*"Draft"*

# North Delta Flood Control Scenarios

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*Prepared for:*
*CALFED Bay-Delta Program*

July 15, 1998

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### Purpose

The purpose of this report is to document the analysis of five flood control alternatives in the North Delta of the Sacramento-San Joaquin Delta. The North Delta study area is shown on Figure 1. The analysis was performed by Ensign & Buckley Consulting Engineers for the CALFED Bay-Delta Program (CALFED), with assistance and/or input provided by the CALFED staff, the County of Sacramento Water Resources Division, and the Sacramento Area Flood Control Agency.

### Background

The study area has been subjected to repeated and extensive flooding in the past, most recently in 1986 and 1997. As a result, the area has been the subject of previous studies, including studies by the U.S. Army Corps of Engineers (COE), the State of California Department of Water Resources (DWR), and the County of Sacramento, and CALFED. This study utilizes much of the information and modeling work that was developed by these previous studies.

The primary sources of flood flows in the North Delta are from the Cosumnes River, Mokelumne River, and Dry Creek; with additional flows contributed by the Morrison Creek Stream Group. The combined drainage area of these watersheds is approximately 1,980 square miles. The COE has estimated the 100-year peak flow from the combination of the Cosumnes and Mokelumne Rivers and Dry Creek to be just over 110,000 cfs. This is far greater than the capacity of the downstream channels; Lost Slough and the Mokelumne River. The limited capacity causes water to backup into a broad floodplain north of New Hope Tract in the area known as the Franklin Pond.

The limited capacity of the Mokelumne River also causes water to backup Snodgrass Slough to the north toward Lambert Road. Lambert Road caps a levee which generally prevents flood waters from flowing north into the Stone Lakes area. The low point in the road is just above elevation 11.0 and during large storm events, water overtops the road and flows north into the Stone Lakes area.

Another significant feature of the region, and of key concern to this study, is the McCormack-Williamson Tract. During large storm events, the combined flows from the Cosumnes and Mokelumne Rivers are conveyed around the McCormack-Williamson Tract in the Mokelumne River and Lost Slough channels. As already indicated, these channels have limited capacity and cause flows to backup against the east levee of the tract into the Franklin Pond area. If the water level becomes high enough, it can trigger a failure of the levee, which results in the tract rapidly filling with water. The water within the tract can then cause a levee failure at the southern end of the tract, sending a surge of water into the North and South Forks of the Mokelumne River, and posing a flooding threat to downstream areas. This failure scenario occurred during both the 1986 and the 1997 flood events. In 1986, the surge of flow out of the McCormack-Williamson Tract caused a levee protecting Tyler Island to overtop and fail. In 1997, the surge caused boats to be knocked loose from the marina at New Hope Landing.

Because of the recurring problems caused by the failure of the McCormack Williamson Tract levees, there has been significant interest in exploring ways to eliminate the problem. The County of Sacramento has previously explored using the tract as a floodway. Weirs were modeled at the upstream and downstream ends of the tract in an effort to eliminate the uncontrolled surges into, and out of, the tract. Modeling results indicated that it would be difficult, if not impossible, to use the tract as a floodway without increasing peak flows and stages downstream of the tract under certain flood scenarios.

Interest in the McCormack Williamson Tract has been renewed due to a proposal by environmental interests to purchase the tract and convert it into fisheries and wild life habitats. CALFED has commissioned this study to analyze the hydraulic effects of converting the tract into seasonal marsh and riparian forest habitats, and to explore additional measures to mitigate for increased flows downstream of the tract.

## Study Approach

Five different scenarios were analyzed for this study using the NETWORK version of the unsteady-flow model DWOPER. The DWR originally developed a NETWORK model of the North Delta for its North Delta Program studies. Ensign & Buckley Consulting Engineers modified the DWR's model for use with Sacramento County's Beach Stone Lakes Flood Control Study and calibrated the model to better fit the 1986 flood event stages and volumes. The COE utilized the model for its South Sacramento County Streams Investigation, and made additional modifications to the model. The COE's modifications included the development of new storm hydrology and the addition of several delta tracts (polders) to the model. The COE provided their model to CALFED for use in this study. Figure 1 shows the NETWORK model cross section locations.

Each flood control scenario was analyzed using two different storm events which were developed by the COE. Both storms were patterned after the 1986 event. The first storm, the Delta Specific storm, produces 100-year flows from the Cosumnes/Mokelumne watersheds and concurrent flows from the Morrison Creek watershed. The second storm, the Morrison Specific storm, produces 100-year flows from the Morrison Creek watershed and concurrent flows from the Cosumnes and Mokelumne Rivers. Hydrographs for these storms are shown on Figures 2 and 3. Documentation of the development of the storms can be found in the July 1996 COE report entitled, "*South Sacramento County Streams, Morrison Creek Stream Group, California – Feasibility-Level Hydrology*."

Modifications to the COE base model were made during this study. The levee elevations around four delta tracts were updated with new data. A list of the revised tracts and the source of the levee data is provided below:

| Tract | Source of Levee Profile |
|---|---|
| New Hope Tract | Kjeldsen-Sinnock & Associates Survey, March 1996 |
| Tyler Island | Kjeldsen-Sinnock & Associates Survey, March 1989 |
| Canal Ranch Tract | Murray, Burns, & Kienlen Survey, June 1991 |
| Brack Tract | Kjeldsen-Sinnock & Associates Survey, September 1989 |

## Analysis of Flood Control Scenarios

As previously indicated, five different flood control scenarios, plus the Base Condition, were analyzed. A description of each scenario, and its effect on the hydraulics in the North Delta is provided below. Figures 4 through 8 present schematic illustrations of each scenario. Tables 1 and 2 present the resultant stages at key locations for each scenario.

