I-94 Rest Area Corridor Study

October 2009

DOWL HKM

MONTANA MDT DEPARTMENT OF TRANSPORTATION

The preparation of this report has been financed in part through grant[s] from the Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation, under the State Planning and Research Program, Section 505 [or Metropolitan Planning Program, Section 104(f)] of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation.

TABLE OF CONTENTS

APPENDICES:

LIST OF TABLES

LIST OF TABLES, continued

LIST OF TABLES, continued

LIST OF TABLES, continued

LIST OF FIGURES

LIST OF FIGURES, continued

ABBREVIATIONS AND ACRONYMS

±........approximately
'........foot (feet)
AADT........Annual Average Daily Traffic
AASHTO........American Association of State Highway and Transportation Officials
ac-ft........acre-feet
ADA........Americans with Disabilities Act
Approx........Approximately
ATR........Automatic Traffic Counter
BOD5........Five-Day Biological Oxygen Demand
CDP........Census Designated Place
DEQ........Montana Department of Environmental Quality
DNRC........Montana Department of Natural Resources and Conservation
EB........Eastbound
EPA........United States Environmental Protection Agency
FHWA........Federal Highway Administration
ft........foot (feet)
ft2........square foot (square feet)
gpd........gallons per day
gpm........gallons per minute
GIS........Geographic Information System
GWIC........Ground-Water Information Center
GWUDISW........Ground Water Under the Direct Influence of Surface Water
HP........Horsepower
IM........Interstate Maintenance
kWh........kilowatt-hour
MBMG........Montana Bureau of Mines and Geology
MBR........Membrane Bioreactor
MCL........Maximum Contaminant Level
MDT........Montana Department of Transportation
METC........Montana Environmental Training Center
mg/L........milligrams per liter
MP........Mile Post
MPDES........Montana Pollution Discharge Elimination System
NRCS........Natural Resources Conservation Service
NRIS........Natural Resource Information System
Orig........Original
PWS........Public Water System
RAS........Return Activated Sludge
Rest Area Plan........Montana Rest Area Plan
RO........Reverse Osmosis
ROW........Right-of-Way
RP........Reference Post
SBR........Sequencing Batch Reactor
TN........Total Nitrogen
TP........Total Phosphorus
TSS........Total Suspended Solids
TYC........Traffic Yearly Count
USDA........United Stated Department of Agriculture
WAS........Waste Activated Sludge
WB........Westbound
WW........Wastewater
WYDOT........Wyoming Department of Transportation

EXECUTIVE SUMMARY

This study examines existing and proposed rest areas within the I-90 corridor from Big Timber to Columbus and the I-94 corridor from Billings to Miles City. The purpose of the study is to assess the current condition of rest area locations, determine the feasibility of upgrading existing facilities, and prioritize proposed improvements.

As part of this study, existing rest area facilities were assessed, with specific attention paid to water, sewer, and power services, as well as building facilities and parking areas. Rest areas were evaluated to determine whether they are meeting current demands, and whether they will be able to meet future demand over the 20-year planning horizon. In light of existing right-of-way boundaries and limitations due to topography, the study also assessed whether any needed future expansions would be feasible or if new sites should be explored.

This study was conducted in accordance with MDT's 1999 Montana Rest Area Plan (referred to as Rest Area Plan throughout this document), amended 2004, which provides guidance regarding appropriate spacing between rest areas. This study also followed an asset management approach in order to enable long-term management of resources and prudent allocation of funds given alternative investment options and competing needs.

Table ES 1 provides a summary of the Greycliff, Custer, Hysham, and Hathaway rest area assessment.

This Page
Intentionally Left Blank

Table ES 1 Summary of Rest Area Assessment

Parameter	Greycliff		Custer		Hysham		Hathaway	
	EB	WB	EB	WB	EB	WB	EB	WB
Size of Building Facility	Existing buildings are undersized to meet current and future demand. Five additional women's stalls and two additional men's stalls would be needed at each site in 2027.		Existing buildings are adequate to meet current and future demand.		Existing buildings are adequate to meet current and future demand.		An additional women's stall would be needed at each site in order to meet future demand.	
Size of Parking Facility	Existing parking areas are undersized to meet current and future demand. Thirteen to 15 additional truck parking spots and 42 additional auto parking spots would be needed at each site in 2027.		Existing parking areas are undersized to meet future demand. One additional truck parking spot and three to seven additional auto parking spots would be needed at each site in 2027.		Existing parking areas are undersized to meet future demand. Four additional truck parking spots and eight to nine additional auto parking spots would be needed at each site in 2027.		Existing parking areas are undersized to meet future demand. Two additional truck parking spots and 10 to 12 additional auto parking spots would be needed at each site in 2027.	
Spacing	Spacing is appropriate.		Spacing is appropriate.		The Hysham rest area is excessively close (approximately 25 miles) to the nearest rest area to the west (Custer).		Spacing is appropriate.	
Water Facilities – **Quantity**	Wells have adequate capacity to meet projected 2027 demand.		Wells have adequate capacity to meet projected 2027 demand.		Wells do not have adequate capacity to meet projected 2027 demand.		There are current supply issues at the Hathaway site. Because the disinfection process wastes some water, irrigation is not possible at certain periods during the summer.	
Water Facilities – **Quality***	Water quality is satisfactory.						Disinfection provided through Reverse Osmosis (RO) system.	
Sewer Facilities	Existing septic tanks and drainfields are undersized to meet current and 2027 demand.		Existing drainfields are undersized to meet 2027 demand.		Existing septic tanks and drainfields are undersized to meet 2027 demand.		Existing septic tanks are undersized to meet 2027 demand.	
Power Facilities	Existing grid power service is sufficient to meet rest area needs over 20-year planning horizon.							
Right-of-Way	Approximately one additional acre needed to meet 2027 demand for parking.	Approximately two additional acres would be needed to meet 2027 demand for the combined wastewater system.	No additional right-of-way would be needed.		No additional right-of-way would be needed assuming conversion of site to a truck parking location.		No additional right-of-way would be needed.	
Recommendation	Consider major rehabilitation of EB and WB sites, including new building facilities, new parking areas and amenities, new drainfield, and new advanced wastewater treatment system. Consider construction of single combined wastewater system at WB site.		Rehabilitate existing EB and WB sites; consider new advanced wastewater treatment systems; convert sites to year round use.		Convert existing rest area to truck parking location; demolish existing facilities and install vault toilets.		Rehabilitate existing water system; consider new advanced wastewater treatment systems, consider installation of two-unit prefabricated restroom facility.	
Urgency of Rehabilitation	Improvements are needed in the **near term** to address rest area's failure to meet current demand.		Improvements should be targeted **over the 20-year planning horizon** as funding becomes available.		**Near-term** conversion could be accomplished at a relatively low cost and would provide immediate savings in maintenance and operation time and costs.		Improvements to the water supply system are needed in the **near term**. Other improvements at the site could be targeted **over the 20-year planning horizon** as funding becomes available.	
Total Ranking Score**	102	103	79	79	78	78	82	81
Approximate Cost (Multi-Phase)	$3.5 million***	$4 million***	$800,000	$700,000	$200,000****	$200,000****	$1.1 million	$1.1 million

Note: Dark orange shaded cells indicate failure to meet current demand or spacing guidelines; light orange cells indicate failure to meet future demand.
*More stringent water quality rules may apply in the future.
**A higher total score indicates a better candidate for rehabilitation due to a more suitable site combined with a greater need for improvements.
***Assumes use of prefabricated building facility. Rehabilitation using site-built facility would cost approximately $5 to 6 million, depending on project phasing.
****Assumes conversion to truck parking location. Rehabilitation of Hysham rest area would cost approximately $1.1 million.

This Page
Intentionally Left Blank

In addition to the four existing rest areas within the study corridor, this study considered the proposed Big Timber and Fort Keogh rest areas as identified on the Montana Rest Area Map (see Appendix O). Based on Rest Area Plan spacing guidelines, neither of these rest areas would be needed now or in the future, assuming that existing rest areas are rehabilitated as recommended in this study. Constructing new facilities would represent a costly and unnecessary allocation of MDT resources. Rehabilitation of existing facilities represents a more cost-effective option, given that existing right-of-way is sufficient in most cases and entrance and exit ramps, building facilities, and other site amenities can be rehabilitated at a lower cost than new construction at a new site. Based on this assessment, construction of new rest areas within the study corridor is not recommended.

The Rest Area Map also notes a proposal to relocate the existing Hysham rest area further to the east. Based on spacing within the corridor, this study recommends conversion of the existing Hysham rest area to a truck parking facility. Therefore, reconstruction of the Hysham facility at a new site is not necessary and is not recommended in this study.

The recommendations noted above regarding new or relocated facilities are dependent on rehabilitation of existing facilities. Further detailed study would be needed to confirm this study's planning-level findings with regard to rehabilitation of water and wastewater systems.

This Page
Intentionally Left Blank

1.0 INTRODUCTION

The Montana Department of Transportation (MDT) initiated a corridor planning process for the portion of I-94 from Miles City to Billings and the segment of I-90 from Big Timber to Columbus in order to assess the current condition of rest area locations, determine the feasibility of upgrading existing facilities, and prioritize proposed improvements.

MDT developed a set of factors to be used to determine whether it is feasible to upgrade and maintain existing rest area locations or whether new locations should be investigated. While all factors were considered, four of these represent higher priority considerations, including provision of water, sewer, and power services and cost of rehabilitation. If a substantial impediment relating to any one of these four factors or a combination of any of the four were discovered, MDT guidelines recommend abandonment of the existing site and identification of an alternate location.

This report documents the general condition of existing rest area facilities and presents information relating to each of the factors to be used for assessment of the sites. If it appears that water, sewer, and power services cannot be reasonably provided at an existing site or that upgrades to the facility would be cost-prohibitive, this study also investigates the feasibility of new rest area sites within the defined study limits in combination with abandonment of existing sites. The end result of this study is a set of recommended improvements for existing rest area sites and an assessment of the need for new rest area sites within the study area. Recommendations proposed in this study are consistent with MDT's 1999 Montana Rest Area Plan (referred to as Rest Area Plan throughout this document), amended 2004.

1.1 Study Area

The study area is defined as the portion of I-90 from Big Timber to Columbus in addition to the segment of I-94 from Billings to Miles City. Existing rest area locations to be assessed within these boundaries include the eastbound (EB) and westbound (WB) Greycliff, Custer, Hysham, and Hathaway rest area locations. The study area and existing rest area locations are illustrated in Figure 1-1.

Chapters 2 through 5 separately discuss the four existing rest areas included in this study. It should be noted that each chapter is intended to largely function as a stand-alone resource with respect to each rest area. While this increases repetition of some information common to one or more of the four facilities, it provides a consolidated location containing all information relating to an individual rest area.

The study also considers proposals for new rest areas within the study corridor, including the Big Timber and Fort Keogh rest areas, as well as the proposed relocation of the existing Hysham rest area. These proposals are discussed in Chapter 6 of this document.

Figure 1-1 Study Area

Symbol	Rest Area Location	Interstate Facility	Approximate MP EB (Eastbound)	Approximate MP WB (Westbound)
▲	Greycliff	I-90	380.9	381.0
▲	Custer	I-94	38.2	41.3
▲	Hysham	I-94	64.7	64.8
▲	Hathaway	I-94	113.5	112.6

2.0 GREYCLIFF REST AREA

2.1 Existing Conditions and Current Demand

2.1.1 General Site Descriptions & Setting

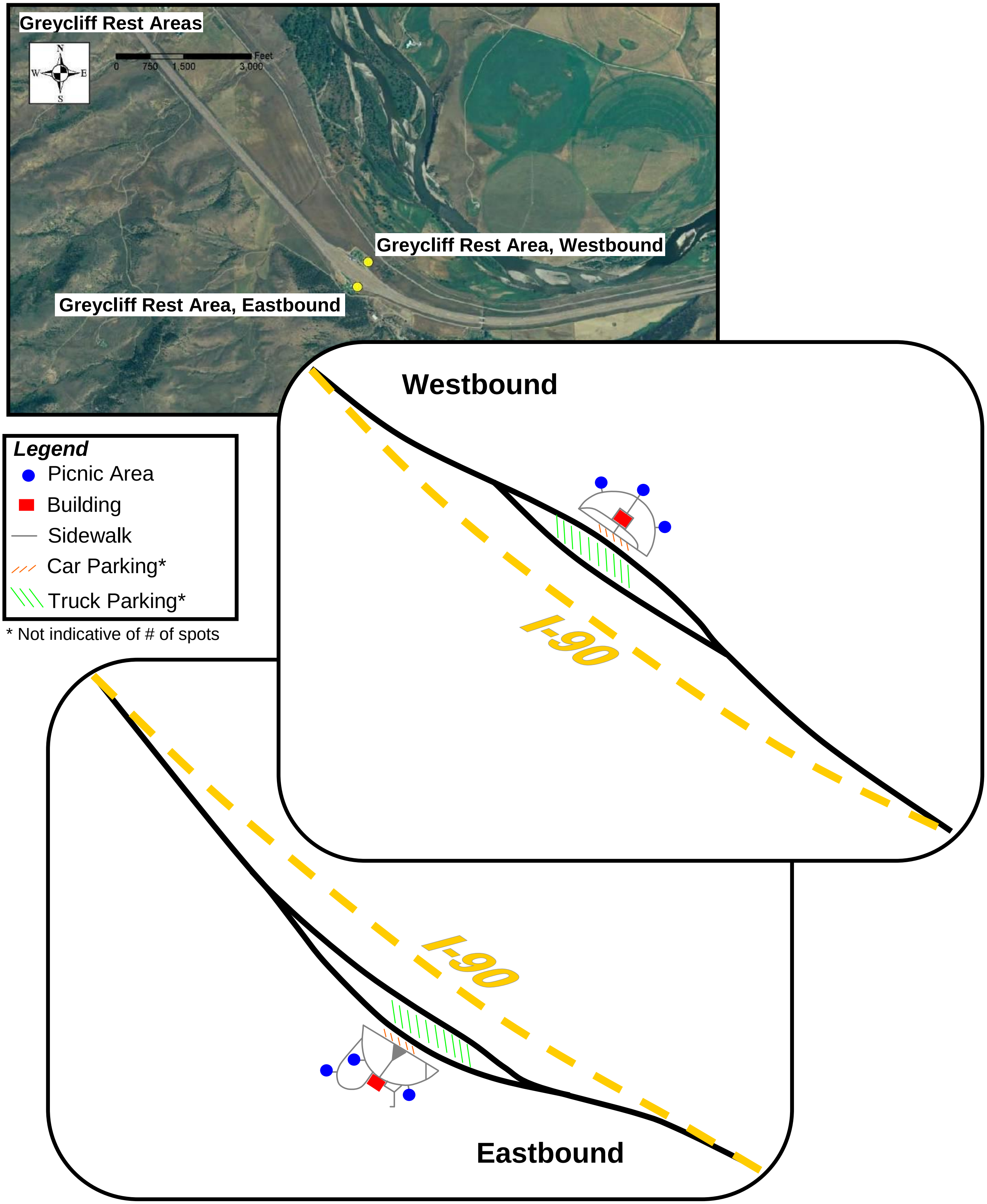
The information provided in this section was gathered from the Rest Area Site Evaluation Forms completed by MDT in April 2008, which are included in Appendix A. Additional information was gathered during site visits conducted on January 19-21, 2009 and from mapping provided by MDT Environmental Services Bureau.

The EB Greycliff rest area site is located atop a hill in a rural setting. The WB Greycliff rest area site is also located on hilly terrain, although nearby topography is rolling or level. There are a few trees at each site, with grassy areas surrounding the buildings. Greycliff Creek is located approximately 500 feet to the east and the Yellowstone River is located within a half mile to the north of the sites. The sites are located outside the floodplain. No other known environmental constraints are located near these sites. A schematic of the Greycliff rest area is presented in Figure 2-1.

Greycliff EB

Greycliff WB

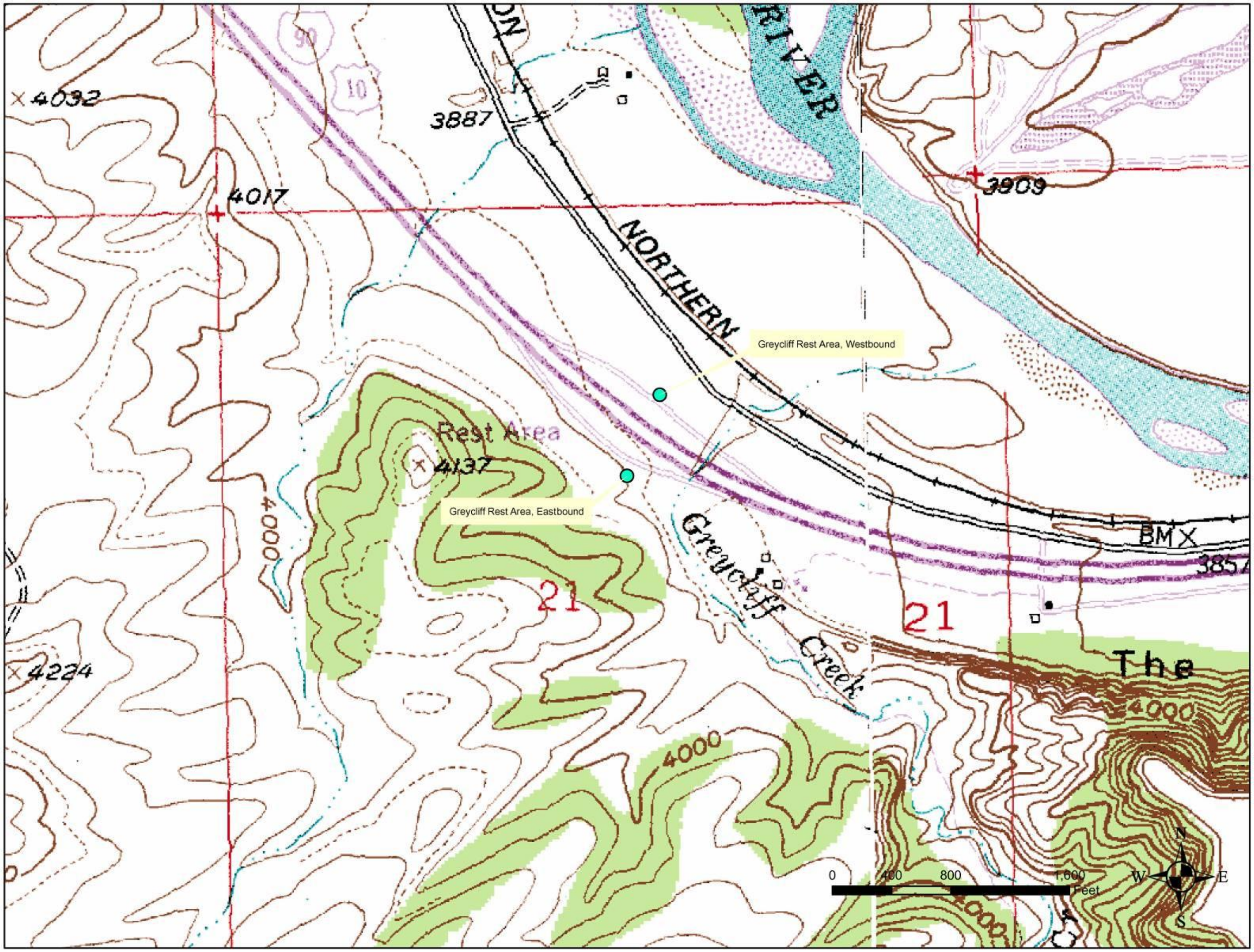
Figure 2-1 Greycliff Rest Area



As shown from the following topographic map, topography at the Greycliff rest area consists of somewhat hilly terrain at the EB site with the ground flattening out as it heads northeast towards the Yellowstone River. The EB site is constrained to the south by a hill and evergreen forest. As shown on the quadrangle map, the ground to both the east and west of the EB site slopes towards the interstate. Greycliff Creek is also located directly east of the EB site.

The Greycliff WB site is located on relatively flat land bordered by the railroad to the north.

Figure 2-2 Topographic Map of Greycliff



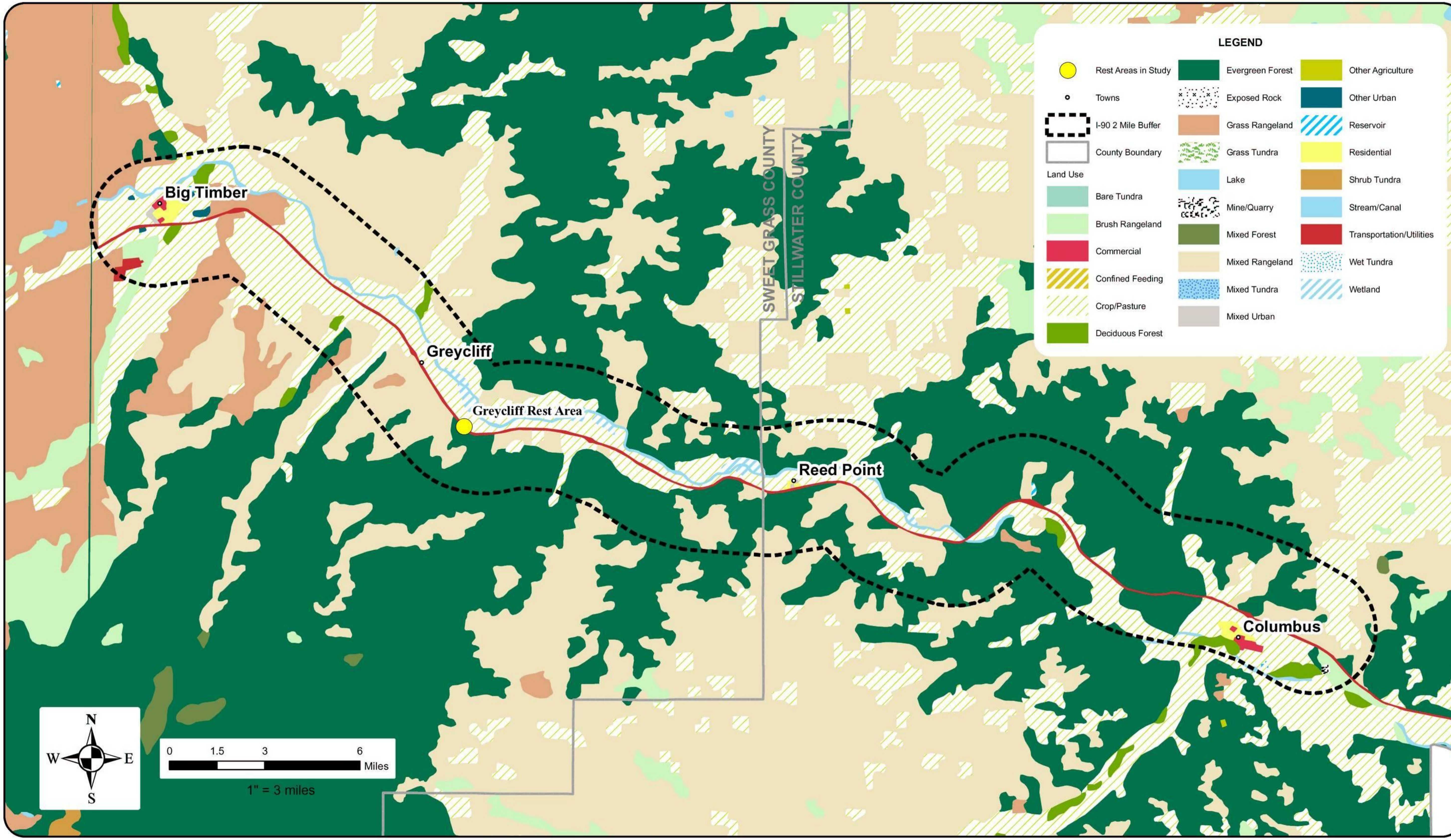
2.1.2 Land Use and Ownership

The Greycliff rest area is bordered by forest to the south and cropland to the north along the Yellowstone River. The remainder of land along the I-90 study boundary is generally used as cropland, pasture, rangeland, and forest. Residential and commercial areas are located near the towns of Big Timber and Columbus. Land uses along the I-90 portion of the study area are illustrated in Figure 2-3.

Land areas adjacent to the Greycliff rest area site are generally in private ownership. Land ownership status along the I-90 portion of the study area is illustrated in Figure 2-4.

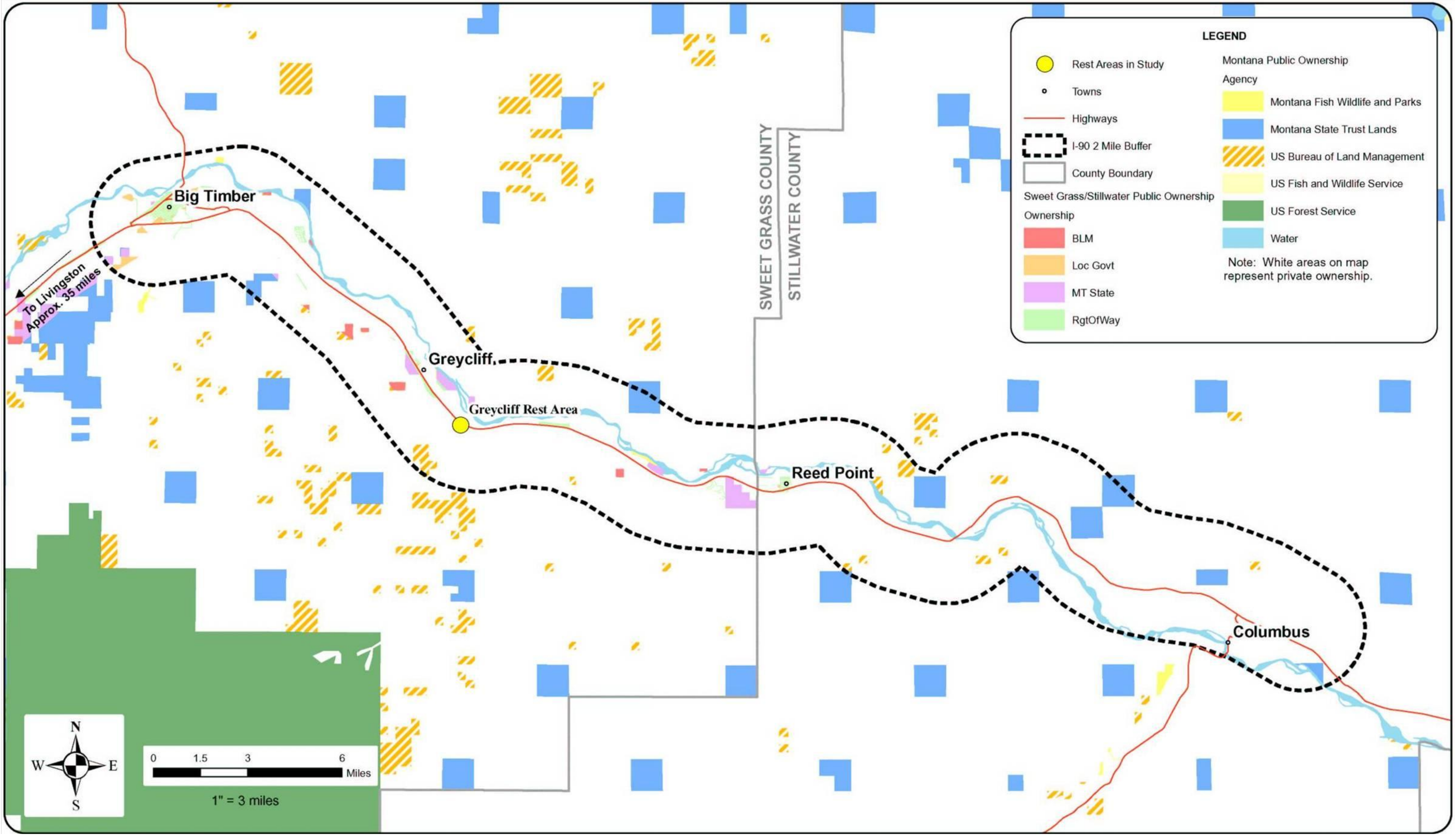
This Page
Intentionally Left Blank

Figure 2-3 Land Use along I-90 Study Boundary



This Page
Intentionally Left Blank

Figure 2-4 Land Ownership along I-90 Study Boundary



This Page
Intentionally Left Blank

2.1.3 Building and General Site Conditions

The Greycliff rest area is generally in good condition. There are two elements at each of the WB and EB sites in need of repair or replacement, as noted in Tables 2.1 and 2.2. Photographs of select elements needing repair or replacement are included in Appendix B.

Table 2.1 Greycliff Building Conditions

Rest Area Site	Roofing	Siding	Paint	Plumbing Fixtures	General Interior Condition	General Exterior Condition
Greycliff EB	Steel – like new	Brick – good	Facia – like new	Stainless – good	Ok (dirty)	Very Good
Greycliff WB	Steel – new	Brick – good	**Facia needs paint**	Stainless – ok	Ok **(Flooring needs repair)***	Very Good

Note: Shaded cells indicate elements in need of repair or replacement.
*Photographs of these elements are included in Appendix B.
Source: MDT Site Evaluation Forms, 2008; DOWL HKM 2009.

Table 2.2 Greycliff General Site Conditions

Rest Area Site	Asphalt	Sidewalks	Landscaping	Picnic Facilities
Greycliff EB	Good **(Truck Striping Needed)***	Ok – Some cracks, steep ramps	Good	2 structures / 13 tables - New / Very Good **(Graffiti on Wall)***
Greycliff WB	Good	Good	Good	3 structures / 15 tables – like new

Note: Shaded cells indicate elements in need of repair or replacement.
*Photographs of these elements are included in Appendix B.
Source: MDT Site Evaluation Forms, 2008; DOWL HKM, 2009.

Table 2.3 describes the existing deceleration (entrance) and acceleration (exit) ramps for each of the rest area sites.

Table 2.3 Greycliff Ramp Conditions

Rest Area Site	Acceleration Ramp	Deceleration Ramp	Sight Distance
Greycliff EB	Good	Good	Good
Greycliff WB	Good	Good	Ok – near corner at Deceleration Ramp

Source: MDT Site Evaluation Forms, 2008; DOWL HKM, 2009.

2.1.4 Maintenance Contracts

General maintenance and cleaning of the rest areas is contracted out to private entities. Maintenance contracts typically encompass cleaning, mowing, weeding, irrigating, painting, cleaning of the picnic areas, and general upkeep. Rest areas are typically cleaned two to three times per day. Each pair of rest areas is administered under one contract. The cost to maintain the Greycliff rest area is approximately $4,200 per month.

2.1.5 Seasons of Operation

The Greycliff rest area is open year round, conforming to the stated Rest Area Prioritization Plan committee's objective for year-round rest area facilities.

2.1.6 Current AADT

An Automatic Traffic Recorder (ATR) site was used to approximate Annual Average Daily Traffic (AADT) at the Greycliff rest area. This dataset included directional splits for the EB and WB sites, as well as a detailed accounting of the number and type of vehicles included in the total volume. AADT volumes for 2007 are presented in Table 2.4.

Table 2.4 Current AADT near Greycliff (2007)

Rest Area	Route	Rest Area Location (RP)	Traffic Count Location (RP)	Total AADT	Total Passenger & Bus (Types 1-4)		Total Small Trucks (Types 5-7)		Total Large Trucks (Types 8-13)		Total Commercial (Types 5-13)	
					AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT
Greycliff EB	I-90	380.9	416	5,113	3,912	76.51	143	2.80	1,058	20.69	1,201	23.49
Greycliff WB		381.0	416	5,094	3,903	76.62	182	3.57	1,009	19.81	1,191	23.38

Source: MDT, 2008.

2.1.7 Current Rest Area Usage

The Rest Area Plan provides guidance regarding rest area usage based on American Association of State Highway and Transportation Officials (AASHTO) formulas. The number of vehicles stopping at a rest area site per hour is calculated as a percentage of the directional traffic volume, with factors accounting for the mainline traffic composition by type of vehicle as well as the type of mainline route. Detailed calculations are provided in Appendix C. The AASHTO methodology for estimating rest area usage is considered highly conservative and is the standard used to date. It should be noted that MDT has initiated a research project to be completed in 2010 that will identify more accurate methods to predict rest area usage.

Table 2.5 presents the number of vehicles per hour estimated at each Greycliff rest area site. The AADT volumes at the EB and WB Greycliff sites are slightly different as shown in Table 2.4, however, the calculated rest area usage is essentially the same for each site. It should be noted that a range of values may be used for car and truck stopping percentages. The range of stopping percentage values provided by AASHTO is intended for use nationwide, although AASHTO recommends that stopping percentages ideally be determined on a case-by-case basis through usage surveys. In the absence of site-specific data, the mid- to low-end of the AASHTO stopping percentage range was used for the purposes of this study because Montana is largely rural in nature and has a relatively small population in comparison to other states.

This study did not consider factors that may affect stopping percentages at individual rest area locations within the study area. In the event that an individual project is developed following this study, site-specific designs may be adjusted on an as-needed basis if justified by special circumstances. Accordingly, usage values presented in this study should be viewed as preliminary estimates; the need for a greater or lesser number of parking spots, restroom stalls,

and other rest area amenities than suggested in this study should be considered at the time of project development for each individual site based on actual usage data.

It is not the intent of this study to design to peak usage at a particular site; rather, a single standardized method is used for all sites. This study will, however, qualitatively address when or under what circumstances the current rest area sites are expected to be physically undersized, requiring consideration of a new site or purchase of additional right-of-way at the current sites. It should also be noted that the MDT Road Design Manual provides slightly different calculation factors. This study used the calculation guidelines presented in the Rest Area Plan.

Table 2.5 Current Rest Area Usage at Greycliff (2007)

Rest Area Site	Total Number of Vehicles Per Hour	Number of Passenger Cars and Buses Per Hour	Number of Commercial Trucks Per Hour**
Greycliff*	84	62	22

Source: MDT, 2008; DOWL HKM, 2009.
Note: Calculations use factors from Table 9, Rest Area Plan, 2004.
*Usage values apply to both EB and WB sites.
**Includes estimate for the number of cars with trailers or RVs (Cars with trailers or RVs = 6, Trucks = 16).

The Rest Area Plan also provides guidance regarding parking at rest areas. The recommended number of spots is calculated as a percentage of the directional traffic volumes, with factors accounting for design hour volumes, traffic composition, and type of route. Parking recommendations are presented in Table 2.6. Detailed calculations for each rest area site are included in Appendix C. Guidelines for the recommended number of ADA parking spots were derived from the ADA Accessibility Guidelines for Buildings and Facilities and are included in the Checklist of Facility Accessibility for each site (Appendix D).

Table 2.6 Greycliff Parking Conditions (2007)

Rest Area Site	Truck Parking Spots		Auto Parking Spots		ADA Parking Spots	
	Actual Number	Recommended Number**	Actual Number	Recommended Number**	Actual Number	Recommended Number***
Greycliff EB	11*	13	14	28	2	2
Greycliff WB	9	13	14	28	2	2

Note: Shaded cells indicate failure to meet the recommended number of parking spots.
Source: MDT, 2008; DOWL HKM, 2009.
*According to the April 2008 MDT Site Evaluation Forms, facility is designed for 11 truck parking spots. Striping was not visible during site visits in January 2009.
**Calculations use factors from Table 9, Rest Area Plan, 2004. Truck parking includes cars with trailers or RVs.
***Based on recommended auto parking spots in Parking Space Matrix, Checklist for Facility Accessibility, MDT 2008.

As noted in Table 2.6, there is a need for two additional truck parking spots and 14 additional automobile parking spots at the Greycliff EB rest area, and four additional truck and 14 additional automobile parking spots at the Greycliff WB rest area. The lack of parking was confirmed through site visits with MDT maintenance personnel, who noted that the Greycliff sites were not designed for the amount of use they receive. Truck parking is inadequate given that there are times when trucks are parked on the ramps. According to maintenance personnel, the EB site receives greater use than the WB site.

The number of ADA parking spots at the Greycliff rest area is adequate given the recommended number of parking spots.

The Rest Area Plan also provides guidance for the recommended number of picnic tables and waste receptacles (referred to as site facilities throughout this document) at each site. As noted in the calculation procedure provided in the bottom portion of Table 12 within the Rest Area Plan, the appropriate number of site facilities is determined by applying factors to the calculated number of parking spaces listed in Table 2.6. Detailed calculations are provided in Appendix C.

Table 2.7 presents the recommended site facilities at each Greycliff site based on current AADT volumes.

Table 2.7 Greycliff Site Facilities (2007)

Rest Area Site	Picnic Tables		Waste Receptacles	
	Actual Number	Recommended Number	Actual Number	Recommended Number
Greycliff EB	13	16	11	12
Greycliff WB	15	16	8	12

Note: Shaded cells indicate failure to meet the recommended number of picnic tables and waste receptacles.
Source: MDT, 2008; DOWL HKM 2009.
*Calculations use factors from Table 12, Rest Area Plan, 2004.

As noted in Table 2.7, there is a need for three additional picnic tables and one additional waste receptacle at the Greycliff EB rest area, and one additional picnic table and four additional waste receptacles at the Greycliff WB rest area. The majority of existing picnic tables at the Greycliff sites are located within picnic shelters each containing four tables. The waste receptacles are located within garbage can racks each containing three garbage cans. A single garbage can is also located within each restroom.

The Rest Area Plan also provides methodology for calculating the required number of restroom stalls and required water usage at each site. The number of required restroom stalls is based on the rest area usage presented in Table 2.5 along with estimates accounting for the number of rest room users per vehicle and an estimated time cycle per fixture. Similarly, water usage is determined by applying a usage rate per person to the total rest area usage listed in Table 2.5. Calculations for the number of restroom stalls and water usage both include a peaking factor of 1.8.

Table 12 within the Rest Area Plan lists the calculation procedure and assumptions used for calculating the number of restroom stalls and water usage. Detailed calculations are provided in Appendix C.

Table 2.8 presents the recommended number of restroom stalls and estimated current water usage in gallons per minute (gpm) at each Greycliff site based on current AADT volumes.

Table 2.8 Restroom Stalls and Water Usage at Greycliff (2007)

Rest Area Site	Women's Stalls		Men's Stalls		Water Usage (Peak Hourly Demand)
	Actual Number	Recommended Number	Actual Number	Recommended Number	
Greycliff EB	3	4	3	3	11 gpm
Greycliff WB	3	4	3	3	11 gpm

Note: Shaded cells indicate failure to meet the recommended number of restroom stalls.
Source: MDT, 2008; DOWL HKM, 2009.
* Calculations use factors from Table 12, Rest Area Plan, 2004.

As noted in Table 2.8, there is a need for one additional women's stall at both the EB and WB Greycliff rest areas. The existing number of men's restroom stalls is adequate. It should be noted that a small line formed in the women's restroom during the EB site visit.

2.1.8 Spacing

The Rest Area Plan recommends spacing between rest areas equal to approximately one hour of travel time under favorable traveling conditions. Figure 2-5 and Table 2.9 present current spacing between rest areas in the I-90 portion of the study corridor. Orange shaded cells indicate distances that slightly exceed the recommended maximum spacing assuming drivers travel at the posted speed limit of 75 miles per hour.

Figure 2-5 Rest Area and City Locations

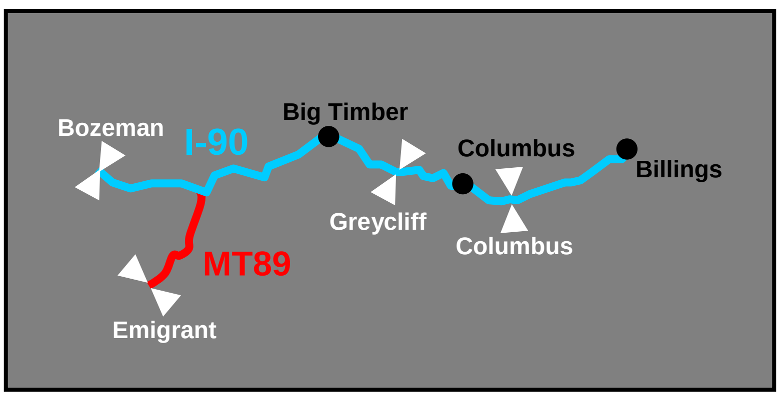


Table 2.9 Spacing between Rest Areas and Nearby Cities with Services

Rest Area Site	Previous Rest Area		Previous City with 24/7 Services		Next Rest Area		Next City with 24/7 Services	
	Name	Distance (miles)	Name	Distance (miles)	Name	Distance (miles)	Name	Distance (miles)
Greycliff EB	Bozeman	75	Big Timber	12	Columbus	38	Columbus	28
	Emigrant	77						
Greycliff WB	Columbus	38	Columbus	28	Bozeman	75	Big Timber	12
					Emigrant	77		

Note: Orange shaded cells indicate distances between rest areas slightly exceeding Rest Area Plan recommendations.
Source: MDT Rest Area Site Evaluation Forms, 2008.

It should be noted that the distance between the Greycliff and Emigrant rest areas only exceeds the Rest Area Plan recommendations by a few miles. All distances generally meet the recommended maximum spacing.

2.1.9 Water, Sewer, and Power Services

Information on existing water, sewer, and power services was obtained from a variety of sources, as noted in Table 2.10.

Table 2.10 Sources for Information on Existing Water, Sewer, and Power Services

Source	Notes
Site visits conducted on January 19-21, 2009 and corresponding meetings with MDT maintenance personnel	Photos of the water, sewer, and power systems taken during the site visits are included within Appendix E and will be referred to throughout this section.
MDT	A variety of data was obtained from MDT including as-built drawings of recent water and sewer system improvements as well as maintenance division questionnaires. Through meetings and correspondence with the MDT maintenance personnel for each site, additional information was obtained including available design criteria, equipment manufacture data, well logs, applicable correspondence, and power records.
Montana Department of Environmental Quality (DEQ)	The Helena and Billings DEQ offices were contacted for any applicable files pertaining to the water and wastewater systems that may have gone through the permitting and approval process.
Online Databases	Several online sources were used to collect information on the rest area sites, including: o Montana Bureau of Mines and Geology (MBMG) Ground-Water Information Center (GWIC) o DEQ Public Water Supply Reports o United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soils Data o Montana Natural Resource Information System (NRIS)

Figure 2-6 depicts the location of specific components relating to the water and wastewater systems.

Figure 2-6 Greycliff Water and Sewer Location Map

Water

Groundwater is the source of potable water at the Greycliff rest area sites. Water from this source is used to serve the rest area facilities including toilets, sinks, and drinking fountains as well as for irrigation of the grass and associated landscaping. The WB site contains one well used for all purposes (irrigation and domestic) while the EB site has two wells, one for irrigation and one to serve the restroom facilities.

Quantity

To assure there is adequate water quantity at the sites, the source capacity of the wells must equal or exceed the design maximum day demand per Circular DEQ-3. Table 2.11 lists the current maximum water use estimates at each Greycliff rest area site. The current estimated restroom water usage is drawn from Table 2.8 above. Irrigation demand is estimated based on requirements from the NRCS and the Montana Irrigation Guide for pasture grass and turf. The NRCS provides consumptive use estimates for pasture grass and turf based on data obtained from several weather stations throughout the state. Several assumptions were made regarding irrigation cycle time, delivery period for the irrigation volume, and system efficiencies in order to determine the estimated irrigation flow rate. An estimated irrigation area was determined using aerial photography and as-built drawings of the irrigation systems. The approximate irrigation limits are depicted in Figure 2-6. Twenty-five percent of the irrigation area was removed from the calculations to account for impervious areas such as buildings, sidewalks, and picnic shelters. Irrigation demand calculations are included in Appendix F along with a more detailed description of how the demands are calculated.

Table 2.11 Greycliff Water Use Estimates

Rest Area Site	Restroom Water Usage (Peak Hourly Demand)	Estimated Irrigation Demand	Total Demand
Greycliff EB	11 gpm	14 gpm	25 gpm
Greycliff WB	11 gpm	13 gpm	24 gpm

Source: MDT, 2008; DOWL HKM, 2009.

Based on discussions during the site visits, there are no water meters installed anywhere in the system. Therefore, actual water use data is not available and the estimates presented in Table 2.11 are the best available current usage estimates.

To determine the well capacities, well log information was downloaded from the MBMG website through the GWIC database. Well log information for the Greycliff sites is included in Appendix G. In addition, MDT maintenance personnel also provided information on pump testing performed in 1987, as shown in Table 2.12. Based on these results, the wells have adequate capacity to serve the existing demand. However, from a water rights perspective, the rest area wells are allowed to pump no more the 35 gpm and 10 acre-feet per year as specified for “exempt wells” per the Montana Department of Natural Resources and Conservation (DNRC). While exempt wells currently tend to be unregulated relative to actual usage, flow restriction valves are typically installed to limit the flow to 35 gpm. Generally, under an exempt well permit, an appropriate pump is selected to limit the flow to within the exempt well allowance of 35 gpm. Without a flow meter, neither the pumping rate nor annual use can be accurately recorded. Therefore, the well log does not necessarily match the actual well pumping rate for whatever pump was ultimately installed.

Table 2.12 Greycliff Pump Testing (1987)

Rest Area Site	Well Depth & Aquifer	Pump Depth & Size	Static Head	Pumping Level	Pumping Rate	Remarks
Greycliff EB*	100 ft, Sandstone (Screen)	85 ft, 3HP	67 ft	71 ft	50 gpm	Very Good Well, Orig. Same gpm
Greycliff WB	54 ft, Sandstone (Screen)	44 ft, 3HP	37 ft	38 ft	75 gpm	Very Good Well, Orig gpm = 50

Source: MDT, 2009.
*Refers to the old well now used exclusively for irrigation. A new potable EB well was drilled in 1998 and therefore is not included in Table 2-12.

Quality

Treatment at the Greycliff sites consists of a single cartridge filter. The filter helps to remove particles that may damage the valving within the restrooms. DEQ conducts routine sanitary surveys on all public water systems in Montana. Findings from a survey conducted in June 2008 noted that routine maintenance of the filters appears to be a problem.

Current standards set forth by the applicable Circular DEQ-3 state that wells must have unperforated casing to a minimum depth of 25 feet or continuous disinfection must be provided. The unperforated casing depth refers to the depth below ground surface where perforations or screening begins. Additionally, per Circular DEQ-3, full time disinfection is required where the water source is an aquifer with a water table that is within 25 feet of the ground surface.

Table 2.13 lists specific data from the Montana Well Log Reports obtained from the GWIC database, which are provided in Appendix G. As shown, the recorded static water levels for the Greycliff rest area wells are approximately 60 feet below ground surface at the EB site and 32 feet below ground surface at the WB site, well below the 25-foot water table threshold. Also, the unperforated casing depths are below the 25-foot minimum depth. Based on the well log information, wells at the Greycliff sites meet the DEQ requirements and therefore do not require disinfection.

Table 2.13 Greycliff Well Log Information

Well	Static Water Level	Unperforated Casing Depth
Greycliff EB (Potable)	58 ft	41.5 ft
Greycliff EB (Irrigation)	57 ft	93.4 ft
Greycliff WB (Potable & Irrigation)	32.5 ft	42.8 ft

Source: MBMG GWIC database, 2009.

The DEQ Public Water Supply System online database was queried to obtain water quality sampling records pertaining to the Greycliff rest area sites. This data is included in Appendix H. The water systems serving the Greycliff rest area sites are classified as transient non-community water supplies meaning that they serve 25 or more persons per day but do not regularly serve the same persons for at least six months per year. Transient non-community water supplies adhere to a specific set of water quality regulations as specified by DEQ. Detailed information can be found on DEQ's website. A summary of these regulations is described briefly below.

Samples for coliform bacteria must be collected either on a monthly or quarterly basis depending on authorization from DEQ. The Greycliff sites are sampled monthly for coliform bacteria. If more than one sample per month/quarter is total coliform-positive, a violation of the maximum contaminant level (MCL) occurs and public notice must be given. In addition to coliform bacteria, all transient non-community water systems must sample annually for nitrates. One sample is adequate unless the result is greater than 5.0 milligrams per liter (mg/L). The MCL for nitrate is 10 mg/L.

Both the EB and WB sites have had recent coliform bacteria MCL violations over the past year. The WB site had MCL violations occurring in June and September of 2008 in addition to one MCL violation in June 2003. The EB site had MCL violations in June and July of 2008. During the recent sanitary survey conducted on June 6, 2008 by DEQ, it was documented that "routine maintenance of the filters appears to be a problem and may have lead to the positive coliform sample and recent health advisory."

Public water supply water quality records indicate that the original well at the EB site has historically had nitrate levels over 5 mg/L. This was confirmed during the site visits in talking with maintenance personnel. Therefore, the original well is no longer used for potable water due to the nitrate problems and is presently used solely for irrigation purposes according to maintenance personnel. A new well was drilled in 1998 to serve the potable water needs of the rest area. Nitrate samples from the new well have all been acceptable.

It is worth noting that DEQ is in the process of determining those groundwater sources that have the potential to be directly influenced by surface water. This process is known as the Ground Water Under the Direct Influence of Surface Water (GWUDISW) determination process. The process will begin with a preliminary assessment by DEQ and, depending on the results, may require additional analysis. Through this process, if groundwater sources are determined to be directly influenced by surface water, they will be subject to Surface Water Treatment Rule requirements.

General Site Observations and Operation / Maintenance Issues

MDT provided results from recent maintenance questionnaires pertaining to each site. These are provided in Appendix I. With respect to the well and water system, the questionnaire indicates that repair of the well, including the pump, has not been required in the last five years. Additionally, the water flow rate has not been tested in the last five years.

According to as-built drawings provided by MDT, all piping in the mechanical rooms was replaced in 1988. In addition, the irrigation systems for both sites were installed in 1988 as well.

Based on information from MDT maintenance personnel, there have been no major issues or maintenance problems with the water systems at Greycliff. The wells have been performing adequately and are able to supply the current demand. Recent repairs to the system have included a new well pump at the WB site approximately three years ago and new water line installed from the well to the building due to leaks. MDT confirmed the nitrate problem with the original well at the EB site and that the new pump and well were installed approximately 11 years ago to serve as the potable water supply with the old well only serving irrigation needs.

A tour of the maintenance/utility room was provided as part of the site visit. Photos are included in Appendix E. The water systems consist of piping from the well to a pressure tank. From there the water travels through a small section of piping, through a filter, and then through piping to serve the toilets and sinks. The utility room also contains an air tank to operate the air valves for flushing toilets. Per MDT, these valves work well. The air valves and other piping are located in a small corridor between the two restrooms. MDT noted it is very difficult to perform routine maintenance on the piping due to the tight fit of this space.

Sewer

On-site sewage treatment at the Greycliff rest areas is accomplished through the use of a septic tank and gravity-fed soil absorption drainfield. Septic tanks are prefabricated structures typically made of concrete that allow solids in the incoming wastewater to settle and form a sludge layer on the bottom of the tank. Light materials such as oil and grease float to the surface. The sludge layer formed on the bottom of the tank will eventually decompose. The rate of decomposition is slow; accordingly the tanks require periodic pumping. The drainfield provides a means of distributing the pretreated waste effluent into the ground. The approximate location of the septic tank and drainfield are shown in Figure 2-6. Based on information from MDT maintenance personnel, the septic tanks and drainfields at the Greycliff sites are the original systems with few updates since they were originally installed. The wastewater system at Greycliff operates entirely by gravity.

Size of System

Rest area wastewater is different from typical residential wastewater in terms of its composition. In residential systems, a variety of sources contribute to wastewater, including toilets, sinks, showers, laundry, and dishwashing. In comparison, the main source of wastewater at a rest area is from toilets. Therefore, the concentration of rest area wastewater is much stronger due to less dilution from other sources. Circular DEQ-4 states that subsurface wastewater disposal systems should only be used for residential strength wastewater and that wastewater exceeding this strength must be pretreated before discharging to drainfield systems.

Based on the above discussion, conventional septic tank and drainfield systems are not recommended for rest area applications. However, because these systems currently exist at the Greycliff site, the following is a discussion of sizing requirements and adequacy to meet the current demand.

Per DEQ design regulations, the minimum acceptable size of a septic tank is 1,000 gallons for any system. DEQ provides guidelines for sizing septic tanks based on the type (residential versus non-residential) and quantity of the design flow. DEQ requires that for non-residential flows greater than 1,500 gallons per day, the tank must have a minimum capacity equal to 2.25 times the average daily flow. The average daily flow is determined using the design factors from Table 12 of the Rest Area Plan for water usage combined with the AADT volumes and estimated percentage of rest area users. Detailed calculations can be found within Appendix J. Existing septic tank sizes were provided by MDT maintenance personnel and are listed in Table 2.14 along with the calculated recommended sizing based on current usage. It should be noted that calculations are based on current standards set forth by DEQ.

Little information was available on the Greycliff drainfields other than a set of as-built drawings provided by MDT showing schematics of the septic tank and drainfield layouts. The as-builts pertained to an improvement project completed in 1988. As part of this project, site improvements included additional signage, new picnic tables, replacement of garbage can racks, and a new irrigation system. There were no improvements to the wastewater system other than the addition of septic tank vent covers.

Rough estimates of the drainfield size were obtained from the scaled site plans included as part of the as-built drawings. The EB site has 11 laterals, each approximately 100 feet in length. The WB site has 18 laterals, each approximately 100 feet in length. Assuming a two-foot wide trench results in a drainfield area of approximately 2,200 square feet for the EB site and 3,600 square feet for the WB site.

Several site characteristics and investigations need to be evaluated for the proper design of the drainfield including soil profile descriptions, percolation tests, and site factors such as slope, drainage, and depth to groundwater. This information was not collected as part of this study but will need to be obtained for any new drainfield design.

For the purposes of this study and to determine rough design estimates, NRCS soils information was used to determine approximate percolation rates. This data is available by county on the NRIS website and is downloadable for use in Geographic Information System (GIS) mapping. The soils mapping was brought into GIS at the correct location so that the soil classifications were determined at each of the rest area sites. Detailed calculations can be found within Appendix J. Rough estimates of existing and proposed drainfield sizes are listed below in Table 2.14.

Table 2.14 Greycliff Septic Tank and Drainfield Size

Rest Area Site	Septic Tank		Drainfield	
	Existing Size	Recommended Size for Existing Usage	Estimated Existing Size	Recommended Size for Existing Usage
Greycliff EB	6,612 gallons	5,700 gallons	2,200 ft^2	8,500 ft^2
Greycliff WB	6,612 gallons	5,700 gallons	3,600 ft^2	8,500 ft^2

Note: Shaded cells indicate failure to meet the recommended drainfield size.
Source: MDT, 2009; DOWL HKM, 2009.

The estimates presented in Table 2.14 indicate that the current wastewater systems are undersized to accommodate the current capacity based on today's standards. However, it should be reiterated that accurate sizing of a drainfield cannot be accomplished without site-specific soils information and percolation test results.

General Site Observations and Operation / Maintenance Issues

MDT provided results from recent maintenance questionnaires pertaining to each site. These are provided in Appendix I. With respect to the septic system, the questionnaire dated July 2008 indicates that the septic tank had been pumped within the last 6 months and that no other repairs had been made to the septic system or drainfield within the last five years.

Based on information from MDT maintenance personnel during the site visit, the wastewater systems are largely original to the sites. The septic tanks are old and need to be pumped at least twice a year. Although Table 2.14 indicates the septic tanks are adequately sized, this frequent need indicates that the tanks are undersized for the amount of use at the rest area. Typical pumping requirements are approximately once every two years.

MDT has not seen any problems or plugging of the drainfields. During the site visits, no above ground markings indicating the location of the drainfield laterals were observed, although the general location of the drainfield was identified and photos were taken. The WB site appears to have a relatively large area surrounding the drainfield indicating that there may be possible room for expansion of the existing drainfield. The drainfield location at the EB site, however, did not appear to have additional room. An observation was made at the EB site that the grass was noticeably greener above the drainfield in comparison to the surrounding natural grasses. In addition, there was a waste/sewer odor noticeable generally throughout this site.

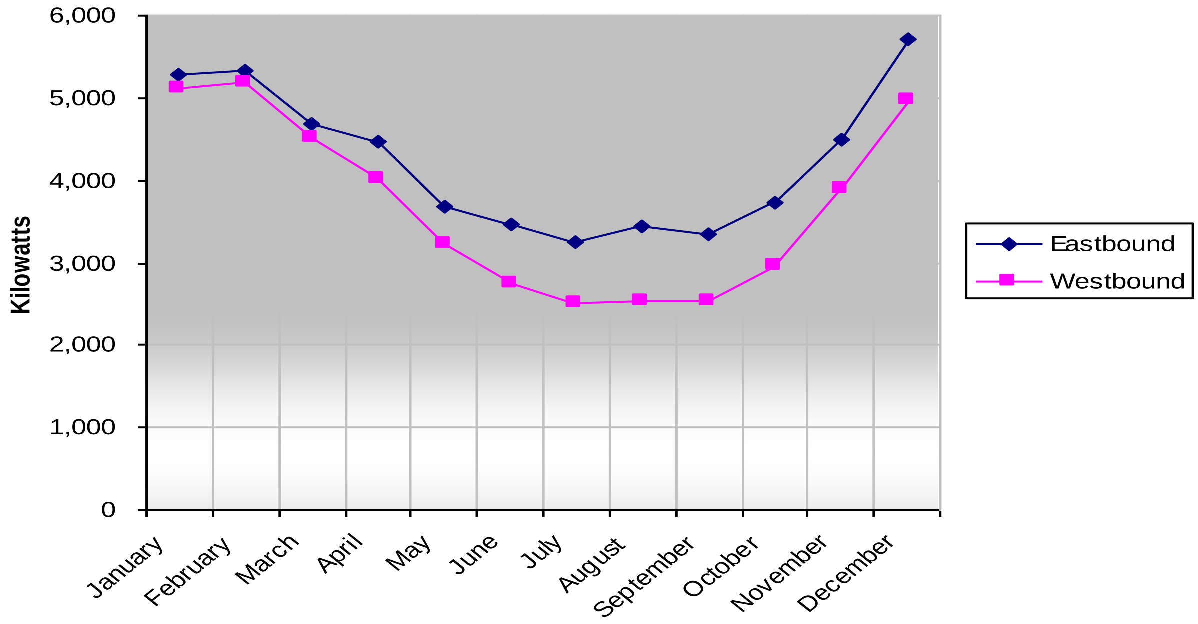
Power

Power is provided at the Greycliff rest areas for heating, lighting, and pumping associated with the well system. The source of heat is electric and the furnace is located in the maintenance room. Power is provided through Beartooth Electric based out of Red Lodge, Montana. Per MDT, there are no major power issues at the sites other than an occasional outage lasting a few seconds. Due to the distance of the power company from the sites, MDT noted that it takes a long time for repairs to be completed.

The heating and lighting systems remain on continuously. Lighting is provided by fluorescent bulbs located in the maintenance room. The light is visible through glass panes located at the top portion of the walls in each restroom. Heat is provided through electric furnaces that are thermostatically operated. There are currently no air conditioning systems installed.

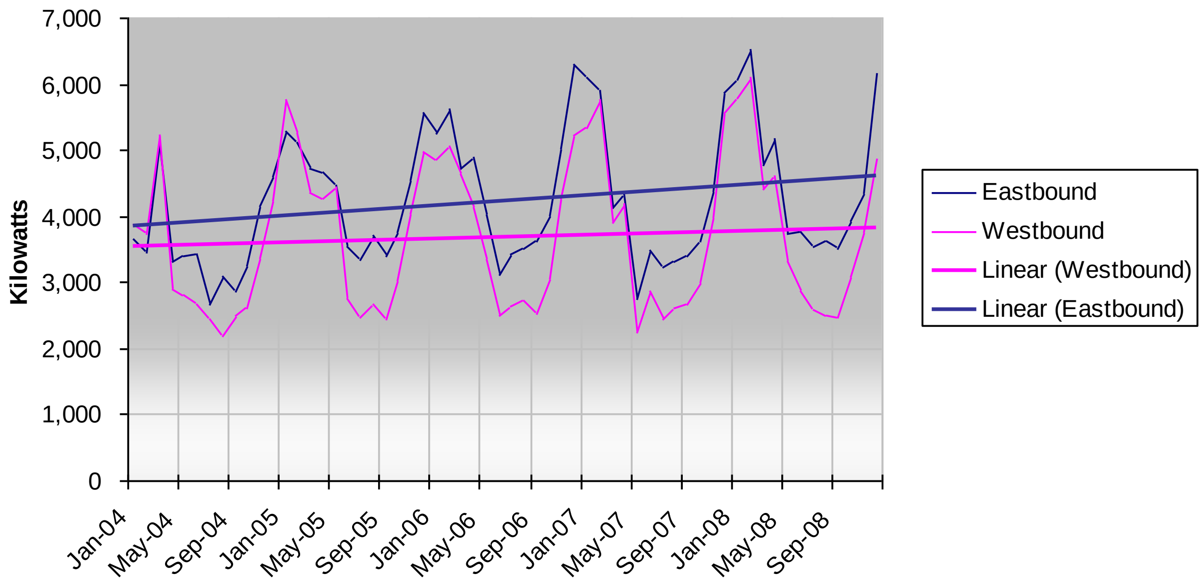
Power records were obtained from the MDT-Billings District office for the five-year period from January 2004 through December 2008. On average, power usage was lowest during the late spring, summer, and early fall months (May through October), while usage increased during winter months (November through April), accounting for higher wintertime heating and lighting needs. Monthly averages over the 5-year period are depicted in Figure 2-7.

Figure 2-7 Greycliff Average Monthly Power Consumption (2004 – 2008)



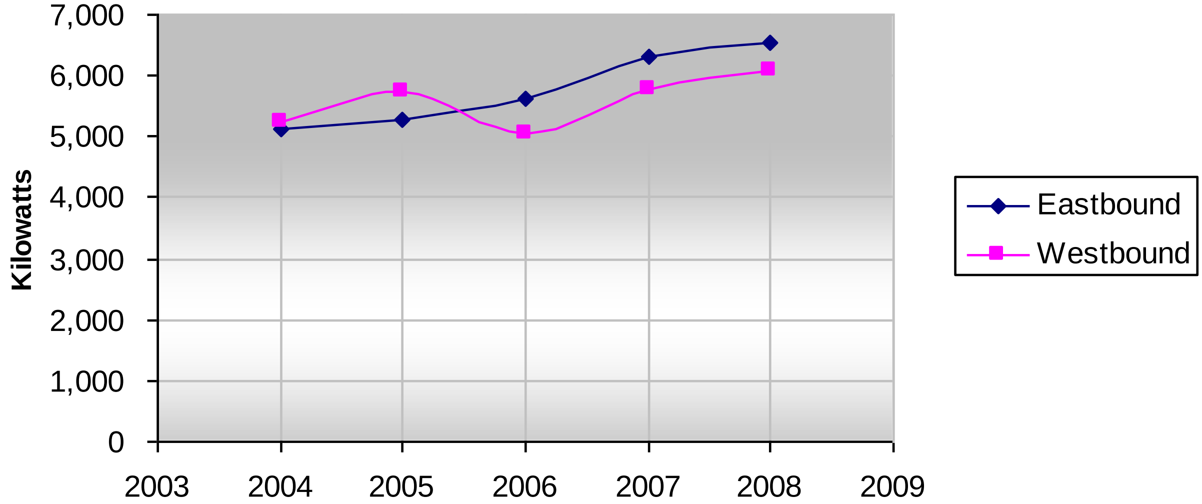
As illustrated in Figure 2-8, the EB site used more electricity than the WB site for the majority of the 5-year period. For both the EB and WB sites, the greatest electricity consumption over the five-year period occurred during the month of February 2008.

Figure 2-8 Greycliff Monthly Electricity Consumption (2004 – 2008)



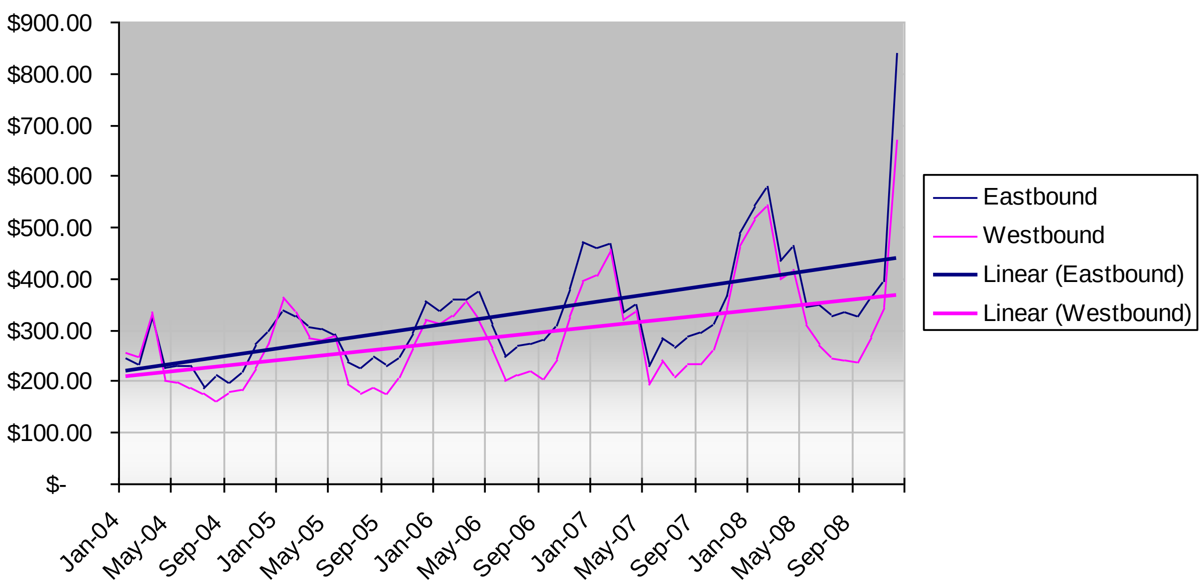
There is a general upward trend in annual usage at both sites, as evidenced by increasingly higher peaks over subsequent winters. This upward trend is illustrated in Figure 2-9.

Figure 2-9 Greycliff Yearly Peak Usage (2004 – 2008)



Cost for electricity generally varied between $0.063 and $0.096 per kilowatt-hour (kWh) over the 2004 to 2008 period, but increased to $0.138 per kWh in December 2008. Due to this price increase, December 2008 was the most expensive month for both the EB and WB sites, as illustrated in Figure 2-10. Given the recent fluctuation in electricity prices, it would be advantageous to reduce usage and associated costs through installation of a more efficient heating system.

Figure 2-10 Greycliff Monthly Electricity Costs



2.1.10 Crash Assessment

Vehicle accident data was supplied for the period from January 1, 2005 to June 30, 2008 by MDT. During this time period, 328 crashes were recorded over the I-90 portion of the study corridor (MP 367.0 – 409.0).

Several aspects were considered for this analysis. First, the number of crashes near each existing rest area was compared. Second, crashes over the entire corridor were evaluated in light of spacing between rest areas. Areas with higher numbers of crashes were assessed to determine if these could be attributed to excessive distances between rest areas. Lastly, incidences of animal vehicle conflicts near the rest areas sites were assessed.

Figure 2-11 illustrates the number of crashes per half-mile segment over the I-90 portion of the corridor.

Figure 2-11 Crashes within Study Area

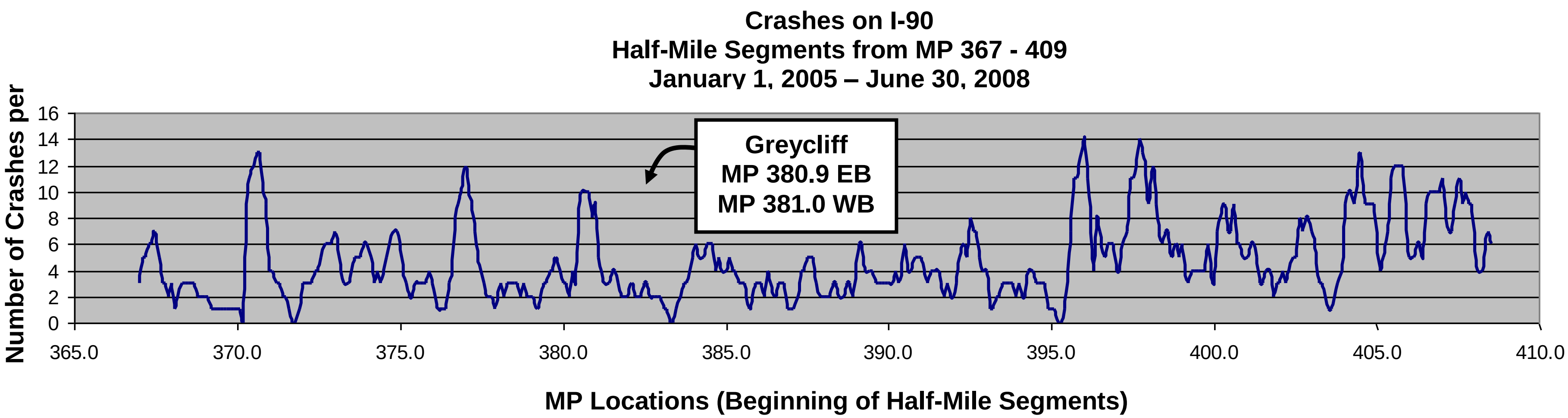


Table 2.15 presents the number of crashes within approximately a quarter mile in each direction from each rest area location (i.e., the half-mile segment is approximately centered at the rest area site).

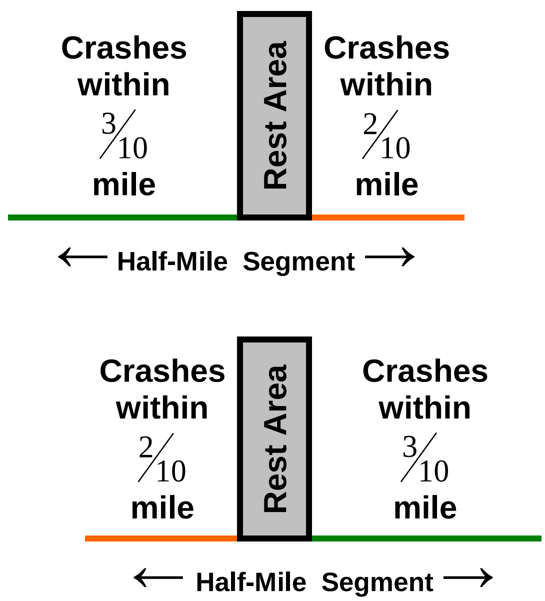
Table 2.15 Number of Crashes within Half-Mile Segment near Greycliff (1/1/2005 – 6/30/2008)

Interstate Facility	Rest Area Location	Approximate MP of Rest Area Location	Half-Mile Segment (MP – MP)	Number of Crashes within Half-Mile Segment	AADT (2007)
I-90	**Greycliff EB**	380.9	a) 380.7 - 381.2 b) 380.6 - 381.1	a) 10 b) 10	10,207
	Greycliff WB	381.0	a) 380.8 - 381.3 b) 381.7 - 381.2	a) 10 b) 10	

Source: MDT, 2008.

Crash locations are recorded in tenth-of-a-mile increments; therefore, it was not possible to determine the number of crashes within exactly a quarter mile in each direction from the rest area location. Therefore, Table 2.15 presents the number of crashes within three-tenths of a mile to one side of the rest area, and two-tenths of a mile to the other side, as well as the reverse. This calculation method is graphically illustrated in Figure 2-12. The two numbers listed under the Number of Crashes column in Table 2.15 correspond to the two half-mile segments as defined for each site. For the Greycliff EB and WB sites, it happens that the number of crashes in each half-mile segment is equal.

Figure 2-12 Two Half-Mile Segments for Rest Areas



The highest number of crashes over a half-mile segment (14 crashes) occurred in two locations on I-90 from MP 396.0± to 396.5± and from MP 397.7± to 398.2±, approximately three to four miles east of the Greycliff rest area site.

Of the 14 crashes in the segment from MP 396.0± to 396.5±, all but three involved a single vehicle. Driver error was noted in seven crashes and excessive speed was a factor in four crashes. Wild animals were involved in six of these crashes.

Of the 14 crashes in the segment from MP 397.7± to 398.2±, all involved a single vehicle. Driver error was noted in nine crashes and excessive speed was a factor in four crashes. Wild animals were involved in three of these crashes. Given the distance from the Greycliff site, the rest area does not appear to be a factor in the high number of crashes in these locations.

The Greycliff rest area is located approximately 76 miles away from the nearest rest area to the west on I-90 (Bozeman), 77 miles from the next rest area to the southwest on Highway 89 (Emigrant), and 56 miles from the next rest area to the northwest on Highway 191 (Harlowton). To the east, the Greycliff rest area is approximately 40 miles from the next rest area on I-90 (Columbus). Although the distance between the Greycliff rest area and the next rest area to the west on I-90 and Highway 89 slightly exceeds the recommended maximum spacing, the two half-mile segments with the highest number of crashes are located to the east of Greycliff. Therefore, spacing does not appear to be a factor in the high incidence of crashes at these locations.

There is a moderate peak in the number of crashes in the segment from MP 380.6± to 381.3± as compared to the number of crashes immediately to the east and west of this location. Traffic volumes at the Greycliff EB and WB sites, located at MP 380.9± and MP 381.0±, respectively, are relatively high compared to volumes at other rest area locations in this study. It is likely that the higher number of crashes near this site is related to higher traffic volumes.

Over the I-90 portion of the corridor, there were a total of 21 crashes in which the driver fell asleep. Two of these (located at MP 381.7 and 382.1) occurred within a mile of the Greycliff rest area. Crashes due to fatigue are noted in relation to the ranking factors included in Section 2.5.

Of the 328 total crashes over the I-90 portion of the corridor during the period January 1, 2005 to June 30, 2008, 128 (or 39.0 percent) involved wild animals. As noted in Section 2.1.3, sight distance on the Greycliff acceleration and deceleration ramps is good and likely does not contribute to the incidence of crashes in this location.

It should be noted that traffic accidents are reported by the Montana Highway Patrol; causation is not always clear at the time of the incident.

2.1.11 ADA Compliance

A detailed Checklist of Facility Accessibility has been completed by MDT for each of the rest area sites in this study. These forms are included in Appendix D. There are a number of elements at each of the rest area sites that do not comply with the Americans with Disabilities Act (ADA), as noted on the forms. Noncompliant elements are noted in Table 2.16.

Table 2.16 Greycliff Elements in Noncompliance with ADA Requirements

Rest Area Site	Noncompliant Element							
	Location of Parking Spaces	Stairway	Ramps	Sinks	Door Hardware	Door Closer / Force	Toilet Stalls	Signage
Greycliff EB	X		X	X	X		X	X
Greycliff WB	X		X	X	X		X	

Source: MDT Checklist of Facility Accessibility, 2008.

2.2 Future Demand

2.2.1 Projected AADT

A compound annual growth rate method was utilized in order to estimate future AADT volumes within the study area. A growth rate of 3.5 percent per year and a 20-year planning horizon were used for this study, for a Design Year of 2027. It should be noted that compounded annual growth of 3.5 percent over 20 years is considered highly conservative. The general calculation formula is shown below.

Growth Rate Calculation Formula

$$(\text{Current AADT})*(1 + [\text{growth rate in decimal form}])^{\text{Number of Years}} = \text{Design Year AADT}$$

Table 2.17 presents future traffic volumes as estimated using the growth rate calculation noted above. Using this growth rate over the 20-year planning period approximately doubles the 2007 AADT values. For the purposes of these estimates, it was assumed that the percentage composition of passenger vehicles and trucks would remain the same as existing percentages.

Table 2.17 Projected AADT near Greycliff (2027)

Rest Area	Route	Rest Area Location RP	Traffic Count Location RP	Total AADT	Total Passenger & Bus (Types 1-4)		Total Small Trucks (Types 5-7)		Total Large Trucks (Types 8-13)		Total Commercial (Types 5-13)	
					AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT
Greycliff EB	I-90	380.9	416	10,174	7,784	76.51	285	2.80	2,105	20.69	2,390	23.49
Greycliff WB		381.0	416	10,136	7,766	76.62	362	3.57	2,008	19.81	2,370	23.38

Source: DOWL HKM, 2009.

2.2.2 Projected Usage

Projected usage at the rest area sites was estimated based on projected traffic volumes. Projected usage calculations follow the same methodology as described for current usage using the mid- to low-range factors for car and truck stopping percentages based on AASHTO formulas. As discussed later in the report, a qualitative analysis will address when or under what circumstances the current rest area sites are expected to be physically undersized.

Table 2.18 presents the number of vehicles per hour projected at the Greycliff rest area site in 2027. Tables 2.19 through 2.21 present the recommended number of parking spaces, site facilities, and restroom stalls based on 2027 projected traffic volumes. Detailed calculations are provided in Appendix C.

Table 2.18 Projected Rest Area Usage at Greycliff (2027)

Rest Area Site	Total Number of Vehicles Per Hour	Number of Passenger Cars and Buses Per Hour	Number of Commercial Trucks Per Hour**
Greycliff*	168	124	44

Source: MDT, 2008; DOWL HKM, 2009.
Note: Calculations use factors from Table 9, Rest Area Plan, 2004.
*Usage values apply to both EB and WB sites.
**Includes estimate for the number of cars with trailers or RVs (Cars with trailers or RVs = 12, Trucks = 32).

