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DATA MANAGEMENT REPORT
(73 pages)

National Transportation Safety Board

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November 17, 1997

Data Management Report

Accident: DCA96MA070

Location: East Moriches, New York

Date: July 17, 1996

Time: 2031 Eastern Daylight Time

Airplane: Boeing 747-131, N93119
Operated as Trans World Airlines (TWA) Flight 800

On July 17, 1996, at about 2031 EDT, a Boeing 747-131, N93119, crashed in the Atlantic Ocean, about 8 miles south of East Moriches, New York, after taking off from John F. Kennedy International Airport (JFK). The airplane was being operated on an instrument flight rules flight plan under the provisions on Title 14 Code of Federal Regulations (CFR), Part 121, on a regularly scheduled flight to Charles De Gaulle International Airport (CDG), Paris, France, as Trans World Airlines (TWA) flight 800. The airplane was destroyed by explosion, fire and impact forces with the ocean. All 230 aboard were killed.

This document describes the activities conducted to track and validate the recovery positions of items recovered during the nine-month search and recovery operation that followed the accident. Extensive data base activities were required to manage the large volume of information created during this operation. This report describes the flow of information during the search and recovery operation, the data base that was created to store that information, and the activities that were conducted to validate that information.

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Overview

This document describes the activities conducted to track and validate the recovery positions of items recovered during the nine-month search and recovery operation that followed the accident. Extensive data base activities were required to manage the large volume of information created during this operation. This report describes the flow of information during the search and recovery operation, the data base that was created to store that information, and the activities that were conducted to validate that information. It must be stressed that as the salvage operation evolved, so did the procedures used by the data management team. Throughout its time in the hangar, the team developed specialized procedures to respond to the growing scope of the operation.

The data management team created a data base known as the Tags data base. During the search and recovery operation, data management activities revolved around three major aspects of the operation: undersea search, diving, and trawling. Each of these three phases of the operation resulted in the creation of a table in the data base. The undersea search operation resulted in the Target table, which contains records concerning about 6,420 targets that were identified during the operation. Items were tagged to track their recovery positions, and the Tags table was created for this purpose. This table contains information on 4,612 tags. Finally, a Trawling table was created to track the last phase of the search and recovery operation. This table contains information on about 13,000 lines run by scallop trawlers collecting undersea items.

Color-coded debris field names were established near the outset of the salvage operation. The Tags table contains information on 4,612 color-coded tags that correspond to these zones. Of these, 3,168 tags were applied before an item was transported to the hangar (ship tags), and 1,444 items were tagged in the hangar (hangar tags). Of the 3,168 ship tags, 645 were applied to items recovered from the Red zone, 462 were assigned to items from the Yellow zone, and 1,885 were assigned to items from the Green zone. The remaining 176 items were recovered from other locations, were found floating, or were recovered from an unknown location.[1]

Not all of the items that were received in the hangar were tagged before they arrived there. Further, some items that were ship tagged broke or were cut (resulting in an untagged portion) during the course of the investigation. To facilitate the identification and tracking of these items, a procedure was developed to tag items in the hangar. Of the 1,444 hangar tags,

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[1] If the debris field of recovery could not be determined for an item, that item was assigned a debris field color code of "white" and given a white tag. In this report, when debris field color code assignments are discussed, these assignments include such "white tagging" actions.

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1,210 were assigned to items recovered during the dive operation (using 2000-series tags), and 234 were applied to items recovered during the trawling operation (using 4000-series tags).[2]

Information in the Tags data base is supported by an estimated 30,000 pages of paper documentation. This documentation was used as reference material for a number of ad hoc validation studies, and to support several global validation efforts. Ad hoc validation studies were conducted on specific pieces when requested by members of the investigative team, and global validation studies were conducted to ensure that each tagged item received the same treatment. These included two, complete paper-to-electronic quality control checks and multiple hangar floor audits in which data center staff checked the information in the data base against the hardware on the hangar floor.

In March, 1997, it became apparent that a global validation of all hangar tags assigned to items recovered during the dive operation was needed. At that time, 1,190 hangar tags had been assigned to items recovered during the dive operation, and a procedure was developed to audit these tags. The audit was requested by David Mayer (NTSB), and the majority of the procedure was developed by Cliff Jennings (Oceaneering). The audit was implemented by Cliff Jennings, Jim Case (SAIC), and Ronan Oger (Oceaneering). David Mayer approved the procedure, supervised the work, and approved the intermediary steps as they were completed. This audit resolved 159 out-of-area ship tags that had not been previously corrected;[3] corrected duplications in the spreadsheets and maps that had been used to assign hangar tags; used these corrected materials to determine the validity of each of the 249 FBI lot numbers for assigning debris field color codes; and, selected standard source tags for each of the 109 FBI multiple-item lots that were found to be valid. Finally, of the 1,190 hangar tags, 143 tags were exempted from this (or any future) global audit because definitive recovery positions were known for these items (these are known as the *exempt tags*). An additional 4 tags had been taken out of circulation in corrective action that pre-dated this audit. This resulted in 1,043 tags to be audited.

No definitive recovery position information was available for the 1,043 non-exempt items that remained the focus of the audit. Consequently, the FBI lot numbers assigned to these items on their arrival in the hangar became the means of assigning debris field color codes to them. Because lot numbers were not available in the data base or in data center records for 366 of the remaining 1,043 non-exempt tags, a search was made of the hangar. Three hundred of these items were located during this search, and the FBI lot numbers of these items were entered into the Tags table. The final task of this project was to evaluate the debris field color code assignments that had been made for the remaining 1,043 non-exempt tags against the new list of

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[2] Note that several 2000-series tags were inadvertently assigned to items that were recovered during trawling. All but four of these were corrected by retagging. Tags W2002, W2003, Z2836, and Z2837 were not corrected.

[3] Out-of-area (OOA) tags are tags with color codes that do not match the reliable recovery latitude and longitude data in the recovery paperwork (e.g., wreckage logs and dive logs). Out-of-area tags were noted during early quality control checks, and a procedure was developed to correct them when they were discovered (and ad hoc validation studies could establish the correct debris field of recovery); however, before the hangar tag audit, no global effort was made to validate and correct each of the OOA tags.

valid lot numbers, and make new assignments where required. Of the 1,043 tags audited, no changes were made to the color codes that had been assigned to 827 tags, and the color codes of 216 tags were changed. A report documenting this project in detail was issued on April 23, 1997. This report has been revised and is incorporated in this document in the section on *Hangar tags* section beginning on page 31, and the *Hangar tag validation project* section beginning on page 57.

Hangar tagging continued during the hangar tag audit. When the data base was frozen, it contained 1,210 hangar tags that were applied to items recovered during the dive operation (including 145 exempt tags). The revised list of valid FBI lot numbers produced during the hangar tag audit was used in all hangar tag assignments made following the audit. The debris field color code assignments made for non-exempt hangar tags represent the *probable* debris fields of recovery for these items. The hangar tag audit ensured that each of these assignments was made using consistent rules. Nonetheless, each assignment represents a *best guess* at information that is simply not available. The color codes assigned to non-exempt hangar tags should be regarded as such.

On the other hand, the information for other tags in the data base may be regarded with much greater certainty. In fact, it is useful to describe the tags data using a different "levels of certainty" for different kinds of tags. The highest level of certainty must be given to ship tags and to exempt hangar tags for which definitive recovery information was available and described during ad hoc validation studies. These are described elsewhere in this report, but examples include tag A2048 (structures group log number LF14A), A004 (RF1), and A236 (CW504). Because supporting paper documentation is available to justify the information in the data base for the ship tags and exempt hangar tags that were not subjected to ad hoc validation studies, and because these tags were subjected to global validation procedures, they occupy the next level of certainty. The non-exempt hangar tags previously discussed occupy the lowest level of certainty.

Before describing the specific details of the data management operation, a final note is in order: The fundamental operating practice of the data management team was to make the best possible determinations concerning the validity of the information in the Tags table (especially recovery positions and debris field color codes) using the available sources of recovery information (wreckage logs, diver logs, ships records, photographs, videotapes, target assignments, FBI evidence records, and, in a limited number of cases, eyewitness identification of parts by knowledgeable members of the investigative team). These determinations were made without regard to the known flight track or to the breakup sequence of the accident airplane or to the known location of a part on the accident airplane prior to its breakup.

Data handling

In August, 1996, an on-site data management team was formed to manage the large amount of information about recovered items. The team established a data center at Calverton and created a data base to track items recovered during the search and recovery phase of the investigation. This is the first time that a Safety Board investigation has been supported by a data management team. The data center was managed by an NTSB investigator, and staffed by 1-3 contract employees from the time of its inception until it was closed at the end of April, 1997. Staff who worked in the data center are listed in *Appendix 1: Data center staff members*.

The data base served as the primary tool for tracking the recovery locations of the items salvaged during the sea operation. The data base includes a Target table, a Tags table, and a Trawling table.

The Target table recorded the results of the undersea search operation. As undersea anomalies were discovered, each was assigned a target number for dive scheduling and recovery tracking purposes. The table contains fields for target number, target latitude and longitude, search date, and search technique (e.g., side-scan sonar, laser line scan). The table also has fields for describing the target. This information was usually added after the target was dived on or prosecuted by a remotely operated vehicle (ROV). The Target table contains information on about 6,420 targets that were identified during the investigation.[4]

Many items were recovered during the dive operation and tagged with color-coded metal tags to indicate the debris field from which they were recovered. A paper wreckage log form was completed by salvage personnel for each tagged item. This form included the tag number and recovery position (latitude and longitude) of the item. These wreckage logs were forwarded to the data center and entered into the Tags table. Hangar staff used updated wreckage log forms to provide descriptions of items, and to make any necessary corrections to information in the data base. The Tags table contains information on 4,612 recovered items.

Expanded search and recovery efforts included the use of commercial fishing trawlers to dredge the ocean floor from November, 1996, through April, 1997. Individual items recovered during the trawling operation were not tagged prior to their arrival at the hangar. Instead, the items from a trawl line (or set of trawl lines) were placed in a bag that was tagged. When the FBI opened each trawl bag, FBI evidence response technicians marked each piece with an FBI lot number. They also completed a trawler log for each bag. The log form contains the FBI lot number and associated trawl line number(s) for the items in each bag. These forms were forwarded to the data center and the information was entered into the Trawling table. This table contains data for about 13,000 trawl lines that were run inside the approximately 40-square-mile search area. An estimated 20,000 items were collected and brought to the hangar during the trawling operation, although many of these items were not parts of the accident airplane.

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[4] This includes biologic targets and other items that were not related to the accident.

The team conducted extensive validation efforts to ensure that the recovery position information in the data base was accurate. A library of hard copy reference materials was established to facilitate these efforts and to serve as primary-source documentation of the information in the data base. This library contains more than 30,000 pages of material and was used to support two complete paper-to-electronic validation studies, hangar floor audits, the hangar tag validation study, and several ad hoc validation studies. The on-site work of the data center was completed and the data base was frozen on April 25, 1997.[5]

Search and recovery[6]

Wreckage and victim recovery operations began immediately after the accident. Private and public use vessels began recovering floating bodies and debris on the evening of the accident under the general coordination of the U.S. Coast Guard. In the weeks following the accident, debris also washed up on beaches throughout the area and was collected by people who often delivered it to local law enforcement authorities or to staff at Coast Guard Station Moriches.

The National Oceanic and Atmospheric Administration (NOAA) survey vessel *Rude* began side scan sonar operations on July 18, 1996. The U.S. Navy Supervisor of Salvage (SUPSALV) was asked to support the recovery operation, and a contracted commercial vessel—the *M/V Pirouette*—arrived on the scene at 2200 on July 19, 1996. The Navy and its contractor, Oceaneering Technologies, began directing search operations. A variety of undersea imaging techniques were used to identify targets and to create maps of the debris fields. These maps were used to plan recovery strategies and to schedule dives to recover parts. The *USS Grasp* arrived on July 22, 1996, and began laying a three-point moor over a concentrated debris pile that had been discovered in the Green zone. The *USS Grapple* arrived on scene on July 29, 1996, and began preparations to lay a four-point moor over a concentrated pile in the Yellow zone. This moor was established on July 30. (Refer to the section on *Debris field locations and identifiers* beginning on page 12 for more information about debris field locations and color codes).

In early August, 1996, the Safety Board determined that the undersea mapping capability being utilized to coordinate dive operations at the SUPSALV/Oceaneering command post at Moriches, could be of general assistance to the investigation. Accordingly, a parallel data and plotting operation was established at the Calverton hangar (the data center).