- *Scenario 1 (see Figure 4)*: Scenario 1 involves removing 500 foot sections of levee at the upstream and downstream ends of the McCormack-Williamson Tract to allow a free movement of flow through the tract. This would allow the tract to be converted into tidal marsh habitat, and would eliminate the uncontrolled surge of flood waters out of the tract due to levee failures. Modeling results indicate that this scenario would provide a significant reduction in stages in areas upstream of the tract. However, it also would result in significant increases in peak flow and stage downstream of the tract. This is clearly illustrated by the results for the Morrison Specific storm shown on Table 1. Scenario 1 reduces the peak stage at Franklin Boulevard by 1.8 feet, and in the Beach Stone Lakes area by 1.5 feet. Downstream, the scenario results in levee failures at Tyler Island, Staten Island, and Hew Hope Tract. These levees do not fail in the Base Condition.

- *Scenario 2 (See Figure 5)*: Scenario 2 would also create breaches in the levees at the upstream and downstream ends of the McCormack-Williamson Tract, but additional components are added in an effort to mitigate for the increased flows downstream. Levee setbacks of 500 feet are added on a portion of the South Mokelumne River, and Canal Ranch Tract is utilized as a tidal marsh/flood storage area. The levee setbacks extend from the downstream end of McCormack-Williamson Tract (Section 125) to the upstream end of Canal Ranch Tract (Section 31). The levees around Canal Ranch Tract are breached at Sections 31 and 35.

  As with Scenario 1, this scenario shows significant benefits upstream of McCormack-Williamson Tract and in the Beach Stone Lakes area. However, the levee setbacks and the storage in Canal Ranch Tract do not completely mitigate for the increased flows in the South Mokelumne. For the Delta Specific storm, Scenario 2 causes the failure of the Staten Island levee at Section 26 and the New Hope Tract levee along Beaver Slough. It also causes Tyler Island to fail earlier, resulting in a larger volume of water entering the tract.

- *Scenario 3 (See Figure 6)*: Scenario 3 is the same as Scenario 2, except Brack Tract is added as a tidal marsh/flood storage area. The results for this scenario are virtually the same as those for Scenario 2. The additional storage in Brack Tract does not provide enough volume to mitigate for the increased flow in the South Mokelumne.

- *Scenario 4 (See Figure 7)*: Scenario 4 breaches the upstream and downstream levee of the McCormack-Williamson Tract and utilizes dredging in the North and South Forks of the Mokelumne River to convey the increased flows downstream. The limits of the dredging are shown on Figure 5. The dredged cross sections were developed by the DWR for its North Delta Program. Due to concerns over impacts to shallow water habitats within the channels, the dredging was generally limited to those portions of the channel which were between elevation -10.0 and -20.0. A few sections were dredged up to elevation -6.0.

For the Morrison Specific storm, Scenario 4 results in a reduced or unchanged peak stage at every cross section in the model. The most significant improvements occur in the Franklin Boulevard area and the Beach Stone Lakes area, which see stage reductions around 3 feet. Significant benefits are also seen at Glanville Tract, which is prevented from failing, and although Canal Ranch Tract still fails, less volume enters the tract.

For the larger Delta Specific storm, the results are mostly positive, but not entirely. For this storm, Scenario 4 prevents Glanville Tract, Tyler Island, and New Hope Tract from failing and provides a reduction in stage at most locations, except for the South Mokelumne River. Increased stages on the South Mokelumne are seen between Sections 31 and 47, and range from 0.1 to 0.7 feet. These increases could potentially be mitigated with levee improvements where necessary. It may also be possible to eliminate, or minimize, the increased stages with modifications to the proposed dredged cross sections at a few critical locations.

- *Scenario 5 (See Figure 8)*: Scenario 5 begins with the same components that are included with Scenario 3 (McCormack-Williamson floodway, 500 foot levee setbacks on the South Mokelumne River, and Canal Ranch and Brack Tract flood storage) and adds dredging on the North Mokelumne. The limits of the dredging are shown on Figure 6. The dredged cross sections used for this scenario are identical to those used on the North Mokelumne for Scenario 4.

For the Morrison Specific storm, Scenario 5 produces a reduction in stages at all cross sections, except for Section 32, which remains unchanged. No Delta Tracts fail.

For the Delta Specific storm, the results are similar to those for Scenario 4. Stages are reduced throughout the study area, except in the South Mokelumne between Sections 28 through 46. The most significant increases are seen between Sections 28 through 33, which have increases ranging from 0.3 to 0.9 feet. Even with these increases, the model predicts no levee overtopping at any of the Delta Tracts. If necessary, these increases could be mitigated with levee improvements, or possibly with additional levee setbacks.

