

County	Sweet Grass	Upstream River Mile	438.5
Classification	UA: Unconfined anabranching	Downstream River Mile	434.7
General Location	Reed Point	Length	3.80 mi (6.12 km)

Narrative Summary

Reach A9 is located in lowermost Sweet Grass County, just upstream of the Sweet Grass/Stillwater county line near Reed Point. The reach is an Unconfined Anabranching reach type. The reach is 3.8 miles long, extending from RM 434.7 to RM 438.5. The lower reach break is the bridge crossing just north of Reed Point. This bridge was originally constructed in 1911 and rebuilt in 2000.

Reach A9 provides an excellent example of a dynamic, largely unmodified Unconfined Anabranching reach type. The stream corridor is typically one half mile wide through the reach, with significant narrowing of that corridor in the downstream direction as the river approaches the bridge at Reed Point. In the uppermost portion of the Reach (RM 437-438.5), the northern valley margin consists of an alluvial fan deposit that is currently irrigated with center pivots. Downstream, the river abuts Cretaceous-age Hell Creek Formation on the northern valley wall, which contains sandstones that tend to form steep cliffs. The reach is characterized by high displacement ratios, extensive split flow and islands, and riparian turnover. Although riparian turnover is evident, the rates of that turnover have gone down in the reach since 1976. Prior to that time (1950-1976), average turnover rates were 5.9 acres per year; from 1976 to 2001 that average rate dropped to 3.6 acres of riparian turnover per year.

Bank armor in Reach A9 consists primarily of 10,000 linear feet of riprap which drapes about 24 percent of the stream bank. About 2,000 feet of that armor was constructed since 2001. This new armor is on the right bank at RM 437.8 where the river was rapidly migrating southward toward the rail line. By the time the bank was armored, the river was within 60 feet of the tracks.

Much of the riprap in Reach A9 is located along the south bank of the river on lower end of the reach where the Yellowstone River approaches the bridge near Reed Point. This bridge marks a major narrowing of the river corridor from about 2,000 feet wide ½ mile upstream of the bridge to 360 feet at the bridge itself. The narrowing is achieved by a ~mile long section of bank armor on the right bank that on its lower end runs due north/south, which is perpendicular to the overall east/west trend of the river. This has caused the river to consolidate into a main thread and abandon an historic side channel just upstream of the bridge at the Indian Fort Fishing Access Site.

Reach A9 has experienced the loss of almost about 3,700 feet of side channel since the 1950s due to dike construction. All of the side channel loss is from one project at the upstream end of the reach, where a side channel was blocked on the north side of the river at RM 438.5.

Even though Reach A9 has experienced some side channel loss, it still supports extensive side channel length. As of 2001 there were 5.1 miles of active side channel in the 3.8 mile long reach. Large islands have persisted in the reach since 1950.

Land use in Reach A9 is predominantly agricultural, although there several hundred acres of non-agricultural uses due to the proximity of the transportation corridor as well as the town of Reed Point. Since 1950, 160 acres of agricultural land have been converted to pivot. A total of 300 acres of developed land are in the Channel Migration Zone. Most of that is in flood irrigation (250 acres), but 40 acres are in transportation. About 13 percent of the CMZ is restricted by physical features.

There is natural gas one pipeline that crosses under the Yellowstone River in Reach A9. It crosses at the upper most end of the reach at RM 438.5 and is consists of a 6 inch pipeline that is owned by Northwestern Energy.

Since 1950, Reach A9 has lost most of its forest that would be considered at low risk of cowbird infestation due to its separation from agricultural infrastructure. In 1950, about 17 acres of forest per valley mile were identified as low risk and by 2001 that forest area had been reduced to 2.5 acres due to development within the reach.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been moderate in this reach. The mean annual flood is estimated to have dropped from 14,000 cfs to 13,300 cfs, a drop of about 5 percent. 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 2,030 cfs to 1,680 cfs with human development, a reduction of 17 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.

The reduction in flows is evident by the contraction of the 5-year floodplain area in Reach A9 by 15 acres, or 6 percent.

CEA-Related observations in Reach A9 include:

- Reduced floodplain turnover rates since 1976
- Approximately 3,700 feet of side channel has been lost due to channel plugging between 1950 and 2011
- Meander belt encroachment at bridge crossing
- Side channel loss as part of armoring at bridge approach

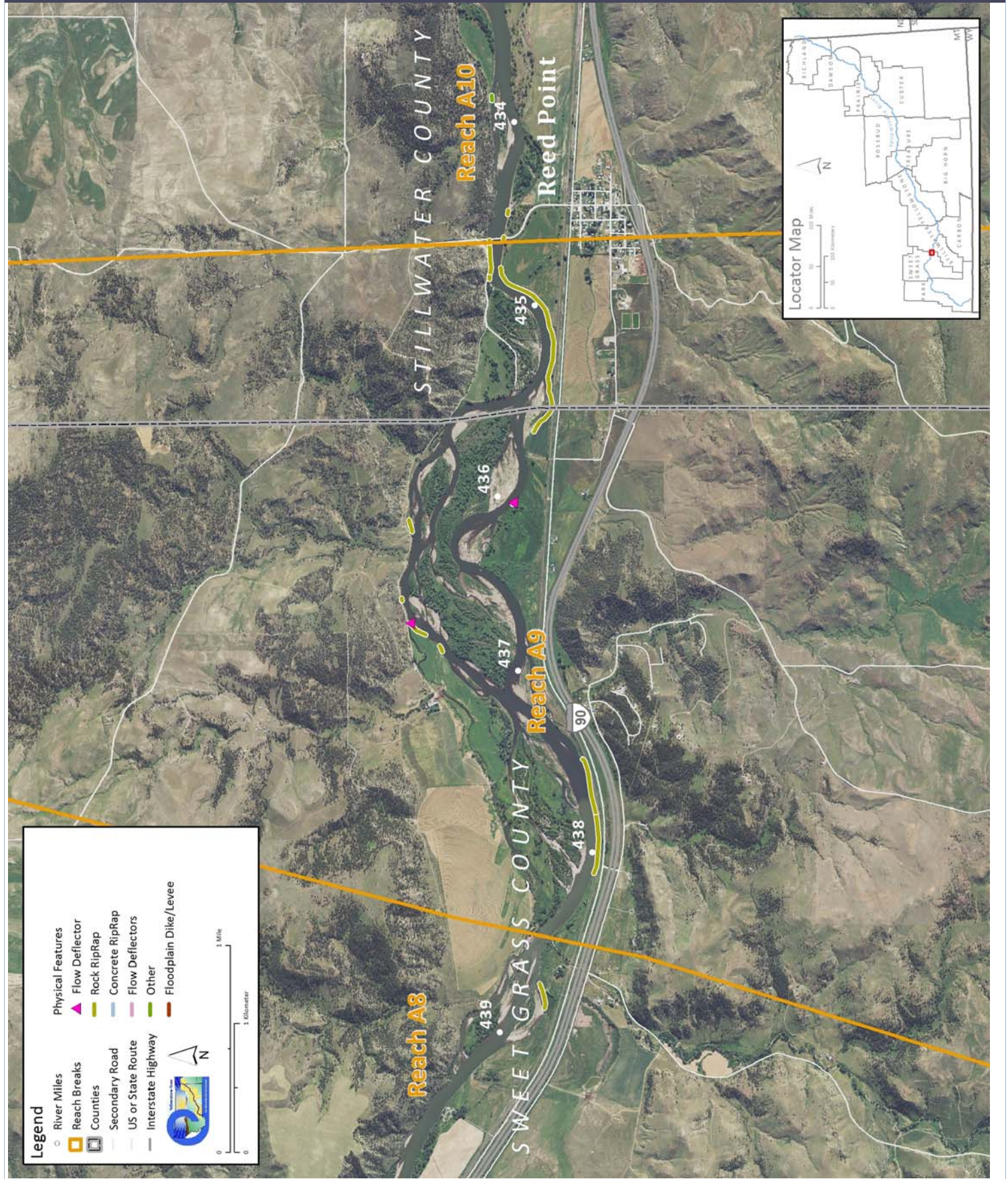
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach A9 include:

- Side channel restoration at RM 438.5
- CMZ management due to extent of CMZ restriction (13 percent)
- Pipeline management for 6-inch natural gas pipeline that crosses under the river at RM 438.5

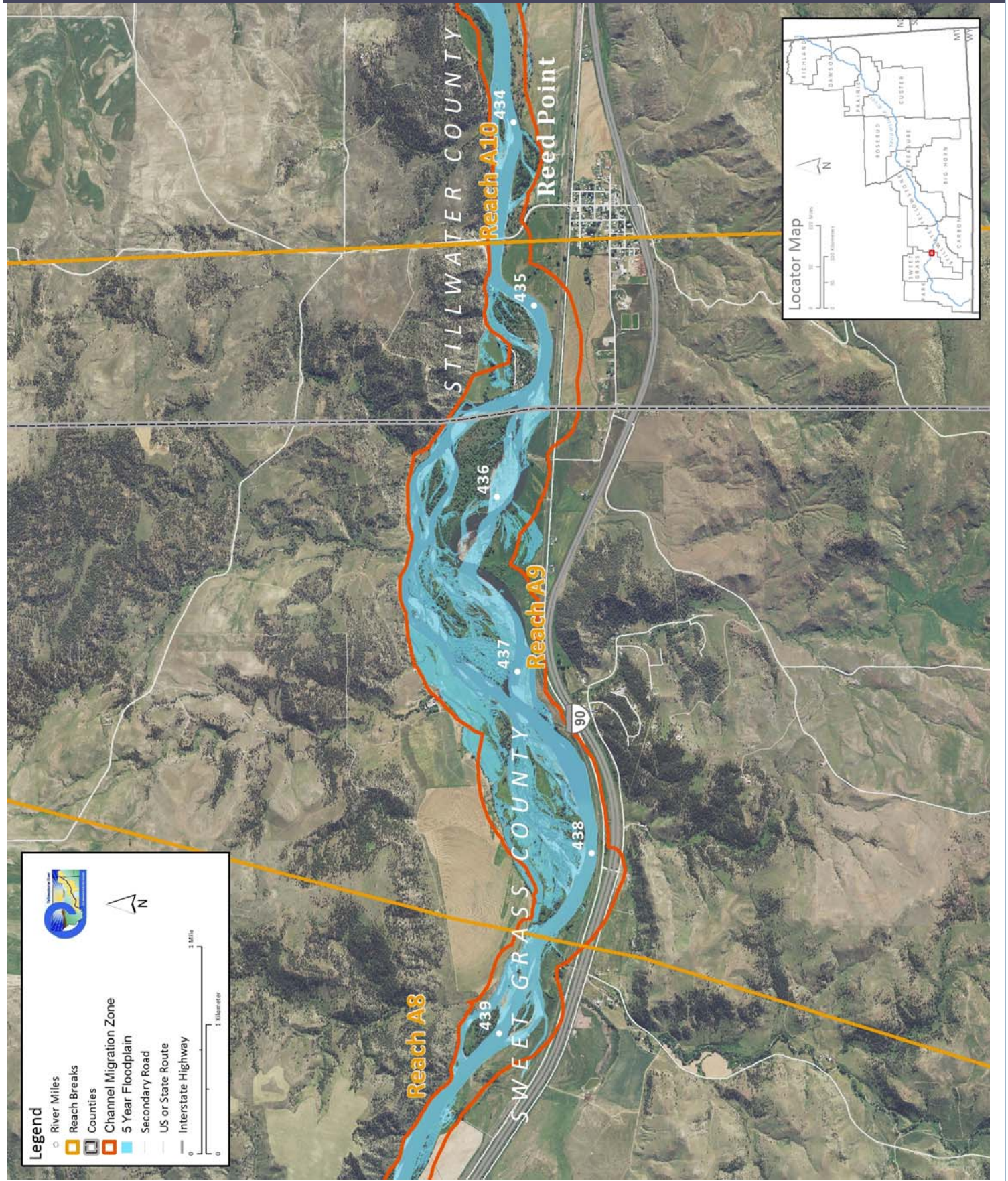
The following table summarizes some key CEA results that have been used to describe overall condition and types of human influences affecting the river. The values are specific to this single reach. Blanks indicate that a particular value was not available for this area. This information is consolidated 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)	27,100	26,300	-3.0%			
100 Year (cfs)	49,900	49,400	-1.0%			
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.
	351.0	420.9	364.2	403.1	52.1	
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	9,898	24.2%	2,012			
Concrete Riprap	0	0.0%	0			
Flow Deflectors	107	0.3%	107			
Total	10,005	24.4%	2,119			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	0	3,717				
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	154.6	90.0				
Acres/Year	5.9	3.6				
Acres/Year/Valley Mile	1.8	1.1	45.11 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)						
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	14.9	6%				
100 Year	19.0	4%				
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.			
	150.9	13%				
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)	2,009.3	1,760.1	Flood (Ac)	462.8	450.6	
Ag. Infrastructure (Ac)	27.7	26.9	Sprinkler (Ac)	0.0	0.0	
Exurban (Ac)	0.0	67.4	Pivot (Ac)	0.0	163.4	
Urban (Ac)	15.6	48.0				
Transportation (Ac)	54.4	169.1				
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.	
	16.2	0.0	16.2	5.0%		
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	9.8	2.9	73.2			
Emergent	32.5	9.7				
Scrub/Shrub	30.9	9.2				
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.			
	0.1	0.0%				
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.	
	16.6	2.1	2.5	-14.2		

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP



County	Stillwater	Upstream River Mile	434.7
Classification	PCS: Partially confined straight	Downstream River Mile	430.3
General Location	Reed Point	Length	4.40 mi (7.08 km)

Narrative Summary

Reach A10 is 4.4 miles long and begins at Reed Point. The reach is a Partially Confined Straight (PCS) reach type, indicating valley wall influences and minimal meandering. The river flows closely along the north valley wall sandstones of the Hell Creek Formation. Migration activity to the south off of the valley wall has been limited and relatively slow, resulting in a fairly narrow Channel Migration Zone and relatively little bank armor. There is only 500 feet of bank armor in the reach, which protects less than 2 percent of the bankline.

