ADAPTIVE MANAGEMENT WORK GROUP MEETING
July 18, 2002

TEMPERATURE CONTROL DEVICE UPDATE

Dennis Kubly, Bureau of Reclamation

The purpose of this presentation is to update the Adaptive Management Work Group (AMWG) on information gathered in the feasibility evaluation for the proposed selective withdrawal device on Glen Canyon Dam and to seek a recommendation from the AMWG on further actions and schedule. The last update was provided at the AMWG meeting on April 12-13, 2001 and included a summary of the second workshop on this subject held January 22-24, 2001. At the April 2001 AMWG meeting, Larry Anderson inquired whether Reclamation had conducted a survey of other facilities with selective withdrawal to determine what designs have been used, their relative successes in meeting delivery targets for water quality variables, and responses of biological communities to changes in the release waters. Reclamation agreed to conduct this survey, and the results are one of the subjects of this presentation.

Another reason for making the presentation and seeking a recommendation at this time is the acknowledged decline in the Grand Canyon endangered humpback chub population. The first population estimate for humpback chub in Grand Canyon, provided by Kaeding and Zimmerman in 1982 was 7000-8000 adult fish. This estimate was based on tag recaptures in the Little Colorado River and a 32 km reach of the Colorado River evenly distributed above and below the tributary mouth. Recent population estimates for adult humpback chub provided by the Fish and Wildlife Service and GCMRC indicate this number in 2001 was below the 2,100 individuals proposed as a minimum viable population in the draft recovery goals for this species. The GCMRC Science Advisors have identified this decline as an ominous situation and have advocated that the temperature control device "should be pursued now so it can be a science and management option in 5 years." They also identified that this action should be taken in conjunction with non-native fish removal and the planning and development of a refugium population.

Survey of Dams with Selective Withdrawal

In our pursuit of information on selective withdrawal systems, we discovered that a survey had been accomplished by the American Society of Civil Engineers and published in their journal in 1970. At that time there were 90 selective facilities identified. In 2001 that number had grown to 107 (Figure 1), and nearly half of that number was found in four states: California, Pennsylvania, Texas, and Oklahoma. The most recent selective withdrawal construction began in April 2002, when the Army Corps of Engineers began modification of Cougar Dam on the McKenzie River in Oregon as part of the larger Willamette River Temperature Control Project.

In addition to being widely distributed geographically, selective withdrawals are found on a large array of dam and reservoir sizes (Figure 2). Dam heights vary from less than 100 feet to more

than 700 feet and reservoir capacities vary from less than 100,000 acre feet to nearly 6,000,000 acre feet. When compared to dams and reservoirs having selective withdrawal, Glen Canyon and Lake Powell stand out, particularly with respect to reservoir capacity (Figure 3).

Selective withdrawals are incorporated into dams for a variety of reasons, but the primary purposes are most often directed at maintenance or improvement of water quality for municipal (human consumption) or recreational benefits. In the 1970 survey there was no mention of using selective withdrawal to benefit Federally listed species, because most environmental laws had not yet been passed, but this purpose has been the driving force behind these dam modifications in the last 20 years.

The survey of selective withdrawals by Reclamation contains 41 questions covering a range of subjects including design, construction, operation and maintenance, purpose, attainment of targets, and environmental effects. It has been sent to operators of a wide cross-section of the known facilities in different geographic areas. The majority of facilities are operated by either Reclamation or the Army Corps of Engineers. Results of the survey will presented to the AMWG at the July meeting.

Criteria for Feasibility Determination

In their 1995 biological opinion on operation of Glen Canyon Dam, the Fish and Wildlife Service provided the following guidelines on determining the feasibility of a selective withdrawal program for Glen Canyon Dam and Lake Powell waters:

> i. review historic information and employ existing modeling with possible updates using alternative reservoir and operating conditions to prepare a set of possible scenarios of temperature changes in the mainstem.
> ii. determine from the literature, experimentation, and consultation with the AGFD, Native American Tribes, National Park Service, Service, and other native fish species experts the anticipated effects on native fish populations which may result from implementation of temperature changes from a selective withdrawal structure. Determine the range of temperatures for successful larval fish development and recruitment and the relationship between larval/juvenile growth and temperature.
> iii. assess the temperature induced interactions between native and non-native fish competitors and predators.
> iv. assess the effects of temperature, including seasonality and degree, on *Cladophora* and associated diatoms, *Gammarus,* aquatic insects, and fish parasites and disease.
> v. evaluate effects of withdrawing water on the heat budget of Lake Powell, effects of potentially warmer inflow into Lake Mead, and the concomitant effects on the biota within both reservoirs. Evaluate the temperature profiles along with heat budget for both reservoirs.
> vi. evaluate effects of reservoir withdrawal level on fine particulate organic matter and important plant nutrients to understand the relationship between withdrawal level and reservoir and downstream resources.

