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April 29, 1982

Clifford Barrett
Regional Director
U.S. Bureau of Reclamation
P.O. Box 11568
Salt Lake City, Utah 84147

Dear Mr. Barrett:

Enclosed are comments on the January 1982 environmental assessment for the proposed Glen Canyon powerplant uprating. We wish to thank you for the opportunity to get involved in the preliminary review process, and hope you will find our analysis beneficial.

Sincerely,

William B. Vandivere

William B. Vandivere
Associate Hydrologist

WBV:dlw

cc: Bob Lippman
Peter Brown

Enclosure

Philip Williams & Associates

REVIEW OF THE ENVIRONMENTAL ASSESSMENT FOR THE GLEN CANYON POWERPLANT UPRATING

by

Philip B. Williams, Ph.D., P.E.

and

William B. Vandivere

April 30, 1982

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REVIEW OF THE ENVIRONMENTAL ASSESSMENT FOR THE GLEN CANYON POWERPLANT UPRATING

Summary

When the operational plan for the Glen Canyon Dam was originally designed, little consideration was given to accommodate, or even define, environmental or recreational flow requirements downstream. Since the completion of the Dam in 1964, it has been operated almost exclusively for power generation and water storage purposes, subject only to a minimum 1000 cfs release requirement for downstream fisheries during the Lake Powell filling period (USBR 1976). However, two significant and interdependent changes in the operation have taken place in the intervening years.

First, Lake Powell completed filling in 1980. Prior to this time annual release volumes from the Dam had largely been dictated by water supply requirements downstream with the excess being stored in the reservoir. Now, whenever feasible, this excess is being released through the Dam's powerplant to generate electricity during peaking periods. Second, since 1966 when full generating capacity was reached, the Dam's powerplant operation has gradually shifted from providing for base load to providing for an expanding peaking power load. Filling of the reservoir was, in fact, a necessary precondition for the long-term expansion of peaking power production at Glen Canyon.

This change has had a significant impact on the seasonal and daily flows downstream. Whereas under base load operation, seasonal average flows varied from 7900 cfs to 15,000 cfs for different months[1], now, the monthly fluctuation is 7100 cfs to 17,600 cfs. This change in release patterns has had major effects on the river morphology and ecology downstream.

The proposed uprating is a continuation of this shift in operation

[1] Based on Table 1, normalized monthly release volume/hours in month.

to extend the use of the Glen Canyon powerplant as a peaking facility. The results of the uprating will thus be to accentuate the impacts already occuring. These are:

1. Shift in seasonal flow releases causing extended low flow periods in spring (March, April, and May) and fall (October), and high flow periods in late summer (July, August, and September) and early winter (November, December, and January).

2. Increase in the daily peak flow rate.

3. Increases in rates of rise and fall of daily river stage during peaking periods.

4. Consequent impacts on channel morphology, beaches, and riparian ecology.

The purpose of an environmental assessment is to describe whether there are potential significant adverse impacts of an action, so that a determination can be made as to whether or not an Environmental Impact Statement (EIS) should be prepared. This environmental assessment cannot perform this function due to two major weaknesses:

-It conceals, or greatly underestimates, adverse environmental impacts of the project.

-It fails to relate the project to any coherent environmental management goals for the Colorado River downstream.

Specifically, the environmental assessment has the following failings:

1. It does not address the seasonal changes in flow rates caused by increasing emphasis on peaking power operation and the subsequent enhancement due to the uprating. This change reduces average flows in the spring and fall period and increases them in the late summer and early winter, as noted above.

2. It significantly underestimates the potential increase in daily flow peaks, portraying it as a 1600 cfs increase from 31,500 cfs to 33,100 cfs, when the potential increase is actually 6100 cfs from the typical current peak flow release of approximately 27,000 cfs.

3. It incorrectly concludes that there will be no effects from increased flows downstream of Lee's Ferry by implying that flow peaks will be of very short duration. In fact, the Bureau's prior analysis shows that, typically, peak flow increases will be of several hours duration, and their effects will continue through the Grand Canyon downstream to the Lake Mead Reservoir.

4. It fails to address changes in the rate of rise and fall of the River due to the increased peak release. The Bureau's prior analysis shows that fluctuations in river level of at least 1.9 feet/hour will be typical as opposed to the 0.5 feet/hour under the current operation.

5. Because the environmental assessment neglects to consider the post-uprate rates of river rise and fall and incorrectly concludes that there will be no effects downstream of Lee's Ferry, it either neglects or greatly underestimates adverse impacts on beach areas, riparian vegetation, fish resources, wildlife, and recreation.

6. The environmental assessment does not address the cumulative impact of historical operational changes at Glen Canyon Dam and the relationship of these changes to the uprating.

7. The information presented is often unsubstantiated and at odds with other Bureau analyses. Such discrepancies indicate that adverse impacts may be worse than is assumed.

Conclusions

It is evident that the uprating may cause significant adverse impacts and that an EIS should be prepared. The preparation of this EIS should provide the opportunity to correct the deficiencies in the early operational planning of Glen Canyon Dam and establish environmental criteria for flows within the Grand Canyon. It can do so within the context of developing an overall management plan for Glen Canyon Dam that optimizes power production while preserving or enhancing environmental and recreational values. The bases for these conclusions are described in detail below.

Discussion

1. Changes in Seasonal Flow Rates - The environmental assessment has failed to address the necessary reallocation of seasonal release volumes which result from an expansion of peaking power generation. This seasonal shift in water releases has been underway since the early 1970s, as is evident from inspection of Table 1, which lists monthly Glen Canyon release volumes for the period 1966-1981, and Figure 1, a graphic representation of the shift. Release volumes appearing in Table 1 were derived by normalizing release figures obtained from Bureau reports (POM-59) which have been previously assembled by Marsik (1981). Normalization of release volumes involves adjustment of historical data to reflect the yearly deviations in total release volumes from that of a specified base figure, so that comparisons are possible. The base yearly release volume selected was 8.25 million acre-feet, which corresponds to both the minimum requirement for Glen Canyon under the terms of the Colorado River Storage Project guidelines, and the base release for projections of proposed future reservoir release schedules.

Averaged monthly releases appearing in Table 1 for water years 1966-1971, 1972-76, and 1977-81, indicate a strong established trend towards reallocation of release totals for the months of January, April, May, and August. Less marked but significant trends are also evident for June, September, and December.[1] The shift to peaking power generation is readily apparent, with spring and fall water releases being sharply reduced to maintain the storage and associated reservoir levels necessary for peaking power generation during the late summer and early winter months. Sharp decreases in release volumes during April, May, and June are especially critical for recreational uses, due to their effect on the early portion of the river running season.

If uprating is implemented at Glen Canyon, the seasonal shift in reservoir releases will be accentuated. Monthly release volumes for post-uprating reservoir operation, as projected by the Bureau, are shown in row (B) of Table 1. Graphic comparison of the normalized monthly average releases and projected releases (row (B) of Table 1) appearing in Figure 1 indicate a major increased release requirement for July, and smaller potential increases for December and January. To supply these increases, current release volumes for October, April, May, and June would have to be reduced by varying amounts depending on reservoir inflow volumes and power marketing agreements. Reductions in current releases for these months would exacerbate the low flow problems presently experienced by river runners downstream from the Dam. A good deal of damage to the downstream riparian habitat from increased peaking operations and reallocation of seasonal flows may have already taken place.

