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LIMITATIONS ON UPPER BASIN DEVELOPMENTS

DUE TO

SHORTAGE OF COLORADO RIVER SUPPLY

March 7, 1961

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March 7, 1961.

Mr. Stanley Mosk,
Attorney General of the State of California,
104 Library and Courts Building,
Sacramento 14, California.

Dear Sir:

Pursuant to requests from your office, I have reviewed the Report of the Special Master to the Supreme Court of the United States in the action, State of Arizona vs. State of California, published and unpublished reports of Federal and State Agencies, and my own report of 1953 to the State of Colorado, to determine the impact of the recommended decree on California, on the other States of the Lower Basin, and upon the States of the Upper Basin.

There is submitted herewith my report on the impact of this decree on the States of the Upper Basin. This has been limited primarily to the extent of the shortage of water to be borne by the Upper Basin and the resulting impact on each Upper Basin State, if California's existing uses are not to be curtailed under the apportionment formula recommended by the Special Master. The limitations imposed upon Upper Basin developments by physical conditions and by the provisions of Article III (c) and (d) of the Colorado River Compact can readily be evaluated from the data presented in this report.

In brief, I find, if California's existing uses are not to be curtailed under the recommended decree, that the water supply available to the Upper Basin from the Colorado River System will be exhausted by existing projects, by projects under construction, by projects already authorized and other projects proposed for construction during the next twenty years.

Respectfully submitted,



RAYMOND A. HILL

RAH/am

LIMITATIONS ON UPPER BASIN DEVELOPMENTS

When the Colorado River Compact was entered into in 1922 there was apportioned from the Colorado River System in perpetuity to the Upper Basin the exclusive beneficial consumptive use of 7,500,000 acre feet of water per annum, including all water necessary for the supply of any rights then existing. However, Simon H. Rifkind, Special Master, in his report of December 5, 1960 to the Supreme Court of the United States in the action, State of Arizona vs. State of California, stated:

This apportionment is accomplished by establishing a ceiling on the quantity of water which may be appropriated in each Basin as against the other. (Page 140).

I regard Article III (a) and (b) as a limitation on appropriative rights and not as a source of supply. (Page 149).

For Compact purposes, Article III (a) and (b) can refer only to limits on appropriations, not to the supply of water itself. (Page 149).

The States of the Upper Basin have proceeded on the assumption that they were entitled to consume the quantity of water apportioned to them by the Compact in disregard of any developments in the Lower Basin, subject only to physical limitations on the available water supply and compliance with the provisions of Article III (c) and (d) of the Colorado River Compact. The Colorado River Storage Project and Participating Projects, now under construction, have been

considered to be only a major step toward such full development of the water resources of the Upper Basin.

The Special Master, however, questioned this premise. He in effect assumed that the Upper Basin will be limited to about two-thirds of its "ceiling" on appropriations. The following statements in the Report are significant in this connection:

A second and controlling assumption. . . . is that the Upper Basin will deplete the virgin flow at Lee Ferry by between 6,500,000 and 6,800,000 acre-feet per annum. Yet there is nothing to indicate that the Upper Basin depletions, which have never exceeded 2,200,000 acre-feet per annum measured at Lee Ferry, will expand to anywhere near 6,500,000 acre-feet. In sharp conflict with this assumption is the estimate expressed in the Report of the Senate Committee which studied the Colorado River Storage Project and potential reservoir construction in the Upper Basin. That Report estimates that future Upper Basin consumptive use will not exceed 4,800,000 acre-feet per annum (depletion of the flow at Lee Ferry would be less), even if the extensive storage capacity envisaged but not as yet authorized for the Upper Basin were eventually constructed. (Pages 111-112).

Then on page 115 of his report the Master concluded:

Existing California uses are in no danger of curtailment unless and until many vast new projects, some of which are not even contemplated at this time, are approved by Congress and constructed.

