

County	Sweet Grass	Upstream River Mile	478.8
Classification	PCB: Partially confined braided	Downstream River Mile	475.4
General Location	Springdale	Length	3.40 mi (5.47 km)

Narrative Summary

Reach A1 is located just downstream of the Springdale Bridge in western-most Sweet Grass County. It is a Partially Confined Braided (PCB) reach type, indicating some influence of the valley wall on river geomorphology, as well as abundant un-vegetated mid-channel bars. The reach is 3.4 miles long. This reach is most prominently characterized by a large meander located at RM 478 that has been very dynamic over recent years. The meander bend has repeatedly migrated to the north and then cut off, leaving broad open gravel bars and a wide active channel corridor. The bendway has been heavily armored on its apex, and partially armored on its downstream limb. With all of the changes at this meander, there has been a net gain of total channel area in the reach of about 50 acres since 1950.

There are about 6,800 feet of rock riprap in the reach, over 1,500 feet of which was constructed since 2001. Several flow deflectors have been eroded out in Reach A1 since 2001. About 25 percent of the bankline was armored as of 2011. There are also over 6,800 feet of mapped transportation encroachment in the river corridor, most of which is the rail line that follows the south bank.

Although the rail line runs along the edge of the river, it is situated on higher terraces and as such has not isolated any 100-year historic floodplain area. However, about 9 percent of the total Channel Migration Zone (CMZ) footprint has become restricted, and these restrictions are due to armoring against both the rail line and irrigated fields. This demonstrates how terraces that may be out of the 100-year floodplain can still be prone to erosion and thus within the CMZ.

The primary land use in the reach is non-irrigated agriculture (~1,100 acres), although there are about 650 acres under some form of irrigation. Pivot irrigation has expanded from 0 acres in 1950 to 302 acres in 2011. Similarly, sprinkler irrigation has expanded from 0 to 250 acres during the same time frame, and the extent of flood irrigated lands dropped from 803 to 123 acres over those 61 years. About 46 acres of land under sprinkler and 10 acres of land under pivot are located within the CMZ.

About 120 acres of wetland have been mapped in the reach, with most of that (84 acres) emergent wetland marsh that is located primarily in the active stream corridor. About 20 acres of wetland have been isolated from the corridor by the rail line near RM 477.8. About 0.7 acres of Russian olive have been mapped in the reach, and these trees are dispersed throughout the corridor.

Hydraulic modeling of the reach shows an extensive network of floodplain channels on the floodplain in Reach A1 that creates some avulsion risk north of the river. Much of the armoring on the large meander at RM 478 has reduced the risk of an avulsion and potential bypass of the Prather Mayborn Westfall Ditch Diversion. In addition, one of the overflow channels has been allowed to activate, which has reduced the potential for additional avulsions. The strategic allowance of channel migration and secondary channel activation has prevented the creation of a severe pinch point at RM 477.4 that may have created long-term instability in the reach.

A large dike at RM 476.7 blocks a ~3,000-foot long side channel and focuses the river towards the south bank and the Prather Mayborn Westfall Ditch Diversion. Although the dike blocks the head of the channel, it is still seasonally accessed by other overflow points from the main river.

This area of the upper Yellowstone River has seen three severe floods in the last 20 years. The 1996 and 1997 floods were very damaging, early-June events that peaked at 37,100 and 38,000 cfs, respectively. At the time, these were considered to be sequential 100-year floods. Then in late June of 2011, the river peaked at 40,600 cfs, which is currently the flood of record at Livingston. This flood exceeded a 100-year event, with both the 1996/1997 events considered to have exceeded a 75-year flood.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been moderate in this reach. The biggest influence has been on low flows: severe low flows described as 7Q10 (the lowest average 7-day flow anticipated every ten years) for summer months has dropped from an estimated 1,750 cfs to 1,570 cfs with human development, a reduction of 10.3 percent. More typical summer low flows, described as the summer 95% flow duration, have dropped from 1,760 cfs under unregulated conditions to 1,680 cfs under regulated conditions at the Livingston gage, a reduction of 4.6 percent.

CEA-Related observations in Reach A1 include:

- Strategic allowance of side channel activation to reduce overall avulsion risk
- Isolation of emergent wetlands by transportation infrastructure
- Blockage of a 3,000-foot long side channel to focus flows to a diversion structure.

Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach A1 include:

- CMZ management due to level of restriction and avulsion risks on north floodplain
- Bank Stabilization Recommended Practices due to current extent of bank armoring (25 percent of total bankline)
- Irrigation diversion structure management at Prather Mayborn Westfall
- Wetland management/restoration due to high wetland concentrations

The following table summarizes some key CEA results that have been used to describe overall condition and types of human influences affecting the river. The values are specific to this single reach. Blanks indicate that a particular value was not available for this area. This information is consolidated from a large dataset that is presented in more detail in the full reach narrative report.

Discharge	Undev.	Developed	% Change	"Undeveloped" flows represent conditions prior to significant human development, whereas "developed" flows reflect the current condition of both consumptive and non-consumptive water use.		
2 Year (cfs)	23,300	22,900	-1.7%			
100 Year (cfs)	43,400	43,200	-0.5%			
Bankfull Channel Area (Ac)	1950	1976	1995	2001	1950-2001	Bankfull channel area is the total footprint of the river inundated at approx. the 2-year flood.
	189.9	216.9	242.7	256.3	66.4	
Physical Features	2011 Length (ft)	% of Bankline	2001-2011 Change	There are additional types of bank armor such as car bodies and steel retaining walls, but they are relatively minor.		
Rock RipRap	6,838	19.2%	1,678			
Concrete Riprap	0	0.0%	0			
Flow Deflectors	2,092	5.9%	-309			
Total	8,930	25.1%	1,369			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	0	2,970				
Floodplain Turnover	1950 - 1976	1976 - 2001	1950-2001 In-channel riparian encroachment (negative number indicates retreat)	The rate of floodplain turnover reflects how many acres of land are eroded by the river. Turnover is associated with the creation of riparian habitat.		
Total Acres	44.0	62.6	-45.46 acres			
Acres/Year	1.7	2.5				
Acres/Year/Valley Mile	0.5	0.8				
Open Bar Area	Point Bars	Bank Attached	Mid-Channel	Total	The type and extent of open sand and gravel bars reflect in-stream habitat conditions that can be important to fish, amphibians, and ground-nesting birds such as least terns.	
Change in Area '50 - '01 (Ac)						
Floodplain Isolation	Acres	% of FP	Floodplain isolation refers to area that historically was flooded, but has become isolated do to flow alterations or physical features such as levees.			
5 Year	13.2	7%				
100 Year	0.0	0%				
Restricted Migration Area	Acres	% of CMZ	Channel Migration Zone restrictions refer to the area and percent of the CMZ that has been isolated by features such as bank armor, dikes, levees, and transportation embankments.			
	65.8	9%				
Land Use	1950	2011	1950	2011	Changes in land use reflect the development of the river corridor through time. The irrigated agricultural are is a sub-set of the mapped agricultural land.	
Agricultural Land (Ac)	1,992.8	1,789.8	Flood (Ac)	803.4	122.6	
Ag. Infrastructure (Ac)	52.1	109.4	Sprinkler (Ac)	0.0	254.2	
Exurban (Ac)	5.4	5.4	Pivot (Ac)	0.0	301.6	
Urban (Ac)	0.0	0.0				
Transportation (Ac)	47.6	81.5				
1950s Riparian Vegetation Converted to a Developed Land Use (ac)	To Irrigated	To Other Use	Total Rip. Converted	% of 1950s Rip.	Changes in the extents of riparian vegetation are influenced by land use changes within the corridor.	
	3.7	0.0	3.7	1.0%		
National Wetlands Inventory	Acres	Acres per Valley Mi	Total Wetland Acres	Wetlands units summarized from National Wetlands Inventory Mapping include Riverine (typically open water sloughs), Emergent (marshes and wet meadows) and Shrub-Scrub (open bar areas with colonizing woody vegetation).		
Riverine	7.4	2.3	129.8			
Emergent	84.3	26.0				
Scrub/Shrub	38.0	11.7				
Russian Olive (2001) (Appx. 100-yr Floodplain)	Acres	%	Russian olive is considered an invasive species and its presence in the corridor is fairly recent. Its spread can be used as a general indicator of invasive plants within the corridor.			
	0.7	0.2%				
Riparian Forest at low risk of Cowbird Parasitism (Ac/Valley Mile)	1950	1976	2001	Change 1950-2011	Cowbirds are associated with agricultural and residential development, displacing native bird species by parasitizing their nests.	
	0.0	0.0	0.0	0.0		

PHYSICAL FEATURES MAP (2011)