Table 2.19 Greycliff Projected Parking Conditions (2027)

Rest Area Site	Truck Parking Spots		Auto Parking Spots		ADA Parking Spots	
	Actual Number	Recommended Number**	Actual Number	Recommended Number**	Actual Number	Recommended Number***
Greycliff EB	11*	24	14	56	2	3 to 4
Greycliff WB	9	24	14	56	2	3 to 4

Note: Shaded cells indicate failure to meet the recommended number of parking spots.
Source: MDT, 2008; DOWL HKM, 2009.
*According to the April 2008 MDT Site Evaluation Forms, facility is designed for 11 truck parking spots. Striping was not visible during site visits in January 2009.
**Calculations use factors from Table 9, Rest Area Plan, 2004. Truck parking includes cars with trailers or RVs.
***Based on recommended auto parking spots in Parking Space Matrix, Checklist for Facility Accessibility, MDT 2008.

Based on preliminary layout of parking spots to meet 20-year demand, the Greycliff EB site will be nearing physical capacity given topography constraints. Beyond the 20-year planning horizon, there may not be physical space to further expand parking areas at either the EB or WB sites.

Table 2.20 Greycliff Projected Site Facilities (2027)

Rest Area Site	Picnic Tables		Waste Receptacles	
	Actual Number	Recommended Number	Actual Number	Recommended Number
Greycliff EB	13	32	11	24
Greycliff WB	15	32	8	24

Note: Shaded cells indicate failure to meet the recommended number of picnic tables and waste receptacles.
Source: MDT, 2008; DOWL HKM, 2009.
*Calculations use factors from Table 12, Rest Area Plan, 2004.

Table 2.21 Projected Restroom Stalls and Water Usage at Greycliff (2027)

Rest Area Site	Women's Stalls		Men's Stalls		Water Usage (Peak Hourly Demand)
	Actual Number	Recommended Number	Actual Number	Recommended Number	
Greycliff EB	3	8	3	5	23 gpm
Greycliff WB	3	8	3	5	23 gpm

Note: Shaded cells indicate failure to meet the recommended number of restroom stalls.
Source: MDT, 2008; DOWL HKM, 2009.
*Calculations use factors from Table 12, Rest Area Plan, 2004.

A number of annual seasonal events occur in the nearby towns of Livingston, Big Timber, Reed Point, and Columbus. The largest of these events occur in the summer months, and include rodeos, music festivals, county fairs, and a sheep run. These events likely draw visitors from outside the immediate area, and may contribute to high summer usage at the Greycliff rest areas. Rest areas are generally not designed to meet peak day or peak season demand. Therefore, the above analysis was not adjusted to account for potential usage fluctuations resulting from seasonal events in the region.

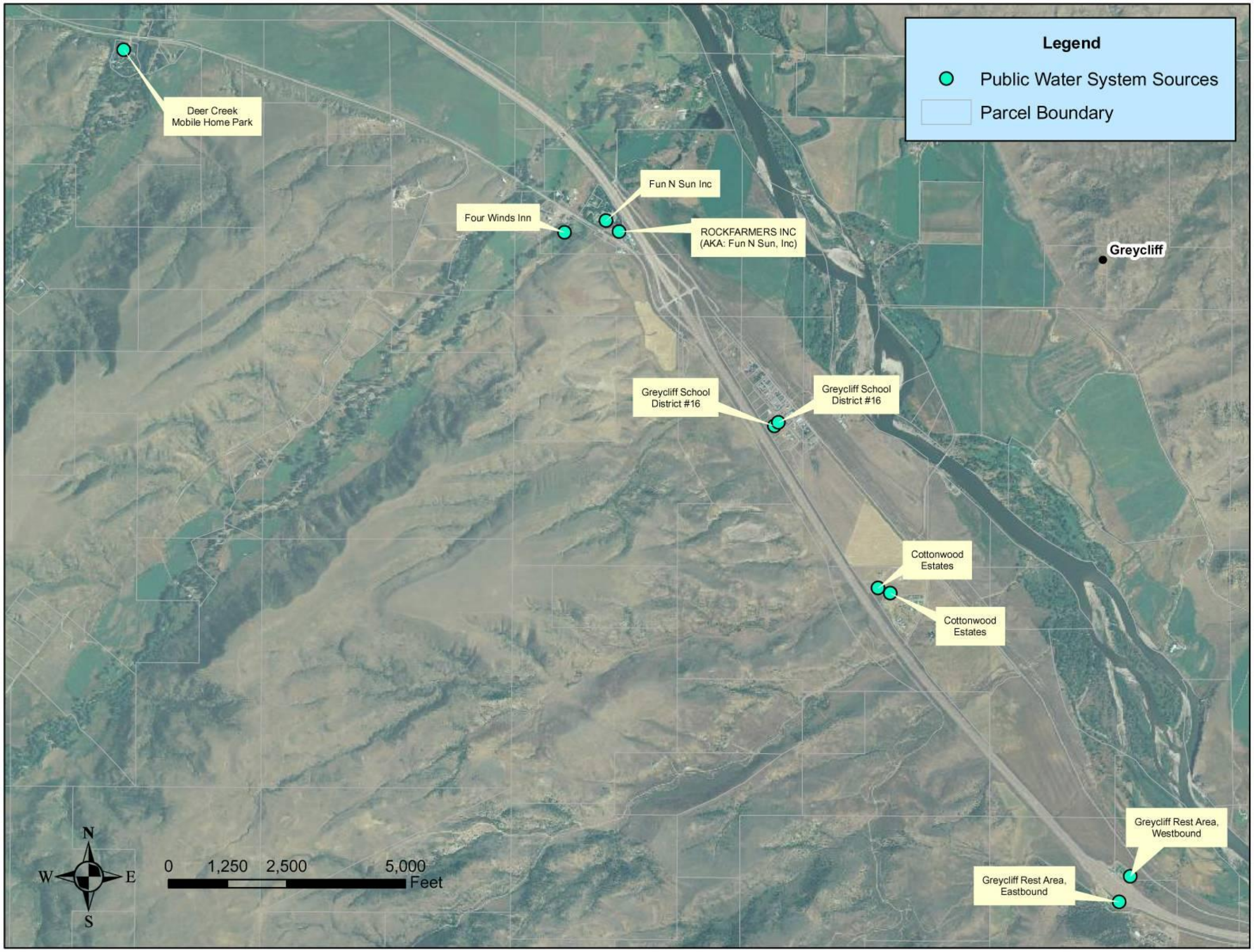
2.3 Assessment of Water, Sewer, and Power Services

The following sections assess the adequacy of the water, sewer, and power utilities at the Greycliff rest areas for meeting the anticipated demands from the 20-year projected rest area usage. Expansion potential to accommodate additional parking will be evaluated along with water, sewer, and power service alternatives that take into account the unique nature of the usage patterns and treatment challenges at a rest area.

To evaluate the potential for the Greycliff rest area to connect to nearby community water or wastewater systems, the Montana Public Water System (PWS) database was queried to select those water systems within 10 miles of the Greycliff rest area. As shown in Figure 2-13, the PWS sources near Greycliff all serve small, isolated properties. The Sweet Grass County Planning Office was contacted to determine if there are any proposed water or sewer projects in or around the town of Greycliff. The Planning Office confirmed that the town of Greycliff is unincorporated and residents currently use individual wells and septic systems.

Greycliff had a population of 56 people in 2000. No figures are available from the 1990 Census or from more recent population estimates following the 2000 Census to establish population trends. Given the small size of the Greycliff community, at this time there are no plans for the town to become incorporated or to develop a community water or wastewater system in the foreseeable future. The next closest community water system is located in the town of Big Timber, approximately 12 miles west of the Greycliff rest area. Due to the distance and small nature of the systems near the Greycliff rest area, it would not be cost effective to extend water service from these sources to the Greycliff rest area site. Therefore, this option will not be discussed further; the remainder of this section will focus on accommodating water and sewer needs at the existing sites.

Figure 2-13 Public Water System Sources near Greycliff



2.3.1 Water Service

Quantity

The projected 20-year peak hourly water demand was calculated based on the methodology specified in the Rest Area Plan. Table 2.22 lists the projected water use estimates at the EB and WB Greycliff rest area sites. Detailed usage calculations are provided in Appendix C and irrigation demand calculations are provided in Appendix F. The usage and irrigation requirements calculated for Greycliff EB and WB are essentially the same with only slight differences. Therefore, the higher of the two (EB) is listed below in Table 2.22 and it is assumed for simplicity that the WB site will also be based on these estimates.

Table 2.22 Greycliff Projected Water Use Estimates (2027)

Rest Area Site	Restroom Water Usage (Peak Hourly Demand)	Estimated Irrigation Demand	Total Demand
Greycliff*	23 gpm	14 gpm	37 gpm

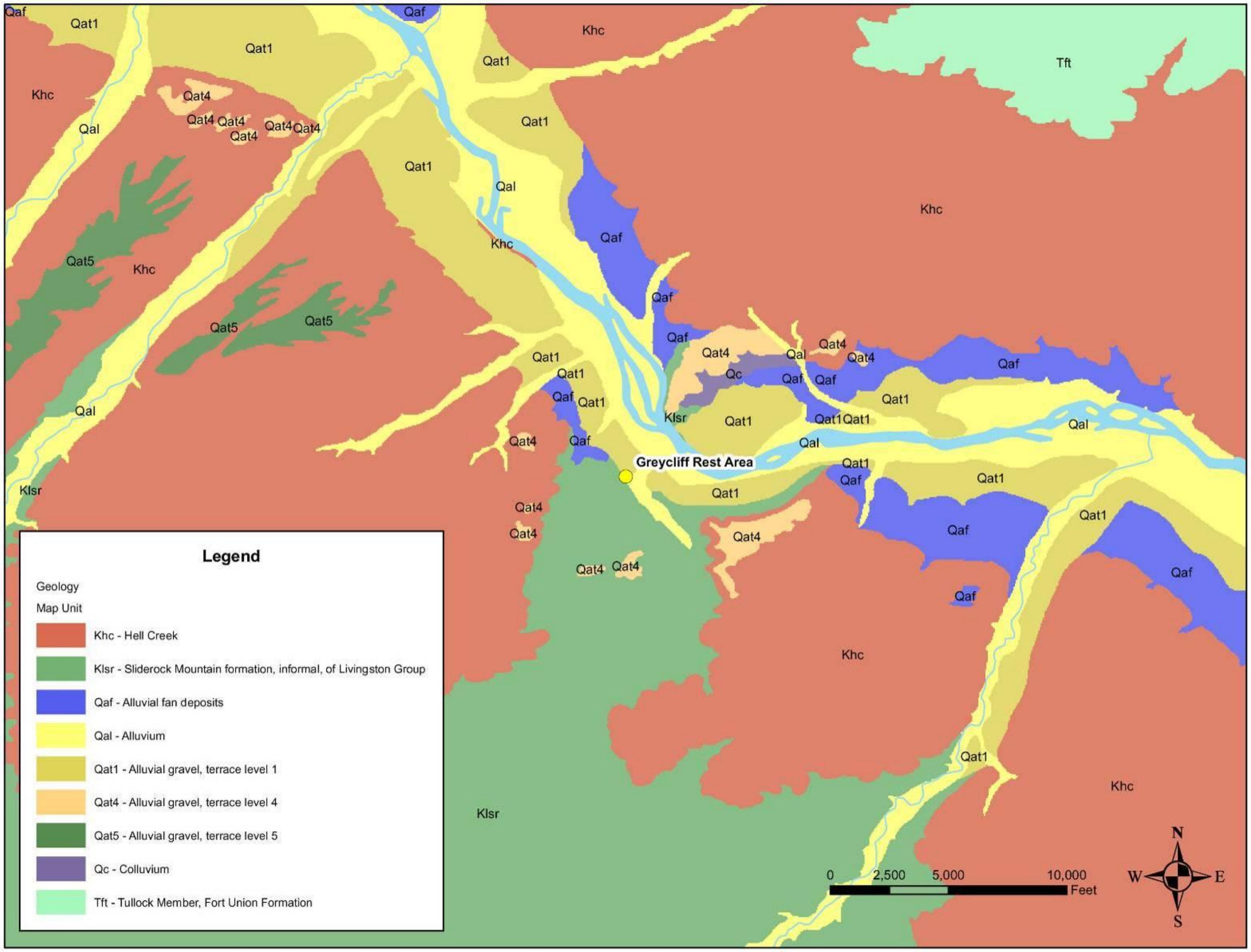
Source: MDT, 2008; DOWL HKM, 2009.
*Refers to one site (EB or WB).

Based on the estimates in Table 2.22 and the well information shown previously in Figure 2-6, the wells at Greycliff have adequate capacity to meet the projected 2027 maximum day demand. Information on the pumping rate has been obtained from the GWIC database as well as from conducting interviews with MDT maintenance personnel. No field work was performed to verify the pumping rates. Therefore, it is recommended that well yield tests be conducted for each well at Greycliff in order to verify the actual pumping rates.

Geologic mapping can be used to determine general aquifer characteristics. Figure 2-14 depicts the geology surrounding the Greycliff rest area. Digital geologic mapping was obtained from the MBMG State Geologic Mapping Program; map unit descriptions can be found within Appendix M. As shown in Figure 2-14, the geology in the vicinity of Greycliff consists of mostly Quaternary alluvial deposits in the Yellowstone River valley. Due to the proximity to surface water, surficial aquifers such as surrounding Greycliff are typically very productive, yield high quality water, and can be tapped by shallow wells. Alluvial aquifers consisting of unconsolidated sedimentary rock are some of the most productive sources of groundwater. In comparison, bedrock aquifers consisting of older consolidated rock are typically less productive and require deeper drilling depths. Well log reports obtained from the GWIC database confirm that the Greycliff wells have high production rates in excess of 50 gpm.

Based on the proximity of the Greycliff rest areas to a major river alluvial aquifer as well as available well log report pumping rates, the wells at Greycliff can be expected to be relatively stable and reliable. However, field pump testing and monitoring would need to be conducted to verify pump rates, recharge rates, and the effect on neighboring wells.

Figure 2-14 Geologic Map of Greycliff



As water demands increase due to usage, it is good practice to examine ways to conserve the water supplies at Greycliff. The Greycliff site is already equipped with low-flow toilets and sinks that turn off after a specified amount of time. One possible method for reducing water usage at the Greycliff sites is to implement xeriscaping techniques. Xeriscaping is a term generally encompassing water-conserving landscaping practices, including the use of drought-resistant native plants and installation of ground cover plantings, mulch, and hardscape materials in favor of water-demanding turf. Water-conserving irrigation practices can also reduce demand. Such practices include scheduling irrigation to occur in the early morning instead of mid-day and the use of drip-irrigation systems as opposed to above-ground sprinklers in order to minimize evaporation and runoff. These types of landscaping techniques would lessen maintenance requirements and require less water, thereby reducing the overall water demand at the rest area sites. Reducing irrigation requirements would free up the well capacity in order to accommodate increased visitor usage.

While reducing water usage is good practice in terms of conservation, due to the non-typical strength of wastewater at a rest area, reducing facility water usage can enrich the waste strength component through reduction of dilution. This issue is discussed further in Section 2.3.2. However, reducing water usage through more efficient irrigation practices will help to conserve water without affecting wastewater strength, as irrigation water does not enter the treatment system.

The Greycliff wells fall under the DNRC category of “exempt” wells. Exempt wells are allowed to pump no more than 35 gpm and 10 acre-feet per year. The estimated future demand slightly exceeds this value. In lieu of pursuing actual water rights for this rest area to allow for higher pumping rates or a greater annual volume, the water conservation measures noted above would be the more economical and practical solution. The timing of irrigation could also be offset with peak visitation such that the peak demand shown in Table 2.22 was never actually attained.

Another way to supplement peak demands is through the addition of storage. Storage tanks can be provided to supplement flows in times of peak demand. In the case of demands this small, one or more hydropneumatic pressure tanks would be adequate to accommodate the brief peaking periods in excess of the 35 gpm limit of the exempt water wells. Alternately, a 1,000 to 2,000 gallon fiberglass tank could be buried on-site and a separate pumping system provided to pressurize the system.

Although it appears that unregulated wells could likely accommodate demand at the Greycliff sites for some time, MDT may want to consider securing water rights in the future as usage increases. Well replacements may be easier to obtain with secured water rights. Therefore, the process and expense of acquiring water rights is discussed as follows.

When applying for a new water right in Montana, different rules and procedures apply depending on whether or not the location is in a closed basin. Several highly appropriated basins in Montana have been closed to new appropriations. Therefore, obtaining a water right in a closed basin requires extensive analysis to show that the water being used will be replaced or “mitigated” such that the net loss from the aquifer is zero. Mitigation could be return of highly treated wastewater to the aquifer, or retirement of a separate existing water right. The majority of closed basins are located in western Montana. The Greycliff rest area falls within the Upper Yellowstone River basin and has not been closed to new appropriations at this time. Therefore, obtaining a water right for the Greycliff rest area does not require analysis to show that the water used is being replaced. The water right process does, however, require that the following DNRC criteria are met:

1. Demonstrate that water is physically and legally available at the site.
2. Demonstrate that nearby water resources will not be adversely affected (i.e. neighboring wells, streams, irrigation ditches, and other sources).
3. Demonstrate beneficial use.

Several hydrogeologic factors must be evaluated to determine if water is physically available at the site. This will most likely require the drilling of test wells to conduct aquifer tests, water quality tests, and water level monitoring. Stream flow monitoring may also be required. Once physical availability is demonstrated, legal availability must be demonstrated through identification and analysis of existing water rights in the vicinity and with regard to potentially-affected surface waters. This process involves significant research into existing water rights and a comparison of existing legal demands to physical water availability. If physical water availability exceeds the existing demand, water is determined to be legally available.

To demonstrate beneficial use, the proposed water use must be justifiable in regards to how it will be used as well as the quantity of water needed.

As described above, acquiring additional water rights is a fairly lengthy process requiring substantial additional analysis. However, if the above criteria can be demonstrated, obtaining additional water rights for Greycliff is a viable option for assuring that sufficient water is available at the site to meet anticipated demands.

Quality

Based on the queried DEQ PWS database, the Greycliff sites historically have not had many water quality violations until recently in the summer of 2008. It is understood that these recent total coliform MCL violations may have been due to maintenance issues with the cartridge filters. The database indicates that there have been no positive total coliform tests since this time and water quality appears to be adequate at both of the Greycliff sites.

It is important that specific sampling protocol be followed in order to minimize issues such as cross-contamination, which can result in false positive readings for coliform. Therefore, it would be advantageous for MDT to develop a standardized sampling program and corresponding operator training to assure that samples are collected appropriately. A detailed sampling plan should be developed for each rest area describing the sample locations; number, type, and size of each sample; sampling method technique, storage, and handling procedures; and sample labeling and chain of reporting standards, including receipt and logging of samples and delivery to the lab.

General guidelines for collecting a coliform bacteria sample are listed in the Drinking Water Regulations for Transient Non-Community Public Water Supplies (DEQ, 1999). These guidelines are summarized below and should be considered when developing a detailed sampling plan.

- Always sample from a cold water tap (avoid leaking faucets, drinking fountains, and outside hydrants)
- Remove any faucet attachments (aeration screens, hoses, etc.)
- Open tap fully and let water run two to three minutes
- Reduce the flow and fill the bottle leaving an airspace which allows mixing by shaking in the lab
- Do not allow cross-contamination when collecting the sample (i.e. do not touch the inner surface of the bottle or lid or touch it to the faucet).
- Transport the sample to the lab as soon as possible. Care should be taken to maintain the sample at normal water temperature.

Additional materials on sampling requirements may be obtained from the U.S. Environmental Protection Agency (EPA) safe water program. Secondly, the Montana Environmental Training Center (METC) periodically hosts training programs for water and wastewater operators at several locations throughout Montana.

Although Greycliff does not currently require disinfection, anticipated regulations may warrant this in the future. The Ground Water Rule set forth by EPA will go into effect on December 1, 2009. This rule states that all groundwater systems not currently providing disinfection must perform triggered source water monitoring if notified of a total coliform-positive routine sample. Depending on the results of the triggered source water monitoring, groundwater systems must correct the deficiency or ultimately provide treatment that achieves at least 4-log treatment of viruses. Required treatment methods would most likely be chlorinated systems allowing sufficient contact time. In general, the Ground Water Rule builds upon the drinking water regulations currently in effect under DEQ for transient non-community water supplies. DEQ will administer the Ground Water Rule and perform routine sanitary surveys to ensure compliance and identify significant deficiencies.

Another process regulated through DEQ is the GWUDISW determination process. This process pertains to the groundwater wells at the Greycliff rest area. The process would begin with a preliminary assessment by DEQ and, depending on the results, could require additional analysis. Through this process, if groundwater sources are determined to be directly influenced by surface water, they will be subject to the Surface Water Treatment Rule requirements and would require disinfection and possible filtration. Based upon the well construction, the depth of aquifer, and proximity to surface waters, it is not expected this will become an issue at the Greycliff sites.

Other Factors

For small water systems, it is important to ensure that wells are protected from sources of contaminants. Per Circular DEQ-3, wells must be located at least 100 feet from any structures used to convey or retain storm or sanitary waste. The wells at Greycliff are more than 100 feet from septic tank and drainfield locations and therefore meet this requirement. Well construction details are provided in the GWIC database sheets located in Appendix G. It is also important to make sure the well construction details and well pumps meet DEQ requirements.

The operation, maintenance, and replacement costs are typically low for this type of small water system. The only significant replacement costs are associated with the actual well pump and possibly some controls (e.g., pressure tank, appurtenances, etc.). Table 2.23 presents typical costs associated with pulling and replacing a well pump. According to MDT maintenance personnel, pumps typically last five to seven years depending on the hardness or corrosiveness of the water. It should be noted that the following costs most likely would not occur in the same year.

Table 2.23 Typical Costs for Rest Area Water Systems

Component	Cost
Parts, fittings, expenses, etc.	$500
Pump	$500 - $750
Labor associated with replacing the pump (i.e. wiring, etc.)	$1,000 - $1,500
Water Filter (replace monthly at $20 each)	$240
Pressure Tank (replace on occasion)	$350
Air/Sequence Valve for Toilets (replace once every two years @ $600 per toilet, assume 3 toilets per year)	$1,800
Hot Water Tank (replace every 3-4 years)	$450
Total Cost	**$4,840 - $5,590**

Source: MDT, 2009.

Anticipated pumping costs are listed below in Table 2.24. Detailed calculations can be found within Appendix K.

Table 2.24 Greycliff Projected Pumping Costs

Rest Area Site	Total Annual Power Costs
Greycliff EB	$721
Greycliff WB	$607

Source: DOWL HKM, 2009.

Conclusions

Based on the above discussion, the following is a summary regarding water service at the Greycliff rest areas:

- The water sources at Greycliff have adequate capacity to meet the 20-year projected design flows. It should be reiterated that field pumping tests were not performed as part of this study.
- Due to the proximity to the Yellowstone River basin, the aquifer serving the Greycliff rest area can be expected to be reliable and allow for highly productive wells.
- Water demand could be further reduced by implementing water-conserving irrigation and landscaping techniques.
- Water quality at the Greycliff sites is generally good, however, through the implementation of the Ground Water Rule and GWUDISW process, more stringent water quality rules may apply in the future and treatment may be necessary.
- Costs associated with maintaining these systems are relatively low.
- As usage increases due to demand beyond the 20-year projections, additional water rights may need to be secured. The Greycliff sites are not currently within a closed basin and new water rights could, most likely, be attained.

2.3.2 Sewer Service

Size of Existing System

As described above in Section 2.1.8, on-site sewage treatment at the Greycliff rest areas is accomplished through the use of a septic tank and gravity-fed soil absorption drainfield. Preliminary sizing calculations for the 20-year projected usage are shown below in Table 2.25 along with the existing system sizing information determined from as-built drawings and information collected from MDT maintenance personnel. Detailed calculations can be found within Appendix J. It should be reiterated that accurate sizing of a drainfield cannot be accomplished without site-specific soils information and percolation test results. This information was not collected as part of this study. The NRCS soils information was used to determine approximate sizing criteria.

Table 2.25 Septic Tank and Drainfield Size for Projected Usage (2027)

Rest Area Site	Septic Tank		Drainfield	
	Existing Size	Recommended Size for Projected Usage (2027)	Estimated Existing Size	Recommended Size for Projected Usage (2027)
Greycliff EB	6,612 gallons	11,500 gallons	2,200 ft^2	17,000 ft^2
Greycliff WB	6,612 gallons	11,400 gallons	3,600 ft^2	16,900 ft^2

Note: Shaded cells indicate failure to meet the recommended septic tank or drainfield size.
Source: MDT, 2009; DOWL HKM, 2009.

As shown above, the existing wastewater treatment system at Greycliff is undersized to accommodate the 20-year projected rest area usage. Furthermore, Circular DEQ-4 states that subsurface wastewater disposal systems should only be used for residential strength wastewater and that wastewater exceeding this strength must be pretreated before discharging to drainfield systems. Table 2.26 below identifies typical ranges of key raw wastewater parameters for highway rest areas as compared to typical domestic wastewater. As can be seen from this generalized table, the raw wastewater strength can be expected to be well in excess of typical domestic values. It is important to note, however, that no raw wastewater sampling data was available from this rest area at the time of this evaluation. Further, the actual raw wastewater concentrations can be widely variable among rest areas.

Table 2.26 Raw Wastewater Strength; Domestic vs. Highway Rest Areas

Raw Wastewater Parameter	Typical Domestic Strength Wastewater Concentrations(1) (mg/L)	Typical Highway Rest Area Wastewater Concentrations (mg/L)
Five-Day Biological Oxygen Demand (BOD_5)	110 - 350	400 - 500
Total Suspended Solids (TSS)	120 - 400	150 - 400
Total Nitrogen (TN)	20 - 70	150 - 250
Total Phosphorus (TP)	4 - 12	20 - 30

(1) Table 3-15; Wastewater Treatment & Reuse, 4th Edition; Metcalf & Eddy, 2003.

Therefore, because the existing system is undersized and septic tank/drainfield systems are not recommended as the sole treatment option for non-residential wastewater, alternative wastewater treatment technologies will be explored and will be the focus of this section.

Wastewater Effluent Quality Requirements

The first driving factor for determination of potential effluent quality criteria is the point of ultimate discharge of the effluent. The two principal means of discharge include direct discharge to surface water and subsurface discharge, which may or may not reach groundwater. Two non-discharging options would include total retention of treated effluent using evaporation as the ultimate disposal and land application or irrigation.

The effluent quality of a subsurface discharge system (i.e. drainfield) depends upon the presence, depth below ground surface, and volume of existing groundwater. Subsurface discharge systems are allowed based upon the concentration of nitrates at the end of an allowable "mixing zone." The mixing zone depends primarily upon the proximity to existing surface water sources and existing groundwater wells. Based upon a required non-degradation analysis, the calculated nitrogen concentration at the end of the mixing zone must be less than or equal to 7.5 mg/L. A smaller allowable mixing zone equates to a requirement for higher quality effluent and more advanced treatment processes. Of further significance related to the permitting of subsurface discharge systems is the total daily discharge volume. A DEQ discharge permit is not required for systems discharging less than 5,000 gallons per day (gpd). While the actual analysis and design of the disposal system would be the same, a system over 5,000 gpd may require more site specific and detailed groundwater information and would require permit and renewal fees.

Direct surface water discharge of effluent would require the highest quality effluent, as well as a lengthy evaluation and permitting process, which may not ultimately be granted by the permitting agency. Direct surface discharge is not considered a viable option for this rest area.

The final options of land application and total retention do not require a discharge permit. Either system would require similar effluent water quality. Effluent quality for land application systems would depend upon the size of irrigable area and the nutrient uptake potential of the associated crop. Total retention systems would generally be designed to secondary treatment standards typical of a wastewater lagoon system with additional consideration potentially given to the odor and algae generation potential of the stored effluent.

Advanced Wastewater Treatment Options

In a conventional on-site system, a septic tank is first used for partial treatment of the wastewater and for accumulation of solids. Secondly, a subsurface drainfield is used for final treatment and disposal of the wastewater. In alternative systems, additional or secondary/advanced treatment is provided between the septic tank and disposal system. This section will focus on four secondary treatment technologies applicable to the Greycliff rest area sites. These are:

- Aerobic Treatment Systems/Package Plants (including Sequencing Batch Reactor (SBR) and Membrane Bioreactor (MBR) systems)
- Lagoon Systems
- Aquatic Treatment Systems
- Recirculating Packed-Bed Filters

It is worth mentioning a few low-cost modifications that can be added to any on-site wastewater system regardless of the treatment method being applied. With any system, it is good practice to install effluent filters on septic tanks. The effluent filter will help to alleviate stress on the downstream processes and piping systems by retaining solids in the septic tank more consistently. In addition, dosing and resting the drainfield through the use of a pumping system rather than the trickle flow that a drainfield typically receives with the conventional gravity system will improve the treatment and extend the life of the drainfield. Dosed systems are also allowed slightly modified trench dimensions and spacing requirements that provide for more effective use of the drainfield area.

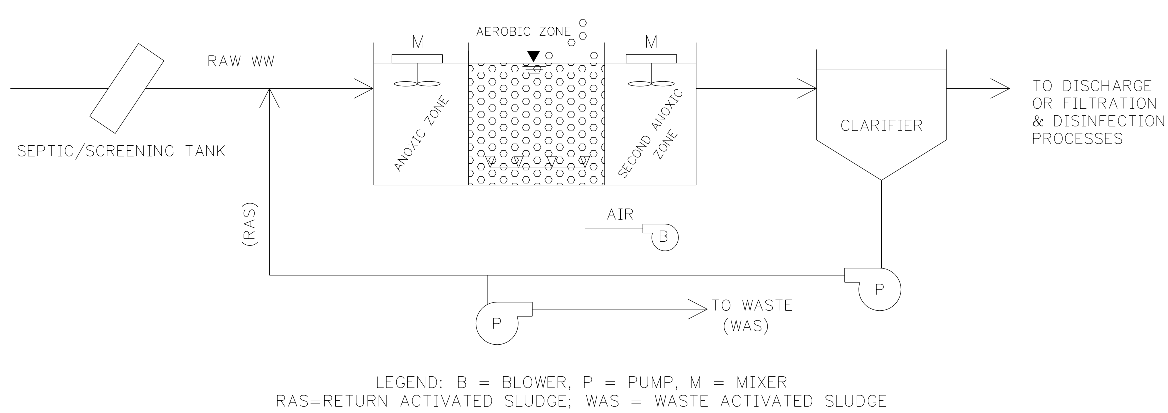
It is important that an alternative system be selected only after an investigation of site-specific conditions. System selection and design should be performed by a professional engineer with a formal design report submitted to the permitting authority.

Advanced Treatment Systems/Package Plants

For applications where stringent effluent quality requirements will apply, a more advanced treatment system in the form of aerobic, activated sludge systems could be required. Such advanced treatment units may include only aerobic zones where greater BOD, TSS and ammonia reduction (i.e. nitrification) can occur. As effluent disposal criteria dictate, more advanced systems may include anoxic (low dissolved oxygen) zones where subsequent nitrogen removal (denitrification) can occur.

A septic tank is intended to remove solids and initiate biological treatment. This process is anaerobic, meaning there is no oxygen in the system. Conversely, advanced treatment systems are aerobic and consist of an aeration tank where incoming wastewater is mixed with biological organisms (i.e. activated sludge) using a large quantity of air. During the aeration process, a portion of the wastewater undergoes biological treatment or the conversion of organic matter to various gases and new microbial cells. Aeration compartments are followed by a settling compartment. A portion of the settled microorganisms or "activated sludge" is then returned to the front of the treatment process as return activated sludge (RAS) to be mixed again with incoming wastewater. Excess sludge or "waste activated sludge" (WAS) must occasionally be removed from system. Figure 2-15 illustrates the basic configuration of an advanced treatment unit for biological nitrogen removal.

Figure 2-15 Advanced Treatment Process Flow Diagram



Advanced treatment units come in many forms of pre-engineered/package wastewater treatment plants; several variations exist depending on the size of system or community being served and ultimate treatment objectives. The process can be modified in many ways to achieve the ultimate treatment objectives. For example, one process applicable to small communities or cluster configurations is the SBR system. SBR systems utilize five steps occurring in the same tank (i.e. both aeration and settling occur in the same tank). Due to the sequential nature of the SBR system, a key element is the control system, consisting of a combination of level sensors and timers. The five steps occurring in sequential order are:

1. Fill
2. React (aeration)
3. Settle (sedimentation/clarification)
4. Draw (decant)
5. Idle

The MBR system is another variation of an aerobic advanced treatment process. The MBR system adds a microfiltration element to the treatment process accomplished through the use of a membrane. The membrane element is typically submerged directly in the treated wastewater at the end of the treatment process. In place of sludge settling/clarification, the membrane captures solids and either re-circulates them into the treatment process or sends them to be wasted. With the addition of the filtration element, MBR systems are more complex than the SBR system and require slightly more maintenance and monitoring to make sure the membrane does not clog and is operating efficiently. Only for very stringent effluent quality requirements would MBR technology be an economic option for this rest area. Biologically, MRB & SBR systems have the same treatment capability. The MBR's distinguishing characteristic is its simultaneous clarification and filtration of the effluent, resulting in extremely high-quality effluent with respect to total suspended solids and making it an ideal process for water reuse applications.

Advanced treatment units can provide a high level of treatment and therefore may reduce drainfield requirements depending on soil type. However, per Circular DEQ-4, monitoring data must be submitted from at least three existing systems operating in similar climates and treating wastewater similar in characteristics before any reduction in drainfield size will be considered. Monitoring data from existing systems must show that effluent quality parameters are met in order to reduce the drainfield area. If these criteria are met, the absorption system size may be reduced by 50 percent, but must still have a replacement area large enough for a standard absorption trench system.

One manufactured advanced aerobic treatment system with case history installations in Montana is the Santec treatment system by Santec Corporation. This system is currently installed in the town of Rocker, Montana to serve two truck stop establishments. Truck stop wastewater effluent is similar in composition to rest area wastewater due to its higher strength. Influent and effluent wastewater monitoring data for the year 2008 was obtained from the Rocker Wastewater Treatment Plant (WWTP). Influent BOD and TSS concentrations are comparable to what is expected of rest area wastewater as listed in Table 2.26; however data was not available for influent total nitrogen and phosphorus concentrations. Effluent monitoring data from the Rocker WWTP indicates that effluent characteristics meet typical standards for secondary treatment.

Proper operation and maintenance of the aerobic unit is critical. Owners are required to obtain service agreements with the manufacturers of these systems and surveillance by qualified personnel is imperative. An alarm system is required to indicate when the treatment system has an alarm condition, such as a high water level or pump failure. In addition, operators are required to obtain proper certification and perform frequent inspection. Based on recent information from DEQ, only two of these types of systems have been reviewed and permitted in Montana in the past year.

If it is found based on results of a non-degradation analysis that more stringent effluent quality requirements apply, advanced treatment options should be considered as a viable option for wastewater treatment at the Greycliff rest area. Advantages of advanced treatment units include:

- Relatively low footprint for equipment although room is still needed for an appropriately sized drainfield.
- Systems are modular in nature allowing for future expansion or modifications.
- A high level of treatment can be obtained.

Disadvantages include:

- Power requirements will increase substantially due to the aeration equipment within the treatment system.
- Intensive operation, maintenance, and management requirements.
- Due to the relatively low number of installed systems in Montana, proper monitoring data needed for permitting may be difficult to obtain.

<u>Lagoon Systems</u>
Lagoon treatment systems are ponds that are engineered and constructed to treat wastewater. There are several types of lagoons classified based on the discharging method. The lagoon system most applicable to a rest area is non-discharging (i.e. evaporation lagoon). A lagoon system is feasible for the projected wastewater flow rates from the rest area. The lagoon would be sized based on this flow rate and the required detention time for BOD and TSS removal.

The advantages of lagoons include:

- Low capital costs
- Minimum operations and operational skills needed
- Sludge withdrawal and disposal needed only at 10-20 year intervals
- Compatibility with land and aquatic treatment processes

The disadvantages of lagoons include:

- Large land areas may be required
- High concentrations of algae may be generated
- Non-aerated lagoons often cannot meet stringent effluent limits (not applicable for a non-discharging lagoon)
- Lagoons can impact groundwater negatively if liners are not used, or if liners are damaged
- Improperly designed and operated lagoons can become odorous[1]

Lagoon systems are not recommended at the Greycliff site because the existing site is not large enough and additional right-of-way would most likely be necessary. In addition, lagoons have the potential to become odorous, making the site unattractive for rest area users. Space at the Greycliff sites is limited and the lagoon would need to be fenced and located far enough from the site to prevent odors or other nuisances from affecting neighboring properties.

[1] Crites and Tchobanoglous, 1998.

Aquatic Treatment Systems

Aquatic treatment systems use plants and animals such as insects, fish, worms, and snails designed to aid in the treatment process. An article from the Federal Highway Administration (FHWA) Public Roads Magazine dated May/June 2000 provides details of this type of system installed at a welcome center in Vermont. The system is called the Living Machine and is picture in Figure 2-16 inside a modular greenhouse. The Vermont Agency of Transportation used this technology at the Guilford welcome center from 1997 to 1999. The system recycles treated wastewater that is clean enough for use in toilets or for irrigation purposes, but not clean enough to drink or to use for washing hands. In 1999, the system was decommissioned at the Guilford welcome center when a new welcome center was opened nearby and was connected to a municipal wastewater system. At the time of the article, however, there were plans to reinstall the Living Machine at another rest area experiencing current failing sewage treatment systems.

An operator is needed to keep the plants alive and monitor the system frequently. As described in the article, the cost of this system is initially high at approximately $250,000.

The Living Machine or a comparable aquatic system is not recommended for the Greycliff rest area. It is described to demonstrate the types of innovative systems being installed at some rest areas throughout the country. This system is still somewhat experimental in nature and would likely require a lengthy permitting process through DEQ. In addition, due to the remote and unsupervised nature of the Greycliff sites, this system would be vulnerable to vandalism. This type of system would also require significant monitoring by a trained operator and would likely necessitate hiring additional full-time maintenance employees.

Figure 2-16 Living Machine

Inside the rest area's wastewater treatment system, plants and animals clean the waste from the water through a series of engineered ecosystems. (Photo by Living Technologies)

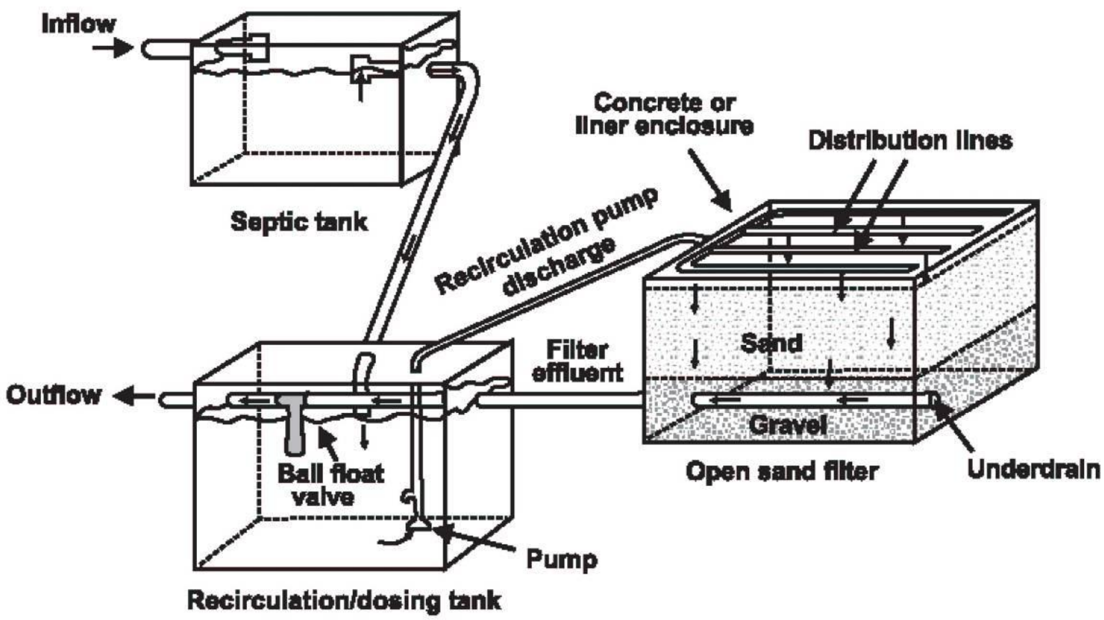
Recirculating (Multi-pass) Packed-Bed Filters

Packed-bed filters use biological and physical processes to effectively treat wastewater. They can be either intermittent (single pass) or recirculating (multi-pass). In intermittent design, the wastewater is applied to the filter only once through several doses per day. In a recirculating system, a portion of the wastewater that has gone through the filter already is returned to the filter. Recirculating filters are more applicable to the Greycliff rest area sites based on the required design flow. Therefore, this section focuses on recirculating packed-bed filters for use as an alternative treatment technology at the Greycliff rest area.

Figure 2-17 illustrates the operation of a recirculating packed-bed filter using sand as the filtering media. A typical packed-bed filter is comprised of the following elements:

1. A container with a liner for holding the medium
2. An underdrain system for removing the treated liquid
3. The filtering medium – Many types of media are used in packed-bed filters. Sand is the most common, but other options include crushed glass, plastic, foam, and synthetic textile media.
4. A distribution and dosing system for applying the liquid to be treated onto the filtering medium (spray nozzles, etc.)
5. Supporting appurtenances

Figure 2-17 Recirculating Sand Filter



Source: EPA Onsite Wastewater Treatment Manual

The septic tank effluent is dosed onto the surface of the filter and is allowed to percolate through the medium to the underdrain system. Recirculating filters combine biological treatment with physical processes such as straining and sedimentation. Biological treatment occurs due to the bioslimes that form on the media particle surfaces. According to EPA, recirculating sand filters frequently replace aerobic package plants in many parts of the country because of their high reliability and lower operating and maintenance requirements.[2]

As an alternative to the recirculating sand filter, textile packed-bed filters utilize non-woven textile chips instead of granular medium, increasing the surface area for the microorganisms to attach and thereby reducing the space requirements of the filter.

[2] EPA Onsite Wastewater Treatment Systems Manual, February, 2002

One manufactured recirculating textile packed-bed filter currently approved by DEQ is the AdvanTex Treatment System by Orenco Systems, Incorporated. AdvanTex systems have been installed in numerous commercial and residential applications in Montana. Conceptual designs for an AdvanTex system have been produced for the new Lima Rest Area proposed for construction later this year (although they are not currently approved to date). AdvanTex systems have been successfully utilized in other nearby rest area applications, including the states of Wyoming and Colorado.

AdvanTex systems are equipped with remote telemetry to give operators and manufacturers the ability to monitor and control their systems remotely. Distributors of AdvanTex systems are located in Bozeman, MT, allowing for fast response times in an emergency.

A key component of systems such as AdvanTex is their modular nature. For example, considering one Greycliff site (EB or WB), the existing design flows and treatment objectives currently warrant a three-pod AdvanTex system. The 20-year projected wastewater design flows at Greycliff call for a five-pod system. The modular nature of this system allows for additional units to be installed in the future as long as adequate space is provided initially. MDT plans to begin collecting data on water usage and wastewater effluent concentrations in the future. As this data becomes known, refinements and adjustments can be made to the required number of future units.

It is worth mentioning that AdvanTex systems are designed to reduce total nitrogen by 60 percent or more. Due to the expected high strength of the incoming wastewater, additional measures such as pretreatment, additives, or polishing components may or may not be needed to obtain effluent total nitrogen levels that meet the acceptable standard. Again, required treatment levels are based on results of a non-degradation analysis that would dictate the design criteria needed.

Recirculating packed bed filters such as the AdvanTex system should be considered as an option for wastewater treatment at the Greycliff rest area. Advantages of recirculating packed bed filter systems are similar to those for advanced aerobic treatment units. However, the packed bed filter system is slightly less complex than the aerobic advanced treatment unit, requiring less monitoring and operational requirements. Power requirements would also be less due to the absence of the aeration equipment.

Subsurface Drainfield

With recirculating filters, DEQ allows a 50 percent reduction in drainfield size from standard absorption system sizing (depending on soil percolation rates). However, this allowance is applied in the context of typical domestic wastewater strength. Therefore, based upon the increased raw wastewater strength, this reduction may not initially be granted, unless adequate performance data at higher raw wastewater concentrations can be provided to justify application of this allowance. This reduction could further be applied to packaged treatment systems with effluent quality meeting or exceeding the typical concentrations from the circulating filters.

Rough calculations were made to determine if the new drainfields will fit on the Greycliff sites after taking into account the reduction in size. The quadrangle map for the area shows that Greycliff Creek runs to the east of the Greycliff EB site, although this creek was not observed during the site visits.

The following should be noted with respect to proximity of the rest areas to surface waters:

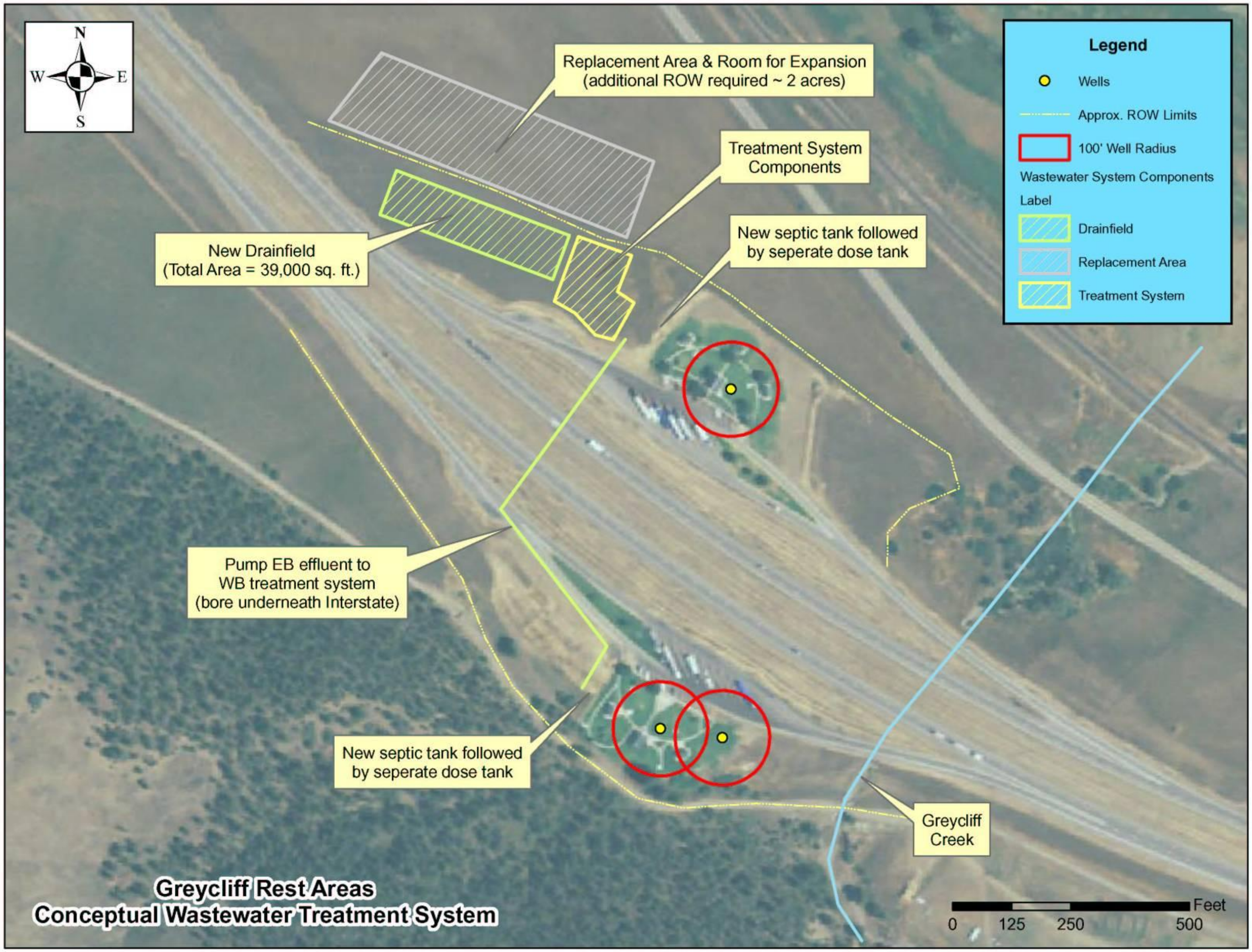
1. Subsurface wastewater disposal systems must be located a minimum horizontal setback distance of 100 feet from any surface water or spring and at least 100 feet outside of any floodplain boundaries.
2. Greater horizontal distance may be required depending on results of a water quality non-degradation analysis. This analysis is not only based on distance but includes other factors such as nutrient load, hydrogeologic conditions, and direction of groundwater flow.
3. Close proximity of the rest area to surface waters could also have an effect on the ground water if ground water sources are determined to be directly influenced by surface water.

Wastewater systems must be located at least 100 feet from any surface waters. Therefore, the only other available area to place the new wastewater system at the Greycliff EB site is over the existing drainfield. This is allowed per Circular DEQ-4 if the current drainfield system has not failed. However, in looking at the quadrangle map and from observations made during the site visits, the Greycliff EB existing drainfield site is located on relatively uneven ground that has a fairly significant slope to the northeast. Per Circular DEQ-4, absorption filed distribution lines and trenches must be level. Therefore, the existing drainfield location at the EB site would most likely require additional earthwork to make the site suitable for a drainfield. The ground continues to slope towards the interstate further west of the rest area. Therefore, even if additional right-of-way were purchased west of the EB rest area, the area would most likely still require additional earthwork and site modifications for placement of a new drainfield.

Due to the limitations at the EB site, one item for consideration with this rest area and any others that may require a higher level of treatment is the use of one treatment system per two rest areas. For instance, a treatment system could be installed at the WB Greycliff rest area. The raw wastewater or septic tank effluent would be pumped from the east side to the west side to utilize a single treatment system. Effluent could then be disposed of entirely on one side or split between the two sides of the interstate, as dictated by the total required disposal area. Small diameter (two- to three-inch) lines would be directionally drilled under the interstate to convey the raw wastewater, septic tank effluent or final effluent to the respective side of the interstate. The costs of conveyance would be mostly offset by not having a second treatment system. In addition to capital cost savings, only one system would have to be maintained in lieu of two separate treatment systems.

Figure 2-18 illustrates a conceptual centralized rest area treatment system that could work at the Greycliff rest area. The figure illustrates approximate areas and locations of the new drainfield. This type of system applies to an advanced aerobic treatment system such as the Santec treatment system or a recirculating packed-bed filter system such as AdvanTex. Detailed drainfield sizing calculations can be found within Appendix J. Approximately two acres of additional right-of-way is shown on the figure to account for a replacement area and some additional room for expansion. It should be noted that preliminary sizing calculations take into account the reduction in drainfield size. If a reduction in drainfield size is not granted, additional right-of-way would be required. The Greycliff WB site appears to have a relatively large area of suitable land to the north of the site.

Figure 2-18 Greycliff Conceptual Wastewater Treatment System



It is reiterated that site-specific soil information was not obtained as part of this study. Ultimate drainfield size and location will need to be determined after this field data is collected.

One additional option for the drainfield is to reconstruct the system as a "bed system." In the case of a replacement not resulting from failure, a bed system is allowed per Circular DEQ-4. The total footprint of this system consists of the design flow rate divided by the soil application rate and results in a slightly reduced drainfield area due to the elimination of the spacing needed between trenches.

Combining bi-directional waste flow under current 2007 projections puts the total average daily wastewater discharge at or slightly above the 5,000 gallon per day discharge permit threshold. The need for a discharge permit under this scenario could possibly be avoided through the use of two separate drainfields each discharging less than 5,000 gallons per day. However, as the wastewater flow increases due to projected usage over the 20-year planning horizon, a discharge permit will likely be required for the Greycliff rest area.

Obtaining a discharge permit through DEQ is a lengthy process requiring substantial analysis of the groundwater characteristics. DEQ estimates that the minimum review time for a discharge permit is one year. Once a discharge permit is obtained, DEQ will require routine testing to assure that the system is in compliance with the established effluent quality characteristics. If the system is found to be in noncompliance, violations may be issued. Discharge permits are also required to be periodically renewed and renewal fees can be costly.

Conclusions

- The existing wastewater systems at Greycliff are undersized to meet current and future demand.
- The sites most likely do not have additional room for appropriately sized conventional systems and replacement areas unless additional right-of-way is purchased.
- Conventional systems are not recommended for non-residential strength wastewater.
- A variety of secondary treatment options exist to improve the level of wastewater treatment for onsite systems. Lagoons and aquatic systems are not recommended at Greycliff due to issues such as land availability, system complexities, and permitting concerns.
- If treatment standards dictate, advanced aerobic treatment systems are one option for wastewater treatment at a rest area. These systems provide a high level of treatment but require trained operators due to system complexities.
- The recirculating packed-bed filter system is another option for a wastewater treatment system at the Greycliff sites, assuming all the non-degradation requirements can be achieved. This system is less complex than an aerobic treatment unit and provides a high level of treatment. Due to the modular nature of these systems, additional units may be installed as needed at a later date, thereby reducing initial costs.
- The Greycliff rest area will likely require a discharge permit in the near future based on current wastewater estimates. Future estimates indicate that the site will need to obtain this permit to accommodate the 20-year projections.
- Land is limited at the Greycliff sites for adequately sized wastewater treatment systems. Wastewater treatment for both sites will most likely need to be accommodated at the WB side where suitable additional right-of-way is potentially available for purchase.

2.3.3 Power Service

Based on historic consumption patterns over the past five years, demand for electricity at the Greycliff rest area will likely continue to increase each year as visitor numbers increase over the 20-year planning horizon. As noted in Section 2.1.8, heating and lighting systems at the site remain on continuously year round; these elements therefore demand a constant yearly supply of electricity. Annual increases in power consumption over the past five years are likely attributable to more frequent well pumping triggered by increasing visitor usage.

As noted in Section 2.1.8, the cost for electricity generally varied between $0.063 and $0.096 per kWh from 2004 to 2008, but increased to $0.138 per kWh in December 2008. Although existing connections to the power grid would be able to meet future demand, any future rehabilitation of the Greycliff rest area should attempt to incorporate a more cost-effective design to reduce energy costs as much as possible, especially given recent rate volatility.

There are two primary means of reducing power costs at the existing Greycliff rest area. The first would entail installation of energy-saving devices, including interior motion-sensitive lighting. With the use of motion sensors, interior lights would turn on only when triggered by a visitor using the facility, thereby saving electricity when the facility was not in use. For safety purposes, outdoor lighting would remain triggered by photoelectric detection devices and would stay on continuously during nighttime hours.

Additional energy-saving techniques would be best employed at the time of site rehabilitation as compared to retrofitting the existing building. For example, orienting a new building facility to receive the maximum amount of sunlight available at the site could reduce lighting and heating needs during daylight hours. In-floor radiant heating may also provide cost savings given reduced maintenance costs and greater efficiency as compared to electric furnaces, which are currently in place at the Greycliff EB and WB sites. New insulation with an increased heat-retention capacity could also be installed; due to tiled interior walls, it would be difficult to refurbish the existing Greycliff buildings with new insulation. All building systems, including heating, lighting, plumbing, and mechanical systems, should be evaluated at the time of rehabilitation in order to provide the most energy-efficient design.

A second means of reducing power costs would involve development and use of an alternative source of energy. The two sources of alternative energy most applicable for rest area sites are solar and wind energy.

Solar energy could be harnessed to power interior and exterior rest area lighting fixtures. Solar panels can be installed on the roof of a structure or directly to parking lot lighting poles. Although solar radiation varies with the changing position of the earth relative to the sun and due to variance in atmospheric conditions, most geographic areas can access useful solar resources.

The Wyoming Department of Transportation (WYDOT) has installed solar panels at 19 rest areas since the 1980s to provide a source of solar heating for restroom buildings. Most of these rest areas also have solar water heaters for the buildings' lavatories. WYDOT estimates that solar heating provides nearly half of these rest areas' energy needs. Given its effectiveness in Wyoming, it is recommended that MDT further explore the viability of solar energy as a source of power for the Greycliff rest area.

Wind may also be a potential source of energy. MDT is currently studying the viability of using wind power at the Anaconda Interchange rest area. The project involves a single tower-mounted wind turbine intended to provide supplemental power for the rest area. As noted in MDT's December 2006 Experimental Project Work Plan, the objective is to determine the cost-effectiveness of the turbine in reducing usage of grid-line power service. Over the course of several years, MDT intends to compare the Anaconda rest area site to other rest areas of similar design and size in terms of power usage and costs, including regular and unscheduled maintenance costs. MDT will conduct a benefit-cost analysis to determine whether wind turbines could provide long-term cost savings at rest area sites. If such a system appears viable based on the results of the Anaconda study, it is recommended that MDT consider the use of wind power at the Greycliff site.

Conclusions

Based on the above discussion, the following is a summary regarding power service at the Greycliff rest areas:

- Existing grid power service is sufficient to meet the needs of the Greycliff rest area over the 20-year planning horizon.
- Trends over the past five years indicate that power usage will likely continue to increase with increasing visitors.
- Energy-saving technology, including motion-sensitive lighting, should be considered in order to reduce power costs.
- Building orientation and all building systems should be evaluated at the time of site rehabilitation in order to provide the most energy-efficient design.
- Alternative sources of energy, including wind and solar power, could be used in the future to supplement grid power, thereby reducing power costs.

2.4 Cost Assessment

This study utilizes an asset management approach with regard to recommended rest area rehabilitation measures. FHWA's December 1999 *Asset Management Primer* defines asset management as follows:

> Asset management is a systematic process of maintaining, upgrading, and operating physical assets cost-effectively. It combines engineering principles with sound business practices and economic theory, and it provides tools to facilitate a more organized, logical approach to decision-making. Thus, asset management provides a framework for handling both short- and long-range planning.

The goal of asset management in the context of this study is to optimize the preservation, upgrading, and timely replacement of corridor rest area facilities through cost-effective management, programming, and resource allocation decisions. In light of increasing user demand, constrained transportation budgets, and mature resources experiencing continuing deterioration, cost-effective investment decisions are imperative. Asset management principles enable long-term management of resources and prudent allocation of funds given alternative investment options and competing needs. With these principles in mind, this section outlines estimated costs for rehabilitation of the Greycliff EB and WB rest area sites.

As detailed in previous sections, the Greycliff EB and WB rest area sites do not meet current user demands and will not meet projected demand over the 20-year planning horizon. Upgrades are needed to the wastewater system in order to meet these demands. Additionally, the restroom building and parking facilities will require reconstruction and expansion to accommodate increasing usage.

Rehabilitation of Greycliff Sites

In order to reduce initial rehabilitation costs and allow progressive project programming, estimates have been prepared assuming phased implementation. It should be noted that while phased implementation reduces initial capital costs and may result in fewer impacts to the traveling public due to shorter construction-related closure periods, it results in higher total project costs due to duplication of certain efforts, including mobilization, traffic control, and administration costs, as well as material and labor cost escalation over the course of project implementation. Escalation costs are not reflected in the cost estimates provided in this study; all project phases are presented in 2009 dollars.

The first phase would involve rehabilitation of the wastewater system to bring it up to current standards and meet current (2007) demand, and would also include site rehabilitation to provide ADA conformity. These upgrades are recommended to occur first in order to ensure continued public health, safety, and access. Additionally, these are relatively low-cost measures in comparison to full rehabilitation of the site. In order to minimize right-of-way needs, it is assumed that a combined bi-directional wastewater system could be constructed on the WB side with some additional right-of-way needed to accommodate the required replacement area.

The second phase would involve expanding the wastewater system to meet future (2027) demand, as well as reconstruction of the restroom facility, which is undersized given projected demand and has outlived its design life. The recommended wastewater system is modular in nature; additional modules can be added over time to expand the capacity of the system. Regarding the building site, it may be possible to salvage the existing concrete slab foundation; further testing would be needed to determine its soundness for future use, however. This phase would be costly given the need to reconstruct the restroom building. The cost estimates in Tables 2.27, 2.28, 2.31 and 2.32 assume a site-built restroom facility. It may be possible to utilize a pre-fabricated facility. The cost savings associated with such an option is shown in Tables 2.29, 2.30, 2.33, and 2.34. An example of a pre-fabricated unit that would accommodate demand at the Greycliff site is included in Appendix L for reference; this example is not intended as a recommendation of a particular manufacturer. It should be noted that the existing facility, including internal ADA upgrades provided in phase one, would be removed under phase two, resulting in some duplication of effort.

The third phase would entail construction of an additional parking area and accompanying sidewalks to meet 2027 demand. New amenities would also be provided, including additional picnic areas, landscaping, and benches. For purposes of this study, it was assumed that the existing acceleration and deceleration lanes could continue to serve the EB and WB facilities; these ramps would be resurfaced in order to extend their useful life.

Multi-phase and single-phase cost estimates for the EB and WB sites are presented in order to illustrate the relative difference in cost between the two. Detailed descriptions of each line item follow. These planning-level cost estimates are intended to be used primarily for comparison purposes between rest area sites in this study. Again, it should be noted that escalation costs are not reflected in the multi-phase cost estimates; all cost estimates are presented in 2009 dollars.

Table 2.27 Multi-Phase Cost Estimate for Greycliff EB (Site-Built Building Facility)

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Greycliff EB (Major Rehabilitation with Site-Built Facility)						
	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$92,000	$92,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	SUBTOTAL 1				**$116,000**
	Mobilization @ 10%	1	Lump Sum	$12,000	$12,000
	SUBTOTAL 2				**$128,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$13,000	$13,000
	Indirect Costs @ 14.06%	1	Lump Sum	$18,000	$18,000
	Construction Contingencies @ 10%	1	Lump Sum	$12,800	$13,000
	Construction Management @ 15%	1	Lump Sum	$19,200	$20,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE I TOTAL				***$192,000***
PHASE II	Wastewater System (2027 Demand)	1	Lump Sum	$6,000	$6,000
	Demolition (Building Site)	1	Lump Sum	$54,000	$54,000
	Grading	5,100	SF/ ft depth	$0.40	$3,000
	Building Facility	1	Lump Sum	$1,200,000	$1,200,000
	Sidewalks	725	SF	$6	$5,000
	SUBTOTAL 1				**$1,268,000**
	Mobilization @ 10%	1	Lump Sum	$127,000	$127,000
	Miscellaneous @ 25%	1	Lump Sum	$317,000	$317,000
	SUBTOTAL 2				**$1,712,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$171,000	$171,000
	Traffic Control	1	Lump Sum	$5,000	$5,000
	Indirect Costs @ 14.06%	1	Lump Sum	$240,700	$241,000
	Construction Contingencies @ 10%	1	Lump Sum	$171,200	$172,000
	Construction Management @ 15%	1	Lump Sum	$256,800	$257,000
	Acquire Right-of-Way	0.3	AC	$2,000	$1,000
	PHASE II TOTAL				***$2,559,000***
PHASE III	Demolition (Curb & Gutter)	1,000	LF	$9	$9,000
	Demolition (Asphalt)	38,000	SF	$4	$152,000
	Grading	172,500	SF/ ft depth	$0.40	$69,000
	Crushed Aggregate Course - New Base	115,000	SF	$1	$115,000
	Pavement Surfacing - New	115,000	SF	$5	$518,000
	Pavement Surfacing - Overlay	52,500	SF	$1	$70,000
	Sidewalks	1,000	SF	$6	$6,000
	Curb and Gutter	1,000	LF	$13	$13,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Fencing - New	0	LF	$3	$0
	Fencing - Reinstall	600	LF	$2	$2,000
	Picnic Areas	1	Lump Sum	$292,000	$292,000
	Rest Area Amenities	1	Lump Sum	$27,000	$27,000
	SUBTOTAL 1				**$1,331,000**
	Mobilization @ 10%	1	Lump Sum	$134,000	$134,000
	Miscellaneous @ 25%	1	Lump Sum	$332,800	$333,000
	SUBTOTAL 2				**$1,798,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$180,000	$180,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$252,800	$253,000
	Construction Contingencies @ 10%	1	Lump Sum	$179,800	$180,000
	Construction Management @ 15%	1	Lump Sum	$269,700	$270,000
	Acquire Right-of-Way	0.5	AC	$2,000	$1,000
	PHASE III TOTAL				***$2,692,000***
GRAND TOTAL					***$5,443,000***

Table 2.28 Single-Phase Cost Estimate for Greycliff EB (Site-Built Building Facility)

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Greycliff EB (Major Rehabilitation with Site-Built Facility)

	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$92,000	$92,000
	Wastewater System (2027 Demand)	1	Lump Sum	$6,000	$6,000
	Demolition (Building Site)	1	Lump Sum	$54,000	$54,000
	Grading	5,100	SF/ ft depth	$0.40	$3,000
	Building Facility	1	Lump Sum	$1,200,000	$1,200,000
	Sidewalks	725	SF	$6	$5,000
	Demolition (Curb & Gutter)	1,000	LF	$9	$9,000
	Demolition (Asphalt)	38,000	SF	$4	$152,000
	Grading	172,500	SF/ ft depth	$0.40	$69,000
	Crushed Aggregate Course - New Base	115,000	SF	$1	$115,000
	Pavement Surfacing - New	115,000	SF	$5	$518,000
	Pavement Surfacing - Overlay	52,500	SF	$1	$70,000
	Sidewalks	1,000	SF	$6	$6,000
	Curb and Gutter	1,000	LF	$13	$13,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Fencing - New	0	LF	$3	$0
	Fencing - Reinstall	600	LF	$2	$2,000
	Picnic Areas	1	Lump Sum	$292,000	$292,000
	Rest Area Amenities	1	Lump Sum	$27,000	$27,000
	SUBTOTAL 1				**$2,691,000**
	Mobilization @ 8%	1	Lump Sum	$216,000	$216,000
	Miscellaneous @ 20%	1	Lump Sum	$539,000	$539,000
	SUBTOTAL 2				**$3,446,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$345,000	$345,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$485,000	$485,000
	Construction Contingencies @ 10%	1	Lump Sum	$345,000	$345,000
	Construction Management @ 15%	1	Lump Sum	$517,000	$517,000
	Acquire Right-of-Way	0.8	AC	$2,000	$2,000
GRAND TOTAL					***$5,150,000***

Table 2.29 Multi-Phase Cost Estimate for Greycliff EB (Prefabricated Building Facility)

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Phase	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
	Greycliff EB (Major Rehabilitation with Prefabricated Facility)				
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$92,000	$92,000
PHASE I	ADA Conformity	1	Lump Sum	$24,000	$24,000
PHASE I	**SUBTOTAL 1**				**$116,000**
PHASE I	Mobilization @ 10%	1	Lump Sum	$12,000	$12,000
PHASE I	**SUBTOTAL 2**				**$128,000**
PHASE I	Planning / Survey / Design @ 10%	1	Lump Sum	$13,000	$13,000
PHASE I	Indirect Costs @ 14.06%	1	Lump Sum	$18,000	$18,000
PHASE I	Construction Contingencies @ 10%	1	Lump Sum	$12,800	$13,000
PHASE I	Construction Management @ 15%	1	Lump Sum	$19,200	$20,000
PHASE I	Acquire Right-of-Way	0	AC	$2,000	$0
PHASE I	**PHASE I TOTAL**				***$192,000***
PHASE II	Wastewater System (2027 Demand)	1	Lump Sum	$6,000	$6,000
PHASE II	Demolition (Building Site)	1	Lump Sum	$54,000	$54,000
PHASE II	Grading	5,100	SF/ ft depth	$0.40	$3,000
PHASE II	Building Facility	1	Lump Sum	$257,000	$257,000
PHASE II	Sidewalks	725	SF	$6	$5,000
PHASE II	**SUBTOTAL 1**				**$325,000**
PHASE II	Mobilization @ 10%	1	Lump Sum	$33,000	$33,000
PHASE II	Miscellaneous @ 25%	1	Lump Sum	$81,300	$82,000
PHASE II	**SUBTOTAL 2**				**$440,000**
PHASE II	Planning / Survey / Design @ 10%	1	Lump Sum	$44,000	$44,000
PHASE II	Traffic Control	1	Lump Sum	$5,000	$5,000
PHASE II	Indirect Costs @ 14.06%	1	Lump Sum	$61,900	$62,000
PHASE II	Construction Contingencies @ 10%	1	Lump Sum	$44,000	$44,000
PHASE II	Construction Management @ 15%	1	Lump Sum	$66,000	$66,000
PHASE II	Acquire Right-of-Way	0.3	AC	$2,000	$1,000
PHASE II	**PHASE II TOTAL**				***$662,000***
PHASE III	Demolition (Curb & Gutter)	1,000	LF	$9	$9,000
PHASE III	Demolition (Asphalt)	38,000	SF	$4	$152,000
PHASE III	Grading	172,500	SF/ ft depth	$0.40	$69,000
PHASE III	Crushed Aggregate Course - New Base	115,000	SF	$1	$115,000
PHASE III	Pavement Surfacing - New	115,000	SF	$5	$518,000
PHASE III	Pavement Surfacing - Overlay	52,500	SF	$1	$70,000
PHASE III	Sidewalks	1,000	SF	$6	$6,000
PHASE III	Curb and Gutter	1,000	LF	$13	$13,000
PHASE III	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
PHASE III	Fencing - New	0	LF	$3	$0
PHASE III	Fencing - Reinstall	600	LF	$2	$2,000
PHASE III	Picnic Areas	1	Lump Sum	$292,000	$292,000
PHASE III	Rest Area Amenities	1	Lump Sum	$27,000	$27,000
PHASE III	**SUBTOTAL 1**				**$1,331,000**
PHASE III	Mobilization @ 10%	1	Lump Sum	$134,000	$134,000
PHASE III	Miscellaneous @ 25%	1	Lump Sum	$332,800	$333,000
PHASE III	**SUBTOTAL 2**				**$1,798,000**
PHASE III	Planning / Survey / Design @ 10%	1	Lump Sum	$180,000	$180,000
PHASE III	Traffic Control	1	Lump Sum	$10,000	$10,000
PHASE III	Indirect Costs @ 14.06%	1	Lump Sum	$252,800	$253,000
PHASE III	Construction Contingencies @ 10%	1	Lump Sum	$179,800	$180,000
PHASE III	Construction Management @ 15%	1	Lump Sum	$269,700	$270,000
PHASE III	Acquire Right-of-Way	0.5	AC	$2,000	$1,000
PHASE III	**PHASE III TOTAL**				***$2,692,000***
GRAND TOTAL					***$3,546,000***

Table 2.30 Single-Phase Cost Estimate for Greycliff EB (Prefabricated Building Facility)

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

	Greycliff EB (Major Rehabilitation with Prefabricated Facility)				
	Item Description	**Approx. Quantity**	**Unit of Measure**	**Estimated Unit Price**	**Amount**
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$92,000	$92,000
	Wastewater System (2027 Demand)	1	Lump Sum	$6,000	$6,000
	Demolition (Building Site)	1	Lump Sum	$54,000	$54,000
	Grading	5,100	SF/ ft depth	$0.40	$3,000
	Building Facility	1	Lump Sum	$257,000	$257,000
	Sidewalks	725	SF	$6	$5,000
	Demolition (Curb & Gutter)	1,000	LF	$9	$9,000
	Demolition (Asphalt)	38,000	SF	$4	$152,000
	Grading	172,500	SF/ ft depth	$0.40	$69,000
	Crushed Aggregate Course - New Base	115,000	SF	$1	$115,000
	Pavement Surfacing - New	115,000	SF	$5	$518,000
	Pavement Surfacing - Overlay	52,500	SF	$1	$70,000
	Sidewalks	1,000	SF	$6	$6,000
	Curb and Gutter	1,000	LF	$13	$13,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Fencing - New	0	LF	$3	$0
	Fencing - Reinstall	600	LF	$2	$2,000
	Picnic Areas	1	Lump Sum	$292,000	$292,000
	Rest Area Amenities	1	Lump Sum	$27,000	$27,000
	SUBTOTAL 1				**$1,748,000**
	Mobilization @ 8%	1	Lump Sum	$140,000	$140,000
	Miscellaneous @ 20%	1	Lump Sum	$350,000	$350,000
	SUBTOTAL 2				**$2,238,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$224,000	$224,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$314,700	$315,000
	Construction Contingencies @ 10%	1	Lump Sum	$223,800	$224,000
	Construction Management @ 15%	1	Lump Sum	$335,700	$336,000
	Acquire Right-of-Way	0.8	AC	$2,000	$2,000
GRAND TOTAL					***$3,349,000***

Table 2.31 Multi-Phase Cost Estimate for Greycliff WB (Site-Built Building Facility)

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Phase	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
	Greycliff WB (Major Rehabilitation with Site-Built Facility)				
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$222,000	$222,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	SUBTOTAL 1				**$246,000**
	Mobilization @ 10%	1	Lump Sum	$25,000	$25,000
	SUBTOTAL 2				**$271,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$27,000	$27,000
	Indirect Costs @ 14.06%	1	Lump Sum	$38,100	$39,000
	Construction Contingencies @ 10%	1	Lump Sum	$27,100	$28,000
	Construction Management @ 15%	1	Lump Sum	$40,700	$41,000
	Acquire Right-of-Way	2	AC	$2,000	$4,000
	PHASE I TOTAL				***$410,000***
PHASE II	Wastewater System (2027 Demand)	1	Lump Sum	$190,000	$190,000
	Demolition (Building Site)	1	Lump Sum	$57,000	$57,000
	Grading	5,100	SF/ ft depth	$0.40	$3,000
	Building Facility	1	Lump Sum	$1,200,000	$1,200,000
	Sidewalks	1,500	SF	$6	$9,000
	SUBTOTAL 1				**$1,459,000**
	Mobilization @ 10%	1	Lump Sum	$146,000	$146,000
	Miscellaneous @ 25%	1	Lump Sum	$364,800	$365,000
	SUBTOTAL 2				**$1,970,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$197,000	$197,000
	Traffic Control	1	Lump Sum	$5,000	$5,000
	Indirect Costs @ 14.06%	1	Lump Sum	$277,000	$277,000
	Construction Contingencies @ 10%	1	Lump Sum	$197,000	$197,000
	Construction Management @ 15%	1	Lump Sum	$295,500	$296,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE II TOTAL				***$2,942,000***
PHASE III	Demolition (Curb & Gutter)	1,100	LF	$9	$10,000
	Demolition (Asphalt)	23,000	SF	$4	$92,000
	Grading	144,000	SF/ ft depth	$0.40	$58,000
	Crushed Aggregate Course - New Base	96,000	SF	$1	$96,000
	Pavement Surfacing - New	96,000	SF	$5	$432,000
	Pavement Surfacing - Overlay	52,500	SF	$1	$70,000
	Sidewalks	1,100	SF	$6	$7,000
	Curb and Gutter	4,000	LF	$13	$52,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Fencing - New	0	LF	$3	$0
	Fencing - Reuse	0	LF	$2	$0
	Picnic Areas	1	Lump Sum	$295,000	$295,000
	Rest Area Amenities	1	Lump Sum	$30,000	$30,000
	SUBTOTAL 1				**$1,200,000**
	Mobilization @ 10%	1	Lump Sum	$120,000	$120,000
	Miscellaneous @ 25%	1	Lump Sum	$300,000	$300,000
	SUBTOTAL 2				**$1,620,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$162,000	$162,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$227,800	$228,000
	Construction Contingencies @ 10%	1	Lump Sum	$162,000	$162,000
	Construction Management @ 15%	1	Lump Sum	$243,000	$243,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE III TOTAL				***$2,425,000***
GRAND TOTAL					***$5,777,000***

Table 2.32 Single-Phase Cost Estimate for Greycliff WB (Site-Built Building Facility)

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Greycliff WB (Major Rehabilitaion with Site-Built Facility)					
	Item Description	**Approx. Quantity**	**Unit of Measure**	**Estimated Unit Price**	**Amount**
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$222,000	$222,000
	Wastewater System (2027 Demand)	1	Lump Sum	$190,000	$190,000
	Demolition (Building Site)	1	Lump Sum	$57,000	$57,000
	Grading	5,100	SF/ ft depth	$0.40	$3,000
	Building Facility	1	Lump Sum	$1,200,000	$1,200,000
	Sidewalks	1,500	SF	$6	$9,000
	Demolition (Curb & Gutter)	1,100	LF	$9	$10,000
	Demolition (Asphalt)	23,000	SF	$4	$92,000
	Grading	144,000	SF/ ft depth	$0.40	$58,000
	Crushed Aggregate Course - New Base	96,000	SF	$1	$96,000
	Pavement Surfacing - New	96,000	SF	$5	$432,000
	Pavement Surfacing - Overlay	52,500	SF	$1	$70,000
	Sidewalks	1,100	SF	$6	$7,000
	Curb and Gutter	4,000	LF	$13	$52,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Fencing - New	0	LF	$3	$0
	Fencing - Reuse	0	LF	$2	$0
	Picnic Areas	1	Lump Sum	$295,000	$295,000
	Rest Area Amenities	1	Lump Sum	$30,000	$30,000
	SUBTOTAL 1				**$2,881,000**
	Mobilization @ 8%	1	Lump Sum	$231,000	$231,000
	Miscellaneous @ 20%	1	Lump Sum	$576,200	$577,000
	SUBTOTAL 2				**$3,689,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$369,000	$369,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$518,700	$519,000
	Construction Contingencies @ 10%	1	Lump Sum	$368,900	$369,000
	Construction Management @ 15%	1	Lump Sum	$553,400	$554,000
	Acquire Right-of-Way	2	AC	$2,000	$4,000
GRAND TOTAL					***$5,514,000***

Table 2.33 Multi-Phase Cost Estimate Greycliff WB (Prefabricated Building Facility)

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Greycliff WB (Major Rehabilitation with Prefabricated Facility)					
	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$222,000	$222,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	SUBTOTAL 1				**$246,000**
	Mobilization @ 10%	1	Lump Sum	$25,000	$25,000
	SUBTOTAL 2				**$271,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$27,000	$27,000
	Indirect Costs @ 14.06%	1	Lump Sum	$38,100	$39,000
	Construction Contingencies @ 10%	1	Lump Sum	$27,100	$28,000
	Construction Management @ 15%	1	Lump Sum	$40,700	$41,000
	Acquire Right-of-Way	2	AC	$2,000	$4,000
	PHASE I TOTAL				***$410,000***
PHASE II	Wastewater System (2027 Demand)	1	Lump Sum	$190,000	$190,000
	Demolition (Building Site)	1	Lump Sum	$57,000	$57,000
	Grading	5,100	SF/ ft depth	$0.40	$3,000
	Building Facility	1	Lump Sum	$257,000	$257,000
	Sidewalks	1,500	SF	$6	$9,000
	SUBTOTAL 1				**$516,000**
	Mobilization @ 10%	1	Lump Sum	$52,000	$52,000
	Miscellaneous @ 25%	1	Lump Sum	$129,000	$129,000
	SUBTOTAL 2				**$697,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$70,000	$70,000
	Traffic Control	1	Lump Sum	$5,000	$5,000
	Indirect Costs @ 14.06%	1	Lump Sum	$98,000	$98,000
	Construction Contingencies @ 10%	1	Lump Sum	$69,700	$70,000
	Construction Management @ 15%	1	Lump Sum	$104,600	$105,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE II TOTAL				***$1,045,000***
PHASE III	Demolition (Curb & Gutter)	1,100	LF	$9	$10,000
	Demolition (Asphalt)	23,000	SF	$4	$92,000
	Grading	144,000	SF/ ft depth	$0.40	$58,000
	Crushed Aggregate Course - New Base	96,000	SF	$1	$96,000
	Pavement Surfacing - New	96,000	SF	$5	$432,000
	Pavement Surfacing - Overlay	52,500	SF	$1	$70,000
	Sidewalks	1,100	SF	$6	$7,000
	Curb and Gutter	4,000	LF	$13	$52,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Fencing - New	0	LF	$3	$0
	Fencing - Reuse	0	LF	$2	$0
	Picnic Areas	1	Lump Sum	$295,000	$295,000
	Rest Area Amenities	1	Lump Sum	$30,000	$30,000
	SUBTOTAL 1				**$1,200,000**
	Mobilization @ 10%	1	Lump Sum	$120,000	$120,000
	Miscellaneous @ 25%	1	Lump Sum	$300,000	$300,000
	SUBTOTAL 2				**$1,620,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$162,000	$162,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$227,800	$228,000
	Construction Contingencies @ 10%	1	Lump Sum	$162,000	$162,000
	Construction Management @ 15%	1	Lump Sum	$243,000	$243,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE III TOTAL				***$2,425,000***
GRAND TOTAL					***$3,880,000***

Table 2.34 Single-Phase Cost Estimate Greycliff WB (Prefabricated Building Facility)

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Greycliff WB (Major Rehabilitation with Prefabricated Facility)					
	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$222,000	$222,000
	Wastewater System (2027 Demand)	1	Lump Sum	$190,000	$190,000
	Demolition (Building Site)	1	Lump Sum	$57,000	$57,000
	Grading	5,100	SF/ ft depth	$0.40	$3,000
	Building Facility	1	Lump Sum	$257,000	$257,000
	Sidewalks	1,500	SF	$6	$9,000
	Demolition (Curb & Gutter)	1,100	LF	$9	$10,000
	Demolition (Asphalt)	23,000	SF	$4	$92,000
	Grading	144,000	SF/ ft depth	$0.40	$58,000
	Crushed Aggregate Course - New Base	96,000	SF	$1	$96,000
	Pavement Surfacing - New	96,000	SF	$5	$432,000
	Pavement Surfacing - Overlay	52,500	SF	$1	$70,000
	Sidewalks	1,100	SF	$6	$7,000
	Curb and Gutter	4,000	LF	$13	$52,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Fencing - New	0	LF	$3	$0
	Fencing - Reuse	0	LF	$2	$0
	Picnic Areas	1	Lump Sum	$295,000	$295,000
	Rest Area Amenities	1	Lump Sum	$30,000	$30,000
	SUBTOTAL 1				**$1,938,000**
	Mobilization @ 8%	1	Lump Sum	$156,000	$156,000
	Miscellaneous @ 20%	1	Lump Sum	$387,600	$388,000
	SUBTOTAL 2				**$2,482,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$248,000	$248,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$349,000	$349,000
	Construction Contingencies @ 10%	1	Lump Sum	$248,200	$249,000
	Construction Management @ 15%	1	Lump Sum	$372,300	$373,000
	Acquire Right-of-Way	2	AC	$2,000	$4,000
GRAND TOTAL					***$3,715,000***

2.4.1 Narrative Description of Bid Items

The cost estimate for the **Wastewater System (2007)** assumes a bi-directional treatment system at the WB site adequate to accommodate the existing 2007 demand. The lump sum for the EB site includes a new septic tank, dose tank, pipe from the EB site to the WB site, and 400 feet of directional drilling underneath the interstate. The lump sum for the WB site includes the AdvanTex treatment system and associated elements such as the septic tank, drainfield, dosing tanks, installation, and operation costs.

