

## MEMORANDUM FOR RECORD

SUBJECT: Levee Conditions of the Salt Ponds at Napa Salt Marsh

This memorandum presents the current known conditions of the levees of the salt ponds of the Napa Salt Marsh. The information used is a product of a site visit on 30-31 August 2001 performed by Mr. Kenneth Harrington, Geotechnical Section Team Leader, in the accompaniment of Mr. Tom Huffman, Wildlife Habitat Supervisor at the Napa Salt Marsh, and an e-mail message from Mr. Huffman to the Napa Salt Marsh PDT on 16 August 2001. The purpose of Mr. Harrington's site visit was to view those areas specifically identified by Mr. Huffman as having a greater potential for problems. The intent of this write-up is to summarize the levees' condition using information taken from Mr. Huffman's e-mail and supplemented with field notes provided by Mr. Harrington.

POND 1

Immediately south of the high voltage transmission towers along the eastern levee, the erosion of the bank has a severe likelihood of adversely impacting the access road. Most of the eastern levee has no inboard slope. In this area the existing road embankment has a crest width of approximately 22 feet and a gravel travel way of approximately 10 feet. The vertical erosion scarp of the western edge is approximately 7.5 feet from the travel way. The eroded bank is rugged and tension cracks can be found behind the scarp.

Further south along the road, the embankment crest width narrows to approximately 16 feet and the gravel travel way is approximately 10 feet wide. The erosion scarp on the western edge is approximately 2.5 feet from the travel way. There is approximately 1 to 1.5 feet of useable shoulder on the east side of the travel way before the ground becomes too soft. Continuing south the road embankment crest widens to approximately 20 feet and the erosion scarp on the western side is approximately 4.5 feet from the travel way. The erosion scarp becomes more rugged, and is approximately 6 feet from the travel way with tension cracks approximately 2 feet behind scarp.

The northern end stretch is very rugged. The erosion scarp is approximately 4 feet from the travel way and tension cracks are present. The travel way is approximately 10 feet in width, and the east shoulder is approximately 3 feet wide. Further south the distance between the erosion scarp on the west of the travel way has widened to approximately 8 feet with local areas only 6 feet. Continuing south the width between the erosion scarp and travel way narrows to 4 feet, with local spots only 3 feet wide. This condition extends south for estimated 75 to 80 feet. The width between the erosion scarp and travel way then widens out to 6 to 8 feet and remains at approximately 8 feet wide. The width eventually widens to approximately 10 feet for the next 70 feet. The erosion scarp along Highway 37 is very steep, and the width of the scarp to the travel way is greater than 10 feet.

## POND 1A

Erosion scarps 4 to 4.5 feet high along the levee face due to wind-wave action can be commonly seen along the northern end of Pond 1A. The north end of Pond 1A extends from north of the high voltage transmission lines to the South Slough. The levee along the north end of the pond is fairly broad. However, wave erosion has created scallops and/or semicircular to triangular shaped embayments in to the levee up to 25 feet in depth and as much as 35 feet in width. A log was found in one embayment, and it is believed that the log acted as a battering ram to help plow the erosion embayments. In a few cases the crest width of the levee behind the embayments was as narrow as 12 to 15 feet. The floors of the embayments are fairly flat, ramping up towards the back. Pickle weed was found growing next to the water's edge in front of the erosion scarps and on the floors of the embayments. The height of the erosion scarps at the back of the embayments can range from 4 to 6 feet. Between the South Slough and outboard levee toe, there is a section of accreted marsh that helps buffer the levee from tidal action. Near the northeast corner of the pond an embayment was found approximately 25 feet wide and 15 to 20 feet deep. At the northeast corner of the pond wind-wave erosion has narrowed the levee to a crest width of an estimated 15 feet. Along the east side of Pond 1A the crest is approximately 20 to 25 feet wide with an erosion scarp approximately 5 to 6 feet high.

The consequences from breaching the north levee is minor, fresh water would flow in to a fresh water pond. Should the levee breach the size of the breach would become progressively larger as channel scour would widen and deepen the breach. The driving force would be the head differential base up on tidal differences between the South Slough and the pond. It is expected that erosion would occur faster in the winter when rainfall has saturated and softened the bay mud levee material.

