To: Missoula County Commissioners September 24, 2012

Montana Department of Transportation

Ref: Maclay Bridge Alliance consultant letter on problems at Maclay Bridge

Dear Sirs/Madams,

Fred Stewart of the Maclay Bridge Alliance sent me a copy of a memo written by Ms. Traci Sylte, a consultant he retained to respond to a letter I had written to you on July 15 regarding conditions I have observed at the current bridge site. If you recall, my letter raised concerns that scour of the river's bed and banks is taking place due to the bridge location and design and that the east side of the river channel is being blocked by gravel bars and islands forming around the 3 bridge piers, likely due to constriction and backwater effects from the bridge. I have reviewed Ms. Sylte's memo and some of my detailed comments on her memo can be found in Attachment A. The most notable items in Ms. Sylte's memo are:

- Ms. Sylte agrees with me on the major issues I have raised regarding the current site.
- Ms. Sylte incorrectly states that Maclay Bridge has functioned better than similar bridges of its era and has been around for almost 75 years. In fact, Maclay Bridge has washed out and been replaced up to five times in the last 100 or so years (please see Attachment B: Summary of Maclay Bridge Washouts and Rebuilding and Future Flood Potential).
- Ms. Sylte presents, without any supporting data or engineering analysis, two options: 1.) leave Maclay Bridge at its current site as the "lowest impact location" or 2.) remove the entire bridge and River Pines Road and force locals to use Kona or Buckhouse Bridges as a way of resolving any concerns. She does not address the merits of a South Avenue location.

I have also included an Attachment C: Missoula Area Bridge Sites, to provide you an overview of bridge sites and their various configurations in the Missoula area.

I continue to support the County's and MDT's approach to fully analyze the situation; identify the impacts; develop options to avoid, minimize, or eliminate problems; and to base this approach on data, engineering analysis, and feedback from the community. The purpose of my letters to you regarding Maclay Bridge is to underscore my ongoing concerns about 4 things: 1.) the unnecessary environmental impacts on the river; 2.) the risks to public safety from the old bridge; 3.) the unnecessary impacts to 5 streets and neighborhoods in Target Range from the current inefficient travel routes, and 4.) the waste of future county tax dollars if we do not fix the problems now.

Sincerely,

/s/Michael Burnside

Michael Burnside

Attachment A: Response to Sylte Comments

The criteria Ms. Sylte includes in her memo for bridge crossings is summarized (in italics) below, followed by my response. Sylte offered these criteria but did not apply them to any of the options MDT and the County are considering:

1. Flood plain capacity and function: Minimize road and crossing footprint within the floodplain and channel migration zone. (I agree: don't construct large abutments into the flood plain and don't build bulky piers with several piers closely spaced and blocking part of the channel, as has been done at the current Maclay Bridge site.)

2. Planform…cross on the most stable and straight river segments that are "sediment transport dominated" rather than "sediment transport limited (depositional)." (I agree: avoid crossing at stream meanders if possible and avoid depositional areas such as those that might exist or be aggravated by piers constructed below a large island where channels converge, as at the current Maclay Bridge site. Instead crossings should be sited where the channel is straight, stable, and sediment transport dominated, such as, for example, at the South Avenue crossing.)

3. Dimension: At least span (i.e. cross without impeding) the bank full or unaltered channel width. (I agree: when you cross a stream, minimize the extent to which you impede its flow or alter its channel. Don't construct abutments or piers that constrict and alter the channel width as has been done at the current site.)

4. Discharge, sediment, and wood transport: accommodate the design discharge and associated bedload and debris without backwater effects. (I agree: The County should design a structure that will survive at least a 100 year flood event and will not create backwater effects. However, a 1988 FEMA study suggests a 100 year flood event might overtop the current bridge deck and destroy the structure. The FEMA study was actually "conservative" in that it did not consider in detail the possible backwater effects created by the current structure nor did it appear to consider in detail documented past peak flows at the site, such as the 1899 or 1948 events.)

5. Gradient: facilitate the natural stable stream gradient through the crossing site. (I agree: don't create a constriction with abutments and piers such as those that exist at the present site since doing so will interfere with the natural stream gradient causing scour and deposition.)

6. Stability: understand, predict trend, and accommodate river instability. (I agree: don't place a bridge at an unstable site on a river where there has been a long history of bridges washing out. Rather, place a crossing where the river is straight and likely more stable.)

7. Substrate and bedforms: provide for the distributions and forms of adjacent river sections. (It is not clear what Ms. Sylte is asserting with this statement, but I presume she is asserting a general principle of adequately designing the bridge to avoid altering natural processes and to which I can agree.)