No side channels have been physically blocked in Reach A10, however there still has been a net loss of almost 2 miles of side channel length since 1950. This is in part due to the loss of a several thousand foot side channel on the south side of the corridor at RM 431. The entrance to the side channel is just downstream of a series of flow deflectors that appear to have contributed to aggradation at the entrance to the side channel.

Riparian mapping in Reach A10 shows a reduction in total acreage of closed timber from 222 acres in 1950 to 155 acres in 2001.

One of the most evident impacts in Reach A10 is floodplain isolation. Due to the transportation encroachment into the reach by the rail line, approximately 30 percent of the 100 year floodplain has become isolated from the river.

Land use in Reach A10 is predominantly agricultural, although there several hundred acres of non-agricultural uses due to the proximity of the transportation corridor as well as the town of Reed Point. All of the irrigated land is in flood. A total of 163 acres of developed land are in the Channel Migration Zone. Almost all of that ground is in flood irrigation. Less than 1 percent of the CMZ is restricted by physical features.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been moderate in this reach. The mean annual flood is estimated to have dropped from 14,000 cfs to 13,300 cfs, a drop of about 5 percent. 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 2,060 cfs to 1,690 cfs with human development, a reduction of 18 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 A10 include:

- Passive loss of anabranching channels, some potentially correlated to flow deflectors
- Floodplain isolation by active rail line.

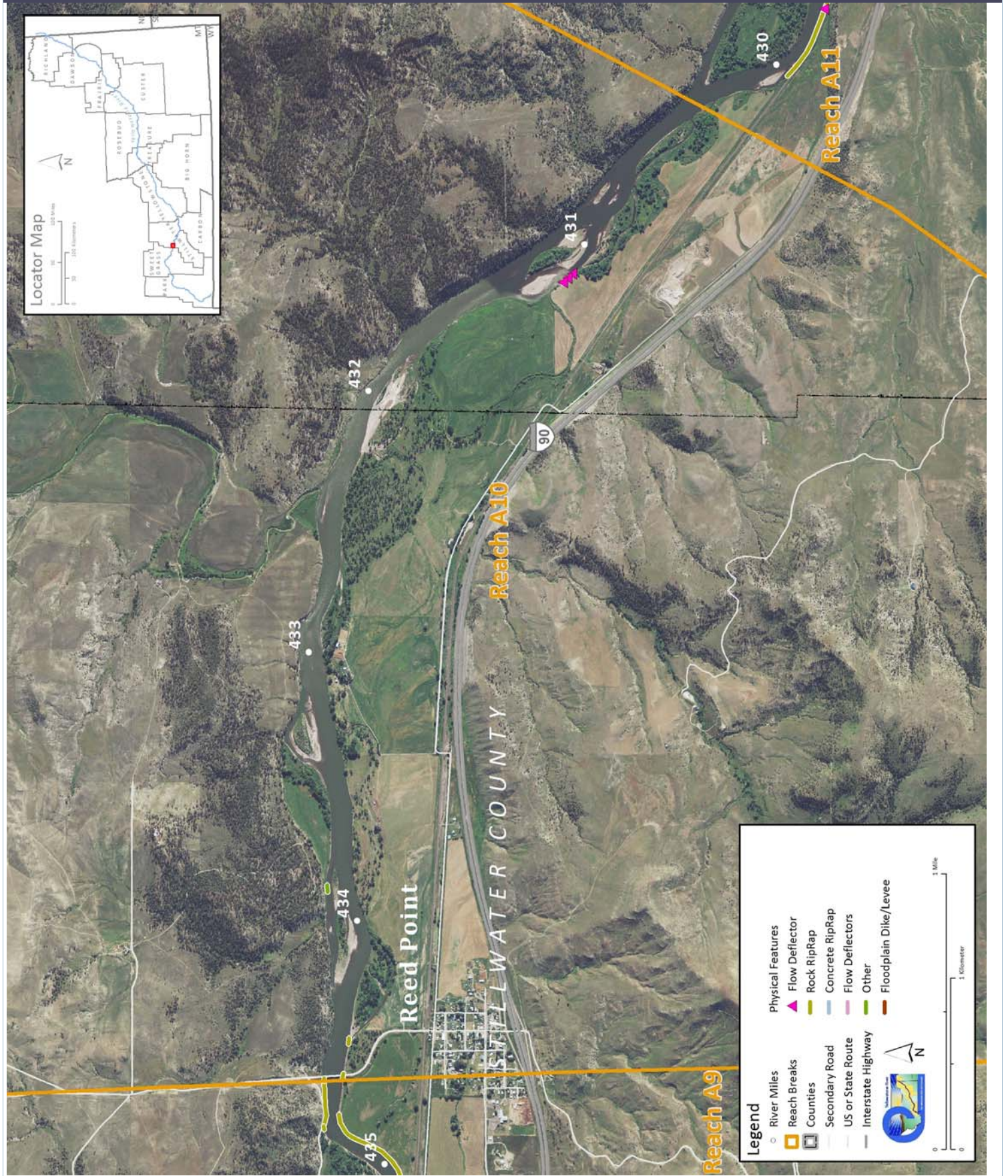
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach A10 include:

- Floodplain restoration/reconnection behind rail line at RM 430.1
- Side channel restoration at RM 431

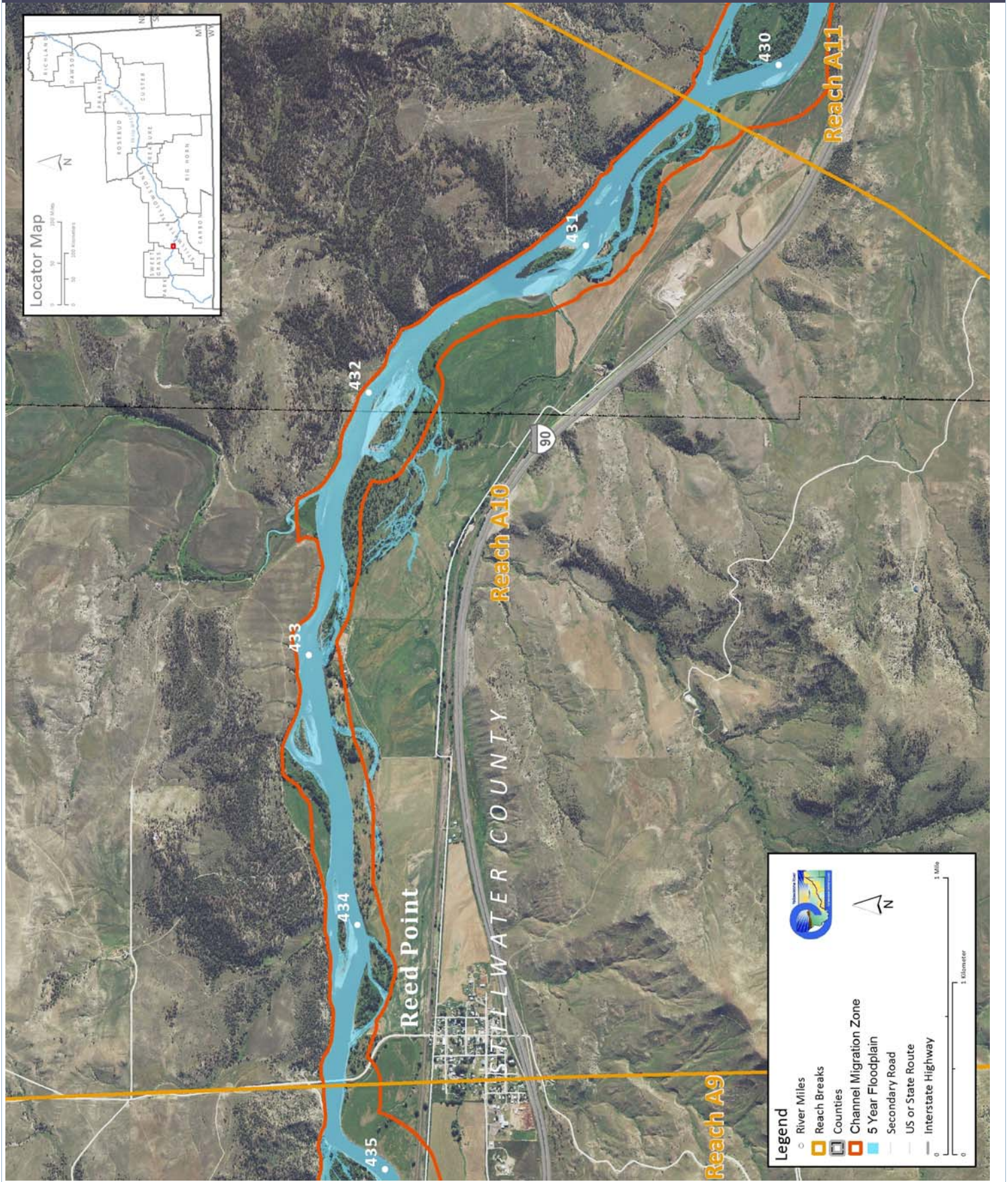
The following table summarizes some key CEA results that have been used to describe overall condition and types of human influences affecting the river. The values are specific to this single reach. Blanks indicate that a particular value was not available for this area. This information is consolidated 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)	27,100	26,300	-3.0%			
100 Year (cfs)	49,900	49,400	-1.0%			
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.
	255.8	268.7	286.2	290.6	34.8	
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	270	0.6%	82			
Concrete Riprap	0	0.0%	0			
Flow Deflectors	255	0.6%	255			
Total	525	1.2%	338			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	0	0				
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	44.4	45.1				
Acres/Year	1.7	1.8				
Acres/Year/Valley Mile	0.4	0.4	-2.51 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)						
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	8.4	22%				
100 Year	191.5	30%				
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.			
	6.1	1%				
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)	2,550.7	2,370.7	Flood (Ac)	636.2	597.4	
Ag. Infrastructure (Ac)	23.4	27.9	Sprinkler (Ac)	0.0	0.0	
Exurban (Ac)	0.0	30.0	Pivot (Ac)	0.0	0.0	
Urban (Ac)	46.2	56.4				
Transportation (Ac)	55.1	158.2				
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.	
	4.3	1.1	5.4	2.0%		
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	0.3	0.1	22.6			
Emergent	15.9	3.9				
Scrub/Shrub	6.4	1.6				
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.			
	0.0	0.0%				
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.	
	3.9	2.6	2.7	-1.3		

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP



County	Stillwater	Upstream River Mile	430.3
Classification	PCB: Partially confined braided	Downstream River Mile	423.3
General Location	I-90 bridge crossing	Length	7.00 mi (11.27 km)

Narrative Summary

Reach A11 is seven miles long and is located at the I-90 Bridge crossing below Reed Point. The reach is a Partially Confined Braided (PCB) reach type, indicating valley wall influences and relatively extensive open gravel bars and small islands. The valley is relatively narrow in this reach, and the river swings from the north valley wall upstream of the bridge to the south valley wall downstream. The valley wall consists of erosion-resistant sandstone cliffs of the Hell Creek Formation. The river has been extremely dynamic in this reach, and over a thousand feet of bank armor has been flanked since 2001. Since 1950, numerous areas have experienced over 500 feet of bank movement.

Similar to other reaches in Region A, the overall footprint of the river channel has increased in size since 1950. In 1950, the channel footprint was 451 acres but by 2001 it had expanded to 567 acres.

About 13 percent of the banks in Reach A11 are armored, with the majority of that armor being rock riprap. Between 2001 and 2011, there was a loss of about 1,200 feet of armor in the reach. Rock riprap was eroded out from the left (north) bank at RM 424.5, where the river flanked about a thousand feet of rock between 2005 and 2011. Since that time, the river has migrated at least 250 feet behind the armor. At least one flow deflector was lost on the same bankline just upstream. About 320 feet of the lost bank protection was flow deflectors.

Over a mile of side channels have been physically blocked in Reach A11 since 1950. The loss has occurred at RM 424, where a road/field dike crosses the old side channel at two locations.

Land use in Reach A11 is predominantly agricultural, although there several hundred acres of transportation-related use associated with I-90 and the rail line. All of the irrigated land is in under flood irrigation. A total of 210 acres of developed land are in the Channel Migration Zone. Almost all of that ground is in flood irrigation, and about 50 acres of the transportation corridor are within the CMZ. About 17 percent of the CMZ is isolated by physical features.