The sea operation was coordinated by SUPSALV personnel at Coast Guard Station Moriches. During the dive operation, target maps and target assignment lists were prepared at

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[5] Any data generated from the Tags table before it was frozen on April 25, 1997, or any maps plotted from it prior to April 15, 1997, must be considered preliminary.

[6] The historical information presented in this report concerning the search and recovery operation is intended only to provide the reader with sufficient information to understand the subsequent data base development and validation, and to acquaint the reader with relevant parts recovery information sources. It is not intended to serve as a complete history of the operation. For more information about the sea operation, refer to SUPSALV's report *U.S. Navy Salvage Report: TWA Flight 800.*

Moriches and distributed to mobile dive teams and each morning. Operating from small boats, mobile scuba dive teams prosecuted targets as assigned during daylight hours. *Grasp* and *Grapple* employed ROVs and surface supplied ("hard hat") divers who operated around the clock recovering wreckage. Personnel at Moriches also pre-numbered color-coded metal tags for tagging recovered items. These tags were distributed based on anticipated needs to the *Grasp* and *Grapple* and also to the Side Loading Warping Tug (SLWT), which was used to collect and tag items from the mobile dive teams and to collect tagged items from the *Grasp* and *Grapple*.[7] Items were transferred from the SLWT to Mike boats (mechanized landing craft) and brought to the dock at Coast Guard Station Shinnecock. (Mike boats were used solely as transfer vessels; they did not tag or recover items.) At Shinnecock, recovered items were transferred to National Guard trucks and brought to the Naval Weapons Industrial Reserve Plant in Calverton, New York (the hangar). This general routine was modified when dictated by rough seas, weather, or other contingencies. For example, recovered items were occasionally stored on the *Oak Hill* command ship, and Navy CH-46 helicopters operating from the *Oak Hill* occasionally brought recovered items directly to the hangar.

Mobile dive team divers completed dive logs to identify the items found and recovered while prosecuting targets. Many items were dived on more than once because locating and rigging them for recovery required more bottom time that was permitted in a single scuba dive. Mobile divers recovered smaller items themselves and transferred these items from their small boats to the SLWT. The SLWT was equipped with an A-frame winch, which was used to recovery larger items rigged for recovery by the divers. Personnel on the warping tug tagged items and completed wreckage logs for items that they recovered or brought aboard from the small boats. Items received by the SLWT from the *Grasp* and *Grapple* were already tagged. Diver logs were brought to personnel at Moriches, and overnight they used them to update the Target table and prepare the next morning's target maps and assignments lists (refer to the *Target table* section beginning on page 19 for more information about the Target table). Wreckage logs were brought to data center staff in the hangar who used them to update the Tags table lists (refer to the *Tags table* section beginning on page *23* for more information about the Tags table).

The dive operation continued until early November, 1997, when it was replaced by a trawling operation, which was also coordinated by personnel at Moriches. During this operation, commercial fishing vessels used modified scallop nets to dredge the ocean floor. Man-made items recovered during this operation were bagged and transferred to shore using either Mike boats or rigid-hulled inflatable (rib) boats, and then trucked to the hangar. Trawling logs were completed for each bag and the information on these logs was entered into the Trawling table (refer to the *Trawling table* section beginning on page 26 for more information). The trawling operation concluded at the end of April, 1997.

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[7] To avoid duplication, all tags distributed to vessels were pre-numbered at one central location, and no blank tags were distributed.

Debris field locations and identifiers

Three search areas were established. These search areas were numbered from east to west. When wreckage tagging began, color-coded metal tags were used to identify recovered items. The three debris fields eventually became known by their assigned color codes. The main debris field, Area 1, became known as the Green zone. Area 2, the area in which the cockpit and forward fuselage were found, became known as the Yellow zone, and Area 3 became known as the Red zone. Throughout this document, these three debris fields will be referred to by their color codes, rather than the numbers used to reference them at the outset of the operation. Figure 1 depicts the three debris fields, their color names, and the latitude and longitude of the points that define the fields. Latitudes and longitudes in Figure 1 and throughout this document are given in degrees-minutes-seconds (DMS) format.[8]

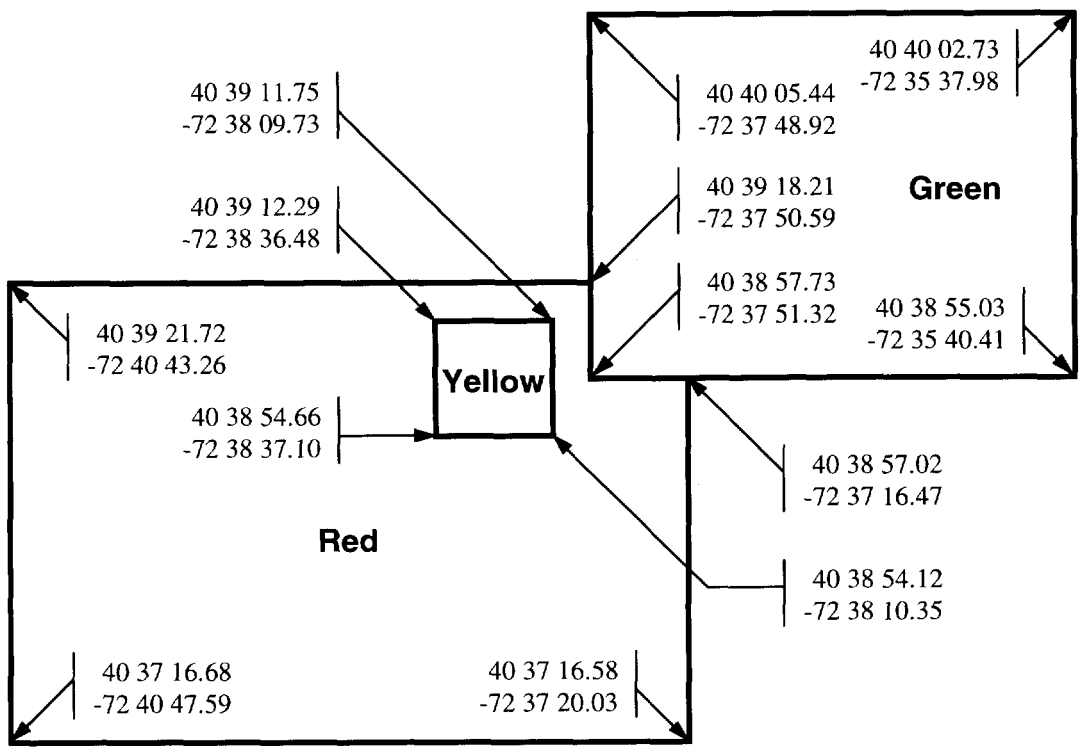

Figure 1: Depiction of the three debris fields and their defining corner points. Latitudes are north latitudes (positive values) and longitudes are west longitudes (negative values). Not to scale.

[8] Spaces were used to separate degrees, minutes, and seconds, but no other punctuation was used (except a decimal point in the seconds, and a leading minus sign to indicate west longitude). For example, "latitude 40 38 26.22" means 40 degrees north latitude, 38 minutes, 26.22 seconds, and "longitude -72 38 27.64" means 72 degrees west longitude, 38 minutes, 27.64 seconds. This format was used in the data base, so it was adopted for this report.

It should be noted from Figure 1 that the three debris fields overlap. The Yellow field lies completely within the Red zone, and the Green debris field partially overlaps the Red zone. It should also be noted that the boundaries of the Red zone were expanded during the dive operation after some wreckage was located just outside the original southern boundary.[9] Further, more than one debris field numbering system was in use before the color codes were developed. Initially, SUPSALV planned to anchor one salvage vessel to recover wreckage from the concentrated debris pile in the northwest portion of the Green zone, and to use mobile dive teams to recover the items scattered throughout the Red zone. When a concentrated debris pile was also located in the northeast portion of the Red zone, the Yellow zone was defined and the *Grapple* was positioned there. Although the debris field names changed and some of the boundaries were expanded, this report uses the final names and boundaries, which are defined in Figure 1. Further, all debris field color code assignments made by the data center were based on the definitions in Figure 1. This means that any validation studies reported in this document, and all hangar tagging assignments made or changed as a result of the hangar tag validation project beginning on page 57, and all out-of-area tag studies (see page 38) were made using these definitions.

Tag colors, prefixes, number ranges, suffixes

Wreckage recovered during the sea operation was tagged with color-coded metal tags. A unique tag number was hand written on each in permanent marker. The tag numbers are stored in the Tags data base, which can be used to research information such as recovery dates and locations. However, some information can be determined directly from the tag color, letter prefix, number, and letter suffix (if any). This section explains these elements.

Tag colors

Initially, only red, yellow, green, and blue tags were issued. Other tag colors came into use later in the dive operation. Items that have red, yellow, or green tags were recovered from the sea floor in the Red, Yellow or, Green debris fields, respectively.[10] Items that have orange tags were recovered from the sea floor in the Orange zone, which is defined as any area other than the Red, Yellow, or Green debris fields (for the purpose of the dive operation, this area is effectively limited to areas north of the Red and Green zones). Blue tags were used for floating items regardless of their recovery location, and white tags were assigned to items for which a debris field color code cannot be assigned (unknown recovery position). During the dive operation red, yellow, green, blue, white, and orange tags were issued. During the trawling operation, only red, green , and orange tags were used.

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[9] The boundary points of the original Red zone were latitude 40 39 20.88, longitude -72 40 01.78; latitude 40 39 18.27, longitude -72 37 53.23; latitude 40 37 57.44, longitude -72 37 56.04; latitude 40 38 00.06, longitude -72 40 04.59.

[10] Some exceptions to these rules were discovered. These exceptions are called out-of-area- tags, and are discussed elsewhere in this document.

A special note concerning floating items is needed: Items that washed ashore were obviously not found floating, but may have blue tags because they had been floating prior to recovery. Further, some items that were recovered floating received blue tags, while others received white tags. For this reason, little distinction should be made between blue tags and white tags. Of course, some items that have tags of other colors may have floated for some period of time before sinking and being recovered from the sea floor.

Tag number components

Each tag "number" is composed of a letter prefix followed by a number that may be up to four digits in length. A letter suffix may follow this number. No spaces or other punctuation were used in the tag number. Examples of valid tag numbers include the following: Z3453, A2008, A189, C076, B001, A189A, T6543, M8101. This section explains the meaning of each of these components.

Prefix letters

Table 1 summarizes the letter prefixes that were used during the dive and trawling operation. These prefix letters are valid for ship tags and hangar tags (hangar tags are explained in the *Hangar tags* section beginning on page 31).

Originally, only the prefix letters A, B, C, D, and E were used. Other prefix letters were added later. Note that new prefix letters were used beginning September 5, 1996, after a Hurricane passed near the area.[11] The prefix letters X, Y, and Z were added to denote wreckage that was recovered post-hurricane.[12] These prefix letters were used to indicate that such items may have been repositioned during the storms (for more information, refer to *Appendix 3: Debris migration*).

Number ranges

Table 2 summarizes the tag numbers that were assigned to recovered items. Tags were pre-numbered, but numbering discontinuities were common. This resulted in tag number gaps in the data base. Further, not every pre-numbered tag was actually used, but unused tags do not appear in the data base because no wreckage logs were filed for them. Finally, although the tags were pre-numbered, they were not always assigned in sequence.

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[11] At its closest point, according to National Hurricane Center data, Hurricane Edouard, with winds of 70 knots, was located about 160 nautical miles from the southeast corner of the Red zone on September 2, 1997, at 0600 UTC.

[12] Note that seven "temporary green" ship tags were issued post-hurricane using the prefix "TG." One of these TG-series tags (TG6) was subsequently assigned structures log number FBM31A, and was retagged with exempt hangar tag Z2742.

Table 1: Prefix letters used in tag numbers.

Prefix	Meaning
A	Recovered from the Red zone (pre-hurricane; used through Sept. 4, 1996)
B	Yellow zone (pre-hurricane; used through Sept. 4, 1996)
C	Green zone (pre-hurricane; used through Sept. 4, 1996)
D	Unknown recovery location (white tag)
E	Floating debris (blue tag)
M,T	Trawler tags (used to tag trawl bags, not individual items)
W	Orange area
X	Red zone (post-hurricane; used after Sept. 4, 1996)
Y	Yellow zone (post-hurricane; used after Sept. 4, 1996)
Z	Green zone (post-hurricane; used after Sept. 4, 1996)

Table 2: Number ranges used in tag numbers.

