County	Richland	**Upstream River Mile**	27.8
Classification	PCM/I: Partly confined meandering/islands	**Downstream River Mile**	13.5
General Location	To Fariview	**Length**	14.30 mi (23.01 km)

Narrative Summary

Reach D14 is located upstream of Fairview. The reach is a 14.3 mile long Partially Confined Meandering with Islands (PCM/I), indicating some valley wall influence, and a meandering main thread with cutoff channels through meander cores forming persistent forested islands.

There is just over a mile of bank armor in the reach, including 3,900 feet of rock riprap and 2,500 feet of flow deflectors. Most of the rock riprap was constructed between 2001 and 2011 (2,300 feet).

Prior to 1950, 3,600 feet of side channel was blocked in the reach at RM 23L.

Similar to many reaches in the Lower Yellowstone Valley, the river channel in Reach D14 has gotten smaller since 1950. The channel contracted by about 309 acres in this reach since 1950, and about 460 acres of riparian vegetation has encroached into old channel areas. This pattern has been consistent in the lower river, and relates primarily to a reduction in flows due to human development. Floodplain turnover rates have dropped from 14.4 acres per year pre-1976 to 6.1 acres per year post-1976. There has also been a major loss of open bar habitat area in the channel; between 1950 and 2001, there was a loss of 510 acres of mid-channel bar area, which can be important habitat to certain species such as least tern.

Land use is predominantly agricultural, with just over a thousand acres of pivot irrigation development since 1950. Development in the reach included conversion of 1,063 acres of 1950s riparian area to other land uses (mostly irrigated agriculture); that represented 36 percent of the entire 1950s riparian footprint. There are 93 acres of pivot irrigated land and 113 acres of urban/exurban development within the Channel Migration Zone (CMZ), making these areas especially susceptible to river erosion. At RM 26L there are three drill pads within the CMZ.

Several dump sites have been mapped on the banks: RM 25R, RM 24.3L, RM 17L, RM 15.8L, and RM 15.8R.

There is one pipeline crossing in Reach D14 at RM 27. It is an 8-inch crude oil pipeline that has been Horizontally Directionally Drilled.

About 41 percent of the historic 5-year floodplain has become isolated, primarily due to flow alterations.

One ice jam was reported in the reach. It was a break-up flood event on March 17, 2011.

There are about 36 acres of mapped Russian olive in the reach.

Reach D14 was sampled as part of the avian study. A total of 30 bird species were identified in the reach. Two bird species identified by the Montana Natural Heritage Program as Potential Species of Concern (PSOC) on the Yellowstone River were found, the Ovenbird and the Plumbeous Vireo. Reach D14 has seen a decrease in the forested area that is at low risk of cowbird parasitism since 1950. At that time, there were 25.6 acres per valley mile of such forest, and that number dropped to 19.6 acres per valley mile by 2001.

CEA-Related observations in Reach D14 include:
- Flow alteration impacts on floodplain access

Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach D14 include:
- Solid waste removal at dump sites at RM 25R, RM 24.3L, RM 17L, RM 15.8L, and RM 15.8R.
- Side channel reactivation at RM 23L
- Pipeline crossing Management at RM 27.
- Russian olive removal

Yellowstone River Reach Narratives — Reach D14

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
2 Year (cfs)	69,900	54,300	-22.3%
100 Year (cfs)	143,000	134,000	-6.3%

"Undeveloped" flows represent conditions prior to significant human development, whereas "developed" flows reflect the current condition of both consumptive and non-consumptive water use.

Bankfull Channel Area (Ac)

1950	1976	1995	2001	1950-2001
2,206.2	2,091.0	1,933.5	1,896.8	-309.4

Bankful channel area is the total footprint of the river inundated at approx. the 2-year flood.

Physical Features

	2011 Length (ft)	% of Bankline	2001-2011 Change
Rock RipRap	3,906	2.6%	2,293
Concrete Riprap	0	0.0%	0
Flow Deflectors	2,505	1.7%	273
Total	**6,411**	**4.2%**	**2,566**

There are additional types of bank armor such as car bodies and steel retaining walls, but they are relatively minor.

Length of Side Channels Blocked (ft)

Pre-1950s	Post-1950s
3,595	0

Numerous side channels have been blocked by small dikes.

Floodplain Turnover

	1950 - 1976	1976 - 2001
Total Acres	375.2	152.5
Acres/Year	14.4	6.1
Acres/Year/Valley Mile	1.1	0.5

1950-2001 In-channel riparian encroachment (negative number indicates retreat)

459.11 acres

The rate of floodplain turnover reflects how many acres of land are eroded by the river. Tunover is associated with the creation of riparian habitat.

