

Memorandum

To: Panel Presenters (Dave Trueman, Jeannie Korn, Joe Shannon, Duncan Patten, Rich Valdez, Bill Persons, and Larry Crist)

CC: Bob Winfree, Bruce Moore, and Dave Garrett

From: Barry D. Gold *BS*

Date: 3/4/98

First let me thank you for agreeing to make a presentation at the upcoming Technical Work Group Meeting. **The meeting is being held March 18, 1998 at the La Quinta Hotel, 2510 Greenway Rd., Phoenix, AZ.**

The request for these presentations was stimulated by a presentation made at the February TWG meeting regarding the status of Reclamation's selective withdrawal activities. I am enclosing information provided by Dave Trueman at that meeting. The main concern raised by TWG members' dealt with concerns over Reclamation's proposed environmental compliance activities.

My overall goal in organizing this panel is to present to the TWG members our current knowledge base regarding the potential effects (both positive and negative) of installing and operating a selective withdrawal structure on Glen Canyon Dam.

Our panel is scheduled to begin at 11:15 a.m. and conclude at 2:15 p.m. with a lunch break from 12:00 to 1:15 p.m. Your presentations will be given in the order shown below. Please keep to your allotted time. I will act as moderator and intend to hold questions until after each panel of presenters has made their presentation.

<u>Time</u>	<u>Presenter / Topic</u>
11:15 (5 min)	Dave Trueman or Bruce Moore – Overview of selective withdrawal. <ul style="list-style-type: none">-- What are the objectives and hoped for outcome of installing and operating a selective withdrawal structure?-- How much warming of the water is sought / anticipated?-- Describe when during the year the warming will occur?-- Describe how many months, in any given year, the water will be warmed?-- At what frequency (i.e., how many months, years in a row) can the water be warmed?-- What are the anticipated effects on the heat budgets of Lake Powell and Lake Mead?

- Does the thermal depletion of the reservoir in one year effect the thermal budget the following year?
- Other ?

11:20 (10 min)

Jeannie Korn / Larry Stevens – Results of GCMRC Temperature Monitoring

- How much does the water warm as it moves downstream?
- What are the seasonal effects on warming the water?
- What are the flow effects (i.e., high vs. low and fluctuating vs. steady flows) on warming the water?
- Can the water be warmed to the desired temperature (e.g., 15°C) by the time it reaches the mouth of the LCR or other desired site, at the appropriate months to benefit spawning and survival of larval and young of year fish.
- What are the effects on backwaters?
- Other?

11:30 (15 min)

Joe Shannon / Dean Blinn – Possible effects of warming the water on the aquatic foodbase.

- What are the optimal / acceptable water temperature ranges for the aquatic food base?
- What times of the year is it more acceptable / less acceptable to have warmer water?
- What are the potential effects of warm water on the algae, diatoms, and Gammarus?
- Interaction effects?
- Possible alternatives to whole river experiments?
- Other?

11:45 (15 min)

Questions and Answers

12:00 (1:15 min)

LUNCH

1:15 (15 min)

Duncan Patten – Summary of GCES Phase II Biological Research

- Lessons learned form GCES Phase II biological research activities and their implications for selective withdrawal.
- Potential effects on the aquatic foodbase, Leas Ferry Trout fishery, native fishes, and Riparian vegetation (e.g., micro climatic changes associated with warmer river temperatures and associated water stress on riparian vegetation).
- Where to from here? Recommendations for future monitoring and research directions?
- Other?

