use of cottonwood and some willow by beaver, with light browsing use by deer on several woody species.

Use of woody species by big game was determined by clean shearing off of leaders, the absence of grazing, or even presence of livestock at most locations visited. Cattle leave abundant signs including tracks, droppings, and mechanical damage to woody species when they have grazed an area. Livestock grazing on woody species tend to tear ends off stems and mechanically damage additional stems, leaving a ragged appearance. Deer generally browse on smaller diameter leaders with clean cuts and small amounts of bark tearing. While one clean bite does not guarantee it was not livestock use, observation of multiple stems on same and adjacent woody species, tracks and animal droppings in the area will usually confirm class of animal utilizing browse. The difficulty is in “quantifying” livestock vs. wildlife use in areas where both have been feeding.

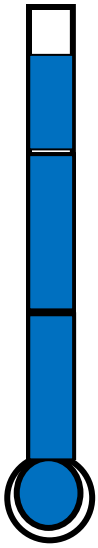
Grazing Allotments

North Side - Cabin #06434; N Hanging 5 #06422; Island #00870 (Unallocated); Wood River Ranch #00905 (Unallocated)

South Side – Evans Bend #09797; Big View #09664; Churchill Butte #19807; Rowe Coulee #09767

**SUMMARY DETERMINATION:** Reach #1was rated well above proper functioning condition and nearly at potential.

In summary, key attributes and processes responsible for the rating of Proper Functioning Condition were adequate riparian-wetland species diversity, age class, vigor, cover of riparian-wetland plants with medium to high stability ratings on the streambanks, stable streambanks, and channel attributes and functions within the range of conditions appropriate for this reach.

| **Functional Rating** | | **Are factors contributing to unacceptable conditions outside the control of the manager?** |
|---|---|---|
| _X_ Proper Functioning Condition<br><br>___ Functional - At Risk<br><br>___ Nonfunctional<br><br>___ Unknown<br><br>**Trend for Functional - At Risk:**<br><br>___ Upward<br>___ Downward<br>___ Not Apparent |  <br>**PFC**<br>**75% to 85%**<br>**FAR**<br>**NF** | Yes ___<br>No _X_<br><br>**If yes, what are those factors?**<br>___ Flow regulations<br>___ Mining activities<br>___ Upstream channel conditions<br>___ Channelization<br>___ Road encroachment<br>___ Oil field water discharge<br>___ Augmented flows<br>___ Other (specify) |

(Revised 1998) (5/2008)

# Appendix A – Plant List for Reaches #1-#6

| **Common Name** | ***Scientific Name*** | **AKA Name(s)** |
|---|---|---|
| alfalfa | *Medicago sativa* | |
| alkali bulrush | *Scirpus maritimus* | Saltmarsh Bulrush |
| alkali cordgrass | *Spartina gracilis* | |
| Baltic rush | *Juncus balticus* | |
| black medic | *Medicago lupulina* | |
| boxelder | *Acer negundo* | |
| Canada thistle | *Cirsium arvense* | |
| cheatgrass | *Bromus tectorum* | downy brome |
| chokecherry | *Prunus virginiana* | |
| common burdock | *Arctium* | |
| common cattail | *Typha latifolia* | broadleaf cattail, cattail |
| common mullein | *Verbascum thapsus* | |
| common reed | *Phragmites australis* | |
| common spikesedge | *Eleocharis palustris* | common spikerush |
| creeping meadow foxtail | *Alopecurus arundinaceus* | |
| crested wheatgrass | *Agropyron cristatum* | |
| diffuse knapweed | *Centaurea diffusa* | |
| field bindweed | *Convolvulus arvensis* | creeping jenny, morning glory |
| green ash | *Fraxinus pennsylvanica* | |
| golden currant | *Ribes aureum* | |
| hardstem bulrush | *Scirpus acutus* | |
| houndstongue | *Cynoglossum officinale* | |
| Japanese brome | *Bromus japonicas* | |
| Kentucky bluegrass | *Poa pratensis* | |
| leafy spurge | *Euphorbia esula* | |
| narrow-leaf cottonwood | *Populus angustifolia* | |
| needle spikerush | *Eleocharis acicularis* | |
| peachleaf willow | *Salix amygdaloides* | |
| perennial pepperweed | *Lepidium latifolium* | |
| plains cottonwood | *Populus deltoides* | great plains cottonwood |
| poison hemlock | *Conium maculatum* | |
| quackgrass | *Agropyron repens* | |
| red-osier dogwood | *Cornus stolonifera* | |
| red top | *Agrostis gigantean (alba)* | |
| reed canarygrass | *Phalaris arundinacea* | |
| rough horsetail | *Equisetum hyemale* | scouringrush horsetail |
| Russian knapweed | *Centaurea maculosa* | |
| Russian olive | *Elaeagnus angustifolia* | |
| Sandbar willow | *Salix exigua* | coyote willow |
| showy milkweed | *Asclepias speciosa* | |
| small-fruit bulrush | *Scirpus microcarpus* | |
| smooth brome | *Bromus inermis* | |

| **Common Name** | ***Scientific Name*** | **AKA Name(s)** |
|---|---|---|
| spotted knapweed | *Centaurea repens* | |
| three-square bulrush | *Scirpus pungens* | |
| water birch | *Betula occidentalis* | |
| western snowberry | *Symphoricarpos occidentalis* | |
| White stem gooseberry | *Ribes inerme* | |
| white sweetclover | *Melilotus alba* | |
| woolly sedge | *Carex lanuginosa (pellita)* | |
| yellow willow | *Salix lutea* | |
| Yellow sweetclover | *Melilotus officinalis* | |

## Appendix B – References for Reaches #1-#6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