Open Bar Area

	Point Bars	Bank Attached	Mid-Channel	Total
Change in Area '50 - '01 (Ac)	9.8	94.4	-510.3	-406.1

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.

Floodplain Isolation

	Acres	% of FP
5 Year	1,046.3	41%
100 Year	1,450.6	17%

Floodplain isolation refers to area that historically was flooded, but has become isolated do to flow alterations or physical features such as levees.

Restricted Migration Area

Acres	% of CMZ
160.9	3%

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.

Land Use

	1950	2011
Agricultural Land (Ac)	8,402.4	8,078.6
Ag. Infrastructure (Ac)	49.0	153.3
Exurban (Ac)	0.0	161.4
Urban (Ac)	0.0	0.0
Transportation (Ac)	65.0	73.2

	1950	2011
Flood (Ac)	3,832.7	3,990.2
Sprinkler (Ac)	0.0	0.0
Pivot (Ac)	0.0	1,003.3

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.

1950s Riparian Vegetation Converted to a Developed Land Use (ac)

To Irrigated	To Other Use	Total Rip. Converted	% of 1950s Rip.
940.2	123.1	1,063.3	36.0%

Changes in the extents of riparian vegetation are influenced by land use changes within the corridor.

National Wetlands Inventory

	Acres	Acres per Valley Mi
Riverine	8.1	0.6
Emergent	137.1	10.9
Scrub/Shrub	144.3	11.5

Total Wetland Acres: **289.5**

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).

Russian Olive (2001) (Appx. 100-yr Floodplain)

Acres	%
35.7	0.8%

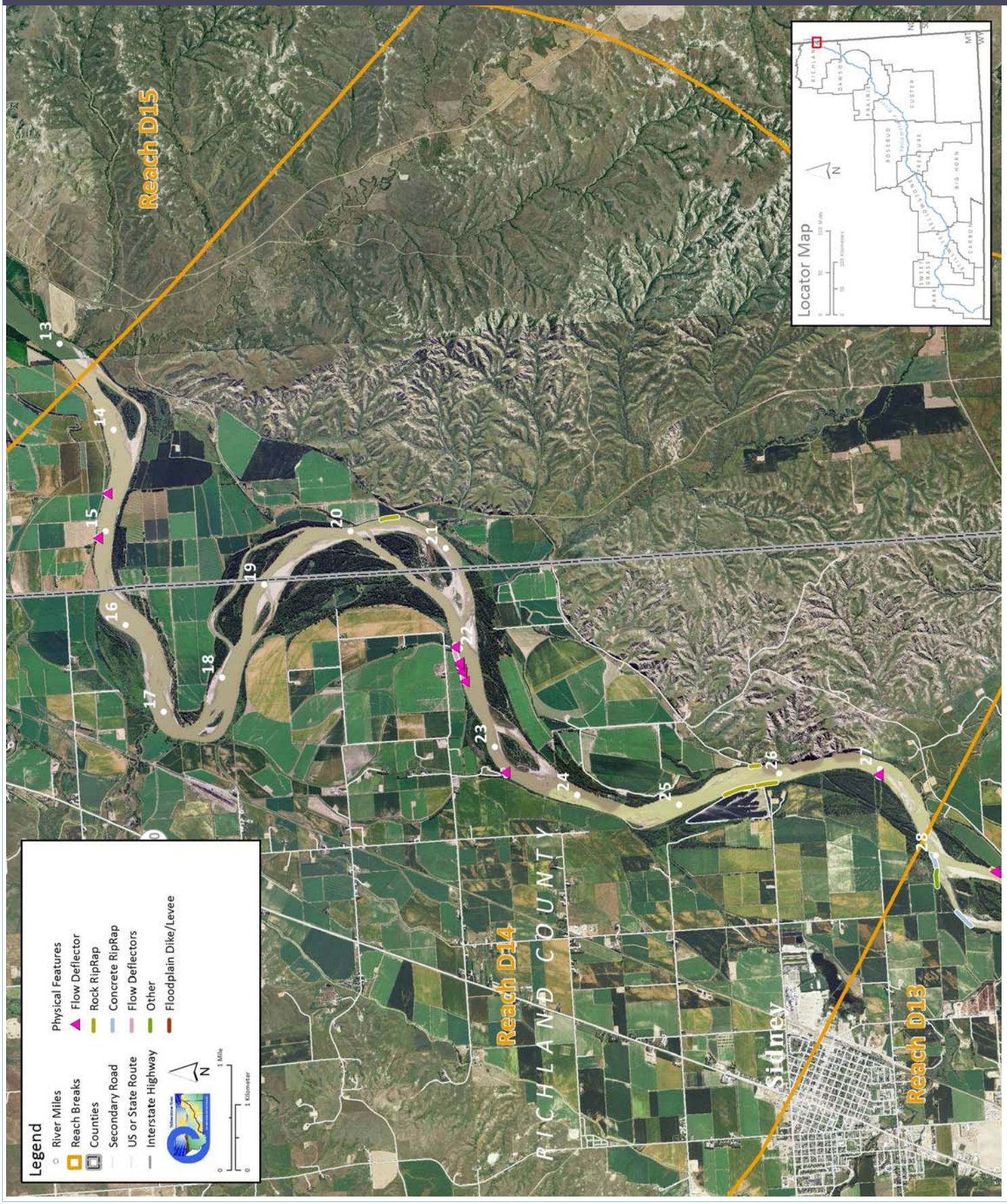
Russian olive is considered an invasive species and its presence in the corridor is fairly recent. Its spread can be used as a general indicator of invasive plants within the corridor.