There is one diversion structure on the right bank at RM 428.3 that feeds the Merrill Columbus Ditch. The diversion is located just downstream of the railroad and county road bridges, which are about 2,100 feet upstream of the I-90 Bridge.

There is one dump site mapped in Reach A11 at RM 425.8.

Riparian mapping in Reach A11 shows a reduction in total acreage of closed timber from 400 acres in 1950 to 230 acres in 2001. Similarly, the extent of mapped shrubs dropped from 170 acres to 82 acres for the same timeframe.

Reach A11 was sampled as part of the avian study. The average species richness in Reach A11 was 9.6, which indicates the average number of species observed during site visits to the reach in cottonwood habitats. The average species richness for all sites evaluated is 8. One bird Species of Concern (SOC), the Bobolink, was identified in the reach. One bird species identified by the Montana Natural Heritage Program as a Potential Species of Concern (PSOC), the Ovenbird, was also found.

Since 1950, Reach A11 has lost most of its forest that would be considered at low risk of cowbird infestation due to its separation from agricultural infrastructure. In 1950, about 35 acres of forest per valley mile were identified as low risk and by 2001 that forest area had been reduced to 13 acres due to development within the reach.

Reach A11 marks a distinct jump in the extent of Russian olive present in the river corridor. The reach has approximately 2.3 acres of mapped Russian olive, which is most concentrated in the vicinity of the bridges.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been moderate in this reach. The mean annual flood is estimated to have dropped from 14,200 cfs to 13,400 cfs, a drop of about 6 percent. 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 2,070 cfs to 1,690 cfs with human development, a reduction of 18 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 A11 include:

- Accelerated erosion behind 1,000 feet of flanked rock riprap.
- Blockage of several thousand feet of side channel
- At least one flanked barb
- Expansion of Russian olive infestation relative to upstream.
- Reduction in both closed timber and shrub riparian extent.

Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach A11 include:

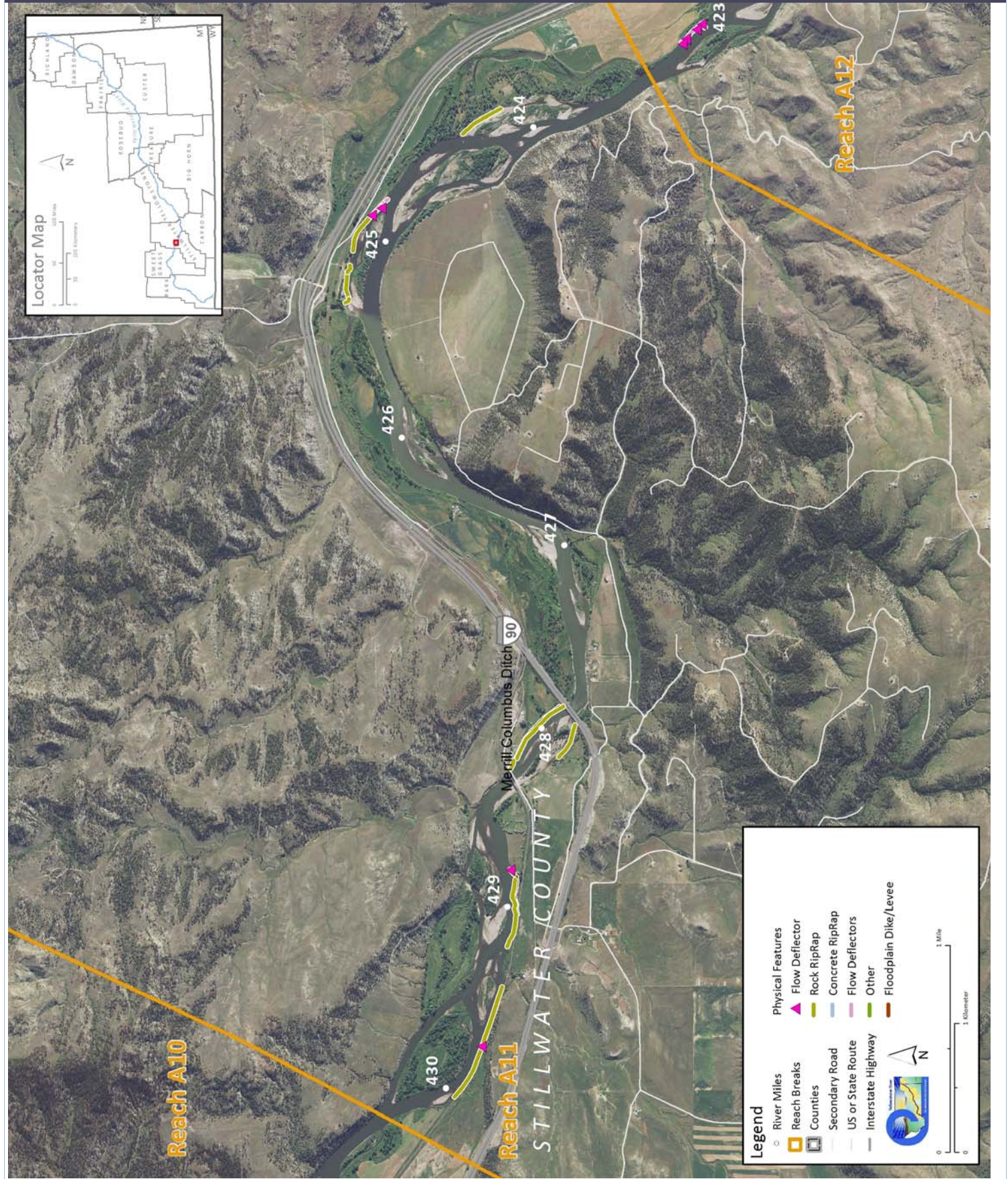
- Floodplain restoration/reconnection behind rail line at RM 430
- Side channel restoration at RM 424

- Bank armor removal at RM 424.5
- CMA management due to extent of CMZ restriction (17 percent)
- Russian olive removal—this is the most upstream reach of major Russian olive colonization
- Solid waste removal from right (south) bank area at RM 425.8
- Irrigation diversion structure management at Merrill Columbus Ditch Diversion at RM 428.3

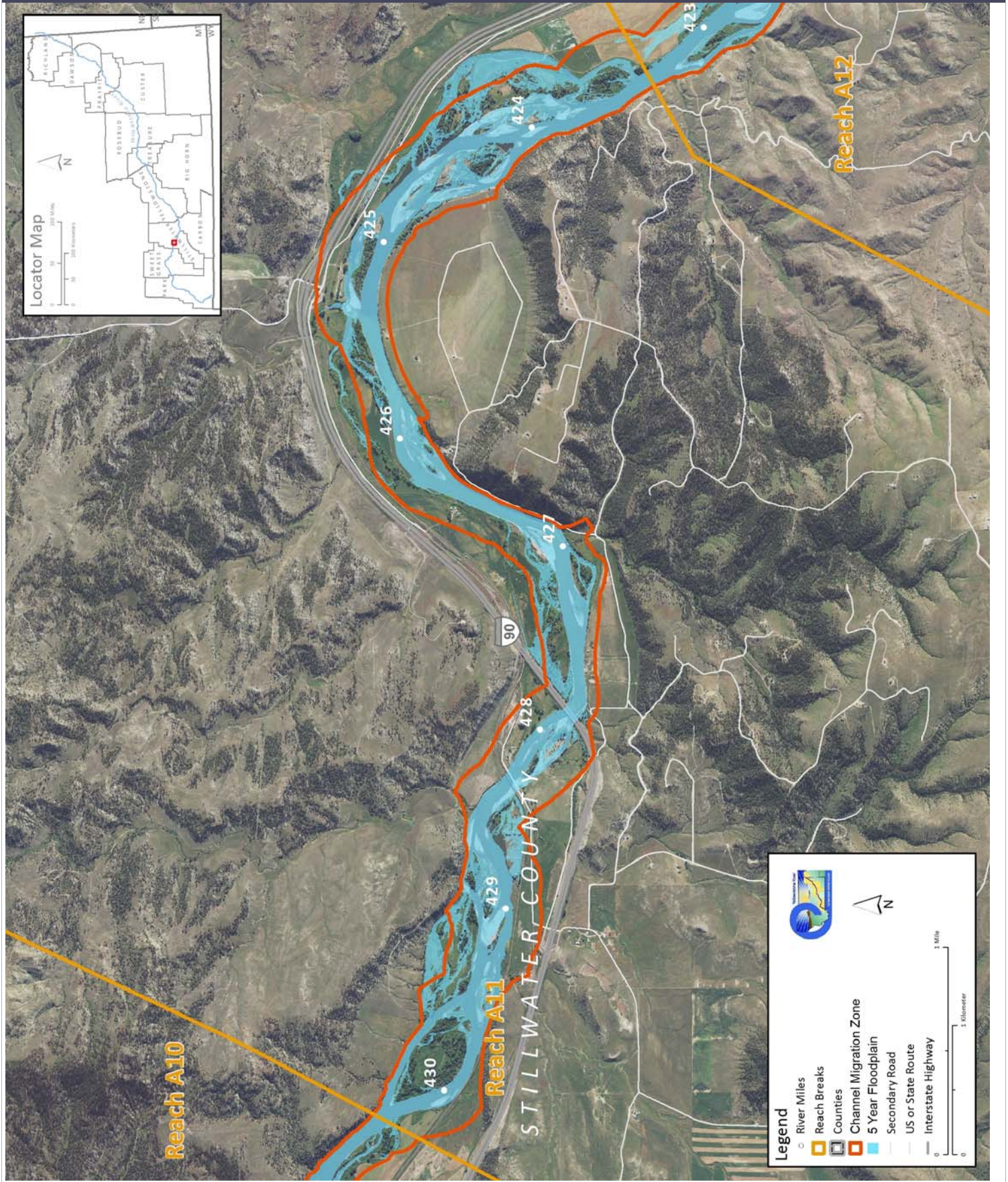
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Discharge	Undev.	Developed	% Change	"Undeveloped" flows represent conditions prior to significant human development, whereas "developed" flows reflect the current condition of both consumptive and non-consumptive water use.		
2 Year (cfs)	27,500	26,700	-2.9%			
100 Year (cfs)	50,600	50,100	-1.0%			
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.
	451.0	492.6	532.9	568.8	117.9	
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	9,701	13.2%	-956			
Concrete Riprap	0	0.0%	0			
Flow Deflectors	286	0.4%	-321			
Total	9,987	13.6%	-1,277			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	0	6,747				
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	135.3	121.7	-65.23 acres			
Acres/Year	5.2	4.9				
Acres/Year/Valley Mile	0.8	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	49.7	21%				
100 Year	38.7	5%				
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.			
	235.8	16%				
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)	2,872.2	2,357.0	Flood (Ac)	351.2	530.6	
Ag. Infrastructure (Ac)	49.4	107.7	Sprinkler (Ac)	0.0	0.0	
Exurban (Ac)	0.0	70.6	Pivot (Ac)	0.0	0.0	
Urban (Ac)	0.0	0.0				
Transportation (Ac)	94.4	326.5				
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.	
	26.6	14.9	41.5	7.0%		
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	20.2	3.2	78.7			
Emergent	28.3	4.6				
Scrub/Shrub	30.2	4.9				
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.			
	2.3	0.1%				
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.	
	34.8	21.2	13.4	-21.4		

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP



County	Stillwater	Upstream River Mile	423.3
Classification	PCB: Partially confined braided	Downstream River Mile	417.3
General Location	To Stillwater confluence	Length	6.00 mi (9.66 km)

Narrative Summary

Reach A12 is seven miles long and is located just upstream of the mouth of the Stillwater River. The reach is a Partially Confined Braided (PCB) reach type, indicating valley wall influences and relatively extensive open gravel bars and small islands. The valley wall consists of erosion-resistant sandstone cliffs of the Hell Creek Formation. The river is confined by the valley wall to the south and by transportation infrastructure to the north. The river has been extremely dynamic in this reach; in some places the banks have migrated over a thousand feet since 1950.

Similar to other reaches in Region A, the overall footprint of the river channel has increased in size since 1950. In 1950, the channel footprint was 434 acres but by 2001 it had expanded to 570 acres.

About 13 percent of the banks in Reach A12 are armored, with the majority of that armor being rock riprap. Between 2001 and 2011, there was a gain of about 1,182 feet of rock riprap and 560 feet of flow deflectors in the reach. At least one flow deflector has been flanked on the right bank just upstream of the Stillwater confluence at RM 418.5. About two miles of transportation encroachments were mapped in Reach A12.

On side channel that is almost four thousand feet long at RM 421 was physically blocked in Reach A12 since 1950. More recently, however, the river has migrated back into the side channel such that the majority of it is now active.

Land use in Reach A12 is predominantly agricultural, although there are several hundred acres of exurban development in the reach. Almost a thousand acres of land is under flood irrigation. A total of 293 acres of developed land are in the Channel Migration Zone. Almost all of that ground is in flood irrigation, although 14 acres are in exurban development and 16 acres are in transportation. About 6 percent of the CMZ is isolated by physical features.

