UNITED STATES

DEPARTMENT OF THE INTERIOR

Walter J. Hickel , Secretary

BUREAU OF RECLAMATION

Floyd E. Dominy , Commissioner

REGION 3

A. B. West, Regional Director

REPORT ON
COMPREHENSIVE RIVER MANAGEMENT PLAN
LOWER COLORADO RIVER
PARKER DIVISION

Colorado River Front Work and Levee System

Arizona — California

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INTERIOR-RECLAMATION, BOULDER CITY, NEVADA

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REGION 3
BOULDER CITY, NEVADA 89005

IN REPLY
REFER TO: 3-470

MAR 14 1969

AIRMAIL

To: Commissioner

From: Regional Director, Boulder City, Nevada

Subject: "Report on Comprehensive River Management Plan--Lower Colorado River--Parker Division"

This letter transmits my "Report on Comprehensive River Management Plan--Lower Colorado River--Parker Division." It has been prepared under the authority of Public Law 469 (60 Stat. 338) approved June 28, 1946, commonly known as the Colorado River Front Work and Levee System Act.

The report presents a plan for stabilization and control of the channel of the Colorado River from Parker, Arizona, to a point 3 miles above the Palo Verde Diversion Dam. In the first 14 miles of river channel below Parker, Arizona, stabilization of the channel will result from dressing and armoring existing riverbanks and from construction of rock-armored fill within the river channel to confine the normal flow in overwide reaches. Because of the urgency created by current development of riverfront lands on the Colorado River Indian Reservation, and with the approval of others interested in this section of the river, the work in the upper 14 miles was initiated in January 1966. The completed work is discussed on page 3 of the report.

In the lower portion of the Division, the excavation of an improved channel by dredging will provide the desired lowering of river water levels and the greatest overall benefit obtainable from the river management work. This work requires the acquisition of a 16-inch cutter-head dredge and appropriate service and support equipment.

The completed project will serve both immediate and long-term needs of the adjacent area. The salvage of 24,200 acre-feet of water annually will reduce the year-to-year draft on Lake Mead and thus

reduce the severity of future water deficiencies. Water salvage through channel improvement is an important increment of a program of water conservation on the lower Colorado River. The testimony presented at the hearings on H. R. 3300, which led to authorization of the Central Arizona Project under Public Law 90-537, clearly identifies the need for such conservation practices. Stabilization of the river channel will facilitate current and future development of Indian Tribal lands along the river, contributing materially to the economic welfare of the Colorado River Indian Tribes.

Completion of the project will reduce the sediment transported by the river in the amount of 788,400 tons per year. Together with completed work in the Palo Verde Division and current work in the Cibola Division, this will significantly reduce the amount of sediment arriving at Imperial Dam. One result will be an extension of the life of the Imperial backwater lakes, which are important fish and wildlife and recreational resources. Another will be a substantial reduction in the quantity of sediment which must be handled at the Imperial Desilting Works, and by the 12-inch dredge "Gila" which is used in disposal of the sediment removed from the river at Imperial Dam.

The project has been planned to serve the multiple-purpose needs of the Region using the planning concepts prescribed by Senate Document No. 97, the Fish and Wildlife Coordination Act, and other Federal directives. A number of proposals for preservation or improvement of recreation or fish and wildlife resources have been considered and those which were found to be feasible have been included in the project plan. Twenty-two percent of the project costs will be expended for fish and wildlife and recreational features.

Exhibit I of the comprehensive plan report is a memorandum report from the Regional Director, Bureau of Sport Fisheries and Wildlife, which evaluates the effect of the project on the fish and wildlife resources of the Parker Division. Since this report reflects consideration of the comments of the Arizona Game and Fish Department and the California Department of Fish and Game (Exhibits III and IV), as well as other local requirements, we have included the proposed fish and wildlife features in our comprehensive plan. The memorandum report makes six recommendations. Recommendations Nos. 1 through 4 have been adopted as part of our comprehensive plan. While we are agreeable also to Recommendations Nos. 5 and 6, the actions proposed cannot be accomplished until local agencies are ready to assume the associated responsibilities.

Exhibit II of the comprehensive plan report presents the recommendations of the Lower Colorado River Land Use Office (now designated the Lower Colorado River Office, Bureau of Land Management) for incorporation of recreational features for the Quien Sabe Area in the comprehensive river management plan. The objectives and recommendations of the Lower Colorado River Land Use Office have been incorporated in the comprehensive plan report, to the extent discussed therein. It should be noted that some of the features proposed by the Lower Colorado River Land Use Office have not been included in the comprehensive plan report. This is because there is a basic problem of availability of water for recommended increased water surface areas. Since the recommendations of the Lower Colorado River Land Use Office were submitted to us, the Colorado River Basin Project Act of September 30, 1968, places new responsibilities upon the river. The river's flow without augmentation is insufficient to permit any new water surface areas to be developed. Indeed, we must, on the contrary, seek ways by which to achieve an even better use of water than previously planned. We have asked the State of Arizona to associate all new water uses adjacent to its Colorado River boundary with a specific contractor with the United States. On the California side, present irrigation and municipal uses exceed that State's 4.4 million acre-foot annual entitlement by 800,000 acre-feet or more. No possibility exists, therefore, for contracting in California for further uses.

This means that the new marinas proposed on the California side would be using water that otherwise would be available for the Central Arizona Project. Spokesmen for Arizona should be aware of this, and of the pattern that may be established. California water users have shown keen interest in water salvage on the lower Colorado. Water salvaged on either side of the river is clearly beneficial to both states. Until the river is augmented, the recreational needs may have to be met by less elaborate installations, such as those upstream from Needles, where a minimum area is devoted to launching and retrieving boats directly into and from the river. While this is less than ideal, it is in keeping with the short water supply with which all uses must live until we achieve augmentation.

I suggest that this report be considered of interim nature, and that interests within Arizona and California holding contracts with the United States for delivery of Colorado River water be asked for their views regarding the new uses in question.

Enclosure

SUMMARY SHEETS

Colorado River Front Work and Levee System

Parker Division

LOCATION: Along the Colorado River in San Bernardino and Riverside Counties, California, and Yuma County, Arizona. The project area begins at Parker, Arizona, and extends downriver to a point 3 miles upriver from the Palo Verde Diversion Dam.

AUTHORITY: Colorado River Front Work and Levee System Act enacted January 21, 1927 (44 Stat. 1010, 1021), and amended by Acts of July 1, 1940 (54 Stat. 708), June 28, 1946 (60 Stat. 338), and May 1, 1958 (72 Stat. 101).

PLAN: The construction of a multiple-purpose project for rectification and stabilization of the channel in the Parker Division of the lower Colorado River. The work will provide significant benefits in water salvage, sediment reduction, drainage, channel stability, and improved navigation. Measures have been included for the preservation of fish and wildlife and recreational resources.

PRIMARY PROJECT FEATURES

Channel Stabilization - Section I

Stabilizing eroding riverbanks	miles	11
Volume of rock riprap	cu. yd.	235,000
Training and jetty fill structures	miles	7.5
Volume of fill structures	cu. yd.	525,000
Bridge across river	each	1
Access and service road construction	miles	34

Channel Stabilization - Section II

Channel dredging and rectification	miles	21.4
Volume of excavation by land-based equipment	cu. yd.	5,800,000
Volume of dredged spoil	cu. yd.	11,600,000
Volume of rock riprap	cu. yd.	516,000
Access and service road construction	miles	53

SUMMARY SHEETS (Continued)

PRIMARY PROJECT FEATURES (Continued)

Fish and Wildlife and Recreation

Deepening of backwater areas by dredging	cu. yd.	4,660,000
Inlet and outlet structures for circulatory flows to backwaters	each	20
Parking and sanitary units	each	5
Road construction	miles	24

PROJECT COSTS

Channel Stabilization - Section I	$ 2,071,500
Channel Stabilization - Section II	7,218,500
Fish and Wildlife measures	2,349,000
Recreation facilities	230,000
Total	$11,869,000 1/

AVERAGE ANNUAL BENEFITS	$ 941,300
AVERAGE ANNUAL COSTS	$ 542,500
BENEFIT-COST RATIO	1.7 to 1.0
CONSTRUCTION PERIOD	6 years 2/
ALLOCATION OF COSTS	Nonreimbursable

1/ Includes $2,277,547 expended as of June 30, 1968, on completed work.
2/ Remaining work.

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LIST OF EXHIBITS

EXHIBIT I

Memorandum Report from the Regional Director, Southwest Region, Bureau of Sport Fisheries and Wildlife, to Regional Director, Region 3, Bureau of Reclamation, dated February 24, 1967. . . . . 24 Sheets

Plate I Parker Division - Channelization Map Showing Typical Fish and Wildlife Management Areas

EXHIBIT II

Lower Colorado River Land Use Office report entitled "Recreation Aspects of Section II of the Parker Division Channelization Plan, Lower Colorado River - Quien Sabe Area - California," dated May 1968. . . . 21 Sheets

Drawing No. LUO 5-4003 Parker Division - Section II, Typical Backbay Recreation Development

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EXHIBIT II (Continued)

Drawing No. LUO 5-8001 Parker Division Channelization Program, Recommended Structures and Channel Access

EXHIBIT III

Letter of August 1, 1966, from Director, Arizona Game and Fish Department, Phoenix, Arizona, to Regional Director, Region 3, Bureau of Reclamation . 7 Sheets

EXHIBIT IV

Editorial Note . . . . . 1 Sheet

Comments of the State of California relative to the Parker Division as described in the report "Comprehensive Plans for the Lower Colorado River - Parker Division, Yuma Division, and Topock Gorge Division - August 1966". . . . . 47 Sheets

EXHIBIT V

Letter from the Area Director, Bureau of Indian Affairs, Phoenix, Area Office, to Regional Director, Region 3, Bureau of Reclamation, July 23, 1965 . . . 1 Sheet

Resolution No. R-53-65 of the Colorado River Tribal Council dated August 7, 1965 . . . . . 1 Sheet

EXHIBIT VI

Basic Estimate DC-1 Summary. . . . . 1 Sheet
Basic Estimate DC-1. . . . . 4 Sheets
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PART I

INTRODUCTION

PART I

INTRODUCTION

Reason for Study

The purpose of this report is to present the plan of the Bureau of Reclamation for rectification and stabilization of the lower Colorado River within the Parker Division. It is submitted in recognition of the responsibilities of the Bureau of Reclamation along the Colorado River for the conservation, regulation and delivery of water, the reduction of sediment movement, the control of potential floods, and the improvement of navigation.

The report includes a multiple-purpose plan for the preservation of fish and wildlife within the Parker Division in accordance with the Fish and Wildlife Coordination Act. 1/ It also recognizes the importance of joint Federal, state, and local participation in a far-reaching program for optimum development of recreational resources along the stabilized riverbanks and adjoining lands. 2/

The necessity of channel improvement work is becoming more urgent in view of recent developments on the Colorado River. The construction of Upper Basin dams and related works together with planned construction of the Central Arizona Project will hasten the time of an anticipated critical water shortage on the Colorado River. It is essential, therefore, that all practicable water conservation practices be undertaken now to reduce waste and uneconomic use of water along the river.

River management work in the Parker Division will play an important role in both stabilizing the river and reducing the losses of water. Rectification of the channel, where alinement and channel widths are poor, will improve conveyance characteristics and permit more exact scheduling and delivery of water. Abandoned sections of the river which are not needed for fish and wildlife and recreational purposes, as discussed later in this report, will be filled with dredged material to reduce losses of water by evaporation. The quality of the water will be improved also as a result of a reduction in the sediment load of the river.

1/ Fish and Wildlife Coordination Act as amended (Act of August 12, 1958 - 72 Stat. 563).

2/ The Lower Colorado River Land Use Plan, U.S. Department of the Interior, January 1964.

Authority

This report is authorized by the Colorado River Front Work and Levee System Act of January 21, 1927 (44 Stat. 1010, 1021) and amended July 1, 1940 (54 Stat. 708), June 28, 1946 (60 Stat. 388), and May 1, 1958 (72 Stat. 101). The amended act is quoted as follows:

> "That for the purpose of controlling the floods, improving navigation, and regulating the flow of the Colorado River, there is hereby authorized to be appropriated, out of any moneys in the Treasury of the United States not otherwise appropriated, for the fiscal year ending June 30, 1928, and annually thereafter, such sums as may be necessary, to be spent by the Bureau of Reclamation under the direction of the Secretary of the Interior, to defray the cost of (a) operating and maintaining the Colorado River front work and levee system in Arizona, Nevada, and California; (b) constructing, improving, extending, operating, and maintaining protection and drainage works and systems along the Colorado River; (c) controlling said river, and improving, modifying, straightening, and rectifying the channel thereof; and (d) conducting investigations and studies in connection therewith . . . ."

Alternative Plans

On January 23, 1964, a meeting was held in Boulder City, Nevada, with representatives of the Bureau of Indian Affairs to discuss river stabilization problems in the Parker Division and explain the plans of the Bureau of Reclamation for that area. Three plans were discussed at the meeting. These are the Channelization Plan, the Alternate Plan, and the Complete Dredging Plan. The Channelization Plan and the Alternate Plan, contained in this report, are similar in that they would stabilize the channel above Alligator Bend by bank protection and training structures, and they would provide for complete stabilization including realinement of portions of the channel below Alligator Bend. They differ, however, in that the Channelization Plan would utilize a dredge for channel excavation below Alligator Bend whereas the Alternate Plan

would confine operations to land-based equipment. The Complete Dredging Plan was considered as a result of informal discussions with personnel of the Bureau of Indian Affairs. It explored the possibility of securing additional head for a potential power source at Headgate Rock Dam. This plan would include dredging the channel above Alligator Bend at a comparatively flat slope in order to achieve a significant lowering of the water surface below Headgate Rock Dam.

During the process of investigation for the Complete Dredging Plan, the Central California Land Development Corporation, which has leased a considerable length of the shoreline on the California side above Alligator Bend, objected to dredging this reach of the channel. It appeared probable that this lease would be canceled if a dredging program were undertaken. The Bureau of Indian Affairs consulted with the Bureau of Reclamation to determine the probable benefits to power production that would be derived from the channel dredging program. The Bureau of Indian Affairs then decided to eliminate the channel dredging above Alligator Bend from further consideration. Therefore, it was deemed unnecessary to further analyze the Complete Dredging Plan and that plan is not part of this report.

Completed Work

While this report is not needed to obtain authority and funds for the work, both of which have already been provided by Congress, it is needed to outline an approved comprehensive plan which can provide the basis for programed activities by other agencies affected by the lower Colorado River. An official report was not issued earlier because of difficulty in resolving conflicts with and among related programs such as fish and wildlife and recreation. Work aimed at resolution of these problems was, nevertheless, continued until publication of this report. In the interim, local agencies have been generally aware of Reclamation's work plan as the result of review drafts of this report distributed in August 1964 and September 1965.

In the several years between issuance of draft reports and publication of this report, impending development of Indian lands in Section I of the Parker Division required that channel

stabilization be accomplished without delay. Since most of the coordination problems were associated with the planned work in Section II of the Parker Division, it was determined that the Section I work would proceed in response to immediate needs. Interested agencies were informed and tacitly approved this procedure.

Completed work in Section I is shown by Drawing No. 423-300-738, River Stabilization Structures. The minor differences between the completed work and the planned work shown by Drawing No. 423-300-356, Bank Protection Structures, are the result of the additional information assembled during final design of the structures.

Cooperation and Acknowledgments

Recognition is given to the following agencies for contributing information and assistance during the preparation of this report:

United States Agencies

Bureau of Indian Affairs
Bureau of Land Management
Bureau of Sport Fisheries and Wildlife
United States Section, International Boundary and Water Commission
Corps of Engineers, Los Angeles District
Lower Colorado River Office, Bureau of Land Management

State of Arizona

Arizona Game and Fish Department
Arizona Interstate Stream Commission
Colorado River Boundary Commission of Arizona

State of California

California Department of Fish and Game
California Department of Water Resources
Colorado River Board of California

Counties

San Bernardino County, California
Riverside County, California
Yuma County, Arizona

Water User Agencies

Colorado River Indian Reservation
Imperial Irrigation District
Metropolitan Water District of California
North Gila Valley Irrigation District
Palo Verde Irrigation District
Reservation Division, Yuma Project
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Mesa Irrigation and Drainage District

Source of Data

The data included in this report are principally derived from records on file in the Regional Office, United States Bureau of Reclamation, Boulder City, Nevada. Other information was obtained from the Bureau of Sport Fisheries and Wildlife, Bureau of Indian Affairs, Lower Colorado River Office (Bureau of Land Management), Colorado River Indian Tribes, publications of the United States Geological Survey, and climatological records of the United States Weather Bureau.

PART II

GENERAL DESCRIPTION

PART II

GENERAL DESCRIPTION

Colorado River - Davis Dam to the International Boundary

The Lower Colorado River Basin below Davis Dam includes parts of three states: Nevada, Arizona, and California. The Bill Williams River and the Gila River are the only perennial tributaries in this reach. However, numerous washes, with a total drainage area of approximately 11,000 square miles, empty into the mainstream at various locations. These washes are normally dry for several years in succession, but occasionally a thunderstorm in the drainage area of a wash will cause a short-duration flood of high intensity. Because the slope of the beds of these washes is generally steep, great quantities of coarse gravel and small boulders are frequently carried into the valley. Where these discharges of coarse alluvial material enter the river directly, they are often sufficient to alter the alinement of the river.

For the major portion of its length between Davis Dam and the International Boundary, the Colorado River flows through a series of alluvial valleys separated by mountain chains. The river flows in well-defined canyons through the mountainous reaches but, within the valley portions of the river's course, the alluvial character of the bed and banks provides little resistance to the tendency of the river to meander and aggrade or degrade the channel.

Typical cross sections of the alluvial valleys, surveyed at right angles to the river, show typical alluvial conformation. The Parker Valley, 7 to 8 miles wide, is practically flat while the Palo Verde Valley, 7 miles wide, shows a slope away from the river of about 1.4 feet per mile.

During the years preceding the closure of Parker and Imperial Dams (1938), major changes in the river channel by avulsion or accretion occurred. Aerial photographs of the valleys of the Colorado River Basin show many old meander patterns that indicate the river has moved across the valleys and back again many times.

The Colorado River from Davis Dam to the International Boundary consists of about 280 miles of waterway and is divided into nine divisions (Drawing No. 423-300-383). Within this length of river, 42 miles are in reservoir (Lake Havasu) and 238 miles are in river channel. The major valleys traversed by the river are:

Mohave Valley (Davis Dam to Topock)	43 miles
Parker, Palo Verde, and Cibola Valleys (Parker to Imperial Dam)	148 miles
Yuma Valley (Imperial Dam to International Boundary)	47 miles

River stabilization work was completed in the Mohave Valley Division in July 1960. The present channel from Big Bend to Topock is a designed channel 450 to 550 feet wide with a capacity of about 25,000 cfs and an average grade of 1.2 feet per mile. A levee system was constructed to contain floodflows of about 70,000 cfs from Topock to 2-1/2 miles above Piute Wash and 50,000 cfs upstream from this point. A 12-inch maintenance dredge has been used in the settling basin above Topock to reduce the sediment inflow to Topock Gorge and Upper Lake Havasu and to prevent the further rise of the water surface elevation at Topock.

Proposed work in the Topock Gorge Division comprises a downstream extension of the designed channel established in the Mohave Valley Division. The principal objectives of such work are to end the long-term cyclic changes of river water levels in the lower Mohave Valley Division and to permit important salvage of water presently lost to phreatophytes.

Stabilization of the river channel was substantially completed in the Palo Verde Division in 1966. The work was accomplished with land-based equipment without recourse to dredging. Since only comparatively short reaches of the river channel required some type of control work, such work was accomplished by bank protective structures and river training structures.

The plan of development in the Cibola Division includes dredging for the purpose of relocating and improving the natural channel. The dredged channel begins approximately 2.2 miles downstream from Taylor Ferry and will terminate at the Adobe Ruins site where the

natural river channel enters a semicanyon section. The dredged channel will be about 16 miles long, 450 feet wide, and on a gradient of 1.2 feet per mile. This work is presently in progress.

The Imperial Division, from Adobe Ruins to Imperial Dam, is presently acting as a sediment trap behind Imperial Dam. A detailed study of the problems involved in this division has been deferred due to the greater urgency of problems in other reaches of the river. Present and future work directed toward controlling sediment production in the upper divisions will prolong the sediment trap life of this division a considerable length of time.

The Yuma Valley is divided into three divisions: Laguna, Yuma, and Limitrophe. In the Laguna Division, a 12-inch dredge was acquired in 1963 to excavate a settling basin downstream from the California sluiceway at Imperial Dam. The dredge has been used in the basin to remove sediment deposits as they accumulate. The operation of this settling basin plus the control of Laguna Reservoir levels, so as to obtain maximum desilting action, will result in only minor amounts of sediment being transported into the river below Laguna Dam. In the Yuma Division, flows in excess of the present normal flows are restricted by the deteriorated condition of the braided channel. Shallow water and moist sandy areas both in and near the low flow channel have become infested with phreatophyte growth. To remedy this deteriorated condition, and to provide an efficient channel for both low flows and potential floodflows, a program of river management must be accomplished. In the Limitrophe Division, the channel represents a flood hazard because it is partially blocked by sediment deposits and is overgrown with vegetation, both of which reduce its flood carrying capacity. As the levee on the American side is 4 feet lower than the levee on the Mexican side, a definite threat to the safety of the valley is posed by the present condition of the channel. Corrective measures in the form of a dredged channel and cleared flood plain have been recommended.

Climate

The Parker Division lies within one of the most severe desert areas in the United States. The climate is hot and dry with precipitation

averaging less than 5 inches annually. Most of the rainfall occurs in the form of summer thunderstorms. The summers are long and hot with maximum temperatures exceeding 115° F. The winters are short and very mild with an almost complete absence of freezing temperatures.

History of Development

River bottom lands in the Parker Valley were farmed by Indians long before Spanish explorations in the area. The cultivated land was probably in random small parcels within the flood plain of the river.

The Colorado River Indian Reservation was established by Act of Congress in 1865. A sum of $50,000 was appropriated in 1867 for initiation of construction of an irrigation canal from the Colorado River.

Water was first turned into this canal in July 1870, but the canal was promptly destroyed and the diversion structures damaged by unusually high floods during that year. Several attempts were made to reconstruct the canal and structures although these facilities could only be used when the stage of the river was such as to allow diversion of water. Because of the great variation in the flow of the river, all such attempts to irrigate these lands by gravity diversion were discontinued and a pumping plant was installed in 1899. This plant was enlarged in 1912 and again in 1918 to a final capacity of 125 cfs. The completion of Headgate Rock Diversion Dam in 1942 provided permanent diversion facilities with sufficient capacity to irrigate the entire 100,000 acres by gravity.

History of River Channel Changes

Prior to the construction of storage dams on the Colorado River, the regimen of the river from the present site of Hoover Dam to the Gulf of California was typical of a river carrying a heavy sediment load over an alluvial bed. In the first 300 miles, the lower Colorado River flows through many miles of comparatively narrow canyons which restrict the movement of the river. However, the canyons are interrupted by several large valleys including

the Mohave, Parker, Palo Verde, and Cibola Valleys, and within these valleys the river was free to follow its natural pattern. The river moved back and forth across the valley bottoms, usually slowly by accretion, but at other times abruptly by avulsions. The numerous sloughs and traces of old channels, still visible in the valley bottoms, are the traces of channel changes that have occurred in comparatively recent times.

Before the construction of the storage dams, the river was actively building up the valleys along its lower reaches. The river channel was frequently higher than much of the valley bottom on either side. When the annual spring snowmelt floods poured down from the mountains unchecked, these low-lying valley bottoms were regularly inundated. The floods carried a heavy concentration of sediment and, as the flood waters spread across the valley, part of the sediment load was carried out of the channel and deposited on the valley floor.

Suspended sediment records indicate that aggradation was active along the lower reaches of the river. Although some suspended sediment samples were taken at Yuma as early as 1892, it was not until sampling was started at Grand Canyon in 1925 that records were available to show the sediment movement through the lower river. From October 1925 through September 1935 1/ the suspended sediment passing Yuma was only about 60 percent of the amount measured at Grand Canyon. The remainder, about 850,000,000 tons, was evidently deposited somewhere between these stations. The character of the river between Grand Canyon and the upper end of the Mohave Valley is such that it is unlikely that much of this sediment was deposited along that reach. Consequently, it is probable that most of this sediment, plus any sediment inflow below Grand Canyon, was deposited in the Mohave Valley and the valleys farther downstream.

The earliest complete record of river conditions in the Parker Valley is the plan and profile of the Colorado River surveyed by the United States Geological Survey in 1902-1903. These maps show a meandering channel with occasional braided reaches. From the present site of Headgate Rock Dam to the site of the Palo Verde Diversion Dam, the river had a length of 43.2 miles with an average

1/ Closure of Hoover Dam was made in February 1935.

slope of 1.7 feet per mile. The 1902-1903 period is also the last record of the river in its natural state.

The earliest structure on the river itself was Laguna Dam, about 10 miles northeast of Yuma, Arizona. Since this structure had a rather low head, it did not cause extensive changes in the river.

The basic character of the river remained unchanged until 1935 when its natural regimen came to an abrupt end with the beginning of storage behind Hoover Dam.

Effect of Construction of Storage Dams

The beginning of storage behind Hoover Dam caused radical changes in the regimen of the lower Colorado River. The effect of Parker and Imperial Dams was not as great as that of Hoover Dam. However, since all three were completed within a 3-year period, the individual influence of each dam is not readily distinguishable.

The first major change was the regulation of the flows in the river by Hoover Dam. Capacity in Lake Mead is normally sufficient to store the annual snowmelt floods that had previously caused problems along the lower river. This stored water can now be released at a fairly uniform rate consistent with downstream demands as well as at a rate which will provide optimum power production.

The second change of major importance, and one that had greater effects on the regimen of the channel itself, was the change in sediment concentration in the flow below the dams. The reservoirs trapped practically all of the sediment carried by the river and clear water, free from sediment, was released through the dams.

Prior to the storage of water, the channel below each dam was in an alluvial fill which had been graded and formed by flows having a high sediment concentration. The sediment transport characteristics of the channel, though reduced by the decreased flow, were otherwise unchanged and the energy formerly expended on transporting the sediment load was now expended in attacking the old channel bed and banks.

The scouring action on the bed and banks of the channel provided a new sediment load to replace that which was deposited in the lake above each dam. The concentration of sediment that the river acquired under the new regimen was never as high as the concentrations which were common in the uncontrolled river but, nevertheless, the quantity of sediment movement has been quite large.

Maximum scour took place immediately below the dams but the amounts of material removed decreased with the distance downstream. In the case of Hoover Dam, the river is confined to a relatively narrow channel for a distance of about 77 miles. Below this confined channel the river enters the Mohave Valley where it was free to meander up to 4 to 5 miles laterally within the confines of the bluff line surrounding the valley. The river picked up sediment throughout this reach and carried this newly acquired load until it reached the influence of Lake Havasu in the vicinity of Topock. As the flow encountered the backwater effect of Lake Havasu and velocities were reduced, the sediment was dropped and channel aggradation took place. Aggradation at Topock started a vicious cycle. The rise in water surface at Topock caused the channel immediately upstream to deteriorate. The cumulative effect of deposition persisted until the channel was almost lost in the lower part of the valley and the river flowed through a series of swamps and sloughs. This process of deterioration continued until 1944 when the rising water threatened property in the town of Needles and the main line of the Atchison, Topeka and Santa Fe Railway.

In 1944, the Bureau of Reclamation established the Office of River Control in Region 3 to deal with problems caused by the aggrading river. Immediate action was taken to raise and strengthen the existing levees and improve drainage for temporary relief while studies and plans for permanent relief were being made. After considerable study a plan was evolved to lower the water surface elevation and provide a stable channel at Needles and the lower end of the Mohave Valley. This plan consisted of two parts: (1) a dredged channel was proposed from Needles to Topock to lower the water surface, improve the flow characteristics and prevent the river from spreading into the swamps; and (2) a

channel rectification program was designed upstream from Needles to Big Bend to reduce bed and bank scour, a source of sediment transported to the lower reaches. This part of the program was required to prevent the dredged channel from again filling with sediment.

To perform the recommended channel work, the Bureau of Reclamation purchased a 20-inch cutterhead dredge. The dredge was delivered to Needles and assembled there in 1948 and early 1949. Operations began in January 1949. In order to relieve the conditions caused by the high water at Needles as soon as possible, channel dredging from Needles to Topock was undertaken first. Dredging of the channel was completed during April 1951; however, it was not until June 25, 1951, that the land plug at the upper end of the new channel was breached by dynamite, and the river was allowed to enter the new channel.

The dredged channel from Needles to Topock accomplished the purpose for which it was designed. Within a week after the river was diverted into the new channel the average water surface elevation at the Needles gage dropped by 3.5 feet and by the end of 1951 the total lowering was about 5 feet. However, the full benefit of the channel has not been retained. As expected, the continued sediment inflow caused the channel to aggrade again. Maintenance dredging was instituted in the Needles to Topock reach and was successful in preventing excessive rise in the water surface at Needles despite a continued rise in the water surface at Topock. In the period 1952 to 1960 the dredge work was directed to completion of a channel between Needles and Big Bend. Following the completion of this channel dredging in July 1960, there has been a steady decrease in the sediment load entering the Needles to Topock reach. The reduced loads combined with maintenance dredging halted the rise in the water surface at Topock and since then the water surfaces at both Topock and Needles have shown slight downward trends.

From Parker Dam to Imperial Dam the channel deterioration took place in much the same manner as from Hoover Dam to Topock. Lake Havasu behind Parker Dam, like Lake Mead, trapped practically all of the sediment inflow, and the water released through Parker Dam was clear and almost free of sediment. Hence, the clear water began to attack the alluvial bed and banks of the channel.

Prior to the completion of Parker and Imperial Dams, a number of permanent river sections were established along the river between these two dams. Resurvey of these river sections, and additional sections which were established as needed, recorded the results of the river's attempt to establish a new regime.

The record of these river sections shows that another factor was responsible for part of the deposition in the lower part of the Parker to Imperial reach. As with all rivers, the profile of the lower Colorado is concave. That is, the slope is steeper at the upper end and progressively flatter in the downstream direction. Between Hoover Dam and Lake Havasu, the slope was steep enough that the river carried sediment downstream to the backwaters of Lake Havasu. However, just above the lower end of the Cibola Valley, the combination of flatter slopes and the increasing sediment load picked up below Parker Dam caused a balance point in the river's transport ability. Below this balance point, or rather balance reach since the point appears to shift back and forth along about a 10-mile reach, the river began to deposit part of the sediment load that had been scoured from the upstream bed and banks.

A pattern of scour and degradation above the balance reach and deposition and aggradation below the reach developed rapidly. Within 2 years after closure of Parker Dam and Imperial Dam all of the river sections from Parker Dam to River Section 22 were showing scour and those from River Section 21 to Imperial Dam were showing aggradation. 1/ (See Drawing No. 423-300-383.)

Scour of the riverbed below Parker Dam and the resultant entrenchment of the channel progressed rapidly. By 1944, the water surface for a flow of 15,000 cfs had dropped about 4 feet in the vicinity of the Palo Verde Irrigation District's intake. This decline in the water surface was so great that gravity diversion to the District's canal was no longer possible except at high flows.

To restore and stabilize the water surface elevation at the intake, the Bureau of Reclamation constructed the temporary Palo Verde Weir in 1945. The weir, which was constructed by dumping rock from an overhead cableway, was completed about April 1945. With subsequent

1/ See Reports of River Control Work and Investigations, Lower Colorado River Basin.

reinforcement, the weir served satisfactorily until it was replaced with the new Palo Verde Diversion Dam in November 1957.

In addition to controlling the water surface, the weir and the Palo Verde Diversion Dam prevented further scour of the riverbed for many miles upstream. From the weir to River Section 32, about 9 miles upstream, scour was entirely stopped and even some aggradation took place. For another 9 or 10 miles above River Section 32, the rate of degradation was reduced. These changes in bed scour and deposition upstream from the weir reduced the amount of sediment passing the weir, and consequently reduced the sediment inflow to the lower reaches of the river.

At the present time, nearly all of the sediment passing the Palo Verde Diversion Dam is the result of active bank erosion and some degradation in the Parker Division. The stabilization of the banks in the upper section of this division by jetties and other structures, and channel rectification by dredging in the lower section will further reduce the sediment inflow to the lower reach of the river.

Previous Reports

The Lower Colorado River Land Use Advisory Committee, United States Department of the Interior, issued the report on "Lower Colorado River Land Use Plan," dated January 1964. This report contains general plans of various Federal, state, county, and municipal agencies to develop many areas along the river for recreational purposes. In general, the preparation of such plans was accomplished recognizing the requirements for river control and rectification activities.

Status of Lands

The irrigable land in the Parker Division lies almost completely within the Colorado River Indian Reservation. The Headgate Rock Diversion Dam was designed to divert sufficient water for irrigation of 100,000 acres by gravity canal. The area irrigated prior to construction of the permanent diversion facilities was less than 10,000 acres. Since then, cultivation has been expanded to include approximately 42,000 acres.

Some lands downstream from the intersection of the western boundary of the Colorado River Indian Reservation and the Colorado River and situated on the west bank are at present being farmed. With some exceptions these have been considered to be Federal lands. They are, however, subject to an unadjudicated claim of the Colorado River Indian Tribes. Recreational and commercial developments have also taken place in portions of this area.

Soils

The soils within the lower Colorado River valley are a heterogenous group of alluvial soils varying from coarse sands to fine textured clays, although the sandy textured soils predominate. Most of the arable lands in the valley have stratified soil profiles which indicate how these lands have been developed by river deposition. Occasionally a soil profile will consist of one soil texture several feet thick. The presence of the clay lens in the soil is often the cause of a perched water table. In places, this lens may cause slow drainage of excess water from the land. In general, the valley land is quite fertile and well suited for crop production when it has been cleared and leveled and furnished with irrigation water. Most of the land contains some soluble salts (white alkali) and in places the concentration is so high that the land must be leached before satisfactory crop production can be attained. Nitrogen in the soil is usually deficient and needs to be added to secure good crop growth. Likewise, all crop yields seem to be improved from the addition of phosphorous. When these minor deficiencies are corrected, the valley land is suited for a wide range of crops.

Water Rights

When the United States created the Colorado River Indian Reservation, it reserved not only land but also the use of enough water from the Colorado River to irrigate the irrigable portions of reserved lands. This water supply is vested in the Tribe rather than individuals and, therefore, falls under the jurisdiction of the Bureau of Indian Affairs.

In its final decree, issued March 9, 1964, in the case Arizona v. California, the Supreme Court of the United States recognized

the water rights of the Colorado River Indian Reservation to be 717,148 acre-feet of Colorado River water to irrigate 107,588 acres. About 100,000 acres of this land fall within the Parker Division.

PART III

PROBLEMS OF PARKER DIVISION AND EFFECTS OF PROPOSED RIVER MANAGEMENT WORK

PART III

PROBLEMS OF PARKER DIVISION AND EFFECTS OF PROPOSED RIVER MANAGEMENT WORK

Erosion and Channel Changes

The distance from Headgate Rock Dam to Palo Verde Diversion Dam is approximately 44.3 river miles. There are no obvious natural channel controls in this reach. Nine permanent river cross sections were surveyed and monumented in the Parker Division in 1938. Later, however, the number of cross sections was increased to 19. Data on average bed elevation, adjusted water surface elevation, and quantities of riverbed material deposited or removed are derived from yearly surveys at these sections. The channel throughout this reach has been subjected to scouring action by the clear water released from Hoover and Parker Dams. Headgate Rock Dam, constructed by the Bureau of Indian Affairs in 1942, stabilized the channel between Parker and Headgate Rock Dams but degradation has continued below Headgate Rock Dam.

The early history of the river in the Parker Division, as with other reaches of the river where lateral movement has been possible because of natural topography, is one of constantly changing channel locations. Although in historic times the river has generally followed its present course, a major channel change resulted in 1942 when a breakthrough occurred across the neck of a wide oxbow known as Alligator Bend about 19 miles downstream from Headgate Rock Dam. The course of the river was shortened approximately 4 miles by this break. With the beginning of storage in Lake Mead in 1935, the maximum flow in the river was substantially reduced. This reduction of maximum flows greatly curtailed the speed of meander development and movement in the valleys.

The release of clear water from Parker Dam caused scour to take place in the entire Parker Division. The average annual scour for the period 1938-1944 was 1.27 feet and the average bed elevation at the surveyed river sections was lowered approximately 7.6 feet during this period. In 1945, the Bureau constructed the Palo Verde Weir to stabilize the water surface at the Palo Verde Irrigation District's diversion. The weir caused a change in the scour pattern through 1950. The upper river sections continued to show scour, though at a greatly reduced rate, while

the lower river sections showed some aggradation. This counterbalance resulted in an annual rate of change in the average bed elevation of the river sections of only 0.02 foot of scour or a total of 0.12 foot for this period. The record for the period 1950-1958 indicates that scour of the riverbed continued but at a reduced rate in comparison with the earliest period of record. The annual rate of change in bed elevation of the river sections was 0.32 foot of scour for a total of 2.6 feet for the 8-year period. The higher than normal flows of 1958 scoured the riverbed to a depth where normal flows no longer had scouring ability and some aggradation has taken place since that time. The rate of aggradation at the river sections over the period 1958-1961 has been 0.22 foot per year or a total of 0.65 foot over the 3-year period. The average river section change in bed elevation for the period 1938-1961 is 9.67 feet of scour. The bed elevation of the river sections has degraded from 10 to 14 feet in the upper end of the division and approximately 6 feet above the Palo Verde Dam. An evaluation of the rate of scour indicates that an average annual degradation of 0.10 foot could prevail with normal flows. This amount of scour would produce 918,000 tons of sediment yearly at the Palo Verde gaging station.

A comparison of aerial photographs of the Parker Division between the 1938 and 1960 flights indicates that throughout most of this period the river was in the process of entrenching a channel with very little lateral movement. The 1960 mosaics show a more clearly defined channel but about 20 miles of the channel are either excessively braided or poorly alined, or a combination of both. However, as the channel became entrenched the gradients were reduced and through the sorting action of the scour process, the bed material became more resistant to erosion. As these developments progressed, the amount of material that the river could scour directly from the bed was progressively reduced and consequently the river began to attack the banks of the channel with more intensity. Although this bank erosion has taken place at varying rates, a comparison of the aerial photographs shows reaches where lateral movement of bank lines amounted to 45 feet per year. It is estimated that one-third of the bank lines (160,000 feet of bank) is affected by active erosion and that the average amount of erosion is about 5.0 feet per year. Bank erosion of this magnitude, with an average bank height of 10 feet, would produce an estimated 396,000 tons of sediment per year. The sediment contributed by the bed and bank erosion to downstream reaches of the river adds significantly to the problem of

excessive sediment inflow to the Imperial Division. Further, bank erosion has an adverse effect on potential recreation and other developments along the riverbank. Such developments as a marina, county park, or private concession are dependent upon stable banks. Left unchecked, bank erosion can also destroy thousands of dollars worth of valuable cultivated and arable land. River management work as described later in this report would substantially eliminate bank erosion problems.

Floods

The Parker Division is protected from floods by the levee system built in conjunction with the construction of the Palo Verde Diversion Dam. The levee system was designed for flows of 75,000 second-feet with a 4-foot freeboard. It is estimated that the water surface of the river would not overtop the levees until flows of about 125,000 second-feet were attained. In order to avoid serious encroachment on the freeboard of the levee system and diversion dam, a 2,000-foot section of the levee immediately above the dam was designed with a freeboard of 1 foot for flows of 75,000 second-feet. This section would be breached by overtopping if the discharge exceeded about 85,000 second-feet. Breaching at this location would provide relief for the dam and spillway as well as the levee system. Since this levee system appears to be entirely adequate, no other flood control work will be required. The effect of river management work will be to provide a slight increase in the carrying capacity of the levee system by improving channel conditions.

Sedimentation

Historically, the Colorado River was one of the major sediment carrying streams in the world. In its natural state the sediment load passing the site of the measuring station below Palo Verde Diversion Dam averaged about 180,000,000 tons per year. Little is known as to how the river managed this enormous load of sediment. The few early records in existence indicate that the river constantly aggraded or degraded its channel in response to changes in channel locations and varying flow patterns.

With the closure of Parker Dam in 1938 and the subsequent release of sediment-free water, the sediment inflow to the river between Parker Dam and Imperial Dam was reduced to a negligible quantity. Moreover, the region

encompassing this reach of the river is one of the most arid parts of the United States (average annual rainfall is less than 4 inches), and the only tributaries are dry washes which rarely contribute sediment to the river. Consequently, nearly all of the sediment load of the river through this reach is a result of bed and bank erosion.

Sediment movement is the basis for most problems of river control. Many such problems have arisen since the construction of dams and reservoirs and other structures on the Colorado River. One of these problems was the lowering of the water surface at the site of the Palo Verde Diversion Dam at the lower end of the Parker Division. The clear water released from Parker Dam caused the river to degrade rapidly. By 1944 the water surface had been lowered so much that the Palo Verde Irrigation District was experiencing difficulty with its diversion. In order to prevent further degradation at this point and maintain the river stage high enough to enable the District to continue gravity diversions, the Bureau of Reclamation constructed the Palo Verde Weir (1945) as a temporary solution to the diversion problem. As a permanent solution, the weir was replaced by the present Palo Verde Diversion Dam in 1957.

Another problem of river control is the amount of sediment that is contributed by the Parker Division to downstream reaches of the river. In order to obtain sediment data, the Bureau of Reclamation established a sampling station below Palo Verde Dam in 1955. An additional station was established at Water Wheel, approximately 18 miles upstream from the Palo Verde Diversion Dam, in 1958. Measurements at these stations, including the suspended sediment sampling and bed material samples, are used to compute the total load at these two stations. Samples at the station below Palo Verde Dam are taken twice per month whereas the Water Wheel station samples are taken once per month. The computed total sediment load at the station below Palo Verde Diversion Dam represents the sediment outflow of the Parker Division to the downstream reaches. The average load for the years 1956-1957, 1959-1962, was 1,314,000 tons per year. The year 1958 was omitted from this average because the sediment load, amounting to 4,918,000 tons, was caused by higher-than-average flows which are expected to occur infrequently with completion of new storage reservoirs in the upper river basin. Future flows in the Parker Division are expected to be regulated to supply only

downstream demands. The proposed river management work in the Parker Division will reduce the sediment passing the Palo Verde Dam by an estimated 60 percent or 788,400 tons per year, resulting in a sediment outflow beyond this point of 525,600 tons per year.

This reduction of the sediment load passing the Palo Verde Dam, after the channel improvement work has been completed in the Parker Division, will occur gradually. Deprived of the sediment which was formerly contributed by the banks, the river will have to adjust its channel slopes. The length of time required for this adjustment cannot be predicted with complete accuracy due to lack of bed material data; however, the adjustments should be substantially completed within 3 to 5 years.

The reduction of 788,400 tons per year from the Parker Division, coupled with the reduction in sediment expected to result from the river management work in the Palo Verde (310,000 tons per year) and Cibola Divisions (350,000 tons per year), will result in a reduction of 1,448,400 tons per year of sediment passing the Adobe Ruins station.

Based on historical conditions (1956-1957, 1959-1962), the trap efficiency of the reach from Adobe Ruins to Imperial Dam, which includes Imperial Reservoir, was calculated to average 73 percent under ordinary flow conditions and with little or no sluicing at Imperial. With 73 percent efficiency, the sediment records for 1956-1957, 1959-1962 give a sediment outflow at Imperial Dam of 631,000 tons per year. Under project conditions, the Palo Verde and Cibola Divisions will reduce the 631,000 tons per year to 453,000 tons per year. With further work in the Parker Division, the 453,000 tons per year will be reduced to 240,000 tons per year.

At Imperial Dam the greater part of the flow is diverted into the Gila Gravity Main and All-American Canals. Although some of the sediment carried by the diverted water passes through the various canal systems, the greater portion is removed by the desilting works and returned to the river below the dam. To prevent accumulation of the returned sediment and the subsequent deterioration of the river channel from Imperial Dam to the International Boundary, it has been necessary to allot part of the flow at Imperial Dam for river regulation. Since this method of sediment disposal was at best only a partial solution,

the Bureau of Reclamation purchased a dredge to intercept the sediment return below Imperial Dam and dispose of it on land. Reduction of the sediment load originating in the Parker Division by bank stabilization and rectification, as proposed in this report, will reduce the amount of sediment outflow from Imperial Dam and Desilting Works by 213,000 tons per year. This will be reflected in the cost of removing the sediment by dredging from the settling basin in the Laguna Division.

Sediment is an important factor in the design of the proposed channel through the Parker Division. In order to provide maximum benefits for sediment reduction, the channel should neither aggrade nor degrade except within narrow limits. To prevent aggradation, the channel must be capable of transporting the sediment load that is in the river at the head of the new channel. To prevent degradation, the transport ability must not be high enough to cause the river to attack the bed or banks.

Studies in this and other divisions of the lower Colorado River indicate that an optimum channel slope is about 1.2 feet per mile. The usual procedure in designing a stable channel is to select a sinuous alinement of sufficient length to attain the required grade. However, in the Parker Division the total drop in elevation is so great that the length of channel required for this optimum slope is longer than can be practicably obtained. To add to the difficulty, the lower end of the channel is within the influence of the backwater from Palo Verde Dam, and the present slope within this influence is less than 1 foot per mile.

Under these conditions, it is not possible to achieve the optimum or even a uniform grade through the whole division without excessive excavation. Consequently, the optimum slope of 1.2 feet per mile will be used where the new channel is bedded in the usual valley alluvium. Steeper slopes will be used where heavier materials form the bed or where the new alinement follows existing reaches of the channel that are relatively stable. The result is that the gradient of the design channel varies from 0.9 foot to 1.8 feet per mile. Studies are continuing in this regard to determine the best slope within the various reaches.

Drainage

At present the drainage system of the Colorado River Indian Reservation consists of two parts. The drainage from the northern end of the valley,

which is the main agricultural area, empties into the river just below Alligator Bend. A riverside drain, constructed in conjunction with the Palo Verde Diversion Dam, drains the lower end of the valley and enters the river below Palo Verde Dam (see Drawings Nos. 423-300-356 and -464).

The installation of the permanent diversion dam to supply water for the Palo Verde Irrigation District placed a definite limit on the degradation of the riverbed at that point and has halted or retarded degradation for a considerable distance upstream. To provide drainage equal to that which would have existed if no obstruction had been placed in the river, an intercepting drain was constructed on the Indian Reservation. The grades for the drain were based on studies of maps of ground water contours, topography, and water surface elevations in the river. The drain was designed for a capacity of 30 cfs at the upstream end, increasing to a capacity of 128 cfs at the outlet just downstream from the permanent diversion dam. This drain begins a few hundred feet south from the outlet of the upper drainage system and about 1-1/2 miles south of Alligator Bend.

Under present conditions, the water surface elevation of the river at the drain outlet is high enough to inhibit proper functioning of the upper drain. The bottom elevation of the drain where it empties into the river is 310.4 feet; the average bed elevation of the river at this point is 309.0 feet. The water surface elevation of the river at 15,000 cfs under present conditions is 317.7 feet. Under these circumstances backwater effects would be noticeable throughout the major portion of the drain.

