2017 Beaverhead River Flushing Flow Synopsis

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The East Bench Unit Joint Board, U.S. Bureau of Reclamation (Reclamation), and Montana Fish, Wildlife & Parks (FWP) released a flow regime from Clark Canyon Reservoir between May 4th and May 8th to mobilize fine sediment deposited into the Beaverhead River by Clark Canyon Creek. Clark Canyon Creek is the first major tributary to the Beaverhead River downstream of Clark Canyon Reservoir. Clark Canyon Creek enters a very robust tailwater fishery; the Beaverhead River typically supports 2,000 to 3,000 trout per mile in this reach and provides one of Montana's premier trophy fisheries. Up to 48,000 days and $21 million dollars are spent by anglers on the Beaverhead River each year, making the viability of this fishery of high importance locally and statewide. Periodic sediment loading from Clark Canyon Creek has had a severe negative affect on this fishery. The problem has been most pronounced when accelerated sediment delivery from Clark Canyon Creek coincides with low flow releases from Clark Canyon Reservoir and sediment loads delivered by the creek exceed transport capacities in the Beaverhead River. These sediment events can result in extensive deposition of fine sediment over several miles of the Beaverhead River and cause a severe decline in the fish population; trout abundances are typically reduced by greater than 50% following large sediment events.

The large reductions in trout abundances and reoccurring nature of these sediment events resulted in numerous concerned citizens, angling groups, and outfitters approaching Beaverhead Watershed Committee (BWC) to help find a solution to this problem. The BWC coordinated several studies to determine the cause of sediment events and the type of flushing flow that would mobilize deposited sediment. Mass failures of the naturally highly erosive volcanic ash geology in the North Fork of Clark Canyon Creek are the primary sediment source. Sediment events are stochastic in nature and are typically associated with rain on snow events or localized thunderstorms; average conditions do not produce harmful sediment loading. When the fine-grained volcanic rocks in this sub-basin become saturated by storm events their inherent instability and steep hill slopes result in massive production of sediment that is rapidly transported to the Beaverhead River. Reclamation completed a sediment flushing flow model and report in 2012 that predicted flows of 600 cfs were needed to mobilize sediment; however, this report did not provide a duration or plan for implementing flushing flows. Therefore, Applied Geomorphology, Inc. (AGI) was contracted to synthesize all previous studies and 1) attempt to define what conditions resulted in a sediment event and 2) the structure of a flushing flow hydrograph that will mobilize and transport the associated sediment from the upper tailwater reach of the Beaverhead River and cumulatively consume less than 2,100 acre-feet. These reports are available on the BWC website (http://www.beaverheadwatershed.org/).

Beginning in the winter of 2013-2014 the East Bench Unit Joint Board, Reclamation, and FWP agreed to annually store 2100 acre-feet of water in Clark Canyon Reservoir to provide a flushing flow if a Clark Canyon Creek sediment event occurred. The 2,100 acre feet was stored by reducing non-irrigation releases from the reservoir by approximately 5 cfs for the duration of the non-irrigation season. In the occurrence of a sediment event the stored water would be delivered as described by AGI (Figure 1) to mobilize and flush it from the upper Beaverhead River and re-deposit it in the floodplain or channel margins to minimize detrimental effects to the fishery. Sediment events did not occur during the first three years water was stored and, as mutually agreed upon, it became available for irrigation.

