

**FLOW CAPACITY OF THE NAPA SALT MARSH CANALS  
BETWEEN PONDS 7 & 8  
REVISED  
28 APRIL 2004**

**1. LOCATION AND CANAL DESCRIPTION**

The Napa Salt Marsh Restoration Project is located at the northeast edge of San Pablo Bay, adjacent to the Napa River. The report focuses on the canal system between Ponds 7 and 8, also referred to as the upper ponds. Ponds 7 and 8 are located north of the Napa Slough. There are two canals and a mixing chamber that consist of the canal system between Ponds 7 and 8. The first canal is located between Ponds 7 and 8, downstream of the mixing chamber and is referred to in this report as the *canal east of Pond 7*. The second canal is located north of Pond 8 and flows into the mixing chamber and is referred to in this report as the *canal north of pond 8 to mixing chamber*. The mixing chamber is located between both canals, west of pond 8 and north of the canal east of Pond 7 and is referred to as the *mixing chamber* in this report.

**2. PUPOSE AND SCOPE**

The purpose of this work is to determine the existing flow capacity of the canal east of Pond 7 and north of Pond 8 that flow to the mixing chamber and the storage volume of the mixing chamber east of Pond 7. Hydraulic analyses of the canals were performed to determine the existing channel capacities.

**3. HYDRAULIC ANALYSIS**

a. **Canal East of Pond 7.** Water surface profiles for various flow rates were modeled using the HEC-River Analysis System (HEC-RAS) computer program. Cross-sections used in the analysis are based on the January 20-21, 2004 survey performed by the San Francisco District (District) Civil Design Section. Cross sections for input into the HEC-RAS model were taken at 30-meter (m) (99.4-ft) intervals along the centerline, oriented left to right looking downstream, for a length of 1,184-m (3,884.5-ft), downstream of the mixing chamber. The HEC-RAS input and output is included in Appendix A.

In general the channel slope is flat, and the water surface elevations at the downstream boundaries were unknown, therefore critical depth was selected as the downstream boundary conditions. To determine the downstream starting water surface elevation two additional representative cross-sections were added downstream of the study area (these are represented with negative stationing in the input/output) to avoid affecting the analysis in the study area. A subcritical profile was determined.

A site visit during January 2004 revealed a relatively straight channel with little low lying vegetation along the slopes of the levees, indicating a Manning's channel roughness of 0.035-0.04. Employment of the procedures by Chow (1959) and in United States Geologic Survey Water-Supply Paper 2339, Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plans (1992) were used to verify the assumption. A base n-value for a straight, uniform smooth channel of a given material was selected and then adjusted according to the surface irregularity, variations in shape and size, obstructions, vegetations and meandering. A Manning's n-value of 0.035 was computed and determined to be appropriate of a clean channel with little vegetation and variation in cross-section, such as would be expected in a channel of this type.

From the surveyed cross-sections it appears that the canal may have once consisted of a uniform trapezoidal channel approximately 1.5-m deep, with a bottom width of 3-m and 0.4H:1V side slopes and a flat channel slope. From the canal profile it appears that there has been a significant amount of levee subsidence throughout the canal, the levees have undergone a loss of bank material into the canal, reducing the canals flow carrying capacity. However, between Stations 10+20 and 7+50 the levee subsidence is the most critical. Typical cross-sections for the canal east of Pond 7 are shown on Plate 1.

It appears that the original left levee height (road side) was at 2.4-m and the right levee height may have been as high as 2.7-m (pond 7a side). The existing left levee elevations vary between 1.9-m and 2.4-m and the right levee elevations vary between 2.7-m and 2.1-m. The levee elevations are shown on Plate 2. The left bank is designated at *LOB* and the right bank is designated as *ROB* on Plate 2. The lowest levee elevation of 1.9-m and a minimum channel depth of 0.4-m occurs at Station 9+60, 220-m (722.8-ft) downstream of the mixing chamber.

Ten water surface profiles for flow rates varying between 0.25-cubic meters per second (cms) to 1.0-cms were modeled in HEC-RAS to determine the maximum flow capacity for the canal. The left levee elevation at Station 9+60 determines the maximum carrying capacity for the canal; it is the elevation when water begins to overtop the levees. The maximum flow capacity for the canal at this location is 1 - cms (35-cfs or 25,567 ac-ft/yr). The canal profile is shown on plate 2.

b. **Mixing Chamber.** The topography of the mixing chamber was also collected during the January 2004 District survey. The mixing chamber volumes were determined in AutoCADD and are shown in Table 1. The water surface elevation was 1.47-m the date of the survey. Volumes and depths are shown for both SI and English Units.

