Automated Surveillance of Disposal Operations During the 1999 Passenger Ship Terminal Project at the Historic Area Remediation Site

Prepared by:

Science Applications
International Corporation
Admiral's Gate
221 Third Street
Newport, RI 02840

Prepared for:

U.S. Army Corps of Engineers
New York District, Operations Division
26 Federal Plaza
New York, NY 10278-0090

July 1999

Delivery Order No. 8 of Indefinite Quantity Contract No. 49

SAIC Project No. 01-0440-04-8958-310
Report No. 93 of the New York Mud Dump Site Studies
SAIC Report No. 471

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ACKNOWLEDGEMENT

This project owes its success to the people who did a lot of things right. This includes the Great Lakes Supervisor, Richard Murphy, who was always helpful with equipment schedules and assistance at the dredge site. The Inspectors, Steve Steinmetz, Allen Donn, and Jay Taylor offered observations key to solving ADISSPlay problems. The USACOE New York District personnel, Beth Nash, Monty Greges and Steve Knowles, provided trip assignments and monitoring oversight. Don Dorson of Bathysystems, Inc. kept the SAIC crew going with potential solutions, warm meals and kind words. We thank the skippers and crews aboard the tugs *William Colnon*, the *Limmerhirt,* and the *Colonel* for contributing their excellent skills and professional demeanor, and the crews aboard the dredges *GL-131* and the *GL-50* for conducting safe operations. We also thank the Great Lakes personnel stationed at the Staten Island yard facility for their help in mobilizing the ADISS equipment aboard the scows. As ever, we appreciate the efforts of the men who ride and operate the scows. Without their efforts and cooperation we would not have solved the many problems encountered during the development of ADISS.

The success of ADISS as an effective monitoring tool at the Historic Area Remediation Site is, in large part, due to the persistent efforts of Brian May whose insight into the future needs of the HARS monitoring program contributed to the creation of several state-of-the-art methods. As the previous HARS Technical Manager within the Operations Division, he played the central role in ADISS and ADISSPlay development. We wish him every success in his endeavor to persevere and flourish within the NYD Planning Division.

1.0 OBJECTIVES

The objectives of the Passenger Ship Terminal (PST) maintenance dredge monitoring project were to: 1) acquire highly accurate navigation data from the operation of dredge material disposal scows in the Historic Area Remediation Site (HARS), 2) provide real-time scow position information to the helmsmen of the tug boats, 3) provide near real-time placement event confirmation over the Internet to the New York District of the U.S. Army Corps of Engineers (NYD), 4) provide and collect event related field records/observations in the digital version of the Inspector forms and completed logs that are submitted to NYD, and 5) provide access to the processed navigation data.

Objective 1: SAIC met the first objective by installing and servicing the Automated Disposal Surveillance Systems (ADISS) on four scows, while under contract to the Great Lakes Dredge and Dock Company. ADISS equipment was initially installed on the *Great Lakes 32* and the *Great Lakes 402* scows, and subsequently on the *BR-8* and the *Great Lakes 401* scows mid-way through the project. The rotation of scows into and out of service was necessary to meet the needs of other dredging projects.

Objective 2: The second objective was addressed with the installation of the ADISSPlay system on the Great Lakes tugboats *William Colnon* and *Limmerhirt*, and on a contracted tug, *Colonel*. Both the *Limmerhirt* and the *Colonel* were added to the rotation of vessels mid-way through the project. The ADISSPlay system received radio signals from the ADISS units installed on the scows and plotted the real-time updates on a display of the NOS chart during each transit. The purpose of the guidance system was to facilitate the accurate placement of dredged material within small target cells assigned to each load by the NYD.

Objective 3: To provide near real-time placement event confirmation on the Internet, ADISS information was transmitted through the Argos satellite system to the Web Site (http://www.adiss-afiss.com), which automatically plotted individual placement locations over a grid of target cells. The intent of the near real-time system was to provide NYD with an early warning of accidental disposals outside the designated HARS cells.

Objective 4: Inspector Log forms were provided in electronic format on the ADISSPlay system installed on the tugboats. By completing the information in the forms for each trip, the Inspectors created a database of information within the ADISSPlay computers, which was retrieved by SAIC and submitted to NYD for inclusion into the Disposal Analysis Network-New York (DAN-NY) system. DAN-NY was an interface created by SAIC for NYD to store and display monitoring information in a Geographic Information System.

Objective 5: Access to processed navigation data retrieved from the scows was provided by two means. Plotted data of track lines for each scow for the PST project were posted (four weekly summaries) on the Internet at: (http://www.adiss-afiss.com), along with other previous HARS placement projects. An executable viewer program to display the track line data on demand was created as the second means of access to ADISS data. The program and database of

processed track line information are available on compact disc (CD) for select distribution to dredging companies and regulatory agencies.

The first two objectives were conducted under the PST monitoring contract with Great Lakes Dredge and Dock, while the last three objectives were accomplished under IDC 49, Delivery Order 8 with NYD to supply specific information necessary to manage HARS disposal operations. The viewer program was developed with SAIC funds, because the intent was to provide NYD and other USACE districts with an inexpensive means of presenting ADISS data without depending on the DAN-NY system for GIS support.

All five objectives formed the basis of a complete disposal monitoring program for the PST project, providing NYD with the tools to manage placement operations at the HARS efficiently within existing statutes and best management practices.

2.0 SYSTEM DESCRIPTIONS

The present ADISS system is composed of the scow positioning and draft recording unit, the Argos Telemetry capability, the helmsman guidance display, the Inspector logs, and the data viewer program. Each element of ADISS was developed under different programs and is described in previous reports. The complete ADISS system was adapted for monitoring placement operations at the HARS.

A complete description of the basic ADISS system is available in the report of the prototype system (SAIC 1998a). The Argos satellite telemetry capabilities, which were retrofit to the ADISS system during the 1997 Capping Project, were described in the project report (SAIC 1998b. The ADISSPlay system, the addition of the Inspector log forms, and the automatic processing of Argos-telemetered data on the Internet were described in a letter report (SAIC 1998c). The display of ADISS data on the Internet and its availability using the viewer program are described below along with a summary of previous ADISS system capabilities.

2.1 ADISS System

The ADISS system was created to accurately monitor the placement of Category II material within a relatively small area at the New York Mud Dump Site during the 1997 Capping project. The system consisted of a GPS receiver, a DGPS receiver, a high-speed logger, flash ram memory, a logic controller, a small battery, antennas, and a pressure sensor (Figure 1). All of the components were Commercial-off-the-Shelf products with a proven history of performance. Only the logic controller was built under contract to SAIC. The firmware executed the logic sequences for detecting vessel draft, proximity to the placement target, and accidental disposal outside the boundaries of the target. The logic sequence allowed the system to operate unattended and reduced the memory capacity and power requirements. Unattended, an installed ADISS system recorded the scow's loading location, its transit and placement location for ten to twenty days depending on number of trips and length of transit. Its performance allowed the Waterways Experiment Station (WES) Engineer, the NYD Mud Dump Site Manager (at the time), and the SAIC Project Manager to jointly review the placement locations on a weekly basis and redirect the locations of placement activities.

Toward the end of the 1997 project placement activities, SAIC developed the Argos satellite telemetry capabilities for ADISS, and retrofitted the six units installed on scows to monitor vessel operations. E-mail messages were received daily by SAIC from the Argos transmitters, relaying battery voltage, vessel status, load and placement times and locations. The only other means of monitoring correct ADISS operation was by checking the indicator lights visible through the view port of the weatherproof case.

Developed as a simple, cost effective monitoring system, ADISS was equipped with three Light Emitting Diodes (LEDs) to visually indicate the mode of operation. The red LED indicated a short or fault in the equipment, while the yellow LED meant proper reception of the GPS signal. The green LED was illuminated when the scow was loaded, and ready for transit. In this manner, scow men could readily radio ADISS status to the Inspectors.

2.2 ADISSPlay System

The current ADISSPlay system was developed over several work assignments, which required real-time scow positioning for accurate placement of dredged material. Initially, a simple version of ADISSPlay was used to illustrate the position of the split-hulled scows over the 990-foot diameter cell, LA-5, for placement of dredged harbor sands off the California coast. The simple system was modified by SAIC to monitor disposal scows at the HARS for the NYD, and included the features of *save* and *print*, and to record the observations of Inspectors during placement events. The ADISSPlay system was refined during a WES project in Mobile Bay, Alabama, to allow the helmsman to operate the system while towing the scow into position for placement. The ADISSPlay system was used to guide the placement of dredged material at the HARS during the Jack Frost Refined Sugar maintenance project. The accuracy of previous placements conducted only with surface buoys increased from 25% to over 70% with ADISSPlay (SAIC 1999).

Recent improvements included NOS chart overlays, ADISS signal indicators, and an innovative electronic Inspector log form. NOS navigation charts were installed on the ADISSPlay system to provide the helmsman with a background of Aids to Navigation. The digitized chart versions were converted for use in the ".bsb" format, and imported into the ADISSPlay program. Several NOS charts were available in the program for use by the helmsman and Inspector. The signal indicators present on the ADISSPlay screen mimic the ADISS LEDs on the logic board, and allowed the Inspector or helmsman to monitor the function of ADISS installed on the scow, remotely. Illumination of the red indicator signaled the Inspector of an ADISS malfunction, while a green light meant the scow was loaded. The yellow signal indicated the ADISS was tracking the scow's position. The extended log form was added to the ADISSPlay program as an alternative to be used when no signals were received from ADISS.

The components of the ADISSPlay system included a VHF radio modem to telemeter scow position information from ADISS to the helmsman display (Figure 2). The transmitted data were received by the tug's modem and input to a laptop PC for immediate processing and display. Scow position was plotted over a grid of the target, allowing the precise placement of dredged material within a predetermined cell (Figure 3). The target assignment for each load was determined by the HARS NYD manager, and entered into the ADISSPlay computer database during installation. During the operation of the guidance system, the Inspector input the trip number, the tug and scow names, the vessel draft (fore and aft), and the cubic yards of material loaded prior to shipping the scow, and following its course to the target cell.

The features of the ADISSPlay system included:

- Real-time display of ADISS position over the HARS placement grid
- NOS chart overlays of the Hudson River, New York Harbor, and New York Bight
- Automatic entry of location, date and time of placement, scow draft and target cell
- Manual entry of tug name, scow name, trip number, vessel draft and load volume
- Automatic highlight of target cell according to trip number assignment
- Record of entered data and disk save
- Print display of each transit track line

- Automatic or manual zoom to the scow position
- Color indication of the pre-designated target cell
- Heading, bearing and distance from scow position to center of target cell
- Creation of Inspector entry log forms into database for the DAN-NY system

2.3 Internet Display of Argos Satellite Telemetry Data

The Internet Argos display of placement events at the HARS allowed NYD site managers to monitor disposal activities remotely without visiting the scows to retrieve the stored data acquired from each disposal event. The Argos transmitter on each ADISS-equipped scow telemetered the position of each placement, which was received by a polar orbiting satellite and throughput to the ground station for e-mail delivery to the Internet server. The e-mail messages contained the identity and DGPS position of the scows, and were automatically listed and plotted over a grid of the HARS (Figure 4). No indication was provided in this method to illustrate a successful placement in pre-assigned target cells, because the purpose of the Argos monitoring was to provide NYD with a means of detecting permit violations outside the boundary area (i.e., accidental placement or "short dump") in a timely manner.

A small-scale map of the Lower New York Harbor and the New York Bight also showed potential placement outside the HARS boundary (Figure 5). If a "short dump" placement was indicated on the Internet display, NYD managers queried SAIC engineers about system test activity as a potential source. Barring a plausible explanation, the ADISS data were downloaded and plotted during a service visit to confirm the location of a potential misplacement. The downloaded vessel track line information from ADISS provided NYD with the accurate position data needed to expeditiously direct the required corrective action.

2.4 Inspector Log Information and Database

The Inspector log was created as part of ADISSPlay to record placement observations electronically within a database for later importation and display to DAN-NY. Previously, log forms were filled out by hand and submitted by fax to NYD, which were filed and electronically keyed into the DAN-NY database by SAIC. Creating an entry form for the same information within ADISSPlay eliminated the additional labor and potential source of error associated with transcribing the Inspector observations.

The Inspector log form contained entries for each project, tug and scow information, loading data, and HARS weather conditions (Figure 6). Entered data was submitted to the database during each trip, and the database was downloaded to disk during service visits to the tug. A printout of each completed form was provided by the ADISSPlay color printer, and was provided to the Great Lakes supervisor.

