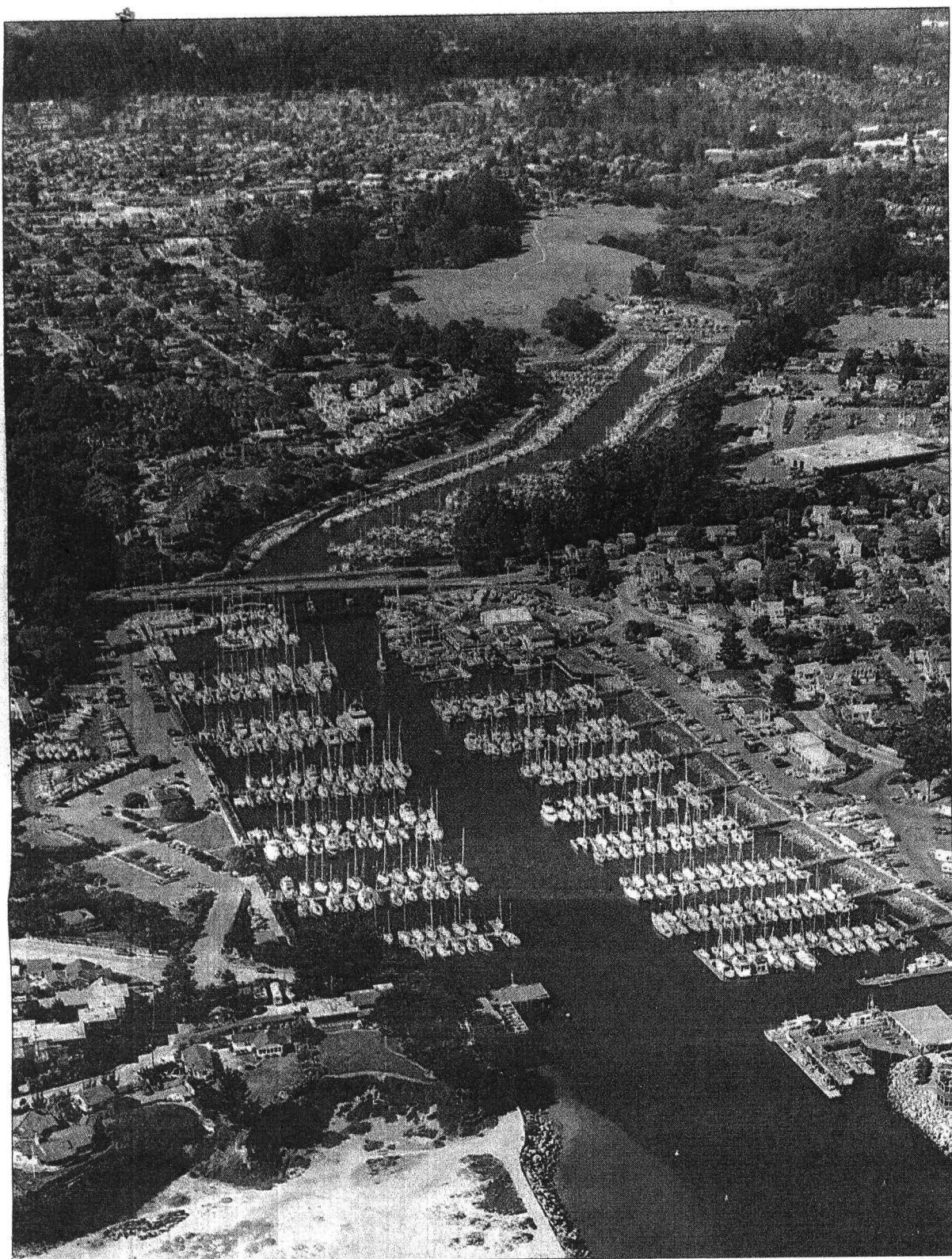


## TSUNAMI AFTERMATH

# What Went Wrong?

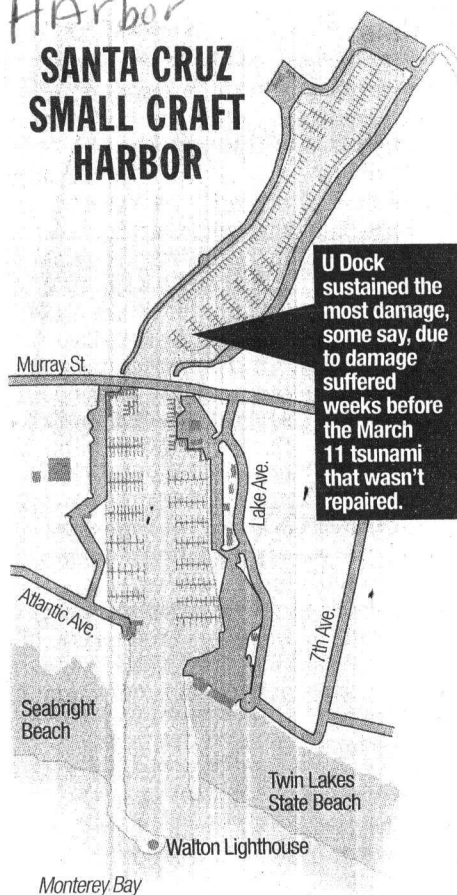
## HARBOR DESIGN MAY HAVE CONTRIBUTED TO TSUNAMI DAMAGE



DAN COYRO/SENTINEL FILE

The Santa Cruz harbor was hit hard by the recent tsunami surges, while other harbors, such as Moss Landing, were not.

### HARBOR SANTA CRUZ SMALL CRAFT HARBOR



ANTHONY L. SOLIS/SENTINEL

By J.M. BROWN

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3 2011

✓ SANTA CRUZ — More than a week after a tsunami forced its way into the Santa Cruz harbor like a rushing river, questions have surfaced about whether the port design and topography of its basin may have contributed to the surge's estimated \$26 million in damage.