A study was made of the ground-water elevations for the months of July and November 1961. Ground-water contours, based on well readings taken July 19-26, 1961, and November 23-29, 1961, were plotted for the irrigated areas in T. 8 N. and 9 N., R. 20 W., and T. 8 N. and 9 N., R. 21 W., G&SRM. These areas were planimetered at 1-foot contour intervals and the results in acres were tabulated for each set of readings. Water-surface elevations for River Sections 34 through 38 were also tabulated for the same periods of time for which the well readings were taken to make a comparison between the changes in ground-water contours and the changes in water-surface elevations of the river. The cumulative acreage between 1-foot elevation intervals was plotted for both periods of observation. Changes in water-surface elevations at river sections were varied and ranged from a low of 2.07 feet at River Section 37 to a high of 3.51 feet at River Section 35. The average change in elevation for River Sections 34 through 38 was 2.63 feet lower in November than in July.

Table 1 shows depth to ground water versus acres for November and July. Approximately 1,100 acres had ground water standing at 4 feet or less and an additional 5,500 acres had ground water standing between 4 and 6 feet during the peak of the irrigation season in July. This amounts to 25 percent of the cultivated acreage in T. 8 N. and 9 N., R. 20 W., and T. 8 N. and 9 N., R. 21 W., G&SRM. The November ground-water situation shows 45 acres had ground water standing at 4 feet or less and 1,376 acres had ground water between 4 and 6 feet (see Drawings Nos. 423-300-425 and -426).

Channel improvement work below Alligator Bend will reduce the water-surface elevation at the mouth of the upper drain and thereby improve the overall efficiency of the drainage system. Although this reduction will not increase the depth to ground water uniformly throughout the drainage area, its effects will be noticeable to a varying degree at all locations. An evaluation of the present ground-water situation indicates that channelization will reduce the water table sufficiently to benefit agricultural lands in all locations having a depth to water table of less than 6 feet.

Under the Channelization Plan for the Parker Division, as mentioned in Part I, the drainage system will empty into the Colorado River at Station 150+00 of the dredged channel. The old river channel will be used as a conveyance channel to connect the present mouth of the drain to the new channel (see Drawing No. 423-300-382). The water-surface elevation at the present mouth of the drain, with a flow of 15,000 cfs in the dredged channel, will be reduced to elevation 314.7 feet. This was determined by calculating the backwater effect of a normal maximum flow of 650 cfs in the bypassed river channel. Floods on Bouse Wash could result in higher discharges but these would be of little significance because of their short duration.

Under normal circumstances, therefore, a lowering of the water surface 3.0 feet from elevation 317.7 feet to elevation 314.7 feet could be expected at the mouth of the drain. This reduction at the outlet of the drain will greatly improve the operation of the drainage system. Computation of the effect of the Alternate Plan gives an elevation at the mouth of the drain of 314.8 feet for a total lowering of water surface at this point of 2.9 feet. The effect of both plans is virtually the same as tne seasonal change in river levels observed in 1961. Therefore, the effect of channelization on water-table elevations has been

TABLE 1

DEPTH TO GROUND WATER VS AREA

Depth to Ground Water From Ground Surface	July 1961 Acres	November 1961 Acres
0 - 3 feet	420	10
3 - 4 feet	673	35
4 - 5 feet	1,787	375
5 - 6 feet	3,750	1,001
6+ feet	19,483	24,692
Total	26,113	26,113

computed using the areas and depths to ground water for July 1961 and November 1961 from Table 1 as a measure of conditions before and after channelization, respectively. Benefits to agriculture have been based on the improved water-table conditions thus derived.

A high-water table is restrictive in the types of crops that can be grown and the yields are generally lower than for lands with adequate drainage. General advantages of a more effective drainage system are:

1. Removal of excess water.
2. Improvement of soil structure and soil aeration.
3. Increased depth of plant rooting with corresponding yield increases.
4. Improved leaching of salts.

Agricultural benefits will result from the increased productivity of lands on which shallow water tables have been improved. From a review of available literature, it is concluded that, compared with lands having a water-table depth of 6 feet or more, yields from lands with a water-table depth of 0 to 4 feet are depressed approximately 25 percent while yields from lands with a water-table depth of 4 to 6 feet are depressed approximately 10 percent. Lowering of the water table provides equivalent gains in total production.

Water Losses

In the Parker Division, there are at present 4,845 acres of exposed water surface under normal flow conditions. Under the Channelization Plan, the surface area of the water will be reduced to 3,052 acres by eliminating meanders, reducing surface channel widths, and filling minor backwater areas with dredged material. Loss of water through evaporation will be minimized by depositing dredged material, wherever possible, in minor backwater areas possessing little value for recreation, fish and wildlife, or other purposes. Some larger backwater areas will receive special consideration and treatment as discussed later in this report. A reduction of 1,793 acres of water-surface area will be attained in the Parker Division. The average annual rate of evaporation for the Parker Division was computed from pan evaporation measured at Boulder City, Nevada, and Davis Dam, Arizona, and was found to be 9.25 feet per year. An adjusted factor of 0.64 was applied to the standard land pan evaporation to determine a net evaporation of 5.92 feet per year. Therefore, the water salvage by a reduction of the exposed water-surface area will be 10,600 acre-feet per year.

Additional water salvage will be obtained by a lowering of the ground-water elevation in those reaches of the river surrounded by phreatophyte growth. Consumptive use of ground water by phreatrophyte growth decreases measurably as the water table goes down. 1/ The Channelization Plan will reduce the ground-water level on about 13,400 acres of land between the existing flood levee system and the river by a maximum of 3.9 feet in the upper reaches and a minimum of 1.2 feet in the lower reaches. Volume-density factors were applied to this acreage on which ground-water levels will be reduced to determine an equivalent area of 6,635 acres. Studies of the present ground-water situation and an analysis of the difference in consumptive use rates at the present and planned ground-water elevations show that 11,500 acre-feet of water will be salvaged annually. Further, the clearing of phreatophyte growth within the limits of the dredged channel where it deviates from the present channel will provide water salvage of 2,100 acre-feet annually (see Drawings Nos. 423-300-464 and -465). Thus, the total reduction in consumptive use of ground water by phreatophyte growth will be 13,600 acre-feet per year.

Reduction of nonbeneficial use by phreatophytes amounting to 13,600 acre-feet per year added to the water salvage through reduced evaporation (10,600 acre-feet per year) will result in a total salvage of 24,200 acre-feet per year. This water will be available for downstream requirements in lieu of releases from upstream storage reservoirs.

Using the same methods as above, the Alternate Plan would reduce the loss of water through evaporation by 3,600 acre-feet per year. Nonbeneficial use of water would be reduced by 3,300 acre-feet per year for a total water salvage of 6,900 acre-feet per year. This salvage is considerably less than the above plan mainly as a result of less reduction in the water-surface elevation.

1/ Middle Rio Grande Project Water Salvage Studies and Water Papers Nos. 1103 and 1423.

PART IV

PLAN OF DEVELOPMENT

PART IV

PLAN OF DEVELOPMENT

Channelization Plan

General. The plan of development divides the Parker Division into two sections. The treatment proposed for each section is based on the characteristics of the river in the particular section. The dividing line between the two sections is approximately at Alligator Bend, about 16 miles below Headgate Rock Dam. Section I is the upstream part of the division extending from Headgate Rock Dam down to Alligator Bend. Section II embraces the remainder of the river down to Palo Verde Dam.

While the present channel of the river in Section I 1/ is in reasonably good alinement, the character of its bed material is the result of vigorous degradation. Through most of this section degradation has developed a blanket of cobble, either on the surface of the bed or under a thin sand cover. Within this section are localized reaches in which the channel is braided, split into two or more channels, or is poorly alined. There are also localized areas of bank cutting which furnish sediment to the river and constitute weak points in the bank where meander action may develop in the future.

The plan of development in this section is to consolidate into a single channel the split or braided reaches of the river, correct misalinement where practicable, and reduce active bank erosion. These objectives will be accomplished by construction of training structures and bank protection works in approximately 11 miles of the 16 miles of channel. In areas where impending residential and commercial developments are anticipated and where vegetative cover for riprap is desired, an earth blanket will be placed over the rock.

The plan of development for the river in Section II calls for an improved channel which will result in lowered water levels in the upstream portion. It is planned to eliminate several braided areas and actively eroding oxbows by realinement of inadequate reaches. Dredged material will be used for the correction of minor misalinements,

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1/ Discussion of work in Section I in this Part IV reflects conditions before work was initiated in January 1966. As discussed on page 3, the work proposed herein under the Channelization Plan in Section I is now substantially complete.

reduction of overwide natural reaches, or for closure of bypassed reaches of natural channel. Material excess to these requirements will be disposed of in a manner acceptable to the Indian landowners and such that it will not cause excessive reduction in the carrying capacity of the floodway. Bank lines will be armored against erosion either by riprap hauled in for that purpose or by gravelly dredged spoil. Service roads will be constructed along the new bank lines for the purpose of riprap placement and maintenance of the channel banks. Many of these service roads will also provide needed recreation access to and within the area.

Section I - Headgate Rock Dam to Alligator Bend. The river, through Section I, is in reasonably good alinement and in some parts the natural channel has fair to good ratios of width to depth. The intensive degradation that has occurred in this section has exercised a sorting action upon the coarse alluvium over which the river flows and an armor of heavy gravel and cobbles has developed on the bottom. There are some areas where high flows in previous years have scoured the bottom deeper than required for normal flows and a layer of sand has been deposited over the gravel. Throughout most of its length this section of the river bottom should resist further degradation under ordinary flow conditions.

Since relocating or deepening the natural channel would destroy the effectiveness of the bed armor, problems that exist in this section will be corrected without dredging.

The problems are primarily minor misalinements, scattered actively cutting banks, and some short-braided and overwide reaches. Field studies indicate that there are approximately 8.1 miles of eroding bank on the Arizona side and approximately 8.2 miles on the California side which will require some form of stabilization. Since the intensity of bank erosion ranges from minor to heavy, a varying amount of protection will be required to stop the cutting action of the river. Stabilizing banks where cutting is heaviest will require a continuous blanket of riprap amounting to as much as 3 cubic yards of quarry-run stone per linear foot. Less active bank erosion will be controlled by somewhat lighter blankets of riprap material.

There are four principal areas in this section where channels that are overwide or split require special treatment. These areas start at 2.3, 6.3, 8.9, and 12.1 miles downstream from Headgate Rock Dam.

In the upstream area, starting just downstream from the bridge at Parker, the present channel is overwide with many bars and small channel islands (Drawing No. 423-300-356). The treatment in this area will be to construct a new concave bank with fill material. This structure which will be built in the present channel will move the flow away from the Arizona side and also reduce the channel width to about 500 feet. The California bank will be stabilized where its location is satisfactory. Where the present California bank is too uneven or not properly situated, a new bank line will be developed. Rock riprap will be windrowed along the desired bank line and the river will be allowed to erode the bank material from the river side of the windrow. When erosion reaches the windrow line, the rock will slide down the bank to halt the erosion and armor the bank slope.

In the second area, which lies between Station 200 and Station 340, the channel is split by Deer Island. The less desirable channel alinement will be closed off and the remaining, or west side, channel will be permitted to develop to proper width by bank stabilization and the use of windrows. At the lower end of this area some minor realinement will be required. The realinement will be accomplished on the California side by windrowing rock along the desired bank lines and by excavating a pilot channel between the windrows. After the flow of the river is directed through the pilot channel, erosion of the new channel banks will continue until halted at the prepared bank lines when the riprap drops into place.

The third area, extending from Station 340 to Station 515, presents essentially the same problems as in the first area and treatment will be by use of training structures, jetties for width control, and by bank stabilization for control of erosion. The last area, which extends from Station 515 near the Riverside-San Bernardino County line to the end of Section I, has a good width-depth ratio. Channel control work will be minimal in this reach and only the banks which show active erosion will be dressed to a smooth alinement and stabilized with riprap.

Access and Service Roads. Access and service roads will be required for construction and maintenance of the structures in Section I. Access roads will connect the gravel pits and quarries used for gravel and rock sources with the structure sites. Service roads will be constructed along the structure alinement for the placement of fill and riprap material and will be placed on the tops of

channel control structures which are constructed entirely of fill. Service roads will also be maintained to provide access to the structures for maintenance work following construction.

Except where there are special requirements, roads will be 20-feet wide to permit two-way traffic by trucks. The surfacing material will be pit-run gravel with soil binder added if required. This material will be placed to a depth of 6 to 8 inches, watered and traffic compacted. Experience with similar road construction in the Mohave and Palo Verde Divisions has proved that such roads are adequate for heavy construction equipment use as long as the surfacing is properly maintained by watering and blading. Existing roads and trails in the area will be utilized wherever practicable and will be widened and surfaced as necessary to bring them up to usable standards.

Access roads will total 12 miles in length. Most of these roads will be on the California side of the river to provide access to rock and gravel sources. Service roads will total 22 miles and will be about evenly divided between both sides of the river.

Bridge. The river channel in this section lies close to the west side of Parker Valley. Rock and gravel are available only in the hills and washes rimming the valley. Potential sources are, therefore, close to the channel on the west side but located several miles distant across the valley on the east side. The only available river crossing is the highway bridge at Parker, Arizona. Present estimates indicate that quarry and gravel pits upstream from the Parker bridge can be used economically for work in the upper portion of Section I. Economic studies indicate that the work in the lower portion of Section I and the upper part of Section II can be reached best from a bridge constructed at a point about 14.7 river miles downstream from Headgate Rock Dam as shown on Drawing No. 423-300-356. The proposed bridge will be a timber pile and laminated deck structure. Because the deck will be at or above levee grade, the clearance above water will be sufficient to permit small boat passage without interruption.

Quarry and Gravel Pit Sites. Rock quarry and gravel pit sites are to be developed by the contractor as directed. For Section I materials, potential sites are located as follows:

Section 2, T. 1 N., R. 25 E., SBM
Section 5, T. 2 S., R. 24 E., SBM
Section 15, T. 1 S., R. 24 E., SBM
Section 26, T. 2 N., R. 25 E., SBM
Section 31, T. 1 S., R. 24 E., SBM
Section 35, T. 2 N., R. 25 E., SBM

Section 1, T. 9 N., R. 20 W., G&SRM
Section 2, T. 9 N., R. 20 W., G&SRM
Section 13, T. 9 N., R. 20 W., G&SRM
Section 31, T. 10 N., R. 19 W., G&SRM
(See Drawing No. 423-300-167 for location.)

Quantities and Costs. The estimated quantities and costs for the bank protection and training structures in Section I are as shown in Table 2.

Section II - Alligator Bend to Palo Verde Dam. In this section the problems of misalinement, sharp bends, overwide channels, and eroding banks are too numerous and extensive to permit treatment as in Section I. The method of treatment in Section II is essentially realinement and the construction of a channel with desired width-depth ratios. The new channel will be constructed by dredging and land-based equipment and, where required, by placing and shaping the material to form new bank lines. Since levees have been constructed as part of the Palo Verde Diversion Dam works, excess excavated material will be placed in the abandoned river channel, in low-lying areas, or will be spread in the floodway in a manner such that the flood channel capacity will not be unduly impaired. Pumping distances of dredged material will be relatively short which will result in increased capacity and overall efficiency of the dredge unit. The banks of the new channel will be stabilized and protected from erosion by a blanket of rock riprap or by dredged material having the proper proportions of coarse gravel. Where practicable, existing stable portions of the natural river will be retained.

The point of beginning, Station 0+00 of the proposed channel, will be in the vicinity of Alligator Bend, approximately 1.6 miles above River Section 35.0 (approximately 16.3 miles below Headgate Rock Dam). Thence, the channelization will proceed in a southerly direction as a series of connecting curves with radii varying from 5,000 feet to 10,000 feet throughout a total length of 21.4 miles (Drawings Nos. 423-300-464 and -465).

TABLE 2

QUANTITIES AND COSTS - SECTION I
CHANNELIZATION PLAN

Item	Quantity	Unit	Average Unit Cost	Cost
1. Clear and Trim Banks	60,000	lin. ft.	$ 0.75	$ 45,000
2. Unclassified Fill	525,000	cu. yd.	1.05	551,300
3. Cover for Riprap	32,000	cu. yd.	0.60	19,200
4. Rock Riprap	235,000	cu. yd.	3.05	716,800
5. Clear and Grade - Access Roads	12.0	miles	2,800.00	33,600
6. Gravel Surface - Access Roads	32,000	cu. yd.	1.20	38,400
7. Clear and Grade - Service Roads	22.0	miles	1,200.00	26,400
8. Gravel Surface - Service Roads 1/	60,000	cu. yd.	1.20	72,000
9. Excavation	180,000	cu. yd.	0.32	57,600
10. Access Bridge	1	each	184,000.00	184,000
		Subtotal		$1,744,300
	Contingencies 5% 2/			87,200
	Subtotal - Construction Cost			$1,831,500
	Engineering Cost			240,000
		TOTAL COST		$2,071,500

1/ Includes top of fill surface.
2/ Reflects substantial completion of work in Section I.

The channel design is based on a dominant flow of 15,000 cfs. The bottom width of the channel will be 450 feet and side slopes will be no steeper than 1.5 to 1. Bank height will be sufficient to provide capacity with suitable freeboard for a flow of 25,000 cfs which is the approximate maximum power release from Parker Dam and the normal maximum flow.

The plan of operation in Section II will require the acquisition of a new dredge and supporting equipment to be operated by Bureau of Reclamation forces. An operating yard and assembly basin will be established on high ground about 2 miles upriver from Lost Lake Resort at a point near the upstream end of Section II. The dredge will be assembled in the temporary basin to be constructed at the yard site, and will dredge the new channel working in the downstream direction.

In Section II, the beginning Station 0+00 is about 2 miles upstream of Lost Lake Resort. At Station 10+00 the new channel will depart from the present river and, in a series of smooth curves, will eliminate the sharp bends and braided areas which the river has developed. The existing river bends are the result of the unstable river adjusting its grade since making its cut across Alligator Bend. The realined channel will return to the river at approximately Station 300+00 and will follow the natural channel to approximately Station 650+00 in order to take advantage of the steeper grades which the river has established in this reach. Below Station 650+00, the river begins a series of very sharp bends which the new channel will correct in a series of smoother curves. The new channel will be anchored on the California side by means of frequent contacts with the existing bluffs in that area. Between Station 650+00 and the end of channelization at Station 1129+40, the new channel will follow the existing river for the greatest practical distance. Construction of the new channel as planned will cause the bypassing of some sections of natural river channel. Any open water which remains in these bypassed sections will be developed for fish and wildlife, recreation, and other purposes.

Channel Excavation. Dredging will proceed in a downstream direction beginning at Station 10+00. The dredge will operate on a 24-hour schedule 5 days a week, allowing 2 days each week for maintenance and repairs. Dredging operations will continue for 10-1/2 months during each year leaving the remaining 1-1/2 months for overhaul

of equipment. By following this schedule, approximately 5 years will be required to complete the channel excavation. In order to expedite the channel excavation it is planned to remove material above the ground-water level by the use of land-based equipment.

In order to minimize sediment movement in the completed channel, it will be excavated to full width and depth. In the case of a major cutoff, as from Station 100+00 to 260+00, the new channel will not be opened to flow until all excavation and bank line stabilization works are completed. Immediately after the new channel is opened, the new bank will be constructed across the upstream end of the old channel to complete the diversion of the riverflow into the new channel. Those portions of the bypassed river channel which remain as off-channel lakes or back bays will be provided with inlet structures, outlets and other improvements to increase their value for fish and wildlife, recreation, and other uses.

Since the existing levees built by the Bureau of Reclamation in connection with the Palo Verde Diversion Dam provide adequate flood protection for the valley, levees are not required in this division. Because the excavated material will not be needed to construct levees, it will be wasted in low areas of the floodway and in the abandoned river channel. Through areas where the new channel lies within the riverbanks, the excavated material will be used to confine the new channel to the design width. Both banks will be stabilized as required throughout the length of the new channel to guard against further lateral movement of the river. The thickness of the stabilizing material will be varied according to its location. Wherever the natural material in the channel excavation will provide the necessary stabilization of the bank lines, no riprap material will be used. It is expected that dredged material placed in the floodway will be of such thickness or location that little reduction of upland game habitat will occur.

Bank Protection. The quantity of stabilizing material used will be that required to provide slope protection with sufficient freeboard at a discharge of 25,000 cfs. The new channel banks will be stabilized with rock or coarse gravel according to the location and vulnerability of the banks as follows:

a. 2.0 cubic yards per linear foot along concave banks.
b. 1.5 cubic yards per linear foot along convex banks.
c. 2.0 cubic yards per linear foot along transition banks (points of reverse curvature).

Access and Service Roads. Except where there are special requirements, access and service roads will be built to the same standards and in the same manner as outlined for Section I (width 20 feet, 6 to 8 inches of gravel surface). Service roads will be required along both sides of the channel, 21.5 miles in California and 21.5 miles in Arizona, a total of 43.0 miles of service roads.

Access roads connecting the channel banks with the pits and quarries used as gravel and rock sources will total 10.0 miles in length.

Bridges. The location of the two pit and quarry sites in Arizona to be used in Section II will require the reinforcing of two canal bridges and the new construction of two additional canal bridges (Drawing No. 423-300-167).

Quarry and Gravel Pit Sites. Rock quarry and gravel pit sites are to be developed by the contractor as directed. For Section II materials, possible sites are located as follows:

Section 2, T. 5 S., R. 23 E., SBM
Section 3, T. 5 S., R. 23 E., SBM
Section 7, T. 2 S., R. 24 E., SBM
Section 13, T. 5 S., R. 23 E., SBM
Section 14, T. 3 S., R. 23 E., SBM
Section 15, T. 3 S., R. 23 E., SBM
Section 31, T. 1 S., R. 24 E., SBM
Section 35, T. 4 S., R. 23 E., SBM

Section 22, T. 6 N., R. 21 W., G&SRM
Section 27, T. 6 N., R. 21 W., G&SRM
Section 31, T. 7 N., R. 20 W., G&SRM
Section 31, T. 8 N., R. 20 W., G&SRM
(See Drawing No. 423-300-167 for location.)

Quantities and Costs. The estimated quantities and costs for the dredged channel, bank protection and appurtenant works in Section II are as shown in Table 3.

TABLE 3

QUANTITIES AND COSTS - SECTION II
CHANNELIZATION PLAN

Item	Quantity	Unit	Average Unit Cost	Cost
1. Dredge Excavation	11,600,000	cu. yd.	$ 0.19	$2,204,000
2. Land Equipment Excavation (Above Water Table)	5,800,000	cu. yd.	0.23	1,334,000
3. Gravel Bedding	10,000	cu. yd.	1.20	12,000
4. Rock Riprap	516,000	cu. yd.	3.05	1,573,800
5. Clear and Grade - Access Roads	10.0	miles	2,800.00	28,000
6. Gravel Surface - Access Roads	26,000	cu. yd.	1.20	31,200
7. Clear and Grade - Service Roads	43.0	miles	1,200.00	51,600
8. Gravel Surface - Service Roads	84,000	cu. yd.	1.20	100,800
9. Bridges:				
(a) New Canal Bridges	2	each	25,000.00	50,000
(b) Reinforce Canal Bridges	2	each	15,000.00	30,000
Subtotal				$5,415,400
Contingencies 20%				1,083,100
Subtotal - Construction Cost				$6,498,500
Engineering Cost				480,000
TOTAL COST				$6,978,500

Operating Yard and Service Facilities. The dredge operations will require the construction of an operating yard and maintenance facilities. The requirements include:

a. A combined office and warehouse for administration of dredge operations and for storage of replacement parts, tools, and lubricants.
b. A shop building to house welding and repair equipment.
c. Yard facilities including a turn basin, a loading dock, refueling equipment, and open storage areas.

The buildings will be of the prefabricated metal type, located on the California side of the cutoff channel upstream from Lost Lake Resort (approximately Station 10+00). This location will have the advantage of being at approximately the upper end of the dredging operations and of being easily accessible from both sides of the river due to the proximity of the proposed bridge. Indian Tribal owned land in the vicinity will be used and no permanent land acquisition will be necessary for yard purposes.

The cost of these facilities will be as follows:

Operating Yard	$200,000
Contingencies 20%	40,000
TOTAL	$240,000

Rights-of-Way. Rights-of-way for the work in the Parker Division will, for the most part, be obtained through negotiation with the Bureau of Indian Affairs, and the Colorado River Indian Tribes. In the southern portion, approximately 13 miles along the channel banks on the California side, either Bureau of Reclamation land or Colorado River Indian Tribal lands now occupied by permittees or illegal occupants will be used for the work. Some private lands on Hall Island, Section 36, T. 3 S., R 23 E., SBM, may be required for the project depending on the final location of the channel in that area and a determination of landownership on Hall Island.

Construction Costs - Sections I and II. The total estimated construction cost of the work using training structures down to Alligator Bend and dredging a channel from there downstream is as follows:

Headgate Rock Dam to Alligator Bend	$2,071,500
Alligator Bend to end of dredged channel	6,978,500
Service facilities	240,000
TOTAL	$9,290,000

Annual Operation and Maintenance. The annual operation and maintenance costs for the Channelization Plan have been based on experience in the Topock to Big Bend channel near Needles, California. From Headgate Rock Dam to Alligator Bend (Section I), the annual maintenance costs have been estimated in accordance with the following schedule:

Years 1 through 3	$4,000 per mile
Years 4 through 10	3,000 per mile
Years 11 through 50	2,700 per mile
Years 51 through 106	2,400 per mile

For the reach from Alligator Bend to Palo Verde Diversion Dam (Section II), higher maintenance costs will be expected until the banks and bed are consolidated. The following schedule was used:

Years 1 through 6	$6,100 per mile
Years 7 through 10	4,300 per mile
Years 11 through 50	3,000 per mile
Years 51 through 106	2,500 per mile

Using the two schedules given above, the average annual operation and maintenance cost for the entire Parker Division from Headgate Rock Dam to Palo Verde Diversion Dam will be $101,000 based on a 100-year period of analysis. Rates beginning with the year 7 were used in the analysis. The maintenance during construction was included as part of the construction cost.

The maintenance work that will be necessary after completion of the project includes annual repair of bank line structures and roads. Bank control and training structures will require periodic replacement of riprap and possible minor relocation as future river conditions require. Maintenance dredging is not anticipated.

Alternate Plan

Section I - Headgate Rock Dam to Alligator Bend. Under this plan, construction above Alligator Bend would be the same as shown in the Channelization Plan at a cost of $2,071,500.

Section II - Alligator Bend to Palo Verde Dam. The primary differences in the Alternate Plan versus the Channelization Plan are as follows:

a. The use of land-based equipment in lieu of a dredge;
b. Considerably less realinement; and
c. The placing of grade control structures at key points along the cutoff channels.

Under this plan the total length of the design channel from Alligator Bend to just above Palo Verde Diversion Dam would be approximately 20.8 miles as compared with the natural channel length of 25.2 miles. The proposed channel would start approximately 1.7 miles upstream from River Section 35.0 and end approximately 1.2 miles downstream from River Section 31.0.

An average slope of 1.20 feet per mile or less would be maintained by seven grade control structures. This slope compares with the natural channel's average slope of 1.57 feet per mile in the upper reach of Section II, and 1.24 feet per mile in the lower reach. Each control structure would be approximately 800 feet long.

The natural river water-surface conditions show a drop in elevation of 33 feet in approximately 25 miles (an average slope of 1.32 feet per mile) at a discharge of about 15,000 cfs.

Grade control structure No. 1 would be designed so that in the first 1.3 miles of channel the water surface slope would be only 0.2 foot per mile greater than the existing slope.

The proposed channel from Station 66+00 to Station 951+00 would drop the water-surface elevation 29.4 feet in 16.8 miles by using six grade control structures, each with a drop of 1.5 feet. This procedure would maintain a water-surface slope of 1.20 feet per mile between control structures. The last 2.8 miles of channel, below control structure

No. 7, would remain at the existing water-surface slope of 0.8 foot per mile. The water-surface elevation would drop approximately 0.3 foot as it passes over this last control structure into the backwater of Palo Verde Diversion Dam.

The proposed channel would be trapezoidal in cross section with a bottom width of 450 feet (the same size and shape as the dredged channel previously discussed). A major disadvantage of the Alternate Plan is that the control structures would curtail navigation at flows of less than 5,000 cfs. This is due to water depths of less than 2.0 feet at the structure crest. Also, a variable stage versus discharge relationship would be encountered when flow quantities are rapidly changing. Backwater conditions would exist for flows up to 14,300 cfs on rising stages, and drawdown conditions would exist for flows down to 13,000 cfs on falling stages. In general, the control structures would create upstream effects of backwater (water-surface elevations above the most desirable hydraulic design) at low flows. In contrast, the grade controls would cause a minor degree of approach section drawdown (a stage below optimum design elevation at high flows). The aforementioned effects are not appreciable in the design range of 10,000 cfs to 20,000 cfs under fairly steady flow conditions (stage changes being slow and at a uniform rate).

Construction would be executed in three major phases as follows:

Phase 1 would be the construction of bank protection and training structures along the existing riverbanks where the natural channel coincides with the design channel and in areas where the natural flow would not be constricted appreciably. The river would be allowed to adjust to these minor obstructions while work progressed on Phase 2.

Phase 2 would be the dry land excavation of cutoff channels and the construction of grade control and bank protection structures. Direct filling with spoil materials would be done in locations with little or no velocity.

Phase 3 would be the extension of training structures across the natural channel in order to direct the flow into the new cutoff channels and the removal of earth plugs from the upstream end of each cutoff channel.

All primary or concave bank protection and training structures would be rock riprapped with 2.0 cubic yards per linear foot. After the completion of the three major phases of construction, the convex or low velocity sides of each curve would be riprapped with 1.5 cubic yards of rock per linear foot to resist bank erosion at high flows over 20,000 cfs.

Access and Service Roads. The same type access and service roads would be required for the Alternate Plan as are described under the Channelization Plan.

Bridges. Access to the quarry sites would require two new canal bridges and the reinforcing of two existing canal bridges. A timber bridge is planned to cross the river in Section I. No river bridge would be required in Section II as the bridge constructed in Section I would provide the necessary access for both sections.

Quantities and Costs. The estimated quantities and costs for the Alternate Plan below Alligator Bend are shown in Table 4.

Construction Costs - Sections I and II. Under the Alternate Plan the cost of the work above Alligator Bend remains the same as the Channelization Plan but the cost of the work below Alligator Bend would be higher. The total estimated construction cost of this plan is as follows:

Headgate Rock Dam to Alligator Bend	$ 2,071,500
Alligator Bend to end of channel	15,029,300
TOTAL	$17,100,800

Annual Operation and Maintenance. As previously pointed out, operation and maintenance costs have been estimated on a cost-per-mile basis. The same procedures as previously used to determine the cost of operation and maintenance of the channel built by dredging in Section II were used to determine the cost of operation and maintenance of the channel built by land-based equipment. The average annual operation and maintenance of the entire Parker Division from Headgate Rock Dam to Palo Verde Diversion Dam would be $99,000 based on a 100-year period of analysis. The maintenance during construction was included as part of the construction cost.

TABLE 4

QUANTITIES AND COSTS - SECTION II
ALTERNATE PLAN

Item	Quantity	Unit	Average Unit Cost	Cost
1. Dry Land Excavation	4,600,000	cu. yd.	$ 0.23	$ 1,058,000
2. Wet Excavation	8,600,000	cu. yd.	0.60	5,160,000
3. Bank Fill (Select)	1,266,700	cu. yd.	1.50	1,900,000
4. Riprap Rock (Bank Protection)	400,000	cu. yd.	3.05	1,220,000
5. Rock for Control Structures	476,000	cu. yd.	3.25	1,547,000
6. Structure Base Excavation	500,000	cu. yd.	1.30	650,000
7. Clear and Grade - Access Roads	14.0	miles	2,800.00	39,200
8. Gravel Surface - Access Roads	36,000	cu. yd.	1.20	43,200
9. Clear and Grade - Service Roads	42.0	miles	1,200.00	50,400
10. Gravel Surface - Service Roads	82,000	cu. yd.	1.20	98,400
11. Bridges:				
(a) New Canal Bridge	2	each	25,000.00	50,000
(b) Reinforce Existing Bridges	2	each	15,000.00	30,000
Subtotal				$11,846,200
Contingencies 20%				2,369,200
Subtotal-Construction Cost				$14,215,400
Engineering Cost				813,900
TOTAL COST				$15,029,300

The maintenance work that would be necessary after completion of the project includes annual repair of bank line structures and access roads. Bank control and training structures would require periodic replacement of riprap and possible minor relocation to adjust to future river conditions.

PART V

FISH AND WILDLIFE CONSIDERATIONS

PART V

FISH & WILDLIFE CONSIDERATIONS

Introduction

During the planning of the project for the Parker Division, the preservation of fish and wildlife resources has been given consideration as a major objective of the work and has been coordinated with other features of the program. Federal, state, and local agencies were provided an opportunity to participate in the development of a cooperative plan. This is in keeping with the present day concept of the Reclamation project as a multiple-purpose undertaking, and with the intent of the Fish and Wildlife Coordination Act.

The Parker Division is developing rapidly as a popular recreational area. After the completion of Hoover Dam and succeeding dams downstream, this reach of the river was transformed into a clear controlled stream which created invaluable potentials for fish and wildlife. At first the only visitors in the area were a few hardy, confirmed fishermen. Gradually fishing camps began to appear at the most accessible places along the riverbank. As the area became better known and roads, transportation, and other facilities were improved, the fishermen continued to appear in ever-increasing numbers. However, they were soon outnumbered by those who were coming to participate in other forms of recreation such as swimming, water skiing and boating. In recent years, more than one-half million recreationists visited the area annually.

The Bureau of Indian Affairs and the Colorado River Tribal Council have plans for extensive resort and urban development in the Parker Division. One developer has initiated work under a plan for development of approximately 8,000 acres, adjacent to 11 miles of river front, on the California side of the river above Alligator Bend. The company plans a large scale recreational-residential development including motels, marinas, golf courses, trailer courts, and other recreation-oriented facilities.

A survey of the Parker Division indicates that the growing popularity of outdoor recreation has resulted in an influx of fishermen in sufficient numbers to overtax the fishery resource. Also, the growing demand

placed upon the water resource by other forms of recreation has made it difficult to maintain a fishery at a satisfactory level of quality. A good fishery is not completely compatible with such water sports as water skiing and speedboating.

Competition from water sports will limit the potential value of river fishing in the Parker Division. Similarly, residential and recreational developments will reduce the ultimate potential for hunting. However, fishing and hunting offer unique opportunities for recreation and relaxation which will be a primary consideration to many of the people who are expected to take advantage of the recreational opportunities provided by the Colorado River. Preservation of existing fish and wildlife values and creation of new values must be considered in a comprehensive plan for stabilization and improvement of the river. This Part V of the report presents a plan which has been cooperatively developed by the Bureau of Reclamation and the Bureau of Sport Fisheries and Wildlife. It incorporates a number of desirable features which have been examined for engineering feasibility and conformity with established rights to water from the Colorado River.

Effects of River Stabilization

The river in the Parker Division would not remain in its present condition even if the benefits of river stabilization were to be foregone. The inherent forces of the river are constantly acting on unprotected banks and river bottom. Sediment is being carried downstream where it is causing many and varied changes in the river bottom and off-channel ponds and backwaters. Without river stabilization, it is probable that many oxbows, backwaters, and pools now providing fish habitat would diminish or disappear completely. Conversely, a reduction of sediment movement by channel stabilization in the Parker Division will retard the natural filling of backwater areas.

Above Alligator Bend, bank line revetment work and jetty construction will have very little effect on the character of the river bottom. The natural action of water currents creates and maintains deep pools, sandbars, quiet waters, and sheltered eddies. In the reach below Alligator Bend, the channel will be improved by dredging and the configuration of the riverbed will quickly adjust, as a result of bed-load movement, to create deep pools, riffles, and quiet waters. This is a natural phenomenon in alluvial riverbeds such as that of

the river in this area. Although there will be an initial reduction of fish spawning and natural habitat, eventually the river is expected to establish greater stability than it would without the project and thus some environmental aspects of importance in the production of fish will be improved.

The primary loss in fish habitat will occur as a result of eventual reduction in the number and size of side channels and backwater areas. However, fishery losses will be mitigated through the development of backwater areas with a high potential for fish production as discussed later in this part of the report.

An analysis of the effects of the proposed river stabilization work indicates that the effect on wildlife will be much less extensive than that sustained by the fishery. The present rapid development of agriculture, urbanized areas, and recreational facilities along the river is expected within a few years to cause a major reduction in present wildlife habitat. Thus, the effects of river work on wildlife will occur principally during the initial years after project completion and are of minor long-term significance.

Project Plans

The Regional Director, Southwest Region, Bureau of Sport Fisheries and Wildlife, with assistance from the California Department of Fish and Game, and the Arizona Game and Fish Department, developed a plan for fish and wildlife in the Parker Division. This plan is outlined in a Memorandum Report from the Regional Director, Bureau of Sport Fisheries and Wildlife, dated February 24, 1967, which is appended to this report as Exhibit I. The Memorandum Report provides a thorough analysis of fish and wildlife losses, and recommendations for their mitigation. The highlights of that Memorandum Report are discussed below.

With completion of river stabilization work, overall fishing success and fishing in the Parker Division will decline from the levels anticipated with the river in its natural state. It is estimated there will be a loss of 165,000 man-days of fishing annually as a direct result of the project.

A comparison of the estimated man-days of all types of hunting in the area with and without the project indicates that the project will cause annual losses in big game, upland game, and waterfowl of 200, 7,500, and 300 man-days, respectively.

The proper selection and placement of riprap on dressed banks and training structures during construction will provide interstices suitable for use as cover and habitat for certain species of fish. Mitigation of about 8,000 man-days of fishing annually will be realized.

Wherever it is feasible, existing channel areas isolated by channel improvement work will be filled with material excavated from the channel. However, material for filling of backwaters will not be available north of Alligator Bend because there will be no dredge excavation of the channel. Below Alligator Bend most backwater areas will be filled but some will remain because the quantity of excavated material is insufficient to fill them or because the distance of the backwater area from the new channel makes filling infeasible. Overall, about 600 acres of backwater will remain after completion of the project even though there will be no curtailment of feasible filling of backwater areas.

About 100 acres of isolated river channel will remain as minor backwaters principally in the area north of Alligator Bend. These will be perpetuated as fish-spawning and -feeding areas. Periodic dredging, or other maintenance work, will preserve the water areas as suitable sites during the life of the project. Mitigation of 17,000 man-days of fishing annually will be realized.

About 500 acres of isolated river channel will remain as five major backwater areas. The development of these areas by initial dredging and subsequent fisheries management will replace a significant part of the project-caused losses. The locations of the five backwater areas are shown on the drawing in Exhibit I as Sites A through E. Any changes in the proposed channel work which would significantly affect these sites will be coordinated through Federal, state, and local agencies prior to construction. Access roads, boat-launching ramps, and adjacent parking and sanitary facilities will be constructed at each site. Development of the five sites will provide approximately 500 acres of attractive lakes for fishing and controlled use for general recreation. A total of 135,000 man-days of fishing annually will be mitigated as a result of this work.

Provisions for freshening the water in the above-described backwater areas will be accomplished by installing inlet and ungated outlet structures. The proposed development of these backwater areas will neither increase the water-surface area nor create a new consumptive use of water.

The preservation of vegetation along the lake perimeters will provide resting areas for dove and quail, and thus contribute to mitigation of

upland-game losses. The lakes and their peripheries will attract upland game and will be responsible for mitigating 500 man-days of hunting in the vicinity of the project. The lakes will also mitigate about 100 man-days annually of waterfowl hunting.

Thus, the losses to fishery habitat will be almost totally mitigated by the development and construction of the features described above. Although the losses of upland-game hunting will not be mitigated to any large degree, this is not considered significant in light of the present limited hunter use of the area and the anticipated rapid development of recreation and urbanization.

In summary, this report of river management work in the Parker Division adopts Recommendations 1 through 4 of the aforementioned Memorandum Report. Recommendations 5 through 6 require administrative decisions which are beyond the scope of this report but warrant further consideration because of the apparent public benefits which would accrue from their adoption.

Preservation of fish and wildlife values are recognized as a major objective of the plan to stabilize the Colorado River in the Parker Division. Where changed conditions or developments preceding the work require adjustment of the plan described in this report, this will be accomplished with full consideration of the effect on fish and wildlife. Changes of major significance to fish and wildlife will generally be accomplished only after consultation with the Bureau of Sport Fisheries and Wildlife, the Arizona Game and Fish Department, the California Department of Fish and Game, the Bureau of Indian Affairs, and the Colorado River Indian Tribes.

Quantities and Costs

Construction of fish and wildlife features will be accomplished simultaneously with, or shortly after, the work on the river channel as local circumstances may require. The estimated quantities and costs associated with features added to the project for the preservation of fish and wildlife values are shown in Tables 5 and 6. Shown in Table 5 is an estimate based on the use of a government-owned and -operated dredge. Costs associated with this method have been used in determining the total project cost as shown in Part VIII of this report.

TABLE 5

QUANTITIES AND COSTS
FISH AND WILDLIFE FEATURES

Item	Quantity	Unit	Average Cost	Cost
1. Dredge Excavation	4,500,000	cu. yd	$ 0.33	$1,485,000 1/
2. Inlet Structures	10	each	5,000	50,000
3. Outlet Structures	10	each	5,000	50,000
4. Construct Roads	24	miles	2,000	48,000
5. Gravel Surface for Roads	85,800	cu. yd.	1.20	103,000
6. Boat Ramps	5	each	12,000	60,000
7. Parking and Sanitary Facilities	5	each	9,000	45,000
		Subtotal		$1,841,000
		Contingencies 20%		368,000
		Subtotal Construction Cost		$2,209,000
		Engineering Cost		140,000
		TOTAL COST		$2,349,000

1/ This cost is based on the use of a 10-inch portable dredge by Reclamation forces. Review indicates that this is the most feasible method of performing the work. The estimated cost of the 10-inch dredge and associated equipment is $131,000.

TABLE 6

QUANTITIES AND COSTS
FISH AND WILDLIFE FEATURES

Item	Quantity	Unit	Average Cost	Cost
1. Dredge Excavation	4,500,000	cu. yd.	$ 0.65	$2,925,000 1/
2. Inlet Structures	10	each	5,000	50,000
3. Outlet Structures	10	each	5,000	50,000
4. Construct Roads	24	miles	2,000	48,000
5. Gravel Surface for Roads	85,800	cu. yd.	1.20	103,000
6. Boat Ramps	5	each	12,000	60,000
7. Parking and Sanitary Facilities	5	each	9,000	45,000
		Subtotal		$3,281,000
		Contingencies 20%		656,000
		Subtotal Construction Cost		$3,937,000
		Engineering Cost		140,000
		TOTAL COST		$4,077,000

1/ This cost is based on recent experience with small dredging contracts in nearby locations.

Benefit-Cost Analysis (Fish and Wildlife Features)

Economic analysis of the project indicates that river stabilization features by themselves create an excess of benefits over costs which warrant their construction even though losses to fish and wildlife would be sustained. This approach has been considered as an alternative course of action in developing the full project. Fish and wildlife features encompassed by the Bureau of Sport Fisheries and Wildlife Recommendations 1 through 4 have also been analyzed as a separable project increment. In economic studies of the fish and wildlife resources, a fisherman-day or hunter-day of use has been valued in accordance with guidelines provided in Supplement No. 1 to Senate Document No. 97, dated May 29, 1962.

Examined as a separable project feature, the benefits and costs of fish and wildlife features for a 100-year period are summarized in the following tabulation:

Total Construction Cost	$2,349,000
Interest During Construction	208,000
Subtotal	$2,557,000
Average Annual Equivalent	84,000
Annual Operation and Maintenance	10,000
Average Annual Cost	$ 94,000
Average Annual Benefits	$ 241,500
Benefit Cost Ratio	2.6 to 1.0

Because of their demonstrated feasibility and importance to the beneficial use of the area included in the project, the features proposed by Recommendations 1 through 4 of the Memorandum Report of the Bureau of Sport Fisheries and Wildlife have been incorporated as features of the project described in this report. Recommendation No. 5 requires consideration of a supply of water for consumptive use which is beyond the scope of this report. Recommendation No. 6 requires development of an agreement and administrative action which are also beyond the scope of this report. Other than to note them as courses of action deserving further cooperative study, they have not been considered in developing the plan outlined in this report, nor have they been considered in evaluating the benefits resulting from the project.

PART VI

RECREATION CONSIDERATIONS

PART VI

RECREATION CONSIDERATIONS

General

The Parker Division contains about 44 miles of river channel and about 88 miles of riverbank. Except for several small tracts in state or private ownership, this riverbank is either within the Colorado River Indian Reservation (about 80 percent of the total riverbank), or within the so-called Quien Sabe Area which extends about 16 miles north of the Palo Verde Diversion Dam in California (about 20 percent of the total riverbank). Since the ownership of these two portions of the Parker Division is a critical factor controlling advance planning of recreation, each is discussed separately below.

Colorado River Indian Reservation

The lands of the Colorado River Indian Reservation are held in trust by the Federal Government for the Colorado River Indian Tribes. The lands cannot be sold but may be leased to operators of agricultural, commercial, or other enterprises, or may be put to use by the Indians themselves. The primary purpose of these lands is to provide livelihood and opportunities for personal development to individual Indians and to assist the Indians, individually and collectively, in their effort to become thoroughly integrated into the social and economic mainstream of the American Society. To this end, they are operated much as private lands would be operated with monetary return from the use of land being a principal measure of the contribution of the lands to the tribal welfare.

Recently enacted legislative authority has permitted long-term leasing (99-year maximum) of tribal lands. This has stimulated an intense interest in leasing of tribal lands since expensive land developments are assured a tenure long enough to amortize the investment. Agricultural development of reservation lands is presently proceeding at a rapid pace.

Present development of tribal lands is largely agricultural development of the area south of Parker, Arizona. The lands being developed are level valley lands, with an abundant supply of irrigation water from

the Colorado River, and are protected from floods by Hoover Dam and by levees constructed by the Bureau of Reclamation at the same time (1956-1958) the Palo Verde Diversion Dam was constructed.

North of Parker, Arizona, the effects of construction of Parker Dam by the Bureau of Reclamation, and the Headgate Rock Diversion Dam by the Bureau of Indian Affairs, have combined to create a broad, deep and very clear reach of the Colorado River, where water surface elevations change very little throughout the year. There is a strong demand for recreational facilities in this area and master planning for land use by Indian interests recognizes a semicommercial development of such recreational facilities as being the apparent best use of this land.

Except for a few areas leased to private individuals for river resorts, there has been very little development of the reservation lands near the river south of Parker in Arizona. However, it is generally recognized that the demand for recreational and residential facilities has reached the point where commercial development of leased land to provide such facilities is feasible, and several miles of riverfront lands in California south of Parker are presently being developed as a residential area. It is expected that the demand for both private use and public use facilities will increase rapidly in the near future, particularly in reaches of the river where the recreational utility of the channel and the stability of bank lines have been improved by river management work.

General planning concepts for use of reservation lands along the river south of Parker have been developed by the Colorado River Indian Tribes and the Bureau of Indian Affairs. Generally these concepts anticipate the growth of a number of resort-type communities with an orientation toward water-related and outdoor recreation. While detailed planning of the expected resort communities necessarily will be deferred to await the developing demand for such facilities, basic concepts have nevertheless emerged. It is anticipated that the communities will be developed around prominent points of interest which in many cases will be locations offering good access to the river or will be backwater areas isolated from the river by river management work by the Bureau of Reclamation. Extensive flood plain areas, too low in elevation for residential development, will remain in native vegetation providing important game habitat which will be perpetuated through the impending period of development. Backwater lakes will generally be developed for fishery values rather than for boating and related recreational values.

