

Electronic Charts on the Alabama, Black Warrior, and Tombigbee Rivers

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Introduction

The Tuscaloosa Site Office of the Corps of Engineers' Mobile District maintains approximately 750 miles of inland waterways for navigation on the Alabama, Black Warrior and lower Tombigbee Rivers. During 1995, commercial towing companies moved 32.8 million tons of commodities on these rivers. The Corps Tuscaloosa Site Office activities include maintenance of a minimum navigation depth throughout the system, keeping the waterway clear of obstructions, and operation of 9 locks. To ensure an efficient and continuously open navigation system, the Site Office has four survey vessels and crews, a snagboat, and access to numerous contractors for dredging or any other task they are unable to perform in-house. During 1998, the Site Office performed \$5 million in contract dredging.

As with most Corps of Engineers districts and offices, the Tuscaloosa Site Office engineer, construction and maintenance requirements in support of navigation have remained steady, or even increased, while budgets and personnel have declined. This difficult situation has forced the Site Office to seek innovative use of technology and new procedures to continue effective support for navigation interests. One such innovation is the development and use of one-person hydrographic survey crews. Another development is dissemination of critical and useful navigation information to users through electronic charts.

Site Office/Navigation Partnership

An invaluable resource in the Tuscaloosa Site Office navigation mission, as with other Corps districts and offices, is their close and cooperative working relationship with commercial navigation interests who daily use the channels. Although the relationship may not be a formal or structured arrangement, the Corps office/industry cooperation is nonetheless a partnership benefiting the Corps' engineering, construction and operation missions for navigation. The partnership also benefits the industry mission of transport of bulk commodities safely and reliably. The Corps office commonly receives timely information about current or developing problems on the waterway from a vessel operator who transits the waterway regularly and knows every bend, buoy and lock and dam in the system. For example Corps personnel may get a call or an e-mail message from a vessel captain (often on a first-name basis) about a submerged object in or near the channel or a strange current pattern at Mile 47, which could indicate a shoaling condition. The Corps office can then dispatch a survey vessel, dredge

or snagboat to the area of concern, which otherwise may not have been noticed until the problem was more significant, costly to remediate, and disruptive to traffic. Although the Corps office in Tuscaloosa is responsible for the whole Alabama – Black Warrior – lower Tombigbee system (AL – BWT), the 15 – person office could never continuously survey and monitor all 750 miles of waterway. Thus, the reconnaissance benefit of the navigation industry partnership is invaluable.

Information is also passed from the Corps office to waterway users concerning waterway construction or maintenance activities or conditions of concern to transiting vessels. Dredging activities in the channel are announced over the web, electronic bulletin board, or even by phone calls. Temporary disruption of lock services are similarly published. Information from recent surveys of critical areas also are provided to navigation users. These areas could be locations, known by the Corps office and vessel operators, to have frequent shoaling conditions, narrower passages or “choke points,” or other conditions that could be a menace to navigation. Survey data is plotted as soundings or contours referenced to river mile posts, top bank information, or buoys on E-size paper and is provided on request to users. This information may be referenced directly by the vessel operator when navigating the waterway, or might be referenced as an annotation on the 1:1000 river charts produced every 10 years by the Site Office. Although this system of information dissemination through hardcopy plots, electronic bulletin boards and word-of-mouth has served the navigation industry well, the Site Office logically seeks to make the whole system electronic, since the information is collected, processed and produced using computer systems. Data dissemination and use by commercial, government, or recreational vessels is certainly feasible and warranted in the era of digital data and low-cost computers. However, a shift to a new system using new technology will be successful only if it is an *improvement* over the existing system. The Tuscaloosa Site Office has thus pursued an innovative pilot program between their Corps office, a towing company that commonly uses the AL-BWT system, and an electronic chart vendor.