The Fish and Wildlife Service also identified that a selective withdrawal should not be considered the only action needed to provide successful mainstem spawning and recruitment and ultimate recruitment for the humpback chub and razorback sucker. They argued in their opinion that aspects of the natural hydrograph, including low, steady releases in the summer, are necessary based on our present knowledge of the temperature capabilities of a selective withdrawal structure and habitat requirements of the species. Dam operations during year 2000 demonstrated that increased warming of the Colorado River can be achieved by reducing the magnitude and daily fluctuation of dam releases. This interaction between hydrology and water temperature also has been recognized by scientists and managers who have attended the two workshops convened to consider the proposed selective withdrawal.

All of the Fish and Wildlife Service guidelines are directed at limnology of the reservoir-tailwater system and responses of associated biological communities, particularly the endangered fish, their food base, and their potential competitors and predators. There are other guidelines, or criteria, that may be necessary to make a final decision in the evaluation of a selective withdrawal for Glen Canyon Dam. Some of these criteria may have to do with:

i. engineering designs and their relative utility
ii. costs of the dam modification
iii. the operations necessary to achieve the desired responses from the device
iv. the ability to detect responses in the target species and species that might impact those species
v. a decision system for if and when to cease operation of the device if undesirable effects are realized.

In our discussion at the AMWG meeting, Reclamation will seek input from the AMWG on the addition of criteria to the guidelines offered by the Fish and Wildlife Service in their biological opinion. We will also entertain discussion about the extent to which the FWS guidelines, or other added criteria, can be addressed before construction and testing of the selective withdrawal. Much information from the scientific literature and expert opinion has been collected to address the guidelines; however, this body of knowledge can not do more than infer the responses of biological organisms in the Colorado River and its tributaries. Also, there is limited opportunity for conducting relevant experiments *ex situ*, that is outside of the Colorado River ecosystem, from which results necessarily have a high probability of predicting responses in the ecosystem under actual operational scenarios.

To finish the determination of feasibility for the proposed selective withdrawal, an environmental assessment (EA) is being written to identify the anticipated effects of elevating water temperatures by operating a selective withdrawal on Glen Canyon Dam. The EA can prescribe operational scenarios or leave the development of those scenarios, which would be considered experiments, to a process of adaptive management as realized in the science plan for testing the selective withdrawal through operation of the dam. Reclamation has committed to a science plan as an accompanying document to the EA. GCMRC, as the science institution for the program, will take responsibility for leading the development of that plan.

Therefore, as action items following this discussion, Reclamation will seek the following AMWG recommendations to the Secretary of the Interior: (1) whether any guidelines or criteria should be added to the existing guidelines for determining the feasibility of constructing and testing a selective withdrawal on Glen Canyon Dam; (2) which guidelines or criteria for the feasibility decision should be determined in the NEPA document for the selective withdrawal, and which components will need to be evaluated by operation of the selective withdrawal following its construction; (3) whether operational scenarios should be identified in the EA as alternatives or as experiments in the science plan.