In this connection, the Master stated on the preceding page:

Moreover, if ever the equities between California's existing uses and new uses in the Colorado River Basin have to be resolved, it will be for Congress to resolve them. No new projects, whether in the Lower or Upper Basin, which would affect Lower Basin main-stream supply can be constructed in the Colorado River Basin without Congressional action or acquiescence.

The magnitude of such uses and the total supply of mainstream water needed were set forth in the footnote on page 104 which reads:

According to the evidence presented in this case, existing California projects presently consume 4,483,885 acre-feet of water per annum from the mainstream. See page 128, infra. This means, under the apportionment formula proposed in this Report, that a total supply of mainstream water sufficient to satisfy 7,667,770 acre-feet of consumptive uses in the Lower Basin per annum would satisfy all of California's present uses.

The total consumptive use in California, however, had increased prior to 1958 (Footnote, Page 128) to 4,586,392 acre feet. The corresponding total supply of mainstream water under the apportionment formula proposed would be increased to 7,872,774 acre feet per year.

The total quantity of water required to be delivered by the Upper Basin in Colorado River at Lee Ferry to avoid curtailment of existing California uses would be about 10 million acre feet per year, more probably 10.5 million acre feet per year, because of deliveries to Mexico pursuant to the Treaty of 1944 and reservoir and channel losses and operational wastes not offset by tributary inflow between Lee Ferry and the International Boundary.

MAGNITUDE OF SHORTAGE

The delivery of an average of at least 10 million acre feet per year of water in Colorado River at Lee Ferry, without limitation of the original apportionment of 7.5 million acre feet for beneficial

consumptive use in the Upper Basin, would require that the average natural undepleted flow of Colorado River at Lee Ferry be at least 17.5 million acre feet per year. The true natural supply has been far less than this quantity. Hence, if the premise of the Special Master be valid, a very severe shortage of water will be imposed on the Upper Basin.

The undepleted or virgin flow of Colorado River at Lee Ferry, as given on page 118 of the report of the Special Master, is quoted below:

TABLE A

AVERAGE ANNUAL VIRGIN FLOW FOR SELECTED PERIODS

<u>Period</u>	<u>Acre Feet per Year</u>
1909-1956	15,211,000
1914-1956	14,920,000
1922-1956	14,008,000
1930-1956	13,085,000

Measurements of the actual flow of Colorado River at Lee Ferry were not commenced until about the beginning of the Water Year 1921-22, so that authentic records of the historical flow at Lee Ferry are available only for that water year and subsequent years. Estimates of the magnitude of the actual flow prior to 1922 could be grossly in error; hence the estimates of the average virgin flow for the period 1909-1956 and the period 1914-1956 are questionable.

R. D. Goodrich, then Chief Engineer, Upper Colorado River Commission, in Engineering Report No. 22 dated November 14, 1955, concluded:

1) On the basis of all the data now available, the present "safe yield" of the Upper Colorado River at Lee Ferry appears to be from 13,000,000 to 14,000,000 acre feet annually. This yield is more than ample for the projects now proposed if sufficient carry-over storage is provided on the main stem and larger tributaries to properly regulate flow to the Lower Basin.

The writer, in a report to the State of Colorado, dated October 31, 1953, stated (page 7):

When this (Colorado River) Compact was negotiated it was thought that the flow of Colorado River under natural conditions would average considerably more than 15 million acre feet per year. It is now evident that such is not the case and that the provisions of Section (d) of Article III will probably limit depletions of the waters of the Upper Basin to some amount less than that allocated in Section (a) of the same article.

In testimony before the Special Master in the action, Arizona vs. California in 1958, the writer pointed out that the flow of Colorado River at Lee Ferry in recent years has been much below normal, and that the dependable undepleted supply was no more than 13.7 million acre feet per year, involving complete regulation of inflow to reservoirs for long periods, such as the historical period from 1926 to 1956 and thereafter until the reservoirs might re-fill.