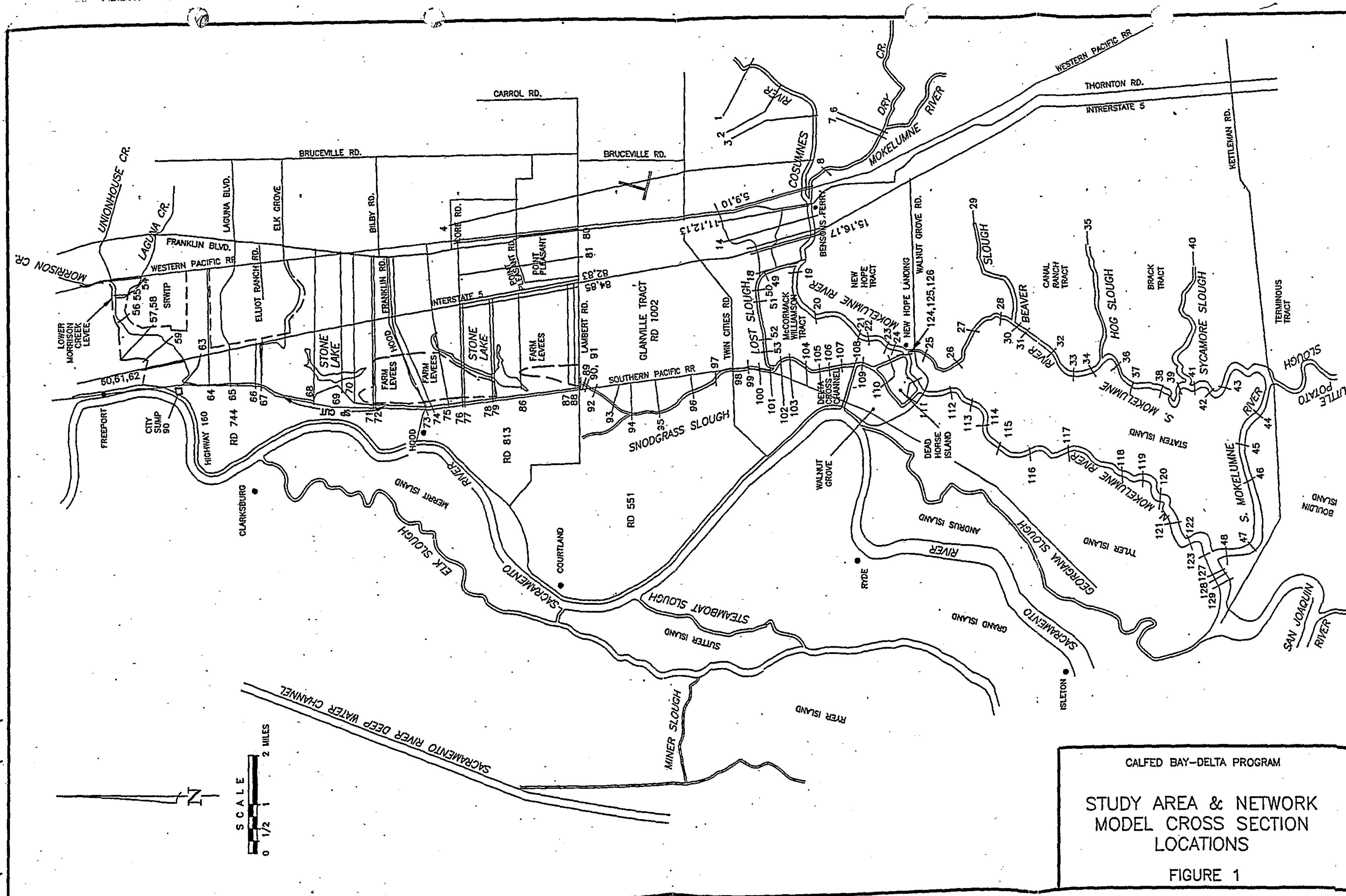
**Limitations of Study**

During the course of this study, several modeling assumptions and simplifications were made. These are described below:

- The 500 foot levee setbacks, which were modeled as a part of Scenarios 2, 3, and 5, were accomplished by directly modifying the top width values in the NETWORK input file. All top width values which corresponded to an elevation at, or above, 0.0 foot were simply increased by 500 feet. This may introduce some inaccuracy since the composite Mannings "n" value may change at each elevation. It is felt than any inaccuracy introduced is relatively minor, and it would not affect the conclusions of the analysis. However, if any of the affected scenarios are pursued further, it is recommended that the Hydrologic Engineer Center's *Geometric Elements from Cross Sections Coordinate* program be used to generate the hydraulic data for all cross sections with levee setbacks.

- The levees surrounding the Delta Tracts were assumed to fail if, and when, they were overtopped. A failed levee was modeled to erode over a period of 12 hours to a maximum width of 200 feet with the base of the breach at the elevation of adjacent natural ground. The flow through a breach was computed based on submerged weir flow using a weir coefficient of 2.6.

- Scenarios 3 and 5 utilize both Canal Ranch Tract and Brack Tract as flood storage/tidal marsh areas. For this analysis, the volume of the two tracts were combined into one storage area since this improved the stability of the model. If either of those scenarios is pursued further, it is recommended that these two tracts be modeled separately.