At the Moss Landing Harbor District, just 24 miles to the south, the tsunami's impact was far less severe. With a deeper harbor mouth and a channel that empties into several sloughs, Moss Landing experienced no loss to boats or docks.

But in the shallower, more confined Santa Cruz harbor, 13 boats sank and a number of docks sustained major damage. At the similarly shallow Crescent City harbor near the Oregon border, docks and boats located in a walled-off inner basin were wiped out. The two harbors comprised much of the state's \$35 million in damage tallied so far among six counties.

### IF YOU GO

#### TSUNAMI MEETING

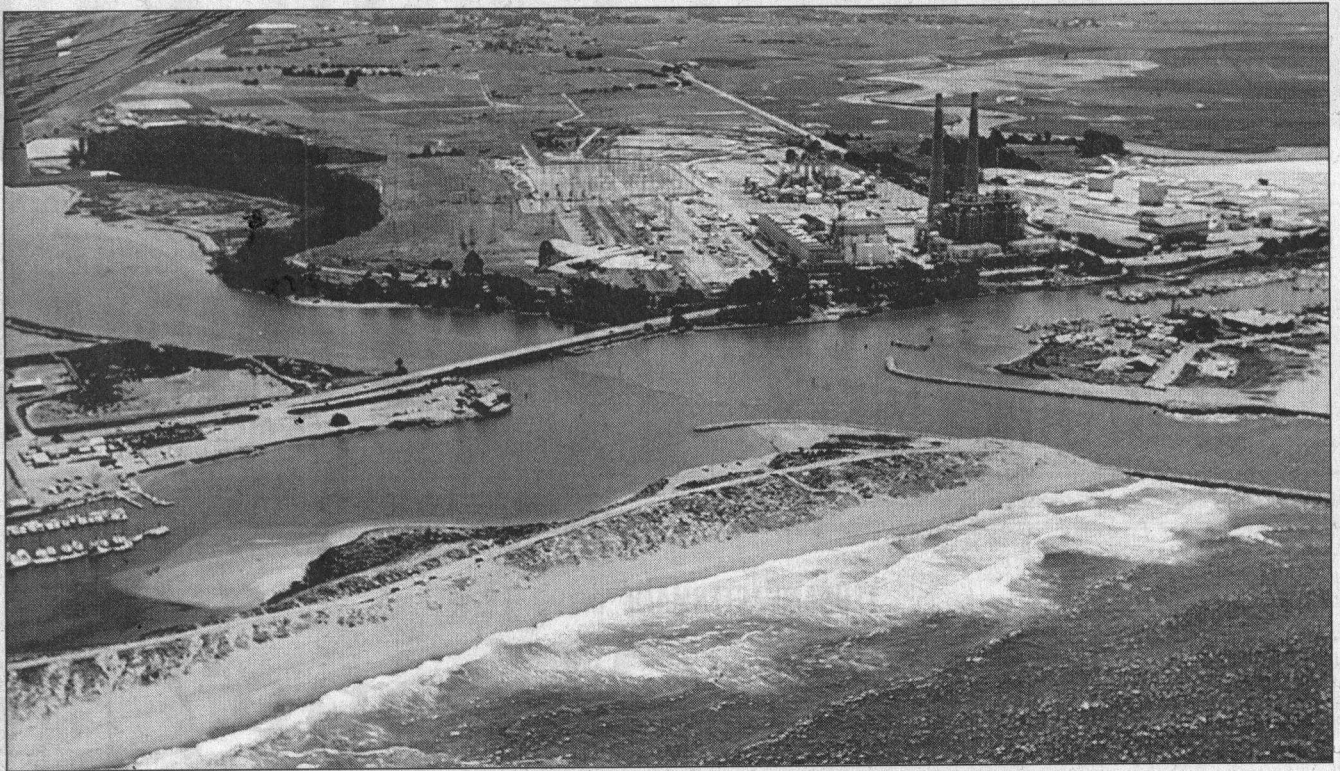
**WHAT:** UC Santa Cruz geophysicist Steven Ward will discuss the science of tsunamis.