The assumption that any larger virgin flow of Colorado River could be put to beneficial use depends on estimates of flow at Lee Ferry prior to 1922 and on the feasibility of complete regulation in reservoirs

of the variable flow of Colorado River over periods of 50 or more consecutive years. It should be accepted by all concerned, therefore, that 14 million acre feet per year is the upper limit of the dependable supply obtainable from the undepleted or virgin flow of Colorado River at Lee Ferry.

The upper limit of depletions of the natural or virgin flow of Colorado River at Lee Ferry is thus no more than 4,000,000 acre feet per year if California's existing uses are not to be curtailed under the apportionment set forth in the decree recommended by the Special Master to the United States Supreme Court. The resulting shortage in the supply of water, required for development of the Upper Basin, is almost one-half of the total supply envisioned by the Compact Commission in 1922 as being available for use in that basin.

PROJECTS FORECLOSED

It is generally recognized that depletions caused by projects in operation or authorized prior to 1949 for construction in the Upper Basin will amount to 2,548,000 acre feet per year. This amount of depletion is broken down among the States of the Upper Basin in H. D. No. 364, 83rd Congress, 2nd Session, page 148, as follows:

Arizona	11,000 acre feet per year
Colorado	1,591,000 acre feet per year
New Mexico	79,000 acre feet per year
Utah	628,000 acre feet per year
Wyoming	239,000 acre feet per year

There would thus remain available to the Upper Basin only about 1,450,000 acre feet per year for all other purposes, if California's

existing uses be not curtailed under the decree recommended by the Special Master. The impact of any such restriction on the Upper Basin as a whole would be more severe on some States than others.

Arizona has only a minor interest in the Upper Basin, and its foreseeable needs are fully covered by the allocation to it of 50,000 acre feet per year as provided in Article III of the Upper Colorado River Basin Compact of 1948.

Under the provisions of that article, Colorado is apportioned 51.75 per cent of the remainder of the supply available for use each year in the Upper Basin from the Colorado River System. Depletions and reservoir losses due to existing and projected developments in Colorado, if sufficient water were to be physically and legally available, are given in Table B. It is apparent from this tabulation that the projected depletions in Colorado would exceed, before 1980, Colorado's share of the 4,000,000 acre feet per year available.

This share would permit full uses on all existing projects, all Participating Projects, and the Collbran Project. It could permit development of the proposed Frying Pan-Arkansas Project, but only by severely limiting the future development of the Blue River Project of the City of Denver. All of the future participating priority projects in Colorado would be foreclosed, including the Savory-Pot Hook Project serving areas in both Wyoming and Colorado and the Animas-La Plata Project serving areas in both New Mexico and Colorado. Neither would

there be any room for expanded municipal and industrial uses of water in Colorado. The great mineral resources of western Colorado would have to remain undeveloped because of lack of water if the premise of the Special Master be valid.

The impact on New Mexico would be more severe because the projected depletions in New Mexico would exceed its share (11.25 per cent) of the supply available to the Upper Basin by about 1975, as shown in Table C. Depletions by existing projects and the Participating Projects under construction would then amount to 88,000 acre feet per year. The New Mexico share of losses from the Storage Project Reservoirs now under construction will be about 78,000 acre feet per year. This leaves only about 280,000 acre feet per year for all other projects in New Mexico.

The San Juan-Chama Project, proposed for early construction, would deplete Colorado River by 110,000 acre feet per year. Depletions due to the proposed Navajo Project are expected to amount to 125,000 acre feet in 1975, and within ten years later to 252,000 acre feet per year. It is apparent that there would not be sufficient water for both of these projects, if California uses are not to be curtailed under the decree recommended by the Special Master to the Supreme Court of the United States.

The impact on Utah would be even more severe because projected depletions in this State, shown on Table D, would exceed its share of 4,000,000 acre feet per year prior to 1975. Depletions by existing

projects and those authorized before 1949 for construction in Utah alone account for more than two-thirds of the 23 per cent available to that State, if California's existing uses are not to be curtailed under the decree recommended by the Special Master. Utah must, of course, bear its share of reservoir losses from Colorado River Storage Projects, so that there would be little more than half enough water available for Participating Projects in Utah, already authorized and in part under construction.