The concept of river communities oriented toward fish and wildlife and other outdoor interests has been developed by the Colorado River Indian Tribes and the Bureau of Indian Affairs with assistance from the Bureau of Sport Fisheries and Wildlife and the Bureau of Reclamation. Basic features to be provided under this concept are described in detail in Part V of this report and in Exhibit I which is the Bureau of Sport Fisheries and Wildlife's report on a fish and wildlife plan for the Parker Division.

Quien Sabe Area

The Quien Sabe Area is, with minor exceptions, Reclamation-withdrawn land westward from the California bank line and lying between a point about 2 miles north of the Palo Verde Diversion Dam and the south line of Section 25, T. 2 S., R. 23 E., SBM. Although the major portion of this area has been determined to be Federal land, it is the subject of an Indian claim of ownership which had not been adjudicated at the end of 1968. The Lower Colorado River Land Use Plan, Department of the Interior, January 1964, describes plans for the development of this area which are based on the assumption of good Federal title to the area. Basically these plans propose development of the northern two-fifths of the Quien Sabe Area as a wildlife management area by the California Department of Fish and Game, and the development of the remaining southern portion as a recreation area by Riverside County, California. The overall development proposals include public access areas to be developed and managed by Riverside County within the wildlife management area.

The May 1968 report of the Lower Colorado River Land Use Office 1/ entitled "Recreational Aspects of Section II of the Parker Division Channelization Plan, Lower Colorado River - Quien Sabe Area - California," was prepared as a cooperative adjunct to Reclamation's basic river management plan for the Parker Division. It is included in this comprehensive planning report as Exhibit II. The Land Use Office report presents plans for retention and improvement (for recreational purposes) of selected lands in the Quien Sabe Area. It does not deal with the larger area encompassed by the Colorado River Indian Reservation where the primary responsibility for recreational development is a part of the overall responsibility of the Indians for their own lands.

1/ Redesignated the Lower Colorado River Office, Bureau of Land Management, on December 30, 1968.

The Land Use Office report proposes that construction by the Bureau of Reclamation be modified or expanded to include such details as extended or improved maintenance roads to provide better recreational access to the area, retention of existing channel areas as backwater for recreational development, provision of access to the river from adjacent public use areas, provision of freshening flows to backwater areas, and others. In addition, the report presents a summary economic evaluation of the recreational aspects of basic river management work and proposed features to improve the recreational potential of the Quien Sabe Area.

Comprehensive Planning Requirements

Reclamation recognizes the advantages to recreation which would result from adoption of the proposals advanced in the Land Use Office report and generally concurs in the goal of improving the recreational potential of the Quien Sabe Area which underlies the proposals. However, there are a number of considerations affecting Reclamation's ability to accomplish the proposals exactly as outlined in the Land Use Office report which are discussed briefly below.

The comprehensive planning required for a Federal multiple-purpose project is accomplished in accordance with Federal directives which require that the goal be attainment of maximum overall project benefits. This frequently imposes a limit on the attainment of single-purpose objectives such as the accomplishment of the greatest possible recreational value or the greatest possible water salvage. Each single-purpose objective must be given weighted consideration.

There are legal considerations and priorities in the use of water from the Colorado River. These are discussed at length in the 1964 Decree of the U. S. Supreme Court in the case of Arizona v. California, and in the preceding Opinion of the Court dated June 3, 1963, for the same case. Additional commitments of the waters of the Colorado River are created by the Colorado River Basin Project Act of September 30, 1968.

The present perfected rights, contracts, and allocations discussed in the Opinion and the Act identified above, fully commit the supply of water available for consumptive use from the lower Colorado River. Extensive studies show that there will be future deficiencies of water supply for authorized users. Consistent with identified needs and with

the requirements of the Supreme Court Decree and the Colorado River Basin Project Act, this comprehensive plan provides for salvage of Colorado River water wherever this may be feasible. For the same reasons, proposals which would create additional consumptive use of Colorado River water have been excluded from the plan.

The preliminary recommendations of fish and wildlife agencies proposed the creation or retention of 1,250 acres of backwater areas for development of the fishery resource. However, this comprehensive river management plan provides for the improvement for fishery use of only 600 acres of backwater. These backwater areas are those which will remain after adoption of all feasible measures to reduce water losses from off-channel open-water areas.

Page 12 of the Land Use Office report (Exhibit II) suggests that an additional 140 acres of backwater be retained for enhancement of general recreation. Since this proposal would result in abandonment of opportunities for feasible filling of channel areas which will not be required for conveyance of water, that proposal and related portions of the 11 Land Use Office recommendations have not been incorporated in this comprehensive river management plan for the Parker Division. Estimates of the economic benefits and costs associated with general recreation facilities to be included in the project have been adjusted accordingly as discussed later in this report.

Use and development of backwater areas for general water-oriented recreation must be confined to the 600 acres of backwater areas which will result from basic river management work. It will be necessary to develop accommodations between conflicting desires for use of these areas. This has already been done for the major backwater area between Channel Stations 635+00 and 720+00 where agreement has been reached that the lower 20 acres of the area designated by the Bureau of Sport Fisheries and Wildlife as "Lakesite D" may be used for boating and general recreation. Similar accommodations may be possible at other locations where backwaters remain after construction of the new dredged channel.

The Land Use Office report is based on an assumption of clear Federal ownership of the Quien Sabe Area. The unadjudicated Indian claim is not specifically considered. This assumption has considerable

merit for planning purposes. If the claim of the Indians is later disallowed, the plans developed will have direct application. Interagency discussions indicate that if a finding on the claim favors the Indians, most of the proposed recreational features will be similarly useful to Indian development of the Quien Sabe Area. The principal difference in development by the Indians would be a somewhat greater emphasis on residential and commercial development for the amortization of development costs and the production of income to support other Indian programs. However, the fact that the need for planning required hypothetical assumptions as to adjudication of title claims should not be taken to indicate that Reclamation has concluded that any particular finding with respect to the claims is more nearly correct, more desirable, or more likely to result. Rather, it appears that any likely decision can be accommodated by minor changes in project plans for recreation. In any event, it is clear that careful planning and coordination will be required to insure that development work preceding adjudication of the Indian claim will be useful after that claim has been decided and to insure that developments on both sides of the river in the Quien Sabe Area will be compatible.

Subject to the considerations discussed above and the specific comments below on 2 of the 11 numbered recommendations, Reclamation concurs in the recommendations presented in the Land Use Office report.

Recommendation 2: Construction of channel banks and filling of the abandoned river channel wherever this is feasible has priority in use of excavated material. Any excess material may be placed to benefit recreation and other resource values affected by the project.

Recommendation 11: This recommendation is outside the scope of Reclamation's comprehensive plan report.

Quien Sabe Area--Economic Factors

The Land Use Office report summarizes construction costs for recreational features in Table 2. However, these costs have been modified in this report to reflect the considerations discussed above. As shown in Exhibit VI of this report, the cost of dredge excavation has been changed to $0.33 per cubic yard to agree with the estimated cost for similar fish and wildlife dredging. Also, the total volume of dredging has been reduced to 160,000 cubic yards. This will allow for deeper excavation in some areas

than would be required for fish and wildlife purposes alone. The improvement of the lower end of the backwater area near Channel Station 720+00 for a marina exemplifies the requirement for which this quantity will provide.

Revised recreational costs are included in the economic analysis (Part VIII) of this report. Recreational features to be constructed will be given appropriate analyses prior to construction to insure that they have feasibility. While the benefits of the recreational features will be higher, as indicated by the Land Use Office report, the recreational benefit in the Quien Sabe Area claimed in the economic analysis of the overall project is the same as the cost of the features. The analyses preceding construction will assure that this conservative level or a higher level of benefits is achieved. The benefit claimed is shown in Table 7, Part VIII.

PART VII

COORDINATION ACTIVITIES

PART VII

COORDINATION ACTIVITIES

General

Paralleling a similar evolution of other Reclamation projects, the river management work performed on the lower Colorado River has grown from small local flood control projects to multiple-purpose projects serving the river from Davis Dam south to the International Boundary. Project goals now include control of floods, salvage of water, stabilizing the river channel, reducing the transportation of sediment, stabilizing and enhancing fish and wildlife habitat, improving recreational opportunities, and others.

Much of the basic data required for comprehensive planning of river management work has been collected through established channels of communication with Federal and state agencies, Indian Tribal Councils, and local entities having an interest in river-based resources. Several of these are identified in Part I of this report.

Initial project planning was limited to the development of a basic channel improvement plan using construction methods tested in earlier river management work. A draft report of an engineering plan for improvement of the river channel was distributed to Federal, state, and local agencies in August 1964.

Comments provided to Reclamation after review of the draft report indicated there was a recognized need for channel stabilization, water salvage, and sediment reduction which would result from the proposed work. After supplementary discussions relating to work scheduling and methods, the Bureau of Indian Affairs, the Colorado River Indian Tribes, and lessees of Indian lands along the river, endorsed the proposed work and recommended its early prosecution. About 80 percent of the total river bank line in the Parker Division is within the Colorado River Indian Reservation. The Colorado River Indian Tribes also have an unadjudicated claim to the remainder of the riverbank lands in the division.

Evaluation reports received from the Bureau of Sport Fisheries and Wildlife, the California Department of Fish and Game, and the Arizona Game and Fish Department, in response to Reclamation's August 1964 report,

stated that the project would have a serious impact on the fish and wildlife resources. Reclamation's review of the three reports indicated that, to varying degrees, each report was based on misconceptions as to the nature and extent of the channel stabilization work and overlooked the concurrent effect on fish and wildlife by factors other than the proposed river management work. Potential population growth and recreational and urban developments, in the project area particularly, had not received adequate recognition. To assure unified and beneficial planning by the Bureau of Reclamation and by the Bureau of Sport Fisheries and Wildlife, the Secretary of the Interior directed, on February 25, 1965, that the activities of these two agencies on any section of the river be fully coordinated before release of draft plans for the review by agencies outside the Department.

In keeping with this directive, the two Bureaus subsequently agreed upon basic data and plans for fish and wildlife within the Parker Division. With the assistance of the Bureau of Sport Fisheries and Wildlife, the Bureau of Indian Affairs, and the Colorado River Indian Tribes, Reclamation's original plan was thereafter expanded to include features important to preservation of the fish and wildlife resources. In September 1965, a new draft of a comprehensive plan for the Parker Division was distributed for review by state and local agencies. Later, at the request of the States of Arizona and California, a review schedule was established to permit simultaneous review of the plans for the Parker, Topock Gorge, and Yuma Divisions. Consequently, official review comments from the two states were not received until August 26, 1966.

Following discussions within the Department of the Interior in December 1965, the primary responsibility for evaluating, planning, and designing recreational aspects and features of river management projects on Federal lands was assigned to the Lower Colorado River Land Use Office. 1/ Subsequently, that office prepared a report entitled "Recreation Aspects of Section II of the Parker Division Channelization Plan," dated April 1967. Copies of that report were furnished to the State of California in response to its request. In May 1968, the report was revised to reflect later information. The revised report is appended hereto as Exhibit II.

1/ Redesignated the Lower Colorado River Office, Bureau of Land Management on December 30, 1968

Results of Local Reviews

Response to the September 1965 draft report of a comprehensive plan for the Parker Division indicated that the proposed work has widespread support. The Colorado River Indian Tribes, who have a proprietary interest in most of the land bordering the river in the division, strongly endorse the work and urge its prompt prosecution. Water user organizations representing municipal, industrial, and agricultural uses of water support the project because of its widespread benefits to the water-using public. Some agencies, particularly the California Department of Parks and Recreation, emphasized the need for continued coordination through design and construction phases of the project. The Arizona Game and Fish Department gave its concurrence to the report subject to several recommendations intended to protect proposed fish and wildlife features from anticipated development of facilities for general recreation in the project area. The California Department of Fish and Game submitted official comments on the proposed work which differ sharply with estimates of present and future conditions and with evaluations of the needs to be met by the work proposed by the Federal agencies. The California Resources Agency submitted several conclusions and recommendations which generally support the position of the California Department of Fish and Game but depreciate the conclusions and recommendations of the Colorado River Board of California and the California Department of Water Resources. Since the only important objection of the plan offered for review originated with state fish and game agencies, the comments provided by those agencies are discussed in additional detail.

Fish and Game Comments

The only serious concern expressed by the Arizona Game and Fish Department was that lack of an uncleared, undeveloped "buffer zone" might reduce the value to wildlife of the project-developed backwater lakes.

Specific plans for development of the areas surrounding these lakes have not been included in the comprehensive plan primarily because of Indian ownership of the lands.

No Federal agency has authority or would wish to make commitments which would preclude future adjustments in the use of Indian lands which might be to the best advantage of the Indians. However, the Colorado River

Indian Tribes and the Bureau of Indian Affairs have developed general planning concepts for Indian lands along the river where the proposed backwater lakes will be developed. These concepts presume that development and occupation of the lakefronts for residential and other purposes will occur over a fairly long period and will be limited somewhat because much of the perimeter is in the flood plain and because the attractiveness of the low lands near the river is considered to depend, to a large part, on the fish and wildlife assets which the area will provide. It is anticipated that substantial portions of each lake will be bordered by unoccupied lands usable by wildlife. Hence, the result should be similar to the concept suggested by the Arizona Game and Fish Department even though "buffer zones" may not completely surround the lakes.

The California Department of Fish and Game differs in several instances with both the estimates of future conditions and the method of preserving fish and wildlife proposed in the September 1965 draft report of a comprehensive plan for the Parker Division. While earlier suggestions by that agency have been fully considered and many have been incorporated in the present plan, most of the more recent suggestions provided in that agency's official comments on the Parker Division have not been included. There were a number of important considerations influencing nonadoption of recommendations by the California Department of Fish and Game. These are briefly discussed below.

The Bureau of Sport Fisheries and Wildlife, by an agreement with the Colorado River Indian Tribes and the Bureau of Indian Affairs, is actively advising and assisting in the management and improvement of the fish and game resources of the Colorado River Indian Reservation. Fish and wildlife planning for the Parker Division has been accomplished by the Bureau of Sport Fisheries and Wildlife in close cooperation with Tribal representatives, the Bureau of Indian Affairs, and the Bureau of Reclamation. Hence, the Bureau of Reclamation, the Bureau of Indian Affairs, and the Colorado River Indian Tribes have placed primary reliance on the fish and wildlife evaluations and recommendations of the Bureau of Sport Fisheries and Wildlife.

The recommendations of the California Department of Fish and Game appear to be aimed primarily at protecting or enhancing fish and game values without sufficient regard for, or consideration of the effect on, other resource values. Federal directives, typified by Senate Document No. 97,

May 1962, do not permit a single-purpose approach to planning for a multiple-purpose project. The maximum overall project benefit must be sought, limiting development of individual resources as may be necessary to reach this goal.

Most of the land in the Parker Division is held in trust for the Indians of the Colorado River Indian Reservation for their best use and maximum benefit. Preparation of detailed plans for development on the Reservation is not practicable at the present time. Urgently needed river management work cannot be deferred merely because future local development cannot presently be described in detail. However, as these plans are firmed up the appropriate agencies will be consulted.

Operation and maintenance of the fish and wildlife resources in the Parker Division, including fish stocking, largely has been and will continue to be provided by Federal agencies. It is unimportant which Federal agency provides this public service. It is most reasonable to assume that this service will continue at a level corresponding to public use which is the principal determinative factor rather than the accomplishment or nonaccomplishment of river management work.

Estimates of costs and benefits have been made in accordance with Federal directives relating to multiple-purpose water resources planning. Suggestions by the California Department of Fish and Game that improper assignment of benefits has been made, appear to be based on unfamiliarity with the prescribed methods of analysis or a misinterpretation of the reported results.

Future Coordination

Coordination activities initiated during the project planning phase will be continued during detailed design and construction of project features. Such coordination with the various Federal agencies of the Department of the Interior and with interested state and local agencies and Indian Tribes will permit more detailed work toward the solution of the many local problems than is possible during project planning and will provide the flexibility needed to meet changed conditions and unforeseen developments. There is a particular need for such coordination in the Quien Sabe reach of the river to insure the compatibility of developments on both sides of the river and to insure that constructed recreational facilities will be useful regardless of the outcome of the Indian claim.

PART VIII

ECONOMIC ANALYSIS

PART VIII

ECONOMIC ANALYSIS

Project Justification

Stabilization and rectification of the channel in the Parker Division is compatible with Reclamation's responsibility to construct and maintain control works and stabilizing features on the lower Colorado River. The river management work will provide significant benefits in water salvage, sediment reduction, drainage, and improved navigation. Measures have been included for the preservation of fish and wildlife and recreational resources.

Economic justification is based on a comparison of tangible benefits and the costs of constructing and maintaining the project. Benefits and costs are expressed as equivalent average annual amounts for purposes of comparison. This benefit-cost analysis is for a 100-year period with interest at 3-1/8 percent per year. This is the interest rate that was in effect in January 1966 when a portion of the work covered by this report was initiated near Parker, Arizona, in response to an immediate need resulting from development of Indian lands.

Selection of Plan

The economic cost of constructing the channel improvement work by the Alternate Plan exclusive of fish and wildlife and recreational considerations has been shown in this report to be $17,100,800. Interest during construction would increase the net Federal investment cost to $18,690,800.

With the Alternate Plan, the present value of benefits which would accrue during the 100-year period of analysis from a reduction of sediment transport and from an improvement of drainage would be the same as under the Channelization Plan or $1,373,600 and $4,142,200, respectively. As discussed earlier, water salvage would be considerably less than under the Channelization Plan and would only amount to $6,739,900. The benefits of the project would total $12,255,700 or somewhat less than the net cost of $18,690,800. A preliminary study indicated that the inclusion of measures for fish and wildlife and recreation would have little effect on the overall benefit-cost relationship. Therefore, the Alternate Plan is considered economically infeasible and has been eliminated from further consideration in this report.

The Channelization Plan provides considerably more water salvage than the Alternate Plan mainly as a result of reduced open-water areas. Consequently, this plan shows feasibility and has been incorporated in the multiple-purpose river management plan together with fish and wildlife and recreational considerations. The economic analysis of the project plan is outlined in greater detail below.

Project Economic Costs

The costs of the project as outlined in this report, including fish and wildlife and recreational features, will be $11,869,000. Interest during construction will add $1,240,700 to the net economic costs. The total estimated cost and its average annual equivalent are shown as follows:

Channel Stabilization	$ 9,290,000
Fish and Wildlife	2,349,000
Recreation	230,000 1/
Construction Cost	$11,869,000
Interest During Construction	1,240,700
Total	$13,109,700
Average Annual Equivalent	$ 429,500
Annual Operation and Maintenance	113,000 2/
Average Annual Cost	$ 542,500

Project Benefits

Sediment Reduction. The benefit due to a reduction of sediment transport will be reflected in the annual cost of removing the sediment by dredging from the settling basin in the Laguna Division. The annual reduction in sediment arriving at the settling basin will be about 213,000 tons per year which is equal to approximately 180,000 cubic yards per year. The cost of mechanical removal of sediment from the settling basin has been estimated at $0.25 per cubic yard. This will result in a benefit of $45,000 annually.

Drainage Improvement. Drainage will be improved on 6,630 acres of land having water-table depths less than 6 feet. An analysis of Palo Verde

1/ Reflects consideration described in Part VI.
2/ Reclamation maintenance of features constructed by Reclamation. Comprises $101,000 for maintenance of channel stabilization features, $10,000 for maintenance of fish and wildlife features, and $2,000 for maintenance of recreation features.

agricultural yields on a crop rotation pattern indicates an average monetary return of $200 per acre per year. Water-table depths of 0 to 4 feet would result in a loss of production of 25 percent, or $50 per acre, while water-table depths of 4 to 6 feet would create losses of 10 percent, or $20 per acre, as previously discussed. As shown in Table 1, a 3-foot lowering of the water table would reduce the total area having a water-table depth of 0 to 4 feet from 1,093 acres to 45 acres, creating an annual benefit of $52,400. The total area having a water-table depth of 4 to 6 feet would be reduced 4,161 acres, creating an annual benefit of $83,220. The total annual benefit that will accrue through improved drainage is $135,700.

Water Salvage. In the calculation of benefits to accrue from the salvage of water by a reduction in water losses, it has been estimated that the benefits would at least equal those which would accrue from the use of an equivalent amount of water for irrigation on arable lands along the lower Colorado River. Data available from studies by the Bureau of Reclamation show that total benefits of $32.00 per acre-foot of water will accrue each year. This value is for an acre-foot of water at Imperial Dam. It has been shown that under conditions that will prevail after the work is complete, a total of 24,200 acre-feet of water will be saved annually by a reduction of evaporation losses and nonbeneficial consumptive use. Thus, the total benefits that will accrue through beneficial consumptive use of the salvaged water are $774,400 annually.

Fish and Wildlife. The recommendations proposed by the Bureau of Sport Fisheries and Wildlife, and adopted as an integral part of the river management plan, will mitigate nearly all of the losses to fish habitat. As a result of the project work, annual losses which will not be mitigated include 5,000 man-days of fishing, 200 man-days of big-game hunting, 7,000 man-days of upland-game hunting, and 200 man-days of waterfowl hunting. The total annual monetary loss of benefits is $23,600.

Recreation. As discussed in Part VI of this report, the costs of recreational features to be constructed as part of the river management work will be offset by the ensuing benefits. While the level of benefits will be higher, an accurate determination is not possible until detailed planning of recreational features is consummated immediately prior to construction. For purposes of this report, a conservative level of benefits, equal to the average annual cost of construction and maintenance, is estimated to be $9,800 annually.

Other Benefits. Other benefits are attributable to the river management work but they are not readily subject to monetary evaluation. Such benefits have positive value, nevertheless. These include the following:

a. Increased effectiveness of routing water through the area for downstream use.

b. Provision of ready access to the riverbanks instead of the limited access presently available.

c. Retention of valuable land which would otherwise be lost through bank erosion.

d. Enhancement of the value of lands along the banks of the river which now have limited value because of the development hazards created by an unstable riverbank.

Summary of Benefits. A summary of the economic benefits claimed above is shown in Table 7.

Benefit-Cost Ratio

The average annual costs of the features described in this report, including channel improvement work and fish and wildlife and recreational measures, are $542,500. Average annual benefits claimed in this report are $941,300. The corresponding benefit-cost ratio for a 100-year period of analysis is 1.7 to 1.0.

TABLE 7

SUMMARY OF BENEFITS

Item	Average Annual Benefits	Present Value of Benefits (100-year Period of Analysis)
Sediment Reduction	$ 45,000	$ 1,373,600
Drainage Improvement	135,700	4,142,200
Water Salvage	774,400	23,638,600
Fish and Wildlife	-23,600	-720,400
Recreation	9,800 1/	299,100 1/
TOTAL	$941,300	$28,733,100

1/ Reflects considerations discussed in Part VI.

PART IX

CONCLUSIONS AND RECOMMENDATIONS

PART IX

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Two plans, the Channelization Plan and the Alternate Plan, have been studied for stabilization of the lower Colorado River through the Parker Division. These plans provide for identical treatment in Section I, Headgate Rock Dam to Alligator Bend. In Section II, Alligator Bend to Palo Verde Dam, both plans provide for realinement of portions of the existing channel. They differ, however, in that the Channelization Plan would employ a dredge for channel excavation whereas the Alternate Plan would use land-based equipment for this purpose.

The primary purposes of both plans are to provide a stable conveyance channel, reduce losses of water, and reduce the sediment load of the river. Both plans also provide for preservation of fish and wildlife and recreational resource values with substantial measures being incorporated in the project plan for this purpose.

On the basis of readily identified tangible values, the Channelization Plan would provide a substantially greater net overall project benefit than the Alternate Plan. The additional benefit provided by the Channelization Plan was a large increase in the water salvage resulting from the project. The benefit-cost ratio for the Channelization Plan, including measures for the preservation of fish and wildlife resources and the recreational potential of the area, is 1.7 to 1.0.

Recommendations

1. It is recommended that the features encompassed by Recommendations 1 through 4 of the Bureau of Sport Fisheries and Wildlife Memorandum Report of February 24, 1967, on the Parker Division, Colorado River Front Work and Levee System, Arizona and California, be incorporated as integral features of the comprehensive plan for river management work in the Parker Division as discussed in Part V of this report.

2. It is recommended that the features proposed by the 11 recommendations in the Lower Colorado River Land Use Office report entitled "Recreation Aspects of Section II of the Parker Division Channelization Plan,

Lower Colorado River - Quien Sabe Area - California," dated May 1968 be incorporated as integral features of the comprehensive plan for river management work in the Parker Division subject to the considerations discussed in Part VI of this report.

3. It is recommended that the Channelization Plan presented in this report, together with the fish and wildlife and recreational features discussed in the two preceding recommendations, be constructed and that nonreimbursable annual appropriations for the orderly prosecution of the program be scheduled in accordance with authority for the Colorado River Front Work and Levee System work contained in Public Law 469 approved June 28, 1946.

EXHIBIT 1

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

February 24, 1967

Memorandum

To: Regional Director, Bureau of Reclamation, Region 3, Bounder City, Nevada

From: Regional Director

Subject: Parker Division, Colorado River Front Work and Levee System, Arizona and California--Bureau of Sport Fisheries and Wildlife report

This memorandum constitutes the Bureau of Sport Fisheries and Wildlife report on fish and wildlife resources in relation to the Parker Division of the Colorado River Front Work and Levee System, Yuma County, Arizona, and Riverside and San Bernardino Counties, California, and is intended to accompany your feasibility report. It has been prepared under the authority and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and has been coordinated with the Bureau of Indian Affairs and the Colorado River Indian Tribes. The California Department of Fish and Game and the Arizona Game and Fish Department rendered assistance in providing some of its background material.

The Colorado River Front Work and Levee System was authorized by the Acts of March 3, 1925 (43 Stat. 1186, 1198), January 21, 1927 (44 Stat. 1010, 1021), July 1, 1940 (54 Stat. 708), and particularly the Act of June 28, 1946 (60 Stat. 338).

Project objectives in the Parker Division are more efficient regulation and movement of the Colorado River flows, reduction of sediment, improvement of drainage from agricultural lands, and water salvage. These objectives will be accomplished by effectuation of a plan of development that provides for rehabilitation of portions of the existing river channel, construction of new channel reaches, stabilization of banks, and elimination of secondary channels and backwater areas.

DESCRIPTION OF THE AREA

The Colorado River Front Work and Levee System extends from Lees Ferry, a few miles downstream from the Utah-Arizona State line, to the international boundary between the United States and Mexico. The Parker Division, one of nine project divisions between Davis Dam and the international boundary, extends about 44 miles downstream from Headgate Rock Dam located a mile north of Parker, Arizona, to Palo Verde Diversion Dam which is 10 miles north of Blythe, California. The Parker Division covers about 44 miles of river channel. Except for several small tracts in State or private ownership, the riverbank is either within the Colorado River Indian Reservation (about 80 percent of the total riverbank) or within the Quien Sabe Point Area which extends about 16 miles north of the Palo Verde Diversion Dam in California (about 20 percent of the total riverbank).

The river in the Parker Division is a broad meandering stream that ranges in width from 350 feet to as much as 1,800 feet in braided reaches. Many large islands divide the channel through its 44-mile course in the project area. Deer Island, located 3 miles south of Parker, Arizona, measures about 1.5 miles in length by 0.5 mile in width at its widest point and is the largest of the islands.

In several reaches, the channel is best described as braided, or subdivided into many shallow secondary channels by small islands and sandbars. Variations in channel width, bottom materials, and bottom topography result in shallow riffles alternating with deeper pool areas.

Colorado River streamflows in the Parker Division are regulated by releases from upstream reservoirs, especially Lake Havasu, the reservoir impounded by Parker Dam located 14.3 river miles upstream from Headgate Rock Dam. Both seasonal and daily variations in streamflows occur in the project area. Most of the water released at Parker Dam is earmarked for delivery to irrigation districts downstream. Irrigation requirements, hence releases at Parker Dam, vary with the growing season. The season of maximum releases at Parker Dam extends from March through September. During the period March through September, average daily flows in the Parker Division range from about 5,500 second-feet to 22,000 second-feet. Mean monthly discharge during this high-flow period averages about 16,600 second-feet. Average daily flows during the low-flow period extending from October through February range from about 1,800 second-feet to 21,000 second-feet. Mean monthly discharge during the low-flow period averages about 9,800 second-feet.

Daily variation in Colorado River flows in the project area results from coordinating releases through multipurpose Parker Dam to provide peak power generation between 10 a.m. and 10 p.m. During winter months, daily variation in water surface elevation, as measured at Water Wheel Gage midway through the project area, averages about 0.5 foot and ranges up to 1.5 feet. During summer months, the daily water surface elevation fluctuation averages 2.5 feet and ranges up to 5 feet.

The Colorado River in the Parker Division meanders through the western half of the Parker Valley, a broad, flat alluvial plain averaging 9 to 10 miles in width and bordered by low-lying mountains. Elevations in the Parker Valley range from about 290 feet to 400 feet. Much of the vegetation is desert shrub. Upland sites are vegetated sparsely with creosote bush, paloverde, bursage, scrub mesquite, and cacti. Uncleared portions of the alluvial plain, however, are covered with dense stands of trees and shrubs, comprised of varying mixtures of mesquite, arrowweed, salt cedar, saltbush, baccharis, willow, and cottonwood. Backwater areas, sloughs, and oxbow lakes are fringed by cattails, rushes, sedges, carrizo cane, and marsh plants.

The project area lies in a climatic zone characterized by mild winters, hot summers, and low rainfall. Mean annual temperature at Parker, Arizona, is 70° F. with extremes of record ranging from 9° to 127° F. Rainfall averages about 5 inches annually. The average frost-free season extends from March 2 to November 26.

The economy of the Parker Valley is based largely on agriculture. Much of the alluvial plain which lies within the Colorado River Indian Reservation has been and is being cleared for irrigated farming. Cotton, truck crops, alfalfa, and small grains are major crops.

The Parker Valley lies approximately midway between Phoenix and Los Angeles, two of the largest and faster growing metropolitan areas in the Pacific Southwest. Total population of the two areas is expected to increase from 10 million in 1960 to nearly 30 million by 2014. With the current population increase, there has developed a burgeoning demand for fishing and hunting and water-oriented recreation. The Colorado River in the Parker Valley, with its unique combination of water, fish and wildlife habitat, location, and favorable climate can be expected to fulfill a substantial part of this demand. In fact, about 15 percent of the river frontage in the Parker Divison already is under lease for intensive recreational, homesite, and commercial development. On the basis of such evidence, it is anticipated that in years to come recreation, tourism, and fishing may supplant agriculture as the major source of income in the Parker Valley.

PLAN OF DEVELOPMENT

The project plan for the Parker Division divides the Colorado River into two sections. Section I extends about 16 miles from Headgate Rock Dam downstream to Alligator Bend. Section II extends downstream about 28 miles from Alligator Bend to Palo Verde Diversion Dam. The treatment proposed for each section is based upon the particular characteristics of the river in each section.

River Section I from Headgate Rock Dam to Alligator Bend is considered in good alignment. Intensive degradation has resulted in the formation of a bottom armor of heavy gravel and rock. The principal problems in Section I are minor misalignments, cutting banks, and some short braided and overwide reaches. Corrective action will entail riprapping banks to reduce erosion, construction of new bank lines in overwide braided reaches to reduce channel width to about 500 feet, and minor realignment by windrowing rock along desired bank lines and excavating a pilot channel between the windrows. Approximately 11 miles of the 16-mile Section I reach will be altered by project construction. No dredging will be required in Section I.

In Section II, the problems of misalignment, sharp bends, overwide channels, and eroding banks are considered too extensive to permit treatment as in Section I. Complete realignment and construction of a channel with desired width-depth ratios is deemed necessary. The channel will be constructed by dredging and land-based equipment. Since there is no requirement for levees, excess spoil will be used to fill the abandoned river channel, other low-lying wet areas, or spread across the floodway so as not to reduce the flood channel capacity. Banks of the new channel will be stabilized and protected from erosion by riprapping.

The new channel will extend 21.4 miles from the vicinity of Alligator Bend downstream to a point about 3 miles above Palo Verde Diversion Dam. The bottom width of the new channel will be 450 feet with side slopes 1.5 to 1. The channel will be designed for a flow of 15,000 second-feet, which is considered the dominant flow. Bank height will be sufficient to provide capacity with suitable freeboard for a flow of 25,000 second-feet which represents the normal maximum flow. Approximately five years will be required for completion of the dredged channel.

Service roads will be built along both banks in the construction areas. Access roads will be built to connect the service roads with highways, quarries, and operating yards. One bridge will be constructed across the river in the center of Section I.

Completion of channelization and bank stabilization will reduce sediment contribution to the river in the Parker Division, as reflected in reduction of sediment arriving at Imperial Dam, by about 213,000 tons annually. Reduction of water surface area from about 4,845 acres to an estimated 3,052 acres will result in an estimated 10,600 acre-feet of water salvage annually. Anticipated reduction in ground-water levels of 1.2 to 3.9 feet on 13,400 acres of bottomland is expected to provide an additional 13,600 acre-feet of water salvage annually.

The assessment of the effects of the proposed river control work on fish and wildlife in this report is based on the differences between two proprections: (1) an appraisal of the changes in the Parker Division expected to occur without the project and (2) an appraisal of the changes expected to occur with the project. The differences between the two then become the net effects which can be attributed to the project. Later on in this report, means and measures to mitigate project-caused fish and wildlife losses and, where feasible, to enhance fish and wildlife are discussed.

FISH

Without the Project

The Parker Division project area of influence on fish includes approximately 44 miles of the Colorado River and about 5 miles of existing backwater and oxbow area formed by old river meanders. These areas comprise about 4,845 surface acres of water, much of which is of value to fishes under normal flow conditions. Construction activities will be undertaken on 32.4 miles of channel within the 44-mile reach described above.

The quality of fish habitat in the Parker Division project area varies from poor to excellent. The backwaters of the Parker Division and the stable reaches of the upper 16 miles of the main channel in Section I provide the best habitat. The poor habitat is found in the shifting silt and sand which characterize portions of the Section II reach of the main channel. In the better reaches of the main channel, riffle areas alternate with deep pools and quiet waters, and the irregular bank line and many river bends create small, deep, sheltered eddies and pockets under steep banks with sand and gravel bars on the opposite shore. These conditions provide an excellent environment for the production of fishes.

In the upper 16 miles which comprise Section I, the river bottom for the most part is composed of coarse gravel and rubble. In the 28-mile

downstream reach which comprises Section II, the bottom consists predominantly of fine sand and silt interspersed with short stretches of gravelly material. Shifting of bottom sand is evident and changes occur in the composition of bottom materials as a result of variation in volume and velocity of streamflow. Each of the more stable bottom types, however, is productive of specific kinds of fish food organisms. The emergent and submerged aquatic plants in the quiet shallow water areas support food organisms in addition to providing cover.

Pockets and tunnels in the high steep banks, primarily in the backwaters, provide channel catfish habitat especially where snags, brush piles, or overhanging vegetation furnish cover. Bass and the various sunfishes nest in shallow areas of quiet backwaters and to a certain extent in the main channel. Riffles provide essential rearing and feeding habitat.

The different kinds of habitat occurring in project area waters thus provide productive spawning and rearing areas for a variety of game and nongame fishes. Largemouth bass, smallmouth bass, channel catfish, yellow bullhead, bluegill, redear sunfish, black crappie, striped bass, and green sunfish are the major game fishes. A few trout and other game fishes from upstream stockings reach the area. Carp, threadfin shad, and various shiners and suckers are common nongame fishes. Bullfrogs are abundant in the quiet backwaters, sloughs, and oxbows and are sought by growing numbers of fishermen. Soft-shelled turtles, prized by gourmets, also are common in project waters. Presently, only a few turtles are taken by fishermen, but turtles undoubtedly will receive more attention in years to come.

Fishing in the Parker Division has been limited in the past by lack of access to the river. In recent years, however, partly in response to growing demand for fishing, the Colorado River Indian Tribes have developed access roads to several points on the river and more are planned along with campgrounds and other facilities. In addition, fisherman access is available from six trailer resorts along the lower 30 miles of the river in the project area. Improved fisherman access and service facilities coupled with an expanding population in Arizona and southern California have attracted increasing numbers of fishermen to the project area.

Most of the Division's fish habitat lies within the boundaries of the Colorado River Indian Reservation. Hence, the Tribal Council has endeavored to captitalize on the demand for fishing for the economic betterment of the Indians. To this end, the Tribal Council and the

Bureau of Indian Affairs have developed a cooperative agreement with the Bureau of Sport Fisheries and Wildlife for technical assistance in developing and maintaining improved fishing within the Reservation. Accordingly, in 1962, in cooperation with personnel of the California Department of Fish and Game and Arizona Game and Fish Department, the Bureau of Sport Fisheries and Wildlife initiated a fisheries management program on the Reservation. The program includes selective stocking and habitat development based on research findings. When fully developed and functioning, the fish and wildlife program on the Reservation can be expected to provide gainful employment for many tribal members.

In addition to productive habitat, a minimum of competition from other forms of water-oriented recreation, notably speedboating and waterskiing, has permitted the realization of fishing in the Parker Division. Shallow riffles, swift currents, trees and brush, sharp bends and other physical characteristics of the river that combine to produce high-quality fish habitat, render much of the river in the Parker Division unsafe for speedboating and waterskiing. Although speedboating and waterskiing activities presently are confined mainly to the vicinity of existing trailer resorts, interest in these activities is growing rapidly.

Planning is going forward by the Bureau of Indian Affairs and Tribal Council for extensive additional resort and urban development in the Parker Division. Attendant localized channel work specifically designed to meet the needs of water-oriented sports is likely to lead to an increase in speedboating and waterskiing and a significant decrease in fishing during the summer months. Riverside developments for private homesites and the demand for trailer courts, motels, and shopping centers can be expected to lead to closure of some of the riverside to public access and to filling and drainage or other disturbance of some of the backwaters which are so vital to fish production. With the advent of all these developments and a great increase in the human population of the project area, there will be less fish habitat and much less fishing. In this regard, approximately 15 percent of the riverside area already is under lease for intensive homesite and general recreational development. Planning of similar development is receiving attention for much of the remaining reach of river within the Reservation.

Consideration of the factors noted above indicates that although the Parker Division has a high potential for fishing, particularly in its backwaters, intensive development of the area for homesites and for general recreation will have an adverse impact on the fishing potential. In the future even without the project, the river will not remain as it is today.

Based upon current fishing estimated at 90,000 man-days annually and an eventual increase to a maximum of about 600,000 fisherman-days, it is estimated that without the project average fishing over the 100-year life of the project would amount to about 355,000 man-days annually.

With the Project

The 44-mile reach of the Colorado River within the Parker Division will experience great changes in years to come. As was indicated in the without-the-project section above, increased development of the area for general recreation and urbanization will have an adverse effect upon the fishing. In addition to such developments, there will be the proposed channelization of the river. This channelization work will involve a reduction of total water of value to fishing from about 4,845 acres to 3,052 acres with extensive losses of warmwater fish habitat and fishing.

Although fishing losses will be offset in part by the Federal Government through selective stocking, habitat development, and other fisheries management techniques specifically designed to meet the channelized conditions, these factors alone will not suffice to mitigate in full the project-caused losses.

The manner in which project construction will affect fish habitat initially will differ strikingly in Section I and Section II. In the upper 16 miles, identified as Section I, channelization will be effected by means of dressed banks, including windrowing riprap along eroding banks to stabilize the bank line. In overwide reaches, new riprapped banks will be constructed which will reduce the channel width to about 500 feet. Stabilization of existing bank lines and construction of new stabilized banks thus will confine the Colorado River flows to a channel of relatively uniform width. In former shallow braided reaches, the enhanced erosive force of the narrowed current will remove small islands and sandbars and generally deepen the channel. Most snags and brush piles will be swept away.

After stabilization of bank lines and channel width, the river will continue to be a dynamic force. The bottom configuration will be uneven and subject to change. Both river depth and current velocities will exhibit considerable variation throughout Section I. The make-up of bottom materials similarly will vary. For a few years after construction of the channel works, sand flats, sandbars, and gravel beds will appear and disappear in response to changes in volume and velocity of Colorado River flows emanating from Parker Dam. Eventually, however, this reach of river is expected to establish greater stability than it would under without-the-project conditions.

The establishment by project construction of a deep, relatively uniform, stabilized main channel through Section I will have notable and permanent effects on fish habitat. Within the confines of the main channel, bass, crappie, and sunfish nesting habitat will be reduced along with most emergent and submerged vegetation which is important as fish cover and for production of insects and other fish food organisms. Riprapping of new and existing bank lines, if accomplished with material of sufficient size to provide adequate-sized interstices, however, could provide some fish habitat.

It is expected that an accelerated shifting of sand flats and sandbars in the initial years after construction in Section I will reduce the productivity of existing feeding habitat and inhibit the establishment of new food-producing areas. The removal of most snags, brush piles, and other channel debris will eliminate vital fish cover. Thus, despite anticipated variations in channel configuration and streamflow characteristics, project construction will reduce significantly the capacity of the main channel to produce or sustain game fishes. The primary loss in fish habitat, however, will occur as a result of eventual reduction in numbers and size of side channels and backwaters. Consequently, fishing success and total fishing effort in the river can be expected to decline.

The detrimental effect of project-caused habitat destruction on fishing in Section I will not be manifested immediately. The construction of new banks and jetties in Section I will create a series of temporary but highly productive backwaters. These small backwaters will extend in an almost continuous though disconnected series from channel station 25+00 near the Colorado River Indian Agency Headquarters to channel station 500+00 approximately 4 miles upstream from the lower end of Section I. Except for a small area at channel station 450+00, the backwaters will be located on the east or Arizona side of the main channel. In addition, one large backwater will be created. Much of this cutoff, however, will be shallow.

Biological investigations have been made of natural backwaters and of similar project-created backwaters in other divisions of the Colorado River Front Work and Levee System. As a result of these studies, the expectation is that for a few years some of the new backwaters in the Parker Division will provide generally excellent and often even outstanding fish-producing habitat and fishing, principally for channel catfish, bass, crappies, and sunfishes. Migration of game and forage fishes from the productive backwaters to the main channel will result in higher fishing success and more man-days of fishing effort than would be possible in the main channel in the

absence of the backwaters. Thus, an initial but temporary enhancement of fishing in Section I may be attributed to the new backwaters.

The constructed banks and jetties that will create the backwaters also will be responsible for their ultimate extinction through biotic succession. Physical stabilization of backwaters, largely through elimination of periodic eroding water currents, will permit the establishment and spread of emergent vegetation, principally tules. Unless halted by sustained human endeavor, vegetation will rapidly invade the shallow areas and, in time, will fill even the deepest portions of the backwaters. The time required for the obliteration of individual backwater areas will vary with physical and biotic conditions present at the time of formation, but observations on other reaches of the Lower Colorado River indicate that the small backwaters will begin to deteriorate immediately and many will cease to exist as fish habitat in from 5 to 10 years. When the loss of backwater habitat occurs, overall fish habitat quality and fishing in Section I will be reduced materially.

As previously indicated in this report, the Colorado River Indian Tribes plan ultimately to lease extensive riverfront acreage for the development of homesites, trailer courts, resorts, marinas, and other recreation-oriented facilities. A lease for a major part of the river frontage in Section I already has been approved. Although these developments generally will inhibit fishing, they also will require the maintenance of open-water areas over a portion of the project-created backwaters. Analyses of similar backwater maintenance indicate the development and maintneance directed primarily toward boating, plus subsequent recreational use of the opened water areas in conjunction with urban or resort developments, result in only fair fish habitat. Nevertheless, maintenance of backwater areas for recreational purposes in Section I will preserve a certain portion of the fishery potential of these areas which otherwise would be lost. This fishery potential will be realized because the conflict of water sports with fishing largely is confined to the warmer six months of the year. During the cooler months, anglers can fish with little interference from speedboaters and waterskiers.

In the 28 miles of Section II, channelization will be accomplished largely by dredging. Approximately 8 miles of the existing channel will be bypassed as a result of new channel alignment. Three major backwater areas plus many smaller cutoff backwaters will be created. Project plans provide for dredge spoil to be wasted in part into the bypassed channel reaches. The banks of the dredged channel will be stabilized by a blanket of rock riprap.

In the course of dredging through existing channel reaches, many of the physical and biotic river features, which collectively comprise present good fish habitat, will be reduced in value. The value of the bypassed channel reaches as fish habitat will be eliminated, initially in part through spoil deposition and eventually entirely through biotic succession. Project information indicates that following construction, natural adjustments in the dredged channel, as in Section I, will result in the development of an uneven bottom configuration with ensuing pockets, sandbars, sand flats, gravel beds, and other manifestations of an uneven bottom including variations in currents. However, the anticipated physical variability in the dredged channel will be inadequate in quality to compensate for the removal of existing nesting, rearing, feeding, and resting areas particularly in side channels and the river-connected backwaters. Fish production and fishing will decline significantly in Section II.

With the project, overall fishing success and fishing in the Parker Division will decline. It is estimated that during the period of analysis about 190,000 man-days of fishing annually will occur. Thus, with no remedial measures, there could be an estimated loss of about 165,000 man-days of fishing annually attributable to project construction.

WILDLIFE

Without the Project

Approximately 11,000 acres are included in the area of project influence for wildlife. The Colorado River mainstem water, backwaters, oxbows, marshy sloughs, and small islands and sandbars occupy about 5,000 acres. Bottomland comprises the remaining 6,000 acres, including the larger islands. This estimate of 6,000 acres is based upon the knowledge that about 34 miles of river will be subjected to construction work with resultant damages to a peripheral strip approximately 500 feet wide on each side of the river comprising about 4,000 acres; and another 2,000 acres of bottomland vegetation of value to wildlife which are likely to be affected through lowering of the water table or clearing of vegetation. Roughly, one half of the total area of project influence on wildlife lies in Arizona and one half in California, with most of the area lying within the Colorado River Indian Reservation.

Several distinct kinds of wildlife habitat occur in the area of project influence. Salt cedar, mesquite, and arrowweed, singly or in combination, dominate the bottomland vegetation along with lesser amounts of baccharis, quailbush, willow, and cottonwood. The tree and shrub densities

in the bottomland vary, with dense almost impenetrable stands giving way to open reaches with only scattered clumps of shrubs and trees. Grasses and forbs are common in the open stands. On the Arizona side of the river, the project area from Parker to the Reservation drain is bordered by irrigated farmland. Presently, the alluvial valley south of the Reservation drain and east of the Reservation levee is occupied by native vegetation, principally mesquite, but current programs on the Indian lands indicate that the entire project area eventually will be bordered on the east by irrigated lands. Small tracts of irrigated farmland are interspersed with bottomland vegetation in the lower portion of the area west of the river but for the most part the bottomland west of the river gives way to a desert-shrub vegetation type. Access roads and trails to the river have been constructed which, along with natural clearings, create an edge effect which enhances the wildlife value of the bottomland vegetation.

Small islands in the braided reaches of the river are covered for the most part with grasses, forbs, and willows. Shallow backwater areas and oxbows are fringed with cattails, sedges, rushes, and other emergent aquatic plants. Portions of old river meanders have developed into marshland dominated by cattails, rushes, sedges, and carrizo cane.

The land and water areas comprising the Parker Division project area generally furnish excellent habitat for a wide variety of game and nongame birds and mammals.

The desert mule deer is the only big-game species in the project area. Deer census data are not available, but some indication of deer numbers was provided by California Department of Fish and Game personnel who have counted as many as 150 deer feeding in a single alfalfa field in the southwest portion of the project area.