Attachment B: Summary of Maclay Bridge Washouts and Rebuilding and Future Flood Potential

On p. 4, item 7 of her memo, Ms. Sylte asserts, "*What I can comment on is that this bridge has lasted a long time, more than 75 years; it has issues common to a lot of undersized bridges on meandering streams; it has also not washed out like so many other bridges of its era have…making one wonder that the site and bridge have functioned together much better than many bridge crossings.*"

Ms. Sylte's statement is <u>very</u> wrong in its "facts." If one researches the checkered history of the bridges at the current site, it is evident bridges have washed out at the current site up to 5 times, or once every 20 to 30 years. Needless to say, that's not a very good track record for a bridge site and it certainly does say something about how "well the site and bridge have functioned together", but not what Ms. Sylte implies. Consider the following documented facts:

1. A bridge appears to have first been constructed at the present site in the late 1800's, when, according to anecdotal information presented by the Maclay Bridge Alliance on its website, a bridge was constructed in 1893 to span the river. No mention is made what happened to this bridge but in 1899, the USGS recorded the largest Bitterroot River flow ever measured at the present bridge site of 38,300 cubic feet of water per second, (which by the way appears to be in the range of the flow that FEMA assumed for a 500 year flood event in its 1988 study.) It is likely any bridge existing at the present site washed out during that huge flood event.

2. A subsequent bridge at the Maclay Bridge site may have been constructed around 1922, since the County's archives contain bridge blueprints dated 1922 for a bridge consisting of two Parker trusses to be built at the Maclay Bridge crossing. According to Maclay Bridge Alliance anecdotal information obtained from long time residents, a bridge was washed out at the current site in 1923 when a large snag hit the bridge during a major flood and knocked it into the river.

3. Various county documents such as the 1994 EA and MDT bridge data bases refer to a bridge constructed or reconstructed at the site in 1935, although no details are given and no plans have yet been found in County archives with that date. A 1935 bridge may have been a replacement for one that washed out in the 30's.

4. In 1948, it is well documented the entire Maclay Bridge washed out in a large flood event that was subsequently reported in <u>The Missoulian</u>. No river flow measurements were taken at that time to indicate flow rates. Historic Commissioners Journals from 1945 to 1964 indicate the county began planning for a reconstruction of bridge abutments and pier(s) after the 1948 flood, but various legal and financial problems blocked its construction. The County engineer resigned over bridge design issues and it is not clear what oversight, if any, was given to construction of piers and abutments, which a contractor may have continued to build on his own at the site. This led to an awkward situation later when the County had to admit the contractor owned the abutments and piers, not the County.

In 1952 when the legal issues were resolved and construction could advance, the County determined it did not have money to construct a new bridge to place on the piers at the site and searched for an inexpensive used one. According to the historic Commissioner's Journals, an old abandoned truss bridge was finally found "up the Blackfoot" at a place called Ninemile Prairie. No records are known that give the age, condition, or history of that bridge. However the Journals state the old Blackfoot bridge was moved to the site and parts of it used in 1952 to erect parts of the current bridge. Since the bridge did not "fit" the site, a short pony truss was inserted in the middle, between two larger Parker trusses, creating a 3 component truss bridge. This meant constructing a second pier in the east river channel beside the existing one to support the pony truss and east Parker truss.

5. In the 1960's, County records indicate the east Parker truss was damaged due to a "wash out" at the east abutment and/or overloading of the truss. Thus, in 1964 the east truss was replaced with two pre-stressed concrete bridge sections and a third pier was added to the channel, not far from the other two piers. This has led to the current arrangement (from west to east) of a Parker truss of undetermined age and origin put in place in 1952; a pony truss also of undetermined age and origin put in place in 1952; and two pre-stressed concrete spans put in place in 1964, with a total of 3 piers in the east side of the river channel.

Future Flood Potential: Factors That Will Affect the Size of Future Bitterroot River Floods

Since 1899, the Bitterroot Valley, which is the watershed for the Bitterroot River, has undergone substantial changes due to human habitation. These changes will act to increase the potential for rapid rain and snow runoff, creating major river peak flows in the future. Those changes include:

- Increased numbers of roads in the mountains which will intercept shallow ground water flows and cause them to flow more quickly to stream channels and into rivers.
- Loss of tree cover due to timber harvest, clear cutting, major forest fires, and roads which will mean snow will melt faster on mountain slopes in the spring.
- Urbanization and "suburbanization", ie, the construction of driveways, parking lots, paved roads, and roof tops, which will cause more rain and snow melt to flow directly into the rivers instead of infiltrating into the ground water.
- A warmer climate which may lead to more extreme storm events as well as more large forest fires. A warmer climate also means winter snows will more rapidly melt in the spring instead of slowly releasing the stored water.