From	To	Meaning
1	**1999**	Issued by salvage ships pre-hurricane.
2000	**2999**	Issued at the Calverton hangar for items recovered prior to the trawling operation. Exception: Z2395-Z2400, Z2551-Z2650 and Z2761 are actually ship tags issued by the warping tug.
3000	**3999**	Issued by salvage ships post-hurricane.
4000	**4999**	Issued at Calverton hangar to debris picked up by trawlers. These tags have a "W", "X" or a "Z" letter prefix, which corresponds to the color of the tag (W = orange tag, X = red tag, Z = green tag). Because the trawlers did not treat the Yellow zone as a separate debris field, no Y prefix was used for 4000 series tags.
5000	**5999**	Issued by SUPSALV personnel at Moriches.
6000	**6999**	Issued by trawlers working the Green zone. Exception: Tags T6020, T6067, T6070, T6074, T6075, and M6061-M6064 were issued by the *Kathy Ann* in the Red zone.
7000	**7999**	Issued by trawlers working the Red zone. During the trawling operation, the Yellow zone was not used. Exception: Tags T7064-T7273 were issued by the *Tradition* in the Green zone, and tags T7917-T7999 were issued by the *Kathy Ann* in the Green zone.
8000	**9999**	Issued by trawlers working areas other than the Red, Yellow, or Green) debris fields. Exception: Tags T8000-T8007 were issued by the Kathy Ann in the Green zone.

Suffix letters

When duplicate tag numbers were issued inadvertently, a letter suffix was appended to the tag number to resolve these duplications, for example A189, A189A, C076, C076A, C076B. For more information, refer to the *Tag duplication study* section beginning on page 40.

Wreckage logs

Salvage personnel tagged items before they arrived at the hangar. As they did so, they completed one wreckage log form (sometimes abbreviated WL) for each tag assignment. On each form, a tag number, target number, initial description and recovery position were recorded. The wreckage logs were forwarded to the data center, where this information was entered into the data base. A sample of a wreckage log, and instructions provided to personnel tagging wreckage can be found in *Appendix 4: Tagging instructions and sample wreckage and diver log.* The information on these logs was entered into the Tags table, and then the forms were filed for later reference.

Updated wreckage logs

Each tagged item in the Tags table has a description. The default description is the description provided on the wreckage log at the time of recovery. Updated wreckage logs (sometimes abbreviated UWL) were created to allow hangar staff to correct or supplement these descriptions. These forms were available in the data center from shortly after its inception until it was closed at the end of April, 1997. When an updated wreckage log was submitted, the information was entered into the Tags table and the paper form was filed with the corresponding wreckage log to document the change. With the exception of minor administrative changes (such as typographical corrections) and global changes documented in this report (such as resulted from the hangar tag validation project described on page 57), changes to the Tags table records were documented with updated wreckage logs.

The frozen Tags table does not contain the information from several updated wreckage logs that were filed in late April, 1997. Consequently, these UWLs appear in *Appendix 5: Updated wreckage logs not included in Tags table.*

Other numbering systems

A variety of other numbering systems were used by various groups to track recovered parts. These systems are briefly described here because, where available, these numbers were stored in the data base.

FBI lot numbers and logs

The FBI evidence response technicians (ERTs) logged parts as they arrived at Calverton. The parts were removed from National Guard trucks, Navy helicopters, or other transport vehicles, and were laid out in the receiving area of the hangar. The ERTs assigned lot numbers to each shipment of parts, and they wrote this lot number on each part in the lot using indelible black markers. Lot numbers consist of the date that the item arrived at the hangar followed by a 1 to 3 digit serial number. The ERTs used evidence logs to track shipments. The logs contain records establishing 249 lots during the dive operation.[13] The FBI logs contain information about 2,917 ship tagged items that were assigned to these lots on their arrival in the hangar. In this document and in the data base, forward slashes were used to separate the date elements, and a dash was placed between the date and serial number. No spaces were used. Examples of valid lot numbers include "8/06/96-36" and "9/22/96-1."

The FBI actually began recording dates on parts on July 18, 1996. Most, if not all, of the parts that were marked the dates "7/18/96" or "7/19/96" were floating items marked at Coast Guard Station Moriches. On August 3, 1996, the ERTs began using evidence logs to assign lot numbers (dates with serial number suffixes) to items as they arrived in the hangar. The 249 lot numbers that were used for hangar tagging have dates that range from August 3 through November 2, 1996.

The ERTs also marked FBI lot number onto items that were recovered by trawlers following the dive operation. These number were used to reference an item to a trawler bag tag, and thus to the geographic position of the trawl line being run when the item was recovered. Because the first items recovered by trawlers arrived in the hangar on November 5, 1996, items that have an FBI lot number with a date portion of "11/05/96" or a more recent date, were recovered by a trawler. (Refer to the section on *Data handling* on page 9 and the section on *Trawling table* on page 26 for more information about trawling and the role played by FBI lot numbers.)

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[13] Actually, the logs contain documentation for more than 249 lots, but only 249 lots contain at least one ship-tagged item. Only lots that contain at least one ship-tagged item are useful for hangar tagging purposes. (Most of the lots that did not contain any ship-tagged items contained only personal effects that washed ashore during the weeks following the accident.)

Structures log numbering

The structures group developed and implemented a numbering system for documenting parts of the aircraft structure. These consisted of a 1 to 3 letter prefix followed by a 1 to 4 digit number. Suffix letters were also used occasionally. In this document and in the data base, no spaces or dashes are used to separate the components. Examples of valid log numbers include "LW6," "CW911," and "LF14A." The letter prefix corresponds to the particular type of airplane structure being documented (e.g., RW means "right wing" and CW means "center wing") Because these log numbers are assigned with regard to aircraft structure, a single part may have more than one log number (e.g., a portion of the right wing that extends into the center wing tank might receive log numbers with "RW" and "CW" prefixes). For more information on structures log numbering, refer to the structures group factual report.

Seat numbering

Seats are referred to in this report and in the data base as a combination of row and seat number(s). The two-digit row number is given first, followed by the single-digit seat number(s) in parentheses. A space separates the row number from the seat number(s), and spaces also separate one seat numbers from another. Single digits are used for the seat numbers, which range from 1 to 10 (zero is used to indicate seat 10). Examples include "27 (4)," which refers to seat 4 in row 27, and "21 (8 9 0)," which indicates seats 8, 9, and 10 of row 21. For more information on seat numbering refer to the cabin interior group factual report.

Aircraft coordinate system

Locations on the airframe may be referenced using the aircraft coordinate system, which involves station numbers and stinger numbers. Fuselage stations (FS) are numbered longitudinally using a reference point forward of the nose of the aircraft as the origin [wing stations and other station numbers are assigned using a different origin]. Stringers are numbered circumferentially from the top of the aircraft to the bottom. Because stringer numbers are duplicated on each side of the aircraft, an "L" or "R" is used to designate the side of the aircraft being referenced.

Parts were often described on updated wreckage logs by their aircraft coordinates. For example "FS 820-940; stringer 6L-17L." Where available, this information was used in the data base to identify parts. Note that in this document and in the data base, FS is used to mean "fuselage station." Occasionally, STA was used to mean "station." Every attempt was made to ensure the accuracy of station and stringer numbers given in the data base; however, this information should be used for guidance only. Refer to the structures group factual report for more information. If discrepancies exist concerning the description of structural items between the data base and structures group documents, the information that appears in the structures group documents should be considered correct.

Data base documentation

Three major tables comprise the data base: These are the Target, Tags, and Trawling tables. This section documents the structure and contents of each of these tables.

Target table

Overview

The term "target" refers to an object or other anomaly discovered on the ocean floor. The Target table contains information concerning these targets, from origination to identification and final disposition. This table was created and maintained by SUPSALV and Oceaneering for the purpose of managing the dive operation, but it has continuing value to the investigation because it was used extensively to cross-check the recovery position information for items in the Tags table.

As targets were discovered during the undersea search operation, they were assigned a number for tracking purposes. When a target was discovered, it was assigned a target identification number, and a new target record was created. The target's number, position, the search technique used to locate it, the name of the vessel finding it, and the date it was found were entered into the new record. If another report subsequently identified a target at the same position, these field values were duplicated for that "new" target.

When a target was prosecuted and identified, a diver log or an ROV log was filed, as appropriate. This form was used to enter data about the target into the target table. This form included: the technique used to identify the target, name of the organization identifying the target, the date of identification, the report number, a brief description, and a more detailed initial description. A sample diver log can be found in *Appendix 4: Tagging instructions and sample wreckage and diver log.*

On recovery, data were entered into the remaining fields in the table. An actual description was entered along with any comments and the tag number assigned to the item was entered, if it was available.

The Target table, which was entirely managed by personnel at Moriches, was instrumental in coordinating the dive operation and proved useful in validating the recovery position information stored in the Tags table. Consequently, a new updated version of the Target table was delivered to the Calverton hangar on a regular basis during the dive operation. However, the Target table was not subjected to the validation and quality control measures that were applied to the Tags table.

Data elements

The Target table contains several elements (or fields): Target number; latitude and longitude; X and Y Coordinates; search type, vessel, and date; description technique,

organization, and date; dive report number; brief, initial and actual description of target; tag number assigned; comments; and, a date/time field containing information about when the record was last updated. Each of these elements will be described in more detail. [14]

Target number (Target #)

Each target was assigned an identification number for tracking purposes. Identification numbers were assigned using the system that appears in Table 3.

Table 3: System used for assigning target numbers.

Prefix	Number	Suffix	Technique	Vessel
none	<2000	*(none)*	side-scan sonar	*Pirouette*
none	>1999	P or S	side-scan sonar	*Rude*
AJ	*(any)*	*(none)*	side-scan sonar	*Able J*
DIG	*(any)*	*(none)*	side-scan sonar	*Diane G*
GPR	*(any)*	*(none)*	ROV contacts	*Grapple*
GRS	*(any)*	*(none)*	ROV contacts	*Grasp*
LLS	*(any)*	*(none)*	laser line scan	*Diane G*
PIR	*(any)*	*(none)*	ROV contacts	*Pirouette*
PS	*(any)*	*(none)*	side-scan sonar	*Pirouette*

Sort number (Sort Number)

This field was used to assist in sorting table, and is of historical value only.

Latitude (Latitude)

This field contains the latitude of the target. Latitude information was generally entered directly from written reports or spreadsheets provided by vessel staff. In the case of *Pirouette* and *Rude*, it was calculated from X/Y coordinates via GeoCalc, the geographic calculator from Blue Marble software.

Latitude values were stored in degrees-minutes-seconds (DMS) format. Spaces were used to separate degrees, minutes, and seconds, and a decimal point was used to indicate decimal seconds. No other punctuation was used. The format of the stored information is "DD MM SS.SS." For example, "40 38 26.22" means 40 degrees north latitude, 38 minutes, 26.22 seconds.

[14] The name in parenthesis following the descriptive name each data element is the exact name of the element in the data base.

Longitude (Longitude)

This field contains the longitude of the target. Longitude information was generally entered directly from written reports or spreadsheets provided by vessel staff. In the case of *Pirouette* and *Rude*, it was calculated from X/Y coordinates via GeoCalc, the geographic calculator from Blue Marble software.

Longitude values were stored in degrees-minutes-seconds (DMS) format. Spaces were used to separate degrees, minutes, and seconds, and a decimal point was used to indicate decimal seconds. A leading minus sign indicates west longitude. No other punctuation was used. The format of the stored information is "-DD MM SS.SS." For example, "-72 38 27.64" means 72 degrees west longitude, 38 minutes, 27.64 seconds.

X Coordinate (X Coord)

Stores position information using the Universal Transverse Mercator (UTM) projection. Data were entered directly from side-scan sonar data for *Pirouette* and *Rude*, and calculated via GeoCalc software from latitude/longitude data from all other vessels. These values were used to plot target maps.

Y Coordinate (Y Coord)

Stores position information using the Universal Transverse Mercator (UTM) projection. Data were entered directly from side-scan sonar data for *Pirouette* and *Rude*, and calculated via GeoCalc software from latitude/longitude data from all other vessels. These values were used to plot target maps.

Search technique (Srch Type)

The search technique used to locate the target was indicated with a one-letter code. The letter "S" was used for side-scan sonar, "L" for laser line scan, "D" for diver visual identification, and the letter "V" was used for a target found during an ROV search.