Lying in close proximity to the open water areas of the river and to irrigated cropland, the bottomlands are justly famed as production areas for white-winged doves, mourning doves, Gambel's quails, and cottontails. Field studies by State biologists have revealed that current annual production of doves in the project area vary from no significant production on cleared land and other sites devoid of mesquite and salt cedar to more than 60 birds per acre on the better stands of mesquite. Dove production, however, does not present a complete picture of dove use since additional thousands of birds from adjoining desert areas visit the area daily for food and water. In addition, migrating doves from northern ranges contribute to fall and winter populations.

Although the lower Colorado River floodplain is noted for the excellence of its dove hunting, its tangles of brush interspersed with open areas in proximity to croplands also provide good habitat and excellent hunting for quails and rabbits.

The combination of the Colorado River mainstem, small islands, sandbars, backwaters, oxbows, and marsh areas provides valuable waterfowl wintering habitat. Many ducks and geese, including the Great Basin Canada goose, and coots, winter in the project area while additional thousands pause to rest and feed during fall and spring migrations. It is expected that expanded agriculture on Indian lands in the Parker Valley will lead to increased use of the area by geese. During the fall and winter, approximately 300,000 waterfowl use-days can be expected in the project area.

With each passing year, waterfowl habitat on the lower Colorado River assumes an increasingly important role in the national waterfowl management program. Habitat shrinkage in other parts of the Pacific Flyway has thrown an ever greater burden on the lower Colorado River for wintering waterfowl populations originating in other parts of the country. Relatedly, the Cibola National Wildlife Refuge was established by Secretarial order signed by Assistant Secretary of the Interior John A. Carver on August 21, 1964. The refuge, which is located in the Cibola Valley about 30 miles downstream from the project area, was established primarily to mitigate waterfowl habitat losses resulting from channelization of the lower Colorado River. When this refuge is fully developed, an estimated 8,800,000 waterfowl use-days will occur annually.

Fur animals, including skunks, raccoons, muskrats, and beavers, are common in the project area. Beaver trails in particular are common along the banks of the Colorado River.

In addition to game animals, the project area provides habitat for a large number of resident and migratory nongame species. An estimated 400 sandhill cranes, the only known population of this species on the lower Colorado River, winter in the project area. Egrets, cormorants, herons, shorebirds, and songbirds winter or nest in the project area. Small nongame mammals also are abundant. The knowledge of the presence of all these forms of wildlife and the sighting of these birds and mammals and their signs add materially to the enjoyment of the people

visiting the river. No present or future estimates of such wildlife-oriented recreation use have been developed, but interest in wildlife and nature study continues to grow.

The importance of the project area for wildlife is evident from the present hunting levels sustained by resident and migratory game populations. The opening of the dove season in September, for example, results in an opening day influx of thousands of hunters from metropolitan centers in southern California and Arizona. Throughout the remainder of the dove season, hunter interest remains high, with weekend surges of hunters. The banks of the river are favored shooting sites for hunters who take advantage of daily movements of doves from roosting to feeding and watering areas. Estimates by the California Department of Fish and Game place average present levels of dove hunting on 10,500 acres on the California side of the Colorado River in the Parker Valley at 39,000 man-days. On the Arizona side of the river, about 22,000 man-days of dove hunting occur on 11,500 acres of habitat. Similar hunting patterns, although with fewer hunters, attain during other upland-game seasons and during the big-game and waterfowl seasons. Doves receive the bulk of hunting effort. On the basis of increasing demand, if left in its present generally semi-wild state, the Parker Valley would receive substantially higher amounts of hunting annually than it receives today.

Generalized long-range plans for development of Reservation lands fronting the Colorado River recently were made available to the Bureau of Sport Fisheries and Wildlife by the Bureau of Indian Affairs. These plans visualize extensive use of suitable riverfront acreage for development of homesites, marinas, motels, resorts, parks and golf courses, and other recreation-oriented urban developments. Most development will be done under leases to non-Indians. Leases in excess of 8,000 acres have been executed and preliminary detailed plans have been completed which, when activated, will convert about 6,400 acres of wildlife habitat along about 11 miles of river south of Headgate Rock Dam, including Deer Island, into a community resembling suburban development. A 1975 population ranging from 2,400 to 5,700 people is envisioned by the lessee, with an expected population of about 34,000 people when the area is developed fully.

Detailed plans and schedules for development of remaining Reservation waterfront lands are not complete. On the basis of trends in demand for scarce riverfront acreage in the Parker Division, it is believed that urbanization and general recreational developments will have a pronounced adverse impact on wildlife and hunting long before the 100-year period of analysis.

Wildlife production gradually will decline, partly as a result of the conversion of habitat to other uses and partly as a result of human disturbance. The presence of homes and other habitations and crowded parks and beaches also will preclude hunting. The value of the Parker Division project area as a wintering and resting area for migrating ducks and geese similarly will deteriorate, principally as a result of human disturbance. It is believed that annual waterfowl use-days will average about 300,000 without the project.

According to available planning data, the proposed recreation-oriented urban developments in the project area will occur over a period of years. The detrimental effects of urbanization on resident and migratory wildlife populations and on hunting will not be noticed immediately. The present annual trend of increasing man-days of hunting in the project area will continue, probably for the next 5 or 10 years, to be followed in all likelihood by a rapid decline in years thereafter.

Without the project, it is estimated that hunting in the Parker Division project area of influence would amount to 12,000 man-days annually. This annual average would be derived almost entirely from high annual totals during the early years. Big game would provide 200 man-days of hunting annually; upland-game hunting, 11,300 man-days annually with doves sustaining the bulk of hunting effort; and waterfowl, 500 man-days annually.

With continued low pelt prices, trapping in the project area would be of minor significance. It is estimated that approximately 300 beavers could be pelted annually, principally in the lower portion of the project area on non-Indian land.

Along with extensive hunting losses associated with urbanization and intensive recreational development, there will be a significant loss of nongame bird populations. Sandhill cranes, egrets, herons, shorebirds, and cormorant will be reduced in numbers in the project area. Some nongame mammals will be affected similarly. It is recognized that wildlife-oriented recreation and nature study associated with nongame as well as game species continues to grow. However, no present or future estimates of wildlife-oriented recreational use have been developed because the extent to which nongame species will persist with urbanization and intensive recreational development along the river is extremely difficult to determine at this time.

With the Project

It was pointed out above that, as a result of conversion of riverfront lands to recreation-oriented urban development, wildlife populations and related hunting would decline. Loss of wildlife and hunting would result from long-range land-use changes and present levels of hunting would continue only during initial years of planning and development. The overall effect of project construction will be to shorten the grace period and hasten the day when hunting in the Parker Division becomes greatly reduced. Thus, the following paragraphs describe anticipated project effects on wildlife largely during the initial years after project construction, the period prior to extensive recreational development and associated urbanization.

Analysis of the effects of project construction on wildlife habitat indicates that the following general changes will occur in the project area of influence: Total acreage of big-game and upland-game habitat will be reduced in quantity and quality; brush, trees, and herbaceous cover will be destroyed directly through dredge spoil deposition; additional habitat will be lowered in quality as a result of vegetation changes stemming from eventual loss of open water areas and some possible lowering of ground water levels.

Some big-game and upland-game habitat losses will occur gradually over a period of years as construction progresses through the Parker Division. Consequently, production of resident big-game and upland-game animals will be reduced and the attractiveness of the project area for migrating doves also will decline.

Channel rehabilitation and new channel construction will isolate and eventually eliminate many existing backwaters, marshy sloughs, and small islands and sandbars that comprise important components of waterfowl habitat in the project area. The loss of backwater and marsh areas will be hastened as a result of dredge spoil deposition and possibly by general lowering of water tables. It is expected that average annual waterfowl use during the period of analysis with the project will total about 100,000 waterfowl use-days, an annual loss of 200,000 use-days over without-the-project conditions. However, most of the ducks and geese displaced from the river in the Parker Division will find haven on the nearby Cibola National Wildlife Refuge.

In the analysis of project construction on fish habitat, it was noted that project construction in Section I will create a series of backwater areas which temporarily will be excellent fish habitat. The

same backwater areas will be excellent waterfowl habitat for a few years. The decline in habitat quality and the ultimate extinction of habitat through the anticipated maintenance of open water areas for recreational use will affect the needs of waterfowl. Waterfowl use of the backwaters will be heavy initially but will decline rapidly with increased human activity.

The major portion of anticipated hunting losses attributable to the project will accrue during the early years of the project with average losses over the 100-year period of analysis as noted below. Big-game hunting with the project will be insignificant. Upland-game hunting is estimated at 3,800 man-days and waterfowl hunting at 200 man-days annually. Big-game, upland-game, and waterfowl hunting losses during the period of analysis, therefore, will be 200, 7,500, and 300 man-days annually, respectively.

Channel dredging and bank stabilization in the lower river reaches will eliminate the most productive beaver habitat in the project area. About 100 beaver pelts will be taken annually. This represents a loss of 200 beaver pelts annually.

It is recognized that demands for wildlife-oriented recreation and nature study will continue to grow. However, no present or future estimates of such wildlife-oriented recreational use have been developed due to the fact that the extent to which nongame species will persist with intensive recreational development and urbanization along the river cannot be determined at this time.

In summation, general recreational development on the project area eventually will eliminate much of the hunting and wildlife-oriented recreation. In addition, the project itself will have adverse effects on hunting, primarily during the early years after construction.

A comparison of the estimated man-days of all types of hunting without the project and with the project is shown in Table 1. Not shown in the table is the net change in beaver pelts taken annually from 300 without the project to 100 with the project, a loss of 200 pelts per year.

Table 1. Summary of Average Annual Man-days of Hunting

Kind of Hunting	Without Project	With Project	Gain or Loss
Big game	200	0	-200
Upland game	11,300	3,800	-7,500
Waterfowl	500	200	-300

DISCUSSION

Proposed channel construction and rehabilitation within the Parker Division of the Colorado River Front Work and Levee System will result in extensive losses of fish habitat and fishing and lesser losses of wildlife habitat and hunting.

The fishery losses largely could be mitigated through project modifications without increasing water surface and without impoundment of flows. Further, if water rights could be made available for impoundment of flows to increase the water areas, fishing could be enhanced. Means of achieving these ends are discussed in the following paragraphs.

Riprapping certain bank lines during project construction, if properly planned, could mitigate some of the losses to fish habitat and fishing. Specifically, placement of large boulders and irregularly shaped rocks generally 18 inches or more in diameter, over at least 50 percent of the riprapped banks below normal water elevations during the period of May 15 to June 15, would be desirable. Project placement of large rocks below the normal water line of these months would provide interstices suitable for use as cover by largemouth bass and channel catfish and provide escape cover and habitat for small fishes. Rocks and rubble in flowing water would also serve as primary anchorage sites for many aquatic insects as well as microscopic food organisms. Some of these riprapped areas would become preferred fishing sites. Mitigation of about 8,000 man-days of fishing could be realized if this work can be accomplished.

Fish habitat in the river channel also could be improved through proper placement of boulders and gravel to form small riffle areas along selected reaches of bank. In addition, some fishing could be maintained through preservation of existing shoreline irregularities where feasible. Estimates of man-days of fishing which could be realized therefrom can be provided when definite plans on this work are available. The potentialities for providing fish habitat and opportunities for fishing are substantial and every effort should be made to accommodate such measures during project construction.

Many small cutoff water areas will remain after project construction. If a total of at least 100 acre of such cutoffs could be perpetuated as fish spawning and feeding sites over the life of the project through periodic dredging or other means of preserving the water areas, additional mitigation of losses amounting to about 17,000 man-days of fishing annually could be realized. Culverts of adequate size would need

to be installed in the dikes and banks to provide ingress and egress of flows of river water and to permit movement of fishes to and from the river. Selection of cutoffs which would best be suited for this purpose could be made when project construction is underway or completed.

The proposed channelization work will bypass at least five major channel reaches including an existing backwater area, all lying within the Colorado River Indian Reservation. According to project plans, the bypassed channel reaches will be used in part for wasting spoil from dredging operations. Those portions of channel bypasses not destroyed directly by spoil deposition soon will become weed-choked and possibly stagnant and will be limited in the habitat which they will provide for fish and wildlife unless measures are taken to maintain them. Without adequate maintenance of the water areas, loss of fish habitat eventually will occur.

With curtailment of spoil deposition and with extensive supplementary dredging and intensive fisheries management, the five major bypassed channel reaches could become productive and attractive fishing lakes capable of replacing a significant part of project-caused fish habitat loss. The bypass lake development also could mitigate a minor part of the upland-game and waterfowl habitat losses. Tentative locations of the five proposed bypass lake sites are indicated on Plate 1 as Sites A through E. It is estimated that at mean flow of the river, about 8,000 second-feet, a total of at least 500 acres of water surface will remain in these lakes after project construction. Details of desired lake form and shape and location of areas to be dredged to establish fish habitat would need to be developed during project construction.

Freshening the waters of these lakes should be accomplished by installing an inlet conduit capable of passing minimum instantaneous inflows of 10 second-feet through the dike at the upstream end of each of the bypass lakes at Sites A, B, D, and E. Each lake also should be connected to the river at its lower end by means of an ungated conduit through a dike. In order to minimize the possible effects of periodic pollution from agricultural drainage at Site C, the inlet and outlet for this bypass lake should be designed to pass minimum instantaneous flows of 20 second-feet. The inlet and outlet conduits on each lake also should be designed to prevent undue movement of larger fishes to and from the river channel. A vertical bar trash rack of 1-inch spacing would suffice for this purpose.

From discussions with Bureau of Reclamation personnel, it is understood that the above-described bypass lake developments at Sites A, B, C, D, and E, and the preservation of 100 acres of small cutoff lakes, would result in neither increased water surface areas nor impoundment of flows.

At least one access point, equipped with a boat-launching ramp or other suitable boat-launching facility and adjacent parking and sanitary facilities and served by an all-weather road, should be provided at each of the lakes.

Development of these lakes would require initial dredging as well as periodic maintenance dredging. Detailed plans for optimum development can be worked out by the Bureau of Reclamation in cooperation with the Bureau of Indian Affairs, the Colorado River Indian Tribes, and the Bureau of Sport Fisheries and Wildlife during project construction. Costs will be contingent largely upon the extent of dredging. At this time, however, preliminary estimates of costs are as follows: $1,452,000 for dredging excavation to a depth of 5 feet; $400,000 for installation of ten inlet and outlet structures; $500,000 for construction of five access roads and related boat-launching sites; and about $220,000 for increased interest cost due to these expenditures.

Construction of the five bypass lakes could create good quality fish habitat totaling about 500 surface acres, and intensive fisheries management by the Federal Government would insure high fishing success and thereby attract large numbers of anglers. The five bypass lakes managed for fishing, with controlled use for general recreation, could mitigate a total of 135,000 man-days of fishing per year.

Unrestricted speedboating and waterskiing on the narrow bypass lakes would cause habitat deterioration through increased turbidity and erosive effects of increased wave action. Furthermore, these activities would pose a threat to the safety of fishermen, and frighten both upland game and waterfowl. The mitigated fishing and hunting attributable to the development of five bypass lakes would be possible only if speedboating and waterskiing were strictly controlled on the lakes.

Heavy recreational use of the lakes, if not controlled adequately, would damage habitat, interfere with management, and discourage fishermen and hunters. It would thus prevent mitigation of fish and wildlife losses.

The Bureau of Indian Affairs has advised the Bureau of Sport Fisheries and Wildlife that it favors the creation of lakes in the bypass channels on Indian lands, but that the lakes eventually might be used for lakeside developments such as homesites and trailer courts with attendant high levels of recreational use other than hunting and fishing. The lakes as planned herein, however, would provide a reasonable degree of compatibility between fishing and an expanded general recreation program on the Reservation and would contribute to stability of the Tribal economy. Lake use, of course, would need to be confined to small boats with

primary emphasis on fishing. Speedboating and waterskiers would be served by the river itself and could be provided with docking and marina facilities at various dredged inlets and bays, while fishermen and others who prefer more contemplative outdoor activities would be serviced by the bypass lakes. The potential fishing use assigned herein is premised on adoption of this type of coordinated planning for development and management.

Fishing could be enhanced by increasing the surface acreage of the five bypass lakes. Increased water area with control of lake levels and flows, would provide even greater returns in man-days of fishing. Under these conditions, in conjunction with cooperatively managed general recreation use, the bypass lakes could be increased in size to cover about 1,100 acres. Although benefits to justify this increase in lake area could be realized, water rights would have to be provided for this purpose. Since the bypass lake sites will be located on the Colorado River Indian Reservation, a decision on whether to use a portion of the Tribal allotment of water for increasing the water surface of one or more of the lakes would have to be made by the Tribal Council and the Bureau of Indian Affairs. Benefits can be ascertained when detailed plans have been made.

Preservation of vegetation on the bypass lake perimeters could provide some nesting areas for doves and quail and thus contribute to the maintenance of upland-game habitat. The lakes and their peripheries would attract doves and would be responsible for mitigating an estimated 500 man-days of dove hunting in the general vicinity. Although an inadequate substitute for existing waterfowl habitat, the bypass lakes would be more attractive to waterfowl than the dredged channel. The bypass lakes could mitigate waterfowl losses by 5,000 waterfowl use-days annually and 100 man-days of waterfowl hunting.

Additional mitigation of wildlife losses and even enhancement might be realized through development and operation of the Quien Sabe Point Area located in the southwest portion of the project area. Site F on Plate I identifies the approximate location of the Quien Sabe Point Area in California.

The wildlife potential of the Quien Sabe Point Area was recognized in the lower Colorado River Land Use Plan released by the U. S. Department of the Interior in January 1964. The Land Use Plan recommended that the Quien Sabe Point Area be made available to the California Department of Fish and Game for eventual development by that agency into a wildlife management and public hunting area. The area included two

sites proposed for recreational development by Riverside County, California. This report concurs with the Land Use Plan recommendation as to that portion of the proposed Quien Sabe Point Area which is determined to be non-Indian lands. It should be recognized, however, that the wildlife habitat and hunting potential of the Quien Sabe Point Area will be contingent largely upon the size of the area, the water supply which the California Department of Fish and Game can provide, and the impact which development of the two recreational sites will have on wildlife. Estimates of possible mitigation and enhancement can be made only after the above problems are clarified and detailed plans for the area are available. Consequently, no estimates of costs to develop the area have been made to date. If and when the status of land ownership and the problem of available water are clarified, a plan of development and the related cost estimates can be made. The lands can then be made available to the California Department of Fish and Game under the provisions of a General Plan as provided in Section 3 of the Fish and Wildlife Coordination Act.

RECOMMENDATIONS

In view of the foregoing, it is recommended that:

1. Boulders and irregularly shaped rocks 18 inches or more in diameter be used in riprapping at least 50 percent of the bank area below normal river elevations for the May 15 to June 15 period.

2. The Bureau of Reclamation in cooperation with the Bureau of Indian Affairs, the California Department of Fish and Game, the Arizona Game and Fish Department, and the Bureau of Sport Fisheries and Wildlife plan for maintenance and restoration of fish habitat in the Colorado River through placement of large rocks, rubble, or gravel at selected sites along the river banks and through preservation of shoreline irregularites where feasible.

3. During and after project construction, the Bureau of Reclamation cooperate with the Bureau of Indian Affairs, the California Department of Fish and Game, the Arizona Game and Fish Department, and the Bureau of Sport Fisheries and Wildlife to preserve at least 100 acres of selected small cutoffs as fish-producing

areas through curtailment of spoil deposition, dredging as required, and installation of culverts to connect the cutoffs with the river.

4. At least 500 acres of major backwater lakes which will exist after project construction be developed for purposes of fish and wildlife management, as outlined in preceding pages of this report.

5. The Bureau of Reclamation consult with the Bureau of Indian Affairs and the Colorado River Indian Tribes to determine their interest and desire in having the Bureau of Reclamation increase the surface acreage of the bypass lakes shown on Plate I as Sites A, B, C, D, and E, for the enhancement of fishing and hunting.

6. The proposed Quien Sabe Point Wildlife Management Area outside of the Colorado River Indian Reservation, approximately as shown as Site F on Plate I, be made available to the California Department of Fish and Game under the provisions of a General Plan as provided in Section 3 of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), for additional possible mitigation of wildlife losses and enhancement of wildlife.

CONCLUSIONS

Completion of the channelization plan in the Parker Division of the Colorado River Front Work and Levee System is expected to result in extensive fish and wildlife losses totaling about 165,000 man-days of fishing per year and 8,000 man-days of hunting annually, including 200 man-days of big-game hunting, 7,500 man-days of upland-game hunting, and 300 man-days of waterfowl hunting. Waterfowl day-use will be reduced from 300,000 to 100,000 annually and there will be a loss of 200 beaver pelts per year. Losses will occur also in populations of nongame birds.

Adoption of Recommendation No. 1 would help replace fish habitat, thereby mitigating about 8,000 man-days of fishing annually. Adoption of Recommendation No. 2 could lead to additional mitigation of fish habitat and fishing, the extent of which can be determined when definite plans for this work are made. If Recommendation No. 3 is followed, mitigation of additional losses amounting to about 17,000 man-days of fishing annually could be realized.

Effectuation of Recommendation No. 4 would provide backwater lakes totaling at least 500 acres in bypassed river channels, which could provide 135,000 man-days of fishing. Thus, development of the fishing lakes and adoption of Recommendation Nos. 1 and 3 could mitigate a total of 160,000 man-days of project-caused fishery losses. Approximately 500 man-days of upland-game hunting and 100 man-days of waterfowl hunting annually also could be mitigated and about 5,000 waterfowl use-days would be realized.

With an increase of water surface and the provision of necessary water from Indian allotments, as indicated in Recommendation No. 5, the bypass lakes could be managed to provide fishing benefits which would exceed the costs.

Mitigation of wildlife losses and even enhancement could be accomplished through establishment and operation of a State wildlife management area, provided that adequate water supplies are available within the State of California. Recommendation No. 6 is presented as the first step toward establishment of the area. Estimates of the value of the area to wildlife and the costs of developing the area can be provided when information on land area, water supply, and associated developments for wildlife as well as details of recreational development are known.

The findings and recommendations reported herein were based on project data available as of September 1965. It is recognized that project plans are still subject to change. Any changes should be brought to the attention of the Bureau of Sport Fisheries and Wildlife and to the California Department of Fish and Game and the Arizona Game and Fish Department. The cooperation and assistance of your staff in the preparation of this report is appreciated.

William T. Krummes

William T. Krummes

HEADGATE ROCK DAM

T. 10 N.
T. 9 N.
R. 19 W.
R. 20 W.
31
6
36
1

Parker

COLORADO INDIAN RESERVATION

ARIZONA

CALIFORNIA

BEGIN SECTION I

Mesa

Colorado River

Site A

DEER ISLAND

T. 8 N.
T. 9 N.
R. 20 W.
R. 21 W.
6
31
36

BEGIN SECTION II
END SECTION I

RESERVATION DRAIN

INDIAN RESERVATION BOUNDARY

R. 25 E.
R. 26 E.
31
36
T. 1 S.
T. 1 N.

Mesa

Site B

ALLIGATOR SLOUGH

RIVERSIDE MOUNTA

T. 2 S.
T. 1 S.

CALIFORNIA

ARIZONA

PROJECT AREA

LOCATION MAP

O RIVER RESERVATION

N

RESERVATION DRAIN

Site C

Site D

Site E

Site F

SLOUGH

RIVERSIDE MOUNTAINS

R. 24 E. / R. 23 E.

T. 6 N. / T. 7 N.

R. 21 W. / R. 22 W.

31 / 36 / 1

T. 5 N. / T. 6 N.

R. 21 W. / R. 22 W.

31 / 36 / 1

T. 5 S. / T. 4 S.

T. 4 S. / T. 3 S.

T. 3 S. / T. 2 S.

95

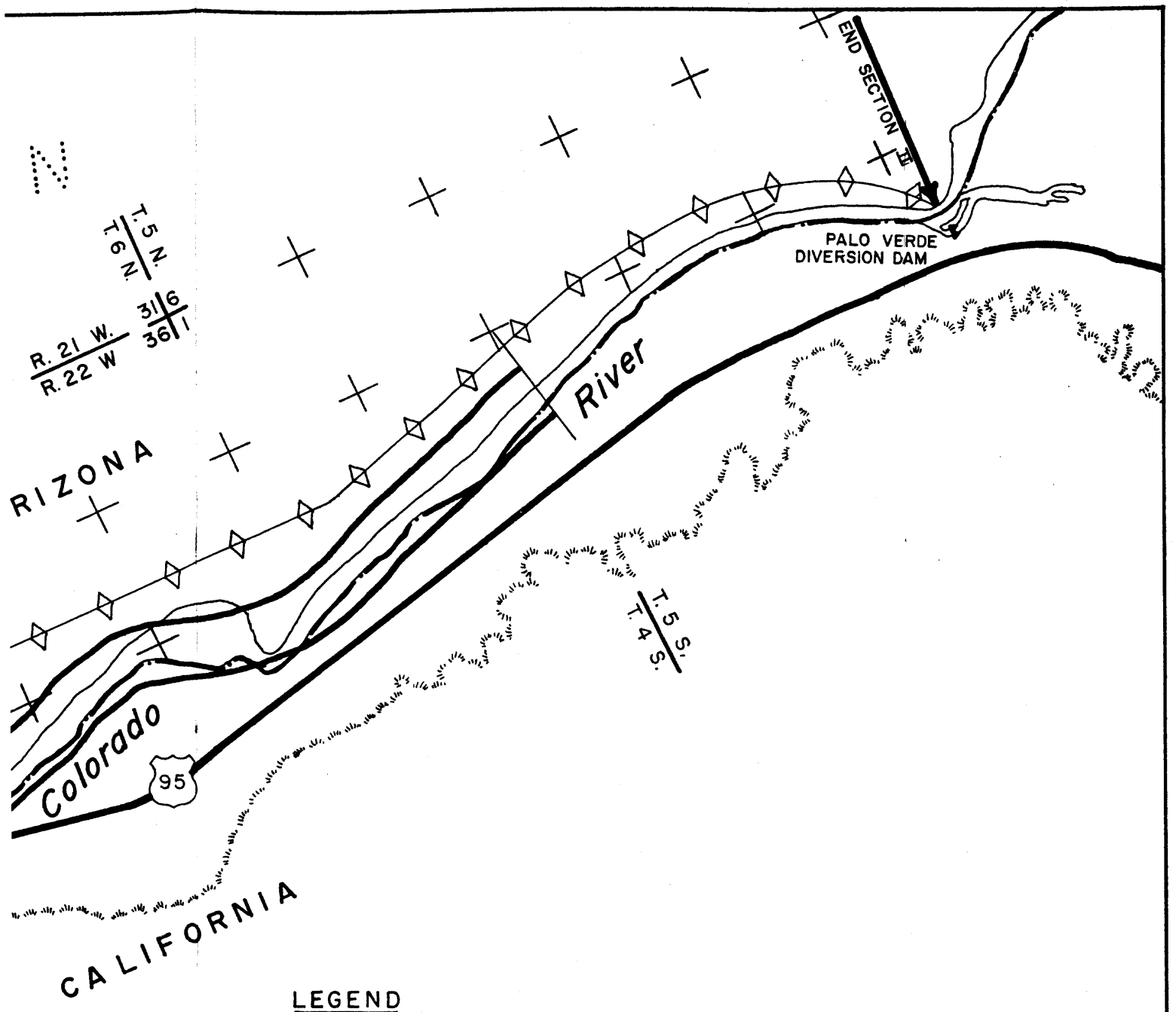
ARIZONA

CALIFORNIA

Colorado River

LEGEND

- FILL
- DRESSED BANK
- WINDROW
- PROPOSED CHANNEL RIGHT OF WAY
- LEVEE
- INLET STRUCTURE
- OUTLET STRUCTURE
- INLET AND OUTLET STRUCTURE
- PROPOSED QUIEN SABE POINT WILDLIFE MANAGEMENT AREA
- PROPOSED FISH AND WILDLIFE MANAGEMENT AREA



LEGEND

- FILL
- DRESSED BANK
- WINDROW
- PROPOSED CHANNEL RIGHT OF WAY
- LEVEE
- INLET STRUCTURE
- OUTLET STRUCTURE
- INLET AND OUTLET STRUCTURE
- PROPOSED QUIEN SABE POINT WILDLIFE MANAGEMENT AREA
- PROPOSED FISH AND WILDLIFE MANAGEMENT AREA

SCALE OF MILES

1 1/2 0 1 2

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

PARKER DIVISION
COLORADO RIVER FRONT WORK AND LEVEE SYSTEM
ARIZONA AND CALIFORNIA

CHANNELIZATION MAP SHOWING TYPICAL FISH AND WILDLIFE MANAGEMENT AREAS

ALBUQUERQUE, NEW MEXCO — REGION 2

DATE: February 1967 — PLATE I

REVISED DEC. 1968

EXHIBIT II

RECREATION ASPECTS OF SECTION II OF THE PARKER DIVISION CHANNELIZATION PLAN LOWER COLORADO RIVER - QUIEN SABE AREA, CALIFORNIA

BY

LOWER COLORADO RIVER LAND USE OFFICE
YUMA, ARIZONA - MAY, 1968

This report offers proposals and suggestions of the Lower Colorado River Land Use Office which are considered important for the implementation of the Lower Colorado River Land Use Plan. These proposals relate to the recreation resources, needs and values of the Quien Sabe area in California. Recommended here are measures needed for the retention and enhancement of the recreation resources and opportunities of the area in relation to the channelization project proposed for Section II of the Parker Division of the Bureau of Reclamation's river management program.

Consideration should also be given to the development of recreational resources on the Colorado River Indian Reservation which must be included in the total recreational potential of the Parker Division. The Bureau of Indian Affairs and the Colorado River Indian Tribe are firmly in support of developments which will enhance recreational values, and they propose to develop recreational facilities on tribal lands. The personnel of the Land Use Office would cooperate, if requested, with the Bureau of Indian Affairs and the Colorado River

Tribal Council in the preparation of recreation development plans for those tribal lands which have waterfront development potential.

The areas on the west bank of the Colorado River, designated in the Lower Colorado River Land Use Plan as the Quien Sabe Point wildlife area and the Quien Sabe county recreation area, are presently under federal administration. It is agreed that full recreational potential could be achieved whether the area is on Indian Reservation land or on federal lands for lease to state or county agencies. The specific proposals of this report will deal with the recreation development of these areas in connection with the proposed river channelization project.

Description of the Area

The proposed Quien Sabe Point wildlife area is about 7 miles long, 1 or 2 miles wide, and is located on the west bank of the Colorado River 20 miles north of Blythe, California. The terrain includes some of the highest quality wildlife habitat along the river.

The proposed Quien Sabe recreation area occupies an additional 7 miles of riverfront downstream from the proposed Quien Sabe wildlife area. The total 14 mile long area is characterized by alluvial flats of varying widths along the river, and desert terraces which rise to the west from the river bottomlands to the Big Maria Mountains, which reach elevations

of over 2,500 feet.

Plan of Development

In the Lower Colorado River Land Use Plan, Riverside County, California, anticipated the development of 13 sites in the proposed Quien Sabe area and two in the state wildlife management area. The latter sites were previously agreed upon by the County of Riverside and the California Department of Fish and Game. The proposed Quien Sabe recreation developments encompass a variety of facilities, including five primitive campgrounds, six general concession sites, four major development sites of combined public and concession-developed resort facilities, and one administrative and archaeological unit.

It is basic to the implementation of the Lower Colorado River Land Use Plan that the Quien Sabe area provide a maximum of recreation opportunities, and to accomplish adequate use of the nearly 14,000 acres of land and limited water resources required to achieve necessary social and economic benefits. The proposals made here are for the 14 mile long Quien Sabe area. The benefits to be derived from these lands are dependent entirely upon retaining and using selected existing water areas required to meet recreation needs. These needs are set forth in the Lower Colorado River Land Use Plan. Recreation requirements also include (1) access to all of the seven retained recreation back bay

water areas along the west bank of the Colorado River; (2) water access for boats between the seven selected recreation back-water areas and the dredged channel; (3) the recreation development of the seven back bays and their water-oriented land areas; and (4) provision for the recreational use of river channel maintenance roads.

Senate Document No. 97 - 87th Congress, 2nd Session, approved by the President on May 15, 1962, provided for full consideration of recreation as a purpose in project formulation and evaluation for use and development of water and related land resources. Consideration is needed in the Bureau of Reclamation's construction program if the recreational resources in this area are to provide the required opportunities for development and use. The river development program can be worked out in full cooperation with the various county, state, and federal agencies who have responsibilities to plan, develop, and administer the wildlife, recreation and water resources under the provisions of the Lower Colorado River Land Use Plan.

Implementation of the Lower Colorado River Land Use Plan in the Quien Sabe area will provide significant human benefits, both social and economic. It is expected that with proper planning and development, the recreation resources in this portion of the lower Colorado River could substantially increase the overall economic benefits to the area. The

preservation and enhancement of recreation resources are also major elements of the Land Use Plan. Cooperative plan implementation by the federal, state and county agencies will provide for greater amounts of the intangible benefits of human enjoyment as well as the fulfillment of individual needs. Full consideration of recreation requirements would provide a better balance of multiple-use objectives for the development of the recreation resources in Section II of the Parker Division.

The development of recreation potential without the river management program would present certain problems, but at the same time it would allow maximum opportunity for water-oriented recreational facility development and use. The unstable river banks, the construction of marina and swimming beach protective structures into the main river channel, shifting riverbottoms, and varying water currents could present problems in the development of many of the needed recreation facilities.

If the channelization project is constructed, its execution needs to insure against losses to existing and potential recreation opportunities, and enhance the recreation use and development potentials in order to meet the growing recreation needs. Such measures would include the retention of desirable backwater areas of adequate size and location

with water access from them to the channelized river. Otherwise, considerable losses to existing and potential uses of water-oriented recreation resources and developments could be expected.

One major problem of not retaining the selected back bay areas during channelization would be the provision of adequate water access to the river including the high cost and legal problems that would be involved in later developing the off river basins needed for boating facilities, swimming beaches and other water-oriented uses. Another problem that would be created by not retaining the selected back bay areas, involves the land development potentials. Without the back bay areas, the probable congestion of a narrow line of facilities along the channelized river bank can be expected. There would be little incentive or capacity for the indepth development of the 14,000 acre land area to meet the growing need for visitor use facilities because of the limited water-oriented facilities which could be developed in support of the greater land area.

Full consideration should be given to the recreational recommendations of the Lower Colorado River Land Use Office in the proposed river management program for Section II of the Parker Division. With this consideration, the recreational potential of the area could approach fulfillment. The retention and development of good quality back bays,

to support the present and proposed recreational facilities with sufficient water access to the dredged river channel, could provide for the development of the full spectrum of recreational potential in the Quien Sabe area. It would also provide for better recreation management control by affording safer and more stable swimming areas, areas for canoeing, fold boating and off channel boat launching and marina developments. The water skiier in the river would also be safely separated from some of the other water sport activities.

Planning for recreational development within the scope of a lower Colorado River management program should include the following: the construction and maintenance of water access for boats from some of the back bay areas to the dredged channel; the dredging of the selected by-passed back bays and inlets; provisions for supplying continuous fresh water currents through by-passed water areas; the public use of the levee roads as access roads; the placement of dredge spoil to enhance the environment; and the public use of project bridges and similar structures.

The fulfillment of the afore-mentioned proposals would permit the development of the basic sites necessary to accomplish many of the objectives in Riverside County's portion of the Lower Colorado River Land Use Plan. These proposals would encourage the development of

adequate water-oriented recreational facilities such as swimming beaches, boat launching ramps and docks, and water-oriented camping and picnicking grounds.

When the facilities recommended in this report are provided in the Quien Sabe area, they should, according to the Bureau of Outdoor Recreation estimates, accommodate approximately 205,000 visitor days of recreation use annually, resulting in a gross economic benefit to the area of $205,000 per year. The present use in the project area, estimated at 135,000 recreation days, would be duplicated by the use under proposed development. The net of needs met by the project recreation features, therefore, would average 70,000 recreation days annually.

The criteria for determining the economic benefits of recreational use are provided in Senate Document No. 97, Supplement No. 1. The supplement states that:

> "... High quality esthetic experiences for all kinds of activities provided should be valued at a higher level than low quality experiences..... Among the more important quality criteria that should be considered are: (1) the expected degree of fishing and hunting success as dependent upon the character of fish and wildlife habitat; and (2) the general attractiveness of a project, including visual aspects

of water quality and scenic characteristics of the project area."

The recommendations of the Bureau of Sport Fisheries and Wildlife to mitigate the fish and wildlife resource losses that will be caused by the river management program of the Lower Colorado River in the Parker Division, will also be beneficial to the quantity and quality of hunting and fishing recreation use in the Quien Sabe area. The development of major backwater lakes proposed by the Bureau of Sport Fisheries and Wildlife should provide excellent boat and bank fishing, retain hunting opportunities, offer opportunities for nature photography, and improve the environment for esthetic enjoyment. However, three of the five proposed fish and wildlife backwater lakes, which average about 100 acres each, are located completely on Indian Reservation lands in Section I. One is completely on Indian reservation lands in Section II of the Parker Division and only one, Lake Site D, borders the Quien Sabe area in Section II. These five lakes will not provide water access to the river or be intensely developed to meet the general recreation needs directly related to the Quien Sabe area. However, below the outlet plugs of lake sites A, B, C and E, small quiet water areas may remain which can provide for offchannel boat launching in conjunction with the uses of those lake sites and the Indian reservation lands.

For the most part, the seven small recreation backwater areas recommended in this report do not duplicate the functions of those contained in the Bureau of Sport Fisheries and Wildlife Plan and identified as Lake Sites A, B, C, D and E. Since the 500 surface acres of backwater referred to in the Bureau of Sport Fisheries and Wildlife Plan will be "...managed for fishing with controlled use for general recreation...", and since they are separated from the Quien Sabe area by as much as 14 miles in the case of Lake Site A, they do not appear to be available to support or satisfy the intense recreation development and use needs of the Quien Sabe area covered by this report. The seven recreational backwater bay areas can, however, contribute some benefits to fish, waterfowl, and other water-oriented game and bird populations.

The large cutoff backwater area between stations 635+00 and 720+ in the proposed channelization design, designated as Lake Site "D" in the Bureau of Sport Fisheries and Wildlife report, is one of the areas proposed primarily for fish and wildlife mitigation and in part for general recreation development. The construction of a dike across the present Colorado River channel just upstream from the beginning of the slough on the west side of Hall Island will separate the types of boat and recreation use in this backwater area. The Bureau of Reclamation has agreed to dredge the area just south of the Lake Site "D" dike for use as a marina. This marina area will have boat access to the main dredged

channel. The backwater area north of the dike will be used to provide for development of high fishing values and for use of low-powered boats, row boats, and canoes primarily for fishing and hunting. Swimming beaches will be located immediately north of the dike as part of the general recreation development of the lower end of Lake Site D. An access road right-of-way will be provided to the section of the Colorado River Indian Reservation land on the east side of the present channel which will be cutoff by the new channel location in this area. The location of the access road will be deferred until site development plans are sufficiently advanced to identify the most appropriate location for this road in conjunction with maximum recreational development of the Lake Site "D" marina area.

Other minor by-passed backwater areas not specifically mentioned, but having good fish and wildlife potential, should be considered for additional dredging and the installation of inlet and outlet structures at the time of channelization to provide sufficient water depth and a fresh water current through the area to reduce stagnancy. Such measures, in addition to providing mitigation for fish and wildlife resource losses in this river division, would provide considerable additions to the sportsman recreation use capacity of the area. Several recreation activities are dependent upon the quality and quantity of fish and wildlife populations available in or near the area.

Table 1 lists the approximate channelization station locations recommended for the proposed inlet structures and points of open water access through the channel embankment, which are needed to provide for the recreational use of seven back bays along the west bank of the proposed channel in the Quien Sabe area. The locations are also shown in Exhibit LUO 5-8001 at the end of this report. Exhibit LUO 5-4003 identifies a typical back bay recreation development, including an inlet structure and channel opening.

These seven backwater areas would retain a total of approximately 140 acres of existing water surface for public recreation use and development. They would afford the use of calm waters, safe from the swift channel current. In addition to the five backwater proposals of the Bureau of Sport Fisheries and Wildlife, as mitigation measures, it is suggested that seven selected recreation back bay areas be retained and developed for general recreational purposes during the channelization construction program. These seven backwater areas should be provided with open water access for boat traffic to and from the river. All the selected backwater areas should be dredged, if necessary, to provide a minimum of four feet of water depth at low river flow. The Land Use Office will need to provide plans in advance of channelization to identify treatment measures of retained areas. The dredging of the backwater areas should

be scheduled for orderly recreation use and development and efficiency in scheduling channel stabilization work. Hence the timing of dredging of backwater areas should be mutually and cooperatively determined by the Bureau of Reclamation and the Lower Colorado River Land Use Office to insure the realization of both river control and recreation objectives.

Dredge spoil could be used to develop or improve recreation developments and related features, including access road fill, swimming beaches, water skiing takeoff points, and picnic and campground sites.

Provisions also need to be made for continuous fresh water flows through the bay areas by installing upstream inlet structures through the channel dike.

With the provision for off-channel recreational facilities in Section II of the Parker Division river management program, there would be no need for the construction of any docking or related facilties to project into the dredged river channel.

It is also proposed that access be provided at necessary locations to connect Highway 95 with the construction and maintenance roads.

Economic Benefits

With the provision of the recommended recreation features of the

channelization project, the water-oriented recreation potential of the Quien Sabe area could be developed to accommodate an estimated 205,000 visitor use days per year. This would provide a net annual economic benefit of $205,000. It would also assure the opportunity for extensive backland recreation use and development on lands which are not water-oriented but psychologically dependent upon the availability of water use areas and features. These backland recreation uses and values have not been estimated.

With the provision of the recommended recreation features, there could be a yearly increase of $70,000 in net recreation economic benefits over the present level.

Conclusions

1. There is need for the retention of recreation back bay areas; the provision of water access from those bays to the controlled channel; the dredging and shaping of back bays and boat access inlets; the installation of inlet structures to supply continuous fresh water circulation through the backwater areas; the development for public use of project bridges, levee roads, channel maintenance roads and access roads; and the planned placement of dredged spoil to enhance the recreation environment.

2. The development of the full recreation potential of the Quien Sabe area (California shoreline) could begin as soon as the land status problems are resolved. At present there are unstable river banks in certain areas. These could present some difficulties. Existing river access and shoreline use could be materially increased through a program for landscape treatment including the shaping and planting of existing river banks. However, river channelization and the retention of adequate existing river areas as quiet water recreation bays can provide stable conditions for concentrated water oriented recreation development and use. When the following recommendations are incorporated into the river management program for Section II of the Parker Division, full recreational development potential can be more reliably assured.

3. Major expansion and development of existing and proposed recreation facilities during channelization, would be somewhat restricted until the Bureau of Reclamation river channelization program is well underway or nearly completed, approximately five years after the start of construction of the

dredged channel in Section II of the Parker Division.

4. The recreational development proposed in this report is general in nature, but the actual details of development will be provided prior to construction and will be based on additional cooperative studies and final location surveys by the Lower Colorado River Land Use Office, the Bureau of Sport Fisheries and Wildlife, the Bureau of Indian Affairs, and the Bureau of Reclamation.

Recommendations

It is recommended that:

1. The Lower Colorado River Land Use Office, in consultation with the Bureau of Reclamation and where appropriate, with the Indian interests, prepare design plans for recreation bay areas to be dredged, stabilized and maintained.

2. The placement of dredge spoil from the channel be planned in coordination with the Lower Colorado River Land Use Office to meet both recreational and channelization needs.

3. Bureau of Reclamation work with the Land Use Office and the Bureau of Indian Affairs in the preparation of a plan for a recreation road system for the Quien Sabe area. Some of

the roads could be built at the time of, and as part of, the dredging and bank revetment operations to be compatible with the future recreational development of the area.

4. The Land Use Office be given a 90-day notice prior to the commencement of channelization work to prepare recreation development plans which will include locations for placement of dredge spoil and the treatment of dredge spoil deposit piles.

6. The seven back bay areas designated for recreational use be dredged to a minimum depth of four feet below the low water level of the proposed river channel.

6. Boat access openings to the seven recreational back bay areas in the west bank of the channelized river be constructed to provide a minimum width of 40 feet at low water to assure safe flow of boat traffic between back bays and the dredged channel.

7. The dredging of each back bay be completed according to a schedule agreeable to both the Lower Colorado River Land Use Office and the Bureau of Reclamation to accommodate the known public recreation needs in the Quien Sabe area.

8. The recreation provisions be included as an integral segment of the project.

9. Inlet structures of sufficient capacity be installed to provide adequate water circulation through the seven backwater areas to reduce high temperatures and stagnancy.

10. The proposed large cutoff backwater area between stations 635/00 and 720/00 be developed primarily as a fish and wildlife mitigation area and in part as a general recreation development area as described in the text of this report.

11. The Bureau of Indian Affairs and the Colorado River Tribal Council utilize the Lower Colorado River Land Use Office in the cooperative preparation of recreation development plans for those areas of Indian lands which have waterfront development potential.

Table 1. Recommended Locations Within Which Retention of 140 Acres of Recreation Water Areas Is Needed

1. Between Station 373+00 with an Inlet Structure and Station 425+00 with an Open Water Access or at Alternate Locations Possible Near Stations 550+00 or 775+00
2. Between Station 497+00 with an Inlet Structure and Station 520+00 with an Open Water Access
3. Opposite Station 700+00 at Lake Site "D" Dike outfall to Station 720+00 with an Open Water Access
4. Between Station 816+00 with an Inlet Structure and Station 842+00 with an Open Water Access
5. Between Station 890+00 with an Inlet Structure and Station 920+00 with an Open Water Access
6. Between Station 975+00 with an Inlet Structure and Station 1005+00 with an Open Water Access
7. Between Station 1075+00 with an Inlet Structure and Station 1100+00 with an Open Water Access

NOTE: Although the average size of these retained water areas is 20 acres, their actual sizes will vary considerably depending upon location, site conditions and needs.

Table 2. Estimated Quantities and Costs of Project Associated Recreation Features

	Quantity	Unit	Avg. Cost	Cost
Excavation of seven recreation backwater areas	1,080,000	cu. yd.	0.30	$324,000
Inlet structures	7	ea.	2,000	14,000
Dressed banks	22,000	lin. ft.	1.50	33,000
Boat Ramps	5	ea.	10,000	50,000
Subtotal				$421,000
Contingencies ± 20%				84,200
Subtotal construction costs				$505,200
Design and engineering costs				50,000
TOTAL COST				$555,200

Operation and maintenance cost of features included here are to be provided by the Bureau of Reclamation for those features constructed by the Bureau of Reclamation.

Table 3. Economic Benefits Attributed to Visitor Use in the Project Area

	Annual Visitor Use Days	Annual Economic Benefits
Present unchannelized river	135,000	$ 135,000
Channelized river with recreation recommendations	205,000	205,000
Direct project recreation benefits	70,000	$ 70,000

NOTE: These figures are for the water-oriented recreational developments and do not include desert-oriented facilities.