The cost estimate for **ADA Conformity** assumes rebuilding existing ramps with appropriate slopes and level pads, adding handrails to ramps, extending existing handrails, lowering sinks and mirrors, relocating grab bars, adding ADA parking stalls and corresponding curb ramps, and adding new ADA signs.

The cost estimate for the **Wastewater System (2027)** assumes additional treatment pods, additional length of drainfield, control modifications, and additional pumping units on the WB site only. Some additional cost is also associated with upsizing elements such as septic and dosing tanks.

The lump sum cost for the site-built **Building Facility** was derived from an average of the 2002 Dena Mora rest area bids, accounting for six percent annual inflation and the actual recommended square footage of the Greycliff buildings. The cost estimates assume new foundations. Testing would need to be performed to determine if the existing slab foundations are sound enough for re-use. The lump sum cost for the prefabricated building facility was obtained directly from a manufacturer. The site-built building assumes a 50-year design life; the design life of a prefabricated building is assumed to be 30 years.

For Phase II, it was assumed that all **Sidewalks** within ten feet of the existing building facility would be impacted, and new sidewalks would be needed to access the new building. For Phase III, new sidewalks would be needed to outline new parking areas and to access new picnic shelters and benches. The unit price was taken from the 2008 MDT Average Prices Catalog.

Demolition costs include removal of the building facility, nearby sidewalks, and necessary curb and gutter. The unit cost was derived from an average of the 2002 Dena Mora rest area bids, accounting for three percent annual inflation. A lower inflation value was used since demolition costs have not risen as sharply as material costs in recent years.

The **Grading** category includes site excavation and compaction. The quantity was determined based on the area of the new building and new parking facilities, in addition to a ten- to twenty-foot buffer area. The unit price was taken from the 2008 MDT Average Prices Catalog.

Unit prices for **Crushed Aggregate Course** and **Pavement Surfacing** were obtained from the 2008 MDT Average Prices Catalog. It was assumed that during Phase II, additional truck and car parking lots would be constructed to accommodate projected future demand, while existing parking areas and ramps would receive an asphalt overlay to extend their design life. Based on rough calculations, new parking areas could be designed to access existing ramps, thereby reducing costs. Drawings used for rough calculations for Phase III are included in Appendix N.

New **Curb and Gutter** would be needed for new parking areas. The unit cost was derived from an average of the 2007 Anaconda Interchange rest area bids.

New **Landscaping and Irrigation** would be needed at the EB and WB facilities. The lump sum costs were derived from an average of the 2007 Anaconda Interchange rest area bids.

No new **Fencing** would be needed at the Greycliff WB site, as new facilities could be constructed entirely within existing right-of-way. Some additional right-of-way would be needed at the EB site, but existing fencing could be reinstalled along the perimeter of new parking areas. The unit price for new fencing was taken from the 2008 MDT Average Prices Catalog; a slightly reduced value was used for reinstalled fencing.

Additional **Picnic Areas** would be needed at both the EB and WB sites. To reduce costs, the estimate assumes a combination of picnic shelters and individual picnic tables. The range of costs depends on the number of picnic tables to be added and whether or not a shelter is needed. The lump sum cost was derived from an average of the 2007 Anaconda Interchange rest area bids.

The **Rest Area Amenities** category includes new benches, ADA parking signs, highway signs, directional arrow signs, and trash receptacles. The lump sum was drawn from an average of the 2007 Anaconda Interchange rest area bids.

The **Miscellaneous** category is estimated to be up to 25 percent for this project because of the potential for unknown factors. It includes items such as:

- Roadside cleanup
- Slope treatment
- Watering
- Ditch or channel excavation
- Shoring, cribbing, or extra excavation
- Adjusting existing manholes, catch basins, valve boxes, and monument cases
- Retaining walls
- Unsuitable excavation
- Undergrounding or relocation of power, telephone, gas, or cable utilities
- Temporary striping
- Temporary water pollution/erosion control
- Sawcutting pavement
- Flagpole
- Striping and signing
- Storm drainage
- ADA ramps and truncated domes
- Lighting
- Dumpster
- Security Cameras

Several cost categories are calculated as percentages of construction, including the **Mobilization** and miscellaneous categories. Additionally, the **Planning/Survey/Design, Indirect Costs, Construction Contingencies, and Construction Management** categories were calculated as percentages of the respective subtotals noted in Tables 2.27 through 2.34. A construction contingency lower than the maximum 25 percent recommended by MDT's cost estimation guidelines was chosen because the majority of unknown factors should be accounted for under the miscellaneous category.

Traffic Control measures are expected to be minimal. Under Phase I, it may be possible for the site to remain open and to maintain operation of the existing wastewater system during installation of the new system. During Phase II and III, the site would likely need to be closed during rehabilitation. Traffic control costs would include signs alerting drivers of the closure, as well as barricades on the entrance and exit ramps.

Based on as-built drawings, it appears that new facilities could be constructed almost entirely within the existing **Right-of-Way** with small amounts of right-of-way required at the WB site for a combined bi-directional wastewater system and at the EB site for additional parking. A Big Timber real estate firm was contacted to determine the average price per acre of agricultural land within close proximity to public infrastructure.

The **Grand Total** cost for the project was compared to the engineer's estimate for the Anaconda Interchange rest area for reasonableness. The Anaconda rest area is a single interchange facility, as compared to the divided EB and WB Greycliff sites. Therefore the cost of the Anaconda facility was compared to a single Greycliff facility. The Anaconda rest area was designed with five men's and five women's stalls, whereas both the EB and WB Greycliff facilities are recommended to have eight women's and five men's stalls, or approximately 30 percent greater demand. Demand directly influences project cost, as it dictates sizing of the building, drainfield and parking areas. Adding 30 percent to the Anaconda engineer's estimate and accounting for six percent annual inflation results in a total project cost of approximately $4.8 million, which is comparable to the EB and WB Greycliff single-phase cost estimate of approximately $5.1 to $5.5 million.

Note: All estimates are presented in 2009 dollars.

2.4.2 Funding Sources

<u>Rest Area Program</u>

The Rest Area Program provides funding for state-maintained rest area projects throughout the state. The Federal Share for Rest Area projects is subject to the sliding scale. For example, rest areas located on the interstate system have a Federal Share of 91.24 percent and the State is responsible for 8.76 percent. The State's percentage is funded through the State Special Revenue Account.

The Montana Transportation Commission approved an annual allocation of funds to the Rest Area Program in September 2008. Funds may be used for new facility construction, rehabilitation and preservation work, which includes replacement of existing facilities. Approximately 80 percent of the funds are for new construction with the remaining 20 percent for rehabilitation and preservation work.

The Rest Area Program is reviewed annually to revisit project priorities, update cost estimates and track progress and reporting. The Montana Transportation Commission approves projects for the Rest Area Program.

<u>Interstate Maintenance</u>

The Interstate Maintenance (IM) Program provides funding for projects on the Interstate System involving resurfacing, restoring, and rehabilitation of the existing roadway. The Federal share for IM projects is 91.24 percent and the State is responsible for 8.76 percent. The State's percentage is funded through the State Special Revenue Account.

Activities eligible under the Interstate Maintenance Program include resurfacing, restoring, and rehabilitation of the roadway. In addition, reconstruction or rehabilitation of bridges, existing interchanges, and over crossings also qualify. Rest Area projects along the interstate are also eligible for Interstate Maintenance Program funds. Preventive maintenance activities are eligible when a state can demonstrate, through its pavement management system, that such activities are a cost-effective means of extending interstate pavement life.

The Montana Transportation Commission approves the fund apportionment to the statewide Interstate Maintenance Program. The IM funds are distributed throughout the financial districts based solely on need.

2.5 Recommendations

Based on the findings of this study, Table 2.35 presents rankings associated with the set of factors to be used to determine whether it is feasible to upgrade and maintain existing rest area locations or whether new locations should be investigated. Four of these factors represent higher priority considerations, including provision of water, sewer, and power services and cost of rehabilitation. If there is a substantial impediment relating to any one of these four factors or a combination of any of the four, MDT guidelines recommend abandonment of the existing site and identification of an alternate location.

A total score of 130 points is possible based on the sum of the weighted scores for each factor. A higher total score for an individual rest area represents a more suitable site combined with a greater need for improvements. Accordingly, a rest area with a higher score is a better candidate for rehabilitation than a rest area with a lower score due to greater feasibility and urgency of improvements. Descriptions of each assigned ranking are provided below.

Water System

The Greycliff water system is not close to a community system that could be cost-effectively accessed. However, wells are easily accessed, water quality is generally good, and sufficient flow is demonstrated through well log records.

Sewer System

A community wastewater system is not located nearby. The proposed wastewater system can be installed at Greycliff without significant burden, but ultimately will require a detailed site investigation. Site constraints exist due to topography and land availability, however, it appears sufficient right-of-way is available for purchase assuming cooperation from adjacent landowners. If right-of-way cannot be easily purchased, it may be necessary to consider a new site.

Power System

The Greycliff site has ready access to the power grid. Costs may continue to increase, although there may be opportunities to reduce energy consumption and/or to utilize supplemental sources of power.

Cost

The total cost of site rehabilitation is relatively high, although phased implementation could reduce initial costs and allow for long-term budgetary planning. It is unknown at this time if there would be cooperative cost contributions.

Urgency of Replacement
Although current maintenance requirements are not burdensome, the drainfields are undersized and the septic systems will require frequent pumping unless the system is upgraded in the near-term.

AADT
Current AADT at each site is approximately 5,100 vehicles.

Spacing
Overall, the Greycliff rest area is appropriately spaced in relation to other nearby rest areas.

Percent Completion
This study represents planning-level consideration of rehabilitation of the Greycliff site. No design work has been performed to date.

System
The Greycliff site is located on Interstate 90.

Percent Usage by Travelers in Corridor
Usage was estimated as a percentage of AADT, per AASTHO guidelines. Additional data would be needed in order to determine actual usage.

Land Use and Ownership
MDT owns the existing EB and WB Greycliff sites. A small amount of additional right-of-way would be needed at the EB and WB sites; adjacent land is in private ownership. It is unknown at this time whether adjacent property owners would be willing sellers of right-of-way.

Topography and Site Accessibility
The Greycliff sites are outside the floodplain and there are no known environmental resources immediately adjacent to the sites. Existing acceleration and deceleration ramps provide sufficient sight distance. Testing would be required to determine soil types at the sites. It appears that the EB site may have topography constraints for locating a new adequately sized drainfield. Although the site will allow rehabilitation over the 20-year planning horizon, topography constraints will likely limit further expansion beyond 20 years assuming compounded annual growth at 3.5 percent per year, as was used in this study.

Safety Corridor
There were two crashes due to fatigue within one mile of the Greycliff rest area. There is a moderate peak in the number of crashes near the Greycliff site as compared to the number of crashes immediately to the east and west of this location

Percent Commercial Use / MCS Facility
Commercial vehicles constitute approximately 23 percent of the AADT at the Greycliff site.

Rehabilitation of Existing Site
Assuming purchase of additional right-of-way is possible, there are no significant impediments to rehabilitation of the existing site over the 20-year planning horizon. However, as projections

are made past the 20-year planning horizon, lack of space due to additional required truck parking and larger wastewater systems would likely require the need to look at a different site.

Seasonal Site Conversion
The Greycliff rest area is currently open year round.

Alternative Funding Available
It is unknown at this time whether alternative sources of funding are available for this project.

ADA Compliance
The existing site does not comply with ADA requirements relating to parking spaces, ramps, sinks, door hardware, toilet stalls, and signage.

Community Involvement
It is unknown at this time whether locals support rehabilitation of the existing Greycliff rest area or are willing to donate right-of-way.

This Page
Intentionally Left Blank

Table 2.35 Rankings for Greycliff Rest Area

Factor		Description	Possible Score	EB Score	WB Score
Priority Considerations and Focus of this Study	Water Facilities	Feasibility of Upgrades to Water System • Community System Available = 3 • Well Easily Accessed = 2 Existing Water Quality • High quality (low turbidity, no need for filtration), sufficient flow = 3 • Poor quality, low flow rate = 0 Urgency of Rehabilitation of Water System • Existing system does not meet current (2007) demand = 4 • Existing system does not meet projected future (2027) demand = 2 • Existing system meets current demand and is projected to meet future (2027) demand = 0	10	5	5
	Sewer Facilities	Feasibility of Upgrades to Sewer System • Community sewer system nearby; connection possible = 5 • Individual system can be installed at site without significant burden = 4 • Individual system installation would be difficult due to lack of land, topography = 0 Urgency of Rehabilitation of Sewer System • Existing system does not meet current (2007) demand = 5 • Existing system does not meet projected future (2027) demand = 2 • Existing system meets current demand and is projected to meet future (2027) demand = 0	10	8	9
	Power Facilities	Energy Source • Energy source is nearby, cost-effective, and/or renewable = 5 • Energy source is remote, costly = 0	5	4	4
	Cost	Cost-effective, with cooperative cost contribution = 10 Cost Prohibitive, no cost sharing = 0	10	5	5
Urgency of Replacement		Facility requires substantial time, money, or staff resources to maintain? Age or facility condition reflected in increasing site costs? • Significant resources required = 10 • Moderate resources required = 5 • Few resources required = 0	10	7	7
AADT		AADT > 2500 = 10 2500 > AADT > 1500 = 7 1500 > AADT > 750 = 5	10	10	10
Spacing		Travel time to next or previous rest opportunity • 40 min < Travel Time < 75 min = 10 • Travel Time > 75 min = 5 • Travel Time < 40 min = 3	10	10	10
Percent Completion		Current plans and process for new facility, reconstruction, or rehabilitation underway, including total funds already obligated to site • Agreement signed, significant work performed and funds obligated, additional right-of-way purchased = 10 • Nothing but an idea = 0	10	2	2
System		Interstate = 5 NHS = 3 Primary = 2	5	5	5
Percent Usage by Travelers in Corridor		**Commercial or Metro Area**: Usage > 9% = 5; 9% > Usage > 5 % = 3; 5% > Usage = 0 **Typical Rural Route**: Usage > 12% = 5; 12% > Usage > 8 % = 3; 8% > Usage = 0 **Information and Welcome Center**: Usage > 15% = 5; 15% > Usage > 9 % = 3; 9% > Usage = 0	5	3	3
Land Use and Ownership		MDT Owned = 5 State = 4 Private = 3 Lease = 1	5	4	4
Topography and Site Accessibility		Outside floodplain; suitable elevation and soil type; construction will not adversely impact environmental resources; topography provides adequate line of sight and safe acceleration / deceleration distances. • Site meets all criteria = 5 • Significant challenges with water table, soil composition, environmental impacts and/or line of site = 0	5	3	3
Safety Corridor		High crash section = 5 No reported crashes due to fatigue = 0	5	3	3
Percent Commercial Use / MCS Facility		Can be incorporated into MCS facility and located in high-need area = 5 Site cannot be incorporated; many parking opportunities available = 0	5	4	4
Rehabilitation of Existing Site		Existing site, considering all elements, can be reconstructed / rehabilitated = 5 Existing site has significant impediments = 0	5	4	4
Seasonal Site Conversion		Site is open year round or can easily be converted = 5 Significant impediment to conversion; must select new site = 0	5	5	5
Alternative Funding Available		Other sources of funds available to build or maintain rest area = 5 Built and maintained solely through RA program set-aside = 0	5	2	2
ADA Compliance		Meets all current ADA specifications = 0 Significant ADA issues (sidewalks, parking, accessibility) must be overcome = 5	5	5	5
Community Involvement		Locals are supportive and will donate land = 5 Locals are not supportive or proactively resistant = 0	5	3	3
TOTAL SCORE			**130**	**102**	**103**

This Page
Intentionally Left Blank

Based on the rankings noted in Table 2.35, there do not appear to be any significant impediments relating to rehabilitation of water, sewer, or power facilities. These systems can be effectively upgraded at the existing EB and WB sites. While there is sufficient existing right-of-way at the WB site to accommodate an expanded parking lot and building facility, some additional right-of-way would be needed in order to construct the combined wastewater system. Additional right-of-way would also be required at the EB site to construct larger parking and building facilities.

Although full site rehabilitation would be costly, it is possible to phase rehabilitation in order to reduce initial costs and plan for future needs. Therefore, it is recommended that MDT expand the existing EB and WB Greycliff sites as funding allows in order to accommodate future demand.

Water Recommendations

- Existing water system is adequate to meet current and future needs assuming some water conservation practices are implemented; replace pumps and maintain system as needed in order to extend design life.
- Conduct inventory of wells and document their condition.
- Install water meters to more accurately define system demand.

Sewer Recommendations

- Conduct detailed site soil investigations to refine design and accurately determine area needed for an appropriately-sized drainfield. Additionally, perform nondegradation analysis to define the groundwater quality impact and establish wastewater system design criteria.
- Conduct wastewater effluent monitoring to establish the existing strength of the wastewater.
- Based upon raw wastewater characteristics and results of a nondegradation analysis, re-evaluate wastewater treatment options so that the most appropriate system may be selected at the Greycliff rest area.
- Install new septic tanks and drainfields.
- Design new system to function as a single combined system on the WB site to reduce long-term operation and maintenance and right-of-way costs.

Power Recommendations

- Consider use of motion-detectors to reduce energy usage.
- Evaluate building orientation and heating, lighting, plumbing and mechanical systems at time of site rehabilitation in order to provide the most energy-efficient design.
- Consider use of solar or wind power to supplement power and reduce monthly energy costs.

Physical Site Recommendations

- Design new building facility to maximize energy efficiency, meet ADA requirements, and accommodate demand over 20-year planning period.
- Consider use of modular or pre-fabricated building facility.
- Perform testing to determine if existing concrete building slab is sound for future re-use.
- Design new parking lots so that existing acceleration and deceleration ramps could continue to serve facilities.
- Incorporate water-saving landscaping into the new design. Use of native, drought-resistant vegetation and smaller turf areas could substantially reduce irrigation needs.
- Consider drip irrigation system to reduce water usage.

General Recommendations and Long Term Considerations

- Pursue negotiations with adjacent landowners to determine willingness to sell additional right-of-way for the EB and WB sites.
- Beyond the 20-year planning horizon, the existing Greycliff rest area sites will be nearing physical capacity and will likely not be able to accommodate additional room for increased truck parking as well as larger wastewater systems. At this point, it may be necessary to look at a different site. This conclusion is made assuming a compounded annual growth rate of 3.5 percent over 20 years, using mid- to low-range AASHTO design factors. It should be noted that projecting usage over the long term beyond the 20-year planning period is highly speculative.

3.0 CUSTER REST AREA

3.1 Existing Conditions and Current Demand

3.1.1 General Site Descriptions & Setting

The information provided in this section was gathered from the Rest Area Site Evaluation Forms completed by MDT in April 2008, which are included in Appendix A. Additional information was gathered during site visits conducted on January 19-21, 2009 and from mapping provided by MDT Environmental Services Bureau.

The area surrounding the Custer rest area sites is generally rural in nature with rolling topography. Each of the sites is located at the top of a hill with views of the Yellowstone Valley drainage. There are a number of trees, with grassy areas surrounding the buildings. The EB site is located near Bergum Coulee. No other known environmental constraints are located near these sites. A schematic of the Custer rest area is presented in Figure 3-1 and a topographic map is provided in Figure 3-2.

Custer EB

Custer WB

Figure 3-1 Custer Rest Area

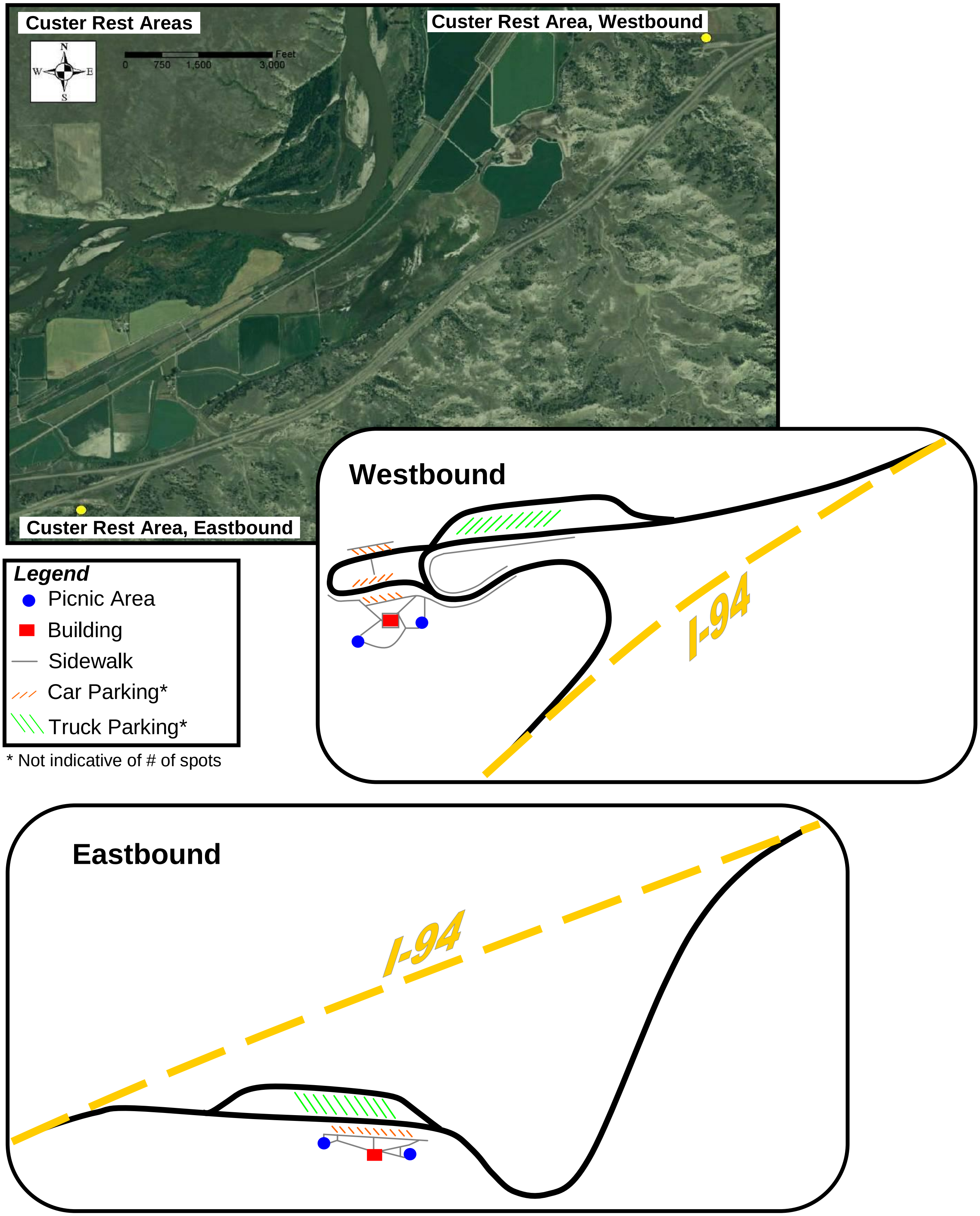
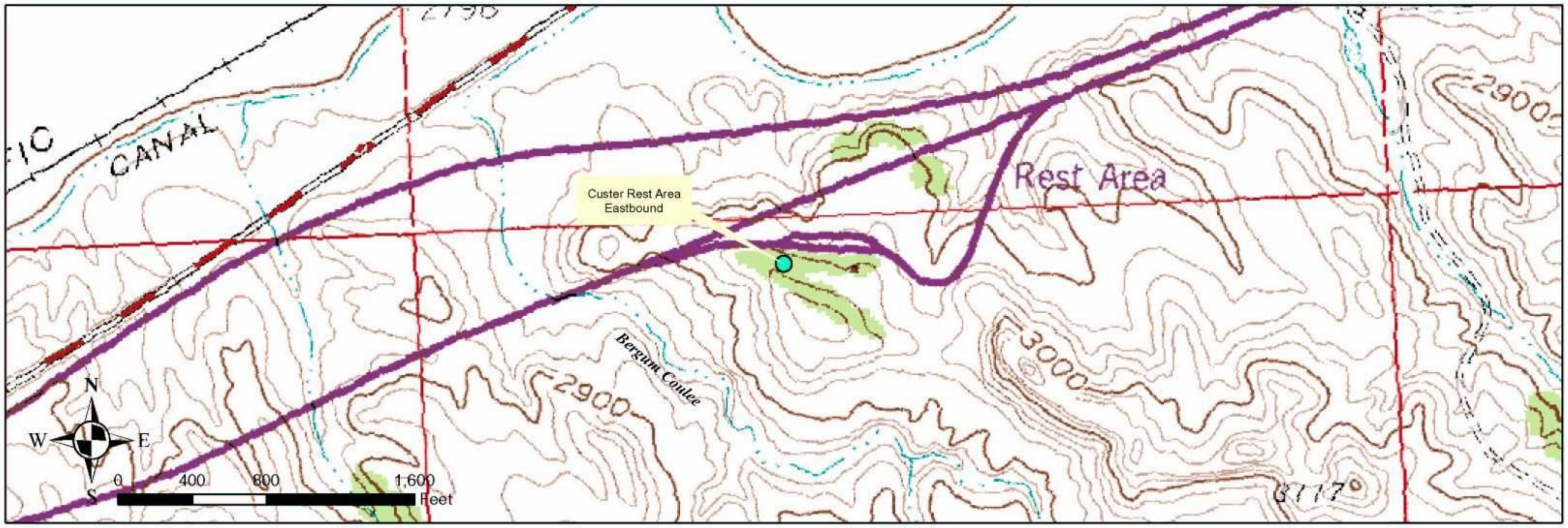
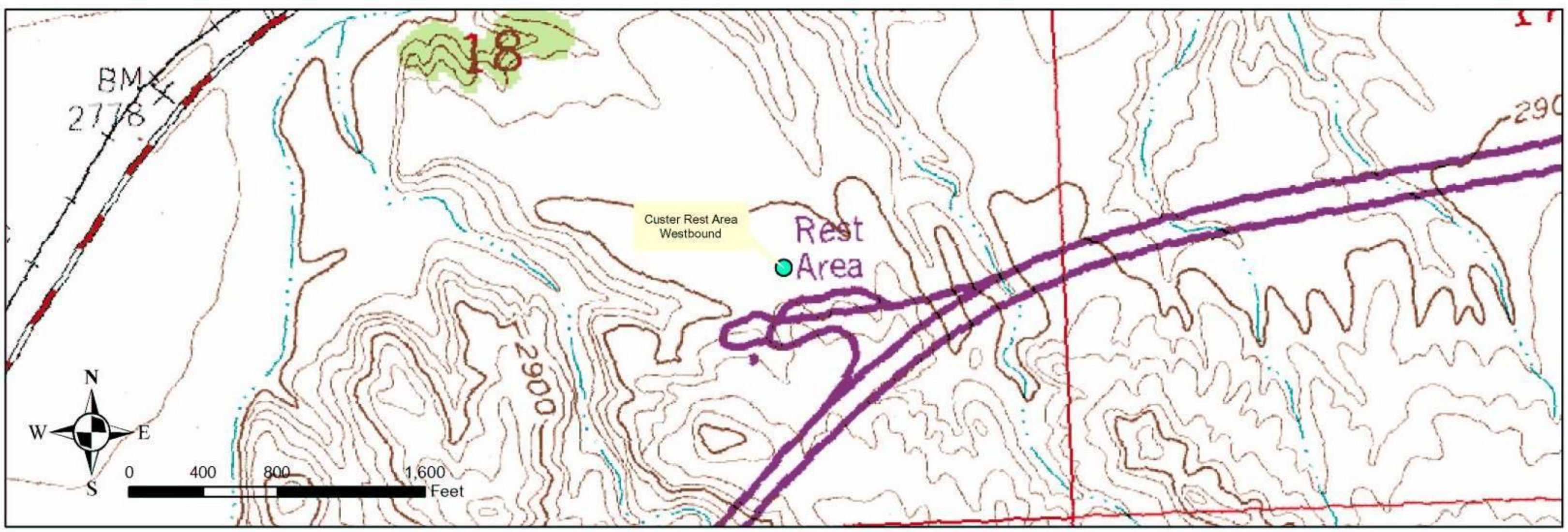


Figure 3-2 Topographic Map of Custer



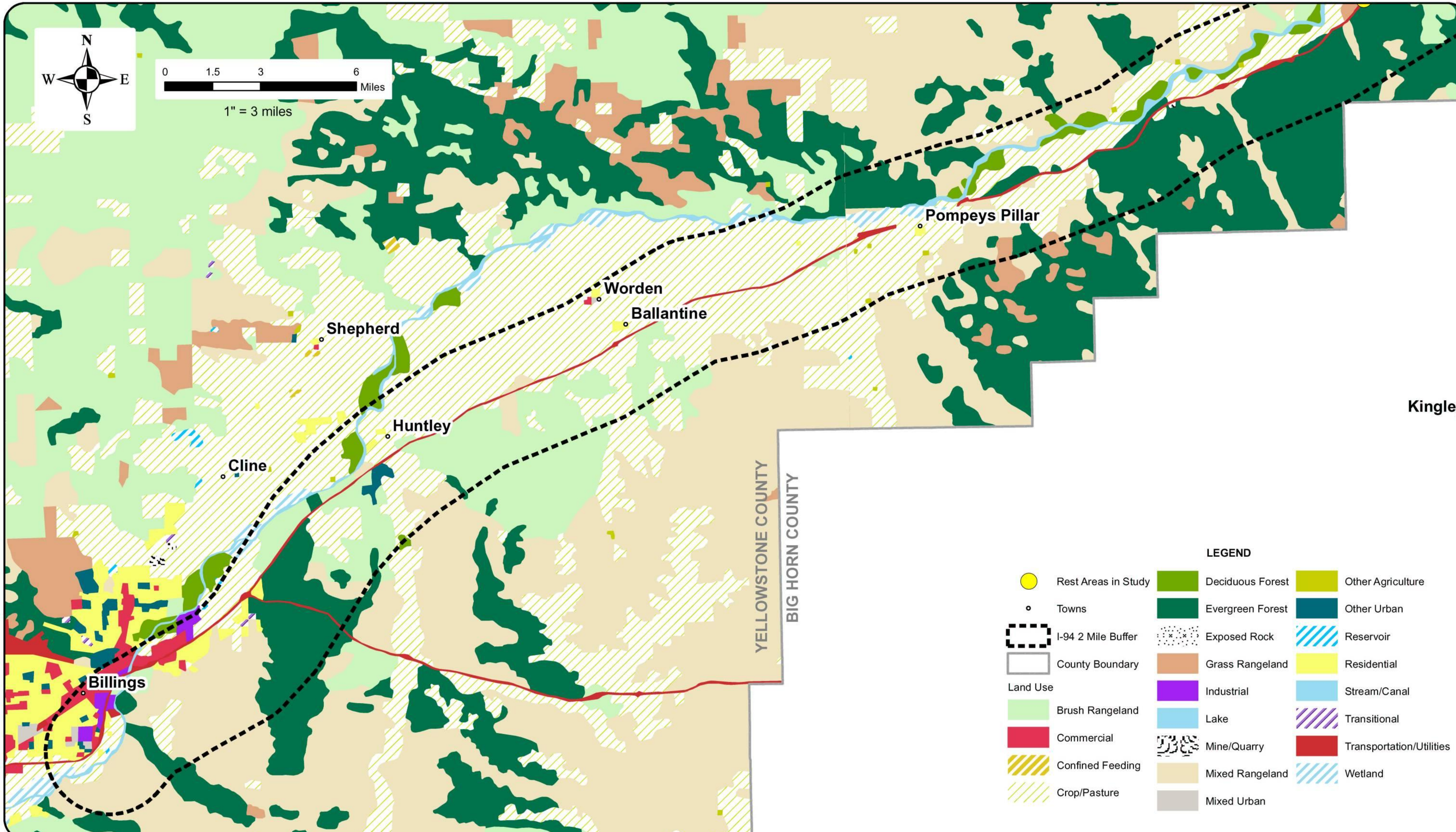


3.1.2 Land Use and Ownership

The Custer rest area is bordered by forest to the south, rangeland to the west, and crop/pasture land to the north. Land uses along the I-94 corridor consist mostly of cropland, pasture, and rangeland. Billings, Forsyth, and Miles City are the major residential/urban areas throughout the I-94 corridor. Land uses are illustrated in Figures 3-3 and 3-4.

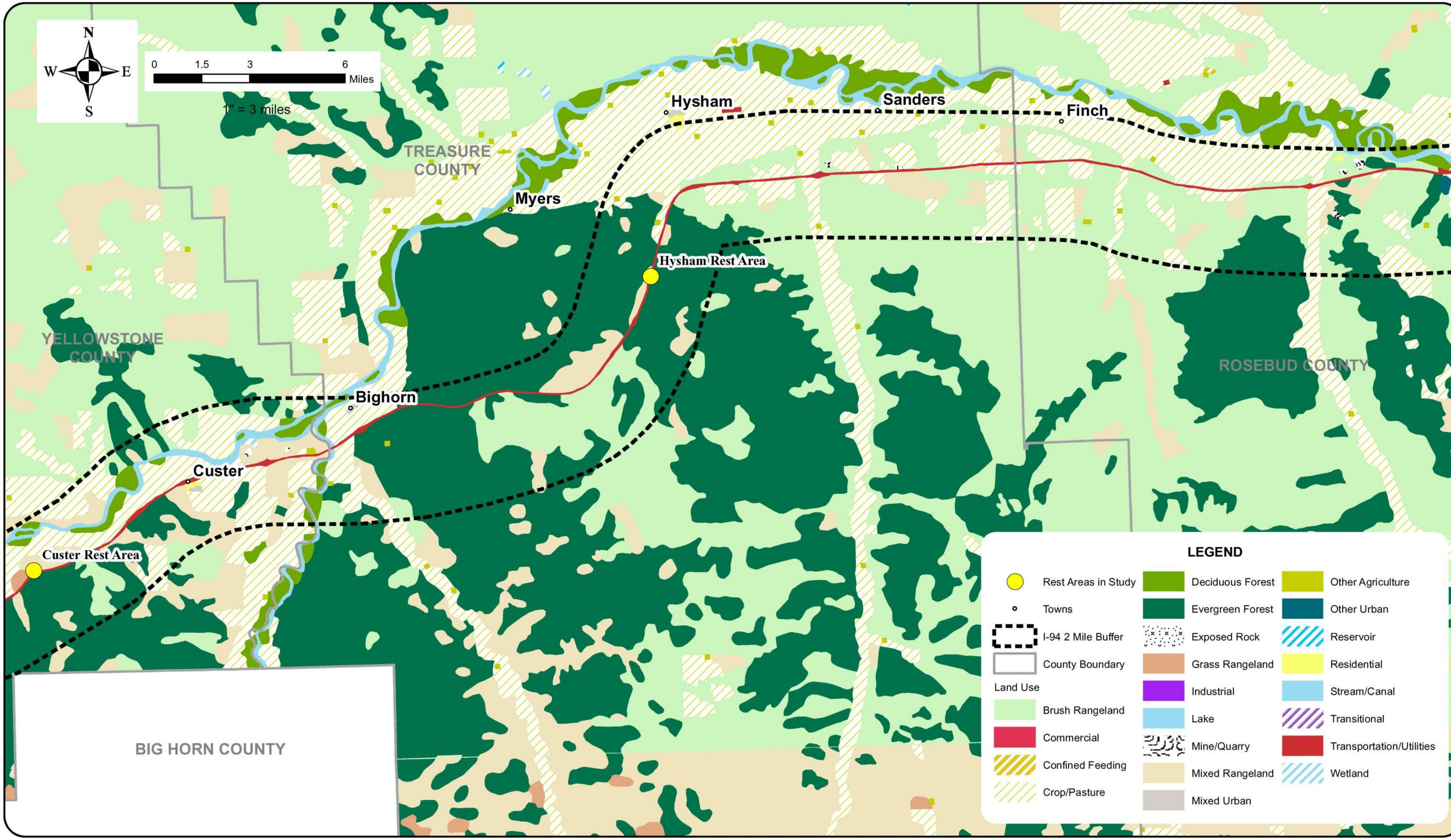
Generally, land throughout the corridor is mostly private with areas of state and BLM land dispersed throughout. Some portions of land throughout the I-94 corridor are owned by the Bureau of Indian Affairs. The Custer rest area is located near land owned by the state of Montana. Land ownership status is illustrated in Figures 3-5 and 3-6.

Figure 3-3 Land Use along I-94 Study Boundary (Billings to Custer)



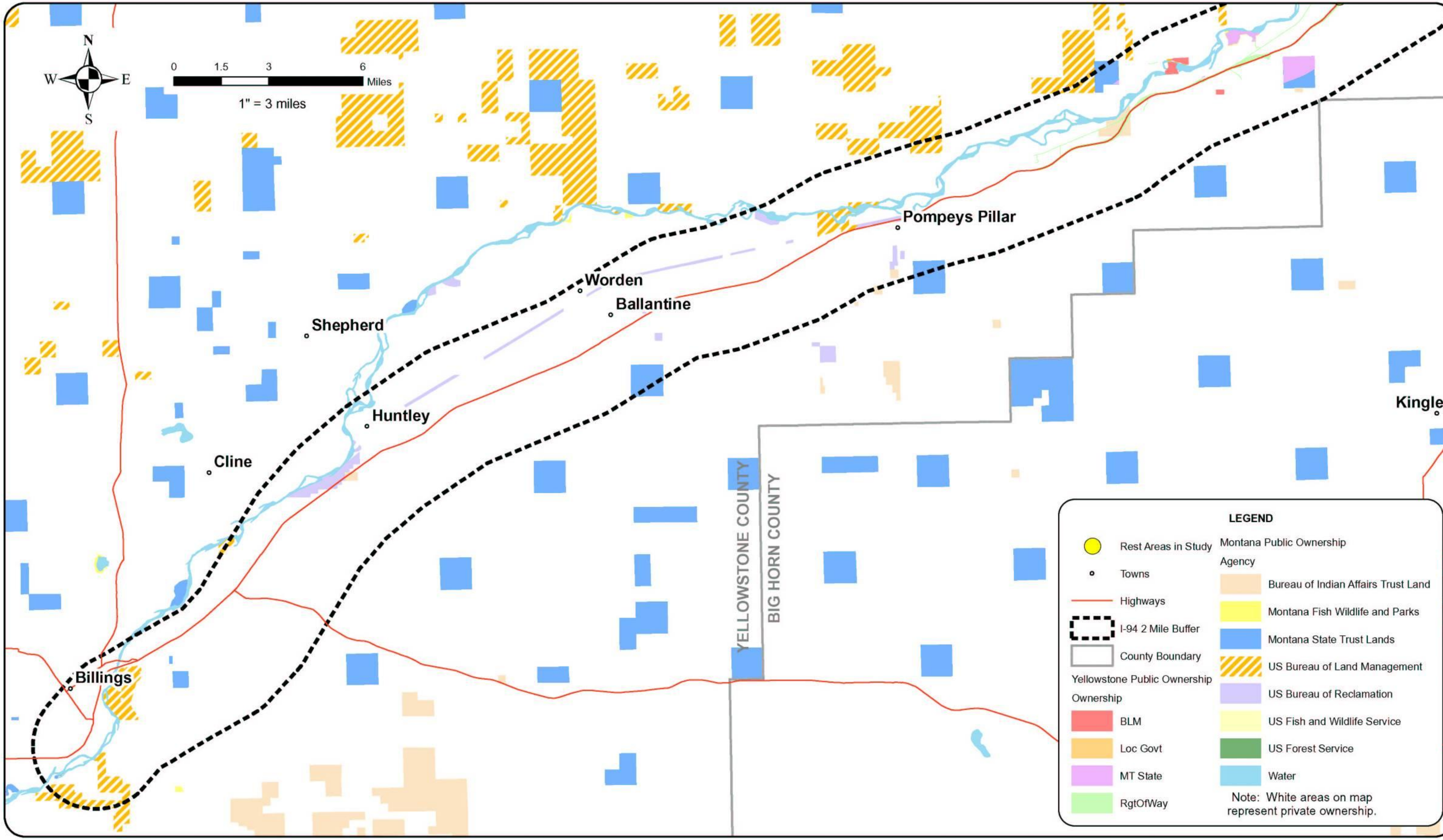
This Page
Intentionally Left Blank

Figure 3-4 Land Use along I-94 Study Boundary (Custer to Forsyth)



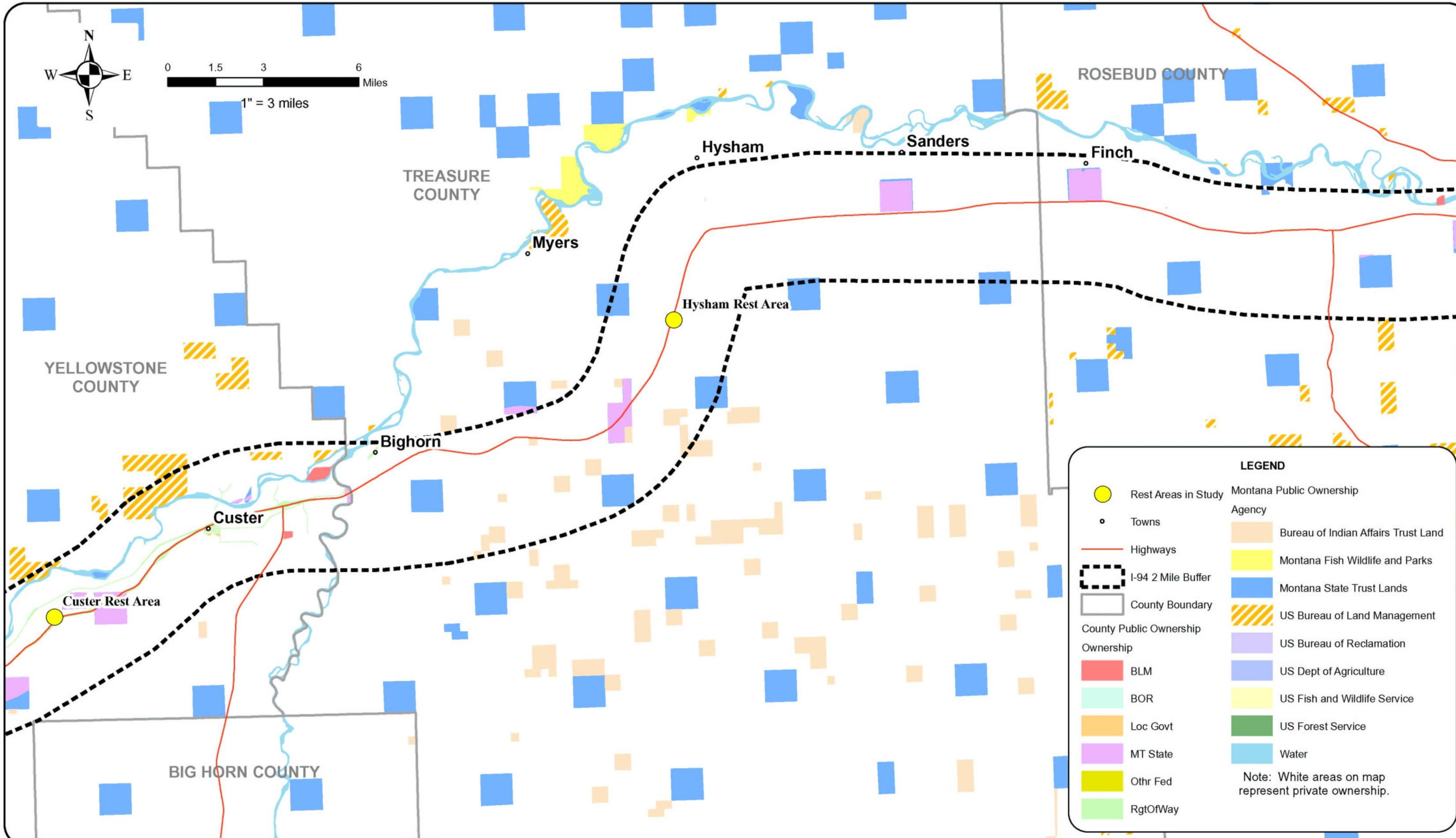
This Page
Intentionally Left Blank

Figure 3-5 Land Ownership along I-94 Study Boundary (Billings to Custer)



This Page
Intentionally Left Blank

Figure 3-6 Land Ownership along I-94 Study Boundary (Custer to Forsyth)



This Page
Intentionally Left Blank

3.1.3 Building and General Site Conditions

The Custer rest area is generally in good condition. A single element at each of the EB and WB sites is in need of repair or replacement, as noted in Tables 3.1 and 3.2. Photographs of select elements needing repair or replacement are included in Appendix B.

Table 3.1 Custer Building Conditions

Rest Area Site	Roofing	Siding	Paint	Plumbing Fixtures	General Interior Condition	General Exterior Condition
Custer EB	**Cedar Shake – poor shape, needs replacement***	Brick – good	Facia – Good	Stainless / Porcelain – OK	Very Good	Good
Custer WB	Cedar Shake – OK	Brick – good	**Needs paint**	Stainless	Good	Good

Note: Shaded cells indicate elements in need of repair or replacement.
*Photographs of these elements are included in Appendix B.
Source: MDT Site Evaluation Forms, 2008; DOWL HKM, 2009.

Table 3.2 Custer General Site Conditions

Rest Area Site	Asphalt	Sidewalks	Landscaping	Picnic Facilities
Custer EB	Very Good	Good (uneven locations are well-marked)*	Good	2 structures / 8 tables - good
Custer WB	Very Good	Good	Good	2 structures / 10 tables - good

*Photographs of these elements are included in Appendix B.
Source: MDT Site Evaluation Forms, 2008; DOWL HKM, 2009.

Table 3.3 describes the existing deceleration (entrance) and acceleration (exit) ramps for the Custer rest area. As noted in Table 3.3, there are sight distance issues at the Custer EB and WB sites. It should be noted that the Custer EB ramp has a centerline radius of 167 feet, which allows a WB-67 to travel the curve at 15 to 20 miles per hour (mph).

Table 3.3 Custer Ramp Conditions

Rest Area Site	Acceleration Ramp	Deceleration Ramp	Sight Distance
Custer EB	**Very curvy, short distance***	Long enough, but steep and curvy	**Not good on Acceleration Ramp***
Custer WB	Curvy	Good	**Not good – on hill***

Note: Shaded cells indicate elements in need of repair or replacement.
*Photographs of these elements are included in Appendix B.
Source: MDT Site Evaluation Forms, 2008; DOWL HKM, 2009.

3.1.4 Maintenance Contracts

General maintenance and cleaning of the rest areas is contracted out to private entities. Maintenance contracts typically encompass cleaning, mowing, weeding, irrigating, painting, cleaning of the picnic areas, and general upkeep. Rest areas are typically cleaned two to three times per day. Each pair of rest areas is administered under one contract. The cost to maintain the Custer rest area is approximately $2,500 per month.

3.1.5 Seasons of Operation

The Custer rest area is currently closed during winter months.

3.1.6 Current AADT

Short-term count data was used to approximate AADT at the Custer rest area; directional splits were not available. For the purposes of this study, equal volumes were assumed for the EB and WB directions. Percentages of vehicles included in the broad categories of passenger vehicles, small trucks, and large trucks were generated from MDT's Traffic Yearly Counts (TYC) table. AADT volumes for 2007 are presented in Table 3.4.

Table 3.4 Current AADT near Custer (2007)

Rest Area	Route	Rest Area Location (RP)	Traffic Count Location (RP)	Total AADT	Total Passenger & Bus (Types 1-4)		Total Small Trucks (Types 5-7)		Total Large Trucks (Types 8-13)		Total Commercial (Types 5-13)	
					AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT
Custer EB	I-94	41.3	47	1,995	1,458	73.11	59	2.98	477	23.91	536	26.89
Custer WB		38.2		1,995	1,459	73.11	60	2.98	477	23.91	537	26.89

Source: MDT, 2008.
Note: Directional counts not available. AADT assumes equal volumes for EB and WB directions.

3.1.7 Current Rest Area Usage

The Rest Area Plan provides guidance regarding rest area usage based on AASHTO formulas. The number of vehicles stopping at a rest area site per hour is calculated as a percentage of the directional traffic volume, with factors accounting for the mainline traffic composition by type of vehicle as well as the type of mainline route. Detailed calculations are provided in Appendix C. The AASHTO methodology for estimating rest area usage is considered highly conservative and is the standard used to date. It should be noted that MDT has initiated a research project to be completed in 2010 that will identify more accurate methods to predict rest area usage.

Table 3.5 presents the number of vehicles per hour estimated at each Custer rest area site. It should be noted that a range of values may be used for car and truck stopping percentages. The range of stopping percentage values provided by AASHTO is intended for use nationwide, although AASHTO recommends that stopping percentages ideally be determined on a case-by-case basis through usage surveys. In the absence of site-specific data, the mid- to low-end of the AASHTO stopping percentage range was used for the purposes of this study because Montana is largely rural in nature and has a relatively small population in comparison to other states.

This study did not consider factors that may affect stopping percentages at individual rest area locations within the study area. In the event that an individual project is developed following this study, site-specific designs may be adjusted on an as-needed basis if justified by special circumstances. Accordingly, usage values presented in this study should be viewed as preliminary estimates; the need for a greater or lesser number of parking spots, restroom stalls, and other rest area amenities than suggested in this study should be considered at the time of project development for each individual site based on actual usage data.

It is not the intent of this study to design to peak usage at a particular site; rather, a single standardized method is used for all sites. This study will, however, qualitatively address when or under what circumstances the current rest area sites are expected to be physically undersized, requiring consideration of a new site or purchase of additional right-of-way at the current sites. It should also be noted that the MDT Road Design Manual provides slightly different calculation factors. This study used the calculation guidelines presented in the Rest Area Plan.

Table 3.5 Current Rest Area Usage at Custer (2007)

Rest Area Site	Total Number of Vehicles Per Hour	Number of Passenger Cars and Buses Per Hour	Number of Commercial Trucks Per Hour*
Custer	32	23	9

Source: MDT, 2008; DOWL HKM, 2009.
Note: Calculations use factors from Table 9, Rest Area Plan, 2004.
*Includes estimate for the number of cars with trailers or RVs.

The Rest Area Plan also provides guidance regarding parking at rest areas. The recommended number of spots is calculated as a percentage of the directional traffic volumes, with factors accounting for design hour volumes, traffic composition, and type of route. Detailed calculations for each rest area site are included in Appendix C. Guidelines for the recommended number of ADA parking spots are included in the Checklist of Facility Accessibility for each site (Appendix D).

Table 3.6 Custer Parking Conditions (2007)

Rest Area Site	Truck Parking Spots		Auto Parking Spots		ADA Parking Spots	
	Actual Number	Recommended Number*	Actual Number**	Recommended Number*	Actual Number*	Recommended Number***
Custer EB	9	5	14	10	4	1
Custer WB	9	5	18	10	2	1

Source: MDT, 2008; DOWL HKM 2009.
*Calculations use factors from Table 9, Rest Area Plan, 2004. Truck parking includes cars with trailers or RVs.
**Actual number of spots determined based on MDT Site Evaluation Forms.
***As recommended in Parking Space Matrix, Checklist for Facility Accessibility, MDT 2008.

As noted in Table 3.6, the existing number of automobile parking spots at the Custer rest area meets or exceeds the recommended number of spots. Although Table 3.6 indicates adequate truck parking at the Custer rest area, MDT maintenance personnel believe additional truck parking is needed. The number of ADA parking spots is more than adequate given the current traffic volumes and approximated usage.

The Rest Area Plan also provides guidance for the recommended number of picnic tables and waste receptacles (referred to as site facilities throughout this document) at each site. As noted in the calculation procedure provided in the bottom portion of Table 12 within the Rest Area Plan, the appropriate number of site facilities is determined by applying factors to the calculated number of parking spaces listed in Table 3.6. Detailed calculations are provided in Appendix C. Table 3.7 presents the recommended site facilities at the Custer sites based on current AADT volumes.

Table 3.7 Custer Site Facilities (2007)

Rest Area Site	Picnic Tables		Waste Receptacles	
	Actual Number	Recommended Number	Actual Number	Recommended Number
Custer EB	8	6	8	5
Custer WB	9	6	14	5

Source: MDT, 2008; DOWL HKM, 2009.
*Calculations use factors from Table 12, Rest Area Plan, 2004.

As noted in Table 3.7, the Custer rest area has an adequate number of picnic tables and waste receptacles. The majority of existing picnic tables at the sites are located within picnic shelters each containing four tables. The waste receptacles are located within garbage can racks each containing two to three garbage cans. A single garbage can is also located within each restroom.

The Rest Area Plan provides methodology for calculating the required number of restroom stalls and required water usage at each site. The number of required restroom stalls is based on the rest area usage determined in Table 3.5 along with estimates accounting for the number of rest room users per vehicle and an estimated time cycle per fixture. Similarly, water usage is determined by applying a usage rate per person to the total rest area usage listed in Table 3.5. Calculations for the number of restroom stalls and water usage both use a peaking factor of 1.8.

Table 12 within the Rest Area Plan lists the calculation procedure and assumptions used for calculating the number of restroom stalls and water usage. Detailed calculations are provided in Appendix C.

Table 3.8 presents the recommended number of restroom stalls and the estimated current water usage at the Custer rest based on current AADT volumes.

Table 3.8 Restroom Stalls and Water Usage at Custer (2007)

Rest Area Site	Women's Stalls		Men's Stalls		Water Usage (Peak Hourly Demand)
	Actual Number	Recommended Number	Actual Number	Recommended Number	
Custer EB	3	3	1	1	4 gpm
Custer WB	3	3	1	1	4 gpm

Source: MDT, 2008; DOWL HKM, 2009.
*Calculations use factors from Table 12, Rest Area Plan, 2004.

The number of restroom stalls at the Custer rest area is equal to the recommended number of stalls based on current usage estimates.

3.1.8 Spacing

The Rest Area Plan recommends spacing between rest areas equal to approximately one hour of travel time under favorable traveling conditions. Figure 3-7 and Table 3.9 present current spacing between rest areas in the I-94 portion of the study corridor. Orange shaded cells indicate distances that exceed the recommended maximum spacing assuming drivers travel at the posted speed limit of 75 miles per hour, and blue shaded cells indicate overly dense spacing between rest areas. While excessive distances between rest areas can inconvenience the traveling public, close spacing between rest areas may represent an unnecessary allocation of MDT resources.

Figure 3-7 Rest Area and City Locations

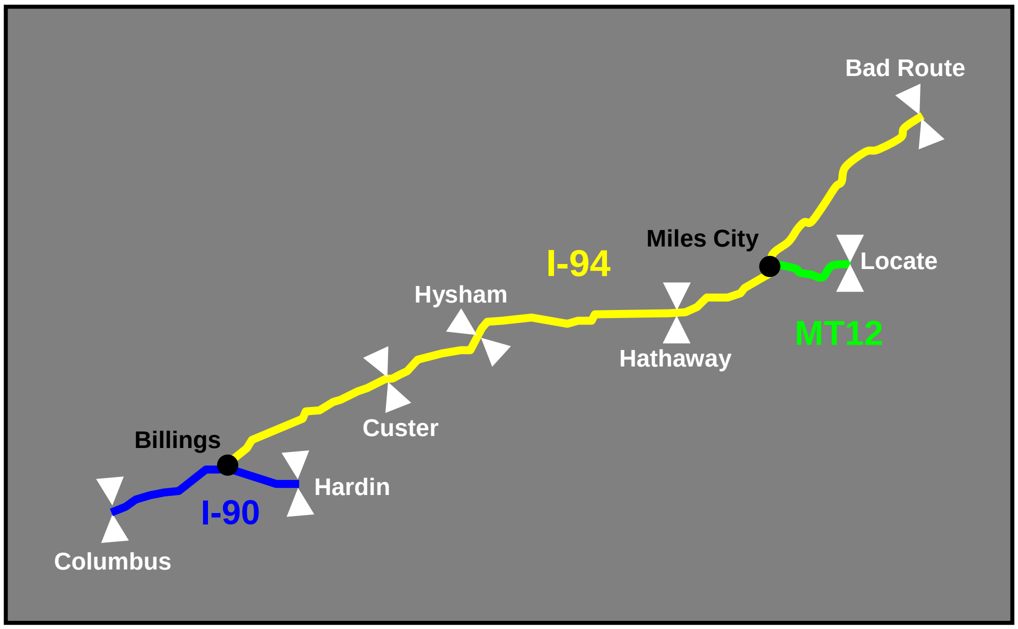


Table 3.9 Spacing between Rest Areas and Nearby Cities with Services

Rest Area Site	Previous Rest Area		Previous City with 24/7 Services		Next Rest Area		Next City with 24/7 Services	
	Name	Distance (miles)	Name	Distance (miles)	Name	Distance (miles)	Name	Distance (miles)
Custer EB	Columbus	**76**	Billings	38	Hysham	**26**	Miles City	100
	Hardin	58						
Custer WB	Hysham	**23**	Miles City	96	Columbus	**79**	Billings	41
					Hardin	62		

Note: Orange shaded cells indicate excessive distances between rest areas; blue shaded cells indicate overly dense spacing.
Source: MDT Rest Area Site Evaluation Forms, 2008.

It should be noted that while the distance between the Custer and Columbus rest areas only exceeds the Rest Area Plan recommendations by one mile, the distance between the Hysham and Custer rest areas is approximately 50 miles closer than recommended under the Plan.

3.1.9 Water, Sewer, and Power Services

Information on existing water, sewer, and power services was obtained from a variety of sources, as noted in Table 3.10.

Table 3.10 Sources for Information on Existing Water, Sewer, and Power Services

Source	Notes
Site visits conducted on January 19-21, 2009 and corresponding meetings with MDT maintenance personnel	Photos of the water, sewer, and power systems taken during the site visits are included within Appendix E and will be referred to throughout this section.
MDT	A variety of data was obtained from MDT including as-built drawings of recent water and sewer system improvements as well as maintenance division questionnaires. Through meetings and correspondence with the MDT maintenance personnel for each site, additional information was obtained including available design criteria, equipment manufacture data, well logs, applicable correspondence, and power records.
DEQ	The Helena and Billings DEQ offices were contacted for any applicable files pertaining to the water and waste water systems that may have gone through the permitting and approval process.
Online Databases	Several online sources were used to collect information on the rest area sites, including: o MBMG GWIC o DEQ Public Water Supply Reports o USDA NRCS Soils Data o NRIS

Figure 3-8 depicts the locations of some of the pertinent water and wastewater system components at the Custer rest area.

Figure 3-8 Custer Water and Sewer Location Map

Water

Groundwater is the source of potable water at the Custer rest area. Water from this source is used to serve the rest area facilities such as toilets, sinks, and drinking fountains, as well as for irrigation of the grass and associated landscaping. The approximate locations of the Custer rest area wells are shown in Figure 3-8. Each well is labeled with the most recent capacity information available in addition to the intended use.

Quantity

To assure there is adequate water quantity at the sites, the source capacity of the wells must equal or exceed the design maximum day demand per Circular DEQ-3. Table 3.11 lists the current maximum water use estimates at each rest area site. The current estimated restroom water usage is drawn from Table 3.8. The irrigation demand is estimated based on requirements from the NRCS and the Montana Irrigation Guide for pasture grass and turf. The NRCS provides consumptive use estimates for pasture grass and turf based on data obtained from several weather stations throughout the state. Several assumptions are made such as the irrigation cycle time, delivery period for the irrigation volume, and system efficiencies in order to come up with the estimated irrigation flow rate. The estimated irrigation area was determined using aerial photography and as-built drawings of the irrigation systems. Twenty-five percent of the irrigation area was removed from the calculations to account for impervious areas such as buildings, sidewalks, and picnic shelters. The irrigation demand calculations are found within Appendix F, along with a more detailed description of how the demands are calculated.

Table 3.11 Custer Water Use Estimates

Rest Area Site	Restroom Water Usage (Peak Hourly Demand)	Estimated Irrigation Demand	Total Demand
Custer EB	4 gpm	4 gpm	8 gpm
Custer WB	4 gpm	4 gpm	8 gpm

Source: MDT, 2008; DOWL HKM, 2009.

Based on discussions during the site visits, there are no water meters installed anywhere in the system. Therefore, actual water use data is not available and the estimates presented in Table 3.11 are the best available current usage estimates.

To determine the well capacities, well log information was downloaded from the MBMG website through the GWIC database. The well log information for the rest area sites can be found within Appendix G. In addition, MDT maintenance personnel also provided information on pump testing performed in 1987 shown in Table 3.12. It should be noted that from a water rights perspective, the rest area wells are allowed to pump no more the 35 gpm and 10 acre-feet per year as specified for "exempt wells" per DNRC. While exempt wells currently tend to be unregulated relative to actual usage, flow restriction valves are typically installed to limit the flow to 35 gpm. Generally, under an exempt well permit, an appropriate pump is selected to limit the flow to within the exempt well allowance of 35 gpm. Without a flow meter, neither the pumping rate nor annual use can be accurately recorded. Therefore, the well log does not necessarily match the actual well pumping rate for whatever pump was ultimately installed.

Table 3.12 Custer Pump Testing (1987)

Rest Area Site	Well Depth & Aquifer	Pump Depth & Size	Static Head	Pumping Level	Pumping Rate	Remarks
Custer EB	298 ft, Sandstone (Screen)	270 ft, 5HP	140 ft	255 ft	33 gpm	Good Well, Orig. gpm = 26
Custer WB	445 ft, Sandstone (Screen)	419 ft, 5HP	128 ft	293 ft	33 gpm	Good Well, Orig. gpm = 50

Source: MDT, 1987.

The Custer rest area wells have adequate capacity to serve the existing domestic and irrigation demand. It was verified through discussions with maintenance personnel that there are no issues with the wells at Custer.

Quality

Treatment at the Custer sites consists of a single cartridge filter. The filter helps to remove particles that may damage the valving within the restrooms. Water for the drinking fountains and hose bib outside the buildings are not filtered.

Current standards set forth by the applicable Circular DEQ-3 state that supply wells must have unperforated casing to a minimum depth of 25 feet or continuous disinfection must be provided. The unperforated casing depth refers to the depth below ground surface where perforation or screening begins. Additionally, per Circular DEQ-3, full time disinfection is required where the water source is an aquifer with a water table that is within 25 feet of the ground surface.

Table 3.13 lists specific data from the Montana Well Log Reports obtained from the GWIC database, which are provided in Appendix G. As shown, the recorded static water levels for the Custer EB and WB rest area wells are well below the 25-foot water table threshold. In addition, the unperforated casing depths are below the 25-foot minimum depth for all wells. Based on the GWIC well log information, the wells at the Custer rest area meet these requirements and therefore do not require disinfection.

Table 3.13 Custer Well Log Information

Well	Static Water Level	Unperforated Casing Depth
Custer EB	135 ft	258 ft
Custer WB	150 ft	404 ft

Source: MBMG GWIC database, 2009.

The DEQ Public Water Supply System online database was queried to obtain water quality sampling records pertaining to the Custer rest area sites. This data is included in Appendix H. The water systems serving the rest area sites are classified as transient non-community water supplies meaning that they serve 25 or more persons per day but do not regularly serve the same persons for at least six months a year. Transient non-community water supplies adhere to a specific set of water quality regulations as specified by DEQ. Detailed information can be found on DEQ's website. A summary of these regulations is described briefly below.

Samples for coliform bacteria must be taken either on a monthly or quarterly basis depending on authorization from DEQ. If more than one sample per month/quarter is total coliform-positive, a violation of the MCL occurs and public notice must be given. In addition to coliform bacteria, all transient non-community water systems must sample annually for nitrates. One sample is adequate unless the result is greater than 5.0 mg/L. The MCL for nitrate is 10 mg/L. The Custer sites sample quarterly for coliform bacteria and have had no recent MCL violations.

If groundwater sources are determined to be directly influenced by surface water through DEQ's GWUDISW determination process, they will be subject to Surface Water Treatment Rule requirements.

General Site Observations and Operation / Maintenance Issues

MDT provided results from recent maintenance questionnaires pertaining to each site. These are provided in Appendix I.

There have been no major issues or maintenance problems with the water systems at Custer. The wells have been performing adequately and are able to supply the current demand. Recent repairs to the system have included a new well pump at the EB site. MDT estimates that well pumps are replaced approximately every one to five years.

A tour of the maintenance/utility rooms was provided at the Custer rest area. Photos are included in Appendix E. The water systems at the Custer sites consist of piping from the well to a pressure tank. From there the water travels through a small section of piping, through a filter, and then through piping to serve the toilets and sinks. The utility rooms contain air tanks to operate the air valves for flushing toilets. The air valves and other piping are located in a small corridor between the two restrooms. A common complaint is the lack of space to perform routine maintenance within these corridors.

Sewer

On-site sewage treatment at the Custer rest area is accomplished through the use of a septic tank and soil absorption drainfield. Septic tanks are prefabricated structures typically made of concrete that allow solids in the incoming wastewater to settle and form a sludge layer on the bottom of the tank. Light materials such as oil and grease float to the surface. The sludge layer formed on the bottom of the tank will eventually decompose. The rate of decomposition is slow; accordingly the tanks require periodic pumping. The drainfield provides a method of distributing the pretreated waste effluent into the ground. The approximate locations of the septic tank and drainfield are shown in Figure 3-8.

Based on information from MDT maintenance personnel, the septic tanks and drainfields at the Custer sites are the original systems with few updates since they were originally installed. The wastewater system at Custer operates entirely by gravity.

Size of System

Based on the higher strength wastewater typical at a rest area, conventional septic tank and drainfield systems are not recommended for rest area applications. However, because these systems currently exist at the Custer sites, the following is a discussion of sizing requirements and adequacy to meet the current demand.

Per DEQ design regulations, the minimum acceptable size of a septic tank is 1,000 gallons for any system. DEQ provides guidelines for sizing septic tanks based on the type (residential versus non-residential) and quantity of the design flow. The average design flow is determined using the design factors from Table 12 of the Rest Area Plan for water usage combined with the AADT volumes and estimated percentage of rest area users.

Preliminary calculations for septic tank and drainfield sizing are made considering today's standards set forth by DEQ. Detailed calculations can be found within Appendix J. Existing septic tank sizes were provided by MDT maintenance personnel and are listed below in Table 3.14 along with the calculated recommended sizing based on current usage.

Little information was available on the Custer drainfields other than a set of as-built drawings provided by MDT showing schematics of the septic tank and drainfield layouts. The as-builts pertained to an improvement project completed in 1987. As part of this project, site improvements included additional signage, new picnic tables, replacement of garbage can racks, and new irrigation system. Little or no improvements were made to the wastewater system. Rough estimates of the drainfield size were obtained from the scaled site plans included as part of the as-built drawings. The lengths of the laterals were scaled from the drawings and a two-foot wide trench was assumed in order to obtain rough estimates of the current drainfield size.

Several site characteristics and investigations need to be evaluated for the proper design of the drainfield including soil profile descriptions, percolation tests, and site factors such as slope, drainage, and depth to groundwater. This information was not collected as part of this study but will need to be obtained for any new drainfield design.

For the purposes of this study and to determine rough design estimates, the NRCS soils information was used to determine approximate percolation rates. This data is available by county on the NRIS website and is downloadable for use in GIS mapping. The soils mapping was brought into GIS at the correct location so that the soil classifications were determined at each of the rest area sites. Detailed calculations can be found within Appendix J. Rough estimates of existing and proposed drainfield sizes are listed below in Table 3.14.

Table 3.14 Custer Septic Tank and Drainfield Size

Rest Area Site	Existing Septic Tank Size	Recommended Tank Size for Existing Usage	Estimated Existing Drainfield Size	Recommended Drainfield Size for Existing Usage
Custer EB	4,500 gallons	2,600 gallons	Unknown	1,900 ft^2
Custer WB	4,500 gallons	2,600 gallons	1,900 ft^2	1,200 ft^2

Source: MDT, 2009; DOWL HKM, 2009.

The estimates presented in Table 3.14 indicate that the current wastewater systems are generally sized adequately to accommodate the current capacity based on today's standards. However, it should be reiterated that accurate sizing of a drainfield cannot be accomplished without site specific soils information and percolation test results. The estimates presented in Table 3.14 are intended to provide general sizing comparison information.

General Site Observations and Operation / Maintenance Issues

MDT provided results from recent maintenance questionnaires (dated July 2008) pertaining to each site. These are provided in Appendix I.

Based on information from MDT maintenance personnel during the Custer site visit, the wastewater systems are largely original to the sites. The only issues are occasional back-up problems due to paper clogs. MDT has not seen any problems relating to plugging of the drainfields. There were no above-ground markings indicating the location of the drainfield laterals, although the general location of the drainfield was identified as shown in the photos included in Appendix E.

Power

Power is provided at the Custer rest area for heating and lighting. The source of heat is electric and the furnace is located in the maintenance room. Power is provided through Yellowstone Valley Electric Cooperative. Per MDT, the EB site sometimes has supply problems.

Power records were obtained from the MDT-Billings District office for the five-year period from January 2004 through December 2008. On average, power usage was lowest during the spring, summer, and early fall months (April through October), while usage increased during winter months (November through March), accounting for higher wintertime heating and lighting needs. Monthly averages over the 5-year period are depicted in Figure 3-9. Figure 3-10 depicts electricity consumption over the entire 5-year period.

Figure 3-9 Custer Average Monthly Power Consumption (2004 – 2008)

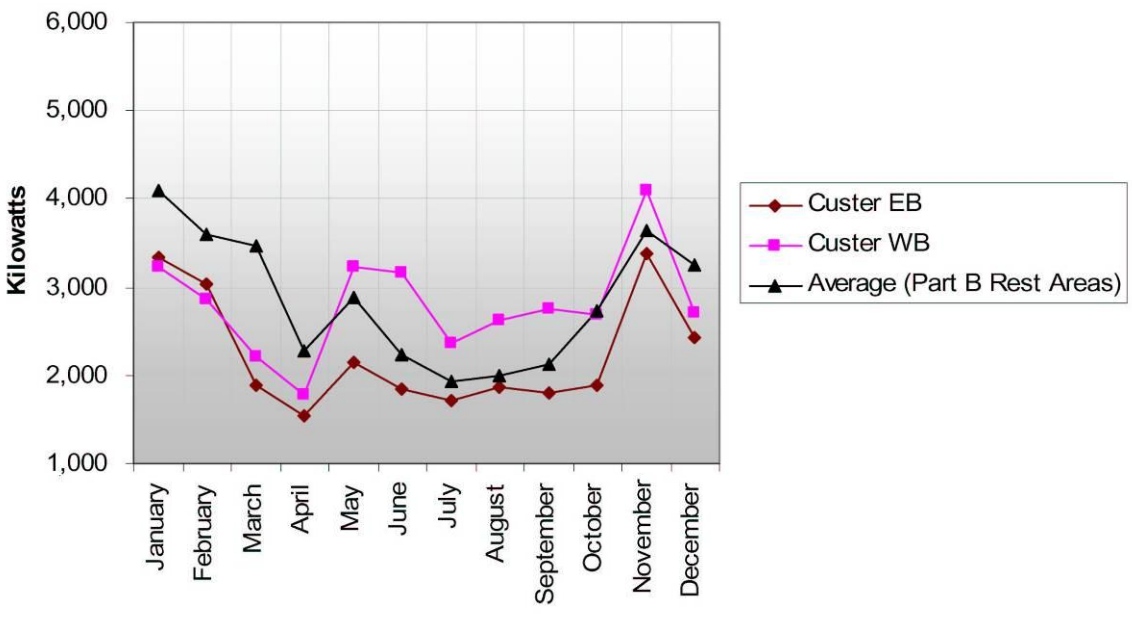
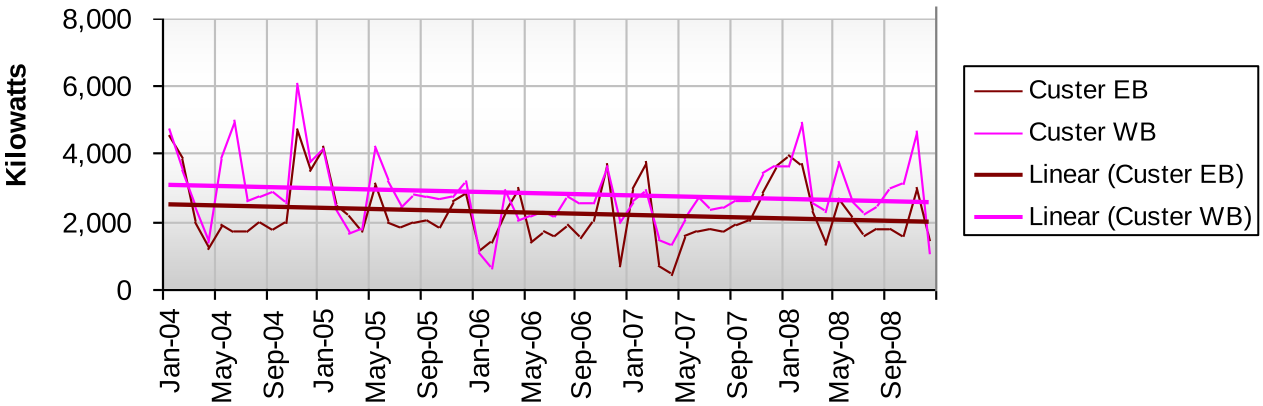
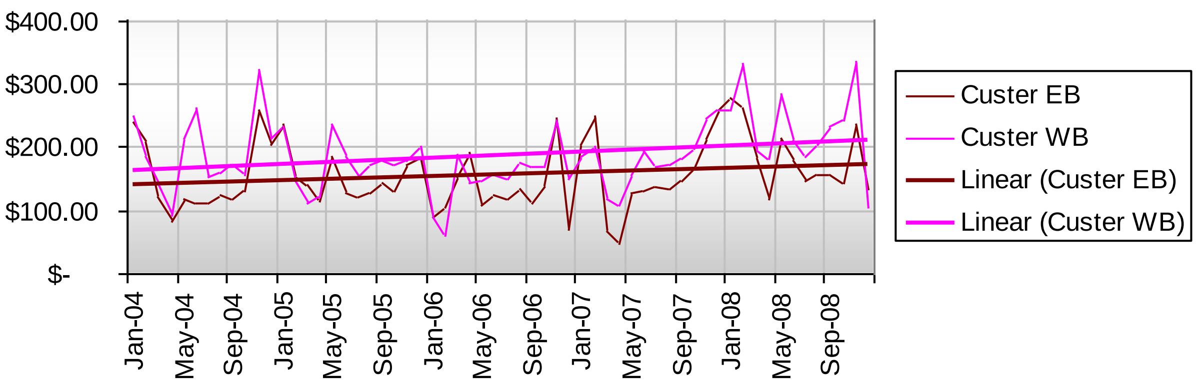


Figure 3-10 Custer Monthly Electricity Consumption (2004 – 2008)



Cost for electricity generally varied between $0.049 and $0.118 per kWh from 2004 to 2008, with costs steadily increasing over the five-year period as indicated by the trend lines in Figure 3-11. While average monthly electricity consumption declined somewhat over the 2004 to 2008 period for the Custer rest area, average monthly electricity costs actually increased due to the increase in unit energy prices.

