Guardians of the Reservoir - Webinar Q&A Log

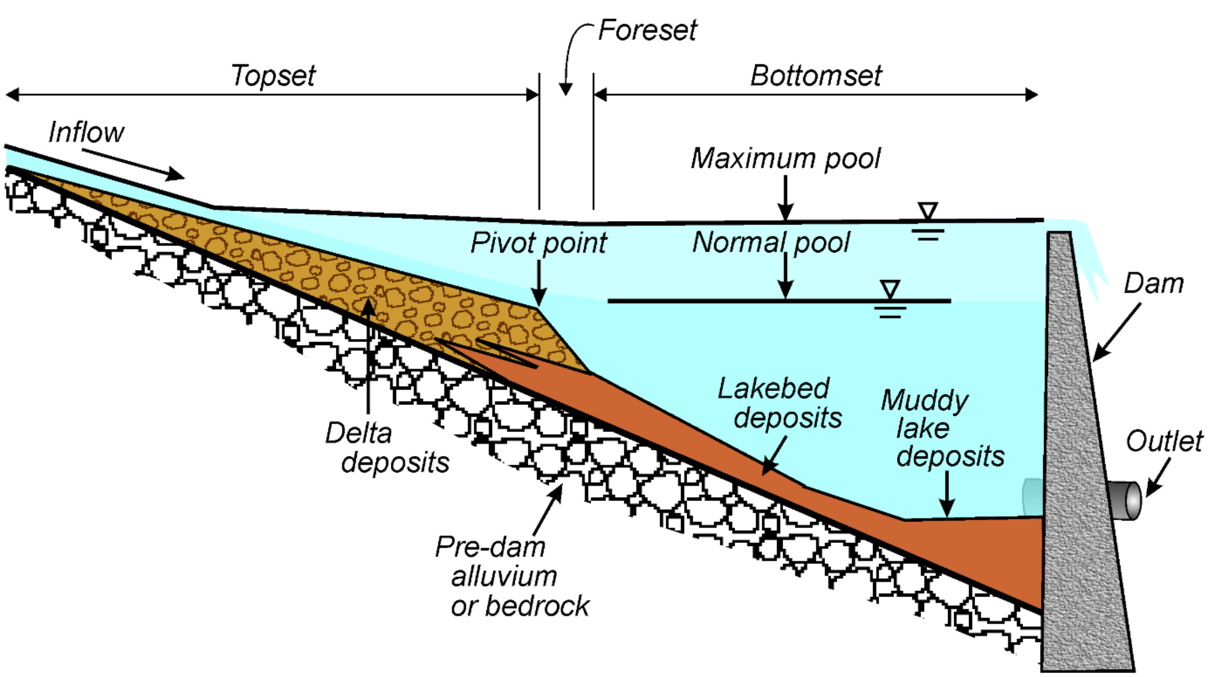
1. Would you allow contestants whose ideas are yet at TRL 3.0 (Experimental proof of concept)?

   Regardless of the current technical maturity of an approach, it may be submitted. There are a few judging criteria that a less mature concept won't score very well in, specifically the Project Plan and Team criteria. Entries that can be successfully developed and demonstrated within the 15-month Phase 2 development window and have a realistic project plan that clearly outlines the timeline and path that will enable an approach to be ready for the Phase 3 demonstration event will likely score better.

   While a lower TRL concept may not score well on the judging scorecard, Reclamation can reach out to a solver after the challenge is complete if they would like to engage further on a submitted proposal.

2. Where are the sedimentation issues within a reservoir and what is the scale or magnitude of the problem?

   The following image shows typical reservoir sedimentation. Coarse sediment (sand and gravel) tends to deposit at the upstream ends of the reservoir and form deltas with shallow water depths (typically 1 to 60 feet). On the other hand, fine sediment (clay and silt) tends to deposit farther downstream (closer to the dam) and at deeper depths (typically 20 to 200 feet).



Reservoirs typically present the following characteristics:

- Typical lengths range from 1 to 30 miles upstream of the dam with sedimentation along the entire length.
- Annual reservoir sedimentation inflow rates range from tens of acre-feet per year to thousands of acre-feet per year. These sediment inflow rates are equivalent to tens of thousands of cubic yards per year to millions of cubic yards per year.
- Sedimentation is typically at water depths that range from 1 to 200 feet.
- Sedimentation includes the whole range of grain sizes, i.e. clay, silt, sand, and gravel. Sand and gravel tend to deposit as shallow deltas at the upstream ends of the reservoir. Clay and silt tend to deposit farther downstream along the reservoir bottom.
- Sedimentation typically includes submerged wood of various sizes (twigs to logs).
- Reservoir water levels fluctuate both seasonally and year to year. Seasonal fluctuations may range from 2 to 20 feet. Fluctuations from year to year can range from 5 to 50 feet.
- The height of dam above the normal reservoir water level typically ranges from 20 to 100 feet.
- The drop in elevation from the top of the dam down to the downstream river channel ranges from 50 to 300 feet.