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STUDY AREA & NETWORK MODEL CROSS SECTION LOCATIONS

FIGURE 1

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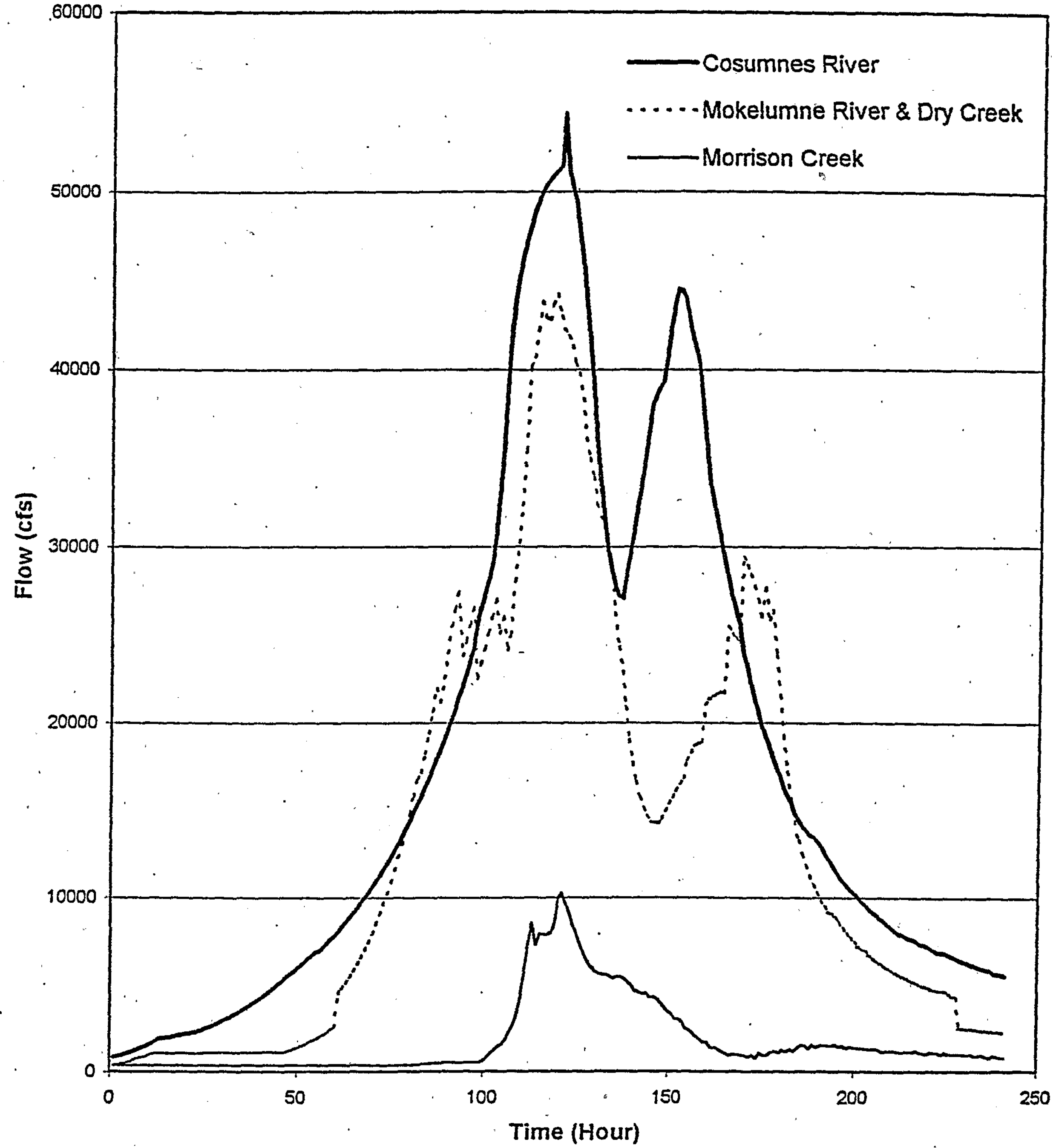
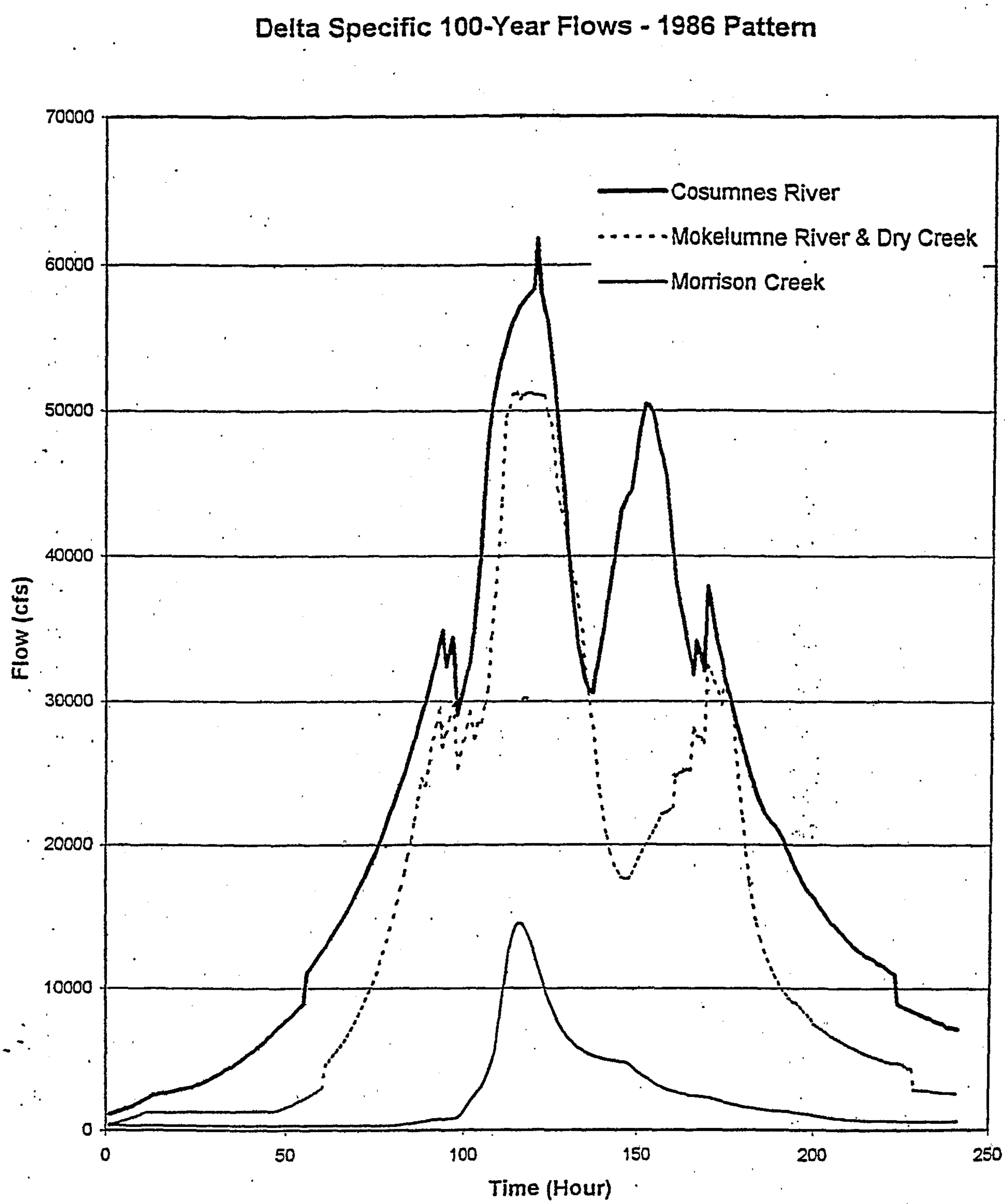
## Morrison Specific 100-Year Flows - 1986 Pattern