Search vessel (Srch ID)

The vessel that originated the target was indicated by a two-letter code. The code "AJ" for *Able J*, "DI" for *Diane G*, "GP" for *Grapple*, "GR" for *Grasp*, "PI" was used for *Pirouette*, and "RU" for *Rude*.

Search date (Srch Date)

The date on which the target was originated was entered in this field.

Identification technique (ID TYP)

The technique used to identify the target was coded using the same values as in the search technique field (Srch type).

Describing organization (Desc ID)

The organization that described the target, such as EOD (U.S. Navy Explosives Ordinance Division), NYPD (New York Police Department), SCPD (Suffolk County Police Department), etc.

Description date (Desc Date)

Date of the identification as reported on the diver or ROV log. This is often the date that an item was recovered.

Report number (Rpt #)

Log number of diver or ROV report(s) pertaining to the target. The report number was numbered using the following convention: DDD-NN, where DDD was a 3 digit representation of the date and NN was a sequential number. For example, 807-22 was used for the 22nd report filed on August 7, 1996.

Brief description (Brief)

Brief (usually one word) description of major items found.

Initial description [Description (Initial)]

Initial (unverified) description by diver or ROV of what was found at the target position. (Where more than one description of an object exists, the description in the Tags table must be assumed to be the most accurate, because it is the only description that was subject to revision by hangar staff. See the section on *Updated wreckage logs* on page 16 for more information about this process.)

Actual description [Description (Actual)]

Actual (unverified) description by diver or ROV of what was found at the target position. (Where more than one description of an object exists, the description in the Tags table must be assumed to be the most technically accurate, because it is the only description that was subject to revision by hangar staff. See the section on *Updated wreckage logs* on page 16 for more information about this process.)

Tag number (Tag #)

Tag number assigned to a recovered item associated with the target. Unlike tag numbers in the Tags table, these tag numbers have not been subjected to any verification procedures. They do not represent a complete listing of assigned tag numbers, and there is no paperwork to support the data entry, but this data field is useful for reference. (Wreckage logs and Updated Wreckage Logs serve to support the corresponding information in the Tags table.).

Comment (Comment)

Any other comment on the nature or disposition of a particular target.

Updated (Updated)

Calculated field, based on when a record was last edited. This field was used to maintain daily synchronization with the Tags table.

Tags table

Overview

As items were recovered, they were assigned tag numbers, and information concerning recovery was recorded on wreckage log forms. These logs were forwarded to the data center for data entry. The information on wreckage logs, and on any updated wreckage logs filed to correct or add to information, was entered into the table.

Data elements

The Tags table contains several data elements: Date and time of tagging; tag number; target number; source tag number (if applicable); latitude and longitude; item description, structures group log number; hangar location; aircraft position; debris field of recovery; aircraft station; updated, FBI log number, and, a date/time field containing information about when the record was last updated. Each of these elements will be described in more detail.[15]

Tag number (Tag #)

Each entry on the Tags table has a unique tag number. No spaces, hyphens or other punctuation was used. Refer to the *Tag colors, prefixes, number ranges, suffixes* section beginning on page 10 for more information about tag numbering.

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[15] The name in parenthesis following the descriptive name of each data element is the exact name of the element in the data base.

Date (Date)

Contains the date that the item was tagged, if provided on the wreckage log. If no date was provided on this form, or if no wreckage log was available for the part, this field usually contains the date that the record was entered into the table.

Time (Time)

Contains the time that the item was tagged, if provided on the wreckage log. This information did not appear on updated wreckage logs, and thus is not available for hangar tagged items.

Target number (Target #)

This field was used to store the target number associated with the item, if applicable and known. The *Target table* section beginning on page 19 documents the assignment of target numbers.

Source tag number (Source Tag #)

Hangar tags were "sourced" to ship tags. The tag number of the source tag is given in this field. Source tags are only valid for hangar tags. Refer to the *Hangar tags* section beginning on page 31 for more information.

Latitude (Latitude)

This field contains the latitude from which an item was recovered (this does not apply to non-exempt hangar tags: Refer to the section on *Hangar tags* beginning on page 31 for more information). Latitude values were stored in degrees-minutes-seconds (DMS) format. Spaces were used to separate degrees, minutes, and seconds, and a decimal point was used to indicate decimal seconds. No other punctuation was used. The format of the stored information is "DD MM SS.SS." For example, "40 38 26.22" means 40 degrees north latitude, 38 minutes, 26.22 seconds.

Longitude (Longitude)

This field contains the longitude from which an item was recovered (this does not apply to non-exempt hangar tags: Refer to the section on *Hangar tags* beginning on page 31 for more information). Longitude values were stored in degrees-minutes-seconds (DMS) format. Spaces were used to separate degrees, minutes, and seconds, and a decimal point was used to indicate decimal seconds. A leading minus sign indicates west longitude. No other punctuation was used. The format of the stored information is "-DD MM SS.SS." For example, "-72 38 27.64" was entered for 72 degrees west longitude, 38 minutes, 27.64 seconds.

Description [Description (Actual)]

The text in this field is a description of the tagged item as provided on the wreckage log. If an updated wreckage log was filed for the item, the corrected description given on that form was entered in this field, supplementing or replacing the previous information, as appropriate. Refer to the sections on *Wreckage logs* on page 16 and *Updated wreckage logs* section on page 16 for more information about these forms.

Structures group log number (Log #)

The structures group assigned log numbers to many items. Where provided to the data center on updated wreckage logs, this information was entered into this field. Refer to the *Structures log numbering* section on page 18 and to the structures group factual report for more information.

Hangar location (Hangar Location)

This field was used to store information about the location of the item in the hangar. Because most items were repositioned in the hangar several times during the investigation, it no longer contains reliable information.

Item category (Aircraft Position)

Each tagged item could be assigned to one of 18 categories to facilitate data base queries. Text strings were entered into this field to indicate the category. The categories were "APU," "Avionics," "Cabin Int.," "Cargo," "Cockpit/Misc.," "ECS/PRESS/O2," "Electric," "Engine," "Floor," "Fuel," "Fuselage," "Human Remains," "Hydraulics," "Landing Gear," "Personal Effects," "Seat," "Tail Section," and "Wing."

Debris field color code (Debris Field)

The following text strings were stored in this field as appropriate: "Floating," "Green," "Orange," "Red," "White," or "Yellow." This information refers to the debris field from which the item was recovered, and was determined from the best available recovery position data for each item. This field was extensively audited. If the color code noted does not match the tag letter prefix, it is because the debris field information was corrected during such an audit. Refer to the *Debris field locations and identifiers* section beginning on page 12, the *Tag colors, prefixes, number ranges, suffixes* beginning on page 13, and the *Out-of-area tag problem* section beginning on page 38 for more information.

Aircraft station or seat number (Aircraft Station)

If information was available concerning the aircraft fuselage station (FS) or wing station (WS) of the item was available, it was stored in this field (refer to the discussion of the *Aircraft coordinate system* on page 18 for more information). Seat numbers were also stored in this field using the convention described in the *Seat numbering* section on page 18.

Updated (Updated)

Calculated field, based on when a record was last edited. This field was used to maintain daily synchronization with the Target table.

FBI lot number (FBI #)

This field was used to store FBI-assigned lot numbers, where available. Data in this field was stored as described in the *FBI lot numbers and logs* section on page 17.

Exempt code (Exempt Debris)

This field is only valid for hangar tagged items. A "yes/no" data type was used for this field. If an item was identified as an exempt item, a "yes" code was entered in the field (this may appear as a "-1"). Otherwise a "no" code (which could appears as a "0") was used. Refer to the section on *Hangar tags* beginning on page 31 for more information about exempt and non-exempt items.

Debris field color code modified (Modify Tag Color)

A "yes/no" data type was used for this field. If a debris field color code was changed as a result of the hangar tag validation project (which included an audit of out-of-area ship tags), a "yes" code was entered in the field (this may appear as a "-1"). Otherwise a "no" code (which may appear as a "0") was used. The hangar tag validation project is detailed beginning on page 57.

General administrative comments (General Admin)

This field was used to store a variety of administrative comments about the record. These include comments associated with the hangar tag audit and with prior validation efforts.

Comments (Comments)

This field was used to store a variety of administrative comments about the record throughout the investigation, including some comments associated with the hangar tag audit and with prior validation efforts. The data in this field should be regarded as preliminary in nature because much of it was superseded by the hangar tag validation project and other validation activities.

Trawling table

Overview

Trawling data entry was based on two sets of paper forms: the trawling log form and the Oceaneering Situation Reports. One trawling log form was completed for each bag of trawled items. These forms contain the following information: Trawler tag number, lines trawled, date

trawled, FBI lot number (which is listed as a "log" number on the form). Although the vessel name and debris field were not part of the form, they were usually provided. Refer to *Appendix 6: Sample of a trawling log* for a sample form. Oceaneering Situation Reports (SITREPS), which were filed twice per ship per trawling day, were used as needed to supplement these forms.

It should be noted that some items recovered during the trawling operation were hangar tagged. When this was done, a 4000-series hangar tag was assigned to the item using its FBI lot number to determine the trawl line number(s), and thus the appropriate color tag. Refer to the section on *Hangar tags* beginning on page 31 for more information.

It should also be noted that many items recovered during the trawling operation were recovered several months after the accident. The hurricanes and storms that affected the area, undersea drift, the undersea disturbance created by trawling itself, and the prevailing undersea drift, may all have acted to reposition items prior to their recovery in trawl nets. Caution should be exercised when interpreting the debris field color codes associated with trawled items. For more information concerning debris migration, refer to *Appendix 3: Debris migration.*

Data elements

The Trawling table contains the following data elements for each trawl line: FBI lot number; trawl date and line number; trawler tag number; debris field color code; vessel name; trawl line number; number of pieces and number of airplane pieces in bag; beginning and ending latitude and longitude of each line; and, the date that the record was entered into the table.

Line number (Line #)

Each entry in the Trawling table corresponds to a line trawled. Trawlers covered these lines, which were often more than a mile long, by towing two 15-foot wide nets. Each line trawled was given a unique identifier called a line number. Note that when specific lines were run more than once, as was usually the case, each passage was given a unique line number. Also note that it was often the case that more than one line was run before lifting the net and bagging a load. When such multiple line sets were run, each line received a unique line number, and the bag that resulted received one tag number.

Line numbers were entered in the following format: P-#-D where ***P*** is a 1-3 character alphanumeric prefix for a set of trawl lines (such as G or 5AA); ***#*** is the 1-3 digit line number within the set, and ***D*** is the direction being trawled, such as NE, NS, or EW. (Some lines numbers also have a suffix. This was done for lines with the prefix A and B in the Orange zone to avoid confusion with different sets of lines A and B in the Red zone. The Orange zone trawl lines affected by this modification are designated with an "OOA" or "OOB" prefix and a trailing "-O".)

The trawler log forms were rarely completed with the line number in the needed format, but the correct format was used in the data base—unless it was impossible to resolve from the information available from SITREPs or Oceaneering and SUPSALV personnel at Moriches. Multiple lines sets were normally listed as: P #, #, ... , # D or P # - # D. Lines were usually

trawled sequentially, though this was not always the case: multiple line sets may consist of discontinuous line numbers.

FBI lot number (FBI Log #)

The FBI assigned one lot number to each trawl bag and marked each piece in that bag with the number. The lot numbers were of the format previously described (see *FBI lot numbers and logs* on page 17).

Trawl date (Trawl Date)

Date the FBI took custody of the bag that resulted from running the trawl line (usually the date that the line was run).

Trawler tag number (Trawler Tag #)

Tag assigned to the trawl bag. Tags were numbered in accordance with the procedures described in the section on *Tag colors, prefixes, number ranges, suffixes* beginning on page 13.

Debris field color code (Debris Field)

The color code of the debris field in which the trawl line was run was entered in this field. Note that no trawl lines were completely contained in the Yellow zone. Thus, the Yellow zone was not used for trawling purposes. Any trawl bags retrieved from trawl lines that were run through the old Yellow zone received red tags. Refer to the section on *Debris field locations and identifiers* beginning on page 12 for more information.

Vessel name (Vessel)

The name of the scallop trawler running the line was entered into this field. These vessels were the *Alpha & Omega, Christian Alexa, Kathy Ann, Nordic Pride* and the *Tradition.*

Number of items in bag (Pieces / Bag)

Beginning in January, 1997, the FBI ERTs began noting the number of items in each trawl bag on the appropriate trawler log. When this information was available, data center staff entered it into the table. Note that because each record in the table corresponds to a trawl line as opposed to a bag, this information was entered more than once for bags that resulted from multiple line sets.

