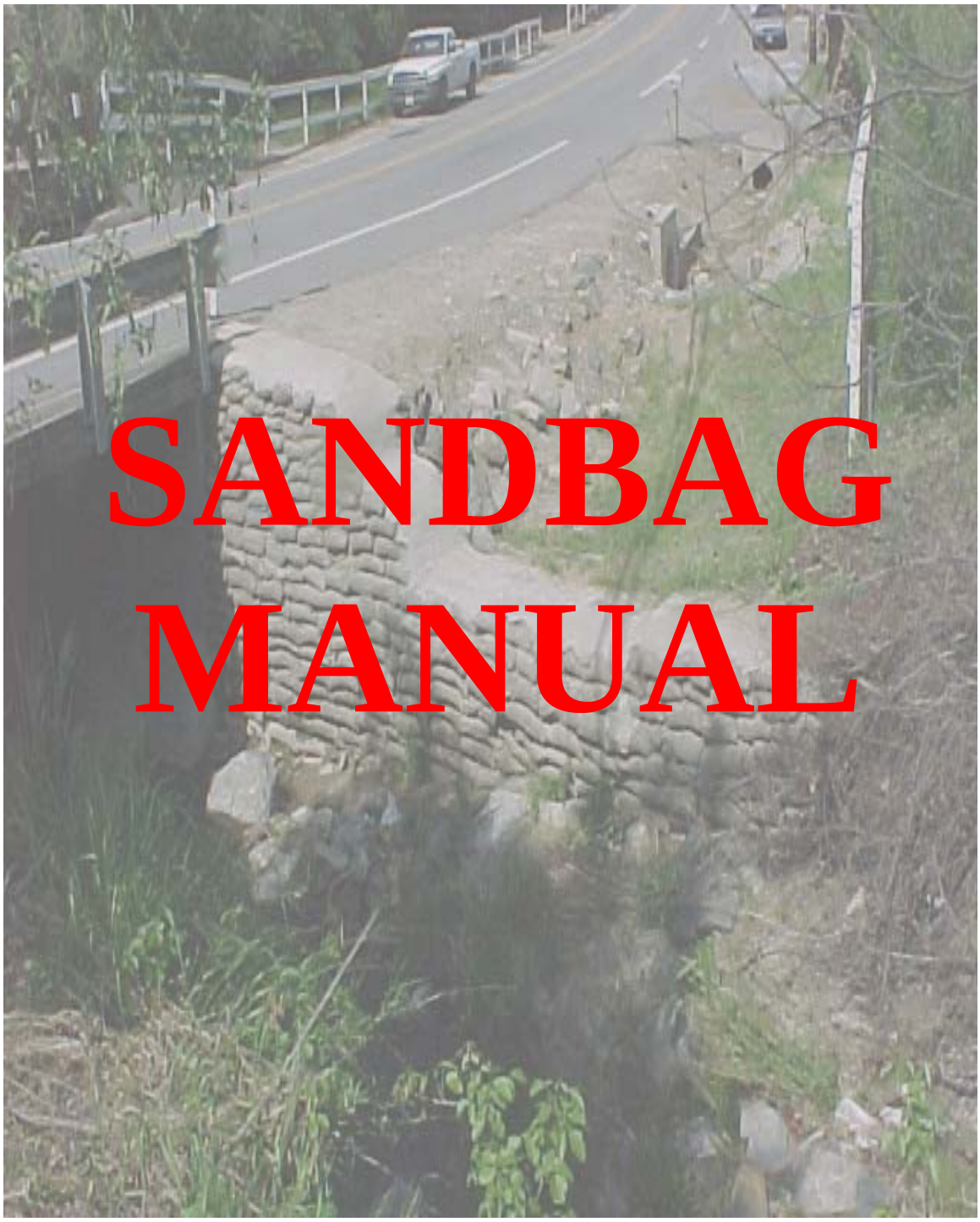
ORANGE COUNTY
RESOURCES AND DEVELOPMENT MANAGEMENT DEPARTMENT



SANDBAG MANUAL

FLOOD FIGHT METHODS
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The methods of flood fighting described in the following paragraphs have proved effective during many years of use by the Department of the Corps of Engineers. It is emphasized that structures other than levees may also require protection from a flood and should not be overlooked. Sketches illustrating the various methods of sandbagging will be discussed in this brochure.