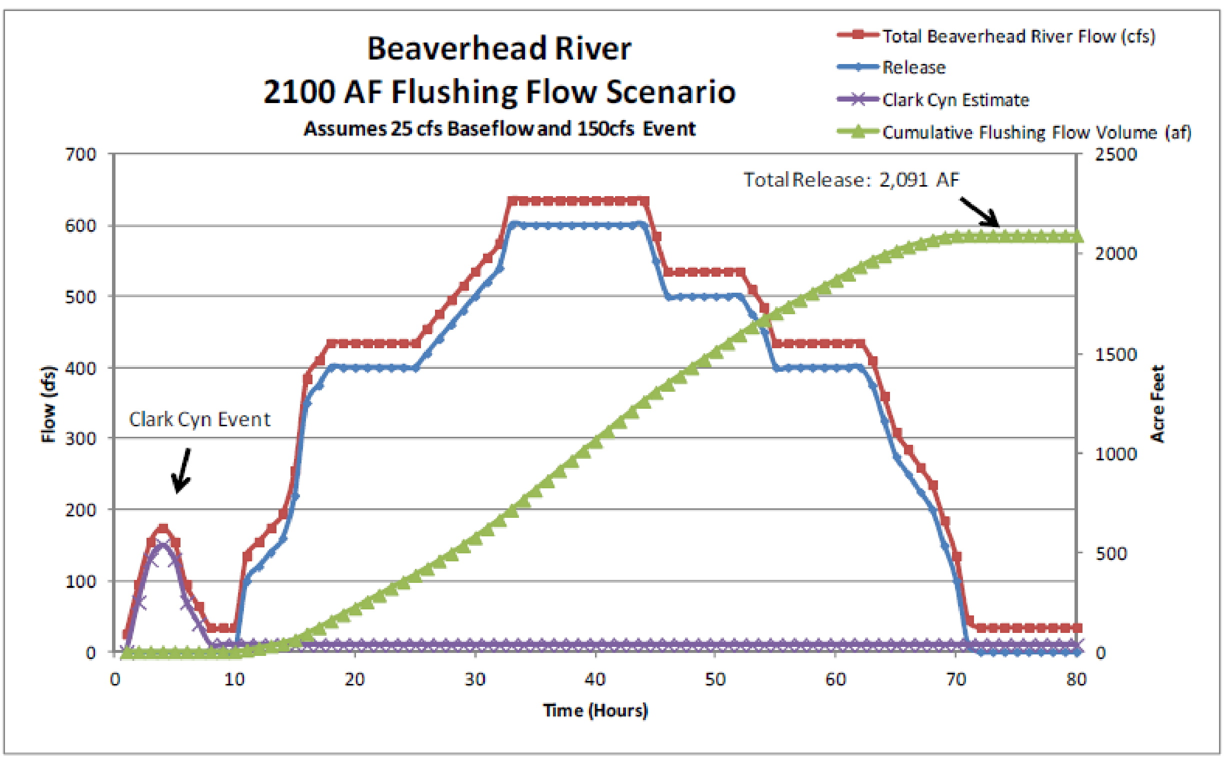

Figure 1. The preferred hydrograph shape and duration for a 2100 acre-foot flushing flow (AGI 2014).

A Clark Canyon Creek sediment event occurred between April 28th and May 1st, 2017. This event deposited fine sediment throughout the Beaverhead River from the mouth of Clark Canyon Creek to several hundred yards below High Bridge (Figure 2). On May 3rd representatives of the East Bench Unit and FWP met on-site and confirmed that a sediment event had occurred and that, although the event was smaller than those in previous years, a flushing flow was warranted. Reclamation concurred with the recommendation and a flushing flow was scheduled to commence on May 5th. The flushing flow was intended to follow the hydrograph described by AGI (2014) and transition directly into irrigation releases based on water orders the East Bench unit had received. On May 4th FWP posted signs at Beaverhead River fishing access sites and notified guides and outfitters of the impending flushing flow via email.

Figure 2. Sediment covering the Beaverhead River channel at High Bridge on May 3rd, 2017.

The flushing flow was initiated on May 5th and concluded on May 8th (Figure 3). Discharge was increased from overwinter releases of 43 cfs to 600 cfs over a 36-hour period. The peak flow of 600 cfs occurred for about 12 hours then discharges were reduced to irrigation demand (247 cfs) over the following 56 hours. About 12 hours after the flushing flow begin a second likely sediment event from Clark Canyon Creek occurred; high flows and sediment were transported into the Beaverhead River for about 24 to 48 hours coinciding with the rising limb of the hydrograph and peak of the flushing flow (Figure 4).