Number of airplane parts in bag (Plane Pieces)

In February, 1997, the FBI ERTs began noting the number of airplane pieces in each trawl bag on the appropriate trawler log. When this information was available, data center staff entered it into the table. Note that because each record in the table corresponds to a trawl line as

opposed to a bag, this information was entered more than once for bags that resulted from multiple line sets.

Beginning latitude (Beg Lat)

This field contains the latitude of the starting point of the trawl line. Differential GPS equipment was used by all trawlers to improve accuracy. Latitude values were stored in degrees-minutes-seconds (DMS) format. Spaces were used to separate degrees, minutes, and seconds, and a decimal point was used to indicate decimal seconds. No other punctuation was used. The format of the stored information is "DD MM SS.SS." For example, "40 38 26.22" means 40 degrees north latitude, 38 minutes, 26.22 seconds.

Beginning longitude (Beg Long)

This field contains the longitude of the starting point of the trawl line. Differential GPS equipment was used by all trawlers to improve accuracy. Longitude values were stored in degrees-minutes-seconds (DMS) format. Spaces were used to separate degrees, minutes, and seconds, and a decimal point was used to indicate decimal seconds. A leading minus sign indicates west longitude. No other punctuation was used. The format of the stored information is "-DD MM SS.SS." For example, "-72 38 27.64" means 72 degrees west longitude, 38 minutes, 27.64 seconds.

Ending latitude (End Lat)

This field contains the latitude of the ending point of the trawl line. Differential GPS equipment was used by all trawlers to improve accuracy. Latitude values were stored in degrees-minutes-seconds (DMS) format. Spaces were used to separate degrees, minutes, and seconds, and a decimal point was used to indicate decimal seconds. No other punctuation was used. The format of the stored information is "DD MM SS.SS." For example, "40 38 26.22" means 40 degrees north latitude, 38 minutes, 26.22 seconds.

Ending longitude (End Long)

This field contains the longitude of the ending point of the trawl line. Differential GPS equipment was used by all trawlers to improve accuracy. Longitude values were stored in degrees-minutes-seconds (DMS) format. Spaces were used to separate degrees, minutes, and seconds, and a decimal point was used to indicate decimal seconds. A leading minus sign indicates west longitude. No other punctuation was used. The format of the stored information is "-DD MM SS.SS." For example, "-72 38 27.64" means 72 degrees west longitude, 38 minutes, 27.64 seconds.

Date entered (Entered Date)

This field contains the date that the record was entered into the table.

Date portion of FBI log number (FBI Date)

The date portion of the FBI log number was entered into this field for administrative use.

Alphabetic portion of trawl line number (Alpha line #)

The alphabetic portion of the trawl line number was entered into this field for administrative use.

Hangar tags

Hangar tags differ distinctly from ship tags. Unlike ship tags, hangar tags were assigned to items after they arrived at the hangar. Two groups of hangar tags were assigned: 2000-series tags were assigned to items recovered during the dive operation, and 4000-series tags were assigned to items recovered by trawlers.

2000-series tags

In mid-August, 1996, a procedure was created to permit hangar staff to tag items in the hangar. Tag numbers in the 2000-series were initially reserved for these hangar tags. This procedure was originally intended to permit continued identification of an untagged portion of an item that broke, was cut, or otherwise separated from a ship-tagged item. The procedure involved attaching a color-coded 2000-series tag to the untagged item and submitting an updated wreckage log (UWL) to the data center. On this form, the tag number of the piece from which the untagged item was separated was used as the "source tag" for the newly assigned 2000-series tag. The recovery position information in the Tags table for the source tag was then used for the corresponding 2000-series hangar tag.

The hangar-tagging procedure was also applied to many parts that arrived in the hangar without a tag, especially when these parts were deemed of special interest to the investigation. In fact, as the recovery operation continued, this became the predominant use of hangar tags. In the early phases of recovery, the intent was to tag every recovered item at the time of recovery. However, as the scope of the recovery expanded, smaller and smaller parts were recovered, and the daily volume of recovered parts grew. Often, groups of smaller objects were delivered to the hangar with only one tag on a container (such as a bag or cargo net). That tag was intended to identify the recovery position for all of the parts in the container. Once untagged items were separated from the tagged item in a container, there remained no means other than FBI lot numbers to determine the debris field from which these items were recovered.

FBI evidence response technicians (ERTs) opened each container in a shipment and marked a lot number on each piece. As lot numbers were assigned, ERTs logged the associated ship tag numbers in FBI evidence log books. Because the FBI lot numbering system was intended to establish chain of custody information for recovered items, it was not dependent on recovery positions. However, because salvage procedures were designed to prevent untagged items from different debris fields from being mixed together, it was reasonable to assume that this segregation would be reflected in FBI lot numbering.[16] Consequently, lot numbers were used to establish debris field color codes for hangar tagged items.

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[16] For example, to preserve debris field segregation, mobile dive teams were generally not assigned to work in more than one debris field per day, and (weather permitting) salvage crews avoided mixing loads in cargo nets or on the transport vessels. Further, SUPSALV provided instructions to tagging personnel regarding maintaining segregation: "If you pick up debris from two different locations, ensure that debris is segregated. Do not mix debris from differet [sic] locations. It is vital that debris is segregated. Do not mix different tag colors when loaded onto

To assign a hangar tag to an untagged item, investigative staff would use the FBI lot number written on the item to look up one of its tagged counterparts in the FBI log books. The tag number of this counterpart item (usually the first ship tag listed for the lot) would be used as the "source tag" for a new 2000-series tag. The color of the source tag was used to determine to color of the hangar tag assigned to the previously-untagged item. This method was employed from late-September through mid-November of 1996.

During this period, certain problems with this method for assigning source tags became apparent. It was clear that debris field segregation had not always been maintained within lots. Some lots were found to contain more ship tagged objects than those itemized in the FBI log books. Positions for these non-logged tagged items were sometimes found to be in a different debris field than the debris field from which the logged parts were recovered, making it inappropriate to assign a color code to a non-tagged item in the lot. Items in other lots were sometimes retrieved from such disparate positions that a debris field assignment to untagged parts from these lots was also inappropriate.

In mid-November, after the dive operation ceased, a concerted attempt was made to clarify which lots were "valid" for 2000-series tagging purposes.[17] Data center staff manually searched all FBI log books for tag numbers. This information was used to create a table listing each lot number and its associated ship tag numbers (the table became known as the FBI lot-to-tag table). Using this table and recovery position information from the Tags table, the ship-tagged items in each lot were then plotted on separate maps. These maps were studied for debris field grouping. Lots that were spread over more than one field, or that contained unlogged parts from another debris field, were identified as "mixed," which meant that they were not valid for assigning debris field color codes to untagged items. (An untagged item from a mixed FBI lot cannot be assigned a debris field of recovery, so a white 2000-series tag should be assigned to that item). A summary of the results of this study, including source tags to be used for valid lots, was created, entitled "FBI Lot Summary," dated November 15, 1996. This list was provided to hangar staff for their use in assigning 2000-series tags and source tags from mid-November, 1996, through March, 1997. However, at the time the summary was made, and subsequently, certain further questions arose about the validity of particular lots. In April, 1997, a further effort was made to resolve all such questions, and to assess their impact on all 2000 series tags in the data base. This effort is documented in the *Hangar tag validation project* section beginning on page 57.

It should be noted that two classes of 2000-series hangar tags have been described. These two classes are known as *exempt* and *non-exempt* tags (terms that apply only to hangar tags attached to items recovered during the dive operation). An exempt tag is one for which a

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the Mike boat." The full text of these instructions appears in *Appendix 4: Tagging instructions and sample wreckage and diver logs.*

[17] The characterization of the validity of FBI-assigned lot numbers in this report is made only with respect to whether they can be used to assign probable debris fields of recovery to items that were not tagged when recovered—a purpose for which they were not intended.

definitive recovery position is known. For these tags, the color code assignment was made on the basis of this position, and the corresponding information was entered into the in the Tags table. All other 2000-series hangar tags are known as non-exempt hangar tags.[18] The debris field color codes for these items were determined by associating them with FBI lot numbers.

The debris field color code assignments made for non-exempt hangar tags represent the *probable* debris fields of recovery for these items. Nonetheless, each assignment represents a *best guess* at information that is simply not available. The color codes assigned to non-exempt hangar tags should be regarded as such. The hangar tag validation project established a standard list of source tags to be used for non-exempt hangar tags (see *Source tag selection* on page 64). The latitude and longitude values given in the Tags table for non-exempt hangar tags are the corresponding values for the source tags.

Although 2000-series tags were reserved for use in the hangar, 87 such tags were issued as ship tags by the SLWT. These include tags Z2395-Z2400, Z2551-Z2557, Z2559, Z2563-Z2592, Z2592A, Z2593-Z2594, Z2601-Z2614, Z2616-Z2617, Z2619-Z2621, Z2623-Z2625, Z2633-Z2649, and Z2761. Although actually ship tags, these tags are treated as exempt hangar tags in this report because they fall in the 2000-series.[19]

Occasionally, hangar tags required corrections (for example, when duplicate tags were issued or when a color coded tag was issued to a non-exempt item from a mixed lot). Hangar tagging errors were corrected using the tag renumbering procedure described in the *Out-of-area tag problem* section beginning on page 38, or by adding a white tag, as described in footnote 26 on page 39.

4000-series tags

At the outset of the trawling operation, a decision was made to reserve the 4000-series of tags for hangar tagging items recovered by trawlers. That is, 4000-series tags were used in the hangar to tag trawled items. (Actually, several 2000-series tags were inadvertently assigned to items that were recovered during trawling. All but four of these were corrected by retagging. Tags W2002, W2003, Z2836, and Z2837 were not corrected.)

Debris field color codes were assigned to trawled items that were hangar tagged based on the geographic location of the line being run when the item was retrieved, which was determined using the FBI lot number marked on the item. Note that because the Yellow zone was not used

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[18] The terms *exempt* and *non-exempt* were chosen with reference to any future audits that resulted from revisions to the FBI Lot Summary. Tags with definitive recovery information are *exempt* from any impact associated with such revisions because their debris field color codes and recovery position information was not determined through an FBI lot number association.

[19] Tags Z2560 and Z2561 were also inadvertently issued as ship tags during the dive operation. These tags were assigned to current meters associated with the search operation. These tags were removed and the gear returned to its owner (SAIC). These tags were not entered into the Tags table.

for trawling purposes, no Yellow hangar tags were assigned to trawled items (refer the *Trawling table* section beginning on page 26 for more information).

Validation procedures and activities

Shortly after the data center was established in the hangar, it became obvious that errors existed in the Tags data base. Examples include, poor item descriptions supplied on wreckage logs (e.g., "Misc. debris" or "aircraft parts"), duplicate tag numbers, and inaccurate recovery positions. It was clear that a variety of quality control measures would be required before the data base was frozen. This section describes the efforts undertaken to detect and correct errors in ship tag data. (Potential errors associated with hangar tags are discussed in the *Hangar tags* section beginning on page 31, and in the *Hangar tag validation project* section beginning on page 57.)

One of the first quality control measures employed was the updated wreckage log system, which allowed hangar staff to correct information (especially item descriptions) in the data base. This system was implemented in mid-August, 1996, and continued until the data base was frozen 8 months later. Further, in September, 1996, data center staff developed an internal procedure that provided the first strategy for ad hoc validation studies. That procedure was used to guide data center staff members in validating tags on an ad hoc basis, and it appears as *Appendix 7: Ad hoc validation procedure.*

Sources of potential error

The data for ship tags were subject to a variety of sources of potential error. These include potential errors when the tags were created (tag duplications), when tag assignments were made (incorrect tag colors or wreckage log paperwork errors), and data entry errors. Tags were pre-numbered for distribution, and were occasionally duplicated, leading to wreckage logs with ambiguous tag number references. When wreckage logs with duplicate tag numbers were received by the data center, these ambiguities were resolved by adding a suffix letter to one of the tag numbers (see *Suffix letters* on page 16). Occasionally, duplicate tags were assigned, but wreckage logs with duplicate tag numbers were not received by the data center. Before the data base was frozen, these were resolved to the extent possible by a tag duplication study conducted by data center staff using FBI evidence logs (see page 40). A total of 66 Tags table records were affected by resolving duplications.