**WHEN:** 7-9 p.m. Monday

**WHERE:** Police Department Community Room, 155 Center St.

SEE HARBOR ON A2





DAN COYRO/SENTINEL FILE

Thanks to its design, the Moss Landing harbor suffered little damage in the March 11 tsunami surges. The depth of water off Moss Landing is much deeper than in Santa Cruz, which may have changed the tsunami's thrust.

## HARBOR

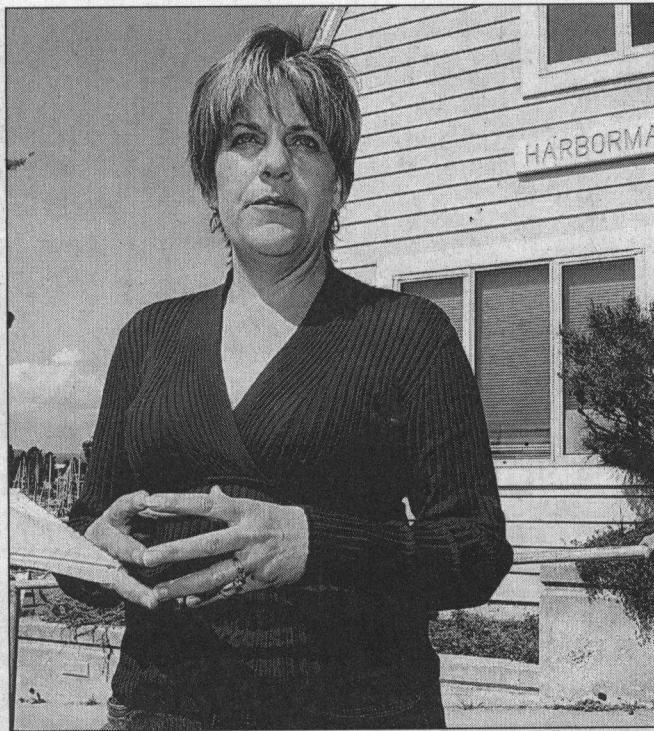
Continued from A1

Santa Cruz Small Craft Harbor officials have readily acknowledged for years that the design of the harbor's entrance, which is down coast from the San Lorenzo River mouth, is less than ideal, requiring dredging every winter to clear out drift. Designed by the Army Corps of Engineers, the channel narrows and veers off on an angle as it spills into the confined upper harbor, where the tsunami became magnified.

"We had people ask the question of whether a different configuration of the jetty or seawall parallel to the sea would have affected some of the wave energy," said Port Commission member Jeff Martin, who is also a civil engineer. "Could they have designed it better? I think so."

But Martin said there is a "low degree of likelihood" the Port District will pursue any major redesign. In addition to ever-present funding challenges, the district would have to overcome any resistance by the Monterey Bay National Marine Sanctuary and state Coastal Commission.

In the meantime, even before the tsunami, the Port District has been drawing on a state loan to improve infrastructure by replacing docks in the north harbor. However,



DAN COYRO/SENTINEL

Harbormaster and Port Director Lisa Ekers has a big job ahead of her as she prepares to fix the estimated \$26 million in damage created by the March 11 tsunami surges.

up the area known as Twin Lakes. The lower harbor, with its 360 slips, was completed in 1964, and work was completed in 1973 on the upper harbor at the outfall of Arana Gulch Creek, where another 455 slips were added.

J.D. Hardesty, a spokesman for the Army Corps of Engineers, said Friday that coastal engineers at the agency's office in San Francisco were reluctant "to comment on decisions based on datum

Scott Sommers, whose 32-foot Bayliner is still docked in what remains of U Dock, said, "I don't think the harbor is bad enough that we need to do a complete redo of the mouth. We just work around the dredge."

But, he said, "If money was no object, we could tear apart the harbor mouth. Other harbors don't have the problems we do. We have much shallower water."

John Battandieri, whose

docks are almost immediately accessible in the lower harbor parallel to the harbor mouth.

Ekers, the Santa Cruz port director, said docks in the lower harbor are laid out so the back and front of vessels, not the sides, face the surge. Even if the docks had been configured away from the opening, she said, "You couldn't design a harbor to perfectly weather 24 hours of tsunami. Something is going to break."

Another major difference between the two harbors is that the tsunami waves entering Moss Landing continued on to Elkhorn Slough and three other small adjacent bodies, where they spent their energy. The sloughs "helped to dissipate those surges tremendously," McIntyre said.

McIntyre also noted that the depth of water off Moss Landing is much deeper than in Santa Cruz, which may have changed the tsunami's thrust.

In Crescent City, where the harbor is confined and shallow like in Santa Cruz, the damage was more severe. The few seasonal docks in direct line of the harbor mouth were largely spared, while the most damage was experienced in a walled-off inner basin accessed through a narrow opening.

"My pier is in the outer basin and we saw very minimal currents," said Lt. Thomas Faulkenberry, commanding officer of the Coast Guard cutter Dorado stationed at



District has been drawing on a state loan to improve infrastructure by replacing docks in the north harbor. However, the Sentinel has learned that several weeks before the March 11 tsunami, a 32-foot power boat got stuck in full-throttle reverse and slammed in to U Dock, which sustained some of the worst destruction in the harbor. Some boat owners wonder whether the damage, which was not immediately repaired, contributed to the dock's overall instability.

"It could be a large portion of the reason that U Dock failed," said Todd Johnson, whose boat at the two-pronged U Dock was destroyed. He said the accident had occurred at "the joints where the two concrete docks meet" and wondered whether the impending layoffs of two maintenance men kept the repairs from getting done.

Harbor officials and other boaters were less convinced of the accident's effect on the destruction at U Dock, saying a sailboat that was flipped over by the tsunami surge and forced under the dock was responsible for the south finger of the U-shaped dock breaking away from its pilings.

Port Director Lisa Ekers said she had heard only vague details about the accident, but said, "I can't imagine that a boat running into a finger would contribute to taking an entire dock out."

Ekers said the repairs to U Dock from the accident likely were not made because the damage was deemed not hazardous. But she said she would probe further.

"If there is a tripping hazard or safety issue, our procedure is it gets dealt with immediately," she said. "If there was some damage that wasn't readily apparent, then maybe not."

She confirmed that two maintenance workers had recently received layoff notices due to budget constraints, but she said the layoffs were being reconsidered in light of the tsunami.

#### HARBOR DESIGN

The Army Corps of Engineers designed the harbor in Santa Cruz at the site of Woods Lagoon, which along with its sibling, Schwan Lagoon, made

coastal engineers at the agency's office in San Francisco were reluctant "to comment on decisions based on datum using 50-year-old technology." But Hardesty said, in general, engineers have observed that "some harbors react differently to tsunamis depending on the direction and amplitude (of the waves.)"

There are so many different variables that come into play here."

