SEDIMENTATION IN MACKAY RESERVOIR

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Introduction

Sediment deposition in Mackay Reservoir is a major concern to farmers, ranchers, residents, recreationists and other water users in the Big Lost River Valley. The reservoir and the 30 miles of channel upstream of the reservoir are the subject of a comprehensive nonpoint source assessment being conducted by a multi-agency, inter-disciplinary group of local, state and federal organizations as part of the Idaho 208 Big Lost River Water Quality Improvement Project.

This report describes the results of a cooperative effort conducted in support of this project by Hydrologists from BLM Salmon District and the Idaho Department of Health and Welfare Division of Environment. The object of the effort was to quantify the present day capacity of Mackay Reservoir and determine:

1- the amount of sedimentation in the reservoir

2- the long term sedimentation rate

3- the rate at which the reservoir capacity is diminishing

4- the life expectency of the reservoir

Description of the Dam and Reservoir

Mackay Reservoir is located about 5 miles north and west of the town of Mackay, Custer County, Idaho in Section 12, Township 7, North, Range 23 East, Boise Meridian. The reservoir has a full capacity of 45,050 acre feet and a 1341 acre surface area at the spillway elevation of 6067 feet.

Mackay Dam was completed in 1917 and is owned and operated by the Big Lost River Irrigation Company of Mackay, Idaho. It is an earthfilled structure of sand, gravel and cobblestone, 1430 feet long, 70 feet high with a top width of 15 feet. It is classified by the State of Idaho Department of Water Resources and the U.S. Army Corps of Engineers as a high hazard dam because of the concentration of people and property downstream and the size of the dam and its storage capacity; not because of its current condition, which is believed to be good.

The reservoir drainage area is 788 square miles. The maximum inflow to the reservoir was 2760 cfs on June 12, 1921, and the maximum outflow was 2990 cfs on June 10, 1921 as measured by the U.S. Geological Survey, Water Resources Division. The computed spillway capacity is 3250 cfs with 4 feet of freeboard on the dam.

The upstream channel is open to the reservoir. The slopes around the reservoir appear to be stable, with very few slumps and side sloughs. During the 1978 Safety Inspection, the dam owners estimated that the bottom of the reservoir had accumulated less than three feet of silt since the dam was constructed. All sediment delivered to the reservoir is believed to be derived from upstream sources, along the mainstem of the river and from the streams of the upper watershed.

Method

Reservoir capacity was measured by computing the sum of the volumes of water columns at regularly spaced depth stations along the seventeen linear transects of the reservoir. Each transects beginning and end point was carefully located on EPA flown large scale (1:4000) high quality natural color aerial photos. A jet boat (19.25 foot long Valeo Model RR Utility Boat with an Evinrude 140 HP motor) started at the shoreline of a transect and accelerated rapidly to a constant velocity. Depth soundings were taken 25 feet from the shore and then at 10 second intervals across each transect.

The lengths of a transect and width of each station were measured photogrammetrically from the aerial photo imagery of the reservoir. Volume computations were performed on a Texas Instruments model TI desk top calculator with printer. Depth readings were recorded to the nearest foot using a Humminbird Tournament Model Depth Sounder manufactured by Techsonic Industries. The unit weight of sediment for the sedimentation rate computations was measured from a sample of sediment taken from the reservoir.

Results and Discussion

The capacity survey indicates that on August 5, 1980, the capacity of Mackay Reservoir was equal to 16,629 acre feet. The 1919 capacity tables (assumed to be correct) indicate that the capacity of the reservoir on August 5 should have been 21,651 acre feet. By subtracting the 1980 measured capacity from the 1919 capacity, the volume of water inferred to be displaced by sediment is 5022 acre feet. While this is 11.1 percent of the full capacity of the reservoir (45,050) it represents 22.2 percent of the reservoir capacity on August 5, the middle of the irrigation season.

The long term sedimentation rate was determined by computing the equivalent weight of sediment from the displaced volume of water over the 64 year age reservoir. The inferred total weight of sediment acre this time period is tons. The acreage annual sedimentation rate is tons/year.

The rate at which reservoir capacity is diminishing is derived by evaluating the change in reservoir capacity due to displacement by sediment over time (figure 3). If one assumes that the current sedimentation rate remains the same, the reservoirs capacity diminishes at an average rate of 78.5 acre feet per year.

The life expectency of the reservoir at the above rate of storage depletion is 592 years for the reservoir at full capacity. While this does not seem to be very significant, it only represents the situation at the very beginning of any irrigation year. The life expectency of the 50% drawdown level (22500 acre feet - representative of mid-irrigation season) is 211 years. The life expectency of the 25% drawdown level (11,000 AF - representative of the late irrigation season) is 86 years.

Summary and Conclusions

The assessment of sedimentation in Mackay Reservoir indicates that reservoir capacity has been diminished by 5022 acre feet in the 64 years since the dam was completed. This figure agrees fairly well with the visual observation made by dam owners in 1978.

The analysis of the rate of depletion indicates that there is indeed a valid concern for the diminishing capacity of the reservoir for irrigation. The impacts of storage depletion are felt more significantly when the reservoir is drawn down to fifty percent of its capacity and less. At the fifty percent drawdown level, storage has been reduced by 22.2 percent. At the twenty-five percent drawdown level, storage has been reduced by 45 percent.

The life expectency of the middle to late season irrigation water storage capacity is on the order of 100 years. This, of course, places a limit on the future potential for irrigation and agriculture in the Big Lost River Valley and substantiates the need for remedial actions on the sediment sources identified along the river and in the upper watershed by the 208 project.

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