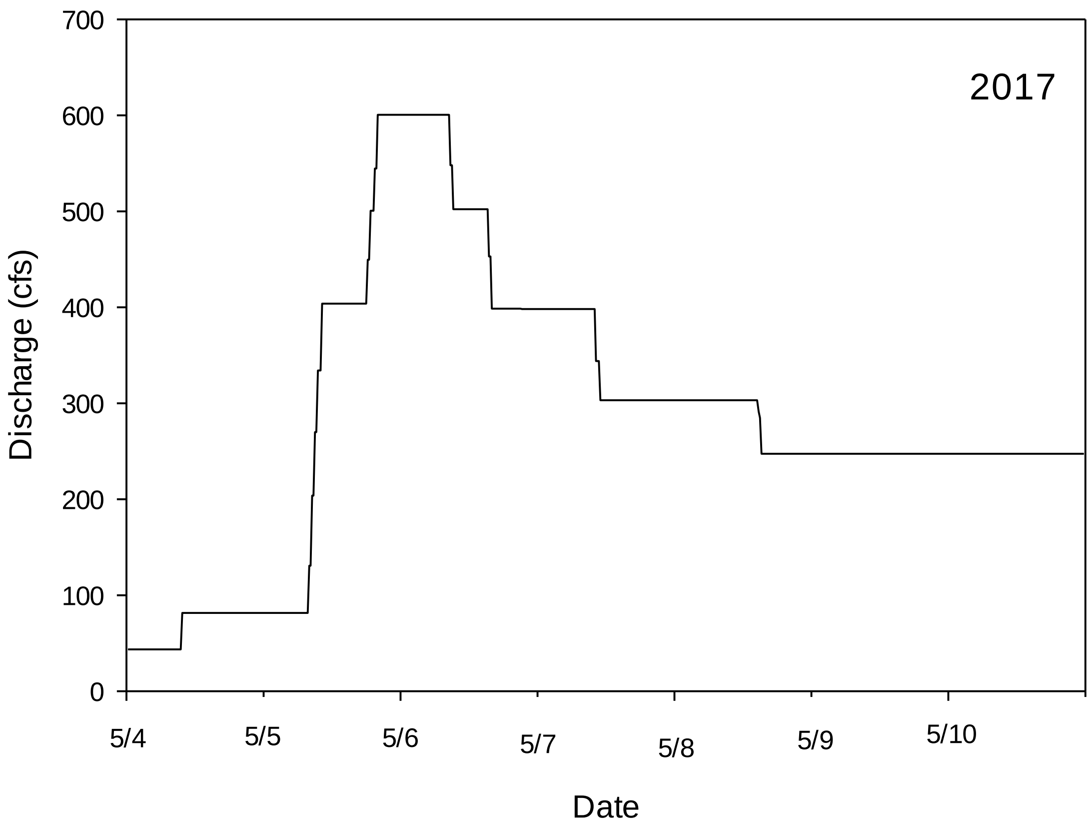

Figure 3. Hydrograph of the 2017 Beaverhead River flushing flow.

Figure 4. Confluence of Clark Canyon Creek and the Beaverhead River during sediment delivery on May 6th.

The flushing flow successfully 1) mobilized sediment deposited by Clark Canyon Creek and 2) prevented deposition of additional Clark Canyon Creek sediment. Beaverhead River turbidity was monitored at various sites between Clark Canyon Dam and Dillon throughout the flushing flow to determine whether material was being mobilized and transported. The general pattern that was observed at all locations downstream of Clark Canyon Creek can be described by turbidities at the Pipe Organ Fishing Access Site (Figure 5). Water clarity decreased to <10 cm of visibility during the rising limb of the hydrograph, which indicates that fine sediment was successfully mobilized. Water clarity begin to increase (24 cm) near the end of the 12-hour peak flow, indicating that mobilization of new material was declining. Over the next two days water clarity continued to improve to near pre-flushing flow levels indicating that all mobilized material had been transported or redeposited in channel margins and other low velocity areas. Water visibility at Buffalo Bridge was >120 cm throughout the flushing flow, which verified that all downstream turbidity resulted from mobilization of fine sediment originating in the Beaverhead River channel and not Clark Canyon Reservoir. Substrate surveys conducted before and after the flushing flow at a riffle below High Bridge indicated that the sediment deposited by Clark Canyon Creek was effectively mobilized and the channel bed was restored to substrates typical of the Beaverhead River; fine sediment was reduced from 78% to 17% of the substrate composition (Figure 6). Moreover, turbidity and substrate surveys indicated that the sediment imported into the Beaverhead River during the flushing flow remained in suspension and was not deposited in riffles immediately downstream of Clark Canyon Creek. Overall, this flushing flow successfully achieved its intended purpose and appears to be a viable solution to mitigate the effects of sediment events originating from Clark Canyon Creek.