The highest recorded flow as measured by the U.S. Geological Survey at the current bridge site was 38,300 cubic feet per second in 1899. At that time, there were few if any man made obstructions along the lower river channel. For example, most of the town of Lolo; the various subdivisions along the Bitterroot River including all of the developments between Lolo and Missoula; Blue Mountain Road; Knife River's levees protecting its gravel pit and workings next to McCauley Butte; and the now-elevated River Pines Rd.(which acts like a levee) did not exist as prominent features until recently. Thus prior to these changes the Bitterroot River could overflow its banks, effectively temporarily storing that water and reducing peak flows that might otherwise reach the current bridge site.

In addition, the present bridge with its projecting abutment and three piers were not there to further constrict the flow and prevent the flood waters from using all of the flood plain at that point. Thus the flood height for a 100 year flood event might be expected to be even higher today at the present bridge than in the past. In short, as more man-made structures channel the river along its lower section, the height of the flood level is raised.

The dramatic effects of urbanization on flood patterns are well documented. For example, in Mercer Creek near Bellevue, Washington, human development along the stream from 1978 to 1994 caused the maximum measured stream flows to be 2 to 3 times higher than during the period from 1956 to 1977 (Hyndmans' Natural Hazards and Disasters, p. 334 (2003)).

Unfortunately, we have major data gaps in the record for past large flood events in Montana that washed out Bitterroot River bridges and thus we do not know the maximum flow of many past large floods which could aid us in assessing future flood risks to bridges. The following is a data table compiled of all USGS and National Weather Service measurements for maximum stream flows for the lower Bitterroot at the present bridge site. Of particular concern is the lack of measurements for peak flows during known major flood events that washed out the current bridge, such as 1923, 1948, and the 1960's. This lack of data makes it difficult to accurately predict the recurrence intervals and maximum flows for 100 year flood events. Thus engineers may choose to rely on unreliable computer models which do not accurately factor in many of the human-caused changes. The variations in gage height in the table are likely due to a number of variables, including presence or absence of human improvements (constrictions) in the flood plain, degree of vertical bed scour that occurred during the flood, etc.

Combined US Geological Survey and National Weather Service Peak Flows for the Bitterroot River Near Maclay Bridge

Water Year	Date	Gage Height In Feet	Stream Flow In CFS
1899	Jun. 20, 1899	11.55	38,300
1900	May 13, 1900	---	18,200
1901	May 30, 1901	---	18,400
1903	Jun. 05, 1903	---	19,700
1904	May 25, 1904	---	18,300
1974	June 18, 1974	13.40	30,000 (NWS)*
1975	June 20, 1975	11.10	19,900 (NWS)*

Water Year	Date	Gage Height In Feet	Stream Flow In CFS
1976	May 15, 1976	11.00	19,500 (NWS)*
1982	June 18, 1982	11.00	23,400 (NWS)*
1990	May 31, 1990	8.13	10,200
1991	Jun. 07, 1991	9.76	15,200
1992	May 01, 1992	6.54	6,370
1993	May 22, 1993	8.71	11,800
1994	Apr. 23, 1994	7.22	7,900
1995	Jun. 04, 1995	9.53	14,400
1996	Jun. 10, 1996	11.83	20,300
1997	May 18, 1997	13.11	24,800
1998	May 27, 1998	8.40	10,000
1999	Jun. 04, 1999	10.65	15,700
2000	May 29, 2000	7.60	8,550
2001	May 15, 2001	7.68	8,610
2002	Jun. 01, 2002	10.33	14,900
2003	Jun. 01, 2003	12.65	21,600
2004	Jun. 07, 2004	7.92	8,830
2005	May 20, 2005	7.94	9,100
2006	May 21, 2006	11.24	17,500
2007	Nov. 08, 2006	9.27	12,200
2008	May 21, 2008	11.97	19,600

