RESULTS AND DISCUSSION

Forage Requirements

As of 2003, 161 feral horses occupy the PMWHR (Coates-Markle 2003). The herd demographics from 1971 through 2003 are shown in Appendix Q (page 131). Presently, there are 22 foals, 22 lactating mares, 32 non-lactating mares, 28 two to three year olds, and 57 stallions (Figure 5, page 50). Based on a review of the literature and personal communications, Table 1 (page 40) was developed to calculate the amount of forage necessary to sustain the 161 horses on the PMWHR (Demment 1979, NRC 1989, Lawrence 1996, Gagnon 2003, Coates-Markle 2003, Holechek et al 2004). Based on these assumptions, 1,189 animal unit months (AUMs) of forage is required to sustain these horses on a twelve-month basis.

Dietary Overlap

The dietary overlap was evaluated by Kissel and others (1996) between feral horses, bighorn sheep, and mule deer. As shown in Table 2 (page 40), it appears there is little overlap between feral horses and mule deer, except potentially during the summer for grass. Mule deer surveys conducted by Montana Fish, Wildlife, and Parks (Stewart 2004 and Pack 2004) indicate that most of the 350 mule deer that occupy the PMWHR during the winter months leave the PMWHR before summer, so competition for forage is not a concern.

The dietary overlap between feral horses and bighorn sheep has the greatest potential in spring and summer for grasses, and potentially in the fall for shrubs. However, a recently completed study, unpublished by the USGS-BRD (Schoenecker 2004), indicated that the approximately 100 bighorn sheep occupying the PMWHR do not range in areas frequented by horses.

Dietary overlap between bighorn sheep and mule deer for grass is greatest in the summer, and for shrubs from summer through winter.

Due to the apparent minimal competition for forage and space between feral horses and bighorn sheep / mule deer, forage requirements and carrying capacity models were developed only for feral horses. Further consideration may be necessary in order to support a larger bighorn sheep population.

Stallions sparring.

Proper Forage Utilization

The conventional wisdom has been that at 50 percent or less use of the current year's growth of a preferred forage plant, plant productivity can be maintained (Crider 1955). Holechek and others (1999) conducted a thorough review of the literature and found that 35-45 percent use may be more appropriate in order to maintain preferred forage plants in desert and semi-desert environments.

Preferred plants are ones that generally are more nutritious and more productive (Ricketts 1994, Ricketts 2002, Holechek et al. 2004). Briske and Richards (1994) noted that some preferred species develop grazing tolerant morphological characteristics. It appears that bluebunch wheatgrass (*Pseudoroegneria spicata*), a dominant preferred species on the PMWHR, has developed a lower growth form on the PMWHR in response to heavy use. Research has consistently demonstrated that on most rangelands, if range improvement is to take place, no more than 30-35 percent use is needed and 40-45 percent use is needed for maintenance of rangeland vegetation (Holechek et al. 1999).

Based on this information, we used harvest efficiencies of 30 percent for preferred and desirable species, and 10 percent for undesirable species when calculating initial stocking rates (the harvest efficiency is the planned actual amount of forage ingested by the animal).

Severely grazed and pedestalled Indian ricegrass.

Plant Communities

The PMWHR was divided into 30 different dominant plant communities (Table 3, page 41). These communities are organized in the table from driest to wettest environments. The spatial distribution of these communities is displayed for each inventory unit in Figure 6 (page 51). The mean annual precipitation (MAP) for the PMWHR can be found in Figure 2 (page 47). Subalpine fir shows up around 25 inches MAP and the solid timberline for Douglas fir (*Pseudotsuga menziesii*) appears to be around 20 inches MAP. Douglas fir first appears at as low as 14-15 inches MAP in the deep coulees, especially on north aspects.

A plant list for the PMWHR by common and scientific names, along with the feral horse grazing preferences and ecological response for each species is shown in Appendices O and P.