Tuscaloosa Electronic Chart Pilot Program

At first consideration, the availability of electronic charts consisting of top bank lines, sailing line, bottom contours, mile stationing and other significant features would appear to be a simple task, since the information already exists in digital form. However, the data does not exist in a single database nor a common format, the navigation users can not be expected to use chart systems similar to the Site Office’s data processing systems, and data needs to be disseminated quickly and continuously. Also, the Site Office has limited personnel and resources to use in the production and publication of electronic chart data. Therefore, the Site Office decided to focus on surveys and data integration to cover entire AL-BWT system; most of which is already collected in their navigation mission. Data formatting and production of charts suitable for

navigation is to be left to system vendors, who will download the Corps data and provide charts and updates to customers using their electronic chart navigation systems.

The pilot program began in March 1998, involving the Site Office, Coastal Oceanographics Inc. who produces the NAVPACK electronic chart program, and the Parker Towing Company, who is a frequent user of the AL-BWT waterway system.

The Tuscaloosa Site Office is producing a set of base charts of the waterways consisting of top bank data, locks and other significant features such as boat ramps, and river mile stationing. Most of the data was collected by laser surveys from survey boats, is in DWG or DXF formats, and over 85% of the AL-BWT system is completed. Bank-to-bank hydrographic surveys are also to be completed and available in separate data sets. The

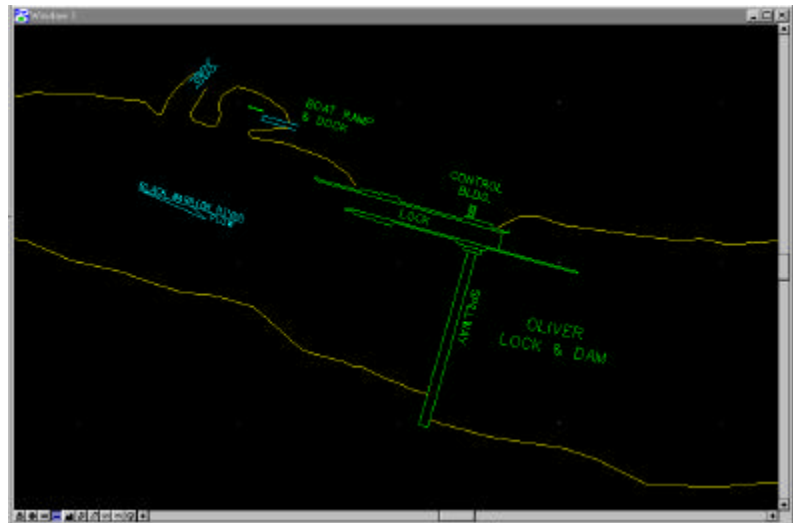


Figure 1: Section of Base Chart for Black Warrior River

The base DXF datasets and the ASCII survey data is provided to Coastal Oceanographics, who reformats the data and produces charts for their NAVPACK product. However, the vector and ASCII chart files produced by the Site Office are to be available on their Web site for open access by any interested vendor or user, and the data will include metadata files describing accuracy, age, coordinate system, units of measure, restrictions, and other information needed by users of the data.

During the one-year pilot program, the Site Office data is being used in the NAVPACK program on the two Parker Towing vessels and the Site Office's snagboat *ROS*. The NAVPACK program runs on a Windows 95 or NT Pentium computer, and accepts positioning in common format from differential Global Positioning Systems (DGPS) and other sensors, such as magnetic or gyro compasses and depth sounders. For the pilot program, Coastal Oceanographics is producing 2-foot contours from the ASCII survey data, which can be integrated with the base charts or added as an update. The Site Office is producing updated survey files every three months, but eventually is to make the survey files available within a few days of the survey. Therefore, users will be able to have up-to-date information on critical areas, either by download from the Web site or by data transfer from an electronic chart vendor.