Figure 3-11 Custer Monthly Electricity Costs



3.1.10 Crash Assessment

Vehicle accident data was supplied for the period January 1, 2005 to June 30, 2008 by the MDT. During this time period, 640 crashes were recorded over the I-94 portion of the study corridor (MP 0.0 – 142.0).

Several aspects were considered for this analysis. First, the number of crashes near each existing rest areas was compared. Second, crashes over the entire corridor were evaluated in light of spacing between rest areas. Areas with higher numbers of crashes were assessed to determine if these could be attributed to excessive distances between rest areas. Lastly, incidences of animal vehicle conflicts near the rest areas sites were assessed.

Table 3.15 presents the number of crashes within approximately a quarter mile in each direction from each rest area location (i.e., the half-mile segment is approximately centered at the rest area site).

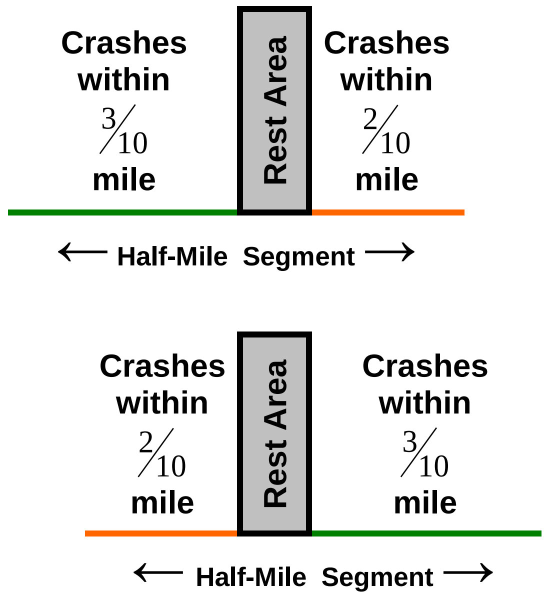
Table 3.15 Number of Crashes within Half-Mile Segment near Custer (1/1/2005 – 6/30/2008)

Interstate Facility	Rest Area Location	Approximate MP of Rest Area Location	Half-Mile Segment (MP – MP)	Number of Crashes within Half-Mile Segment	AADT (2007)
I-94	Custer EB	38.2	a) 38.0 - 38.5 b) 37.9 - 38.4	a) 7 b) 7	3,990
	Custer WB	41.3	a) 41.1 - 41.6 b) 41.0 - 41.5	a) 2 b) 3	

Source: MDT, 2008.

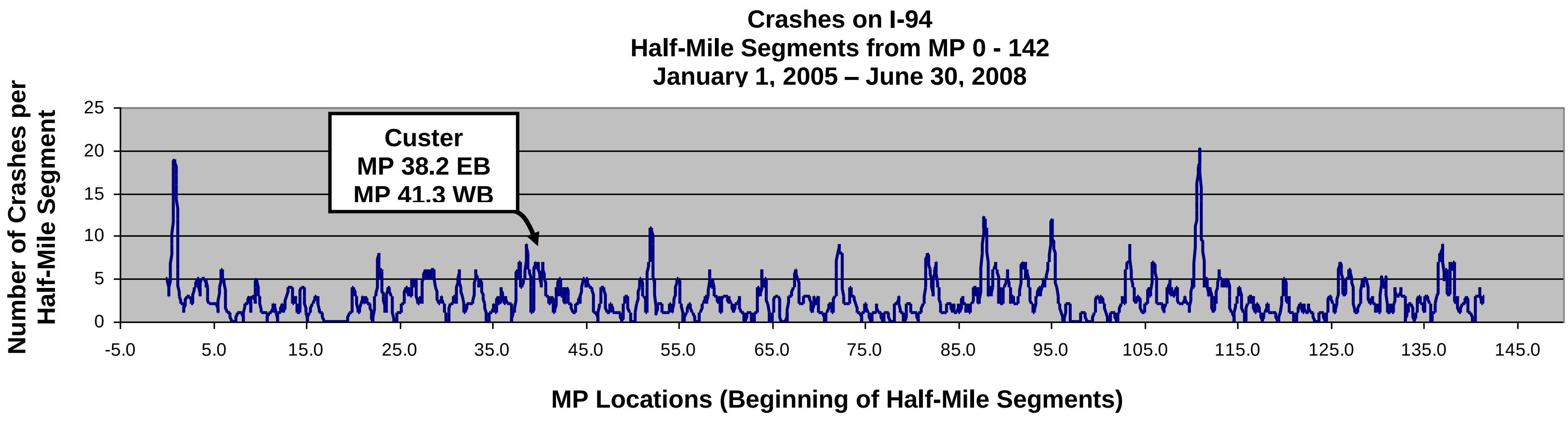
Crash locations are recorded in tenth-of-a-mile increments; therefore, it was not possible to determine the number of crashes within exactly a quarter mile in each direction from the rest area location. Therefore, Table 3.15 presents the number of crashes within three-tenths of a mile to one side of the rest area, and two-tenths of a mile to the other side, as well as the reverse. This calculation method is graphically illustrated in Figure 3-12. The two numbers listed under the Number of Crashes column in Table 3.15 correspond to the two half-mile segments as defined for each site. For the Custer rest area, the number of crashes in each half-mile segment is equal at the EB site and differs slightly at the WB site.

Figure 3-12 Two Half-Mile Segments for Rest Areas



As noted in Section 3.1.3, sight distance is an issue on exit and entrance ramps at the Custer EB and WB sites. This may contribute to the incidence of crashes in this location. Figure 3-13 illustrates the number of crashes in each half-mile segment over the entire corridor.

Figure 3-13 Crashes within Study Area



Over the I-94 portion of the corridor, there were a total of 36 crashes in which the driver fell asleep. None of these occurred within a mile of the Custer rest area. Of the 640 total crashes over the I-94 portion of the corridor, 233 (or 36.4 percent) involved wild animals. The Custer rest area appears to have a high number of animal-vehicle collisions within a mile of the site, although this is not reflected in corridor mapping provided by MDT. As noted in Section 3.1.3, sight distance is an issue on exit and entrance ramps at the Custer EB and WB sites. This may contribute to the incidence of crashes in this location.

3.1.11 ADA Compliance

A detailed Checklist of Facility Accessibility has been completed for each of the rest area sites in this study. These forms are included in Appendix D. There are a number of elements at each of the rest area sites that do not comply with ADA requirements, as noted on the forms. Noncompliant elements at the Custer rest area are noted in Table 3.16.

Table 3.16 Custer Elements in Noncompliance with ADA Requirements

Rest Area Site	Noncompliant Element							
	Location of Parking Spaces	Stairway	Ramps	Sinks	Door Hardware	Door Closer / Force	Toilet Stalls	Signage
Custer EB	X	X			X	X	X	X
Custer WB	X				X	X	X	X

Source: MDT Checklist of Facility Accessibility, 2008.

3.2 Future Demand

3.2.1 Projected AADT

A compound annual growth rate method was utilized in order to estimate future AADT volumes within the study area. A growth rate of 3.5 percent per year and a 20-year planning horizon were used for this study, for a Design Year of 2027. The general calculation formula is shown below.

Growth Rate Calculation Formula

$$(\text{Current AADT})*(1 + [\text{growth rate in decimal form}])^{\text{Number of Years}} = \text{Design Year AADT}$$

Table 3.17 presents future traffic volumes as estimated using the growth rate noted above. Using this growth rate over the 20-year planning period approximately doubles the 2007 total AADT values. For the purposes of these estimates, it was assumed that the percentage composition of passenger vehicles and trucks would remain the same.

Table 3.17 Projected AADT near Custer (2027)

Rest Area	Route	Rest Area Location RP	Traffic Count Location RP	Total AADT	Total Passenger & Bus (Types 1-4)		Total Small Trucks (Types 5-7)		Total Large Trucks (Types 8-13)		Total Commercial (Types 5-13)	
					AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT
Custer EB	I-94	41.3	47	3,970	2,902	73.10	119	3.00	949	23.90	1,068	26.90
Custer WB		38.2		3,969	2,902	73.12	118	2.97	949	23.91	1,067	26.88

Source: DOWL HKM, 2009.
Note: Directional counts not available. AADT assumes equal volumes for EB and WB directions.

3.2.2 Projected Usage

Projected usage at the rest area sites was estimated based on projected traffic volumes. Projected usage calculations follow the same methodology as described for current usage.

Table 3.18 presents the number of vehicles per hour projected at the Custer rest area in 2027. Tables 3.19 through 3.21 present the recommended number of parking spaces, site facilities, and restroom stalls based on 2027 projected traffic volumes. Detailed calculations are provided in Appendix C.

Table 3.18 Projected Rest Area Usage at Custer (2027)

Rest Area Site	Total Number of Vehicles Per Hour	Number of Passenger Cars and Buses Per Hour	Number of Commercial Trucks Per Hour**
Custer*	65	46	19

Source: MDT, 2008; DOWL HKM, 2009.
Note: Calculations use factors from Table 9, Rest Area Plan, 2004.
*Usage values apply to both EB and WB sites.
**Includes estimate for the number of cars with trailers or RVs.

Table 3.19 Custer Projected Parking Conditions (2027)

Rest Area Site	Truck Parking Spots		Auto Parking Spots		ADA Parking Spots	
	Actual Number*	Recommended Number**	Actual Number*	Recommended Number**	Actual Number*	Recommended Number***
Custer EB	9	10	14	21	4	1
Custer WB	9	10	18	21	2	1

Note: Shaded cells indicate failure to meet the recommended number of parking spots.
Source: MDT, 2008; DOWL HKM, 2009.
*Actual number of spots drawn from the MDT Site Evaluation Forms.
**Calculations use factors from Table 9, Rest Area Plan, 2004. Truck parking includes cars with trailers or RVs.
***Based on recommended auto parking spots in Parking Space Matrix, Checklist for Facility Accessibility, MDT 2008.

Table 3.20 Custer Projected Site Facilities (2027)

Rest Area Site	Picnic Tables		Waste Receptacles	
	Actual Number	Recommended Number	Actual Number	Recommended Number
Custer EB	8	12	8	9
Custer WB	9	12	14	9

Note: Shaded cells indicate failure to meet the recommended number of picnic tables and waste receptacles.
Source: MDT, 2008; DOWL HKM, 2009.
Calculations use factors from Table 12, Rest Area Plan, 2004.

Table 3.21 Projected Restroom Stalls and Water Usage at Custer (2027)

Rest Area Site	Women's Stalls		Men's Stalls		Water Usage (Peak Hourly Demand)
	Actual Number	Recommended Number	Actual Number	Recommended Number	
Custer EB	3	3	3	2	9 gpm
Custer WB	3	3	3	2	9 gpm

Source: MDT, 2008; DOWL HKM, 2009.
Calculations use factors from Table 12, Rest Area Plan, 2004.

A number of annual seasonal events occur in Billings, Miles City, and other small rural communities along the I-94 corridor. The largest of these events occur in the summer months, and include rodeos, music festivals, and county fairs. These events likely draw visitors from outside the immediate area, and may contribute to high summer usage at the Custer rest area. Rest areas are generally not designed to meet peak day or peak season demand. Therefore, the above analysis was not adjusted to account for potential usage fluctuations resulting from seasonal events in the region.

3.3 Assessment of Water, Sewer, and Power Services

The following sections assess the adequacy of the water, sewer, and power utilities at the Custer rest area in terms of meeting the anticipated demands from the 20-year projected rest area usage. Expansion potential to accommodate additional parking will be evaluated along with water, sewer, and power service alternatives that take into account the unique nature of the usage patterns and treatment challenges at a rest area.

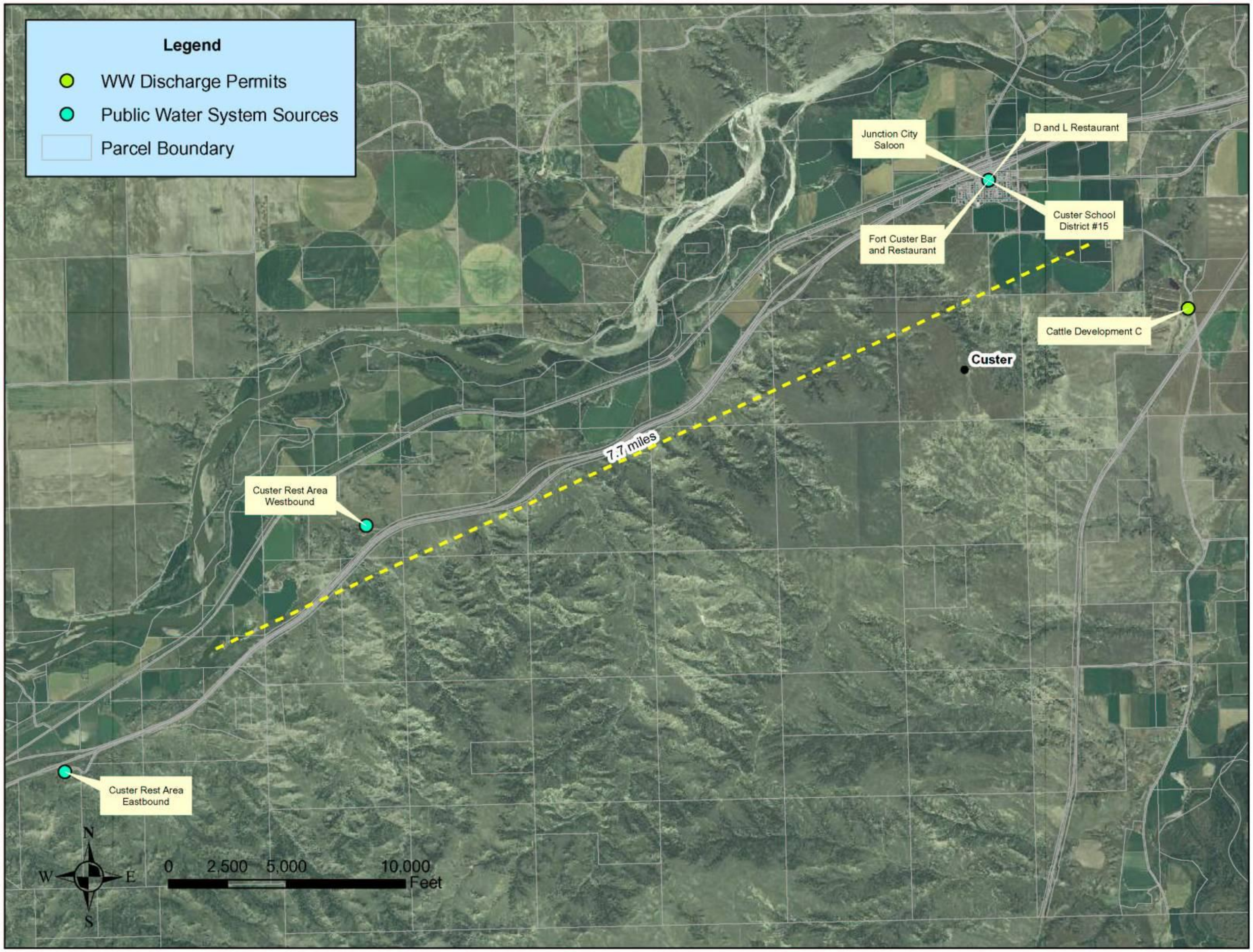
To evaluate the potential for the Custer rest area to connect to nearby community water or wastewater systems, the PWS database was queried to select those water systems within 10 miles of each rest area site as shown in Figure 3-14. The DEQ Montana Pollution Discharge Elimination System (MPDES) permitted facilities were also downloaded from the NRIS site by county and queried to select those wastewater discharge permit locations within 10 miles of each rest area site. An MPDES permit is required by DEQ to construct or use any outlet for discharge of sewage, industrial, or other wastes into state surface or groundwater.

As shown in Figure 3-14, the nearest PWS sources to the Custer rest area are located in the town of Custer. The PWS sources in Custer consist of three restaurants/bar establishments and one school. According to the 2000 Census data, the town of Custer is labeled as a Census

Designated Place (CDP) having a population of 145 people. No figures are available from the 1990 Census or from more recent population estimates following the 2000 Census to establish population trends. The Yellowstone County Planning Office was contacted to determine if there are any proposed water or sewer projects in or around the town of Custer. The Planning Office confirmed that the town of Custer is unincorporated and residents currently use individual wells and septic systems. Given the small size of the Custer community, at this time there are no plans for the town to become incorporated or to develop a community water or wastewater system in the foreseeable future.

Due to the distance and small nature of the systems near the Custer rest area, it would not be cost effective to extend water service from these sources to the rest area sites. Therefore, this option will not be discussed further; the remainder of this section will focus on accommodating water and sewer needs at the existing sites.

Figure 3-14 Public Water System Sources near Custer



3.3.1 Water Service

Quantity

The projected 20-year peak hourly water demand was calculated based on the methodology specified in the Rest Area Plan. Table 3.22 lists the projected water use estimates at the Custer rest area. Detailed usage calculations are provided in Appendix C and irrigation demand calculations are provided in Appendix F. The usage and irrigation requirements calculated for Custer EB and WB are the same.

Table 3.22 Custer Projected Water Use Estimates (2027)

Rest Area Site	Restroom Water Usage (Peak Hourly Demand)	Estimated Irrigation Demand	Total Demand	Well Capacity
Custer*	9 gpm	4 gpm	13 gpm	33 gpm

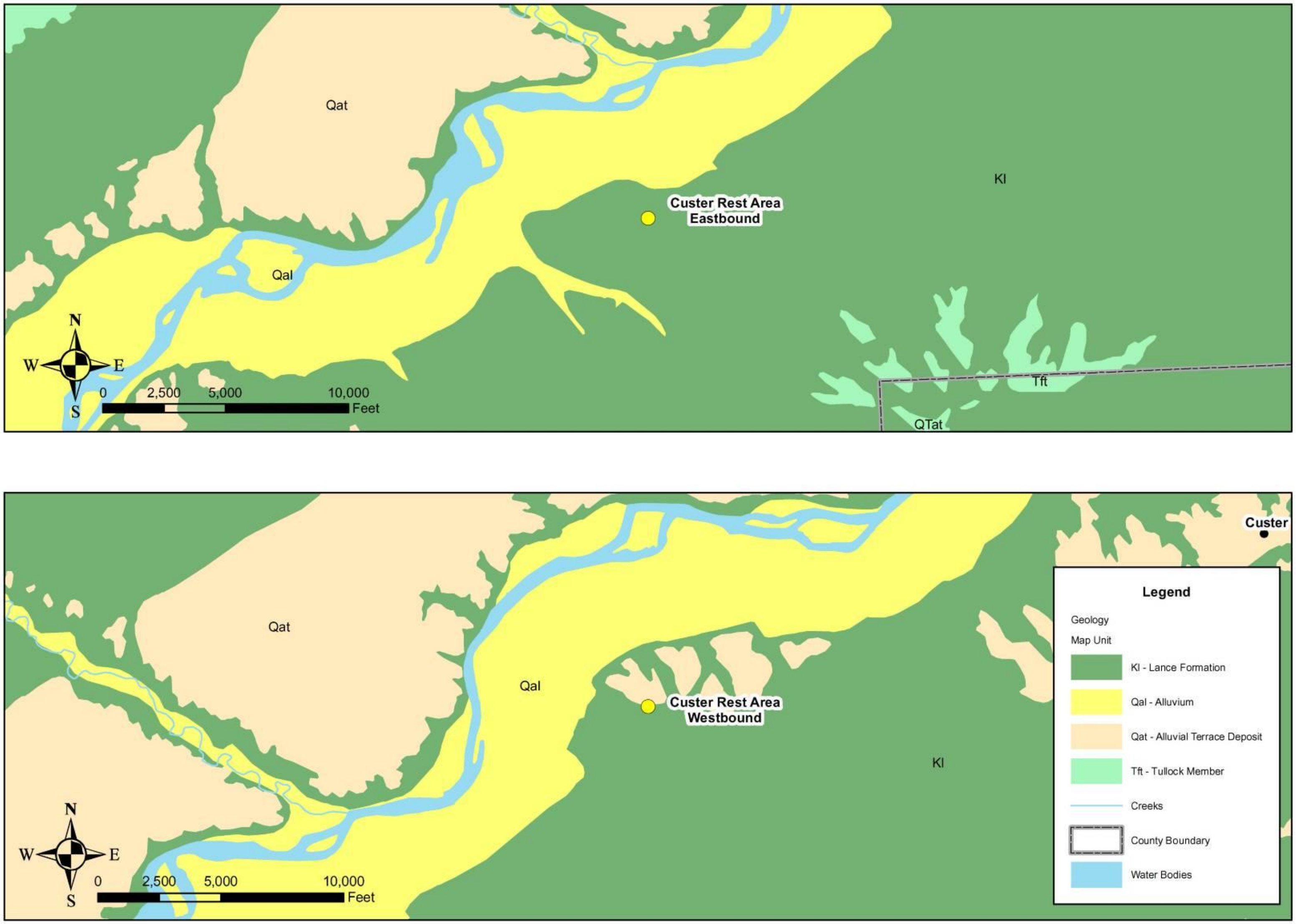
Source: MDT, 2008; DOWL HKM, 2009.
*Refers to one site (EB or WB).

Based on the estimates in Table 3.22, the wells at Custer have adequate capacity to meet the projected 2027 peak day demand.

Information on the pumping rate has been obtained from the GWIC database as well as from conducting interviews and obtaining additional data from MDT maintenance personnel. No field work was performed to verify the pumping rates. Therefore, it is recommended that well yield tests be conducted for each well at the Custer sites in order to verify the actual pumping rates.

Geologic mapping can be used to determine general aquifer characteristics. Figure 3-15 depicts the geology surrounding the Custer rest area. Digital geologic mapping was obtained from the MBMG State Geologic Mapping Program. Map unit descriptions can be found within Appendix M.

Figure 3-15 Geologic Map of Custer



As shown previously on the topographic maps of the rest area sites, the Custer rest area sits on top of a narrow, flat-topped ridge that overlooks the Yellowstone River Valley to the north. Most of the available groundwater within this aquifer is found within permeable rocks such as sandstone and coal as is characteristic of the ridges bordering the Yellowstone River. Considerable amounts of shale may also be present within this aquifer. Finer-grained materials such as shale are less permeable and tend to impede groundwater flow.

The Custer rest area sites are largely located within the Lance formation. The Lance formation is interbedded sandstone and shale, and is between 400 and 500 feet thick. Static water levels versus pumping water levels obtained from the GWIC well logs show that while the Custer wells are moderate producers of groundwater, there is quite a bit of drawdown caused by pumping. Additional wells with similar pumping rates can likely be developed, but care should be taken to not over-pump and dewater the aquifer.

As water demands increase due to usage, it is good practice to examine ways to conserve the water supplies at Custer. One possible method for reducing water usage at the Custer sites is to implement xeriscaping techniques. Xeriscaping is a term generally encompassing water-conserving landscaping practices, including the use of drought-resistant native plants and installation of ground cover plantings, mulch, and hardscape materials in favor of water-demanding turf. Water-conserving irrigation practices can also reduce demand. Such practices include scheduling irrigation to occur in the early morning instead of mid-day and the use of drip-irrigation systems as opposed to above-ground sprinklers in order to minimize evaporation and runoff. These types of landscaping techniques would lessen maintenance requirements and require less water, thereby reducing the overall water demand at the rest area sites. Reducing irrigation requirements would free up the well capacity in order to accommodate increased visitor usage.

While reducing water usage is good practice in terms of conservation, due to the non-typical strength of wastewater at a rest area, reducing facility water usage can enrich the waste strength component through reduction of dilution. This issue is discussed further in Section 3.3.2. However, reducing water usage through more efficient irrigation practices will help to conserve water without affecting wastewater strength, as irrigation water does not enter the treatment system.

Although it appears that unregulated wells could likely accommodate demand at the Custer sites for some time, MDT may want to consider securing water rights in the future as usage increases. Well replacements may be easier to obtain with secured water rights. Therefore, the process and expense of acquiring water rights is discussed as follows.

When applying for a new water right in Montana, different rules and procedures apply depending on whether or not the location is in a closed basin. Several highly appropriated basins in Montana have been closed to new appropriations. Therefore, obtaining a water right in a closed basin requires extensive analysis to show that the water being used will be replaced or "mitigated" such that the net loss from the aquifer is zero. Mitigation could be return of highly treated wastewater to the aquifer, or retirement of a separate existing water right. The majority of closed basins are located in western Montana. The Custer rest area does not currently fall within a closed basin. Therefore, obtaining a water right for the Custer rest area does not require analysis to show that the water used is being replaced. The water right process does, however, require that the following DNRC criteria are met:

1. Demonstrate that water is physically and legally available at the site.
2. Demonstrate that nearby water resources will not be adversely affected (i.e. neighboring wells, streams, irrigation ditches, and other sources).
3. Demonstrate beneficial use.

Several hydrogeologic factors must be evaluated to determine if water is physically available at the site. This will most likely require the drilling of test wells to conduct aquifer tests, water quality tests, and water level monitoring. Stream flow monitoring may also be required. Once physical availability is demonstrated, legal availability must be demonstrated through identification and analysis of existing water rights in the vicinity and with regard to potentially-affected surface waters. This process involves significant research into existing water rights and a comparison of existing legal demands to physical water availability. If physical water availability exceeds the existing demand, water is determined to be legally available.

To demonstrate beneficial use, the proposed water use must be justifiable in regards to how it will be used as well as the quantity of water needed.

As described above, acquiring additional water rights is a fairly lengthy process requiring substantial additional analysis. However, if the above criteria can be demonstrated, obtaining additional water rights for Custer is a viable option for assuring that sufficient water is available at the site to meet anticipated demands.

It should be reiterated that the water use projections shown above in Table 3.22 are estimates based on assumed values for rest area usage and approximate irrigated areas. MDT has initiated a research project to be completed in 2010 that will identify more accurate methods to predict rest area usage.

Quality

Based on the queried DEQ PWS database, the Custer sites historically have not had any recorded total coliform MCL violations. Additionally, all recorded nitrate samples for Custer have been in compliance. The Custer rest area does not currently provide disinfection and adheres to the sampling requirements for transient non-community water supplies.

It is important that specific sampling protocol be followed in order to minimize issues such as cross-contamination, which can result in false positive readings for coliform. Therefore, it would be advantageous for MDT to develop a standardized sampling program and corresponding operator training to assure that samples are collected appropriately. A detailed sampling plan should be developed for each rest area describing the sample locations; number, type, and size of each sample; sampling method technique, storage, and handling procedures; and sample labeling and chain of reporting standards, including receipt and logging of samples and delivery to the lab.

General guidelines for collecting a coliform bacteria sample are listed in the Drinking Water Regulations for Transient Non-Community Public Water Supplies (DEQ, 1999). These guidelines are summarized below and should be considered when developing a detailed sampling plan.

- Always sample from a cold water tap (avoid leaking faucets, drinking fountains, and outside hydrants)
- Remove any faucet attachments (aeration screens, hoses, etc.)
- Open tap fully and let water run two to three minutes
- Reduce the flow and fill the bottle leaving an airspace which allows mixing by shaking in the lab
- Do not allow cross-contamination when collecting the sample (i.e. do not touch the inner surface of the bottle or lid or touch it to the faucet).
- Transport the sample to the lab as soon as possible. Care should be taken to maintain the sample at normal water temperature.

Additional materials on sampling requirements may be obtained from the EPA safe water program. Secondly, the METC periodically hosts training programs for water and wastewater operators at several locations throughout Montana.

Although Custer does not currently require disinfection, anticipated regulations may warrant this in the future. The Ground Water Rule set forth by EPA will go into effect on December 1, 2009. This rule states that all groundwater systems not currently providing disinfection must perform triggered source water monitoring if notified of a total coliform-positive routine sample. Depending on the results of the triggered source water monitoring, groundwater systems must correct the deficiency or ultimately provide treatment that achieves at least 4-log treatment of viruses. Required treatment methods would most likely be chlorinated systems allowing sufficient contact time. In general, the Ground Water Rule builds upon the drinking water regulations currently in effect under DEQ for transient non-community water supplies. DEQ will administer the Ground Water Rule and perform routine sanitary surveys to ensure compliance and identify significant deficiencies.

Another process regulated through DEQ is the GWUDISW determination process. This process pertains to the groundwater wells at the Custer rest area. The process would begin with a preliminary assessment by DEQ and, depending on the results, could require additional analysis. Through this process, if groundwater sources are determined to be directly influenced by surface water, they will be subject to the Surface Water Treatment Rule requirements and would require disinfection and possible filtration. Based upon the well construction, the depth of aquifer, and proximity to surface waters, it is not expected this will become an issue at the Custer rest area.

Other Factors

For small water systems, it is important to ensure that wells are protected from sources of contaminants. Per Circular DEQ-3, wells must be located at least 100 feet from any structures used to convey or retain storm or sanitary waste. The wells at Custer are more than 100 feet from septic tank and drainfield locations and therefore meet this requirement. Well construction details are provided in the GWIC database sheets located in Appendix G. It is also important to make sure the well construction details and well pumps meet DEQ requirements.

The operation, maintenance, and replacement costs are typically low for this type of small water system. Assuming no disinfection, the only significant associated replacement costs are in the actual well pump and possibly some controls (e.g., pressure tank, appurtenances, etc.). Table 3.23 presents typical costs associated with pulling and replacing a well pump. According to MDT maintenance personnel, pumps typically last five to seven years depending on the hardness or corrosiveness of the water. It should be noted that the following costs most likely would not occur in the same year.

Table 3.23 Typical Costs for Rest Area Water Systems

Component	Cost
Parts, fittings, expenses, etc.	$500
Pump	$500 - $750
Labor associated with replacing the pump (i.e. wiring, etc.)	$1,000 - $1,500
Water Filter (replace monthly at $20 each)	$240
Pressure Tank (replace on occasion)	$350
Air/Sequence Valve for Toilets (replace once every two years @ $600 per toilet, assume 3 toilets per year)	$1,800
Hot Water Tank (replace every 3-4 years)	$450
Total Cost	**$4,840 - $5,590**

Source: MDT, 2009.

Anticipated pumping costs associated with the irrigation and potable wells are listed below in Table 3.24. These estimates are based on several assumptions such as pump horsepower, annual consumption, and estimated hours of pumping per year. Detailed calculations can be found within Appendix K.

Table 3.24 Custer Projected Pumping Costs

Rest Area Site	Total Annual Power Costs
Custer EB	$785
Custer WB	$773

Source: DOWL HKM, 2009.

Conclusions

Based on the above discussion, the following is a summary regarding water service at the Custer rest area:

- The water sources at Custer have adequate capacity to meet the 20-year projected design flows. It should be reiterated that field pumping tests were not performed as part of this study.
- The aquifer serving the Custer rest area can be expected to be relatively reliable.
- Water demand could be further reduced by implementing water-conserving irrigation and landscaping techniques.
- Water quality at the Custer sites is generally good, however, through the implementation of the Ground Water Rule and GWUDISW process, more stringent water quality rules may apply in the future and treatment may be necessary.
- Costs associated with maintaining these systems are relatively low.
- As usage increases due to demand beyond the 20-year projections, additional water rights may need to be secured. The Custer sites are not currently within a closed basin; therefore new water rights could, most likely, be attained.

3.3.2 Sewer Service

Size of Existing System

As described above in Section 3.1.8, on-site sewage treatment at the Custer rest area is accomplished through the use of a septic tank and soil absorption drainfield. The drainfield at Custer is gravity-fed. Preliminary sizing calculations for the 20-year projected usage are shown below in Table 3.25 along with the existing system sizing information determined from as-built drawings and information collected from MDT maintenance personnel. Detailed calculations can be found within Appendix J. The NRCS soils information was used to determine approximate sizing criteria where percolation test data was not available.

Table 3.25 Septic Tank and Drainfield Size for Projected Usage at Custer (2027)

Rest Area Site	Septic Tank		Drainfield	
	Existing Size	Recommended Size for Projected Usage (2027)	Estimated Existing Size	Recommended Size for Projected Usage (2027)
Custer EB	4,500 gallons	4,400 gallons	Unknown	3,900 ft^2
Custer WB	4,500 gallons	4,400 gallons	1,900 ft^2	2,500 ft^2

Note: Shaded cells indicate failure to meet the recommended septic tank or drainfield size.
Source: MDT, 2009; DOWL HKM, 2009.

As shown above, the existing drainfields at Custer are undersized to accommodate the 20-year projected rest area usage. Furthermore, Circular DEQ-4 states that subsurface wastewater disposal systems should only be used for residential strength wastewater and that wastewater exceeding this strength must be pretreated before discharging to drainfield systems. Table 3.26 below identifies typical ranges of key raw wastewater parameters for highway rest areas as compared to typical domestic wastewater. As can be seen from this generalized table, the raw wastewater strength can be expected to be well in excess of typical domestic values. It is important to note, however, that no raw wastewater sampling data was available from this rest area at the time of this evaluation. Further, the actual raw wastewater concentrations can be widely variable among rest areas.

Table 3.26 Raw Wastewater Strength; Domestic vs. Highway Rest Areas

Raw Wastewater Parameter	Typical Domestic Strength Wastewater Concentrations(1) (mg/L)	Typical Highway Rest Area Wastewater Concentrations (mg/L)
BOD_5	110 - 350	400 - 500
TSS	120 - 400	150 - 400
TN	20 - 70	150 - 250
TP	4 - 12	20 - 30

(1) Table 3-15; Wastewater Treatment & Reuse, 4^{th} Edition; Metcalf & Eddy, 2003.

Therefore, because the existing system is undersized and septic tank/drainfield systems are not recommended as the sole treatment option for non-residential wastewater, alternative wastewater treatment technologies will be explored and will be the focus of this section.

Wastewater Effluent Quality Requirements

The first driving factor for determination of potential effluent quality criteria is the point of ultimate discharge of the effluent. The two principal means of discharge include direct discharge to surface water and subsurface discharge, which may or may not reach groundwater. Two non-discharging options would include total retention of treated effluent using evaporation as the ultimate disposal and land application or irrigation.

The effluent quality of a subsurface discharge system (i.e. drainfield) depends upon the presence, depth below ground surface, and volume of existing groundwater. Subsurface discharge systems are allowed based upon the concentration of nitrates at the end of an allowable "mixing zone." The mixing zone depends primarily upon the proximity to existing surface water sources and existing groundwater wells. Based upon a required non-degradation analysis, the calculated nitrogen concentration at the end of the mixing zone must be less than or equal to 7.5 mg/L. A smaller allowable mixing zone equates to a requirement for higher quality effluent and more advanced treatment processes. Of further significance related to the permitting of subsurface discharge systems is the total daily discharge volume. A DEQ discharge permit is not required for systems discharging less than 5,000 gpd. While the actual analysis and design of the disposal system would be the same, a system over 5,000 gpd may require more site specific and detailed groundwater information and would require permit and renewal fees.

Direct surface water discharge of effluent would require the highest quality effluent, as well as a lengthy evaluation and permitting process, which may not ultimately be granted by the permitting agency. Direct surface discharge is not considered a viable option for this rest area.

The final options of land application and total retention do not require a discharge permit. Either system would require similar effluent water quality. Effluent quality for land application systems would depend upon the size of irrigable area and the nutrient uptake potential of the associated crop. Total retention systems would generally be designed to secondary treatment standards typical of a wastewater lagoon system with additional consideration potentially given to the odor and algae generation potential of the stored effluent.

Advanced Wastewater Treatment Options

In a conventional on-site system, a septic tank is first used for partial treatment of the wastewater and for accumulation of solids. Secondly, a subsurface drainfield is used for final treatment and disposal of the wastewater. In alternative systems, additional or secondary/advanced treatment is provided between the septic tank and disposal system. This section will focus on four secondary treatment technologies applicable to the Custer rest area sites. These are:

- Aerobic Treatment Systems/Package Plants (including SBR and MBR systems)
- Lagoon Systems
- Aquatic Treatment Systems
- Recirculating Packed-Bed Filters

It is worth mentioning a few low-cost modifications that can be added to any on-site wastewater system regardless of the treatment method being applied. With any system, it is good practice to install effluent filters on septic tanks. The effluent filter will help to alleviate stress on the downstream processes and piping systems by retaining solids in the septic tank more consistently. In addition, dosing and resting the drainfield through the use of a pumping system rather than the trickle flow that a drainfield typically receives with the conventional gravity system will improve the treatment and extend the life of the drainfield. Dosed systems are also allowed slightly modified trench dimensions and spacing requirements that provide for more effective use of the drainfield area.

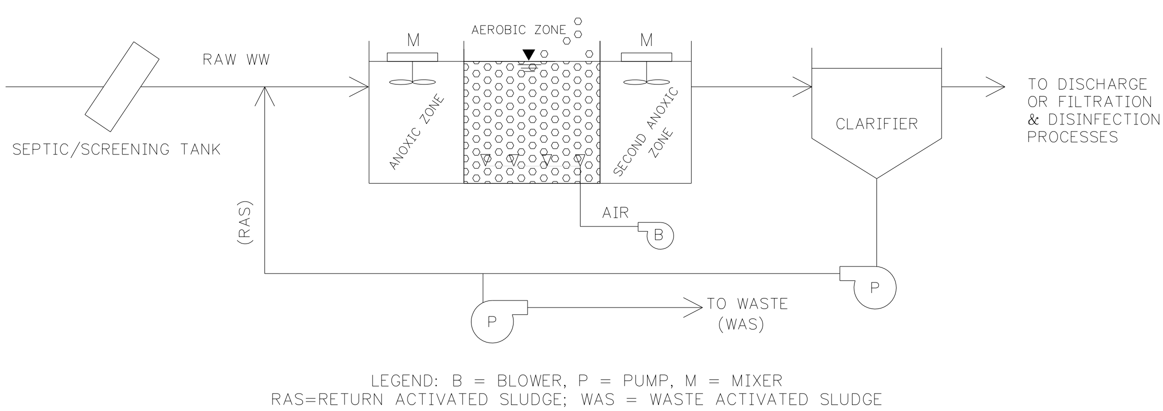
It is important that an alternative system be selected only after an investigation of site-specific conditions. System selection and design should be performed by a professional engineer with a formal design report submitted to the permitting authority.

Advanced Treatment Systems/Package Plants

For applications where stringent effluent quality requirements will apply, a more advanced treatment system in the form of aerobic, activated sludge systems could be required. Such advanced treatment units may include only aerobic zones where greater BOD, TSS and ammonia reduction (i.e. nitrification) can occur. As effluent disposal criteria dictate, more advanced systems may include anoxic (low dissolved oxygen) zones where subsequent nitrogen removal (denitrification) can occur.

A septic tank is intended to remove solids and initiate biological treatment. This process is anaerobic, meaning there is no oxygen in the system. Conversely, advanced treatment systems are aerobic and consist of an aeration tank where incoming wastewater is mixed with biological organisms (i.e. activated sludge) using a large quantity of air. During the aeration process, a portion of the wastewater undergoes biological treatment or the conversion of organic matter to various gases and new microbial cells. Aeration compartments are followed by a settling compartment. A portion of the settled microorganisms or "activated sludge" is then returned to the front of the treatment process as RAS to be mixed again with incoming wastewater. Excess sludge or WAS must occasionally be removed from system. Figure 3-16 illustrates the basic configuration of an advanced treatment unit for biological nitrogen removal.

Figure 3-16 Advanced Treatment Process Flow Diagram



Advanced treatment units come in many forms of pre-engineered/package wastewater treatment plants; several variations exist depending on the size of system or community being served and ultimate treatment objectives. The process can be modified in many ways to achieve the ultimate treatment objectives. For example, one process applicable to small communities or cluster configurations is the SBR system. SBR systems utilize five steps occurring in the same tank (i.e. both aeration and settling occur in the same tank). Due to the sequential nature of the SBR system, a key element is the control system, consisting of a combination of level sensors and timers. The five steps occurring in sequential order are:

1. Fill
2. React (aeration)
3. Settle (sedimentation/clarification)
4. Draw (decant)
5. Idle

The MBR system is another variation of an aerobic advanced treatment process. The MBR system adds a microfiltration element to the treatment process accomplished through the use of a membrane. The membrane element is typically submerged directly in the treated wastewater at the end of the treatment process. In place of sludge settling/clarification, the membrane captures solids and either re-circulates them into the treatment process or sends them to be wasted. With the addition of the filtration element, MBR systems are more complex than the SBR system and require slightly more maintenance and monitoring to make sure the membrane does not clog and is operating efficiently. Only for very stringent effluent quality requirements would MBR technology be an economic option for this rest area. Biologically, MRB & SBR systems have the same treatment capability. The MBR's distinguishing characteristic is its simultaneous clarification and filtration of the effluent, resulting in extremely high-quality effluent with respect to total suspended solids and making it an ideal process for water reuse applications.

Advanced treatment units can provide a high level of treatment and therefore may reduce drainfield requirements depending on soil type. However, per Circular DEQ-4, monitoring data must be submitted from at least three existing systems operating in similar climates and treating wastewater similar in characteristics before any reduction in drainfield size will be considered. Monitoring data from existing systems must show that effluent quality parameters are met in order to reduce the drainfield area. If these criteria are met, the absorption system size may be reduced by 50 percent, but must still have a replacement area large enough for a standard absorption trench system.

One manufactured advanced aerobic treatment system with case history installations in Montana is the Santec treatment system by Santec Corporation. This system is currently installed in the town of Rocker, Montana to serve two truck stop establishments. Truck stop wastewater effluent is similar in composition to rest area wastewater due to its higher strength. Influent and effluent wastewater monitoring data for the year 2008 was obtained from the Rocker WWTP. Influent BOD and TSS concentrations are comparable to what is expected of rest area wastewater as listed in Table 3.26; however data was not available for influent total nitrogen and phosphorus concentrations. Effluent monitoring data from the Rocker WWTP indicates that effluent characteristics meet typical standards for secondary treatment.

Proper operation and maintenance of the aerobic unit is critical. Owners are required to obtain service agreements with the manufacturers of these systems and surveillance by qualified personnel is imperative. An alarm system is required to indicate when the treatment system has an alarm condition, such as a high water level or pump failure. In addition, operators are required to obtain proper certification and perform frequent inspection. Based on recent information from DEQ, only two of these types of systems have been reviewed and permitted in Montana in the past year.

If it is found based on results of a non-degradation analysis that more stringent effluent quality requirements apply, advanced treatment options should be considered as a viable option for wastewater treatment at the Custer rest area. Advantages of advanced treatment units include:

- Relatively low footprint for equipment although room is still needed for an appropriately sized drainfield.
- Systems are modular in nature allowing for future expansion or modifications.
- A high level of treatment can be obtained.

Disadvantages include:

- Power requirements will increase substantially due to the aeration equipment within the treatment system.
- Intensive operation, maintenance, and management requirements.
- Due to the relatively low number of installed systems in Montana, proper monitoring data needed for permitting may be difficult to obtain.

<u>Lagoon Systems</u>

Lagoon treatment systems are ponds that are engineered and constructed to treat wastewater. There are several types of lagoons classified based on the discharging method. The lagoon system most applicable to a rest area is non-discharging (i.e. evaporation lagoon). A lagoon system is feasible for the projected wastewater flow rates from the rest area. The lagoon would be sized based on this flow rate and the required detention time for BOD and TSS removal.

The advantages of lagoons include:

- Low capital costs
- Minimum operations and operational skills needed
- Sludge withdrawal and disposal needed only at 10-20 year intervals
- Compatibility with land and aquatic treatment processes

The disadvantages of lagoons include:

- Large land areas may be required
- High concentrations of algae may be generated
- Non-aerated lagoons often cannot meet stringent effluent limits (not applicable for a non-discharging lagoon)
- Lagoons can impact groundwater negatively if liners are not used, or if liners are damaged
- Improperly designed and operated lagoons can become odorous[3]

Lagoon systems are not recommended at the Custer site because the existing site is not large enough and additional right-of-way would most likely be necessary. In addition, lagoons have the potential to become odorous, making the site unattractive for rest area users. Space at the Custer sites is limited and the lagoon would need to be fenced and located far enough from the site to prevent odors or other nuisances from affecting neighboring properties.

[3] Crites and Tchobanoglous, 1998.

Aquatic Treatment Systems

Aquatic treatment systems use plants and animals such as insects, fish, worms, and snails designed to aid in the treatment process. An article from the FHWA Public Roads Magazine dated May/June 2000 provides details of this type of system installed at a welcome center in Vermont. The system is called the Living Machine and is picture below in Figure 3-17 inside a modular greenhouse. The Vermont Agency of Transportation used this technology at the Guilford welcome center from 1997 to 1999. The system recycles treated wastewater that is clean enough for use in toilets or for irrigation purposes, but not clean enough to drink or to use for washing hands. In 1999, the system was decommissioned at the Guilford welcome center when a new welcome center was opened nearby and was connected to a municipal wastewater system. At the time of the article, however, there were plans to reinstall the Living Machine at another rest area experiencing current failing sewage treatment systems.

An operator is needed to keep the plants alive and monitor the system frequently. As described in the article, the cost of this system is initially high at approximately $250,000.

The Living Machine or a comparable aquatic system is not recommended for the Custer rest area. It is described to demonstrate the types of innovative systems being installed at some rest areas throughout the country. This system is still somewhat experimental in nature and would likely require a lengthy permitting process through DEQ. In addition, due to the remote and unsupervised nature of the Custer rest area, this system would be vulnerable to vandalism. This type of system would also require significant monitoring by a trained operator and would likely necessitate hiring additional full-time maintenance employees.

Figure 3-17 Living Machine

Inside the rest area's wastewater treatment system, plants and animals clean the waste from the water through a series of engineered ecosystems. (Photo by Living Technologies)

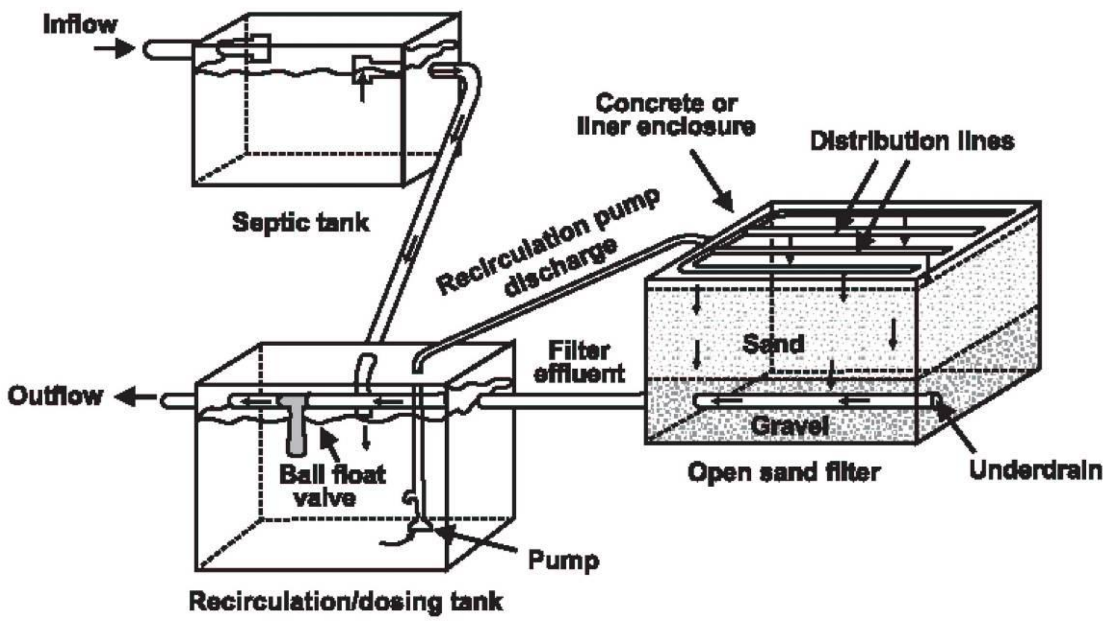
Recirculating (Multi-pass) Packed-Bed Filters

Packed-bed filters use biological and physical processes to effectively treat wastewater. They can be either intermittent (single pass) or recirculating (multi-pass). In intermittent design, the wastewater is applied to the filter only once through several doses per day. In a recirculating system, a portion of the wastewater that has gone through the filter already is returned to the filter. Recirculating filters are more applicable to the Custer rest area based on the required design flow. Therefore, this section focuses on recirculating packed-bed filters for use as an alternative treatment technology at the Custer rest area.

Figure 3-18 illustrates the operation of a recirculating packed-bed filter using sand as the filtering media. A typical packed-bed filter is comprised of the following elements:

1. A container with a liner for holding the medium
2. An underdrain system for removing the treated liquid
3. The filtering medium – Many types of media are used in packed-bed filters. Sand is the most common, but other options include crushed glass, plastic, foam, and synthetic textile media.
4. A distribution and dosing system for applying the liquid to be treated onto the filtering medium (spray nozzles, etc.)
5. Supporting appurtenances

Figure 3-18 Recirculating Sand Filter



Source: EPA Onsite Wastewater Treatment Manual

The septic tank effluent is dosed onto the surface of the filter and is allowed to percolate through the medium to the underdrain system. Recirculating filters combine biological treatment with physical processes such as straining and sedimentation. Biological treatment occurs due to the bioslimes that form on the media particle surfaces. According to EPA, recirculating sand filters frequently replace aerobic package plants in many parts of the country because of their high reliability and lower operating and maintenance requirements.[4]

[4] EPA Onsite Wastewater Treatment Systems Manual, February, 2002

As an alternative to the recirculating sand filter, textile packed-bed filters utilize non-woven textile chips instead of granular medium, increasing the surface area for the microorganisms to attach and thereby reducing the space requirements of the filter.

One manufactured recirculating textile packed-bed filter currently approved by DEQ is the AdvanTex Treatment System by Orenco Systems, Incorporated. AdvanTex systems have been installed in numerous commercial and residential applications in Montana. Conceptual designs for an AdvanTex system have been produced for the new Lima Rest Area proposed for construction later this year (although they are not currently approved to date). AdvanTex systems have been successfully utilized in other nearby rest area applications, including the states of Wyoming and Colorado.

AdvanTex systems are equipped with remote telemetry to give operators and manufacturers the ability to monitor and control their systems remotely. Distributors of AdvanTex systems are located in Billings, MT, allowing for fast response times in an emergency.

A key component of systems such as AdvanTex is their modular nature. The modular nature of this system allows for additional units to be installed in the future as long as adequate space is provided initially. MDT plans to begin collecting data on water usage and wastewater effluent concentrations in the future. As this data becomes known, refinements and adjustments can be made to the required number of future units.

It is worth mentioning that AdvanTex systems are designed to reduce total nitrogen by 60 percent or more. Due to the expected high strength of the incoming wastewater, additional measures such as pretreatment, additives, or polishing components may or may not be needed to obtain effluent total nitrogen levels that meet the acceptable standard. Again, required treatment levels are based on results of a non-degradation analysis that would dictate the design criteria needed.

Recirculating packed bed filters such as the AdvanTex system should be considered as an option for wastewater treatment at the Custer rest area. Advantages of recirculating packed bed filter systems are similar to those for advanced aerobic treatment units. However, the packed bed filter system is slightly less complex than the aerobic advanced treatment unit, requiring less monitoring and operational requirements. Power requirements would also be less due to the absence of the aeration equipment.

Subsurface Drainfield

With recirculating filters or advanced treatment units, a 50 percent reduction (depending on soil percolation rates) in drainfield size from standard absorption system sizing may be allowed provided that adequate performance data at higher raw wastewater concentrations can be supplied.

Rough calculations were made to determine if the new drainfields will fit on the Custer sites after taking into account the reduction in size. Detailed calculations can be found in Appendix J. Wastewater systems must be located at least 100 feet from any surface waters and 100 feet from floodplain boundaries. Drainfields should also be relatively level.

The following should be noted with respect to proximity of the rest areas to surface waters:

1. Subsurface wastewater disposal systems must be located a minimum horizontal setback distance of 100 feet from any surface water or spring and at least 100 feet outside of any floodplain boundaries.
2. Greater horizontal distance may be required depending on results of a water quality non-degradation analysis. This analysis is not only based on distance but includes other factors such as nutrient load, hydrogeologic conditions, and direction of groundwater flow.
3. Close proximity of the rest area to surface waters could also have an effect on the ground water if ground water sources are determined to be directly influenced by surface water.

The nearest surface water sources to the Custer sites are approximately 500 to 1,000 feet away. Due to these relatively large distances, the surface waters near Custer are not expected to be an issue but will ultimately depend on the results of a non-degradation analysis.

Figure 3-19 depicts specific site constraints at the rest area and shows approximate areas suitable for wastewater systems. The figure illustrates approximate areas and locations of the new drainfields and wastewater systems.

The Custer sites appear to have adequate areas on relatively flat ground for possible wastewater system expansion within the existing right-of-way.

Figure 3-19 Custer Conceptual Wastewater Treatment System

It is reiterated that site-specific soil information was not obtained as part of this study. Ultimate drainfield size and location will need to be determined after this field data is collected. One additional option for the drainfield is to reconstruct the system as a "bed system." In the case of a replacement not resulting from failure, a bed system is allowed per Circular DEQ-4. The total footprint of this system consists of the design flow rate divided by the soil application rate and results in a slightly reduced drainfield area due to the elimination of the spacing needed between trenches.

The projected 20-year wastewater design flows for the Custer sites are below the 5,000 gpd limit required for a discharge permit.

Conclusions

- The existing wastewater systems at Custer are generally sized adequately to meet the current demand. The systems will need to be expanded to meet future demand.
- Conventional systems are not recommended for non-residential strength wastewater.
- A variety of secondary treatment options exist to improve the level of wastewater treatment for on-site systems. Lagoons and aquatic systems are not recommended due to issues such as land availability, system complexities, and permitting concerns.
- If treatment standards dictate, advanced aerobic treatment systems are one option for wastewater treatment at a rest area. These systems provide a high level of treatment but require trained operators due to system complexities.
- The recirculating packed-bed filter system is another option for a wastewater treatment system at the Custer sites, assuming all the non-degradation requirements can be achieved. This system is less complex than an aerobic treatment unit and provides a high level of treatment. Due to the modular nature of these systems, additional units may be installed as needed at a later date, thereby reducing initial costs.
- Discharge permits will most likely not be required at the Custer sites.

3.3.3 Power Service

Given the decline in energy consumption over the past five years, demand for electricity at the Custer rest area may increase more slowly than expected as visitor numbers increase over the 20-year planning horizon.

As noted in Section 3.1.8, the cost for electricity generally varied between $0.049 and $0.118 per kWh from 2004 to 2008. Although existing connections to the power grid would be able to meet future demand, any future rehabilitation of the Custer rest area should attempt to incorporate a more cost-effective design to reduce energy costs as much as possible, especially given recent rate volatility.

There are two primary means of reducing power costs at the existing Custer rest area. The first would entail installation of energy-saving devices, including interior motion-sensitive lighting. With the use of motion sensors, interior lights would turn on only when triggered by a visitor using the facility, thereby saving electricity when the facility was not in use. For safety purposes, outdoor lighting would remain triggered by photoelectric detection devices and would stay on continuously during nighttime hours.

A second means of reducing power costs would involve development and use of an alternative source of energy. The two sources of alternative energy most applicable for rest area sites are solar and wind energy.

Solar energy could be harnessed to power interior and exterior rest area lighting fixtures. Solar panels can be installed on the roof of a structure or directly to parking lot lighting poles. Although solar radiation varies with the changing position of the earth relative to the sun and due to variance in atmospheric conditions, most geographic areas can access useful solar resources.

WYDOT has installed solar panels at 19 rest areas since the 1980s to provide a source of solar heating for restroom buildings. Most of these rest areas also have solar water heaters for the buildings' lavatories. WYDOT estimates that solar heating provides nearly half of these rest areas' energy needs. Given its effectiveness in Wyoming, it is recommended that MDT further explore the viability of solar energy as a source of power for the Custer rest area.

Wind may also be a potential source of energy. MDT is currently studying the viability of using wind power at the Anaconda Interchange rest area. The project involves a single tower-mounted wind turbine intended to provide supplemental power for the rest area. As noted in MDT's December 2006 Experimental Project Work Plan, the objective is to determine the cost-effectiveness of the turbine in reducing usage of grid-line power service. Over the course of several years, MDT intends to compare the Anaconda rest area site to other rest areas of similar design and size in terms of power usage and costs, including regular and unscheduled maintenance costs. MDT will conduct a benefit-cost analysis to determine whether wind turbines could provide long-term cost savings at rest area sites. If such a system appears viable based on the results of the Anaconda study, it is recommended that MDT consider the use of wind power at the Custer rest area.

Conclusions

Based on the above discussion, the following is a summary regarding power service at the Custer rest area:

- Existing grid power service is sufficient to meet the needs of the Custer rest area over the 20-year planning horizon.
- While usage has declined somewhat over the past five years, power usage will likely increase slowly over time with increasing visitors.
- Energy-saving technology, including motion-sensitive lighting, should be considered in order to reduce power costs at all three rest areas.
- Alternative sources of energy, including wind and solar power, could be used in the future to supplement grid power, thereby reducing power costs.

3.4 Cost Assessment

This study utilizes an asset management approach with regard to recommended rest area rehabilitation measures. FHWA's December 1999 *Asset Management Primer* defines asset management as follows:

> Asset management is a systematic process of maintaining, upgrading, and operating physical assets cost-effectively. It combines engineering principles with sound business practices and economic theory, and it provides tools to facilitate a

more organized, logical approach to decision-making. Thus, asset management provides a framework for handling both short- and long-range planning.

The goal of asset management in the context of this study is to optimize the preservation, upgrading, and timely replacement of corridor rest area facilities through cost-effective management, programming, and resource allocation decisions. In light of increasing user demand, constrained transportation budgets, and mature resources experiencing continuing deterioration, cost-effective investment decisions are imperative. Asset management principles enable long-term management of resources and prudent allocation of funds given alternative investment options and competing needs. With these principles in mind, this section outlines estimated costs for rehabilitation of the Custer EB and WB rest area sites.

As detailed in previous sections, the existing Custer rest area sites meet current user demands. Upgrades are needed to the wastewater systems in order to meet future demands over the 20-year planning horizon. Additionally, parking facilities will require expansion to accommodate increasing usage.

Rehabilitation of Custer Sites

Estimates have been prepared assuming phased implementation in order to reduce initial rehabilitation costs and allow progressive project programming. It should be noted that while phased implementation reduces initial capital costs and may result in fewer impacts to the traveling public due to shorter construction-related closure periods, it results in higher total project costs due to duplication of certain efforts, including mobilization, traffic control, and administration costs, as well as material and labor cost escalation over the course of project implementation. Escalation costs are not reflected in the cost estimates provided in this study; all project phases are presented in 2009 dollars.

The first phase would involve rehabilitation of the wastewater system, assuming a higher level of treatment is required to bring it up to current standards, and would also include site rehabilitation to provide ADA conformity. These upgrades are recommended to occur first in order to ensure continued public health, safety, and access. Additionally, these are relatively low-cost measures in comparison to full rehabilitation of the site. Under the first phase, the Custer rest area would also be converted from seasonal to year-round use. Conversion should not require any capital expenditures, but would entail increased maintenance and operation costs associated with snow plowing, heating, and other general wintertime maintenance and operation needs.

The second phase would involve expanding the wastewater system to meet future (2027) demand, as well as upgrading the existing restroom facilities. The recommended wastewater system is modular in nature; additional modules can be added over time to expand the capacity of the system.

The third phase would entail construction of additional parking areas and accompanying sidewalks to meet 2027 demand. New amenities would also be provided, including additional picnic areas, landscaping, and benches. For purposes of this study, it was assumed that the existing acceleration and deceleration lanes could continue to serve the Custer rest area facilities; these ramps would be resurfaced in order to extend their useful life.

Multi-phase and single-phase cost estimates are presented in order to illustrate the relative difference in cost between the two. Detailed descriptions of each line item follow. These planning-level cost estimates are intended to be used primarily for comparison purposes between rest area sites in this study. Again, it should be noted that escalation costs are not reflected in the multi-phase cost estimates; all cost estimates are presented in 2009 dollars.

Table 3.27 Multi-Phase Cost Estimate for Custer EB Rehabilitation

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Custer EB (Rehabilitation)					
	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$85,000	$85,000
PHASE I	ADA Conformity	1	Lump Sum	$24,000	$24,000
PHASE I	**SUBTOTAL 1**				**$109,000**
PHASE I	Mobilization @ 10%	1	Lump Sum	$11,000	$11,000
PHASE I	**SUBTOTAL 2**				**$120,000**
PHASE I	Planning / Survey / Design @ 10%	1	Lump Sum	$12,000	$12,000
PHASE I	Indirect Costs @ 14.06%	1	Lump Sum	$16,900	$17,000
PHASE I	Construction Contingencies @ 10%	1	Lump Sum	$12,000	$12,000
PHASE I	Construction Management @ 15%	1	Lump Sum	$18,000	$18,000
PHASE I	Acquire Right-of-Way	0	AC	$2,000	$0
PHASE I	**PHASE I TOTAL**				***$179,000***
PHASE II	Wastewater System (2027 Demand)	1	Lump Sum	$5,000	$5,000
PHASE II	Building Upgrades	1	Lump Sum	$16,000	$16,000
PHASE II	**SUBTOTAL 1**				**$21,000**
PHASE II	Mobilization @ 10%	1	Lump Sum	$3,000	$3,000
PHASE II	Miscellaneous @ 25%	1	Lump Sum	$5,300	$6,000
PHASE II	**SUBTOTAL 2**				**$30,000**
PHASE II	Planning / Survey / Design @ 10%	1	Lump Sum	$3,000	$3,000
PHASE II	Traffic Control	1	Lump Sum	$5,000	$5,000
PHASE II	Indirect Costs @ 14.06%	1	Lump Sum	$4,200	$5,000
PHASE II	Construction Contingencies @ 10%	1	Lump Sum	$3,000	$3,000
PHASE II	Construction Management @ 15%	1	Lump Sum	$4,500	$5,000
PHASE II	Acquire Right-of-Way	0	AC	$2,000	$0
PHASE II	**PHASE II TOTAL**				***$51,000***
PHASE III	Demolition (Curb & Gutter)	0	LF	$9	$0
PHASE III	Grading	1,500	SF/ ft depth	$0.40	$1,000
PHASE III	Crushed Aggregate Course - New Base	325	SF	$1	$1,000
PHASE III	Pavement Surfacing - New	325	SF	$5	$2,000
PHASE III	Pavement Surfacing - Overlay	80,000	SF	$1.33	$107,000
PHASE III	Sidewalks	600	SF	$6	$4,000
PHASE III	Curb and Gutter	15	LF	$13	$1,000
PHASE III	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
PHASE III	Picnic Areas	1	Lump Sum	$72,000	$72,000
PHASE III	Rest Area Amenities	1	Lump Sum	$12,000	$12,000
PHASE III	**SUBTOTAL 1**				**$258,000**
PHASE III	Mobilization @ 10%	1	Lump Sum	$26,000	$26,000
PHASE III	Miscellaneous @ 25%	1	Lump Sum	$64,500	$65,000
PHASE III	**SUBTOTAL 2**				**$349,000**
PHASE III	Planning / Survey / Design @ 10%	1	Lump Sum	$35,000	$35,000
PHASE III	Traffic Control	1	Lump Sum	$10,000	$10,000
PHASE III	Indirect Costs @ 14.06%	1	Lump Sum	$49,100	$50,000
PHASE III	Construction Contingencies @ 10%	1	Lump Sum	$34,900	$35,000
PHASE III	Construction Management @ 15%	1	Lump Sum	$52,400	$53,000
PHASE III	Acquire Right-of-Way	0	AC	$2,000	$0
PHASE III	**PHASE III TOTAL**				***$532,000***
GRAND TOTAL					***$762,000***

Table 3.28 Single-Phase Cost Estimate for Custer EB Rehabilitation

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

DOWL HKM

Custer EB (Rehabilitation)					
	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$85,000	$85,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	Wastewater System (2027 Demand)	1	Lump Sum	$5,000	$5,000
	Building Upgrades	1	Lump Sum	$16,000	$16,000
	Demolition (Curb & Gutter)	0	LF	$9	$0
	Grading	1,500	SF/ ft depth	$0.40	$1,000
	Crushed Aggregate Course - New Base	325	SF	$1	$1,000
	Pavement Surfacing - New	325	SF	$5	$2,000
	Pavement Surfacing - Overlay	80,000	SF	$1.33	$107,000
	Sidewalks	600	SF	$6	$4,000
	Curb and Gutter	15	LF	$13	$1,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Picnic Areas	1	Lump Sum	$72,000	$72,000
	Rest Area Amenities	1	Lump Sum	$12,000	$12,000
	SUBTOTAL 1				**$388,000**
	Mobilization @ 8%	1	Lump Sum	$32,000	$32,000
	Miscellaneous @ 20%	1	Lump Sum	$78,000	$78,000
	SUBTOTAL 2				**$498,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$50,000	$50,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$70,000	$70,000
	Construction Contingencies @ 10%	1	Lump Sum	$50,000	$50,000
	Construction Management @ 15%	1	Lump Sum	$75,000	$75,000
	Acquire Right-of-Way	0	AC	$2,000	$0
GRAND TOTAL					*$753,000*

Table 3.29 Multi-Phase Cost Estimate for Custer WB Rehabilitation

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Phase	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
	Custer WB (Rehabilitation)				
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$85,000	$85,000
PHASE I	ADA Conformity	1	Lump Sum	$24,000	$24,000
PHASE I	**SUBTOTAL 1**				**$109,000**
PHASE I	Mobilization @ 10%	1	Lump Sum	$11,000	$11,000
PHASE I	**SUBTOTAL 2**				**$120,000**
PHASE I	Planning / Survey / Design @ 10%	1	Lump Sum	$12,000	$12,000
PHASE I	Indirect Costs @ 14.06%	1	Lump Sum	$16,900	$17,000
PHASE I	Construction Contingencies @ 10%	1	Lump Sum	$12,000	$12,000
PHASE I	Construction Management @ 15%	1	Lump Sum	$18,000	$18,000
PHASE I	Acquire Right-of-Way	0	AC	$2,000	$0
PHASE I	**PHASE I TOTAL**				***$179,000***
PHASE II	Wastewater System (2027 Demand)	1	Lump Sum	$5,000	$5,000
PHASE II	Building Upgrades	1	Lump Sum	$16,000	$16,000
PHASE II	**SUBTOTAL 1**				**$21,000**
PHASE II	Mobilization @ 10%	1	Lump Sum	$3,000	$3,000
PHASE II	Miscellaneous @ 25%	1	Lump Sum	$5,300	$6,000
PHASE II	**SUBTOTAL 2**				**$30,000**
PHASE II	Planning / Survey / Design @ 10%	1	Lump Sum	$3,000	$3,000
PHASE II	Traffic Control	1	Lump Sum	$5,000	$5,000
PHASE II	Indirect Costs @ 14.06%	1	Lump Sum	$4,200	$5,000
PHASE II	Construction Contingencies @ 10%	1	Lump Sum	$3,000	$3,000
PHASE II	Construction Management @ 15%	1	Lump Sum	$4,500	$5,000
PHASE II	Acquire Right-of-Way	0	AC	$2,000	$0
PHASE II	**PHASE II TOTAL**				***$51,000***
PHASE III	Demolition (Curb & Gutter)	75	LF	$9	$1,000
PHASE III	Grading	1,000	SF/ ft depth	$0.40	$1,000
PHASE III	Crushed Aggregate Course - New Base	600	SF	$1	$1,000
PHASE III	Pavement Surfacing - New	600	SF	$5	$3,000
PHASE III	Pavement Surfacing - Overlay	87,500	SF	$1.33	$117,000
PHASE III	Sidewalks	600	SF	$6	$4,000
PHASE III	Curb and Gutter	75	LF	$13	$1,000
PHASE III	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
PHASE III	Picnic Areas	1	Lump Sum	$5,000	$5,000
PHASE III	Rest Area Amenities	1	Lump Sum	$11,000	$11,000
PHASE III	**SUBTOTAL 1**				**$202,000**
PHASE III	Mobilization @ 10%	1	Lump Sum	$21,000	$21,000
PHASE III	Miscellaneous @ 25%	1	Lump Sum	$50,500	$51,000
PHASE III	**SUBTOTAL 2**				**$274,000**
PHASE III	Planning / Survey / Design @ 10%	1	Lump Sum	$27,000	$27,000
PHASE III	Traffic Control	1	Lump Sum	$10,000	$10,000
PHASE III	Indirect Costs @ 14.06%	1	Lump Sum	$38,500	$39,000
PHASE III	Construction Contingencies @ 10%	1	Lump Sum	$27,400	$28,000
PHASE III	Construction Management @ 15%	1	Lump Sum	$41,100	$42,000
PHASE III	Acquire Right-of-Way	0	AC	$2,000	$0
PHASE III	**PHASE III TOTAL**				***$420,000***
GRAND TOTAL					***$650,000***

Table 3.30 Single-Phase Cost Estimate for Custer WB Rehabilitation

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Custer WB (Rehabilitation)

	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$85,000	$85,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	Wastewater System (2027 Demand)	1	Lump Sum	$5,000	$5,000
	Building Upgrades	1	Lump Sum	$16,000	$16,000
	Demolition (Curb & Gutter)	75	LF	$9	$1,000
	Grading	1,000	SF/ ft depth	$0.40	$1,000
	Crushed Aggregate Course - New Base	600	SF	$1	$1,000
	Pavement Surfacing - New	600	SF	$5	$3,000
	Pavement Surfacing - Overlay	87,500	SF	$1.33	$117,000
	Sidewalks	600	SF	$6	$4,000
	Curb and Gutter	75	LF	$13	$1,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Picnic Areas	1	Lump Sum	$5,000	$5,000
	Rest Area Amenities	1	Lump Sum	$11,000	$11,000
	SUBTOTAL 1				**$332,000**
	Mobilization @ 8%	1	Lump Sum	$27,000	$27,000
	Miscellaneous @ 20%	1	Lump Sum	$66,000	$66,000
	SUBTOTAL 2				**$425,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$43,000	$43,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$60,000	$60,000
	Construction Contingencies @ 10%	1	Lump Sum	$43,000	$43,000
	Construction Management @ 15%	1	Lump Sum	$64,000	$64,000
	Acquire Right-of-Way	0	AC	$2,000	$0
GRAND TOTAL					***$645,000***

3.4.1 Narrative Description of Bid Items

The cost estimate for the **Wastewater System (2007)** assumes a treatment system at each site adequate to bring it up to current standards. The lump sum includes the AdvanTex treatment system and associated elements such as the septic tank, drainfield, dosing tanks, installation, and operation costs.

The cost estimate for the **Wastewater System (2027)** assumes additional length of drainfield, and upsizing of septic and dosing tanks if needed. Initial estimates assume a 2-pod AdvanTex treatment system is adequate for both the 2007 and 2027 demand estimates. Therefore, additional treatment pods are not included in the 2027 estimate.

The cost estimate for **ADA Conformity** assumes rebuilding extending existing handrails, relocating grab bars, adding ADA parking stalls and corresponding curb ramps, and adding new ADA signs.

Building Upgrades include the cost of new restroom stalls; new porcelain sinks, toilets, and urinals; and new epoxy flooring for all existing rest area sites.

For Phase III, it was assumed that **Sidewalks** would be needed to outline new parking areas and to access new picnic shelters and benches. The unit price was taken from the 2008 MDT Average Prices Catalog.

Demolition costs for rehabilitation of the sites include removal of sidewalks, curb and gutter, and/or necessary asphalt to accommodate new parking facilities. The unit cost was derived from an average of the 2002 Dena Mora rest area bids, accounting for three percent annual inflation. A lower inflation value was used since demolition costs have not risen as sharply as material costs in recent years.

The **Grading** category includes site excavation and compaction. The quantity was determined based on the area of new parking facilities, in addition to a ten- to twenty-foot buffer area. The unit price was taken from the 2008 MDT Average Prices Catalog.

Unit prices for **Crushed Aggregate Course** and **Pavement Surfacing** were obtained from the 2008 MDT Average Prices Catalog. It was assumed that during Phase III, additional truck and car parking lots would be constructed to accommodate projected future demand, while existing parking areas and ramps would receive an asphalt overlay to extend their design life. Based on rough calculations, new parking areas could be designed to access existing ramps for the Custer sites, thereby reducing costs. Drawings used for rough calculations for Phase III are included in Appendix N.

New **Curb and Gutter** would be needed for new parking areas. The unit cost was derived from an average of the 2007 Anaconda Interchange rest area bids.

New **Landscaping and Irrigation** would be needed at the EB and WB facilities. The lump sum costs were derived from an average of the 2007 Anaconda Interchange rest area bids.

Additional **Picnic Areas** would be needed at each rehabilitated site. To reduce costs, the estimate assumes a combination of picnic shelters and individual picnic tables. The range of costs depends on the number of picnic tables to be added and whether or not a shelter is needed. The lump sum cost was derived from an average of the 2007 Anaconda Interchange rest area bids.

The **Rest Area Amenities** category includes new benches, ADA parking signs, highway signs, directional arrow signs, and trash receptacles. The lump sum was drawn from an average of the 2007 Anaconda Interchange rest area bids and varies between sites based on the number of trash receptacles needed.

The **Miscellaneous** category is estimated to be up to 25 percent for this project because of the potential for unknown factors. It includes items such as:

- Roadside cleanup
- Slope treatment
- Watering
- Ditch or channel excavation
- Shoring, cribbing, or extra excavation
- Adjusting existing manholes, catch basins, valve boxes, and monument cases
- Retaining walls
- Unsuitable excavation
- Undergrounding or relocation of power, telephone, gas, or cable utilities
- Temporary striping
- Temporary water pollution/erosion control
- Sawcutting pavement
- Flagpole
- Striping and signing
- Storm drainage
- ADA ramps and truncated domes
- Lighting
- Dumpster
- Security Cameras

Several cost categories are calculated as percentages of construction, including the **Mobilization** and miscellaneous categories. Additionally, the **Planning/Survey/Design, Indirect Costs, Construction Contingencies, and Construction Management** categories were calculated as percentages of the respective subtotals noted in Tables 3.27 through 3.30. A construction contingency lower than the maximum 25 percent recommended by MDT's cost estimation guidelines was chosen because the majority of unknown factors should be accounted for under the miscellaneous category.

Traffic Control measures are expected to be minimal. Under Phase I, it may be possible for the site to remain open and to maintain operation of the existing wastewater system during installation of the new system. During Phase II and III, the site would likely need to be closed during rehabilitation. Traffic control costs would include signs alerting drivers of the closure, as well as barricades on the entrance and exit ramps.

Based on as-built drawings, it appears that new facilities could be constructed entirely within the existing **Right-of-Way** at each site.

3.4.2 Funding Sources

Rest Area Program

The Rest Area Program provides funding for state-maintained rest area projects throughout the state. The Federal Share for Rest Area projects is subject to the sliding scale. For example, rest areas located on the interstate system have a Federal Share of 91.24 percent and the State is responsible for 8.76 percent. The State's percentage is funded through the State Special Revenue Account.

The Montana Transportation Commission approved an annual allocation of funds to the Rest Area Program in September 2008. Funds may be used for new facility construction, rehabilitation and preservation work, which includes replacement of existing facilities. Approximately 80 percent of the funds are for new construction with the remaining 20 percent for rehabilitation and preservation work.

The Rest Area Program is reviewed annually to revisit project priorities, update cost estimates and track progress and reporting. The Montana Transportation Commission approves projects for the Rest Area Program.