The Forest Service and Penn's Cabin units are dominated by bluebunch wheatgrass / sage and Douglas fir / forb and mountain snowberry (*Symphoricarpos oreophilus*) communities, transitioning into subalpine fir / forb and Idaho fescue (*Festuca idahoensis*) / forb communities to the north. The Burnt Timber unit is dominated by Utah juniper / bluebunch wheatgrass and bluebunch wheatgrass / sage communities, while the Big Coulee unit is dominated by Utah juniper / black sage (*Artemisia nova*) / bluebunch wheatgrass, Douglas fir / spike fescue, and bluebunch wheatgrass / sage communities. The Britton Springs unit is dominated by a Wyoming big sage (*Artemisia tridentata ssp. wyomingensis*) / shortstem buckwheat (*Eriogonum brevicaule*) community, with the administrative pasture being dominated by a Wyoming big sage / rubber rabbitbrush (*Ericameria nauseosa*) community. The National Park unit is dominated by a Utah juniper / curl-leaf mountain mahogany / low forb / needle and thread (*Hesperostipa comata*) community.

Forest Service inventory unit; transect location number 1.

Border between the Forest Service and Penn's Cabin inventory units.

Penn's Cabin inventory unit; transect location number 1.


Penn's Cabin inventory unit; transect location number 1.

Ecological Sites

The ecological sites served as the basis for the inventory (NRCS 1997). Each inventory unit's ecological sites are displayed in Figures 7-13 (pages 52-58). The legend for ecological site symbols can be found in Appendix A (page 77).

The ecological site descriptions contain the information describing the historic climax plant community (HCPC) or 'potential' for each ecological site. These descriptions can be found in

Appendices B through E (page 79-85). Figure 3 (page 48) indicates the locations and construction year of exclosures that helped in describing the potential for each ecological site. Appendix L (page 98) provides transect data for selected exclosures and reference areas.

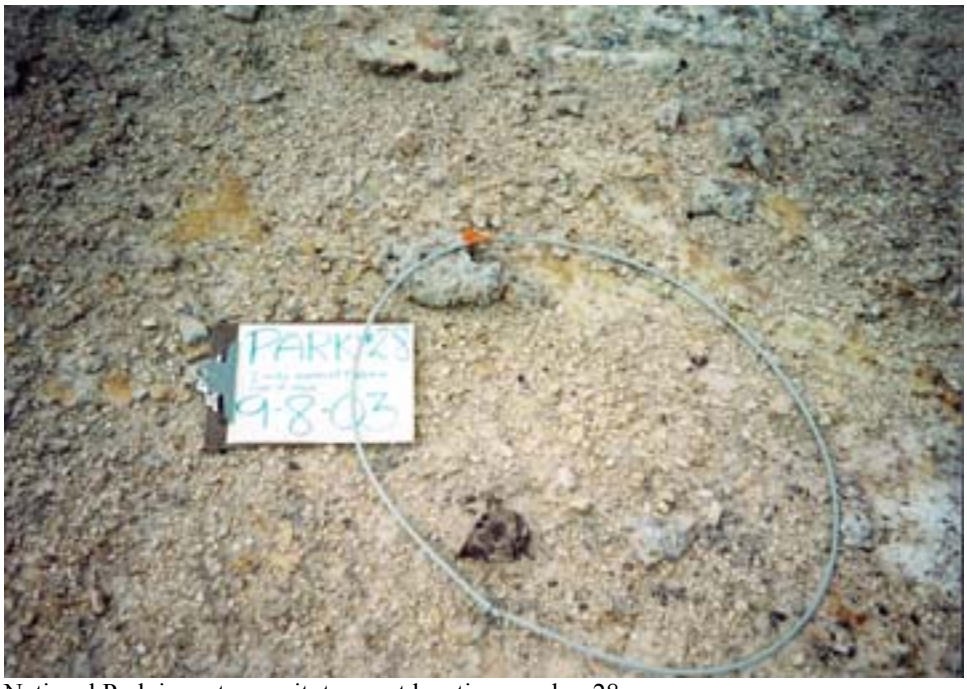
Similarity Index

The similarity index (S.I.) is the amount and type of vegetation presently on an ecological site relative to the HCPC for that site (NRCS 1997). It is expressed as a percentage between one and 100 percent, with 100 percent being the HCPC.

The S.I. provides a quantitative measure of health in terms of species diversity and productivity. It gives a relative idea of where the ecological sites plant community is ecologically, and where it could potentially go.

Presently the various inventory units overall S.I.s could be characterized as follows: Britton Springs 21 percent; National Park 44 percent; Big Coulee 29 percent; Burnt Timber 27 percent; Forest Service 45 percent; and Penn's Cabin 18 percent. A detailed spatial depiction of the S.I.s can be found in Figure 14 (page 59).