3. Some dredges can move 5,000 cubic yards of sand an hour. Is cost their major limitation? How much can safely be sent downstream?
    - Cost is the major limitation when incorporating sediment management at a large reservoir. The amount of sediment that can be sent downstream varies by location depending on permitting, endangered or threatened species in the downstream river, and downstream land ownership and use along the river corridor. More information about current dredging techniques is available in USACE (2015).
4. What is the current gold standard for sedimentation removal rate? Is a slower rate acceptable if the cost is significantly less?

    The gold standard for a sedimentation removal rate would be to remove enough sediment to keep up with the average annual incoming load. This would preserve the present reservoir storage capacity into the future. Some reservoirs have such a large incoming load that keeping up with incoming sediment may not be possible. A slower rate is acceptable as long as the rate is able to prevent significant storage loss over a multi-year scale. Solutions that remove sediment slowly or on a smaller scale could still be considered as a local remedy if cost or other improvements are addressed.
5. Is wildlife also classified as animals or plants living on the reservoir floor, if so; is there an acceptable level of local disruption allowed?

    Yes, wildlife has a broad classification to include terrestrial and aquatic species. Of particular concern is areas with threatened or endangered species. Any sediment removal system is likely to have some local disruption within the reservoir and this is acceptable. Prior to sediment removal management, federal projects typically undergo environmental assessments and permitting to limit and mitigate impacts where necessary. Solutions should aim to not impact wildlife more than a traditional dredging system, and any reduction in impact would be important to highlight.

6. Are there examples of dams that can pass through floating woody debris?

   The ability to transport floating woody debris varies by location. Some dams can pass large wood over the spillway. When wood must be passed through gates, tunnels, or over a spillway with baffles the wood can get stuck and risk not being able to close off the outlet or damage the structure.

7. If some of my Phase 1 proposed steps are accepted, are there teams to carry out Phases 2 & 3?

   Solvers will need to organize to develop their own teams for the various phases.

8. What should be the lifespan of the sediment system?

   Reservoir sediment management will have to be conducted each year to keep up with the inflowing sediment loads. A new sediment management system could be inexpensive and replaced frequently or more expensive and replaced less frequently. Economic analysis will determine the least cost approach.

9. What is the critical factor that leads you away from the use of conventional dredging? Too slow? Too costly? Too inefficient?

   Conventional dredging will continue to be a tool in the toolbox for many reservoirs. However, as innovative solutions that increase efficiency and reduce costs are developed more sediment management can be addressed within the limited budgets available.

10. Can you please provide more details on the composition of the sediment?

    Because federal reservoirs are located across the US within a wide range of landscape settings, there is a wide range of geochemical composition of the sediment. Coarse reservoir sediments range from sand to large cobbles while fine sediments range from silt to clay. Sediment properties can vary within a reservoir (clay to gravel) and typically vary widely from reservoir to reservoir. Specific data on sediment properties are only available for a few reservoirs. This competition is looking for solutions than can work for many reservoirs and is not intended to focus on a specific set of sediment properties for a specific reservoir.

11. Currently, how do you monitor sedimentation in these reservoirs?

    Sediment monitoring typically occurs with bathymetric surveys that are used to assess current storage (volume) over the range of reservoir stage operations (see Erosion and Sedimentation Manual, Chapter 9, https://www.usbr.gov/tsc/techreferences/mands/mands-pdfs/Erosion%20and%20Sedimentation%20Manual.pdf and more information on reservoir surveys at https://www.usbr.gov/tsc/techreferences/reservoir.html).

    The current topography is compared to "as-built" topography when available, to determine the sedimentation volume and spatial distribution. Where as-built topography is not available, estimates are made of the original surface through sediment probes, core samples, drilling, and other techniques. The reservoir operations, capacity, fluctuation in stage, and incoming discharge are also considered in monitoring to assess trap efficiency (how much sediment passes through or over dam versus trapped in reservoir), if and when sediment is flushed through drawdown or gate openings, or other means. When sediment management is planned, sediment data is also collected to further characterize the gradation and other characteristics important for determining the best method for removal.

12. Can you provide information regarding the proximity of railroad sidings and navigable waterways to the identified reservoirs?

    This is site specific and varies by location. Many reservoirs in the mountainous portions of the western United States have no nearby railroads or navigable waterways to transport equipment. In some cases, roadways are not nearby. The infrastructure requirements of any solutions should be considered by the solver.

13. Will nutrient or pollutant reduction benefits of removing sedimentation from reservoirs/lakes be a competitive advantage?

    While nutrient or pollutant reduction is beneficial in some of our systems, this will not factor into the evaluation criteria.

14. Why do you want to move the sediment downstream rather than remove them?

    Rivers rely on both the natural water and sediment load to establish ecosystems and establish a dynamic equilibrium. When sediment is removed from this equation, the downstream river is impacted and the landscape and ecosystem altered. Lack of sediment downstream from reservoirs can result in a number of problems, such as channel incision and bank erosion that causes loss of land or damage to infrastructure, reduction in aquatic and terrestrial habitat through riverbed coarsening and reduction in overbank flooding, lack of connectivity to floodplains reducing important nutrient and food exchange for both species and healthy soils, and loss of shoreline downstream due to reduced supply to coastal deltas. Some sediment can be repurposed for beneficial uses, but it is expensive to transport, costly to “clean” before reuse, and there is not enough room on the landscape to store all of the sediment trapped in reservoirs.

15. Does each dam and reservoir system require a different solution given they will have different conditions?

    It is unlikely there is a one-size-fits-all solution however, a solution may be applicable to many similar reservoirs.

16. Can one participant participate with multiple entries?

    No, please submit only your top solution to the challenge. We recommend you focus on a single quality entry as opposed to multiple entries.

17. What were the conclusions from the previous competition?

    You can view the results of the previous competition here https://www.usbr.gov/newsroom/stories/detail.cfm?RecordID=66923

18. Without removal and storage of the sediment, won't the removal rate from the reservoir depend on the acceptable discharge rate into the stream below the dam?

    Discharge into the downstream river is beyond the scope of this competition. The solutions should focus on innovative methods to remove and transport sediment.

19. Is the sediment problem to be resolved from point of view of affecting storage volume or the sediment entering the turbines or use location along with water?

    The focus of this competition is to maintain reservoir storage capacity.

20. Why do you express cost in $/cubic yard and not $/ton/mile as it is usually done for slurry pipelines in mining?

    Reservoir sediment management is tied to increasing storage volume, and thus sediment removal metrics are typically tied to $/cubic yard. Sediment mass is highly variable depending on grain size and bulk density, and thus typically not used for estimating cost.

21. In the previous reservoir webinar, there was mention of dams with integrated bypass pipes. But if I remember correctly, the bypass pipes were fed with inputs relatively close to the dams. I am more intrigued by incorporating dam bypass features fed with suspended solids further upstream of the dam (albeit it with careful design to minimize clogging). How frequent (years) are major dam restorations... that would allow the incorporation of these bypass approaches?

    Sediment bypass pipes that pass over, around, or through a dam or abutments are possible. However, constructing holes through dams is generally not desired, especially at deep depths. The upstream entrance to any holes through a dam should normally be above the reservoir water surface. This competition is looking for improvements to sediment management that do not cause dam safety concerns.

22. Are draglines the standard for removal on deep reservoirs? Are bottom vacuums usable?

    Relatively few reservoirs have ever been dredged and there is no standard method. Conventional dredging (hydraulic and mechanical) and dry excavation have been the most common methods employed to remove sediment from reservoirs. Dredging of reservoir sediment can be a viable option in cases where the reservoir pool cannot be drawn down for sediment management purposes. More information can be found in Morris and Fan (1998) and USACE (2015).

23. Do some of the lakes concentrate up usefully valuable ores, such as rutile, iron ore, gold or perhaps semi-precious stones? Are there any cases where useful recovery has taken place?

    This is not common. In general, the sediment removed is silt, sand, and gravel that does not contain valuable ores or semi-precious stones.

24. Has discharge of sediment from reservoirs caused sedimentation issues downstream or should that be a concern or addressed in the solution?

    Relatively few reservoirs have ever been dredged and few of those have discharged sediment downstream. The downstream discharge of sediment will help restore the natural sediment continuity. However, discharge of sediment into the downstream river is beyond the scope of this competition.

25. Is it okay to give the solution that doesn't remove the deposited sediments but permanently solves the problem of further sedimentation?

    This prize competition focuses on developing more affordable solutions for the removal of sediments already deposited in the reservoirs as one potential strategy for long-term sustainable management. The solutions should focus on removal and/or transport of sediment that work with existing infrastructure.

    Upstream reduction in sediment loads entering the reservoir, or major modifications to the dam to bypass or flush sediment are not the scope of this competition. For context, there are three broad sediment management strategies to help preserve the storage capacity of reservoirs (Kondolf, et al., 2014 and Randle, et al., 2017), but these are not the scope of this competition:

    1. Reduction of sediment loads reaching the reservoir (watershed management practices).
    2. Prevention of sediment deposition within the reservoir (sediment bypassing or sluicing).
    3. Removal of sediments already deposited in the reservoir (drawdown flushing, dredging, or excavation), or a combination of these strategies.

26. Does the Bureau of Reclamation usually manage land downstream from its reservoirs? If so, would they require permits to store sediment on land that they manage?

    Reclamation typically does not manage lands downstream from reservoirs. Land access approvals would be necessary for sediment management activities. Land management and sediment storage on land is beyond the scope of this competition.

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