Riparian Forest at low risk of Cowbird Parasitism (Ac/Valley Mile)

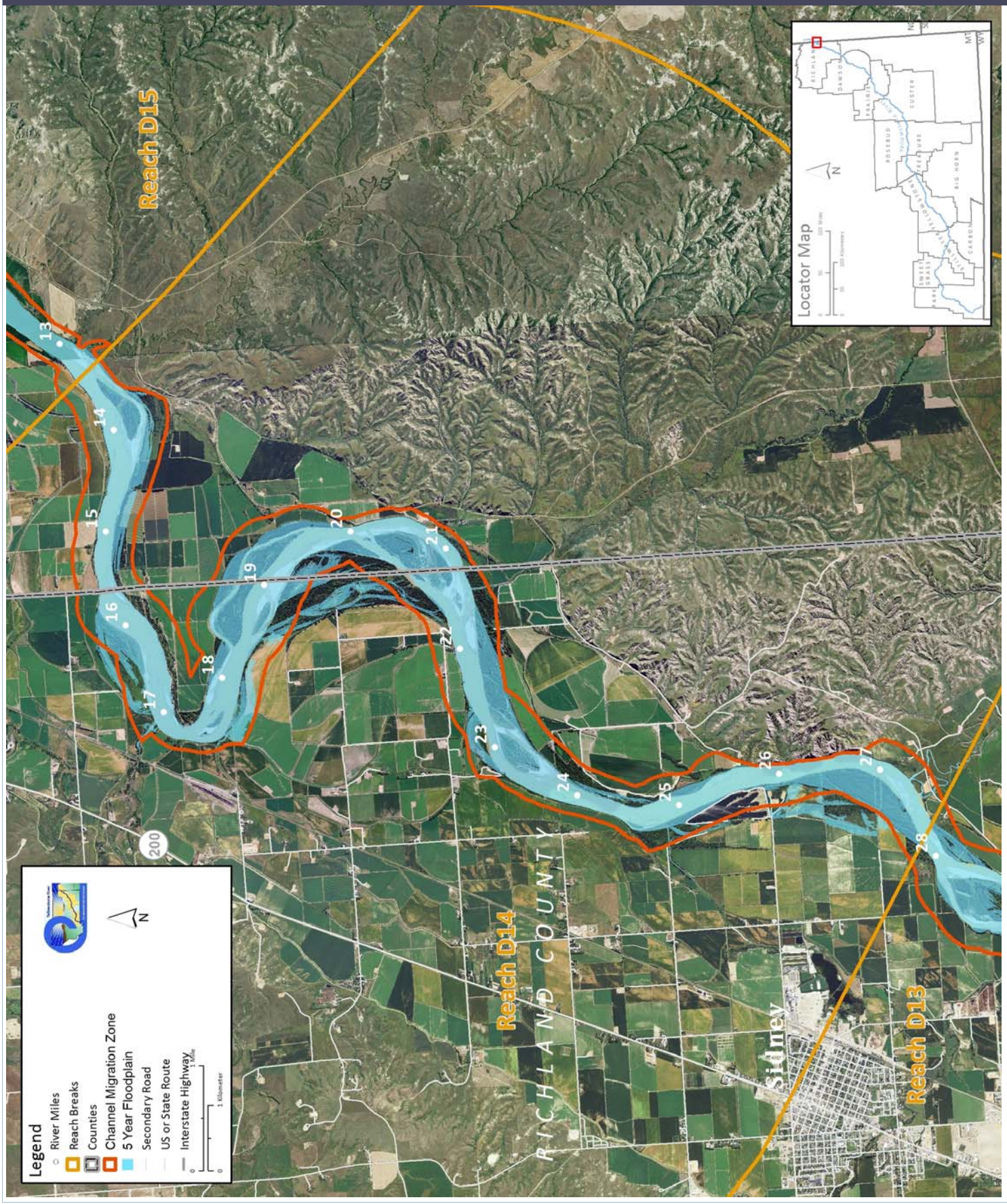
1950	1976	2001	Change 1950-2011
25.6	38.1	19.6	-5.9

Cowbirds are associated with agricultural and residential development, displacing native bird species by parasitizing their nests.