The Site Office intends to adopt the Tri-Service standard for hydrographic data representation, once the standard has been finalized, which will be the same schema used by the Mississippi Valley Division, and eventually the entire Corps of Engineers. The Site Office also is participating in the development of a federal hydrographic standard, which is based on the Tri-Service standard. These actions ensure that the data on the AL-BWT will migrate to a common standard used on inland, as well as coastal waterways. The current and future actions result in full compliance with Corps of Engineers policy on dissemination of electronic chart data on navigation projects.

System Evaluation

As of December 1998, the NAVPACK program with AL-BWT charts has been used for eight months aboard the *ROS* and the Parker Towing vessels *Cathy Parker* and *Allison Haun*. Each vessel uses DGPS with the Coast Guard Radiobeacon broadcast, which produces 1-3 meter horizontal positioning accuracy, and uses a desktop Pentium computer to run NAVPACK, with 17-inch CRT display. Each vessel operator has logged numerous hours with the electronic charts and have provided numerous comments about further suiting the system to use on the confined river channels. However, each operator has also been pleased with the new chart systems and wishes to continue their use. Some observations gained during the pilot program are given below.

Low Visibility: The availability of accurate charts displaying the vessel's real-time position during conditions of low-visibility is cited as one of the most significant



Figure 2: Aboard the Allison Haun on the Black Warrior River

benefits of the electronic chart system. The problem of loss of visual land references leading to disorientation and unknown position, as occurred in the AMTRAK disaster, is solved with such systems. The electronic chart system also has the *potential* of enabling continued transit during fog or storms that currently force vessels to halt until better visibility.

Look Ahead: Vessel operators found the ability to "look ahead" to upcoming areas in the planned voyage quite useful. In some cases, this could be areas that are less than a mile away but are around a bend, and thus are not visible. Such capability is helpful in route planning, and is particularly useful to operators who have not logged numerous years of experience and are not intimately familiar with the waterway.

Radar Overlay: The electronic chart and radar technologies can be viewed as complimentary capabilities. The latter can “see” objects in the line-of-site, even during low visibility, while the former is not subject to obstructions. The two systems should be combined into a common display to reduce clutter in the wheelhouse from “one more system” and avoid the complication of viewing two different systems. Presumably, cost could be reduced, as well.

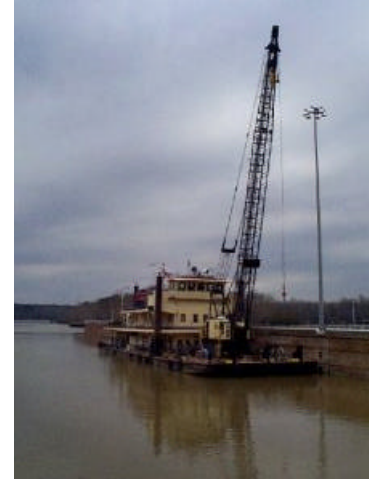


Figure 3: Snagboat ROS

Heading Error: The absence of a heading device was clearly a problem in display of the vessel on the chart. During lower speeds and during turns, when the sequence of past positions from the DGPS could not provide accurate heading information, the heading vessel image on the screen showed large inaccuracies. Particularly when the vessel or barges are shown being on land (and the vessel is not aground!), user confidence in the system is reduced. The *Cathy Parker* has a digital magnetic compass which can be interfaced with NAVPACK, but the large magnetic fields from the barges and cargo cause large errors in azimuth. Dual DGPS receivers and antennas with 50 feet of separation on the *Allison Haun* were tested, 2-3 meter positioning accuracy still produced heading errors of several degrees. Larger separations by placing one antenna on the leading end a barge are possible, although radio link with the electronic chart system is required, since a long cable is not feasible.

Land Information: As indicated by other users of electronic chart systems, extensive information displayed for the bank and over land is discouraged to avoid a cluttered view. However, some key features (some included in the pilot charts); such as boat ramps, major roads, medical facilities; that are needed for safety or convenience (area restaurants?) are desired.



Figure 4: NAVPACK System Aboard the *Cathy Parker*

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