**Table 1**  
**Depth –Volume Table for Mixing Chamber Volumes**

Elevation (m)	Depth (m)	Volume (m <sup>3</sup> )	Depth (ft)	Volume (ft <sup>3</sup> )
-0.3	0	0.00	0.0	0
0	0.3	1.34	1.0	47
0.3	0.6	6.24	2.0	220
0.6	0.9	87	3.0	3072
0.9	1.2	295	3.9	10407
1.2	1.5	550	4.9	19414
1.5	1.8	845	5.9	29845
1.8	2.1	1184	6.9	41802
2	2.3	1439	7.5	50808

c. **Canal North of Pond 8 to Mixing Chamber.** Again, water surface profiles for various flow rates were modeled using the HEC-River Analysis System (HEC-RAS) computer program. Cross-sections used in the analysis are based on the January 2004 survey performed by the San Francisco District (District) Civil Design Section. Five cross sections for input into the HEC-RAS model were taken at 100-meter intervals along the centerline, oriented left to right looking downstream. The HEC-RAS input and output is included in Appendix A.

Again, the water surface elevations at the downstream boundaries were unknown and critical depth was selected as the downstream boundary condition. To determine the downstream starting water surface elevation one additional representative cross-section was added downstream of the study area (represented with negative stationing in the input/output) to avoid affecting the analysis in the study area. A subcritical profile was determined.

A Manning's n-value of 0.035 was determined, in the same manner as above, to be appropriate of a clean channel with little vegetation and variation in cross-section, such as would be expected in a channel of this type.

From the surveyed cross-sections the canal may have once consisted of a uniform trapezoidal channel and a flat channel slope. The canal is approximately 650-m (2133.5-ft) in length. The existing left levee elevations vary between 3-m 3.5-m and the right levee elevations are consistent at 3-m. The levee elevations are shown on Plate 3. The left bank is designated at *LOB* and the right bank is designated as *ROB* on Plate 3. The existing channel depth varies between 2.4-m and 3.3-m. A typical cross-section of the canal north of Pond 8 to the mixing chamber is shown on Plate 4.

Eight water surface profiles for flow rates varying between 50-cms to 120-cms were modeled in HEC-RAS to determine the maximum flow capacity and volumes for the canal. The right levee elevation at a consistent 3-m determined the maximum

carrying capacity for the canal, the elevation when water begins to overtop the levees. The maximum flow capacity for the canal is 100-cms (3,500-cfs or 2,500,000 ac-ft/yr). The canal profile is shown on Plate 3.

Since this canal performs more appropriately as a storage area before water enters the mixing chamber, approximate depth-volume capacities were determined in HEC-RAS and are shown in Table 2 below. The water surface elevation was 1.48-m the day of the survey. Volumes and depths are shown for both SI and English Units.

**Table 2**  
**Depth - Volume Table for**  
**Canal North of Pond 8 to Mixing Chamber**

Depth (m)	Volume (m <sup>3</sup> )	Depth (ft)	Volume (ac-ft)
0	0	0.0	0
1.71	18,500	5.6	15
2.01	24,100	6.6	19
2.45	32,500	8.0	26
3.05	45,300	10.0	37
3.29	50,700	10.8	41

#### 4. SUMMARY

Evaluation of existing conditions indicates that levee system along the canal east of Pond 7 and the canal north of Pond 8 begin to over top at 35-cms and 100-cms, respectively. It was also determined that the mixing chamber has a storage capacity of 1,439-cubic meters. The maximum capacities for each of the areas of interest are summarized in Table 3 below, in both SI and English units.