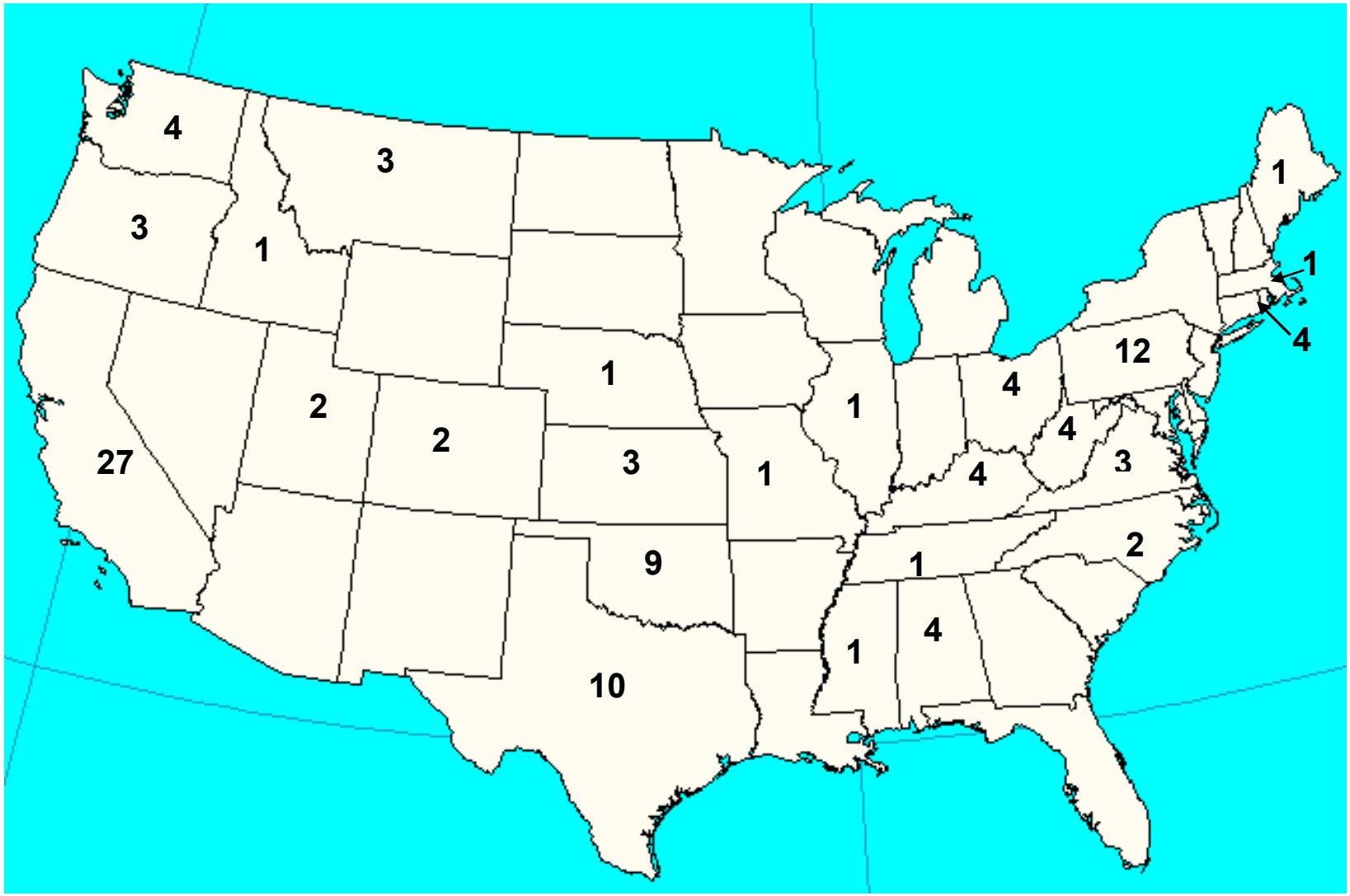
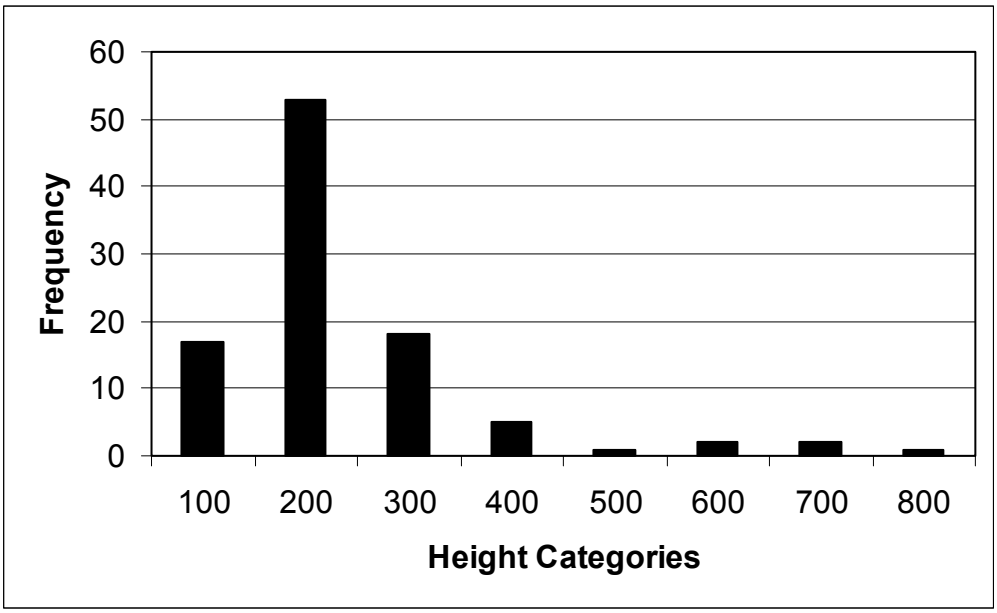


Figure 1. Number of dams with selective withdrawal by state in the United States as of 2001.