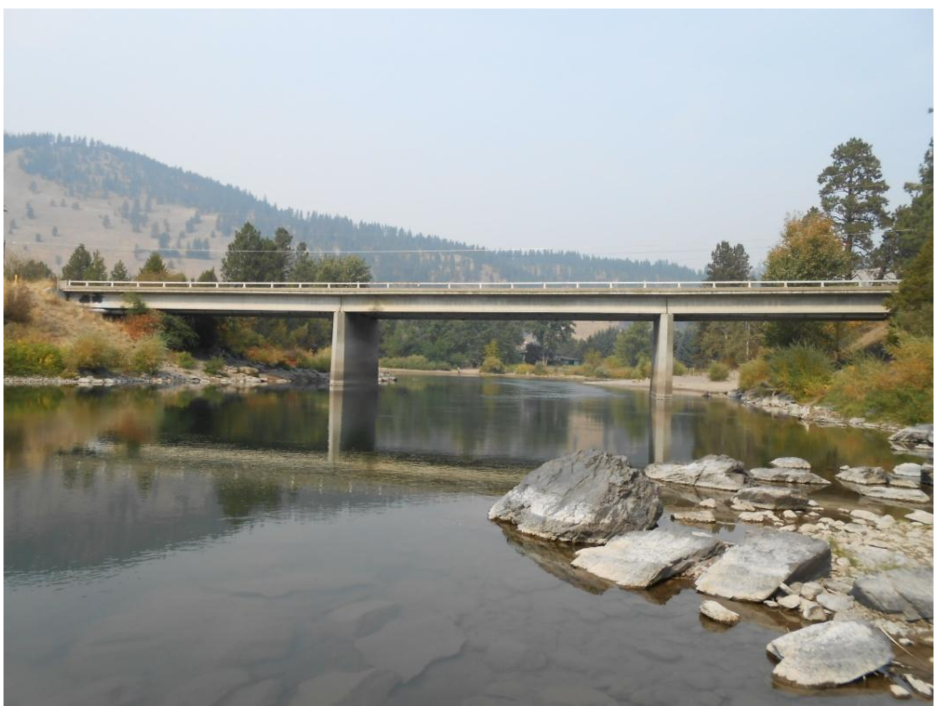
Water Year	Date	Gage Height In Feet	Stream Flow In CFS
2009	Jun. 01, 2009	11.38	17,900
2010	Jun. 06, 2010	9.94	13,900
2011	Jun. 09, 2011	11.37	18,600

indicates data combined from NWS measurements

Attachment C: Missoula Area Bridge Sites

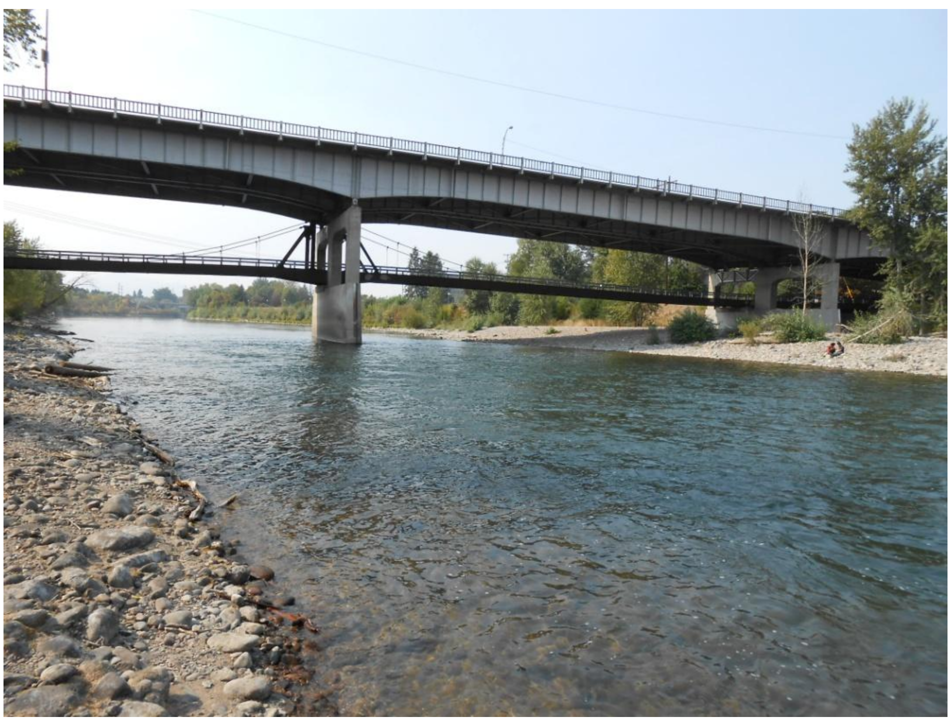
Ms. Sylte states that all bridges provide some stream access for the recreating public and that is certainly true. However not all bridges create significant attractions such as large scour holes and sand bars, or offer a truss structure that invites diving as does Maclay Bridge. Therefore it is incorrect to make a broad generalization that "all bridges create recreation sites".