An extended log form was also available on ADISSPlay in the event that no signals were received from the ADISS-equipped scow towed by the tugboat. The extended log included entries for tug position and orientation of the scow, and beginning and ending times of placement (Figure 7). This additional information would be required to estimate the relative position of the

scow from the recorded position of the tug during placement. The extended Inspector log contained the same information recorded in Inspector logs used during the previous disposal projects at the New York Mud Dump Site when ADISS was not required.

2.5 Internet Access to Processed ADISS Data

The Internet display of processed ADISS data provided access by the dredging industry, regulatory agencies, and other interested parties to ADISS data processed from the scows. Before posting on the site (http://www.adiss-afiss.com), the scow navigation and draft data were processed to determine the location of each placement, plotted over the disposal grid, and sent to the dredging company and/or NYD for review. Review of the plotted track lines by both would have been critical in the event of a short dump or a misplacement of dredged material. Equivocal data would not have been posted on the Internet.

The Internet site was equipped with a side-bar navigation tool to facilitate locating the pre-plotted placement summaries. Under *New York* programs, the current Passenger Ship Terminal project was labeled *PST 1999*. Approximately twenty placements were plotted for each image, and a total of four images were produced for this project. All four images were posted in thumbnail presentation, which could be activated to reveal detail and printed for a hardcopy record. A fifth image contained the summary of all placements recorded at the HARS with ADISS for PST 1999.

2.6 CD Viewer Display of ADISS Data

The executable program written to display processed ADISS data stored in the database was distributed in a Beta version to NYD for review and testing. The program and database of the PST 1999 data distributed on CD were automatically installed on the host computer and launched during application. Plots of track line data could be selected by date or vessel for a given project and combined with other events or individually displayed (Figure 8). Plots could be produced in large scale for viewing details or in small scale for gaining perspective.

The CD viewer provided the means to illustrate the contents of the processed information in the ADISS database with the flexibility needed by different regulatory agencies (EPA). Once installed on a host computer, the viewer program can import updated versions of the ADISS database of either on-going or new projects.

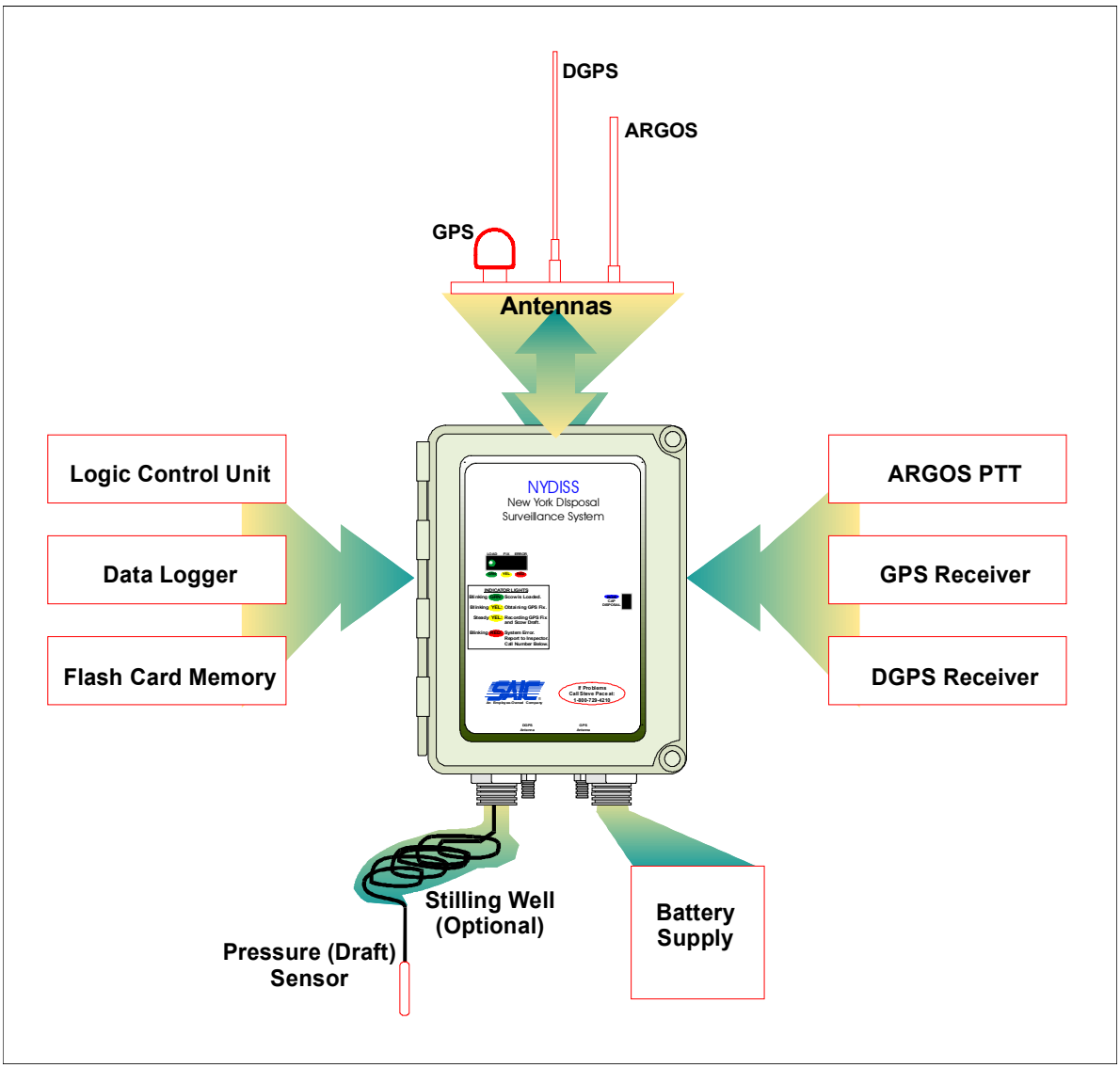

Figure 1. The major components of ADISS including Commercial-off-the-Shelf (COTS) components and the logic control unit produced by SAIC.

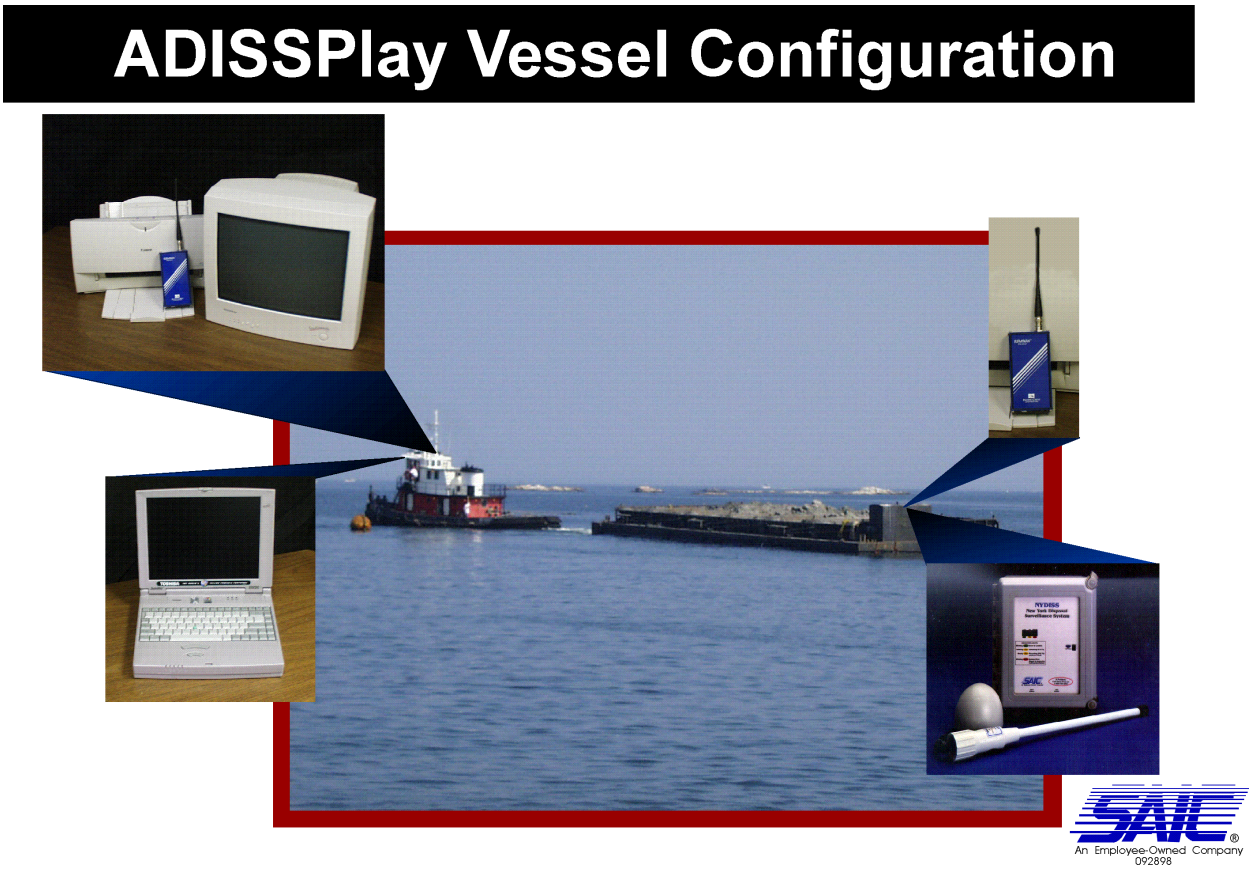

Figure 2. ADISSPlay equipment configuration onboard tug and scow.

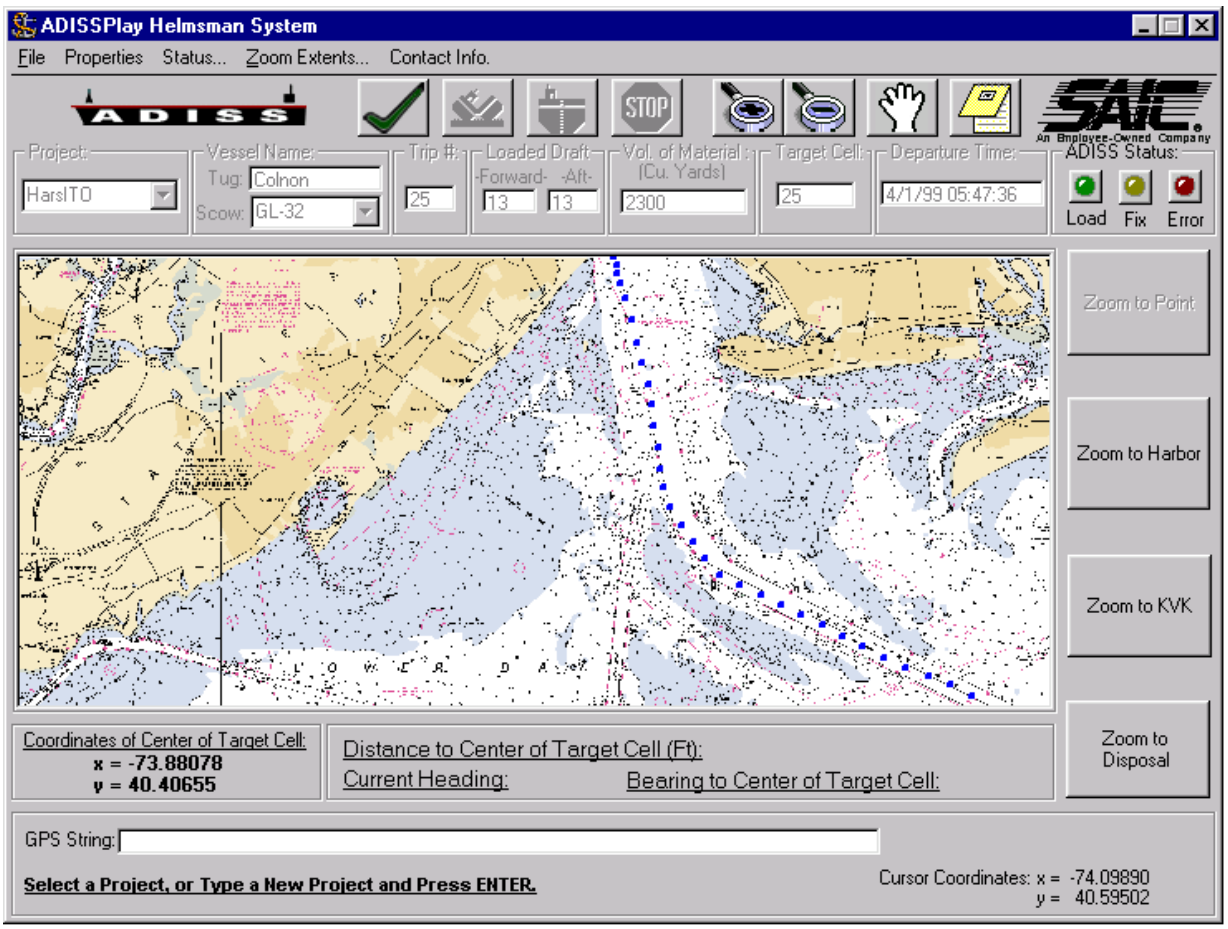

Figure 3. ADISSPlay helmsman display during a transit to the Historic Area Remediation Site (HARS).