## POND 2

In the east-northeast corner of Pond 2 there are two eroded V-shaped scallops. One scallop is approximately 15 feet wide and the remaining crest is approximately 3 to 3.5 feet wide. The second scallop is approximately 33 to 35 feet wide and is protected by a wooden fence-like structure. There is an estimated 2 to 2.5 feet of crest width remaining in this section.

There is severe erosion along the interior pond side of the northern levee. Ice plant vegetation overhangs the vertical erosion scarp; wind and waves undercut the bank and vegetation. Small caves, approximately 2 to 3 feet deep, have been forming along the softer parts of the levee. There is visible evidence of crumbled banks due to probable cave collapse. The height of the vertical banks is approximately 5 to 6 feet.

Along the bank of the northern levee there is a tree root sticking out. The pond caretaker commented that approximately 8 years ago there was only about 1 foot of the root

exposed. Now there is an estimated 7 feet of tree root exposed, meaning that there has been up to six feet of bank retreat. To the west of this point, caves undercut the bank and local bank crumbling is visible. The remnants of an old iron tractor were noticed several tens of feet offshore of the levee, but the caretaker commented that he was told that at one time the tractor was at the toe of the levee. Erosion is less severe approaching the corner of Pond 2.

The nearly vertical side slopes resulting from wind and wave erosion is very evident along the interior side of the perimeter levee. Approximately 97% of the levees are covered with ice plants, which have helped to protect the levees over time. There is a 48-inch culvert covered by a narrow strip of eroding levee material. The width of the crest is approximately 4.5 feet, and the total width is approximately 9 to 9.5 feet. Water moves from the canal into the pond.

The levee on the east end of Pond 2 is scalloped, and has a crest width of 9 feet. The top of the bank is 5 to 6 feet above current pond elevation. The levee on the east-northeast corner of Pond 2 is deeply eroded, and a V-shaped wooden structure has been placed within the bank to help break up waves. The crest width is approximately 4 feet. There is also a substantial amount of accreted marsh on the outboard side.

The entire section of the northern levee is in the worst shape. If it was not for the protective covering of the ice plants and the accreted marsh, the levee may have already breached. In some sections, only 1/3 of the outboard levee toe remains, due to erosion.

### POND 3

The eastern and northeastern portion of the levee is adequate due to the protective covering of the accreted marsh along the Napa River. Along the southeast corner, however, there is only a small strip of levee with no protective covering. Also, there is a trench cut through the levee approximately 3 to 3.5 feet deep, 2 feet wide across the top, with near vertical sides along the bottom 1 foot. The gradient is very flat, sloping gently to the river. The crest of the levee is approximately 7 to 7.5 feet high. The portion of the levee at the downstream end of the slough has a near vertical scarp due to erosion.

### POND 4

Overall, Pond 4 has wide, sloping levees that are well vegetated. The levee upstream of the transmission lines is protected with approximately 500 feet of riprap. The crest width of the levee is 20 to 30 feet in this section. The pond side slope is benched, but overall the slope is adequate.

The south end of the levee at Pond 4 has a vertical scarp along the riverside. The crest of the levee is covered in ice plants (2.5 to 3 feet high) on the river edge. The crest curves 15 to 30 feet before sloping on a 2.5:1 slope or flatter into the pond. The scarp is 6 to 7

feet in height. There is a 1 to 1.5-foot differential in the ground surface elevation along the levee crest. Overtopping of the levee would occur during an extremely high flood.

Along the China Slough south of PG&E transmission tower, there is erosion of the bank, due to current sweep around the outside of the bend. The crest of the levee in this area is approximately 18 feet. The crest begins to widen in a northeasterly direction, increasing to more than 30 feet. There is a lack of vegetation on the relatively new material. The erosion scarp is approximately 6 to 7 feet. Tension cracks up to 2 feet in depth exist behind the scarp. Salt deposits are very evident, and water is present in deeper areas and in borrow channels.

Near the exit point, the erosion scarp is up to 7 feet high on the outside of a curve. The crest is approximately 16 to 18 feet wide and is built with the newer material, but there are irregular lumps along the surface from dredge material placement. The crest is relatively uncompacted and is consolidating from self-weight. Further north the crest width is 15 to 16 feet and consists of recently placed dredge material from the borrow channel. Sediment and vegetation accretion are evident south of the transmission tower.