Interstate Maintenance

The IM Program provides funding for projects on the Interstate System involving resurfacing, restoring, and rehabilitation of the existing roadway. The Federal share for IM projects is 91.24 percent and the State is responsible for 8.76 percent. The State's percentage is funded through the State Special Revenue Account.

Activities eligible under the Interstate Maintenance Program include resurfacing, restoring, and rehabilitation of the roadway. In addition, reconstruction or rehabilitation of bridges, existing interchanges, and over crossings also qualify. Rest Area projects along the interstate are also eligible for Interstate Maintenance Program funds. Preventive maintenance activities are eligible when a state can demonstrate, through its pavement management system, that such activities are a cost-effective means of extending interstate pavement life.

The Montana Transportation Commission approves the fund apportionment to the statewide Interstate Maintenance Program. The IM funds are distributed throughout the financial districts based solely on need.

3.5 Recommendations

Based on the findings of this study, Table 3.31 presents rankings associated with the set of factors to be used to determine whether it is feasible to upgrade and maintain existing rest area locations or whether new locations should be investigated. Four of these factors represent higher priority considerations, including provision of water, sewer, and power services and cost of rehabilitation. If there is a substantial impediment relating to any one of these four factors or a combination of any of the four, MDT guidelines recommend abandonment of the existing site and identification of an alternate location.

A total score of 130 points is possible based on the sum of the weighted scores for each factor. A higher total score for an individual rest area represents a more suitable site combined with a greater need for improvements. Accordingly, a rest area with a higher score is a better candidate for rehabilitation than a rest area with a lower score due to greater feasibility and urgency of improvements. Descriptions of each assigned ranking are provided below.

Water System
The Custer water system is not close to a community system that could be cost-effectively accessed. However, wells are easily accessed, and water quality is generally good. Sufficient flow is demonstrated through well log records at Custer.

Sewer System
Community wastewater systems are not located nearby. The proposed wastewater system can be installed without significant burden, but ultimately will require a detailed site investigation.

Power System
The Custer sites have ready access to the power grid. Costs may continue to increase, although there may be opportunities to reduce energy consumption and/or to utilize supplemental sources of power.

Cost
The total cost of site rehabilitation at the Custer sites is relatively low because projected demand does not warrant construction of a new building facility. Phased implementation could be used to reduce initial costs and allow for long-term budgetary planning. It is unknown at this time if there would be cooperative cost contributions.

Urgency of Replacement
The Custer sites currently meet existing demand. Although current maintenance requirements are not burdensome, the conventional septic tank and drainfield systems are not designed to accommodate high-strength wastewater and will require frequent pumping unless the system is upgraded in the near-term.

AADT
Current AADT at the each site is approximately 2,000 vehicles.

Spacing
Overall, the Custer rest area is appropriately spaced in relation to other nearby rest areas.

Percent Completion
This study represents planning-level consideration of rehabilitation of the three sites. No design work has been performed to date.

System
The Custer sites are located on Interstate 94.

Percent Usage by Travelers in Corridor
Usage was estimated as a percentage of AADT, per AASTHO guidelines. Additional data would be needed in order to determine actual usage.

Land Use and Ownership
MDT owns the existing sites. No additional right-of-way would be needed in order to meet future demand.

Topography and Site Accessibility

The Custer sites are outside the floodplain and there are no known environmental resources immediately adjacent to the sites. There are sight distance issues associated with the acceleration and deceleration ramps at both sites. Testing would be required to determine soil types at the sites.

Safety Corridor

There were no crashes due to fatigue within one mile of the Custer rest area.

Percent Commercial Use / MCS Facility

Commercial vehicles constitute approximately 27 percent of the AADT at the Custer sites.

Rehabilitation of Existing Site

There are no significant impediments to rehabilitation of the existing Custer sites.

Seasonal Site Conversion

The Custer site is currently closed during the winter season, but could easily be converted to year-round use.

Alternative Funding Available

It is unknown at this time whether alternative sources of funding are available for this project.

ADA Compliance

The existing Custer sites do not comply with ADA requirements relating to parking spaces, stairways, door hardware / closers, toilet stalls, and signage.

Community Involvement

It is unknown at this time whether locals support rehabilitation of the existing Custer rest area; no additional right-of-way would be required.

This Page
Intentionally Left Blank

Table 3.31 Rankings for Custer Rest Area

Factor		Description	Possible Score	EB Score	WB Score
Priority Considerations and Focus of this Study	**Water Facilities**	Feasibility of Upgrades to Water System • Community System Available = 3 • Well Easily Accessed = 2 Existing Water Quality • High quality (low turbidity, no need for filtration), sufficient flow = 3 • Poor quality, low flow rate = 0 Urgency of Rehabilitation of Water System • Existing system does not meet current (2007) demand = 4 • Existing system does not meet projected future (2027) demand = 2 • Existing system meets current demand and is projected to meet future (2027) demand = 0	10	5	5
	Sewer Facilities	Feasibility of Upgrades to Sewer System • Community sewer system nearby; connection possible = 5 • Individual system can be installed at site without significant burden = 4 • Individual system installation would be difficult due to lack of land, topography = 0 Urgency of Rehabilitation of Sewer System • Existing system does not meet current (2007) demand = 5 • Existing system does not meet projected future (2027) demand = 2 • Existing system meets current demand and is projected to meet future (2027) demand = 0	10	6	6
	Power Facilities	Energy Source • Energy source is nearby, cost-effective, and/or renewable = 5 • Energy source is remote, costly = 0	5	5	5
	Cost	Cost-effective, with cooperative cost contribution = 10 Cost Prohibitive, no cost sharing = 0	10	5	5
Urgency of Replacement		Facility requires substantial time, money, or staff resources to maintain? Age or facility condition reflected in increasing site costs? • Significant resources required = 10 • Moderate resources required = 5 • Few resources required = 0	10	2	2
AADT		AADT > 2500 = 10 2500 > AADT > 1500 = 7 1500 > AADT > 750 = 5	10	7	7
Spacing		Travel time to next or previous rest opportunity • 40 min < Travel Time < 75 min = 10 • Travel Time > 75 min = 5 • Travel Time < 40 min = 3	10	10	10
Percent Completion		Current plans and process for new facility, reconstruction, or rehabilitation underway, including total funds already obligated to site • Agreement signed, significant work performed and funds obligated, additional right-of-way purchased = 10 • Nothing but an idea = 0	10	2	2
System		Interstate = 5 NHS = 3 Primary = 2	5	5	5
Percent Usage by Travelers in Corridor		**Commercial or Metro Area** Usage > 9% = 5 9% > Usage > 5 % = 3 5% > Usage = 0 **Typical Rural Route** Usage > 12% = 5 12% > Usage > 8 % = 3 8% > Usage = 0 **Information and Welcome Center** Usage > 15% = 5 15% > Usage > 9 % = 3 9% > Usage = 0	5	3	3
Land Use and Ownership		MDT Owned = 5 State = 4 Private = 3 Lease = 1	5	5	5
Topography and Site Accessibility		Outside floodplain; suitable elevation and soil type; construction will not adversely impact environmental resources; topography provides adequate line of sight and safe acceleration / deceleration distances. • Site meets all criteria = 5 • Significant challenges with water table, soil composition, environmental impacts and/or line of site = 0	5	4	4
Safety Corridor		High crash section = 5 No reported crashes due to fatigue = 0	5	0	0
Percent Commercial Use / MCS Facility		Can be incorporated into MCS facility and located in high-need area = 5 Site cannot be incorporated; many parking opportunities available = 0	5	4	4
Rehabilitation of Existing Site		Existing site, considering all elements, can be reconstructed / rehabilitated = 5 Existing site has significant impediments = 0	5	5	5
Seasonal Site Conversion		Site is open year round or can easily be converted = 5 Significant impediment to conversion; must select new site = 0	5	4	4
Alternative Funding Available		Other sources of funds available to build or maintain rest area = 5 Built and maintained solely through RA program set-aside = 0	5	2	2
ADA Compliance		Meets all current ADA specifications = 0 Significant ADA issues (sidewalks, parking, accessibility) must be overcome = 5	5	2	2
Community Involvement		Locals are supportive and will donate land = 5 Locals are not supportive or proactively resistant = 0	5	3	3
TOTAL SCORE			**130**	**79**	**79**

This Page
Intentionally Left Blank

Based on the rankings noted in Table 3.31, there do not appear to be any significant impediments relating to rehabilitation of water, sewer, or power facilities at the Custer sites.

Although full site rehabilitation would be costly, it is possible to phase rehabilitation in order to reduce initial costs and plan for future needs. Therefore, it is recommended that MDT rehabilitate the Custer sites as funding allows in order to accommodate future demand.

Water Recommendations
- Existing water system is adequate to meet current and future needs at Custer assuming some water conservation practices are implemented; replace pumps and maintain system as needed in order to extend design life.
- Conduct inventory of wells and document their condition.
- Install water meters to more accurately define system demand.

Sewer Recommendations
- Conduct detailed site soil investigations to refine design and accurately determine area needed for an appropriately-sized drainfield. Additionally, perform nondegradation analysis to define the groundwater quality impact and establish wastewater system design criteria.
- Conduct wastewater effluent monitoring to establish the existing strength of the wastewater.
- Based upon raw wastewater characteristics and results of a nondegradation analysis, re-evaluate wastewater treatment options so that the most appropriate system may be selected at the Custer rest area.
- Install new septic tanks and drainfields.

Power Recommendations
- Consider use of motion-detectors to reduce energy usage.
- Evaluate building orientation and heating, lighting, plumbing and mechanical systems at time of site rehabilitation in order to provide the most energy-efficient design.
- Consider use of solar or wind power to supplement power and reduce monthly energy costs.

Physical Site Recommendations
- Upgrade building facilities to maximize energy efficiency, meet ADA requirements, and accommodate demand over 20-year planning period.
- Design new parking lots so that existing acceleration and deceleration ramps could continue to serve facilities.
- Incorporate water-saving landscaping into the new design. Use of native, drought-resistant vegetation and smaller turf areas could substantially reduce irrigation needs.
- Consider drip irrigation system to reduce water usage.

General Recommendations and Long Term Considerations
- Consider opening the Custer rest area for year-round access.
- Attempt to minimize closure periods to the extent practicable during rest area rehabilitation. Each of the three phases of rehabilitation for the Custer sites could likely be completed within one to two weeks. Scheduling improvements to occur in the off-peak tourist season (early spring or late fall, as opposed to mid-summer) could reduce impacts to the traveling public somewhat. It should be noted that single-phase implementation would likely require a longer closure period.

4.0 HYSHAM REST AREA

4.1 Existing Conditions and Current Demand

4.1.1 General Site Descriptions & Setting

The information provided in this section was gathered from the Rest Area Site Evaluation Forms completed by MDT in April 2008, which are included in Appendix A. Additional information was gathered during site visits conducted on January 19-21, 2009 and from mapping provided by MDT Environmental Services Bureau.

The Hysham rest area sites are located on relatively flat ground amid rolling terrain in a rural setting. There are a few trees at the sites, with grassy areas surrounding the buildings. Box Elder Creek runs adjacent to I-94 and is located on the west side of the interstate near this rest area. The sites are located outside the floodplain. An existing oil pipeline also runs near this site on the west side of I-94. No other known environmental constraints are located near this site. A schematic of the Hysham rest area is presented in Figure 4-1 and a topographic map is provided in Figure 4-2.

Hysham EB

Hysham WB

Figure 4-1 Hysham Rest Area

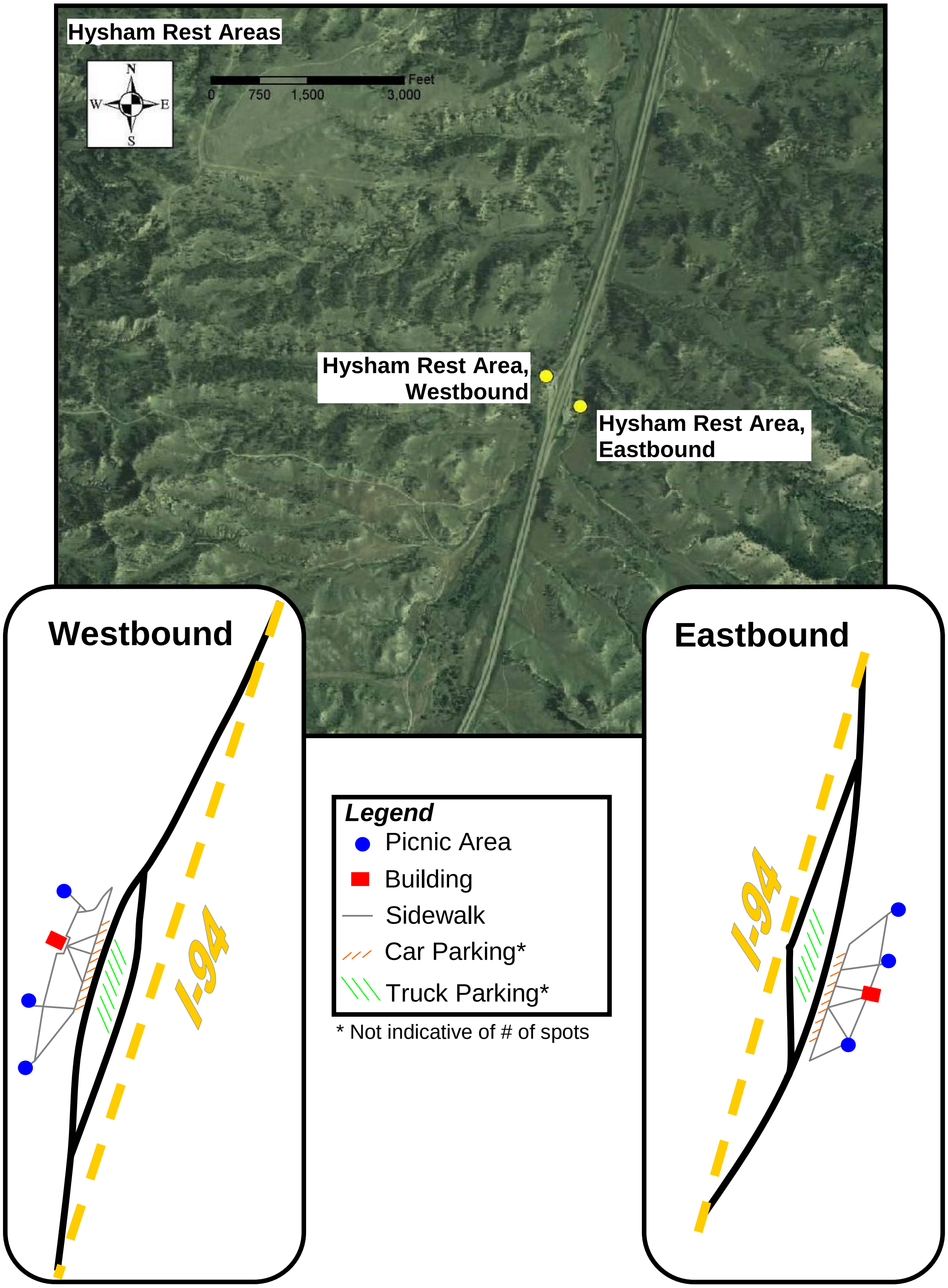
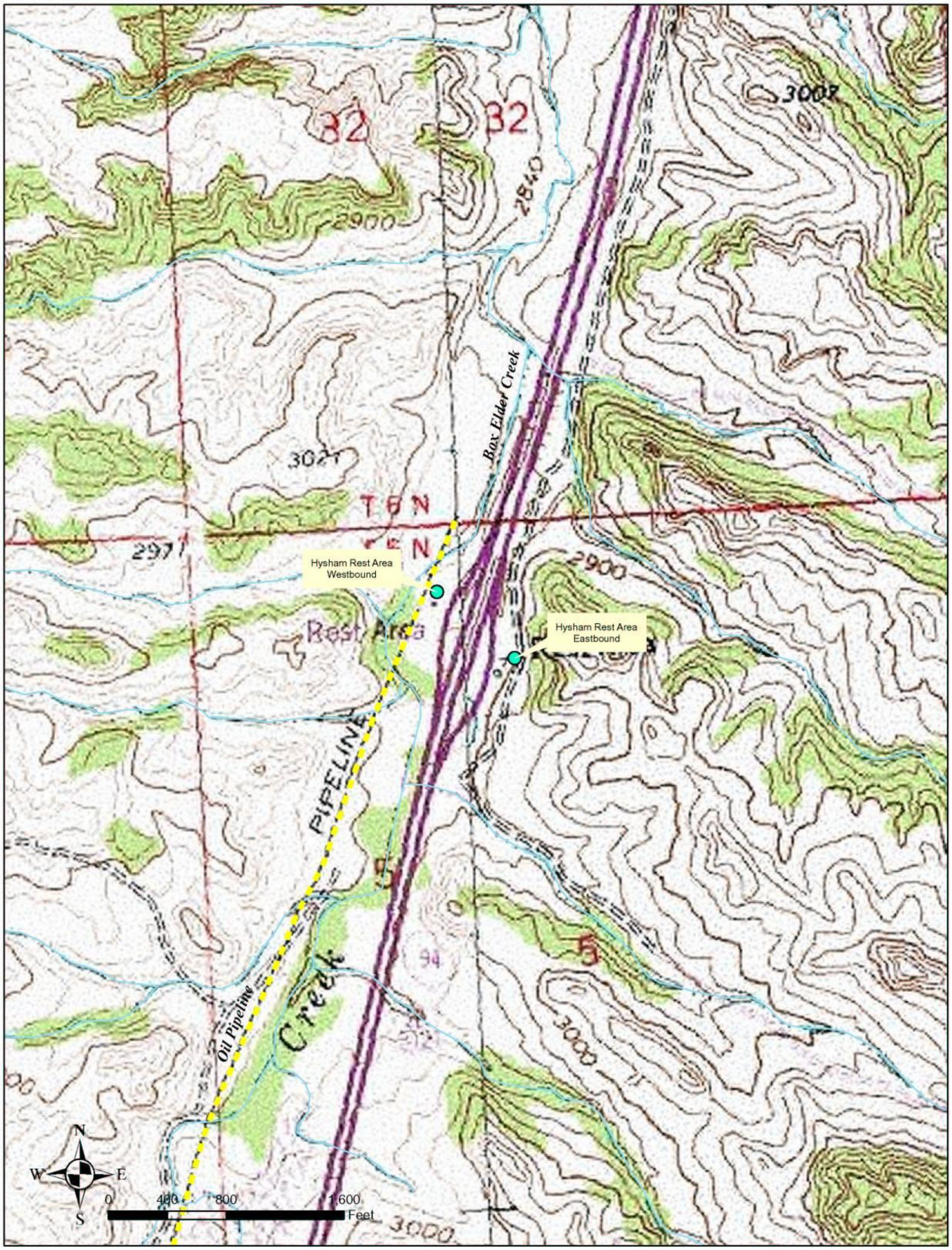


Figure 4-2 Topographic Map of Hysham



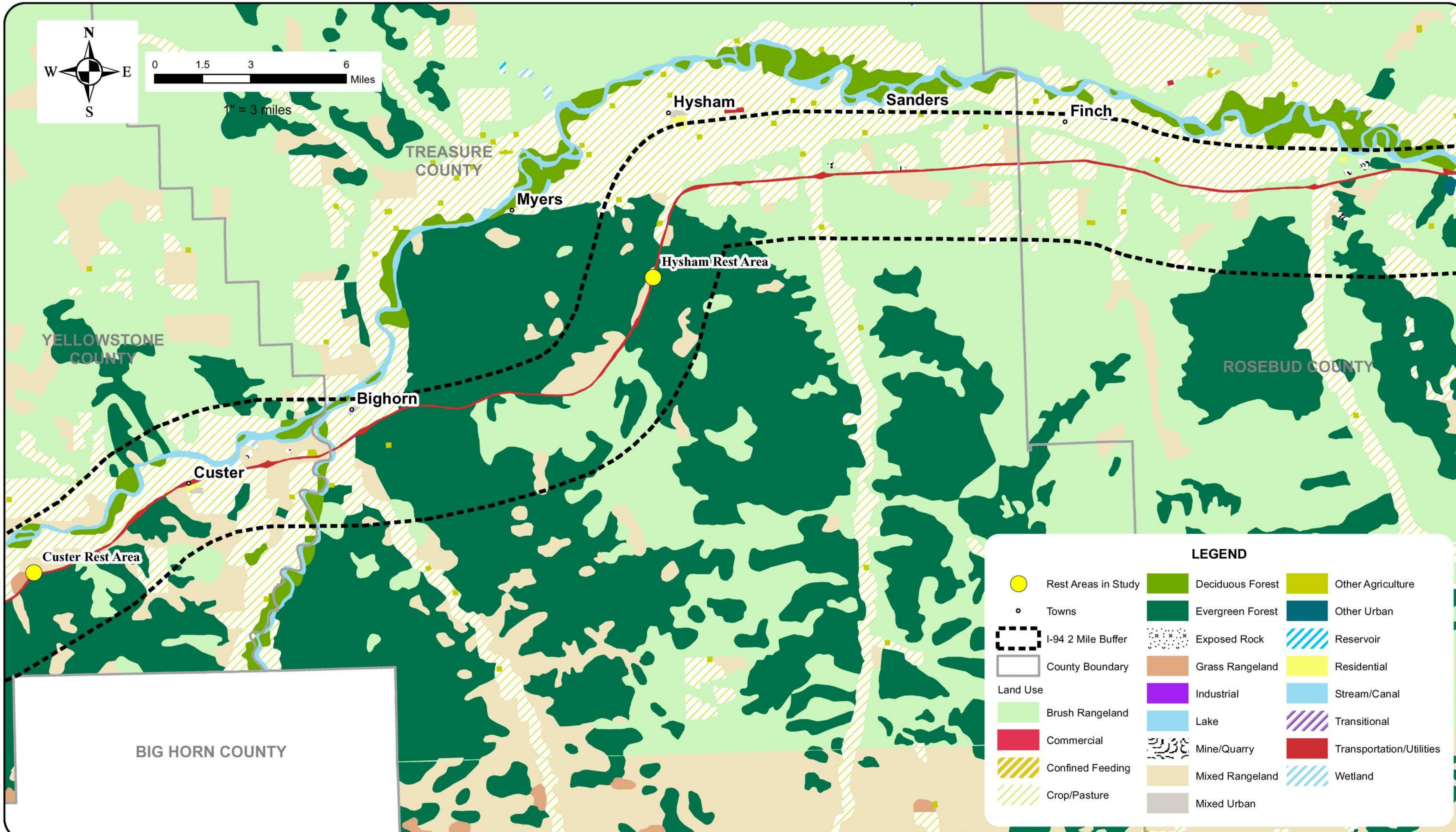
4.1.2 Land Use and Ownership

Forest lands nearly surround the Hysham rest area. The remaining land uses along the I-94 corridor consist mostly of cropland, pasture, and rangeland. Billings, Forsyth, and Miles City are the major residential/urban areas throughout the I-94 corridor. Land uses are illustrated in Figure 4-3.

Generally, land throughout the corridor is mostly private with areas of state and BLM land dispersed throughout. Some portions of land throughout the I-94 corridor are owned by the Bureau of Indian Affairs. Land areas adjacent to the Hysham rest area sites are generally in private ownership. Land ownership status adjacent to each site is illustrated in Figure 4-4.

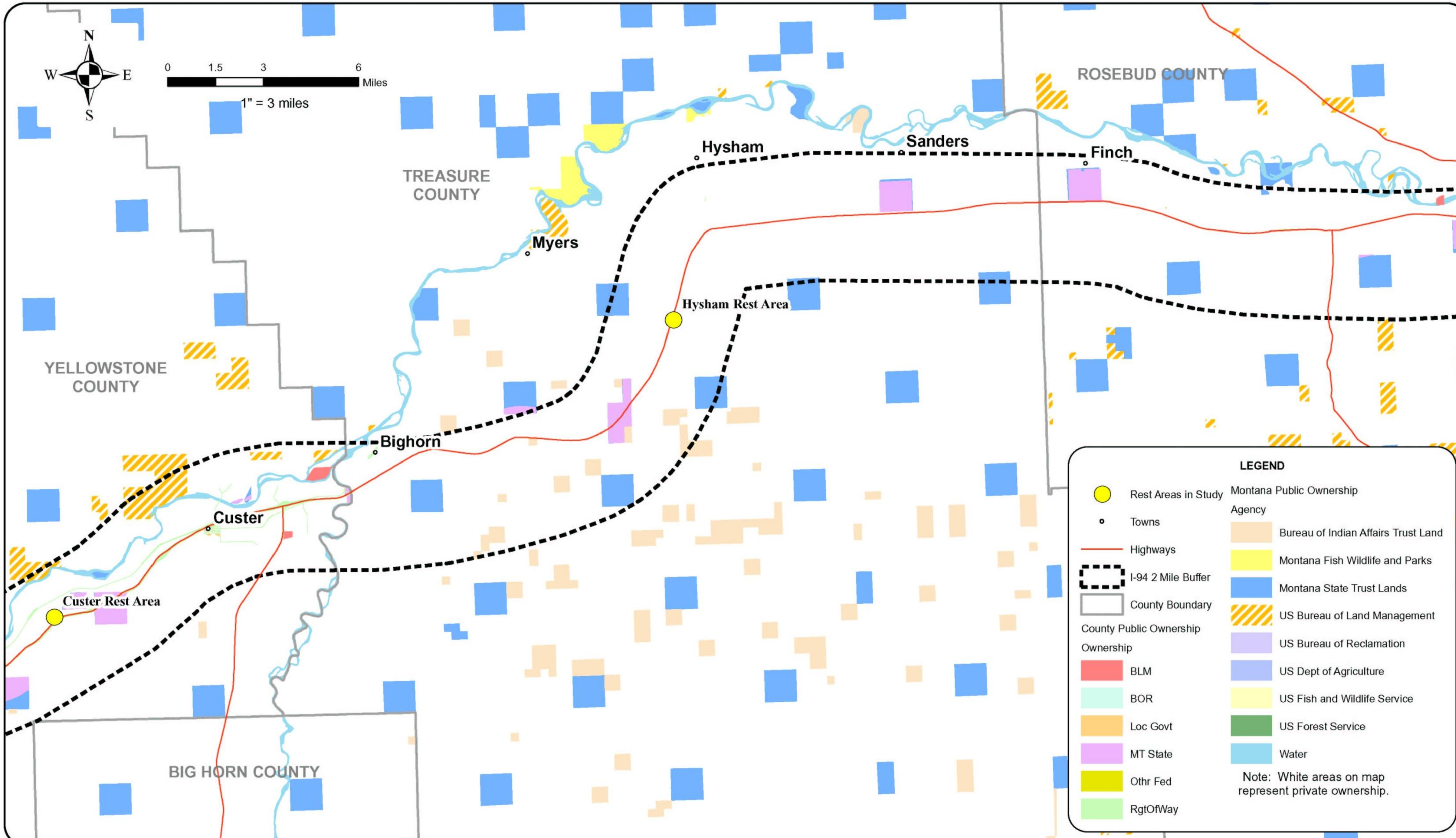
This Page
Intentionally Left Blank

Figure 4-3 Land Use along I-94 Study Boundary (Custer to Forsyth)



This Page
Intentionally Left Blank

Figure 4-4 Land Ownership along I-94 Study Boundary (Custer to Forsyth)



This Page
Intentionally Left Blank

4.1.3 Building and General Site Conditions

The Hysham rest area is generally in good condition. There are a few elements at each of the sites in need of repair or replacement, as noted in Tables 4.1 and 4.2. Photographs of select elements needing repair or replacement are included in Appendix B.

Table 4.1 Hysham Building Conditions

Rest Area Site	Roofing	Siding	Paint	Plumbing Fixtures	General Interior Condition	General Exterior Condition
Hysham EB	Steel - Good	Painted Concrete / Rock - good	**Needs facia and interior paint**	Stainless / Porcelain – OK	Good **(Flooring needs work)**	Good
Hysham WB	Steel – like new	Painted Rock / Stone - good	Ok **(Picnic Area Needs Paint)***	Stainless	Good **(Graffiti on Stalls)***	Good

Note: Shaded cells indicate elements in need of repair or replacement.
*Photographs of these elements are included in Appendix B.
Source: MDT Site Evaluation Forms, 2008; DOWL HKM, 2009.

Table 4.2 Hysham General Site Conditions

Rest Area Site	Asphalt	Sidewalks	Landscaping	Picnic Facilities
Hysham EB	Good	**Ok (chipped and uneven)***	Ok	3 structures / 12 tables – new
Hysham WB	Good	Like New	Good	3 structures / 12 tables - good

Note: Shaded cells indicate elements in need of repair or replacement.
*Photographs of these elements are included in Appendix B.
Source: MDT Site Evaluation Forms, 2008; DOWL HKM, 2009.

Table 4.3 describes the existing deceleration (entrance) and acceleration (exit) ramps for each of the rest area sites.

Table 4.3 Hysham Ramp Conditions

Rest Area Site	Acceleration Ramp	Deceleration Ramp	Sight Distance
Hysham EB	Short	Short	Good
Hysham WB	Short and curvy	Short and curvy	Ok

Note: Shaded cells indicate elements in need of repair or replacement.
*Photographs of these elements are included in Appendix B.
Source: MDT Site Evaluation Forms, 2008; DOWL HKM, 2009.

4.1.4 Maintenance Contracts

General maintenance and cleaning of the rest areas is contracted out to private entities. Maintenance contracts typically encompass cleaning, mowing, weeding, irrigating, painting, cleaning of the picnic areas, and general upkeep. Rest areas are typically cleaned two to three times per day. Each pair of rest areas is administered under one contract. The cost to maintain the Hysham rest area is approximately $3,600 per month.

4.1.5 Seasons of Operation

The Hysham rest area is open year round, conforming to the stated Rest Area Prioritization Plan committee's objective for year-round rest area facilities.

4.1.6 Current AADT

Short-term count data was used to approximate AADT at the Hysham rest area. Directional splits were not available at these count locations. For the purposes of this study, equal volumes were assumed for the EB and WB directions. Percentages of vehicles included in the broad categories of passenger vehicles, small trucks, and large trucks were generated from MDT's TYC table. AADT volumes for 2007 are presented in Table 4.4.

Table 4.4 Current AADT near Hysham (2007)

Rest Area	Route	Rest Area Location (RP)	Traffic Count Location (RP)	Total AADT	Total Passenger & Bus (Types 1-4)		Total Small Trucks (Types 5-7)		Total Large Trucks (Types 8-13)		Total Commercial (Types 5-13)	
					AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT
Hysham EB	I-94	64.7	67	2,265	1,326	80.62	110	2.43	768	16.95	439	19.38
Hysham WB		64.8		2,265	1,326	80.62	55	2.43	384	16.95	439	19.38

Source: MDT, 2008.
Note: Directional counts not available. AADT assumes equal volumes for EB and WB directions.

4.1.7 Current Rest Area Usage

The Rest Area Plan provides guidance regarding rest area usage based on AASHTO formulas. The number of vehicles stopping at a rest area site per hour is calculated as a percentage of the directional traffic volume, with factors accounting for the mainline traffic composition by type of vehicle as well as the type of mainline route. Detailed calculations are provided in Appendix C. The AASHTO methodology for estimating rest area usage is considered highly conservative and is the standard used to date. It should be noted that MDT has initiated a research project to be completed in 2010 that will identify more accurate methods to predict rest area usage.

Table 4.5 presents the number of vehicles per hour estimated at the Hysham rest area. It should be noted that a range of values may be used for car and truck stopping percentages. The range of stopping percentage values provided by AASHTO is intended for use nationwide, although AASHTO recommends that stopping percentages ideally be determined on a case-by-case basis through usage surveys. In the absence of site-specific data, the mid- to low-end of the AASHTO stopping percentage range was used for the purposes of this study because Montana is largely rural in nature and has a relatively small population in comparison to other states.

This study did not consider factors that may affect stopping percentages at individual rest area locations within the study area. In the event that an individual project is developed following this study, site-specific designs may be adjusted on an as-needed basis if justified by special circumstances. Accordingly, usage values presented in this study should be viewed as preliminary estimates; the need for a greater or lesser number of parking spots, restroom stalls,

and other rest area amenities than suggested in this study should be considered at the time of project development for each individual site based on actual usage data.

It is not the intent of this study to design to peak usage at a particular site; rather, a single standardized method is used for all sites. This study will, however, qualitatively address when or under what circumstances the current rest area sites are expected to be physically undersized, requiring consideration of a new site or purchase of additional right-of-way at the current sites. It should also be noted that the MDT Road Design Manual provides slightly different calculation factors. This study used the calculation guidelines presented in the Rest Area Plan.

Table 4.5 Current Rest Area Usage at Hysham (2007)

Rest Area Site	Total Number of Vehicles Per Hour	Number of Passenger Cars and Buses Per Hour	Number of Commercial Trucks Per Hour**
Hysham*	38	29	9

Source: MDT, 2008; DOWL HKM, 2009.
Note: Calculations use factors from Table 9, Rest Area Plan, 2004.
*Usage values apply to both EB and WB sites.
**Includes estimate for the number of cars with trailers or RVs.

The Rest Area Plan also provides guidance regarding parking at rest areas. The recommended number of spots is calculated as a percentage of the directional traffic volumes, with factors accounting for design hour volumes, traffic composition, and type of route. Detailed calculations for each rest area site are included in Appendix C. Guidelines for the recommended number of ADA parking spots are included in the Checklist of Facility Accessibility for each site (Appendix D).

Table 4.6 Hysham Parking Conditions (2007)

Rest Area Site	Truck Parking Spots		Auto Parking Spots		ADA Parking Spots	
	Actual Number	Recommended Number*	Actual Number**	Recommended Number *	Actual Number*	Recommended Number ***
Hysham EB	5	5	17	13	2	1
Hysham WB	5	5	18	13	3	1

Source: MDT, 2008; DOWL HKM, 2009.
*Calculations use factors from Table 9, Rest Area Plan, 2004. Truck parking includes cars with trailers or RVs.
**Actual number of spots determined based on site visits conducted in January 2009.
***As recommended in Parking Space Matrix, Checklist for Facility Accessibility, MDT 2008.

As noted in Table 4.6, the existing number of automobile parking spots at the Hysham rest area meets or exceeds the recommended number of spots. Although Table 4.6 indicates adequate truck parking at the Hysham rest area, MDT maintenance personnel believe additional truck parking is needed. MDT maintenance personnel commented that trucks often park at the Hysham rest area at night, filling the ramps and parking lot, making it difficult for other travelers to enter. The number of ADA parking spots at each of the rest areas is more than adequate given the current traffic volumes and approximated usage.

The Rest Area Plan also provides guidance for the recommended number of picnic tables and waste receptacles (referred to as site facilities throughout this document) at each site. As noted in the calculation procedure provided in the bottom portion of Table 12 within the Rest Area Plan, the appropriate number of site facilities is determined by applying factors to the calculated number of parking spaces listed in Table 4.6. Detailed calculations are provided in Appendix C.

Table 4.7 presents the recommended site facilities at the Hysham rest area based on current AADT volumes.

Table 4.7 Hysham Site Facilities (2007)

Rest Area Site	Picnic Tables		Waste Receptacles	
	Actual Number	Recommended Number	Actual Number	Recommended Number
Hysham EB	12	7	8	5
Hysham WB	12	7	11	5

Source: MDT, 2008; DOWL HKM, 2009.
Calculations use factors from Table 12, Rest Area Plan, 2004.

As noted in Table 4.7, the Hysham rest area has an adequate number of picnic tables and waste receptacles. The majority of existing picnic tables at the sites are located within picnic shelters each containing four tables. The waste receptacles are located within garbage can racks each containing two to three garbage cans. A single garbage can is also located within each restroom.

The Rest Area Plan provides methodology for calculating the required number of restroom stalls and required water usage at each site. The number of required restroom stalls is based on the rest area usage determined in Table 4.5 along with estimates accounting for the number of rest room users per vehicle and an estimated time cycle per fixture. Similarly, water usage is determined by applying a usage rate per person to the total rest area usage listed in Table 4.5. Calculations for the number of restroom stalls and water usage both use a peaking factor of 1.8.

Table 12 within the Rest Area Plan lists the calculation procedure and assumptions used for calculating the number of restroom stalls and water usage. Detailed calculations are provided in Appendix C.

Table 4.8 presents the recommended number of restroom stalls and estimated current water usage at each site based on current AADT volumes.

Table 4.8 Restroom Stalls and Water Usage at Hysham (2007)

Rest Area Site	Women's Stalls		Men's Stalls		Water Usage (Peak Hourly Demand)
	Actual Number	Recommended Number	Actual Number	Recommended Number	
Hysham EB	4	2	4	1	5 gpm
Hysham WB	4	2	4	1	5 gpm

Source: MDT, 2008; DOWL HKM, 2009.
Calculations use factors from Table 12, Rest Area Plan, 2004.

The number of restroom stalls at the Hysham rest area exceeds the recommended number of stalls based on current usage estimates.

4.1.8 Spacing

The Rest Area Plan recommends spacing between rest areas equal to approximately one hour of travel time under favorable traveling conditions. Figure 4-5 and Table 4.9 present current spacing for the Hysham rest area. Blue shaded cells indicate overly dense spacing between rest areas. Close spacing between rest areas may represent an unnecessary allocation of MDT resources.

Figure 4-5 Rest Area and City Locations

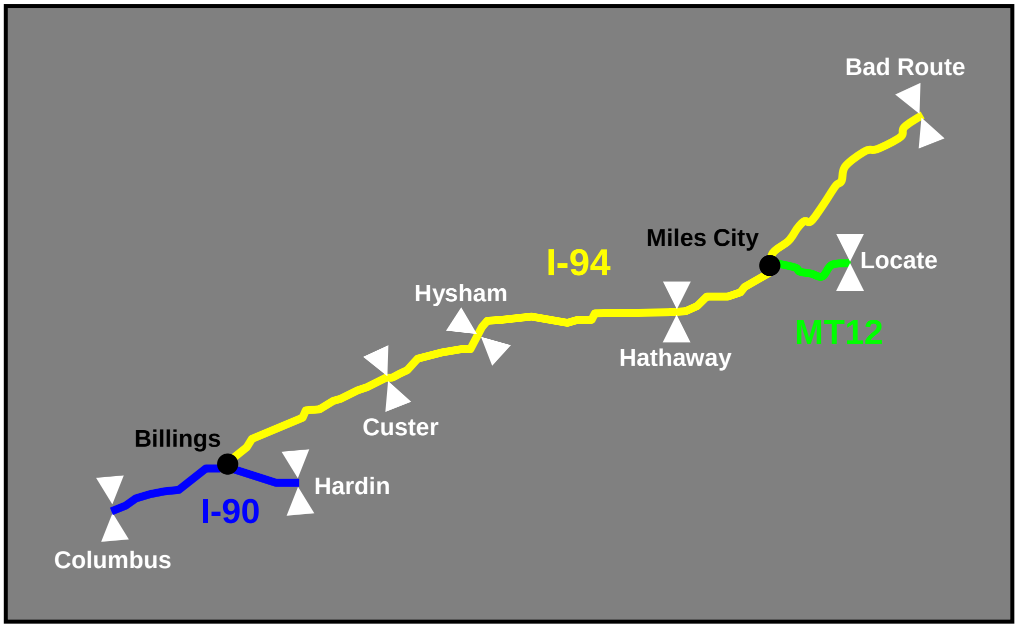


Table 4.9 Spacing between Rest Areas and Nearby Cities with Services

Rest Area Site	Previous Rest Area		Previous City with 24/7 Services		Next Rest Area		Next City with 24/7 Services	
	Name	Distance (miles)	Name	Distance (miles)	Name	Distance (miles)	Name	Distance (miles)
Hysham EB	Custer	**26**	Billings	64	Hathaway	49	Miles City	74
Hysham WB	Hathaway	48	Miles City	74	Custer	**23**	Billings	64

Note: Blue shaded cells indicate overly dense spacing.
Source: MDT Rest Area Site Evaluation Forms, 2008.

The distance between the Hysham and Custer rest areas is approximately 50 miles closer than recommended under the Plan.

As noted in Section 3.1.4, the Custer rest area is closed during the winter months. During these periods of closure, the spacing between subsequent rest areas would extend to 102 miles between the Columbus rest area and the Hysham rest area, and 84 miles between the Hardin rest area and the Hysham rest area. This is shown in Table 4.10. Orange shaded cells indicate distances between rest areas that exceed the recommended maximum spacing, assuming drivers travel at the posted speed limit of 75 miles per hour. It should be noted that excessive distances between rest areas can inconvenience the traveling public.

Table 4.10 Changes in Spacing between Rest Areas During Winter Months

Rest Area Site	Previous Rest Area		Previous City with 24/7 Services		Next Rest Area		Next City with 24/7 Services	
	Name	Distance (miles)	Name	Distance (miles)	Name	Distance (miles)	Name	Distance (miles)
Hysham EB	Columbus	**102**	Billings	64	Hathaway	48	Miles City	74
	Hardin	**84**						
Hysham WB	Hathaway	48	Miles City	74	Columbus	**102**	Billings	64
					Hardin	**84**		

Source: MDT Rest Area Site Evaluation Forms, 2008.
Note: Orange shaded cells indicate distances between rest areas exceeding Rest Area Plan recommendations.

4.1.9 Water, Sewer, and Power Services

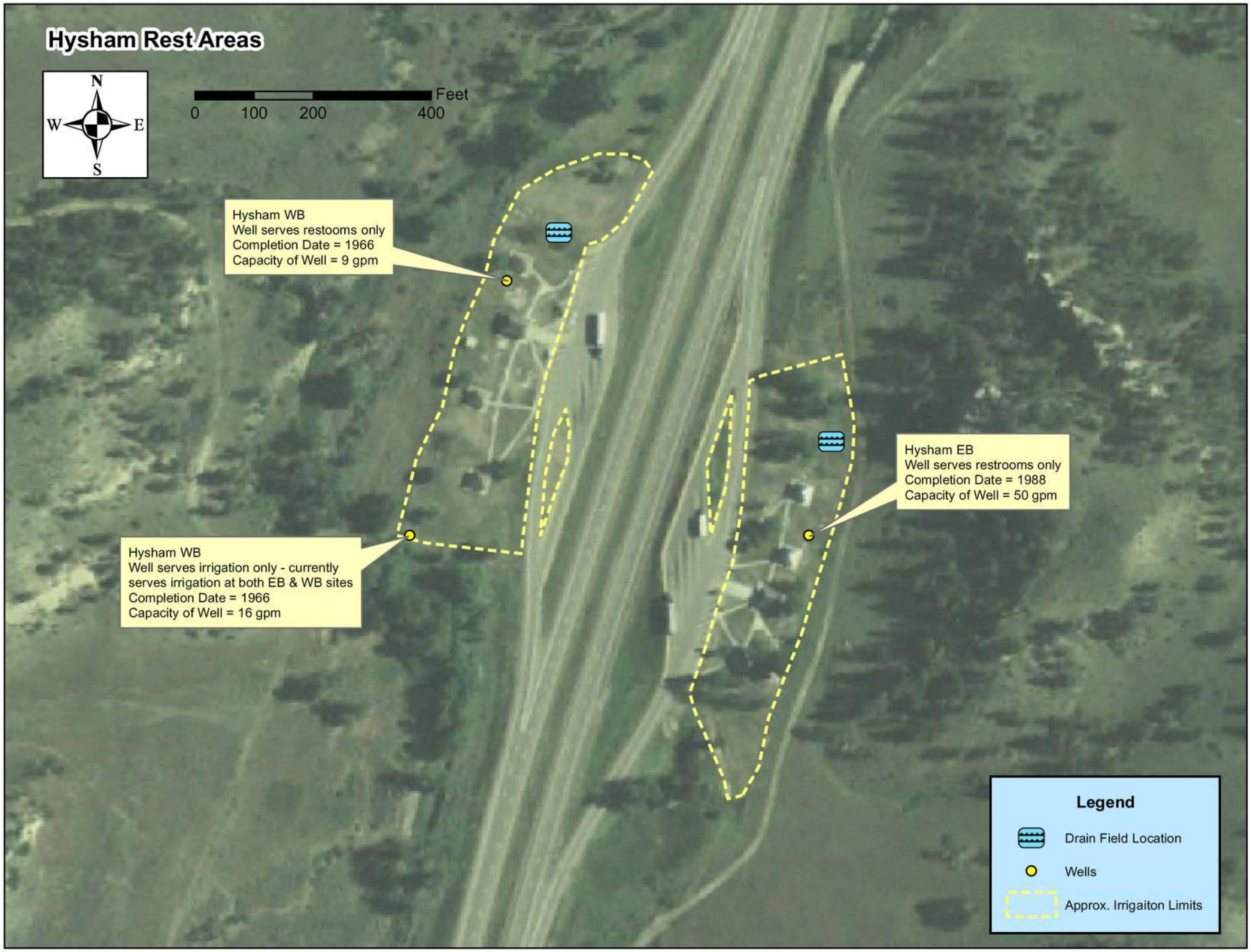
Information on existing water, sewer, and power services was obtained from a variety of sources, as noted in Table 4.11.

Table 4.11 Sources for Information on Existing Water, Sewer, and Power Services

Source	Notes
Site visits conducted on January 19-21, 2009 and corresponding meetings with MDT maintenance personnel	Photos of the water, sewer, and power systems taken during the site visits are included within Appendix E and will be referred to throughout this section.
MDT	A variety of data was obtained from MDT including as-built drawings of recent water and sewer system improvements as well as maintenance division questionnaires. Through meetings and correspondence with the MDT maintenance personnel for each site, additional information was obtained including available design criteria, equipment manufacture data, well logs, applicable correspondence, and power records.
DEQ	The Helena and Billings DEQ offices were contacted for any applicable files pertaining to the water and waste water systems that may have gone through the permitting and approval process.
Online Databases	Several online sources were used to collect information on the rest area sites, including: ○ MBMG GWIC ○ DEQ Public Water Supply Reports ○ USDA NRCS Soils Data ○ NRIS

Figure 4-6 depicts the locations of some of the pertinent water and wastewater system components at the Hysham rest area.

Figure 4-6 Hysham Water and Sewer Location Map



Water

Groundwater is the source of potable water at the Hysham rest area sites. Water from this source is used to serve the rest area facilities such as toilets, sinks, and drinking fountains, as well as for irrigation of the grass and associated landscaping. The approximate locations of the Hysham wells are shown in Figure 4-6. Each well is labeled with the most recent capacity information available in addition to the intended use.

Quantity

To assure there is adequate water quantity at the sites, the source capacity of the wells must equal or exceed the design maximum day demand per Circular DEQ-3. Table 4.12 lists the current maximum water use estimates at each rest area site. The current estimated restroom water usage is drawn from Table 4.8. The irrigation demand is estimated based on requirements from the NRCS and the Montana Irrigation Guide for pasture grass and turf. The NRCS provides consumptive use estimates for pasture grass and turf based on data obtained from several weather stations throughout the state. Several assumptions are made such as the irrigation cycle time, delivery period for the irrigation volume, and system efficiencies in order to come up with the estimated irrigation flow rate. The estimated irrigation area was determined using aerial photography and as-built drawings of the irrigation systems. Twenty-five percent of the irrigation area was removed from the calculations to account for impervious areas such as buildings, sidewalks, and picnic shelters. The irrigation demand calculations are found within Appendix F, along with a more detailed description of how the demands are calculated.

Table 4.12 Hysham Water Use Estimates

Rest Area Site	Restroom Water Usage (Peak Hourly Demand)	Estimated Irrigation Demand	Total Demand
Hysham EB	5 gpm	32 gpm	37 gpm
Hysham WB	5 gpm	36 gpm	41 gpm

Source: MDT, 2008; DOWL HKM, 2009.

Based on discussions at the site visits, there are no water meters installed anywhere in the system. Therefore, actual water use data is not available and the estimates presented in Table 4.12 are the best available current usage estimates.

To determine the well capacities, well log information was downloaded from the MBMG website through the GWIC database. The well log information for the rest area sites can be found within Appendix G. In addition, MDT maintenance personnel also provided information on pump testing performed in 1987 shown in Table 4.13. It should be noted that from a water rights perspective, the rest area wells are allowed to pump no more the 35 gpm and 10 acre-feet per year as specified for “exempt wells” per DNRC. While exempt wells currently tend to be unregulated relative to actual usage, flow restriction valves are typically installed to limit the flow to 35 gpm. Generally, under an exempt well permit, an appropriate pump is selected to limit the flow to within the exempt well allowance of 35 gpm. Without a flow meter, neither the pumping rate nor annual use can be accurately recorded. Therefore, the well log does not necessarily match the actual well pumping rate for whatever pump was ultimately installed.

Table 4.13 Hysham Pump Testing (1987)

Rest Area Site	Well Depth & Aquifer	Pump Depth & Size	Static Head	Pumping Level	Pumping Rate	Remarks
Hysham WB	65 ft, Gravel (Screen)	60 ft, 1.5 HP	14 ft	30 ft	9 gpm	Need to clean well. Could use larger pump, Orig. gpm = 28

Source: MDT, 1987.
Hysham EB is not included in the above table because a new well was drilled in 1988.

The Hysham EB well has adequate capacity to serve the irrigation and domestic needs of the rest area, however, this well currently only serves the EB restrooms, with irrigation being provided from one of the WB wells. Maintenance personnel revealed that it is a future goal to discontinue serving EB irrigation from the WB well and eventually serve the entire EB site with the EB well. It was observed at the EB site visit that the grass was not as well maintained as the WB site (i.e. dirt and mud where grass should have been). It is also a future goal to install a new irrigation system similar to the system recently installed at the WB site.

The data provided on the Hysham WB wells indicates that the capacities may not be adequate to serve the estimated demands listed in Table 4.12. However, maintenance personnel did not identify any issues with the water system at Hysham WB and it was observed that the grass and landscaping were very well maintained. The Hysham WB well has most likely been rehabilitated since the 1987 pump test data based on the remarks listed in Table 4.13. Removing the EB irrigation demand from the WB irrigation well will also free up capacity for the WB site. A new irrigation and fertilizer system has recently been installed at this site according to maintenance personnel.

Quality

Treatment at the Hysham sites consists of a single cartridge filter. The filter helps to remove particles that may damage the valving within the restrooms. Water for the drinking fountains and hose bib outside the buildings are not filtered.

Current standards set forth by the applicable Circular DEQ-3 state that supply wells must have unperforated casing to a minimum depth of 25 feet or continuous disinfection must be provided. The unperforated casing depth refers to the depth below ground surface where perforation or screening begins. Additionally, per Circular DEQ-3, full time disinfection is required where the water source is an aquifer with a water table that is within 25 feet of the ground surface.

Table 4.14 lists specific data from the Montana Well Log Reports obtained from the GWIC database, which are provided in Appendix G. As shown, the recorded static water level for the Hysham EB well is below the 25-foot water table threshold. Recorded static water levels at the Hysham WB wells, however, are less than the 25-foot minimum depth and could indicate the presence of high groundwater. However, these static water levels were recorded in 1966 and DEQ Public Water Supply System water quality records do not indicate that total coliform MCL violations has been an issue. Nonetheless, it is recommended that the static water level at the Hysham WB potable well be verified during the spring when groundwater levels are expected to be at their highest levels. If the static water level is less than 25 feet, and there are no confining units between the well screen and the nearest stream, there is a potential that DEQ will require disinfection of the water.

As noted in Table 4.14, the unperforated casing depths for all Hysham wells are below the 25-foot minimum depth.

Table 4.14 Hysham Well Log Information

Well	Static Water Level	Unperforated Casing Depth
Hysham EB	46.89 ft	28 ft
Hysham WB (Potable)	14 ft	63 ft
Hysham WB (Irrigation)	24 ft	No completion records

Source: MBMG GWIC database, 2009.

The DEQ Public Water Supply System online database was queried to obtain water quality sampling records pertaining to the Hysham rest area sites. This data is included in Appendix H. The water systems serving the rest area sites are classified as transient non-community water supplies meaning that they serve 25 or more persons per day but do not regularly serve the same persons for at least six months a year. Transient non-community water supplies adhere to a specific set of water quality regulations as specified by DEQ. Detailed information can be found on DEQ's website.

Samples for coliform bacteria must be collected either on a monthly or quarterly basis depending on authorization from DEQ. The Hysham sites sample quarterly for coliform bacteria. If more than one sample per month/quarter is total coliform-positive, a violation of the MCL occurs and public notice must be given. In addition to coliform bacteria, all transient non-community water systems must sample annually for nitrates. One sample is adequate unless the result is greater than 5.0 mg/L. The MCL for nitrate is 10 mg/L. The Hysham EB rest area has had no recent MCL violations. The Hysham WB rest area had one MCL violation for total coliform in 1995.

If groundwater sources are determined to be directly influenced by surface water through DEQ's GWUDISW determination process, they will be subject to Surface Water Treatment Rule requirements.

General Site Observations and Operation / Maintenance Issues

MDT provided results from recent maintenance questionnaires pertaining to each site. These are provided in Appendix I.

There have been no major issues or maintenance problems with the water systems at Hysham. A new irrigation system is planned for the EB site next year.

A tour of the maintenance/utility rooms was provided at the Hysham rest area. Photos are included in Appendix E. The water systems at Hysham consist of piping from the well to a pressure tank. From there the water travels through a small section of piping, through a filter, and then through piping to serve the toilets and sinks. The utility rooms contain air tanks to operate the air valves for flushing toilets. The air valves and other piping are located in a small corridor between the two restrooms. A common complaint is the lack of space to perform routine maintenance within these corridors.

Sewer

On-site sewage treatment at the Hysham rest area is accomplished through the use of a septic tank and soil absorption drainfield. The approximate location of the septic tank and drainfield are shown in Figure 4-6.

The entire Hysham WB wastewater system was replaced in 2007. A new septic tank, drainfield, and dosing system were installed. A new septic tank and dosing system were installed at the EB site in 1988. Pressure dosing is accomplished through the use of a pumping system installed in conjunction with the septic tank. The dosing pumps help to provide uniform distribution to the drainfield area.

Size of System

Based on the higher strength wastewater typical at a rest area, conventional septic tank and drainfield systems are not recommended for rest area applications. However, because these systems currently exist at the Hysham sites, the following is a discussion of sizing requirements and adequacy to meet the current demand.

Preliminary calculations for septic tank and drainfield sizing are made considering today's standards set forth by DEQ. Per DEQ design regulations, the minimum acceptable size of a septic tank is 1,000 gallons for any system. DEQ provides guidelines for sizing septic tanks based on the type (residential versus non-residential) and quantity of the design flow. DEQ requires that for non-residential flows greater than 1,500 gallons per day, the tank must have a minimum capacity equal to 2.25 times the average daily flow. The average daily flow is determined using the design factors from Table 12 of the Rest Area Plan for water usage combined with the AADT volumes and estimated percentage of rest area users. Detailed calculations can be found within Appendix J. Existing septic tank sizes were provided by MDT maintenance personnel and are listed in Table 4.15 along with the calculated recommended sizing based on current usage.

Detailed design information was provided on the Hysham WB wastewater installation. Little information was provided on the Hysham EB site with the exception of a set of as-built drawings provided by MDT for an improvement project completed in 1988. A new septic tank and dosing system were installed as part of this project. Rough estimates of the drainfield size and septic tank were obtained from the scaled site plans included as part of the as-built drawings. The site plan showed twelve 70-foot-long laterals. Assuming a trench width of three feet (allowed for dosed systems), the total drainfield area is approximately 2,520 square feet.

Several site characteristics and investigations need to be evaluated for the proper design of the drainfield, including soil profile descriptions, percolation tests, and site factors such as slope, drainage, and depth to groundwater. This information was not collected as part of this study but will need to be obtained for any new drainfield design.

For the purposes of this study and to determine rough design estimates, NRCS soils information was used to determine approximate percolation rates. The Hysham wastewater system calculations use percolation rate information obtained from more recent design reports. Detailed calculations can be found within Appendix J. Rough estimates of existing and proposed drainfield sizes are listed in Table 4.15.

Table 4.15 Hysham Septic Tank and Drainfield Size

Rest Area Site	Septic Tank		Drainfield	
	Existing Size	Recommended Size for Existing Usage	Estimated Existing Size	Recommended Size for Existing Usage
Hysham EB	2,800 gallons	3,100 gallons	2,520 ft^2	1,400 ft^2
Hysham WB*	2,000 gallons	3,100 gallons	1,480 ft^2	1,400 ft^2

Source: MDT, 2009; DOWL HKM, 2009.
Note: Shaded cells indicate failure to meet the recommended number of parking spots.
*System was replaced in 2007. Plans contain detailed design criteria.

The estimates presented in Table 4.15 indicate while the existing drainfields are sized adequately to accommodate the current capacity based on today's standards, septic tanks at both sites are undersized. It should be reiterated that accurate sizing of a drainfield cannot be accomplished without site specific soils information and percolation test results. The estimates presented in Table 4.15 are intended to provide general sizing comparison information.

General Site Observations and Operation / Maintenance Issues

MDT provided results from recent maintenance questionnaires (dated July 2008) pertaining to each site. These are provided in Appendix I.

The Hysham WB wastewater system was replaced last year with a new septic tank, drainfield, and dosing system due to the failure of the original system. The new system is working well. Parts of the EB site have been updated throughout the year. There have been little to no problems with the EB drainfield but the septic tank is old and rotten and the lift pumps need to be updated. The EB septic tank currently needs to be pumped at least twice a year. MDT maintenance personnel mentioned that the wastewater at Hysham is pre-treated before being distributed to the septic tank and drainfield through the injection of microorganisms that aid in the breakdown of organic material.

Power

Power is provided at the Hysham rest areas for heating and lighting, as well as the dosing pumps. The source of heat is electric and heating is provided through the floors of the restrooms.

The heating and lighting systems remain on continuously at the Hysham rest areas. Fluorescent ceiling panels provide lighting at Hysham.

Power records were obtained from the MDT-Billings District office for the five-year period from January 2004 through December 2008. On average, power usage was lowest during the spring, summer, and early fall months (April through October), while usage increased during winter months (November through March), accounting for higher wintertime heating and lighting needs. Monthly averages over the 5-year period are depicted in Figure 4-7. Figure 4-8 depicts electricity consumption over the entire 5-year period.

Figure 4-7 Hysham Average Monthly Power Consumption (2004 – 2008)

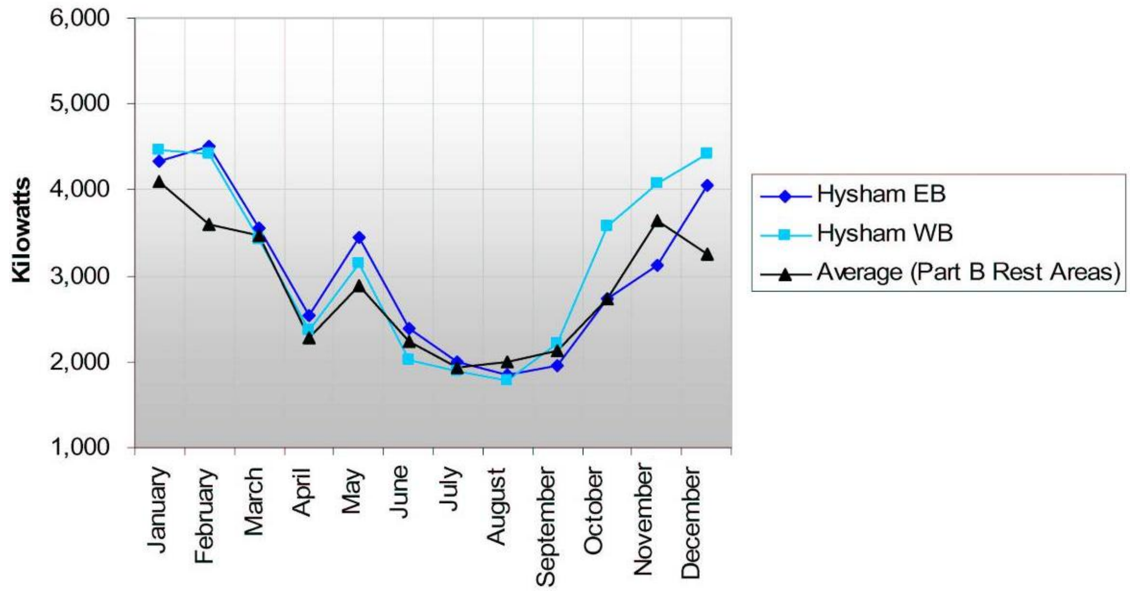
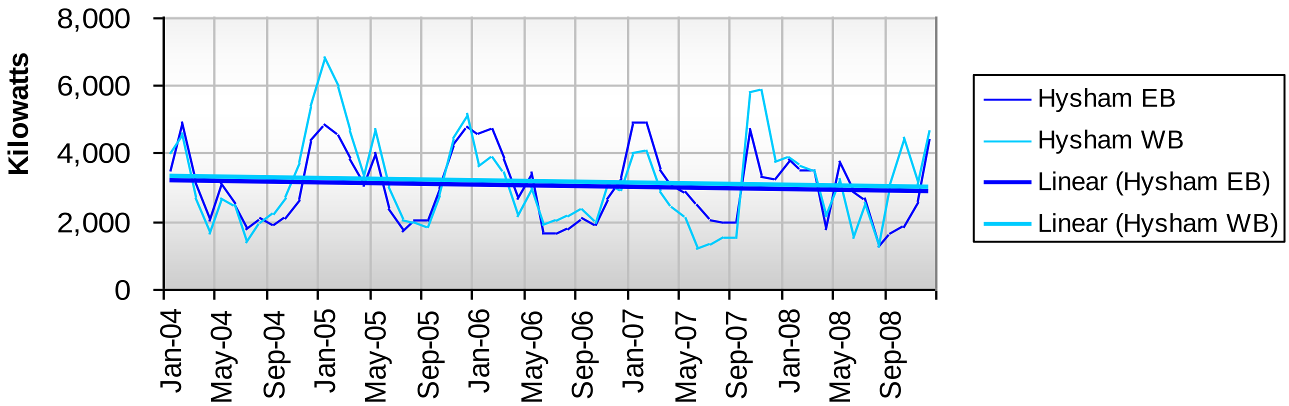


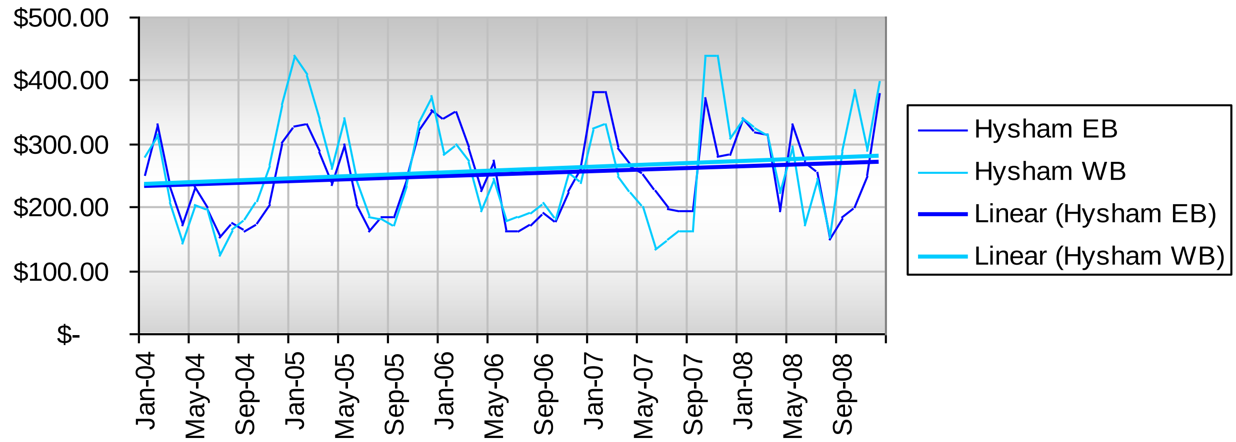
Figure 4-8 Hysham Monthly Electricity Consumption (2004 – 2008)



There is a general downward trend in annual usage at the Hysham rest area sites, as evidenced by the trend lines shown in Figure 4-8.

Cost for electricity generally varied between $0.049 and $0.118 per kWh from 2004 to 2008, with costs steadily increasing over the five-year period as indicated by the trend lines in Figure 4-9. While average monthly electricity consumption declined somewhat over the 2004 to 2008 period for Hysham sites, average monthly electricity costs actually increased due to the increase in unit energy prices.

Figure 4-9 Hysham Monthly Electricity Costs



4.1.10 Crash Assessment

Vehicle accident data was supplied for the period January 1, 2005 to June 30, 2008 by MDT. During this time period, 640 crashes were recorded over the I-94 portion of the study corridor (MP 0.0 – 142.0).

Several aspects were considered for this analysis. First, the number of crashes near each existing rest areas was compared. Second, crashes over the entire corridor were evaluated in light of spacing between rest areas. Areas with higher numbers of crashes were assessed to determine if these could be attributed to excessive distances between rest areas. Lastly, incidences of animal vehicle conflicts near the rest areas sites were assessed.

Table 4.16 presents the number of crashes within approximately a quarter mile in each direction from each rest area location (i.e., the half-mile segment is approximately centered at the rest area site).

Table 4.16 Number of Crashes within Half-Mile Segment near Hysham (1/1/2005 – 6/30/2008)

Interstate Facility	Rest Area Location	Approximate MP of Rest Area Location	Half-Mile Segment (MP – MP)	Number of Crashes within Half-Mile Segment	AADT (2007)
I-94	**Hysham EB**	64.7	a) 64.5 - 65.0 b) 64.4 - 64.9	a) 3 b) 5	4,530
	Hysham WB	64.8	a) 64.6 - 65.1 b) 64.5 - 65.0	a) 2 b) 5	

Source: MDT, 2008.

Crash locations are recorded in tenth-of-a-mile increments; therefore, it was not possible to determine the number of crashes within exactly a quarter mile in each direction from the rest area location. Therefore, Table 4.16 presents the number of crashes within three-tenths of a mile to one side of the rest area, and two-tenths of a mile to the other side, as well as the reverse. This calculation method is graphically illustrated in Figure 4-10. The two numbers listed under the Number of Crashes column in Table 4.16 correspond to the two half-mile segments as defined for each site. For the Hysham EB and WB sites, the number of crashes in each half-mile segment differs somewhat.

Figure 4-10 Two Half-Mile Segments for Rest Areas

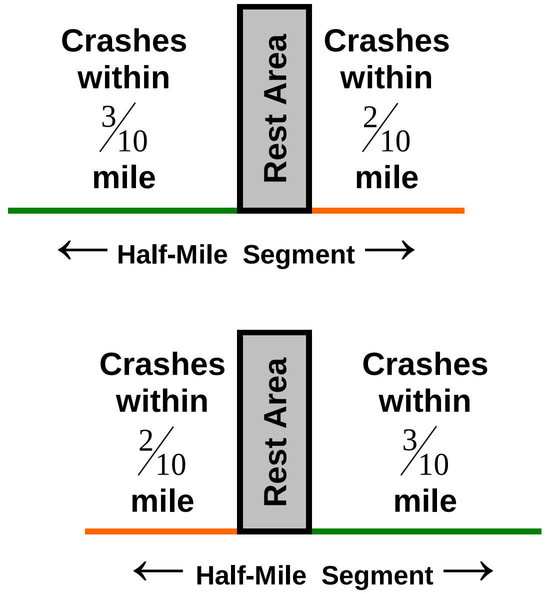
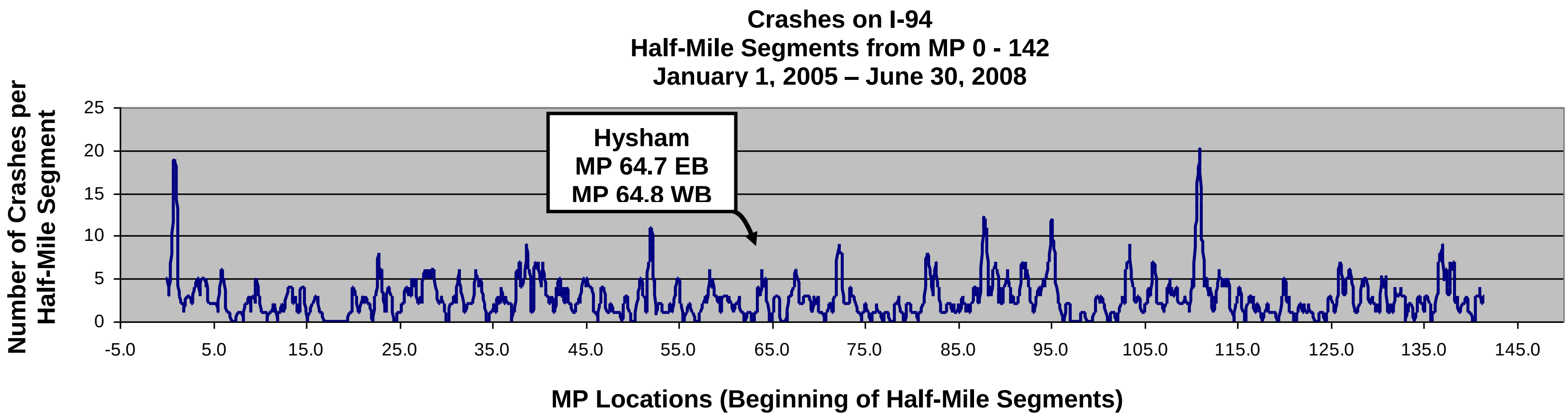


Figure 4-11 illustrates the number of crashes in each half-mile segment over the entire corridor.

Figure 4-11 Crashes within Study Area



Over the I-94 portion of the corridor, there were a total of 36 crashes in which the driver fell asleep. None of these occurred within a mile of the Hysham rest areas.

Of the 640 total crashes over the I-94 portion of the corridor, 233 (or 36.4 percent) involved wild animals. No animal-vehicle crash concentrations were noted near the Hysham rest area.

4.1.11 ADA Compliance

A detailed Checklist of Facility Accessibility has been completed for each of the rest area sites in this study. These forms are included in Appendix D. There are a number of elements at each of the rest area sites that do not comply with ADA requirements, as noted on the forms. Noncompliant elements at the Hysham rest area are noted in Table 4.17.

Table 4.17 Hysham Elements in Noncompliance with ADA Requirements

Rest Area Site	Noncompliant Element							
	Location of Parking Spaces	Stairway	Ramps	Sinks	Door Hardware	Door Closer / Force	Toilet Stalls	Signage
Hysham EB				X			X	X
Hysham WB				X			X	X

Source: MDT Checklist of Facility Accessibility, 2008.

4.2 Future Demand

4.2.1 Projected AADT

A compound annual growth rate method was utilized in order to estimate future AADT volumes within the study area. A growth rate of 3.5 percent per year and a 20-year planning horizon were used for this study, for a Design Year of 2027. The general calculation formula is shown below.

Growth Rate Calculation Formula

$$(\text{Current AADT})*(1 + [\text{growth rate in decimal form}])^{\text{Number of Years}} = \text{Design Year AADT}$$

Table 4.18 presents future traffic volumes as estimated using the growth rate noted above. Using this growth rate over the 20-year planning period approximately doubles the 2007 total AADT values. For the purposes of these estimates, it was assumed that the percentage composition of passenger vehicles and trucks would remain the same.

Table 4.18 Projected AADT near Hysham (2027)

Rest Area	Route	Rest Area Location RP	Traffic Count Location RP	Total AADT	Total Passenger & Bus (Types 1-4)		Total Small Trucks (Types 5-7)		Total Large Trucks (Types 8-13)		Total Commercial (Types 5-13)	
					AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT
Hysham EB	I-94	64.7	67	4,507	3,634	80.63	110	2.44	764	16.95	874	19.39
Hysham WB		64.8		4,507	3,633	80.61	109	2.42	764	16.95	873	19.37

Source: DOWL HKM, 2009.
Directional counts not available. AADT assumes equal volumes for EB and WB directions.

4.2.2 Projected Usage

Projected usage at the rest area sites was estimated based on projected traffic volumes. Projected usage calculations follow the same methodology as described for current usage.

Table 4.19 presents the number of vehicles per hour projected at the Hysham rest area sites in 2027. Tables 4.20 through 4.22 present the recommended number of parking spaces, site facilities, and restroom stalls based on 2027 projected traffic volumes. Detailed calculations are provided in Appendix C.

Table 4.19 Projected Rest Area Usage at Hysham (2027)

Rest Area Site	Total Number of Vehicles Per Hour	Number of Passenger Cars and Buses Per Hour	Number of Commercial Trucks Per Hour**
Hysham*	75	58	17

Source: MDT, 2008; DOWL HKM, 2009.
Note: Calculations use factors from Table 9, Rest Area Plan, 2004.
*Usage values apply to both EB and WB sites.
**Includes estimate for the number of cars with trailers or RVs.

Table 4.20 Hysham Projected Parking Conditions (2027)

Rest Area Site	Truck Parking Spots		Auto Parking Spots		ADA Parking Spots	
	Actual Number*	Recommended Number**	Actual Number*	Recommended Number**	Actual Number*	Recommended Number***
Hysham EB	5	9	17	26	2	1
Hysham WB	5	9	18	26	3	1

Note: Shaded cells indicate failure to meet the recommended number of parking spots.
Source: MDT, 2008; DOWL HKM, 2009.
*Actual number of spots determined based on site visits conducted in January 2009.
**Calculations use factors from Table 9, Rest Area Plan, 2004. Truck parking includes cars with trailers or RVs.
***Based on recommended auto parking spots in Parking Space Matrix, Checklist for Facility Accessibility, MDT 2008.

Table 4.21 Hysham Projected Site Facilities (2027)

Rest Area Site	Picnic Tables		Waste Receptacles	
	Actual Number	Recommended Number	Actual Number	Recommended Number
Hysham EB	12	14	8	11
Hysham WB	12	14	11	11

Note: Shaded cells indicate failure to meet the recommended number of picnic tables and waste receptacles.
Source: MDT, 2008; DOWL HKM, 2009.
Calculations use factors from Table 12, Rest Area Plan, 2004.

Table 4.22 Projected Restroom Stalls and Water Usage at Hysham (2027)

Rest Area Site	Women's Stalls		Men's Stalls		Water Usage (Peak Hourly Demand)
	Actual Number	Recommended Number	Actual Number	Recommended Number	
Hysham EB	4	4	4	2	10 gpm
Hysham WB	4	4	4	2	10 gpm

Source: MDT, 2008; DOWL HKM, 2009.
Calculations use factors from Table 12, Rest Area Plan, 2004.

A number of annual seasonal events occur in Billings, Miles City, and other small rural communities along the I-94 corridor. The largest of these events occur in the summer months, and include rodeos, music festivals, and county fairs. These events likely draw visitors from outside the immediate area, and may contribute to high summer usage at the Hysham rest area. Rest areas are generally not designed to meet peak day or peak season demand. Therefore, the above analysis was not adjusted to account for potential usage fluctuations resulting from seasonal events in the region.

4.3 Assessment of Water, Sewer, and Power Services

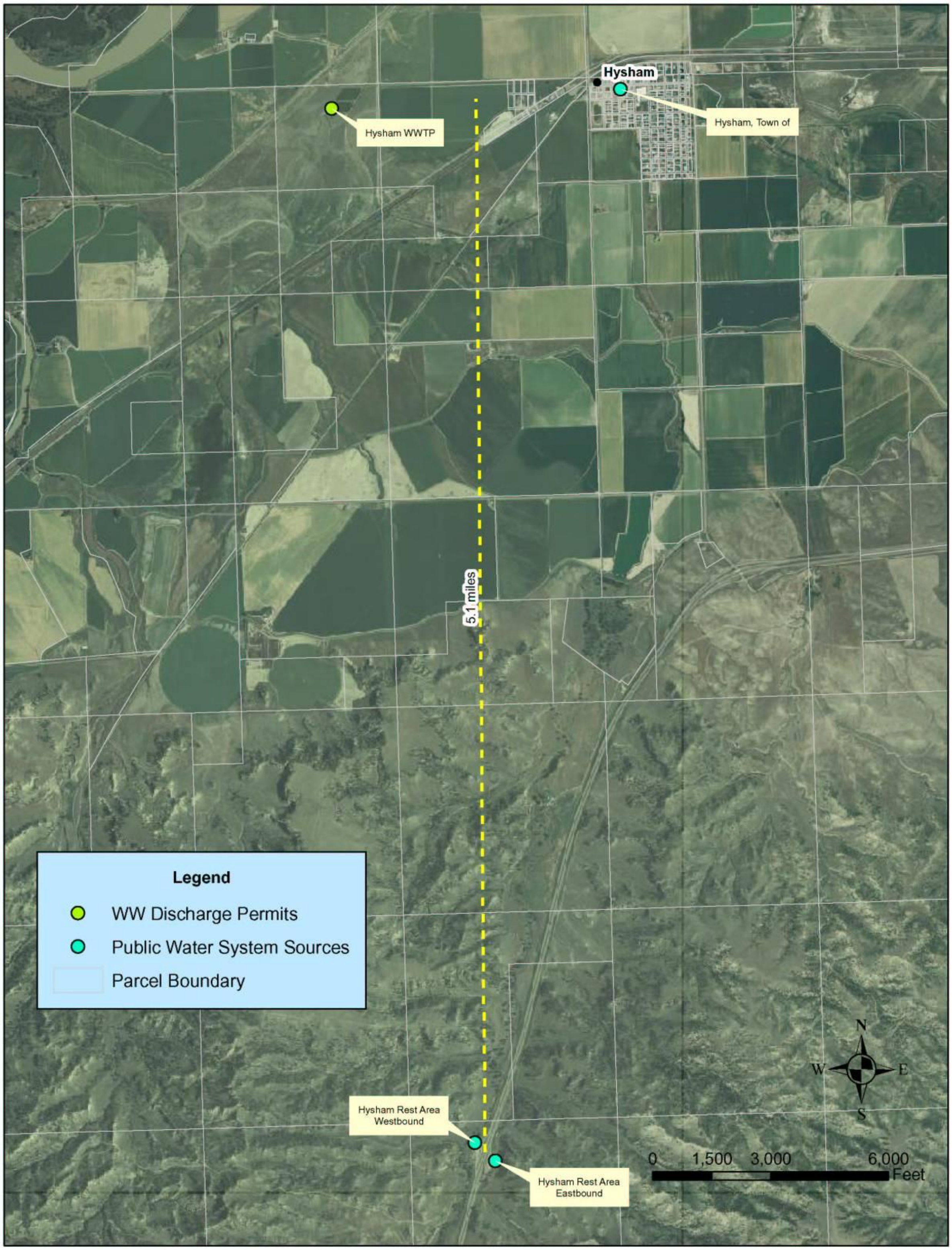
The following sections assess the adequacy of the water, sewer, and power utilities at the Hysham rest area in terms of meeting the anticipated demands from the 20-year projected rest area usage. Expansion potential to accommodate additional parking will be evaluated along with water, sewer, and power service alternatives that take into account the unique nature of the usage patterns and treatment challenges at a rest area.

