Sediment budget for Lewis & Clark Lake

Where does the sediment come from?

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The construction of dams along the Missouri River has disrupted the transport of sediments downstream. The formation of large reservoirs behind dams results in decreased flow velocity and deposition of sediments that form a delta that progressively builds into the reservoir. The deposition of sediment has formed a delta in the Niobrara, NE and Springfield, SD areas that is encroaching into Lewis and Clark Lake. The deposition of this sediment has had both negative and positive effects including rising water tables, localized flooding, and increased wetland habitat, among others. Ultimately, the reservoir will fill with sediment affecting hydroelectric power generation, recreation, and local infrastructure (Coker et al., 2009).

Studies have been conducted to assess the sources and amounts of sediment entering Lewis and Clark Lake including USACE (2001) and WEST (2010). We use these studies to assess the approximate amounts of sediment entering the reservoir each year by source area. Note that estimates of sediment addition can vary widely depending on the method used and that annual rates of sediment accumulation in the reservoir can vary depending on drought or flood conditions.

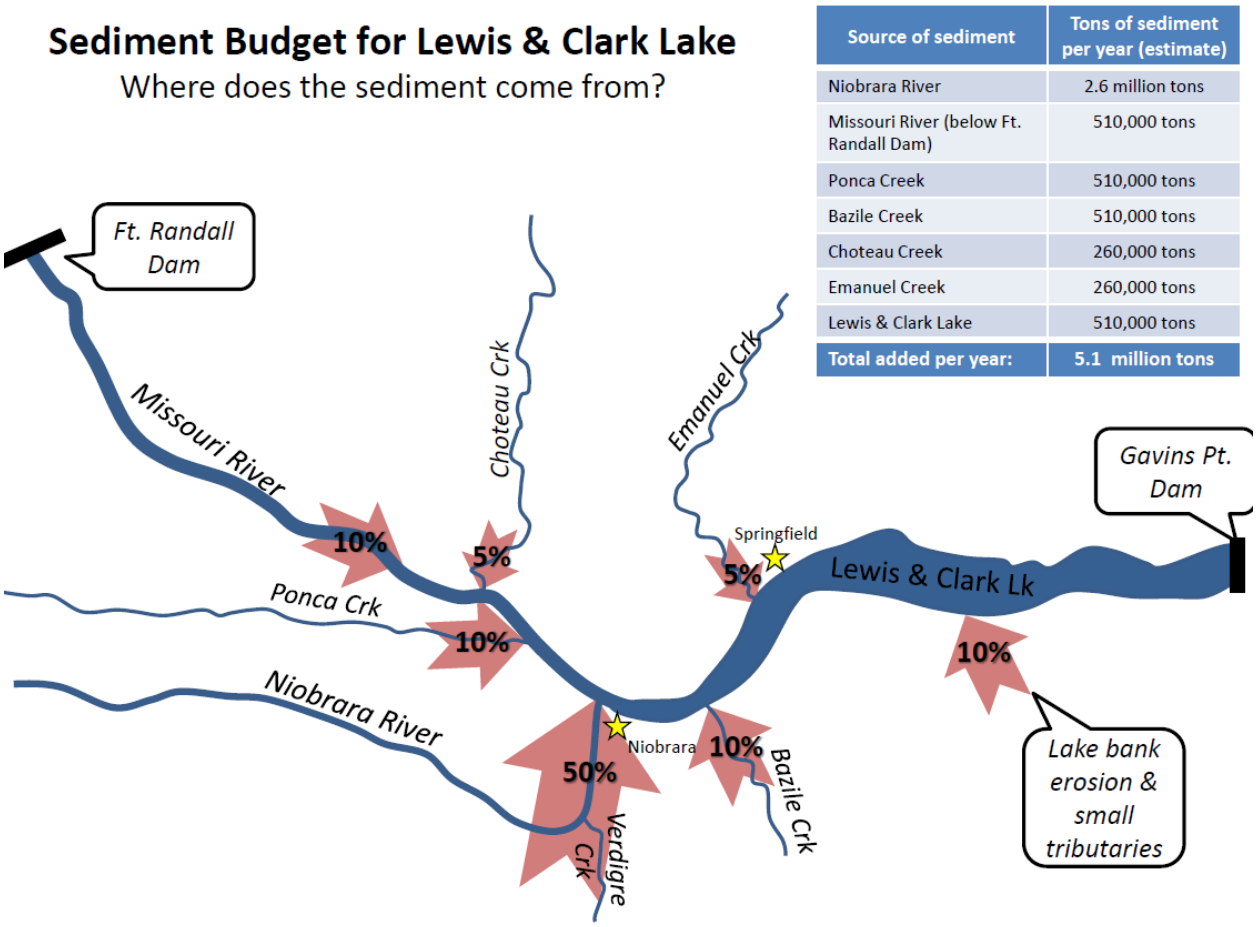
Previous reports commonly report volumes of sediment entering the reservoir in acre-feet. An acre-foot is equivalent to covering an acre of land with water one foot deep. The USACE reports that 2,625 acre-feet of sediment is accumulating in the reservoir per year. This volume of sediment is approximately equivalent to 5.1 million tons (using the USACE's estimate of 90 lbs per cubic foot). They have used these volume estimates, along with volumes of the Missouri River channel, to estimate the time it would take for the delta to migrate into and fill Lewis and Clark Lake.