This is supported by a brief survey of Missoula area bridges to observe any with situations similar to Maclay Bridge, ie, with obvious deep swimming holes created by scour, or sand bar conditions around multiple piers. Of the ten bridges surveyed to compare with Maclay Bridge, none had multiple piers placed closely in one part of the channel. Most had streamlined piers designed not to impede the flow, with abutments that did not act to obstruct the stream during high flow. With one exception, none of the ten bridges were associated with a major swimming/diving/sunbathing recreation site. The exception, the East Missoula Bridge over the Clark Fork, does provide access to a large sand and gravel point bar upstream at a natural pre-existing meander in the river that many find an attraction. But the bridge did not create those circumstances, merely provided access to them. Attached are a series of photos of Missoula-area bridges for your information and comparison.

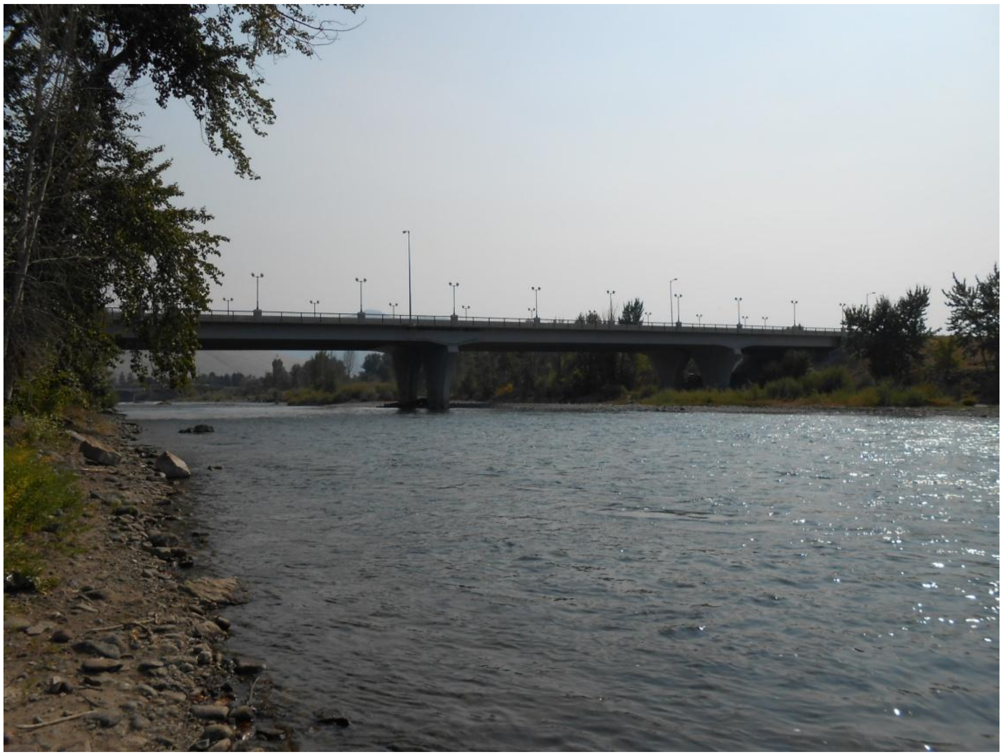


East Missoula Bridge on the Clark Fork looking upstream. Notice the well designed piers and lack of abutments that constrict the flow. The point bar upstream of the bridge on the right is the recreational draw in the area.

University pedestrian bridge on the Clark Fork looking upstream. Notice the few piers, lack of scour and sandbars, and little evidence of recreation use.