Notice that the lowest S.I.s are in the units with available perennial water (lowest and highest elevations). The exception to this is the National Park unit where the dominant plant community is Utah juniper. These ecological sites on which juniper and mahogany dominate have been termed "shrub" sites. They have a large amount of shrubs in the HCPC. Since these plants are only used lightly, their productivity remains more similar to the potential, hence a higher similarity to potential. Also notice the higher S.I.s in the lower Britton Springs administrative pasture verses adjacent areas within the PMWHR (30 percent vs. 15 percent).



National Park inventory unit; transect location number 28.

National Park inventory unit; transect location number 28.

Apparent Trend

Presently, the trend is down overall (Figure 15, page 60). This contrasts with current habitat objectives for the range. The trend transect data is summarized in Table 4 (page 42). The transect locations are shown on Figure 4 (page 49). Generally, the inventory units with the lowest mean annual precipitation (MAP) have the greatest percentage of downward trend. This relates to the ability of a preferred plant to maintain itself under heavy grazing pressure (Briske 1991, Briske and Richards 1994, Briske and Richards 1995, Briske 1996, Holechek et al. 1999). In the six- to nine-inch MAP zone, no more than 35 percent utilization of an individual forage plant may be appropriate to maintain that plant. In the 10- to 14-inch MAP zone it may be 40 percent, 15- to 19-inch zone 45 percent, and in the 20-inch+ zone 50 percent utilization may be appropriate.

Severe soil erosion was noted in all of the six inventory units with the percentage of transects in the unit noting it as follows: Britton Springs, 92 percent; Big Coulee, 74 percent; Burnt Timber, 59 percent; Forest Service, 55 percent; National Park, 31 percent; and Penn's Cabin, 29 percent. Plant pedestalling was most severe in the driest environments with an average of three-inch plant pedestals across the Britton Springs unit. Pedestals as high as two feet were documented in the Britton Springs and National Park units on Wyoming big sage and pricklypear cactus (*Opuntia polyacantha*) plants. It is estimated that pedestals as high as two feet occurred on 20 percent of the Britton Springs and National Park Units.

Severe soil erosion with over 2.5 feet of soil loss in the National Park inventory unit.

Plant pedestalling in the National Park inventory unit.

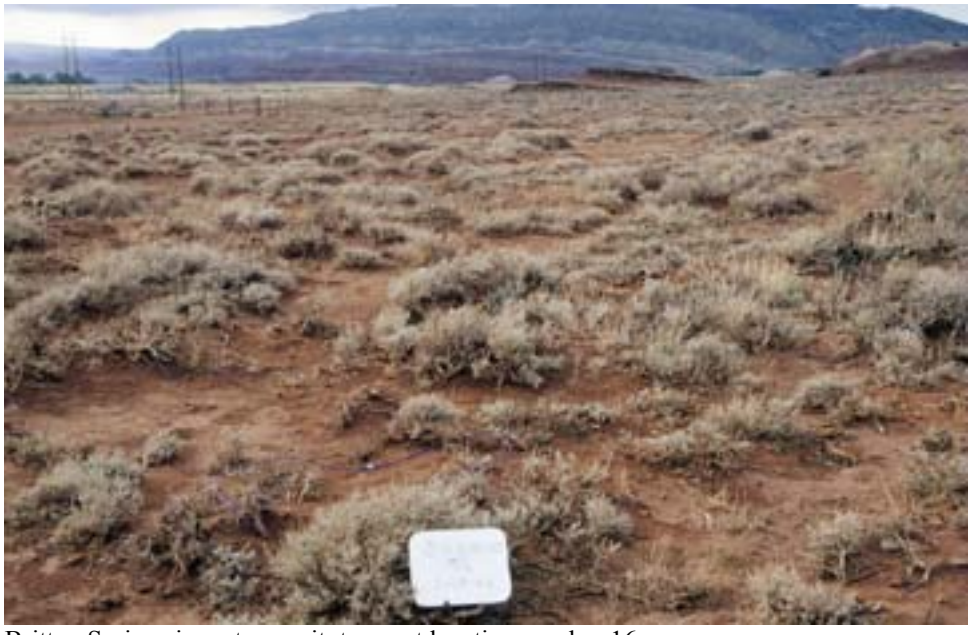
Big Coulee inventory unit; transect location number 24.