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP



Yellowstone River Reach Narratives — Reach D15

County	Mckenzie	**Upstream River Mile**	13.5
Classification	PCM/I: Partially confined meandering/islands	**Downstream River Mile**	7.5
General Location	Downstream of Fairview	**Length**	6.00 mi (9.66 km)

Narrative Summary

Reach D15 is located downstream of Fairview. The reach is a 6 mile long Partially Confined Meandering with Islands (PCM/I), indicating some valley wall influence, and a meandering main thread with cutoff channels through meander cores forming persistent forested islands.

No bank armor was mapped in the reach, and no side channels have been blocked.

Similar to many reaches in the Lower Yellowstone Valley, the river channel in Reach D15 has gotten smaller since 1950. The channel contracted by about 190 acres in this reach since 1950, and about 210 acres of riparian vegetation has encroached into old channel areas. This pattern has been consistent in the lower river, and relates primarily to a reduction in flows due to human development.

Land use is predominantly agricultural, with 71 acres of pivot irrigation development since 1950. A total of 54 percent of the 100 year floodplain has become isolated (1,885 acres), and most of this isolation is from agricultural dikes. Approximately 23 percent of the 5-year floodplain has become isolated (168 acres).

There is a drill pad on the edge of the CMZ at RM 10.8L.

One ice jam was reported in the reach. It was a break-up flood event on February 12, 1996.

Reach D15 was sampled as part of the avian study. A total of 30 bird species were identified in the reach. Two bird species identified by the Montana Natural Heritage Program as Potential Species of Concern (PSOC) on the Yellowstone River were found, the Ovenbird and the Plumbeous Vireo.. Reach D15 has seen a decrease in the forested area that is at low risk of cowbird parasitism since 1950. At that time, there were 25.6 acres per valley mile of such forest, and that number dropped to 19.6 acres per valley mile by 2001.

CEA-Related observations in Reach D15 include:
- Flow alteration impacts on floodplain access

Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach D15 include:
- Russian olive removal

Yellowstone River Reach Narratives — Reach D15

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
2 Year (cfs)	69,900	54,300	-22.3%
100 Year (cfs)	143,000	134,000	-6.3%

"Undeveloped" flows represent conditions prior to significant human development, whereas "developed" flows reflect the current condition of both consumptive and non-consumptive water use.

Bankfull Channel Area (Ac)

1950	1976	1995	2001	1950-2001
988.3		887.9	798.9	-189.3

Bankful channel area is the total footprint of the river inundated at approx. the 2-year flood.

Physical Features

	2011 Length (ft)	% of Bankline	2001-2011 Change
Rock RipRap	0	0.0%	0
Concrete Riprap	0	0.0%	0
Flow Deflectors	0	0.0%	0
Total	**0**	**0.0%**	**0**

There are additional types of bank armor such as car bodies and steel retaining walls, but they are relatively minor.

Length of Side Channels Blocked (ft)

Pre-1950s	Post-1950s
0	0

Numerous side channels have been blocked by small dikes.

Floodplain Turnover

	1950 - 1976	1976 - 2001
Total Acres		
Acres/Year		
Acres/Year/Valley Mile		

1950-2001 In-channel riparian encroachment (negative number indicates retreat)

208.49 acres

The rate of floodplain turnover reflects how many acres of land are eroded by the river. Tunover is associated with the creation of riparian habitat.

Open Bar Area

	Point Bars	Bank Attached	Mid-Channel	Total
Change in Area '50 - '01 (Ac)	0	89.7	-57.5	32.2

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.

Floodplain Isolation

	Acres	% of FP
5 Year	168.1	23%
100 Year	1,884.7	54%

Floodplain isolation refers to area that historically was flooded, but has become isolated do to flow alterations or physical features such as levees.

Restricted Migration Area

Acres	% of CMZ
21.1	1%

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.