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[1] Averages computed for both December and January are understated, apparently due to efforts to complete filling of the reservoir later in the 1980 water year.

2. Underestimation of Peak Flow Increase - The Environmental Assessment contends that the uprating will result in a minimal 1600 cfs increase in the peak flow rate over the present 31,500 cfs. A review of historical data provided in Attachment A of the environmental assessment suggests that the stated increase is misleading. Although the difference in maximum peak flows attainable, given best efficiency operating conditions for the power plant, between pre and post-uprate conditions is 1600 cfs, the difference between the projected maximum and the average annual maximum release which has occurred since the reservoir reached an elevation of 3641 feet is approximately 6,100 cfs, or a post-uprate increase of greater than 20 percent. A listing of the average annual maximum release for the period 1974-81 appears in Table 2. Prior to 1974, the reservoir water surface elevation was less than 3641 feet, the elevation necessary for achieving the current maximum power plant discharge of 31,500 cfs. If past operating policy were maintained, average annual maximum peak flow rates for post-uprate conditions could be less than the maximum 33,100cfs projected. However, there are two factors which would tend to reduce this prospect: 1) the recently completed filling of the Powell reservoir in 1980, and 2) the establishment of peaking power as the accepted mode of operation at Glen Canyon. The filling of the reservoir increases the probability of occurrence for that range of reservoir elevations which is required to produce maximum power generation. Therefore, it is more likely that post-uprate peak flows will be of greater magnitudes and will be reached more often than has been the case historically. Increased capability for peaking power at Glen Canyon would also tend to reinforce the efforts to maximize peaking power output through marketing agreements, since revenues from peaking power sales are high.

3. Peak Flow Impacts Downstream of Lee's Ferry - The assertion that post-uprate increases in peak flows downstream of Lee's Ferry would diminish to zero is incorrect, based on analysis of hydrographs presented in a previous document which described typical future flow patterns for the proposed addition of 250 MW of generating capacity at Glen Canyon (USBR 1981). These hydrographs traced the progress of a flood wave resulting from the proposed operational changes downstream from the Dam and into Grand Canyon National Park. Figures 2 through 4 indicate the probable effect of the uprating on a "typical" Wednesday flow pattern for high reservoir elevations at Glen Canyon Dam, Lee's Ferry, and Phantom Ranch in Grand Canyon National Park. A flow trace interpolated between the pre-uprate summer condition (dotted line) and the former projected "peaking power" condition (broken line) under a 250 MW power generating increase, has been superimposed on each of the original graphs. It should be noted that the interpolated hydrograph peak for a typical Wednesday and a 186 MW expansion is less than the maximum discharge which could be attained given the high reservoir levels assumed. Use of this particular hydrograph, thus understates the potential increase in both the rate of river rise and fall, and peak flow rate for the post-uprate condition. However, for purposes of comparison, the flow trace for the post-uprate condition was assumed to be proportional to the ratio of the previously proposed 250 MW increase and the currently proposed increase of 186 MW (1150 MW to 1336 MW). The flow trace plotted in Figure 4 for the Phantom Ranch gaging station indicates that the duration of the increased peak flows is in excess of 5 hours. Thus, as the Bureau has pointed out in the present environmental assessment, downstream flows will approach a steady state, or stabilization of the peaks and troughs of the release wave, resulting in minimal dampening of the flow peaks generated

under post-uprating reservoir operation.

4. Increased Rates of Rise and Fall in the River - Changes in the daily release patterns resulting from uprating at Glen Canyon will produce concomitant changes in the characteristics of daily flow patterns downstream of the Dam. The Bureau states on page 14 of the environmental assessment that the uprating will cause a vertical rise in the Colorado River of 0.2 of a foot at Lee's Ferry and that this rise would diminish to zero downstream. This 0.2 foot rise is an underestimate (as shown in Figure 7), and in any case, of equal significance is the change in the rate of rise and fall of the river stage which would result from post-uprate reservoir operation. Again, the Bureau's (1981) analysis has been utilized along with data on downstream river channel characteristics to produce a comparison of pre and post-uprate conditions. Table 3 outlines channel characteristics which correspond to specified rates of flow for Lee's Ferry and Phantom Ranch gaging stations. In lieu of river depths derived from channel cross-sections, the available data was used to calculate the hydraulic depth[1] of the River at the various flow rates. This information was then plotted and graphed in Figure 5. Next, a graphical transformation was made between Figure 5 and Figures 3 and 4 for Lee's Ferry and Phantom Ranch gaging stations. The resulting graphs of hydraulic depth vs. time for a typical Wednesday during the summer at high reservoir elevations are shown in Figures 6 and 7. Since the hydraulic depth is roughly equivalent to the river stage, the slope of the graph at any point represents the rate of rise or fall in the river depending on the time of day. The maximum rate of river rise experienced without the uprate is estimated to be 0.5 foot/hour at Lee's Ferry and 0.9 foot/hour

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[1] The hydraulic depth is the depth of an equivalent rectangular channel and is equal to the channel cross-sectional area divided by the channel top width.

at Phantom Ranch, while the maximum rate of rise with the uprate is projected to be 1.9 feet/hour and 1.8 feet/hour at Lee's Ferry and Phantom Ranch respectively. On the other hand, the estimated maximum rate of river fall for no uprate and uprate conditions at Lee's Ferry would be 0.3 foot/hour and 1.8 feet/hour, while the rate of river fall at Phantom Ranch with and without uprating would be the same. The steepness of the rates of rise and fall shown in Figure 6 for the post-uprate condition at Lee's Ferry is a reflection of the narrowness of the river channel at low flows as indicated by the graph in Figure 5.

The extreme nature of these projected changes in hydrograph characteristics produced by an uprating are cause for concern, as the environmental effects of such alterations in the downstream flow regime could be significant (see discussion, point 5). Furthermore, there are other reaches downstream of Glen Canyon Dam which are narrower than Lee's Ferry. Narrower channel reaches result in higher rates of river rise and fall due to the more rapid change in water depth with increasing discharge. Therefore, it is critical that further analysis be done using actual channel cross-sections at multiple points downstream of the Dam.

5. <u>Underestimation of Adverse Environmental Effects Downstream</u> - Because the hydrologic impacts of the uprating are significant, consequent environmental impacts will be significant, contrary to the conclusions of the environmental assessment. The greatly increased rate of river rise and fall resulting from post-uprating reservoir operation could potentially cause increased channel scour and severe erosion of beach areas. Frequent cycles of inundation and exposure can be expected to erode important stretches of the river corridor which have been approaching stabilization over the years since the disruption of natural river flow in 1964 (Stevens 1981). As

channel scour patterns are altered and new sections of the riverbank are eroded, pools which are currently favored by fish for spawning may be filled. Increased post-uprate rates of river fall would exacerbate present fish stranding problems, as pools are segregated as the result of rapidly declining river stages (McCall, personal communication 1982). The potential loss of beach areas presently acting as campsites and angling spots would decrease recreational use downstream of the Dam and into Grand Canyon National Park (Dolan 1981). These potential adverse impacts on the downstream environment underscore the need for a comprehensive analysis of reservoir-powerplant operations at Glen Canyon and their likely influence on erosion and sediment transport regimes.