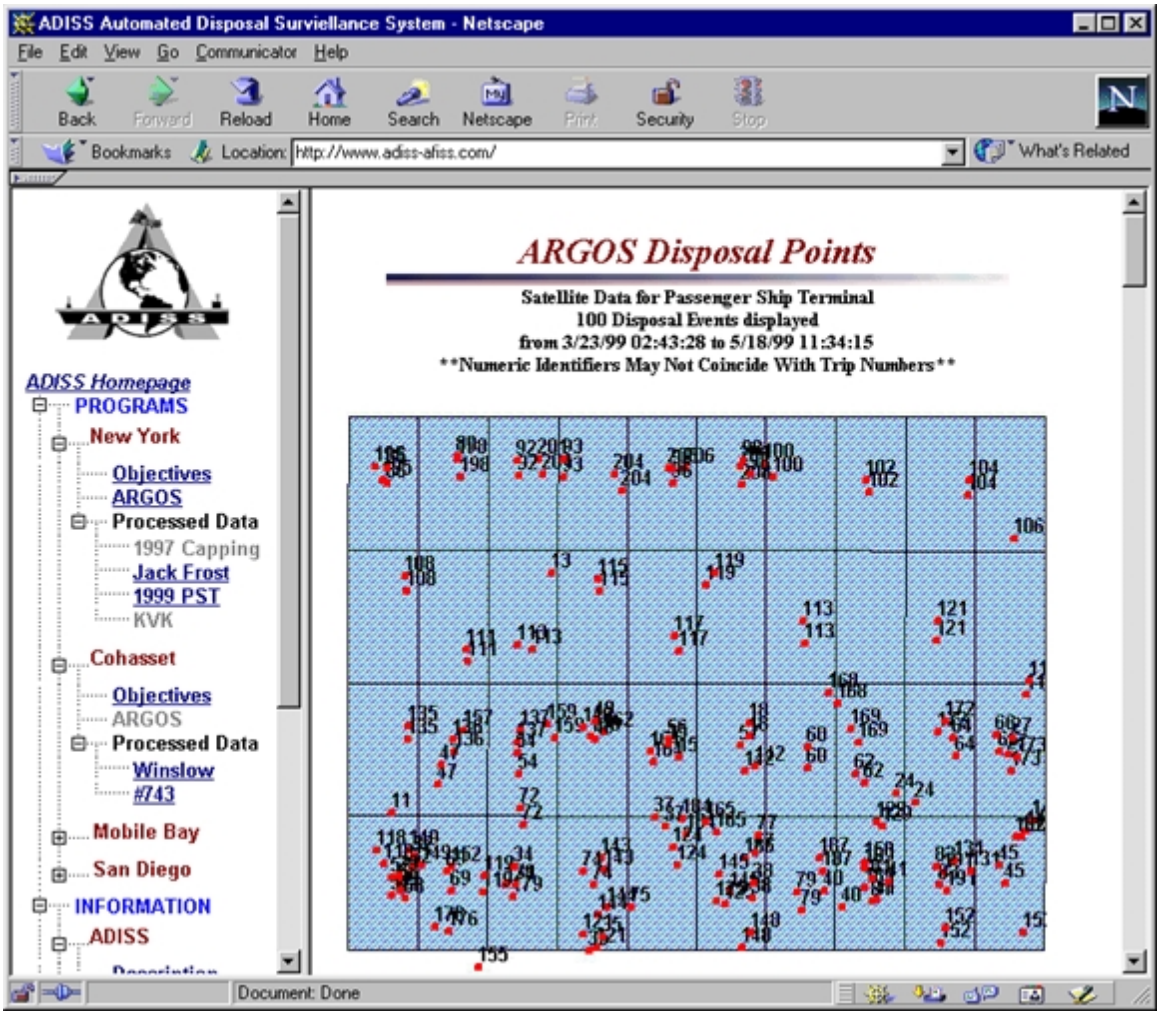

Figure 4. Format of the Argos-transmitted placement data at the HARS target cells as it appeared on the Internet (http://www.adiss-afiss.com).

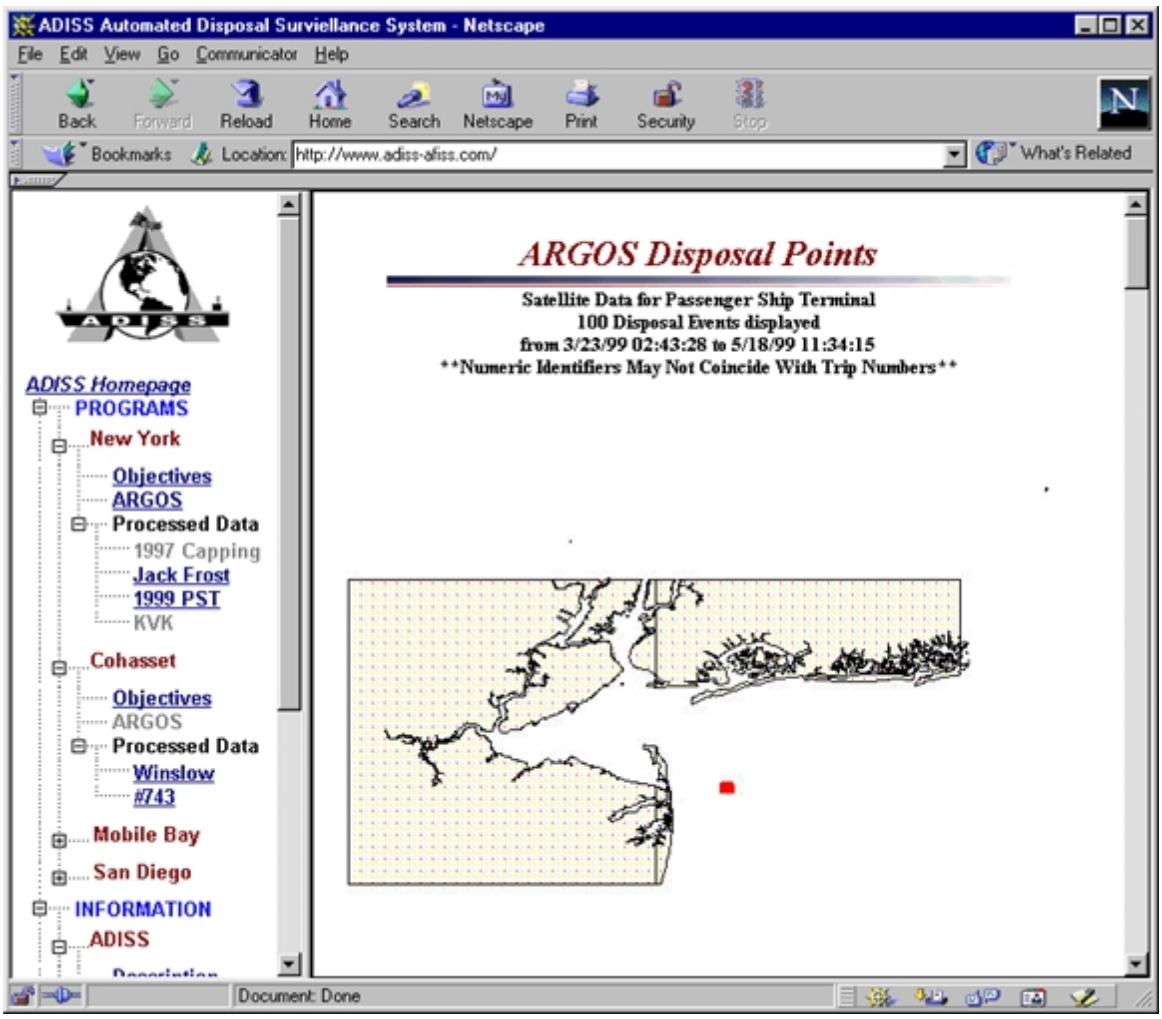

Figure 5. Format of the Argos-transmitted placement data within the New York Bight as it appeared on the Internet (http://www.adiss-afiss.com).

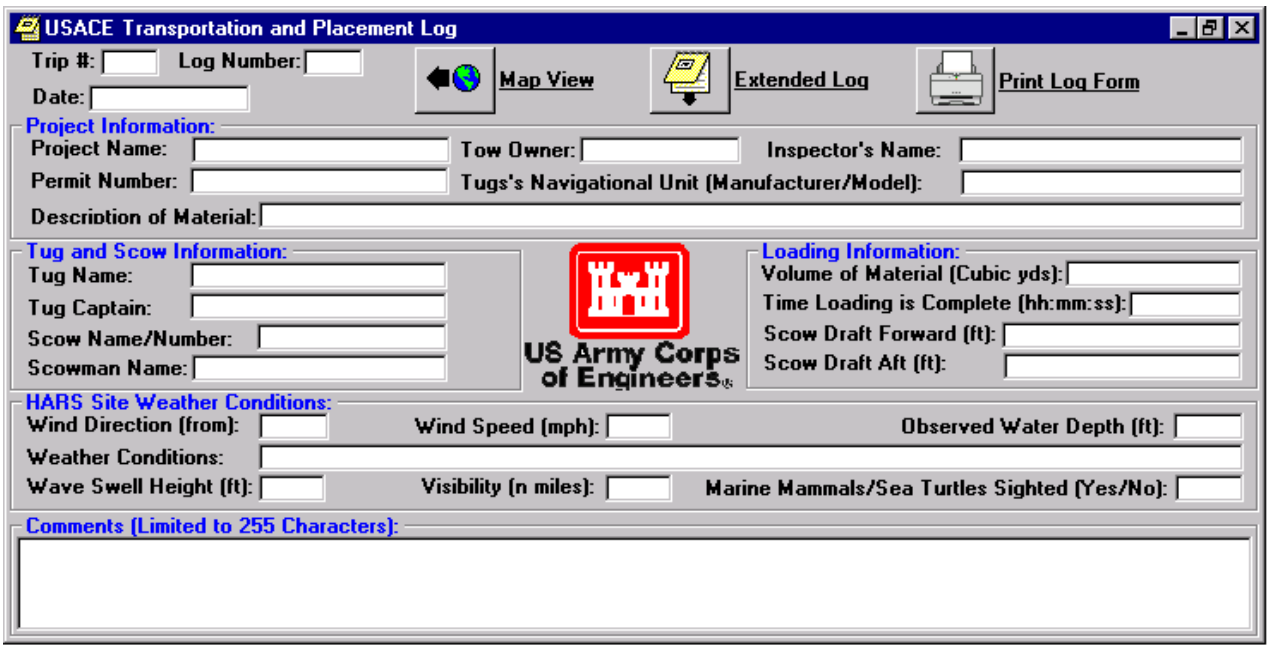

Figure 6. ADISSPlay Inspector Log Sheet for manual entry into database.

USACE Transportation and Placement Log

Trip #: Log Number:
Date:

Map View | Condensed Log | Print Log Form

Project Information:
Project Name: Tow Owner: Inspector's Name:
Permit Number: Tugs's Navigational Unit (Manufacturer/Model):
Description of Material:

Tug and Scow Information:
Tug Name:
Tug Captain:
Scow Name/Number:
Scowman Name:

US Army Corps of Engineers

Loading Information:
Volume of Material (Cubic yds):
Time Loading is Complete (hh:mm:ss):
Scow Draft Forward (ft):
Scow Draft Aft (ft):

HARS Site Weather Conditions:
Wind Direction (from): Wind Speed (mph): Observed Water Depth (ft):
Weather Conditions:
Wave Swell Height (ft): Visibility (n miles): Marine Mammals/Sea Turtles Sighted (Yes/No):

Comments (Limited to 255 Characters):

Transit/Placement Information:
Time Departed Dredge Site: mm/dd/yy, hh:mm:ss Tug Position Determined By(GPS/DGPS): Approx. Distance from Scow to Target (ft):
Time Scow arrives at Project Placement Area: mm/dd/yy, hh:mm:ss Length of Towline at Discharge (ft): Scow Heading (deg.):
Dist. from Tug's Nav. Antenna to Tug's Towing Bit (ft): Direction of Scow Relative to Tugs Towing Bit (degrees): Est. Scow Speed (kts):

Start Time (DOORS OPEN): hh:mm:ss Tug Speed (kts): Tug Heading (deg.):
GPS/DGPS: Latitude (dd.mm.min) Longitude (dd.mm.min)

End Time (Placement is Complete): hh:mm:ss Tug Speed (kts): Tug Heading (deg.):
GPS/DGPS: Latitude (dd.mm.min) Longitude (dd.mm.min)

Post Placement Time (DOORS CLOSED): hh:mm:ss Tug Speed (kts): Tug Heading (deg.):
GPS/DGPS: Latitude (dd.mm.min) Longitude (dd.mm.min)

Figure 7. ADISSPlay Extended Log Sheet for manual entry into database.