Riparian mapping in Reach A12 shows a reduction in total acreage of open timber from 43 acres in 1950 to 23 acres in 2001.

Reach A12 was sampled as part of the avian study. The average species richness in Reach A12 was 7.6, which indicates the average number of species observed during site visits to the reach in cottonwood habitats. The average species richness for all sites evaluated is 8. One bird species identified by the Montana Natural Heritage Program as Potential Species of Concern (PSOC), the Dickcissel, was identified in the reach.

Since 1950, Reach A12 has lost all of its forest that would be considered at low risk of cowbird infestation due to its separation from agricultural infrastructure. In 1950, about 4 acres of forest per valley mile were identified as low risk and by 2001 that forest area had been reduced to zero.

Reach A12 has approximately 3 acres of mapped Russian olive, which is most concentrated on the north side of the river on the banks of the main channel, side channels, and sloughs.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been moderate in this reach. The mean annual flood is estimated to have dropped from 14,400 cfs to 13,600 cfs, a drop of about 6 percent. 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 2,080 cfs to 1,690 cfs with human development, a reduction of 19 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 A12 include:

- Recapture of previously blocked side channel
- Flanking of barbs

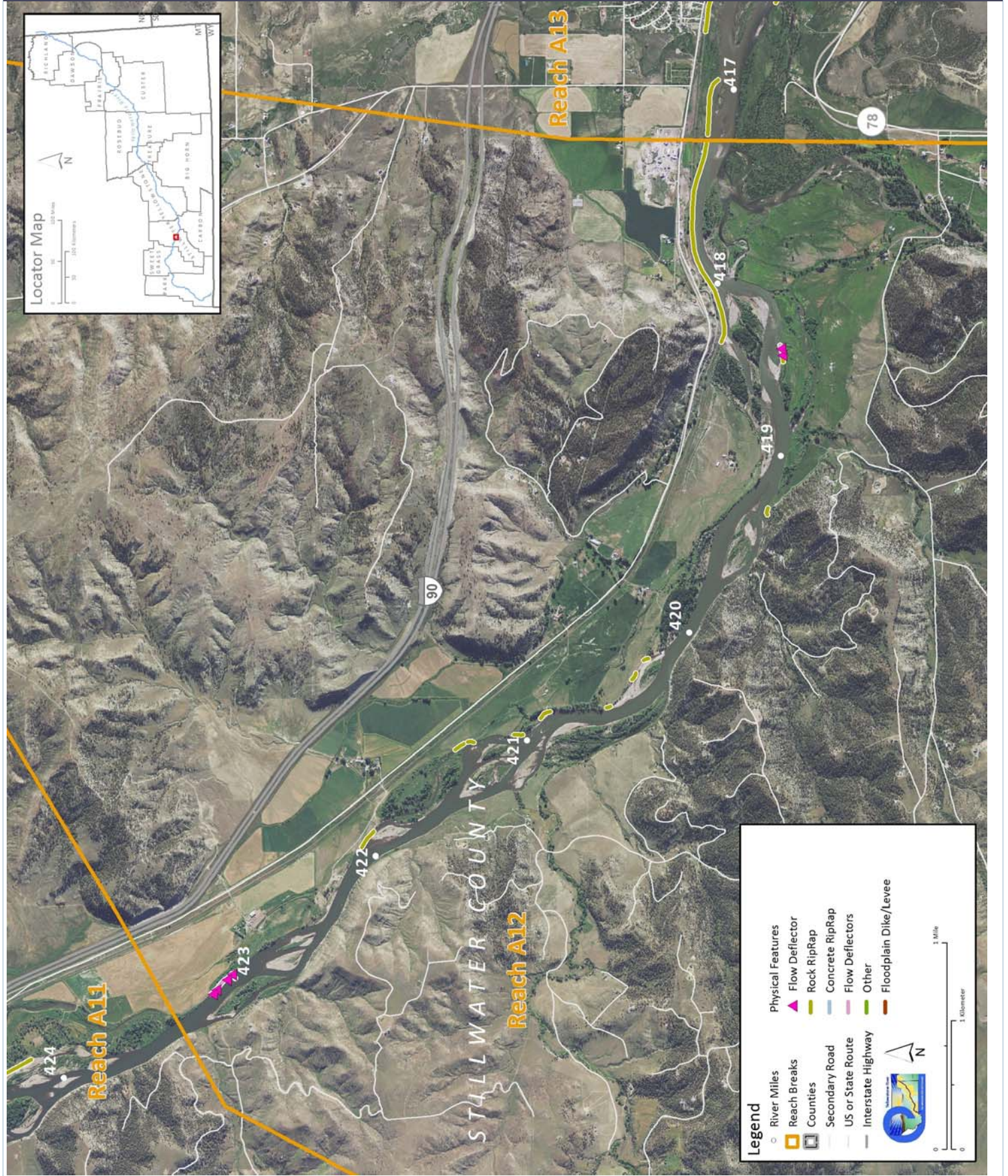
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach A12 include:

- Bank armor removal at RM 418.5
- Russian olive removal (3 acres)

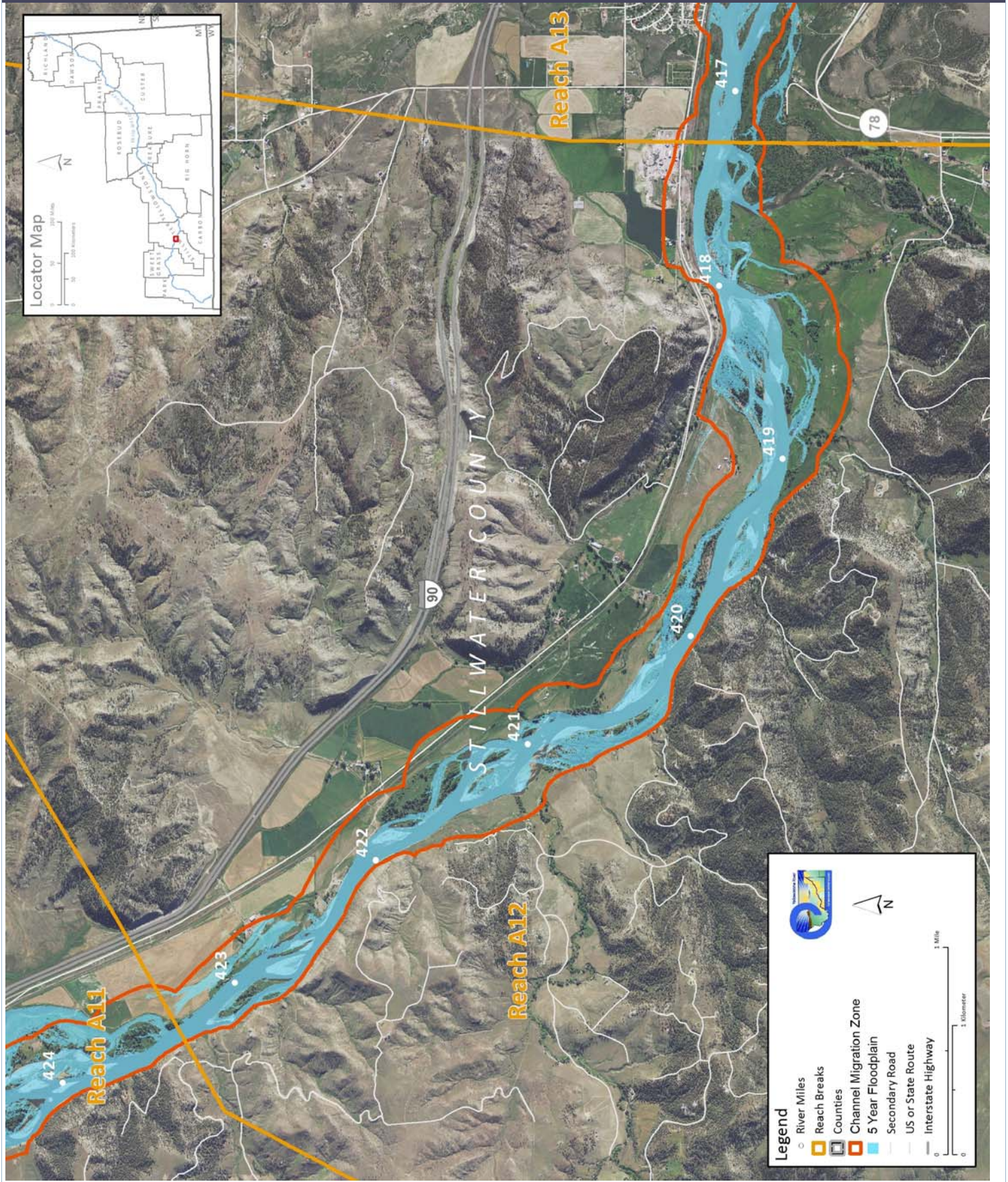
The following table summarizes some key CEA results that have been used to describe overall condition and types of human influences affecting the river. The values are specific to this single reach. Blanks indicate that a particular value was not available for this area. This information is consolidated 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)	27,900	27,000	-3.2%			
100 Year (cfs)	51,300	50,800	-1.0%			
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.
	434.2	466.7	457.0	569.8	135.6	
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	7,315	11.4%	1,182			
Concrete Riprap	0	0.0%	0			
Flow Deflectors	855	1.3%	556			
Total	8,170	12.7%	1,739			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	0	3,771				
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	134.0	158.7	-12.71 acres			
Acres/Year	5.2	6.3				
Acres/Year/Valley Mile	0.9	1.1				
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	14.0	14%				
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.			
	91.1	6%				
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)	3,331.1	2,990.0	Flood (Ac)	1,201.2	979.6	
Ag. Infrastructure (Ac)	60.8	79.4	Sprinkler (Ac)	0.0	0.0	
Exurban (Ac)	6.5	143.3	Pivot (Ac)	0.0	1.4	
Urban (Ac)	0.0	0.0				
Transportation (Ac)	70.2	96.2				
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.	
	5.3	0.0	5.3	2.0%		
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	5.7	1.0	130.4			
Emergent	55.5	9.9				
Scrub/Shrub	69.1	12.3				
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.			
	2.9	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.	
	4.1	0.0	0.0	-4.1		

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP



County	Stillwater	Upstream River Mile	417.3
Classification	PCA: Partially confined anabranching	Downstream River Mile	413.7
General Location	Columbus	Length	3.60 mi (5.79 km)

Narrative Summary

Reach A13 is 3.6 miles long and is located at Columbus. The reach is a Partially Confined Anabranching (PCA) reach type, indicating some valley wall influence and relatively extensive forested islands. Reach A13 marks an abrupt widening in the river valley as the erosion resistant sandstone cliffs of the Hell Creek Formation transition downstream into the more erodible Bearpaw Shale. The reach is urbanized with most development concentrated on the north side of the river. Migration rates since 1950 have been moderate in this reach largely due to extensive bank armoring.

Similar to other reaches in Region A, the overall footprint of the river channel has increased in size since 1950. In 1950, the channel footprint was 258 acres but by 2001 it had expanded to 327 acres. This was accompanied by a net loss of about 40 acres of riparian area to channel during that same timeframe.

About 28 percent of the banks in Reach A13 are armored, with the majority of that armor being rock riprap. Reach A13 has almost 3,000 feet of concrete riprap, reflecting an abrupt increase in the use of concrete as armor relative to upstream. The concrete is on the north bank of the river just upstream of the Columbus Bridge. Between 2001 and 2011, there was a gain of about 2,800 feet of rock riprap in the reach; most of this was on the north side of the river adjacent to town.

Land use in Reach A13 is predominantly agricultural, although there are over 600 acres of exurban/exurban development within the mapping footprint. Approximately one half of the agricultural land is in flood irrigation (600 acres). No other types of irrigation were mapped in the reach. A total of 133 acres of developed land are in the Channel Migration Zone, and about half of that is in urban/exurban development. About 13 percent of the CMZ is isolated by physical features, most of which is armor protecting the railroad in Columbus.

About 18 percent of the historic 100-year floodplain has become isolated from the river due primarily to the downstream shadow caused by the Columbus Bridge embankment on the north side of the river.

There is one pipeline crossing in Reach A13, a natural gas crossing called the Lake Basin-Absarokee Line owned by NW energy. The pipeline crosses the river at RM 417.

One ice jam has been recorded in this reach. On February 6, 1996, an ice jam break-up was reported to cause local flooding.

There are corrals that are part of an animal handling facility in the reach, north of the river at RM 414.

Riparian mapping in Reach A13 shows a reduction of about 50 acres of closed timber in the reach since 1950.

