CHAPTER VII

EFFECTS OF OPERATION OF CVP AND SWP EXPORTS PUMPS NEAR TRACY

CHANNEL DEPTHS AND CROSS SECTIONS

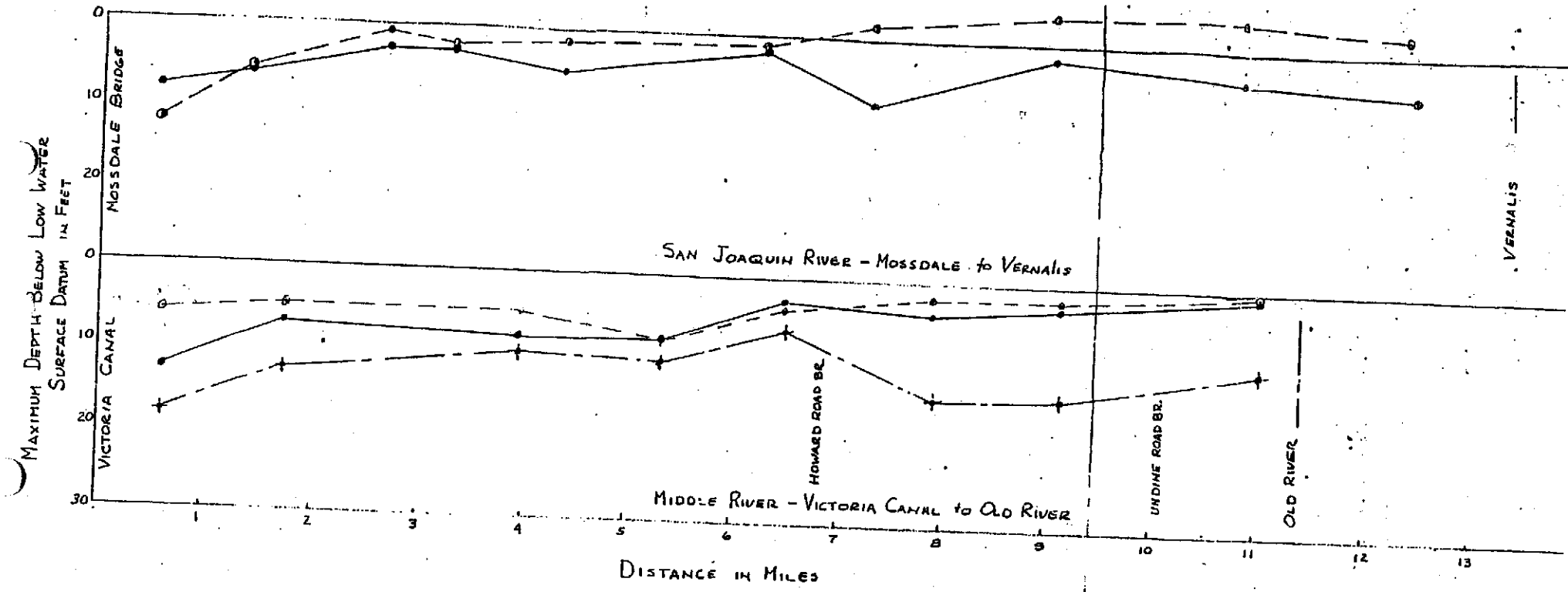
The geometry of the channels within the southern Delta was studied to determine whether the channel cross sections and bottom elevations have changed since the 1930's in such a way as to alter water circulation patterns and water depths to a degree that modifies the southern Delta water supply.

Channel Surveys

Prior to 1913, most existing channels within the South Delta Water Agency were well defined, due in part to the sidedraft clamshell dredge which was used over many years to construct the levee system within the South Delta and to keep channels clean of sediment. Since 1913 most of the channels in the South Delta have been surveyed several times. The results of surveys are summarized if figure VII-1.

Available survey data include:

Date of survey	Channels surveyed	Source of data
1913	Old River - Middle River to Victoria Canal Middle River - Old River to Victoria Canal Grant Line and Fabian Canals	USCE
1933-34	All SDWA channels	USC&GS
1957	Grant Line and Fabian Canals, plus Salmon Slough and Paradise Cut	DWR
1965	Grant Line and Fabian Canals	USCE
1973	Old River-San Joaquin River to Victoria Canal Middle River-Old River to Victoria Canal Grant Line and Fabian Canals	DWR
1976	San Joaquin River-Vernalis to Mossdale	DWR



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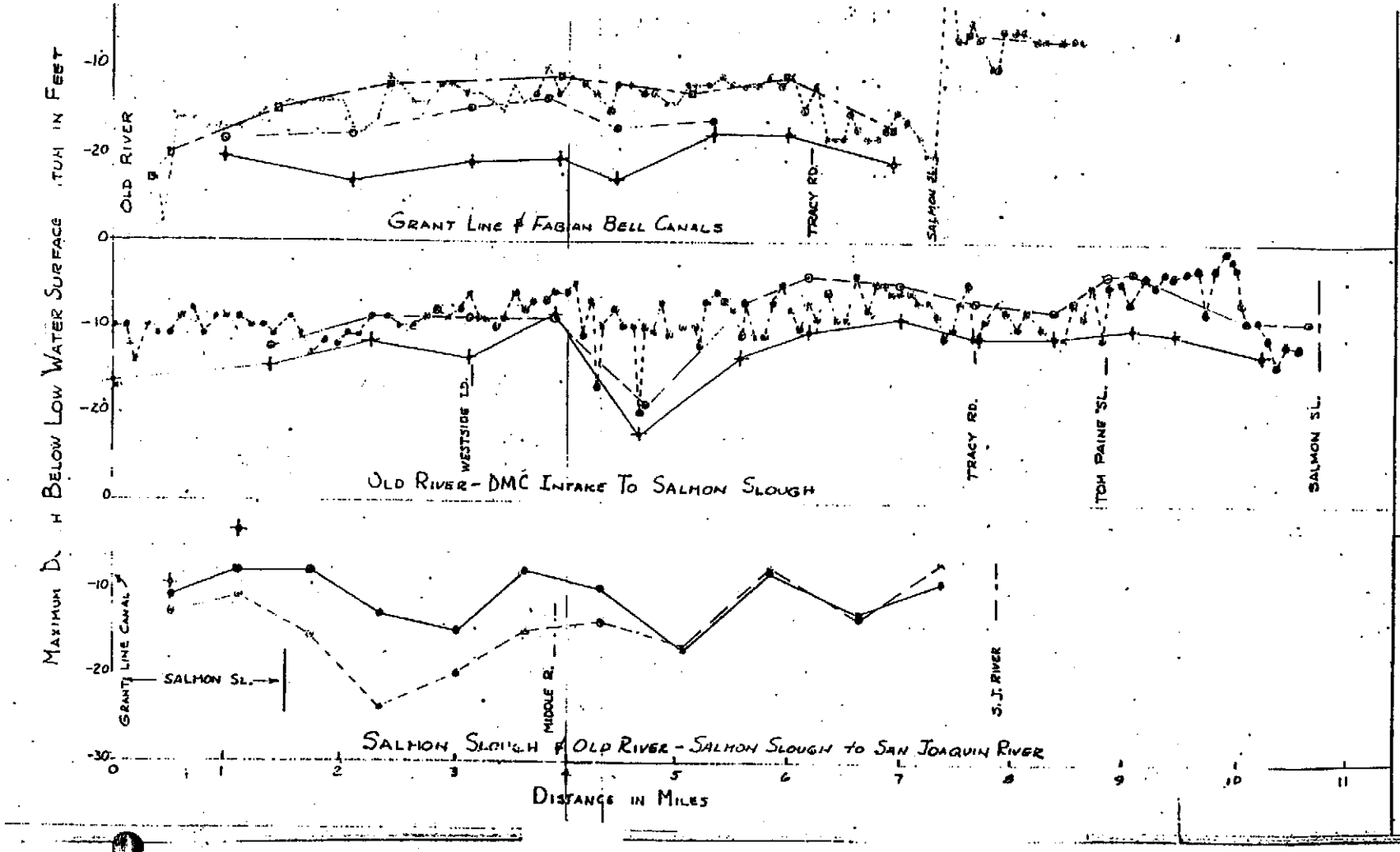

SOUTH DELTA CHANNEL DEPTH SURVEYS

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Figure

In describing the geometry of the channels, especially the depth, it is appropriate to use a fixed reference plane. For example, navigation charges which need to be site specific use local MLLW. However, this locally oriented datum varies from -0.2 ft MSL to +0.5 ft MSL within the SDWA and is dependent upon the condition of San Joaquin River inflow.

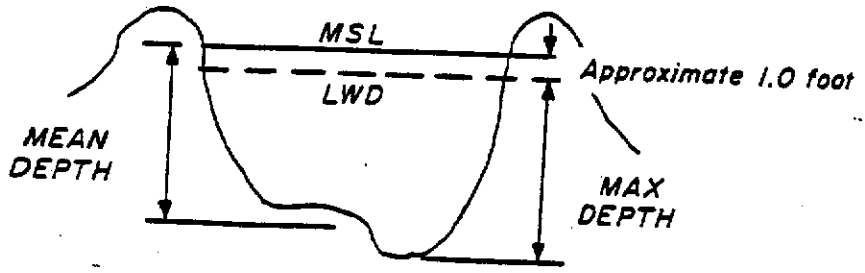
Much of the hydrographic data used in this study was taken from charts used by the Corps of Engineers to build the Sausalito model of the Bay-Delta, the low water datum, (LWD) of 1.0 foot below mean sea level as shown in the sketch below, which was used by the Corps to integrate data from diverse sources, was also adopted for the present study. It is a conservative datum in that it is lower than the local MLLW levels throughout the SDWA by a foot or more.

Most of the channels, dredged prior to 1913, were 10 to 20 feet below the LWD. By 1933-34, however, most channels surveyed had aggraded significantly. Existing survey data indicate that in some channels, such as the southern reaches of Middle River, little dredging has been done. Data on dredging to maintain the levees and to provide fill for road construction were not available.

In the 1973 and 1976 surveys channel geometry was determined for reaches from Vernalis on the San Joaquin River to the State and Federal pumping plants near Clifton Court Forebay, including Old River and the Grant Line and Fabian-Bell Canals, and for the Middle River between Old River and Victoria Canal. To determine channel bottom profiles, bottom elevations taken at 1/2 to 1-1/2-mile intervals were averaged. The shapes of the channels studied were such that the average water depths approximated the hydraulic radius. An example of the channel mean depths and cross sections observed in the 1973 survey for the

reach of Old River between Clifton Court and the San Joaquin River is presented in figure VII-2.

The diagram below illustrates the differences between average and maximum depths and between LWD and MSL.



Bottom elevations of the major channels were further analyzed in relationship to the survey dates and the initial operations of the Federal and State pumping plants.

San Joaquin River--Vernalis to Mossdale Bridge. Most of this reach has aggraded since the 1933-34 surveys. By 1976 the elevation of the stream bottom had risen 0.5 to 9.5 feet above the 1933-34 levels, with an average increase of about 4.0 feet. The bottom elevation of the reach from Vernalis to a point approximately 4.8 miles north of the San Joaquin River club varied from 2 to 7 feet below the LWD in 1933 and varied from 1.5 to 3.5 feet above LWD in 1976. This aggradation generally causes a corresponding reduction in water depth.

Old River, San Joaquin River to and including Salmon Slough. In 1973, streambed elevations of this 7.5-mile reach were equal to or below that measured in the 1933-34 survey. The 1973 elevations ranged from 8 to 24 feet below LWD with an average of about 14 feet; the 1933-34 elevations varied from 8 to 17 feet with an average of about 10 feet. Therefore, during the intervening

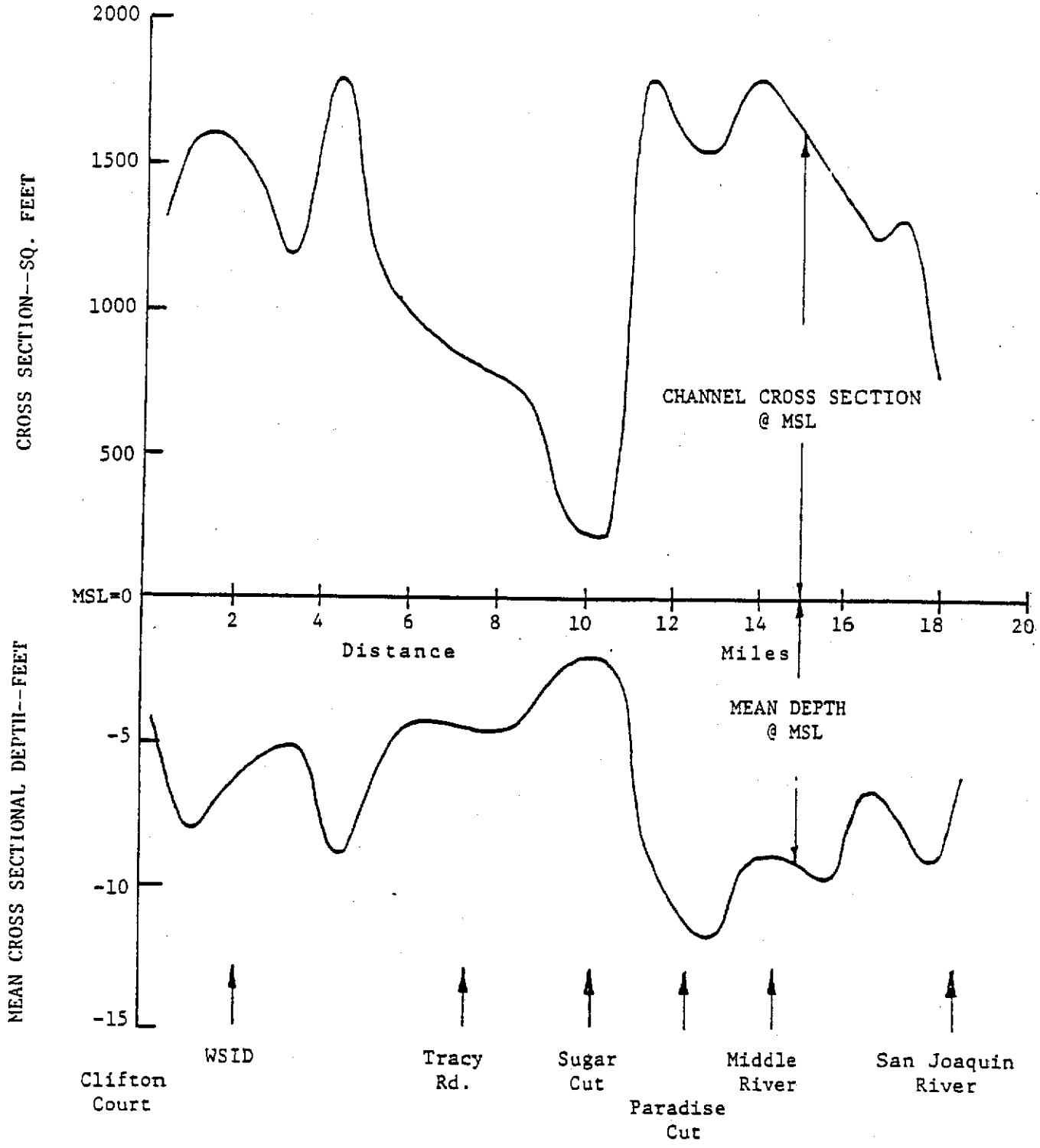


Figure VII-2 CHANNEL PROPERTIES, OLD RIVER, CLIFTON COURT TO SAN JOAQUIN RIVER
(Data from 1973 DWR Survey, Datum is Mean Sea Level)

40 years, the channel had degraded an average of 4 feet, but with very little change in the upstream 1/3 of the reach.

Old River, to Salmon Slough to Delta-Mendota Canal Intake Channel. Bottom elevations of this 11-mile channel averaged 12 feet in 1913, with a range of 9 to 22 feet below LWD. The channel had displayed a 3.5-foot aggradation by the 1933-34 survey. However, the channel had not had any further significant change by the 1973 survey. The 1933-34 and the 1973 surveys each indicated a similar channel restriction near the bifurcation of Old River and Tom Paine Slough. Maximum cross sectional depths measured in 1973 through the 4-mile restricted section averaged about 6 feet with a minimum of 4 feet with reference to LWD elevation. The mean elevation of the bottom of the most restricted area is about 2 feet below mean sea level as shown in figure VII-2. Where as the maximum depth below LWD was about 3.7 feet.

Grant Line and Fabian Canals--In 1913 the elevation of these paralleling 7-mile channels averaged more than 20 feet below LWD. By 1957 they had aggraded about 8 feet with an average depth of 12 feet below LWD, remaining at that depth until after the 1965 survey. By the 1973 survey, however, the channels had degraded to an average of about 16 feet below LWD. The channel depths could have been influenced by maintenance dredging and/or increases in channel velocities due to operation of Clifton Court Forebay. Flow restrictions have not been apparent in these channels.

Middle River--Old River to Victoria Canal--In 1913, the channel elevation of this 11.5-mile reach of Middle River varied between 7 and 18 feet below LWD with an average of about 12 feet below LWD. By the 1933-34 survey, channel bed had aggraded to an average of about 6 feet below LWD elevation. Further

aggradation was shown by the 1973 survey to an average depth of 4 feet below LWD elevation. However, the 6-mile reach directly north of Old River has only aggraded about 0.5 feet since the 1933-34 survey. Both the 1933-34 and 1973 surveys recorded a restriction 0.4 of a mile north of the head of Middle River with maximum depths of 1.0 in 1933-34 and 0.5 feet in 1973, below LWD elevation.

Calculated Hydraulic Resistance in Old River

The resistance to flow, assuming present channel geometry in Old River, was studied as a basis for examination of the effect of reduced water levels on water circulation through this channel.

Using channel cross section data obtained by the DWR in 1973, the hydraulic resistance characteristics were estimated for some 22 channel segments of Old River between Clifton Court and the main stem of the San Joaquin River. It can be shown by open channel flow hydraulics that resistance, the relationship between head loss and channel discharge, is proportional to the square of channel width and the 10/3 power of the mean depth. In essence, this means that a narrow, shallow channel greatly restricts flow--much more dramatically than might at first appear to be the case by inspection in the field. For example, simply reducing channel width and depth by one-half each, thereby reducing the effective area to one-quarter, increases hydraulic resistance for the same length and roughness more than 40 times. These effects are especially evident in the central section of Old River in the vicinity of Tom Paine Slough where mean channel depths below mean sea level average less than 3 feet and widths are less than 100 feet.

The channel cross sections and depths along Old River are illustrated graphically in figure VII-2. In figure VII-3 the cumulative hydraulic resistance