

County	Rosebud	Upstream River Mile	236.3
Classification	PCM/I: Partially confined meandering/islands	Downstream River Mile	225
General Location	Forsyth to Cartersville Bridge	Length	11.30 mi (18.19 km)

Narrative Summary

Reach C11 is located in Rosebud County, just downstream from the community of Forsyth. The reach is an 11.3 mile long Partially Confined Meandering channel type, extending from RM 225.0 to RM 236.3. The partial confinement is imposed by bedrock bluffs south of the river. The floodplain area north of the river has become isolated by about 9 miles of abandoned railroad grade. Rosebud Creek enters the Yellowstone River in the lowermost end of the reach from the south, and Little Porcupine Creek and Horse Creek flow in from the north. The Far West fishing access is located on the north bank at the downstream end of the reach. Reach C11 is relatively dynamic with most erosion and bank migration occurring on the downstream limbs of major meanders.

In Reach C11, the river commonly runs along the southern bluff line that is made up of Cretaceous age Lance Formation and Hell Creek Formation. The BNSF line follows this edge of the valley, and as a result much of the bluff line is armored. According to Womack (2001), the Hell Creek Formation in this area consists of resistant cemented sandstone that forms a 12 foot cap over claystone, which is subject to small slumps on the very steep slope below the rail line, thus driving the need for bank armor. Bank migration is also very active in the reach; at RM 229 for example, the river has migrated almost 700 feet southward since 1950 and is now within 100 feet of the rail line.

As of 2011 there were over 4.5 miles of bank armor protecting about 20 percent of the total bankline in Reach C11, and almost all of that armor is rock riprap protection against the active rail line. Since 2001, about 1,500 feet of flow deflectors have been built in the reach as well to protect irrigated fields on the north bank. Physical features mapping indicates the loss of 500 feet of car bodies between 2001 and 2011 at RM 230.1L where the bank has eroded behind the car bodies which are now up to 70 feet out in the river. A ~500 foot-long stretch of rock riprap on the north side of the river at RM 226.6R is currently protecting flood irrigated land, but is becoming flanked on its upstream end.

Reach C11 has seen major losses of side channels due to small floodplain dikes. Since 1950, 4.3 miles of side channel have been blocked. Three major side channels have dikes blocking them; at RM 232R across from the mouth of Porcupine Creek, at RM 230L below the mouth of Horse Creek, and at RM 229R. All of these channels appear to have good potential for reactivation. There are other older dikes that block swales that could also be potentially reactivated (e.g. RM 234R).

Similar to other reaches downstream of the Bighorn River confluence, the river channel has become smaller in Reach C11 since 1950. In 2001, the bankfull footprint was about 130 acres smaller than it was in 1950, and riparian mapping shows over 200 acres of riparian encroachment into old channel areas. Floodplain turnover rates are also lower; from 1950-1975 the average annual rate of floodplain turnover was 9.3 acres per year, and since 1975 it has been 6.4 acres per year.

On the north side of the river, the abandoned Milwaukee rail line isolates extensive historic floodplain area. At the 100 year event, 767 acres of contiguous area is isolated by the old rail line embankment, accounting for 17 percent of the mapped 100-year floodplain area. Just upstream of the mouth of Horse Creek, however, the river has migrated through the embankment. That erosion through the embankment will continue as the river is actively flanking rock riprap at the mouth of Horse Creek. The active BNSF line also isolates pockets of historic floodplain on the south side of the river.

A total of 328 acres of land that would normally be in the river's natural Channel Migration Zone (CMZ) have become restricted by physical features, which represents about 9 percent of the total CMZ area.

Land uses in Reach C11 are predominantly agricultural, with some conversion from flood irrigation to pivot since 1950. As of 2011 there were about 450 acres under pivot irrigation in the reach, and 76 of those acres are within the 5-year floodplain. Pivot irrigation has also encroached into the CMZ; about 65 acres that were developed for pivot are within the CMZ footprint. This area under pivot is at RM 227.5R, where a large pivot field has been developed in the core of a major meander. Irrigation development included riparian clearing; between 1950 and 2011 about 124 acres of riparian area was cleared for irrigation, which is 8 percent of the total 1950s riparian area.

Reach C11 hosts a relatively dense concentration of wetlands; there are almost 40 acres of wetland per valley mile in the reach, most of which is emergent marshes and wet meadows. There are also 183 acres of mapped Russian olive in the reach, which is distributed throughout the riparian zone and locally concentrated in blocked side channels.

Reach C11 was sampled as part of the fisheries study. A total of 27 species were sampled in the reach, including Sauger and Blue Sucker, both of which have been identified as Species of Concern by the Montana Natural Heritage Program.

Reach C11 was also sampled as part of the avian study. A total of 42 bird species were identified in the reach, including three Species of Concern: The Chimney Swift, Ovenbird, and Plumbeous Vireo. Reach C11 has seen a reduction in the extent of riparian forest considered at low risk of cowbird parasitism. In 1950, there were 31.3 acres of such forest per valley mile, and by 2001 that forest extent had dropped to 19.8 acres per valley mile.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been major in this reach. The 2-year flood, which strongly influences overall channel form, has dropped by 24 percent. Low flows have also been impacted; severe low flows described as 7Q10 (the lowest average 7-day flow anticipated every ten years) for summer months has dropped from an estimated 4,820 cfs to 3,060 cfs with human development, a reduction of 37 percent. More typical summer low flows, described as the summer 95% flow duration, have dropped from 6,300 cfs

under unregulated conditions to 3,370 cfs under regulated conditions, a reduction of 47 percent.

Fall and winter base flows have increased in Reach C11 by about 60 percent.