Land Use

	1950	2011
Agricultural Land (Ac)	6,215.4	7,485.3
Ag. Infrastructure (Ac)	86.2	192.8
Exurban (Ac)	0.0	35.8
Urban (Ac)	0.0	0.0
Transportation (Ac)	79.3	70.6

	1950	2011
Flood (Ac)	3,955.0	6,101.5
Sprinkler (Ac)	0.0	0.0
Pivot (Ac)	0.0	71.3

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.

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.

National Wetlands Inventory

	Acres	Acres per Valley Mi
Riverine	1.6	0.3
Emergent	20.2	3.5
Scrub/Shrub	68.7	11.9

Total Wetland Acres: **90.5**

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).

Russian Olive (2001) (Appx. 100-yr Floodplain)

Acres	%
0.8	0.1%

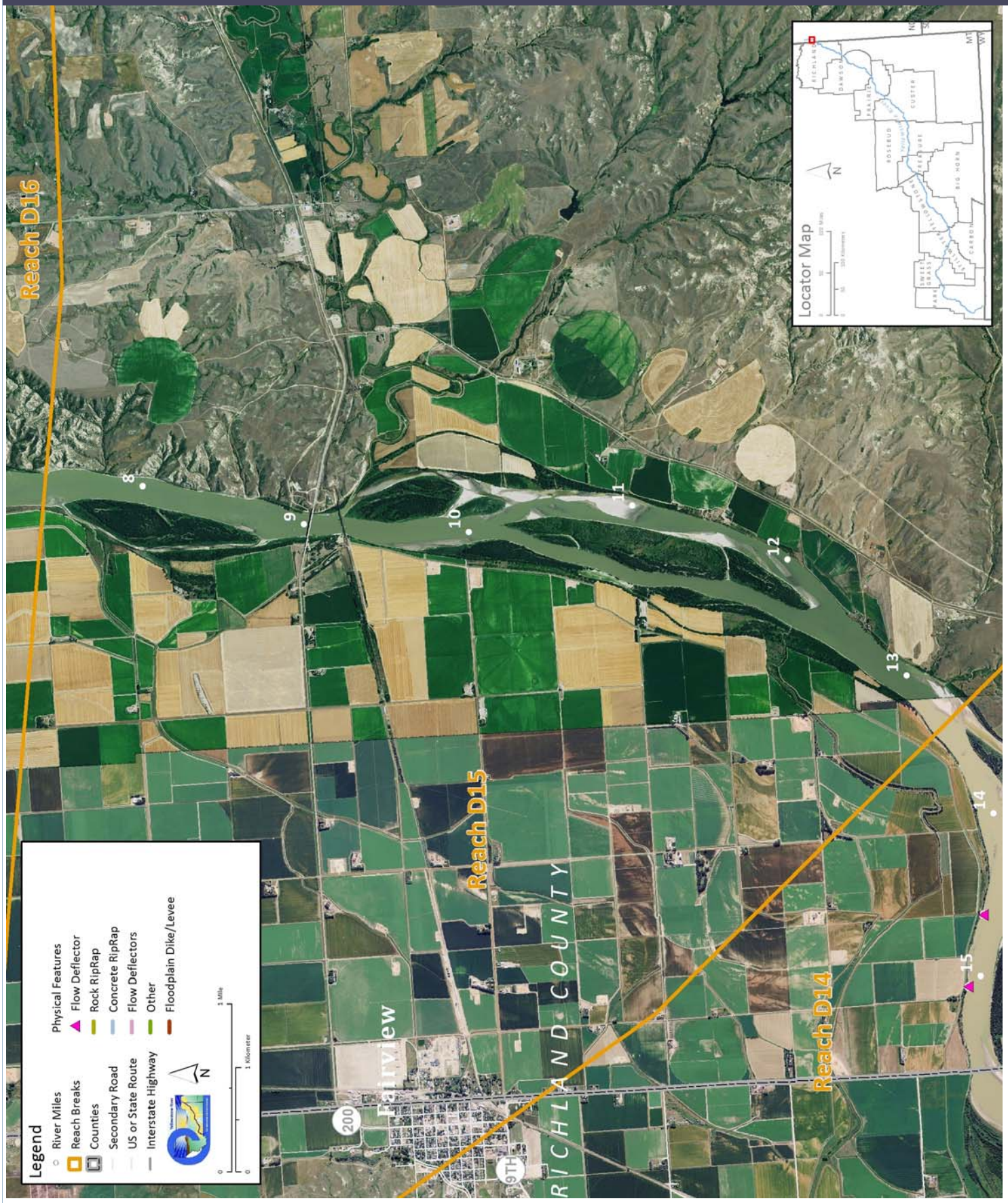
Russian olive is considered an invasive species and its presence in the corridor is fairly recent. Its spread can be used as a general indicator of invasive plants within the corridor.