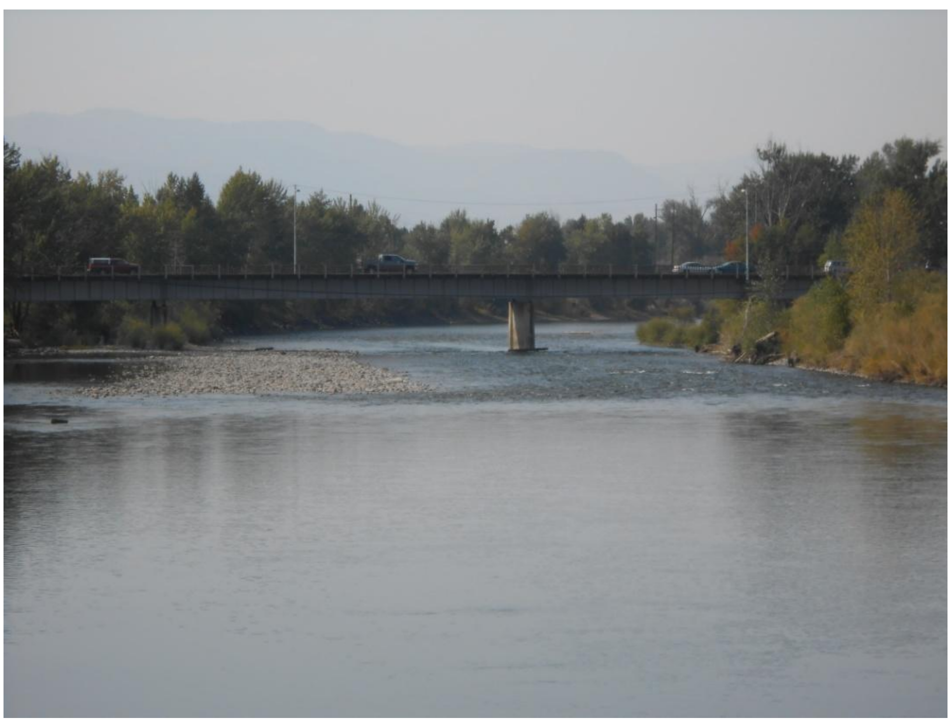
Madison Street Bridge on the Clark Fork looking downstream. The gravel bar on right is partly due to the delta from Rattlesnake Creek which enters the Clark Fork just upstream. Notice the well designed pier and lack of channel constriction.



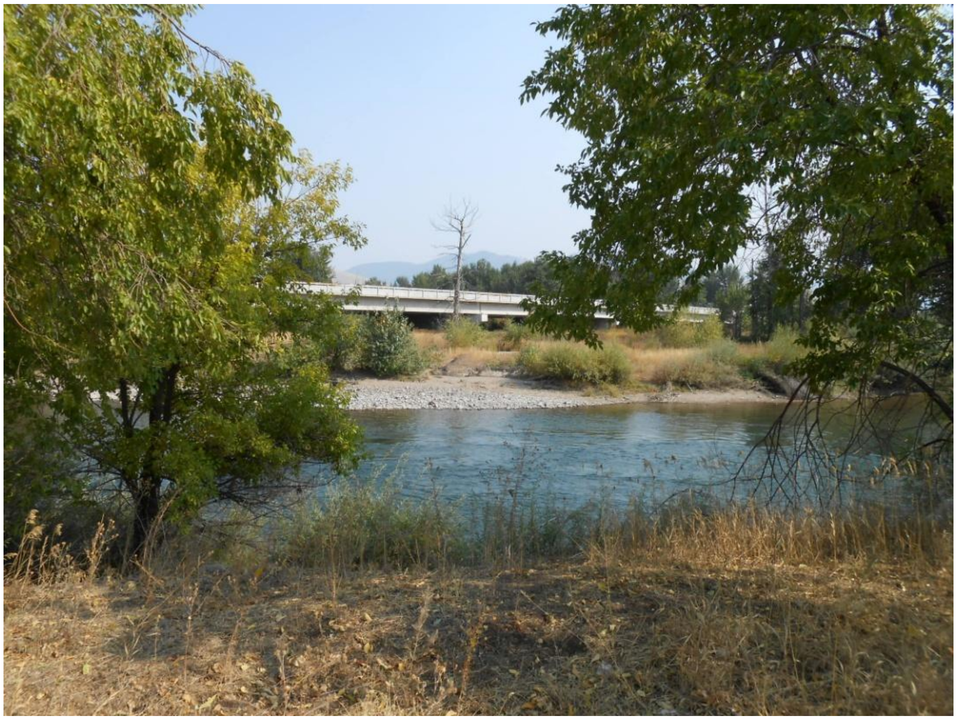
Orange Street Bridge on the Clark Fork looking upstream. Again the piers and abutments to not constrict the flow and thus little scour or sand bar development is evident. There is little evidence of recreation use.

Missoula railroad bridge on the Clark Fork looking upstream. The piers are blocky and not streamlined but do not appear to be significantly constricting the flow. No evidence of recreation use.