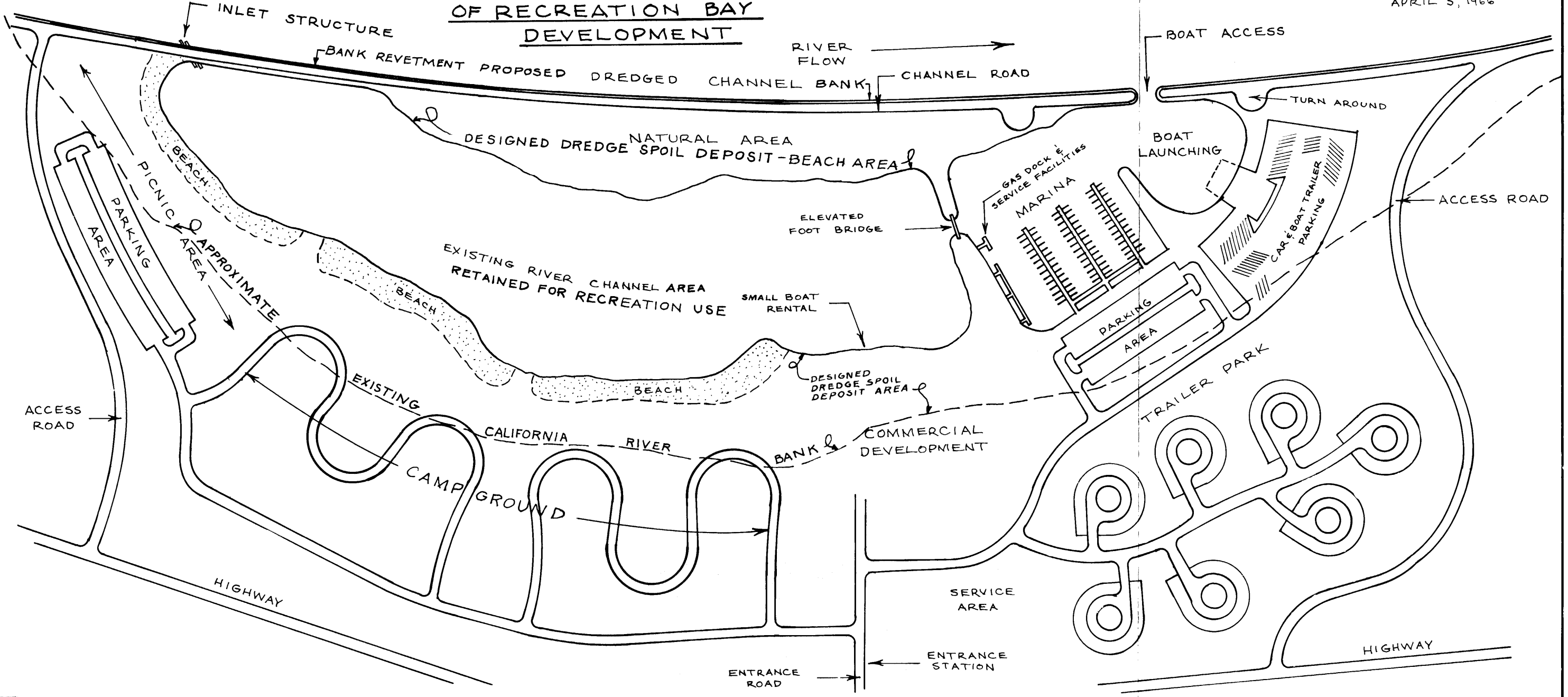
PARKER DIVISION – SECTION II

TYPICAL SCHEMATIC OF RECREATION BAY DEVELOPMENT

SCALE 1"=200'

L.U.O. 5-4003

APRIL 5, 1966



COLORADO RIVER INDIAN RESERVATION

13 | 24
14 | 23

24 | 25
23 | 26

25 | 36
26 | 35

350+00

400+00

425+00

450+00

500+00

550+00

600+00

650+00

700+00

LEVEE

DRAIN

FLOW

DIKE

COLORADO RIVER

ACCRETION TO PRIVATE LANDS

U.S. HWY. 95

WATER WHEEL

36 | 1
35 | 2

35 | 2
34 | 3

2 | 11
3 | 10

11 | 14
10 | 15

T.2S. S.B.M.

T.3S.

KEY:

RECOMMENDED STRUCTURES

CHANNEL ACCESS

INLET STRUCTURES

PROPOSED CHANNEL

T. 6 N. G&S.R.M.
T. 5 N.

13 | 24	
14 | 23	
24 | 25	
23 | 26	
25 | 36	
26 | 35	
36 | 1	
35 | 2	
23 | 26	
22 | 27	
25 | 36	
26 | 35	
2 | 11	
3 | 10	
11 | 14	
10 | 15	
14 | 23	
15 | 22	

700+00
750+00
800+00
850+00
900+00
950+00
1000+00
1050+00

RIVER
ACCRETION TO PRIVATE LANDS
HALL ISLAND
HORSE ISLAND
LEVEE
DRAIN
RIVER BEND LODGE
TWIN PALMS
PARADISE POINT & HACKER'S CAMP
LUCKY "R" RESORT
OLD LEVEE
U.S. HWY. 95

RECOMMENDED STRUCTURES

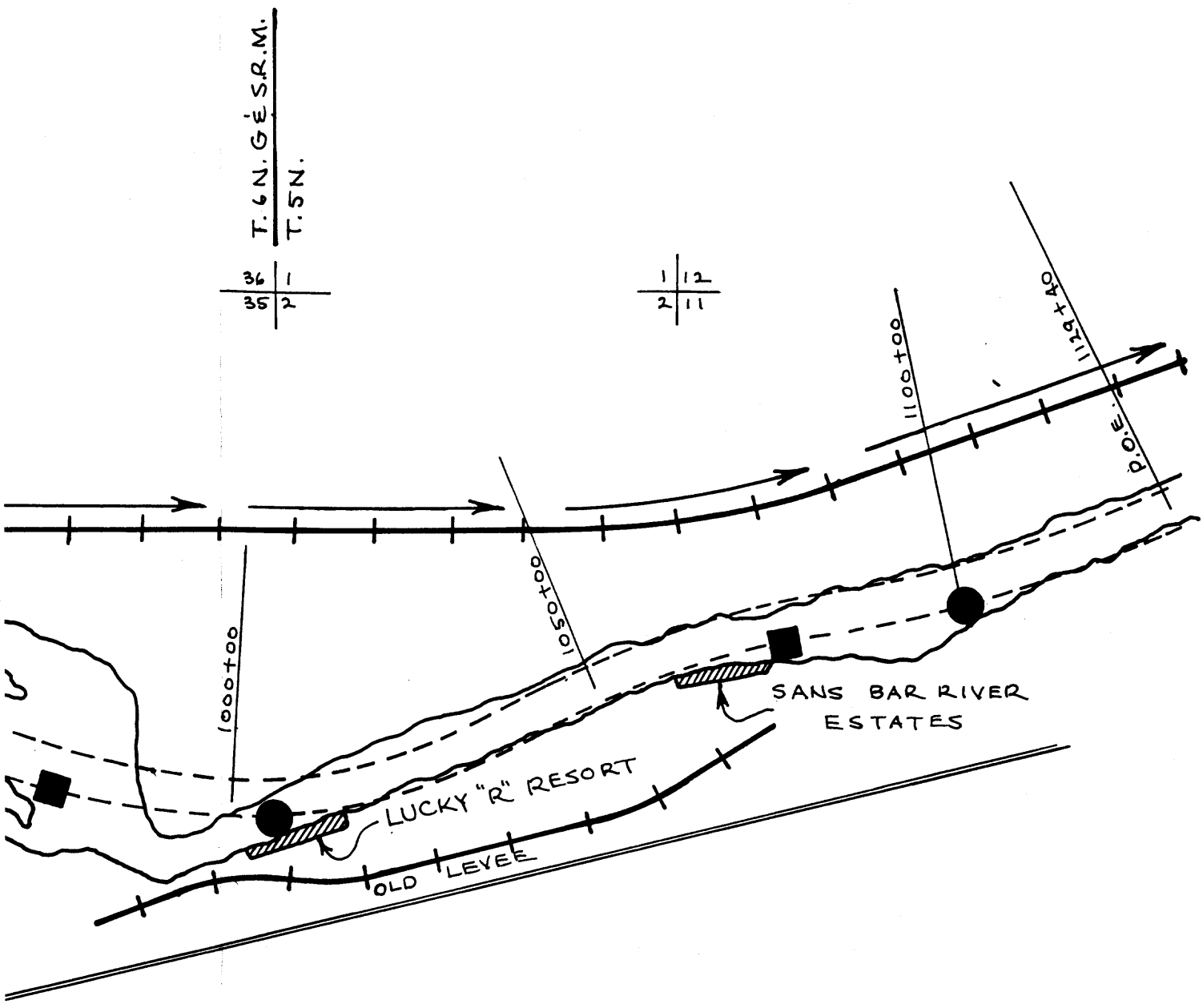
N

SCALE 1" = 2000'

UNITED STAT
LOWER COLOR
RECOMMEN
CH
PARKER DIVISIO

REFERENCE:
BASE MAPS 423-300-46

YUMA, ARIZONA,



UNITED STATES DEPARTMENT OF INTERIOR
LOWER COLORADO RIVER LAND USE OFFICE

RECOMMENDED STRUCTURES AND CHANNEL ACCESS

PARKER DIVISION CHANNELIZATION PROGRAM

REFERENCE: BASE MAPS 423-300-464, 423-300-465	DRAWN BY GAP
YUMA, ARIZONA, MARCH 30, 1966	LUO-5-8001

EXHIBIT III

ARIZONA GAME & FISH DEPARTMENT
120 Arizona State Building 1688 W. Adams Phoenix, Arizona 85007 271-4295
WENDELL G. SWANK Director PHIL M. COSPER Assistant Director

August 1, 1966

Mr. A. B. West, Regional Director
Region 3
Bureau of Reclamation
U. S. Department of the Interior
Boulder City, Nevada

Dear Mr. West:

In accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U. S. C. 661 et seg.) and as Director of the Arizona Game and Fish Department exercising the administration of the wildlife resources of the State of Arizona, we are submitting comments and recommendations on "Draft Report, Comprehensive River Management Plan Lower Colorado River, Parker Division," a segment of the Lower Colorado River Front Work and Levee System. In addition to our comments and recommendations contained herein, we are enclosing a copy of your Parker Division report which contains our suggested changes and additions. These changes occur on pages 16, 18, 19, and 30, of the Bureau of Sport Fisheries and Wildlife Draft Report dated April 20, 1966. Our suggestions for specific changes in the Bureau of Sport Fisheries and Wildlife Draft Report were presented in the attached letter to the Regional Director, U. S. Bureau of Sport Fisheries and Wildlife, Albuquerque, New Mexico dated August 1, 1966.

The description of fish, wildlife, fish and wildlife habitat and fish and wildlife losses were amply covered in the U. S. Bureau of Sport Fisheries and Wildlife Draft Report. We accept these evaluations and will not repeat them, although we are including estimates of additional losses not described in their report.

Our comments and recommendations on the coordinated Bureau of Reclamation Draft Report are as follows:

1. Habitat destruction, attendant upon completion of proposed channel construction and rehabilitation within the Parker Division, will result in extensive and largely irreplaceable losses of fish and wildlife and related hunting and fishing. These losses will occur in a region where demand for hunting and fishing interest has grown greatly and will continue to grow. The loss of hunting and fishing in the Parker Division project area will be missed keenly not only from the standpoint of recreation for hundreds of thousands of hunters from Arizona, California and other states, but also from the economic standpoint of the Colorado River Indian Tribe, and other communities in the area. For these reasons every effort must be made to retain as much original habitat as possible and to replace habitat destroyed by channelization.

2. Construction of new banks and jetties in the section of the river between Headgate Rock Dam to Alligator Bend as part of the channelization program will create a series of temporary but highly productive backwaters. Most of these backwater areas will be located on the Arizona side of the main channel.

On the basis of biological investigations of comparable project-created backwaters in other divisions of the Lower Colorado River it is estimated that some of these new backwaters in the Parker Division will initially provide excellent fish-producing habitat and fishing, principally for channel catfish, bass, crappies and sunfishes. Migration of game and forage fishes from the productive backwaters to the main channel will result in higher fishing success and more man-days of fishing effort than would be possible in the main channel in the absence of the backwaters; however, this will be confined to channel areas immediately adjacent to the backwaters.

The Bureau of Sport Fisheries and Wildlife recognizes that these backwater areas will be of a temporary nature and will eventually be destroyed through biotic succession. We believe, however, that the Bureau of Sport Fisheries and Wildlife has been too liberal in their estimate of the value of these backwater areas for fish and wildlife. The Bureau estimates that deterioration will begin in 5 to 10 years and that backwaters will cease to exist in 15 to 20 years. Comparable backwater areas in the Mohave Division became extinct within 5 years after channelization in that division was completed. Cutoff backwater areas in the Palo Verde Division have almost entirely filled with aquatic vegetation within only two years after completion of channelization. We believe that deterioration of project created backwater areas in the Parker Division will begin immediately after creation, and that if these areas are not maintained by continued dredging they will cease to exist as fish habitat in from 5 to 10 years.

3. The Bureau of Reclamation estimates that 600 acres of relatively low density mesquite and salt cedar will be removed by clearing of phreatophyte growth within the limits of the planned channel where it deviates from the present channel. Average density of this vegetation ranges between 40 and 50 percent. This reduction in acreage of salt cedar and mesquite will result in the loss of 4,000 mourning and whitewinged doves annually in the Parker Division. These losses were not discussed in the Bureau of Sport Fisheries and Wildlife Report.

4. The Bureau of Sport Fisheries and Wildlife has indicated in their report that fishing losses caused by channelization will be offset in part by selective stocking, habitat development and other fisheries management techniques specifically designed to meet the channelized conditions.

If this fishery program is implemented we recommend that it be considered as mitigation and all costs of the program be borne by the project.

5. The Bureau of Sport Fisheries and Wildlife have indicated in their report that the Colorado River Indians have plans for extensive urbanization of their reservation. These plans visualize extensive use of suitable riverfront acreage for development of homesites, marinas, motels, resorts, parks, golf courses and other recreation-oriented developments. Most development will be done under lease to non-Indians. Leases in excess of 8,000 acres have been executed and preliminary detailed plans have been completed which, when activated, will convert about 6,400 acres of wildlife habitat along about 9 miles of river south of Headgate Rock Dam, including Deer Island, into a community resembling suburban development. A 1975 population ranging from 2,400 to 5,700 people is envisioned by the lessee, with an expected ultimate population of about 34,000 people.

Detailed plans and schedules for development of remaining reservation waterfront lands are not completed. On the basis of trends in demand for scarce riverfront acreage on other reaches of the Lower Colorado River, it is believed that in terms of effects on wildlife and hunting, urbanization and general recreational developments will be complete long before the end of the period of analysis.

Urbanization and river channelization will cause an overall reduction of fish and wildlife on the Colorado River Indian Reservation. However, without urbanization an overall reduction in fish and wildlife of the same magnitude would occur as a result of channelization alone. Because some of this overall reduction will occur as a result of urbanization, channelization will not be as detrimental to fish and wildlife as it would be if no urbanization was planned.

In their September 8, 1965, report the Bureau of Sport Fisheries and Wildlife has considered the impact of planned urbanization of the Colorado River Indian Reservation in estimating fish and wildlife losses caused by the channelization project. The estimates of hunting and fishing use without and with-the-project presented in this report are lower than they would be if no urban development was contemplated by the Indians.

In a review draft of a report on the Parker Division dated October 21, 1964, the Bureau of Sport Fisheries and Wildlife presented estimates of hunting and fishing losses caused by channelization without adjustments made for the effects of urban development.

Fish and wildlife use estimates from these two reports are presented below to show the effects of channelization on fish and wildlife without and with urbanization.

Man-Days Hunting and Fishing Use in the Parker Division

Hunting or Fishing Activity	Without Urbanization			With Urbanization		
	Without Project	With Project	Losses	Without Project	With Project	Losses
Big Game	1,000	200	- 800	200	0	- 200
Upland Game	92,000	18,000	- 74,000	11,300	3,800	- 7,500
Waterfowl	4,000	300	- 3,700	500	200	- 300
Total Hunting	97,000	18,500	- 78,500	12,000	4,000	- 8,000
Fishing	675,000	54,000	-621,000	355,000	190,000	-165,000
Total Man-Days	772,000	72,500	-699,500	367,000	194,000	-173,000

It is evident from the above table that an overall loss of 699,500 man-days of hunting and fishing will occur annually as a result of urbanization and channelization in the Parker Division. Without urbanization an overall loss of 699,500 man-days of hunting and fishing would occur as a result of channelization alone. With implementation of urbanization plans annual losses charged to channelization are estimated at 173,000 man-days of hunting and fishing annually.

Channelization in the Parker Division will cut off and isolate a number of existing backwater areas, which, if not maintained will eventually be destroyed through biotic succession. The Bureau of Sport Fisheries and Wildlife has made the following recommendations in their report concerning maintenance of these areas for fish and wildlife purposes:

1. That during and after project construction the Bureau of Reclamation cooperate with the Bureau of Indian Affairs, the California Department of Fish and Game, the Arizona Game and Fish Department, and the Bureau of Sport Fisheries and Wildlife to preserve at least 100 acres of selected small cutoffs as fish producing areas through curtailment of spoil deposition, dredging as required, and installation of culverts to connect the cutoffs with the river.

2. That at least 500 acres of major backwater lakes which will exist after project construction be developed and maintained for purposes of fish and wildlife management. This would include initial dredging of these lakes, installation of inlet and outlet structures, and periodic maintenance dredging.

3. That the Bureau of Reclamation consult with the Bureau of Indian Affairs and the Colorado River Indian Tribes to determine their interest and desire in having the Bureau of Reclamation further construct, as a project feature, water control structures in the five bypass lake outlets which would permit impoundment and manipulation of lake water levels. This would increase the area of the five backwater lakes from 500 to 1,100 surface acres.

The Bureau of Indian Affairs has advised the Bureau of Sport Fisheries and Wildlife that it favors the creation of lakes in the bypass channels on Indian lands, but that the lakes eventually might be used for lakeside developments such as homesites and trailer courts, with attendant high levels of recreational use other than hunting and fishing.

Development and maintenance of five backwater lakes totalling 500 surface acres as recommended by the Bureau of Sport Fisheries and Wildlife would mitigate annually 500 man-days of upland game hunting, 100 man-days of waterfowl hunting and 135,000 man-days of fishing if the perimeters of these backwater lakes could be protected from urbanization.

We recommend that a buffer zone of from one-fourth to one-half mile wide in which no urban development is permitted be established around the perimeter of each of the five developed backwater lakes. In addition, we recommend that no water-skiing be permitted on these lakes. If such a buffer zone cannot be established construction of these lakes cannot be considered an effective mitigation measure for fish and wildlife because eventual urbanization

will destroy much of their fish and wildlife value. If establishment of a buffer zone is not possible, we recommend that the portion of the fish and wildlife losses caused by channelization in the Parker Division that will not be mitigated by these five backwater lakes because of attendant urbanization, be mitigated elsewhere on the Lower Colorado River, possibly in another division.

Several possible locations exist where fish and wildlife losses in the Parker Division could be mitigated. The mitigation potential of each of these sites should be thoroughly explored, and an alternate mitigation plan selected if our recommendation for establishment of a buffer zone around each of the five bypass lakes in the Parker Division is not acceptable. An alternate mitigation plan should also provide for mitigation of 5,000 man-days of fishing, 200 man-days of big game hunting, 7,000 man-days of upland game hunting and 200 man-days of waterfowl hunting, which will be lost due to channelization in the Parker Division, and for which no mitigation measures were recommended in the Bureau of Sport Fisheries and Wildlife Report.

The Bureau of Sport Fisheries and Wildlife has indicated to us that the newly established Cibola National Wildlife Refuge contains potential for mitigation of all of the fish and wildlife losses sustained in the Parker Division. Another possibility for mitigation lies in improvement and intensive management of existing backwaters in Havasu and Imperial Refuges. Improvement of potholes outside the lined channel in the Mohave Division is a mitigation possibility for waterfowl losses. The Planet Ranch on the Bill Williams River attracts thousands of geese annually and contains excellent potential for mitigation of waterfowl losses. A possibility for mitigation of fish losses lies in placement of rock structures in the riprapped river channel to provide fish cover.

With the addition of our comments and recommendations contained herein, the Arizona Game and Fish Department concurs with the Draft Report, Comprehensive River Management Plan, Lower Colorado River, Parker Division.

We appreciate the opportunity to comment and submit recommendations on this project.

Sincerely,

Wendell G. Swank

Wendell G. Swank, Director

WGS/ljt

Enclosures

cc: Regional Director, U.S. Bureau of Sport Fisheries & Wildlife, Albuquerque, N. M.
Director, California Department of Fish & Game, Sacramento, California
Superintendant, U.S. Bureau of Indian Affairs, Parker, Arizona
21 Members, Secretary of Interior's Colorado River Advisory Committee

EXHIBIT IV

Editorial Note

The contents of Exhibit IV are from the official comments of the State of California as presented in its consolidated report "Comprehensive Plans for the Lower Colorado River - Parker Division, Yuma Division, and Topock Gorge Division - August 1966." Exhibit IV contains only those portions of the California report which are pertinent to the Parker Division. The text of the California report relating to other divisions of the Colorado River Front Work and Levee System is reproduced in current reports describing plans for those divisions. For subject matter not specifically related to any division, reference should be made to the state's consolidated report.

The portions of the full report included in Exhibit IV are as follows:

	Pages
Summary of Conclusions	4a - 4d Inclusive
State's Recommendations	4e
Comments of the Department of Water Resources	5 - 7 Inclusive
Comments of the Department of Fish and Game	20 - 46 Inclusive
Comments of the Department of Parks and Recreation	109-116 Inclusive
Comments of the Division of Highways, Department of Public Works	117-118 Inclusive
Comments of the Colorado River Board of California	119
Comments of the Colorado River Boundary Commission of the State of California	120

SUMMARY OF CONCLUSIONS

The State of California finds that plans of the U. S. Bureau of Reclamation for comprehensive river management work in the Topock Gorge, Parker, and Yuma Divisions of the Lower Colorado River are not clearly justified in terms of benefits to the citizens of the State. The State is not convinced by the reports that there is a pressing need for construction of the proposed projects and questions the necessity for proceeding with construction until the need is adequately demonstrated, especially with reference to Topock Gorge.

Conclusions on specific features of the comprehensive plan, based on the State's review of the three draft reports, are as follows:

1. The control of phreatophytes, the clearing of brush from the channel and elimination of backwaters would greatly reduce existing habitat for important fish and wildlife resources. Plans recommended by the U. S. Bureau of Sport Fisheries and Wildlife, and presented as part of the proposed work, would not adequately mitigate the anticipated fish and wildlife losses. These recreation resource losses are not in the best interests of the people of California.

2. The overall program of the Colorado River Front Works and Levee System should be responsible for any unmitigated losses to fish and wildlife resources occurring in an individual division or segment of the system.

3. Costs and benefits of fish and wildlife enhancement and mitigation features of the proposed projects are not clearly separated

in the three draft reports and have been incorrectly applied to certain project features. The project takes credit for benefits associated with measures that simply maintain existing fish and wildlife habitat. Such measures are a project responsibility under federal and state policies and benefits cannot be justifiably claimed. Moreover, benefits have been assigned to recreational use of nongame wildlife species incidental to proposed fish and wildlife mitigation features while project-caused losses of such values have not been considered. The State believes nongame resource losses far exceed alleged benefits.

In addition, costs of annual maintenance and operation of proposed fish and wildlife mitigation measures are not shown as a project responsibility. Proper assignment of fish and wildlife benefits and costs must be made before the validity of the project cost-benefit ratio can be ascertained.

4. The relationship of geologic formations and the river, with its backwater impoundments, beaches and riparian vegetation, in Topock Gorge constitutes one of the outstanding natural resources of the Pacific Southwest. Proposed dredging in the gorge would result in the destruction of its scenic value. The State is opposed to any project activities in the Topock Gorge Division which would adversely affect existing scenic and recreational values.

5. Implementation of project plans for the Topock Gorge Division could impair the operation and financial stability of the Park Moabi marina by reduction of water depth in the harbor and entrance channel and by reduction in the numbers of boaters using the marina. The State has loaned $300,000 to San Bernardino County for development

of the Park Moabi marina. Moreover, the County, as well as private interests have made additional investments in the marina and plans call for further investments of about $1,500,000. The State needs to be assured that these investments will not be jeopardized by proposed project works.

6. In the Parker and Yuma Divisions, the project will result in deterioration of the quality of recreation, especially in the realm of visits for scenic appreciation, viewing and photographing wildlife and general enjoyment of land and water areas.

7. The construction of side slopes in trapezoidal channel reaches of the river to a proposed 1.5 to 1 ratio would be hazardous to recreationists. Thus, the project would create conditions unfavorable to public safety.

8. Construction of the proposed projects would reduce the sediment load of the river and stabilize the river channel for flood control and navigation for small crafts.

9. The reported salvage of water would be for the most part a transfer of water from one beneficial purpose to another, the beneficiaries of which are not well defined. Distribution of any water made available for other uses by the proposed project is not defined by the report. It is not clear whether California would receive any of the water.

10. The Bureau of Reclamation should establish the channel alignment above the river Section 8-S within the Yuma Division so that the State Division of Highways can proceed with designs for a new bridge for Interstate Route 8 which crosses the river at Yuma, Arizona.

11. The proposed drift within the Topock Gorge Division at the location of the new Interstate Route 40 Highway Bridge could possibly lower the bed of the river below the toe of the existing grouted rock

revetment. Due to the configuration of the river at the rock revetment, it appears that the bridge abutment on the Arizona side of the river should be protected by a blanket of one-ton ungrouted rock at the toe of the revetment, and that rock should be added to the abutment fill on the California side at the time any deterioration of the channel is observed.

12. The proposed realignment would not affect the state boundary inasmuch as the Interstate Compact now before Congress for approval has fixed the geographic boundary between Arizona and California as the 1962 position of the Colorado River.

13. The proposed realignment of the river channel would not affect fee ownership to land along the Colorado River inasmuch as land titles are based on the last known natural location of the river, which may be the 1962 position in some areas or in some other location prior to avulsive or man-made changes in the river channel.

STATE'S RECOMMENDATIONS

As a result of the review by the State of California of the reports on the lower Colorado River within the Topock Gorge, Parker, and Yuma Divisions, it is recommended that:

1. The present outstanding scenic value of the Topock Gorge be preserved. The plan presented in the Topock Gorge report should not be implemented.

2. The Yuma and Parker reports should be resubmitted to the State after being revised to reflect the comments of the Department of Fish and Game and the Department of Parks and Recreation.

COMMENTS OF THE DEPARTMENT OF WATER RESOURCES

The Department of Water Resources has a direct interest in all projects involving the development of water resources within the State in accordance with the provisions set forth in Division 6, Part 6 of the California Water Code, which states in part:

> "Section 12579. It is hereby declared that recurrent floods on streams and rivers, and other waterways of the State, causing loss of life and property, disruption of commerce, interruption of transportation and communications, and wasting of water, are detrimental to the peace, health, safety, and welfare of the people of the State. The control, storage, and full beneficial use of flood waters, and the prevention of damage by flood waters, and the washing away of river and stream banks by floods are proper functions and activities of the State, in cooperation with counties, cities, state agencies and public districts, and in cooperation with the United States, or any of its departments or agencies."

Of particular interest is the extent to which these projects are compatible with The California Water Plan, a plan for the general and coordinated development of the water resources of California.

The primary purpose of the recommended plans of improvement for the Topock Gorge Division, Parker Division, and the Yuma Division is to provide for the control and regulation of the waters of the Lower Colorado River. The three project plans also provide for a total annual salvage of an estimated 69,600 acre-feet of water for beneficial purposes.

In December 1963 the Department of Water Resources reviewed and provided comments on the Bureau's report entitled "Pacific Southwest Water Plan". In that report the total amount of water available for salvage was considered reasonable. The quantity of water estimated to be salvaged by the three proposed improvements represents only a portion of the total amount available. The amount proposed for salvage was limited by the Bureau to optimize the multiple-purpose uses of the river. The proposed channel improvements will greatly improve the

physical properties of the water, by reducing the sediment load; however, there will be no significant change in the mineral characteristics of the water.

The Department of Water Resources recognizes the need for the implementation of a comprehensive river management plan that would develop and conserve the water resources of the State. The plans presented in the Bureau's reports are considered to be in accordance with The California Water Plan.

On the basis of the review of these three reports and the Department's previous studies of Colorado River channelization, made in 1955 and 1957 for the Colorado River Boundary Commission, the recommended plans appear to be feasible and are considered adequate to improve channel stabilization, salvage water, and provide for sediment control.

From information provided in the Bureau's reports, the recommended plans appear to be economically justified, as anticipated benefits exceed project costs.

Inasmuch as the proposed projects for the Topock Gorge, Parker, and Yuma Divisions along the Colorado River would provide additional water supply for the State of California, as well as flood control, navigation, land reclamation, and other benefits, it is considered to be in the public interest to initiate construction of the proposed improvements at the earliest possible date.

Conclusions

The Department of Water Resources believes there is a need for the construction of the proposed projects on the Colorado River to conserve water supplies and to regulate the flow of the river, and considers the proposed plans of improvement to be in substantial conformance with The California Water Plan. Based on the review of the three reports, it is concluded that:

1. Construction of the proposed project will greatly reduce the sediment load of the river, stabilize the river channel for flood control and navigational purposes, and salvage water for beneficial purpose.
2. It is in the general public interest that the plans for improvements within the Topock Gorge, Parker, and Yuma Divisions of the Colorado River be implemented as soon as possible.

PARKER DIVISION

INTRODUCTION

This report is a revision of our previously released report, dated November 19, 1964, entitled "Comments of the California Department of Fish and Game on Parker Division, Colorado River Front Work and Levee System - U.S. Bureau of Reclamation".

Differences between information found in this report and our November 19, 1964, report are the result of our opportunity to expand our study of the Parker Division area and the result of reviewing revised project plans.

The Lower Colorado River Front Work and Levee System extends from Lee's Ferry, Arizona, to the southerly International Boundary. The Parker Division is one of nine project divisions, created by the Bureau of Reclamation for purposes of administration and construction, between Davis Dam and the International Boundary. The Parker Division is approximately 44 miles in length and extends from Headgate Rock Diversion Dam, about one mile north of Parker, Arizona, to Palo Verde Diversion Dam, about 10 miles north of Blythe, California. The Colorado River Indian Reservation bounds the Colorado River on both sides except for approximately 21 miles on the California side from the Palo Verde Diversion Dam north.

The river in the Parker Division is termed an "old river" geologically. Its sediment load is high, aggrading and degrading with changes in the flow volume, and it tends to meander back and forth across the flood plain. The upper 20 mile reach of the river in the Parker Division has high cliffs and talus slopes along one-third of its banks. The remainder of the shoreline is characterized by sandy beaches and dense vegetation. The river channel ranges from 350 to 1,800 feet in width. Large, vegetated islands dot the course of the river through the project area. The natural forces of storm, and water that give life to a stream such as the Colorado River were tempered with the construction of the Hoover, Parker, and other upstream dams.

The water moving down the riverbed today is under the control of man, and flucuates both daily and seasonally in response to needs for power, agricultural, municipal and industrial uses. Average daily flows from March through September range from 5,500 cfs to 22,000 cfs, with a monthly mean of 16,600 cfs, while average daily flows from October through February range from 1,800 cfs to 21,000 cfs, with a monthly mean of 9,800 cfs. Daily fluctuation in river flows in the Parker Division are due to hydroelectric power peaking releases from Parker Dam, about 14 miles upstream from Headgate Rock Diversion Dam. Daily fluctuation in river surface elevation at Waterwheel Gage, midway through the project area, averages about 0.5 feet and ranges to 1.5 feet during the winter months. During summer months, the daily fluctuation of river surface elevation averages about 2.5 feet and ranges to 5.0 feet.

The primary purposes for channelization of the Parker Division are:

1. Sediment reduction
2. Water salvage
3. Water table reduction on adjacent lands.

The Bureau of Reclamation indicates that with completion of the channelization plan, the sediment load arriving at the Laguna desilting basin will be reduced by approximately 213,000 tons, or 180,000 cubic yards annually. The Bureau of Reclamation also indicates that evaporation and "nonbeneficial" consumptive use of water will be reduced by about 24,200 acre feet per year.

The Bureau of Reclamation claims that drainage will be improved on 6,630 acres of land having water table depths less than 6 feet. A 3-foot lowering of the water table would reduce the total area having a water table depth of 0 to 4 feet from 1,093 acres to 45 acres. The total area having a water table depth of 4 to 6 feet would be reduced 4,161 acres.

The Bureau of Reclamation in its Preliminary Plan Draft Report for the Parker Division considers three plans of development for channelization. These have been designated the channelization plan, the alternate plan, and the complete dredge plan. Because of greater economic feasibility, the channelization plan is the plan the Bureau of Reclamation has recommended for adoption and is the plan under evaluation in this report. The Parker Division is divided into two sections, each of which requires different methods to effect river stabilization.

Problems in Section I (Headgate Rock Diversion Dam to Alligator Bend - 16 miles) are, in the Bureau of Reclamation's terminology, minor misalignments, scattered actively cutting banks, and some short braided and overwide reaches. Proposed alterations of the existing river channel in Section I include minor realignment, construction of training structures and bank protection works with some bank construction from fill material in the braided reaches to reduce channel width to about 500 feet.

In Section II (Alligator Bend to Palo Verde Diversion Dam - 28 miles), the problems of "misalignment", sharp bends, overwide channels and eroding banks are to be corrected by complete realignment and construction of a new dredged channel. Bottom width of the dredged channel will be about 450 feet and side slopes will have a ratio of 1.5 to 1.

Analyses of project effects on fish and wildlife contained in the Bureau's report are based on a 100 year period of analysis.

FISH - WITHOUT THE PROJECT

Fish habitat in the Parker Division can be separated into two general categories--one is backwater habitat, which consist of relatively quiet water adjacent to the river banks, secondary channels of slow velocity, and quiet backwaters. The other is the main channel of the river.

Backwater habitat provides living space for large variety and number of aquatic organisms. Backwaters also furnish protective cover for gamefish. Cover in the Parker Division consists of living vegetation, boulders, old burrows, logs, stumps, undercut banks, and brush piles. Immature fish would be exposed to excessive predation without protective cover. Reproduction, egg incubation, and the young fish nurseries are primarily restricted to backwaters.

Gamefish, then, in the Parker Division are dependent on backwaters for most of their food and cover. Destruction or detrimental alteration of the backwater habitat will cause a proportional decline in the quantity of gamefish, dependent on this backwater habitat.

Major gamefishes found in the Parker Division are largemouth bass, striped bass, black crappie, bluegill, redear and green sunfish, channel catfish and yellow bullhead. Carp and threadfin shad are the predominant non-game fishes.

In addition to fish, bullfrogs are common to the Parker Division and seek marshy areas and weedy, heavily vegetated banks for existence. Soft shelled turtles are also common in this division. These turtles are dependent upon backwaters for food and cover.

We estimate the standing crop (total weight at any given moment) of gamefish per surface acre in backwaters at 50 pounds.

The main channel provides a limited homogeneous environment for some forms of aquatic life, important to man. Channel catfish and threadfin shad are two notable examples in the Parker Division, although these forms do venture occasionally into backwater areas for food and to spawn.

The standing crop of gamefish per surface acre in the main channel is estimated to be 20 pounds.

A combination of the standing crop for both types of habitat indicates an average standing crop per surface acre of about 25 pounds of gamefish for the 4,845 water surface acres in the Parker Division. This is a total standing crop of about 121,125 pounds of gamefish.

We do not have sufficient data to estimate the standing crop of bullfrogs or soft shelled turtles. Bullfrogs and soft shelled turtles are considered excellent fare and are sought by an increasing number of fishermen.

Existing total fishing pressure in the Parker Division is estimated at 90,000 man-days annually. Angling use is increasing rapidly and current projections indicate fishing pressure will approximate 600,000 man-days annually by the end of the 100 year project analysis. We estimate average fishing effort over the life of the project will be about 355,000 man-days annually.

WILDLIFE - WITHOUT THE PROJECT

Wildlife depends upon vegetation for its well-being. Vegetation provides cover for nesting, feeding, resting, and escape. The principal forms of riparian and floodplain vegetation found within the Parker Division include salt cedar, Tamarix pentandra; seepwillow, Baccharis glutinosa; arrowweed, Pluchea sericea; honey mesquite, Prosopis chilensis; and screwbean mesquite, Prosopis pubescens. Some areas within this Division afford good stands of cottonwood, Populus fremontii; willow, Salix spp.; and smartweed, Polygonum spp.

Backwater areas support a variety of aquatic vegetation. Some of the most common aquatic plants include common water nymph, Najas guadalupensis; holly-leaved naiad, Najas marina; sago pondweed, Potamogeton pectinatus; water milfoil, Myriophyllum sp.; and coontail, Ceratophyllum sp. Other aquatics include cattail; Typha sp.; sedge, Scirpus spp.; and rush, Juncus spp.

The California Department of Fish and Game hunter-use figures are for the California side of the river. Wildlife-use figures, excepting dove and waterfowl, are restricted to the California side. Dove- and waterfowl-use estimates are for both sides of the river.

Big Game:

The Parker Division of the Colorado River supports the largest herd of desert burro deer found in California. These deer generally spend the winter and spring months in the mountains and washes near the Colorado River. When the green vegetation has been consumed or has depreciated in food value, the deer migrate to the dense vegetation bordering the river.

Habitat of the burro deer consists of stands of salt cedar, arrowweed, willows, cottonwood, and screwbean and honey mesquite. Stands of vegetation in the dry washes which drain into the river are used during migrations to and from the neighboring mountains. Riparian vegetation affords vital food, concealment, and resting cover for deer and fawns. The most common riparian food plants are mesquite and willow; however, in times of need, seepwillow and even salt cedar may be browsed. When available, the green shoots of the perennial grasses provide grazing. Deer frequently ford the river in search for food. It is not uncommon to see deer browsing on the plant growth on the numerous islands found throughout the river in the Parker Division.

The total man-days of deer hunting on the Parker Division is far in excess of that which would be expected on the basis of available deer and annual kill. The reported kill of 22 deer in 1962 and 17 deer in 1963 is inaccurate, since many hunters fail to return their tags. However, it is reasonably safe to assume that the total deer harvest is not in excess of 3 percent of the deer population. This low percentage of hunter success can be mainly attributed to the excellent escape cover found along this reach of the river.

Department of Fish and Game surveys show an average of 25 man-days hunting for each deer killed. Assuming a total kill of 30 deer, there is presently a total of 750 man-days of deer hunting annually.

Upland Game Mammals:

Only two species of upland game mammals are found in the Parker Division; the cottontail rabbit and the black-tailed jackrabbit.

The cottontail is commonly associated with the dense brush along the banks of the river. Brush provides the shelter generally sought when selecting a burrow site and provides avenues of gravel and escape from predators. Food is provided in the form of annual and perennial grasses and shrubs.

Cottontail hunting pressure is difficult to determine, since the hunting season overlaps the dove and quail seasons. Cottontail are generally taken incidental to dove and quail hunting. We estimate 1,000 man-days of cottontail hunting annually.

Jackrabbit requirements are similar to the cottontail, except jackrabbits exist in the drier portions of the Division and are not quite as dependent upon the river for their welfare. Hunting pressure is undetermined. They are hunted year-round. It is doubtful that this animal receives hunting pressure comparable to that received by the cottontail, since their populations along the river are generally considered to be much lower.

Furbearers and Other Nongame Mammals:

Some of the furbearers which inhabit the Parker Division are beaver, muskrat, raccoon, and kit fox. Other nongame mammals include the bobcat and the coyote.

Of the furbearers, the only one having commercial importance in the Parker Division is the beaver. The beaver of this region are predominately river bank dwellers. They usually seek areas in which they may burrow near their food supply. Their diet consists mainly of the bark of willow and poplar, though they may also eat the bark of seepwillow and the roots of salt cedar, tubers and bulbs should the need arise.

Beaver sign is commonly found along this portion of the river, though the numbers are not considered to be abundant. Recent harvest of these animals approximates 300 beaver yearly. Based on an average return to the trapper of $8 per pelt, the present annual harvest is valued at $2,400 per year.

Furbearing and other nongame animals provide many hours of esthetic enjoyment. The knowledge of the presence of these forms of wildlife and the sighting of these animals and their sign adds materially to the enjoyment of the people visiting the river. In addition to esthetic enjoyment, some of the furbearing and nongame animals provide hunting. We estimate an average of 20 hunting parties per weekend, averaging 2 hunters per party. During the annual six-month period of maximum hunting activity, about 1,000 man-days are spent in pursuit of this resource.

Upland Game Birds:

The gambel's quail is the only upland game bird found on the Parker Division. These birds are common in the riparian and flood plain habitat along the river where the quail populations are directly linked to the types and abundance of certain plant species. Quail utilize the dense thickets of brush as an escape route when pursued, and also for protection while roosting and nesting. This brush also provides essential food supplies. The legume family, typified by mesquite, is an important source of food for quail.

The present density of gambel's quail is approximately 1.6 birds per acre in the Parker Division. The quail resource is presently under-harvested, although approximately 15,000 man-days are spent hunting these birds.

Migratory Birds - Doves:

During the spring and summer months, the Parker Division is an important feeding, resting and nesting area for thousands of mourning and white-winged doves. In this region, the white-winged dove commonly nests and roosts in mesquite and salt cedar. Cottonwood, willow, and citrus trees are also utilized for nesting. White-winged dove are primarily grain feeders with fruits and seeds of a large number of trees, shrubs, and herbaceous plants constituting a sizeable portion of their diet.

Water is an absolute requirement in the breeding habitat of the white-winged dove. This requirement is met in this desert region by the presence of the Colorado River. The mourning dove's nesting and feeding requirements are not as specific as those of the white-winged dove. However, the mourning dove must have adequate roosting areas. The bulk of the mourning dove's diet consists of grain and other agricultural crops. They also eat fruits and seeds of native flora.

Recent studies indicate an average use figure of approximately 8.3 doves per acre within the Parker Division. This abundance estimate is believed to be very conservative in certain reaches of the Parker Division; notably, the floodplain and riparian area between the San Bernardino County line and Alligator Bend, known as "The Strand." On the California portion of the 44 mile Parker Division, annual dove hunting pressure averages about 1,000 man-days per mile, or a total of 44,000 man-days per year.

Migratory Birds - Waterfowl - Ducks:

After departure of the dove populations in late summer, waterfowl begin to congregate on the Parker Division. This stretch of the river is an important resting area for many thousands of waterfowl during the winter months. Many of these birds stop for a short time here to rest and feed, then continue on their long migrations. Others remain on the area throughout the winter.

During the winters of 1963, 1964, and 1965, from September through February, cooperative waterfowl survey flights were conducted on a bi-weekly schedule over the Lower Colorado River. Data from these flights indicate an average of 115,540 duck-days of use seasonally on the

Parker Division. These counts indicate that cinnamon teal, green-winged teal, shoveler and pintail are the ducks most commonly found on the Parker Division between late September and early November. By late November, the cinnamon teal have departed the Parker Division and large numbers of mallard, goldeneye, and bufflehead have arrived from the north.

The pintail and mallard eat predominately vegetable matter, with the pondweeds being of chief value, they also eat large amounts of water nymph, and the fruits of water milfoil, sedges, and rushes.

The teal and shovelers eat a higher percentage of insects, crayfish, and fresh water clams than most of the dabbling ducks, their vegetable requirements are primarily the same as those of the other dabblers.

In addition to the dabbling ducks, many species of diving ducks also inhabit the area, including the redhead, canvasback, scaup, ruddy duck, and as previously mentioned, the goldeneye and bufflehead. With the exception of the canvasback, redhead, and to some extent the scaup, these divers all eat large amounts of insects, crayfish, fresh water clams, and small fish. The redhead and canvasback have feeding habits similar to the majority of the dabblers; while the scaup eats about equal amounts of plant and animal matter.

An important factor in understanding the feeding habits of ducks is that, with the exception of the teals and the shoveler, dabblers are quite mobile in their quest for food. Some dabblers will fly several miles to an area of agricultural activity. Many dabblers search for food in fields and meadows near the water. Diving ducks lack the mobility of dabblers due to their anatomical structure. They have a difficult time walking on land and, consequently, are dependent upon aquatic areas for their feeding activities.

Migratory Birds - Waterfowl - Geese:

During the winter, the Parker Division is utilized as a resting area by three common forms of geese. The white-fronted goose passes through the area in October and early November. Snow geese and Great Basin Canada geese soon follow. Geese utilize the sandbars and beaches as resting areas, generally doing their foraging in the nearby fields. Grain crops, alfalfa, and seeds from sedges and other native herbaceous plants, predominate in the diet of these birds. The three year waterfowl survey along the river indicates an average seasonal use of 23,433 goose-days in this division.

Migratory Birds - Waterfowl - Coots:

In addition to ducks and geese, the division is inhabited by a large number of coots, about 5 percent of the coot population is resident. Coots are primarily a grazing species, and will eat practically anything which might be eaten by cattle. They are quite awkward on land and are seldom found far from water. The three year waterfowl survey on the Parker Division indicated an average of 91,247 coot-days of use seasonally and an average of 230,220 days of waterfowl use seasonally. The Parker Division receives an annual waterfowl hunter-use of approximately 3,525 hunter-days.

Nongame Birds:

The Parker Division is utilized by many additional forms of bird and mammal life. It is a resting and feeding area for the sandhill crane, which uses sandbars as resting sites and feeds upon grasses and aquatic vegetation, and upon grain and alfalfa crops grown on nearby farms.

Many herons and egrets may be seen, along this stretch of the river, wading in the shallow waters in search of food, and resting on sandbars and in the brush along the river's edge. Stilts, willets, avocets, sandpipers, and a host of other shorebirds utilize the sandbars and backwaters of this Division for resting and feeding.

Loons, grebes, cormorants, pelicans, and many other diving birds may be found here seasonally.

Birds of prey, including such endangered species as the osprey and golden eagle, are associated with the riparian and floodplain vegetation of the Parker Division.

A multitude of songbird species are dependent upon the riparian and floodplain vegetation which provides them with feeding, resting, nesting, and escape cover.

Values are largely intangible for the pleasure received by an individual who enjoys the presence of the many game and nongame animals which inhabit this region.

There is a need for study on the Parker Division in terms of the ecological relationships of the wildlife resource. It is certain that vegetative control or any alteration of the river course by channel realignment and training structures or by narrowing and deepening the river's channel, will bring about significant changes in wildlife habitat, and numbers and types of existing animal life.

FISH - WITH THE PROJECT (Without Mitigation Features)

The Bureau of Reclamation's project to realign, channelize, and stabilize the river in the Parker Division will reduce the fishery through the direct destruction of habitat. Further reduction of the fishery resource will occur from the new recreational uses that the Bureau of Reclamation's project will make possible. There will be extensive shoreline construction of roads, golf courses, housing, and commercial establishments as well as high-speed boating and water skiing on the narrowed, deepened channel.

The proposal (excluding mitigation proposals) is to reduce the total water surface from 4,845 to 2,452 acres. This reduction will eliminate all of the existing backwaters and some of the existing main channel. If these 2,393 acres of water surface are eliminated, so too will be the production of fish foods, fish reproduction, as well as frog and turtle habitat. The result will be a precipitous decline in the resource to a point where it will no longer support the present angler use, nor ever attain its potential of 355,000 angler days per year.

The water-conveyance channel that will exist upon the completion of the Bureau of Reclamation's project will not be comparable to the present main channel, and will provide an estimated standing crop of only five pounds of fish per acre. On the remaining 2,452 acres, the total standing crop will approximate 12,250 pounds.

Over the life of the project, in the Parker Division, we estimate a continuous loss in the standing crop of 108,875 pounds of game fish and a continuous loss of 280,000 angler days every year. Table 1 summarizes these facts.