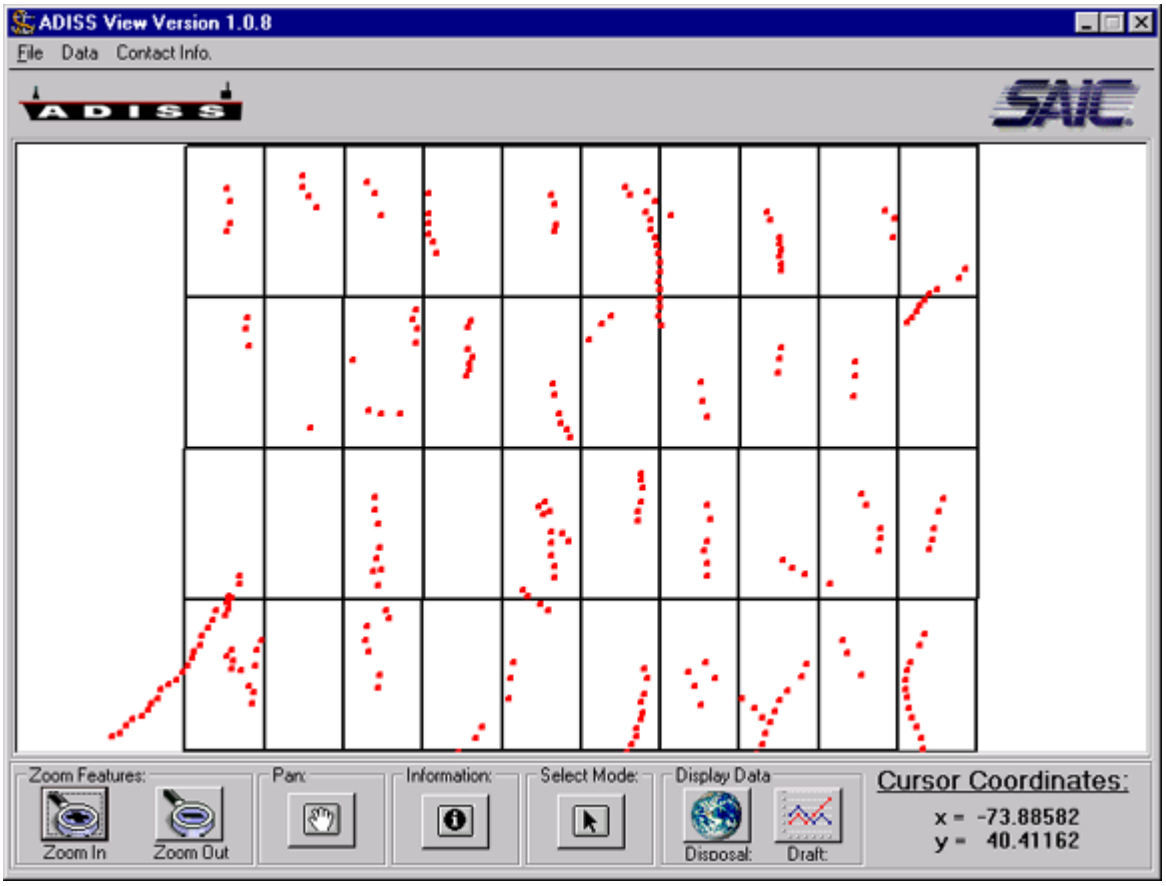

Figure 8. ADISSView executable program for displaying track lines from database.

3.0 INSTALLATION AND SERVICE

ADISS equipment was installed on scows at the Great Lakes Dredge and Dock Company Staten Island facility prior to transit to the Passenger Ship Terminal dredge site. Later, when the dredging equipment was rotated to accommodate changing schedules, ADISS equipment was installed on replacement scows. ADISSPlay equipment was also installed on three tugboats to accommodate schedule requirements.

3.1 ADISS System

Two ADISS units were installed on split-hulled scows *GL- 32* and *GL-402* at the Staten Island facility on March 20, 1999. Both scows had been previously equipped with ADISS, so the procedure was simplified to: 1) bolting the weather-proof housing to the outside of the doghouse, 2) erecting the GPS, DGPS, Argos and VHF modem antenna harness on the roof, and 3) placing the pressure sensor safely in the aft ram well (Figure 9). Mid-way through the project, the *GL-32* was replaced with the *GL-401* and the *BR-8*. ADISS equipment was transferred at the Staten Island yard within a day, and caused no interruption to the dredging schedule.

Once installed, ADISS was tested for proper signal reception, and normal logic function was determined with the readout of a palmtop computer. Logic function was also demonstrated by the proper illumination sequence of indicator lights. The red light flashed through the view port of the weather-proof enclosure if the circuitry to the receiver antennas was corrupt. The yellow light signified activation of the GPS receiver, while the green light showed the pressure sensor was activated. If both the green and yellow flashed simultaneously, the scow should have been filled and waiting for transit to the HARS. A solitary green light meant the scow was empty. If all of the lights flashed simultaneously, the GPS received insufficient signal strength to obtain a position fix, and would continue to illuminate green, yellow and red until it did. The lights were checked to determine the potential source of error when the Inspector did not see the scow's position on the ADISSPlay monitor.

Successful recording of ADISS track lines depended on receiving GPS signals during loading, transit, and placement operations. If the GPS signal was not received, the data was not recorded internally or transmitted by VHF modem to ADISSPlay on the tugboat. At times it was possible to receive and record track line data within ADISS, but not to display the transmitted data with ADISSPlay due to radio frequency interference.

Dredging operations began on March 20, 1999, at the Passenger Ship Terminal, but scow placement trips to the HARS were delayed by rough sea conditions until March 23. The dredging operations were completed May 1, 1999, forty-one days after start-up.

Installation tests revealed initial problems with VHF radio modem reception, and intermittent GPS reception. Both problems were ameliorated, but not completely solved during the first week of operation. Even though reprogramming the squelch levels relieved some of the interference, radio reception of ADISS signals were chronically affected along the Hudson River. The Inspector would not initiate the ADISSPlay program until the tug was south of The Battery on

Manhattan Island. The reception of GPS signals was marginally improved by adding radio frequency filters and pre-amplifiers to the antenna circuits.

Once the electronic remedies had been implemented, ADISS equipment problems were limited to intermittent signal reception and a low battery. Signal reception from GPS satellites was inexplicably difficult to maintain during the project, and a few maintenance visits were made to replace functional ADISS equipment. An ADISS unit failed to operate one day after the scheduled completion of the project, and a replacement battery restored service until the project was finished.

3.2 ADISSPlay System

ADISSPlay systems were installed on the tugboats, *William Colnon*, *Limmerhirt*, and *Colonel*. The *William Colnon* was equipped with ADISSPlay on March 20, 1999, and made the first placement transits with scows *GL-32* and *GL-402* to the HARS. The *Limmerhirt* was briefly added to the rotation of equipment mid-way through the project, and was replaced by the *Colonel*, which ran alternate trips with the *William Colnon* during the second half of the project.

The assignment of HARS target cells for the Passenger Ship Terminal project was programmed into the ADISSPlay units from information supplied by NYD. The substitution of rectangular-shaped cells for the arc-shaped cells previously used during the Refined Sugar project was made to ease the task of lining up the tug and scow during the approach to the designated target cell, thereby increasing placement accuracy.

During the Passenger Ship Terminal project the successful operation of ADISSPlay depended on the skill and judgement of the Inspectors. Of the three Inspectors assigned to the project, only the first had received previous ADISSPlay training during the Jack Frost Refined Sugar, Inc. dredging project. Both the relief Inspector aboard the *William Colnon* and the alternate assigned to the *Colonel* were computer neophytes, and required on-the-job training from SAIC.

After receiving demonstrations and instructions, the Inspectors operated ADISSPlay and reported any difficulties to SAIC for diagnosis and corrective action. When one of the ADISSPlay databases was inadvertently corrupted, the Inspector corrected the problem under direction from SAIC. They also modified their operational technique to suit the situation. Adapting to poor radio reception near Manhattan Island, the Inspectors did not start the ADISSPlay program until the tugs had transited the lower harbor, where reception improved. When the GPS signals were suddenly lost, the Inspectors used the DGPS positioning of the tug to estimate placement of the loaded scows. Although they did not always follow placement protocol as determined by Great Lakes, the Inspectors were responsive to changes in the operational conditions imposed on the ADISSPlay system, and worked to find solutions around the problem.

3.3 Internet Display of Argos Satellite Telemetry Data

Prior to the dredging activities at the Passenger Ship Terminal, the Argos telemetry display was modified to show the placement of disposal events in near real-time on the Internet. After each

placement event occurred at the HARS, an e-mail message containing the scow position was received and posted on the ADISS Web Site. The position information was listed by order of occurrence and plotted on an overlay of the target cells. The display was cumulative and showed all of the placement events.

Mid-way through the project SAIC added a new plotting option, which showed the entire transit route, including the project dredging site. The new viewing option allowed NYD managers, to monitor placement operations for accidental disposals outside the boundary of the HARS. This display was also cumulative and showed all placement events, including the false signals initiated by SAIC during throughput tests of the Argos system.

3.4 Inspector Log Information and Database

The Inspector log was installed as part of the ADISSPlay program on each tugboat, and the Inspectors were trained in its use. Data entered on the forms were entered into the database during each disposal trip. The database from the tugs was downloaded and will be entered into the DAN-NY data set installed at NYD.

In practice, the Inspectors completed both the short and extended log forms during the project. Although the ADISS equipment worked properly during most of the project, the extended log form was also completed and printed out at the request of the Dredging Supervisor. At the end of each transit the log printout was faxed to the Supervisor for review and submittal to the NYD.

Figure 9. ADISS installed on the "doghouse" (green structure) of the Great Lakes 402 scow at the Passenger Ship Terminal dredge site.

4.0 DATA PROCESSING AND DISPLAY

Each of the systems produced data for processing, analysis, and display. The ADISS data were plotted for each transit, placement event, and draft time series. When ADISS data were not recorded internally in the flash memory, the ADISSPlay records were analyzed and plotted, instead. Plots for each trip were submitted to Great Lakes in a data report, and summary plots were posted on the Internet (http://www.adiss-afiss.com). The Argos satellite-telemetered data were automatically plotted and posted on the Internet, which facilitated near real-time monitoring of placement events by NYD. The Inspector logs for all trips recorded with the ADISSPlay system were submitted to NYD for inclusion into the DAN-NY database. In addition to the hard copy printout of processed data, the database was included on a CD with a beta version of the data viewer and submitted to NYD for evaluation.

4.1 ADISS Data Acquisition Results

All ADISS navigation and draft data were processed and analyzed at the SAIC Newport facility with software developed for the purposes of parsing, plotting and archiving the information. Processing routines were written in Visual Basic®, and plotting routines were created in ArcView® as described previously (SAIC 1998d). During processing, the pressure data were examined for the sudden change in draft, signifying placement events (Figure 10). Once the beginning and end of each event was designated in the data record, the database was updated and the attributed data points were plotted over the target cells. Each plot was labeled with its trip number and submitted in the report to Great Lakes (Figure 11). The plots and the database of ADISS information were archived on CD-ROM with ADISSPlay data and figures with the Inspector logs.

The ADISS processing routine also included saving the attributed points of each placement in four, ten-day summaries, which were posted on the Internet. The summaries showed the progress of placement throughout the course of monitoring the disposal operations (Figures 12-15), and reflected the sequence of trip assignments to the target cells. A summary figure illustrated the areas covered at the HARS by dredged material from the Passenger Ship Terminal project (Figure 16).

Out of a total of 117 placement trips made to the HARS, 94 were successfully recorded by ADISS. Of the 23 trips not recorded by ADISS, nine were recorded by ADISSPlay. The total number of trips successfully recorded by both systems represented an 88% data recovery rate for the Passenger Ship Terminal Project. This was comparable to the 1999 Jack Frost Refined Sugar dredging project, where 89% of the trips made to the HARS were recovered.

