

<b>County</b>	Park	<b>Upstream River Mile</b>	485.4
<b>Classification</b>	PCS: Partially confined straight	<b>Downstream River Mile</b>	481
<b>General Location</b>	East End	<b>Length</b>	4.40 mi (7.08 km)

## Narrative Summary

Reach PC20 is 4.4 miles long and flows through a narrow canyon known as East End just above Springdale. The reach is Partially Confined Straight (PCS); the river flows through a canyon that provides some curvature however that sinuosity is created by the canyon itself and does not reflect river meandering. Within Reach PC20, the river is closely bound by both the railroad line and Interstate. In places, the transportation infrastructure has been cut into the valley wall; in other areas it encroaches into the historic river floodplain. As a result, numerous slivers of historic floodplain area have become isolated from the river through the canyon, and most of these isolated floodplain areas are currently irrigated. Within the floor of the canyon, the river does show some migration, side channel formation, and habitat complexity, although those dynamics are relatively suppressed due to the natural and human-induced confinement.

Because of the moderately dynamic nature of the river and the encroachment by transportation infrastructure, there are over two miles of bank armor in Reach PC20, and about 1,100 feet of that armor was constructed since 2001. All of the armor is on the right bank of the river where the channel is against the railroad line. Over a quarter of the banks are armored.

The primary land use in Reach PC20 is non-irrigated agriculture, although there are 79 acres of ground under sprinkler irrigation, and 115 acres under pivot. All of the irrigation is well out of the Channel Migration Zone (CMZ).

Over 100 acres of wetlands have been mapped in Reach PC20 and there is some minor Russian olive present. All of the wetlands are in the active river corridor, on low surfaces that host emergent and scrub/shrub wetland types.

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 relatively small 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 1,730 cfs to 1,570 cfs with human development, a reduction of 9.3 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 PC20 include:

- Corridor confinement by transportation infrastructure.
- Agricultural development and irrigation of historic floodplain area that has become isolated from the river by transportation infrastructure.

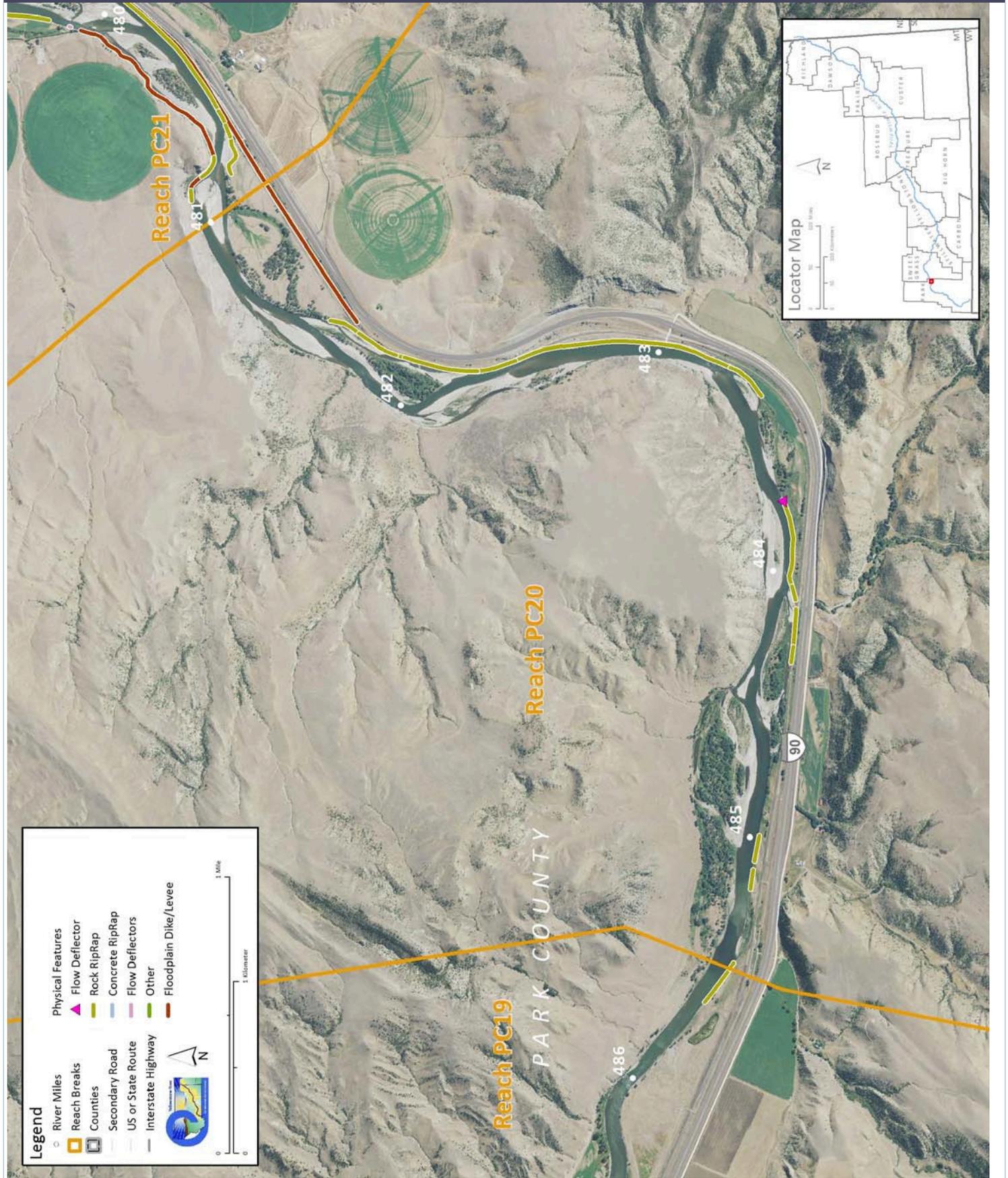
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach PC20 include:

- CMZ Management due to current restriction of 11 percent of the Channel Migration Zone
- Bank Stabilization Recommended due to 27 percent of banks being armored in reach

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.

<b>Discharge</b>	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)	22,400	22,000	-1.8%			
100 Year (cfs)	41,800	41,600	-0.5%			
<b>Bankfull Channel Area (Ac)</b>	1950	1976	1995	2001	1950-2001	Bankful channel area is the total footprint of the river inundated at approx. the 2-year flood.
	230.9			259.5	28.7	
<b>Physical Features</b>	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	12,763	27.0%	1,099			
Concrete Riprap	0	0.0%	0			
Flow Deflectors	56	0.1%	56			
<b>Total</b>	<b>12,819</b>	<b>27.1%</b>	<b>1,155</b>			
<b>Length of Side Channels Blocked (ft)</b>	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	0	0				
<b>Floodplain Turnover</b>	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 Acres/Year Acres/Year/Valley Mile			acres			
<b>Open Bar Area</b>	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)						
<b>Floodplain Isolation</b>	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 100 Year						
<b>Restricted Migration Area</b>	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.			
	66.7	11%				
<b>Land Use</b>	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)	2,165.7	1,987.4	Flood (Ac)	133.5	9.2	
Ag. Infrastructure (Ac)	27.4	71.6	Sprinkler (Ac)	0.0	79.1	
Exurban (Ac)	0.0	0.0	Pivot (Ac)	0.0	114.9	
Urban (Ac)	0.0	0.0				
Transportation (Ac)	81.6	150.5				
<b>1950s Riparian Vegetation Converted to a Developed Land Use (ac)</b>	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.	
<b>National Wetlands Inventory</b>	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	1.0	0.3	<b>111.1</b>			
Emergent	64.3	15.8				
Scrub/Shrub	45.8	11.2				
<b>Russian Olive (2001) (Appx. 100-yr Floodplain)</b>	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.			
	0.2	0.0%				
<b>Riparian Forest at low risk of Cowbird Parasitism (Ac/Valley Mile)</b>	1950	1976	2001	Change 1950-2011	Cowbirds are associated with agricultural and residential development, displacing native bird species by parasitizing their nests.	

## PHYSICAL FEATURES MAP (2011)



## CHANNEL MIGRATION ZONE MAP