6. Failure to Address the Cumulative Impacts of Dam Operation - As was indicated in the discussion for point 1, the changes directly attributable to the proposed uprating are partially obscured by previous alterations in reservoir operation policy. A clear shift from a base load to peaking load operational mode is apparent in historical reservoir release data (see Figure 1. Since no major structural modifications were made to the powerplant during the 1966-81 period, no comprehensive environmental evaluation of the intensified impacts resulting from the shift toward increased peaking power operation was undertaken. A draft assessment of environmental impacts at Glen Canyon was published by the Bureau (USBR 1976), but it failed to address the impacts of this shift toward peaking operations. Therefore, for an adequate assessment of the environmental impacts resulting from the proposed uprating, an investigation of the cumulative effects of operational changes over the past 15 years is necessary. This can only be accomplished through preparation of a comprehensive EIS for reservoir-powerplant operations at Glen Canyon.

7. Unsubstantiated Information in the Environmental Assessment - Apart from the inaccuracies addressed earlier in this critique, the environmental assessment contains unsubstantiated statements related to hydrology, including:

-page 7, paragraph 1---The Bureau refers to hydrologic flow sequences which are not identified or referenced. Computer synthesis of probable future inflows to Lake Powell requires statistical evaluation of historical data and its subsequent fitting to a probability model. In such procedures critical interpretive assumptions are made. Therefore, substantiation of the forecasts offered as a result of the modeling is necessary from both a purely hydrologic standpoint and a power generation standpoint, since forecasted reservoir levels ultimately influence benefit-cost analysis.

-page 9, paragraph 5---It is asserted that minimum releases will be maintained as in the past, except during emergency situations which may occur during drought years. No criteria is offered to define the conditions under which an emergency situation would exist. The statement does, however, infer that the future commitment to a minimum flow requirement would be tenuous. The Bureau should describe its drought operational plan and its consequent impacts on the downstream environment.

-Page 3, point No. 5---Here the Bureau contends that if the uprating is not implemented they will lose both the capability of better regulating the River and the ability to avoid and control spills. On the contrary, the proposed uprate and expansion of peaking power capacity at Glen Canyon would encourage maintaining the reservoir at high levels, increasing the probability of spills. Further substantiation of the Bureau's claim is required.

-page 17, paragraph 9---It is asserted that on the average, approximately 2 feet of additional terrestrial environment would be inundated and that this means no significant impacts to terrestrial habitat would result. There is no substantiation for this important conclusion and, on the contrary, it appears to be greatly underestimated.

-Attachment A, page 6---The discharge listed for January 29, 1979 is 31,571 cfs at a reservoir elevation of 3629 feet. According to the Bureau's own operational constraints (see page 3 of EA), a discharge of this magnitude can only take place at reservoir elevations in excess of 3641 feet. Moreover, the monthly power operations report for January 1979 indicates that there were no releases downstream for purposes other than for power generation. If it is true that 31,571 cfs was discharged through the Glen Canyon powerplant at a reservoir elevation of 3629 feet, the basic premises for the post-uprating reservoir-powerplant operation are brought into question. It is possible, at reduced powerplant operating efficiencies and lower reservoir levels, to produce an equivalent electrical output with a higher discharge. Therefore, reservoir elevations which are less than those lying within the range cited by the Bureau (currently, ≥3641 feet) could be affected by the uprating, since they could be matched with higher discharges to increase their respective power generating capacities.

-page 10, Table 1---The majority of the release figures listed in this table are at variance with the Bureau's own monthly operational summaries (P.O.M.-59). Another weakness of the presentation is its failure to indicate what portion, if any, of the release volumes can be attributed to discharge, either through the Dam's river outlets or over its spillways. Inclusion of spillage, i.e., non-powerplant discharge, in the cited figures is misleading since the purported intent of the EA is to compare pre and post-uprate powerplant discharge potential.

REFERENCES

Dolan, R. 1981. Analysis of potential recreational impacts due to high water releases from Glen Canyon Dam on the Colorado River in the Grand Canyon. Charlottesville, Va.

Marsik, G. 1981. A study of possible future and historic monthly release volumes from Glen Canyon Dam in acre/feet. Preliminary draft; October, 1981.

McCall, T. 1982. Arizona Game and Fish Department, personal communication.

Stevens, L. 1981. Impacts of proposed water level increases on riparian habitat and recreational river use in Grand Canyon National Park. Research biologist - Northern Arizona University, Flagstaff, Ariz., March 1981.

U.S. Bureau of Reclamation 1981. Typical future flow patterns for CRSP power peaking capacity generation at outlet-Glen Canyon Dam, Arizona. June, 1981.

U.S. Bureau of Reclamation 1976. Draft assessment of environmental impact-Operation of Glen Canyon Dam and Lake Powell Colorado River Storage Project: Arizona-Utah. January, 1976.

TABLE 1

GLEN CANYON RELEASES: NORMALIZED MONTHLY POWERPLANT RELEASE VOLUMES IN ACRE-FEET 1/

YEAR		OCT.	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.
1966-71		718450	656262	600288	533384	554600	641838	845376	1003028	764672	667544	666195	617846
		599145	637023	583168	667328	560819	715154	821051	908349	730038	664101	721598	627817
		413098	454016	544208	626376	458596	829578	957051	924547	882594	836018	594747	617337
		578463	581741	583213	527139	421778	649926	810380	712259	823009	910491	884426	749509
		586055	663824	769528	669361	424944	451565	899796	869611	777518	752676	722176	653583
		479729	442140	648224	469589	399056	535252	1017355	877159	865278	902243	850592	726533
	Ave.	562490	572501	621438	582196	469965	647_19	891835	882492	807185	788979	739981	665437
1972-76		498060	670862	836759	712853	378326	307948	697353	796974	796914*	785836*	896629*	819250
		600536	628636	913382	1071791	697618	598682	989609	527327	601945	704891	527327	396791
		510650	443592	347165	849602	316592	398388	505660	800777	896883	1209524	1188806	779136
		527739	629261	510052	688374	502330	459817	424817	795704	875704	1080348	881574	834122
		596282	414747	513816	684573	733291	670291	647980	1026359	733078	747534	700017	825223
	Ave.	546653	551420	624235	801458	525631	487025	653084	789428	780957	905827	890487	734905
1977-81		785490	887716	794657	991863	471500	464902	168490	217275	473059	863392	1172294	962765
		373010	393572	819223	932505	604029	572408	479291	635466	742126	690777	1060320	965204
		681951	663835	886039	1024544	744272	221184	359204	524320	607233	845990	1047214	663282
		475612	625710	505543	474395	485464	469132	651992	639581	1033543*	1192659*	1221136	730411
		761918	945827	765337	739245	621143	434910	459449	544388	526778	860510	906969	675133
	Ave.	615596	703336	754160	832510	585282	432523	423685	512206	677348	890666	1081587	799359
	(B) 2/	600000	700000	800000	900000	700000	400000	400000	400000	600000	1000000	1000000	750000

1/ Adjusted to 8.25 million acre-feet base water year

2/ Projected post-uprate release volumes "Source: Western Area Power Administration

* Reservoir "spill" occurred either through reservoir outlets or over spillways

TABLE 2

GLEN CANYON RELEASES: YEARLY AVERAGE MAXIMUM FLOWS [1]

Based on monthly average maximums for each year [2,3]