Several missed trips were due to a sudden loss of the GPS satellite signal, which occurred intermittently throughout the project to the ADISS units. All three units were tested successfully at the SAIC facilities prior to and during the installation on scows. Reports of missed trips by the Inspectors resulted in service visits to the scows. Only one ADISS unit was replaced even though it tested satisfactory on the scow. Nine of the 23 missed trips were not recorded, because

internal corrosion prevented the ADISS flash-RAM memory module from functioning correctly on the *GL-402*.

4.2 ADISSPlay Data Acquisition Results

Processing the ADISSPlay data took place on-the-fly when the ADISS information was received from the VHF radio modem installed in the wheelhouse of the tugboats. The data were plotted as it was received on the helmsman display screen over an electronic version of a NOS chart. The display of scow positions was automatically adjusted within ADISSPlay to account for the offset distance between the GPS antenna location on the roof of the doghouse to the center of the hopper bin.

The operation of the ADISSPlay software required the Inspector to determine when the placement began and ended for each load. During the sequence of events, the Inspector would activate the "open doors" icon to start the placement, and release the "close doors" symbol to indicate when the load had left the scow. Both actions were recorded within the ADISSPlay database, and were available for evaluation.

Both the ADISS data recorded on flash memory and the ADISSPlay records provided a means for comparison between the draft-activated ADISS and the Inspector-estimated ADISSPlay of placement location. When ADISS data was plotted over ADISSPlay data for a few of the placement trips, the results were the same. Each Inspector used ADISSPlay to indicate where the loads were placed during the sequence of scow disposal events. During the beginning of each placement the Inspector activated the "open doors" icon on the ADISSPlay screen to mark the initiation of the disposal sequence in the database. When the load of material was dumped from the scow, the Inspector initiated the "close doors" icon, and the end of the placement event was annotated in the database.

Disposal events recorded by ADISS closely matched those from ADISSPlay. The most experienced Inspector anticipated the start and end of the three placement events, where the direction of travel was from north to south (Figure 17). The second Inspector logged two placement events on ADISSPlay correctly, and closely matched the start and end positions as recorded with ADISS (Figure 18). The third Inspector logged two placements late in the sequence, and almost after the events occurred (Figure 19). These comparisons demonstrate that ADISSPlay can provide an effective means of accurately recording placement locations at the HARS with Inspector participation.

4.3 Argos-Telemetry Data Acquisition Results

Placement of dredged material at the HARS was successfully reported in near real-time on the Internet. The paired positions illustrated on the Argos page of the ADISS Internet Web Site represented the start and the end of each placement event. The page showed a distribution of events weighted toward the southern half of the disposal grid (Figure 4), where the NYD assigned the majority of placement events.

The Argos results reflected those plotted from the ADISS data. In a comparison of 35 disposal events taken place during April 21 to May 1, 1999, Argos data was plotted over ADISS placement positions (Figure 20). The start and end disposal positions provided with the Argos-telemetered data were sometimes bracketed by the track lines plotted from ADISS data.

The differences between the positions provided by the two data sets were due to the setting of the Argos transmission sequence. Since Argos offered a limited band-width for data telemetry, only two positions were sent per placement event. During the ADISS setup sequence for the Passenger Ship Terminal monitoring project, the Argos transmitter was programmed to send the first and second positions after the draft sensor signal dropped below the pre-set threshold setting. The decrease in pressure sensor output below the threshold was used in the ADISS logic to determine when the load was released from the scow, and triggered the two Argos transmissions. The two Argos positions were recorded at a six-second interval, and did not always span the longer time required to dump the entire contents of the loaded scow.

The small-scale map of the Lower New York Harbor and the New York Bight revealed no accidental placements outside the boundaries of the HARS (Figure 5). Only the HARS area received dredged material from the Passenger Ship Terminal project.

Had a "short dump" event appeared on the Argos page, SAIC would have quickly visited the scow to recover data stored in the ADISS flash memory. The track line information would have been expeditiously plotted for confirmation of the accidental placement of the material, and position data would have been forwarded to NYD for remedial action.

In practice, several system throughput tests were conducted during the course of the monitoring program, which resulted in a few "short dump" indications. The NYD staff monitoring the Argos page requested information on the current ADISS activities, proving the efficacy of the method.

4.4 Inspector Log Information and Database Results

Although the time and date information was entered into the ADISSPlay database correctly, the date instead of the time was printed out on the Inspector log reports. This was more of a nuisance than a significant problem, which required the Inspectors to write the time on the hardcopy sheets by hand. A quick inspection of the database revealed that the correct times and dates were entered from the ADISSPlay input.

Presently, a fix has been made to the programming routine for generating the hardcopy reports, which eliminated the need for manual entry on the forms after printing.

Changes made to the database included trip number corrections, which had been entered incorrectly when the sequence of tows between the tugs was changed.

4.5 Internet Access to Processed ADISS Data

Weekly summaries of the placement events were added to the Internet site at the end of the PST 1999 project, when all of the processed data were reviewed by Great Lakes Dredge and Dock. As described in Section 2.5, the thumbnail illustrations were accessible under the *New York* section of the side-bar navigator and are illustrated in Figures 11–15. Data retrieved from the ADISS units installed on the scows were processed by SAIC to determine the location of each placement as indicated by the sudden change in vessel draft in the data string (Figure 10). Once the series of positions where changes in draft were identified, the database containing the entire transit was updated. At the end of the project, when weekly summaries were plotted, they were converted to the thumbnail format and posted on the Internet. Figure 16, which represents the summary of all placement activity during the PST 1999 project, was also posted on the Internet.

4.6 CD Display of ADISS Processed Data

The features of the viewer allowed the user to access the database of processed ADISS information. Once processed and copied on CD, the database could be queried for position fix and draft information on a point-by-point basis. Draft and position data could be summarized in a table and exported in .csv file format for report preparation. The report feature was enhanced with the load volume entries from the Inspector logs, making summary volume reports a key feature of the viewer.

The central capability of the viewer was to graphically display the scow track lines during placement. Others included graphically displaying the draft values during the entire transit, and extending the plotting capability to include the track lines of the transit to the HARS. Data on each plotted position could be displayed allowing the user to determine the time, latitude, longitude, and draft of each fix.

Both the draft plots and the track line plots could be printed, but only the draft plots could be exported in bitmap format (.bmp). A needed improvement was the ability to export the track lines for report preparation.

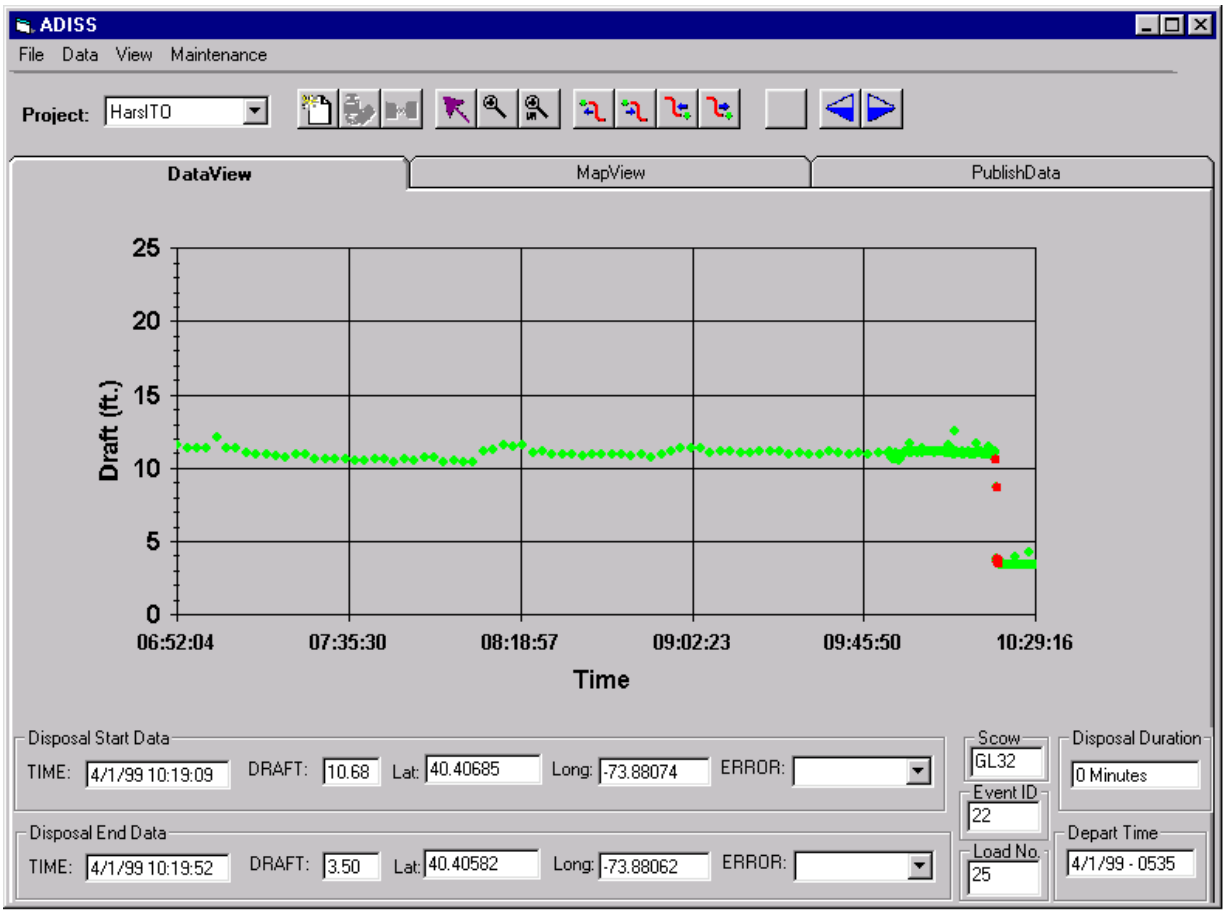

Figure 10. ADISS data processing tool illustrating the draft versus time plot used to determine the placement event at the HARS. Green points represent draft-transit data. Red points represent placement data, which were updated in the database and plotted over the target cells (Figure 11).

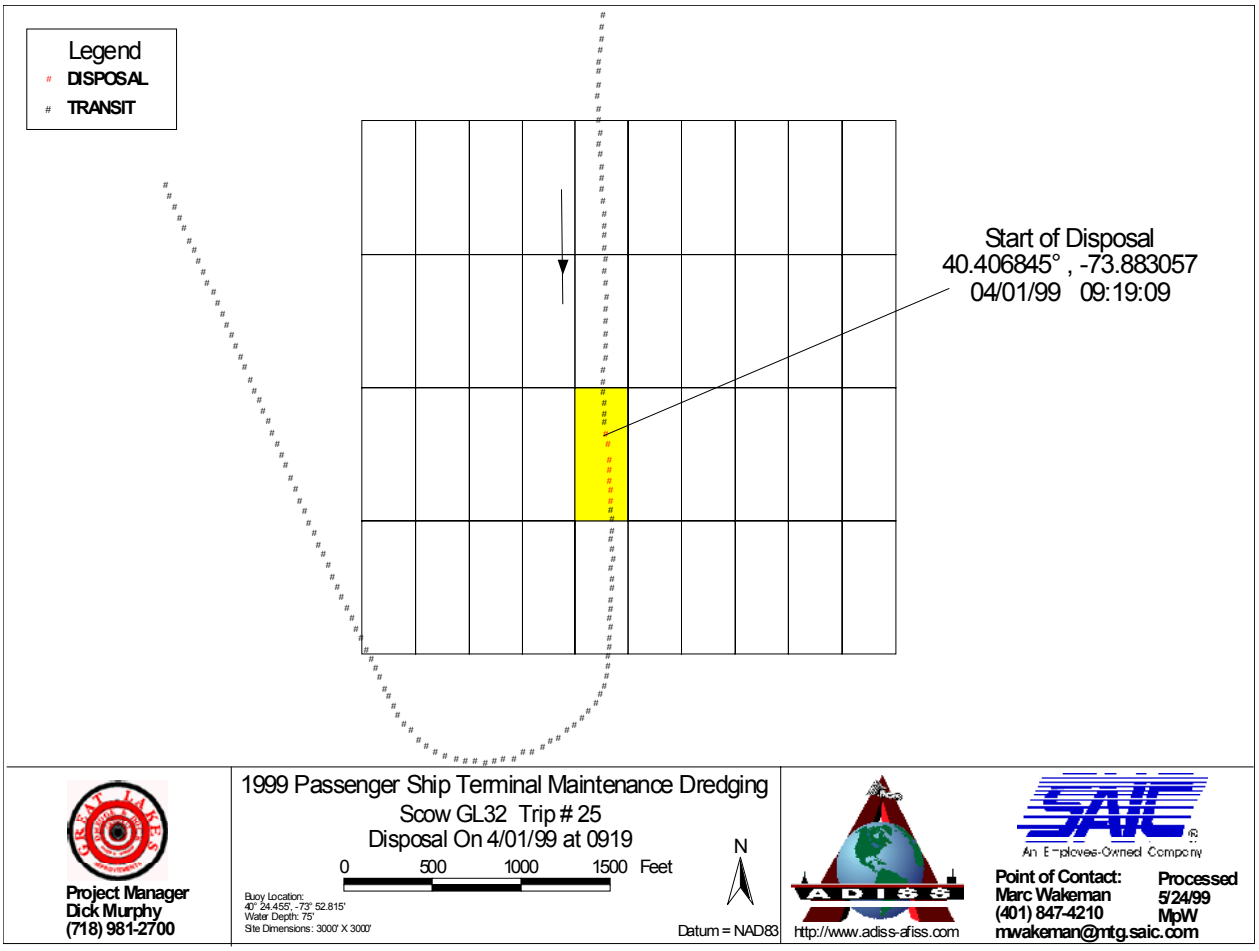

Figure 11. Example of ADISS data acquired during placement within the HARS. Data points represented DGPS positions of the center of each scow recorded at 6-second intervals.