CALFED BAY-DELTA PROGRAM
NORTH DELTA FLOOD CONTROL SCENARIOS

**INPUT HYDROGRAPHS**

JULY, 1998 FIGURE 2

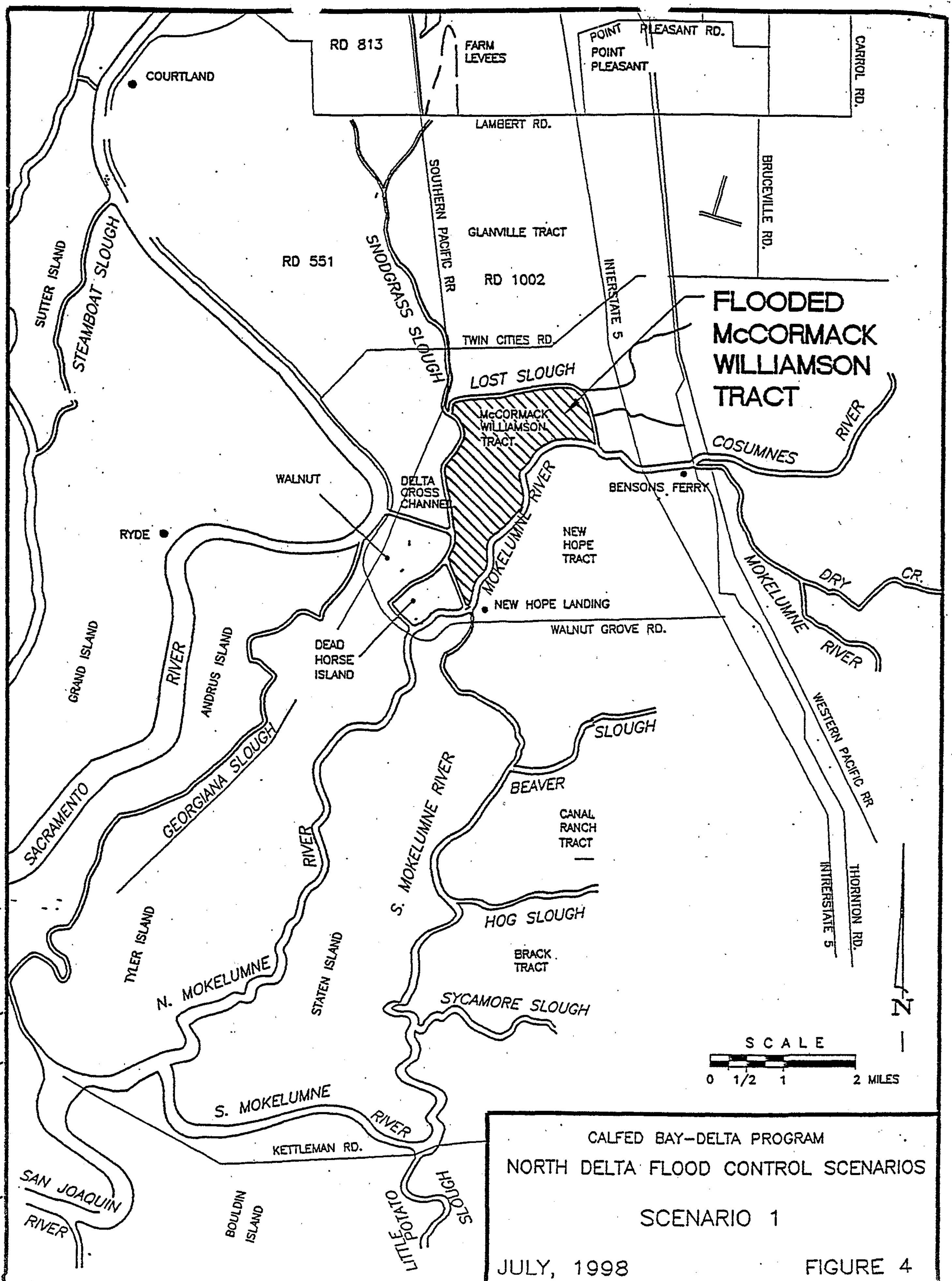



CALFED BAY-DELTA PROGRAM

NORTH DELTA FLOOD CONTROL SCENARIOS

**INPUT HYDROGRAPHS**

JULY, 1998 FIGURE 3


RD 813
FARM LEVEES
POINT PLEASANT RD.
POINT PLEASANT
CARROL RD.
COURTLAND
LAMBERT RD.
SOUTHERN PACIFIC RR
BRUCEVILLE RD.
GLANVILLE TRACT
RD 551
RD 1002
SNODGRASS SLOUGH
INTERSTATE 5
SUTTER ISLAND
STEAMBOAT SLOUGH
FLOODED McCORMACK WILLIAMSON TRACT
TWIN CITIES RD.
LOST SLOUGH
McCORMACK WILLIAMSON TRACT
COSUMNES RIVER
WALNUT
DELTA CROSS CHANNEL
MOKELUMNE RIVER
BENSONS FERRY
RYDE
NEW HOPE TRACT
DRY CR.
NEW HOPE LANDING
WALNUT GROVE RD.
MOKELUMNE RIVER
DEAD HORSE ISLAND
GRAND ISLAND
RIVER
ANDRUS ISLAND
SLOUGH
WESTERN PACIFIC RR
GEORGIANA SLOUGH
BEAVER
SACRAMENTO
S. MOKELUMNE RIVER
CANAL RANCH TRACT
RIVER
HOG SLOUGH
INTERSTATE 5
THORNTON RD.
TYLER ISLAND
BRACK TRACT
STATEN ISLAND
N. MOKELUMNE
SYCAMORE SLOUGH
N
SCALE
0 1/2 1 2 MILES
S. MOKELUMNE
RIVER
KETTLEMAN RD.
SAN JOAQUIN
RIVER
BOULDIN ISLAND
LITTLE POTATO SLOUGH
H:\SERVERDWGS\426\FIGURE4
CALFED BAY-DELTA PROGRAM
NORTH DELTA FLOOD CONTROL SCENARIOS
SCENARIO 1
JULY, 1998
FIGURE 4