Methods of Flood Fighting

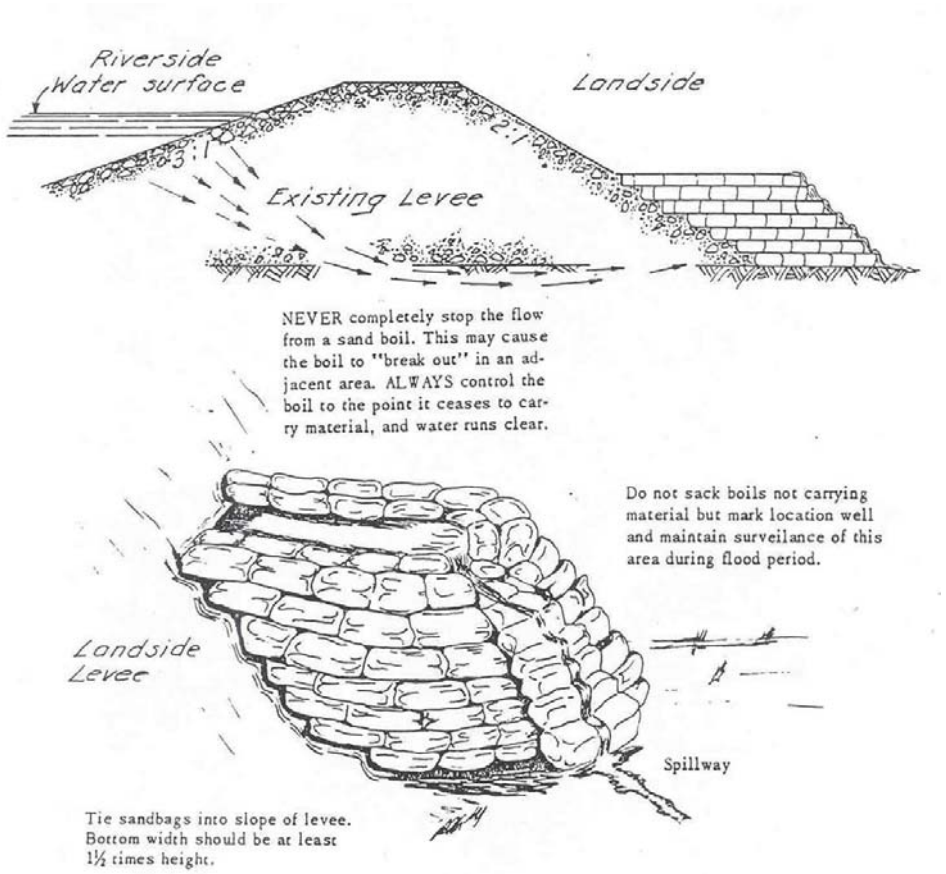
The main causes which may contribute to levee failure during periods of high water or flood flows are:

1. Seepage through or under the levee of sufficient magnitude to cause a “boil” and leaks through the levee caused by burrowing animals.
2. Erosion of the levee due to current or wave action.
3. Overtopping as a result of river water surface elevations in excess of levee height.