Year	Average Annual Maximum Release (cfs)	
1974	26772	8 yr mean = 26,812
75	27850	
76	27465	
77	25996	
78	27753	
79	27463	
80	27242	
81[4]	23955	

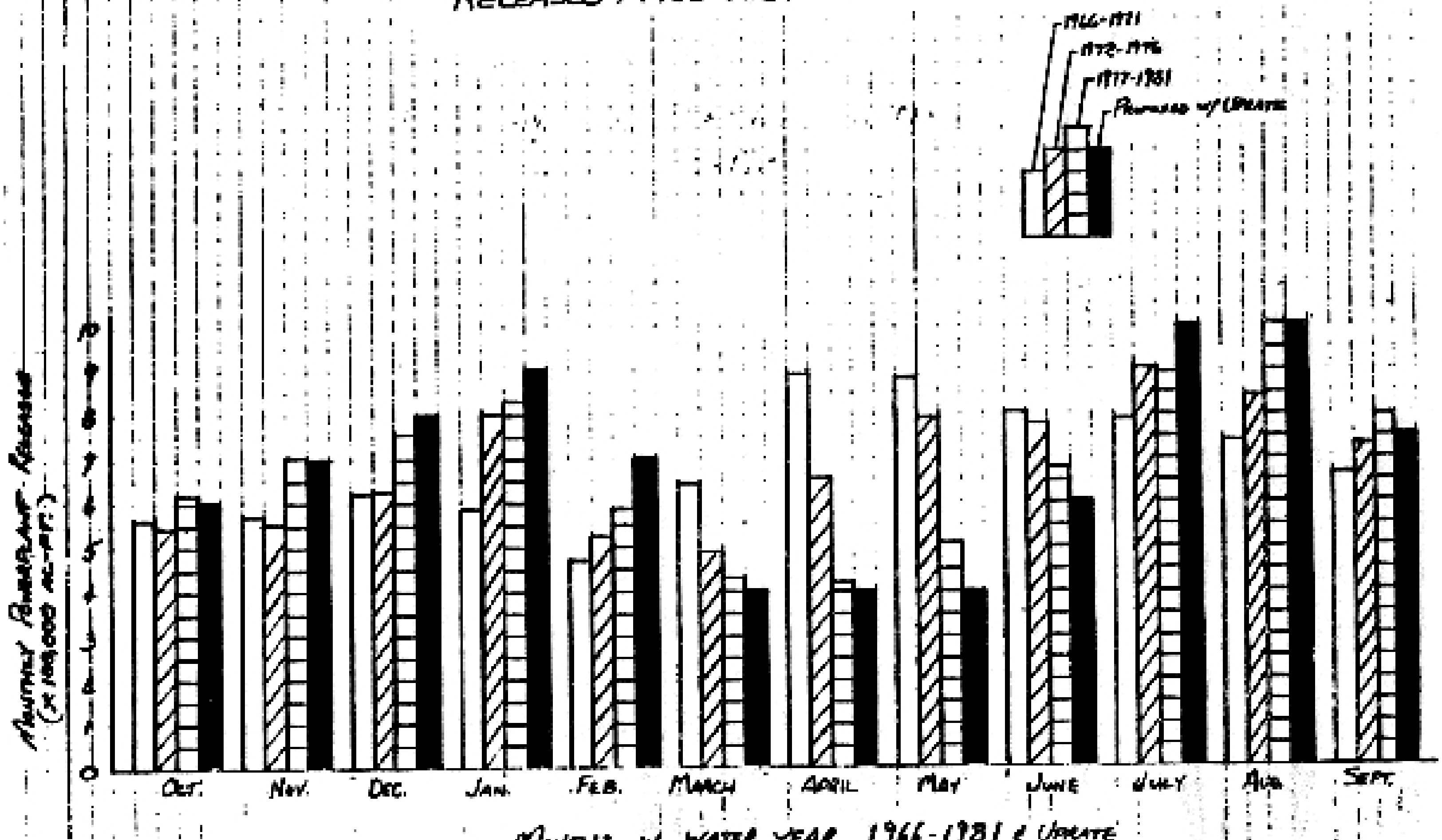
1/ Historical release data - source: Attachment B: "Maximum Release of Water from Glen Canyon Dam for Each Month From Sept. 1964 to Sept 1981 and Each Day Release Exceeded 28,000 cfs", USBR, prepared 11/9/81.

2/ For months with more than 1 release >28,000 cfs, only the maximum value was used. Also, surplus flow above the listed turbine-generator maximum capacity of 31,500 cfs was neglected, as it was assumed to represent either river outlet and/or spillway discharge, ie. not delivered thru penstocks.

3/ During the period 1966-1973, the reservoir elevation failed to reach 3641 ft., therefore these years were neglected since attainment of the maximum generator output of 1150 MW corresponds to this elevation