The sources of sediment entering the lake include the Missouri River, bank erosion at Lewis and Clark Lake, and several tributaries of the Missouri River including the Niobrara River, Ponca Creek, Bazile Creek, Choteau Creek, and Emanuel Creek.

The largest of these sources is the Niobrara River, a sandy bed river transporting sediments from the Sand Hills of Nebraska. The Niobrara River includes sediment from Verdigre Creek,

which enters the Niobrara a few miles upstream from its confluence with the Missouri, as well as the Keya Paha River. Numerous estimates (summarized in WEST, 2010) report that the Niobrara River contributes between 1.8 and 3.4 million tons of sediment per year to the reservoir. Here, we use an average of this data, 2.6 million tons per year, for our estimates. This amount of sediment equates to approximately 1,326 acre-feet, or about 50% of the total sediment entering the reservoir per year. This is similar to what others (USACE, 2001; Coker et al., 2009; WEST, 2010) have estimated, from 40% to upwards of 60%.

The Missouri River itself contributes about 10% (about 510,000 tons) of the sediment to the reservoir. This sediment is derived from scour of the channel downstream of Fort Randall Dam and erosion along the river banks. Ponca Creek, one of the larger tributaries on this stretch of the Missouri River, contributes another 10% of the sediment to the reservoir. The headwaters of Ponca Creek are in South Dakota, but the creek's confluence is in Nebraska just upstream from the Niobrara River confluence.



Bazile Creek, a tributary that enters the Missouri River just downstream of Niobrara in Nebraska, contributes another 10% of the sediment to the reservoir. Lewis and Clark Lake also contributes about 10% of the sediment via bank erosion and contributions from small drainages surrounding the lake. The remaining 10% is split up between Choteau Creek and Emanuel Creek, small tributaries of the Missouri River in South Dakota.

The USACE estimates that if no changes in sedimentation occur, Lewis and Clark Lake will fill completely by the year 2175. Using USACE data, we have depicted the extent of the delta at 25 years (2038), 50 years (2063) and 100 years (2113) into the future. Research and discussions regarding the sustainability of the reservoir in the future have resulted in several possible alternatives to the filling of the reservoir. These are outlined in Coker et al. (2009) and include removing and relocating sediment from the delta onto sand bars or non-river locations, piping sediment from the delta to the river downstream of Gavins Point Dam, and flushing or sluicing via the dam.

Another alternative may include controlling the amount of sediment delivered by the largest source, the Niobrara River. WEST (2010) estimated that approximately 80% of the sediment coming from the Niobrara River is derived from channel, bank, and gully erosion. They suggest that changes in land-use management, such as the implementation of riparian zones along the river, may significantly reduce sediment additions into the Niobrara River. If practices to control sediment entering the Missouri River or any tributaries delivering sediment to Lewis and Clark Lake were to be implemented on a large scale, this may reduce the rate at which the delta grows over time, thus prolonging the life of the reservoir.

To predict future reductions in sedimentation and its effect on the delta, we have also depicted where the delta front would be at 25, 50, and 100 years in the future if there was an approximately 50% reduction in sediment delivery to the reservoir. This would reduce the rate at which the delta progresses into the reservoir by about half.

References cited:

Coker, H.E., R. H. Hotchkiss, and D.A. Johnson (2009), Conversion of a Missouri River dam and reservoir to a sustainable system: sediment management. Journal of the American Water Resources Association, vol. 45, p. 815-827.

USACE (2001), Niobrara and Missouri Rivers, South Dakota and Nebraska, Sediment Strategies, Reconnaissance Report, 60 p.

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