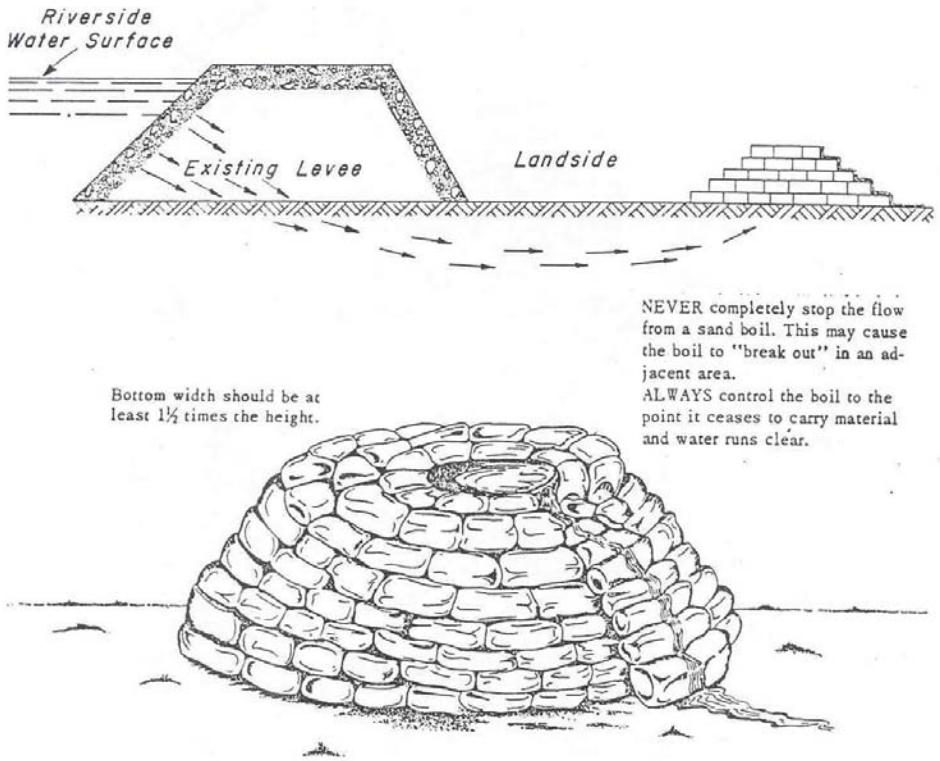
The various methods used to prevent failure by these causes under emergency conditions are known as “flood fighting”.

Boils: A "boil" is a condition whereby enough pressure is produced by a high water stage so that water is "piped" through or under the levee with sufficient velocity to carry earthen material to the landward side. These danger spots are serious if sand and other material are being carried in suspension by the discharging water. If not controlled, these particles of earthen material will be eroded from within the levee at an accelerated pace; thus causing a local subsidence of the levee section. The continuation of this process will eventually result in a break in the levee by allowing the flood waters to flow directly over the crest or through the levee.

The common method of controlling boils consists of building up a watertight sack ring around the boil to a height necessary to reduce the velocity of flow to the point at which earth material is no longer discharged from the boil. The flow of water should never be stopped completely, because this may cause the boil to "break out" in an area adjacent to the existing sack ring. The sack ring around the boil should be large enough to effectively encompass the defective area immediately surrounding the discharge spot. If several boils of sufficient force to displace sand or earth are observed, a sack sublevee may be built around the entire nest of boils to such a height that none of the boils will discharge with enough velocity to move sand or other material from the levee foundation.

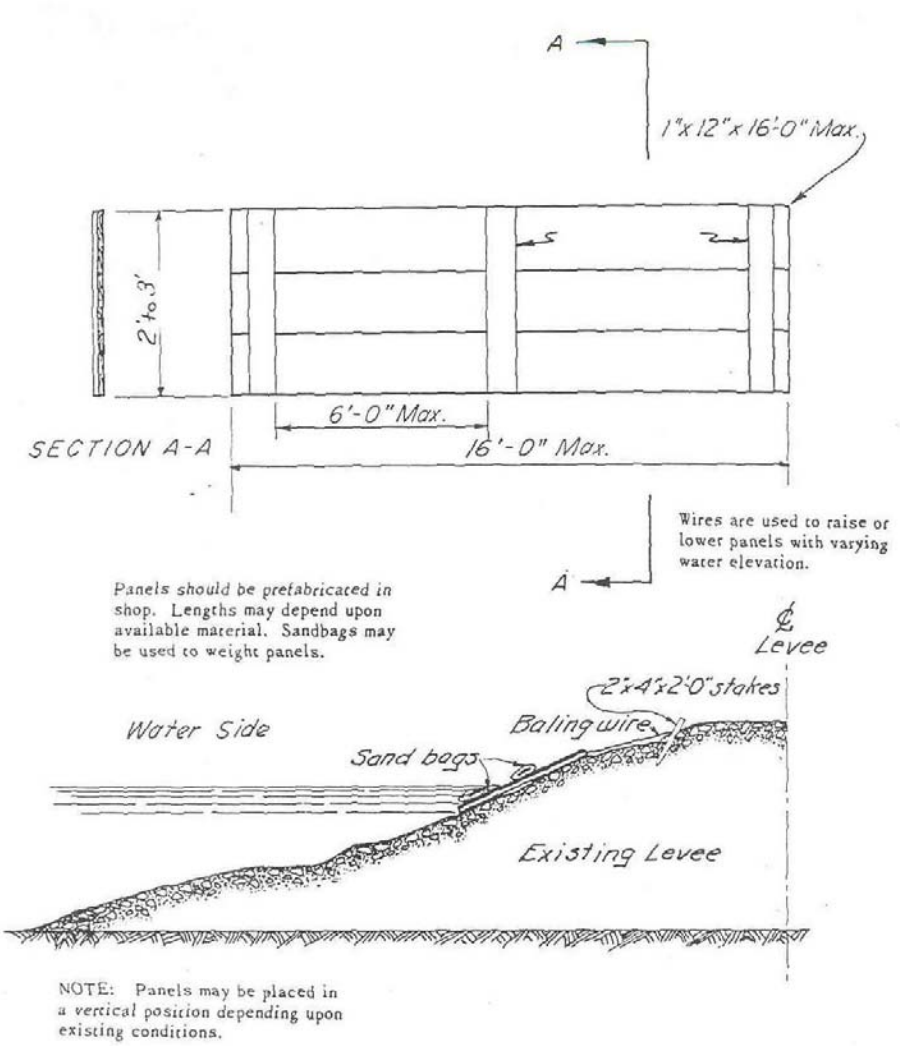


CONTROL OF SAND BOILS
(Near levee)

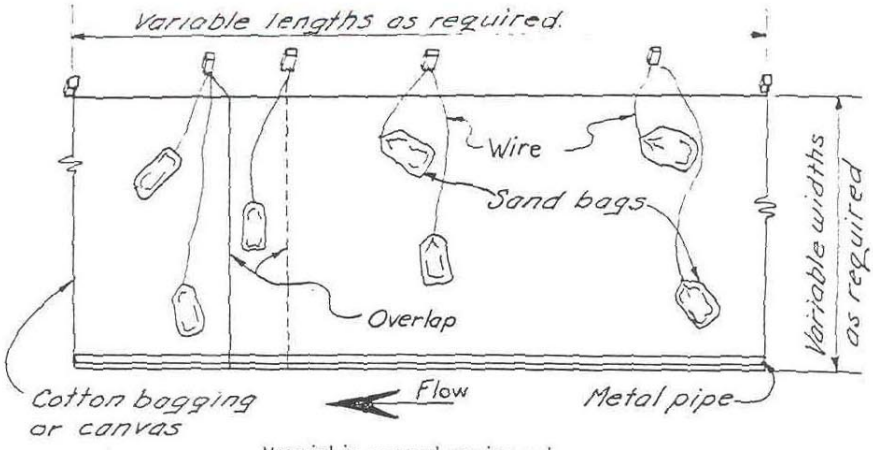


CONTROL OF SAND BOILS
(Away from levee)

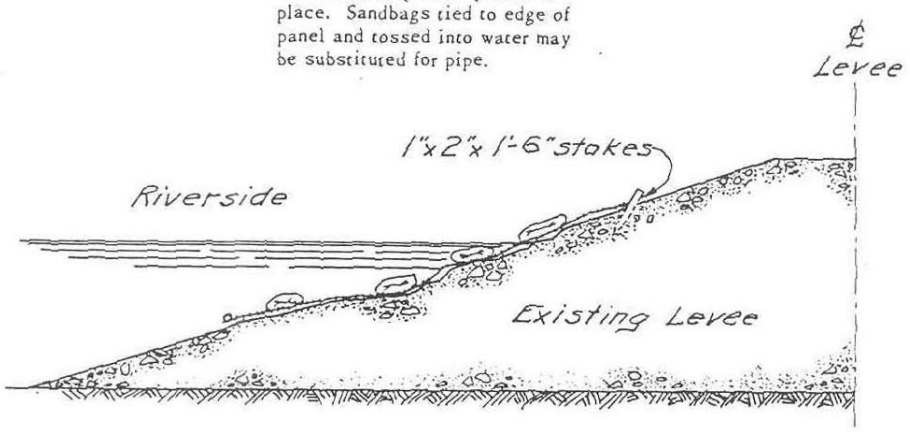
Wavewash: All levees adjacent to wide stretches of water should be watched during periods of high wind to detect the starting of wavewash. If the slope is well sodded, a high wind of a limited duration should cause little damage. During periods of high wind and high water, ample labor should stand by and experienced engineering personnel should observe where the washouts are beginning by sounding or, if the current is slow and the slope not steep, by actually wading along the submerged slope. The sketch found on page 14 shows a movable type of wavewash protection consisting of wood panels which have been used with good results. Its advantage is that the panels can be built rapidly at any convenient location and easily installed. Another method of protection is the use of sections of cotton bagging adequately weighted and placed over the washed areas. A third method is the placement of sandbags directly in the eroded area. The bags should extend to-sufficient height to give protection above the anticipated rise in water surface.



WAVE WASH PROTECTION



Material is wrapped on pipe and rolled into water. Bags placed at random keep cloth panels in place. Sandbags tied to edge of panel and tossed into water may be substituted for pipe.

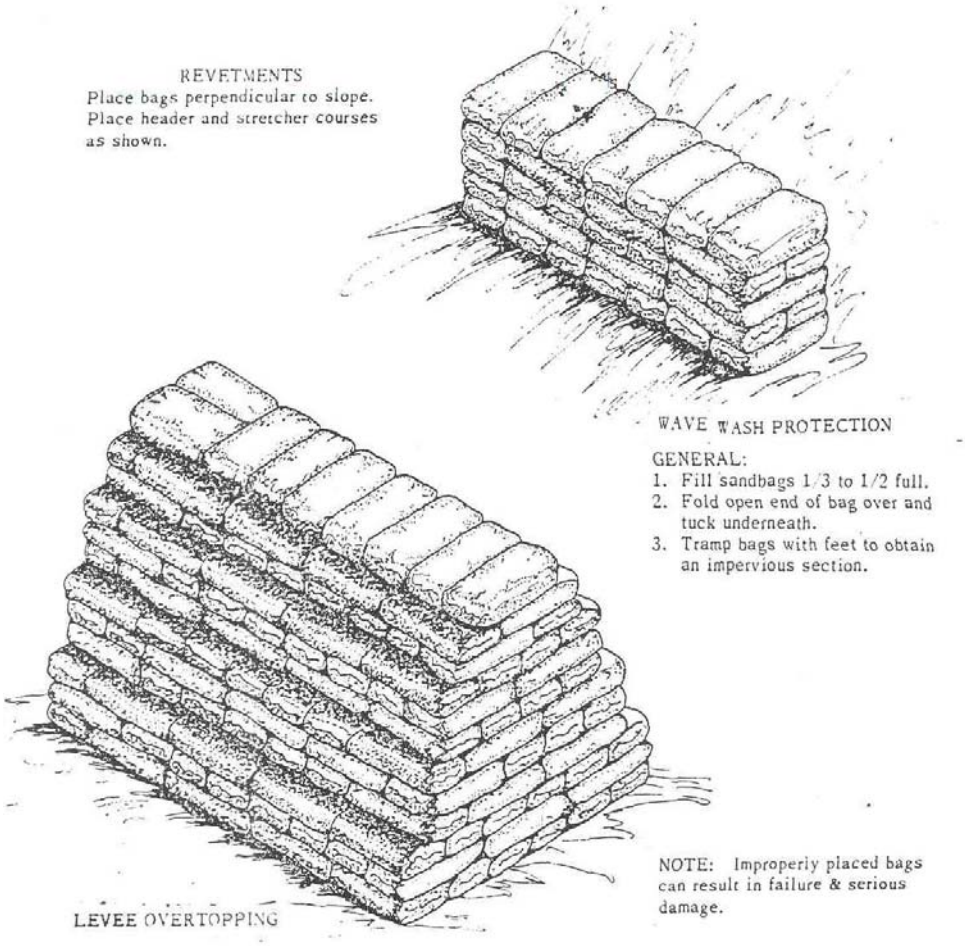


Always lay cloth panels in an upstream direction. Tie all bags to levee with wire and stakes.

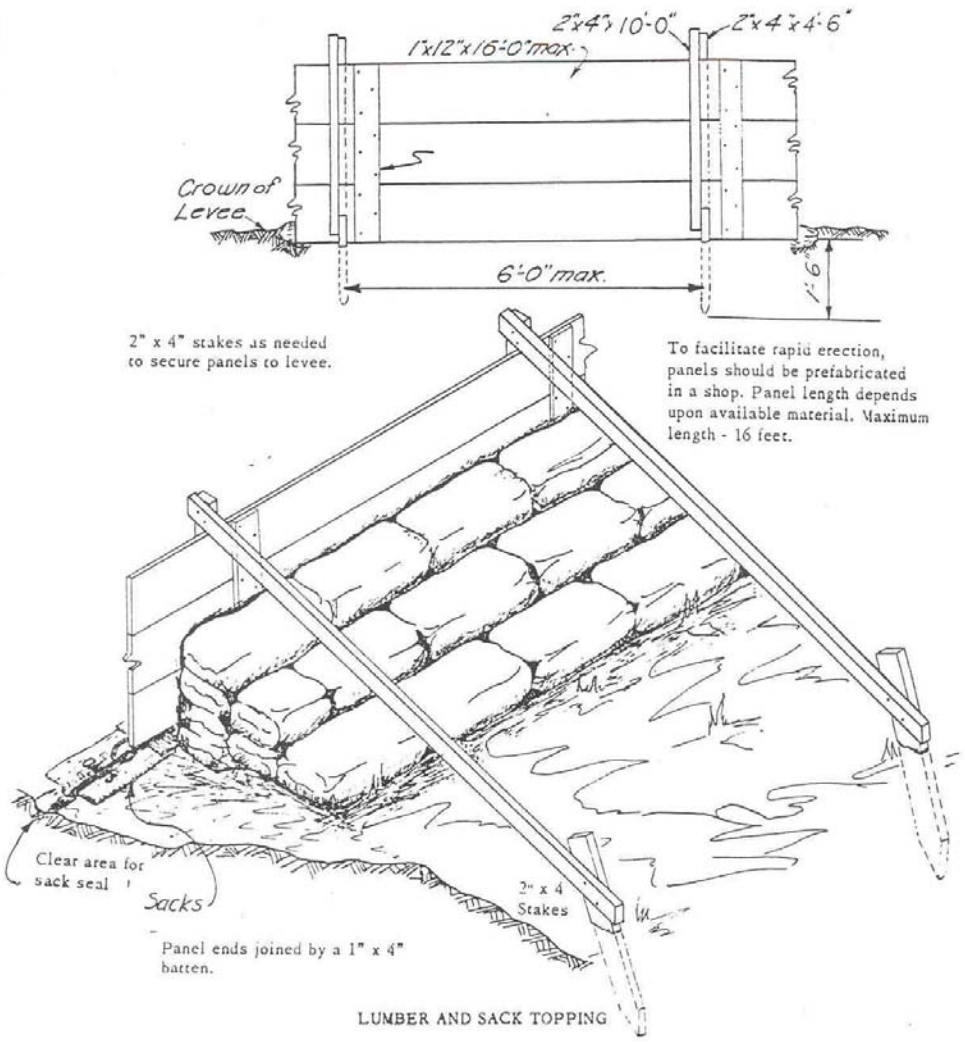
WAVE WASH PROTECTION

Levee Topping: If any reach has an elevation lower than the anticipated high water elevations, steps should be taken to provide emergency topping to raise the levee grade to forecasted flood heights. Levee topping may be required at road or stock crossings, low levee sections or railroad crossings. The following is a brief description of the various methods that may be used to increase levee height.

Lumber and Sack Topping: This method utilizes wooden panels on the waterward side of the levee crown reinforced on the landward side with sandbags, and is a common method of raising low reaches during emergencies. Stakes, 2" x 4" x 6', should be driven on the riverside of the crown, 6' apart, and the panels nailed to the landside of the stakes. This wall should then be backed with sandbags sufficient in number to support the panels against the anticipated high water. In extreme cases, a three foot topping may be provided if properly braced behind with sacks and earth. In some instances, it may be practical to back up the panels with tamped earth obtained in the vicinity in lieu of sandbags.



ADDITIONAL USES OF SANDBAGS



CONTROL OF LEVEE OVERTOPPING

Mud Boxes: This method consists of two parallel wooden walls placed near the waterward side of the levee crown and filled with available material. Spacing of the walls will vary with height, but should be proportional to a box 24 inches in height and 30 inches wide. This method has the advantage of permitting a portion of the levee crown to remain as a limited roadway, while the emergency topping exists. Mud boxes may be utilized when fill material is "soupy" or of a liquid nature if the boxes are lined with canvas or burlap material.

Current Scouring: A careful observation should be made of the riverside slope of levees to detect possible erosion due to current action. Trouble spots may occur at the ends of old levee dikes, road crossing, ramps and places where pipes and other structures penetrate the levee. If any indication of scour is observed, soundings should be taken to observe the amount and progress of the scour. An effective method to check scour on slopes or at end of dikes is to construct deflection dikes using brush, tree tops or lumber, or by driving pairs of long stakes and wiring together and filling in between the stakes with brush and filled sacks or stone. Levee scour can also be alleviated by the use of the methods described for wavewash if care is taken to see that scour does not take place under the protection thus afforded.

SUGGESTED OUTLINE

FLOOD FIGHT TRAINING COURSE

I. Sand Boils

A. Explain Different Types of Boils

B. Demonstrate the Filling and Handling of Sandbags

1. How to Fill
2. How to Carry

C. Methods of Containing Boils

1. Sack ring around boil (have class build sack ring around boil)
    a. Clear area around boil to provide a water tight bond
    b. Lay sack ring around boil selecting diameter by size of boil
    c. Stagger joint and tamp
    d. Build ring only to a height to prevent material from being discharged
    e. Explain what would happen if you shut off flow of water
    f. Explain hand test to be used at night to determine if boil is still carrying material
    g. Construct drain to carry off water
    h. Base width of boil should not be less than on and a half times the contemplated height
    i. Weak ground near the boil should be included within the ring
2. Sack chimney using corrugated pipe (use model for class instruction)
    a. Seal around base
    b. Tamp bags
    c. Bags lapped and joints staggered
    d. Test water
    e. Cut hole in pipe at elevation where water stops carrying material
3. Horseshoe ring (use model for class instruction
    a. Bags must be sealed into levee slope
    b. Scoop out dirt to secure
    c. Tamp and lap bags and stagger joints
4. Sub levees or bow levees
    a. Explain their use
        (1) Reduce pressure
        (2) Prevent movement of foundation material

II. Wavewash and Current Erosion

A. Canvas Protection

1. Drive stakes
2. Wire canvas to stake
3. Fold canvas
4. Secure sandbags to leading edge
5. Throw out canvas
6. Weight down with sacks
7. Lap