Further north the upstream effect due to excavation is less evident (approximately 21 to 23 feet). This is the end of where recent dredge material has been placed. In the vicinity and south of the PG&E transmission tower, the crest is more rounded (approximately 12 feet) and crest and slopes are well vegetated. The slope is estimated at 3H:1V or flatter. Erosion begins again on the north side of the towers at the tangent to the channel curve, and the scarp height increases in height in a southerly, downstream direction towards the tower. The tower's foundation base acts as an erosion block, protecting the channel bank immediately downstream.

#### POND 5

Pond 5 has wide, sloping levees and good protective covering from ice plants. Accreted marsh strips surround the levees on all sides. The levees of Pond 5 are adequate to prevent breaching.

#### PONDS 6-6A

Pond 6 has relatively wide, sloping levees with vegetative cover and a strip of accreted marsh surrounding the exterior slopes of the levees. Pond 6A levee has adequate width and slope and is well vegetated. There is substantial toe erosion outboard along the Napa Slough on the west levee and along the North levee outboard toe. The North and East levees are high and narrow with a steep drop off into the slough. Accreted marsh protects most of the North and West levees. The south end is severely eroded near the vertical scarp on the slough side. The crest is approximately 4 feet wide with tension cracks. Proceeding easterly on the levee, there is a narrow crest approximately 3 feet long and 2 feet wide. The side slope is approximately 2H:1V down to the canal. The crest width is

approximately 3 feet wide for the first 50 feet and then widens out to approximately 4 to 5 feet. There are tension cracks along the crest of the slope. The scarp height is greater than 6 feet. The erosion scarp crest widens from approximately 4 to 12 feet, and the scarp has significantly diminished the toe to the east.

## POND 7

At the southern end of Pond 7, the low area of water reaches the canal along Pond 7. There is very little vegetation along Pond 7 levees due to the high salinities present in the pond. There is potential that the high salinity water of Pond 7 may overtop during extreme wet storms and wet years. However, the water could be contained within the salt panel system. Portions of the southeast section of the Pond 7 levee are eroding.

Looking toward the east, the effects of wave erosion on the levee are noticeable. The crest width is on the order of 6 feet over a 30 to 40-foot long stretch. During the last El Nino event water from Pond 7 nearly overtopped the levee and wave runoff crossed the centerline of the levee.

The levee between Ponds 7 and 7A has experienced wind erosion, more so on the Pond 7A side. Wind erosion is also noticeable along the crest of the levee. The crest is 6 to 8 feet wide; the surface is powdery and is easily transported by the wind when dry and varies from very thin to ½ inch in thickness. Overtopping would occur during a very wet year when Ponds 7 is full, and the wind of an extremely wet storm would drive waves over the top. The soil is erodable and there are old clumps of mud, some of which contain a lot of peat.

## POND 7A

In the N-NW corner of Pond 7A, the low area of the levee is subject to wave attacks resulting in a vertical scarp on the outboard side and a brackish pond. However, the levee width appears to be wide enough not to be an immediate problem. The water level in Pond 7A is controllable. There is a very small likelihood of overtopping except in extreme El Nino types of years. There are also low areas in the middle portion of northern levee. The scarp is 3 to 4 feet in height and 15 feet from the levee crest. There are tension cracks approximately 3 to 4 feet behind the scarp. The scarp growth and bank retreat are a result of the water level in the brackish pond outboard of Pond 7A and the resulting wave attack. Erosion of the levee is controllable and the levee has a very low priority for any repairs.

The low area of the northern levee at Pond 7A is approximately 150 to 200 feet in length. The water in Pond 7A could overtop during a severe storm that causes all of the ponds to fill, if there are no low areas for storage and high winds to drive water. The water in Pond 7A has a very high salinity, but considerably less than Pond 7, and therefore little vegetation is present on the northern and eastern levees. The West levee is well

vegetated and protected from tidal action of Hudeman Slough by a strip of accreted marsh.

#### POND 8

The levees at Pond 8 have broad gentle slopes. There is a 1 to 2-foot differential in the ground surface elevation along the levee crest in the northeast corner of Pond 8. Pond 8 has a canal running along the north levee and a portion of the east levee. This canal supplies water from Cargill. At the time of the site visit the water level in the canal was estimated to be approximately 2 feet lower in elevation than required to overtop the levee. Overtopping has occurred when the canal is fully charged; the water elevation in the canal would be between 3.5 and 4 feet NGVD. Mr. Huffman's assessment of the east and west levee sections is that they are adequate; the west levee is covered with ice plants and an accreted marsh strip runs along the south and west levees.

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