Erosion pavement in the Big Coulee inventory unit.

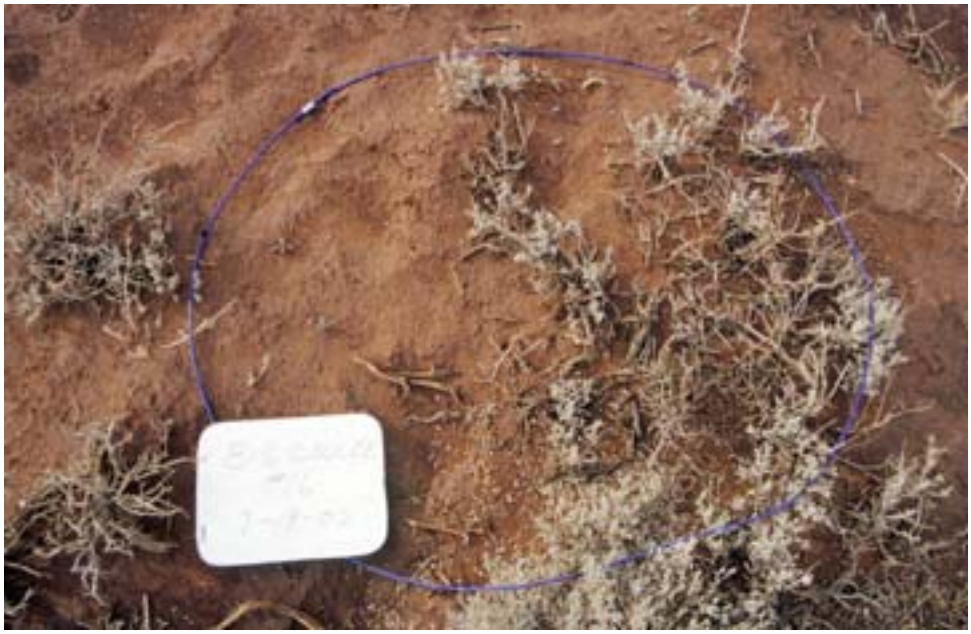
Erosion pavements are formed when the fine soil particles near the soil surface are either blown or washed away, leaving behind the heavier gravels, cobbles, and stones on the surface. These areas often look as though they are very cobbly and bouldery with little soil. However, as you dig into the soil profile the rocks are discovered to be mostly superficial. Every inventory unit noted erosion pavements. Burnt Timber and Big Coulee had the greatest amount of erosion pavements.

Gully erosion was noted in the Burnt Timber and Penn's Cabin units.

The percent bare soil cover was very high across the PMWHR ranging from an average of 56 percent in the Britton Springs unit to 25 percent in the Forest Service and Penn's Cabin units. If rocks are added in, the percentage cover varies from 84 percent in the Britton Springs unit (driest unit with the least forage and nearly the lowest S.I.) to 35 percent in the Forest Service unit (about the wettest unit with the most forage and the highest S.I.). If the relative proportion of rock to bare soil increases in the future, this may be a further indication of declining range trend.



Britton Springs inventory unit; transect location number 16.



Britton Springs inventory unit; transect location number 16.

Britton Springs inventory unit; transect location number 16.

Biological crusts, made up of lichens and mosses, tended to be non-existent in areas that had heavier grazing and finer textured, deeper soils. These are also the areas with more erosion taking place. Figure 16 (page 61) depicts the coverage of biological crusts across the PMWHR.

The turkey flats exclosure illustrates the downward range trend. The S.I. was 52 percent inside and 20 percent outside, the initial recommended stocking rate was 3.5 times higher inside than out, and the total production was almost double inside versus out. There was 59 percent bare soil outside (50 percent inside) with six-inch plant pedestalling, and only one percent basal cover of grass compared to seven percent inside. This is an example of the recuperative capacity of the range when grazing relief is provided over time.