Reach A13 has approximately 5 acres of mapped Russian olive, which is spread out both within the riparian corridor and through the town of Columbus. There are also over 100 acres of mapped wetland in the reach, most of which is emergent marshes and wet meadows.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been moderate in this reach. The mean annual flood is estimated to have dropped from 14,400 cfs to 13,600 cfs, a drop of about 6 percent. 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 2,270 cfs to 1,760 cfs with human development, a reduction of 22 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 A13 include:

- A jump in the use of concrete armor relative to upstream
- Armoring associated with urbanization
- Urban/Exurban development in CMZ

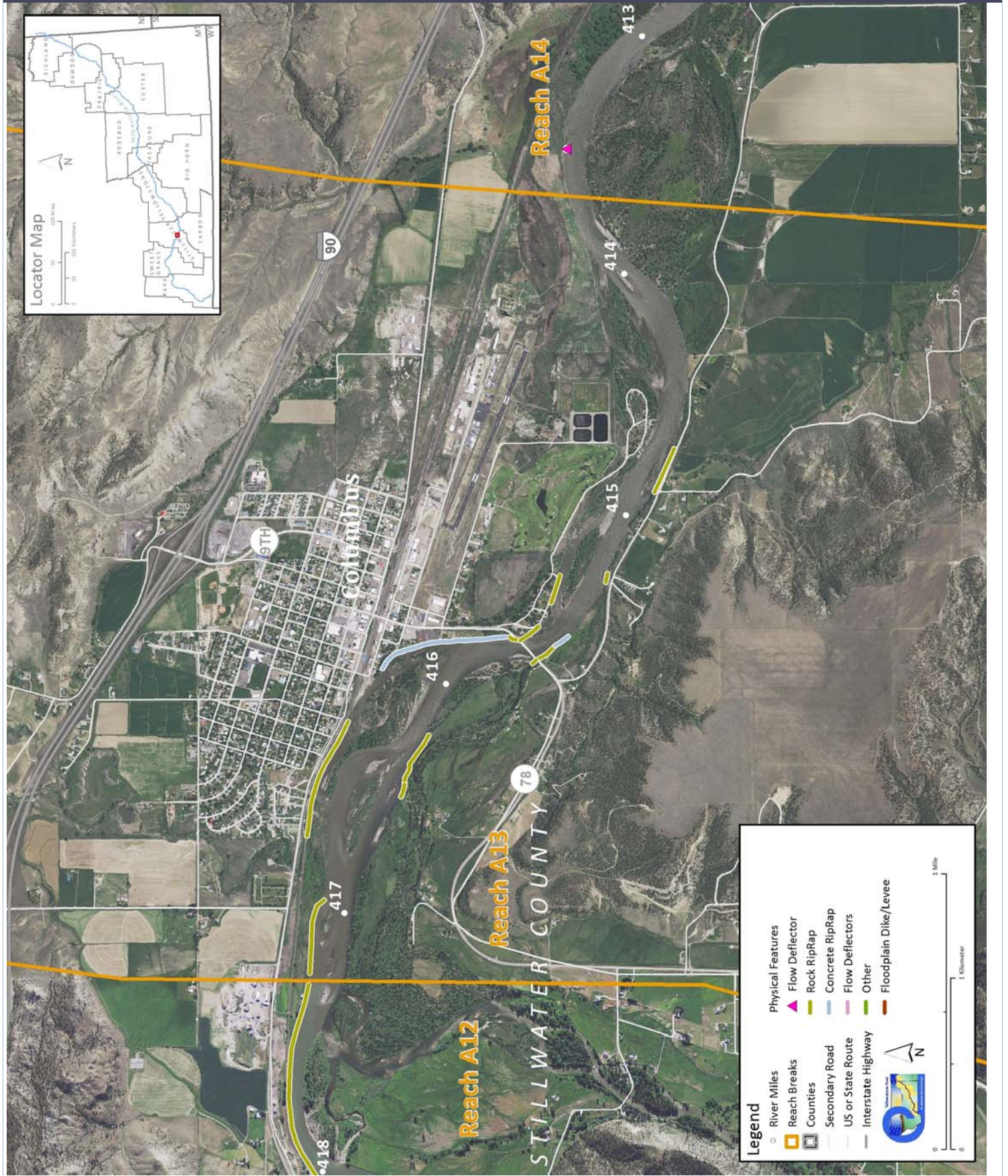
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach A13 include:

- CMZ management at Columbus due to high level of encroachment
- Nutrient management at corrals at RM 414
- Bank Stabilization Recommended Practices due to extent of armoring in reach (28 percent)
- Russian olive removal (5 acres)
- Pipeline management (natural gas) for main river crossing at RM 417
- Wetland restoration/management due to extent of mapped wetland (110 acres)

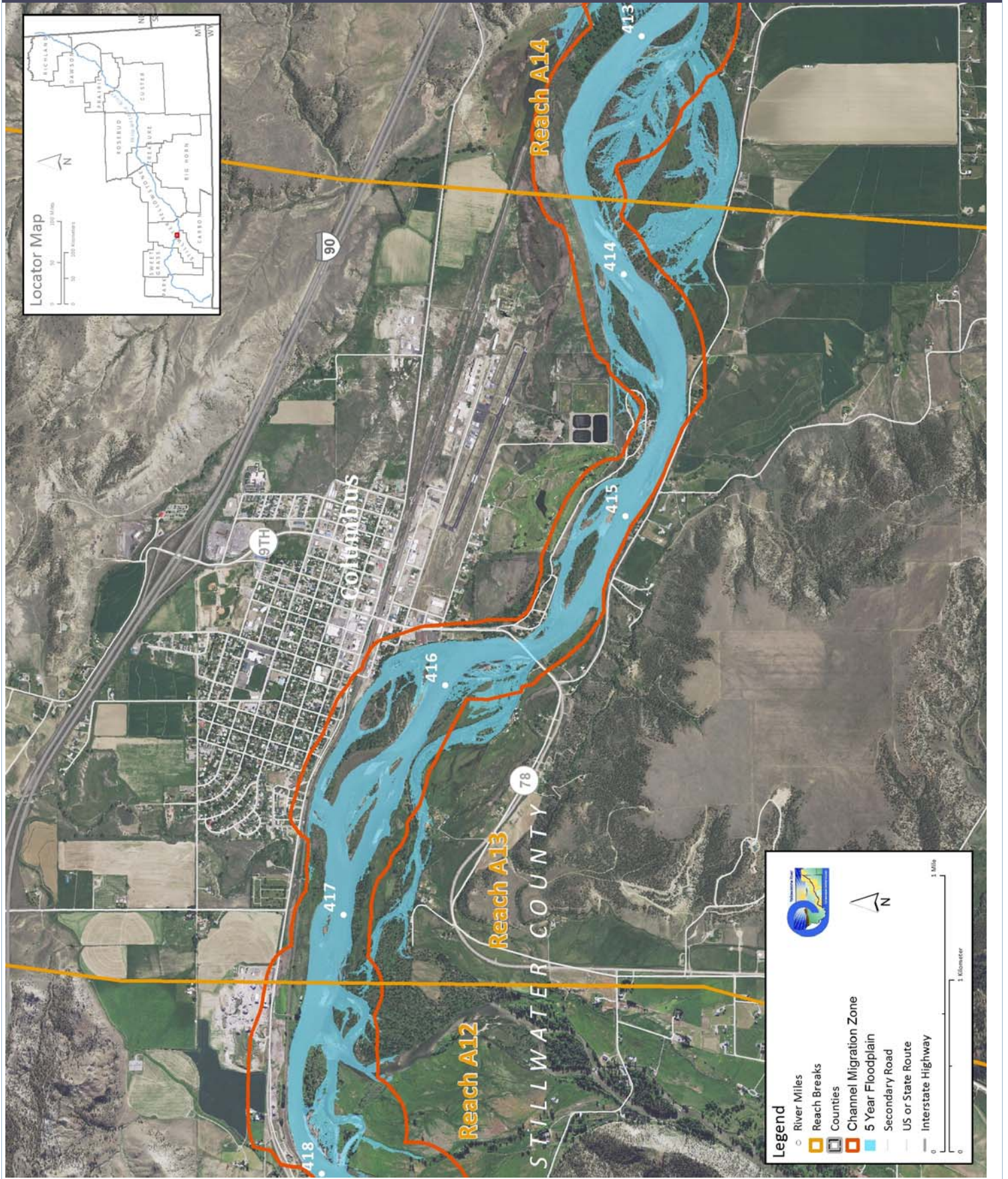
The following table summarizes some key CEA results that have been used to describe overall condition and types of human influences affecting the river. The values are specific to this single reach. Blanks indicate that a particular value was not available for this area. This information is consolidated 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)	31,000	29,800	-3.9%			
100 Year (cfs)	56,600	55,900	-1.2%			
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.
	258.2	280.0	301.0	326.6	68.4	
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	7,874	20.7%	2,783			
Concrete Riprap	2,837	7.5%	0			
Flow Deflectors	0	0.0%	0			
Total	10,711	28.2%	2,783			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	0	0				
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	65.5	62.6	-38.55 acres			
Acres/Year	2.5	2.5				
Acres/Year/Valley Mile	0.8	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	11.1	13%				
100 Year	71.7	18%				
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.			
	100.8	13%				
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)	1,778.1	1,332.0	Flood (Ac)	686.0	599.0	
Ag. Infrastructure (Ac)	43.8	79.2	Sprinkler (Ac)	0.0	0.0	
Exurban (Ac)	13.1	245.8	Pivot (Ac)	0.0	0.0	
Urban (Ac)	270.5	384.9				
Transportation (Ac)	68.1	66.5				
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.	
	18.9	36.7	55.6	14.0%		
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	18.1	5.7	110.1			
Emergent	75.8	23.8				
Scrub/Shrub	16.2	5.1				
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.			
	5.0	1.1%				
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)



CHANNEL MIGRATION ZONE MAP



County	Stillwater	Upstream River Mile	413.7
Classification	PCA: Partially confined anabranching	Downstream River Mile	405.9
General Location	Below Columbus	Length	7.80 mi (12.55 km)

Narrative Summary

Reach A14 is located in Stillwater County, just downstream of Columbus. The reach is a Partially Confined Anabranching (PCA) reach type, reflecting some valley while influence coupled with relatively extensive forested islands. The reach is 7.8 miles long, extending from RM 405.9 to RM 413.7. The partial geologic confinement within Reach A14 is created by interbedded sandstone and shale of the Cretaceous-age Judith River Formation that intermittently forms the active channel margin on either its right or left bank. The Parkman Sandstone, a massive cliff-forming unit within the Judith River Formation, forms cliffs against the channel that are commonly over 150 feet high.

Similar to other reaches in Region A, the overall footprint of the river channel has increased in size since 1950. In 1950, the channel footprint was 637 acres but by 2001 it had expanded to 728 acres. This was accompanied by a net loss of about 32 acres of riparian area to channel during that same timeframe.

Approximately 16 percent of the bankline in Reach A14 is armored, and the armor is almost entirely rock riprap, with a very short section of flow deflectors. The armor is located almost entirely on the northern corridor margin, where transportation infrastructure (mainly railroad) follows the edge of the valley.

Over three miles of side channels have been blocked in Reach A14, with about half of the blockages occurring prior to 1950 and half after. The losses occurred on two distinct channels, one at RM 410 on the south side of the corridor and one at RM 407 on the north side.

Land use in Reach A14 is almost entirely agricultural, with almost 260 acres mapped as agricultural infrastructure. This in part reflects corrals that are part of an animal handling facility on the north side of the river at RM 409. There are 1,300 acres under flood irrigation in the reach, and 144 acres in pivot. A total of 227 acres of developed land are in the Channel Migration Zone, most of that is in flood irrigation (215 acres). Less than 2 percent of the CMZ is isolated by physical features, all of which is behind the armored rail line on the north side of the river.

There is one major diversion in Reach A14; Cove Ditch diverts water from the north bank at RM 410.

Reach A14 was sampled as part of the avian study. The average species richness in Reach A14 was 7.9, which indicates the average number of species observed during site visits to the reach in cottonwood habitats. The average species richness for all sites evaluated is 8. Riparian mapping in Reach A14 shows a reduction of about 100 acres of closed timber in the reach since 1950. Since 1950, Reach A14 has lost most of its forest that would be considered at low risk of cowbird infestation due to its separation from agricultural infrastructure. In 1950, about 10.5 acres of forest per valley mile were identified as low risk and by 2001 that forest area had been reduced to 0.5 acres per valley mile.