Wyoming would be in a somewhat better position, but its 14 per cent share of 4,000,000 acre feet would be exhausted soon after 1980 if developments proceed as projected (Table E). Depletions by existing projects amount to 239,000 acre feet and Participating Projects to Colorado River Storage Project are estimated to deplete the flow of Colorado River by 104,000 acre feet in 1980 and eventually by 156,000 acre feet per year. The Sublette Project and the portion of the Savory-Pot Hook Project in Wyoming are expected to deplete the river to the extent of 65,000 acre feet in 1980, and eventually to the extent of 118,000 acre feet per year. There would remain, therefore, a very small margin, if any, for municipal and industrial uses unless the Participating Projects were cut back.

The total projected depletion of the virgin flow of Colorado River at Lee Ferry is recapitulated in Table F with the assumption that there would be no expansion of existing uses in the Upper Basin portion of Arizona. The totals shown in that Table are summarized below:

TOTAL OF PROJECTED DEPLETIONS IN UPPER BASIN

<u>Year</u>	<u>Acre Feet</u>
1965	2,779,000
1970	3,526,000
1980	4,855,000
1990	5,629,000
2000	6,134,000

The foregoing estimates of depletion of the flow of Colorado River at Lee Ferry were based on published and unpublished reports of the U. S. Bureau of Reclamation and various State agencies. The magnitude of these projected depletions differs little from that set forth in earlier reports by the Bureau of Reclamation, but the probable time of development has been condensed to conform to construction schedules, the status of Feasibility Reports, and estimated dates of submission of other Feasibility Reports.

In my opinion, the economic potential of the Upper Basin justifies and will force early development to the limit of the water supply available, now that the Upper Colorado River Storage Project is under construction. This situation is glowingly described in a pamphlet recently issued by the U. S. Bureau of Reclamation, as follows:

The Upper Colorado River Basin may have been late in exploration, slow in settlement, and limited in development, but the Upper Basin boldly faces a new future which will see its many resources utilized on an ever-widening scale.

The future of the Upper Colorado River Basin lies in its resources. The most important resource is water -- water which is corralled and put to work rather than allowed to plunge wildly toward the sea, wasting its energy in the rapids of the colorful canyons.

The Upper Colorado River Basin has the water -- it has land to be irrigated -- it has canyons with dam sites where much water can be stored and where hydro-electric power can be produced -- it has petroleum, coal, and natural gas -- it has oil shales and rare hydro-carbons -- it has mineral resources of uranium and other atomic ores, of many strategic metals, of phosphate and other needed nonmetallic ores.

But, these many resources are largely dormant -- sleeping giants yet to be awakened. The future will see the use of Upper Basin resources on an ever-widening scale under a development program which will bring together the resources of water, power, land, and minerals ...

The future begins to unfold for the Upper Colorado River Basin.

INHERENT CONFLICT

If California's existing uses are in no danger of curtailment under the apportionment formula recommended by the Special Master to the Supreme Court of the United States, the burden of the inevitable shortage of water supply will fall on the Upper Basin States.

Arizona and Nevada would be free to develop and use much more water from the mainstream of Colorado River than they could use beneficially on existing projects supplied from that source. Hence, to

make use of the water apportioned to them under the recommended decree, Arizona and Nevada would have to construct new projects. These projects would be as feasible as any of the projected projects in the Upper Basin. Neither Arizona nor Nevada can be expected to forego use of the water apportioned to them. Their new projects will thus be competitive with every new project in the Upper Basin.

California, even under the presumption that its existing uses are in no danger of curtailment, will still be dependent upon the unused part of the water apportioned to the other States in both the Upper Basin and Lower Basin. This will be true even to the extent of supplying water through existing works in California to meet demands that are already greater than those stated in the Report of the Special Master.