B. Canvas Protection (Using Pipe)

1. Roll canvas in pipe
2. Secure to stake
3. Use pike poles to roll out
4. Weight down with sacks

C. Wood Panel Protection

1. Panel prefabricated in yard
2. Wire panels together
3. Wire to stakes
4. Wire sacks to panel
5. Lower panels into water using pike poles
6. Lap

D. Explain Additional Measures That Can be Taken to Prevent Wavewash

1. Brush
2. Trees
3. Sandbags
4. Old car bodies

E. Safety

1. Life jackets
2. Throwing life lines

III. Overlapping

A. Lumber and Sack Topping (Have Class Construct)

1. Determine height to be built – assign a specific job to each man
2. Place stakes along levee
3. Place panels along levee

4. Seal panels to levee
5. Nail the panels to the vertical stakes and tie cross braces to them
6. Back panels with dirt or sandbags
7. Discuss where this method would be used
    a. Low spots
    b. Railroad crossing
    c. Road crossing

B. Mud Box (Use Model for Class Instruction)
1. Explain why it is used
    a. Control soupy material
    b. Keep levee crown roadway open
2. How They Are Built
    a. The panels are nailed to the stakes and sealed at the bottom in the same manner that we build lumber and sack topping
    b. Size, 24 inches high and 30 inches wide
    c. Tope of panels can be held together with wire

C. Sack Topping (Use Model for Class Instruction)
1. Explain its use
    a. Raise crown or levee
    b. Prevent overtopping
2. Explain how to build
    a. Do not tie sacks
    b. Stagger so that the butt end of one sack overlaps on the top of the lower sack
    c. Base should be wider than top
    d. Not to be built over three feet high

Examples

Companies that provide ready made sandbags have hopper and conveyor belt production and can turn out thousands of bags in a short time

Bags are filled then loaded onto trucks and transported to job sites

During emergency situations it may require a private contractor to provide large amounts of sandbags to be filled, transported and placed.

Southbound Santiago Canyon Road

Sandbags were placed in rows 2-3 layers high to control flow from the roadside ditch. This will help prevent water from sheeting into the travel way and creating a potential hazard to traffic. Steep hillsides are a major silt problem in canyons. Note that sandbags are placed on the barricade to stabilize it during overflow.

Oso Parkway .25 miles east of Antonio Parkway

Sandbags were placed on Oso Parkway several years ago and continue to control erosion in the median

Major erosion can occur along a center median that does not have the benefit of landscaping. Placing sandbags in a chevron pattern can reduce erosion and silt from spilling out into the travel way.

Oso Parkway

Drain inlet protected with a row of sandbags. Bags were placed to prevent water and silt from sheeting into the travel way.

Erosion control using sandbags placed as chevrons. Note the silt building up behind sandbags spilling into roadway

Bags place for a long period of time should be monitored. Silt should be removed to collect more silt. This is a bad example of sandbag placement.

New construction sites placed sandbags to control newly graded areas in compliance with Regional State Water Control Board Regulations. Silt is trapped in sandbags then removed when the pocket is filled. Without the placement at construction sites, loose sand and silt would have sheeted into traffic lanes creating a hazard.

Chevrons and a row of sandbags placed along an A/C roadway for erosion control

Sandbags along this toll road bridge underpass had major scouring and mud sheeting along the service road. Bags were placed in a chevron pattern to help prevent scouring.

B01 U/S 91 freeway at Burton way (top view)

B01 U/S 91 freeway at Burton way (side view)

Sandbags and visqueen are used to stabilize a slope until heave equipment can begin repair work.

Example of sandbags filled with concrete to prevent erosion adjacent to A/C walk path. This should be used only as a temporary measure for embankment shoring

Damaged lining on E05 U/S Orangethorpe L/S

Placing sandbags to stabilize and help reduce further damage.

E05 U/S Orangethorpe L/S

Sandbags could have helped prevent the major washout behind this concrete lining. A plugged up drain caused water to sheet outside of the concrete v-ditch and created the damage.