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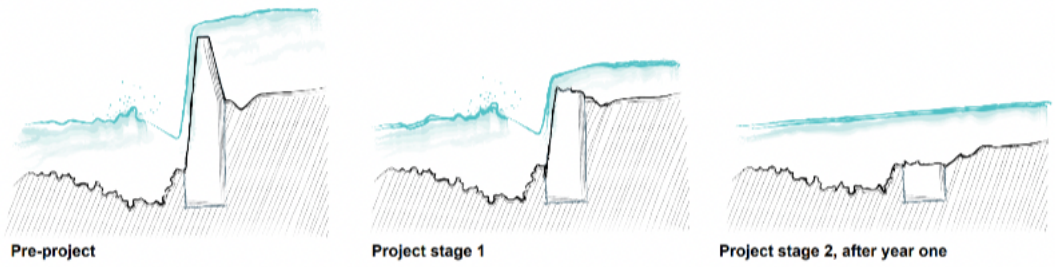
Re-Engineering the Glen Canyon Dam

The Glen Canyon covers a large area of the Colorado River, being around 710 ft tall and 1,560 feet across [1] , making it difficult to remove the dam without causing wide destruction of the surrounding environment and without requiring a large budget. Other than the budget, one of the largest concerns over removing the dam is the possible flux of sediment that would move through the river once it is removed.

Because of the sediment stored behind the dam, approximately 100 million tons per year according to Glen Canyon Institute, I would propose that a staged dam removal is used to allow water to be released over time. Using a staged dam removal process would mean that the dam is slowly removed over a time period of several years. Because Glen Canyon Dam is a concrete arch dam [1], I would suggest that a process like the one used for the Glines Canyon Dam be implemented. The Glines Canyon Dam was similarly a concrete arch dam and was around 210 ft (64 m) tall [3]. With around 15-16 million m^3 of sediment stored behind the dam, it was important for the dam removal process to consider how much sediment would be released [3]. This process begins with hydraulic hammers removing the height of the dam needed to reach the waterline [4]. They then continued by creating alternating notches on each side of the dam to slowly release the water and sediment from behind the dam. Each of the notches are chosen as the dam is in the process of being removed to allow for consideration of factors such as the reservoir levels, the slope, and the aggregate of sediments behind the dam [4]. An example of

this process is shown in Figure 1 below. As the Glen Canyon Dam has numerous characteristics similar to that of the Glines Canyon Dam, I believe that this would be the best decision to allow for the Colorado River to return to its initial beauty.

Figure 1:



Note: Simple staged dam removal process after a single year. Retrieved November 13, 2022, from "Solving Dam Problems: Iowa's 2010 Plan for Dam Mitigation" on http://publications.iowa.gov/33756/1/Dam_Mitigation_Plan_2010.pdf.

The staged dam removal process would have multiple benefits that would be advantageous for the future of the Colorado River and its surrounding communities and environment. One of the largest advantages, as mentioned above, is this process's ability to control the flux of the sediment flow. As there is a large amount of sediment behind the dam, it is necessary to make sure that the dam removal process doesn't cause a large influx of sediment flow. Fish are vital to their surrounding environment, so it is important to make sure their habitats and migratory patterns are not badly affected by this decision. Dams often interrupt the migratory patterns of

fish because they obstruct the natural paths that fish take, but there are also multiple other factors that affect the fish. The sediments that pile up in reservoirs can carry toxins, flow times change, and oxygen increases or decreases in different locations around the dam, all of which can have negative effects on the fish population [5]. The staged dam removal process would reduce all these effects, while using fish migratory patterns in order to make decisions on the depths of the notches they create [3].

One of the largest concerns over removing the Glen Canyon Dam is the loss of energy coming from the hydropower plant. The dam creates power for over 5 million customers along with multiple Native American tribes, so the removal of this dam would cause a large population to lose their source of power [6]. This same issue is projected to happen as the drought is lowering water levels throughout the Western United States. Currently, the Lake Powell Reservoir is at one of its lowest levels as it recently sunk below its target threshold of 3,525 ft. The elevation at which the reservoir will be unable to continue producing electricity is 3,490 ft, and, although the snow melt will increase the elevation for some time, there is a chance that the dam will have to stop generating power in the coming years [6].

The budget required to remove a dam of this size will have to be large considering the amount of area that has to be controlled and taken down. According to a paper by Ben Blachly and Emi Uchida from the University of Rhode Island, the cost to remove a dam costs “on average, $30,620 per additional vertical foot and $1,360 per additional horizontal foot” when it includes year and state fixed effects [7]. This would set the marginal cost of the dam removal to around $25,000,000. Because this proposal is for a staged dam removal set over multiple years, this cost would be spread over around 3-5 years.

A staged dam would provide the best opportunity to allow for the appropriate precautions when considering multiple factors such as the fish population, the flux of sediment, and cost of removal. Designing the removal process to last over the span of several years will allow for the essential planning needed to take into consideration the river and its surrounding communities.

References

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