**Table 3**  
**Summary of Flow Capacities and Volumes**

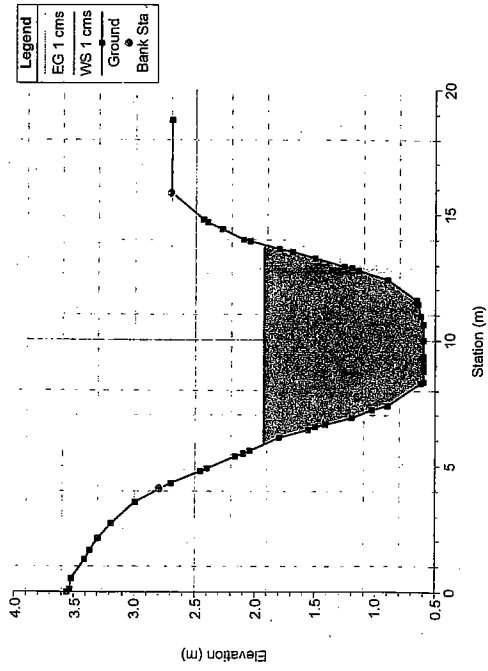
Location	Min Elev m (ft)	Max Elev m (ft)	Depth m (ft)	Volume m <sup>3</sup> (ac-ft)	Capacity cms (cfs) [ac-ft/yr]
Canal East of Pond 7 Station 9+60	1.5 (4.9)	1.9 (6.2)	0.4 (1.3)	N/A	1.0 (35) (25,567)
Mixing Chamber	-0.3 (-1)	2 (6.6)	2.3 (7.5)	1,439 (1.2)	N/A
Canal North of Pond 8 to Mixing Chamber	-0.3 (-1)	3 (9.8)	3.28 (10.8)	50,700 (42)	100 (3,500) [2,500,000]

## 5. CONVERSION FACTORS

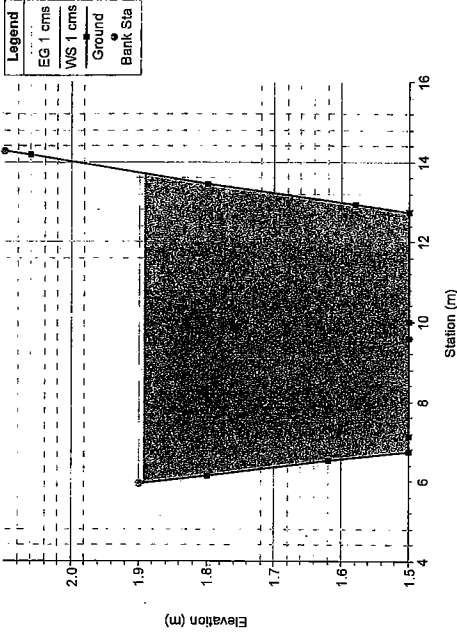
The following conversion factors were used in this study:

- a. Multiply meters by 3.28083 to obtain feet.
- b. Multiply cubic meters by 35.3147 to obtain cubic feet.
- c. 43,560 square feet = 1 acre