To evaluate the potential for the Hysham rest area to connect to nearby community water or wastewater systems, the Montana PWS database was queried to select those water systems within 10 miles of each rest area site as shown on Figure 4-12. The DEQ MPDES permitted facilities were also downloaded from the NRIS site by county and queried to select those wastewater discharge permit locations within 10 miles of each rest area site. An MPDES permit is required by DEQ to construct or use any outlet for discharge of sewage, industrial, or other wastes into state surface or groundwater.

The town of Hysham is located approximately five miles north of the Hysham rest area sites as shown on Figure 4-12. According to the PWS database and MPDES permit locations, the town of Hysham is served by a community water system and municipal wastewater treatment plant. Census information lists the town of Hysham as an incorporated town having a population of 361 people in 1990 and a population of 330 people in 2000. The Census 2007 population estimate for Hysham was 248 people. Based on the Census data, the population for the town of Hysham is declining. Due to the decline in population and lack of nearby communities, it is unlikely that the town of Hysham has plans for expanding their water or sewer systems.

Due to the distance and small nature of the systems near the Hysham rest area, it would not be cost effective to extend water service from these sources to the rest area sites. Therefore, this option will not be discussed further; the remainder of this section will focus on accommodating water and sewer needs at the existing sites.

Figure 4-12 Public Water System Sources near Hysham



4.3.1 Water Service

Quantity

The projected 20-year peak hourly water demand was calculated based on the methodology specified in the Rest Area Plan. Table 4.23 lists the projected water use estimates at the Hysham rest area sites. Detailed usage calculations are provided in Appendix C and irrigation demand calculations are provided in Appendix F.

Table 4.23 Hysham Projected Water Use Estimates (2027)

Rest Area Site	Restroom Water Usage (Peak Hourly Demand)	Estimated Irrigation Demand	Total Demand	Well Capacity
Hysham EB	10 gpm	32 gpm	42 gpm	50 gpm
Hysham WB	10 gpm	36 gpm	46 gpm	25 gpm*

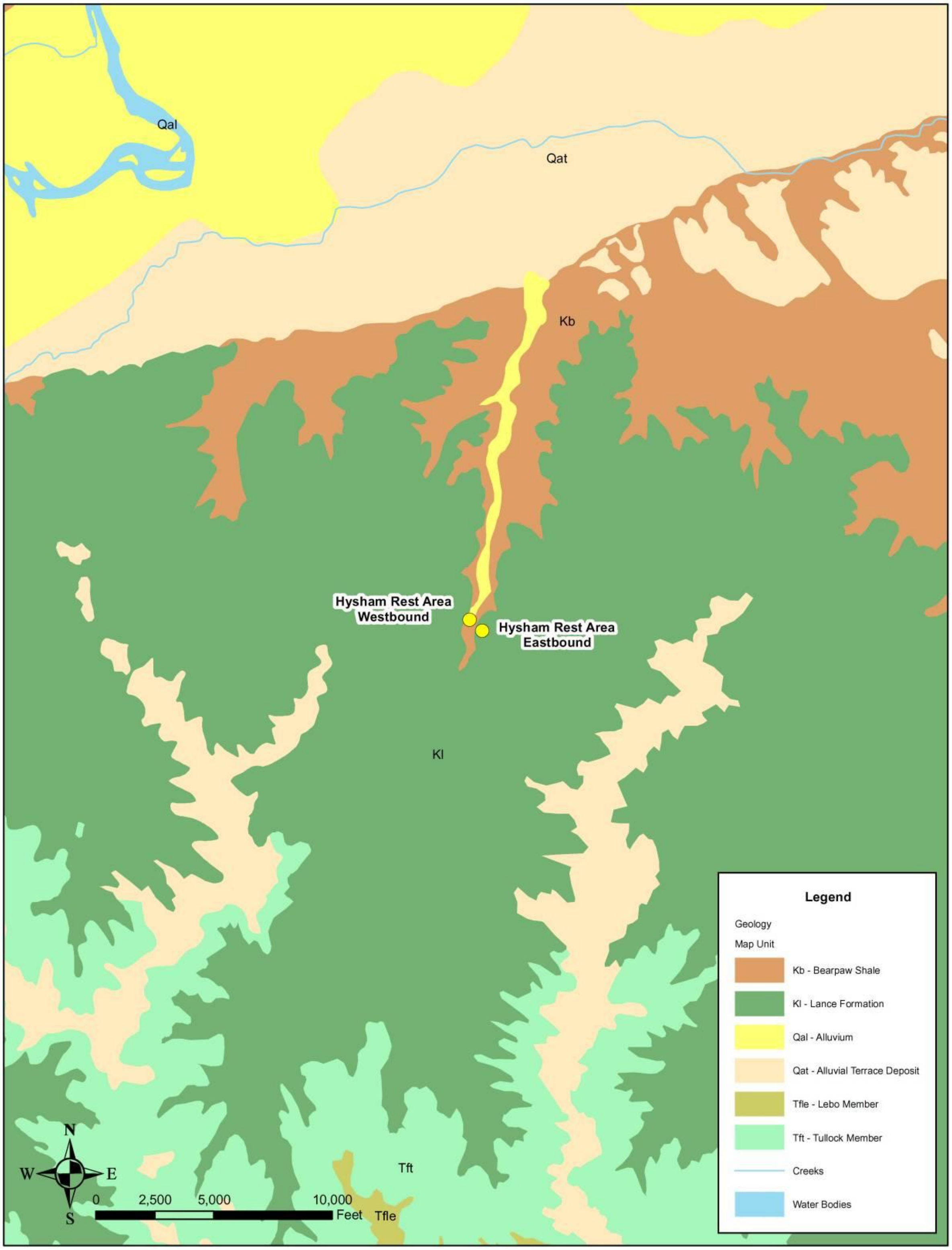
Source: MDT, 2008; DOWL HKM, 2009.
*Combined capacity of the wells at Hysham WB (irrigation well = 16 gpm, potable well = 9 gpm).

Based on the estimates in Table 4.23, the combined capacity of the wells at the Hysham EB and WB sites do not have adequate capacity to serve both the restrooms and the current irrigated areas.

Information on the pumping rate has been obtained from the GWIC database as well as from conducting interviews and obtaining additional data from MDT maintenance personnel. No field work was performed to verify the pumping rates. Therefore, it is recommended that well yield tests be conducted for each well at Hysham sites in order to verify the actual pumping rates.

Geologic mapping can be used to determine general aquifer characteristics. Figure 4-13 depicts the geology surrounding the Hysham rest area. Digital geologic mapping was obtained from the MBMG State Geologic Mapping Program. Map unit descriptions can be found within Appendix M.

Figure 4-13 Geologic Map of Hysham



As shown previously on the topographic maps of the rest area sites, Hysham rest area sits on top of a narrow, flat-topped ridge that overlooks the Yellowstone River Valley to the north. Most of the available groundwater within this aquifer is found within permeable rocks such as sandstone and coal as is characteristic of the ridges bordering the Yellowstone River. Considerable amounts of shale may also be present within this aquifer. Finer-grained materials such as shale are less permeable and tend to impede groundwater flow.

The Hysham EB rest area is located within the Lance formation. The Lance formation is interbedded sandstone and shale, and is between 400 and 500 feet thick. Additional wells with similar pumping rates can likely be developed, but care should be taken to not over-pump and dewater the aquifer. The Hysham WB wells are located within alluvium consisting of gravel, silt, and clay along the Box Elder Creek. It is generally a good shallow groundwater producer, but the total aquifer thickness is limited, consequently pumping and groundwater levels should be monitored. The WB irrigation well log indicates that the pump runs all night. This may or may not be occurring and may or may not be a concern. But, if this well is pumping all night for irrigation, it would be wise to evaluate if the aquifer can continue to sustain this use.

As water demands increase due to usage, the Hysham rest area will most likely need to find ways to conserve water supplies, drill additional wells, or rehabilitate existing wells. Based on the most recent available pump testing data (Table 4.13), the Hysham WB well had a 1987 pumping rate of 9 gpm. However, remarks from this test indicate that the original pump rate was 28 gpm and that the well could use a larger pump. If the well were rehabilitated to allow the 28 gpm capacity, the Hysham rest areas would have adequate capacity to meet the 2027 demand. These sites are already equipped with low-flow toilets and sinks that turn off after a specified amount of time. Another possible method for reducing water usage is to implement xeriscaping techniques and water-conserving irrigation practices. These types of landscaping techniques would lessen maintenance requirements and require less water, thereby reducing the overall water demand at the rest area sites. Reducing irrigation requirements would free up the well capacity in order to accommodate increased visitor usage.

The Hysham sites include larger irrigated areas as compared to other sites in this study. Therefore, the Hysham sites have the potential to reduce the irrigated area by utilizing xeriscaping and other water-conserving landscaping techniques.

Further, exempt wells are allowed to pump no more than 35 gpm and 10 ac-ft per year. The estimated future demand at Hysham slightly exceeds this value considering the current amount of irrigated area. In lieu of pursuing actual water rights for this rest area to allow for higher pumping rates or a greater annual volume, the water conservation measures noted above would likely be the more economical and practical solution. The timing of the irrigation could also be offset with peak visitation such that the peak demand shown in the table above was never actually attained.

Another way to supplement peak demands is through the addition of storage. Storage tanks can be provided to supplement flows in times of peak demand. In the case of demands this small, one or more hydropneumatic pressure tanks would be adequate to accommodate the brief peaking periods in excess of the 35 gpm limit of the exempt water wells. Alternately, a 1,000 to 2,000 gallon fiberglass tank could be buried on-site and a separate pumping system provided to pressurize the system.

MDT may want to consider securing water rights in the future as usage increases at Hysham. Well replacements may be easier to obtain with secured water rights. Therefore, the process and expense of acquiring water rights is discussed as follows.

When applying for a new water right in Montana, different rules and procedures apply depending on whether or not the location is in a closed basin. Several highly appropriated basins in Montana have been closed to new appropriations. Therefore, obtaining a water right in a closed basin requires extensive analysis to show that the water being used will be replaced or "mitigated" such that the net loss from the aquifer is zero. Mitigation could be return of highly treated wastewater to the aquifer, or retirement of a separate existing water right. The majority of closed basins are located in western Montana. The Hysham rest area does not currently fall within a closed basin. Therefore, obtaining a water right for the Hysham rest area does not require analysis to show that the water used is being replaced. The water right process does, however, require that the following DNRC criteria are met:

1. Demonstrate that water is physically and legally available at the site.
2. Demonstrate that nearby water resources will not be adversely affected (i.e. neighboring wells, streams, irrigation ditches, and other sources).
3. Demonstrate beneficial use.

Several hydrogeologic factors must be evaluated to determine if water is physically available at the site. This will most likely require the drilling of test wells to conduct aquifer tests, water quality tests, and water level monitoring. Stream flow monitoring may also be required. Once physical availability is demonstrated, legal availability must be demonstrated through identification and analysis of existing water rights in the vicinity and with regard to potentially-affected surface waters. This process involves significant research into existing water rights and a comparison of existing legal demands to physical water availability. If physical water availability exceeds the existing demand, water is determined to be legally available.

To demonstrate beneficial use, the proposed water use must be justifiable in regards to how it will be used as well as the quantity of water needed.

As described above, acquiring additional water rights is a fairly lengthy process requiring substantial additional analysis. However, if the above criteria can be demonstrated, obtaining additional water rights for Hysham is a viable option for assuring that sufficient water is available at the site to meet anticipated demands.

It should be reiterated that the water use projections shown in Table 4.23 are estimates based on assumed values for rest area usage and approximate irrigated areas. MDT has initiated a research project to be completed in 2010 that will identify more accurate methods to predict rest area usage.

Quality

Based on the queried DEQ PWS database, the Hysham sites historically have not had any recorded total coliform MCL violations with the exception of Hysham WB having one MCL violation in July 1995. Additionally, all recorded nitrate samples for Hysham have been in compliance. These sites do not currently provide disinfection and adhere to the sampling requirements for transient non-community water supplies.

It is important that specific sampling protocol be followed in order to minimize issues such as cross-contamination, which can result in false positive readings for coliform. Therefore, it would be advantageous for MDT to develop a standardized sampling program and corresponding operator training to assure that samples are collected appropriately. A detailed sampling plan should be developed for each rest area describing the sample locations; number, type, and size of each sample; sampling method technique, storage, and handling procedures; and sample labeling and chain of reporting standards, including receipt and logging of samples and delivery to the lab.

General guidelines for collecting a coliform bacteria sample are listed in the Drinking Water Regulations for Transient Non-Community Public Water Supplies (DEQ, 1999). These guidelines are summarized below and should be considered when developing a detailed sampling plan.

- Always sample from a cold water tap (avoid leaking faucets, drinking fountains, and outside hydrants)
- Remove any faucet attachments (aeration screens, hoses, etc.)
- Open tap fully and let water run two to three minutes
- Reduce the flow and fill the bottle leaving an airspace which allows mixing by shaking in the lab
- Do not allow cross-contamination when collecting the sample (i.e. do not touch the inner surface of the bottle or lid or touch it to the faucet).
- Transport the sample to the lab as soon as possible. Care should be taken to maintain the sample at normal water temperature.

Additional materials on sampling requirements may be obtained from the EPA safe water program. Secondly, the METC periodically hosts training programs for water and wastewater operators at several locations throughout Montana.

Although Hysham does not currently require disinfection, anticipated regulations may warrant this in the future. The Ground Water Rule set forth by EPA will go into effect on December 1, 2009. This rule states that all groundwater systems not currently providing disinfection must perform triggered source water monitoring if notified of a total coliform-positive routine sample. Depending on the results of the triggered source water monitoring, groundwater systems must correct the deficiency or ultimately provide treatment that achieves at least 4-log treatment of viruses. Required treatment methods would most likely be chlorinated systems allowing sufficient contact time. In general, the Ground Water Rule builds upon the drinking water regulations currently in effect under DEQ for transient non-community water supplies. DEQ will administer the Ground Water Rule and perform routine sanitary surveys to ensure compliance and identify significant deficiencies.

Another process regulated through DEQ is the GWUDISW determination process. This process pertains to the groundwater wells at the Hysham rest area. The process would begin with a preliminary assessment by DEQ and, depending on the results, could require additional analysis. Through this process, if groundwater sources are determined to be directly influenced by surface water, they will be subject to the Surface Water Treatment Rule requirements and would require disinfection and possible filtration.

Other Factors

For small water systems, it is important to ensure that wells are protected from sources of contaminants. Per Circular DEQ-3, wells must be located at least 100 feet from any structures used to convey or retain storm or sanitary waste. The wells at Hysham are more than 100 feet from septic tank and drainfield locations and therefore meet this requirement. Well construction details are provided in the GWIC database sheets located in Appendix G. It is also important to make sure the well construction details and well pumps meet DEQ requirements.

The operation, maintenance, and replacement costs are typically low for this type of small water system. Assuming no disinfection, the only significant associated replacement costs are in the actual well pump and possibly some controls (e.g., pressure tank, appurtenances, etc.). Table 4.24 presents typical costs associated with pulling and replacing a well pump. According to MDT maintenance personnel, pumps typically last five to seven years depending on the hardness or corrosiveness of the water. It should be noted that the following costs most likely would not occur in the same year.

Table 4.24 Typical Costs for Rest Area Water Systems

Component	Cost
Parts, fittings, expenses, etc.	$500
Pump	$500 - $750
Labor associated with replacing the pump (i.e. wiring, etc.)	$1,000 - $1,500
Water Filter (replace monthly at $20 each)	$240
Pressure Tank (replace on occasion)	$350
Air/Sequence Valve for Toilets (replace once every two years @ $600 per toilet, assume 3 toilets per year)	$1,800
Hot Water Tank (replace every 3-4 years)	$450
Total Cost	**$4,840 - $5,590**

Source: MDT, 2009.

Anticipated pumping costs associated with the irrigation and potable wells are listed below in Table 4.25. These estimates are based on several assumptions such as pump horsepower, annual consumption, and estimated hours of pumping per year. Detailed calculations can be found within Appendix K.

Table 4.25 Hysham Projected Pumping Costs

Rest Area Site	Total Annual Power Costs
Hysham EB	$686
Hysham WB	$1,040

Source: DOWL HKM, 2009.

Conclusions

Based on the above discussion, the following is a summary regarding water service at the Hysham rest area:

- Based on current available data, the water sources at Hysham may have trouble supplying the future 20-year projected demand unless irrigation area is reduced or wells are rehabilitated. It should be reiterated that field pumping tests were not performed as part of this study.
- The aquifer serving the Hysham rest area can be expected to be relatively reliable.
- Water demand could be further reduced by implementing water-conserving irrigation and landscaping techniques.
- Water quality at the Hysham sites is generally good, however, through the implementation of the Ground Water Rule and GWUDISW process, more stringent water quality rules may apply in the future and treatment may be necessary.
- Costs associated with maintaining these systems are relatively low.
- As usage increases due to demand beyond the 20-year projections, additional water rights may need to be secured. The Hysham sites are not currently within a closed basin; therefore new water rights could, most likely, be attained.

4.3.2 Sewer Service

Size of Existing System

As described above in Section 4.1.8, on-site sewage treatment at the Hysham rest area is accomplished through the use of a septic tank and soil absorption drainfield. The drainfields at Hysham are pressure dosed. Preliminary sizing calculations for the 20-year projected usage are shown below in Table 4.26 along with the existing system sizing information determined from as-built drawings and information collected from MDT maintenance personnel. Detailed calculations can be found within Appendix J. The NRCS soils information was used to determine approximate sizing criteria where percolation test data was not available.

Table 4.26 Septic Tank and Drainfield Size for Projected Usage at Hysham (2027)

Rest Area Site	Septic Tank		Drainfield	
	Existing Size	Recommended Size for Projected Usage (2027)	Estimated Existing Size	Recommended Size for Projected Usage (2027)
Hysham EB	2,800 gallons	5,100 gallons	2,520 ft^2	2,800 ft^2
Hysham WB	2,000 gallons	5,100 gallons	1,480 ft^2	2,800 ft^2

Note: Shaded cells indicate failure to meet the recommended septic tank or drainfield size.
Source: MDT, 2009; DOWL HKM, 2009.

As shown above, all of the existing wastewater treatment systems at Hysham are undersized to accommodate the 20-year projected rest area usage. Furthermore, Circular DEQ-4 states that subsurface wastewater disposal systems should only be used for residential strength wastewater and that wastewater exceeding this strength must be pretreated before discharging to drainfield systems. Table 4.27 identifies typical ranges of key raw wastewater parameters for highway rest areas as compared to typical domestic wastewater. As can be seen from this generalized table, the raw wastewater strength can be expected to be well in excess of typical domestic values. It is important to note, however, that no raw wastewater sampling data was available from this rest area at the time of this evaluation. Further, the actual raw wastewater concentrations can be widely variable among rest areas.

Table 4.27 Raw Wastewater Strength; Domestic vs. Highway Rest Areas

Raw Wastewater Parameter	Typical Domestic Strength Wastewater Concentrations(1) (mg/L)	Typical Highway Rest Area Wastewater Concentrations (mg/L)
BOD_5	110 - 350	400 - 500
TSS	120 - 400	150 - 400
TN	20 - 70	150 - 250
TP	4 - 12	20 - 30

(1) Table 3-15; Wastewater Treatment & Reuse, 4th Edition; Metcalf & Eddy, 2003.

Therefore, because the existing system is undersized and septic tank/drainfield systems are not recommended as the sole treatment option for non-residential wastewater, alternative wastewater treatment technologies will be explored and will be the focus of this section.

Wastewater Effluent Quality Requirements

The first driving factor for determination of potential effluent quality criteria is the point of ultimate discharge of the effluent. The two principal means of discharge include direct discharge to surface water and subsurface discharge, which may or may not reach groundwater. Two non-discharging options would include total retention of treated effluent using evaporation as the ultimate disposal and land application or irrigation.

The effluent quality of a subsurface discharge system (i.e. drainfield) depends upon the presence, depth below ground surface, and volume of existing groundwater. Subsurface discharge systems are allowed based upon the concentration of nitrates at the end of an allowable “mixing zone.” The mixing zone depends primarily upon the proximity to existing surface water sources and existing groundwater wells. Based upon a required non-degradation analysis, the calculated nitrogen concentration at the end of the mixing zone must be less than or equal to 7.5 mg/L. A smaller allowable mixing zone equates to a requirement for higher quality effluent and more advanced treatment processes. Of further significance related to the permitting of subsurface discharge systems is the total daily discharge volume. A DEQ discharge permit is not required for systems discharging less than 5,000 gpd. While the actual analysis and design of the disposal system would be the same, a system over 5,000 gpd may require more site specific and detailed groundwater information and would require permit and renewal fees.

Direct surface water discharge of effluent would require the highest quality effluent, as well as a lengthy evaluation and permitting process, which may not ultimately be granted by the permitting agency. Direct surface discharge is not considered a viable option for this rest area.

The final options of land application and total retention do not require a discharge permit. Either system would require similar effluent water quality. Effluent quality for land application systems would depend upon the size of irrigable area and the nutrient uptake potential of the associated crop. Total retention systems would generally be designed to secondary treatment standards typical of a wastewater lagoon system with additional consideration potentially given to the odor and algae generation potential of the stored effluent.

Advanced Wastewater Treatment Options

In a conventional on-site system, a septic tank is first used for partial treatment of the wastewater and for accumulation of solids. Secondly, a subsurface drainfield is used for final treatment and disposal of the wastewater. In alternative systems, additional or secondary/advanced treatment is provided between the septic tank and disposal system. This section will focus on four secondary treatment technologies applicable to the Hysham rest area sites. These are:

- Aerobic Treatment Systems/Package Plants (including SBR and MBR systems)
- Lagoon Systems
- Aquatic Treatment Systems
- Recirculating Packed-Bed Filters

It is worth mentioning a few low-cost modifications that can be added to any on-site wastewater system regardless of the treatment method being applied. With any system, it is good practice to install effluent filters on septic tanks. The effluent filter will help to alleviate stress on the downstream processes and piping systems by retaining solids in the septic tank more consistently. In addition, dosing and resting the drainfield through the use of a pumping system rather than the trickle flow that a drainfield typically receives with the conventional gravity system will improve the treatment and extend the life of the drainfield. Dosed systems are also allowed slightly modified trench dimensions and spacing requirements that provide for more effective use of the drainfield area.

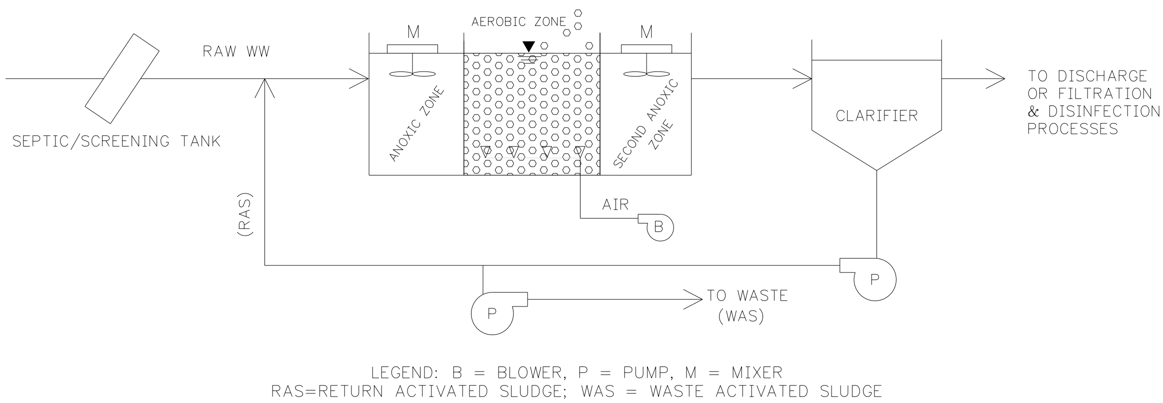
It is important that an alternative system be selected only after an investigation of site-specific conditions. System selection and design should be performed by a professional engineer with a formal design report submitted to the permitting authority.

<u>Advanced Treatment Systems/Package Plants</u>

For applications where stringent effluent quality requirements will apply, a more advanced treatment system in the form of aerobic, activated sludge systems could be required. Such advanced treatment units may include only aerobic zones where greater BOD, TSS and ammonia reduction (i.e. nitrification) can occur. As effluent disposal criteria dictate, more advanced systems may include anoxic (low dissolved oxygen) zones where subsequent nitrogen removal (denitrification) can occur.

A septic tank is intended to remove solids and initiate biological treatment. This process is anaerobic, meaning there is no oxygen in the system. Conversely, advanced treatment systems are aerobic and consist of an aeration tank where incoming wastewater is mixed with biological organisms (i.e. activated sludge) using a large quantity of air. During the aeration process, a portion of the wastewater undergoes biological treatment or the conversion of organic matter to various gases and new microbial cells. Aeration compartments are followed by a settling compartment. A portion of the settled microorganisms or “activated sludge” is then returned to the front of the treatment process as RAS to be mixed again with incoming wastewater. Excess sludge or WAS must occasionally be removed from system. Figure 4-14 illustrates the basic configuration of an advanced treatment unit for biological nitrogen removal.

Figure 4-14 Advanced Treatment Process Flow Diagram



Advanced treatment units come in many forms of pre-engineered/package wastewater treatment plants; several variations exist depending on the size of system or community being served and ultimate treatment objectives. The process can be modified in many ways to achieve the ultimate treatment objectives. For example, one process applicable to small communities or cluster configurations is the SBR system. SBR systems utilize five steps occurring in the same tank (i.e. both aeration and settling occur in the same tank). Due to the sequential nature of the SBR system, a key element is the control system, consisting of a combination of level sensors and timers. The five steps occurring in sequential order are:

1. Fill
2. React (aeration)
3. Settle (sedimentation/clarification)
4. Draw (decant)
5. Idle

The MBR system is another variation of an aerobic advanced treatment process. The MBR system adds a microfiltration element to the treatment process accomplished through the use of a membrane. The membrane element is typically submerged directly in the treated wastewater at the end of the treatment process. In place of sludge settling/clarification, the membrane captures solids and either re-circulates them into the treatment process or sends them to be wasted. With the addition of the filtration element, MBR systems are more complex than the SBR system and require slightly more maintenance and monitoring to make sure the membrane does not clog and is operating efficiently. Only for very stringent effluent quality requirements would MBR technology be an economic option for this rest area. Biologically, MRB & SBR systems have the same treatment capability. The MBR's distinguishing characteristic is its simultaneous clarification and filtration of the effluent, resulting in extremely high-quality effluent with respect to total suspended solids and making it an ideal process for water reuse applications.

Advanced treatment units can provide a high level of treatment and therefore may reduce drainfield requirements depending on soil type. However, per Circular DEQ-4, monitoring data must be submitted from at least three existing systems operating in similar climates and treating wastewater similar in characteristics before any reduction in drainfield size will be considered. Monitoring data from existing systems must show that effluent quality parameters are met in order to reduce the drainfield area. If these criteria are met, the absorption system size may be reduced by 50 percent, but must still have a replacement area large enough for a standard absorption trench system.

One manufactured advanced aerobic treatment system with case history installations in Montana is the Santec treatment system by Santec Corporation. This system is currently installed in the town of Rocker, Montana to serve two truck stop establishments. Truck stop wastewater effluent is similar in composition to rest area wastewater due to its higher strength. Influent and effluent wastewater monitoring data for the year 2008 was obtained from the Rocker WWTP. Influent BOD and TSS concentrations are comparable to what is expected of rest area wastewater as listed above in Table 4.27; however data was not available for influent total nitrogen and phosphorus concentrations. Effluent monitoring data from the Rocker WWTP indicates that effluent characteristics meet typical standards for secondary treatment.

Proper operation and maintenance of the aerobic unit is critical. Owners are required to obtain service agreements with the manufacturers of these systems and surveillance by qualified personnel is imperative. An alarm system is required to indicate when the treatment system has an alarm condition, such as a high water level or pump failure. In addition, operators are required to obtain proper certification and perform frequent inspection. Based on recent information from DEQ, only two of these types of systems have been reviewed and permitted in Montana in the past year.

If it is found based on results of a non-degradation analysis that more stringent effluent quality requirements apply, advanced treatment options should be considered as a viable option for wastewater treatment at the Hysham rest area. Advantages of advanced treatment units include:

- Relatively low footprint for equipment although room is still needed for an appropriately sized drainfield.
- Systems are modular in nature allowing for future expansion or modifications.
- A high level of treatment can be obtained.

Disadvantages include:

- Power requirements will increase substantially due to the aeration equipment within the treatment system.
- Intensive operation, maintenance, and management requirements.
- Due to the relatively low number of installed systems in Montana, proper monitoring data needed for permitting may be difficult to obtain.

Lagoon Systems

Lagoon treatment systems are ponds that are engineered and constructed to treat wastewater. There are several types of lagoons classified based on the discharging method. The lagoon system most applicable to a rest area is non-discharging (i.e. evaporation lagoon). A lagoon system is feasible for the projected wastewater flow rates from the rest area. The lagoon would be sized based on this flow rate and the required detention time for BOD and TSS removal.

The advantages of lagoons include:

- Low capital costs
- Minimum operations and operational skills needed
- Sludge withdrawal and disposal needed only at 10-20 year intervals
- Compatibility with land and aquatic treatment processes

The disadvantages of lagoons include:

- Large land areas may be required
- High concentrations of algae may be generated
- Non-aerated lagoons often cannot meet stringent effluent limits (not applicable for a non-discharging lagoon)
- Lagoons can impact groundwater negatively if liners are not used, or if liners are damaged
- Improperly designed and operated lagoons can become odorous[5]

Lagoon systems are not recommended at the Hysham rest area because the existing sites are not large enough and additional right-of-way would most likely be necessary. In addition, lagoons have the potential to become odorous, making the site unattractive for rest area users. Space at the Hysham rest area is limited and the lagoon would need to be fenced and located far enough from the site to prevent odors or other nuisances from affecting neighboring properties.

<u>Aquatic Treatment Systems</u>

Aquatic treatment systems use plants and animals such as insects, fish, worms, and snails designed to aid in the treatment process. An article from the FHWA Public Roads Magazine dated May/June 2000 provides details of this type of system installed at a welcome center in Vermont. The system is called the Living Machine and is picture in Figure 4-15 inside a modular greenhouse. The Vermont Agency of Transportation used this technology at the Guilford welcome center from 1997 to 1999. The system recycles treated wastewater that is clean enough for use in toilets or for irrigation purposes, but not clean enough to drink or to use for washing hands. In 1999, the system was decommissioned at the Guilford welcome center when a new welcome center was opened nearby and was connected to a municipal wastewater system. At the time of the article, however, there were plans to reinstall the Living Machine at another rest area experiencing current failing sewage treatment systems.

An operator is needed to keep the plants alive and monitor the system frequently. As described in the article, the cost of this system is initially high at approximately $250,000.

The Living Machine or a comparable aquatic system is not recommended for the Hysham rest area. It is described to demonstrate the types of innovative systems being installed at some rest areas throughout the country. This system is still somewhat experimental in nature and would likely require a lengthy permitting process through DEQ. In addition, due to the remote and unsupervised nature of the Hysham rest area, this system would be vulnerable to vandalism. This type of system would also require significant monitoring by a trained operator and would likely necessitate hiring additional full-time maintenance employees.

[5] Crites and Tchobanoglous, 1998.

Figure 4-15 Living Machine

Inside the rest area's wastewater treatment system, plants and animals clean the waste from the water through a series of engineered ecosystems. (Photo by Living Technologies)

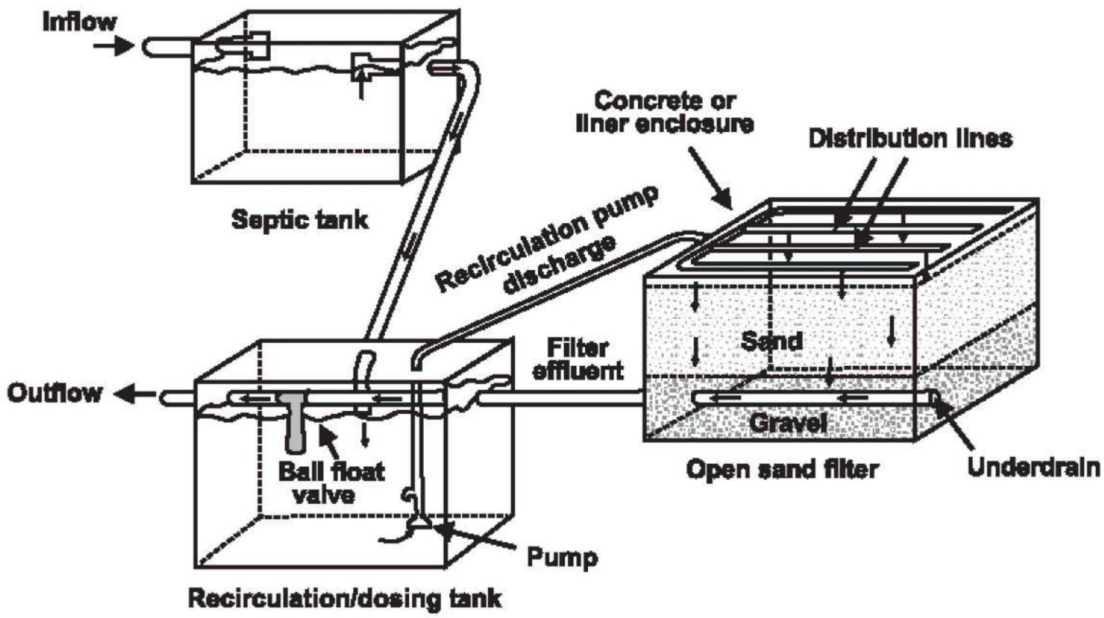
Recirculating (Multi-pass) Packed-Bed Filters

Packed-bed filters use biological and physical processes to effectively treat wastewater. They can be either intermittent (single pass) or recirculating (multi-pass). In intermittent design, the wastewater is applied to the filter only once through several doses per day. In a recirculating system, a portion of the wastewater that has gone through the filter already is returned to the filter. Recirculating filters are more applicable to the Hysham rest area based on the required design flow. Therefore, this section focuses on recirculating packed-bed filters for use as an alternative treatment technology at the Hysham rest area.

Figure 4-16 illustrates the operation of a recirculating packed-bed filter using sand as the filtering media. A typical packed-bed filter is comprised of the following elements:

1. A container with a liner for holding the medium
2. An underdrain system for removing the treated liquid
3. The filtering medium – Many types of media are used in packed-bed filters. Sand is the most common, but other options include crushed glass, plastic, foam, and synthetic textile media.
4. A distribution and dosing system for applying the liquid to be treated onto the filtering medium (spray nozzles, etc.)
5. Supporting appurtenances

Figure 4-16 Recirculating Sand Filter



The septic tank effluent is dosed onto the surface of the filter and is allowed to percolate through the medium to the underdrain system. Recirculating filters combine biological treatment with physical processes such as straining and sedimentation. Biological treatment occurs due to the bioslimes that form on the media particle surfaces. According to EPA, recirculating sand filters frequently replace aerobic package plants in many parts of the country because of their high reliability and lower operating and maintenance requirements.[6]

As an alternative to the recirculating sand filter, textile packed-bed filters utilize non-woven textile chips instead of granular medium, increasing the surface area for the microorganisms to attach and thereby reducing the space requirements of the filter.

One manufactured recirculating textile packed-bed filter currently approved by DEQ is the AdvanTex Treatment System by Orenco Systems, Incorporated. AdvanTex systems have been installed in numerous commercial and residential applications in Montana. Conceptual designs for an AdvanTex system have been produced for the new Lima Rest Area proposed for construction later this year (although they are not currently approved to date). AdvanTex systems have been successfully utilized in other nearby rest area applications, including the states of Wyoming and Colorado.

AdvanTex systems are equipped with remote telemetry to give operators and manufacturers the ability to monitor and control their systems remotely. Distributors of AdvanTex systems are located in Billings, MT, allowing for fast response times in an emergency.

A key component of systems such as AdvanTex is their modular nature. The modular nature of this system allows for additional units to be installed in the future as long as adequate space is provided initially. MDT plans to begin collecting data on water usage and wastewater effluent

[6] EPA Onsite Wastewater Treatment Systems Manual, February, 2002

concentrations in the future. As this data becomes known, refinements and adjustments can be made to the required number of future units.

It is worth mentioning that AdvanTex systems are designed to reduce total nitrogen by 60 percent or more. Due to the expected high strength of the incoming wastewater, additional measures such as pretreatment, additives, or polishing components may or may not be needed to obtain effluent total nitrogen levels that meet the acceptable standard. Again, required treatment levels are based on results of a non-degradation analysis that would dictate the design criteria needed.

Recirculating packed bed filters such as the AdvanTex system should be considered as an option for wastewater treatment at the Hysham rest area. Advantages of recirculating packed bed filter systems are similar to those for advanced aerobic treatment units. However, the packed bed filter system is slightly less complex than the aerobic advanced treatment unit, requiring less monitoring and operational requirements. Power requirements would also be less due to the absence of the aeration equipment.

Subsurface Drainfield

With recirculating filters or advanced treatment units, a 50 percent reduction (depending on soil percolation rates) in drainfield size from standard absorption system sizing may be allowed provided that adequate performance data at higher raw wastewater concentrations can be supplied.

Rough calculations were made to determine if the new drainfields will fit on the Hysham sites after taking into account the reduction in size. Detailed calculations can be found in Appendix J. Wastewater systems must be located at least 100 feet from any surface waters and 100 feet from floodplain boundaries. Drainfields should also be relatively level. Figure 4-17 depicts specific site constraints at the Hysham rest area and shows approximate areas suitable for wastewater systems. The figure illustrates approximate areas and locations of the new drainfields and wastewater systems.

The following should be noted with respect to proximity of the rest areas to surface waters:

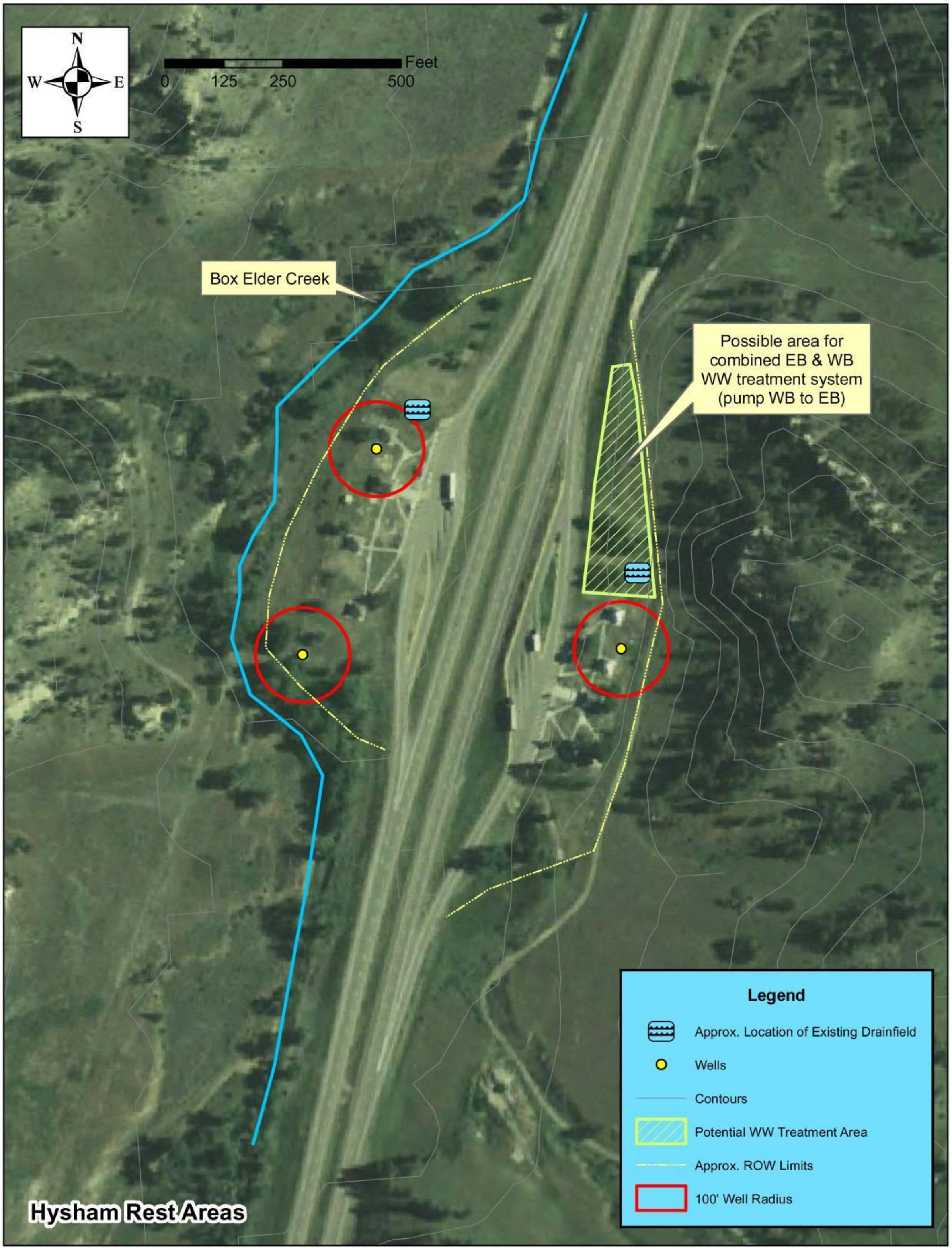
1. Subsurface wastewater disposal systems must be located a minimum horizontal setback distance of 100 feet from any surface water or spring and at least 100 feet outside of any floodplain boundaries.
2. Greater horizontal distance may be required depending on results of a water quality non-degradation analysis. This analysis is not only based on distance but includes other factors such as nutrient load, hydrogeologic conditions, and direction of groundwater flow.
3. Close proximity of the rest area to surface waters could also have an effect on the ground water if ground water sources are determined to be directly influenced by surface water.

There are several surface waters identified on the quadrangle map near Hysham. Most of these are at least 500 to 1,000 feet away with the exception of Box Elder Creek, which is directly adjacent to the Hysham WB site, approximately 100 to 200 feet away. Due to the proximity of this site to the creek in addition to high static water levels indicated from the well log, Box Elder Creek has a greater potential to impact the site but again, will ultimately depend upon additional analysis.

The Hysham sites are constrained due to Box Elder Creek and lack of available area within the existing right-of-way boundaries. The wastewater systems at Hysham WB must be outside the floodplain of the creek. In addition, due to the possible presence of high groundwater indicated from the well logs, demonstrating compliance with groundwater and surface water non-degradation rules may be more difficult.

A centralized wastewater treatment system should be considered for the Hysham site due to the close proximity of the EB and WB sites. In addition, a centralized treatment system would make better use of the available area. The raw wastewater or septic tank effluent would be pumped from the west side to the east side to utilize a single treatment system. Effluent could then be disposed of entirely on one side or split between the two sides of the interstate, as dictated by the total required disposal area. Small diameter (two- to three-inch) lines would be directionally drilled under the interstate to convey the raw wastewater, septic tank effluent or final effluent to the respective side of the interstate. The costs of conveyance would be mostly offset by not having a second treatment system. In addition to capital cost savings, only one system would have to be maintained in lieu of two separate treatment systems. Additional right-of-way is most likely necessary to make adequate wastewater systems work at the Hysham sites.

Figure 4-17 Hysham Conceptual Wastewater Treatment System



It is reiterated that site-specific soil information was not obtained as part of this study. Ultimate drainfield size and location will need to be determined after this field data is collected. One additional option for the drainfield is to reconstruct the system as a “bed system.” In the case of a replacement not resulting from failure, a bed system is allowed per Circular DEQ-4. The total footprint of this system consists of the design flow rate divided by the soil application rate and results in a slightly reduced drainfield area due to the elimination of the spacing needed between trenches.

The projected 20-year wastewater design flows for the Hysham sites are below the 5,000 gpd limit required for a discharge permit. Combining bi-directional waste flow at the Hysham site puts the total average daily wastewater discharge at approximately 4,500 gpd, below the 5,000 gpd threshold. However, as the wastewater flow increases due to projected usage beyond the 20-year projections, a discharge permit could be required for the Hysham rest area.

Conclusions

- The existing wastewater systems at Hysham are generally sized adequately to meet the current demand. The systems will need to be expanded to meet future demand.
- The Hysham sites most likely do not have additional room for appropriately-sized conventional systems and replacement areas unless additional right-of-way is purchased.
- Conventional systems are not recommended for non-residential strength wastewater.
- A variety of secondary treatment options exist to improve the level of wastewater treatment for on-site systems. Lagoons and aquatic systems are not recommended due to issues such as land availability, system complexities, and permitting concerns.
- If treatment standards dictate, advanced aerobic treatment systems are one option for wastewater treatment at a rest area. These systems provide a high level of treatment but require trained operators due to system complexities.
- The recirculating packed-bed filter system is another option for a wastewater treatment system at the Hysham sites, assuming all the non-degradation requirements can be achieved. This system is less complex than an aerobic treatment unit and provides a high level of treatment. Due to the modular nature of these systems, additional units may be installed as needed at a later date, thereby reducing initial costs.
- Discharge permits will most likely not be required at the Hysham sites within the 20-year planning horizon.
- Land is limited at the Hysham sites for adequately-sized wastewater treatment systems. Wastewater treatment for both sites will most likely need to be accommodated at the EB side.

4.3.3 Power Service

Given the decline in energy consumption over the past five years, demand for electricity at the Hysham rest areas may increase more slowly than expected as visitor numbers increase over the 20-year planning horizon.

As noted in Section 4.1.8, the cost for electricity generally varied between $0.049 and $0.118 per kWh from 2004 to 2008. Although existing connections to the power grid would be able to meet future demand, any future rehabilitation of the Hysham rest areas should attempt to incorporate a more cost-effective design to reduce energy costs as much as possible, especially given recent rate volatility.

There are two primary means of reducing power costs at the existing Hysham rest area. The first would entail installation of energy-saving devices, including interior motion-sensitive lighting. With the use of motion sensors, interior lights would turn on only when triggered by a visitor using the facility, thereby saving electricity when the facility was not in use. For safety purposes, outdoor lighting would remain triggered by photoelectric detection devices and would stay on continuously during nighttime hours.

A second means of reducing power costs would involve development and use of an alternative source of energy. The two sources of alternative energy most applicable for rest area sites are solar and wind energy.

Solar energy could be harnessed to power interior and exterior rest area lighting fixtures. Solar panels can be installed on the roof of a structure or directly to parking lot lighting poles. Although solar radiation varies with the changing position of the earth relative to the sun and due to variance in atmospheric conditions, most geographic areas can access useful solar resources.

WYDOT has installed solar panels at 19 rest areas since the 1980s to provide a source of solar heating for restroom buildings. Most of these rest areas also have solar water heaters for the buildings' lavatories. WYDOT estimates that solar heating provides nearly half of these rest areas' energy needs. Given its effectiveness in Wyoming, it is recommended that MDT further explore the viability of solar energy as a source of power for the Hysham rest area.

Wind may also be a potential source of energy. MDT is currently studying the viability of using wind power at the Anaconda Interchange rest area. The project involves a single tower-mounted wind turbine intended to provide supplemental power for the rest area. As noted in MDT's December 2006 Experimental Project Work Plan, the objective is to determine the cost-effectiveness of the turbine in reducing usage of grid-line power service. Over the course of several years, MDT intends to compare the Anaconda rest area site to other rest areas of similar design and size in terms of power usage and costs, including regular and unscheduled maintenance costs. MDT will conduct a benefit-cost analysis to determine whether wind turbines could provide long-term cost savings at rest area sites. If such a system appears viable based on the results of the Anaconda study, it is recommended that MDT consider the use of wind power at the Hysham rest area.

Conclusions

Based on the above discussion, the following is a summary regarding power service at the Hysham rest area:

- Existing grid power service is sufficient to meet the needs of the Hysham rest area over the 20-year planning horizon.
- While usage has declined somewhat over the past five years, power usage will likely increase slowly over time with increasing visitors.
- Energy-saving technology, including motion-sensitive lighting, should be considered in order to reduce power costs at all three rest areas.
- Alternative sources of energy, including wind and solar power, could be used in the future to supplement grid power, thereby reducing power costs.

4.4 Cost Assessment

This study utilizes an asset management approach with regard to recommended rest area rehabilitation measures. FHWA's December 1999 *Asset Management Primer* defines asset management as follows:

> Asset management is a systematic process of maintaining, upgrading, and operating physical assets cost-effectively. It combines engineering principles with sound business practices and economic theory, and it provides tools to facilitate a more organized, logical approach to decision-making. Thus, asset management provides a framework for handling both short- and long-range planning.

The goal of asset management in the context of this study is to optimize the preservation, upgrading, and timely replacement of corridor rest area facilities through cost-effective management, programming, and resource allocation decisions. In light of increasing user demand, constrained transportation budgets, and mature resources experiencing continuing deterioration, cost-effective investment decisions are imperative. Asset management principles enable long-term management of resources and prudent allocation of funds given alternative investment options and competing needs. With these principles in mind, this section outlines estimated costs for rehabilitation of the Hysham EB and WB rest area sites, as well as a No Build option, which would entail conversion of the Hysham site to a truck parking area.

As detailed in previous sections, the existing Hysham rest area sites meet current user demands. Upgrades are needed to the water and wastewater systems in order to meet future demands over the 20-year planning horizon. Additionally, parking facilities will require expansion to accommodate increasing usage.

Rehabilitation of Hysham Sites

Estimates have been prepared assuming phased implementation in order to reduce initial rehabilitation costs and allow progressive project programming. It should be noted that while phased implementation reduces initial capital costs and may result in fewer impacts to the traveling public due to shorter construction-related closure periods, it results in higher total project costs due to duplication of certain efforts, including mobilization, traffic control, and administration costs, as well as material and labor cost escalation over the course of project implementation. Escalation costs are not reflected in the cost estimates provided in this study; all project phases are presented in 2009 dollars.

The first phase would involve rehabilitation of the wastewater system, assuming a higher level of treatment is required to bring it up to current standards and meet current (2007) demand, and would also include site rehabilitation to provide ADA conformity. These upgrades are recommended to occur first in order to ensure continued public health, safety, and access. Additionally, these are relatively low-cost measures in comparison to full rehabilitation of the site.

The second phase would involve expanding the wastewater system to meet future (2027) demand, rehabilitation of the WB well to meet 2027 demand, and upgrading the existing restroom facilities. The recommended wastewater system is modular in nature; additional modules can be added over time to expand the capacity of the system.

The third phase would entail construction of additional parking areas and accompanying sidewalks to meet 2027 demand. New amenities would also be provided, including additional picnic areas, landscaping, and benches. For purposes of this study, it was assumed that the existing acceleration and deceleration lanes could continue to serve the Hysham EB site; these ramps would be resurfaced in order to extend their useful life. The Hysham WB site would require a new entrance ramp; the Hysham WB exit ramp would be resurfaced under this phase.

No Build Option

A No Build option was developed for the Hysham rest area due to its close proximity to nearby rest areas. Closure of the Hysham rest area would result in appropriate spacing between the Custer and Hathaway rest areas, as recommended in the Rest Area Plan. Based on recommended rest area spacing, the Hysham rest area currently represents an unnecessary expenditure of MDT resources in terms of operation and maintenance time and costs.

Under a No Build option, the Hysham site would be converted from a rest area to a truck parking location. As part of this conversion, the existing restroom building and associated sidewalks and rest area amenities would be demolished. Vault toilets would be installed, and maintenance operations would be minimized.

Multi-phase and single-phase cost estimates for the EB and WB sites are presented in order to illustrate the relative difference in cost between the two. Detailed descriptions of each line item follow. These planning-level cost estimates are intended to be used primarily for comparison purposes between rest area sites in this study. Again, it should be noted that escalation costs are not reflected in the multi-phase cost estimates; all cost estimates are presented in 2009 dollars.

Table 4.28 Multi-Phase Cost Estimate for Hysham EB Rehabilitation

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Hysham EB (Rehabilitation)					
	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$120,000	$120,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	SUBTOTAL 1				**$144,000**
	Mobilization @ 10%	1	Lump Sum	$15,000	$15,000
	SUBTOTAL 2				**$159,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$16,000	$16,000
	Indirect Costs @ 14.06%	1	Lump Sum	$22,400	$23,000
	Construction Contingencies @ 10%	1	Lump Sum	$15,900	$16,000
	Construction Management @ 15%	1	Lump Sum	$23,900	$24,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE I TOTAL				***$238,000***
PHASE II	Wastewater System (2027 Demand)	1	Lump Sum	$79,000	$79,000
	Building Upgrades	1	Lump Sum	$16,000	$16,000
	SUBTOTAL 1				**$95,000**
	Mobilization @ 10%	1	Lump Sum	$10,000	$10,000
	Miscellaneous @ 25%	1	Lump Sum	$23,800	$24,000
	SUBTOTAL 2				**$129,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$13,000	$13,000
	Traffic Control	1	Lump Sum	$5,000	$5,000
	Indirect Costs @ 14.06%	1	Lump Sum	$18,100	$19,000
	Construction Contingencies @ 10%	1	Lump Sum	$12,900	$13,000
	Construction Management @ 15%	1	Lump Sum	$19,400	$20,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE II TOTAL				***$199,000***
PHASE III	Demolition (Curb & Gutter)	500	LF	$9	$5,000
	Demolition (Sidewalk)	500	SF	$4	$2,000
	Demolition (Asphalt)	900	SF	$4	$4,000
	Grading	11,000	SF/ ft depth	$0.40	$5,000
	Crushed Aggregate Course - New Base	9,000	SF	$1	$9,000
	Pavement Surfacing - New	9,000	SF	$5	$41,000
	Pavement Surfacing - Overlay	62,000	SF	$1.33	$83,000
	Sidewalks	500	SF	$6	$3,000
	Curb and Gutter	700	LF	$13	$10,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Picnic Areas	1	Lump Sum	$4,000	$4,000
	Rest Area Amenities	1	Lump Sum	$14,000	$14,000
	SUBTOTAL 1				**$238,000**
	Mobilization @ 10%	1	Lump Sum	$24,000	$24,000
	Miscellaneous @ 25%	1	Lump Sum	$59,500	$60,000
	SUBTOTAL 2				**$322,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$32,000	$32,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$45,300	$46,000
	Construction Contingencies @ 10%	1	Lump Sum	$32,200	$33,000
	Construction Management @ 15%	1	Lump Sum	$48,300	$49,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE III TOTAL				***$492,000***
GRAND TOTAL					***$929,000***

Table 4.29 Single-Phase Cost Estimate for Hysham EB Rehabilitation

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Hysham EB (Rehabilitation)

	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$120,000	$120,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	Wastewater System (2027 Demand)	1	Lump Sum	$79,000	$79,000
	Building Upgrades	1	Lump Sum	$16,000	$16,000
	Demolition (Curb & Gutter)	500	LF	$9	$5,000
	Demolition (Sidewalk)	500	SF	$4	$2,000
	Demolition (Asphalt)	950	SF	$4	$4,000
	Grading	11,000	SF/ ft depth	$0.40	$5,000
	Crushed Aggregate Course - New Base	9,000	SF	$1	$9,000
	Pavement Surfacing - New	9,000	SF	$5	$41,000
	Pavement Surfacing - Overlay	62,000	SF	$1.33	$83,000
	Sidewalks	500	SF	$6	$3,000
	Curb and Gutter	700	LF	$13	$10,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Picnic Areas	1	Lump Sum	$4,000	$4,000
	Rest Area Amenities	1	Lump Sum	$14,000	$14,000
	SUBTOTAL 1				**$477,000**
	Mobilization @ 8%	1	Lump Sum	$39,000	$39,000
	Miscellaneous @ 20%	1	Lump Sum	$96,000	$96,000
	SUBTOTAL 2				**$612,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$61,000	$61,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$86,000	$86,000
	Construction Contingencies @ 10%	1	Lump Sum	$61,000	$61,000
	Construction Management @ 15%	1	Lump Sum	$92,000	$92,000
	Acquire Right-of-Way	0	AC	$2,000	$0
GRAND TOTAL					***$922,000***

Table 4.30 Multi-Phase Cost Estimate for Hysham WB Rehabilitation

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Hysham WB (Rehabilitation)

Phase	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$87,000	$87,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	SUBTOTAL 1				**$111,000**
	Mobilization @ 10%	1	Lump Sum	$12,000	$12,000
	SUBTOTAL 2				**$123,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$12,000	$12,000
	Indirect Costs @ 14.06%	1	Lump Sum	$17,300	$18,000
	Construction Contingencies @ 10%	1	Lump Sum	$12,300	$13,000
	Construction Management @ 15%	1	Lump Sum	$18,500	$19,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE I TOTAL				***$185,000***
PHASE II	Well Rehabilitation	1	Lump Sum	$15,000	$15,000
	Wastewater System (2027 Demand)	1	Lump Sum	$3,000	$3,000
	Building Upgrades	1	Lump Sum	$16,000	$16,000
	SUBTOTAL 1				**$34,000**
	Mobilization @ 10%	1	Lump Sum	$4,000	$4,000
	Miscellaneous @ 25%	1	Lump Sum	$8,500	$9,000
	SUBTOTAL 2				**$47,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$5,000	$5,000
	Traffic Control	1	Lump Sum	$5,000	$5,000
	Indirect Costs @ 14.06%	1	Lump Sum	$6,600	$7,000
	Construction Contingencies @ 10%	1	Lump Sum	$4,700	$5,000
	Construction Management @ 15%	1	Lump Sum	$7,100	$8,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE II TOTAL				***$77,000***
PHASE III	Demolition (Curb & Gutter)	650	LF	$9	$6,000
	Demolition (Sidewalk)	0	SF	$4	$0
	Demolition (Asphalt)	15,700	SF	$4	$63,000
	Grading	55,000	SF/ ft depth	$0.40	$22,000
	Crushed Aggregate Course - New Base	31,000	SF	$1	$31,000
	Pavement Surfacing - New	31,000	SF	$5	$140,000
	Pavement Surfacing - Overlay	52,000	SF	$1.33	$70,000
	Sidewalks	500	SF	$6	$3,000
	Curb and Gutter	650	LF	$13	$9,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Picnic Areas	1	Lump Sum	$4,000	$4,000
	Rest Area Amenities	1	Lump Sum	$11,000	$11,000
	SUBTOTAL 1				**$417,000**
	Mobilization @ 10%	1	Lump Sum	$42,000	$42,000
	Miscellaneous @ 25%	1	Lump Sum	$104,300	$105,000
	SUBTOTAL 2				**$564,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$56,000	$56,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$79,300	$80,000
	Construction Contingencies @ 10%	1	Lump Sum	$56,400	$57,000
	Construction Management @ 15%	1	Lump Sum	$84,600	$85,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE III TOTAL				***$852,000***
GRAND TOTAL					***$1,114,000***

Table 4.31 Single-Phase Cost Estimate for Hysham WB Rehabilitation

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Hysham WB (Rehabilitation)

	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Wastewater System (2007 Demand)	1	Lump Sum	$87,000	$87,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	Well Rehabilitation	1	Lump Sum	$15,000	$15,000
	Wastewater System (2027 Demand)	1	Lump Sum	$3,000	$3,000
	Building Upgrades	1	Lump Sum	$16,000	$16,000
	Demolition (Curb & Gutter)	650	LF	$9	$6,000
	Demolition (Sidewalk)	0	SF	$4	$0
	Demolition (Asphalt)	15,700	SF	$4	$63,000
	Grading	55,000	SF/ ft depth	$0.40	$22,000
	Crushed Aggregate Course - New Base	31,000	SF	$1	$31,000
	Pavement Surfacing - New	31,000	SF	$5	$140,000
	Pavement Surfacing - Overlay	52,000	SF	$1.33	$70,000
	Sidewalks	500	SF	$6	$3,000
	Curb and Gutter	650	LF	$13	$9,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Picnic Areas	1	Lump Sum	$4,000	$4,000
	Rest Area Amenities	1	Lump Sum	$11,000	$11,000
	SUBTOTAL 1				**$562,000**
	Mobilization @ 8%	1	Lump Sum	$45,000	$45,000
	Miscellaneous @ 20%	1	Lump Sum	$113,000	$113,000
	SUBTOTAL 2				**$720,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$72,000	$72,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$101,000	$101,000
	Construction Contingencies @ 10%	1	Lump Sum	$72,000	$72,000
	Construction Management @ 15%	1	Lump Sum	$108,000	$108,000
	Acquire Right-of-Way	0	AC	$2,000	$0
GRAND TOTAL					***$1,083,000***

Table 4.32 Single-Phase Cost Estimate for Hysham EB No Build

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Hysham EB (No Build)

	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Vault Toilets	1	Lump Sum	$33,000	$33,000
	Demolition (Building)	1	Each	$52,000	$52,000
	Demolition (Concrete Slabs and Sidewalks)	9,500	SF	$4	$38,000
	Demolition (Picnic Shelters)	3	Each	$2,000	$6,000
	SUBTOTAL 1				**$129,000**
	Mobilization @ 10%	1	Lump Sum	$13,000	$13,000
	Miscellaneous @ 25%	1	Lump Sum	$32,300	$33,000
	SUBTOTAL 2				**$142,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$14,000	$14,000
	Traffic Control	1	Lump Sum	$2,000	$2,000
	Indirect Costs @ 14.06%	1	Lump Sum	$20,000	$20,000
	Construction Contingencies @ 10%	1	Lump Sum	$14,200	$15,000
	Construction Management @ 15%	1	Lump Sum	$21,300	$22,000
GRAND TOTAL					***$215,000***

Table 4.33 Single-Phase Cost Estimate for Hysham WB No Build

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Hysham WB (No Build)

	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Vault Toilets	1	Lump Sum	$33,000	$33,000
	Demolition (Building)	1	Each	$52,000	$52,000
	Demolition (Concrete Slabs and Sidewalks)	9,200	SF	$4	$37,000
	Demolition (Picnic Shelters)	3	Each	$2,000	$6,000
	SUBTOTAL 1				**$128,000**
	Mobilization @ 10%	1	Lump Sum	$13,000	$13,000
	Miscellaneous @ 25%	1	Lump Sum	$32,000	$32,000
	SUBTOTAL 2				**$141,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$14,000	$14,000
	Traffic Control	1	Lump Sum	$2,000	$2,000
	Indirect Costs @ 14.06%	1	Lump Sum	$19,800	$20,000
	Construction Contingencies @ 10%	1	Lump Sum	$14,100	$15,000
	Construction Management @ 15%	1	Lump Sum	$21,200	$22,000
GRAND TOTAL					***$214,000***

4.4.1 Narrative Description of Bid Items

The cost estimate for **Well Rehabilitation** at the WB site includes labor, materials, and engineering oversight associated with taking the existing well off line, removing the pumping equipment, videotaping the well, and rehabilitating/cleaning the well if the well has potential for enhancement. After rehabilitation, the well would be pump tested to verify its capacity and the amount of improvement. It is assumed that the existing pumping equipment can be reinstalled after rehabilitation.

The cost estimate for the **Wastewater System (2007)** assumes a bi-directional treatment system at the EB site adequate to accommodate the existing 2007 demand. The lump sum for the WB site includes a new septic tank, dose tank, pipe from the WB site to the EB site, and 400 feet of directional drilling underneath the interstate. The lump sum for the EB site includes the AdvanTex treatment system and associated elements such as the septic tank, drainfield, dosing tanks, installation, and operation costs.

The cost estimate for the **Wastewater System (2027)** assumes additional treatment pods, additional length of drainfield, control modifications, and additional pumping units on the EB site only. Some additional cost is also associated with upsizing elements such as septic and dosing tanks if needed.

The cost estimate for **ADA Conformity** assumes rebuilding existing ramps with appropriate slopes and level pads, adding handrails to ramps, extending existing handrails, lowering sinks and mirrors, relocating grab bars, and adding new ADA signs.

Building Upgrades include the cost of new restroom stalls; new porcelain sinks, toilets, and urinals; and new epoxy flooring for all existing rest area sites.

The cost estimate for **Vault Toilets** assumes a single building with two individual unisex rooms.

For Phase III, it was assumed that **Sidewalks** would be needed to outline new parking areas and to access new picnic shelters and benches. The unit price was taken from the 2008 MDT Average Prices Catalog.

Demolition costs for rehabilitation of the sites include removal of sidewalks, curb and gutter, and/or necessary asphalt to accommodate new parking facilities. Demolition costs for the No Build option include removal of the building facility, all existing sidewalks except those adjacent to parking areas, and all existing picnic shelters, tables, and benches. The unit cost was derived from an average of the 2002 Dena Mora rest area bids, accounting for three percent annual inflation. A lower inflation value was used since demolition costs have not risen as sharply as material costs in recent years.

The **Grading** category includes site excavation and compaction. The quantity was determined based on the area of new parking facilities, in addition to a ten- to twenty-foot buffer area. The unit price was taken from the 2008 MDT Average Prices Catalog.

Unit prices for **Crushed Aggregate Course** and **Pavement Surfacing** were obtained from the 2008 MDT Average Prices Catalog. It was assumed that during Phase III, additional truck and car parking lots would be constructed to accommodate projected future demand, while existing parking areas and ramps would receive an asphalt overlay to extend their design life. Based on rough calculations, new parking areas could be designed to access existing ramps at the Hysham EB site, thereby reducing costs. In order to accommodate the recommended number of parking spots for 2027, a new entrance ramp would be required at the Hysham WB site. Drawings used for rough calculations for Phase III are included in Appendix N.

New **Curb and Gutter** would be needed for new parking areas. The unit cost was derived from an average of the 2007 Anaconda Interchange rest area bids.

New **Landscaping and Irrigation** would be needed at the EB and WB facilities. The lump sum costs were derived from an average of the 2007 Anaconda Interchange rest area bids.

Additional **Picnic Areas** would be needed at each rehabilitated site. To reduce costs, the estimate assumes a combination of picnic shelters and individual picnic tables. The range of costs depends on the number of picnic tables to be added and whether or not a shelter is needed. The lump sum cost was derived from an average of the 2007 Anaconda Interchange rest area bids.

The **Rest Area Amenities** category includes new benches, ADA parking signs, highway signs, directional arrow signs, and trash receptacles. The lump sum was drawn from an average of the 2007 Anaconda Interchange rest area bids and varies between sites based on the number of trash receptacles needed.

The **Miscellaneous** category is estimated to be up to 25 percent for this project because of the potential for unknown factors. It includes items such as:

- Roadside cleanup
- Slope treatment
- Watering
- Ditch or channel excavation
- Shoring, cribbing, or extra excavation
- Adjusting existing manholes, catch basins, valve boxes, and monument cases
- Retaining walls
- Unsuitable excavation
- Undergrounding or relocation of power, telephone, gas, or cable utilities
- Temporary striping
- Temporary water pollution/erosion control
- Sawcutting pavement
- Flagpole
- Striping and signing
- Storm drainage
- ADA ramps and truncated domes
- Lighting
- Dumpster
- Security Cameras

Several cost categories are calculated as percentages of construction, including the **Mobilization** and miscellaneous categories. Additionally, the **Planning/Survey/Design, Indirect Costs, Construction Contingencies, and Construction Management** categories were calculated as percentages of the respective subtotals noted in Tables 4.28 through 4.33. A construction contingency lower than the maximum 25 percent recommended by MDT's cost estimation guidelines was chosen because the majority of unknown factors should be accounted for under the miscellaneous category.

Traffic Control measures are expected to be minimal. Under Phase I, it may be possible for the site to remain open and to maintain operation of the existing wastewater system during installation of the new system. During Phase II and III, the site would likely need to be closed during rehabilitation. Traffic control costs would include signs alerting drivers of the closure, as well as barricades on the entrance and exit ramps.

Based on as-built drawings, it appears that new facilities could be constructed entirely within the existing **Right-of-Way** at each site.

4.4.2 Funding Sources

<u>Rest Area Program</u>
The Rest Area Program provides funding for state-maintained rest area projects throughout the state. The Federal Share for Rest Area projects is subject to the sliding scale. For example, rest areas located on the interstate system have a Federal Share of 91.24 percent and the State is responsible for 8.76 percent. The State's percentage is funded through the State Special Revenue Account.

The Montana Transportation Commission approved an annual allocation of funds to the Rest Area Program in September 2008. Funds may be used for new facility construction, rehabilitation and preservation work, which includes replacement of existing facilities. Approximately 80 percent of the funds are for new construction with the remaining 20 percent for rehabilitation and preservation work.

The Rest Area Program is reviewed annually to revisit project priorities, update cost estimates and track progress and reporting. The Montana Transportation Commission approves projects for the Rest Area Program.

<u>Interstate Maintenance</u>
The IM Program provides funding for projects on the Interstate System involving resurfacing, restoring, and rehabilitation of the existing roadway. The Federal share for IM projects is 91.24 percent and the State is responsible for 8.76 percent. The State's percentage is funded through the State Special Revenue Account.

Activities eligible under the Interstate Maintenance Program include resurfacing, restoring, and rehabilitation of the roadway. In addition, reconstruction or rehabilitation of bridges, existing interchanges, and over crossings also qualify. Rest Area projects along the interstate are also eligible for Interstate Maintenance Program funds. Preventive maintenance activities are eligible when a state can demonstrate, through its pavement management system, that such activities are a cost-effective means of extending interstate pavement life.

The Montana Transportation Commission approves the fund apportionment to the statewide Interstate Maintenance Program. The IM funds are distributed throughout the financial districts based solely on need.

4.5 Recommendations

Based on the findings of this study, Table 4.34 presents rankings associated with the set of factors to be used to determine whether it is feasible to upgrade and maintain existing rest area locations or whether new locations should be investigated. Four of these factors represent higher priority considerations, including provision of water, sewer, and power services and cost of rehabilitation. If there is a substantial impediment relating to any one of these four factors or a combination of any of the four, MDT guidelines recommend abandonment of the existing site and identification of an alternate location.

A total score of 130 points is possible based on the sum of the weighted scores for each factor. A higher total score for an individual rest area represents a more suitable site combined with a greater need for improvements. Accordingly, a rest area with a higher score is a better candidate for rehabilitation than a rest area with a lower score due to greater feasibility and urgency of improvements. Descriptions of each assigned ranking are provided below.

Water System

The Hysham water systems are not close to a community system that could be cost-effectively accessed. However, wells are easily accessed, and water quality is generally good. Quantity is limited at Hysham for the 20-year projections. Well rehabilitation is most likely needed at the Hysham WB site to accommodate 2027 demand.

Sewer System

Community wastewater systems are not located nearby. The Hysham site is constrained due to surface water features and general lack of right-of-way. This site may require the additional purchase of right-of-way to accommodate appropriately sized systems, unless a bi-directional system is installed.

Power System

The Hysham rest area has ready access to the power grid. Costs may continue to increase, although there may be opportunities to reduce energy consumption and/or to utilize supplemental sources of power.

Cost

The total cost of site rehabilitation at the Hysham sites is relatively low because projected demand does not warrant construction of a new building facility. Phased implementation could be used at Hysham to reduce initial costs and allow for long-term budgetary planning. While the No Build option would require some initial capital cost in order to convert the Hysham site to a truck parking location, it may be the most cost-effective measure over the long-run by minimizing maintenance costs over time and avoiding costly parking and wastewater upgrades at the site. It is unknown at this time if there would be cooperative cost contributions.

Urgency of Replacement

The Hysham sites currently meet existing demand. Although current maintenance requirements are not burdensome, the conventional septic tank and drainfield systems are not designed to accommodate high-strength wastewater and will require frequent pumping unless the system is upgraded in the near-term.

AADT

Current AADT at the sites is approximately 2,300 vehicles.

Spacing

The Hysham rest area is spaced too closely to other nearby rest areas.

Percent Completion
This study represents planning-level consideration of rehabilitation of the three sites. No design work has been performed to date.

System
The Hysham sites are located on Interstate 94.

Percent Usage by Travelers in Corridor
Usage was estimated as a percentage of AADT, per AASTHO guidelines. Additional data would be needed in order to determine actual usage.

Land Use and Ownership
MDT owns the existing sites. No additional right-of-way would be needed, assuming conversion of the existing Hysham rest area to a truck parking location. If the Hysham rest area were rehabilitated, additional right-of-way would likely be needed in order to meet future demand, unless a bi-directional wastewater system is installed.

Topography and Site Accessibility
The Hysham sites are outside the floodplain and there are no known environmental resources immediately adjacent to the sites. Existing acceleration and deceleration ramps provide sufficient sight distance at the Hysham site. Testing would be required to determine soil types at the sites.

Safety Corridor
There were no crashes due to fatigue within one mile of the Hysham rest area.

Percent Commercial Use / MCS Facility
Commercial vehicles constitute approximately 20 percent of the AADT at the three sites.

Rehabilitation of Existing Site
The Hysham site may require additional right-of-way to accommodate upgraded wastewater systems.

Seasonal Site Conversion
The Hysham rest area is currently open year round.

Alternative Funding Available
It is unknown at this time whether alternative sources of funding are available for this project.

ADA Compliance
The existing sites do not comply with ADA requirements relating to sinks, toilet stalls, and signage.

Community Involvement
It is unknown at this time whether locals support rehabilitation of the existing Hysham rest areas; additional right-of-way may be required.

Table 4.34 Rankings for Hysham Rest Area

Factor		Description	Possible Score	EB Score	WB Score
Priority Considerations and Focus of this Study	Water Facilities	Feasibility of Upgrades to Water System • Community System Available = 3 • Well Easily Accessed = 2 Existing Water Quality • High quality (low turbidity, no need for filtration), sufficient flow = 3 • Poor quality, low flow rate = 0 Urgency of Rehabilitation of Water System • Existing system does not meet current (2007) demand = 4 • Existing system does not meet projected future (2027) demand = 2 • Existing system meets current demand and is projected to meet future (2027) demand = 0	10	7	7
	Sewer Facilities	Feasibility of Upgrades to Sewer System • Community sewer system nearby; connection possible = 5 • Individual system can be installed at site without significant burden = 4 • Individual system installation would be difficult due to lack of land, topography = 0 Urgency of Rehabilitation of Sewer System • Existing system does not meet current (2007) demand = 5 • Existing system does not meet projected future (2027) demand = 2 • Existing system meets current demand and is projected to meet future (2027) demand = 0	10	9	9
	Power Facilities	Energy Source • Energy source is nearby, cost-effective, and/or renewable = 5 • Energy source is remote, costly = 0	5	5	5
	Cost	Cost-effective, with cooperative cost contribution = 10 Cost Prohibitive, no cost sharing = 0	10	5	5
Urgency of Replacement		Facility requires substantial time, money, or staff resources to maintain? Age or facility condition reflected in increasing site costs? • Significant resources required = 10 • Moderate resources required = 5 • Few resources required = 0	10	4	4
AADT		AADT > 2500 = 10 2500 > AADT > 1500 = 7 1500 > AADT > 750 = 5	10	7	7
Spacing		Travel time to next or previous rest opportunity • 40 min < Travel Time < 75 min = 10 • Travel Time > 75 min = 5 • Travel Time < 40 min = 3	10	3	3
Percent Completion		Current plans and process for new facility, reconstruction, or rehabilitation underway, including total funds already obligated to site • Agreement signed, significant work performed and funds obligated, additional right-of-way purchased = 10 • Nothing but an idea = 0	10	2	2
System		Interstate = 5 NHS = 3 Primary = 2	5	5	5
Percent Usage by Travelers in Corridor		**Commercial or Metro Area**: Usage > 9% = 5; 9% > Usage > 5 % = 3; 5% > Usage = 0 **Typical Rural Route**: Usage > 12% = 5; 12% > Usage > 8 % = 3; 8% > Usage = 0 **Information and Welcome Center**: Usage > 15% = 5; 15% > Usage > 9 % = 3; 9% > Usage = 0	5	3	3
Land Use and Ownership		MDT Owned = 5 State = 4 Private = 3 Lease = 1	5	5	5
Topography and Site Accessibility		Outside floodplain; suitable elevation and soil type; construction will not adversely impact environmental resources; topography provides adequate line of sight and safe acceleration / deceleration distances. • Site meets all criteria = 5 • Significant challenges with water table, soil composition, environmental impacts and/or line of site = 0	5	5	5
Safety Corridor		High crash section = 5 No reported crashes due to fatigue = 0	5	0	0
Percent Commercial Use / MCS Facility		Can be incorporated into MCS facility and located in high-need area = 5 Site cannot be incorporated; many parking opportunities available = 0	5	4	4
Rehabilitation of Existing Site		Existing site, considering all elements, can be reconstructed / rehabilitated = 5 Existing site has significant impediments = 0	5	2	2
Seasonal Site Conversion		Site is open year round or can easily be converted = 5 Significant impediment to conversion; must select new site = 0	5	5	5
Alternative Funding Available		Other sources of funds available to build or maintain rest area = 5 Built and maintained solely through RA program set-aside = 0	5	2	2
ADA Compliance		Meets all current ADA specifications = 0 Significant ADA issues (sidewalks, parking, accessibility) must be overcome = 5	5	2	2
Community Involvement		Locals are supportive and will donate land = 5 Locals are not supportive or proactively resistant = 0	5	3	3
TOTAL SCORE			**130**	**78**	**78**

This Page
Intentionally Left Blank

Based on the rankings noted in Table 4.34, the Hysham site is constrained due to topography, land availability, and surface water features complicating the installation of new wastewater systems. Further, it is spaced too closely to nearby rest areas and would be a good candidate for closure. Implementing the No Build option at the Hysham site would reduce maintenance costs and avoid costly upgrades at the site. Therefore, it is recommended that MDT convert the Hysham site to a truck parking location. If full site rehabilitation is pursued at the Hysham rest area, it is possible to phase rehabilitation in order to reduce initial costs and plan for future needs.