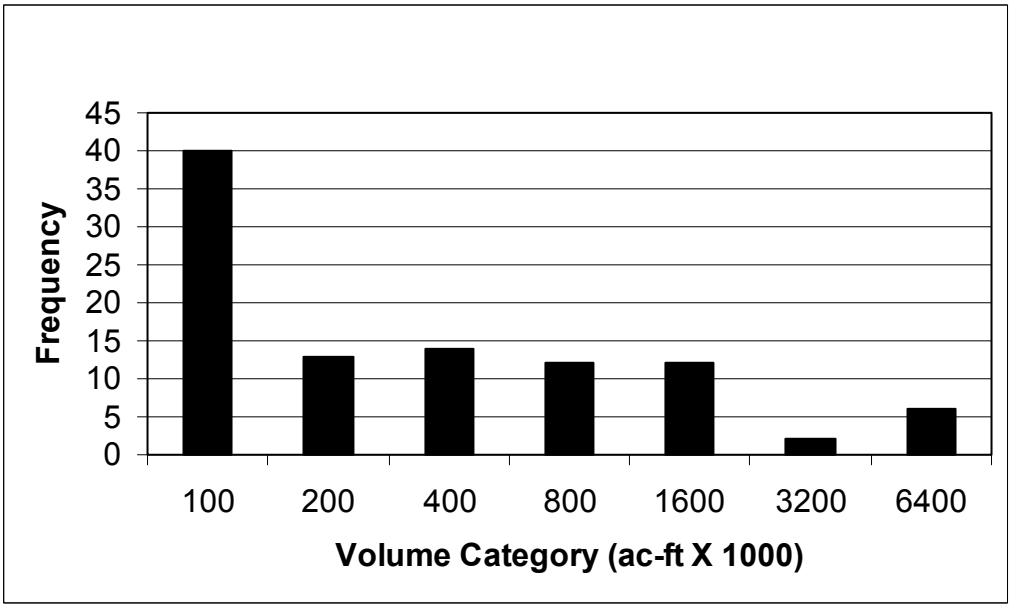


Figure 2. Frequency of dam heights (top) and reservoir capacities (bottom) of facilities having selective withdrawals in the United States in year 2001.

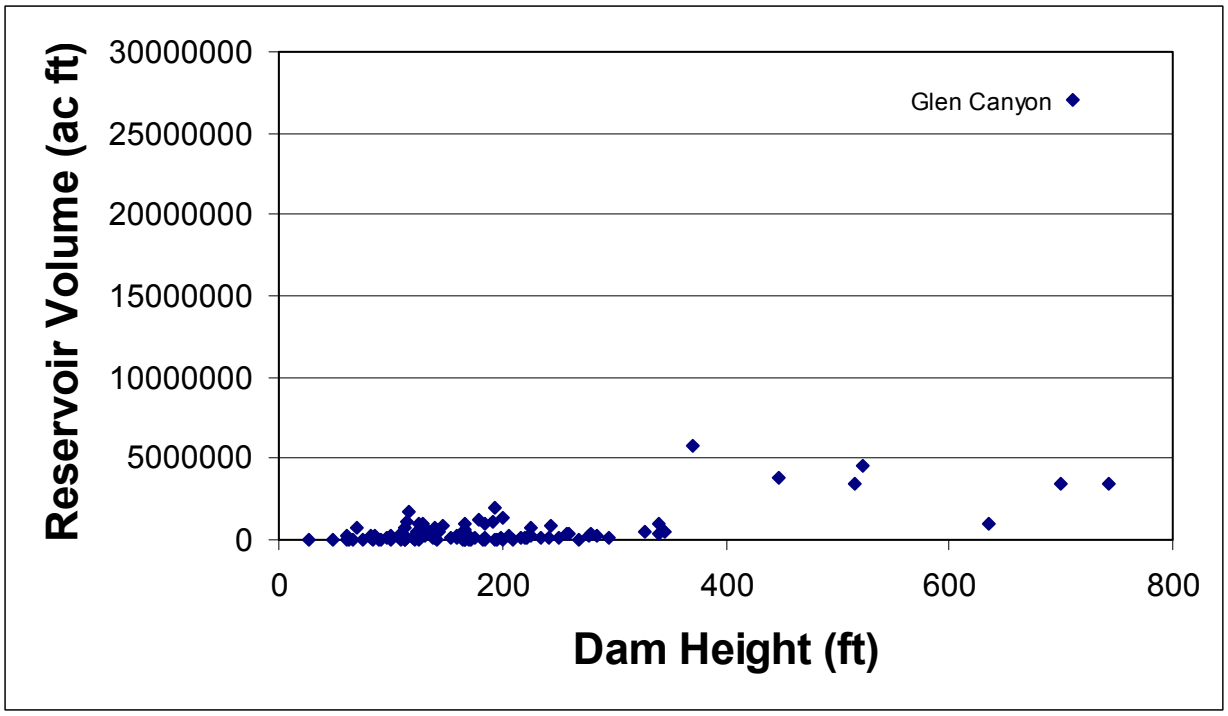


Figure 3. Dam height by reservoir volume combinations for facilities having selective withdrawal in the United States in 2001. Glen Canyon Dam and Lake Powell inserted for comparison.