TABLE 1

Summary of Water Surface Acreage, Fish, and Angler Days Lost
With the Project (without mitigation features)

	Estimated Standing Crop of Game Fish in Pounds	Estimated Angler Days	Estimated Water Surface Acres
Without the Project	121,125	355,000	4,845
With the Project (without mitigation)	12,250	75,000	2,452
Loss With the Project (without mitigation)	108,875	280,000	2,393

WILDLIFE - WITH THE PROJECT (Without Mitigation Features)

The narrow band of vegetation adjacent to the river is the most highly productive portion of the wildlife habitat in the Parker Division. A key to the understanding of the wildlife community in this area is the recognition that the river runs through the desert, and without water there would be a limited amount of wildlife. Under natural conditions, the river meanders over a large area and a great amount of wildlife food and cover exists. The unnatural confinement of this stream and removal of adjacent cover will result in a transition to more desert-like conditions for wildlife, and a decline in populations.

The proposed project without mitigation features will reduce the water surface area of the Parker Division from 4,845 acres to 2,452 acres. This is a 49 percent decrease in water area. Areas to be eliminated are the critical shallow food producing waters and the associated shore areas which wildlife seek for food and cover.

Approximately 600 acres of mesquite, about 175 acres of which are in California, are to be cleared to provide access for the dredging equipment and construction of the realigned river channel. Wildlife numbers will be reduced simultaneously with destruction of habitat and by deterioration of riparian habitat along the channelized river.

Hunter pressure will not be reduced in exact proportion to the reduction of wildlife because hunters will continue to seek game; however, much of the game will no longer exist, and hunter success will be low.

The Bureau of Reclamation indicates on page 33 of its April, 1966, Draft Report, Comprehensive River Management Plan, Lower Colorado River, Topock Gorge Division, that the ground water will be lowered an average of 1 1/2 feet throughout the cleared area as a result of the gorge dredging in the Topock Division. They state this lowering will aid in maintenance against reinfestation of phreatophytes because reseeding and regrowth becomes less vigorous as the result of the drier surface soils. Relating this statement to the Parker Division, we assume that some existing phreatophytes will live out their life span, die, and not be replaced; wildlife values will decrease in proportion to the disappearance of these phreatophytes.

The following estimates are based on vegetative removal for channelization. The estimates must be recognized as conservative because there is no method at this time to estimate the deterioration of phreatophytes outside the cleared channel area.

Big Game:

Reduction of the areas which produce the necessary forage plants, such as willow and screwbean and honey mesquite, will reduce the number of deer this region is capable of supporting. Since these deer are dependent upon the riparian and flood plain vegetation to meet their summer and fall food needs, the size of the herd will be limited to the number of animals which can be supported by the remaining available riparian and floodplain forage.

We estimate the loss of deer at 10 percent of the existing population. A decrease of 200 man-days of hunting annually will occur.

Upland Game Mammals:

Cottontail populations will be reduced approximately 15 percent by the proposed work in the Parker Division. Elimination of riparian vegetation will leave the animals unprotected when they come to the river seeking water. Elimination of essential escape cover and food will be a prime factor in the reduction of this animal's numbers. Reduced abundance of cottontail will bring about an estimated annual loss of 50 man-days of hunting. Since jackrabbits are not dependent upon the riparian growth along the river to any great extent, little reduction in their numbers or hunter pressure is anticipated.

Furbearers and Other Non-game Mammals:

Beaver and muskrat will be seriously affected by channelization. Riprapping the banks will make burrowing impossible for these animals. Removal of aquatic, floodplain, and riparian vegetation will eliminate valuable food plants. It is estimated that muskrat populations will be decreased 50 percent. Beaver will suffer an estimated 70 percent reduction in numbers, concomitant with a 70 percent decrease in animals harvested. This represents a loss of 210 animals which otherwise would be harvested annually. Based on an average return to the trapper of $8 per pelt, this represents an annual loss of $1,680. This reduced trapper success will bring about a reduction of about 200 man-days per year of trapping.

Channelization of the Parker Division is expected to have a minimal effect upon predatory non-game mammals. Predators will be reduced about 5 percent, primarily as a result of reduction of prey species. This reduction in predatory mammals will result in an annual loss of approximately 50 man-days of hunting.

Upland Game Birds:

Reduction in quality quail habitat by channelization will result in a reduction of about 10 percent of the existing quail population. This reduction in quail numbers will bring about a 10 percent reduction in hunter-day use, an annual loss of approximately 1,500 man-days of hunting.

Migratory Birds - Doves:

Channelization will result in a loss of nearly 5 percent of the existing white-winged and mourning dove populations.

Channelization of the Parker Division, as planned by the Bureau of Reclamation, will result in an elimination of sandbar and sandy beach areas. Such areas are currently very popular with both dove and waterfowl hunters. Loss of these areas to hunters, together with reduction in dove numbers, will result in an estimated annual reduction of 2,200 man-days of dove hunting in the Parker Division.

Migratory Birds - Waterfowl:

All species of waterfowl will be affected by channelization of the Parker Division.

Restriction of channel width and deepening of the channel, combined with a reduction in surface acreage of slow and quiet waters, will cause a decrease of about 60 percent of the available aquatic animal life and approximately 75 percent of the available aquatic plant forms used extensively by foraging waterfowl. Food losses will primarily affect the diving ducks, since they are unable to forage on land; however, the extensive losses of resting areas in the form of sandbars, beaches, and slow and quiet waters, will affect all forms of waterfowl. These effects will bring about an estimated decrease of 75 percent of the annual diving duck use on this area. Dabbling ducks and coots will be the least affected forms of waterfowl; however, we estimate channelization will decrease dabbling duck numbers by 65 percent, and coot numbers by 60 percent.

Geese use the Parker Division chiefly as a resting area during their migrations, and with a decrease of nearly 90 percent of the available resting areas, a decrease of 90 percent of the geese visiting the area may be expected.

In summary, channelization of the Parker Division, as planned by the Bureau of Reclamation, will cause an annual loss of about 156,716 waterfowl-use days.

The Division plays a key role in terms of supplying goose hunting area along the Colorado River; about 70 percent of California Colorado River goose hunters utilize this area. Reduction in goose numbers in this section of the river will bring about a loss of nearly 90 percent of the existing goose-hunter pressure.

An overall analysis of the post-project waterfowl hunter pressure indicates a reduction of approximately 70 percent. This reduction in hunter pressure will be attributable to both destruction of waterfowl habitat with concomitant reduction in waterfowl numbers, and to removal of sandbars and sandy beaches which provide not only resting and feeding areas for waterfowl, but also hunting areas as well. This represents an estimated annual loss of 2,500 man-days of waterfowl hunting.

Non-game Birds:

Channelization of the Parker Division will affect practically all forms of life in that area directly and to some degree affect the plant and animal complex of the entire Lower Colorado River Basin.

Reduction of sandbars and beaches will reduce numbers of wading and shore birds by about 60 percent, since these birds will no longer have these existing areas, necessary for feeding and resting. In the case of the sandhill crane, losses will be 90 percent, since their requirements are similar to those for geese.

Such piscivorous diving birds as loons, grebes, kingfishers, cormorants, and pelicans will be reduced in number by about 70 percent.

The proposed channelization for this section of the river should have little overall effect upon birds of prey, with the exception of such endangered species as the golden eagle and the osprey. Overall numbers

of birds of prey will be reduced by about 5 percent. However, the osprey, which is primarily a fish eater, will be limited to the available fish resource. Since about 70 percent of the total fisheries resource will be eliminated, a reduction of nearly 70 percent of osprey numbers is expected.

Insectivorous birds, such as swallows and flycatchers will be reduced in proportion to the decrease in the river's aquatic and riparian dependent insect populations; an estimated reduction of nearly 60 percent.

Seed-eating songbirds will be limited primarily by the abundance of riparian and floodplain vegetation available to them for perching, feeding, and protection. These birds will be reduced by an estimated 5 percent.

Table 2 describes the estimated annual loss of man-days of hunting with the project (without mitigation features).

TABLE 2

Estimated Annual Loss of Man-Days of Hunting With the Project
(Without Mitigation)

	Man-days of Hunting Without the Project	Man-days of Hunting With the Project	Annual Loss
Deer	750	550	200
Cottontail	1,000	950	50
Furbearers and Varmints	1,000	950	50
Quail	15,000	13,500	1,500
Dove	44,000	41,800	2,200
Waterfowl	3,525	1,025	2,500
Totals	65,275	58,775	6,500

With the project, there will be substantial annual wildlife losses, and an annual loss of 6,500 hunter-days for the 100 year projected life of the project (without mitigation features).

DEPARTMENT COMMENTS ON BUREAU OF RECLAMATION REPORT

The Bureau of Reclamation, in its draft report, estimates a loss of 165,000 man-days of fishing annually as a direct result of the project, plus losses in big game, upland game, and waterfowl hunting man-days of 200, 7,500, 300 annually, respectively.

The Bureau of Sport Fisheries and Wildlife recommended six mitigation and/or enhancement features which are included in Exhibit II of the Bureau of Reclamation's Parker Division Draft Report of September, 1965.

The Bureau of Reclamation proposes to adopt recommendation numbers 1 through 4 and indicates that recommendation numbers 5 through 6 require administrative decisions which are beyond the scope of the report.

The draft report indicates recommendations 1 through 4, mentioned above, will mitigate 160,000 man-days of fishing annually. This would indicate a net annual loss of 5,000 man-days of fishing.

The draft report also indicates that preservation of lakes and vegetation along the lake perimeters will provide mitigation for about 600 man-days of hunting. This would indicate a net loss of 7,400 man-days of hunting annually. The above figures include the Arizona and California sides of the river.

Recommendation number 1 adopted by the Bureau of Reclamation includes the proper selection and placement of riprap on dressed bank and training structures during construction which will provide interstices suitable for use as cover and habitat for certain species of fish. The Bureau of Reclamation indicates that mitigation of about 8,000 man-days of fishing annually will be realized through this work.

We believe the effectiveness of this recommendation toward mitigating angler-day losses has been overestimated. The habitat created would soon be eliminated due to filling of interstices by siltation. Part of the riprap in the dredged Mohave Valley Division consists of rocks 18 inches or more in diameter, yet almost no value as warmwater gamefish habitat can be ascribed to this riprap.

The Bureau of Reclamation declared its intent to adopt recommendation number 2. It is not discussed in its text as a mitigation feature. One of the major features of recommendation number 2 is the preservation of shoreline irregularities wherever feasible. While this feature is presently neither enhancement nor mitigation, the concept has considerable merit. Another major feature is placement of large rocks, rubble or gravel at selected sites along the river bank. This feature, depending on how it is implemented and maintained, could effect substantial fishery mitigation.

Recommendation number 3 adopted by the Bureau of Reclamation proposes that approximately 100 acres of small backwaters will be selected cooperatively by interested agencies for perpetuation of fish spawning and feeding areas. Periodic dredging, or other maintenance work, will preserve the water areas as suitable sites during the life of the project. The Bureau estimates mitigation of 17,000 man-days of fishing annually. We agree with this if these waters are maintained for fish spawning and feeding areas.

Recommendation number 4 proposes development of five major backwater areas after channelization for fishing and controlled use for general recreation. The Bureau indicates a total of 135,000 man-days of fishing annually will be mitigated as a result of this work. We believe this estimate is too high. With an approximate standing crop of gamefish of 50 pounds per surface acre, these five lakes, totaling 500 acres, would accommodate a total standing crop of approximately 25,000 pounds of gamefish. The quality of angling will not be sufficient to account for 135,000 annual angler-days. We estimate that approximately 83,000 annual man-days of fishing will be mitigated by development of the 500 acres of backwater lakes if the lakes are protected from urban development, water skiing and speed boating.

The Bureau report indicates that the Bureau of Indian Affairs and the Colorado River Tribal Council have plans for extensive resort and urban development in the Parker Division. The State of California has not received formal plans from the Bureau of Indian Affairs relating to resort and urban development on Indian lands near the river in the Parker Division. It is our understanding that their plans are of such a nature that Bureau of Reclamation adoption of recommendations 3 and 4 of the Bureau of Sport Fisheries and Wildlife will be of questionable value for fish and wildlife.

The State of California joins with the Game and Fish Department of Arizona in rejecting the proposals for 100 acres of selected backwaters and five bypassed lakes, as mitigation unless these waters are guaranteed protection against influences which would diminish or destroy their effectiveness for fish and wildlife and their associated recreation.

The Bureau of Reclamation bases mitigation of 135,000 man-days of fishing annually on development of the five major backwater lakes (500 acres) by initial dredging and intensive fisheries management. Initial dredging will not be sufficient to maintain an adequate fishery in these lakes throughout the 100 year period of project analysis. Periodic dredging or other maintenance work would be required.

The Bureau of Reclamation bases mitigation partially on intensive fisheries management of these five backwater lakes. They do not stipulate whether or not this management is to be provided as a project cost. If this management is used as a basis for mitigation, it must be a project cost.

The Bureau report indicates the developed lakes and their peripheries will attract upland game and will be responsible for mitigating 500 man-days of hunting in the vicinity of the project and that the lakes will also mitigate about 100 man-days annually of waterfowl hunting.

The lakes do not provide increased water surface acreage in the division. Their development, with protection by a buffer strip, would increase the value for waterfowl and we agree that this would result in an annual mitigation of 100 man-days of waterfowl hunting. The lakes and the vicinity around the lakes would not mitigate 500 man-days of upland game hunting. Manipulation of the vegetation could provide mitigation.

Land and water, and the condition or quality of the land and water, are the factors upon which the existence of fish and wildlife populations depend. The recreational values associated with fish and wildlife are directly related to

their abundance. Changes in the condition of land and water may increase or decrease fish and wildlife values, depending on what these changes are. The Bureau of Reclamation's Parker Division project proposes increased control of the Colorado River. This will effect a change on the land and water in the area which will be detrimental to fish and wildlife and their associated attributes.

The change will effect a two-pronged attach on fish and wildlife resources and their associated values. First, the river control work will reduce the carrying capacity of the land and water for fish and wildlife. The second prong of this attack is often more destructive to fish and wildlife values than the first. This is the creation of conditions that allow urbanization to the very edge of the river.

We are not denying the need and value of certain Colorado River control work.

We do object strongly to the attitude expressed in the Draft Report that the effects of river work on wildlife will be of minor long-term significance because of the present rapid development of agriculture, urbanized areas and recreational facilities along the river. Extensive agriculture and urbanized areas exist along the Colorado River today and will increase in the future principally because of river control work by the Bureau of Reclamation.

The Bureau of Reclamation indicates that the Parker Division project will help solve a drainage problem on lands in the vicinity of the river to increase the total agricultural yield. They have, and we believe rightfully so, used the benefits of the increased agricultural yield in their economic analysis of the project.

The Bureau should not discount as something that would happen anyway a land use change effected by the project resulting in an economic loss to the project. We are referring here to the Bureau's claim that urbanization along the river will negate the effects of the Bureau's river control work on wildlife in the long term.

We quote the following from Exhibit II of the Bureau's Draft Report. "In addition to productive habitat, a minimum of competition from other forms of water-oriented recreation, notably speedboating and waterskiing, has contributed to total fishing in the Parker Division. Shallow riffles, swift currents, trees and brush, sharp bends and other physical characteristics of the river that combine to produce high-qaulity fish habitat, render much of the river in the Parker Division unsafe for speedboating and waterskiing. Presently, speedboating and waterskiing activities are confined mainly to the vicinity of existing trailer resorts." A change in the high quality fishery resource will be the direct result of activities, or activities permitted by the Bureau of Reclamation.

The Bureau's Draft Report indicates that without river stabilization, it is probable that many oxbows, backwaters and pools now providing fish habitat would diminish or disappear completely. We agree with this and point out that the Bureau failed to indicate that the inherent forces in the river constantly acting on unprotected banks and river bottom would create new oxbows, backwaters and pools.

The Bureau's Draft Report states that the influx of fishermen has overtaxed the fishery of the Parker Division. We do not believe that fishermen are present in numbers sufficient to overtax the fishery. Severe daily river water surface fluctuation from upstream dam releases plus loss of recruitment of gamefish to the Division from nursery areas outside the Parker Division, because of dams, have impaired the quality of the fishery of the Parker Division.

The Bureau of Reclamation claims that stabilization of the river, because of channelization, will cause some aspects of fish production to be improved. Stability or homeostasis (the trend in a channelized stream) in an aquatic environment, or any environment, is terminal and marks the decline and eventual elimination of the affected populations. A variety and interspersion of habitat types is vital to maintain a thriving biotic community.

The Bureau, in its Draft Report, states: "Loss of water through evaporation would be minimized by filling, wherever possible, minor backwater areas possessing little value for recreation, fish and wildlife or other purposes." We declare that minor backwaters have a significant measurable value for birds, mammals and frogs. Spoil placement should be coordinated with the Arizona Game and Fish Department, the California Department of Fish and Game, and the Bureau of Sport Fisheries and Wildlife, to minimize damage to fish and wildlife.

The Draft Report indicates a nonbeneficial use by phreatophytes of 13,600 acre feet of water per year. Phreatophytes have a beneficial use because they are an important part of the wildlife habitat of the area.

The Bureau, in its benefit-cost analysis has indicated an annual operation and maintenance cost of fish and wildlife features of $10,000. We do not believe $10,000 annually is sufficient to operate and maintain the 500 acres of lakes, the 100 acres of backwaters, the five boat ramps, the five parking and sanitary facilities, the 24 miles of roads, and the 20 inlet and outlet structures included in the cost estimates, or the intensive fisheries management which the Bureau included in its report, but did not include in the cost estimates. The California Department of Parks and Recreation has found that annual maintenance and operation costs for boat ramps, parking and sanitary facilities are usually directly related to use and are about 25 cents per user-day. The estimate of annual costs for these facilities should be $25,000, which does not include fisheries management costs.

The Bureau of Reclamation has examined each mitigation proposal separately for economic justification. Under the Fish and Wildlife Coordination Act, mitigation must be accomplished at project cost and need not be justified economically. Further, since all benefits from mitigation cannot be measured in tangible terms of economists, the mitigation features should not be judged solely in terms of economic feasibility.

DEPARTMENT COMMENTS ON BUREAU OF SPORT FISHERIES AND WILDLIFE EXHIBIT

The Bureau of Sport Fisheries and Wildlife memorandum of September 8, 1965, to the Bureau of Reclamation is included as Exhibit II in the Bureau of Reclamation's "Draft Report, Comprehensive Plan, Lower Colorado River Channelization, Parker Division."

This memorandum constitutes the Bureau of Sport Fisheries and Wildlife report on fish and wildlife resources in relation to the Parker Division of the Colorado River Front Work and Levee System.

The California Department of Fish and Game received a corrected copy of the memorandum dated November 26, 1965 on May 31, 1966.

The Bureau of Sport Fisheries and Wildlife in describing the project area states, " . . . The 44 mile reach of the Colorado River in the Parker Division lies within the Colorado River Indian Reservation."

The State of California cannot accept this statement. The State of California, Attorney General's Office (opinion number 63/90 November 18, 1963) states that the land over which the Colorado River flows in California is not part of the Colorado River Indian Reservation. Further, it was declared the states own the bed of navigable streams within their borders (United States v Utah 283 V.S. 64 (1931).

The memorandum of November 26, 1965, in the section titled, "Wildlife, Without the Project" indicates approximately 11,000 acres are included in the area of project influence for wildlife and states that almost all of the area lies within the boundary of the Colorado River Indian Reservation.

The original memorandum of September 8, 1965, indicates 2,700 acres of non-Indian land in the project area. This figure was undoubtedly conservative because the Bureau of Sport Fisheries and Wildlife recognizes river bed lands, within the Parker Division, as Indian land.

For clarification, the State of California claims all land from the center of the old river channel to the low water level on the west bank prior to artifical influences. In addition, land adjacent to the river on the California side along about a 21 mile stretch of the southern end of the Division is outside the boundary of the Colorado River Indian Reservation.

We are in accord with the estimate of the Bureau of Sport Fisheries and Wildlife that average fishing over the life of the project would amount to about 355,000 man-days annually without the project.

The Bureau of Sport Fisheries and Wildlife estimates about 190,000 man-days of fishing annually with the project, over the life of the project, without mitigation.

We cannot agree with the Bureau of Sport Fisheries and Wildlife that there will be only a loss of 165,000 man-days of fishing annually attributable to the project, without mitigation.

With the project, but without mitigation features, fish habitat over the life of the project will consist almost entirely of the stabilized main channel. A few small backwaters in Section I will remain as fish habitat for five to ten years.

We believe it is unreasonable to expect a standing crop of about 12,250 pounds of gamefish to provide 190,000 man-days of angling annually, even though greatly improved access is provided. A more reasonable figure for angler-use with the project, but without the mitigation features, would be approximately 75,000 man-days annually. This would represent a loss of 280,000 man-days of fishing.

The Bureau of Sport Fisheries and Wildlife states fishing losses, due to channelization, will be offset in part by selective stocking, habitat development, and other fisheries management techniques, specifically designed to meet channelized conditions. The Bureau of Sport Fisheries and Wildlife further indicates these techniques will partially mitigate fish losses but does not assign the cost of these techniques to the channelization project. If these fishery management techniques are not supplied at project cost, then they cannot be claimed as mitigation for fish losses.

The Bureau of Sport Fisheries and Wildlife indicates small backwaters formed behind training structures in Section I will begin to deteriorate in five to ten years and will cease to exist as fish habitat in 15 to 20 years.

We maintain these backwaters will begin to deteriorate immediately after their formation and, if the Mohave Valley Division is any criterion, will cease to exist as fish habitat in five to ten years.

The Bureau of Sport Fisheries and Wildlife states fishery losses can be largely mitigated through project modifications, and that if water rights were available for impoundment of water to increase water area, fishing could be enhanced.

Our studies indicate with the project, including mitigation features, a 65 percent loss of gamefish, from about 121,125 pounds to approximately 42,250 pounds will occur, concurrent with a loss of an estimated 180,000 man-days of fishing annually. This is a reduction from about 355,000 man-days to about 175,000 man-days.

If water rights were available for further modification of the bypass lakes to increase water area, about 78,875 pounds of gamefish and approximately 180,000 man-days of fishing would have to be provided before enhancement could be claimed.

The corrected memorandum of November 26, 1965 indicates that the Cibola National Wildlife Refuge 30 miles downstream from the project area will eventually attract 8,800,000 days of waterfowl use. The purpose of the Cibola Refuge is to mitigate waterfowl losses up and down the river.

Mitigation cannot occur on the Cibola Refuge until the area has been improved over its present state. The State of California has not received plans from the Bureau of Sport Fisheries and Wildlife delineating improvements for the Cibola Refuge that would attract additional waterfowl.

We are very much in favor of conditions on the Cibola Refuge that would attract 8,800,000 days of waterfowl use. We would feel more secure if we knew the source of water that will improve the Cibola Refuge.

The Bureau of Sport Fisheries and Wildlife memorandum presents six recommendations as shown below:

1. That boulders and irregularly shaped rocks 18 inches or more in diameter be used in riprapping at least 50 percent of the bank area below normal river elevations for the May 15 to June 15 period.

2. That the Bureau of Reclamation in cooperation with the Bureau of Indian Affairs, the California Department of Fish and Game, the Arizona Game and Fish Department, and the Bureau of Sport Fisheries and Wildlife, plan for preservation of fish habitat in the Colorado River through placement of large rocks, rubble, or gravel at selected sites along the river bank and through preservation of shoreline irregularities wherever feasible.

3. That during and after project construction the Bureau of Reclamation cooperate with the Bureau of Indian Affairs, the California Department of Fish and Game, the Arizona Game and Fish Department, and the Bureau of Sport Fisheries and Wildlife to preserve at least 100 acres of selected small cutoffs as fish producing areas through curtailment of spoil deposition, dredging as required, and installation of culverts to connect the cutoffs with the river.

4. That at least 500 acres of major backwater lakes which will exist after project construction be developed as outlined on pages 35, 36, and 37 of their memorandum for purposes of fish and wildlife management.

5. That the Bureau of Reclamation consult with the Bureau of Indian Affairs and the Colorado River Indian Tribes to determine their interest and desire in having the Bureau of Reclamation further develop, as a project feature, impoundment at one or more channel bypasses, shown on Plate 1 as Sites A, B, C. D, and E of their memorandum and as described on page 38 of the same memorandum, into lakes to be administered and managed for the enhancement of fishing and hunting.

6. That the proposed Quien Sabe Point Wildlife Management Area outside of the Colorado River Indian Reservation, as described in the Lower Colorado River Land Use Plan, approximately as shown as Site F on Plate 1 of their memorandum, be made available to the California Department of Fish and Game for mitigation of wildlife losses under the provisions of a General Plan as provided in Section 3 of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U:S.C. 661 et seq.).

Recommendation number 1 proposes to mitigate for about 8,000 man-days of fishing.

Riprapping of irregularly shaped rocks, generally 18 inches or more in diameter, was done in portions of the Mohave Valley Division. Siltation has partially filled the interstices and no benefit to warmwater fishes may be related to such riprapping in the Mohave Division. We have no reason to believe that the recommended riprapping will be any more effective in the Parker Division.

Recommendation number 2 seems to us to be a sound management proposal. Preservation of shoreline irregularities must not be considered as a mitigation measure, but as a habitat preservation feature. The placement of large rocks, rubble, or gravel at selected sites to create shoreline irregularities along the river banks is a proper mitigation feature, but there should be provision made for maintenance of such conditions for the life of the project.

We agree that recommendation number 3 will mitigate about 17,000 man-days of fishing losses provided the 100 acres of cutoffs are protected by a buffer zone from resort development and high speed boating.

Recommendation number 4 proposes five bypass lakes totaling about 500 acres with initial and periodic dreding and intensive fisheries management. Cost estimates were provided for the initial development but no costs were provided for the necessary maintenance and intensive fisheries management. The latter cost items are a necessary feature of mitigation and should be project costs.

The Bureau of Sport Fisheries and Wildlife estimates the five developed lakes will mitigate for 135,000 man-days of fishing annually. Our analysis of the potential standing crop of gamefish indicates mitigation would amount to only 83,000 man-days of fishing.

The Bureau also estimates the bypass lakes will mitigate 5,000 waterfowl-use days and 100 man-days of hunting annually. We believe this estimate is reasonably accurate if the lakes are protected from a high level of recreational use, other than hunting. Intensive recreational use, including speed boating and water skiing, would also seriously interfere with angling use of the lakes.

The Bureau's supporting information for recommendation number 4 includes the following statement, "Preservation of vegetation in the bypass lake perimeters could provide some nesting areas for doves and quail and thus contribute to mitigation of upland-game losses. The lakes and their peripheries would attract doves and would be responsible for restoring an estimated 500 man-days of dove hunting in the general vicinity of the project." Vegetation and water exist in the area and attract doves and quail without the project. Preservation of habitat must not be considered mitigation.

The Bureau of Sport Fisheries and Wildlife memorandum indicates that planning is well advanced by the Bureau of Indian Affairs and Colorado River Indian Tribal Council for extensive additional resort and urban development in the Parker Division. The memorandum further indicates that this increased human activity will eliminate much of the hunting. We state emphatically that most of the present urbanization and agriculture along the Lower Colorado River is a direct result of past river control work. In fact, one of the major purposes of the Colorado River Front Work and Levee System is to allow and protect such endeavors.

We believe that without the Parker Division Project, extensive resort and urban development will not occur adjacent to the river. Such developments will occur as a result of the project; therefore, it is the project that will eliminate much of the hunting. We maintain that any reduction of the high potential for fishing in the Parker Division will be essentially a direct result of river control and water salvage work.

California has not received formal plans from the Bureau of Indian Affairs relating to extensive resort and urban development in the Parker Division. The California Department of Fish and Game and the Arizona Game and Fish Department both reject the five bypass lakes and the 100 acres of small cutoffs as mitigation measures unless 1) a substantial buffer zone is created around the lakes to preserve the vegetation and resort development is prevented within the buffer zone, and 2) water skiing and speed boating are prevented in the lakes.

Recommendation number 5 proposes enlargement of one or more of the bypass lakes considered in recommendation number 4 with a Tribal allotment of water for the increased surface acreage. We are in favor of this proposal providing there is a firm commitment for the life of the project that the lakes will be dedicated primarily to fishing and hunting.

Recommendation number 6 proposes that an area south of the Colorado River Indian Reservation and west of the Colorado River, the Quien Sabe Point area, be made available to the California Department of Fish and Game for mitigation of wildlife losses.

The Bureau of Sport Fisheries and Wildlife supporting information indicates the wildlife habitat and hunting potential of the Quien Sabe Point area will be contingent largely upon the water supply which the California Department of Fish and Game can provide for use on the area. The California Department of Fish and Game does not have water to provide for use on the area, nor will there be an opportunity to obtain water unless additional water is obtained from the Colorado River for use by the California Department of Fish and Game. Water must be supplied to the California Department of Fish and Game for the area before recommendation number 6 is construed as mitigation.

The transfer of the Quien Sabe Point area is already a part of the Lower Colorado River Land Use Plan which has been approved by the Secretary of the Interior and, therefore, its inclusion here without provision of water and management improvements to be provided at project cost, does not constitute mitigation.

DEPARTMENT COMMENTS ON LOWER COLORADO RIVER LAND USE OFFICE REPORT

A review of the Bureau of Reclamation's draft reports for the Parker, Topock Gorge, and Yuma Divisions of the Colorado River disclosed that the draft reports for the Topock Gorge and Yuma Divisions contained exhibits prepared by the Lower Colorado River Land Use Office. The draft report for the Parker Division does not include an exhibit prepared by the Lower Colorado River Land Use Office.

Contact with the Lower Colorado River Land Use Office and the Bureau of Reclamation revealed a report had been submitted by the Lower Colorado River Land Use Office, but this report was not available to the State of California for review.

The opportunity should be given for California to review proposals of the Lower Colorado River Land Use Office accepted by the Bureau of Reclamation before the final report of the Bureau of Reclamation is prepared. The comments of the states of Arizona and California should be received by the Bureau of Reclamation before proceeding further with the Parker Division report and work.

SUMMARY OF DEPARTMENT OF FISH AND GAME COMMENTS ON THE PARKER DIVISION REPORT OF THE BUREAU OF RECLAMATION:

Channelization, and other river control work, in the Parker Division, as proposed by the Bureau of Reclamation -- including mitigation features adopted by the Bureau -- will result in substantial annual losses of soft shelled turtles, frogs, fish, wildlife, and the attendant man-days of use.

A dispute exists relating to land ownership in the old river bed, and the present river bed, in the Parker Division. The status of land ownership will determine the affect mitigation proposals, adopted by the Bureau of Reclamation, may have on fish and wildlife values in the Division.

The Lower Colorado River Land Use Office report on the Parker Division has not been made available to the State of California for review and comment. Review of proposals of an agency of the Department of the Interior included only in a final report would not seem to be in accord with the intent of the Fish and Wildlife Coordination Act.

Evaluation by the California Department of Fish and Game of fish and wildlife aspects in relation to the Parker Division project presents information substantially different than that presented in the Bureau of Reclamation's draft report on the Parker Division.

Table 4 is a summary of the information to be found in the Bureau of Reclamation draft report relating to annual man-days of hunting, waterfowl use-days, and man-days of fishing without the project; and with the project, without and with mitigation, and the U. S. Bureau of Reclamation figures include the respective areas in California and Arizona. Not shown in the table is the net change in beaver pelts taken annually from 300 without the project to 100 with the project, a loss of 200 pelts per year.

Table 4 also presents California Department of Fish and Game evaluation, based on several years of study, of hunting, waterfowl use-days, and fishing, annually, in relation to the Parker Division project. Man-days of hunting are for California, only.

With the Parker Division project, and with mitigation features adopted by the Bureau of Reclamation, the California Department of Fish and Game estimates a substantial annual loss of wildlife, including 151,700 waterfowl use-days annually; a continuous loss of 78,875 pounds of standing crop of gamefish concurrent with an annual loss of 180,000 man-days of fishing; an annual loss of 200 beaver pelts; and an annual loss of 6,400 man-days of hunting in California.

TABLE 4

SUMMARY OF CALIFORNIA DEPARTMENT OF FISH AND GAME
AND
U. S. BUREAU OF RECLAMATION
ON
HUNTING, WATERFOWL USE-DAYS AND FISHING, ANNUALLY

Man-Days of Hunting	Without the Project	With the Project			
		Without Mitigation	Loss	With Mitigation	Loss
Big Game - Calif.	750	550	200	550	200
" " - USBR.	200	0	200	0	200
Upland Game - Calif. 1/	61,000	57,200	3,800 2/	57,200	3,800
" " - USBR.	11,300	3,800	7,500	4,300	7,000
Waterfowl - Calif.	3,525	1,025	2,500 2/	1,125	2,400
" " - USBR.	500	200	300	300	200
California Totals	65,275	58,775	6,500	58,875	6,400
Waterfowl 3/ - Calif.	230,200 4/	73,520	156,700	78,520	151,700
Use-Days - USBR	300,000	100,000	200,000	105,000	195,000
Man-Days of - Calif.	355,000	75,000	280,000	175,000 5/	180,000 5/
Fishing - USBR	355,000	190,000	165,000	350,000	5,000

1/ Includes rabbits, doves, quail, and nongame mammals such as the coyote and fox.

2/ California area only.

3/ Includes seasonal and resident.

4/ 3-year census.

5/ Intensive fisheries management and the placement of large rocks, rubble or gravel at selected sites along the river bank, implemented as a project cost, could increase man-days of fishing over 175,000 in the Parker Division. Further study is required to determine just how much increase might occur.

RECOMMENDATIONS OF THE CALIFORNIA DEPARTMENT OF FISH AND GAME ON THE PARKER DIVISION

In view of the foregoing, it is recommended:

1. That the Bureau of Reclamation furnish the states of California and Arizona, the report on the Parker Division obtained by the Bureau of Reclamation from the Lower Colorado River Land Use Office for review and comment; and indicate the recommendations of the Lower Colorado River Land Use Office the Bureau of Reclamation intends to adopt.

2. That the Bureau of Reclamation delay preparation of its final report on the Parker Division until all agencies concerned have had adequate time to review and comment on the Lower Colorado River Land Use Office report, and until the Bureau of Reclamation has had adequate time to evaluate the comments of Arizona and California on the Lower Colorado River Land Use Office report.

3. That the Bureau of Reclamation plan adequate mitigation features in the river area of the Parker Division on lands where mitigation can in fact be accomplished and maintained.

4. That no plans for river control work in the Parker Division be carried out until adequate mitigation features become an integral part of the entire plan. The Arizona and California Fish and Game Departments shall be consulted in the development of alternative mitigation plans.

5. That the Bureau of Reclamation accepts the California Department of Fish and Game re-evaluation of fish and wildlife, and associated recreation, in relation to with-and-without project conditions in the Parker Division for evaluation prior to preparation of a final report.

6. That the Bureau of Reclamation locate the equipment base up-river from the bridge north of section 34, T1S-R24E SB.B&M. to preserve the high wildlife values in the area known as "The Strand" **or preferably down river below "The Strand".**

7. That the Bureau of Reclamation adopt proposals of the Bureau of Sport Fisheries and Wildlife, for retention and maintenance of about 100 acres of backwaters, and improvement and maintenance of 500 acres of bypass lakes in the Parker Division for mitigation of fish and wildlife losses. An added provision should be made for preservation of a quarter mile to one-half mile vegetative buffer strip around the waters, and subject to unlimited free access by the public for fish and wildlife centered recreation. If establishment of these buffer strips is not possible, we recommend evaluation of the effects on the bypass lakes and backwaters, without the buffer strips. After this evaluation, fish and wildlife losses, still remaining, should be mitigated elsewhere in the Parker Division, or in another division of the river, as a responsibility of the Lower Colorado River Front Work and Levee System.

8. That the Bureau of Reclamation provide project funds for operation and maintenance wherever it has adopted continuing management programs as a mitigation feature.

9. That the Bureau of Reclamation avoid making any reference to mitigation, or enhancement where preservation of existing fish and wildlife habitat is proposed. Preservation of existing fish and wildlife habitat should not be claimed as mitigation or enhancement in the Federal Reports and wherever this has been done we do not concur that any mitigation or enhancement value accrues.

10. That the Bureau of Sport Fisheries and Wildlife and the Bureau of Reclamation, in cooperation with Arizona Game and Fish Department and California Department of Fish and Game develop a plan of fish and wildlife mitigation to compensate for the loss of 6,400 man-days of hunting; 151,700 waterfowl-use days; 180,000 man-days of fishing and 78,875 pounds of standing crop of game fish. The development and implementation of such a plan shall be the responsibility of the Colorado River Front Works and Levee Program.

11. We concur in the following recommendations of the Bureau of Sport Fisheries and Wildlife with the exceptions noted:

    a. Recommendation No. 2.

    b. Recommendation No. 3, providing that the 100 acres of cutoff backwaters are protected by a buffer zone from resort development and high speed boating, and is subject to unlimited free access by the public for fish and wildlife centered recreation.

    c. Recommendation No. 4, providing that the necessary maintenance and intensive fisheries management costs necessary for mitigating 83,000 man-days of fishing, 5,000 waterfowl-use days and 100 man-days of hunting, are considered as project costs.

    d. Recommendation No. 5, providing there is a firm commitment for the life of the project that the lakes will be dedicated primarily to fish and wildlife production, and fishing and hunting.

COMMENTS OF THE DEPARTMENT OF PARKS AND RECREATION

The Department of Parks and Recreation has reviewed the Bureau of Reclamation's comprehensive river management plan reports for Topock Gorge, Parker and Yuma Divisions on the Lower Colorado River. The review involved both the Divisions of Beaches and Parks and Small Craft Harbors. Our comments, based upon this review, are reported below.

It should first, and most importantly, be noted that the Department of Parks and Recreation is opposed to any changes in the Colorado River or its channel within the Topock Gorge Division which would adversely affect the present outstanding scenic character of the gorge. The relationship of colorful volcanic formations, the river, backwater lakes, beaches and streamside growth in Topock Gorge is considered to be unique. This area has been included by the U. S. Department of the Interior in the Lower Colorado River Land Use Report as a potential future State Park. While no aquisition program is underway, the State Park Commission has endorsed the concept.

The following general discussion will be limited to those features of the reports common to both the Parker and the Yuma Divisions.

Channelization of the reaches of the Lower Colorado River within Parker and Yuma Divisions will materially change the types of recreational use now experienced in these areas. Fish and wildlife patterns will change because of reduced water surface, change in sediment load, river depth and velocity, and water temperature; vegetative types will change because of removal of native vegetation and phreatophyte growth and the planting of proposed recreational areas with landscaping and turf materials.

Along many reaches of the river, the quality of recreation experience gained by the visitors will diminish upon completion of the project. This will be true, especially in the realm of visits for scenic appreciation, viewing and photographing wildlife and general enjoyment of the land and water areas. The quantity of visitor use in recreation days will probably increase, if the recommendations of the Lower Colorado River Land Use Office are followed in implementing the proposed river management plans. The use, for the most part, will be of a different type. Much of the use will involve active water associated recreation, rather than the passive type of recreation, such as viewing and appreciating scenic areas and wildlife resources.

The reports recommend that side slopes in the proposed channels be constructed to a 1-1/2 to 1 ratio. From the standpoint of the safety of recreation users, side slopes should not exceed 3 to 1. In reaches which are planned for active recreation use, side slopes should not exceed a ratio of 6 to 1.

The Lower Colorado River Land Use Office recommends that clearing and planting be done with technical assistance from that office and from the Federal Bureau of Sports Fisheries and Wildlife. The general review of plans for clearing, planting, spoil areas, side slope areas, protective material for channel banks and general alignment of the channel should be provided by the Lower Colorado River Land Use Office, other concerned Federal agencies, and most important, the States of California and Arizona. It is important that wherever plantings are proposed, water be available for sufficient irrigation to establish and maintain these plantings.

In its management plans for each of the three reports for the Lower Colorado River, the Bureau of Reclamation proposes construction of access and service roads for purposes of project construction and maintenance. It is recommended that these service roads be so constructed and maintained as to permit access to the subject reaches of the Lower Colorado River for recreation purposes consistent with public health and safety and retention of the scenic character of Topock Gorge.

The following specific comments are directed toward the Topock Gorge Division report.

Since the Topock Gorge area is being considered for ultimate inclusion in the State Park System, it is important that:

1. No changes be made in the Colorado River or its channel which would adversely affect the present outstanding scenic character of Topock Gorge.

2. Deepening of the channel, if necessary, be accomplished by means other than by dredging, depositing the excavated material in spoil banks along the lower cliffs forming the gorge and riprapping the newly created channel. It is possible that by removing material gradually from the downstream portion of the gorge, the channel can be deepened and cleared by the natural action of the river.

3. Recreation use zones within the gorge area be established to avoid competition among varying recreation interests to protect those scenic features which may be destroyed by adverse use or overuse.

4. Boating speeds be established and enforced which would provide for boater safety, preservation of wildlife and wildlife habitat, and preservation of the outstanding scenic character of the gorge.

5. Public access roads to the gorge area be located and constructed to provide maximum public utilization with minimum disturbance of the scenic and wilderness attributes which now characterize it.

The Division of Small Craft Harbors has loaned $300,000 to San Bernardino County to prepare a site and develop a small craft marina on the Colorado River at Park Moabi about 1 mile upstream from the entrance to Topock Gorge. The security for repayment of this loan is the gross revenue received from the operation of the marina. The loan is being amortized at a 3% interest rate over a period of 20 years from March 15, 1960. The County, as well as private interests, has made additional investments in the park, and plans call for further investments of about $1,500,000. The Bureau of Reclamation recently dredged the harbor and has agreed to maintain a suitable entrance channel.

On the basis of information in the Topock Gorge Division report, it is not clear whether the proposed excavations in the gorge will lower the present water level in the marina harbor or otherwise adversely affect the operation of the marina. Any excavation by the Bureau of Reclamation in Topock Gorge which would reduce the depth of water in the marina harbor, prevent or hinder use of the entrance channel, or reduce the number of boaters utilizing the marina would endanger the repayment of the Small Craft Harbor loan made on the Park Moabi marina and would also endanger the investments made by San Bernardino County and private investors.

From an economic viewpoint, any project or program that renders the Park Moabi marina inoperable would result in an annual loss of $745,000 in business activities in the community, and the loss of investment opportunities in the amount of $14,000,000. Any decrease in the

demand for the facilities and services of the marina through limitations imposed by water conditions, or any imposed increase in costs, would discourage, in direct relation to their adverse affects, further developments, and decrease the income expected through the utilization of the existing facilities. The direct effect to the Division of Small Craft Harbors would be the impairment of the security of the remaining balance of $270,000 of the initial loan of $300,000, which loan is secured by the gross income to the marina, or impel the County to make repayments from its general fund.

The following specific comments apply to the Parker Division:

The Parker Division report made few references and gave little consideration to recreation, either existing or that which would result from the implementation of the report.

This report states that the preparation of the Lower Colorado River land use plan was accomplished in full recognition of the requirements for river control and rectification activities. It is true that the lower Colorado River Land Use Plan was developed in an atmosphere of awareness of the Bureau of Reclamation's channelization proposals. However, the working staff and advisory committee responsible for the land use plan were opposed to a large portion of the proposals by the Bureau to channelize the Colorado River within the Parker and other Divisions. Their objections were based mainly on the adverse effects of channelization on fish and wildlife and recreation resources.

The following specific comments will apply to the Yuma Division:

The Department of Parks and Recreation supports in principle the 13 recommendations presented by the Lower Colorado River Land Use Office.

The Bureau of Reclamation takes exception to those portions of the Lower Colorado River Land Use Office's recommendations which involve consumptive use of waters and which recommend construction of recreation features and facilities for which no operator is apparently available. Further objection is made by the Bureau of Reclamation on the basis of the necessity for staged development of recreation facilities, rather than the development of all facilities initially. It is suggested that the Lower Colorado River Land Use Office prepare a plan for staging the recreation developments proposed within the Yuma Division over a reasonable period of time. It is strongly recommended that other interested Federal agencies and the States of California and Arizona be consulted concerning recreation facility development staging. It is intended that this plan would delineate the points in time when specific recreation facilities and development would be required, based upon anticipated use and need.

It is obvious that proposals for landscape plantings and off-channel impoundments would require the consumptive use of water. If recreation plans as indicated by the Bureau are to be successfully implemented, it will be necessary for recreation interests to acquire the rights to the amount of water required for these purposes. Since most of the recreation users will originate from those areas which have rights to the use of Colorado River water, it should not be too difficult to impress upon these people, and the Districts which represent them, that the allocation of a reasonable share of their water should be reserved for recreation and fish and wildlife resources and activities.

Although the Bureau of Reclamation states that Recommendations #12 and #13 are beyond the scope of its report, these are sound recommendations from the standpoint of recreation and should receive favorable

consideration from the standpoint of the overall plan for management of the entire Lower Colorado River Basin.

Conclusions:

1. The relationship of geologic formations and the river, with its backwater lakes, beaches and riparian vegetation, in Topock Gorge constitutes one of the outstanding natural resources of the Pacific Southwest. Proposed dredging in the gorge would result in the destruction of its scenic value. The Department of Parks and Recreation is opposed to any project activities in the Topock Gorge Division which would adversely affect the outstanding scenic character of the gorge.

2. Along many of the reaches of the Lower Colorado River outside of Topock Gorge, the quality of recreation experience gained by visitors to the area will diminish upon completion of the project. This is especially true in the area of scenic appreciation, viewing and photographing wildlife and general enjoyment of the land and water areas.

3. In reaches of the river outside of Topock Gorge which could be developed for active recreational use in connection with a channelization project, the side slopes of the trapezoidal channel sections should be designed for both the safety and comfort of the recreational users.

4. Access and service roads built for project construction purposes should be constructed and maintained in a manner which would permit public access to the subject reaches of the Lower Colorado River for recreation purposes consistent with public health and safety and retention of the wilderness character of Topock Gorge.

5. Construction of the proposed plan of improvement for the Topock Gorge Division could adversely affect the operation and financial

stability of the Park Moabi marina by reduction of water depth in the marina harbor and entrance channel and by the reduction in boaters utilizing the marina.

6. Proposals by the Bureau of Reclamation for landscape plantings and off-channel impoundments would require the consumptive use of water. If recreation plans, as indicated by the Bureau, are to be successfully implemented, water rights for these purposes must be secured.

Recommendations:

1. It is recommended that the present outstanding scenic character of Topock Gorge be preserved. Any deepening of the channel, if found to be necessary, should be accomplished by means which are totally consistent with this objective.

2. It is recommended that the Lower Colorado River Land Use Office prepare a plan for staging the recreation developments within the Parker and Yuma Divisions of the Lower Colorado River over the repayment period of the project. Other interested federal agencies and the States of California and Arizona should be consulted concerning recreation facility development staging. This plan should include general and specific review of the Bureau's plans for clearing, planting spoil areas, side slope ratios, protective material for channel banks and a general alignment of the channel to assure that work in connection with these items is fully compatible with the recreation purpose of the project.

COMMENTS OF THE DIVISION OF HIGHWAYS, DEPARTMENT OF PUBLIC WORKS

Yuma Division

A new bridge is presently under design for the Interstate 8 crossing at Yuma. We propose to allow for pier alignment and depths in accordance with this report; however, we would like to have the channel alignment above River Section 8-S established so that we can design our bridge accordingly. There are no conflicts with other highways in the area.

Parker Division

It appears that the proposed construction will not interfere with existing State Route 95. Since Route 95 is a part of the Freeway and Expressway System, it will ultimately be constructed to freeway or expressway standards. As soon as alternate locations are developed we will confer with the Bureau of Reclamation in regard to coordinating our work with the channelization plan for the lower Colorado River.