General Recommendations and Long Term Considerations

- Consider closing the Hysham site and converting to a truck stop.

If full rehabilitation is pursued:

Water Recommendations

- Existing water system is adequate to meet current and future needs at Hysham assuming some water conservation practices are implemented and the WB well is rehabilitated; replace pumps and maintain system as needed in order to extend design life.
- Conduct inventory of wells and document their condition.
- Install water meters to more accurately define system demand.

Sewer Recommendations

- Conduct detailed site soil investigations to refine design and accurately determine area needed for an appropriately-sized drainfield. Additionally, perform nondegradation analysis to define the groundwater quality impact and establish wastewater system design criteria.
- Conduct wastewater effluent monitoring to establish the existing strength of the wastewater.
- Based upon raw wastewater characteristics and results of a nondegradation analysis, re-evaluate wastewater treatment options so that the most appropriate system may be selected at the Hysham rest areas.
- Install new septic tanks and drainfields.
- Design new system to function as a single combined system on the EB site of Hysham to reduce long-term operation and maintenance and right-of-way costs.

Power Recommendations

- Consider use of motion-detectors to reduce energy usage.
- Evaluate building orientation and heating, lighting, plumbing and mechanical systems at time of site rehabilitation in order to provide the most energy-efficient design.
- Consider use of solar or wind power to supplement power and reduce monthly energy costs.

Physical Site Recommendations

- Upgrade building facilities to maximize energy efficiency, meet ADA requirements, and accommodate demand over 20-year planning period.
- Design new parking lots so that existing acceleration and deceleration ramps could continue to serve facilities, where possible.
- Incorporate water-saving landscaping into the new design. Use of native, drought-resistant vegetation and smaller turf areas could substantially reduce irrigation needs.
- Consider drip irrigation system to reduce water usage.

5.0 HATHAWAY REST AREA

5.1 Existing Conditions and Current Demand

5.1.1 General Site Descriptions & Setting

The information provided in this section was gathered from the Rest Area Site Evaluation Forms completed by MDT in April 2008, which are included in Appendix A. Additional information was gathered during site visits conducted on January 19-21, 2009 and from mapping provided by MDT Environmental Services Bureau.

The Hathaway rest area is located in a rural setting amid rolling terrain. The EB site is located on relatively flat ground, while the WB site is located at the top of a hill. Vegetation at the sites consists of sagebrush and grass. The Yellowstone River is located to the north of the WB site. This section of river is a high quality fishery that provides habitat for Threatened and Endangered species, as well as other aquatic and terrestrial species. Sweeney Creek, which is a prairie stream with moderate fishery value, is also located in the vicinity of the WB rest area. The sites are located outside the floodplain. Coal prospects have been identified near the EB rest area on the south side of I-94. A coal inventory has identified two tunnels in this area. A schematic of the Hathaway rest area is presented in Figure 5-1 and a topographic map is provided in Figure 5-2.

Hathaway EB

Hathaway WB

Figure 5-1 Hathaway Rest Area

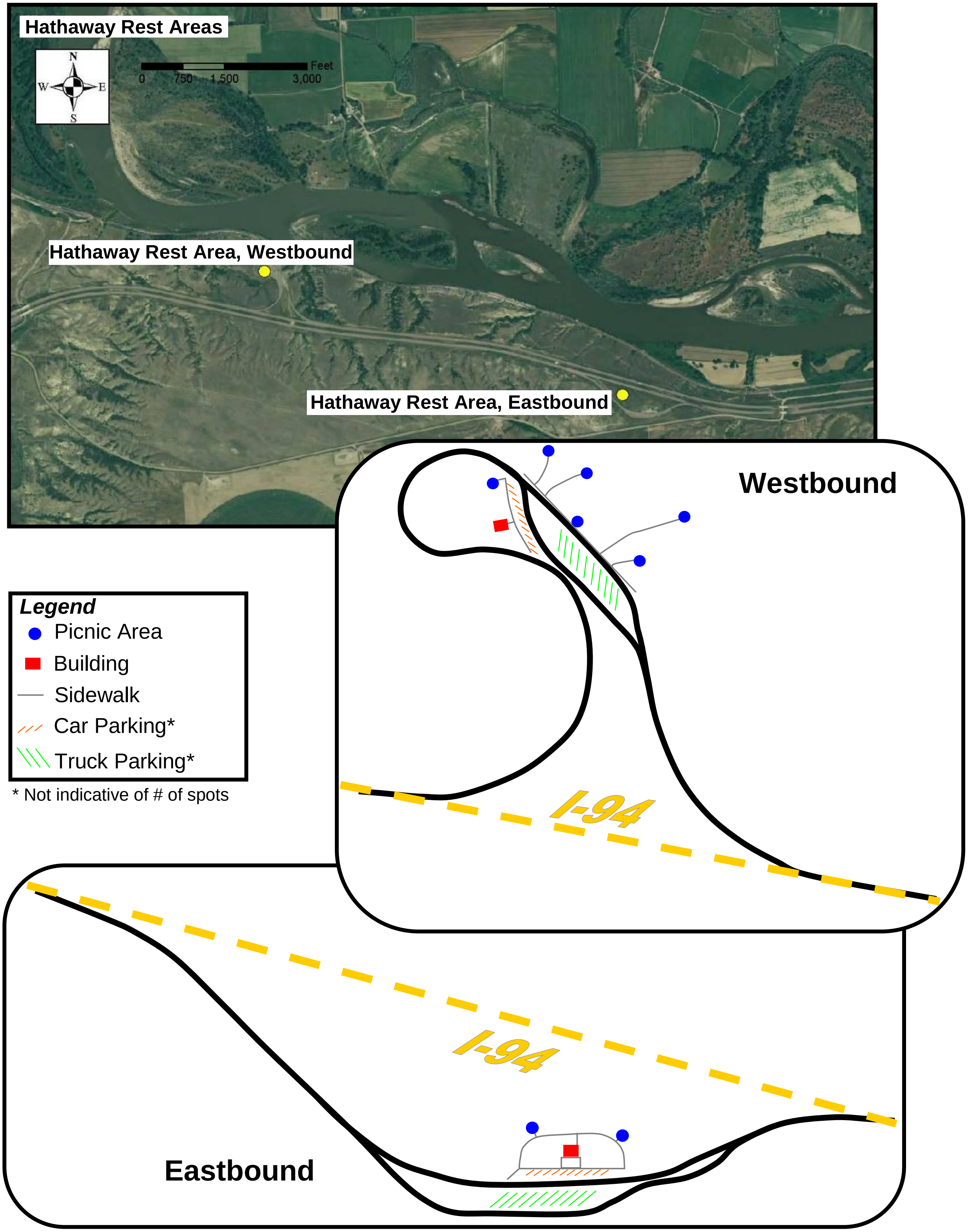
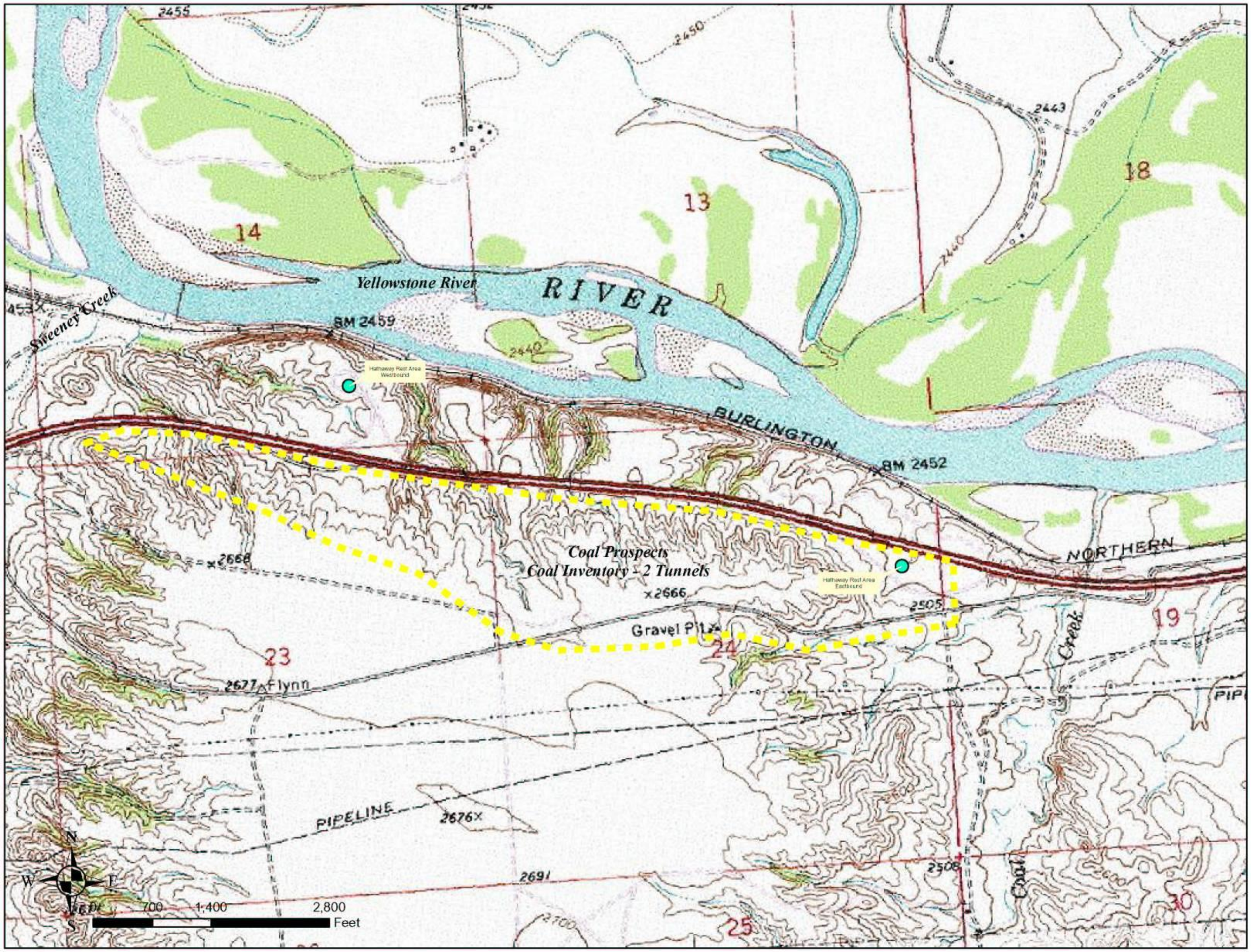


Figure 5-2 Topographic Map of Hathaway



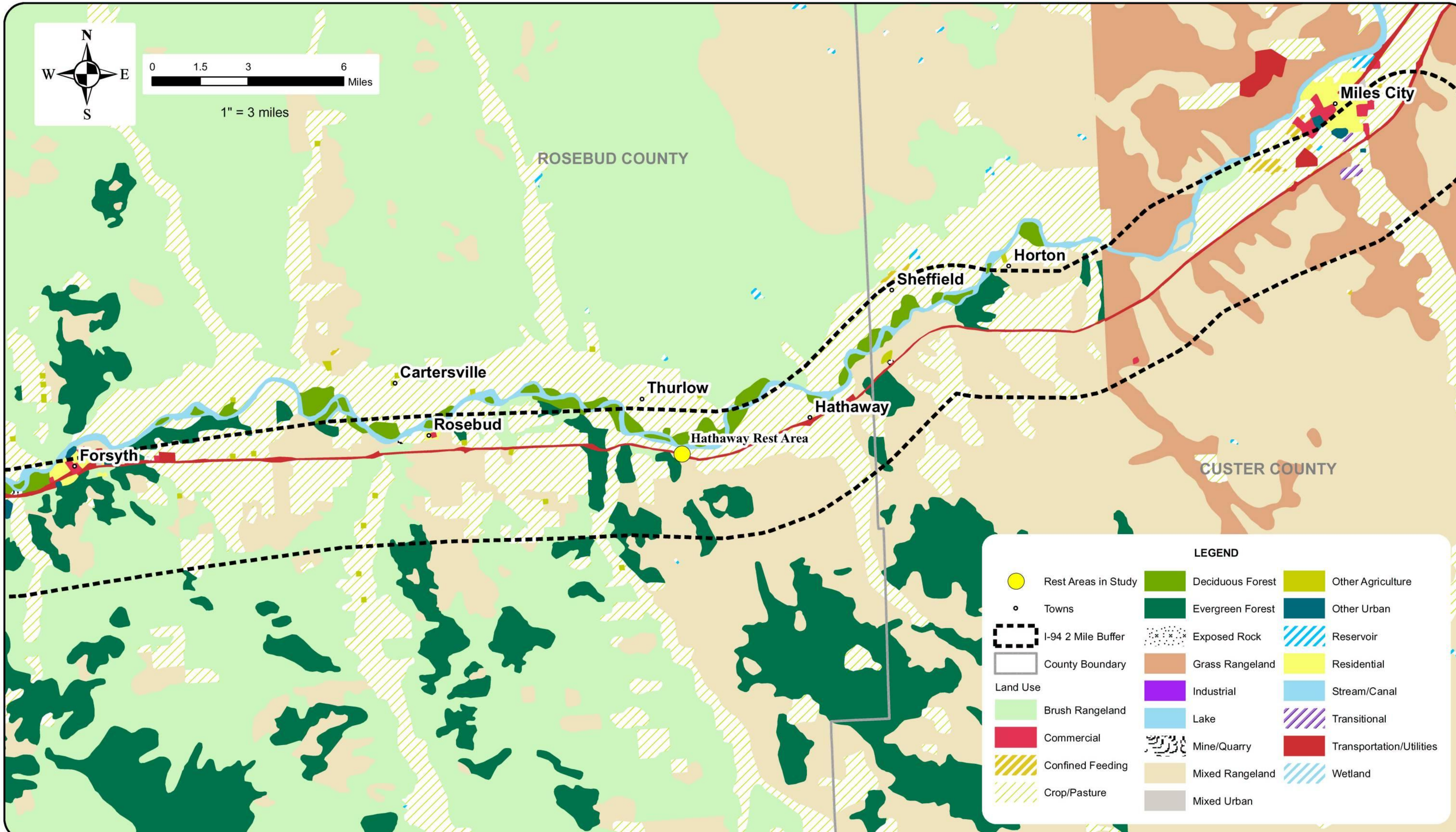
5.1.2 Land Use and Ownership

The Hathaway rest area is bordered by a small section of forest with the majority of land used as cropland and rangeland. The remaining land uses along the I-94 corridor consist mostly of cropland, pasture, and rangeland. Billings, Forsyth, and Miles City are the major residential/urban areas throughout the I-94 corridor. Land uses are illustrated in Figure 5-3.

Generally, land throughout the corridor is mostly private with areas of state and BLM land dispersed throughout. Some portions of land throughout the I-94 corridor are owned by the Bureau of Indian Affairs. Land areas adjacent to the Hathaway rest area sites are generally in private ownership. Land ownership status adjacent to each site is illustrated in Figure 5-4.

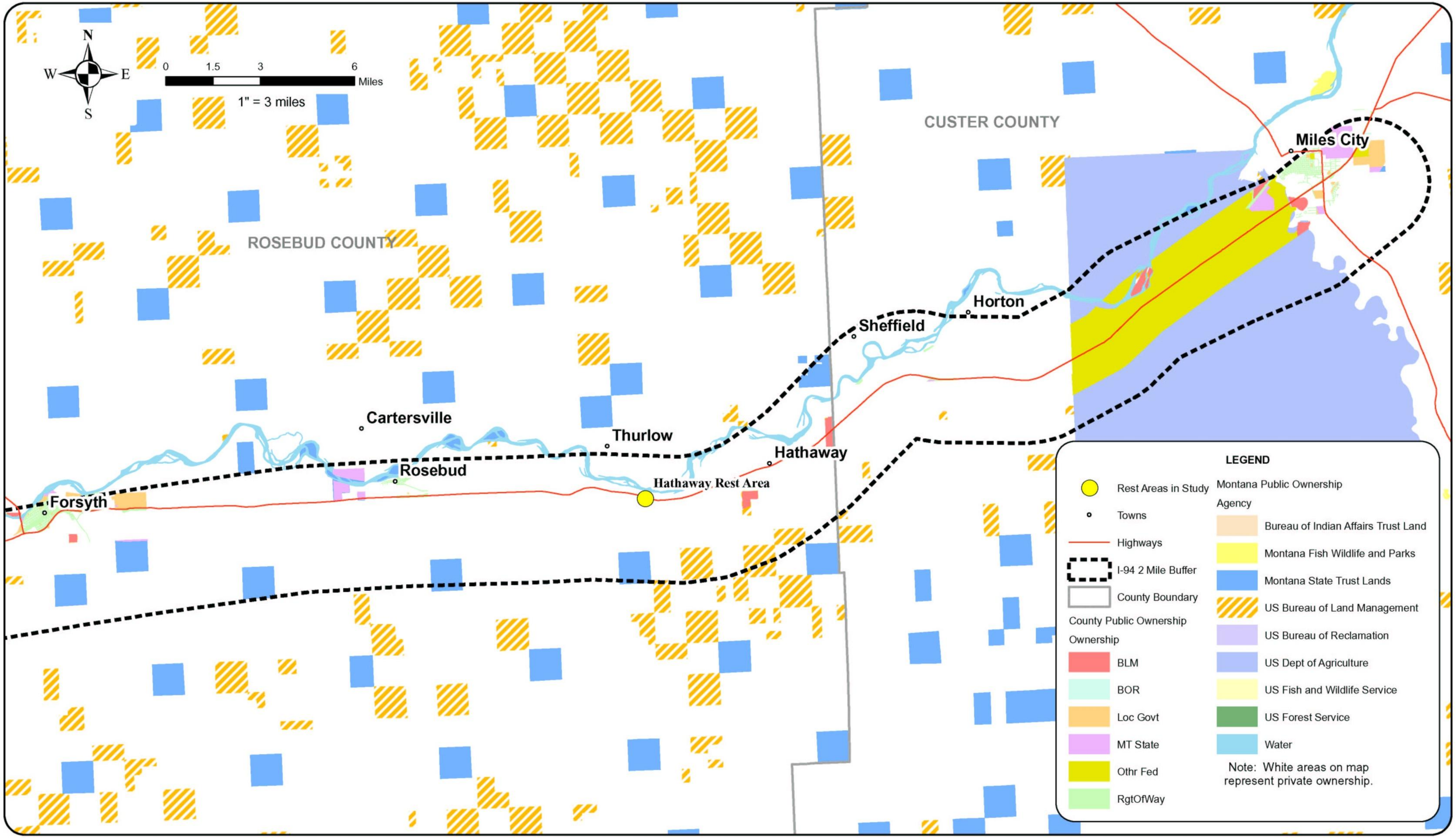
This Page
Intentionally Left Blank

Figure 5-3 Land Use along I-94 Study Boundary (Forsyth to Miles City)



This Page
Intentionally Left Blank

Figure 5-4 Land Ownership along I-94 Study Boundary (Forsyth to Miles City)



This Page
Intentionally Left Blank

5.1.3 Building and General Site Conditions

The Hathaway rest area is generally in good condition. There are a few elements at the EB site in need of repair or replacement, as noted in Tables 5.1 and 5.2. Photographs of select elements needing repair or replacement are included in Appendix B.

Table 5.1 Hathaway Building Conditions

Rest Area Site	Roofing	Siding	Paint	Plumbing Fixtures	General Interior Condition	General Exterior Condition
Hathaway EB	Steel – new	Brick – good	Facia – Good	Stainless – Good	Good	Good **(Sidewalk Drainage)***
Hathaway WB	Steel – like new	Brick – good	Good	Stainless – Good	Good	Good

Note: Shaded cells indicate elements in need of repair or replacement.
*Photographs of these elements are included in Appendix B.
Source: MDT Site Evaluation Forms, 2008; DOWL HKM, 2009.

Table 5.2 Hathaway General Site Conditions

Rest Area Site	Asphalt	Sidewalks	Landscaping	Picnic Facilities
Hathaway EB	Very Good	**Fair / Poor (lots of cracks)***	Good	2 structures / 10 tables – fair / **needs paint***
Hathaway WB	Very Good	Good	Good	6 structures / 12 tables - good

Note: Shaded cells indicate elements in need of repair or replacement.
*Photographs of these elements are included in Appendix B.
Source: MDT Site Evaluation Forms, 2008; DOWL HKM, 2009.

Table 5.3 describes the existing deceleration (entrance) and acceleration (exit) ramps for the Hathaway rest area sites. As noted in Table 5.3, there is a sight distance issue at the Hathaway WB rest area site.

Table 5.3 Hathaway Ramp Conditions

Rest Area Site	Acceleration Ramp	Deceleration Ramp	Sight Distance
Hathaway EB	Adequate, but not level (possible frost heave)	Adequate	Adequate
Hathaway WB	Curvy	Curvy, but adequate	**Not good – on hill***

Note: Shaded cells indicate elements in need of repair or replacement.
*Photographs of these elements are included in Appendix B.
Source: MDT Site Evaluation Forms, 2008; DOWL HKM, 2009.

5.1.4 Maintenance Contracts

General maintenance and cleaning of the rest areas is contracted out to private entities. Maintenance contracts typically encompass cleaning, mowing, weeding, irrigating, painting, cleaning of the picnic areas, and general upkeep. Rest areas are typically cleaned two to three times per day. Each pair of rest areas is administered under one contract. The cost to maintain the Hathaway rest area is approximately $4,200 per month.

5.1.5 Seasons of Operation

The Hathaway rest area is open year round, conforming to the stated Rest Area Prioritization Plan committee's objective for year-round rest area facilities.

5.1.6 Current AADT

Short-term count data was used to approximate AADT at the Hathaway rest area. Directional splits were not available at these count locations. For the purposes of this study, equal volumes were assumed for the EB and WB directions. Percentages of vehicles included in the broad categories of passenger vehicles, small trucks, and large trucks were generated from MDT's TYC table. AADT volumes for 2007 are presented in Table 5.4.

Table 5.4 Current AADT near Hathaway (2007)

Rest Area	Route	Rest Area Location (RP)	Traffic Count Location (RP)	Total AADT	Total Passenger & Bus (Types 1-4)		Total Small Trucks (Types 5-7)		Total Large Trucks (Types 8-13)		Total Commercial (Types 5-13)	
					AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT
Hathaway EB	I-94	113.5	103	2,265	1,721	76.00	72	1.59	507	22.41	543	24.00
Hathaway WB		112.6		2,265	1,722	76.00	36	1.59	508	22.41	544	24.00

Source: MDT, 2008.
Directional counts not available. AADT assumes equal volumes for EB and WB directions.

5.1.7 Current Rest Area Usage

The Rest Area Plan provides guidance regarding rest area usage based on AASHTO formulas. The number of vehicles stopping at a rest area site per hour is calculated as a percentage of the directional traffic volume, with factors accounting for the mainline traffic composition by type of vehicle as well as the type of mainline route. Detailed calculations are provided in Appendix C. The AASHTO methodology for estimating rest area usage is considered highly conservative and is the standard used to date. It should be noted that MDT has initiated a research project to be completed in 2010 that will identify more accurate methods to predict rest area usage.

Table 5.5 presents the number of vehicles per hour estimated at the Hathaway rest area. It should be noted that a range of values may be used for car and truck stopping percentages. The range of stopping percentage values provided by AASHTO is intended for use nationwide, although AASHTO recommends that stopping percentages ideally be determined on a case-by-case basis through usage surveys. In the absence of site-specific data, the mid- to low-end of the AASHTO stopping percentage range was used for the purposes of this study because Montana is largely rural in nature and has a relatively small population in comparison to other states.

This study did not consider factors that may affect stopping percentages at individual rest area locations within the study area. In the event that an individual project is developed following this study, site-specific designs may be adjusted on an as-needed basis if justified by special circumstances. Accordingly, usage values presented in this study should be viewed as preliminary estimates; the need for a greater or lesser number of parking spots, restroom stalls,

and other rest area amenities than suggested in this study should be considered at the time of project development for each individual site based on actual usage data.

It is not the intent of this study to design to peak usage at a particular site; rather, a single standardized method is used for all sites. This study will, however, qualitatively address when or under what circumstances the current rest area sites are expected to be physically undersized, requiring consideration of a new site or purchase of additional right-of-way at the current sites. It should also be noted that the MDT Road Design Manual provides slightly different calculation factors. This study used the calculation guidelines presented in the Rest Area Plan.

Table 5.5 Current Rest Area Usage at Hathaway (2007)

Rest Area Site	Total Number of Vehicles Per Hour	Number of Passenger Cars and Buses Per Hour	Number of Commercial Trucks Per Hour**
Hathaway*	37	27	10

Source: MDT, 2008; DOWL HKM, 2009.
Note: Calculations use factors from Table 9, Rest Area Plan, 2004.
*Usage values apply to both EB and WB sites.
**Includes estimate for the number of cars with trailers or RVs.

The Rest Area Plan also provides guidance regarding parking at rest areas. The recommended number of spots is calculated as a percentage of the directional traffic volumes, with factors accounting for design hour volumes, traffic composition, and type of route. Detailed calculations for each rest area site are included in Appendix C. Guidelines for the recommended number of ADA parking spots are included in the Checklist of Facility Accessibility for each site (Appendix D).

Table 5.6 Hathaway Parking Conditions (2007)

Rest Area Site	Truck Parking Spots		Auto Parking Spots		ADA Parking Spots	
	Actual Number	Recommended Number*	Actual Number**	Recommended Number*	Actual Number*	Recommended Number***
Hathaway EB	9	5	14	12	4	1
Hathaway WB	9	5	12	12	4	1

Source: MDT, 2008; DOWL HKM, 2009.
*Calculations use factors from Table 9, Rest Area Plan, 2004. Truck parking includes cars with trailers or RVs.
**Actual number of spots determined based on site visits conducted in January 2009.
***As recommended in Parking Space Matrix, Checklist for Facility Accessibility, MDT 2008.

As noted in Table 5.6, the existing number of automobile and truck parking spots at the Hathaway sites meets or exceeds the recommended number of spots. The number of ADA parking spots at each of the rest areas is also more than adequate given the current traffic volumes and approximated usage.

The Rest Area Plan also provides guidance for the recommended number of picnic tables and waste receptacles (referred to as site facilities throughout this document) at each site. As noted in the calculation procedure provided in the bottom portion of Table 12 within the Rest Area Plan, the appropriate number of site facilities is determined by applying factors to the calculated number of parking spaces listed in Table 5.6. Detailed calculations are provided in Appendix C.

Table 5.7 presents the recommended site facilities at the Hathaway sites based on current AADT volumes.

Table 5.7 Hathaway Site Facilities (2007)

Rest Area Site	Picnic Tables		Waste Receptacles	
	Actual Number	Recommended Number	Actual Number	Recommended Number
Hathaway EB	10	7	8	5
Hathaway WB	12	7	11	5

Source: MDT, 2008; DOWL HKM, 2009.
Calculations use factors from Table 12, Rest Area Plan, 2004.

As noted in Table 5.7, the rest area sites have adequate numbers of picnic tables and waste receptacles. The majority of existing picnic tables at the sites are located within picnic shelters each containing four tables. The waste receptacles are located within garbage can racks each containing two to three garbage cans. A single garbage can is also located within each restroom.

The Rest Area Plan provides methodology for calculating the required number of restroom stalls and required water usage at each site. The number of required restroom stalls is based on the rest area usage determined in Table 5.5 along with estimates accounting for the number of rest room users per vehicle and an estimated time cycle per fixture. Similarly, water usage is determined by applying a usage rate per person to the total rest area usage listed in Table 5.5. Calculations for the number of restroom stalls and water usage both use a peaking factor of 1.8.

Table 12 within the Rest Area Plan lists the calculation procedure and assumptions used for calculating the number of restroom stalls and water usage. Detailed calculations are provided in Appendix C.

Table 5.8 presents the recommended number of restroom stalls and estimated current water usage at each site based on current AADT volumes.

Table 5.8 Restroom Stalls and Water Usage at Hathaway (2007)

Rest Area Site	Women's Restroom Stalls		Men's Restroom Stalls		Water Usage (Peak Hourly Demand)
	Actual Number	Recommended Number	Actual Number	Recommended Number	
Hathaway EB	3	2	3	1	5 gpm
Hathaway WB	3	2	3	1	5 gpm

Source: MDT, 2008; DOWL HKM, 2009.
Calculations use factors from Table 12, Rest Area Plan, 2004.

The number of restroom stalls at the Hathaway rest area exceeds the recommended number of stalls based on current usage estimates.

5.1.8 Spacing

The Rest Area Plan recommends spacing between rest areas equal to approximately one hour of travel time under favorable traveling conditions. Figure 5-5 and Table 5.9 present current spacing between rest areas in the I-94 portion of the study corridor. Orange shaded cells indicate distances that slightly exceed the recommended maximum spacing assuming drivers travel at the posted speed limit of 75 miles per hour.

Figure 5-5 Rest Area and City Locations

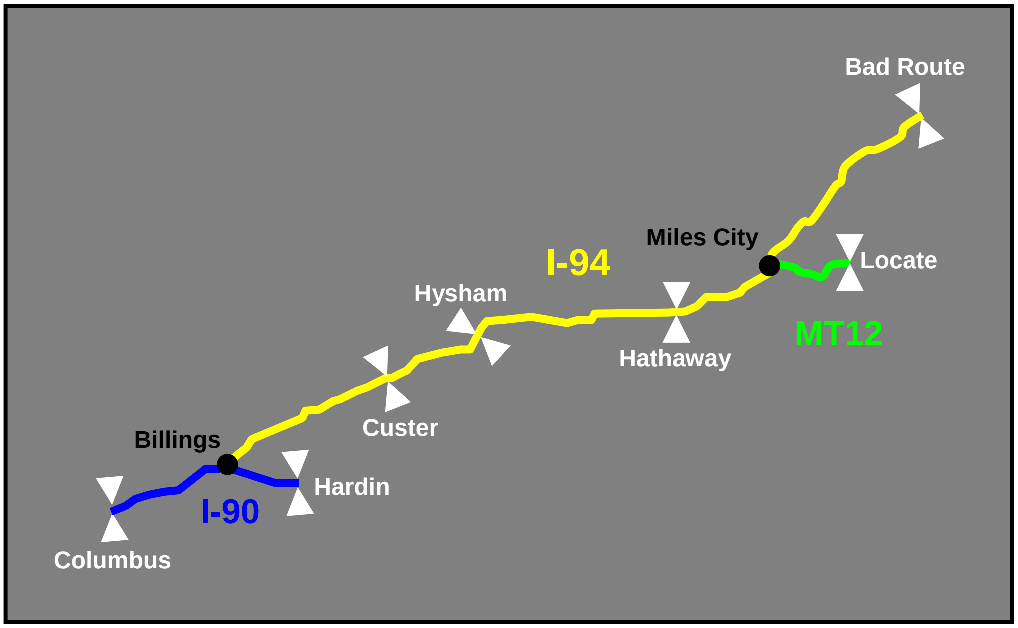


Table 5.9 Spacing between Rest Areas and Nearby Cities with Services

Rest Area Site	Previous Rest Area		Previous City with 24/7 Services		Next Rest Area		Next City with 24/7 Services	
	Name	Distance (miles)	Name	Distance (miles)	Name	Distance (miles)	Name	Distance (miles)
Hathaway EB	Hysham	49	Billings	113	Bad Route	79	Miles City	25
					Locate	64		
Hathaway WB	Bad Route	79	Miles City	25	Hysham	48	Billings	113
	Locate	65						

Note: Orange shaded cells indicate distances between rest areas slightly exceeding Rest Area Plan recommendations; blue shaded cells indicate overly dense spacing.
Source: MDT Rest Area Site Evaluation Forms, 2008.

It should be noted that the distance between the Hathaway and Bad Route rest areas only exceeds the Rest Area Plan recommendations by a few miles.

5.1.9 Water, Sewer, and Power Services

Information on existing water, sewer, and power services was obtained from a variety of sources, as noted in Table 5.10.

Table 5.10 Sources for Information on Existing Water, Sewer, and Power Services

Source	Notes
Site visits conducted on January 19-21, 2009 and corresponding meetings with MDT maintenance personnel	Photos of the water, sewer, and power systems taken during the site visits are included within Appendix E and will be referred to throughout this section.
MDT	A variety of data was obtained from MDT including as-built drawings of recent water and sewer system improvements as well as maintenance division questionnaires. Through meetings and correspondence with the MDT maintenance personnel for each site, additional information was obtained including available design criteria, equipment manufacture data, well logs, applicable correspondence, and power records.
DEQ	The Helena and Billings DEQ offices were contacted for any applicable files pertaining to the water and wastewater systems that may have gone through the permitting and approval process.
Online Databases	Several online sources were used to collect information on the rest area sites, including: ○ MBMG GWIC ○ DEQ Public Water Supply Reports ○ USDA NRCS Soils Data ○ NRIS

Figure 5-6 depicts the locations of some of the pertinent water and wastewater system components.

Figure 5-6 Hathaway Water and Sewer Location Map

Water

Groundwater is the source of potable water at the Hathaway rest area sites. Water from this source is used to serve the rest area facilities such as toilets, sinks, and drinking fountains, as well as for irrigation of the grass and associated landscaping. The approximate locations of the Hathaway wells are shown in Figure 5-6. Each well is labeled with the most recent capacity information available in addition to the intended use.

Quantity

To assure there is adequate water quantity at the sites, the source capacity of the wells must equal or exceed the design maximum day demand per Circular DEQ-3. Table 5.11 lists the current maximum water use estimates at the Hathaway rest area sites. The current estimated restroom water usage is drawn from Table 5.8. The irrigation demand is estimated based on requirements from the NRCS and the Montana Irrigation Guide for pasture grass and turf. The NRCS provides consumptive use estimates for pasture grass and turf based on data obtained from several weather stations throughout the state. Several assumptions are made such as the irrigation cycle time, delivery period for the irrigation volume, and system efficiencies in order to come up with the estimated irrigation flow rate. The estimated irrigation area was determined using aerial photography and as-built drawings of the irrigation systems. Twenty-five percent of the irrigation area was removed from the calculations to account for impervious areas such as buildings, sidewalks, and picnic shelters. The irrigation demand calculations are found within Appendix F, along with a more detailed description of how the demands are calculated.

Table 5.11 Hathaway Water Use Estimates

Rest Area Site	Restroom Water Usage (Peak Hourly Demand)	Estimated Irrigation Demand	Total Demand
Hathaway EB	5 gpm*	11 gpm	16 gpm
Hathaway WB	5 gpm*	4 gpm	9 gpm

Source: MDT, 2008; DOWL HKM, 2009.
*Does not include estimate for the amount of water used during the RO treatment process.

Based on discussions at the site visits, there are no water meters installed anywhere in the system. Therefore, actual water use data is not available and the estimates presented in Table 5.11 are the best available current usage estimates.

To determine the well capacities, well log information was downloaded from the MBMG website through the GWIC database. The well log information for the rest area sites can be found within Appendix G. It should be noted that from a water rights perspective, the rest area wells are allowed to pump no more the 35 gpm and 10 acre-feet per year as specified for "exempt wells" per DNRC. While exempt wells currently tend to be unregulated relative to actual usage, flow restriction valves are typically installed to limit the flow to 35 gpm. Generally, under an exempt well permit, an appropriate pump is selected to limit the flow to within the exempt well allowance of 35 gpm. Without a flow meter, neither the pumping rate nor annual use can be accurately recorded. Therefore, the well log does not necessarily match the actual well pumping rate for whatever pump was ultimately installed.

The most current flow rate information for the Hathaway rest areas was provided by MDT maintenance personnel in the form of a certificate of water right. The WB site has a total flow rate of 16 gpm while the EB site has a total flow rate of 18 gpm. It should be noted that well log information for the Hathaway EB well lists the original pump rate as 60 gpm. Based on this information and the estimated demand in Table 5.11, the wells appear to have sufficient capacity. However, MDT maintenance personnel revealed that the wells at both the EB and WB sites are not able to meet the demand on the system. As a result, the wells pump sand. Maintenance personnel stated that if the irrigation systems are not used, the wells seem to do fine. However, as a result, they are not able to keep the grass green in the summer. The water system at Hathaway is more complex than the rest areas discussed in previous chapters. Both sites are equipped with reverse osmosis (RO) units to provide treatment due to high nitrate levels in the water. The RO units require a certain amount of water to operate and the additional demand from this operation may be one of the reasons for the capacity issues with the wells. The RO system is discussed later in this section.

Quality

Treatment at the Hathaway rest area consists of multiple filters, RO units, storage tanks, and chlorination.

Current standards set forth by the applicable Circular DEQ-3 state that supply wells must have unperforated casing to a minimum depth of 25 feet or continuous disinfection must be provided. The unperforated casing depth refers to the depth below ground surface where perforation or screening begins. Additionally, per Circular DEQ-3, full time disinfection is required where the water source is an aquifer with a water table that is within 25 feet of the ground surface.

Table 5.12 lists specific data from the Montana Well Log Reports obtained from the GWIC database, which are provided in Appendix G. As shown, the recorded static water levels for the Hathaway EB and WB rest area wells are well below the 25-foot water table threshold.

Based on the GWIC well log information, the wells at Hathaway meet the requirements for unperforated casing depths. It should be noted that the Hathaway sites are currently providing disinfection so this standard does not apply.

Table 5.12 Hathaway Well Log Information

Well	Static Water Level	Unperforated Casing Depth
Hathaway EB	60 ft	235 ft
Hathaway WB	180 ft	320 ft

The DEQ Public Water Supply System online database was queried to obtain water quality sampling records pertaining to the Hathaway rest area sites. This data is included in Appendix H. The water systems serving the rest area sites are classified as transient non-community water supplies meaning that they serve 25 or more persons per day but do not regularly serve the same persons for at least six months a year. Transient non-community water supplies adhere to a specific set of water quality regulations as specified by DEQ. Detailed information can be found on DEQ's website. A summary of these regulations is described briefly below.

Samples for coliform bacteria must be collected either on a monthly or quarterly basis depending on authorization from DEQ. The Hathaway rest area is sampled monthly for coliform bacteria. If more than one sample per month/quarter is total coliform-positive, a violation of the MCL occurs and public notice must be given. In addition to coliform bacteria, all transient non-community water systems must sample annually for nitrates. One sample is adequate unless the result is greater than 5.0 mg/L. The MCL for nitrate is 10 mg/L. The Hathaway EB rest area has had recent total coliform MCL violations occurring in 2007 and 1997. The Hathaway WB site has had no recent MCL violations.

If groundwater sources are determined to be directly influenced by surface water through DEQ's GWUDISW determination process, they will be subject to Surface Water Treatment Rule requirements.

General Site Observations and Operation / Maintenance Issues

MDT provided results from recent maintenance questionnaires pertaining to each site. These are provided in Appendix I.

As previously noted, the Hathaway wells are not able to keep up with the demands of the sites. MDT maintenance personnel periodically shut down the irrigation systems in order for the system to function properly. Installation of low maintenance landscaping practices such as decorative rock in place of the grass could alleviate the issue. The Hathaway sites both contain RO water treatment systems due to the high nitrate levels found in the water. The water serving the toilets is filtered and does not go through the RO system while the water to the sinks and drinking fountains goes through the RO system. There are a number of issues with the RO system, including:

- The filters need to be changed often due to the wells pumping sand.
- Approximately 60 percent of the water needed to run the RO system is wasted, thereby increasing the water demand at the site.
- Due to the large size of the RO unit at the WB site, there have been overflow problems with the storage tanks.

MDT maintenance personnel suggested installation of a smaller RO unit similar to the system installed at the EB site. Water is also chlorinated after passing through the RO system.

A tour of the maintenance/utility rooms was provided at the Hathaway rest area. Photos are included in Appendix E. The water systems at Hathaway consist of piping from the well to a pressure tank. From there the water travels through a small section of piping, through a filter, and then through piping to serve the toilets and sinks. The Hathaway sites also contain additional equipment relating to the RO treatment system such as the RO unit itself, a water storage tank to hold the RO treated water, and a chlorination system. The utility rooms contain air tanks to operate the air valves for flushing toilets. The air valves and other piping are located in a small corridor between the two restrooms. A common complaint is the lack of space to perform routine maintenance within these corridors.

Sewer

On-site sewage treatment at the Hathaway rest area is accomplished through the use of a septic tank and soil absorption drainfield. The approximate location of the septic tank and drainfield are shown in Figure 5-6.

The wastewater systems at Hathaway were equipped with dosing systems in 1995. Also part of this project was the addition of new drainfields at both sites. It is unclear if the systems currently operate using both the existing and new drainfields or only the new drainfield installed in 1995.

Size of System

Based on the higher strength wastewater typical at a rest area, conventional septic tank and drainfield systems are not recommended for rest area applications. However, because these systems currently exist at the Hathaway sites, the following is a discussion of sizing requirements and adequacy to meet the current demand.

Preliminary calculations for septic tank and drainfield sizing are made considering today's standards set forth by DEQ. Per DEQ design regulations, the minimum acceptable size of a septic tank is 1,000 gallons for any system. DEQ provides guidelines for sizing septic tanks based on the type (residential versus non-residential) and quantity of the design flow. DEQ requires that for non-residential flows greater than 1,500 gallons per day, the tank must have a minimum capacity equal to 2.25 times the average daily flow. The average daily flow is determined using the design factors from Table 12 of the Rest Area Plan for water usage combined with the AADT volumes and estimated percentage of rest area users. Detailed calculations can be found within Appendix J. Existing septic tank sizes were provided by MDT maintenance personnel and are listed in Table 5.13 along with the calculated recommended sizing based on current usage. It should be noted that calculations are based on current standards set forth by DEQ.

A sanitary sewer disposal report dated 1995 was obtained for the Hathaway rest area. According to this report accompanied with the as-built drawings, approximate existing septic tank and drainfield sizes were obtained. It was assumed that the new drainfields are used in conjunction with the original drainfields.

Several site characteristics and investigations need to be evaluated for the proper design of the drainfield including soil profile descriptions, percolation tests, and site factors such as slope, drainage, and depth to groundwater. This information was not collected as part of this study but will need to be obtained for any new drainfield design.

The Hathaway wastewater system calculations use percolation rate information obtained from a 1995 design report. Detailed calculations can be found within Appendix J. Rough estimates of existing and proposed drainfield sizes are listed in Table 5.13.

Table 5.13 Hathaway Septic Tank and Drainfield Size

Rest Area Site	Existing Septic Tank Size	Recommended Tank Size for Existing Usage	Estimated Existing Drainfield Size	Recommended Drainfield Size for Existing Usage
Hathaway EB	4,380 gallons	3,900 gallons	4,720 ft^2	2,200 ft^2
Hathaway WB	4,380 gallons	3,900 gallons	4,690 ft^2	2,200 ft^2

Source: MDT, 2009; DOWL HKM, 2009.
Note: Existing sizing information obtained from as-built drawings and 1995 sanitary sewer disposal report.

The estimates presented in Table 5.13 indicate that Hathaway's current wastewater systems are adequately sized to accommodate the current capacity based on today's standards. However, it should be reiterated that accurate sizing of a drainfield cannot be accomplished without site specific soils information and percolation test results. The estimates presented in Table 5.13 are intended to provide general sizing comparison information.

General Site Observations and Operation / Maintenance Issues

MDT provided results from recent maintenance questionnaires (dated July 2008) pertaining to each site. These are provided in Appendix I.

There have been no maintenance issues with the Hathaway wastewater systems. Dosing systems were installed in 1995. The drainfields are marked with posts and the area surrounding the fields is relatively large.

Power

Power is provided at the Hathaway rest area for lighting and heating, as well as for the dosing pumps. The heating system was recently updated to a motion-activated system and the heat is provided through new propane tanks recently installed underground at each site. Fluorescent lighting is provided in the mechanical room. Lighting remains on continuously.

Power records were obtained from the MDT-Billings District office for the five-year period from January 2004 through December 2008. On average, power usage was lowest during the spring, summer, and early fall months (April through October), while usage increased during winter months (November through March), accounting for higher wintertime heating and lighting needs. Monthly averages over the 5-year period are depicted in Figure 5-7. Figure 5-8 depicts electricity consumption over the entire 5-year period.

Figure 5-7 Hathaway Average Monthly Power Consumption (2004 – 2008)

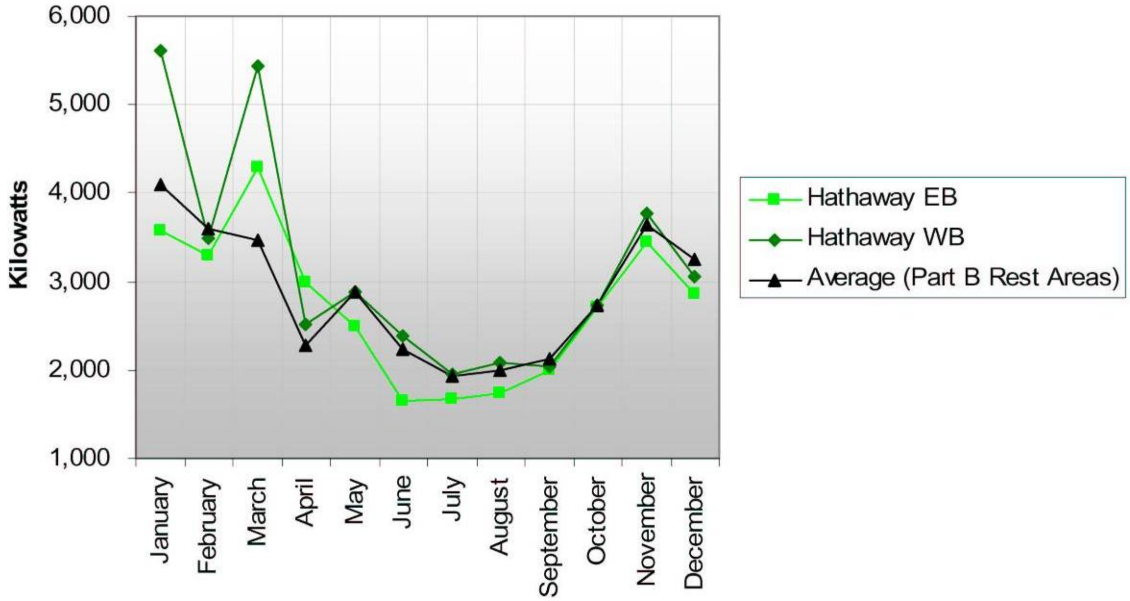
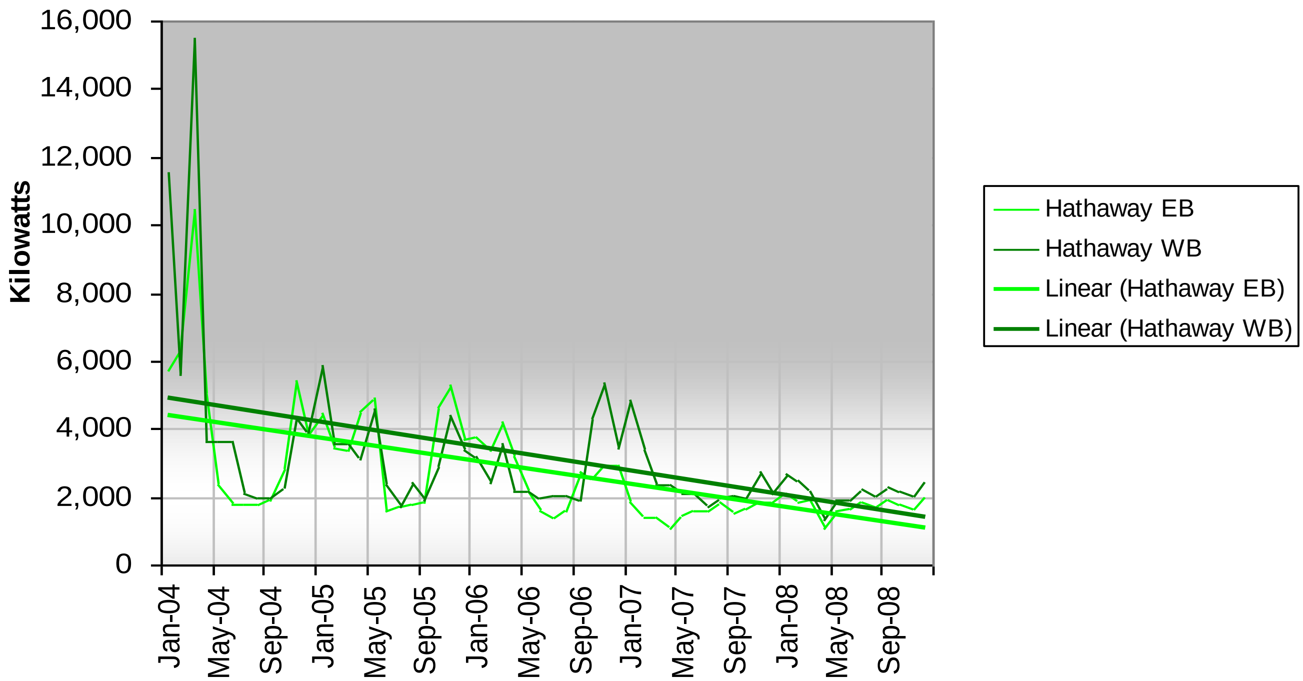


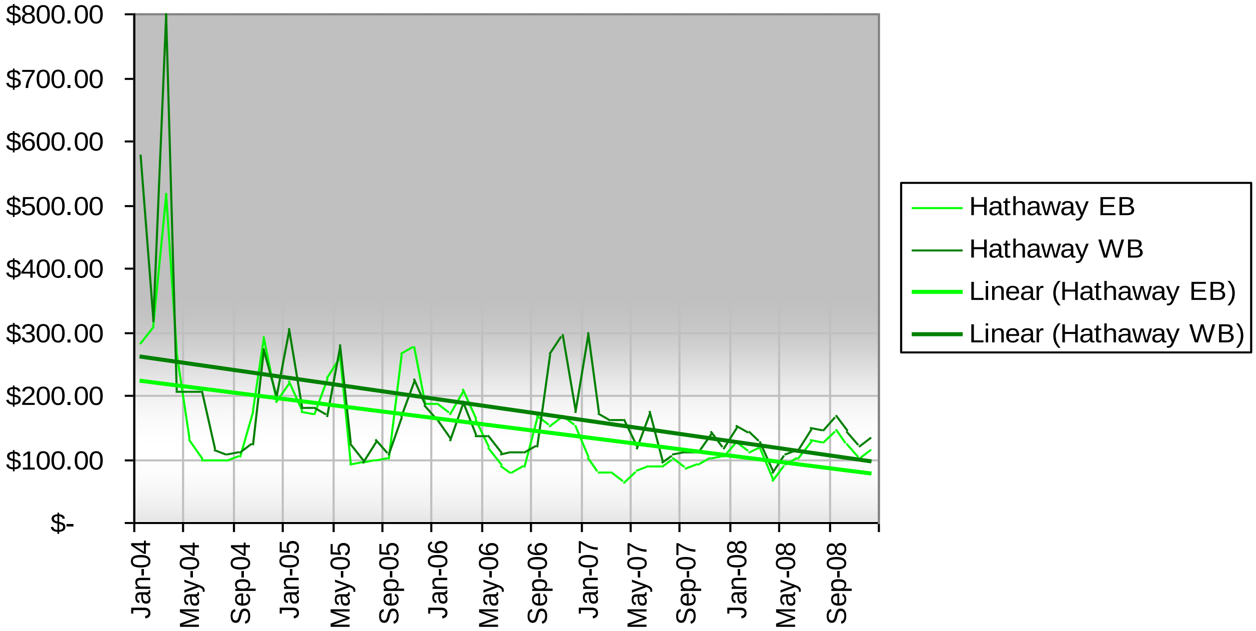
Figure 5-8 Hathaway Monthly Electricity Consumption (2004 – 2008)



There is a general downward trend in annual usage at Hathaway rest area sites, as evidenced by the trend lines shown in Figure 5-8. This is due, in part, to the use of alternate energy sources at the Hathaway rest area sites. In December 2006, the Hathaway EB rest area recorded its first use of propane; Hathaway WB followed in September 2007. This supplemental source of energy contributed to the decline in electricity consumption, as shown in Figure 5-8.

Cost for electricity generally varied between $0.049 and $0.118 per kWh from 2004 to 2008, with costs generally increasing over the five-year period. Although unit energy prices increased, electricity costs for the Hathaway rest area declined due to the marked decrease in consumption over the five-year period, as shown in Figure 5-9.

Figure 5-9 Hathaway Monthly Electricity Costs



5.1.10 Crash Assessment

Vehicle accident data was supplied for the period January 1, 2005 to June 30, 2008 by MDT. During this time period, 640 crashes were recorded over the I-94 portion of the study corridor (MP 0.0 – 142.0).

Several aspects were considered for this analysis. First, the number of crashes near each existing rest areas was compared. Second, crashes over the entire corridor were evaluated in light of spacing between rest areas. Areas with higher numbers of crashes were assessed to determine if these could be attributed to excessive distances between rest areas. Lastly, incidences of animal vehicle conflicts near the rest areas sites were assessed.

Table 5.14 presents the number of crashes within approximately a quarter mile in each direction from each rest area location (i.e., the half-mile segment is approximately centered at the rest area site).

Table 5.14 Number of Crashes within Half-Mile Segment near Hathaway (1/1/2005 – 6/30/2008)

Interstate Facility	Rest Area Location	Approximate MP of Rest Area Location	Half-Mile Segment (MP – MP)	Number of Crashes within Half-Mile Segment	AADT (2007)
I-94	Hathaway EB	113.5	a) 113.3 - 113.8 b) 113.2 - 113.7	a) 5 b) 5	4,530
	Hathaway WB	112.6	a) 112.4 - 112.9 b) 112.3 - 112.8	a) 2 b) 2	

Source: MDT, 2008.

Crash locations are recorded in tenth-of-a-mile increments; therefore, it was not possible to determine the number of crashes within exactly a quarter mile in each direction from the rest area location. Therefore, Table 5.14 presents the number of crashes within three-tenths of a mile to one side of the rest area, and two-tenths of a mile to the other side, as well as the reverse. This calculation method is graphically illustrated in Figure 5-10. The two numbers listed under the Number of Crashes column in Table 5.14 correspond to the two half-mile segments as defined for each site. For the Hathaway EB and WB sites, the number of crashes in each half-mile segment is equal at each site.

Figure 5-10 Two Half-Mile Segments for Rest Areas

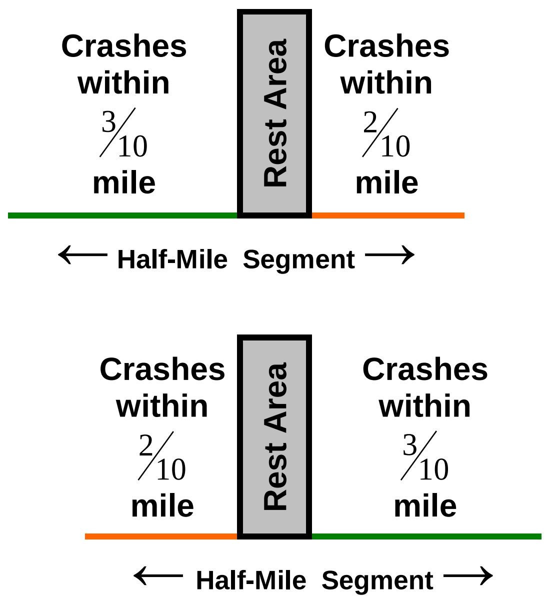
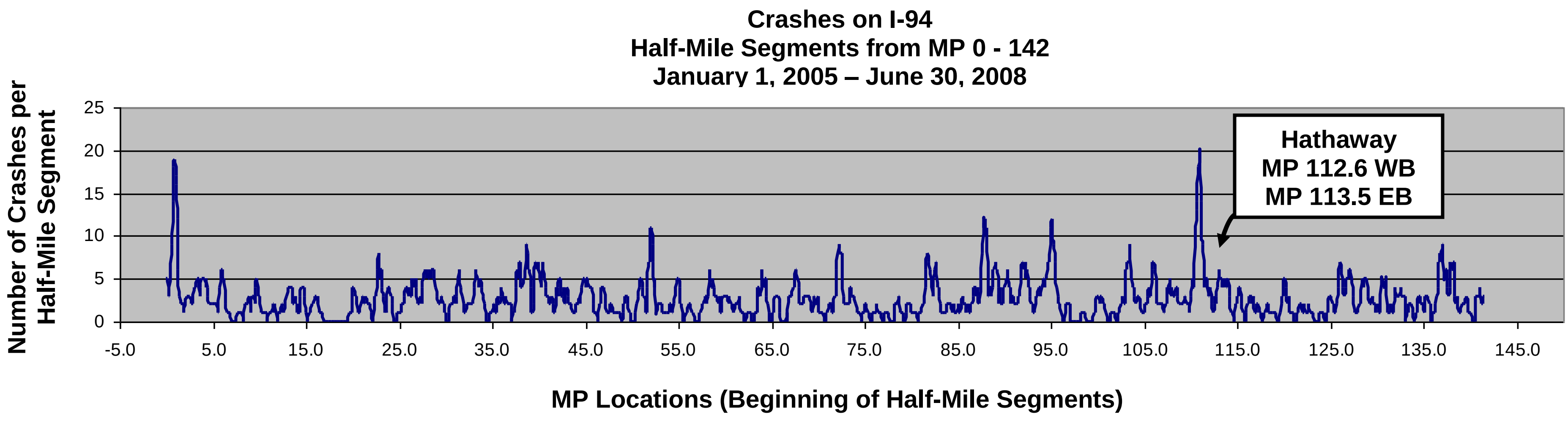


Figure 5-11 illustrates the number of crashes in each half-mile segment over the entire corridor.

Figure 5-11 Crashes within Study Area



The highest number of crashes over a half-mile segment (20 crashes) occurred on I-94 from MP 111.0± to 111.5±, to the west of the Hathaway rest area site. Of these 20 crashes, all but one involved a single vehicle. Driver error was noted in 11 crashes and excessive speed was a factor in 8 crashes. Wild animals were involved in three of these crashes.

The Hathaway rest area is located approximately 50 miles away from the nearest rest area to the west (Hysham), nearly 65 miles away from the next rest area to the east on Highway 12 (Locate) and nearly 80 miles away from the nearest rest area to the east on I-94 (Bad Route). Although the distance between the Hathaway rest area and the next rest area to the east on I-94 slightly exceeds the recommended maximum spacing, the crash concentration is located to the west of Hathaway. Therefore, spacing does not appear to be a factor in the high incidence of crashes at this location.

Over the I-94 portion of the corridor, there were a total of 36 crashes in which the driver fell asleep. None of these occurred within a mile of the Hathaway rest area.

Of the 640 total crashes over the I-94 portion of the corridor, 233 (or 36.4 percent) involved wild animals. Although corridor mapping provided by MDT notes high animal-vehicle collisions on I-94 near the Hathaway rest area, other locations in the corridor appear to have higher numbers of animal-vehicle collisions.

5.1.11 ADA Compliance

A detailed Checklist of Facility Accessibility has been completed for each of the rest area sites in this study. These forms are included in Appendix D. There are a number of elements at each of the rest area sites that do not comply with ADA requirements, as noted on the forms. Noncompliant elements at Hathaway are noted in Table 5.15.

Table 5.15 Hathaway Elements in Noncompliance with ADA Requirements

Rest Area Site	Noncompliant Element							
	Location of Parking Spaces	Stairway	Ramps	Sinks	Door Hardware	Door Closer / Force	Toilet Stalls	Signage
Hathaway EB				X				X
Hathaway WB				x			X	X

Source: MDT Checklist of Facility Accessibility, 2008.

5.2 Future Demand

5.2.1 Projected AADT

A compound annual growth rate method was utilized in order to estimate future AADT volumes within the study area. A growth rate of 3.5 percent per year and a 20-year planning horizon were used for this study, for a Design Year of 2027. It should be noted that compounded annual growth of 3.5 percent over 20 years is considered highly conservative. The general calculation formula is shown below.

Growth Rate Calculation Formula

$$(\text{Current AADT})*(1 + [\text{growth rate in decimal form}])^{\text{Number of Years}} = \text{Design Year AADT}$$

Table 5.16 presents future traffic volumes as estimated using the growth rate noted above. Using this growth rate over the 20-year planning period approximately doubles the 2007 total AADT values. For the purposes of these estimates, it was assumed that the percentage composition of passenger vehicles and trucks would remain the same.

Table 5.16 Projected AADT near Hathaway (2027)

Rest Area	Route	Rest Area Location RP	Traffic Count Location RP	Total AADT	Total Passenger & Bus (Types 1-4)		Total Small Trucks (Types 5-7)		Total Large Trucks (Types 8-13)		Total Commercial (Types 5-13)	
					AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT	AADT	% of Total AADT
Hathaway EB	I-94	113.5	103	4,507	3,425	76.00	72	1.60	1,010	22.41	1,082	24.01
Hathaway WB		112.6		4,507	3,425	76.00	71	1.58	1,010	22.41	1,081	23.98

Source: DOWL HKM, 2009.
Directional counts not available. AADT assumes equal volumes for EB and WB directions.

5.2.2 Projected Usage

Projected usage at the rest area sites was estimated based on projected traffic volumes. Projected usage calculations follow the same methodology as described for current usage.

Table 5.17 presents the number of vehicles per hour projected at the Hathaway rest area sites in 2027. Tables 5.18 through 5.20 present the recommended number of parking spaces, site facilities, and restroom stalls based on 2027 projected traffic volumes. Detailed calculations are provided in Appendix C.

Table 5.17 Projected Rest Area Usage at Hathaway (2027)

Rest Area Site	Total Number of Vehicles Per Hour	Number of Passenger Cars and Buses Per Hour	Number of Commercial Trucks Per Hour**
Hathaway*	74	54	20

Source: MDT, 2008; DOWL HKM, 2009.
Note: Calculations use factors from Table 9, Rest Area Plan, 2004.
*Usage values apply to both EB and WB sites.
**Includes estimate for the number of cars with trailers or RVs.

Table 5.18 Hathaway Projected Parking Conditions (2027)

Rest Area Site	Truck Parking Spots		Auto Parking Spots		ADA Parking Spots	
	Actual Number*	Recommended Number**	Actual Number*	Recommended Number**	Actual Number*	Recommended Number***
Hathaway EB	9	11	14	24	4	1
Hathaway WB	9	11	12	24	4	1

Note: Shaded cells indicate failure to meet the recommended number of parking spots.
Source: MDT, 2008; DOWL HKM, 2009.
*Actual number of spots determined based on site visits conducted in January 2009.
**Calculations use factors from Table 9, Rest Area Plan, 2004. Truck parking includes cars with trailers or RVs.
***Based on recommended auto parking spots in Parking Space Matrix, Checklist for Facility Accessibility, MDT 2008.

Table 5.19 Hathaway Projected Site Facilities (2027)

Rest Area Site	Picnic Tables		Waste Receptacles	
	Actual Number	Recommended Number	Actual Number	Recommended Number
Hathaway EB	10	14	8	11
Hathaway WB	12	14	11	11

Note: Shaded cells indicate failure to meet the recommended number of picnic tables and waste receptacles.
Source: MDT, 2008; DOWL HKM, 2009.
Calculations use factors from Table 12, Rest Area Plan, 2004.

Table 5.20 Projected Restroom Stalls and Water Usage at Hathaway (2027)

Rest Area Site	Women's Restroom Stalls		Men's Restroom Stalls		Water Usage (Peak Hourly Demand)
	Actual Number	Recommended Number	Actual Number	Recommended Number	
Hathaway EB	3	4	3	2	10 gpm
Hathaway WB	3	4	3	2	10 gpm

Note: Shaded cells indicate failure to meet the recommended number of restroom stalls.
Source: MDT, 2008; DOWL HKM, 2009.
Calculations use factors from Table 12, Rest Area Plan, 2004.

A number of annual seasonal events occur in Billings, Miles City, and other small rural communities along the I-94 corridor. The largest of these events occur in the summer months, and include rodeos, music festivals, and county fairs. These events likely draw visitors from outside the immediate area, and may contribute to high summer usage at the Hathaway rest area. Rest areas are generally not designed to meet peak day or peak season demand. Therefore, the above analysis was not adjusted to account for potential usage fluctuations resulting from seasonal events in the region.

5.3 Assessment of Water, Sewer, and Power Services

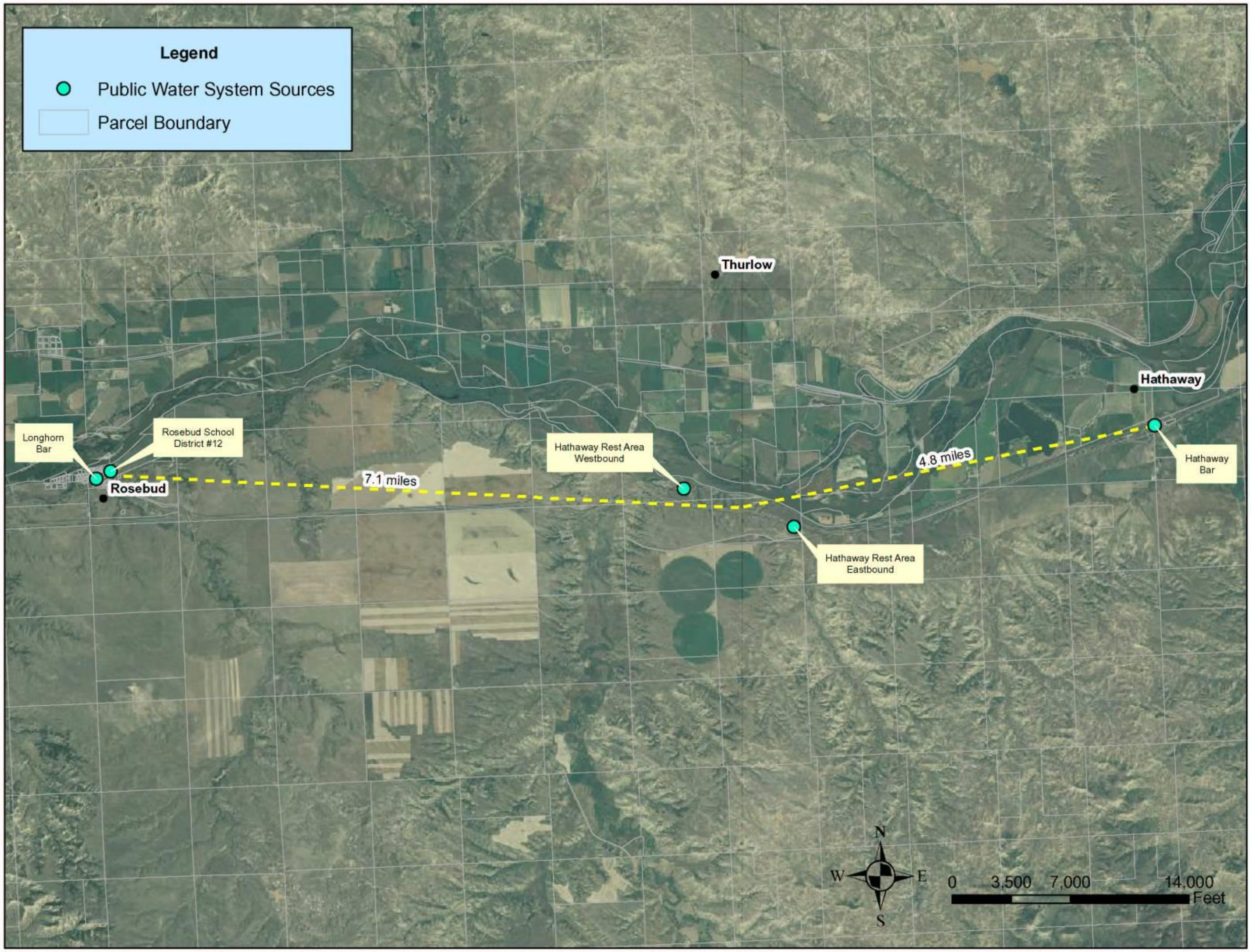
The following sections assess the adequacy of the water, sewer, and power utilities at the Hathaway rest area in terms of meeting the anticipated demands from the 20-year projected rest area usage. Expansion potential to accommodate additional parking will be evaluated along with water, sewer, and power service alternatives that take into account the unique nature of the usage patterns and treatment challenges at a rest area.

To evaluate the potential for the Hathaway rest area to connect to nearby community water or wastewater systems, the Montana PWS database was queried to select those water systems within 10 miles of each rest area site as shown in Figure 5-12. The DEQ MPDES permitted facilities were also downloaded from the NRIS site by county and queried to select those wastewater discharge permit locations within 10 miles of each rest area site. An MPDES permit is required by DEQ to construct or use any outlet for discharge of sewage, industrial, or other wastes into state surface or groundwater.

The Hathaway rest area is located between the communities of Rosebud to the west and Hathaway to the east. The PWS database lists small isolated water systems in these communities serving school districts and bar establishments. There are no MPDES permits within 10 miles of the Hathaway rest areas. These communities are not listed as CDPs or incorporated towns by the Census Bureau. Due to the small nature of these communities, it is unlikely that these communities will develop community water or sewer systems in the near future.

Due to the distance and small nature of the systems near the Hathaway rest area, it would not be cost effective to extend water service from these sources to the rest area sites. Therefore, this option will not be discussed further; the remainder of this section will focus on accommodating water and sewer needs at the existing sites.

Figure 5-12 Public Water System Sources near Hathaway



5.3.1 Water Service

Quantity

The projected 20-year peak hourly water demand was calculated based on the methodology specified in the Rest Area Plan. Table 5.21 lists the projected water use estimates at the Hathaway rest area sites. Detailed usage calculations are provided in Appendix C and irrigation demand calculations are provided in Appendix F.

Table 5.21 Hathaway Projected Water Use Estimates (2027)

Rest Area Site	Restroom Water Usage (Peak Hourly Demand)	Estimated Irrigation Demand	Total Demand	Well Capacity
Hathaway EB	10 gpm*	11 gpm	21 gpm	18 gpm
Hathaway WB	10 gpm*	4 gpm	14 gpm	16 gpm

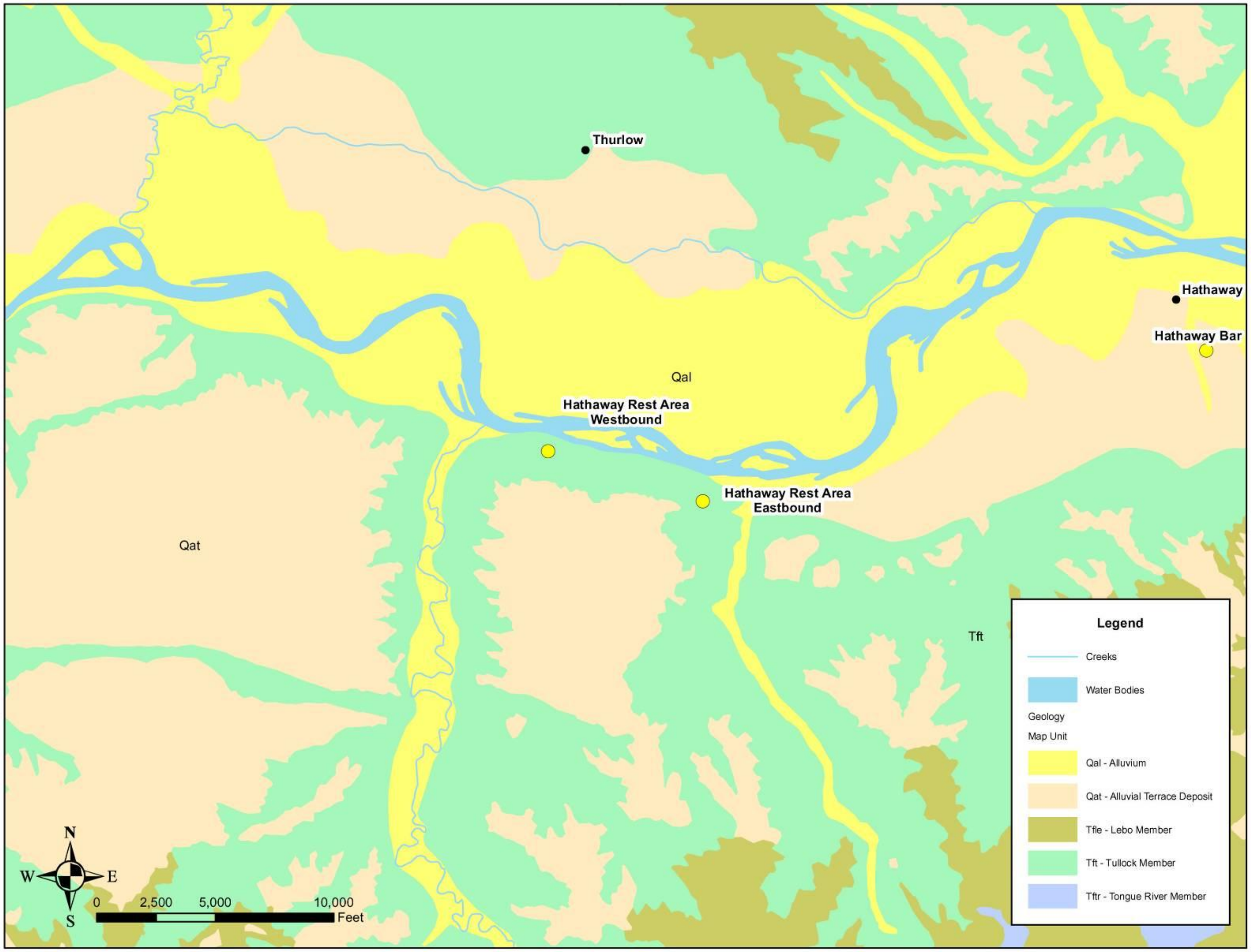
Source: MDT, 2008; DOWL HKM, 2009.
*Does not include estimate for the amount of water used during the RO treatment process.

Based on the estimates in Table 5.21, the Hathaway well capacities are very near the projected 2027 demand. Further, the projected demands listed above in Table 5.21 do not take into account the water used during the RO treatment process. Therefore, the Hathaway wells do not have adequate capacity to meet the future demand under the status of the existing system.

Information on the pumping rate has been obtained from the GWIC database as well as from conducting interviews and obtaining additional data from MDT maintenance personnel. No field work was performed to verify the pumping rates. Therefore, it is recommended that well yield tests be conducted for each well at the Hathaway sites in order to verify the actual pumping rates.

Geologic mapping can be used to determine general aquifer characteristics. Figure 5-13 depicts the geology surrounding the Hathaway rest area. Digital geologic mapping was obtained from the MBMG State Geologic Mapping Program. Map unit descriptions can be found within Appendix M.

Figure 5-13 Geologic Map of Hathaway



As shown previously on the topographic maps of the rest area sites, the Hathaway rest area sits on top of a narrow, flat-topped ridge that overlooks the Yellowstone River Valley to the north. Most of the available groundwater within this aquifer is found within permeable rocks such as sandstone and coal as is characteristic of the ridges bordering the Yellowstone River. Considerable amounts of shale may also be present within this aquifer. Finer-grained materials such as shale are less permeable and tend to impede groundwater flow.

Figure 5-13 indicates the Hathaway rest area is within the Tullock Member of the Fort Union Formation. The Tullock formation consists of interbedded sandstone and shale. Based on discussions with maintenance personnel, the wells at Hathaway are not able to meet the current demand without eliminating the irrigation demand. This may be due to the additional water required for operation of their RO system. As water demands increase due to usage, the Hathaway rest area will most likely need to find ways to conserve water supplies, drill additional wells, or rehabilitate the existing wells.

One possible method for reducing water usage is to implement xeriscaping techniques and water-conserving irrigation practices. These types of landscaping techniques would lessen maintenance requirements and require less water, thereby reducing the overall water demand at the rest area sites. Reducing irrigation requirements would free up the well capacity in order to accommodate increased visitor usage. The Hathaway EB site has the potential to reduce some irrigated area. It has been confirmed through site visits that the Hathaway WB site already has difficulty keeping the grass adequately watered due to well capacity issues. Therefore, it is essential that this site find ways to implement water-conserving landscaping techniques.

It is also recommended that the Hathaway wells be inspected and tested. It is possible that the well pumps have deteriorated due to constituents in the water chemistry in addition to normal wear and tear occurring over time. Over time, crusting can occur within the well and pump, causing a build-up of fine particles. Once the well has been cleaned out and re-developed, it is recommended that a pump test be conducted and the current yield compared to the original yield. As previously mentioned, the Hathaway EB well log indicates a much higher pump rate than currently observed.