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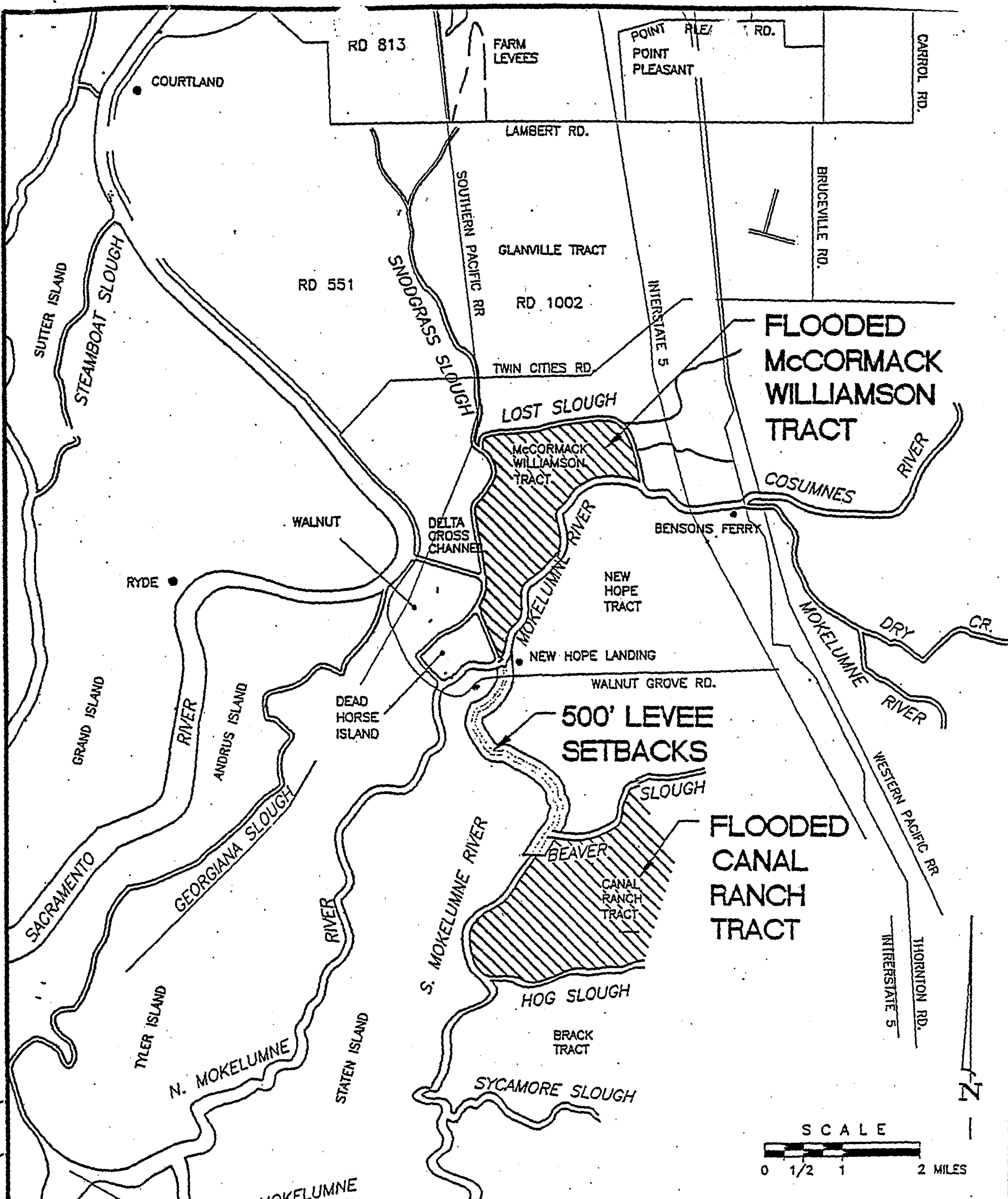