4) Jan - Sept only

FIGURE 1 CHANGES IN MONTHLY POWERPLANT RELEASES: 1966-1981 1/



1/ Based on normalized release volumes summarized in Table I

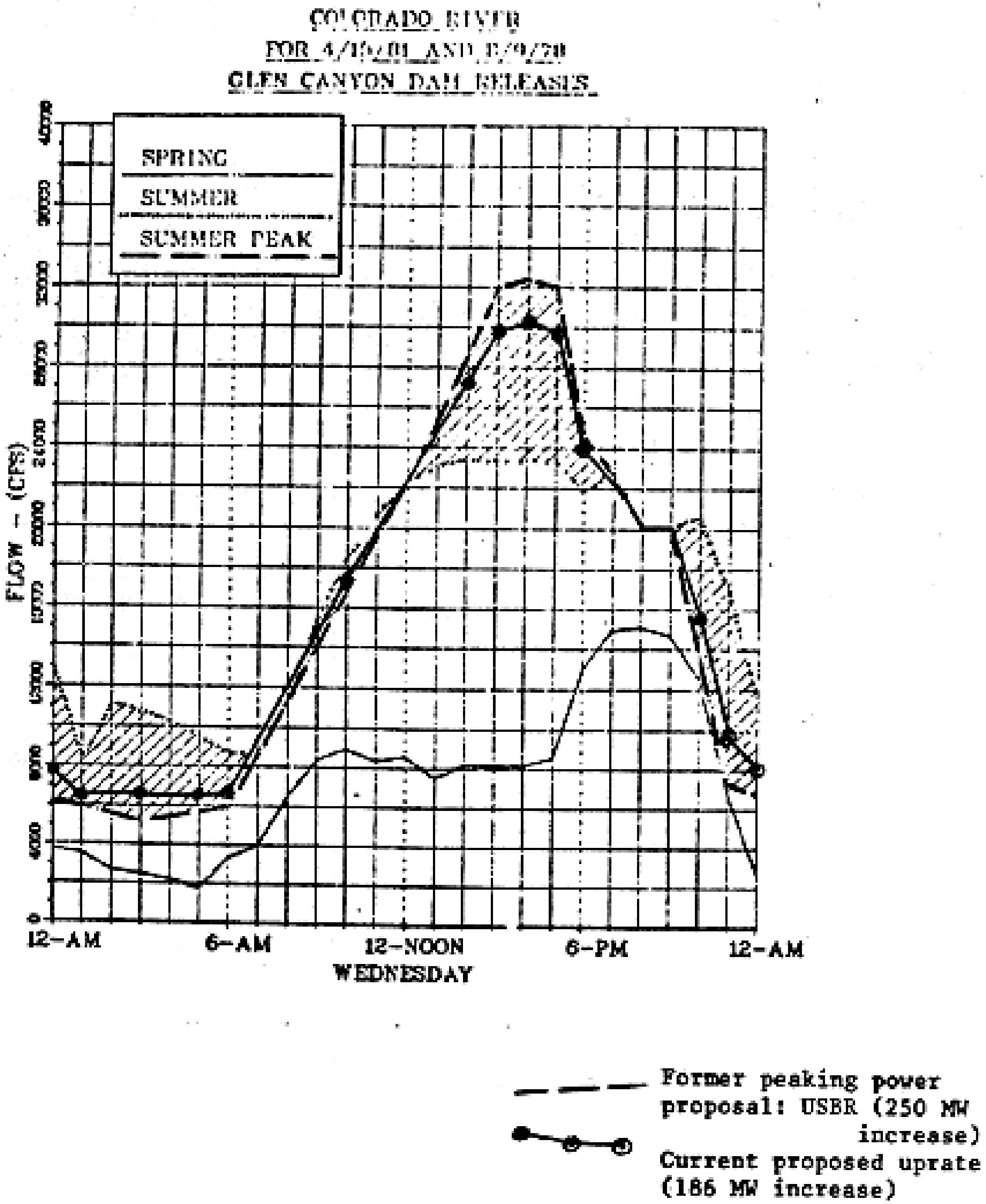


Figure 2

FLOOD WAVE HYDROGRAPHS AT GLEN CANYON DAM
(Source: USBR 1981)

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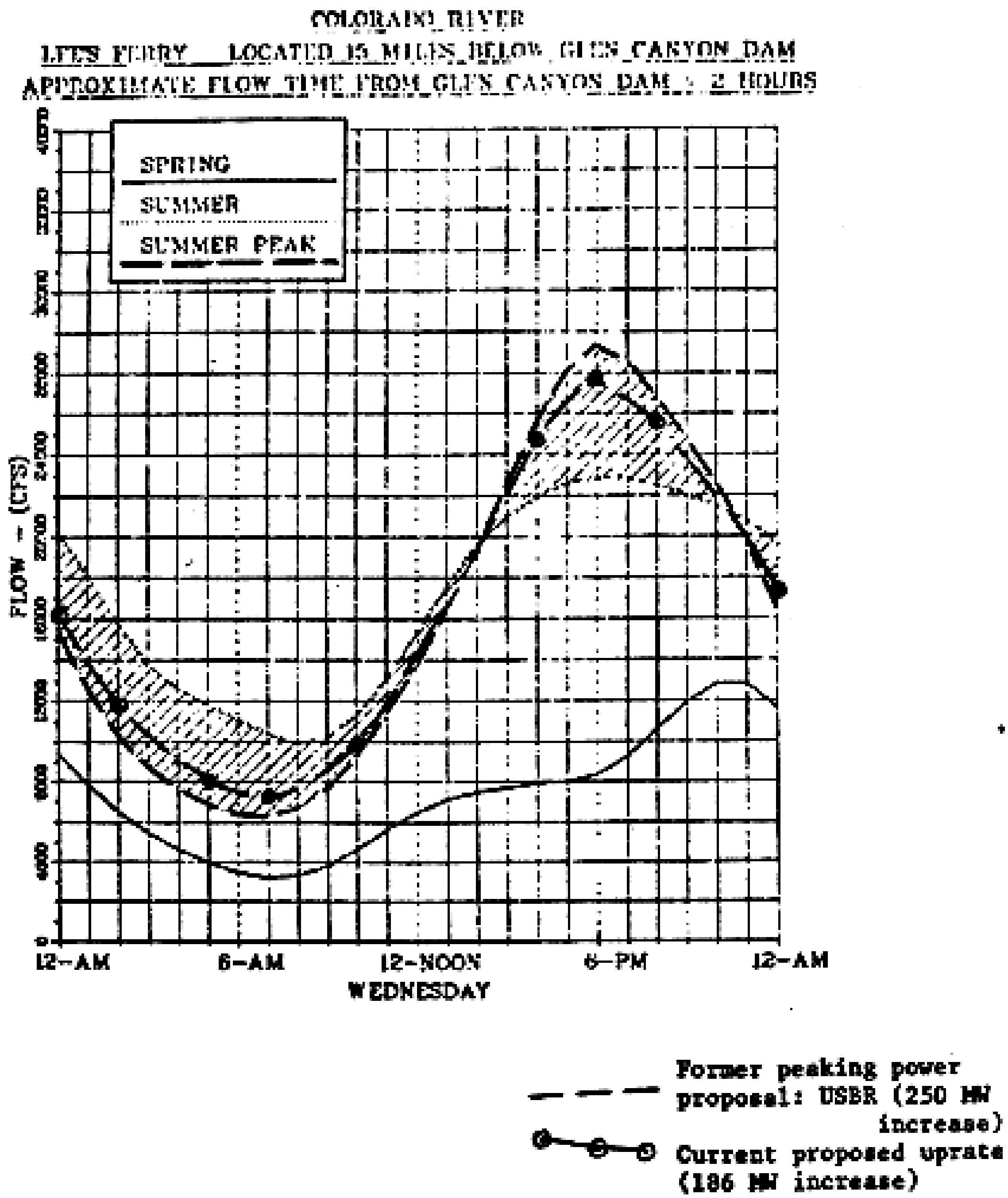

Figure 3

FLOOD WAVE HYDROGRAPHS AT LEE'S FERRY GAGING STATION (Source: USBR 1981)