Reach A14 has approximately 2.5 acres of mapped Russian olive, which is concentrated along ditches and low riparian/wetland areas north of the river. There are also over 250 acres of mapped wetland in the reach, most of which is emergent marshes and wet meadows. About 27 acres of emergent wetland have been isolated from the river corridor by the rail line at RM 413.5.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been moderate in this reach. The mean annual flood is estimated to have dropped from 16,200 cfs to 15,100 cfs, a drop of about 7 percent. 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 2,280 cfs to 1,770 cfs with human development, a reduction of 22 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 A14 include:

- Isolation of large wetland area by rail line
- Over 3 miles of side channel blockages
- Large corrals that are part of an animal handling facility within 1,000 feet of the riverbank

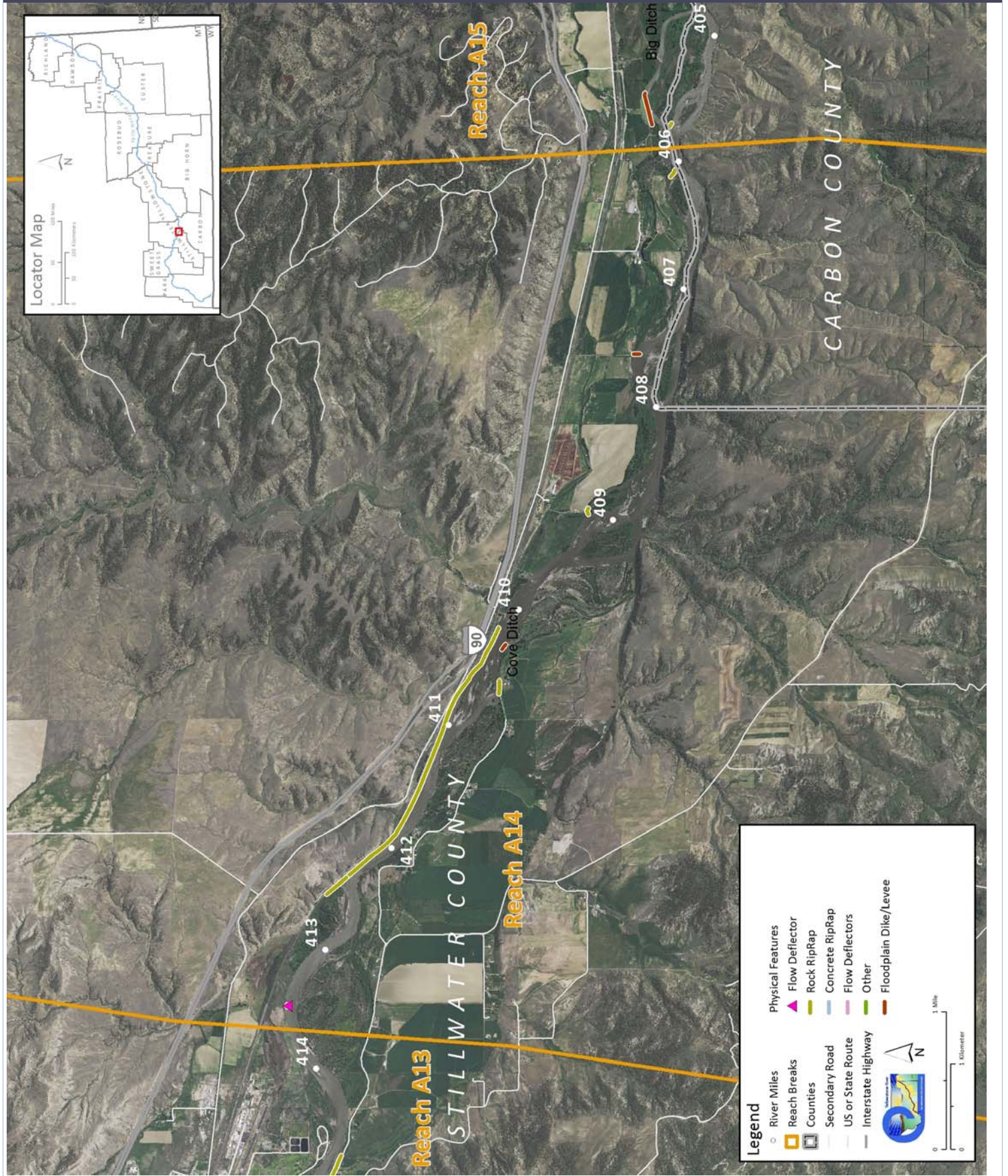
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach A14 include:

- Side channel restoration at RM 410 and RM 407
- Russian olive removal (2.5 acres)
- Nutrient management at corrals that are part of an animal handling facility at RM 409
- Irrigation diversion structure management at Cove Ditch Diversion
- Wetland management/restoration at large complex isolated from river by rail line at RM 413.5

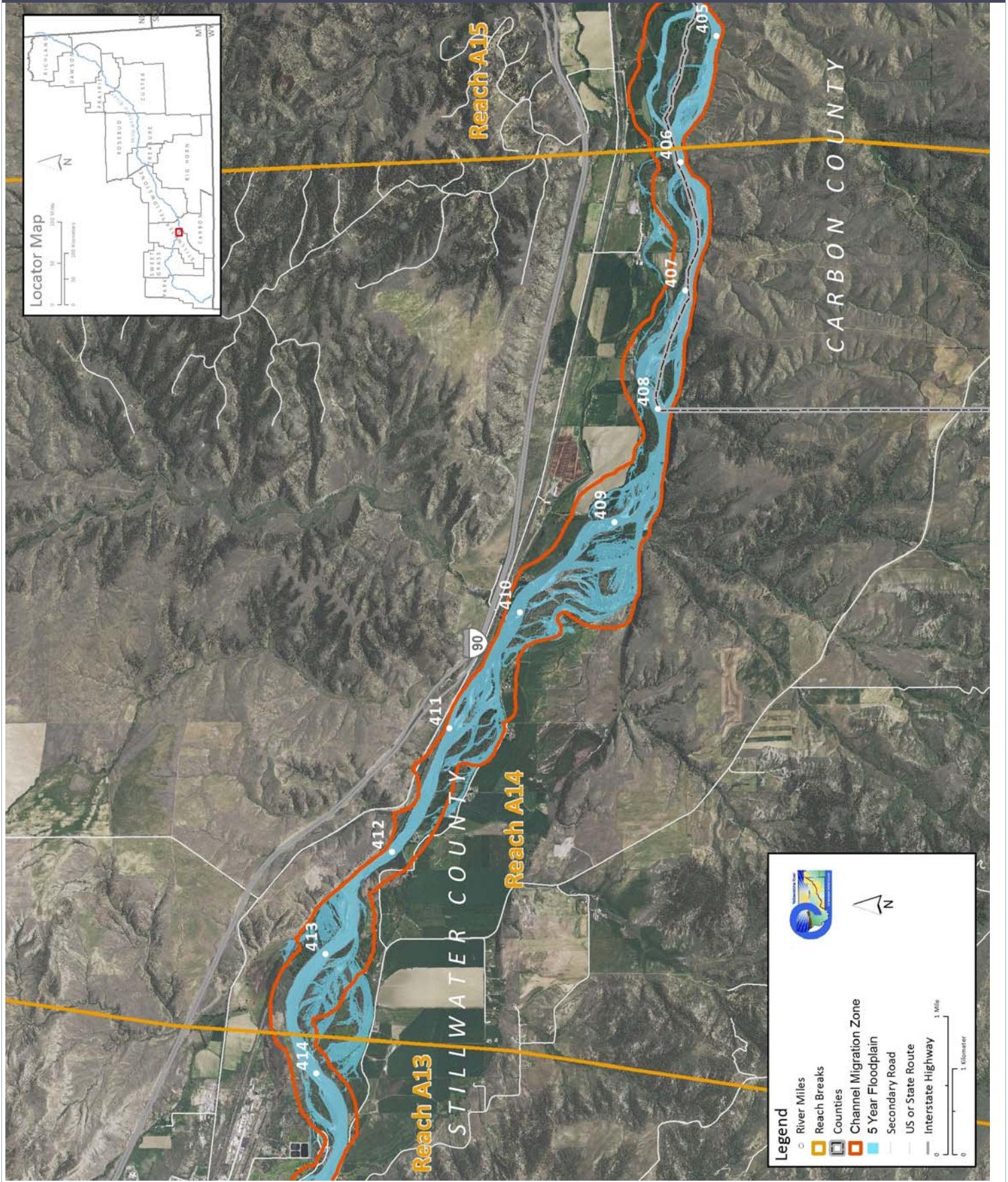
The following table summarizes some key CEA results that have been used to describe overall condition and types of human influences affecting the river. The values are specific to this single reach. Blanks indicate that a particular value was not available for this area. This information is consolidated 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)	31,000	29,800	-3.9%			
100 Year (cfs)	56,600	55,900	-1.2%			
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.
	637.3	675.2	635.5	727.9	90.6	
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	13,457	16.4%	1,807			
Concrete Riprap	0	0.0%	0			
Flow Deflectors	64	0.1%	0			
Total	13,521	16.5%	1,807			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	9,672	9,176				
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	185.7	141.7	-31.84 acres			
Acres/Year	7.1	5.7				
Acres/Year/Valley Mile	1.0	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	40.7	13%				
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.			
	25.7	1%				
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)	4,716.0	4,443.6	Flood (Ac)	1,663.6	1,319.8	
Ag. Infrastructure (Ac)	73.7	258.5	Sprinkler (Ac)	0.0	0.0	
Exurban (Ac)	0.0	0.0	Pivot (Ac)	0.0	144.0	
Urban (Ac)	0.0	0.0				
Transportation (Ac)	90.2	188.5				
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.	
	11.7	3.2	14.9	2.0%		
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	14.4	2.0	283.3			
Emergent	211.3	29.3				
Scrub/Shrub	57.6	8.0				
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.			
	2.5	0.1%				
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.	
	10.5	0.5	0.5	-10.0		

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP



County	Stillwater	Upstream River Mile	405.9
Classification	PCB: Partially confined braided	Downstream River Mile	400
General Location	Follows Stillwater/Carbon County line	Length	5.90 mi (9.50 km)

Narrative Summary

Reach A15 is located in Stillwater County between Columbus and Park City. The reach is a Partially Confined Braided (PCB) reach type, reflecting some valley wall influence coupled with relatively extensive open gravel bars and low flow channels. The reach is 5.9 miles long. The partial geologic confinement within Reach A15 is created by interbedded sandstone and shale of the Cretaceous-age Judith River Formation that intermittently forms the active channel margin on its right bank. The Parkman Sandstone, a massive cliff-forming unit within the Judith River Formation, forms cliffs against the channel that are commonly over 150 feet high.

Approximately 8 percent of the bankline in Reach A15 is armored, and the armor is almost entirely rock riprap, with a very short section of concrete armor. The armor is entirely located on the north bank of the river, across from the bluffs to the south.

Although no side channels have been mapped as blocked in the reach, the total anabranching channel length has dropped from 6.2 miles in 1950 to 4.2 miles in 2001.

Land use in Reach A15 is almost entirely agricultural, with over 200 acres mapped as agricultural infrastructure. This includes a large corral complex that is part of an animal handling facility on the north side of the river at RM 404. The corrals are behind a canal, but within a few hundred feet of the riverbank. There are 528 acres under flood irrigation in the reach, and 81 acres in pivot. A total of 119 acres of developed land are in the Channel Migration Zone, and all of that land is in flood irrigation. About 9 percent of the CMZ is isolated by physical features, all of which is behind armored canals associated with the Big Ditch Diversion, which diverts water from the north bank at RM 405.3. The Big Ditch Diversion structure fully spans a side channel of the river that is about 275 feet wide.

Riparian mapping in Reach A15 shows a reduction of about 60 acres of closed timber in the reach since 1950. Riparian recruitment rates have been relatively high; between 1950 and 2001 there were 200 acres of areas that recruited new riparian vegetation, and most of that was in old 1950s channels that were abandoned and became colonized. These abandoned channels also have high concentrations of Russian olive. Since 1950, Reach A15 has lost almost all of its forest that would be considered at low risk of cowbird infestation due to its separation from agricultural infrastructure. In 1950, about 20 acres of forest per valley mile were identified as low risk and by 2001 that forest area had been reduced to 1.

There are also over 150 acres of mapped wetland in the reach, most of which is emergent marshes and wet meadows. Large expanses of emergent wetlands have developed in side channels that have been passively lost since 1950 ("passively" meaning not blocked but abandoned).