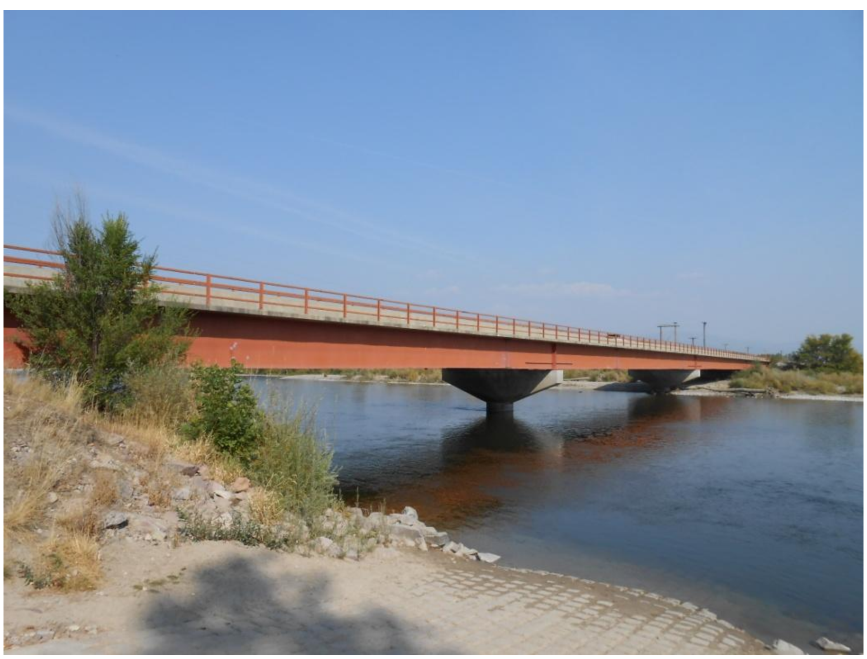
California Street pedestrian bridge on the Clark Fork, a suspension bridge with one pier located on a pre-existing island. Again the abutments and piers do not constrict the river flow.



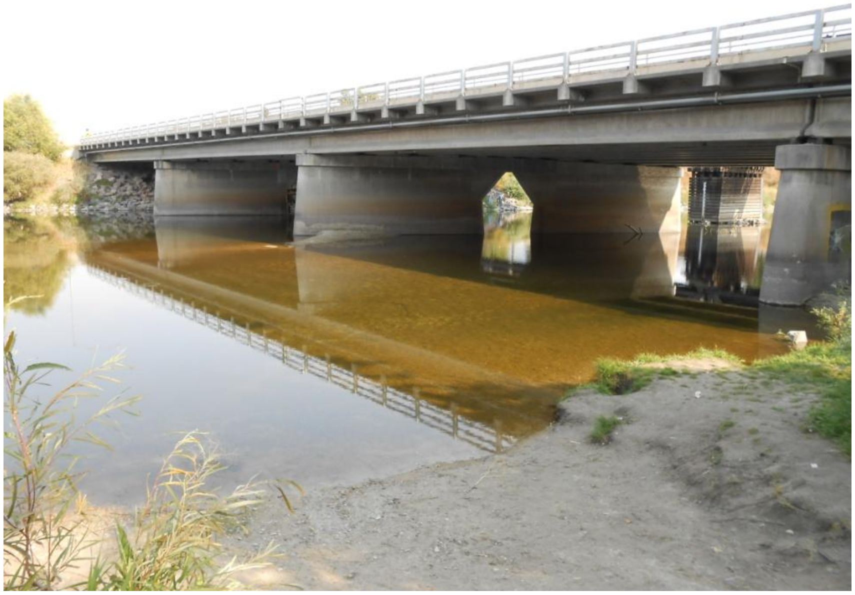
Russell Street Bridge on the Clark Fork from upstream. Again there is minimal pier and abutment constriction of the channel and little evidence of recreation use.