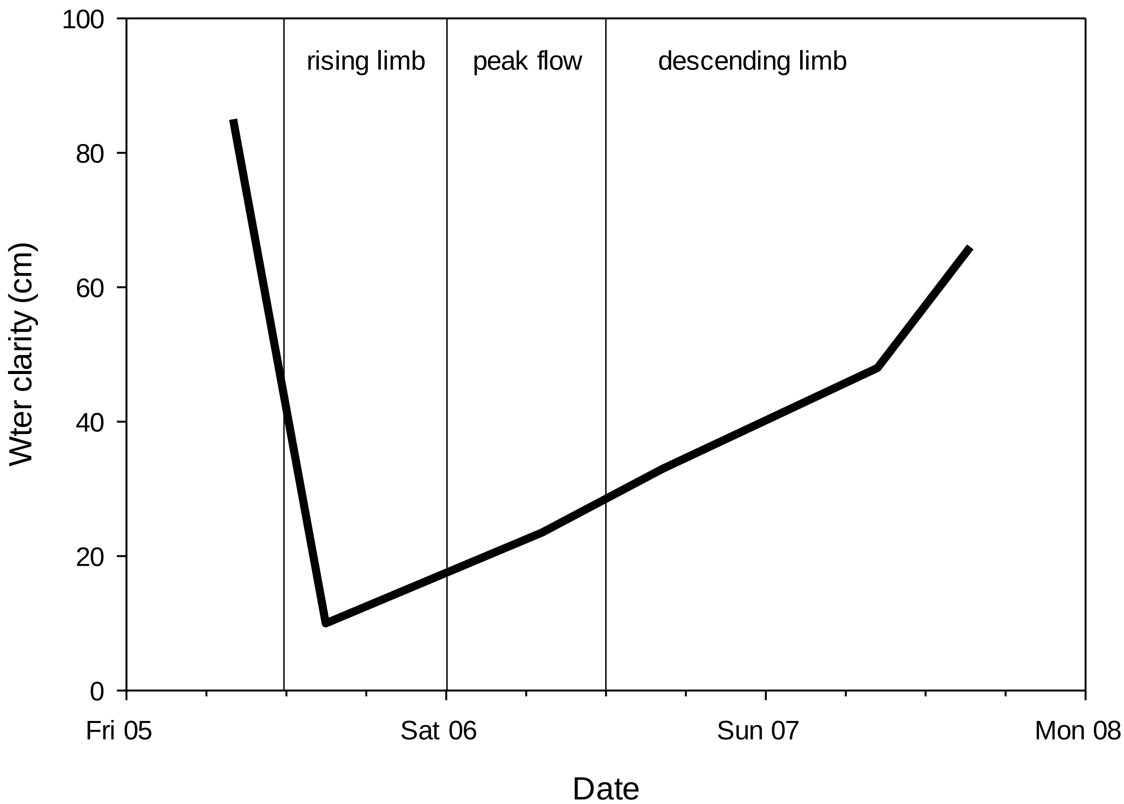

Figure 5. Water clarity at Pipe Organ Fishing Access Site during the Beaverhead River flushing flow. Water clarity was measured in cm of visibility using a secchi tube.

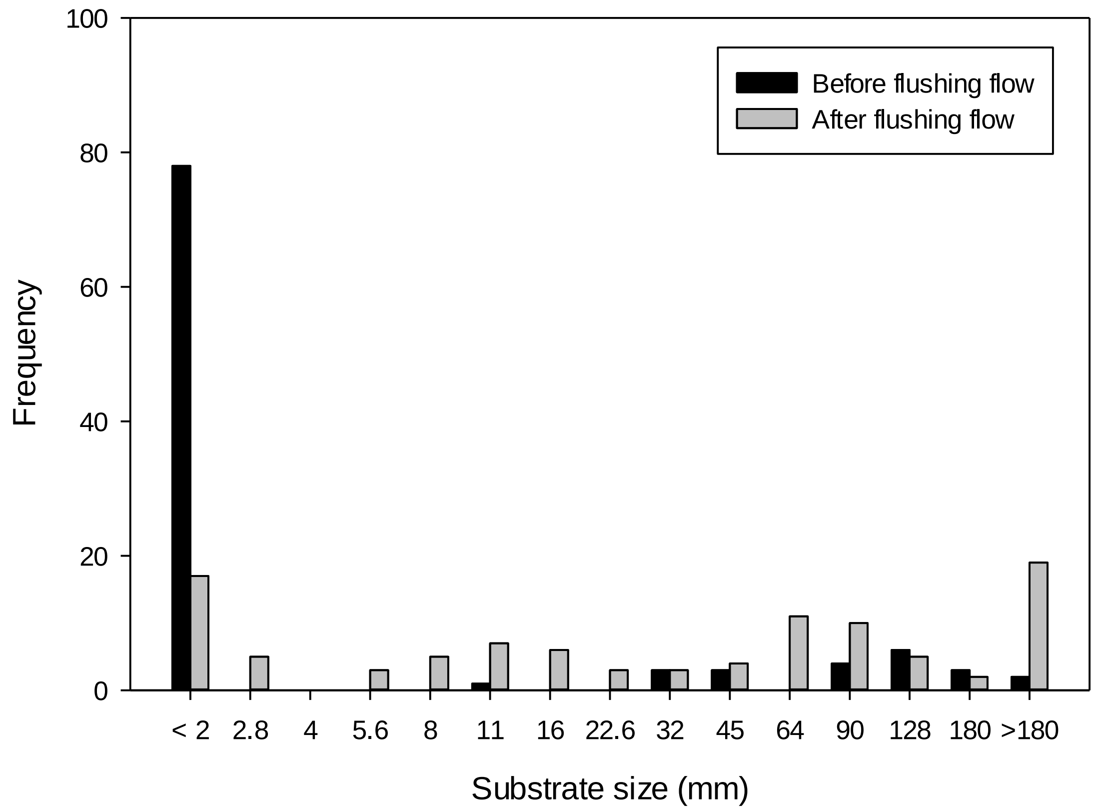

Figure 6. Substrate composition of the riffle immediately below High Bridge before (black) and after (gray) the Beaverhead River flushing flow. Substrate composition was assessed with a 100 pebble count at even intervals across four evenly spaced transects using a gravelomoter.