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been moderate in this reach. The mean annual flood is estimated to have dropped from 16,200 cfs to 15,100 cfs, a drop of about 7 percent. 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 2,286 cfs to 1,770 cfs with human development, a reduction of 23 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 A15 include:

- Passive loss of 2 miles of side channel
- Russian olive colonization in abandoned side channels
- Emergent wetland development in abandoned side channels
- Large corrals that are part of an animal handling facility within 300 feet of the riverbank

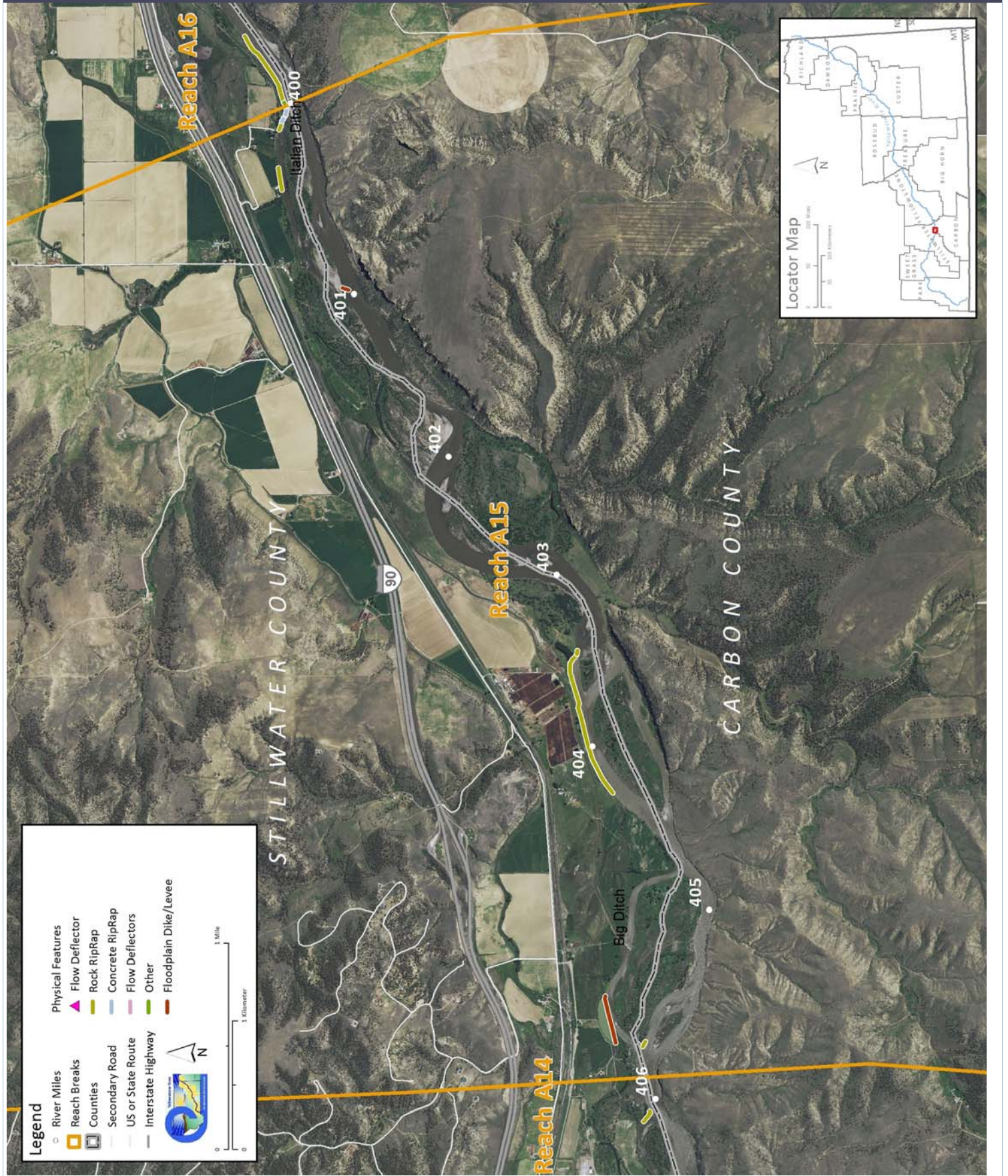
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach A15 include:

- Side channel restoration to reactivate 2 miles of passively lost channels
- Russian olive removal (1.2 acres)
- Nutrient management at corrals that are part of an animal handling facility at RM 404
- Consideration of watercraft passage at Big Ditch Diversion Structure
- Consideration of fish passage limitations at Big Ditch Diversion Structure
- Wetland management/restoration due to extent of mapped wetland (150 acres)

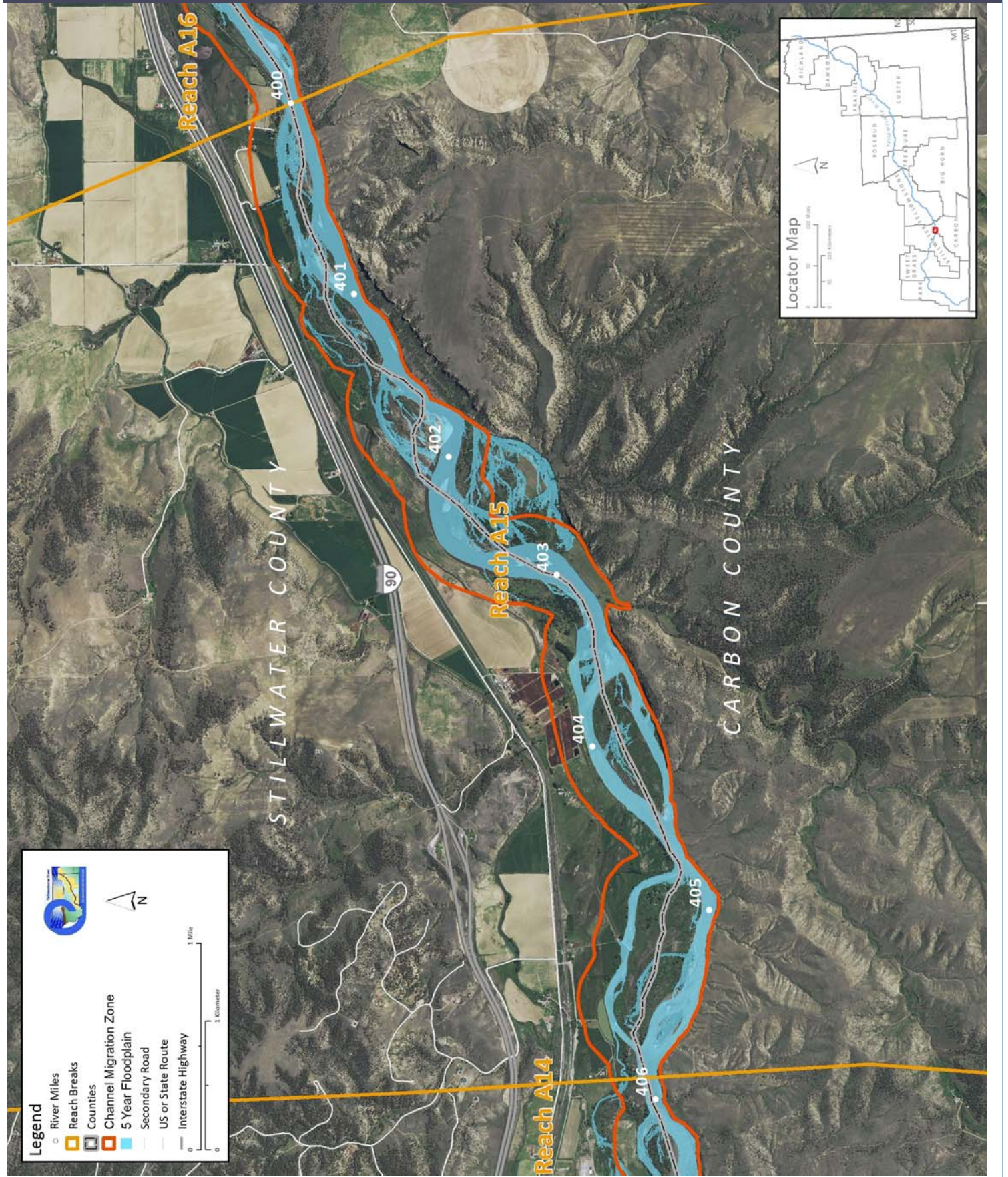
The following table summarizes some key CEA results that have been used to describe overall condition and types of human influences affecting the river. The values are specific to this single reach. Blanks indicate that a particular value was not available for this area. This information is consolidated 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)	31,000	29,800	-3.9%			
100 Year (cfs)	56,600	55,900	-1.2%			
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.
	450.3	488.7	440.1	511.1	60.8	
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	4,667	7.5%	35			
Concrete Riprap	483	0.8%	0			
Flow Deflectors	0	0.0%	0			
Total	5,150	8.3%	35			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	1,617	0				
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	141.8	120.0	4.7 acres			
Acres/Year	5.5	4.8				
Acres/Year/Valley Mile	1.1	0.9				
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	27.2	25%				
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.			
	122.4	8%				
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)	2,738.8	2,533.8	Flood (Ac)	924.9	527.9	
Ag. Infrastructure (Ac)	96.8	213.3	Sprinkler (Ac)	0.0	0.0	
Exurban (Ac)	0.0	2.2	Pivot (Ac)	0.0	80.5	
Urban (Ac)	0.0	0.0				
Transportation (Ac)	59.4	144.9				
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.	
	9.1	0.1	9.3	2.0%		
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	10.4	2.0	168.9			
Emergent	131.1	25.4				
Scrub/Shrub	27.4	5.3				
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.			
	1.2	0.1%				
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.	
	19.9	17.5	21.2	1.2		

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP



County	Stillwater	Upstream River Mile	400
Classification	PCA: Partially confined anabranching	Downstream River Mile	392.4
General Location	Park City	Length	7.60 mi (12.23 km)

Narrative Summary

Reach A16 is 7.6 miles long and is located just south of Park City. The reach is a Partially Confined Anabranching reach type, indicating some valley wall influences as well as relatively extensive forested islands. The partial geologic confinement within Reach A16 is created by interbedded sandstone and shale. In addition, both low and high alluvial terraces intermittently form the active river corridor margin.

Approximately 9 percent of the bankline in Reach A16 is armored, and the armor is almost entirely rock riprap, some short sections of concrete armor and flow deflectors. The armor is located almost entirely on the northern corridor margin, against terrace margins. Its use is split evenly between protecting agricultural and exurban residential land uses. On the upstream end of the reach, rock armor protects the Italian Ditch Diversion and Canal, which divert water on the north bank of the river at RM 400. Over four miles of floodplain dikes have been mapped in the reach, most of which follow ditches on the north floodplain.

Although there is no evidence that side channels have been intentionally blocked off in Reach A16, there has still been a net loss of over a mile of side channel since 1950. Similar to most reaches in Region A, the loss of side channels has been accompanied by an overall increase in the total channel footprint; since 1950, the bankfull channel area of Reach A16 has increased by 40 acres.

Land use in Reach A16 is almost entirely agricultural, although there are almost 300 acres of urban/exurban development in the mapping footprint. There are corrals that are part of an animal handling facility within 1,000 feet of an abandoned river swale at RM 395. Over a thousand acres under of ground in Reach A16 are under flood irrigation, and about 11 are in pivot. About 150 acres of developed land are in the Channel Migration Zone, and almost 40 acres of that is in urban/exurban development. About 6 percent of the total CMZ is restricted by bank armor and dikes.

There is one pipeline crossing in Reach A16. It crosses under the river at RM 396.7 and consists of a 24 inch crude oil pipeline that is owned by Kinder Morgan Pipelines. This pipeline was horizontally drilled during its installation.

Reach A16 was sampled as part of the avian study. The average species richness in Reach A16 was 8.5, which indicates the average number of species observed during site visits to the reach in cottonwood habitats. The average species richness for all sites evaluated is 8. An average of one cowbird was observed during the field sampling visits. Reach A16 has lost about one half of its riparian forest considered at low risk of cowbird parasitism since 1950. At that time, there were about 12 acres of forest per valley mile considered to be isolated enough from agricultural infrastructure and urban/exurban development to be considered at low risk. By 2011, about 6.6 acres considered low risk remained.

There are over 250 acres of mapped wetland in the reach, with most of that emergent marshes and wet meadows. Many of these wetland areas occupy old river swales on the floodplain north of the river, or abandoned channels in the active corridor.

The reach has extensive Russian olive, with almost 30 acres of mapped footprint in the reach.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been moderate in this reach. The mean annual flood is estimated to have dropped from 16,900 cfs to 15,500 cfs, a drop of about 8 percent. 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 2,310 cfs to 1,780 cfs with human development, a reduction of 23 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 A16 include:

- Passive loss of over a mile of side channel
- Russian olive colonization in abandoned side channels
- Emergent wetland development in abandoned side channels

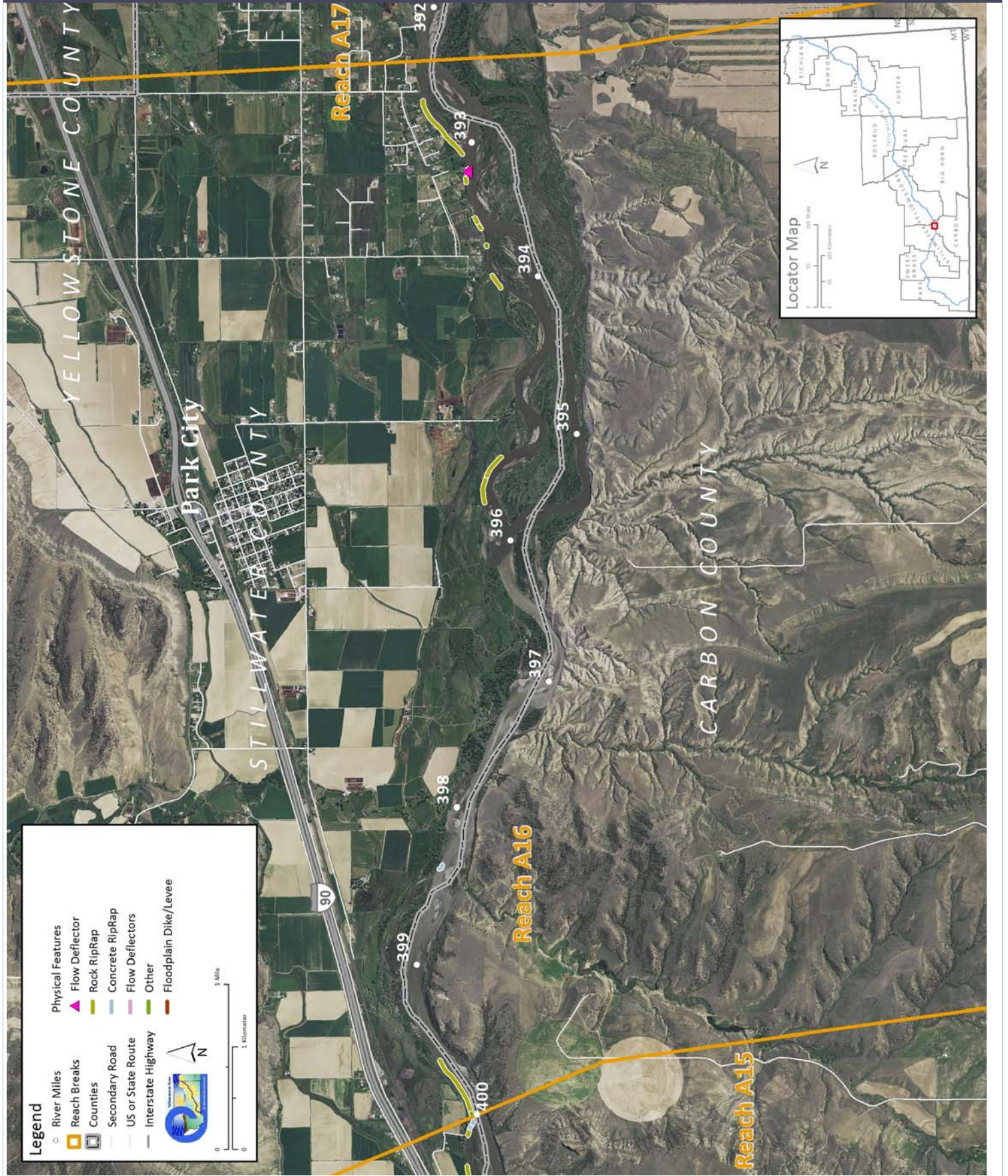
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach A16 include:

- Diversion structure management at Italian Ditch Diversion RM 400
- Nutrient management at corrals that are part of an animal handling facility at RM 395.
- Russian olive removal (29 acres)
- Wetland management/restoration due to extent of mapped emergent wetland (214 acres emergent, 270 acres total wetland)

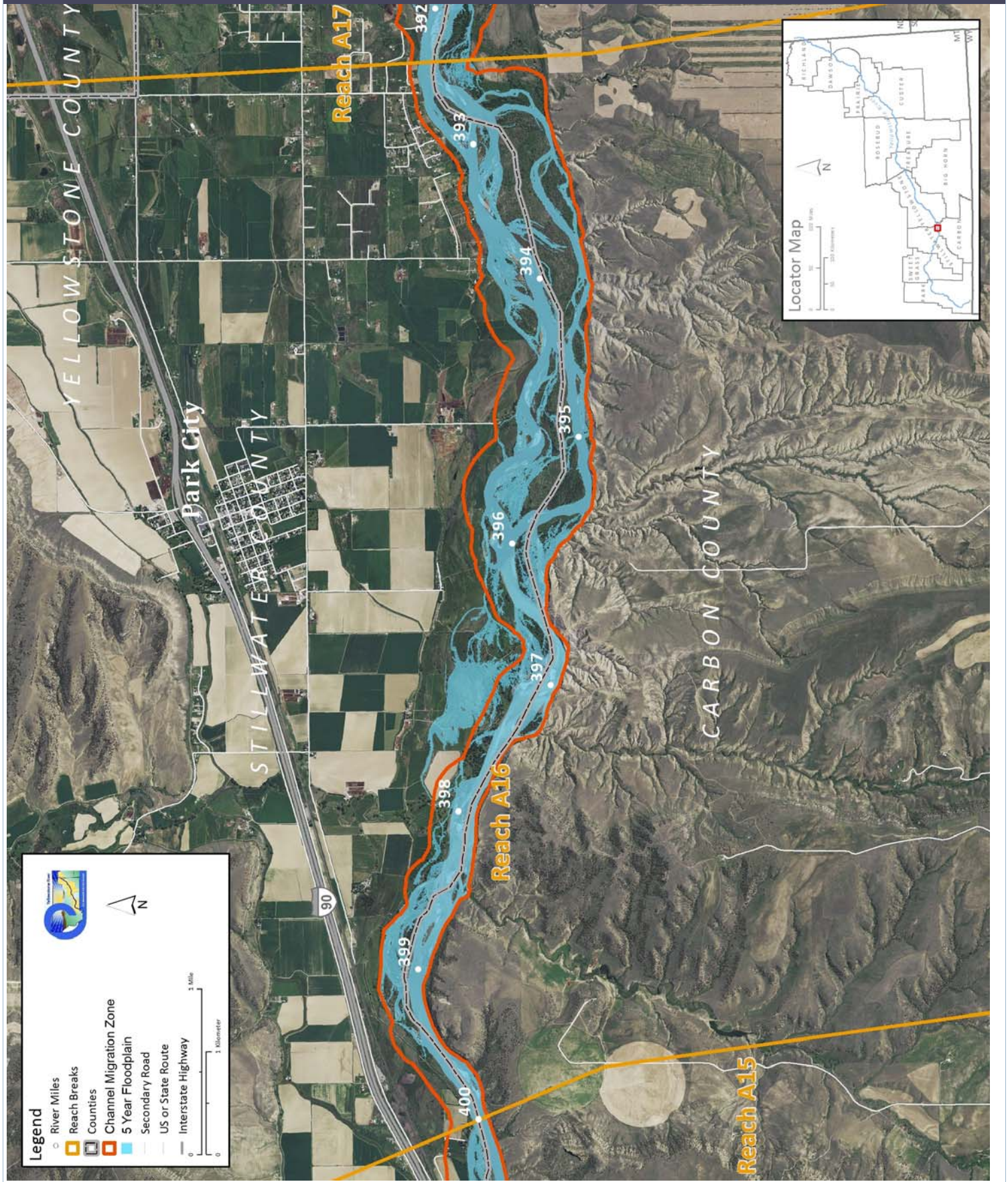
The following table summarizes some key CEA results that have been used to describe overall condition and types of human influences affecting the river. The values are specific to this single reach. Blanks indicate that a particular value was not available for this area. This information is consolidated 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)	32,200	30,600	-5.0%			
100 Year (cfs)	58,600	57,600	-1.7%			
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.
	746.5	772.1	676.5	812.6	66.1	
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	6,789	8.4%	2,351			
Concrete Riprap	9	0.0%	-158			
Flow Deflectors	128	0.2%	128			
Total	6,926	8.5%	2,321			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	0	0				
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	203.1	214.4	-4.96 acres			
Acres/Year	7.8	8.6				
Acres/Year/Valley Mile	1.2	1.3				
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	42.3	13%				
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.			
	104.4	5%				
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)	4,008.9	3,532.8	Flood (Ac)	1,587.8	1,095.2	
Ag. Infrastructure (Ac)	70.7	132.8	Sprinkler (Ac)	0.0	0.0	
Exurban (Ac)	0.0	268.0	Pivot (Ac)	0.0	10.6	
Urban (Ac)	0.0	0.0				
Transportation (Ac)	21.5	73.5				
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.	
	7.2	3.5	10.6	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	10.7	1.6	268.0			
Emergent	214.0	32.0				
Scrub/Shrub	43.3	6.5				
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.			
	28.7	1.8%				
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.	
	12.1	14.5	6.6	-5.5		

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP



County	Yellowstone	Upstream River Mile	392.4
Classification	UA: Unconfined anabranching	Downstream River Mile	386
General Location	To Laurel	Length	6.40 mi (10.30 km)

Narrative Summary

Reach A17 is 7.6 miles long and is located just above Laurel. The reach is classified as Unconfined Anabranching (UA), which is characteristically one of the most dynamic reach types on the river. The river is flowing in the alluvial valley with minimal influences of the valley wall and through numerous forested islands. There are sites in Reach A17 where the river has migrated almost 1,000 feet since 1950.

Approximately 13 percent of the bankline in Reach A17 is armored by rock riprap, concrete riprap and flow deflectors. Between 2001 and 2011 the total length of rock riprap increased by about a half of a mile. At RM 387, a ~750 foot long stretch of flow deflectors on the left bank have been flanked, and by fall 2011 the river had migrated about 120 feet behind the flanked armor. The deflectors are still visible in the channel. In some places such as at RM 389.8, bank armor on both sides of the river narrows the corridor to about one channel width, or 1,000 feet.

Over a mile of side channels in Reach A17 were blocked prior to 1950. Two major channels were blocked on the north side of the river, one at the Buffalo Mirage Fishing Access Site at RM 391.5, and the other at Rm 389.5. These channels, as well as other secondary channels that were passively lost, host fairly dense concentrations of Russian olive. Similar to most reaches in Region A, the loss of side channels has been accompanied by an increase in the total river footprint, indicating that flow concentration into the main river channel has caused it to enlarge. Between 1950 and 2001, the size of the channel increased from 560 acres to 645 acres.

Land use in Reach A17 is primarily agricultural, although there are almost 600 acres of urban/exurban development in the reach as the river approaches the City of Laurel. Since 1950, there has been a reduction in flood irrigated acres of about 550 acres, and an increase in pivot irrigation from 0 acres in 1950 to 284 acres in 2011. A total of 383 acres of developed ground are in the mapped Channel Migration Zone; and about 11 percent of the CMZ has been isolated by physical features protecting those land uses.

At RM 388.5, a headgate diverts water into an old side channel that has been converted to a canal on the north side of the river. About ½ mile downstream, the canal is riprapped where it was recently threatened by rapid northward river migration. At this location, the river has migrated over 800 feet northward since 1950. The main channel of the river now flows along the riprapped canal embankment for about 750 feet.

There are corrals that are part of an animal handling facility within 600 feet of the north riverbank at RM 392.

Side channel loss and channel migration in Reach A17 has resulted in relatively high rates of riparian recruitment. Since 1950, there has been 330 acres of land that experience recruitment of new riparian vegetation. Most of that recruitment was in abandoned channels (200 acres) and about 27 acres of recruitment was direct result of channel migration.

Two ice jams have been recorded in Reach A17, in 1996 and 1997. Both occurred during the month of February, and were reported to have occurred at the Laurel Bridge.

There are over 200 acres of mapped wetland in the reach, with most of that emergent marshes and wet meadows. Many of these wetland areas occupy river swales on the floodplain north of the river, or abandoned channels in the active corridor.

Almost 22 acres of Russian olive has been mapped in the floodplain.

Reach A17 was sampled as part of the avian study. The average species richness in Reach A17 was 7.7, which indicates the average number of species observed during site visits to the reach in cottonwood habitats. The average species richness for all sites evaluated is 8. An average of 0.9 Cowbirds (a bird that parasitizes other bird's nests) were observed in cottonwood habitats during the field sampling visits. Reach A17 has lost about two thirds of its riparian forest considered at low risk of cowbird parasitism since 1950. At that time, there were about 28 acres of forest per valley mile considered to be isolated enough from agricultural infrastructure and urban/exurban development to be considered at low risk. By 2011, about 10 acres per valley mile considered low risk remained.

A total of three Potential Species of Concern (PSOCs) were observed in Reach A17 during the avian study, including the Black and White Warbler, Chimney Swift, and Ovenbird. One Species of Concern (SOC), the Bobolink, was also observed in Reach A17.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been moderate in this reach. The mean annual flood is estimated to have dropped from 16,900 cfs to 15,500 cfs, a drop of about 8 percent. 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 2,320 cfs to 1,780 cfs with human development, a reduction of 23 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 A17 include:

- Flanking of flow deflectors and accelerated erosion behind flanked structures
- Physical blockage of over a mile of side channel
- Russian olive colonization in abandoned side channels

- Emergent wetland development in abandoned side channels
- Ice jamming potentially associated with the Laurel Bridge

Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach A17 include:

- Bank armor removal (flanked flow deflectors), RM 387
- Side channel restoration at RM 391.5 and RM 389.5
- Nutrient management associated with corrals that are part of an animal handling facility at RM 392.
- Russian olive removal (22 acres)
- Wetland management/restoration due to extent of mapped wetland (200 acres)
- Irrigation diversion structure management at headgate on side channel at RM 388.5

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)	32,200	30,600	-5.0%			
100 Year (cfs)	58,600	57,600	-1.7%			
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.
	560.0	608.9	557.5	644.6	84.6	
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	6,184	9.1%	2,584			
Concrete Riprap	2,205	3.2%	0			
Flow Deflectors	671	1.0%	-176			
Total	9,060	13.3%	2,407			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	7,639	0				
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	195.3	180.6	-19.75 acres			
Acres/Year	7.5	7.2				
Acres/Year/Valley Mile	1.3	1.3				
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	46.4	9%				
100 Year	89.9	7%				
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.			
	245.6	11%				
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)	4,530.2	4,110.3	Flood (Ac)	1,927.0	1,384.1	
Ag. Infrastructure (Ac)	68.6	118.5	Sprinkler (Ac)	0.0	0.0	
Exurban (Ac)	59.1	292.3	Pivot (Ac)	0.0	283.8	
Urban (Ac)	95.4	203.9				
Transportation (Ac)	50.2	50.2				
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.	
	6.0	0.8	6.8	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	9.4	1.6	226.2			
Emergent	203.4	35.6				
Scrub/Shrub	13.4	2.3				
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.			
	21.8	6.7%				
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.	
	27.7	64.2	9.7	-18.0		