Rangeland Health

On a scale of one to five, with one being an extreme departure from the health of the HCPC and five being a departure of none to slight, the following is the average rangeland health ratings for the PMWHR (Figures 17-19, pages 62-63):

- Penn's Cabin 3.75 – slight to moderate
- Forest Service 3.25 – moderate
- Burnt Timber 2.5 – moderate
- Big Coulee 3 – moderate
- Britton Springs 2 – moderate to extreme
- National Park 2.25 – moderate to extreme

Worksheet scores of four to five are considered healthy, with attributes closely resembling those of the historic climax plant community. Scores of 2.6 to 3.9 are considered at risk for site deterioration, and may be vulnerable to additional disturbances, such as strong climatic events, or

excessive grazing pressure. Scores of 2.5 or less are unhealthy and reflect attributes within the plant community which may not be able to recover from degradation without energy input, such as mechanical alteration.

Half of the PMWHR is at risk for site deterioration and half is unhealthy. The average rangeland health rating for the PMWHR is 2.75. The Britton Springs, lower Burnt Timber, and the north and south ends of the National Park units have crossed a threshold they may not be able to recover from due to cumulative historical grazing impacts.

Burnt Timber inventory unit; transect number 6.


Burnt Timber inventory unit; transect number 6.

Pedestalled forb in the Burnt Timber inventory unit.

Noxious Weeds

Halogeton (*Halogeton glomeratus*), spotted knapweed (*Centaurea biebersteinii*), saltcedar (*Tamarix ramosissima*), and malcolmia (*Malcolmia africana*) were the noxious weeds identified on the PMWHR (Figure 20, page 64). Halogeton, an annual weed that is poisonous to domestic sheep, was the most pervasive weed on the PMWHR covering most of the Britton Springs unit (3926 acres with the cover class ranging from less than one percent to 25-100 percent). The southern end of the Burnt Timber unit also has considerable halogeton. It was spotty elsewhere, however it appeared not to exist at locations above about 13 inches MAP.

Spotted knapweed locations were spotty and usually next to the Burnt Timber Ridge road. Saltcedar was located at one spot just east of the Britton Springs administrative corrals.

Malcolmia, an introduced African annual weed common to the Great Basin region, was located along the Burnt Timber Ridge road and the Sykes Ridge road in the Big Coulee inventory unit.

This noxious weed inventory was not meant to be comprehensive. Other locations of these and other noxious weeds may exist. Russian knapweed (*Acroptilon repens*) exists just south of the PMWHR and may exist on the PMWHR, but was not detected in this study.

National Park inventory unit; transect location number 10.

Halogeton is a non-native invasive annual weed.

Feral Horse Carrying Capacity

Historical Studies

Various studies of the carrying capacity of the PMWHR have been conducted over the years. These include a very broad range condition analysis done in about 1966, "Herd Management Area Plan" utilizing range condition class observations (USDI 1984 and 1992), various trend and

utilization analysis (Voss and Hanify 1990, BLM 1998, Gerhardt and Detling 1998, Fahnestock and Detling 1999, Gerhardt and Detling 2000), and a study by Coughenour (2000). Coughenour discussed the idea of "ecological carrying capacity" which he identified as the maximum numbers of feral horses the PMWHR could support, but not necessarily without impact to the habitat. He also discussed the idea of "economic carrying capacity" (maximum sustained yield) which is 50-60 percent of ecological carrying capacity.

The 1984 BLM study (HMAP) indicated a total of 2,154 animal unit months (AUMs) of forage on the PMWHR, with 1,823 AUMs being usable. At the time, a 1.25 animal unit factor was used for each feral horse. Taking 1,823 AUMs divided by 12 months gives 151 animal units (AUs). Dividing 151 AUs by 1.25 AUs per feral horse, 121 feral horses could be supported on the PMWHR without habitat deterioration.

Animal Unit Months of Forage at a 100 Percent Grazability

If the PMWHR could be grazed at 100 percent efficiently with regard to terrain and distance to water, then the AUMs outlined in Table 5 (page 43) would be appropriate.

One hundred percent grazability applies when no overgrazing of an area occurs because an animal is willing to access steeper slopes or walk a further distance from water to get a fresh bite.

Notice that nearly half of the total forage is in the Forest Service unit. The AUMs/AC. column of Table 5 (page 43), which represents the concentration of feed, shows the Forest Service unit as having nearly twice the concentration of feed as in the Penn's Cabin unit. The concentration of feed in the Penn's Cabin unit is nearly twice that of the other units. However, the Penn's Cabin unit has nearly three times the concentration of feed as the Britton Springs unit.

The stocking rate for the Forest Service unit is .066 AUMs/acre. Although this is higher than the other units, .066 AUMs/AC. is still not a large number for a stocking rate. This is especially true when you consider it equates to 15 acres necessary to feed one 1,000-pound cow (one animal unit) for one month, or about 10 acres for a PMWHR lactating mare (.69 of an animal unit). The typical concentration of feed on the prairies of Eastern Montana would be around .22 AUMs/acre, or 4.5 acres per animal unit, or about three acres per PMWHR lactating mare per month.

Grazability Models

The present AUMs on the PMWHR, if it could be grazed at 100 percent efficiency, would be 1,132 (Table 5, page 43) plus or minus 20 percent for sampling error (Figure 21, page 65). This is nearly the AUMs needed to support the 161 horses on the PMWHR as of 2003 (Table 1, page 40). However, 100 percent grazability is not realistic in a rugged, steep, and poorly watered landscape such as the PMWHR. This is supported by BLM actual use data.

Usable range must be determined to accurately assess the proper stocking rate at which habitat deterioration does not take place or is minimized. Due to the fact that studies have not been conducted concerning feral horse slope use and distance to water versus rangeland deterioration, a model tailored to the PMWHR was created.

For slope use, GPS locations of herd groups recorded by the BLM over several years were superimposed over a digital elevation map (DEM). The percent slope used by the herd group was

then determined from the overlay by month and season. We discovered that from late spring through fall (May-November), feral horses used less than or equal to (≤) 30 percent slopes 95 percent of the time. From winter through early spring (December-April) feral horses used ≤50 percent slopes 95 percent of the time (Table 6, page 43).

To make sure the feral horses were not just using the slopes based on the percentage of availability, we charted the percent of area within each slope class (Tables 7-8, pages 43-44) and compared it against the actual slopes used by feral horses. Between May-November feral horses used ≤20 percent slopes 85 percent of the time, while these slopes only made up 54 percent of the landscape available. The feral horses used ≥31 percent slopes only 5 percent of the time, even though the availability of those slopes on the landscape was 28 percent. Feral horses essentially did not use slopes over 50 percent.

Between December-April feral horses used ≤30 percent slopes 80 percent of the time, while the availability of those slopes on the landscape was 72 percent. Slopes ≥51 percent were used 5 percent of the time, while the availability of those slopes on the landscape was 10 percent.

From this information, ≤30 percent slopes were considered grazable acres in one model and ≤50 percent slopes were considered grazable in another (Figures 22-23, pages 66-67).

Watering source information provided by the BLM is shown in Figure 24 (page 68). Since some of the water sources are only available for a short time or are relatively unavailable, only the perennial water sources were considered in the models. The temporary water sources were excluded because they were essentially only available during the forage growing season. This is the time when the greatest damage to plant health can occur.

Four scenarios were developed to assess the grazability of the range as the feral horses are forced to move further from water in search of forage. These scenarios were superimposed over ≤30 percent slopes available for grazing and ≤50 percent slopes available for grazing. Eight grazing outcomes were assessed. Table 9 (page 44) describes the parameters used to evaluate each scenario.

Notice that with scenario #1 between 45 to 50 feral horses could be supported without deterioration to their habitat (Figures 25-26, pages 69-70). Habitat deterioration involves an overall decline in range trend, health, or similarity index. These numbers are 28 to 31 percent of the current horse numbers on the PMWHR. With scenario #2, between 62 and 71 feral horses could be supported (Figures 27-28, pages 71-72). Scenario #3 could support 105 to 126 feral horses (Figures 29-30, pages 73-74). Scenario #4 could support 117 to 142 feral horses or 73 to 88 percent of the current numbers (Figures 31-32, pages 75-76).

Scenario #3 and #4 require the operation of the mid-mountain water catchments in the Big Coulee and Burnt Timber units, and frame the correct proper stocking number when considering mid-mountain water.

Scenario #1 and #2 frame the correct proper stocking number when considering no available water at mid-mountain. It is understood that feral horses use mid mountain water during the winter when snow is available for water. However, range deterioration is greatest when heavy forage use occurs during the growing season, and least in the winter dormant season

(Crider 1955, Briske 1991, Briske and Richards 1994, Briske and Richards 1995, Briske 1996, Holechek et al. 1999). **Utilization of the forage could be more uniform across the PMWHR with mid-mountain water.**