It addition to well rehabilitation, modifications can most likely be implemented to the RO disinfection process in order to increase efficiency and reduce water waste. For example, the waste stream of the RO treated water could be saved and stored for irrigation rather than allowing it to be wasted. Also, MDT maintenance personnel have had problems with the RO units overfilling the storage tanks. The RO system at Hathaway was originally installed in the early 1990's. Based on discussions with a distributor of this system, the earlier-style RO units did not come equipped with tank level monitoring equipment. A control panel and associated level controls could be retrofitted to the original system to allow the RO system to turn on and off based on the water level in the storage tank, thereby alleviating overflow problems and reducing wasted water.

Exempt wells are allowed to pump no more than 35 gpm and 10 acre-feet (ac-ft) per year. In lieu of pursuing actual water rights for this rest area to allow for higher pumping rates or a greater annual volume, the water conservation measures noted above would likely be the more economical and practical solution. The timing of the irrigation could also be offset with peak visitation such that the peak demand shown in the table above was never actually attained.

Another way to supplement peak demands is through the addition of storage. Storage tanks can be provided to supplement flows in times of peak demand. In the case of demands this small, one or more hydropneumatic pressure tanks would be adequate to accommodate the brief peaking periods in excess of the 35 gpm limit of the exempt water wells. Alternately, a 1,000 to 2,000 gallon fiberglass tank could be buried on-site and a separate pumping system provided to pressurize the system.

MDT may want to consider securing water rights in the future as usage increases at the Hathaway rest area. Well replacements may be easier to obtain with secured water rights. Therefore, the process and expense of acquiring water rights is discussed as follows.

When applying for a new water right in Montana, different rules and procedures apply depending on whether or not the location is in a closed basin. Several highly appropriated basins in Montana have been closed to new appropriations. Therefore, obtaining a water right in a closed basin requires extensive analysis to show that the water being used will be replaced or “mitigated” such that the net loss from the aquifer is zero. Mitigation could be return of highly treated wastewater to the aquifer, or retirement of a separate existing water right. The majority of closed basins are located in western Montana. The Hathaway rest area does not currently fall within a closed basin. Therefore, obtaining a water right for the Hathaway rest area does not require analysis to show that the water used is being replaced. The water right process does, however, require that the following DNRC criteria are met:

1. Demonstrate that water is physically and legally available at the site.
2. Demonstrate that nearby water resources will not be adversely affected (i.e. neighboring wells, streams, irrigation ditches, and other sources).
3. Demonstrate beneficial use.

Several hydrogeologic factors must be evaluated to determine if water is physically available at the site. This will most likely require the drilling of test wells to conduct aquifer tests, water quality tests, and water level monitoring. Stream flow monitoring may also be required. Once physical availability is demonstrated, legal availability must be demonstrated through identification and analysis of existing water rights in the vicinity and with regard to potentially-affected surface waters. This process involves significant research into existing water rights and a comparison of existing legal demands to physical water availability. If physical water availability exceeds the existing demand, water is determined to be legally available.

To demonstrate beneficial use, the proposed water use must be justifiable in regards to how it will be used as well as the quantity of water needed.

As described above, acquiring additional water rights is a fairly lengthy process requiring substantial additional analysis. However, if the above criteria can be demonstrated, obtaining additional water rights for Hathaway is a viable option for assuring that sufficient water is available at the site to meet anticipated demands.

It should be reiterated that the water use projections shown above in Table 5.21 are estimates based on assumed values for rest area usage and approximate irrigated areas. MDT has initiated a research project to be completed in 2010 that will identify more accurate methods to predict rest area usage.

Quality

The Hathaway rest area currently provides disinfection through an RO filter and chlorination system due to the presence of high nitrates in the water. Correspondence between MDT and DEQ (formerly the Department of Health and Environmental Sciences) dated July 1991 documents the requirement for full time disinfection due to unsatisfactory water quality samples. The RO system has been effective in improving water quality at the Hathaway rest area sites as there have been no recorded violations of the nitrate MCL and only two isolated total coliform MCL violations since the system was installed in the 1990s. Based on discussion with MDT maintenance personnel, it appears that the current RO system may be oversized for the current usage as there have been recent issues with overfilling of the storage tanks. As a result, MDT maintenance is considering switching to smaller RO units. MDT may also want to consider installing a level monitoring system to alleviate tank overfill problems.

It is important that specific sampling protocol be followed in order to minimize issues such as cross-contamination, which can result in false positive readings for coliform. Therefore, it would be advantageous for MDT to develop a standardized sampling program and corresponding operator training to assure that samples are collected appropriately. A detailed sampling plan should be developed for each rest area describing the sample locations; number, type, and size of each sample; sampling method technique, storage, and handling procedures; and sample labeling and chain of reporting standards, including receipt and logging of samples and delivery to the lab.

General guidelines for collecting a coliform bacteria sample are listed in the Drinking Water Regulations for Transient Non-Community Public Water Supplies (DEQ, 1999). These guidelines are summarized below and should be considered when developing a detailed sampling plan.

- Always sample from a cold water tap (avoid leaking faucets, drinking fountains, and outside hydrants)
- Remove any faucet attachments (aeration screens, hoses, etc.)
- Open tap fully and let water run two to three minutes
- Reduce the flow and fill the bottle leaving an airspace which allows mixing by shaking in the lab
- Do not allow cross-contamination when collecting the sample (i.e. do not touch the inner surface of the bottle or lid or touch it to the faucet).
- Transport the sample to the lab as soon as possible. Care should be taken to maintain the sample at normal water temperature.

Additional materials on sampling requirements may be obtained from the EPA safe water program. Secondly, the METC periodically hosts training programs for water and wastewater operators at several locations throughout Montana.

Other Factors

For small water systems, it is important to ensure that wells are protected from sources of contaminants. Per Circular DEQ-3, wells must be located at least 100 feet from any structures used to convey or retain storm or sanitary waste. The wells at Hathaway are more than 100 feet from septic tank and drainfield locations and therefore meet this requirement. Well construction details are provided in the GWIC database sheets located in Appendix G. It is also important to make sure the well construction details and well pumps meet DEQ requirements.

The operation, maintenance, and replacement costs are typically low for this type of small water system. Assuming no disinfection, the only significant associated replacement costs are in the actual well pump and possibly some controls (e.g., pressure tank, appurtenances, etc.). Table 5.22 presents typical costs associated with pulling and replacing a well pump. According to MDT maintenance personnel, pumps typically last five to seven years depending on the hardness or corrosiveness of the water. It should be noted that the following costs most likely would not occur in the same year.

Table 5.22 Typical Costs for Rest Area Water Systems

Component	Cost
Parts, fittings, expenses, etc.	$500
Pump	$500 - $750
Labor associated with replacing the pump (i.e. wiring, etc.)	$1,000 - $1,500
Water Filter (replace monthly at $20 each)	$240
Pressure Tank (replace on occasion)	$350
Air/Sequence Valve for Toilets (replace once every two years @ $600 per toilet, assume 3 toilets per year)	$1,800
Hot Water Tank (replace every 3-4 years)	$450
Total Cost	**$4,840 - $5,590**

Source: MDT, 2009.

The water system at Hathaway is somewhat complex due to the RO and chlorination systems used to disinfect the water. A local distributor was contacted to determine approximate costs of a comparable RO system as is installed at Hathaway. A comparably sized RO floor-mounted system ranges from approximately $13,500 to $16,100. The more expensive unit includes additional features such as the electronic controller and other programmable features. There are additional associated costs pertaining to appurtenances such as the additional storage tanks required for storage of the RO treated water and adjacent chlorination system.

Anticipated pumping costs associated with the irrigation and potable wells are listed below in Table 5.23. These estimates are based on several assumptions such as pump horsepower, annual consumption, and estimated hours of pumping per year. Detailed calculations can be found within Appendix K.

Table 5.23 Hathaway Projected Pumping Costs

Rest Area Site	Total Annual Power Costs
Hathaway EB	$851
Hathaway WB	$857

Source: DOWL HKM, 2009.

Conclusions

Based on the above discussion, the following is a summary regarding water service at the Hathaway rest area:

- The water sources at Hathaway currently have supply issues and will most likely not be able to meet additional demand due to increased usage in their current state. It is recommended that the wells/pumps at Hathaway be inspected and possibly redeveloped. It should be reiterated that field pumping tests were not performed as part of this study.
- Modifications can most likely be made to the RO treatment system to in order to increase efficiency.
- The aquifer serving the Hathaway rest area can be expected to be relatively reliable.
- Water demand could be further reduced by implementing water-conserving irrigation and landscaping techniques.
- Water quality at the Hathaway sites is generally good, however, through the implementation of the Ground Water Rule and GWUDISW process, more stringent water quality rules may apply in the future and treatment may be necessary. The Hathaway site is currently providing disinfection and has maintained adequate water quality.
- Costs associated with maintaining these systems are relatively low, although additional costs are associated with the treatment system at Hathaway.
- As usage increases due to demand beyond the 20-year projections, additional water rights may need to be secured. The Hathaway sites are not currently within a closed basin; therefore new water rights could, most likely, be attained.

5.3.2 Sewer Service

Size of Existing System

As described above in Section 5.1.9, on-site sewage treatment at the Hathaway rest area is accomplished through the use of a septic tank and soil absorption drainfield. The drainfield at Hathaway is pressure dosed. Preliminary sizing calculations for the 20-year projected usage are shown below in Table 5.24 along with the existing system sizing information determined from as-built drawings and information collected from MDT maintenance personnel. Detailed calculations can be found within Appendix J. The NRCS soils information was used to determine approximate sizing criteria where percolation test data was not available.

Table 5.24 Septic Tank and Drainfield Size for Projected Usage at Hathaway (2027)

Rest Area Site	Septic Tank		Drainfield	
	Existing Size	Recommended Size for Projected Usage (2027)	Estimated Existing Size	Recommended Size for Projected Usage (2027)
Hathaway EB	4,380 gallons	6,400 gallons	4,720 ft^2	3,600 ft^2
Hathaway WB	4,380 gallons	6,400 gallons	4,690 ft^2	3,600 ft^2

Note: Shaded cells indicate failure to meet the recommended septic tank or drainfield size.
Source: MDT, 2009; DOWL HKM, 2009.

As shown above, the septic tanks at Hathaway are undersized to accommodate the 20-year projected rest area usage. Furthermore, Circular DEQ-4 states that subsurface wastewater disposal systems should only be used for residential strength wastewater and that wastewater exceeding this strength must be pretreated before discharging to drainfield systems. Table 5.25

below identifies typical ranges of key raw wastewater parameters for highway rest areas as compared to typical domestic wastewater. As can be seen from this generalized table, the raw wastewater strength can be expected to be well in excess of typical domestic values. It is important to note, however, that no raw wastewater sampling data was available from this rest area at the time of this evaluation. Further, the actual raw wastewater concentrations can be widely variable among rest areas.

Table 5.25 Raw Wastewater Strength; Domestic vs. Highway Rest Areas

Raw Wastewater Parameter	Typical Domestic Strength Wastewater Concentrations(1) (mg/L)	Typical Highway Rest Area Wastewater Concentrations (mg/L)
BOD_5	110 - 350	400 - 500
TSS	120 - 400	150 - 400
TN	20 - 70	150 - 250
TP	4 - 12	20 - 30

(1) Table 3-15; Wastewater Treatment & Reuse, 4th Edition; Metcalf & Eddy, 2003.

Therefore, because the existing system is undersized and septic tank/drainfield systems are not recommended as the sole treatment option for non-residential wastewater, alternative wastewater treatment technologies will be explored and will be the focus of this section.

Wastewater Effluent Quality Requirements

The first driving factor for determination of potential effluent quality criteria is the point of ultimate discharge of the effluent. The two principal means of discharge include direct discharge to surface water and subsurface discharge, which may or may not reach groundwater. Two non-discharging options would include total retention of treated effluent using evaporation as the ultimate disposal and land application or irrigation.

The effluent quality of a subsurface discharge system (i.e. drainfield) depends upon the presence, depth below ground surface, and volume of existing groundwater. Subsurface discharge systems are allowed based upon the concentration of nitrates at the end of an allowable “mixing zone.” The mixing zone depends primarily upon the proximity to existing surface water sources and existing groundwater wells. Based upon a required non-degradation analysis, the calculated nitrogen concentration at the end of the mixing zone must be less than or equal to 7.5 mg/L. A smaller allowable mixing zone equates to a requirement for higher quality effluent and more advanced treatment processes. Of further significance related to the permitting of subsurface discharge systems is the total daily discharge volume. A DEQ discharge permit is not required for systems discharging less than 5,000 gpd. While the actual analysis and design of the disposal system would be the same, a system over 5,000 gpd may require more site specific and detailed groundwater information and would require permit and renewal fees.

Direct surface water discharge of effluent would require the highest quality effluent, as well as a lengthy evaluation and permitting process, which may not ultimately be granted by the permitting agency. Direct surface discharge is not considered a viable option for this rest area.

The final options of land application and total retention do not require a discharge permit. Either system would require similar effluent water quality. Effluent quality for land application systems would depend upon the size of irrigable area and the nutrient uptake potential of the associated crop. Total retention systems would generally be designed to secondary treatment standards typical of a wastewater lagoon system with additional consideration potentially given to the odor and algae generation potential of the stored effluent.

Advanced Wastewater Treatment Options

In a conventional on-site system, a septic tank is first used for partial treatment of the wastewater and for accumulation of solids. Secondly, a subsurface drainfield is used for final treatment and disposal of the wastewater. In alternative systems, additional or secondary/advanced treatment is provided between the septic tank and disposal system. This section will focus on four secondary treatment technologies applicable to the Hathaway rest area sites. These are:

- Aerobic Treatment Systems/Package Plants (including SBR and MBR systems)
- Lagoon Systems
- Aquatic Treatment Systems
- Recirculating Packed-Bed Filters

It is worth mentioning a few low-cost modifications that can be added to any on-site wastewater system regardless of the treatment method being applied. With any system, it is good practice to install effluent filters on septic tanks. The effluent filter will help to alleviate stress on the downstream processes and piping systems by retaining solids in the septic tank more consistently. In addition, dosing and resting the drainfield through the use of a pumping system rather than the trickle flow that a drainfield typically receives with the conventional gravity system will improve the treatment and extend the life of the drainfield. Dosed systems are also allowed slightly modified trench dimensions and spacing requirements that provide for more effective use of the drainfield area.

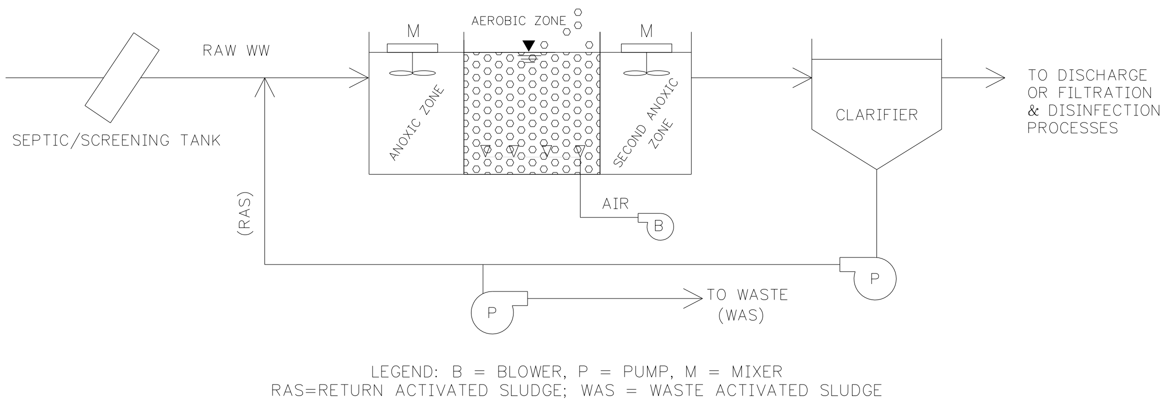
It is important that an alternative system be selected only after an investigation of site-specific conditions. System selection and design should be performed by a professional engineer with a formal design report submitted to the permitting authority.

<u>Advanced Treatment Systems/Package Plants</u>

For applications where stringent effluent quality requirements will apply, a more advanced treatment system in the form of aerobic, activated sludge systems could be required. Such advanced treatment units may include only aerobic zones where greater BOD, TSS and ammonia reduction (i.e. nitrification) can occur. As effluent disposal criteria dictate, more advanced systems may include anoxic (low dissolved oxygen) zones where subsequent nitrogen removal (denitrification) can occur.

A septic tank is intended to remove solids and initiate biological treatment. This process is anaerobic, meaning there is no oxygen in the system. Conversely, advanced treatment systems are aerobic and consist of an aeration tank where incoming wastewater is mixed with biological organisms (i.e. activated sludge) using a large quantity of air. During the aeration process, a portion of the wastewater undergoes biological treatment or the conversion of organic matter to various gases and new microbial cells. Aeration compartments are followed by a settling compartment. A portion of the settled microorganisms or “activated sludge” is then returned to the front of the treatment process as RAS to be mixed again with incoming wastewater. Excess sludge or WAS must occasionally be removed from system. Figure 5-14 illustrates the basic configuration of an advanced treatment unit for biological nitrogen removal.

Figure 5-14 Advanced Treatment Process Flow Diagram



Advanced treatment units come in many forms of pre-engineered/package wastewater treatment plants; several variations exist depending on the size of system or community being served and ultimate treatment objectives. The process can be modified in many ways to achieve the ultimate treatment objectives. For example, one process applicable to small communities or cluster configurations is the SBR system. SBR systems utilize five steps occurring in the same tank (i.e. both aeration and settling occur in the same tank). Due to the sequential nature of the SBR system, a key element is the control system, consisting of a combination of level sensors and timers. The five steps occurring in sequential order are:

1. Fill
2. React (aeration)
3. Settle (sedimentation/clarification)
4. Draw (decant)
5. Idle

The MBR system is another variation of an aerobic advanced treatment process. The MBR system adds a microfiltration element to the treatment process accomplished through the use of a membrane. The membrane element is typically submerged directly in the treated wastewater at the end of the treatment process. In place of sludge settling/clarification, the membrane captures solids and either re-circulates them into the treatment process or sends them to be wasted. With the addition of the filtration element, MBR systems are more complex than the SBR system and require slightly more maintenance and monitoring to make sure the membrane does not clog and is operating efficiently. Only for very stringent effluent quality requirements would MBR technology be an economic option for this rest area. Biologically, MRB & SBR systems have the same treatment capability. The MBR's distinguishing characteristic is its simultaneous clarification and filtration of the effluent, resulting in extremely high-quality effluent with respect to total suspended solids and making it an ideal process for water reuse applications.

Advanced treatment units can provide a high level of treatment and therefore may reduce drainfield requirements depending on soil type. However, per Circular DEQ-4, monitoring data must be submitted from at least three existing systems operating in similar climates and treating wastewater similar in characteristics before any reduction in drainfield size will be considered. Monitoring data from existing systems must show that effluent quality parameters are met in order to reduce the drainfield area. If these criteria are met, the absorption system size may be reduced by 50 percent, but must still have a replacement area large enough for a standard absorption trench system.

One manufactured advanced aerobic treatment system with case history installations in Montana is the Santec treatment system by Santec Corporation. This system is currently installed in the town of Rocker, Montana to serve two truck stop establishments. Truck stop wastewater effluent is similar in composition to rest area wastewater due to its higher strength. Influent and effluent wastewater monitoring data for the year 2008 was obtained from the Rocker WWTP. Influent BOD and TSS concentrations are comparable to what is expected of rest area wastewater as listed above in Table 5.25; however data was not available for influent total nitrogen and phosphorus concentrations. Effluent monitoring data from the Rocker WWTP indicates that effluent characteristics meet typical standards for secondary treatment.

Proper operation and maintenance of the aerobic unit is critical. Owners are required to obtain service agreements with the manufacturers of these systems and surveillance by qualified personnel is imperative. An alarm system is required to indicate when the treatment system has an alarm condition, such as a high water level or pump failure. In addition, operators are required to obtain proper certification and perform frequent inspection. Based on recent information from DEQ, only two of these types of systems have been reviewed and permitted in Montana in the past year.

If it is found based on results of a non-degradation analysis that more stringent effluent quality requirements apply, advanced treatment options should be considered as a viable option for wastewater treatment at the Hathaway rest area.

Advantages of advanced treatment units include:

- Relatively low footprint for equipment although room is still needed for an appropriately sized drainfield.
- Systems are modular in nature allowing for future expansion or modifications.
- A high level of treatment can be obtained.

Disadvantages include:

- Power requirements will increase substantially due to the aeration equipment within the treatment system.
- Intensive operation, maintenance, and management requirements.
- Due to the relatively low number of installed systems in Montana, proper monitoring data needed for permitting may be difficult to obtain.

<u>Lagoon Systems</u>

Lagoon treatment systems are ponds that are engineered and constructed to treat wastewater. There are several types of lagoons classified based on the discharging method. The lagoon system most applicable to a rest area is non-discharging (i.e. evaporation lagoon). A lagoon system is feasible for the projected wastewater flow rates from the rest area. The lagoon would be sized based on this flow rate and the required detention time for BOD and TSS removal.

The advantages of lagoons include:

- Low capital costs
- Minimum operations and operational skills needed
- Sludge withdrawal and disposal needed only at 10-20 year intervals
- Compatibility with land and aquatic treatment processes

The disadvantages of lagoons include:

- Large land areas may be required
- High concentrations of algae may be generated
- Non-aerated lagoons often cannot meet stringent effluent limits (not applicable for a non-discharging lagoon)
- Lagoons can impact groundwater negatively if liners are not used, or if liners are damaged
- Improperly designed and operated lagoons can become odorous[7]

Lagoons have the potential to become odorous, making the site unattractive for rest area users. The lagoon would also need to be fenced and located far enough from the site to prevent odors or other nuisances from affecting neighboring properties. Therefore, a lagoon is not recommended at the Hathaway rest area.

Aquatic Treatment Systems

Aquatic treatment systems use plants and animals such as insects, fish, worms, and snails designed to aid in the treatment process. An article from the FHWA Public Roads Magazine dated May/June 2000 provides details of this type of system installed at a welcome center in Vermont. The system is called the Living Machine and is picture below in Figure 5-15 inside a modular greenhouse. The Vermont Agency of Transportation used this technology at the Guilford welcome center from 1997 to 1999. The system recycles treated wastewater that is clean enough for use in toilets or for irrigation purposes, but not clean enough to drink or to use for washing hands. In 1999, the system was decommissioned at the Guilford welcome center when a new welcome center was opened nearby and was connected to a municipal wastewater system. At the time of the article, however, there were plans to reinstall the Living Machine at another rest area experiencing current failing sewage treatment systems.

An operator is needed to keep the plants alive and monitor the system frequently. As described in the article, the cost of this system is initially high at approximately $250,000.

The Living Machine or a comparable aquatic system is not recommended for the Hathaway rest area. It is described to demonstrate the types of innovative systems being installed at some rest areas throughout the country. This system is still somewhat experimental in nature and would likely require a lengthy permitting process through DEQ. In addition, due to the remote and unsupervised nature of the Hathaway rest area, this system would be vulnerable to vandalism. This type of system would also require significant monitoring by a trained operator and would likely necessitate hiring additional full-time maintenance employees.

[7] Crites and Tchobanoglous, 1998.

Figure 5-15 Living Machine

Inside the rest area's wastewater treatment system, plants and animals clean the waste from the water through a series of engineered ecosystems. (Photo by Living Technologies)

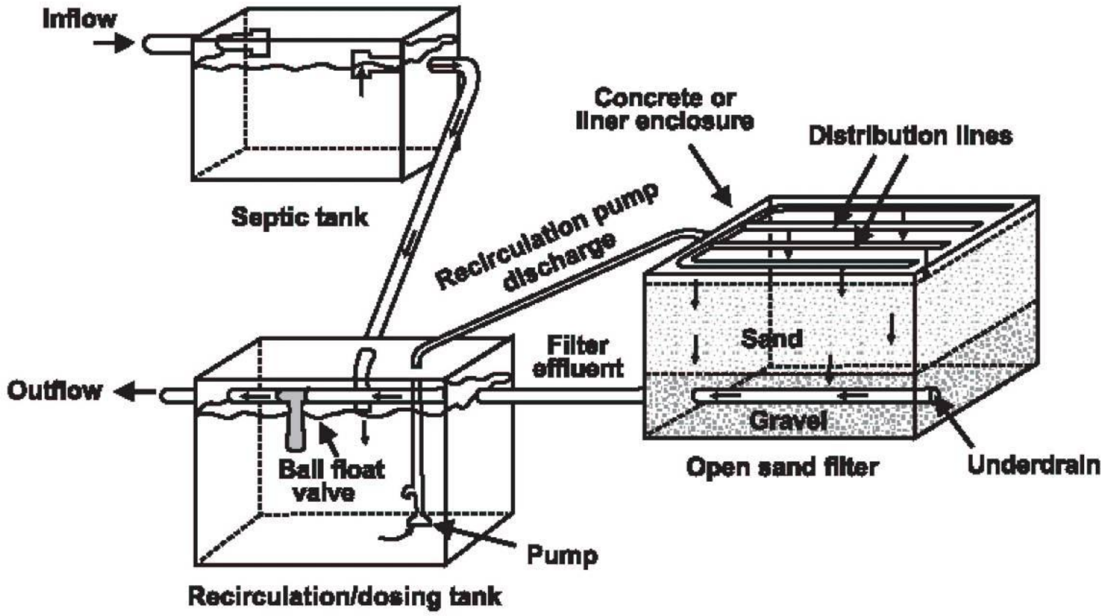
Recirculating (Multi-pass) Packed-Bed Filters

Packed-bed filters use biological and physical processes to effectively treat wastewater. They can be either intermittent (single pass) or recirculating (multi-pass). In intermittent design, the wastewater is applied to the filter only once through several doses per day. In a recirculating system, a portion of the wastewater that has gone through the filter already is returned to the filter. Recirculating filters are more applicable to the Hathaway rest area based on the required design flow. Therefore, this section focuses on recirculating packed-bed filters for use as an alternative treatment technology at the Hathaway rest area.

Figure 5-16 illustrates the operation of a recirculating packed-bed filter using sand as the filtering media. A typical packed-bed filter is comprised of the following elements:

1. A container with a liner for holding the medium
2. An underdrain system for removing the treated liquid
3. The filtering medium – Many types of media are used in packed-bed filters. Sand is the most common, but other options include crushed glass, plastic, foam, and synthetic textile media.
4. A distribution and dosing system for applying the liquid to be treated onto the filtering medium (spray nozzles, etc.)
5. Supporting appurtenances

Figure 5-16 Recirculating Sand Filter



The septic tank effluent is dosed onto the surface of the filter and is allowed to percolate through the medium to the underdrain system. Recirculating filters combine biological treatment with physical processes such as straining and sedimentation. Biological treatment occurs due to the bioslimes that form on the media particle surfaces. According to EPA, recirculating sand filters frequently replace aerobic package plants in many parts of the country because of their high reliability and lower operating and maintenance requirements.[8]

As an alternative to the recirculating sand filter, textile packed-bed filters utilize non-woven textile chips instead of granular medium, increasing the surface area for the microorganisms to attach and thereby reducing the space requirements of the filter.

One manufactured recirculating textile packed-bed filter currently approved by DEQ is the AdvanTex Treatment System by Orenco Systems, Incorporated. AdvanTex systems have been installed in numerous commercial and residential applications in Montana. Conceptual designs for an AdvanTex system have been produced for the new Lima Rest Area proposed for construction later this year (although they are not currently approved to date). AdvanTex systems have been successfully utilized in other nearby rest area applications, including the states of Wyoming and Colorado.

AdvanTex systems are equipped with remote telemetry to give operators and manufacturers the ability to monitor and control their systems remotely. Distributors of AdvanTex systems are located in Billings, MT, allowing for fast response times in an emergency.

A key component of systems such as AdvanTex is their modular nature. The modular nature of this system allows for additional units to be installed in the future as long as adequate space is provided initially. MDT plans to begin collecting data on water usage and wastewater effluent

[8] EPA Onsite Wastewater Treatment Systems Manual, February, 2002

concentrations in the future. As this data becomes known, refinements and adjustments can be made to the required number of future units.

It is worth mentioning that AdvanTex systems are designed to reduce total nitrogen by 60 percent or more. Due to the expected high strength of the incoming wastewater, additional measures such as pretreatment, additives, or polishing components may or may not be needed to obtain effluent total nitrogen levels that meet the acceptable standard. Again, required treatment levels are based on results of a non-degradation analysis that would dictate the design criteria needed.

Recirculating packed bed filters such as the AdvanTex system should be considered as an option for wastewater treatment at the Hathaway rest area. Advantages of recirculating packed bed filter systems are similar to those for advanced aerobic treatment units. However, the packed bed filter system is slightly less complex than the aerobic advanced treatment unit, requiring less monitoring and operational requirements. Power requirements would also be less due to the absence of the aeration equipment.

Subsurface Drainfield

With recirculating filters or advanced treatment units, a 50 percent reduction (depending on soil percolation rates) in drainfield size from standard absorption system sizing may be allowed provided that adequate performance data at higher raw wastewater concentrations can be supplied.

Rough calculations were made to determine if the new drainfields will fit on the Hathaway sites after taking into account the reduction in size. Detailed calculations can be found in Appendix J. Wastewater systems must be located at least 100 feet from any surface waters and 100 feet from floodplain boundaries. Drainfields should also be relatively level. Figure 5-17 depicts specific site constraints at each site and shows approximate areas suitable for wastewater systems. The figure illustrates approximate areas and locations of the new drainfields and wastewater systems.

The following should be noted with respect to proximity of the rest areas to surface waters:

1. Subsurface wastewater disposal systems must be located a minimum horizontal setback distance of 100 feet from any surface water or spring and at least 100 feet outside of any floodplain boundaries.
2. Greater horizontal distance may be required depending on results of a water quality non-degradation analysis. This analysis is not only based on distance but includes other factors such as nutrient load, hydrogeologic conditions, and direction of groundwater flow.
3. Close proximity of the rest area to surface waters could also have an effect on the ground water if ground water sources are determined to be directly influenced by surface water.

The Hathaway WB site is in somewhat close proximity (approximately 500 feet) to the Yellowstone River although it is located much higher as it sits on top of a bench overlooking the river valley and is outside the floodplain boundary.

The Hathaway sites appear to have adequate areas for possible wastewater system expansion. There appears to be sufficient right-of-way at the EB and WB sites located on relatively flat ground. The Hathaway WB site is located more than 100 feet from the floodplain boundary of the Yellowstone River. However, due to this site's close proximity to the Yellowstone River, a new wastewater system must demonstrate compliance with DEQ groundwater and surface water non-degradation rules.

Figure 5-17 Hathaway Conceptual Wastewater Treatment System

It is reiterated that site-specific soil information was not obtained as part of this study. Ultimate drainfield size and location will need to be determined after this field data is collected. One additional option for the drainfield is to reconstruct the system as a “bed system.” In the case of a replacement not resulting from failure, a bed system is allowed per Circular DEQ-4. The total footprint of this system consists of the design flow rate divided by the soil application rate and results in a slightly reduced drainfield area due to the elimination of the spacing needed between trenches.

The projected 20-year wastewater design flows for the Hathaway sites are below the 5,000 gpd limit required for a discharge permit.

Conclusions

- The existing wastewater systems at Hathaway are generally sized adequately to meet the current demand. The systems will need to be expanded to meet future demand.
- Conventional systems are not recommended for non-residential strength wastewater.
- A variety of secondary treatment options exist to improve the level of wastewater treatment for on-site systems. Lagoons and aquatic systems are not recommended due to issues such as land availability, system complexities, and permitting concerns.
- If treatment standards dictate, advanced aerobic treatment systems are one option for wastewater treatment at a rest area. These systems provide a high level of treatment but require trained operators due to system complexities.
- The recirculating packed-bed filter system is another option for a wastewater treatment system at the Hathaway sites, assuming all the non-degradation requirements can be achieved. This system is less complex than an aerobic treatment unit and provides a high level of treatment. Due to the modular nature of these systems, additional units may be installed as needed at a later date, thereby reducing initial costs.
- Discharge permits will most likely not be required at the Hathaway sites.

5.3.3 Power Service

Given the decline in energy consumption over the past five years, demand for electricity at the Hathaway rest area may increase more slowly than expected as visitor numbers increase over the 20-year planning horizon.

As noted in Section 5.1.8, the cost for electricity generally varied between $0.049 and $0.118 per kWh from 2004 to 2008. Although existing connections to the power grid would be able to meet future demand, any future rehabilitation of Hathaway rest area should attempt to incorporate a more cost-effective design to reduce energy costs as much as possible, especially given recent rate volatility.

There are two primary means of reducing power costs at the existing Hathaway rest area. The first would entail installation of energy-saving devices, including interior motion-sensitive lighting. With the use of motion sensors, interior lights would turn on only when triggered by a visitor using the facility, thereby saving electricity when the facility was not in use. For safety purposes, outdoor lighting would remain triggered by photoelectric detection devices and would stay on continuously during nighttime hours.

A second means of reducing power costs would involve development and use of an alternative source of energy. The two sources of alternative energy most applicable for rest area sites are solar and wind energy.

Solar energy could be harnessed to power interior and exterior rest area lighting fixtures. Solar panels can be installed on the roof of a structure or directly to parking lot lighting poles. Although solar radiation varies with the changing position of the earth relative to the sun and due to variance in atmospheric conditions, most geographic areas can access useful solar resources.

WYDOT has installed solar panels at 19 rest areas since the 1980s to provide a source of solar heating for restroom buildings. Most of these rest areas also have solar water heaters for the buildings' lavatories. WYDOT estimates that solar heating provides nearly half of these rest areas' energy needs. Given its effectiveness in Wyoming, it is recommended that MDT further explore the viability of solar energy as a source of power for the Hathaway rest area.

Wind may also be a potential source of energy. MDT is currently studying the viability of using wind power at the Anaconda Interchange rest area. The project involves a single tower-mounted wind turbine intended to provide supplemental power for the rest area. As noted in MDT's December 2006 Experimental Project Work Plan, the objective is to determine the cost-effectiveness of the turbine in reducing usage of grid-line power service. Over the course of several years, MDT intends to compare the Anaconda rest area site to other rest areas of similar design and size in terms of power usage and costs, including regular and unscheduled maintenance costs. MDT will conduct a benefit-cost analysis to determine whether wind turbines could provide long-term cost savings at rest area sites. If such a system appears viable based on the results of the Anaconda study, it is recommended that MDT consider the use of wind power at the Hathaway rest area.

Conclusions

Based on the above discussion, the following is a summary regarding power service at the Hathaway rest area:

- Existing grid power service is sufficient to meet the needs of the Hathaway rest area over the 20-year planning horizon.
- While usage has declined somewhat over the past five years, power usage will likely increase slowly over time with increasing visitors.
- Energy-saving technology, including motion-sensitive lighting, should be considered in order to reduce power costs at all three rest areas.
- Alternative sources of energy, including wind and solar power, could be used in the future to supplement grid power, thereby reducing power costs.

5.4 Cost Assessment

This study utilizes an asset management approach with regard to recommended rest area rehabilitation measures. FHWA's December 1999 *Asset Management Primer* defines asset management as follows:

> Asset management is a systematic process of maintaining, upgrading, and operating physical assets cost-effectively. It combines engineering principles with sound business practices and economic theory, and it provides tools to facilitate a

more organized, logical approach to decision-making. Thus, asset management provides a framework for handling both short- and long-range planning.

The goal of asset management in the context of this study is to optimize the preservation, upgrading, and timely replacement of corridor rest area facilities through cost-effective management, programming, and resource allocation decisions. In light of increasing user demand, constrained transportation budgets, and mature resources experiencing continuing deterioration, cost-effective investment decisions are imperative. Asset management principles enable long-term management of resources and prudent allocation of funds given alternative investment options and competing needs. With these principles in mind, this section outlines estimated costs for rehabilitation of the Hathaway EB and WB rest area sites.

As detailed in previous sections, the existing Hathaway rest area sites meet current user demands, with the exception of water quantity. Well rehabilitation is needed; it is recommended that wells and pumps be inspected and rehabilitated in order to accommodate current demand. Upgrades are needed to the wastewater systems in order to meet future demands over the 20-year planning horizon. Additionally, parking facilities will require expansion to accommodate increasing usage and an additional women's restroom stall will be needed at the Hathaway EB and WB sites.

Rehabilitation of Hathaway Sites

Cost estimates have been prepared assuming phased implementation in order to reduce initial rehabilitation costs and allow progressive project programming. It should be noted that while phased implementation reduces initial capital costs and may result in fewer impacts to the traveling public due to shorter construction-related closure periods, it results in higher total project costs due to duplication of certain efforts, including mobilization, traffic control, and administration costs, as well as material and labor cost escalation over the course of project implementation. Escalation costs are not reflected in the cost estimates provided in this study; all project phases are presented in 2009 dollars.

The first phase would involve rehabilitation of the EB and WB wells, in addition to rehabilitation of the EB and WB wastewater system, assuming a higher level of treatment is required to bring it up to current standards and meet current (2007) demand. This phase would also include site rehabilitation to provide ADA conformity. These upgrades are recommended to occur first in order to ensure continued public health, safety, and access. Additionally, these are relatively low-cost measures in comparison to full rehabilitation of the site.

The second phase would involve expanding the wastewater system to meet future (2027) demand, as well as upgrading the existing restroom facilities. The recommended wastewater system is modular in nature; additional modules can be added over time to expand the capacity of the system. Under this phase the Hathaway rest area would also receive a prefabricated two-stall restroom facility to meet future demand.

The third phase would entail construction of additional parking areas and accompanying sidewalks to meet 2027 demand. New amenities would also be provided, including additional picnic areas, landscaping, and benches. For purposes of this study, it was assumed that the existing acceleration and deceleration lanes could continue to serve the rest area facilities; these ramps would be resurfaced in order to extend their useful life.

Multi-phase and single-phase cost estimates for the EB and WB sites are presented in order to illustrate the relative difference in cost between the two. Detailed descriptions of each line item follow. These planning-level cost estimates are intended to be used primarily for comparison purposes between rest area sites in this study. Again, it should be noted that escalation costs are not reflected in the multi-phase cost estimates; all cost estimates are presented in 2009 dollars.

Table 5.26 Multi-Phase Cost Estimate for Hathaway EB Rehabilitation

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Hathaway EB (Rehabilitation)

Phase	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Well Rehabilitation	1	Lump Sum	$15,000	$15,000
	Wastewater System (2007 Demand)	1	Lump Sum	$121,000	$121,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	SUBTOTAL 1				**$160,000**
	Mobilization @ 10%	1	Lump Sum	$16,000	$16,000
	SUBTOTAL 2				**$176,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$18,000	$18,000
	Indirect Costs @ 14.06%	1	Lump Sum	$24,700	$25,000
	Construction Contingencies @ 10%	1	Lump Sum	$17,600	$18,000
	Construction Management @ 15%	1	Lump Sum	$26,400	$27,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE I TOTAL				***$264,000***
PHASE II	Wastewater System (2027 Demand)	1	Lump Sum	$5,000	$5,000
	New Two-Stall Building (pre-fabricated)	1	Lump Sum	$75,000	$75,000
	Building Upgrades	1	Lump Sum	$16,000	$16,000
	SUBTOTAL 1				**$96,000**
	Mobilization @ 10%	1	Lump Sum	$10,000	$10,000
	Miscellaneous @ 25%	1	Lump Sum	$24,000	$24,000
	SUBTOTAL 2				**$130,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$13,000	$13,000
	Traffic Control	1	Lump Sum	$5,000	$5,000
	Indirect Costs @ 14.06%	1	Lump Sum	$18,300	$19,000
	Construction Contingencies @ 10%	1	Lump Sum	$13,000	$13,000
	Construction Management @ 15%	1	Lump Sum	$19,500	$20,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE II TOTAL				***$200,000***
PHASE III	Demolition (Curb & Gutter)	200	LF	$9	$2,000
	Demolition (Sidewalk)	500	SF	$4	$2,000
	Demolition (Asphalt)	1,000	SF	$4	$4,000
	Grading	4,500	SF/ ft depth	$0.40	$2,000
	Crushed Aggregate Course - New Base	2,500	SF	$1	$3,000
	Pavement Surfacing - New	2,500	SF	$5	$12,000
	Pavement Surfacing - Overlay	105,000	SF	$1.33	$140,000
	Sidewalks	1,300	SF	$6	$8,000
	Curb and Gutter	450	LF	$13	$6,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Picnic Areas	1	Lump Sum	$72,000	$72,000
	Rest Area Amenities	1	Lump Sum	$14,000	$14,000
	SUBTOTAL 1				**$323,000**
	Mobilization @ 10%	1	Lump Sum	$33,000	$33,000
	Miscellaneous @ 25%	1	Lump Sum	$80,800	$81,000
	SUBTOTAL 2				**$437,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$44,000	$44,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$61,400	$62,000
	Construction Contingencies @ 10%	1	Lump Sum	$43,700	$44,000
	Construction Management @ 15%	1	Lump Sum	$65,600	$66,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE III TOTAL				***$663,000***
GRAND TOTAL					***$1,127,000***

Table 5.27 Single-Phase Cost Estimate for Hathaway EB Rehabilitation

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Hathaway EB (Rehabilitation)					
	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
PHASE I	Well Rehabilitation	1	Lump Sum	$15,000	$15,000
	Wastewater System (2007 Demand)	1	Lump Sum	$121,000	$121,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	Wastewater System (2027 Demand)	1	Lump Sum	$5,000	$5,000
	New Two-Stall Building (pre-fabricated)	1	Lump Sum	$75,000	$75,000
	Building Upgrades	1	Lump Sum	$16,000	$16,000
	Demolition (Curb & Gutter)	200	LF	$9	$2,000
	Demolition (Sidewalk)	500	SF	$4	$2,000
	Demolition (Asphalt)	1,000	SF	$4	$4,000
	Grading	4,500	SF/ ft depth	$0.40	$2,000
	Crushed Aggregate Course - New Base	2,500	SF	$1	$3,000
	Pavement Surfacing - New	2,500	SF	$5	$12,000
	Pavement Surfacing - Overlay	105,000	SF	$1.33	$140,000
	Sidewalks	1,300	SF	$6	$8,000
	Curb and Gutter	450	LF	$13	$6,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Picnic Areas	1	Lump Sum	$72,000	$72,000
	Rest Area Amenities	1	Lump Sum	$14,000	$14,000
	SUBTOTAL 1				**$579,000**
	Mobilization @ 8%	1	Lump Sum	$47,000	$47,000
	Miscellaneous @ 20%	1	Lump Sum	$116,000	$116,000
	SUBTOTAL 2				**$742,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$74,000	$74,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$104,300	$105,000
	Construction Contingencies @ 10%	1	Lump Sum	$74,200	$75,000
	Construction Management @ 15%	1	Lump Sum	$111,300	$112,000
	Acquire Right-of-Way	0	AC	$2,000	$0
GRAND TOTAL					***$1,118,000***

Table 5.28 Multi-Phase Cost Estimate for Hathaway WB Rehabilitation

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

Phase	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
	Hathaway WB (Rehabilitation)				
PHASE I	Well Rehabilitation	1	Lump Sum	$15,000	$15,000
	Wastewater System (2007 Demand)	1	Lump Sum	$121,000	$121,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	SUBTOTAL 1				**$160,000**
	Mobilization @ 10%	1	Lump Sum	$16,000	$16,000
	SUBTOTAL 2				**$176,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$18,000	$18,000
	Indirect Costs @ 14.06%	1	Lump Sum	$24,700	$25,000
	Construction Contingencies @ 10%	1	Lump Sum	$17,600	$18,000
	Construction Management @ 15%	1	Lump Sum	$26,400	$27,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE I TOTAL				***$264,000***
PHASE II	Wastewater System (2027 Demand)	1	Lump Sum	$5,000	$5,000
	New Two-Stall Building (pre-fabricated)	1	Lump Sum	$75,000	$75,000
	Building Upgrades	1	Lump Sum	$16,000	$16,000
	SUBTOTAL 1				**$96,000**
	Mobilization @ 10%	1	Lump Sum	$10,000	$10,000
	Miscellaneous @ 25%	1	Lump Sum	$24,000	$24,000
	SUBTOTAL 2				**$130,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$13,000	$13,000
	Traffic Control	1	Lump Sum	$5,000	$5,000
	Indirect Costs @ 14.06%	1	Lump Sum	$18,300	$19,000
	Construction Contingencies @ 10%	1	Lump Sum	$13,000	$13,000
	Construction Management @ 15%	1	Lump Sum	$19,500	$20,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE II TOTAL				***$200,000***
PHASE III	Demolition (Curb & Gutter)	0	LF	$9	$0
	Demolition (Sidewalk)	1,050	SF	$4	$5,000
	Demolition (Asphalt)	200	SF	$4	$1,000
	Grading	2,000	SF/ ft depth	$0.40	$1,000
	Crushed Aggregate Course - New Base	1,000	SF	$1	$1,000
	Pavement Surfacing - New	1,000	SF	$5	$5,000
	Pavement Surfacing - Overlay	137,500	SF	$1.33	$183,000
	Sidewalks	1,000	SF	$6	$6,000
	Curb and Gutter	1,000	LF	$13	$13,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Picnic Areas	1	Lump Sum	$4,000	$4,000
	Rest Area Amenities	1	Lump Sum	$11,000	$11,000
	SUBTOTAL 1				**$288,000**
	Mobilization @ 10%	1	Lump Sum	$29,000	$29,000
	Miscellaneous @ 25%	1	Lump Sum	$72,000	$72,000
	SUBTOTAL 2				**$389,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$39,000	$39,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$54,700	$55,000
	Construction Contingencies @ 10%	1	Lump Sum	$38,900	$39,000
	Construction Management @ 15%	1	Lump Sum	$58,400	$59,000
	Acquire Right-of-Way	0	AC	$2,000	$0
	PHASE III TOTAL				***$591,000***
GRAND TOTAL					***$1,055,000***

Table 5.29 Single-Phase Cost Estimate for Hathaway WB Rehabilitation

DOWL HKM

I-94 REST AREA CORRIDOR STUDY
Planning Level Estimate of Costs

	Item Description	Approx. Quantity	Unit of Measure	Estimated Unit Price	Amount
	Hathaway WB (Rehabilitation)				
PHASE I	Well Rehabilitation	1	Lump Sum	$15,000	$15,000
	Wastewater System (2007 Demand)	1	Lump Sum	$121,000	$121,000
	ADA Conformity	1	Lump Sum	$24,000	$24,000
	Wastewater System (2027 Demand)	1	Lump Sum	$5,000	$5,000
	New Two-Stall Building (pre-fabricated)	1	Lump Sum	$75,000	$75,000
	Building Upgrades	1	Lump Sum	$16,000	$16,000
	Demolition (Curb & Gutter)	0	LF	$9	$0
	Demolition (Sidewalk)	1,050	SF	$4	$5,000
	Demolition (Asphalt)	200	SF	$4	$1,000
	Grading	2,000	SF/ ft depth	$0.40	$1,000
	Crushed Aggregate Course - New Base	1,000	SF	$1	$1,000
	Pavement Surfacing - New	1,000	SF	$5	$5,000
	Pavement Surfacing - Overlay	137,500	SF	$1.33	$183,000
	Sidewalks	1,000	SF	$6	$6,000
	Curb and Gutter	1,000	LF	$13	$13,000
	Landscaping and Irrigation	1	Lump Sum	$58,000	$58,000
	Picnic Areas	1	Lump Sum	$4,000	$4,000
	Rest Area Amenities	1	Lump Sum	$11,000	$11,000
	SUBTOTAL 1				**$544,000**
	Mobilization @ 8%	1	Lump Sum	$44,000	$44,000
	Miscellaneous @ 20%	1	Lump Sum	$109,000	$109,000
	SUBTOTAL 2				**$697,000**
	Planning / Survey / Design @ 10%	1	Lump Sum	$70,000	$70,000
	Traffic Control	1	Lump Sum	$10,000	$10,000
	Indirect Costs @ 14.06%	1	Lump Sum	$98,000	$98,000
	Construction Contingencies @ 10%	1	Lump Sum	$70,000	$70,000
	Construction Management @ 15%	1	Lump Sum	$105,000	$105,000
	Acquire Right-of-Way	0	AC	$2,000	$0
GRAND TOTAL					***$1,050,000***

5.4.1 Narrative Description of Bid Items

The cost estimate for **Well Rehabilitation** at the EB and WB sites includes labor, materials, and engineering oversight associated with taking the existing well off line, removing the pumping equipment, videotaping the well, and rehabilitating/cleaning the well if the well has potential for enhancement. After rehabilitation, the well would be pump tested to verify its capacity and the amount of improvement. It is assumed that the existing pumping equipment can be reinstalled after rehabilitation.

The cost estimate for the **Wastewater System (2007)** assumes a treatment system at each site adequate to accommodate the existing 2007 demand. The lump sum includes the AdvanTex treatment system and associated elements such as the septic tank, drainfield, dosing tanks, installation, and operation costs.

The cost estimate for the **Wastewater System (2027)** assumes additional length of drainfield, and upsizing of septic and dosing tanks if needed. Initial estimates assume a 3-pod AdvanTex treatment system is adequate for both the 2007 and 2027 demand estimates. Therefore, additional treatment pods are not included in the 2027 estimate.

The cost estimate for **ADA Conformity** assumes lowering sinks and mirrors, relocating grab bars, and adding new ADA signs.

The cost estimate for the **New Two-Stall Building** assumes a prefabricated building and cement slab. The Hathaway EB and WB sites would require the installation of this facility to meet 2027 travel demand.

Building Upgrades include the cost of new restroom stalls; new porcelain sinks, toilets, and urinals; and new epoxy flooring for all existing rest area sites.

For Phase III, it was assumed that **Sidewalks** would be needed to outline new parking areas and to access new picnic shelters and benches. The unit price was taken from the 2008 MDT Average Prices Catalog.

Demolition costs for rehabilitation of the sites include removal of sidewalks, curb and gutter, and/or necessary asphalt to accommodate new parking facilities. The unit cost was derived from an average of the 2002 Dena Mora rest area bids, accounting for three percent annual inflation. A lower inflation value was used since demolition costs have not risen as sharply as material costs in recent years.

The **Grading** category includes site excavation and compaction. The quantity was determined based on the area of new parking facilities, in addition to a ten- to twenty-foot buffer area. The unit price was taken from the 2008 MDT Average Prices Catalog.

Unit prices for **Crushed Aggregate Course** and **Pavement Surfacing** were obtained from the 2008 MDT Average Prices Catalog. It was assumed that during Phase III, additional truck and car parking lots would be constructed to accommodate projected future demand, while existing parking areas and ramps would receive an asphalt overlay to extend their design life. Based on rough calculations, new parking areas could be designed to access existing ramps for the

Hathaway EB and WB sites, thereby reducing costs. Drawings used for rough calculations for Phase III are included in Appendix N.

New **Curb and Gutter** would be needed for new parking areas. The unit cost was derived from an average of the 2007 Anaconda Interchange rest area bids.

New **Landscaping and Irrigation** would be needed at the EB and WB facilities. The lump sum costs were derived from an average of the 2007 Anaconda Interchange rest area bids.

Additional **Picnic Areas** would be needed at each rehabilitated site. To reduce costs, the estimate assumes a combination of picnic shelters and individual picnic tables. The range of costs depends on the number of picnic tables to be added and whether or not a shelter is needed. The lump sum cost was derived from an average of the 2007 Anaconda Interchange rest area bids.

The **Rest Area Amenities** category includes new benches, ADA parking signs, highway signs, directional arrow signs, and trash receptacles. The lump sum was drawn from an average of the 2007 Anaconda Interchange rest area bids and varies between sites based on the number of trash receptacles needed.

The **Miscellaneous** category is estimated to be up to 25 percent for this project because of the potential for unknown factors. It includes items such as:

- Roadside cleanup
- Slope treatment
- Watering
- Ditch or channel excavation
- Shoring, cribbing, or extra excavation
- Adjusting existing manholes, catch basins, valve boxes, and monument cases
- Retaining walls
- Unsuitable excavation
- Undergrounding or relocation of power, telephone, gas, or cable utilities
- Temporary striping
- Temporary water pollution/erosion control
- Sawcutting pavement
- Flagpole
- Striping and signing
- Storm drainage
- ADA ramps and truncated domes
- Lighting
- Dumpster
- Security Cameras

Several cost categories are calculated as percentages of construction, including the **Mobilization** and miscellaneous categories. Additionally, the **Planning/Survey/Design, Indirect Costs, Construction Contingencies, and Construction Management** categories were calculated as percentages of the respective subtotals noted in Tables 5.26 through 5.29. A construction contingency lower than the maximum 25 percent recommended by MDT's cost estimation guidelines was chosen because the majority of unknown factors should be accounted for under the miscellaneous category.

Traffic Control measures are expected to be minimal. Under Phase I, it may be possible for the site to remain open and to maintain operation of the existing wastewater system during installation of the new system. During Phase II and III, the site would likely need to be closed during rehabilitation. Traffic control costs would include signs alerting drivers of the closure, as well as barricades on the entrance and exit ramps.

Based on as-built drawings, it appears that new facilities could be constructed entirely within the existing **Right-of-Way** at each site.

5.4.2 Funding Sources

Rest Area Program

The Rest Area Program provides funding for state-maintained rest area projects throughout the state. The Federal Share for Rest Area projects is subject to the sliding scale. For example, rest areas located on the interstate system have a Federal Share of 91.24 percent and the State is responsible for 8.76 percent. The State's percentage is funded through the State Special Revenue Account.

The Montana Transportation Commission approved an annual allocation of funds to the Rest Area Program in September 2008. Funds may be used for new facility construction, rehabilitation and preservation work, which includes replacement of existing facilities. Approximately 80 percent of the funds are for new construction with the remaining 20 percent for rehabilitation and preservation work.

The Rest Area Program is reviewed annually to revisit project priorities, update cost estimates and track progress and reporting. The Montana Transportation Commission approves projects for the Rest Area Program.

Interstate Maintenance

The IM Program provides funding for projects on the Interstate System involving resurfacing, restoring, and rehabilitation of the existing roadway. The Federal share for IM projects is 91.24 percent and the State is responsible for 8.76 percent. The State's percentage is funded through the State Special Revenue Account.

Activities eligible under the Interstate Maintenance Program include resurfacing, restoring, and rehabilitation of the roadway. In addition, reconstruction or rehabilitation of bridges, existing interchanges, and over crossings also qualify. Rest Area projects along the interstate are also eligible for Interstate Maintenance Program funds. Preventive maintenance activities are eligible when a state can demonstrate, through its pavement management system, that such activities are a cost-effective means of extending interstate pavement life.

The Montana Transportation Commission approves the fund apportionment to the statewide Interstate Maintenance Program. The IM funds are distributed throughout the financial districts based solely on need.

5.5 Recommendations

Based on the findings of this study, Table 5.30 presents rankings associated with the set of factors to be used to determine whether it is feasible to upgrade and maintain existing rest area locations or whether new locations should be investigated. Four of these factors represent higher priority considerations, including provision of water, sewer, and power services and cost of rehabilitation. If there is a substantial impediment relating to any one of these four factors or a combination of any of the four, MDT guidelines recommend abandonment of the existing site and identification of an alternate location.

A total score of 130 points is possible based on the sum of the weighted scores for each factor. A higher total score for an individual rest area represents a more suitable site combined with a greater need for improvements. Accordingly, a rest area with a higher score is a better candidate for rehabilitation than a rest area with a lower score due to greater feasibility and urgency. Descriptions of each assigned ranking are provided below.

Water System

The Hathaway water systems are not close to a community system that could be cost-effectively accessed. However, wells are easily accessed, and water quality is generally good. Hathaway currently experiences water quantity issues. Hathaway must maintain a water treatment system, thereby increasing operation and maintenance requirements at this site.

Sewer System

Community wastewater systems are not located nearby. The proposed wastewater system can be installed at the Hathaway sites without significant burden, but ultimately will require a detailed site investigation.

Power System

The Hathaway sites have ready access to the power grid. Costs may continue to increase, although there may be opportunities to reduce energy consumption and/or to utilize supplemental sources of power.

Cost

The total cost of site rehabilitation at the Hathaway sites is relatively low because projected demand does not warrant construction of a new building facility and the cost for a small prefabricated unit would be relatively low. Phased implementation could be used to reduce initial costs and allow for long-term budgetary planning. It is unknown at this time if there would be cooperative cost contributions.

Urgency of Replacement

The Hathaway sites currently meet existing demand. Although current maintenance requirements are not burdensome, the conventional septic tank and drainfield systems are not designed to accommodate high-strength wastewater and will require frequent pumping unless the system is upgraded in the near-term.

AADT

Current AADT at the Hathaway sites is approximately 2,300 vehicles.

Spacing

Overall, the Hathaway rest area is appropriately spaced in relation to other nearby rest areas.

Percent Completion

This study represents planning-level consideration of rehabilitation of the three sites. No design work has been performed to date.

System

The Hathaway sites are located on Interstate 94.

Percent Usage by Travelers in Corridor
Usage was estimated as a percentage of AADT, per AASTHO guidelines. Additional data would be needed in order to determine actual usage.

Land Use and Ownership
MDT owns the existing sites. No additional right-of-way would be needed in order to meet future demand.

Topography and Site Accessibility
The Hathaway sites are outside the floodplain and there are no known environmental resources immediately adjacent to the sites. There are sight distance issues at the Hathaway sites with regard to acceleration and deceleration ramps. Testing would be required to determine soil types at the sites.

Safety Corridor
There were no crashes due to fatigue within one mile of the Hathaway rest area.

Percent Commercial Use / MCS Facility
Commercial vehicles constitute approximately 24 percent of the AADT at the Hathaway sites.

Rehabilitation of Existing Site
There are no significant impediments to rehabilitation of the existing Hathaway sites.

Seasonal Site Conversion
The Hathaway rest area is currently open year round.

Alternative Funding Available
It is unknown at this time whether alternative sources of funding are available for this project.

ADA Compliance
The existing sites do not comply with ADA requirements relating to sinks, toilet stalls, and signage.

Community Involvement
It is unknown at this time whether locals support rehabilitation of the existing Hathaway rest area; no additional right-of-way would be required.

This Page
Intentionally Left Blank

Table 5.30 Rankings for Hathaway Rest Area

Factor		Description	Possible Score	EB Score	WB Score
Priority Considerations and Focus of this Study	Water Facilities	Feasibility of Upgrades to Water System • Community System Available = 5 • Well Easily Accessed = 4 Existing Water Quality • High quality (low turbidity, no need for filtration), sufficient flow = 5 • Poor quality, low flow rate = 0 Urgency of Rehabilitation of Sewer System • Existing system does not meet current (2007) demand = 5 • Existing system does not meet projected future (2027) demand = 2 • Existing system meets current demand and is projected to meet future (2027) demand = 0	10	8	8
	Sewer Facilities	Feasibility of Upgrades to Sewer System • Community sewer system nearby; connection possible = 5 • Individual system can be installed at site without significant burden = 4 • Individual system installation would be difficult due to lack of land, topography = 0 Urgency of Rehabilitation of Water System • Existing system does not meet current (2007) demand = 5 • Existing system does not meet projected future (2027) demand = 2 • Existing system meets current demand and is projected to meet future (2027) demand = 0	10	6	6
	Power Facilities	Energy Source • Energy source is nearby, cost-effective, and/or renewable = 5 • Energy source is remote, costly = 0	5	5	5
	Cost	Cost-effective, with cooperative cost contribution = 10 Cost Prohibitive, no cost sharing = 0	10	5	5
Urgency of Replacement		Facility requires substantial time, money, or staff resources to maintain? Age or facility condition reflected in increasing site costs? • Significant resources required = 10 • Moderate resources required = 5 • Few resources required = 0	10	6	6
AADT		AADT > 2500 = 10 2500 > AADT > 1500 = 7 1500 > AADT > 750 = 5	10	7	7
Spacing		Travel time to next or previous rest opportunity • 40 min < Travel Time < 75 min = 10 • Travel Time > 75 min = 5 • Travel Time < 40 min = 3	10	10	10
Percent Completion		Current plans and process for new facility, reconstruction, or rehabilitation underway, including total funds already obligated to site • Agreement signed, significant work performed and funds obligated, additional right-of-way purchased = 10 • Nothing but an idea = 0	10	2	2
System		Interstate = 5 NHS = 3 Primary = 2	5	5	5
Percent Usage by Travelers in Corridor		<u>Commercial or Metro Area</u>: Usage > 9% = 5; 9% > Usage > 5 % = 3; 5% > Usage = 0 <u>Typical Rural Route</u>: Usage > 12% = 5; 12% > Usage > 8 % = 3; 8% > Usage = 0 <u>Information and Welcome Center</u>: Usage > 15% = 5; 15% > Usage > 9 % = 3; 9% > Usage = 0	5	3	3
Land Use and Ownership		MDT Owned = 5 State = 4 Private = 3 Lease = 1	5	5	5
Topography and Site Accessibility		Outside floodplain; suitable elevation and soil type; construction will not adversely impact environmental resources; topography provides adequate line of sight and safe acceleration / deceleration distances. • Site meets all criteria = 5 • Significant challenges with water table, soil composition, environmental impacts and/or line of site = 0	5	5	4
Safety Corridor		High crash section = 5 No reported crashes due to fatigue = 0	5	0	0
Percent Commercial Use / MCS Facility		Can be incorporated into MCS facility and located in high-need area = 5 Site cannot be incorporated; many parking opportunities available = 0	5	3	3
Rehabilitation of Existing Site		Existing site, considering all elements, can be reconstructed / rehabilitated = 5 Existing site has significant impediments = 0	5	5	5
Seasonal Site Conversion		Site is open year round or can easily be converted = 5 Significant impediment to conversion; must select new site = 0	5	2	2
Alternative Funding Available		Other sources of funds available to build or maintain rest area = 5 Built and maintained solely through RA program set-aside = 0	5	TBD	TBD
ADA Compliance		Meets all current ADA specifications = 0 Significant ADA issues (sidewalks, parking, accessibility) must be overcome = 5	5	2	2
Community Involvement		Locals are supportive and will donate land = 5 Locals are not supportive or proactively resistant = 0	5	3	3
TOTAL SCORE			**130**	**82**	**81**

This Page
Intentionally Left Blank

Based on the rankings noted in Table 5.30, there are no significant impediments relating to rehabilitation of water, sewer, or power facilities at the Hathaway sites. The Hathaway sites will require rehabilitation of the existing wells or may need to drill additional wells to meet current and future demand.

Although full site rehabilitation would be costly, it is possible to phase rehabilitation in order to reduce initial costs and plan for future needs. Therefore, it is recommended that MDT rehabilitate the Hathaway sites as funding allows in order to accommodate future demand.

Water Recommendations

- Existing water system at Hathaway is unable to meet current demand. Evaluate treatment process for adequate sizing and operation so as to possibly reduce the demand on the system. Implement water conservation practices and rehabilitate wells.
- Conduct inventory of wells and document their condition.
- Install water meters to more accurately define system demand.

Sewer Recommendations

- Conduct detailed site soil investigations to refine design and accurately determine area needed for an appropriately-sized drainfield. Additionally, perform nondegradation analysis to define the groundwater quality impact and establish wastewater system design criteria.
- Conduct wastewater effluent monitoring to establish the existing strength of the wastewater.
- Based upon raw wastewater characteristics and results of a nondegradation analysis, re-evaluate wastewater treatment options so that the most appropriate system may be selected at the Hathaway rest area.
- Install new septic tanks and drainfields.

Power Recommendations

- Consider use of motion-detectors to reduce energy usage.
- Evaluate building orientation and heating, lighting, plumbing and mechanical systems at time of site rehabilitation in order to provide the most energy-efficient design.
- Consider use of solar or wind power to supplement power and reduce monthly energy costs.

Physical Site Recommendations

- Upgrade building facilities to maximize energy efficiency, meet ADA requirements, and accommodate demand over 20-year planning period.
- Consider use of modular or pre-fabricated building facility at the Hathaway site.
- Design new parking lots so that existing acceleration and deceleration ramps could continue to serve facilities.
- Incorporate water-saving landscaping into the new design. Use of native, drought-resistant vegetation and smaller turf areas could substantially reduce irrigation needs.
- Consider drip irrigation system to reduce water usage.

General Recommendations and Long Term Considerations

- Attempt to minimize closure periods to the extent practicable during rest area rehabilitation. Each of the three phases of rehabilitation for the Hathaway sites could likely be completed within one to two weeks. Scheduling improvements to occur in the off-peak tourist season (early spring or late fall, as opposed to mid-summer) could reduce impacts to the traveling public somewhat.

6.0 OTHER CONSIDERATIONS

In addition to providing individual assessments of the Greycliff, Custer, Hysham, and Hathaway rest areas, this study considers rest area proposals within the I-90 / I-94 study corridor from Big Timber to Miles City.

According to the Montana Rest Area Planning Map (see Appendix O), the Big Timber rest area has been proposed just to the east of the town of Big Timber and the Fort Keogh rest area has been proposed just to the west of Miles City. Additionally, the map notes a proposal to relocate the existing EB Hysham rest area site further to the east. It should be noted that rest areas are named according to MDT convention and generally reference nearby sites or towns; the proposed Big Timber and Fort Keogh rest areas are not intended to impact town sites or federal lands.

As noted in previous chapters, the Rest Area Plan recommends spacing between rest areas equal to approximately one hour of travel time under favorable traveling conditions. For reference in this chapter, current spacing between rest areas over the entire I-90 / I-94 study corridor is presented in Table 6.1. Orange shaded cells indicate distances that slightly exceed the recommended maximum spacing assuming drivers travel at the posted speed limit of 75 miles per hour, and blue shaded cells indicate overly dense spacing between rest areas. Again, it is important to note that while excessive distances between rest areas can inconvenience the traveling public, close spacing between rest areas may represent an unnecessary allocation of MDT resources.

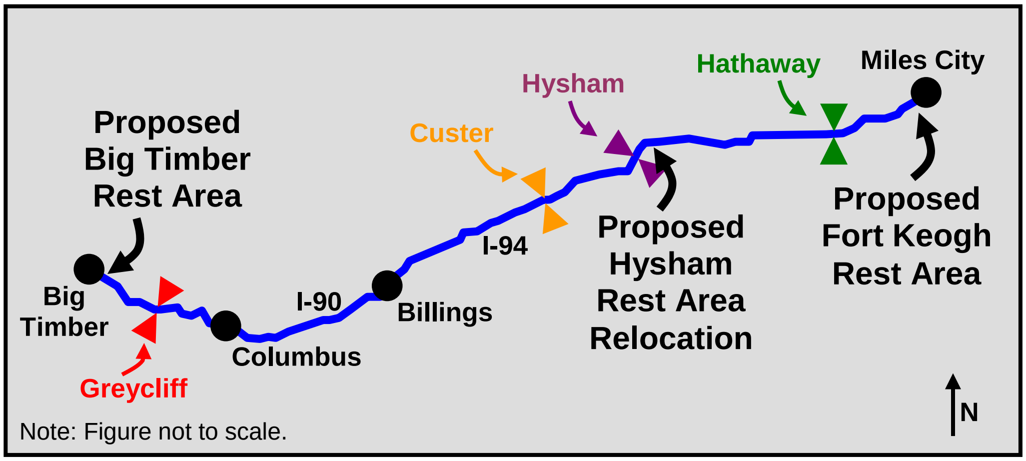
Table 6.1 Rest Area Spacing Over I-90 / I-94 Corridor

Rest Area Site	Previous Rest Area		Previous City with 24/7 Services		Next Rest Area		Next City with 24/7 Services	
	Name	Distance (miles)	Name	Distance (miles)	Name	Distance (miles)	Name	Distance (miles)
Greycliff EB	Bozeman	75	Big Timber	12	Columbus	38	Columbus	28
	Emigrant	**77**						
Greycliff WB	Columbus	38	Columbus	28	Bozeman	75	Big Timber	12
					Emigrant	**77**		
Custer EB	Columbus	**76**	Billings	38	Hysham	**26**	Miles City	100
	Hardin	58						
Custer WB	Hysham	**23**	Miles City	96	Columbus	**79**	Billings	41
					Hardin	62		
Hysham EB	Custer	**26**	Billings	64	Hathaway	49	Miles City	74
Hysham WB	Hathaway	48	Miles City	74	Custer	**23**	Billings	64
Hathaway EB	Hysham	49	Billings	113	Bad Route	**79**	Miles City	25
					Locate	64		
Hathaway WB	Bad Route	**79**	Miles City	25	Hysham	48	Billings	113
	Locate	65						

Note: Orange shaded cells indicate distances between rest areas slightly exceeding Rest Area Plan recommendations; blue shaded cells indicate overly dense spacing.
Source: MDT Rest Area Site Evaluation Forms, 2008.

Figure 6-1 presents a map of the study corridor, including the locations of the proposed construction / reconstruction projects discussed in this chapter.

Figure 6-1 Map of Rest Area Proposals in Study Corridor



Rest area proposals are discussed separately in the following sections.

6.1 Proposed Big Timber Rest Area

As noted in Table 6.1, the Greycliff rest area is currently spaced approximately one hour of driving time from the nearest rest areas to the west on I-90 (Bozeman rest area) and on US 89 (Emigrant rest area). Construction of the Big Timber rest area would reduce the distance from Greycliff to the next rest area to the west to only 12 miles. This distance is excessively close and would represent an unnecessary allocation of MDT resources. If the Greycliff rest area is rehabilitated as recommended in Chapter 2, there would be no need to construct the new Big Timber rest area from a spacing perspective.

Although the cost of an entirely new rest area was not determined for this study, it would likely be substantially higher than major rehabilitation of the existing Greycliff rest area. A new rest area would require acquisition of right-of-way for an entirely new site, as well as construction of entirely new facilities. In contrast, the major rehabilitation recommended at Greycliff could utilize existing right-of-way and some of the existing parking areas, sidewalks, and amenities at the site.

For these reasons, construction of a new rest area at Big Timber is not recommended. Again, it should be noted that this recommendation is dependent upon successful rehabilitation of the Greycliff rest area. The planning-level assessment documented in this report suggests that rehabilitation of the Greycliff sites is possible. If, however, during future detailed studies it is determined that there is an insurmountable impediment to rehabilitation of Greycliff, construction of a rest area at Big Timber could be reconsidered.

6.2 Proposed Fort Keogh Rest Area

As noted in Table 6.1, the Hathaway rest area is currently spaced approximately one hour of driving time from the nearest rest areas to the east on I-94 (Bad Route rest area) and on US 12 (Locate rest area). Construction of the Fort Keogh rest area near Miles City would reduce the distance from Hathaway to the next rest area to the east to only 25 miles. This distance is excessively close and would represent an unnecessary allocation of MDT resources. If the Hathaway rest area is rehabilitated as recommended in Chapter 5, there would be no need to construct the new Fort Keogh rest area from a spacing perspective.

Although the cost of an entirely new rest area was not determined for this study, it would likely be substantially higher than rehabilitation of the existing Hathaway rest area. As noted above, a new rest area would require acquisition of right-of-way for an entirely new site, as well as construction of entirely new facilities. In contrast, the rehabilitation recommended at Hathaway could utilize existing right-of-way, the existing building facility, existing entrance and exit ramps, and most of the existing parking areas, sidewalks, and amenities at the site.

For these reasons, construction of a new rest area at Keogh is not recommended. Again, it should be noted that this recommendation is dependent upon successful rehabilitation of the Hathaway rest area. The planning-level assessment documented in this report suggests that rehabilitation of the Hathaway sites is possible. If, however, during future detailed studies it is determined that there is an insurmountable impediment to rehabilitation of Hathaway, construction of a rest area at Fort Keogh could be reconsidered.

6.3 Relocation of Hysham EB Rest Area

As noted in Table 6.1, the Hysham rest area is currently spaced approximately 25 miles away from the next rest area to the west (Custer rest area). This spacing is excessively close and represents an unnecessary allocation of MDT resources. If the Custer and Hathaway rest areas are rehabilitated as recommended in Chapters 3 and 5, there would be no need to relocate the EB Hysham rest area slightly to the east from a spacing perspective. Based on the Hysham assessment contained in Chapter 4, this study recommends converting the existing Hysham rest area into a truck parking facility.

Although the cost of an entirely new rest area was not determined for this study, it would likely be substantially higher than rehabilitation of the existing Custer and Hathaway rest areas and closure of the existing Hysham rest area. As noted above, a new rest area would require acquisition of right-of-way for an entirely new site, as well as construction of entirely new facilities. In contrast, the rehabilitation recommended at Custer and Hathaway could utilize existing right-of-way, existing building facilities, existing entrance and exit ramps, and most of the existing parking areas, sidewalks, and amenities at the site. Closure of the Hysham rest area would be relatively inexpensive and would reduce maintenance and operation costs.

For these reasons, the proposed relocation of the Hysham EB rest area is not recommended.

7.0 PUBLIC AND AGENCY INVOVLEMENT

A draft version of the Corridor Study document was made available for public and agency review and comment from August 25 to September 25, 2009. Additionally, a public meeting was held September 15, 2009 to discuss the study process, the study findings, and present the study recommendations regarding rehabilitation of existing rest area sites. MDT received a total of five written comments regarding the study. These comments are included in Appendix P, along with MDT responses. In general, public and agency comments were supportive of the findings and recommendations of the study. One additional comment was received via a phone call from the USDA inquiring about the exact location of the proposed Fort Keogh rest area. As noted in Chapter 6, rest areas are named according to MDT convention and generally reference nearby sites or towns; the proposed Fort Keogh rest area is not intended to impact Fort Keogh federal lands.

8.0 REFERENCES

A Guide to WYDOT Rest Areas: Making the Wyoming Travel Experience Even Better. Wyoming Department of Transportation Public Affairs Office, February 2006, http://dot.state.wy.us/Default.jsp?sCode=hwyra

ADA Accessibility Guidelines for Buildings and Facilities, US Department of Justice.

AdvanTex Treatment Systems, Version 1.2, Design/Engineering Package for Commercial and Multi-Family Wastewater Treatment, Orenco Systems Incorporated, July, 2007.

Application for Beneficial Water Use Permit, Information & Instructions Form No. 600 and Criteria Addendum A, Montana Department of Natural Resources and Conservation.

Asset Management Primer. U.S. Department of Transportation Federal Highway Administration Office of Asset Management, December 1999.

Average Prices Catalog. Montana Department of Transportation Contract Plans Bureau, January 2008 – December 2008.

Circular DEQ-3, Standards for Small Water Systems, Montana Department of Environmental Quality, February 24, 2006 Edition.

Circular DEQ-4, Montana Standards for Subsurface Wastewater Treatment Systems, Montana Department of Environmental Quality, 2004 Edition.

Experimental Project Work Plan: Evaluation of a Tower-Mounted Wind Turbine for the Generation of Supplemental Power for the Anaconda Interchange Rest Area. Montana Department of Transportation Research Programs, December 2006.

Final Bid Tabulation for Dena Mora Rest Area. Montana Department of Transportation, September 2002.

Final Bid Tabulation for Anaconda Interchange Rest Area. Montana Department of Transportation, April 2007.

Geologic Map of the Forsyth 30' x 60' Quadrangle, Eastern Montana, Susan M. Vuke, Robert N. Bergantino, Roger B. Colton, Edith M. Wilde, and Edward L. Heffern, Montana Bureau of Mines and Geology, Open File Report MBMG 425, 2001.

Geologic Map of the Hysham 30' x 60' Quadrangle, Eastern Montana, Susan M. Vuke, M. Wilde, and Robert N. Bergantino, Montana Bureau of Mines and Geology, Open File Report 486, 2003.

Ground Water Rule: A Quick Reference Guide, EPA-816-F-08-029, U.S. Environmental Protection Agency – Office of Water (4606M), June 2008, www.epa.gov/safewater.

Ground Water Rule Compliance, Pontius, Frederick W., American Water Works Association Journal, February 2009, Volume 101, Number 2, Pages 24-32.

MDT Maintenance Personnel:
Ken Hembree
Ken Rockeman
Mike Patch
Rich Prokop
Terry Ulman

Montana Ground Water Atlas, Montana Natural Resource Information System, Water Information System, http://nris.mt.gov/wis/data/groundwater.htm

Montana Irrigation Guide, USDA Soil Conservation Service, Federal Building, Room 443, 10 East Babcock Street, Bozeman, MT 59715, updated 1988 and 1995.

Montana Rest Area Plan, State of Montana Department of Transportation, December 1999, amended May 2004.

Onsite Wastewater Treatment Systems Manual, EPA/625/R-00/008, U.S. Environmental Protection Agency – Office of Research and Development, February 2002.

Preliminary Geologic Map of the Big Timber 30' x 60' Quadrangle South-Central Montana, David A. Lopez, Montana Bureau of Mines and Geology, Open File Report MBMG 405, 2000.

Public Water Supply Section, Drinking Water Regulations for Transient Non-Community Public Water Supplies, Montana Department of Environmental Quality, November 24, 1999.

PWS-5, Ground Water Under the Direct Influence of Surface Water (GWUDISW), Montana Department of Environmental Quality, 2008 Edition.

Quantifying Roadside Rest Area Usage, The New England Transportation Consortium, November 2002, http://docs.trb.org/00941461

Septic System Impact Study, Goose Creek Watershed, HKM Engineering, December 2006.

Small and Decentralized Wastewater Management Systems, Crites and Tchobanoglous, 1998.

Water Rights in Montana, Montana Department of Natural Resources and Conservation, Legislative Environmental Quality Control, Montana University System Water Center, October, 2008.

Wastewater Treatment and Reuse, 4th Edition, Metcalf and Eddy, 2003.

Vermont Rest Area Uses Green Wastewater Treatment System. Federal Highway Administration Turner-Fairbank Highway Research Center, May/June 2000, http://www.tfhrc.gov/pubrds/mayjun00/vermont.htm

This Page
Intentionally Left Blank