Riparian Forest at low risk of Cowbird Parasitism (Ac/Valley Mile)

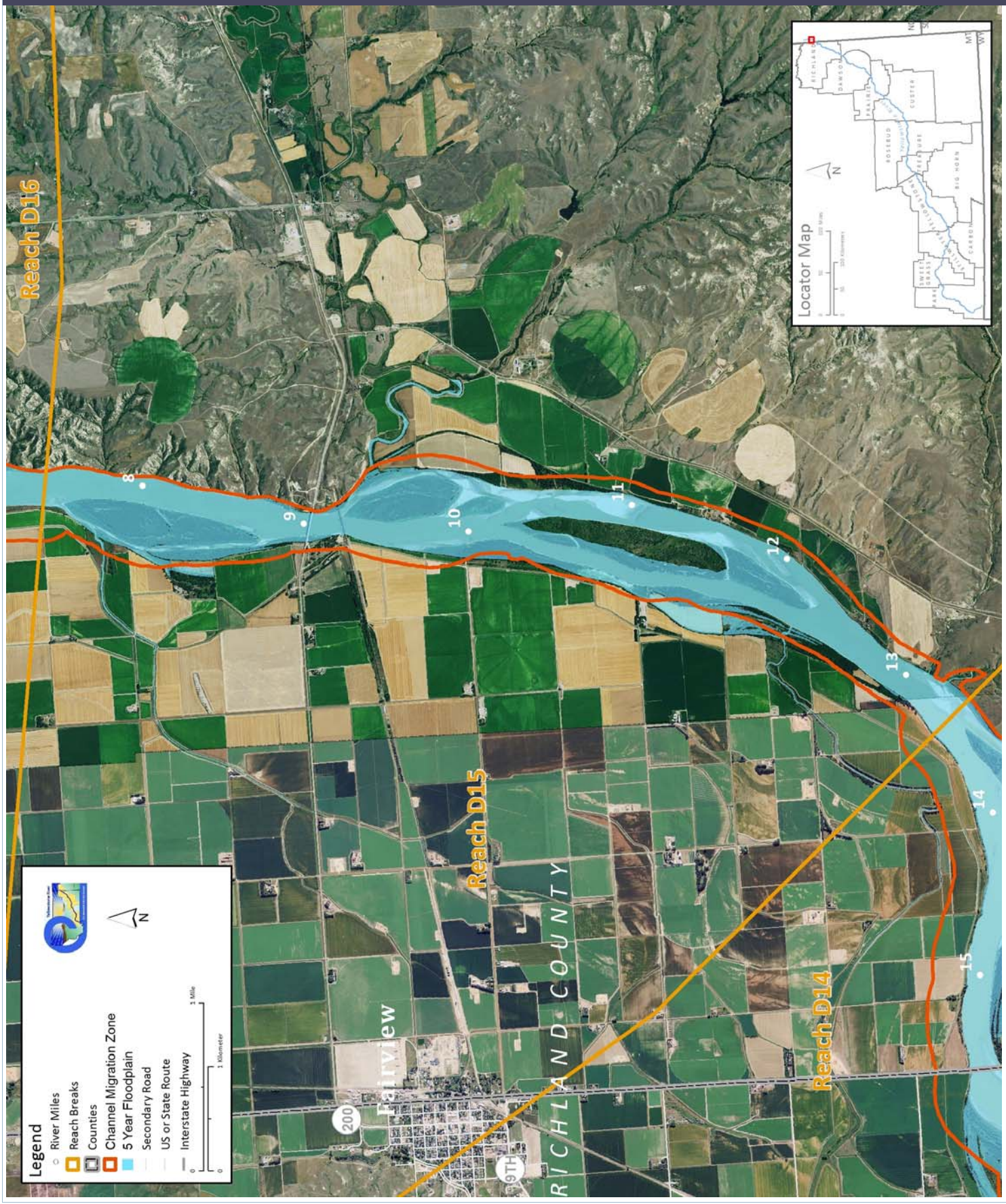
1950	1976	2001	Change 1950-2011
10.1		23.0	12.9

Cowbirds are associated with agricultural and residential development, displacing native bird species by parasitizing their nests.

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP



County	Mckenzie	**Upstream River Mile**	7.5
Classification	US/I: Unconfined straight/islands	**Downstream River Mile**	0
General Location	To Missouri River	**Length**	7.50 mi (12.07 km)

Narrative Summary

Reach D16 is the lowermost reach of the Yellowstone River, extending 7.5 miles to the confluence with the Missouri River. It is a unique reach type, referred to as Unconfined Straight (US), and it has numerous forested islands that have developed since the 1950s.

Reach D16 has only a few hundred feet of rock riprap along its 7.5 mile length, and all of that was built since 2001. No side channels have been blocked.

The most striking change in Reach D16 since 1950 is the encroachment of riparian vegetation onto old sand bars. Between 1950 and 2001, the size of the channel has dropped by 550 acres, and there has been 472 acres of riparian encroachment into old channel areas. Much of this encroachment converted open sand bars into forested islands. There has been a loss of over 150 acres of sand bar since 1950. This change has resulted in a conversion of almost 7 miles low flow channels around gravel bars to anabranching side channels around islands.

Land use in the reach is dominated by flood irrigation. The extent of flood irrigated lands increased from 4,600 acres in 1950 to about 8,500 acres in 2011. The floodplain is very flat and broad in this lowermost portion of the Yellowstone River valley, and as a result, floodplain development for agriculture has substantially altered floodplain access. About 29 percent of the 100-year floodplain has become isolated from the river, and a fraction of this (1.6 percent) has been attributed to flow alterations, whereas 27 percent has been associated with agricultural features on the floodplain such as roads and ditches. There are about 480 acres of flood irrigated land within the Channel Migration Zone of Reach D16.

Land use mapping shows several drill pads in the lower portion of the reach that are within several thousand feet of the river. There are four drill pads on a narrow strip of land at the mouth that lies between the Yellowstone and Missouri Rivers.

Reach D16 has a notably high concentration of mapped wetlands. There are about 580 acres of mapped wetland in the reach, which translates to about 80 acres per valley mile. Along the rest of the river, wetland densities rarely exceed 50 acres per valley mile. Reach D16 only has 3.5 acres of mapped Russian olive, which is a relatively low density for reaches below Billings.

Because of the riparian encroachment, Reach D16 has seen an increase in the area of riparian forest considered at low risk of cowbird parasitism; in 1950 there were about 250 acres of such forest per valley mile, and in 2001 there were 308 acres per valley mile.

The changes in Reach D16 are due in part to major flow alterations in the reach. The 2-year discharge, which is considered to have a large influence on channel size, has been reduced by 22 percent due to human development.

CEA-Related observations in Reach D16 include:
- Extensive riparian encroachment with flow alterations
- Conversion of open sand bars to forested islands

Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach D16 include:
- Drill pad considerations
- Riparian protections

Yellowstone River Reach Narratives — Reach D16

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
2 Year (cfs)	69,900	54,300	-22.3%
100 Year (cfs)	143,000	134,000	-6.3%

"Undeveloped" flows represent conditions prior to significant human development, whereas "developed" flows reflect the current condition of both consumptive and non-consumptive water use.

Bankfull Channel Area (Ac)

1950	1976	1995	2001	1950-2001
1,515.1		1,157.3	960.1	-555.0

Bankful channel area is the total footprint of the river inundated at approx. the 2-year flood.

Physical Features

	2011 Length (ft)	% of Bankline	2001-2011 Change
Rock RipRap	266	0.3%	266
Concrete Riprap	0	0.0%	0
Flow Deflectors	0	0.0%	0
Total	**266**	**0.3%**	**266**

There are additional types of bank armor such as car bodies and steel retaining walls, but they are relatively minor.

Length of Side Channels Blocked (ft)

Pre-1950s	Post-1950s
0	0

Numerous side channels have been blocked by small dikes.

Floodplain Turnover

	1950 - 1976	1976 - 2001
Total Acres		
Acres/Year		
Acres/Year/Valley Mile		

1950-2001 In-channel riparian encroachment (negative number indicates retreat)

472.19 acres

The rate of floodplain turnover reflects how many acres of land are eroded by the river. Tunover is associated with the creation of riparian habitat.

Open Bar Area

	Point Bars	Bank Attached	Mid-Channel	Total
Change in Area '50 - '01 (Ac)	10.3	45.8	-208.4	-152.3

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.

Floodplain Isolation

	Acres	% of FP
5 Year	105.9	31%
100 Year	390.4	29%

Floodplain isolation refers to area that historically was flooded, but has become isolated do to flow alterations or physical features such as levees.

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.

Land Use

	1950	2011
Agricultural Land (Ac)	10,472.2	14,362.1
Ag. Infrastructure (Ac)	87.1	270.2
Exurban (Ac)	0.0	63.7
Urban (Ac)	0.0	0.0
Transportation (Ac)	0.0	17.9

	1950	2011
Flood (Ac)	4,631.0	8,492.4
Sprinkler (Ac)	0.0	0.0
Pivot (Ac)	0.0	0.0

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.

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.