Officials and boaters agree that sedimentation, drainage and confinement also may play significant roles.

Martin, the port commissioner and engineer, trained his camera on the upper harbor as the tsunami ripped through on the morning of March 11, sending currents that he estimated at eight knots crashing around the north channel. Martin, whose own boat was stored at V Dock, watched as waves tipped over a 25-foot Striper sailboat and shoved it under the neighboring U Dock, which is the first on the north side of the bridge.

"There is a possibility that both the narrowing and change of angle of the harbor at the Murray Street Bridge caused some intensification of the current," he said.

He said the harbor may have been better off not being located at the drainage site for Arana Gulch Creek, but more excavation would have been costly.

Ekers said it's too difficult to tell whether the channel's narrowing in the north harbor was the most significant factor in the tsunami's power, but she noted that, "As it got further in to the channel, the tsunami behaved differently than it did in the south harbor, which is deeper water, wider and shaped like a natural lagoon."

She acknowledged that the harbor's entrance "poses a continual challenge caused by shoaling." She said the Port District is studying ways to cut down on the amount of winter dredging, possibly by altering the jetties, but recommendations won't be ready for several months.

we do. We have much shallower water."

John Battandieri, whose boat barely survived the tumult on U Dock, said he isn't surprised the Moss Landing harbor came out virtually unscathed.

"There are thousands of

**'If there is a tripping hazard or safety issue, our procedure is it gets dealt with immediately. If there was some damage that wasn't readily apparent, then maybe not.'**

LISA EKERS, Santa Cruz harbormaster

acres of wetlands and estuaries where the water has to go," he said. "(In Santa Cruz), the water just gets up there and has nowhere to go and shoots back down again. Once that water gets under the bridge, where it is funneling through there is the narrowest session of water."

Steven Ward, a research geophysicist with the Department of Earth and Planetary Sciences at UC Santa Cruz, said waves restricted to a defined space like the harbor are certain to create greater variances in height. "Any time you have a confined space, you set up resonance, like a bell ringing," he said.

During a public meeting at the Police Department's Community Room on Monday, Ward will discuss how tsunamis form and spread across the ocean. He said the volume of water and the size of harbor openings may also make a difference in how tsunamis affect individual ports.

#### OTHER HARBORS

Linda McIntyre, general manager and harbormaster at Moss Landing Harbor District for the past 12 years, said she believes her port was saved from any major damage because the docks don't directly face the open ocean.

"There is no immediate impact to vessels and docks because they are not situated in the immediate path of the entrance channel," she said.

When boats enter the Moss Landing harbor they travel to the right or left to dock protected from the ocean by large land barriers. In Santa Cruz,

mal currents," said Lt. Thomas Faulkenberry, commanding officer of the Coast Guard cutter Dorado stationed at Crescent City. "Within the inner basin and marina, every single one of those docks saw damage."

He said, "The tsunami just pushes so much water in the path of least resistance, and there is no where to go" in a confined area. Harbor officials are studying the installation of a removable dam that would slow water in the future.

#### DOCK REPAIRS

Funded by a state Department of Boating and Waterways loan, the Santa Cruz Port District is in the process of replacing slips in the north harbor. U Dock, the first one inside the upper harbor, is on the to-do list.

Harbor officials doubt the accident that occurred several weeks ago worsened the dock's condition, but some boaters disagree. They say a 32-foot Bayliner powerboat crashed into the dock at its slip after getting jammed in full-throttle reverse.

"You could see where (the accident) broke some of the rings that holds the dock to the piling," said Jody Connolly, a U Dock live-aboard resident whose boat was destroyed. "It had stress cracks. It wasn't structurally sound."

Although Connolly agrees that the 25-foot Striper sailboat shoved under the dock by the tsunami surge was the primary reason the dock fell apart, he said he believes the earlier accident contributed. He said the dock, due to its proximity to the narrowing of the channel, should have been replaced by now.

"If we had newer docks, I don't think it would have been as bad," he said.

But Scott Sommers, a fellow U Dock boater who also has 32-foot Bayliner, said, "We were slated for a dock redo anyway" and the earlier accident "wasn't that much damage."

He concluded, "The harbor does good maintenance on the dock, and I'm not sure any dock could withstand having a boat shoved underneath."