Topock Gorge Division

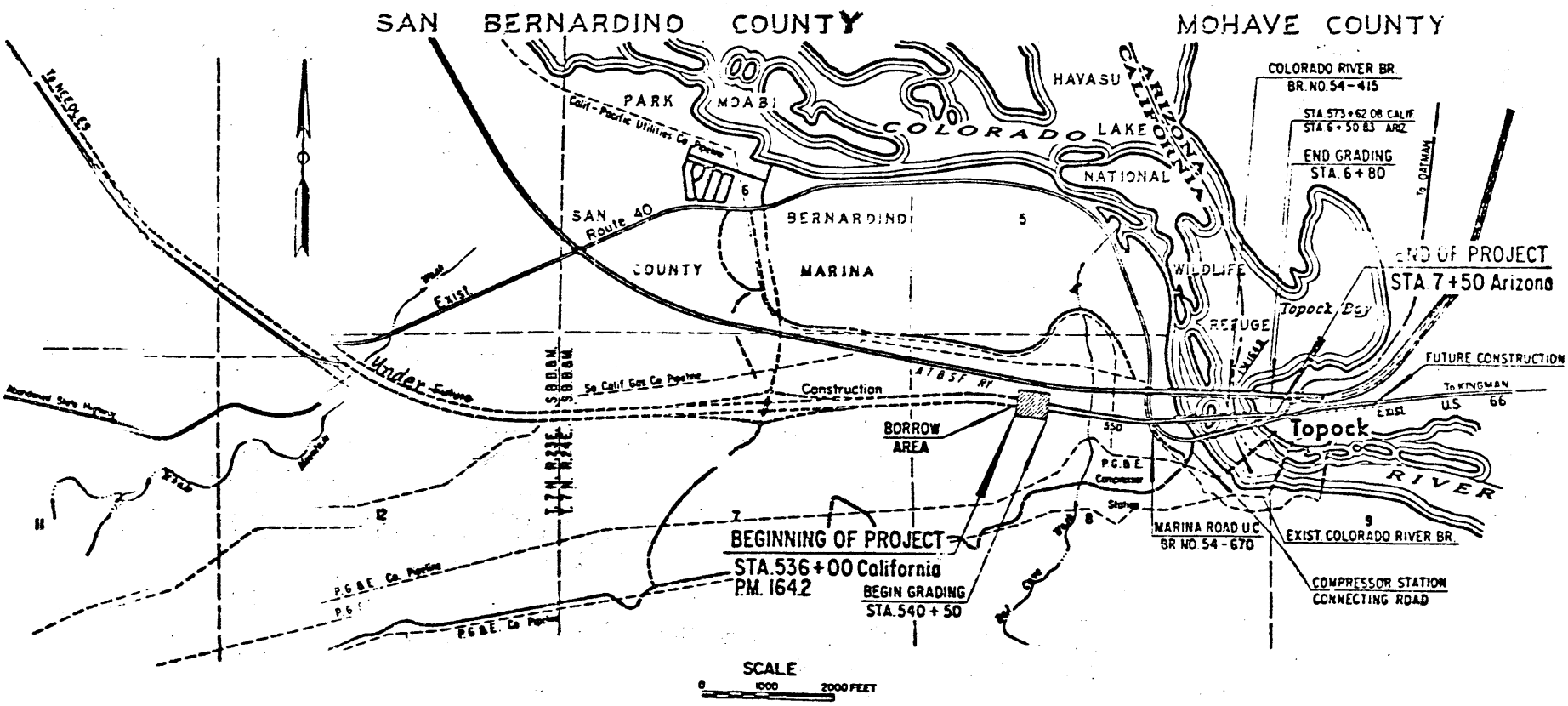
The attached print of the current State highway contract on Interstate Route 40 west of Topock shows the new location of Route 40 at its Colorado River crossing. It is anticipated that traffic will be using the new facility by August of this year.

The new bridge has abutments protected by grouted rock slope protection down to an elevation of 444, which is 10 feet below the ground surface at the abutments. Dredging, as proposed to a downstream elevation of 438 could possibly lower the river bottom below the existing grouted

rock slope protection at the Route 40 bridge. Due to the configuration of the river at this point we believe that the abutment on the Arizona side should be protected by one ton rock slope protection (ungrouted) at the toe of the grouted rock. This will protect the abutment fill should scour occur below elevation 444. The abutment fill on the California side is in lesser danger of such scour and rock may be added at the time any degradation of the channel is observed.

In San Bernardino County California and Mohave County Arizona at the Colorado River near Topock

FREEWAY
by resolution of the California Highway Commission
March 22, 1961



Length of Project = 3,861.25 Feet = 0.73 Mile

08 - SBd - 40

COMMENTS OF THE COLORADO RIVER BOARD OF CALIFORNIA

The Colorado River Board is in accord with the objectives of the Bureau of Reclamation's river management program for the Lower Colorado River. Agricultural, municipal, and industrial water users in California have long depended upon Colorado River for their water supply. Even so, these users face the prospect of a reduction in their supply from the river. This prospect prompts the Board to support all reasonable and feasible means for conservation of the water of the main stream, including river channelization and elimination of phreatophytes; the Bureau of Reclamation program offers reasonable and feasible means for conserving water now being consumed non-beneficially.

Even more water could be salvaged from the Colorado River, but the Board recognizes, as does the Bureau of Reclamation, that the conflicting demands of the various classes of users must be weighed in any management program for the river. The program proposed in the three reports seeks a reasonable balance among the purposes of water salvage, river control, enhancement of recreational opportunities, and mitigation of fish and wildlife losses; it is consistent with an objective of H.R. 4671, a pending bill endorsed by Governor Brown and the Colorado River Board. Section 305 of that bill provides in part:

> The main stream salvage unit shall include programs for water salvage along and adjacent to the main stream of the Colorado River . . . . Such programs shall be consistent with maintenance of a reasonable degree of undisturbed habitat for fish and wildlife in the area . . . .

The Colorado River Board endorses the program of the Bureau of Reclamation and urges its implementation as soon as possible.

COMMENTS OF THE COLORADO RIVER BOUNDARY COMMISSION
(State Lands Division)

The proposed improvements will probably have very little effect on the activities of this Division. It is possible that the realignment could change the course of the river and thus cause certain pier permits or leases on the river to become unnecessary.

The realignment will not affect the state boundary between Arizona and California; because the Interstate Compact, now before Congress for approval, fixed the geographical boundary with reference to the 1962 position of the Colorado River.

The proposed realignment also will not affect fee ownership to land along the Colorado River; because land titles are based on the last known natural location of the river, which may be the 1962 position in some areas or some other location prior to an avulsive or man-made change.

EXHIBIT V

IN REPLY REFER TO

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS
Phoenix Area Office
P. O. Box 7007
Phoenix, Arizona 85011

Land Operations
Irrigation

JUL 23 1965

Mr. A. B. West
Regional Director
Bureau of Reclamation
Region 3
Boulder City, Nevada

Dear Mr. West:

Reference is made to your letter of August 27, 1964, and the "Draft Report on Comprehensive Plan - Colorado River Channelization - Parker Valley Division" transmitted therewith.

Since then there have been a number of meetings of representatives of the Colorado River Tribes, Bureau of Reclamation, Bureau of Indian Affairs, and other interested parties concerning the proposed works. After these discussions and review of the report, the Bureau of Indian Affairs has the understanding that the features of work presented in the plan are generalized to show the overall objectives of the plan. Details of the work will be based on additional studies, reviews, and final location surveys. We also understand that your plans will include consideration of the multi-purpose development of shorelines, backwater areas and adjacent land areas, including dredging of bypassed water areas.

The Bureau of Indian Affairs approves the objectives and general plan of river control presented in the report.

We believe the Tribal Council will take favorable action on the matter at its next meeting.

The details of work will be subject to further studies, location surveys and discussions between the Bureau of Reclamation, Bureau of Indian Affairs, and Colorado River Tribes. Separate letters of agreement will be written with regard to each reach of the river before construction starts in the reach.

Sincerely yours,

Area Director

cc:
Supt., Colorado River Agency
Tribe (thru: Supt., Colorado River Agency)
Commissioner of Indian Affairs
Regional Solicitor,L.A.
F.L.Kirgis,Tribal Attorney
Denver

Resolution No. R - 53 - 65

RESOLUTION

COLORADO RIVER TRIBAL COUNCIL

A Resolution to approve the objectives and general plan of river control presented in the "Draft Report on Comprehension Plan-Colorado River Channelization-Parker Valley Division".

Be it resolved by the Tribal Council of the Colorado River Indian Tribes, in regular meeting assembled on August 7, 1965

WHEREAS, the Colorado River Tribal Council has the authority under Article VI, Section 1(a) to negotiate with Federal, State, and local governments on behalf of the Colorado River Indian Tribes, and

WHEREAS, there have been a number of meetings of representatives of the Colorado River Tribes, Bureau of Reclamation, Bureau of Indian Affairs and attorneys and officials of the Central California Land Development Company concerning the "Draft Report on Comprehension Plan - Colorado River Channelization - Parker Valley Division," and

WHEREAS, all parties concerned have arrived at a mutual agreement on a general plan of river control presented in the above-mentioned report,

NOW, THEREFORE, BE IT RESOLVED, that the Colorado River Tribal Council acting on behalf of the Colorado River Indian Tribes, approves the objectives and general plan of river control presented in the report.

BE IT FURTHER RESOLVED, that the details of all work will be subject to further studies, local surveys and discussions between the Bureau of Reclamation, Bureau of Indian Affairs, Colorado River Indian Tribes and officials of the Central California Land Development Company, and that separate letters of agreement will be written with regard to each reach of the river before construction starts in the reach.

The foregoing resolution was on August 7, 1965 duly approved by a vote of 6 for and 1 against, by the Tribal Council of the Colorado River Indian Tribes, pursuant to authority vested in it by Section 1(a), Article VI of the Constitution (or By-Laws) of the Tribes, ratified by the Tribes on July 17, 1937, and approved by the Secretary of the Interior on August 13, 1937, pursuant to Section 16 of the Act of June 18, 1934, (48 Stat. 984). This resolution is effective as of the date of its adoption.

COLORADO RIVER TRIBAL COUNCIL

By Herman D. Laffoon, by

Herman D. Laffoon, Sr., Chairman

Gladys B. Rumo Secretary

Approved:

Superintendent

EXHIBIT VI

7-1720
(6-62)
Bureau of Reclamation

BASIC ESTIMATE DC-I SUMMARY

PROJECT Colo. R. Front Work & Levee System
Date of Estimate January 1969
Prices as of January 1969
Sheet 1 of 1 sheets

Prepared by Boulder City, Nevada

Previous Estimate Prices as of

PROPERTY CLASS	PROPERTY IDENTIFICATION	PROPERTY ACCOUNT	PROPERTY DESCRIPTION	LABOR AND MATERIALS BY CONTRACTOR COST	MATERIALS AND EQUIPMENT BY GOVERNMENT COST	LABOR BY GOVERNMENT FORCES COST	FIELD COST PROPERTY ACCOUNT	TOTAL FIELD COST IDENTIFIED PROPERTY	SERVICE FACILITIES IDENTIFIED PROPERTY	INVEST'GNS ENGR'G. AND OTHER COST IDENTIFIED PROPERTY	TOTAL COST IDENTIFIED PROPERTY	TOTAL COST PROPERTY CLASS	TOTAL COST IDENTIFIED PROPERTY
1			2	3	4	5	6	7	8	9	10	11	12
09			CHANNELS, LEVEES AND FLOODWORKS					10,989,000		880,000	11,869,000		
			River Management - Parker Division										
09	01		ABOVE ALLIGATOR BEND - SECTION I					1,831,500		240,000	2,071,500		
09	01	377	Waterways	1,831,500			1,831,500						
09	02		BELOW ALLIGATOR BEND - SECTION II					6,738,500		480,000	7,218,500		
09	02	377	Waterways	3,853,700	1,190,200	1,454,600	6,498,500						
09	02	380	Miscellaneous Equipment	240,000			240,000						
09	03		FISH AND WILDLIFE FEATURES					2,209,000		140,000	2,349,000		
09	03	376	Structures and Improvements	427,000	690,000	1,092,000	2,209,000						
09	03	380	Miscellaneous Equipment		0		0						
09	04		Recreation Features					210,000		20,000	230,000		
09	04	376	Structures and Improvements	146,400	25,400	38,200	210,000						

Form 7-1432
(6-65)
Bureau of Reclamation

INSTRUCTIONS FOR USE OF THIS FORM ARE CONTAINED IN CHAPTER 6, PART 152 OF THE RECLAMATION INSTRUCTIONS

BASIC ESTIMATE DC-1

OFFICE PREPARED BY: Boulder City, Nevada

PROJECT Colorado River Front Work & Levee System
Date of Estimate January 1969
Prices as of January 1969
Sheet 1 of 4 sheets

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	PAY ITEM	DESCRIPTION	QUANTITY AMOUNT	QUANTITY UNIT	LABOR AND MATERIALS BY CONTRACTOR UNIT COST	LABOR AND MATERIALS BY CONTRACTOR TOTAL COST	MATERIALS AND EQUIPMENT BY GOVERNMENT UNIT COST	MATERIALS AND EQUIPMENT BY GOVERNMENT TOTAL COST	LABOR BY GOVERNMENT FORCES UNIT COST	LABOR BY GOVERNMENT FORCES TOTAL COST	FIELD COST COLS. 4, 5, & 6 UNIT COST	FIELD COST COLS. 4, 5, & 6 TOTAL COST	FIELD COST PLANT ACCOUNT	FIELD COST IDENTIFIED PROPERTY	SERVICE FACILITIES IDENTIFIED PROPERTY	OTHER COSTS IDENTIFIED PROPERTY	TOTAL COST IDENTIFIED PROPERTY	TOTAL COST PROPERTY CLASS	TOTAL COST ALL CLASSES
1				2	3		4		5		6		7		8	9	10	11	12	13	14
09				CHANNELS, LEVEES, AND FLOODWORKS												10,989,000		880,000	11,869,000		11,869,000
				River Management, Parker Division - About 11 miles of the Colorado River will be rectified by construction of bank reinforcement and protective works. About 21 miles of the Colorado River will be channelized for river regulation and water conservation.																	
	01			ABOVE ALLIGATOR BEND - SECTION I												1,831,500		240,000	2,071,500		
				Bank protection and training structures upstream from Alligator Bend for control of the river where no dredging is required.																	
		377		WATERWAYS											1,831,500						
			1	Clear and trim banks	60,000	L.F.		45,000					0.75	45,000							
			2	Unclassified Fill	525,000	C.Y.		551,300					1.05	551,300							
			3	Cover for Riprap	32,000	C.Y.		19,200					0.60	19,200							
			4	Rock Riprap	235,000	C.Y.		716,800					3.05	716,800							
			5	Clear and Grade - Access Roads	12	Miles		33,600					2,800	33,600							
			6	Gravel Surface - Access Roads	32,000	C.Y.		38,400					1.20	38,400							
			7	Clear and Grade - Service Roads	22	Miles		26,400					1,200	26,400							
			8	Gravel Surface - Service Roads	60,000	C.Y.		72,000					1.20	72,000							
			9	Excavation	180,000	C.Y.		57,600					0.32	57,600							
			10	Access Bridge	1	Each		164,000						164,000							
				Subtotal				1,744,300						1,744,300							
				Contingencies (5%)				87,200						87,200							
				Field Cost 09-01-377				1,831,500						1,831,500							
				Engineering Cost														(240,000)			
	02			BELOW ALLIGATOR BEND - SECTION II												6,736,500		480,000	7,216,500		
				Dredging of channel 450' wide approximately 21 miles long with bank protection.																	
		377		WATERWAYS											6,498,500						
			1	Dredge Excavation	11,600,000	C.Y.				991,800		1,212,200	0.19	2,204,000							
			2	Land Equipment Excavation (Above water table)	5,800,000	C.Y.		1,334,000					0.23	1,334,000							
			3	Gravel Bedding	10,000	C.Y.		12,000					1.20	12,000							
			4	Rock Riprap	516,000	C.Y.		1,573,800					3.05	1,573,800							
			5	Clear and Grade - Access Roads	10	Miles		28,000					2,800	28,000							
			6	Gravel Surface - Access Roads	26,000	C.Y.		31,200					1.20	31,200							
			7	Clear and Grade - Service Roads	43	Miles		51,600					1,200	51,600							
			8	Gravel Surface - Service Roads	84,000	C.Y.		100,800					1.20	100,800							
			9	New Canal Bridges	2	Each		50,000					25,000	50,000							
			10	Reinforce Canal Bridges	2	Each		30,000					15,000	30,000							
				Subtotal				3,211,400		991,800		1,212,200		5,415,400							

GPO 850-708

Form 7-1432
(6-65)
Bureau of Reclamation

INSTRUCTIONS FOR USE OF THIS FORM ARE CONTAINED IN CHAPTER 6, PART 152 OF THE RECLAMATION INSTRUCTIONS

BASIC ESTIMATE DC-I

OFFICE PREPARED BY: Boulder City, Nevada

PROJECT Colorado River Front Work & Levee Sys.
Date of Estimate January 1969
Prices as of January 1969
Sheet 2 of 4 sheets

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	PAY ITEM	DESCRIPTION	QUANTITY AMOUNT	QUANTITY UNIT	LABOR AND MATERIALS BY CONTRACTOR UNIT COST	LABOR AND MATERIALS BY CONTRACTOR TOTAL COST	MATERIALS AND EQUIPMENT BY GOVERNMENT UNIT COST	MATERIALS AND EQUIPMENT BY GOVERNMENT TOTAL COST	LABOR BY GOVERNMENT FORCES UNIT COST	LABOR BY GOVERNMENT FORCES TOTAL COST	FIELD COST COLS. 4, 5, & 6 UNIT COST	FIELD COST COLS. 4, 5, & 6 TOTAL COST	FIELD COST PLANT ACCOUNT	FIELD COST IDENTIFIED PROPERTY	SERVICE FACILITIES IDENTIFIED PROPERTY	OTHER COSTS IDENTIFIED PROPERTY	TOTAL COST IDENTIFIED PROPERTY	TOTAL COST PROPERTY CLASS	TOTAL COST ALL CLASSES
1				2	3		4		5		6		7		8	9	10	11	12	13	14
	C2			BELOW ALLIGATOR BEND - SECTION II (Continued)																	
		377		WATERWAYS (Continued)																	
				Subtotal				3,211,400		991,800		1,212,200		5,415,400							
				Contingencies (20%)				642,300		198,400		242,400		1,083,100							
				Field Cost 09-02-377				3,853,700		1,190,200		1,454,600		6,498,500							
				Engineering Cost														(465,000)			
		380		MISCELLANEOUS EQUIPMENT											240,000						
			1	Dredging Equipment Acquisition	1	Each				795,000				795,000							
				Contingencies (10%)						80,000				80,000							
				Field Cost						875,000				875,000							
				Engineering Cost														(15,000)			
			2	Salvage - Construction Equipment																	
				Dredge	1	Each				-475,000				-475,000							
				Depreciation	5	Years				-400,000				-400,000							
				Salvage and Depreciation						-875,000				-875,000							
			3	General Service Equipment		L.S.		200,000						200,000							
				Contingencies (20%)				40,000						40,000							
				Field Cost 09-02-380				240,000						240,000							
				Dredge and Equipment Cost (Includes shipping)																	
				16" Dredge 500,000																	
				Tow boat 100,000																	
				Barges:																	
				Fuel 30,000																	
				Winch 25,000																	
				Pipe 20,000																	
				Pipelines:																	
				Pontoon 100,000																	
				Shore 20,000																	
				795,000																	
				Contingency (10%) 80,000																	
				Subtotal 875,000																	
				Engineering 15,000																	
				Total Cost 890,000																	

GPO 850-708

Form 7-1432
(6-65)
Bureau of Reclamation

INSTRUCTIONS FOR USE OF THIS FORM ARE CONTAINED IN CHAPTER 6, PART 152 OF THE RECLAMATION INSTRUCTIONS

BASIC ESTIMATE DC-1

OFFICE PREPARED BY: Boulder City, Nevada

PROJECT Colorado River Front Work & Levee System
Date of Estimate January 1969
Prices as of January 1969
Sheet 3 of 4 sheets

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	PAY ITEM	DESCRIPTION	QUANTITY AMOUNT	QUANTITY UNIT	LABOR AND MATERIALS BY CONTRACTOR UNIT COST	LABOR AND MATERIALS BY CONTRACTOR TOTAL COST	MATERIALS AND EQUIPMENT BY GOVERNMENT UNIT COST	MATERIALS AND EQUIPMENT BY GOVERNMENT TOTAL COST	LABOR BY GOVERNMENT FORCES UNIT COST	LABOR BY GOVERNMENT FORCES TOTAL COST	FIELD COST COLS. 4, 5, & 6 UNIT COST	FIELD COST COLS. 4, 5, & 6 TOTAL COST	FIELD COST PLANT ACCOUNT	FIELD COST IDENTIFIED PROPERTY	SERVICE FACILITIES IDENTIFIED PROPERTY	OTHER COSTS IDENTIFIED PROPERTY	TOTAL COST IDENTIFIED PROPERTY	TOTAL COST PROPERTY CLASS	TOTAL COST ALL CLASSES
1				2	3		4		5		6		7		8	9	10	11	12	13	14
	03			FISH AND WILDLIFE FEATURES												2,209,000		140,000	2,349,000		
		376		STRUCTURES AND IMPROVEMENTS											2,209,000						
			1	Dredge Excavation	4,500,000	C.Y.			575,000		910,000		0.33	1,485,000							
			2	Inlet Structures	10	Each		50,000					5,000	50,000							
			3	Outlet Structures	10	Each		50,000					5,000	50,000							
			4	Construct Roads	24	Miles		48,000					2,000	48,000							
			5	Gravel Surface - Roads	85,800	C.Y.		103,000					1.20	103,000							
			6	Boat Ramps	5	Each		60,000					12,000	60,000							
			7	Parking and Sanitary Facilities	5	Each		45,000					9,000	45,000							
				Subtotal				356,000		575,000		910,000		1,841,000							
				Contingencies (20%)				71,000		115,000		182,000		368,000							
				Field Cost 09-03-376				427,000		690,000		1,092,000		2,209,000							
				Engineering Cost														(129,000)			
		380		MISCELLANEOUS EQUIPMENT											0						
			1	Dredging Equipment Acquisition	1	Each			119,000					119,000							
				Contingencies (10%)					12,000					12,000							
				Field Cost 09-03-380					131,000					131,000							
				Engineering Cost														(11,000)			
			2	Salvage - Construction Equipment																	
				Dredge	1	Each			-71,000					-71,000							
				Depreciation	5	Years			-60,000					-60,000							
				Salvage and Depreciation					-131,000					-131,000							

Dredge and Equipment Cost (Includes shipping)

10" Portable Dredge	65,000	
Pipelines:		
Pontoon	20,000	
Shore	7,000	
Work Boat and Equipment	7,000	
	119,000	
Contingency (10%)	12,000	
Subtotal	131,000	
Engineering	11,000	
Total Cost	142,000	

GPO 850-708

Form 7-1432
(6-65)
Bureau of Reclamation

INSTRUCTIONS FOR USE OF THIS FORM ARE CONTAINED IN CHAPTER 6, PART 152 OF THE RECLAMATION INSTRUCTIONS

BASIC ESTIMATE DC-1

OFFICE PREPARED BY: Boulder City, Nevada

PROJECT Colorado River Front Work & Levee System
Date of Estimate January 1969
Prices as of January 1969
Sheet 4 of 4 sheets

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	PAY ITEM	DESCRIPTION	QUANTITY AMOUNT	QUANTITY UNIT	LABOR AND MATERIALS BY CONTRACTOR UNIT COST	LABOR AND MATERIALS BY CONTRACTOR TOTAL COST	MATERIALS AND EQUIPMENT BY GOVERNMENT UNIT COST	MATERIALS AND EQUIPMENT BY GOVERNMENT TOTAL COST	LABOR BY GOVERNMENT FORCES UNIT COST	LABOR BY GOVERNMENT FORCES TOTAL COST	FIELD COST COLS. 4, 5, & 6 UNIT COST	FIELD COST COLS. 4, 5, & 6 TOTAL COST	FIELD COST PLANT ACCOUNT	FIELD COST IDENTIFIED PROPERTY	SERVICE FACILITIES IDENTIFIED PROPERTY	OTHER COSTS IDENTIFIED PROPERTY	TOTAL COST IDENTIFIED PROPERTY	TOTAL COST PROPERTY CLASS	TOTAL COST ALL CLASSES
1				2	3		4		5		6		7		8	9	10	11	12	13	14
	04			RECREATION FEATURES												210,000		20,000	230,000		
		376		STRUCTURES AND IMPROVEMENTS											210,000						
			1	Dredge Excavation	160,000	C.Y.				21,200		31,800	0.33	53,000							
			2	Structures and Related Items		LS		70,000						70,000							
			3	Riverbank Modifications		LS		52,000						52,000							
				Subtotal				122,000		21,200		31,800		175,000							
				Contingencies (20%)				24,400		4,200		6,400		35,000							
				Field Cost 09-04-376				146,400		25,400		36,200		210,000							
				Engineering Cost														(20,000)			

GPO 850-708

LEGEND: Types of Activity

Preconstruction and Other Work | Construction

LINE NO.	CLASS AND ACCOUNT	PROGRAM ITEM	QUANTITY	UNIT	ESTIMATED TOTAL	TOTAL TO JUNE 30, '68	FISCAL YEARS First	Second	Third	Fourth	Fifth	Sixth		BALANCE TO COMPLETE	ESTIMATED COMPLETION DATE	LINE NO.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	09	CHANNELS, LEVEES, AND FLOODWAYS														1
2		River Management - Parker Division														2
3																3
4	09-01	ABOVE ALLIGATOR BEND - SECTION I	11	Miles	2,071,500	1,892,786			90,000	88,714				None		4
5																5
6	09-02	BELOW ALLIGATOR BEND - SECTION II	21	Miles	7,218,500	384,761										6
7		Dredge Excavation and Bank Protection			(6,978,500)	(384,761)	73,900	792,000	1,074,000	1,551,000	1,600,000	1,502,839		None		7
8		General Service Equipment			(240,000)		30,000	82,000	56,000	24,000	24,000	24,000		None		8
9																9
10	09-03	FISH AND WILDLIFE FEATURES			2,349,000		582,687	83,000	270,000	471,000	471,000	471,313		None		10
11																11
12	09-04	RECREATION FEATURES			230,000						115,000	115,000		None		12
13																13
14																14
15		TOTAL EXPENDITURES			11,869,000	2,277,547	686,587	957,000	1,490,000	2,134,714	2,210,000	2,113,152		None		15
16																16
17																17
18																18
19																19
20																20
21																21
22																22
23																23
24																24
25																25
26																26
27																27
28																28
29																29
30																30
31																31
32																32
33																33

Notes:

Recommended: _____ (Operating Office Head) _____ (Date)

Recommended: _____ (Regional Director) _____ (Date)

Recommended: _____ (Chief, Div. of P C & F) _____ (Date)

Approved: _____ (Commissioner) _____ (Date)

Revised: _____ (Date)

SHEET 1 OF 1 SHEETS

Form PF-2 — UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION — MARCH 1964

CONTROL SCHEDULE

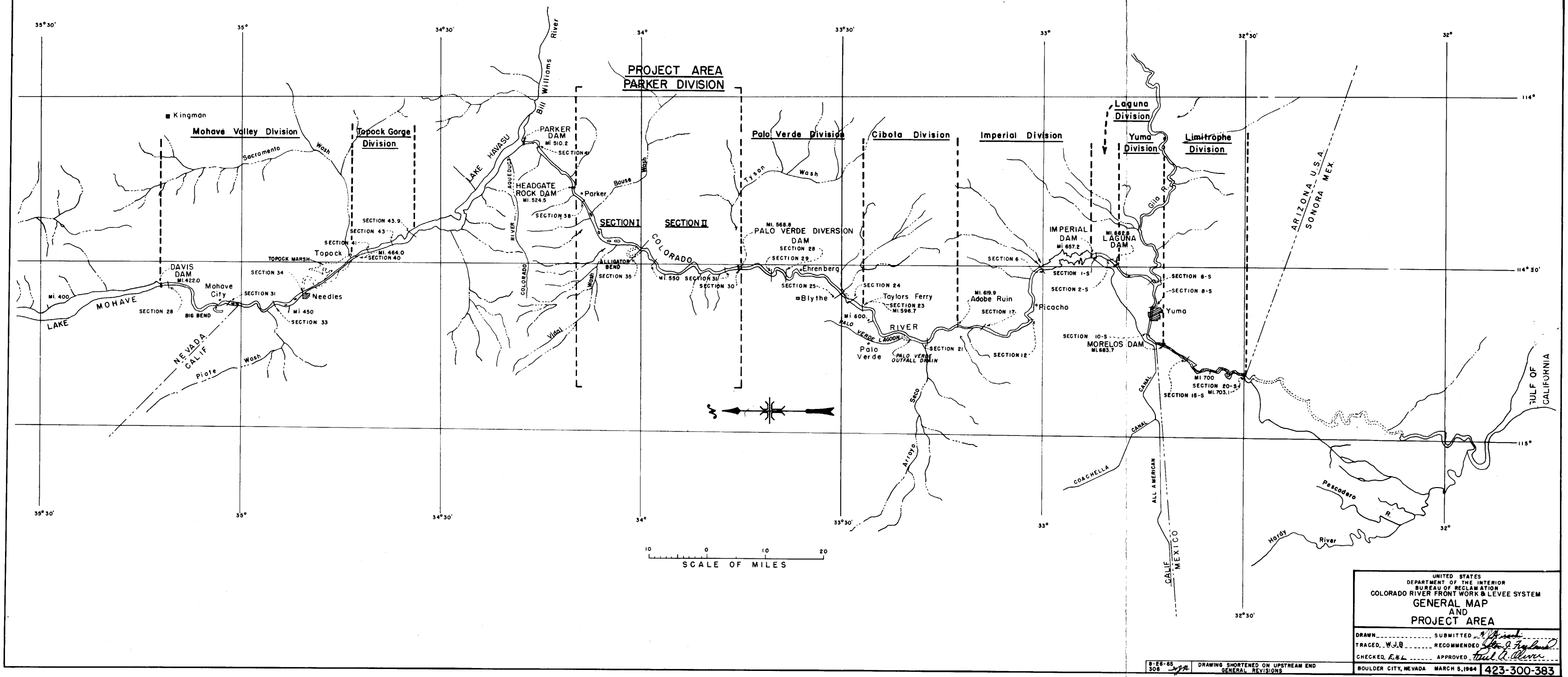
Parker Division

Boulder City, Nevada (OFFICE) — January 1969 (DATE) — 3 (REGION)

☐ GENERAL INVESTIGATIONS ☐ CONSTRUCTION ☐ LOAN PROGRAM ☒ OTHER

GPO 840-944

DRAWINGS



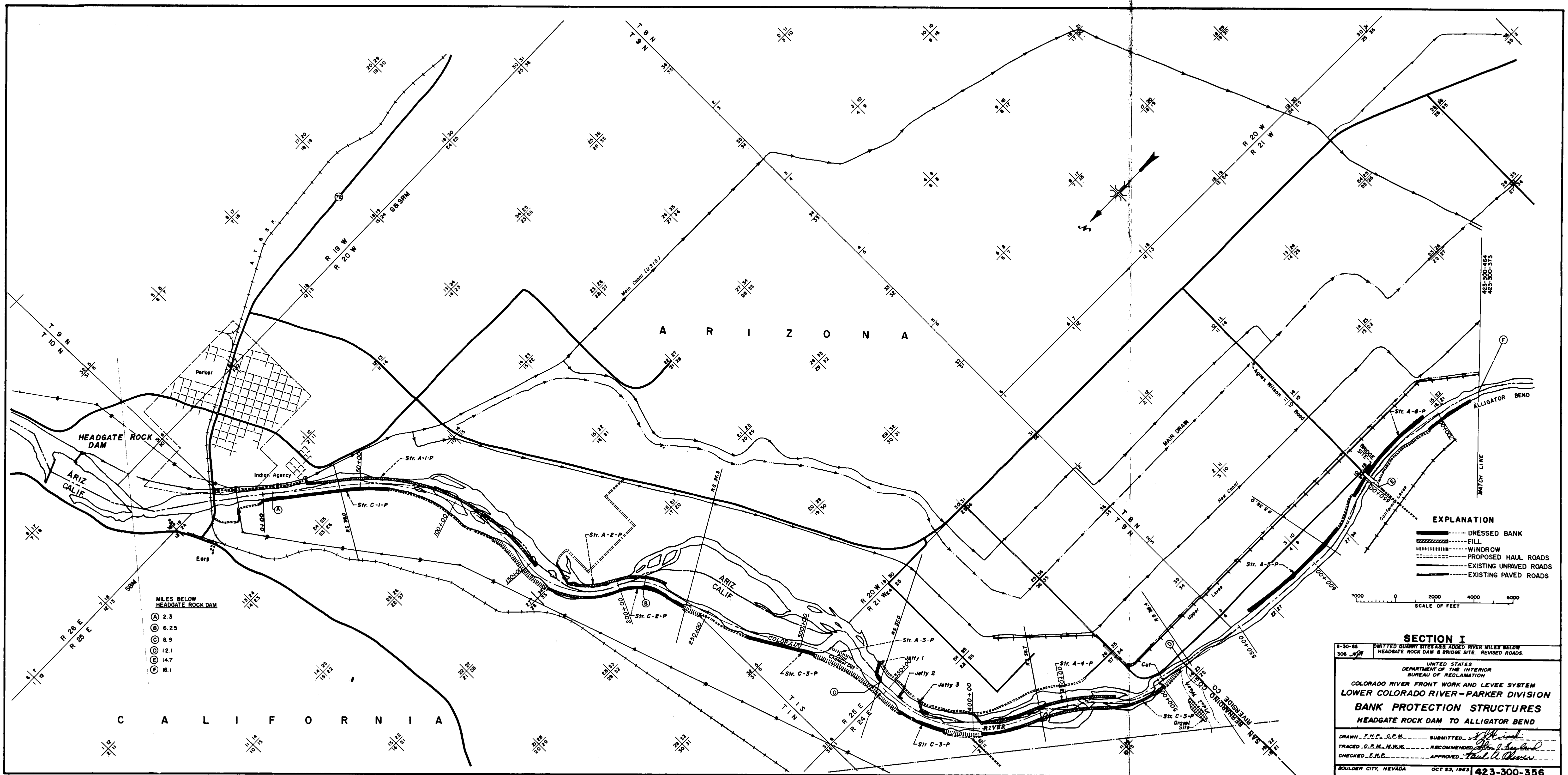
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER FRONT WORK & LEVEE SYSTEM

GENERAL MAP AND PROJECT AREA

DRAWN _____ SUBMITTED _____
TRACED W.J.B. RECOMMENDED _____
CHECKED E.W.L. APPROVED _____

8-26-65 308	DRAWING SHORTENED ON UPSTREAM END GENERAL REVISIONS	
BOULDER CITY, NEVADA	MARCH 5, 1964	423-300-383

INTERIOR-RECLAMATION, BOULDER CITY, NEVADA



SECTION I

8-30-65 306	OMITTED QUARRY SITES A&B. ADDED RIVER MILES BELOW HEADGATE ROCK DAM & BRIDGE SITE. REVISED ROADS.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER FRONT WORK AND LEVEE SYSTEM

LOWER COLORADO RIVER-PARKER DIVISION

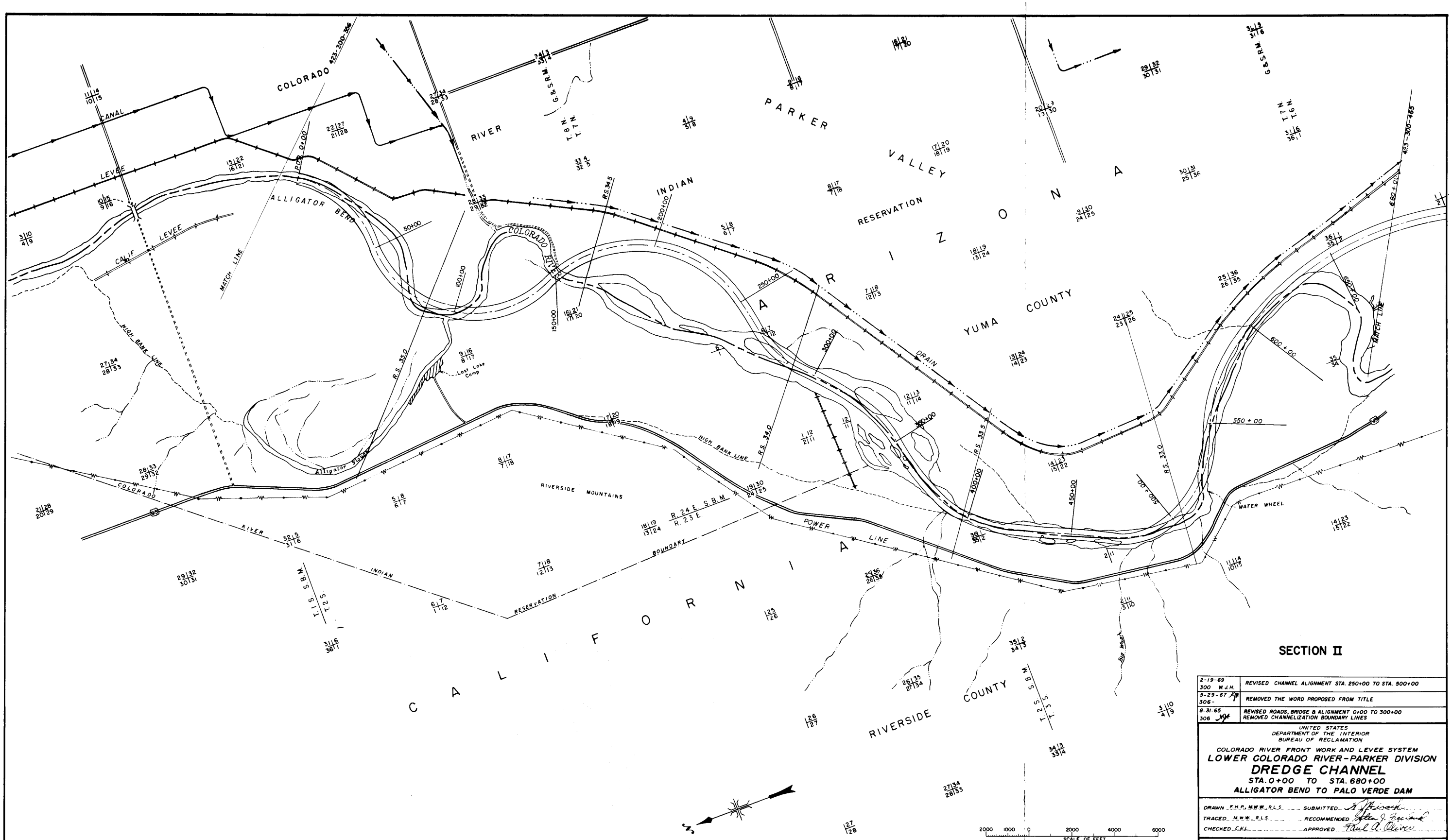
BANK PROTECTION STRUCTURES

HEADGATE ROCK DAM TO ALLIGATOR BEND

DRAWN F.H.P., C.P.M. SUBMITTED [signature]
TRACED C.P.M., M.W.W. RECOMMENDED [signature]
CHECKED F.H.P. APPROVED Paul A. Oliver

BOULDER CITY, NEVADA OCT. 23, 1963 **423-300-356**

INTERIOR RECLAMATION, BOULDER CITY, NEVADA



SECTION II

2-19-69 300 W.J.H.	REVISED CHANNEL ALIGNMENT STA. 250+00 TO STA. 300+00
5-29-67 306-	REMOVED THE WORD PROPOSED FROM TITLE
8-31-65 306	REVISED ROADS, BRIDGE & ALIGNMENT 0+00 TO 300+00 REMOVED CHANNELIZATION BOUNDARY LINES

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER FRONT WORK AND LEVEE SYSTEM

LOWER COLORADO RIVER-PARKER DIVISION

DREDGE CHANNEL

STA. 0+00 TO STA. 680+00

ALLIGATOR BEND TO PALO VERDE DAM

DRAWN F.H.P., M.W.W., R.L.S. — SUBMITTED K. Hirsch

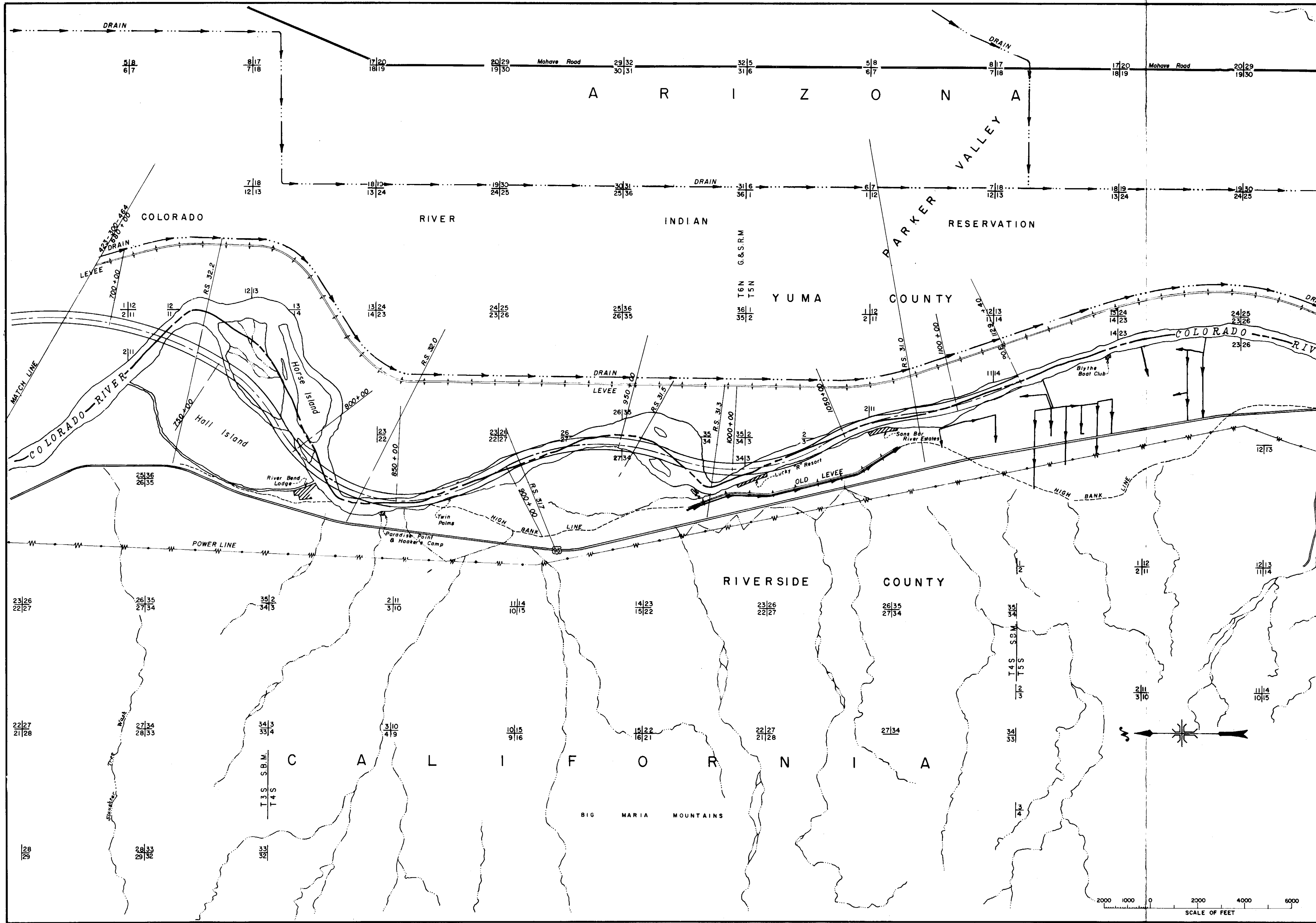
TRACED M.W.W., R.L.S. — RECOMMENDED Glen J. Fairchild

CHECKED F.H.L. — APPROVED Paul A. Olsen

BOULDER CITY, NEVADA — JULY 31, 1964 — SHEET 1 OF 2

423-300-464

INTERIOR-RECLAMATION BOULDER CITY NEVADA



SECTION II

5-29-67 306 W.J.H.	REMOVED WORD PROPOSED FROM TITLE
9-1-65 306	REVISED ROADS. REMOVED CHANNELIZATION BOUNDARY LINES.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER FRONT WORK AND LEVEE SYSTEM
LOWER COLORADO RIVER – PARKER DIVISION
DREDGE CHANNEL
STA. 680+00 TO STA. 1129+40
ALLIGATOR BEND TO PALO VERDE DAM

DRAWN F.H.P., M.W.W., R.L.S. SUBMITTED [signature]
TRACED M.W.W., R.L.S. RECOMMENDED [signature]
CHECKED E.H.L. APPROVED [signature]

BOULDER CITY, NEV. JULY 31, 1964
SHEET 2 OF 2
423-300-465

INTERIOR-RECLAMATION, BOULDER CITY, NEVADA

ELEVATIONS

330
325
320
315
310
305
300

Elev 322.2
Existing Water Surface Elev @ Q = 15,000 c.f.s.
Original ground surface ℄ of Dredge Channel
Design Water Surface Elev @ Q = 15,000 c.f.s.
Elev 319.0
Elev 313.8
Slope = 1.54 feet per mile
Average Bed Elevation
Elev 310.8
Design Bottom Grade
Point of Beginning = Sta. 0+00
Sta. 85+00 = R.S. 35.0
Sta. 170+00 = R.S. 34.5
Sta. 290+00 = R.S. 34.0
Sta. 400+00 = R.S. 33.5
Original ground surface ℄ of Dredge Channel
Existing Water Surface Elev @ Q = 15,000 c.f.s.
Elev 307.4
Design Water Surface Elev @ Q = 15,000 c.f.s.
Elev 304.6
Average Bed Elevation
Elev 298.6
Design Bottom Grade
Elev 296.6

