# Sun Workstations Solves Galveston Bay Showdown

Will Young Oysters Sink Texas Shipping? Environmentalists and steamship companies face a showdown over whether to dredge Galveston Bay. One hundred years ago they might have settled their dispute with Colt .45's. But the peacemaker for this modern-day standoff will be the computer workstation.

Shipping interests claim that visits by more and larger vessels will enrich the state's economy. To accommodate them, the Port of Houston and the U.S. Army Corps of Engineers want to deepen and widen the 50-mi channel in Galveston Bay, the largest and most economically significant of the seven estuaries along the Texas Coast.

In an estuary, salt and fresh water mix, creating a brackish habitat for oysters, shrimp, and fish. Because these creatures tolerate only small changes in temperature, salinity, or nutrients, environmentalists argue that dredging will upset this delicate balance, harm oyster and shrimp harvests, and endanger much of Texas' $3 billion water-related economy.

The search for support led both sides to the Texas Water Development Board (TWDB), the agency that plans, finances, and develops Texas' marine resources. New computer simulations in development on Sun workstations will soon help TWDB monitor and forecast changes in Texas waterways, and predict, for example, the outcomes for dredging Galveston's channel. Once completed, these programs will help Texans share their water resources for the next 50 years.

## Sun Workstations Simulate Complex Ecosystems

TWDB began developing large scale computer simulations several years ago when lawmakers authorized it to update methods for evaluating fresh water needs along the Gulf Coast. The agency's 30-year-old computer models for circulation and salinity could not show the effects that physical, chemical, and biological changes have on large ecosystems. Newer mathematical models provide greater detail but require more powerful computers.

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"To upgrade our modeling, we first needed to upgrade our computers," says TWDB Biologist Gary Powell. "It was no good developing a million dollars worth of code and wasting it on hardware that simply couldn't provide the level of detail we required."

TWDB used to share mainframe time with other state agencies but that system was slow. When one of TWDB's simulations took 700 hr to complete, other divisions made the agency run its math-intensive simulations on nights and weekends.

Timesharing cost TWDB $295,000 annually. Results were slow and lacked detail. The agency considered sharing the powerful Cray mainframe at University of Texas but it also involved waiting between processing runs. TWDB evaluated PC's, but decided they lacked the necessary speed and power. Finally, the agency turned to computer workstations. A Sun workstation ran the 700-hr program in 100 hr, beating all other competitors and TWDB selected it for the task.

"We couldn't afford $2 million for a mainframe," Powell says. "But spending $65,000 for a Sun workstation eliminated the $295,000 service charge for timesharing. It paid for itself in the first 90 days.

"The major benefit is time," Powell added. "The state gives us adequate money and staff, but a $40,000-a-year engineer waiting a week for results is still wasting his time and the state's money."

**A Day--or Three--On The Bay**

At the recommendation of seven top scientists, TWDB selected a two-dimensional computer model that was developed for the North Sea by William Gray, chairman of the civil engineering department at Notre Dame University. With Gray's help, the agency is calibrating the model for three of Texas' seven estuaries. Galveston Bay will be the first one finished.

To complete calibration, TWDB researchers spend 72 hours, or three full tidal cycles on the bay. They measure wind speed, the velocity and direction of the waterflow, and its salinity and depth. They enter this information into computer along with contour information about the bottom of the bay.

To simulate estuary conditions, a scientist runs TXBLEND, TWDB's version of Gray's North Sea model, on a Sun workstation. The program generates a hydrodynamic model of the estuary's physical movements followed by a transport model of its chemical changes. With the Sun workstation's power and speed scientists now complete both models at once. On the mainframe, they ran separately.

Scientists edit the models, changing values for river inflows, tidal elevations, or meteorology conditions. to create varying scenarios for the estuaries. For example, what will happen if Galveston channel is dredged?

"To interpret the results," Powell says, "engineers need pictures, not 10,000 pages of printouts." TWDB uses Precision Visual Inc. (PVI) DI-3000 to display both simple plots and three-dimensional contoured representations of the waterways. The workstation's powerful graphics take full advantage of the program's bells and whistles, Powell says. "That surprised us. We knew we were getting a good number cruncher and that was our chief reason for buying Sun. But in addition, we got a tremendous file server with a good graphic interface that helps our analysts."

**Graphics Replace Cumbersome Tables**

With the PVI program, scientists create maps using the results of the hydrodynamic and transport models. They overlay them with arrows showing water movement. Their orientation shows waterflow direction; their length, waterflow velocity. They also connect points of equal salinity with lines to show the distribution patterns of salt and fresh water.

In the past, a researcher plotted an estuary map, drew arrows, and connected salinity points by hand because the mainframe output lacked visual detail. With the Sun workstation's advanced graphics, the researcher can zoom to examine sections of an estuary and identify problems such as sedimentation blocking a waterflow.

Instead of plotting hardcopy for distribution, researchers simply access the file server and download the graphic to their Sparc stations. Ethernet links the Sun workstation to

the agency's two other workstations, while Appletalk connects it with Macintoshes and a laser printer.

**Blazing Speed Isn't Everything, But It Sure Helps**

TWDB uses the Sun-4/260 chiefly as a number cruncher. Its speed and memory enable scientists to run simulations with greater resolution, over longer times and with larger geographiies than in the past. Galveston water watchers hope that these capabilities will eventually yield the facts needed to decide the dredging issue.

The former programs divided Galveston Bay into a grid of 600 squares, 1-nmi (nautical mile) on a side. The new simulation uses a grid of 3,000 computational cells, some of them with sides only a few hundred feet long. The previous hardware wouldn't process 3,000 cells, Powell says. It would take weeks. The Sun takes a couple of days. "We process more information with the faster machine, achieve greater resolution, and accurately represent the geometry of the bay."

The Sun's greater speed can simulate a one-year model in only five days, a taks impractical on the mainframe. In fact, the agency can now simulate events that last for years, if necessary. For the first time, the workstations enable TWDB to model interconnected estuaries on the Texas Coast and to understand how water moving among bays effects salinity and nutrients.

"It's not only a question of doing things faster," says Rubin Solis, TWDB hydrologist and system administrator for the Sun system. "We simply couldn't run multibay models with our old system, because the limited memory and processing power of the Unisys restricted the number of data elements in a simulation. The Sun workstation lets us run these studies as a single system without worrying about the size of the estuary or the length of the simulation."

Researchers used to collect water data manually every other month from dozens of sites in the bays. Today, remote sensors sample conditions hourly at hundreds of locations and researchers download the data electronically. "We have more storage space on the Sun. It's a tremendous file server and it moves data quickly," Powell adds.

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**Solving Present And Future Water Disputes**

Texas shipping interests, environmentalists, and legislators await completion of the Galveston Bay model to predict whether dredging a new channel will endanger marine life in the estuary. They are joined by other Texas locals and officials who want to use computer models during the drought season to better manage waterflow from man-made reservoirs and a natural lake that feed freshwater to the Corpus Christi Bay. Annother group asks whether the multi-billion dollar Formosa Plastics plant can divert freshwater from a nearby reservoir, use it for processing, and return it to Matagorda Bay without effecting marine life.

"Agencies call us all the time," Powell says. "They want to know how soon they can use our models." TWDB expects to release its computer simulation manuals during the summer of 1991 and its codes by year end. Then perhaps, peace will return to Texas waterways, guided by the cool hand of the TWDB and its trusty computer workstations.



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