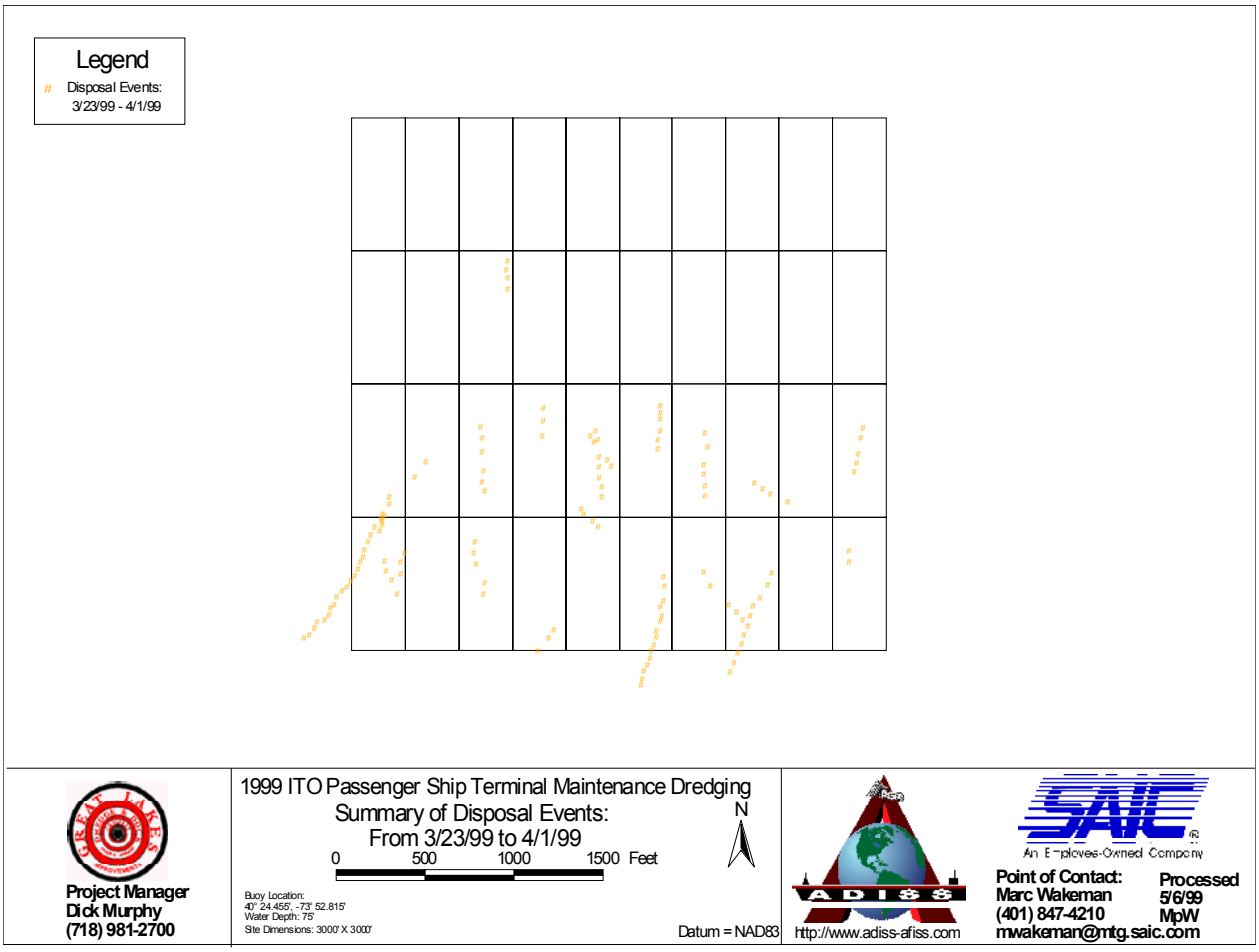

Figure 12. Summary of placement events recorded in ADISS flash memory during the Passenger Ship Terminal project March 23 through April 1, 1999.

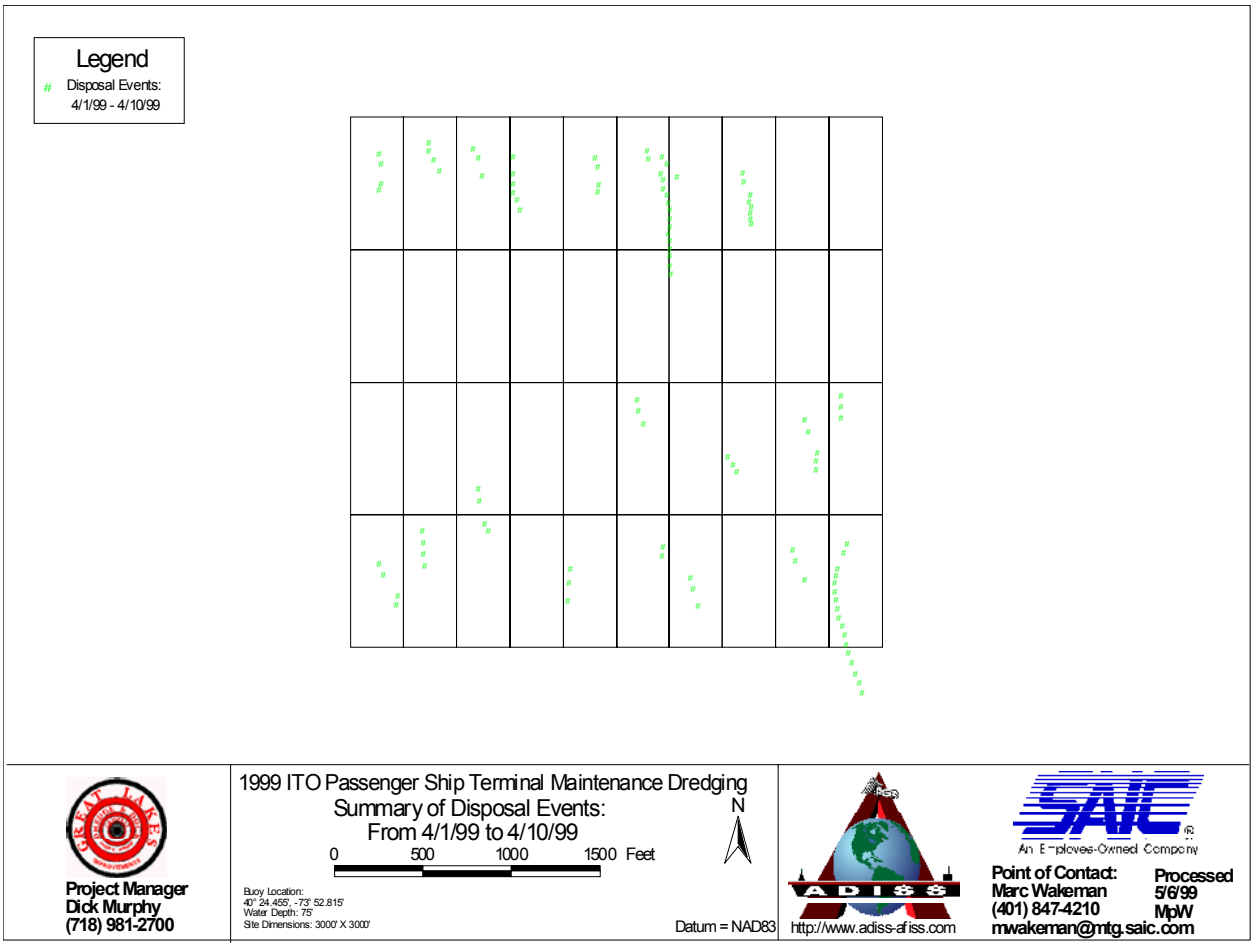

Figure 13. Summary of placement events recorded in ADISS flash memory during the Passenger Ship Terminal project April 1 through April 10, 1999.

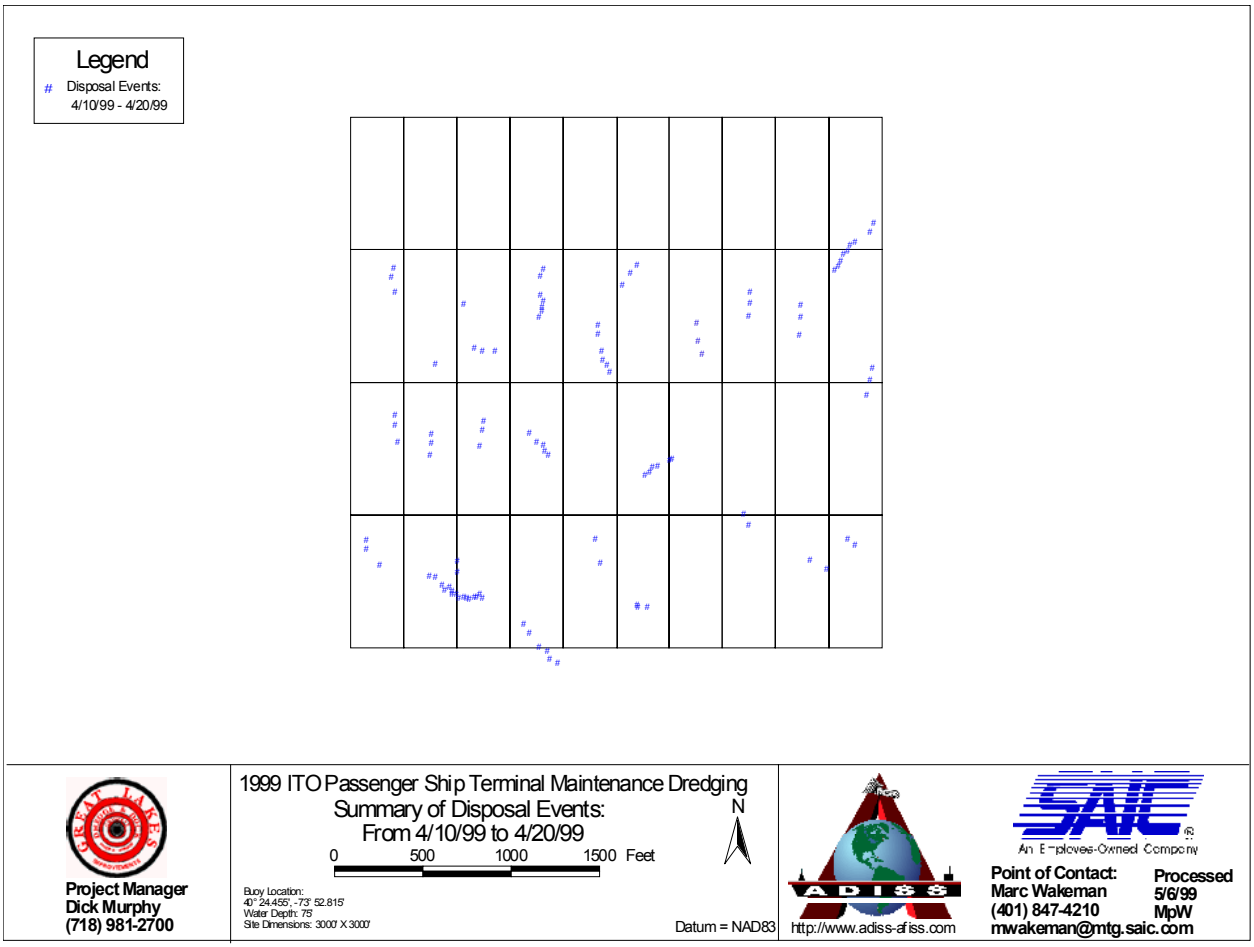

Figure 14. Summary of placement events recorded in ADISS flash memory during the Passenger Ship Terminal project April 10 through April 20, 1999.