Pre-numbered, color-coded tags were dispensed to salvage crews as dictated by their target assignments. However, salvage crews did not always have adequate supplies of correctly colored tags during recovery operations. Rather than leave a recovered item untagged, tags of one color were occasionally assigned to items recovered from a debris field of a different color. For example, a red tag might be assigned to an item recovered from the Yellow zone. This error was identified early in the dive operation, and it became known as the out-of-area tag problem. Procedures to correct out-of-area tags were implemented and these errors were corrected (see the *Out-of-area tag problem* section beginning on page 38 and the *Out-of-area tag audit* section beginning on page 58 for more information).

The data recorded on wreckage logs were also subject to error. When available, personnel on *Grasp* and *Grapple* entered item recovery positions on wreckage logs, but often the

positions given on wreckage logs for items recovered by these vessels was the position of the ship at the time of recovery, rather than the actual recovery location of the item; however, these usually only differ slightly.[20] Because *Grasp* and *Grapple* were not usually prosecuting targets specifically assigned by personnel at Moriches, positions given for items recovered by these vessels could not be validated against Target table entries.[21] However, daily situation reports (SITREPS) issued by SUPSALV were consulted to ensure that positions provided for these items were credible given reported ship positions, and when suspect position values were found, these were resolved by contacting SUPSALV staff who consulted deck logs to provide the exact position of the vessel at the time of recovery.

Unlike *Grasp* and *Grapple* crews, mobile dive teams dived on targets as assigned; they did not conduct independent searches for new targets.[22] The position values in the Target table correspond to the target assignments provided to the dive teams. For this reason, the position given in the Target table is the most accurate recovery position available for an item recovered while prosecuting a given target.[23] Therefore, whenever a target number was available, the position given on the wreckage log was cross-checked with the information in the target table. When position discrepancies were found and definitive item descriptions were available to ensure that the correct Target table record had been identified, the position given in the Tags table was adjusted to match the Target table position.

It must be acknowledged that some potential errors made during tag assignment might not have been discovered using these methods. For example, if a dive team prosecuted more than one target before assigning tags and completing wreckage logs, incorrect recovery position and target number data could have been recorded on one or more wreckage logs. Further, tags may have become detached during transportation, or after an item arrived in the hangar.

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[20] Surface supplied divers were limited to a lateral distance of about 50 feet (15.24 meters) from their vessel, and these vessels were usually only slightly repositioned in their moors using electric winches a few times each day as needed.

[21] Two concentrated debris piles were identified during the search operation, and *Grasp* was assigned to clear the debris pile in the Green zone, and *Grapple* was assigned to clear the pile in the Yellow zone. Unlike the mobile dive teams, these vessels did not receive specific daily target assignments from SUPSALV personnel at Moriches. Consequently, target numbers are generally not available for items recovered by *Grasp* and *Grapple.*

[22] Some dive teams used hand held sonar equipment to assist them in re-locating items at or near their assigned target positions, but mobile dive teams did not search for new targets.

[23] GPS receivers are subject to known error. Typically, commercial GPS systems, which were used by civilian dive teams can determine longitude to within about 50 meters and latitude to about 78 meters. Differential GPS is more accurate, and was used by Navy personnel. Positions determined by differential GPS receivers are typically accurate to within about 1.3 meters of longitude and to within about 2.0 meters of latitude. Positions provided by Navy divers in diver logs and positions given in the Target table were determined using differential GPS. For this reason, Target table position values are more accurate that those provided by salvage personnel (who may not have had access to differential GPS equipment) on wreckage logs.

Error could also be introduced into the data base during data entry. For this reason, when entry was completed by one staff member, a second staff member checked the newly-entered records against the wreckage logs to correct data entry errors before filing the paper forms. In this manner, several typing errors were corrected immediately. Two complete paper-to-electronic audits of the Tags table were performed to further protect the system from data entry errors. These audits are discussed in the next section.

Paper-to-electronic audits

Although data center staff checked newly entered Tags table records for data entry errors before filing newly received wreckage logs, two paper-to-electronic audits were conducted to further protect the data base against data input errors. Additionally, the during the second such audit the recovery positions stored in the data base for ship tags were validated against all available recovery paperwork. Jim Case (SAIC) conducted both paper-to-electronic audits, which were extensive projects, each requiring several weeks to complete.

The first paper-to-electronic audit began in late-September, and was completed on November 5, 1996. Each wreckage log and updated wreckage log on file in the data center was compared with each corresponding record in the Tags data base. Data entry errors were corrected, a list of missing wreckage logs was created, and a list of tags requiring further validation was made. The list of missing wreckage logs was used to track down as much of this paperwork as possible, and ad hoc validation studies were conducted as needed.

This first paper-to-electronic audit validated the data base against the wreckage logs and updated wreckage logs, but it became obvious that it would also be necessary to validate the wreckage logs against the other recovery paperwork. Wreckage logs and updated wreckage logs were already being filed in binders, but other recovery paperwork was not available in the data center. Consequently, a concerted effort was undertaken to gather copies of all paperwork associated with the recovery operation to facilitate future validation efforts. Binders containing diver logs and FBI evidence logs were set up and maintained in the data center to be used in conjunction with the wreckage logs and updated wreckage logs in quality assurance activities.

After the dive operation concluded, a second paper-to-electronic audit was performed. The second paper-to-electronic audit not only validated the information in the Tags table against the wreckage logs and updated wreckage logs, it also validated the recovery positions given on wreckage logs using information in the Target table and diver logs. The recovery positions given in the Target table and in diver logs were often more accurate than those provided on wreckage logs (refer to the *Sources of potential error* section beginning on page 35 for more information). Although the first paper-to-electronic audit was essentially a quality assurance check to ensure that wreckage log information had been correctly typed into the data base, this second audit also validated that information, where possible.

During both paper-to-electronic audits, entries in the Tags table were compared against wreckage logs and updated wreckage logs, and any data entry errors were corrected. However, during the second audit, the recovery positions were further validated using Target table data and diver logs, where available. When an entry in the Tags table could be matched with an entry in

the Target table, the wreckage log recovery position was compared with the location of the assigned target in the Target table. Target table records were also used to locate any applicable diver logs. Descriptions and other information provided on these diver logs were used to ensure that the correct Target table records was identified for comparison, and they also provided additional sources of recovery position data.

Essentially, a hierarchy of paperwork was used during the second paper-to-electronic audit. If no Target table record or diver log could be located against which to validate the wreckage log recovery position for a given tag, the wreckage log position was used in the Tags table. Whenever a target number was available, the position given on the wreckage log was cross-checked with the information in the Target table. Small position discrepancies (less than about 30 meters) are within commercial GPS tolerance and were generally ignored. When the position discrepancies were larger, and definitive item descriptions were available, the position given in the Target table was used as the recovery position in the Tags table to correct for position reporting errors. Dive logs were also consulted, to assist in these determinations. Because many items were recovered after multiple dives (often by different divers on different days, each supplying GPS readings), several independent recovery positions were often available. Generally, if a value was in error, it would emerge as significantly different from the others, and the remaining positions would closely mach the values in the Target table. This provided converging evidence that the Target table position was the best one available.

Out-of-area tag problem

Each time data center staff used latitude and longitude values in the Tags table to generate plots of recovered items, tags of one color were noted to plot in a debris field of another color. For example, an item that is described in the data base as a "food cart w/4 drawers" was recovered from latitude 40 38 57.40, longitude -72 39 10.60. Although this position is in the Red zone, the item was assigned *yellow* tag B083. Consequently, this "yellow" item plotted in the Red zone. Ship tags such as this became known as out-of-area (OOA) tags.

Throughout the investigation, several OOA tags came to the attention of data center staff, usually because hangar staff requested an ad hoc validation study of such pieces. Although it was clear that a global audit of these pieces would eventually be required, there was an immediate need to develop a procedure to correct tags whose colors were found to be incorrect using the ad hoc validation procedure (see *Appendix 7: Ad hoc validation procedure*).

Such a correction procedure was created in late-September, 1996, and it appears in *Appendix 8: Tag renumbering procedure.*[24] This procedure was used to correct OOA tags and was also used to change the tag color of hangar-tagged items, when needed. Essentially, the procedure involved replacing the incorrect tag with a correctly-colored 2000-series tag and

[24] At the time the procedure was created, data center staff were aware of 56 out-of-area tags. Of these 56 tags, a verifiable recovery position was available for 43, 8 had not yet been verified, and 5 were personal effects. Twenty of these 56 items had been recovered by mobile dive teams. This information was briefed at a progress meeting that occurred on September 25, 1996.

documenting these changes by filing a notice with the original wreckage log and also filing an updated wreckage log for the new (exempt) 2000-series tag.[25,26] There was never a global effort to validate and correct all of the OOA tags using this procedure; however, it was used on an as-needed basis when OOA tags were brought to the attention of data center staff. A search of data center files revealed five OOA tags that were corrected by retagging. These are listed in Table 4, and each is discussed in the *Specific data issues* section of this report (specific page references are provided in the table). A global audit of the remaining OOA tags was undertaken later as part of the hangar tag validation project, and this effort is documented beginning on page 58.

Table 4: Out of area retagging actions prior to hangar tag audit.

Original tag	Retagged as	Log number(s)	See report page
B003	C2447, C2448	CW704B, CW704A	48
B004	C2151	RW7, CW104, CW301, CW707	55
B061	A2048	LF14A	49
B561	A2031	RF21	53
Z3453	X2201	LF74	53

Hangar floor audits

As the hangar operation progressed, hangar staff sorted parts by aircraft section (e.g., left wing, empennage). Each of these sections was audited, most more than once. Floor audits were conducted to ensure maximum agreement between the data in the Tags table and the physical tags and parts on the hangar floor. Audits were conducted by data center staff members in accordance with the procedure that appears in *Appendix 9: Hangar floor audit procedure.* Each of these audits required several days and involved creating an inventory of the parts in the section, and noting the tag numbers and lot numbers on each. Further, any log numbers assigned to pieces of the aircraft structure (or seat numbers) were recorded. This information was compared with data stored in the Tags table and used to resolve discrepancies (such as duplicated log numbers) and enter data that had been previously unavailable (such as FBI lot numbers).

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[25] Because this procedure involved removing ship tags, data center staff were concerned that it could adversely affect the FBI's evidence chain of custody procedures. Before the procedure was implemented, it was discussed with the head of the ERT team (Sue Cheslack) who agreed that it was appropriate because it was designed to correct errors made before items reached the hangar.

[26] It should also be noted that after this procedure was also used to correct hangar tagging errors before the hangar tag validation project. For example, if a color coded hangar tag was assigned to an item from a mixed lot, the tag was removed and replaced with a white 2000-series tag. Data center staff became aware that some members of the investigative team preferred that the original tags not be removed. This led to an informal "white tag added" procedure for those cases where recovery information was unavailable. Instead of removing a tag to replace it with a white hangar tag to indicate that that an item's recovery position was unknown, hangar staff began adding an unnumbered white tag to signify this. There is no difference between (1) replacing a color-coded tag with a white tag, and (2) adding a white tag to an item with a color-coded tag. Both signify that the recovery position is unknown, and "White" was entered as the debris field code for the item in the Tags table.

Further, physical audits of the hangar floor provided an opportunity for data center staff to check for tagged items in the hangar for which corresponding wreckage logs had not yet arrived in the data center. When such undocumented tags were found, staff were usually able to track down the appropriate paperwork. Table 5 lists floor audit completion dates by each section audited.

Table 5: Floor audit completion dates by aircraft section audited.

Aircraft section	Audit dates
Center wing tank	10/05/96, 11/07/96, 2/02/97
Empennage	12/18/96, 1/09/97
Landing gear	12/18/96, 1/08/97
Left fuselage	11/22/96
Left wing	11/06/96, 12/08/96, 1/27/97
Powerplants	4/20/97
Right fuselage	11/22/96
Right wing	7/10/96, 11/16/96, 1/21/97
Seats	10/07/96, 12/05/96

Tag duplication study

Tag numbers in the Tags table serve as unique identifiers, but some ship tags were inadvertently duplicated during the dive operation.[27] These were handled on an ad hoc basis as they came to the attention of data center staff. When wreckage logs were received with duplicate tag numbers, a suffix letter was appended to one or more tag numbers to resolve any ambiguous references. By mid-April, 1996, data center staff had resolved 23 tags that had been duplicated once and 2 tags that had been duplicated twice (for a total of 52 records affected by suffix additions). At that time, a global search for duplicated tags that were unknown to data center staff was made. Seven additional tags that were duplicated once were found during this study.

This study involved searching the FBI evidence logs for tag numbers that were members of more than one FBI lot. When more than one reference to a tag number was found in the FBI logs, Tags table records were created with suffix letters appended to ensure that a unique tag number was stored in the table for each duplicated tag logged. For example, the FBI logs contained two references to tag A438, but only one entry existed in the Tags table. Consequently, a second record was created for tag A438A.

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[27] All tags were manually numbered, so duplications were possible. To avoid duplication, all tags were pre-numbered at one central location, and no blank tags were distributed. Tags were usually pre-numbered by personnel at Moriches in blocks of 50, and then counted prior to distribution to guard against duplication. A log of tag numbers issued was maintained to further avoid duplication.

The tag duplication study resulted in the creation of seven additional Tags table records: A438A, A475A, A614A, C300A, Z3226A, Z3536A, and Z5093A. These 7 new records with suffix letters correspond to 7 previously-existing records for tag numbers without suffix letters (for a grand total of 66 records affected by suffix additions). Wreckage logs and Target table data were then searched for descriptions of these "new" items. These descriptions were used to determine which FBI lot number was actually assigned to which item within each duplicated pair. Then, a search was made of the hangar floor for each of the duplicated tags to determine which item in each duplicated pair was actually tagged with the tag number that did not have a suffix added to the tag number. Finally, a search of the Tags table was made to ensure that the correct description, FBI lot numbers, and target numbers were stored for each of the items in the duplicated pairs. Table 6 contains information concerning the seven duplicated tag numbers that were found during this study.

Table 6: Duplicated tags identified during tag duplication study.

Tag #	Log #	Debris Field	Latitude	Longitude	FBI #	Description
A614	LF37A	Red	40 38 28.29	-72 38 49.71	8/12/96-4	forward lower cargo bay structure FS 800 left hand side
A614A					8/16/96-10	piece of frame - (possibly A614)
A438		Red	40 38 57.40	-72 38 37.80	8/15/96-11	clothing
A438A		Red	40 39 53.92	-72 38 40.36	8/15/96-6	
A475	CW604	Red	40 38 32.09	-72 38 55.64	8/19/96-11	SWB #3, LH web, LBL 20-83
A475A					8/20/96-13	
Z3226		Green	40 39 48.47	-72 37 02.59		misc. metal debris
Z3226A		Green	40 39 41.91	-72 38 18.16	10/2/96-1	"grey/green metal piece of skin, one life preserver, one tee-shirt, one foot long green metal ladder-shaped piece"
C300		Green	40 39 42.00	-72 37 22.00	8/11/96-2	#3 engine
C300A		Green	40 39 43.00	-72 37 23.00	8/10/96-16	duct work section
Z3536		Green	40 39 45.70	-72 37 30.90	9/26/96-17	luggage, personal effects
Z3536A					9/27/96-1	metal debris / misc. debris
Z5093		Orange	40 39 36.83	-72 38 18.16	10/26/96-7	aircraft skin
Z5093A		Orange	40 39 40.10	-72 38 33.75	10/26/96-6	aircraft skin

Undocumented tags

Some items were entered into the Tags table without receipt of a paper wreckage log. A search was made of the data base, and 109 such undocumented entries were found (a list appears in *Appendix 10: Undocumented tags.* Because the newly-created Tags table was initially populated using data from spreadsheets that were in use when the data center was set up (sometimes referred to as the early QA list), most of these undocumented items were initial entries in the Tags table.

Although wreckage logs were filled out for these items and used to enter the information about them into the early spreadsheets, wreckage logs for the 109 undocumented items were never available to data center staff in the hangar. Consequently, recovery position information for these items was determined from the spreadsheets. During the data center's operation in the hangar, it was believed that this was a source of accurate information, and that the absence of a paper wreckage log was not significant. In fact, computer-printed wreckage logs were generated and filed for many of these items because the data management team had no reason to question the data from the early QA list. However, in producing the list that appears in the appendix, it was noted that most of the undocumented tags are contained in a single range of low-numbered B-series tags (B001-B080). This range includes several tags that have been shown to be out-of-area tags. These include B003 (see *CW704A and CW704B* on page 48), B004 (see *RW7, CW104, CW301, and CW707* on page 55) and B061 [see *LF14A (and RF1)* on page 48]. These tags do not appear on the list of undocumented tags in the appendix because they have been resolved. Although the tags that do appear on the list are not necessarily invalid, there must remain some concern over the validity of the recovery data associated with them because no recovery paperwork is available for these items.

Miscellaneous

On April 19-20, 1997, in preparation for freezing the data base, several global changes were made to the data in the Tags table. All references to human bodies (e.g., bone, tooth, flesh, skull) were changed to "human remains." All descriptions of personal articles (e.g., cameras, passports, watches) were changed to "personal effects." All specifically described articles of clothing (e.g., a blue shirt or a green dress) were changed to "clothing." All items described as backpacks, carry-on bags, suitcases, and the like were changed to "luggage." Word capitalization was standardized, and several spelling errors were corrected. Finally, several inconsistent abbreviations were standardized (these appear in *Appendix 2: Glossary of terms and abbreviations*).

Wreckage logs not in Tags table

Well after the data base was frozen, a wreckage log that had not been entered into the data base was found filed with FBI ERT paperwork. This prompted a complete search of the ERT log books for any other wreckage logs filed there that had not been entered into the data base. A total of 7 wreckage logs documenting tagged items that had not been entered into the Tags table was found. Each of these is detailed in Table 7. While conducting this audit, an anomaly concerning FBI lot 10/03/96-4 was noted. This anomaly does not affect data in the Tags table,

but could have affected hangar tagging. Refer to the Lot 10/03/96-4 section on page 62 for a discussion of this anomaly.

Table 7: Data from wreckage logs not in Tags table.

Tag	Target	Date	Time	Description	Latitude	Longitude
W5021		10/31/96	0500	Personal effects recovered by fishing trawler	40 21 56.88	-72 26 21.84
Z1725	PS4186	10/10/96	1131	Row 29 seats 8, 9, and 10	40 40 16.43	-72 37 48.03
Z1726	PS20476	10/10/96	1138	Debris	40 40 42.47	-72 37 34.29
Z1727	PS20479	10/10/96	1138	VCR tape	40 39 46.78	-72 36 43.48
Z1728	PS20478	10/10/96	1138	Debris	40 39 45.67	-72 36 38.29
Z1729	PS20466	10/10/96	1203	Debris	40 39 43.49	-72 36 30.28
Z1730	PS20468	10/10/96	1203	Debris	40 39 44.28	-72 37 22.71
Z1763	DIG414	10/02/96	1345	3 pieces of debris	40 39 34.75	-72 36 24.13
Z1764	AJ35146	10/02/96	1230	Large piece of debris (I-beam?)	40 38 23.82	-72 36 01.80
Z1765	LLS462	10/02/96	1350	Debris	40 39 37.51	-72 36 16.14
Z1766	DIG392	10/02/96	1345	Debris	40 39 35.99	-72 36 32.66
Z1767	DIG435	10/02/96	1350	Debris	40 39 41.69	-72 36 35.50
Z1768	DIG374	10/02/96	1350	Debris and plastic bag containing unknown contents	40 39 37.60	-72 36 27.00
Z1769	DIG382	10/02/96	1350	Plastic bag containing 1 photo, 1 small piece of honeycomb fiber	40 39 38.65	-72 36 28.31
Z1770	DIG382	10/02/96	1350	Canvas type debris and metal debris	40 39 38.65	-72 36 28.31
Z1771	LLS516		1350	Plastic bag containing personal effects and debris - seatbelt	40 39 37.86	-72 36 34.77

Other validation issues

After the data base was frozen, representatives of the FBI and the cabin interior group asked for clarification about certain tagging issues. A series of meetings was held in which these issues were discussed, and some errors were found in the data base. A summary of these meetings appears in *Appendix 17: Summary of meetings with representatives of the FBI and the cabin interior group.* The activities reported in this appendix represent a further audit of tags

assigned to certain cabin interior items, conducted with the cabin interior group. No corresponding audit was undertaken for any other tags because no other investigative groups requested such an effort.

Specific data issues

This section reports the results of several special studies conducted to validate recovery locations for parts. These studies were conducted on an ad hoc basis when requested by hangar staff. Regardless of whether these studies resulted in retagging or changes being made to the data base, a report was written and filed in the data center. Each of these reports has been abstracted here. Because each of the individual reports was written prior to the completion of the hangar operation, each was based on preliminary information. Each has been abstracted in this document using final information. Therefore, this document supersedes any prior validation reports produced by data center staff.

CVR and FDR

The cockpit voice recorder (CVR) and flight data recorder (FDR) were recovered off the *Grasp* on July 24, 1996, but were not tagged. July 24, 1996, was one of the *Grasp*'s first days in a three-point moor in the Green zone. Although the CVR and FDR were not tagged, a search of the Target table located two targets of interest: Target GRS40 and target 2064.2S. Target GRS40 was assigned to latitude 40 39 54.00, longitude -72 37 30.00 following an ROV visual identification described as "CVR & FDR (Black Boxes)." Target 2064.2S was assigned to a sonar return detected by the *Rude* at latitude 40 39 47.04, longitude -72 37 28.84. Although these positions are only about 700 feet apart, the position of target 2064.2S is assumed to be more accurate because it was established via sonar equipment.

No dive reports associated with target GRS40 could be located, but 2 dive reports associated with target 2064.2S were filed (724-26 and 724-27). Both dive reports refer to the recovery of the two recorders and give their recovery locations as latitude 40 39 46.64, longitude -72 37 29.30. It is concluded that the CVR and FDR were recovered from the Green zone near this position.

A102 and A413

A102 and A413 are each the lower plates of galley service cart stow bins. The two items were recovered at the same location (within GPS tolerance) in the Red zone.

A102 was recovered by a mobile dive team prosecuting target LLS5 on August 3, 1996. Diver log 803-25 corresponds to the recovery of A102. The recovery position given for the target, and by the dive team on dive log 803-25, and on the wreckage log is latitude 40 38 59.74, longitude -72 39 02.41, which is in the Red zone.

A413 was recovered on August 14, 1996, while a mobile dive team was diving on sonar target DIG11 at latitude 40 38 59.90, longitude -72 39 01.20. Diver log 814-25 corresponds to the recovery of A102. Diver report 814-25 and the wreckage log give these coordinates as the recovery position, but poor handwriting on the wreckage log caused the latitude to be incorrectly entered in the Tags table as 40 38 39.90. On March 3, 1997, an updated wreckage log was filed

and this error was corrected in the Tags table. A413 was recovered in the Red zone from latitude 40 38 59.90, longitude -72 39 01.20.

B163 tag duplications

Several tags with the number B163 were found in multiple locations loose in the hangar. The wreckage log for B163 has a description of the part as a "dumb waiter," but the data base depicts B163 as seat 4 (9). Throughout the course of the hangar operation, at least five B163 tags have been found loose on the main hanger floor.

Seat 4 (9) has FBI lot number 8/05/96-3. An audit of the cabin hanger found that seat 4 (9) had once been tagged as B163, but it was untagged at the time of the audit. The seat was hangar-tagged B2069 using B163 as the source tag. Because tag B163 was obviously duplicated several times, using B163 as a source tag for that seat, or for any other hangar-tagged part, could be misleading. Consequently, the Tags table record for tag B163 reflects that is was changed to tag B2069, and the debris field record for B2069 notes that its debris field is white. This issue is further discussed in the section concerning the hangar tag validation project (see *Validity determinations* beginning on page 59).

C186 and C301

This section validates the recovery locations of the right wing (C186) and the number three engine (C301) and discusses their undersea separation distances prior to recovery.

C186 (RW3)

The wing part identified by the structures group as RW3 has two diver reports (808-4 and 808-13) and one wreckage log supporting the validity of the Tags data base information. David Mayer (NTSB) and James Case (SAIC) visually inspected RW3 on March 12, 1997, and found two C186 tags on it. RW3 includes the centerline of the nacelle of the number three engine.

Recovery positions provided in the two dive reports differ slightly for this piece: Dive report 808-4 gives the recovery position as latitude 40 39 43.99, longitude -72 37 19.76; report 808-13 gives the recovery position as latitude 40 39 43.66, longitude -72 37 22.17. These two GPS readings correspond to points that are about 189 feet apart.