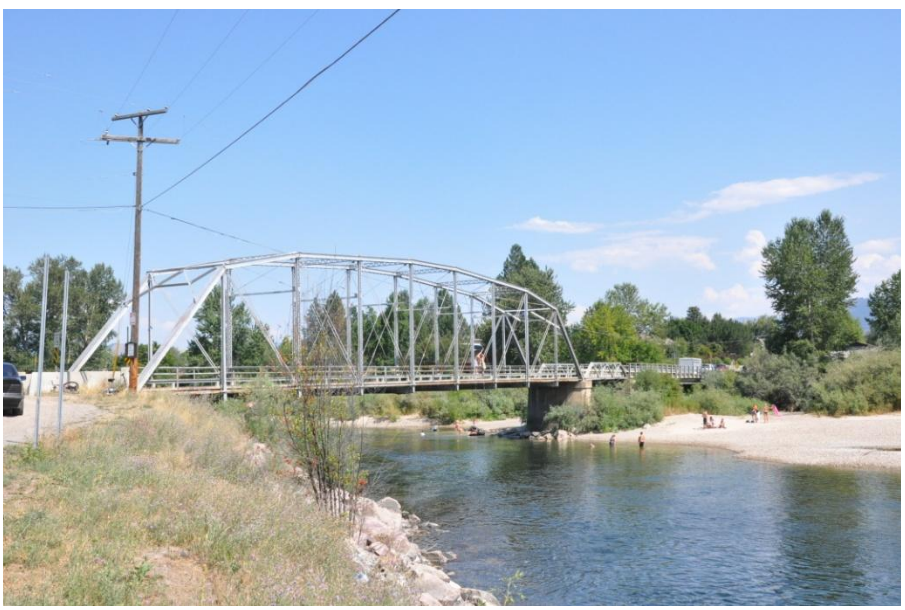
Reserve Street Bridge on the Clark Fork looking upstream. Again there are minimal piers and abutments constricting the flow and no evidence of scour or sand bar creation due to these structures.



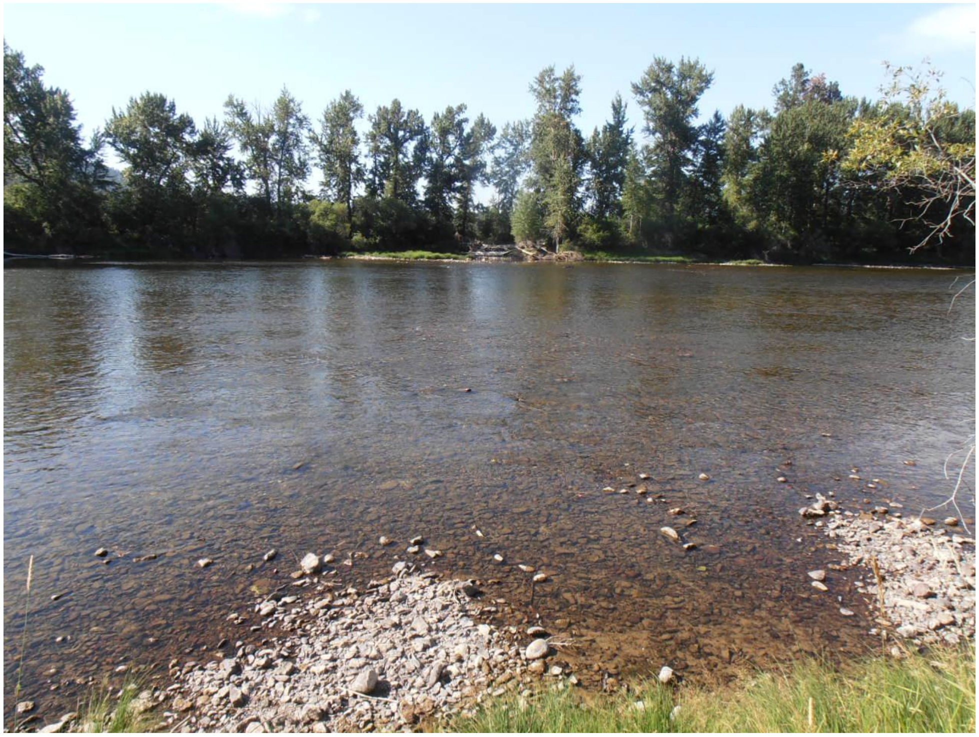
Kona Ranch Bridge on the Clark Fork looking downstream. Again it shows well designed abutments and piers with minimal river constriction, scour, or sand bar development. The only recreation use is at the river access point nearby, constructed by the MTFWP.



Buckhouse Bridge on the Bitterroot River looking upstream, with a timber-cribbed pier of the old railroad bridge parallel to Buckhouse just visible to the right. There are 3 piers at Buckhouse but they are stream lined and widely spaced and do not appear to be creating a major swimming hole or sandbars.



Maclay Bridge on the Bitterroot River looking downstream. The bridge consists of 4 sections with 3 piers close together in the east channel. The west abutment on the left is a prominence that was constructed into the channel, creating a constriction between it and the 3 large cement piers in the east side of the channel where the sand bars and island have developed. The scour hole extends under the truss bridge section where the diver is preparing to jump.



A view to the west of the Bitterroot River in the vicinity of the proposed West South Avenue bridge crossing. The Bitterroot River is straight and relatively shallow here, with no sand or gravel bar development.