CEA-Related observations in Reach C11 include:

- Extensive floodplain isolation by the abandoned Milwaukee rail line on the north bank.
- Extensive blocking of side channels
- A regionally high extent of Russian olive possibly associated with the loss of side channels.
- Extensive armoring with CMZ encroachment
- Flanking of car bodies
- Active flanking of riprap

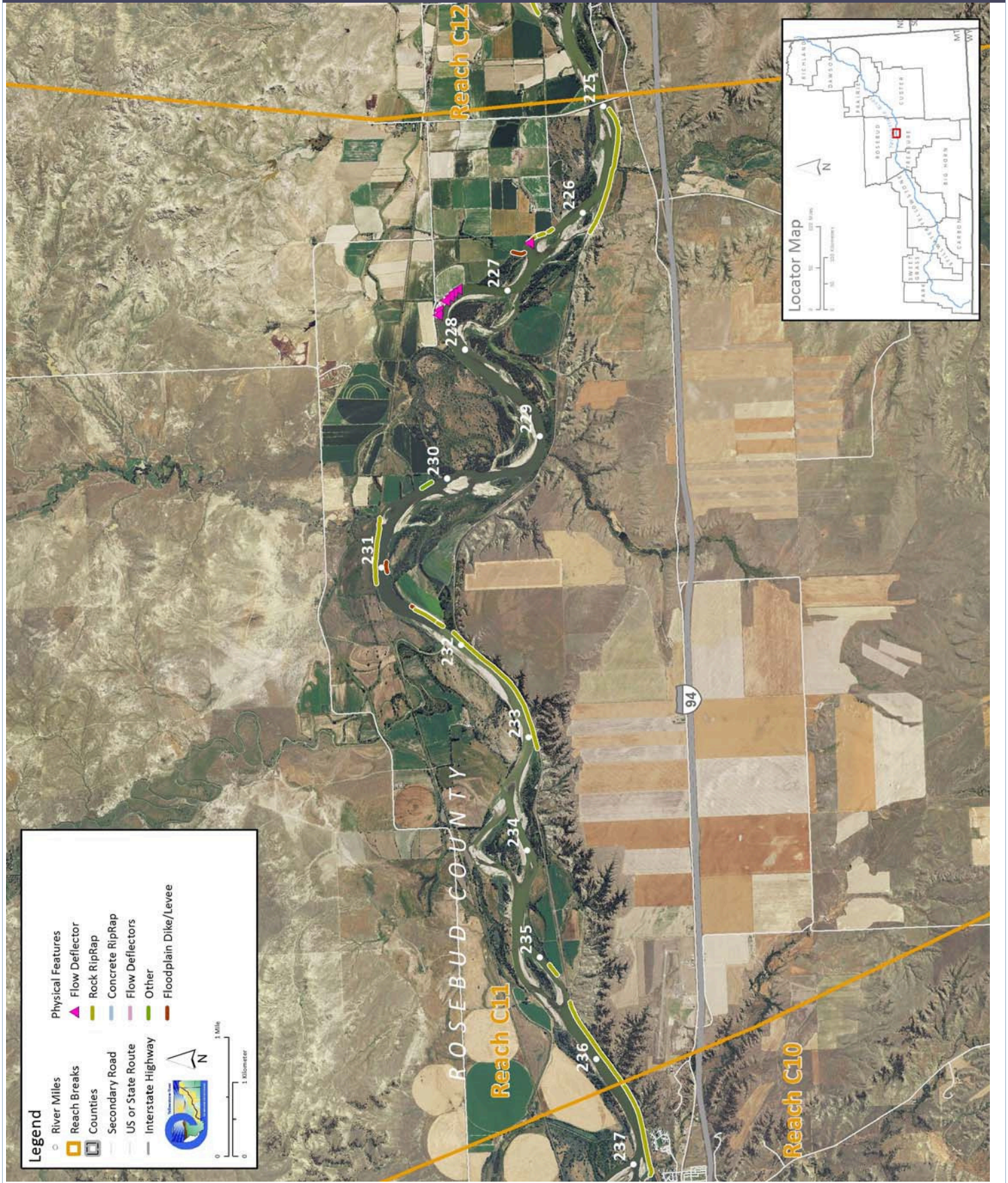
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach C11 include:

- Removal of car bodies in river at RM 230.1L
- Side channel reactivation at RM 232R, RM 230L, and RM 229 R.
- Floodplain reconnection behind abandoned railroad grade RM 231L
- Russian olive removal

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)	61,800	47,200	-23.6%			
100 Year (cfs)	120,000	99,000	-17.5%			
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.
	1,314.1	1,280.1	1,149.5	1,190.3	-123.8	
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	22,607	18.8%	816			
Concrete Riprap	0	0.0%	0			
Flow Deflectors	1,511	1.3%	1,511			
Total	24,118	20.1%	2,328			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	0	22,745				
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	241.5	159.1				
Acres/Year	9.3	6.4				
Acres/Year/Valley Mile	1.1	0.7	211.61 acres			
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)	-50.3	41.6	44.5	35.9		
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	1,289.7	51%				
100 Year	1,123.9	25%				
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.			
	328.1	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)	8,045.7	8,737.7	Flood (Ac)	3,056.3	2,655.9	
Ag. Infrastructure (Ac)	67.8	86.7	Sprinkler (Ac)	0.0	0.0	
Exurban (Ac)	0.0	0.0	Pivot (Ac)	0.0	451.4	
Urban (Ac)	2.0	2.0				
Transportation (Ac)	148.6	123.6				
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.	
	123.5	1.7	125.1	8.0%		
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	51.2	5.8	356.8			
Emergent	230.5	26.1				
Scrub/Shrub	75.1	8.5				
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.			
	182.6	2.3%				
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.	
	31.3	22.5	19.8	-11.5		

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP