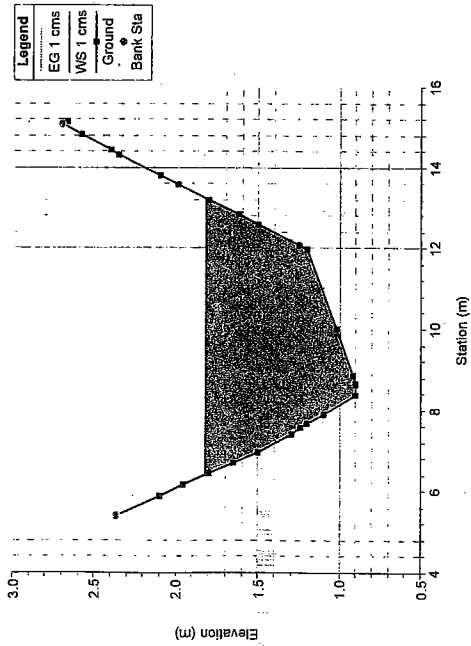
RS = 1170.000 Napa Canal East of Pond 7



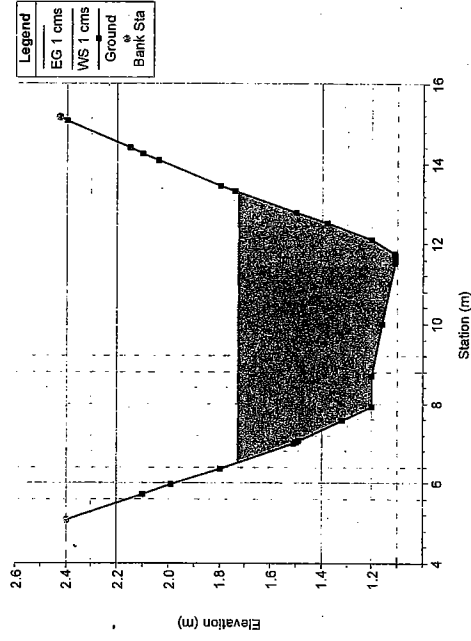
RS = 960.000 Napa Canal East of Pond 7



RS = 720.000 Napa Canal East of Pond 7



RS = 240.000 Napa Canal East of Pond 7

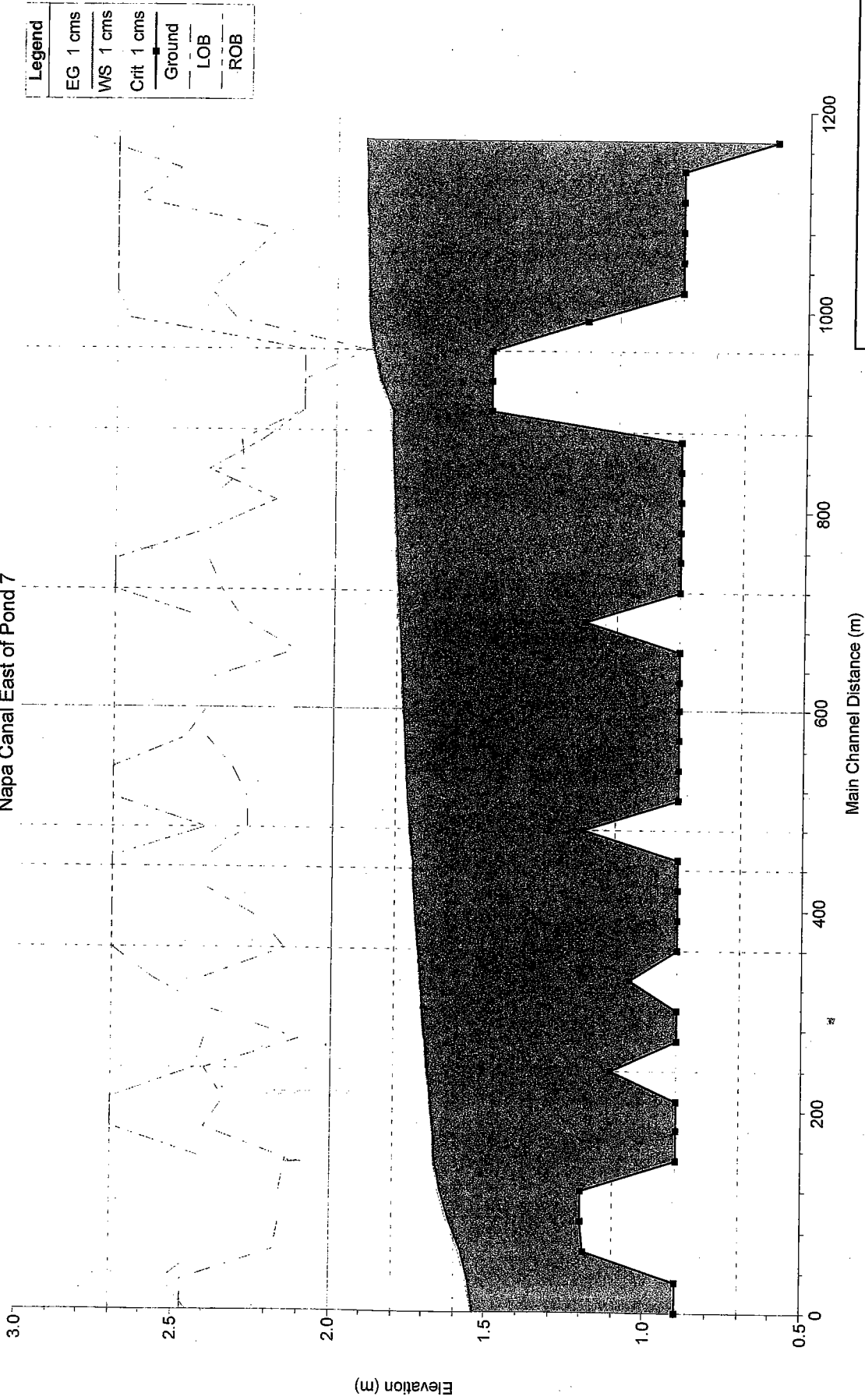


Napa Salt Marsh Restoration Project,  
Napa County, CA

**Canal East of Pond 7  
Cross Sections  
PLATE 1**

US Army Corps of Engineers  
San Francisco District

Napa Canal East of Pond 7



Napa Salt Marsh Restoration Project,  
Napa County, CA

**Canal East of Pond 7  
Profile  
PLATE 2**

US Army Corps of Engineers  
San Francisco District

