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HYDRAULIC LABORATORY REPORT NO. 145

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SKELETON OUTLINE OF A PLAN FOR DEVELOPING THE DELTA-MENDOTA IRRIGATION WATER SUPPLY AND SALT-WATER REPULSION IN THE SACRAMENTO-SAN JOAQUIN DELTA REGION - CENTRAL VALLEY PROJECT, CALIFORNIA

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Denver, Colorado
July 10, 1944

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Branch of Design and Construction
Engineering and Geological Control
and Research Division

Denver, Colorado

Laboratory Report No. 145
(Supplements Laboratory
Report No. 142)
Hydraulic Laboratory
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Reviewed by: R. F. Blanks
W. R. Young

July 10, 1944

Subject: Skeleton outline of a plan for developing the Delta-Mendota Irrigation Water Supply and Salt-Water Repulsion in the Sacramento-San Joaquin Delta Region - Central Valley Project, California.

1. There has been in progress in the hydraulic laboratory, since March 1943, a study involving the use of a model of the Delta region of the San Joaquin and Sacramento Rivers in the Central Valley of California. The operation and study of the model have suggested a general plan for controlling the intrusion of the ocean salinity into the delta and for transporting water from the Sacramento River to the intake of the Delta-Mendota pumping plant to meet the terms of the "Contract for the Exchange of Waters." The primary purpose of initiating the model studies was to clarify the conditions affecting the various alternative plans for development, but they also have been effective in indicating the practicability of a plan of development whereby construction of some of the initial project features could be undertaken immediately. The studies have reached a point where it becomes necessary that some plan be adopted as a basis for continuing laboratory, field, and office investigations. The plan suggested herein is sufficiently flexible that the initial construction can be integrated with any variation for ultimate development that may be determined by Project Planning studies, by further work in the laboratory, and by field experience.

2. The conferences, tests, and studies in connection with the hydraulic laboratory program have led to the following tentative conclusions:

(a) The sustained flow in the San Joaquin River is now approximately 600 s.f. with a pollution of 800 to 1,200 parts per million of total dissolved solids. The quality of the Sacramento River water for flows of 15,000 s.f. is now somewhere between 100 and 120 p.p.m. of total dissolved solids.

(b) The "Contract for Exchange of Waters" dated July 27, 1939, states in part:

> "The weighted annual average of dissolved solids in substitute waters delivered to Contracting Companies pursuant to this contract shall not exceed by more than thirty-five percent (35%) the weighted annual average of dissolved solids which would result if all of such waters had been taken from the Sacramento River at the head of Snodgrass Slough; provided, however, that the weighted average of dissolved solids in

waters delivered to the contracting companies from October 1 of any year to June 30 of the following year, shall not exceed 200 parts per million; and the weighted average of dissolved solids in waters delivered to the contracting companies from July 1 to September 30 in any year shall not exceed 300 parts per million. No part of such substitute waters shall be taken from the San Joaquin River between the head of Temple Slough and Lathrop, nor from streams entering the San Joaquin River between Temple Slough and the mouth of the Merced River."

The limitations in this paragraph make it necessary to insure that very little if any of the poor quality San Joaquin River water reaches the Delta-Mendota pumping plant intake. Ultimately this could be accomplished by building a bypass along the south and west sides of the delta to carry the San Joaquin flow from a point near Mossdale to Suisun Bay at some point west of Antioch.

This bypass will be required eventually, in addition to any other remedial measures, to protect the southern half of the delta from pollution by San Joaquin River water which is expected to increase in quantity and decrease in quality as the Delta-Mendota use develops.

Under present conditions the entire discharge of the San Joaquin River would flow into the Delta-Mendota pumping plant and the resulting contamination would depend upon the quality and quantity of the San Joaquin flow. Assuming that the Sacramento River water contains 100 parts per million of dissolved solids, the maximum allowable pollution that may be added by San Joaquin water is 35 p.p.m. of dissolved solids. This limit would be exceeded if the San Joaquin River flow is more than 400 s.f. of 500 p.p.m. water or 180 s.f. of 1000 p.p.m. water. The greater the flow of the San Joaquin River with a given pollution the poorer will be the quality of a given Delta-Mendota pumping load. Also the less the pumping load, the poorer will be its quality for a given quantity and quality of San Joaquin River flow. This contamination is practically independent of the magnitude of the transfer of Sacramento River water.

The proportion of San Joaquin water reaching the pumping plant intake could be reduced to 50 percent by constructing a dam in Old River just downstream from its bifurcation with the San Joaquin River. The net effect of the dam would be to double the allowable flow of the San Joaquin River. Increasing San Joaquin River flow and decreasing the pumping load with the dam in place have the effect of lowering the quality of the Delta-Mendota water. A further reduction in the figure of 50 percent could be accomplished only by substantially increasing the transfer flow from the Sacramento River.

(c) The maximum consumptive use in the delta will be 3600 s.f. of which 2400 will be used in the San Joaquin portion and 1200 in the Sacramento portion. The consumptive use varies from 500 to 3600 s.f.

(d) The delta can be protected from ocean salinity by providing the required net outflow. This outflow is the same whether the State Plan of diversion or the closed channel is used. The only change that occurs in the delta due to operation of the State Plan is that the entire stretch of Old River from its mouth to the Delta-Mendota pumping plant assumes a uniform salinity due to the negative average flow of this reach. The ocean salinity at the mouth of Old River will not be affected by operation of the State Plan and will be no greater than a few parts per 100,000 of chlorine and may be zero.

(e) To protect the delta region against the intrusion of ocean salinity, it has been concluded in bulletin 27 that the salinity at Antioch must be maintained at or less than 100 parts of chlorine per 100,000 parts of water. It has been previously accepted that this condition could be maintained by a sustained total net flow of 3,300 s.f. past Antioch. It appears from the results of the present studies that this flow will be sufficient only if the most unfavorable future hydrograph is similar to those used in its determination. If the period of low flow is materially longer than those of record, as might be expected under Central Valley Project operation, the required flow will be more nearly 5,500 s.f. The control flow required for the most unfavorable future hydrograph will be less than 5,500 s.f. by an amount depending upon the shape of the hydrograph. All estimates of flows required for various conditions in the following pages are based upon a low-flow period of indefinite length, which requires a control flow of 5,500 s.f., and a sustained consumptive use of 3,600 s.f.

(f) With the Delta-Mendota pumping plant in operation to the extent of 4,600 s.f. and with <u>no consideration of quality of water</u> the factors controlling water requirements in the delta are repulsion of ocean salinity and satisfaction of the needs of the San Joaquin portion of the delta.

(1) With Snodgrass Slough not opened a flow of 20,000 s.f. in the Sacramento River would be required because most of the transfer of water must take place at the river junction near Collinsville which requires that the salinity at this point be kept low.

(2) If the transfer above the junction was increased by opening and dredging Snodgrass Slough, the required flow could be decreased to 18,000 s.f.

(3) If the transfer of water through Snodgrass Slough is increased by pumping, the required flow would be 14,000 s.f.

(g) When the <u>quality of the Delta-Mendota water with respect to ocean salinity is considered</u> the controlling factor in the water requirements in the "Contract for Exchange of Waters" quoted in

paragraph 2(b). Assuming the bypass constructed, the flow in the Sacramento River required to satisfy the Delta-Mendota pumping requirements as to quality and quantity, protect the delta against ocean salinity, and meet consumptive use in the delta varies with the transfer flow.

(1) With Snodgrass Slough not opened, a flow of 24,000 s.f. in the Sacramento River would be required because the water transferred at Collinsville must have a higher quality than in 2(f) (1).

(2) If Snodgrass Slough is opened and dredged, the required flow could be reduced to 22,000 s.f.

(3) If the transfer through Snodgrass Slough is increased by pumping, the required flow would be 14,000 s.f.

3. The preceding tentative conclusions suggest a step-by-step plan of development, as follows:

(a) Build Delta-Mendota pumping plant and canal, and dredge a section of Old River to provide an approach to the pumping plant.

(b) Build the bypass to drain the polluted water of the San Joaquin River from the delta unless the quality of the Sacramento River water and the quality and quantity of the San Joaquin River water are such as to justify, temporarily, such measures as the dam in the Old River.

(c) Before the supply of excess water available from Shasta Reservoir for salinity control is depleted, build one of the additional reservoirs contemplated in the state-wide plan and, after that other reservoirs, successively, as required to maintain storage ahead of demands in order to supply the water needed for salinity control. When a deficiency of fresh water develops in the San Joaquin portion of the delta, or salinity conditions become objectionable, transfer more water from the Sacramento River by building Snodgrass Slough diversion, initially with no pumping and eventually with a pumping plant. The control of salinity by releases from storage in mountain reservoirs was suggested in "Report on Salt Water Barrier" by Walker R. Young, Bulletin 22, volume 1, state of California, Division of Water Resources, 1929, page 33, as follows:

"Salinity in the delta can be controlled through construction of storage reservoirs in the mountains from which water could be released during the season of low river discharge in the amount necessary to act as a natural barrier against invasions of salt water. Mountain storage would be a temporary expedient for the reason that, ultimately, there will be use for all of the available flow from the rivers, and the discharge into Suisun Bay and thence to the ocean, of water sufficient to act as a natural barrier against salt, would be an economic waste. However, storage created in

mountain reservoirs constructed mainly for other purposes might advantageously be used for some time to control the salinity in the upper bays and delta channels during development of the requirement for full use of the reservoirs for the purpose for which they were primarily constructed, thus deferring the large investment in the Salt Water Barrier."

(d) As the program of water utilization develops, correlate field and model performance to determine the sustained flow required to control ocean salinity.

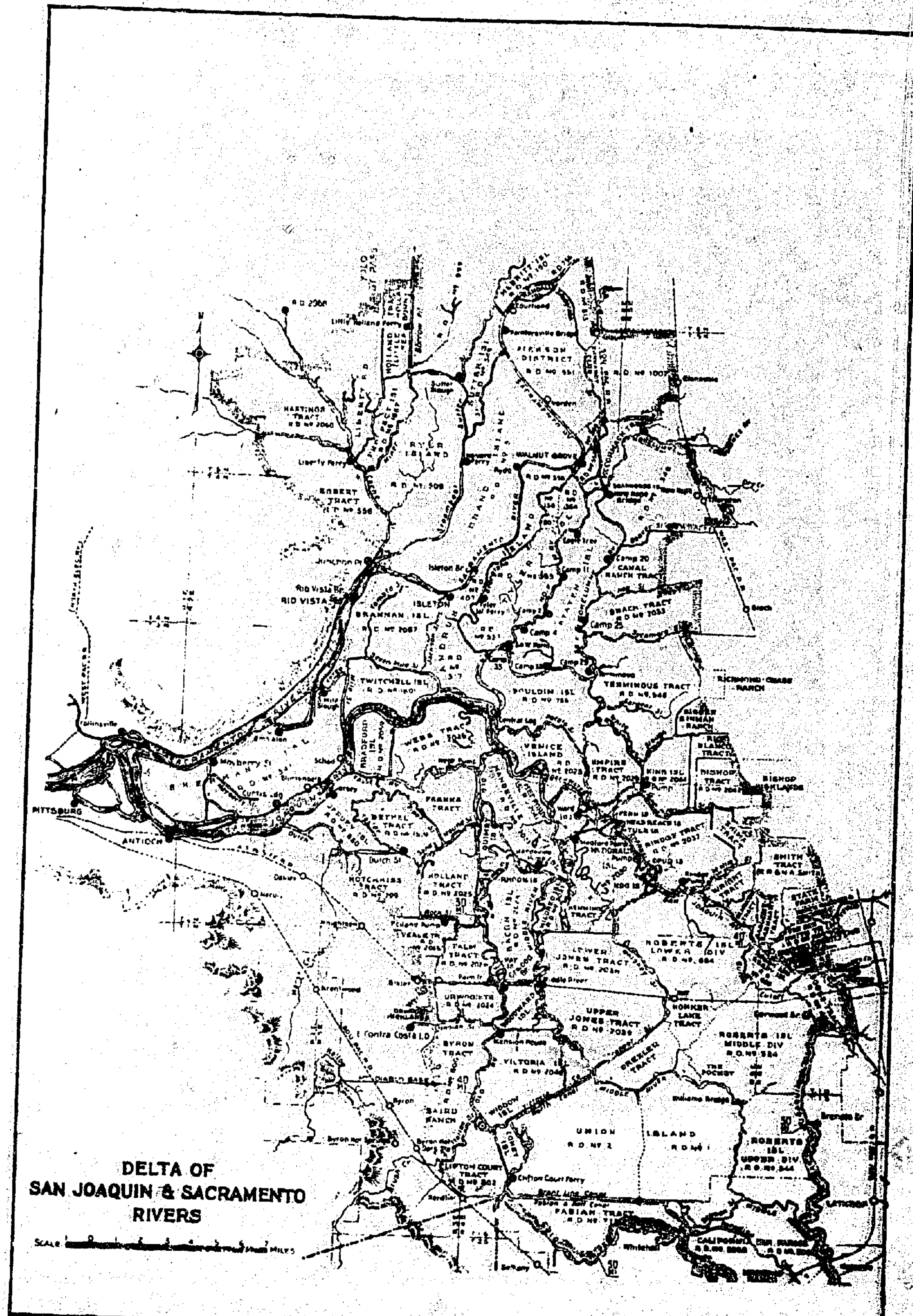
(e) When the value of the fresh water required to act as a natural barrier against ocean salinity becomes sufficiently high, the construction of the salt-water barrier may be justified. This will occur only when the utilization of the difference between the quantity of fresh water required to act as a natural barrier against ocean salinity intrusion and the smaller quantity required for operation of the salt-water barrier becomes essential to the full development of the water resources of the Central Valley. The time when the salt-water barrier may be justified or required will be the same from the standpoint of protection of the delta against salinity intrusion whether the state plan or the closed cross-channel is used. If, in order to provide water of suitable quality to meet the "Contract for the Exchange of Waters," it should be deemed necessary to construct either the closed cross-channel or the salt-water barrier, the latter would be preferable because of the water saved, the more positive protection afforded the delta region, and the fact that, ultimately, the barrier may be needed even though the closed channel had been built. The cost of the closed cross-channel would be a high percentage of the cost of the salt-water barrier.

4. This plan provides a flexible program for Delta-Mendota diversion and salinity repulsion whereby construction can be started immediately on the Delta-Mendota pumping plant and canal, and such coincidental features as may be justified by Branch of Project Planning studies. Additional features of the project can be schedules for future development as further field and Project Planning studies may dictate.

5. An assembly report of all information and supporting data accumulated during the course of studies and tests in the hydraulic laboratory is being compiled, which, together with field investigations and studies being conducted by the Branch of Project Planning, will supply data for developing the suggested plan.

Approved July 22, 1944

S. O. Harper
Chief Engineer.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