National Wetlands Inventory

	Acres	Acres per Valley Mi
Riverine	25.3	3.6
Emergent	254.9	36.2
Scrub/Shrub	278.2	39.5

Total Wetland Acres: **558.4**

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).

Russian Olive (2001) (Appx. 100-yr Floodplain)

Acres	%
3.5	0.1%

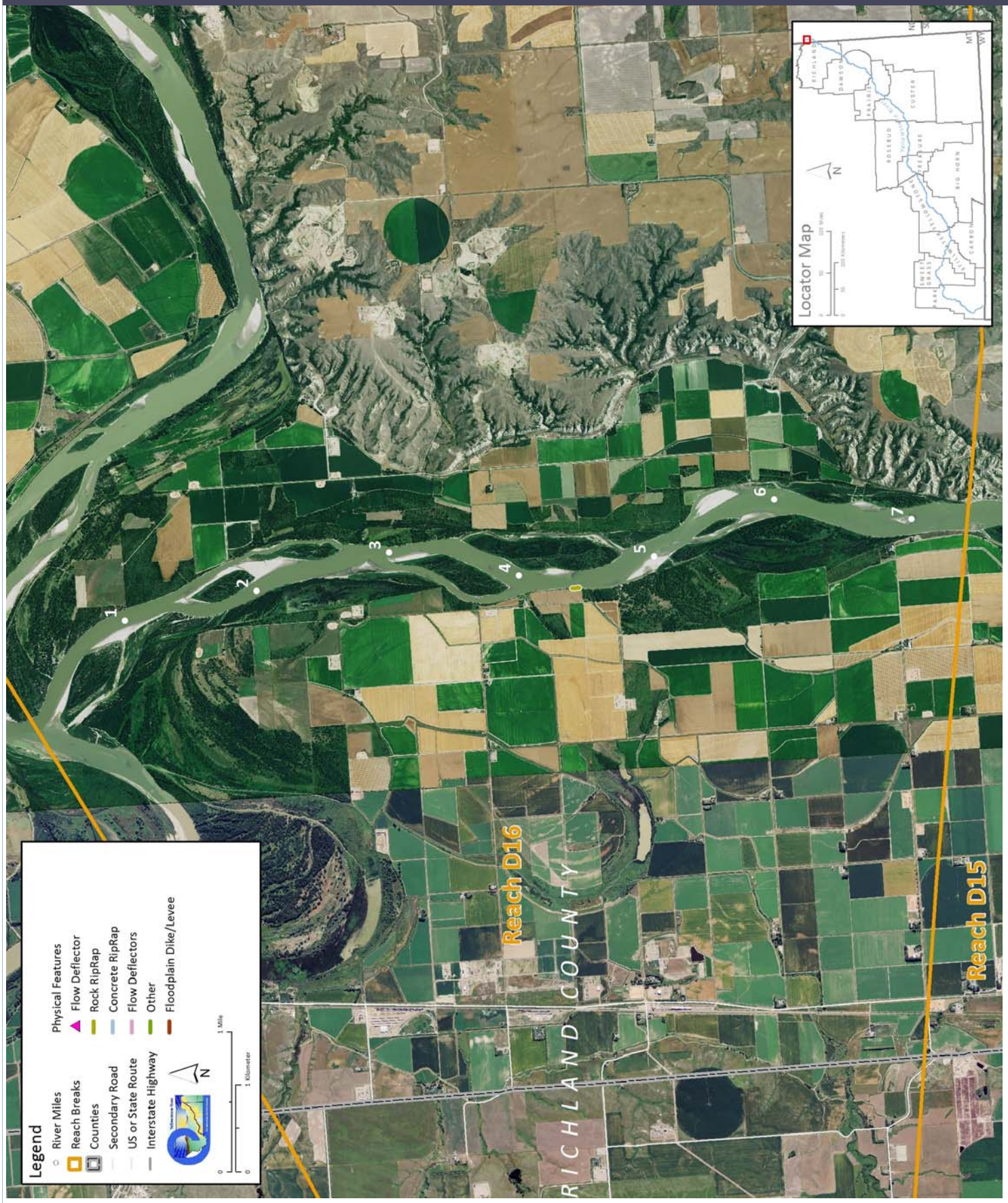
Russian olive is considered an invasive species and its presence in the corridor is fairly recent. Its spread can be used as a general indicator of invasive plants within the corridor.

Riparian Forest at low risk of Cowbird Parasitism (Ac/Valley Mile)

1950	1976	2001	Change 1950-2011
230.3		307.9	77.6

Cowbirds are associated with agricultural and residential development, displacing native bird species by parasitizing their nests.

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP