SUMMARY OF TECHNICAL STUDIES

FOR THE

SACRAMENTO AND SAN JOAQUIN RIVER BASINS, CALIFORNIA COMPREHENSIVE STUDY

Numerous technical analyses were conducted during the Sacramento and San Joaquin River Basins Comprehensive Study (Comprehensive Study) to inventory resource conditions in the study area and to analyze problems and opportunities for flood management and ecosystem restoration. These studies were performed using an unprecedented suite of technical modeling tools developed by the U.S. Army Corps of Engineers, Sacramento District (Corps) and the California Department of Water Resources (DWR) to simulate the hydrology, hydraulics, ecosystem function, flood risk and associated economic damages in the Sacramento and San Joaquin river systems. Extensive data were collected to support these models and studies, including topography, historic stream flows, sedimentation and geomorphologic data, geotechnical data, land use, and economic data. The models will be used by the Corps, DWR, and others in developing future flood management and environmental improvement projects in the Sacramento and San Joaquin river basins. Opportunities for future projects and discussion of other aspects of the Comprehensive Plan can be found in the *Interim Report, Sacramento and San Joaquin River Basins Comprehensive Study, California*, 2002.

The following provides a summary of the technical tools and analyses performed to date under the Comprehensive Study and describes how the various technical tools can be used individually and collectively to evaluate potential system-wide solutions. The attached technical appendices contain detailed descriptions of the models and other technical tools used by the Comprehensive Study:

Appendix A – Information Papers

Appendix B – Synthetic Hydrology Technical Documentation

Appendix C – Reservoir Operations Modeling

Appendix D – Hydraulic Technical Documentation

Appendix E – Risk Analysis

Appendix F – Economics Technical Documentation

Appendix G – Ecosystem Functions Model

INTRODUCTION

The Sacramento and San Joaquin river basins cover a drainage area of over 43,000 square miles, shown in **Figure 1**. A mixture of climate conditions, geologic formations, river attributes, natural resources and habitats, flood management infrastructure, and rural and urban development characterizes this large study area. Past flood damage reduction and environmental restoration projects have typically examined single resources or relatively

small portions of the system, with little consideration of impacts to adjacent reaches or cumulative impacts to the river system as a whole. The Comprehensive Study has performed more extensive, watershed-based analyses. A new set of technical tools was required to perform these system-wide evaluations of opportunities to improve flood management and the ecosystem in the diverse river systems of the Central Valley, summarized in **Table 1**.

TABLE 1
COMPREHENSIVE STUDY TECHNICAL EVALUATION TOOLS

Topic	Technical Product	Description
Surveys and Mapping	Topography Digital Terrain Models Aerial Photographs	Mapping along the river corridors of the Sacramento and San Joaquin rivers, their major tributaries, and bypass systems.
Hydrology	Synthetic Hydrology	Unregulated synthetic flood hydrology for multiple storm runoff conditions in the valley, including events with a 50%, 10%, 4%, 2%, 1%, 0.5%, and 0.2% chance of occurrence in any given year
	HEC-5 Models	Simulates the operation of 73 headwater and foothill reservoirs tributary to the Sacramento and San Joaquin Rivers
Hydraulics	UNET Models	Simulates river system hydraulics for over 1,000 miles of Central Valley rivers, flood bypasses, and other major waterways
	FLO-2D Models	Simulates the movement of water through valley floodplains
	DSM2 (Delta Simulation Model 2)	Evaluates potential impacts to complex hydrodynamic conditions in the Sacramento-San Joaquin Delta
Geotechnical	Levee performance curves	Series of curves approximating the probability of failure of levees within the Sacramento and San Joaquin River basins
Flood Risk and Economics	HEC-FDA (Flood Damage Analysis)	Evaluates existing flood risk and economic damages in the Central Valley, incorporating risk and uncertainty
Ecosystem	EFM (Ecosystem Functions Model)	Gauges the response of riparian, wetland, and riverine habitats to changes in hydrology and riverine hydraulics
Information Management	GIS (Geographic Information System)	Geographic database of the Sacramento and San Joaquin River basins (including hydrography, habitat, urban development and infrastructure, flood management facilities, properties, geology, and much more)
	CAD (Computer Aided Design)	Riverine topography and bathymetry, digital elevation models, aerial photos, river and levee alignments

The topography, hydrology, modeling tools, and other data developed for the Comprehensive Study will be a valuable resource for future studies in the Central Valley. The study tools, assumptions, and evaluation approach are tailored to be effective and efficient when applied

to watershed-scale studies. While the level of detail is suitable for evaluation of the river systems as a whole, the tools and evaluation processes may not be suitable for detailed studies of smaller river reaches or local conditions. Future studies choosing to use the Comprehensive Study's tools should carefully consider their appropriateness and make individual determinations of whether the tools can fulfill their unique technical needs.

Study Area

The Comprehensive Study area shown in **Figure 1** includes the combined watersheds of the Sacramento and San Joaquin River basins. The study focuses on solving flooding and ecosystem problems within the floodplains of the Sacramento and San Joaquin rivers and the lower reaches of their major tributaries.

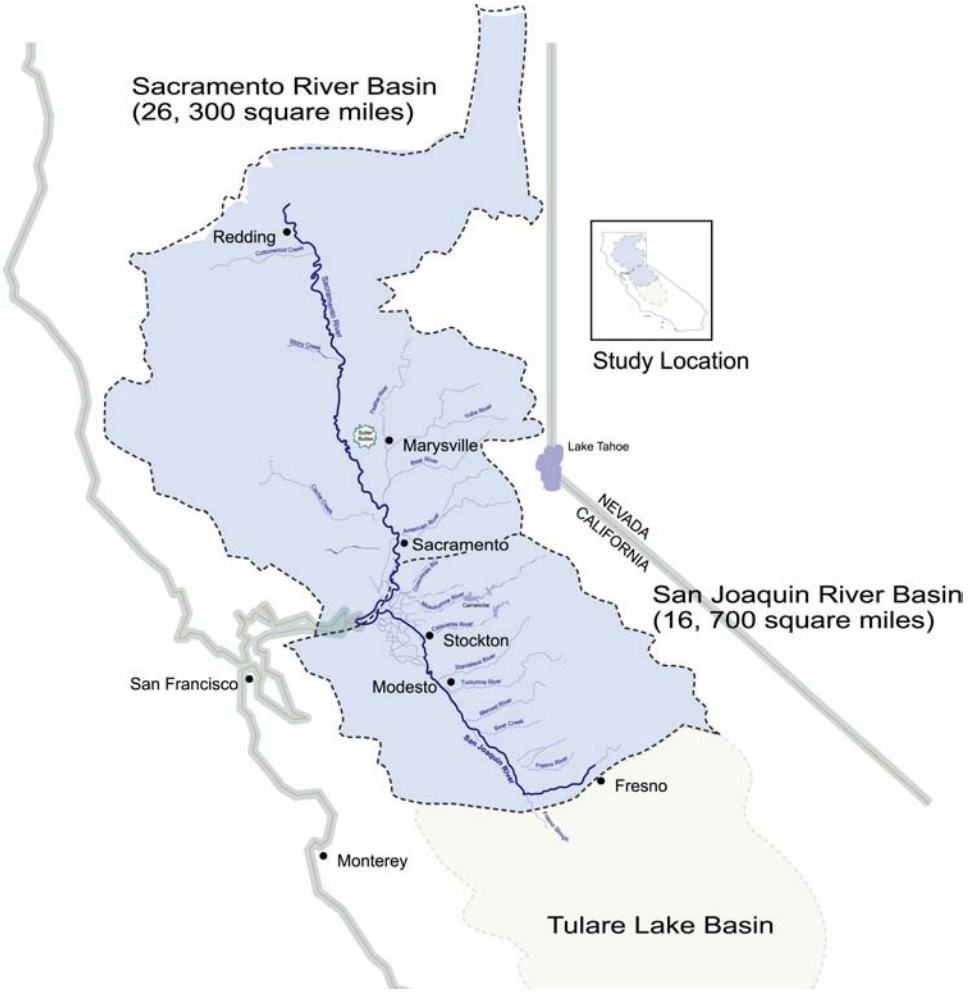

FIGURE 1 – STUDY AREA

The Tulare Lake basin is not included in the study area, although the contribution of flood flows from the Kings River to the San Joaquin River is considered. Flooding and related ecosystem problems on the Mokelumne, Calaveras, Cosumnes, and American rivers, and Cache Creek and other small streams are being addressed in other studies and are, therefore, not a primary focus of the Comprehensive Study. Similarly, while the Comprehensive Study

has developed tools for evaluating impacts to the Sacramento-San Joaquin Delta, and the region may be included in future plans, the Delta it is not part of the primary study area.

Future Studies

It is anticipated that additional technical studies will be required in the future to support the development of specific regional and system-wide plans for flood damage reduction and ecosystem restoration. These include geomorphological studies; sediment transport tools; more detailed geotechnical analyses of levee performance; coordinated reservoir reoperation; and other studies to address local or regional concerns. These studies will be completed as part of future feasibility studies, as appropriate, and could utilize a variety of tools or methods; hence, they are not described in this document.

SURVEYS AND MAPPING

Many of the tools developed for the Comprehensive Study required updated surveys and mapping. This data includes topographic contour mapping, digital elevation models, and aerial photographs.

Extensive topographic data were collected to support development of the hydraulic models and is described in detail in *Appendix D - Hydraulic Technical Documentation*. In general, the mapping covers linear riverine reaches that include the main river channel, levees (if present), and the overbanks for a distance of approximately 300 feet landward of the levees. **Table 2** summarizes the river reaches where topographic data were collected. Black and white aerial photographs were also developed along the river corridors. Topographic data were collected using hydrographic, photogrammetric, and LIDAR mapping techniques. Bathymetric data provided detailed channel geometry below the waterline. In the overbanks, U.S. Geologic Survey (USGS) 30-meter digital elevation models (DEMs) and 10-meter DEMs, where available, were used in developing the hydraulic models.

At the onset of the study, current mapping in the Sacramento River basin was readily available from recent projects but data in the San Joaquin River basin was often dated or incomplete. Survey data in the Sacramento River basin was collected between 1995 and 1999 and consists primarily of 2-foot contour mapping above and below the waterline along the major watercourses. The exception is 5-foot contours developed in the Butte basin and 4-foot contour mapping along portions of the Feather River.

Due to the absence of current mapping, extensive topographic data were collected in the San Joaquin River basin specifically for the Comprehensive Study. Hydrographic and photogrammetric surveys of the San Joaquin River basin were conducted in 1998 and a survey of the overbank areas was conducted in 2000. Data were collected to produce 2-foot contour mapping above and below the waterline along the major watercourses.

TABLE 2
TOPOGRAPHIC DATA COLLECTION

Watercourse	Reach
Sacramento River Basin	
Sacramento River	Collinsville to Vina-Woodson Bridge
Steamboat Slough	Entire length
Sutter Slough	Entire length
Miner Slough	Entire length
Georgiana Slough	Entire length
Cache Slough	Lower end
Three Mile Slough	Entire length
Shag, Hass, and Lindsey Sloughs	Lower end
American River	Mouth at Sacramento River to Nimbus Dam
Yolo, Sutter, Tisdale & Sacramento Bypasses and Tributaries	Entire lengths of bypasses, lower ends of tributaries
Butte Basin	This data consists primarily of the east overbank between the Sutter Buttes and Vina-Woodson Bridge extending 3 to 11 miles to the east of the Sacramento River.
Feather River	Sutter Bypass to Oroville Dam
Yuba River	Feather River to the Narrows
Bear River	Feather River to Highway 65 (hydrographic data was not collected along the Bear River due to a dense canopy of vegetation which prohibited GPS equipment from functioning)
San Joaquin River Basin	
San Joaquin River	Stockton to Friant Dam
Middle River	North/Victoria Canals to Old River
Old River	Tracy Boulevard to San Joaquin River
Grant Line Canal	Tracy Boulevard to Doughty Cut
Doughty Cut	Grant Line Canal to Old River
Paradise Cut	Old River to San Joaquin River
Stanislaus River	San Joaquin River to Oakdale
Tuolumne River	Lower 12 miles
Laird Slough	Entire length
Merced River	San Joaquin River to above Highway 99
Bear Creek	San Joaquin River to East Side Canal
Deep Slough	Bear Creek to Eastside/Mariposa Bypasses
Mariposa Bypass	San Joaquin River to Eastside Bypass
Eastside/Chowchilla Bypass	Deep Slough to San Joaquin River
Ash Slough	Eastside Bypass to Highway 152
Berenda Slough	Eastside Bypass to Highway 152
Fresno River	Eastside Bypass too Road 16
Fresno Slough	San Joaquin River to James Slough
James Slough	Fresno Slough to James Road

Note: Data for the reaches listed above were collected along mainstem and tributary river corridors (extending approximately 300 feet landward of adjacent levees or natural banks) and within flood management bypasses and overflow basins.