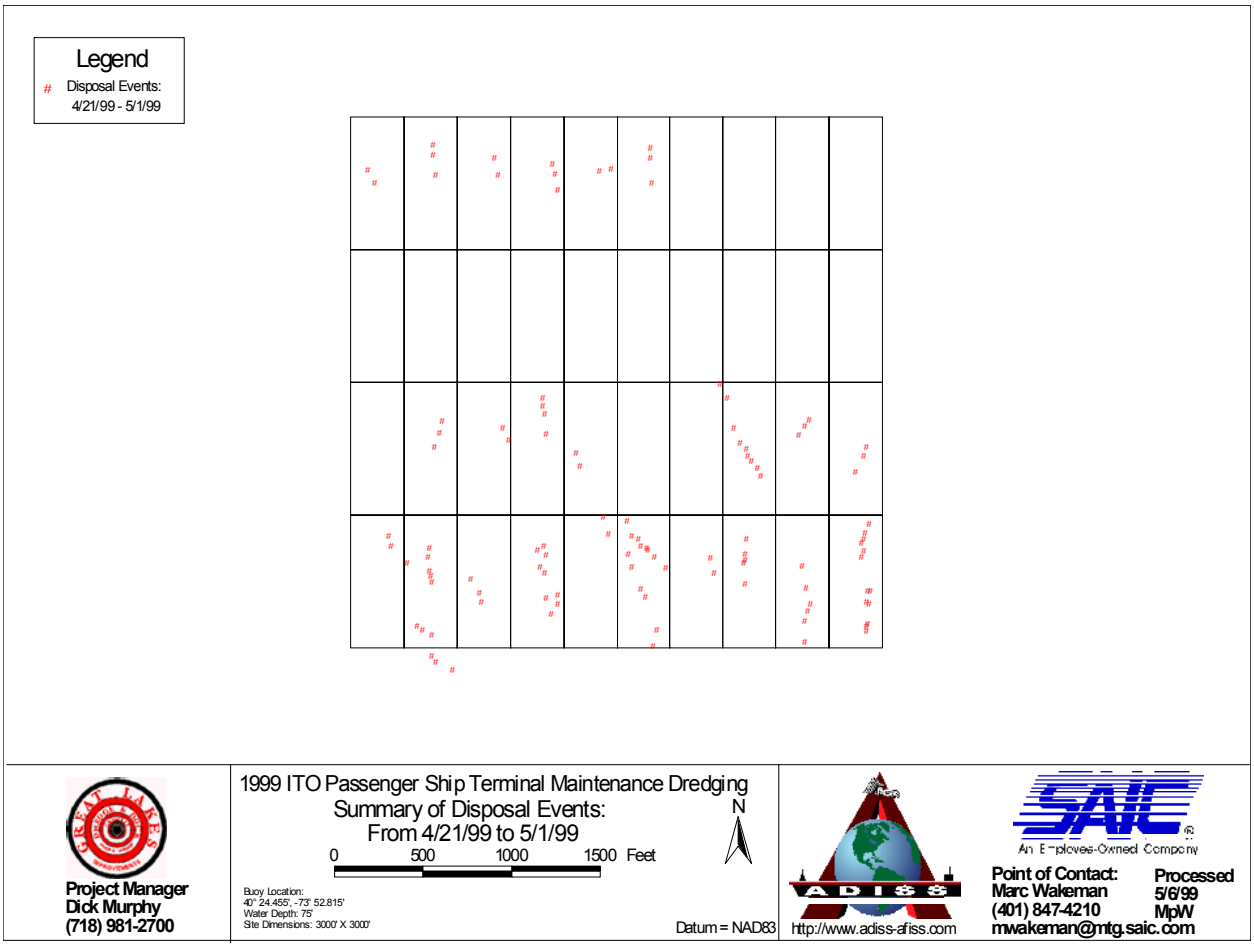

Figure 15. Summary of placement events recorded in ADISS flash memory during the Passenger Ship Terminal project April 20 through May 1, 1999.

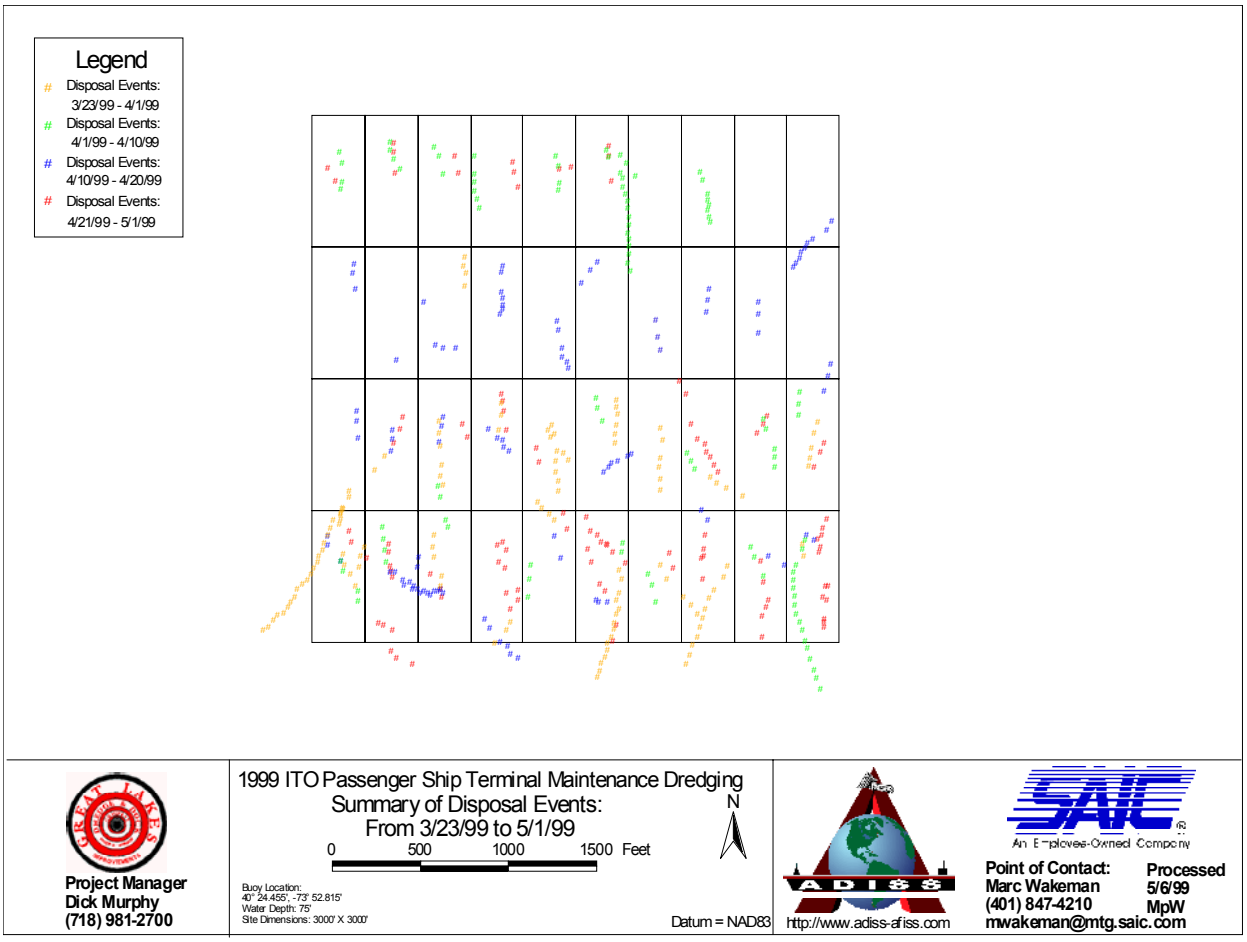

Figure 16. Summary of placement events recorded in ADISS flash memory during the Passenger Ship Terminal project March 23 through May 1, 1999.

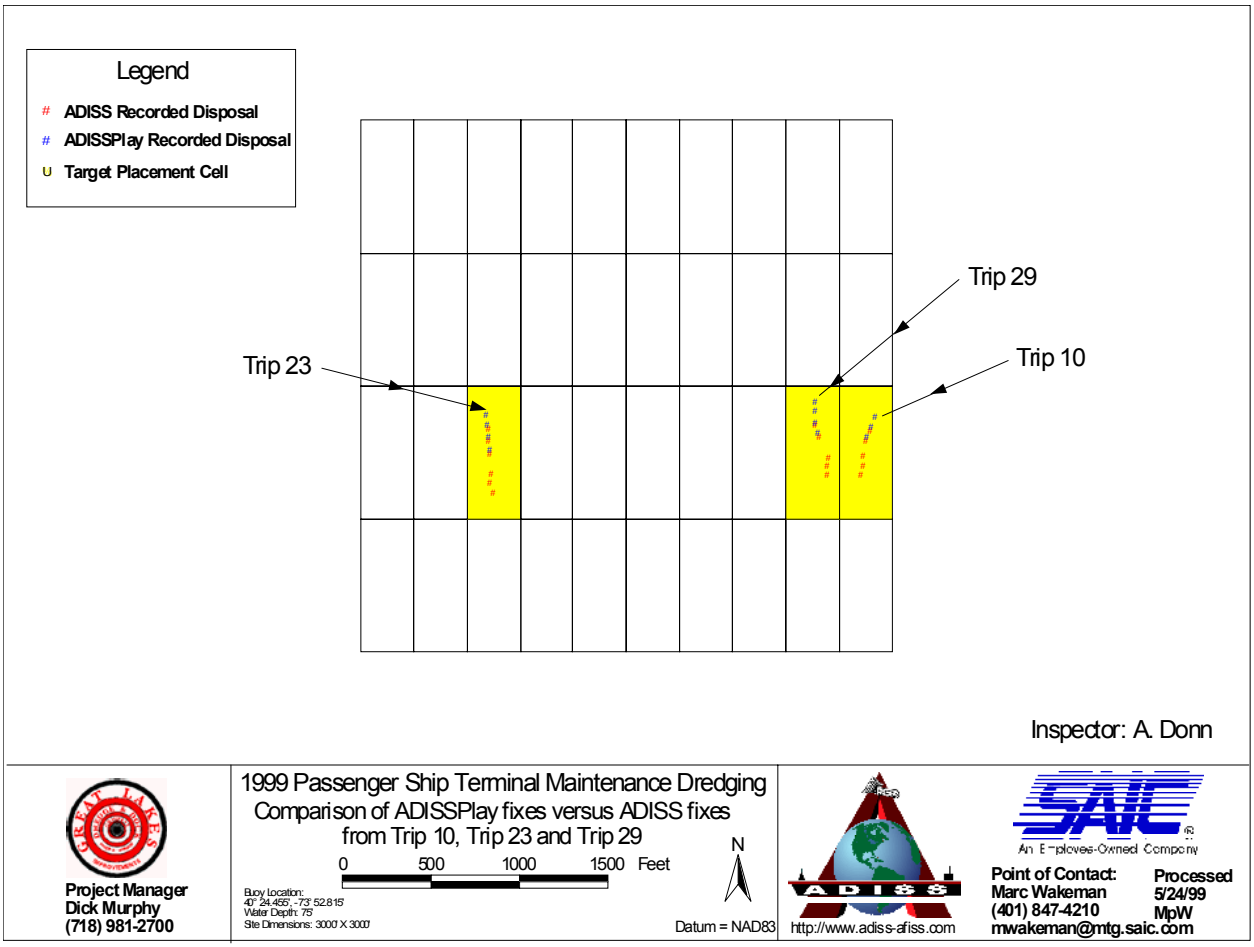

Figure 17. Comparison of ADISSPlay placement positions versus ADISS-recorded placement positions during trips #10, #23, and #29.