- 1:30 (15 min) Rich Valdez / Steve Carothers - Results of the Data Integration Project.
- Implications of findings from data integration report on timing, magnitude, and frequency of warming the water.
 - Potential effects on LCR and other aggregations of HBC?
 - Tributary vs. mainstem population effects?
 - Native vs. non-native interactions?
 - Other?
- 1:45 (10 min) Bill Persons / Tim Hoffnagle - Selective Withdrawal and Lees Ferry Trout
- What are optimum / acceptable temperature ranges for rainbow trout?
 - When should the water be warmed? When should the water NOT be warmed?
 - Possible implications regarding disease and parasites and native / non-native interactions?
 - Other?
- 1:55 (20 min) Larry Crist - Lessons learned from Flaming Gorge selective withdrawal activities and their relevance to Glen canyon Dam
- Overview of selective withdrawal at Flaming Gorge: How much is the water warmed? When during the year and for how long is the water warmed? With what frequency (i.e., every year or every other year) is the water warmed?
 - What have been the effects of warming the water on the aquatic food base, native and non-native fish. Review should cover growth rates in the aquatic food base and change in composition, if any, spawning, recruitment, native / non-native interactions, disease, etc.
 - Other?
- 2:15 (15 min) Questions and Answers

Finally, I will be out of the office from Thursday, March 5 through Friday, March 13. If you need any help please contact Serena at 520/556-7094.

BRIEFING PAPER

Prepared for:

Submitted: January 15, 1998

State: AZ, CA, CO, NM, NV, UT, WY

Bureau: WBR

TITLE: Glen Canyon Dam - Temperature Controls

ISSUE: Funding for Temperature Controls (\$15 million)

BACKGROUND:

- ◆ **Environmental Issues** - Prior to construction of Glen Canyon Dam, the Colorado River would warm seasonally from near freezing to about 85°F. Since construction of the dam, releases from the dam are consistently cold throughout the year (about 45-50°F). As this water moves downstream, it warms to about 60°F, but this is not quite warm enough to allow endangered warm water fish (humpback chub) to reproduce in the mainstem of the Colorado River.
- ◆ **FWS Biological Opinion** - In their Endangered Species Act (ESA) biological opinion, the FWS found that the operation of Glen Canyon Dam jeopardizes the existence of two endangered fishes. Their reasonable and prudent alternative states that "Reclamation shall implement a selective withdrawal program for Lake Powell waters..." and study the impacts.
- ◆ **Scoping Issues** - In scoping the issues and potential impacts, Reclamation has found that the majority of scientists believe that temperature controls would be an effective tool, but there are complex ecological interactions that may defy prediction. For example, there is a relatively small chance that warm water may encourage competitors, impact food bases, or have other unexpected impacts.
- ◆ **Feasibility Studies** - In its Value Planning Report dated April 24, 1997, Reclamation looked at several alternatives and found a relatively simple modification to the existing penstocks that would provide for temperature control. Based on Reclamation's September 1997 Feasibility Cost Estimates, a typical selective withdrawal structure could cost between \$40 million and \$140 million, depending upon the type of design. The proposed modification would take advantage of the existing trashrack structure and bulkhead gate rails, reducing the costs to \$15 million or less. Each penstock would be able to individually draw water from either its original elevation or at a fixed elevation near the surface. In the summer months of years when the reservoir is near full, the intakes could be opened near the surface to allow warm water to enter the penstocks. Some penstocks may be used to cool the releases if needed. Blending would be used to adjust the release temperatures.
- ◆ **Test Concept** - In scoping the potential impacts, Reclamation found that the majority of scientists believe that temperature controls have been an effective tool at other locations and should be an effective tool to aid in the management of the river below Glen Canyon Dam, but there are complex ecological interactions that may defy prediction. The hypothesis is that warm water will give more advantages to the native fish than to the nonnative fish, but this hypothesis has yet to be proven by a test. Reclamation proposes to modify the penstocks to test (confirm) this hypothesis

directly. If successful, the penstock modifications for the test may be used as a permanent temperature management tool.

- ◆ **Construction Authority** - The CRSP Act, Section 8 states, "In connection with CRSP, the Secretary is authorized to investigate, plan, construct, operate, and maintain... (2) facilities to mitigate losses of, and improved conditions for, the propagation of fish and wildlife..." This authority was used in the mid 1970's to construct a selective withdrawal structure at Flaming Gorge Dam (another CRSP facility). Section 5 of the Act, Limitations on the Use of Power Revenues, prohibits the use of power revenues for section 8 activities. As with previous work at Flaming Gorge, construction appropriations would be used to modify the intakes at Glen Canyon Dam.
- ◆ **Funding Needs** - Depending upon the outcome of the environmental assessment, 4 to 8 penstocks may be modified. The costs would range from \$10 million for the 4-unit modification, which would be the initial construction plan, to \$15 million for the 8-unit modification.
- ◆ **Current Plans** - Reclamation has begun an environmental assessment and depending upon its complexity, a draft is scheduled for completion by December 1998. If funded, the modifications to the intakes would begin in FY-2000. Construction would take 12 months and funding may be split over two fiscal years with \$10 million in 2000 and \$5million in 2001.

POSITION OF INTERESTED PARTIES:

- ◆ The FWS believes that temperature controls are required to remove jeopardy to endangered fishes. The goal of the Service's Reasonable and Prudent Alternative is to provide temperatures required for successful spawning/recruitment of humpback chub in the main channel of the Colorado River below Glen Canyon Dam.
- ◆ This plan has the support of the Glen Canyon Adaptive Management Work Group participants.
- ◆ To comply with the Endangered Species Act and meet the objectives of the Grand Canyon Protection Act, Reclamation must pursue this element of the Reasonable and Prudent Alternative.

PROGRAM CONTACT: David Trueman, Program Manager, 801/524-3753

GLEN CANYON TEMPERATURE CONTROL STUDIES/

INTRODUCTION

Prior to construction of Glen Canyon Dam, the Colorado River would warm seasonally from near freezing to about 85°F. Since construction of the dam, cold water (about 50°F) has been drawn year round from the depths of Lake Powell through fixed level intakes and then released downstream. Near the dam, these cold releases are tolerated by the (nonnative) trout fishery, but are below optimal. As the water moves further downstream, it warms to about 60°F, but this is not quite warm enough to allow endangered warm water fish (humpback chub) to reproduce in the mainstem of the Colorado River.

In their biological opinion on the operation of Glen Canyon Dam, the U.S. Fish and Wildlife Service recommended that temperature controls at the dam be investigated by Reclamation. Increasing the dam's discharge temperature is believed to be a key element in the recovery of native fish (humpback chub) near the Little Colorado River. Reclamation agreed to study the feasibility of temperature controls in its EIS on the operation of Glen Canyon Dam.

To appreciate the interest in temperature controls, one has only to look upstream at another major dam in the system. Much like Glen Canyon Dam, discharge temperatures from Flaming Gorge Dam were cold and steady before temperature controls were installed in 1978. After the dam was retrofitted with a selective level withdrawal structure, release temperatures in the summer were increased from 50°F to a peak of nearly 70°F.

The addition of temperature controls at Flaming Gorge Dam has had a remarkable impact on the river system below the dam. Trout growth rates immediately below the dam have increased significantly in response to the warmer water. At the same time, native fish are doing better downstream (in reach near the Yampa River). In their 1981 report on macroinvertebrates and fish populations above the mouth of the Yampa River, Paul Holden and Larry Crist of BIO/WEST concluded that, "The outlet modification of Flaming Gorge was expected to increase downstream water temperatures during spring, summer, and fall periods, which it did. This caused the Green River above the mouth of the Yampa River to follow a more natural yearly

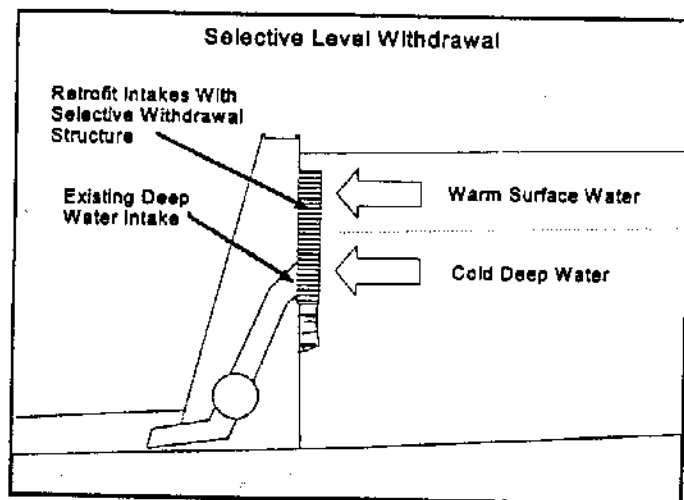


Figure 1-Penstock intakes would be modified to take warm, surface water from the reservoir during the summer.

temperature regime. This in turn created conditions acceptable to more benthic invertebrate taxa, because [temperature] cues for life history development were present. Increased diversity, due to a more equitable distribution of abundance among taxa, was a significant result." They went on to observe that diversity and reproductive success of warm water fish increased near the mouth of the Yampa River while cold water species declined in abundance and predominance. In many ways, the situation and problems at Glen Canyon Dam appear to be remarkably similar to those at Flaming Gorge Dam.

Preliminary work done by Reclamation on temperature controls for Glen Canyon Dam suggests that releases from the dam could be warmed in July, August, and September. During the warmest part of the season, release temperatures might be increased by up to about 18°F (release temperature would be up to about 68°F). ^{20°C} ~~7.2°C~~ Much as they did at Flaming Gorge, these warmer releases are expected to improve growth rates for the cold water sport fishery immediately below the dam. Then, as the water moves downstream to the vicinity of the Little Colorado River, it would warm enough to support recruitment of young native fish. Warmer summer flows may also increase the biodiversity of the invertebrate population by providing seasonal temperature cues, but may cause some potential adverse impacts that need to be investigated. For example, warm water released from the reservoir caused Flaming Gorge Reservoir to cool. Lake Powell is larger and may not have this problem, but if it does, it may impact the lake's forage fish which are sensitive to winter temperatures. Another concern is that warmer water in the lower reaches of the river may allow nonnative (warm water) fish to compete with native fish. There may be ways to deal with these problems. These and other potential impacts will be studied in detail over the next several years.

In 1994, Reclamation developed its plans to study the feasibility of retrofitting Glen Canyon Dam's deep, cold water intakes with adjustable level intakes (a selective level withdrawal structure). The potential cost of the facility is estimated at between \$60 million and \$100 million. Funding to begin working on the evaluation was received from Congress in 1996. Two studies are currently underway, and more work will follow. The two studies include: (1) temperature modeling of the river/reservoir system and (2) a study to look at how warm water releases might impact the productivity of the river below the dam. These studies should be completed in 1997. In 1998, Reclamation plans to begin an environmental assessment of the potential impacts, costs, and benefits of the facility and its operation.

Attached are a list responses to questions that have been raised about the process. Additional questions should be addressed to Mr. David Trueman, GC Temperature Control Study Manager, at telephone number (801) 524-3753 or fax (801) 524-5499 or by e-mail on the INTERNET at dtrueman@uc.usbr.gov.

**QUESTIONS AND ANSWERS
ON
GLEN CANYON TEMPERATURE CONTROL STUDIES**

Why begin with an environmental assessment when an EIS might be needed?

Reclamation agreed to study temperature controls in response to the recommendations of the FWS and commitments made in the Glen Canyon EIS. Reclamation has made no commitments beyond this one study at this time. The NEPA process may lead Reclamation to analyze other alternatives as we progress through project planning and NEPA compliance.

How can reclamation contemplate using a FONSI to build the temperature control device?

At this point in time, Reclamation has only committed to analyzing the feasibility of temperature controls (not other alternatives). The NEPA process may lead Reclamation to analyze other alternatives as we progress through project planning and NEPA compliance.

Isn't warming the water to recover an endangered species considered a significant impact?

Reclamation will wait to evaluate the significance of the impacts of temperature controls until after its public review and environmental assessment process is completed.

Will temperature controls work?

Temperature control is a well-understood management tool that has been proven to be very effective at improving fisheries throughout the world. We fully expect the temperature control structure to be effective; however, we are carefully evaluating all potential effects for this particular application.

What are some of the potential impacts from the temperature control structure?

The potential impacts were discussed in several workshops by GCES researchers and scientists. Other potential impacts will be investigated, but some of the most interesting ones include the potential to:

- Chub - Improve temperatures for humpback chub near Little Colorado River.
- Trout - Improve temperatures for the sport fishery below the dam.
- Productivity - Create seasonal thermal cues in the river. Increase species diversity and productivity of the river.
- Forage Fish - Impacts may need to be monitored and the operation managed to avoid possible impact to the forage fish in Lake Powell.
- Competition/Predation - Impacts may need to be monitored and the operation managed to avoid an increase in competition/predation on chub.

Will Reclamation include plans to monitor the results of temperature modifications in its report?

Reclamation believes that it is critical to apply the scientific method of hypothesis testing to the complex environmental issues in question. Namely, to measure the impacts projected in the planning studies to confirm or disprove these hypotheses. As theories are proven or disproven by experiment and observation, we fully expect that the management TCS will be refined or adapted.

Will the public have an opportunity to comment on the plan?

The public has and will have several opportunities for input and review. Reclamation has held workshops on temperature controls in January, April, and November of 1992 and June and October of 1994. Quarterly meetings with the Glen Canyon Transition Work Group started in 1995 and will continue with public meetings and discussions with the Glen Canyon Adaptive Management Work Group once it is chartered. A public review of the draft environmental assessment will provide an opportunity for meaningful public discussion and comment.

Who will pay for the temperature studies and the facility?

Unlike the GCES and GCEIS which were funded from CRSP power revenues, the CRSP Act authorizes Reclamation to fund this type of activity from its CRSP Section 8 construction funds which are non-reimbursable. These are federal appropriations. This is consistent with the funding of temperature controls at Flaming Gorge Dam, another CRSP feature.

What will be included in the feasibility and environmental assessment?

This will evolve as the studies progress, but the following list summarizes the start of our study plan.

Proposed Impacts and Risks to be Assessed:

Costs

Lake Powell

Water Temperature
Dissolved Oxygen
Trace Elements
Sport Fishery
Forage Fish
Reservoir Evaporation

Nutrients
Salinity
Primary Productivity
Recreation
Native Fish
Power Production ✓

River below Glen Canyon Dam

Water Temperature
Dissolved Oxygen
Trace Elements
Native Fish
Recreation
Air Temperatures

Nutrients
Salinity
Primary Productivity
Non-Native Fish
Evaporation

Lake Mead

Water Temperature
Dissolved Oxygen
Trace Elements
Fishery
Reservoir Evaporation

Nutrients
Salinity
Primary Productivity
Recreation

Other Issues:

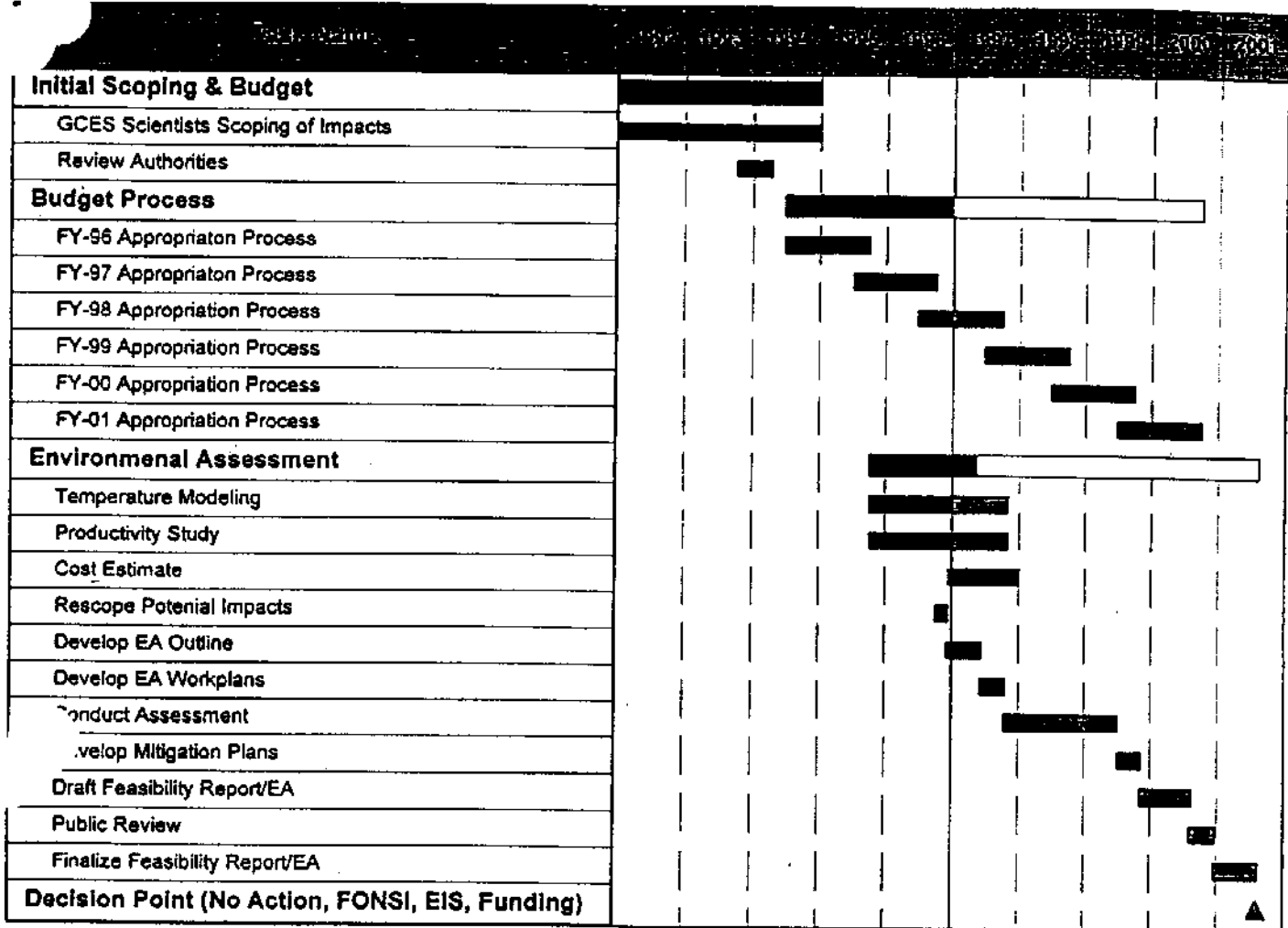
Section 7 Consultation (Endangered Species Act)
Environmental Commitments
Post-project Testing Plans

Mitigation Plans
404 Permit

GLEN CANYON DAM TEMPERATURE CONTROL STUDIES

- The scope of the BR study is limited to the commitments made by Reclamation in the GCEIS and the FWS recommendation that BR study the feasibility of temperature controls in their Biological Opinion on the operation of Glen Canyon Dam.
- BR has committed to studying the feasibility of temperature controls at GCD.
- BR has not yet committed to construction of the TCD.
- Studies will be funded by Section 8 CRSP construction funds (federal appropriations) using Flaming Gorge as the model.
- BR will evaluate costs and potential impacts of TCD.
- BR will reconsult with the FWS on the study results.
- BR will conduct a thorough public review of its draft report and the TCD.
- BR may propose adaptive management to refinement operation of the TCS after the facility is built.

Glen Canyon Temperature Control Project Schedule



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