It is not to be expected, on the other hand, that Colorado or New Mexico or Utah or Wyoming will acquiesce willingly in limitations on their development sufficient to insure enough water, under the apportionment formula recommended by the Special Master, to satisfy existing California uses.

It follows, therefore, that should the Supreme Court resolve the present controversy between Arizona and California in accord with the recommendations of its Special Master, there will be created a new and greater conflict involving all the States of the Colorado River Basin.

The opinion of the Special Master, quoted below, thus has particular significance:

.....if ever the equities between California's existing uses and new uses in the Colorado River Basin have to be resolved, it will be for Congress to resolve them. No new projects, whether in the Lower or Upper Basin, which would affect Lower Basin mainstream supply can be constructed in the Colorado River Basin without Congressional action or acquiescence.

Raymond A. Hill

Los Angeles, California
March 7, 1961

TABLE B

PROJECTED DEPLETIONS IN COLORADO
OF
FLOW OF COLORADO RIVER AT LEE FERRY

Project or Service	Expected Depletions - 1000s Acre Feet				
	1965	1970	1980	1990	2000
Depletions by Existing Projects and Projects authorized before 1949	1591	1591	1591	1591	1591
Participating Projects - CRSP	24	35	35	35	35
Other Current Projects	17	67	162	222	272
Future Participating Projects	17	97	311	520	601
Municipal and Industrial	1	16	220	335	460
Share of Reservoir Losses	52	155	357	409	477
Total Expected Depletion	1702	1961	2676	3112	3436

TABLE C

PROJECTED DEPLETIONS IN NEW MEXICO
OF
FLOW OF COLORADO RIVER AT LEE FERRY

Project or Service	Expected Depletions - 1000s Acre Feet				
	1965	1970	1980	1990	2000
Depletions by Existing Projects and Projects authorized before 1949	79	79	79	79	79
Participating Projects - CRSP	9	9	9	9	9
Other Current Projects	20	171	367	426	426
Future Participating Projects	-	13	27	39	39
Future Municipal and Industrial	-	-	-	-	-
Share of Reservoir Losses	11	34	78	89	104
 Total Expected Depletion	 119	 306	 560	 642	 657

TABLE D

PROJECTED DEPLETIONS IN UTAH
OF
FLOW OF COLORADO RIVER AT LEE FERRY

Project or Service	Expected Depletions - 1000s Acre Feet				
	1965	1970	1980	1990	2000
Depletions by Existing Projects and those authorized before 1949	628	628	628	628	628
Participating Projects - CRSP	20	173	233	255	255
Other Current Projects	-	-	-	-	-
Future Participating Projects	5	10	13	13	13
Future Municipal and Industrial	-	-	40	120	190
Share of Reservoir Losses	23	69	159	182	212
Total Expected Depletion	676	880	1073	1198	1298

TABLE E

PROJECTED DEPLETIONS IN WYOMING
OF
FLOW OF COLORADO RIVER AT LEE FERRY

Project or Service	Expected Depletions - 1000s Acre Feet				
	1965	1970	1980	1990	2000
Depletions by Existing Projects and those authorized before 1949	239	239	239	239	239
Participating Projects - CRSP	14	44	104	156	156
Other Current Projects	-	-	-	-	-
Future Participating Projects	4	38	65	100	118
Future Municipal and Industrial	-	5	30	60	90
Share in Reservoir Losses	14	42	97	111	129
Total Expected Depletion	271	368	535	666	732

TABLE F

PROJECTED DEPLETION IN UPPER BASIN
OF
FLOW OF COLORADO RIVER AT LEE FERRY

State Responsible	Quantities in Thousands of Acre Feet				
	1965	1970	1980	1990	2000
Arizona - Existing Uses	11	11	11	11	11
Colorado	1702	1961	2676	3112	3436
New Mexico	119	306	560	642	657
Utah	676	880	1073	1198	1298
Wyoming	271	368	535	666	732
Total Projected Depletions	2779	3526	4855	5629	6134