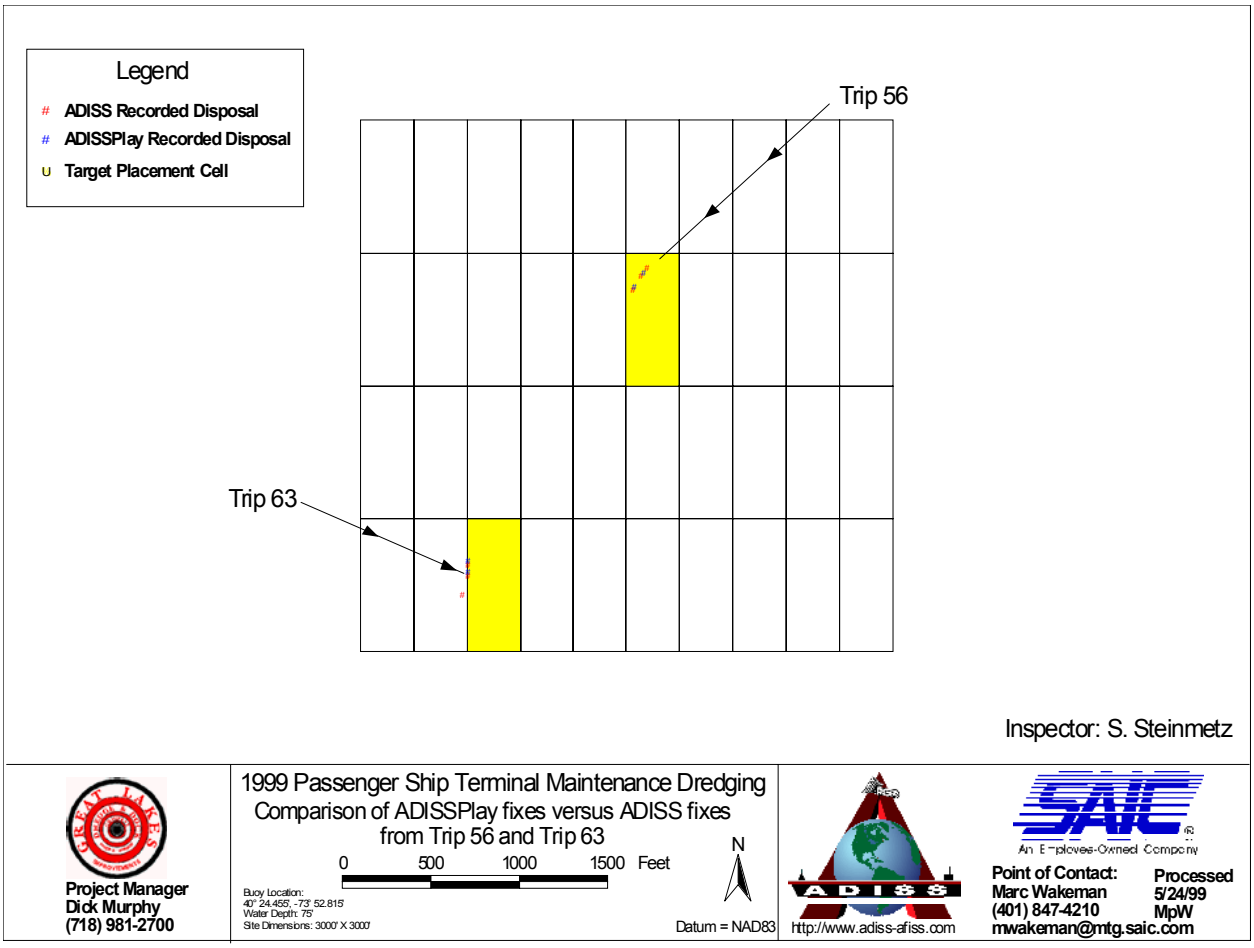

Figure 18. Comparison of ADISSPlay placement positions versus ADISS-recorded placement positions during trips #56 and #63.

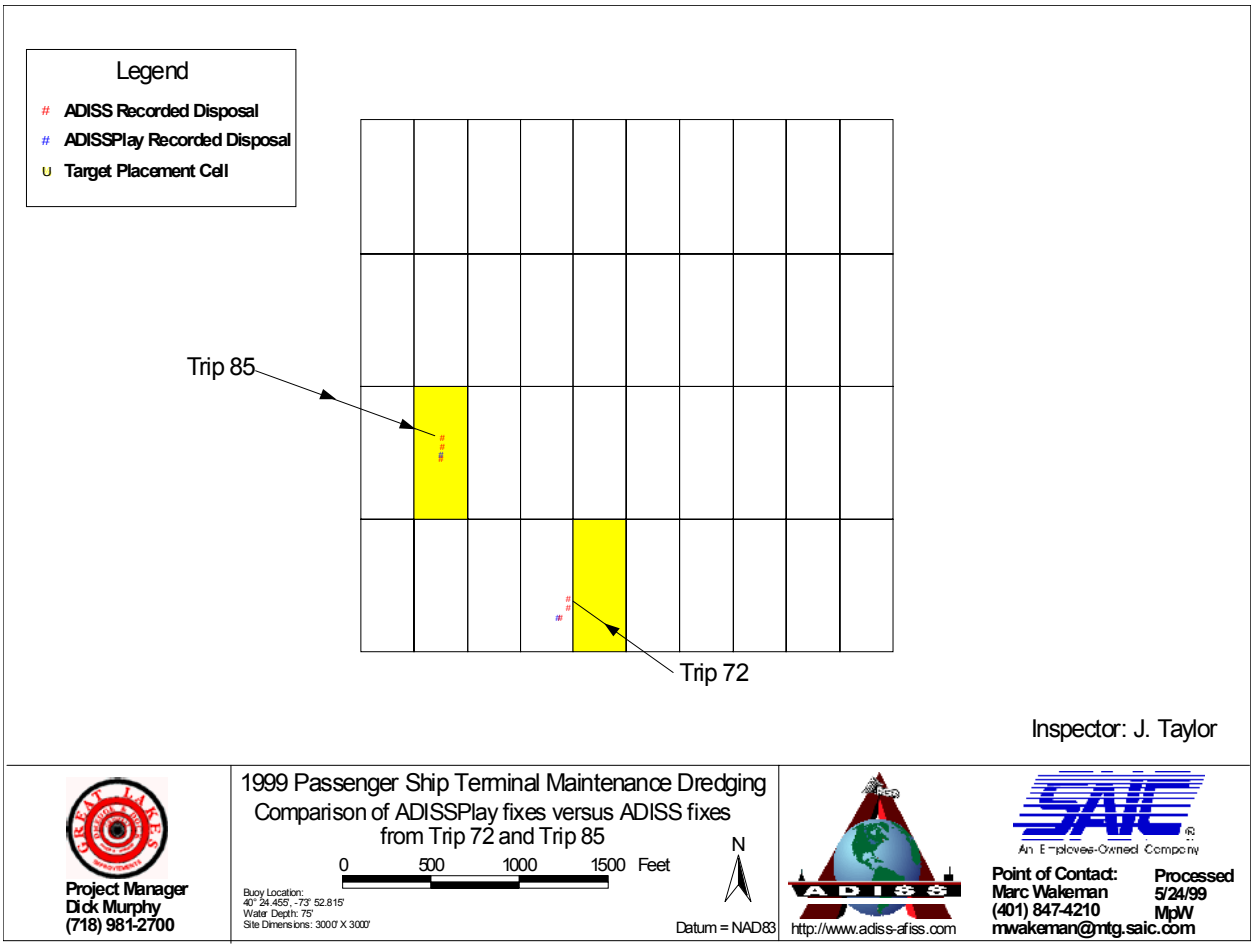

Figure 19. Comparison of ADISSPlay placement positions versus ADISS-recorded placement positions during trips #72 and #85.

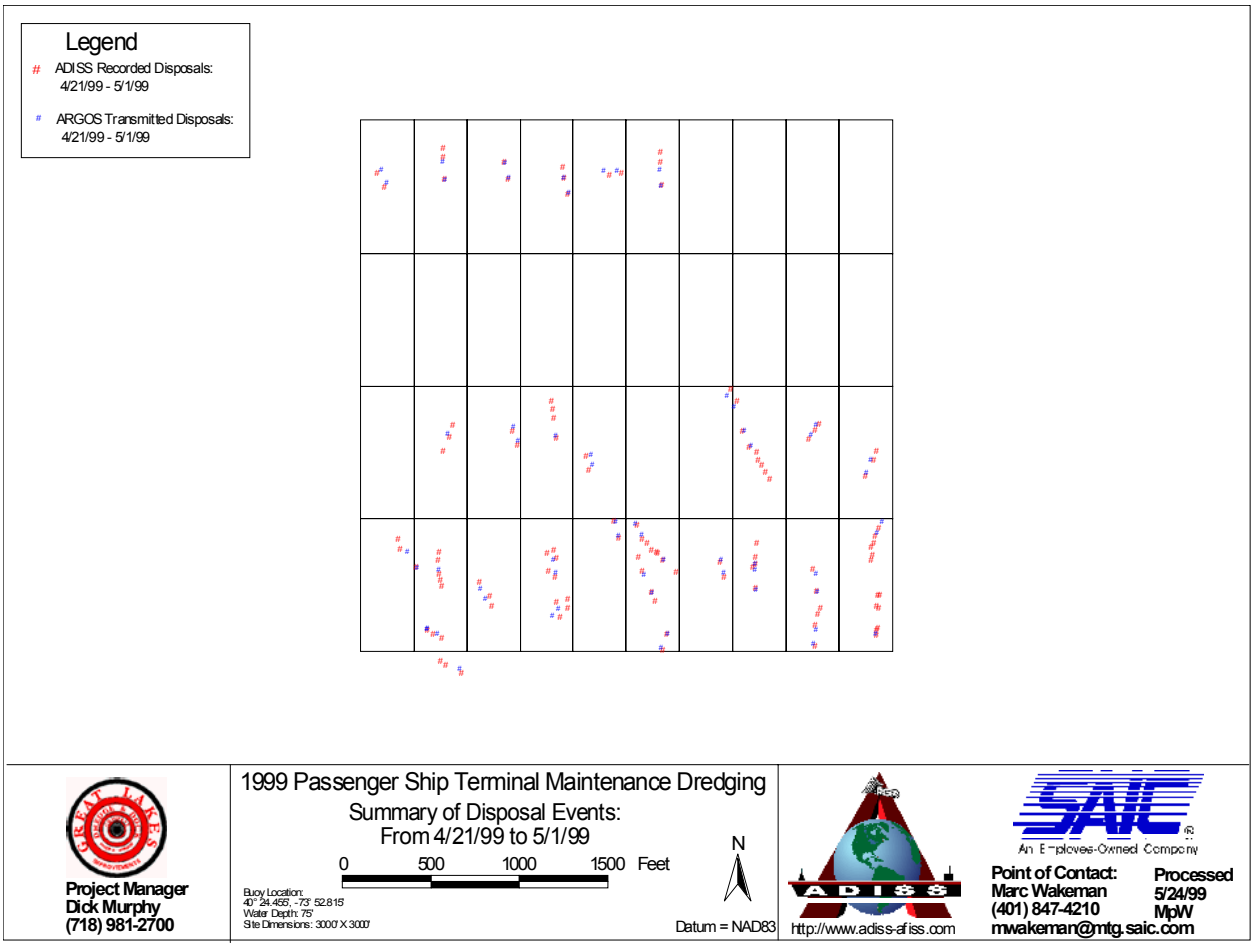

Figure 20. Comparison of ADISSPlay placement positions versus ADISS-recorded placement positions during trips #81 through #116.

5.0 SUMMARY AND RECOMMENDATIONS

The following summarizes the results of monitoring the placement operations at the HARS during the Passenger Ship Terminal Project:

- ADISS units aboard four Great Lakes scows and ADISSPlay systems in the wheelhouses of the tugs recorded 88% of all placement events.

- The ADISSPlay installed on three tugs showed an 88% successful placement rate in assigned target cells when used with the helmsman display.

- The Argos-telemetered data provided near real-time updates on the Internet (http://www.adiss-afiss.com) of placement operations at HARS, and no accidental placements occurred outside the designated area.

- The Inspector log data entered into ADISSPlay was accurate and needed minor correction.

- Four weekly summaries of placement activities were posted on the Internet site for public outreach.

- A beta version of the database viewer was distributed to NYD personnel for evaluation.

The following recommendations are suggested improvements to HARS management operations:

- At the beginning of each project, assign a surplus of target cells for dredged material placement.

- Establish a protocol for placement procedures should the ADISSPlay system lose the navigation signal. This could consist of: 1.) delaying the placement event for 20 to 30 minutes at the HARS until the ADISS equipment regains acquisition of the GPS signal, 2.) failing #1, proceeding with the placement event using the tug's GPS equipment, estimating scow position based on layback distances and bearing to the tug's heading, and recording the information on the extended form of the Inspector log, or 3.) returning to the dredge site for repair, if navigation is not available on both the scow and the tug.

- Modify the Internet display of the Argos-telemetered data to indicate the proper placement in each of the pre-assigned target cells.

- Continue to develop the capabilities of the database viewer including the ability to convert track line plots to bitmap format, the ability to return the user to the query screen from the draft plot screen, the capability to print point information, add the HARS boundary to the track line plot background, change coordinate display, and add on-line help menu.

6.0 REFERENCES

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