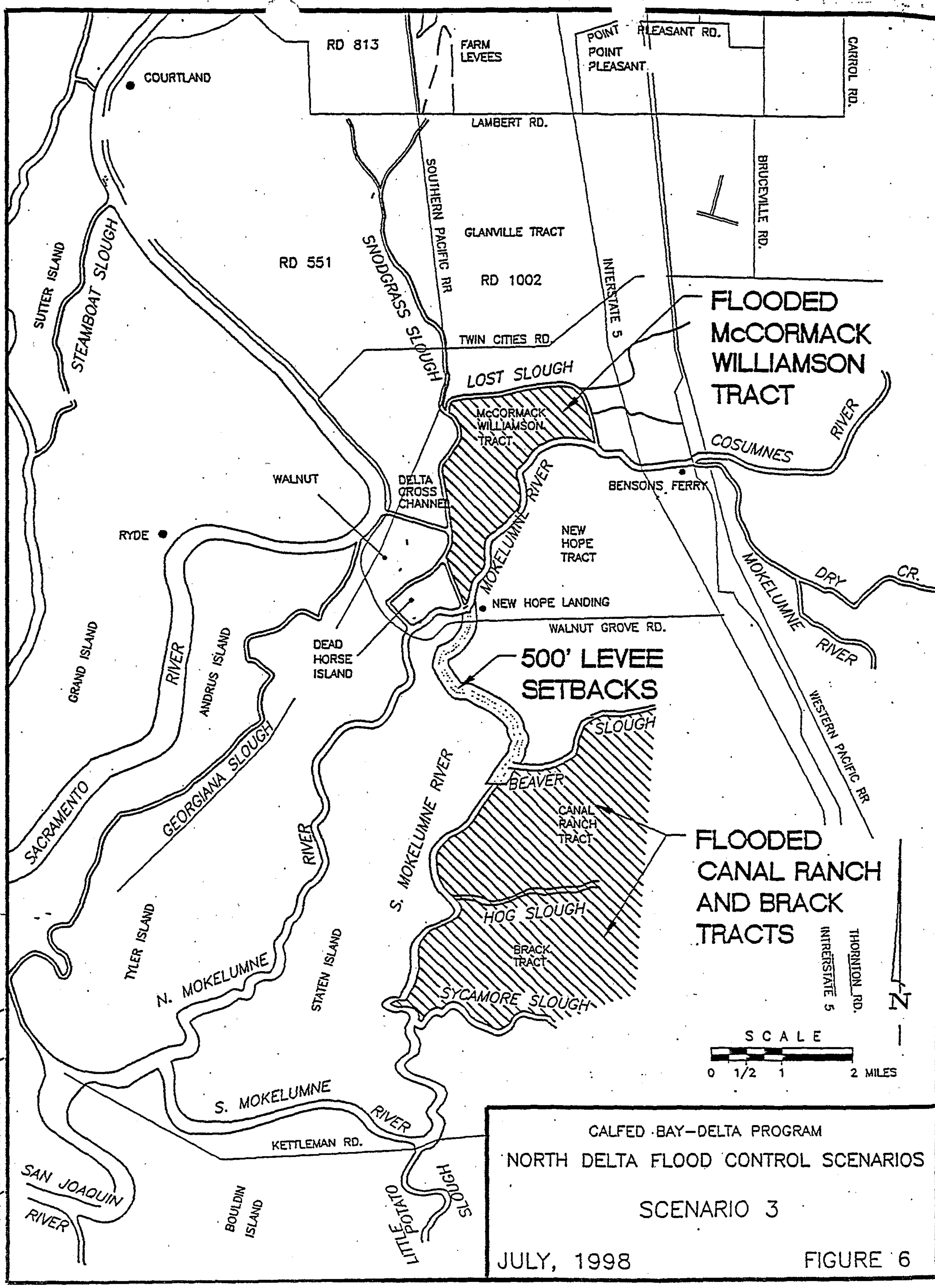

CALFED BAY-DELTA PROGRAM

NORTH DELTA FLOOD CONTROL SCENARIOS

SCENARIO 2

JULY, 1998 FIGURE 5

H:\SERVERDWGS\426\FIGURE5



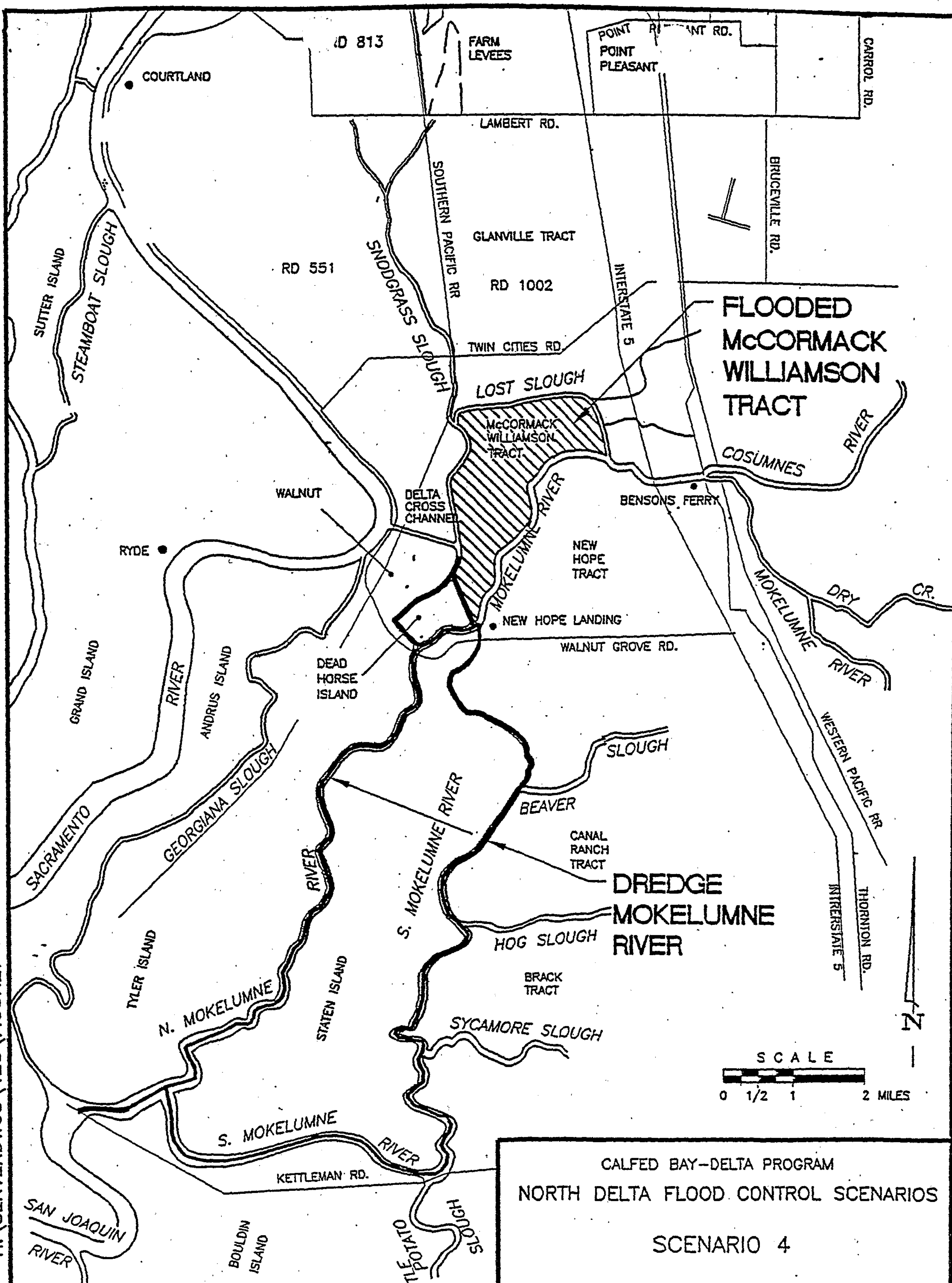

CALFED BAY-DELTA PROGRAM

NORTH DELTA FLOOD CONTROL SCENARIOS

SCENARIO 3

JULY, 1998

FIGURE 6

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NORTH DELTA FLOOD CONTROL SCENARIOS

SCENARIO 4

JULY, 1998 FIGURE 7

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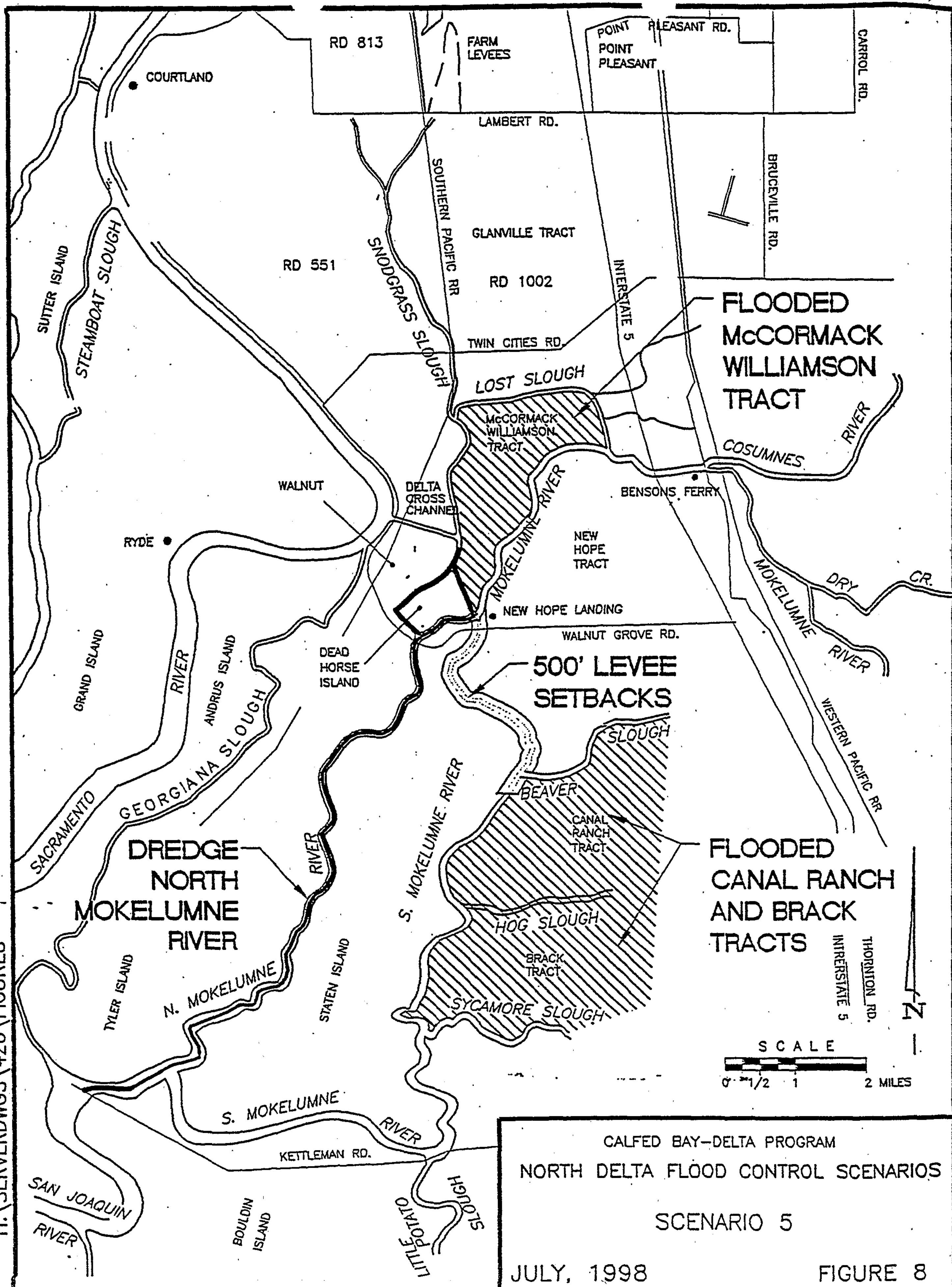
G-002867




CALFED BAY–DELTA PROGRAM

NORTH DELTA FLOOD CONTROL SCENARIOS

SCENARIO 5

JULY, 1998

FIGURE 8

H:\SERVERDWGS\426\FIGURE8

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