0+00 50+00 100+00 150+00 200+00 250+00 300+00 350+00 400+00 450+00 500+00 STATIONS

SECTION II

8-31-65 306 JGR	REVISED GROUND PROFILE	
7-31-64 300 R.L.S.	REVISED GROUND PROFILE	

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

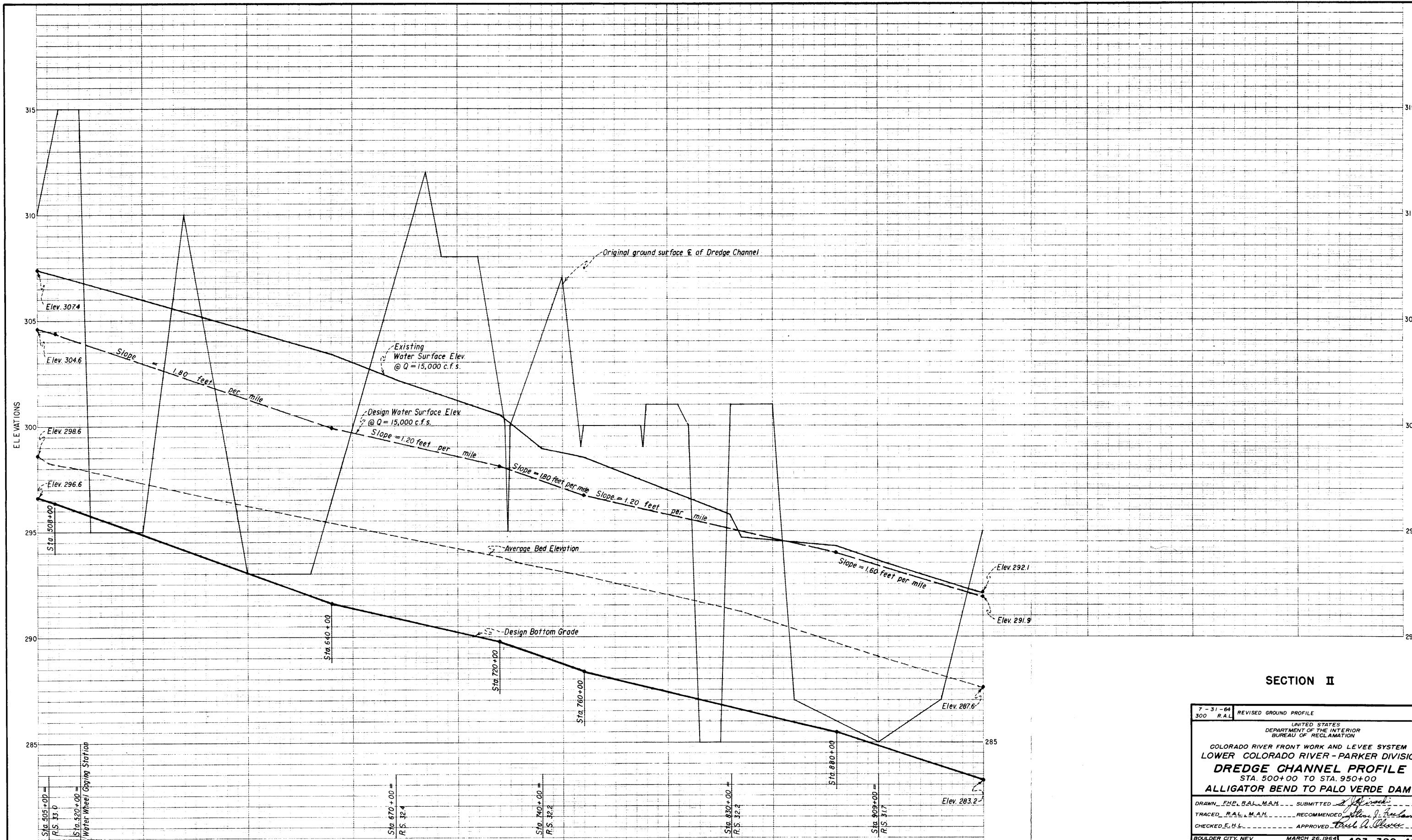
COLORADO RIVER FRONT WORK AND LEVEE SYSTEM
LOWER COLORADO RIVER - PARKER DIVISION

DREDGE CHANNEL PROFILE
STA. 0+00 TO STA. 500+00
ALLIGATOR BEND TO PALO VERDE DAM

DRAWN F.H.P. B.B.L. M.A.H. R.L.S. SUBMITTED
TRACED B.B.L. M.A.H. R.L.S. RECOMMENDED
CHECKED E.H.L. APPROVED

BOULDER CITY, NEV. SHEET 1 OF 3 MARCH 27, 1964 | 423-300-418

INTERIOR RECLAMATION, BOULDER CITY, NEVADA



SECTION II

7-31-64 300 R.A.L.	REVISED GROUND PROFILE

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

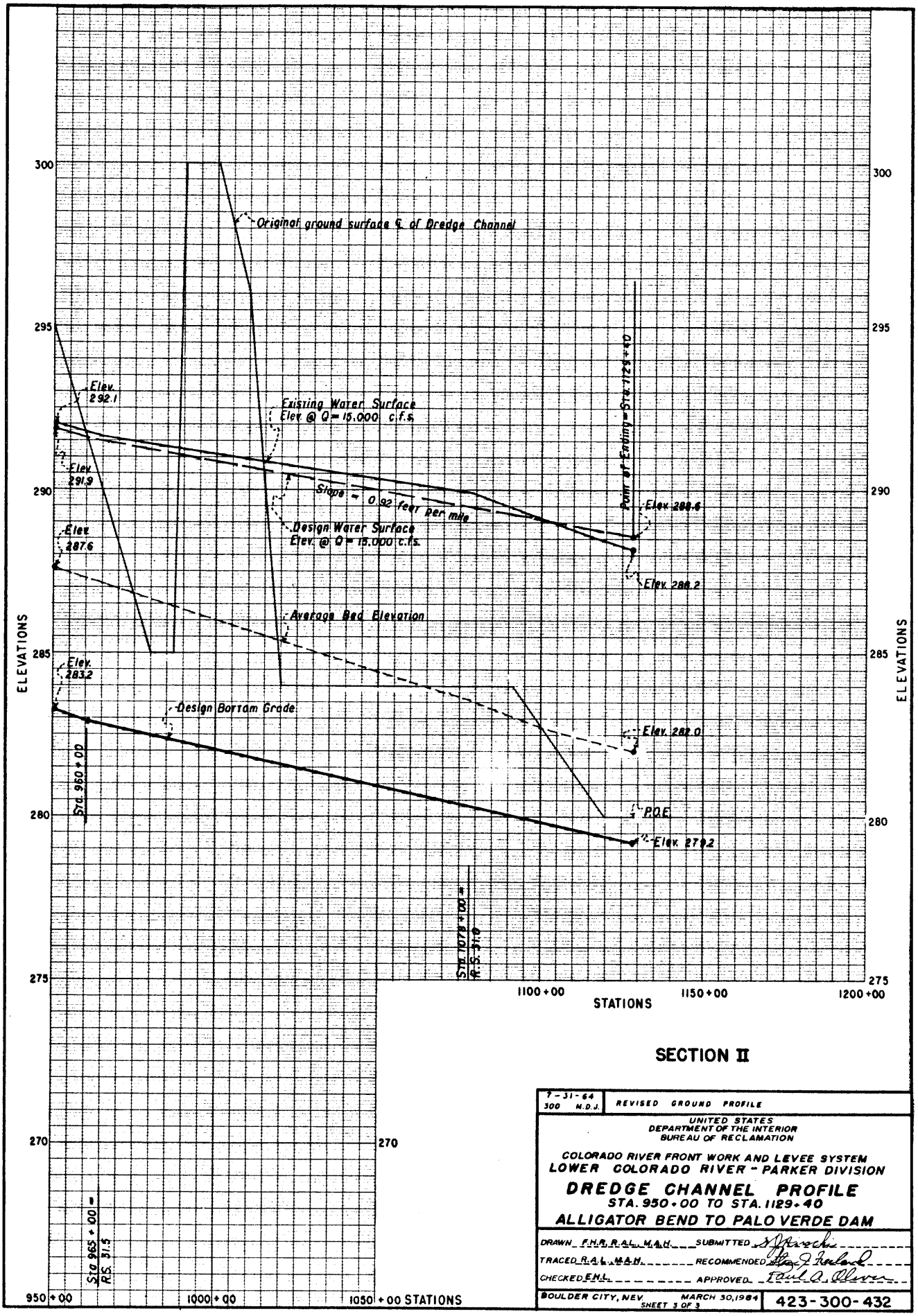
COLORADO RIVER FRONT WORK AND LEVEE SYSTEM
LOWER COLORADO RIVER - PARKER DIVISION

DREDGE CHANNEL PROFILE
STA. 500+00 TO STA. 950+00
ALLIGATOR BEND TO PALO VERDE DAM

DRAWN FHP, R.A.L., M.A.H. SUBMITTED
TRACED R.A.L., M.A.H. RECOMMENDED
CHECKED E.H.L. APPROVED

BOULDER CITY, NEV. MARCH 26, 1964
SHEET 2 OF 3

423-300-420



SECTION II

7-31-64 300 M.D.J.	REVISED GROUND PROFILE

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER FRONT WORK AND LEVEE SYSTEM
LOWER COLORADO RIVER - PARKER DIVISION

DREDGE CHANNEL PROFILE
STA. 950+00 TO STA. 1129+40
ALLIGATOR BEND TO PALO VERDE DAM

DRAWN F.H.R. R.A.L. M.A.H. SUBMITTED
TRACED R.A.L. M.A.H. RECOMMENDED
CHECKED E.M.L. APPROVED

BOULDER CITY, NEV. MARCH 30, 1964
SHEET 3 OF 3

423-300-432

COLORADO 423-300-356

CANAL

LEVEE

CALIF. LEVEE

ALLIGATOR BEND

MATCH LINE

0+00

50+00

GRADE CONTROL-1

DRY CUT

100+00

COLORADO RIVER

R.S. 34.5

DRY CUT

200+00

150+00

GRADE CONTROL-2

R.S. 33.0

Lost Lake Camp

HIGH BANK LINE

Alligator Slough

RIVERSIDE MOUNTAINS

R. 24 E. S.B.M.
R. 23 E.

BOUNDARY

INDIAN RESERVATION

RIVER

T. 8 N.
T. 7 N.

G. & S.R.M.

PARKER VALLEY

INDIAN RESERVATION

ARIZONA

CALIFORNIA

YUMA COUNTY

RIVERSIDE COUNTY

T. 1 S.
T. 2 S.

R. 8 W.

POWER LINE

DRAIN

R.S. 33.5

300+00

350+00

400+00

450+00

GRADE CONTROL-3

DRY CUT

500+00

OFFSET

HIGH BANK LINE

WATER WHEEL

R. 21 W. G. & S.R.M.
R. 22 W.

423-300-381

550+00

600+00

GRADE CONTROL-4

DRY CUT

650+00

MATCH LINE

HIGH BANK LINE

By Wash

SCALE OF FEET
2000 1000 0 2000 4000 6000

SECTION II

9-1-65 306-A/A	REVISED ROADS, BRIDGE

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER FRONT WORK AND LEVEE SYSTEM

LOWER COLORADO RIVER—PARKER DIVISION

ALTERNATE PLAN

STA. 0+00 TO STA. 650+00

ALLIGATOR BEND TO PALO VERDE DAM

DRAWN F.H.P., M.W.W.	SUBMITTED
TRACED M.W.W.	RECOMMENDED
CHECKED E.H.L.	APPROVED Paul A. Oliver

BOULDER CITY, NEVADA DEC. 3, 1963
SHEET 1 OF 2

423-300-373

INTERIOR-RECLAMATION, BOULDER CITY, NEVADA

ARIZONA

CALIFORNIA

COLORADO RIVER INDIAN RESERVATION

PARKER VALLEY

YUMA COUNTY

RIVERSIDE COUNTY

BIG MARIA MOUNTAINS

R 21 W R 22 W G.&S.R.M.

T6N T5N G.&S.R.M.

T5N T4N G.&S.R.M.

T3S T4S S.B.M.

T4S T3S S.B.M.

R 24 E R 23 E S.B.M.

423-300-373

DRAIN

COLORADO RIVER

DRY CUT

GRADE CONTROL-5

GRADE CONTROL-6

GRADE CONTROL-7

Hall Island

Horse Island

LEVEE

OLD LEVEE

HIGH BANK LINE

MATCH LINE

POWER LINE

Mohave Road

Fort Yuma Road

River Bend Lodge

Twin Palms

(Paradise Point) & Hagen's Camp

Lucky "R" Resort

Sons Bar River Estates

Blythe Boat Club

PALO VERDE DIVERSION DAM

GAGING STA.

R.S. 32.2

R.S. 32.0

R.S. 31.8

R.S. 31.0

R.S. 30.2

650+00

700+00

750+00

800+00

850+00

900+00

1000+00

1096+85 POE

SCALE OF FEET 2000 1000 0 2200 4000 6000

SECTION II

9-1-65 308	REVISED ROADS

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER FRONT WORK AND LEVEE SYSTEM

LOWER COLORADO RIVER-PARKER DIVISION

ALTERNATE PLAN

STA 650+00 TO STA.1096+85

ALLIGATOR BEND TO PALO VERDE DAM

DRAWN F.H.P., M.W.W. SUBMITTED

TRACED M.W.W. RECOMMENDED

CHECKED F.H.L. APPROVED Paul A. Oliver

BOULDER CITY, NEV. DEC. 12, 1963 SHEET 2 OF 8

423-300-381

INTERIOR-RECLAMATION, BOULDER CITY, NEVADA

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER FRONT WORK AND LEVEE SYSTEM
LOWER COLORADO RIVER - PARKER DIVISION

PROFILE FOR ALTERNATE PLAN
STA. 0 + 00 TO STA. 450 + 00
ALLIGATOR BEND TO PALO VERDE DAM

DRAWN E.M.P. R.A.L. M.A.M.	SUBMITTED	
TRACED R.A.L. M.A.M.	RECOMMENDED	
CHECKED E.H.L.	APPROVED	

BOULDER CITY, NEVADA MARCH 31, 1964 SHEET 1 OF 3

423 - 300 - 419

SECTION II

ELEVATIONS

STATIONS 0+00 50+00 100+00 150+00 200+00 250+00 300+00 350+00 400+00 450+00

Sta 0+00 = Point of Beginning

Sta 73+00 = R.S. 35.0

Sta 154+00 = R.S. 34.5

Sta 261+00 = R.S. 34.0

Sta 368+00 = R.S. 33.5

Elev 299.5

Elev 300.0

Design Bottom Grade

Average Bed Elevation

Elev 307.8

Existing Water Surface Elev @ Q = 15,000 c.f.s

Elev 308.5

Design Water Surface Elev @ Q = 15,000 c.f.s

Control Structure No. 2 = Sta 170+00

Control Structure No. 1 = Sta 62+00

Elev 308.0

Control Structure #2 (Elev 310.5)

Elev 313.1

Elev 313.8

Control Structure #1 (Elev 314.4)

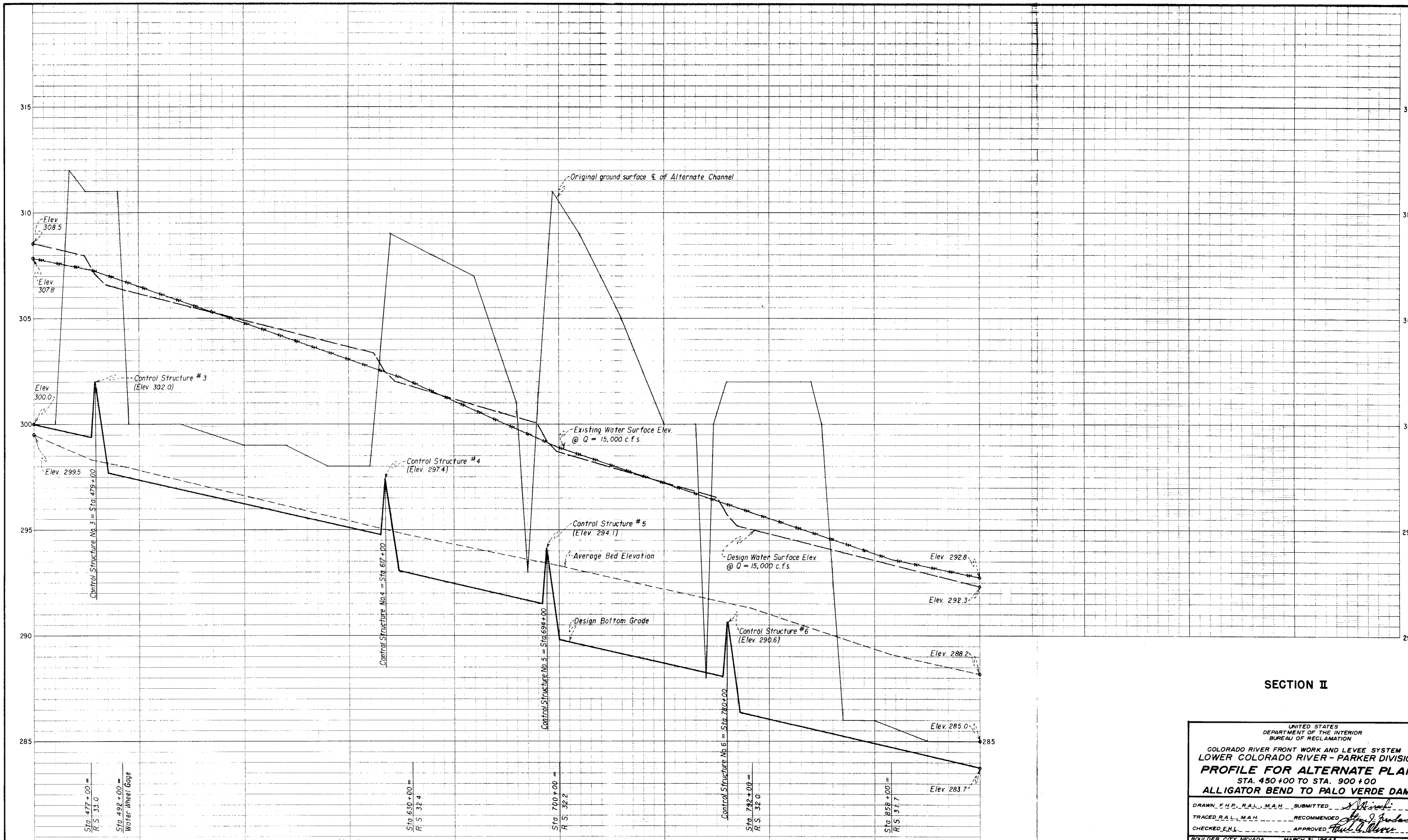
Original ground surface ℄ of Alternate Channel

Elev 321.8

Elev 322.8

Bed

300
305
310
315
320
325
330



SECTION II

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER FRONT WORK AND LEVEE SYSTEM
LOWER COLORADO RIVER - PARKER DIVISION

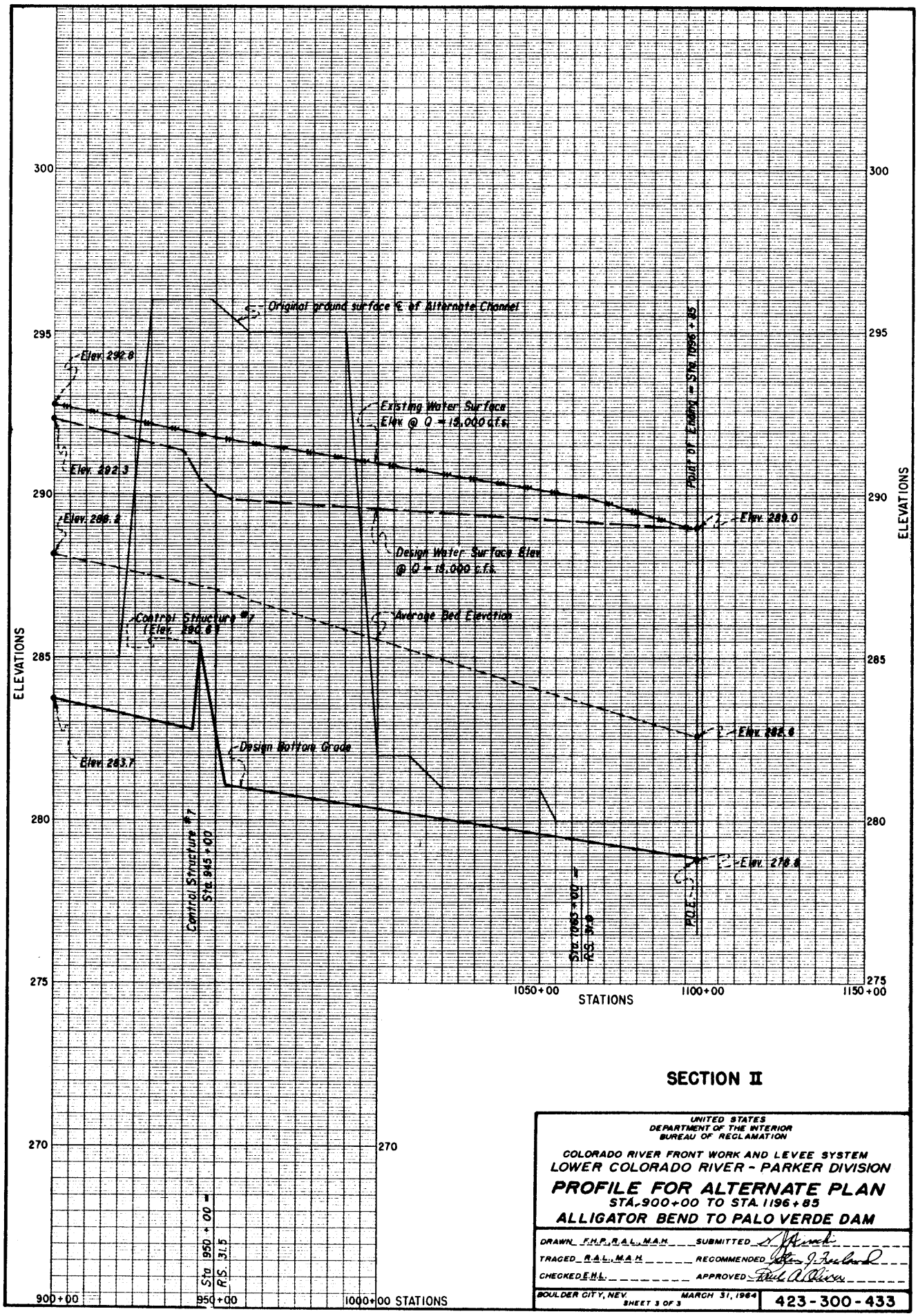
PROFILE FOR ALTERNATE PLAN
STA. 450+00 TO STA. 900+00
ALLIGATOR BEND TO PALO VERDE DAM

DRAWN E.H.P., R.A.L., M.A.H. SUBMITTED
TRACED R.A.L., M.A.H. RECOMMENDED
CHECKED E.H.L. APPROVED

BOULDER CITY, NEVADA MARCH 31, 1964
SHEET 2 OF 3

423-300-421

INTERIOR RECLAMATION BOULDER CITY, NEVADA



SECTION II

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

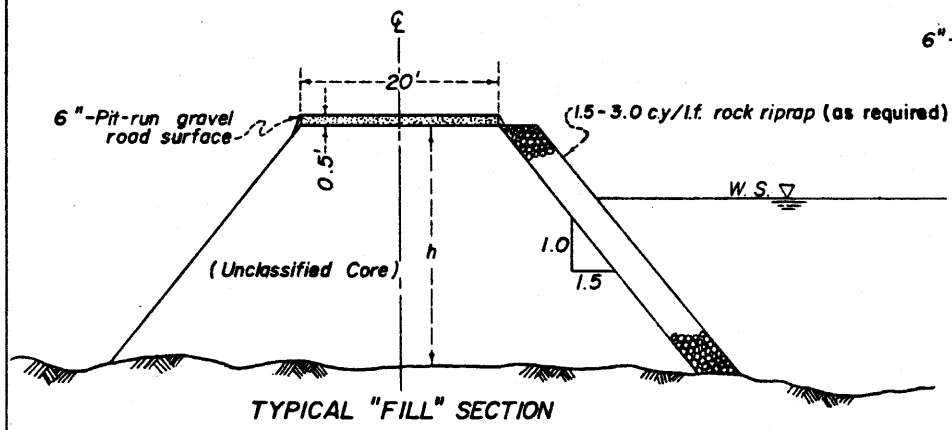
COLORADO RIVER FRONT WORK AND LEVEE SYSTEM
LOWER COLORADO RIVER - PARKER DIVISION

PROFILE FOR ALTERNATE PLAN
STA. 900+00 TO STA. 1196+85
ALLIGATOR BEND TO PALO VERDE DAM

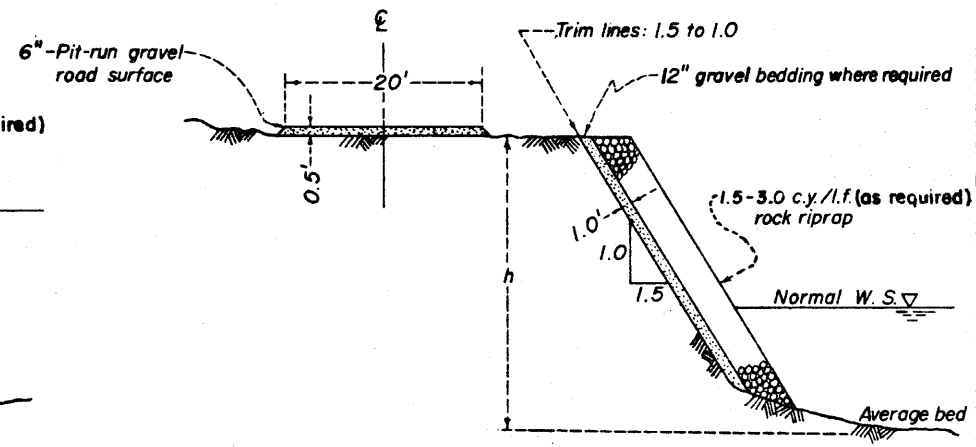
DRAWN F.H.P., R.A.L., M.A.H.	SUBMITTED
TRACED R.A.L., M.A.H.	RECOMMENDED
CHECKED E.H.L.	APPROVED

BOULDER CITY, NEV. MARCH 31, 1964
SHEET 3 OF 3

423-300-433



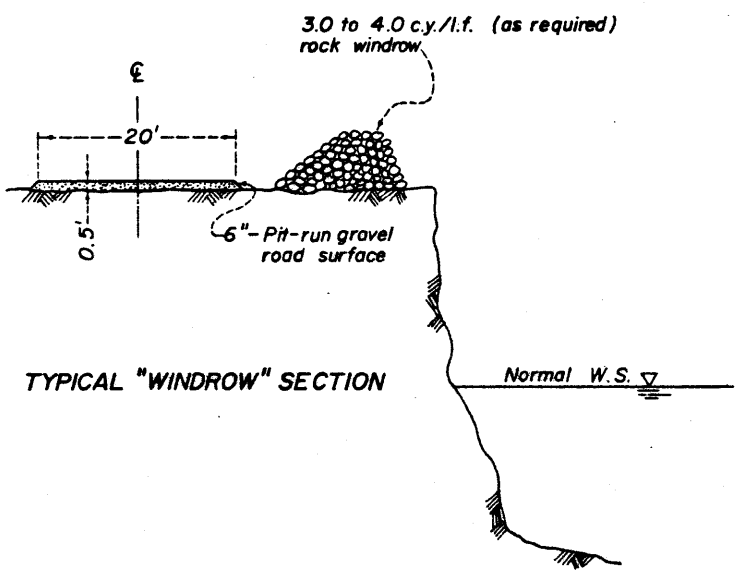
TYPICAL "FILL" SECTION



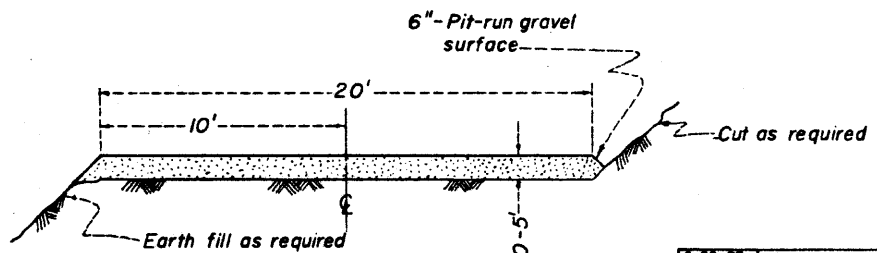
TYPICAL "DRESSED BANK" SECTION

Note: If core material is not adequate, 12" gravel bedding will be required under riprap.

Note: Drawing not to scale



TYPICAL "WINDROW" SECTION



TYPICAL "HAUL ROAD" SECTION

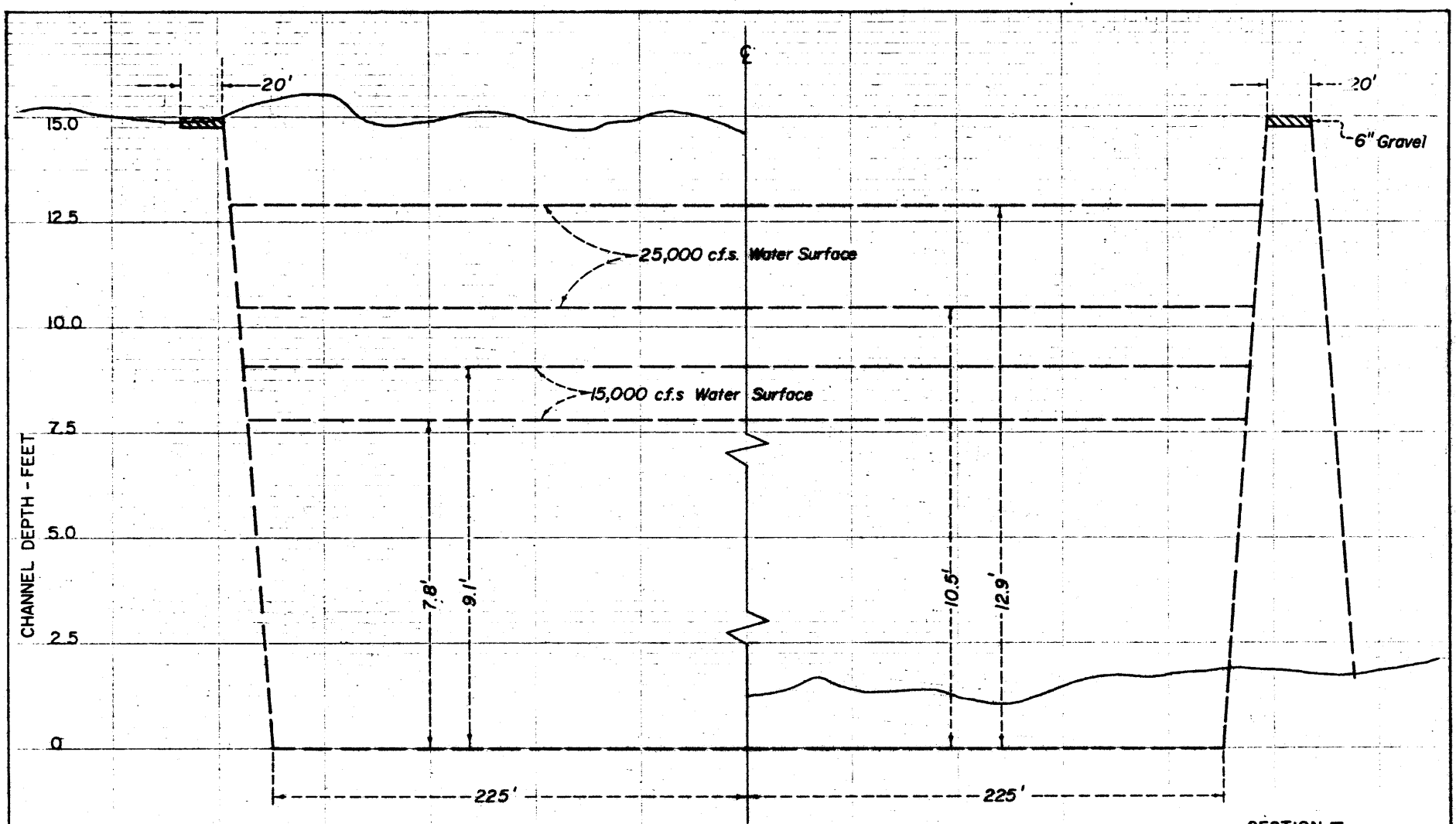
8-29-65 306	REVISED TYPICAL FILL & DRESSED BANK DATA

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER FRONT WORK AND LEVEE SYSTEM
LOWER COLORADO RIVER – PARKER DIVISION

BANK PROTECTION STRUCTURES
TYPICAL SECTIONS

DRAWN F.H.P., H.B. SUBMITTED
TRACED H.N.B. RECOMMENDED
CHECKED E.H.L. APPROVED

BOULDER CITY, NEV. MAR. 27, 1964 | 423-300-422



SECTION II

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER FRONT WORK AND LEVEE SYSTEM
LOWER COLORADO RIVER - PARKER DIVISION

DESIGN SECTION
PARKER DIVISION DREDGE CHANNEL

DRAWN F.H.P., H.N.B. SUBMITTED
TRACED H.N.B RECOMMENDED
CHECKED H.N. APPROVED

BOULDER CITY, NEV. MAR. 24, 1964

423-300-424

NOTE

Depth at 15,000 c.f.s. varies from 7.8' to 9.1' Depending on slope.
Depth at 25,000 c.f.s varies from 10.5' to 12.9' Depending on slope.
Minimum freeboard 2.1' at 25,000 c.f.s.

COLORADO RIVER

CALIFORNIA

ARIZONA

U.S.B.R. LEVEE

U.S.B.R. DRAIN

MAIN DRAIN

MAIN CANAL

Poston Compl 36

Parker Townsite

T9N T8N

T8N T7N

R21W R20W

R20W R19W

LEGEND

DEPTH BELOW GROUND SURFACE

- 0 to 4 Feet
- 4 to 6 Feet
- Below 6 Feet

SCALE OF MILES

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER FRONT WORK AND LEVEE SYSTEM
LOWER COLORADO RIVER – PARKER DIVISION

GROUND WATER CONDITION
JULY 1961

T8N & T9N, R20W & R21W, G.&S.R.M.

DRAWN E.H.P. R.A.L. SUBMITTED

TRACED R.A.L. RECOMMENDED

CHECKED E.H.L. APPROVED

BOULDER CITY, NEV. APRIL 3, 1964

423-300-425

INTERIOR-RECLAMATION, BOULDER CITY, NEVADA

COLORADO RIVER

CALIFORNIA

ARIZONA

T9N T8N

R21W R20W

T8N T7N

U.S.B.R. LEVEE

U.S.B.R. DRAIN

MAIN DRAIN

MAIN CANAL

Poston Comp I

Parker Townsite

R20W R19W

T9N T8N

R21W R20W

T8N T7N

LEGEND

DEPTH BELOW GROUND SURFACE

- 0 to 4 Feet
- 4 to 6 Feet
- Below 6 Feet

SCALE OF MILES

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

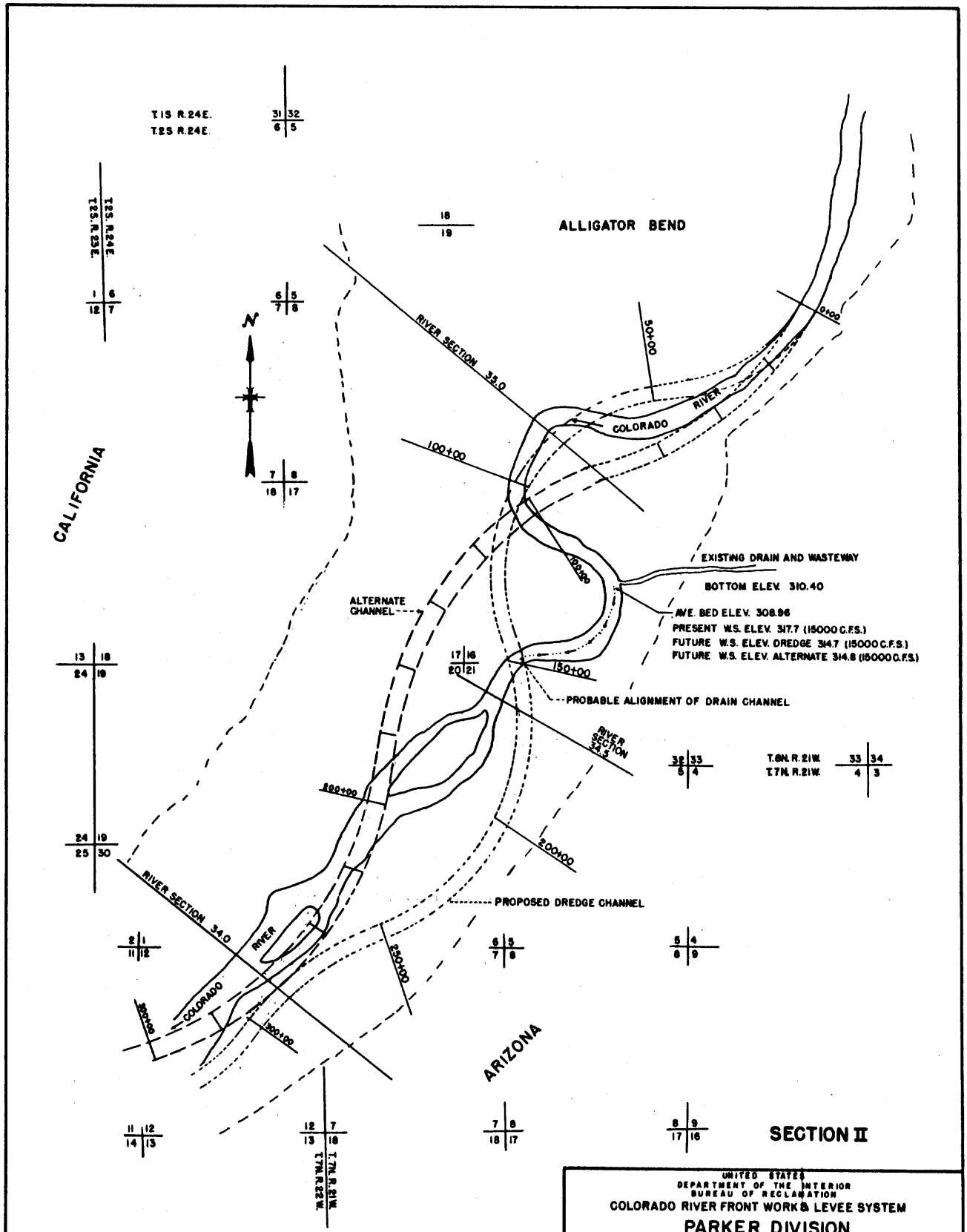
COLORADO RIVER FRONT WORK AND LEVEE SYSTEM
LOWER COLORADO RIVER - PARKER DIVISION

GROUND WATER CONDITION
NOVEMBER 1961
T8N & T9N, R20W & R21W; G.& S.R.M.

DRAWN E.H.P. R.A.L. SUBMITTED
TRACED R.A.L. RECOMMENDED
CHECKED E.H.L. APPROVED Paul A. Olson

BOULDER CITY, NEV. APRIL 3, 1964 423-300-426

INTERIOR RECLAMATION, BOULDER CITY, NEVADA



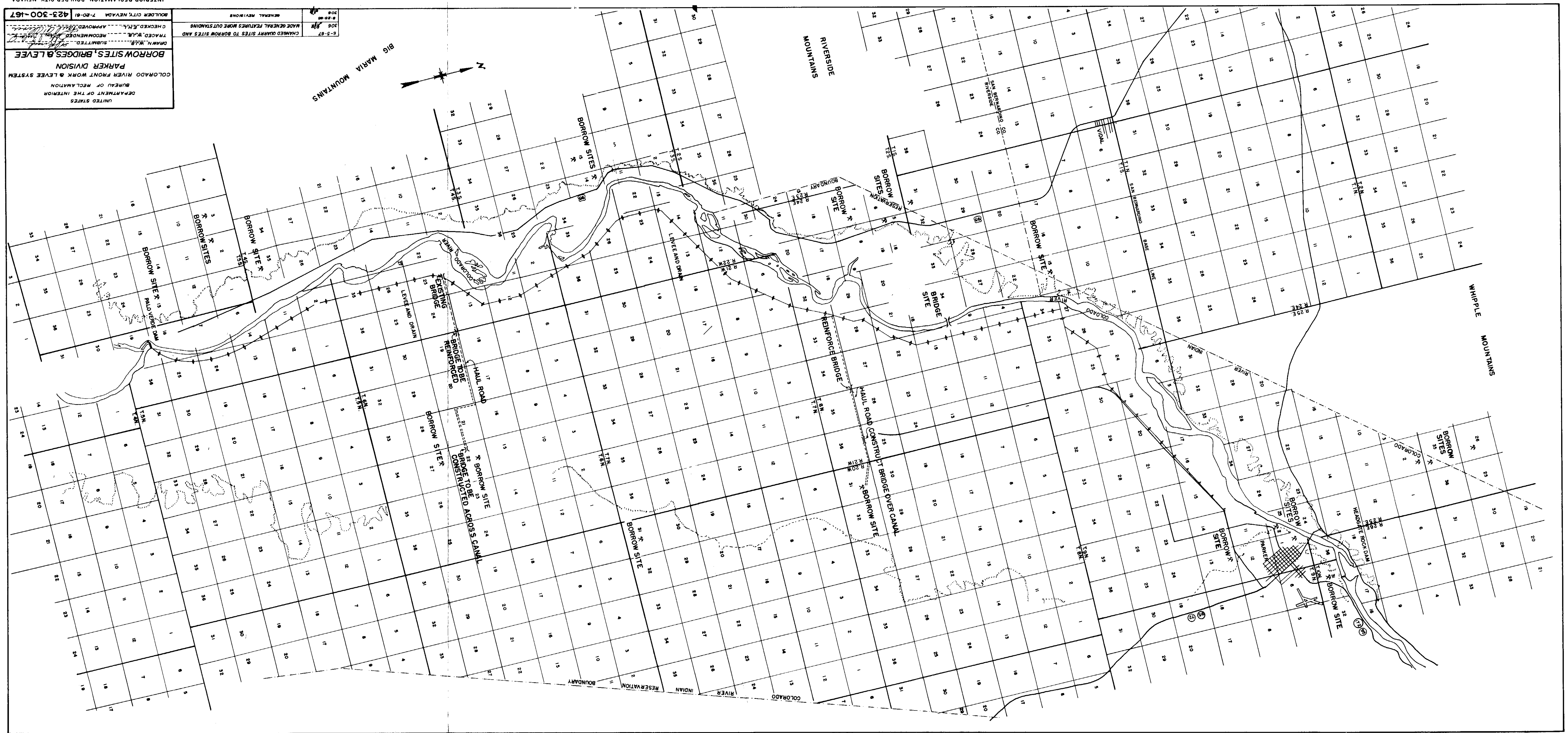
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER FRONT WORKS & LEVEE SYSTEM

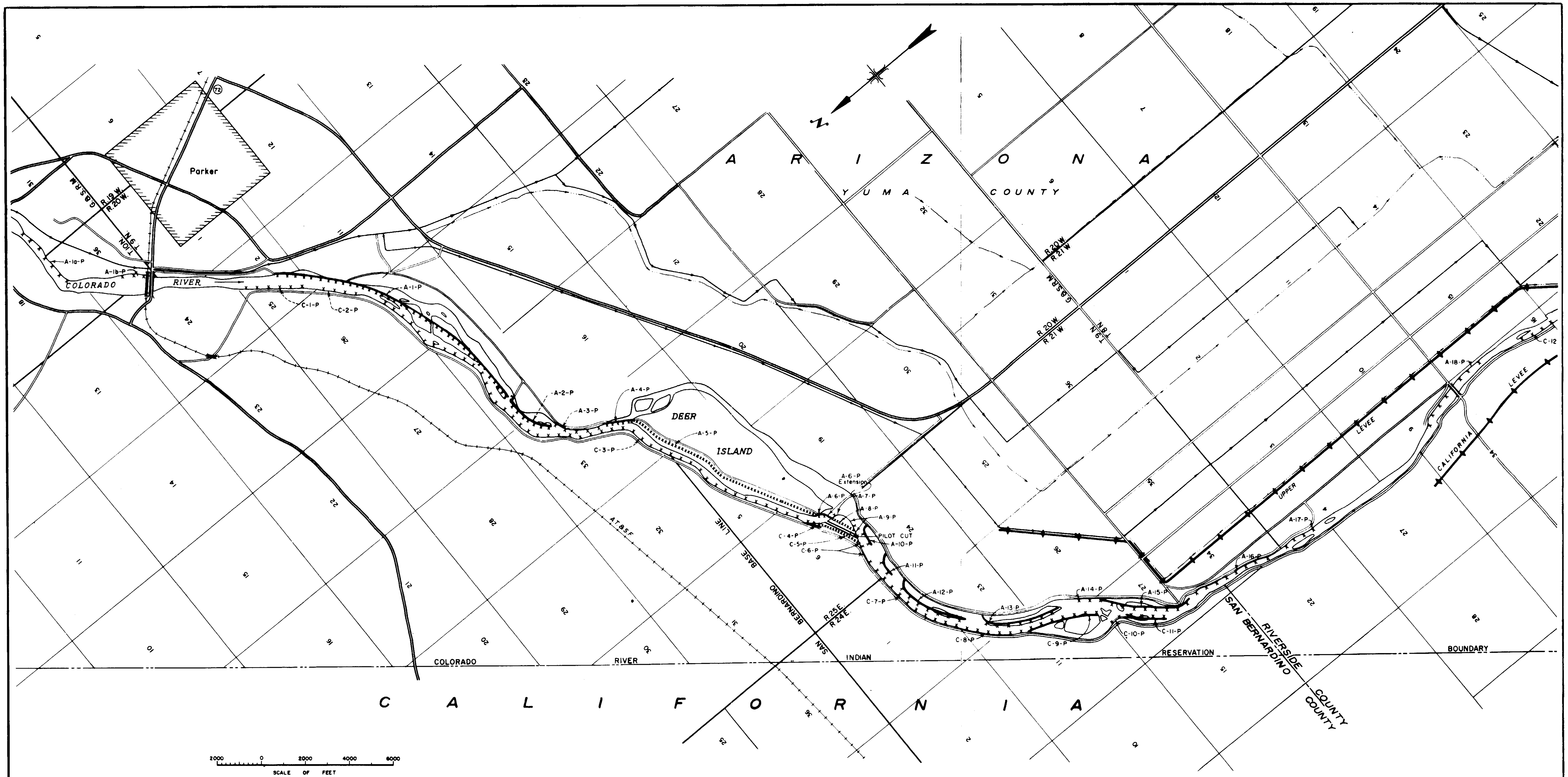
PARKER DIVISION

DRAINAGE OUTLET SITUATION
PRESENT AND FUTURE CONDITIONS

DRAWN E.H.L. SUBMITTED
TRACED K.H.B. RECOMMENDED
CHECKED E.H.L. APPROVED

8-30-65 308	REVISED ALIGNMENT, DREDGE CHANNEL & ELEV. 311.8 TO 314.7	BOULDER CITY, NEVADA 11-26-63	423-300-382


UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER FRONT WORK & LEVEE SYSTEM
PARKER DIVISION
BORROW SITES, BRIDGES, & LEVEE
DRAWN W.J.B. SUBMITTED
TRACED W.J.B. RECOMMENDED
CHECKED R.H.L. APPROVED
BOULDER CITY, NEVADA 7-20-61
423-300-167
CHANGED QUARRY SITES TO BORROW SITES AND MADE GENERAL FEATURES MORE OUTSTANDING
GENERAL REVISIONS
BIG MARIA MOUNTAINS
RIVERSIDE MOUNTAINS
WHIPPLE MOUNTAINS
N
BORROW SITES
BORROW SITE
PALO VERDE DAM
EXISTING BRIDGE
LEVEE AND DRAIN
BRIDGE TO BE REINFORCED
HAUL ROAD
BRIDGE TO BE CONSTRUCTED ACROSS CANAL
REINFORCE BRIDGE
HAUL ROAD CONSTRUCT BRIDGE OVER CANAL
BRIDGE SITE
COLORADO RIVER
COLORADO RIVER INDIAN RESERVATION BOUNDARY
SAN BERNARDINO CO.
RIVERSIDE CO.
SAN BERNARDINO BASE LINE
VIDAL
PARKER
HEADGATE ROCK DAM
BORROW SITE
BORROW SITES



EXPLANATION OF SYMBOLS

DRESSED BANK
WINDROW RIPRAP
FILL TYPE STRUCTURE

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
LOWER COLORADO RIVER FRONT WORK & LEVEE SYSTEM
PARKER DIVISION— SECTION I

RIVER STABILIZATION STRUCTURES
COMPLETED WORK

DRAWN DRB	SUBMITTED [signature]
TRACED	RECOMMENDED [signature]
CHECKED [initials]	APPROVED Roy D. Gear
BOULDER CITY, NEV. JAN. 20, 1969	423-300-738