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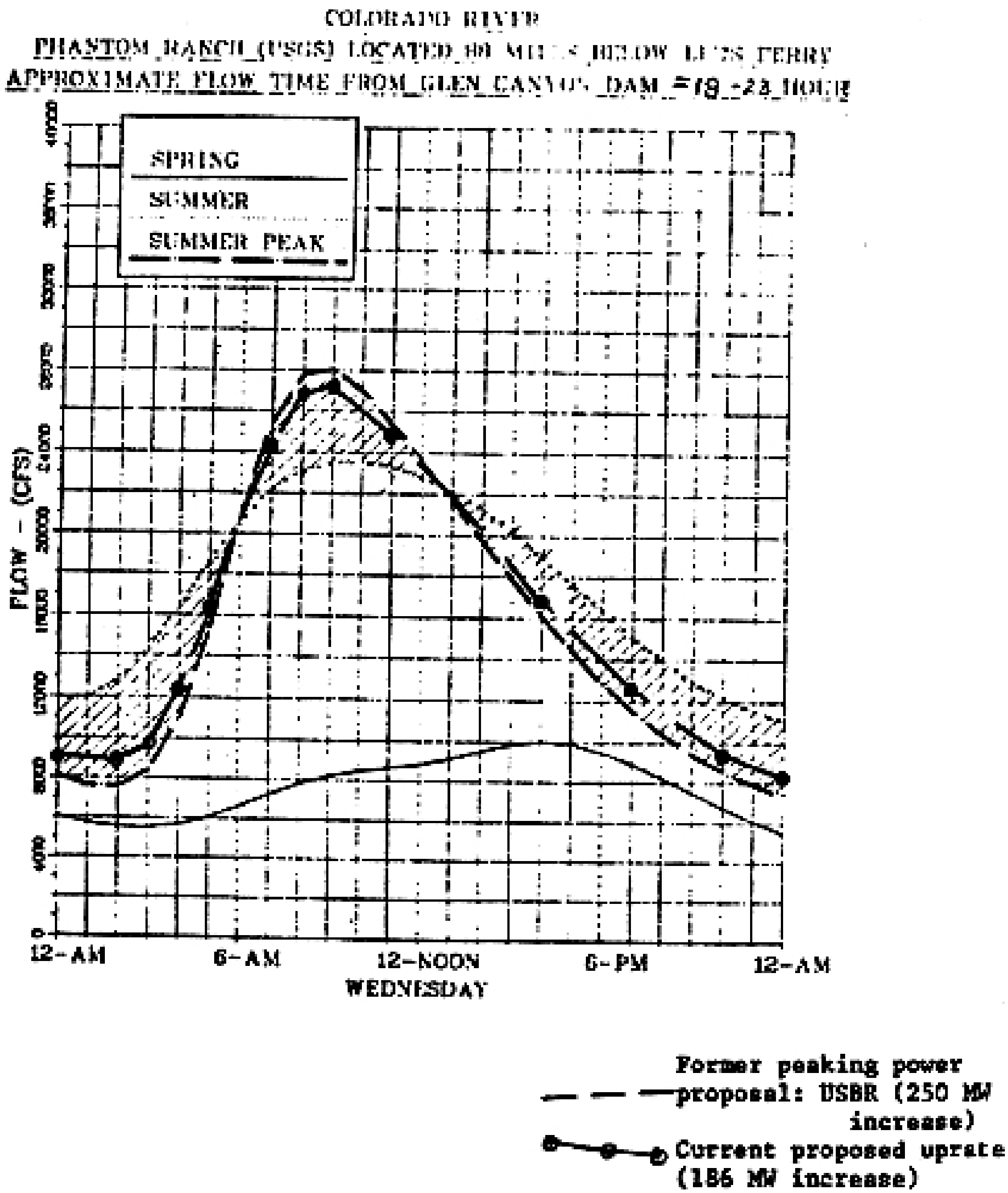

Figure 4

FLOOD WAVE HYDROGRAPHS AT PHANTOM RANCH GAGING STATION - GRAND CANYON N.P. (Source: USBR 1981)

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Table 3

Colorado River Channel Characteristics: Downstream from Glen Canyon Dam [1]

Station	Discharge (cfs)	Width (ft)	X-Sectional Area (ft²)	Hydraulic Depth (ft) [3]
Lees Ferry	7320	360	2260	6.3
	8230	375	3460	9.2
	15,400	408	4420	10.8
	21,000	395 [2]	4680	11.8
	34,000	399 [2]	5430	13.6
Phantom Ranch	2760	276	2260	8.2
	8610	283	3460	12.2
	15400	290	4420	15.2
	17,300	295	4680	15.9
	26,800	300	5430	18.1

1/ Source: U.S. Geological Survey, Tucson, Az., March, 1982.

2/ Sand bars probably present

3/ Hydraulic depth = depth of an equivalent rectangular channel = X-sectional area / channel top width

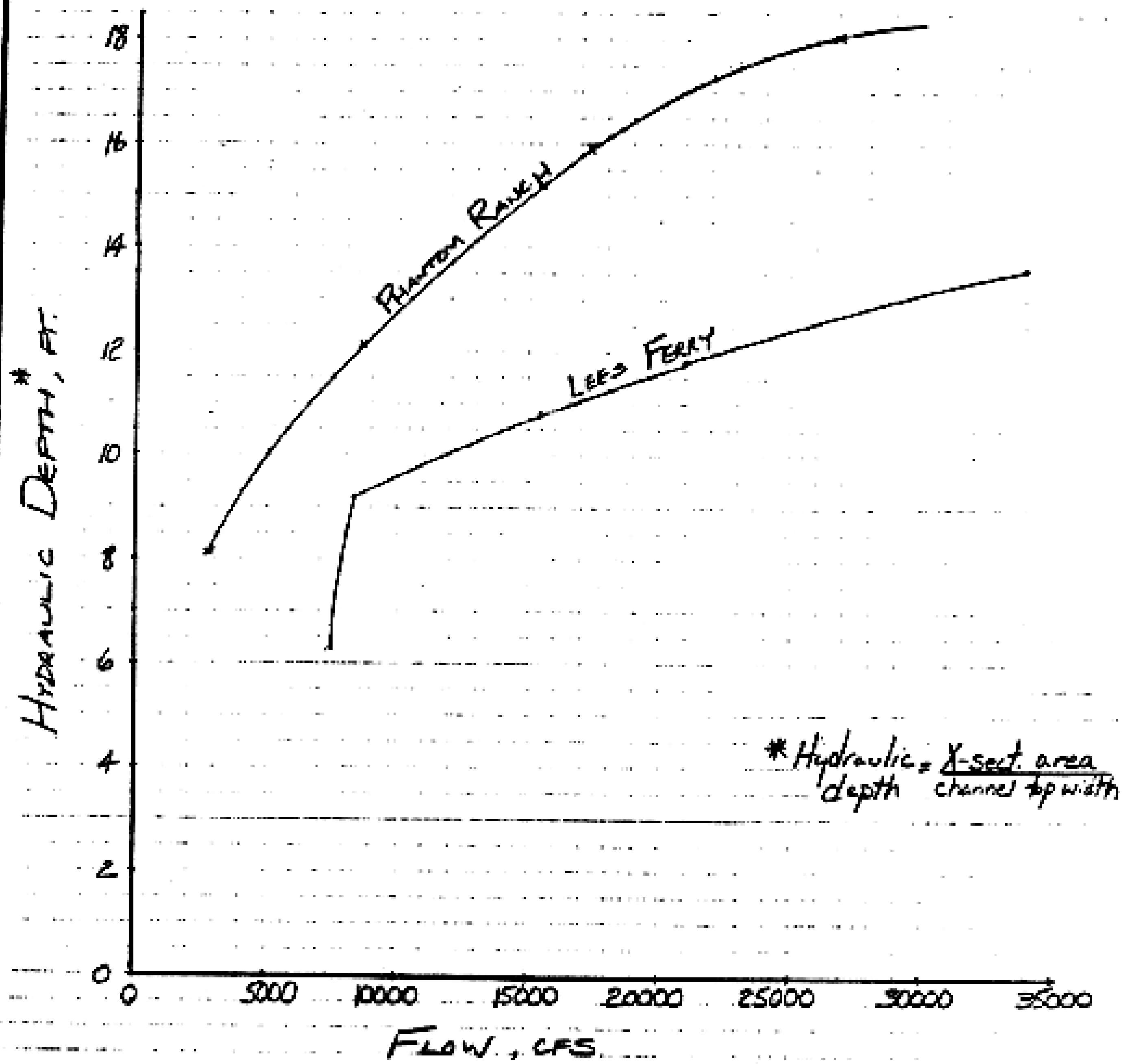

Figure 5

RIVER DEPTH VS. DISCHARGE - COLORADO RIVER AT LEE'S FERRY AND PHANTOM RANCH GAGING STATIONS

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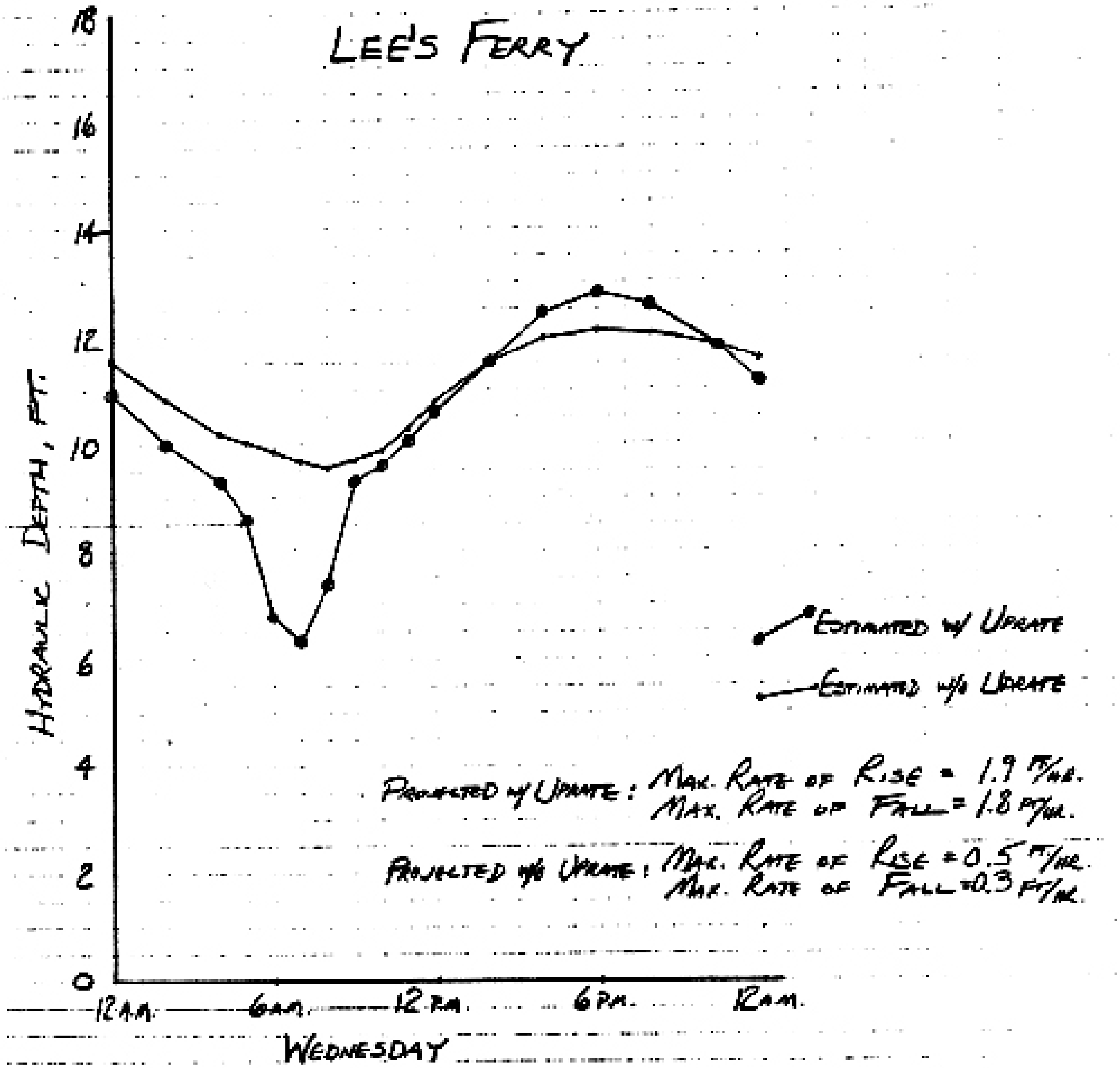

Figure 6

RIVER DEPTH VS. TIME - COLORADO RIVER AT LEE'S FERRY GAGING STATION

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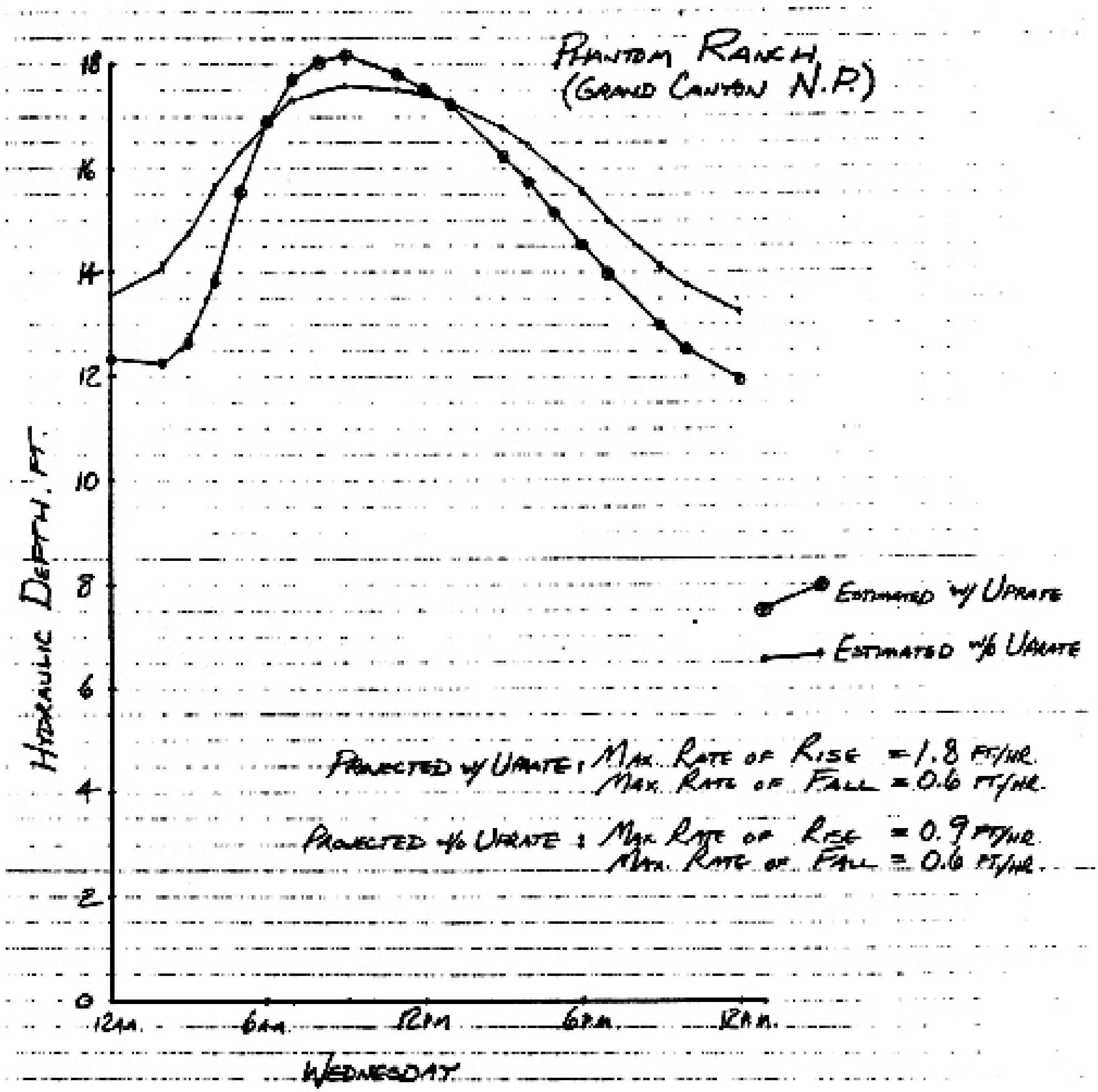

Figure 7

RIVER DEPTH VS. TIME - PHANTOM RANCH GAGING STATION

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RESUME

PHILIP B. WILLIAMS, PH.D., P.E.

EDUCATION

1970 Ph.D. in Hydraulics, specializing in fluvial sediment hydraulics. University of London, University College Civil and Municipal Engineering Department.

1966 Bachelor of Engineering in Civil and Structural Engineering, specializing in hydrology. Sheffield University, Civil Engineering Department.

PROFESSIONAL REGISTRATION

Civil Engineer No. 21483 (California)

PROFESSIONAL EXPERIENCE

1979-present Philip Williams & Associates
Consultants in Hydrology, San Francisco

1976-1979 Dr. Philip B. Williams, P.E.
Consultant in Hydrology, San Francisco

1973-1975 Senior Associate
Environmental Impact Planning Corporation, San Francisco

1970-1972 Senior Engineer
Bechtel, Inc., Pipeline Division, San Francisco

Dr. Williams has been engaged in a wide range of hydrologic and engineering hydraulics work since he emigrated to the United States in 1970. His work has included delineation of flood hazard in developing areas, evaluation of urbanization effects on watershed sediment production, supervision of research in two-phase flow fluid mechanics, testimony as an expert witness on flood control dam operation, work with landscape architects to develop recreational land use plans, studies of effects of land use changes on groundwater resources, preparation of harbor maintenance dredging plans, analysis of multipurpose reservoir operation, salt marsh restoration design, and critique of dam safety analysis and analysis for groundwater management programs.

Much of this work has been related to analyzing the environmental effects of hydrologic changes, and this has often involved working with professionals of other disciplines in the preparation of planning feasibility or environmental impact studies. He has directed and participated in over 80 environmental assessments on projects including flood control, residential development, freeways, national parks, commercial developments and land use zoning changes.

PROFESSIONAL SOCIETIES

Member: American Society of Civil Engineers
Member: Association of Environmental Professionals
Member: American Water Resources Association

TECHNICAL PAPERS

"Deposition Velocities, Transition Velocities and Spatial Distribution of Solids in Slurry Pipelines" (co-authored by Nash, Aude, Kenny, Seiter and Jacques). Hydrotransport 1 Proceedings, Coventry, England. September 1970.

"The Initiation of Sediment Ripples on Flat Sand Beds" (co-authored by P. H. Kemp). ASCE Hydraulics Division Journal. April 1971.

"The Design of Slurry Pipeline Systems" delivered to the Symposium on Two Phase Flows, University of Tennessee Space Institute, Tullahoma, Tennessee. July 1971.

"The Initiation of Sediment Ripples from Artificial Distrubances" (co-authored by P. H. Kemp). ASCE Hydraulics Division Journal. June 1972.

"The Effect of Wind on Energy Consumption in Buildings" (co-authored by E. Arens). Energy and Buildings, Vol. 1, Issue No. 1, 1977.

"Taking Another Look at Electrical System Reliability." Public Utilities Fortnightly. March 17, 1977.

"Dam Design, Is the Technology Faulty?" New Scientist. February 2, 1978.

"The EIR Process as a Tool for Implementing Flood Plain Management Policies" Proceedings of Flood Management Conference. Sacramento, California. California Department of Water Resources. Report No. 44. March 1979.

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RESUME

WILLIAM BENTON VANDIVERE

EDUCATION

1980 M.S. Watershed Management/Hydrology
University of Arizona

1975 B.S. Civil Engineering/Water Resources
University of Illinois

PROFESSIONAL EXPERIENCE

1981–present Associate Hydrologist
Philip Williams & Associates, San Francisco

1980–1981 Staff Hydrologist
Leeds, Hill & Jewett, Inc., San Francisco

1978–1980 Graduate Research Assistant, University of Arizona
School of Renewable Natural Resources. Tuscon, Arizona

1978 Graduate Research Assistant, Northern Arizona University,
Department of Civil Engineering. Flagstaff, Arizona

1975–1977 Civil Engineer I, City of Chicago, Department of Public Works,
Bureau of Engineering. Chicago, Illinois

In the last five years Mr. Vandivere has been involved in the analysis of a variety of watershed and hydraulic studies, including the analysis of runoff from unbanizing watersheds, development of design measures to reduce peak runoff and sediment load, and an analysis of water supply needs for San Bruno Mountain Park, San Mateo County, California. While in Arizona he researched forest hydrologic influences and the impact of hypothetical second-home development on streamflow characteristics in Coconino National Forest. In addition he researched coal mining reclamation technology, focusing on the evaluation of precipitation uncertainty influencing the effectiveness of reclamation efforts in semi arid regions. He has also investigated sewage system design and the analysis of water hammer problems in municipal pumbing stations.

PUBLICATIONS

- "Impact of Development on On-Stream Flow" (co-authored by P.D. Trotta & J.J. Rogers). Proceedings of the Arizona Section, American Water Resources Association, Vol. 9. Tuscon, Arizona, 1979.
- "Uncertainty in Sedimentation Pond Design" (co-authored by D.R. Davis) Presented at the 1979 Winter Meeting of the American Society of Agricultural Engineers. New Orleans, La. December 12, 1979.
- "Sediment Yield Prediction for Black Mesa Coal Spoils" (co-authored by M.N. Fogel & L.H. Hekman). Presented at the 1979 Winter Meeting of the American Society of Agricultural Engineers. New Orleans, La. December 14, 1979.

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RESUME

PETER THOMAS VORSTER

EDUCATION

1975	A.B. Geology and Geography (double major) University of California, Berkeley, California

PROFESSIONAL EXPERIENCE

1979- Present	Water Resource Analyst Philip Williams & Associates
1979	Research and Educational Activities Director Mono Lake Committee, Lee Vining, California
1977- 1978	Researcher - California Water Atlas Governor's Office of Planning and Research, Sacramento, California
1976	Hydrological Field Assistant U.S. Geological Survey, Medford, Oregon

Since graduating from Berkeley in 1975, Mr. Vorster has been engaged in a variety of work in the earth sciences and resource planning. In his most recent work, he has specialized in the analysis of California's water resource policies, including water supply and management problems in Southern California. Much of this experience was gained as a principal researcher in the preparation of the California Water Atlas. In addition to water resource analysis, Mr. Vorster's work in the past four years has included developing an environmental monitoring program for a State weather modification project, environmental assessments of the Mono Basin and salt marshes in the San Francisco Bay, as well as considerable practical field experience in streamflow and water quality monitoring and geological and geomorphological field mapping.

PROFESSIONAL SOCIETIES

Association of American Geographers
American Geophysical Union

PUBLICATIONS

"Rainmaking Regulated" (co-authored by Linda Adams). OPR Journal, Vol. 2.1. July 1979.

California Water Atlas, State of California, William Kahrl, Editor, 1979. Principal Researcher.