C301 (number three engine)

Using data center paperwork, photographs contained within the powerplants factual report, and visual inspection of the engine, David Mayer and James Case confirmed that C301 is the correct tag number for the number three engine. Although the tag is no longer attached to the engine it was found near it (it was likely removed during teardown). A wreckage log does not exist for tag C301, but the visual identification and supporting diver report paperwork show conclusively that the data for C301 is valid. Five dive reports (808-1, 808-2, 808-3, 808-14, and 808-15) pertain to the number three engine.

One of the diver logs does not contain a recovery position, but two different positions are given in the other four logs Dive reports 808-2 and 808-3 give latitude 40 39 43.31, longitude -72 37 22.83. Dive reports 808-14 and 808-15 give the position as latitude 40 39 43.66, longitude -72 37 22.17. These two GPS readings correspond to points that are about 62 feet apart.

Summary

It is concluded that the number three engine was found on the sea floor very close to RW3. Based on the two recovery positions given for each piece, and considering GPS tolerance, the number three engine was found no more than about 247 feet from RW3 (see Figure 2).

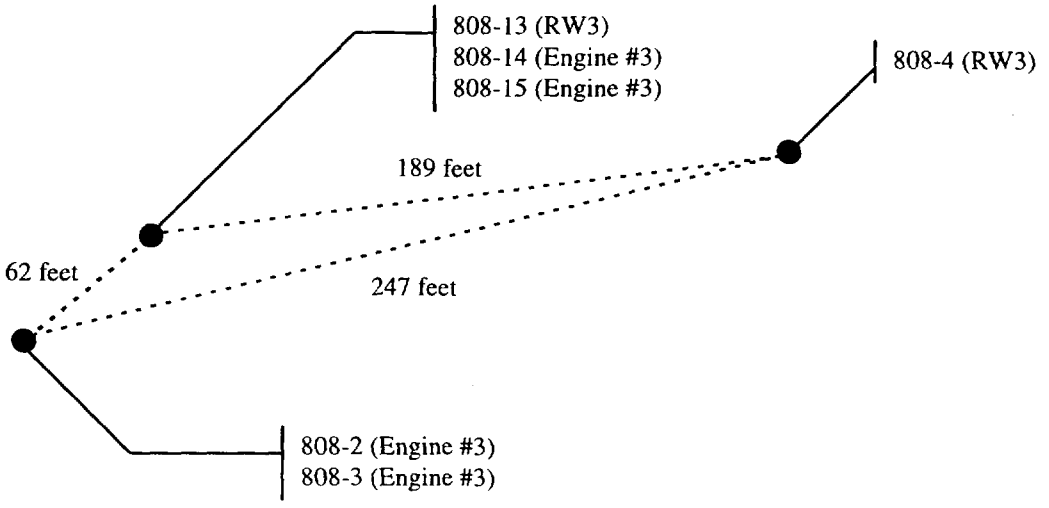

Figure 2: Separation distance of number three engine from RW3.

CW504

Structures group log number CW504 was assigned to A236, which is a part of the wing center section front spar web.

On August 5, 1996, the *Diane G* identified target LLS367 at latitude 40 38 45.26, longitude -72 39 51.96. A mobile dive team recovered this item on August 7, 1996, and filed dive report 807-42. Tag A236 was assigned to the recovered item. The diver sketch and description of the recovered part match CW504.

The laser line scan image associated with target LLS367 was compared to the physical part on the hangar floor by David Mayer (NTSB), Phil Goodwin (Oceaneering), and by other hangar staff. It was determined that the underwater image matches CW504. The same position given in the Target table (latitude 40 38 45.26, longitude -72 39 51.96) is overprinted on the laser line scan image. The laser line scan navigational system relies on a dual redundant differential GPS system to validate navigation information. When an image is captured, the

latitude/longitude will only print if both systems agree (within tolerance), otherwise an error message is printed. CW504 was recovered from the Red zone at latitude 40 38 45.26, longitude -72 39 51.96.

CW704A and CW704B

CW704A was originally tagged as B003 and a piece that was cut from it (CW704B) was subsequently assigned hangar tag B2003. In the data base, CW704A is described as "SWB #2, RBL 33-3," and CW704B has the description, "SWB #2 RBL 11 stiffener." Because surrounding parts were recovered from the Green zone, the actual recovery position of B003 was questioned.

Bob Swaim (NTSB) and Kelvin Deane (Boeing) remember B003 being pulled out of the water on the starboard side of the *Grasp* by surface-supplied divers on July 26, 1996. On this date, *Grasp* was in a three-point moor in the Green zone at latitude 40 39 48.00, and longitude -72 37 30.00 (± 50 meters). Kelvin Deane drew a sketch of this piece (dated July 27, 1996), which matches the piece Bob Swaim remembers being recovered by *Grasp*.

B003 was recovered from the Green debris field, but incorrectly assigned a yellow tag. Consequently, CW704A was retagged with green tag C2448 to replace B003, and CW704B was retagged as C2447 to replace B003. Source tag C261 was used for both C2447 and C2448.

CW911

CW911 was hangar tagged with red tag A2054 using A254 as the source tag. CW911 is marked with FBI lot number 8/08/96-14. In the FBI evidence logs, 31 tag numbers are listed for 8/08/96-14. All 31 of these tags are from the Red zone, consequently, CW911 was given a red tag.

In early December, 1996, is became apparent that FBI lot number 8/08/96-14 was a mixed lot. The large section of the right wing was given two FBI #s 8/08/96-14 and 8/08/96-30. There are pictures of the right wing on the deck of the *Grasp*, and there is no doubt this piece was recovered from the Green zone. Further, RW32 (C210) has FBI lot number 8/08/96-14. The FBI evidence logs show C210 as having been assigned lot number 8/08/96-30. Apparently, several items that should have received FBI lot number 8/08/96-30 received lot number 8/08/96-14 instead. These incorrectly logged parts invalidate FBI lot 8/08/96-14 for hangar tagging purposes. Consequently, CW911 (along with other parts from lot 8/08/96-14) that had been hangar tagged, were retagged to white. (See the *Hangar tag validation project* section beginning on page 57 for more information about hangar tagging, and refer to the section on *Lot 8/08/96-14* on page 61 for a specific discussion of this lot.)

LF14A, LF14B, LF14C and RF1

The keel beam is in three large pieces with many smaller pieces. LF14A is the forward portion of the keel beam. LF14B and LF14C are the two aft sections of the keel beam. Because

LF14A was found near RF1, the section concerning LF14A also provides a validation of the recovery position of RF1.

LF14A (and RF1)

This portion of the keel beam was originally tagged as B061, but the validity of this yellow tag was questioned. No description of B061 was available in the Tags table, and no Target table record or wreckage log was available for B061 (see the discussion of *Undocumented tags* on page 42). Consequently, a search of underwater videotapes was made. In November, 1996, LF14A was found on a dive videotape. Three pieces of wreckage are seen on this tape: No identification was made of the first piece, but the second is RF1 (A004), and the third is LF14A.

A004 was recovered while prosecuting target 2686.7P at latitude 40 38 41.29, longitude -72 39 15.25. The Target table lists several other targets at or near these coordinates. The diver reports associated with recoveries made while prosecuting these targets were examined, and one was found to match LF14A.

Diver log 729-17 describes a 20-foot long by 1½-foot wide by 3-foot tall "box" recovered while diving target 12738.9S. This target number was assigned to a sonar return discovered at latitude 40 38 41.50, longitude -72 39 15.20. The description and sketch on the diver log match LF14A. The description given for the item recovered notes that "A/C service lamp L222" is marked on the part, and this notation is found near the forward lamp on the left side of LF14A. Therefore, LF14A was recovered from latitude 40 38 41.5, longitude -72 39 15.2, which is in the Red zone. Consequently, LF14A was retagged as A2048 in November, 1996.[28]

The recovery position of the LF14A was questioned again. The recovery position of this piece came into question because the paper label affixed to the videotape used to determine that LF14A was recovered near RF1 contained apparently erroneous information. Further, the recovery position of RF1 was also questioned. The recovery position of LF14A that justified retagging the item to A2048 was based on information provided in diver log 729-17; not on information on the videotape label or on any supporting paperwork associated with RF1; however, further research was conducted in September and October, 1997.

The label on the videotape that shows LF14A near RF1 appears as Figure 3. On this videotape, a diver is seen examining and manipulating RF1 and then swimming for about 2½ minutes before encountering LF14A. This established that the two pieces were found in close proximity, but some information on the videotape label requires clarification.

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[28] Although dive report 729-17 gives the position of LF14A as latitude 40 38 41.5, longitude -72 39 15.2, the recovery position of RF1 (A004) was entered into the Tags table because it was thought to be the most precise measurement available at the time. This position is latitude 40 38 41.29, longitude -72 39 15.25.

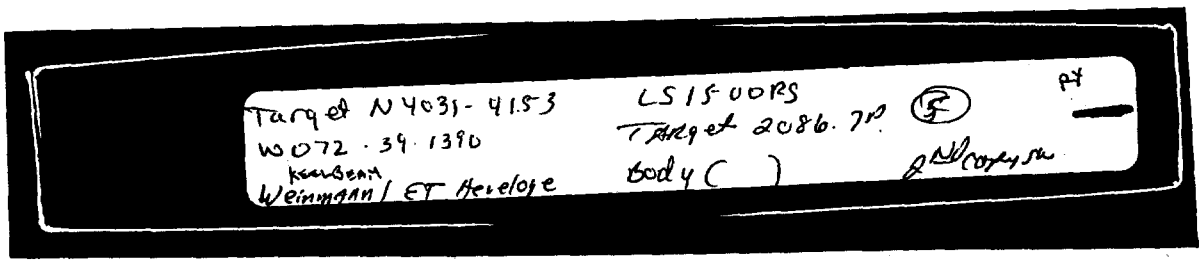

Figure 3: Label from diver videotape that shows LF14A in close proximity to RF1 on sea floor prior to recovery

The marking "N 4031 - 41.53" appears following the word "Target."[29] Underneath this marking is "W 072 39 1390," which clearly corresponds to longitude -72 39 13.90. The tape label also contains notations "Keel Beam" and "Target 2086.7P." The divers' names ("Weinmann / ET Hereloge") are also present on the label. Finally, the notation "2nd copy sw" is present in the lower right corner of the label. The FBI duplicated all original diver and ROV videotapes and provided copies with hand copied labels to the NTSB. Consequently, NTSB investigators examined the original tape and original label at the New York Office of the FBI to determine if the program material on the tapes and the information on the labels were identical.

The FBI video technician who duplicated the tape provided the original to NTSB investigators and viewed it with them. It was agreed that the two tapes contain identical program material, but the labels differed slightly. The original tape label has the notation "Target 2686.7P," and it also has the notation that the tape was made by EOD dive team No. 1 during Dive No. 4. The words "keel beam" do not appear on the original label, because they were added in the hangar well after the tape was duplicated.

A search of the Target table was made for target 2086.7P, but no target by this number was found. However, target number 2686.7P is a valid target number. Target 2686.7P was established at latitude 40 38 41.29, longitude -72 39 15.25 by the search vessel *Rude* using side scan sonar. Dive reports 724-2 and 724-16 describe the prosecution of this target.[30]

Dive report 724-2 notes that it was filed by "EOD #1" for "Dive #4," and also notes that the divers were prosecuting target 2686.7P on this dive. The target sketch provided on the report is of a rectangular box-like structure, and the dimensions given are 10-feet long by 24-inches wide by 36-inches tall. The dive report gives latitude 40 31 41.53 and longitude -72 39 13.90 as

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[29] This notation was originally believed to represent a target number, but the target number is given elsewhere on the label. This marking is actually describes a latitude of 40 31 41.53, but no diving was conducted at this latitude. This error is discussed below.

[30] These dive reports were filed by different divers who each conducted dives on target 2686.7P on July 24, 1996. According to the reports, the dive described in report 724-16 began at 14:08.39 and concluded at 14:24.48. The dive documented in report 724-2 commenced at 1500 and ended at 1516.

the location of the item. These coordinates exactly match those written on the videotape label. Dive report 724-2 was filed by divers Weinmann and Etheredge. Diver Weinmann's name appears on the videotape label and diver Etheredge's name was apparently incorrectly written as "ET Hereloge" on the tape label. However, it is concluded that dive report 724-2 is the report that corresponds to the videotape on which LF14A and RF1 are seen in close proximity.

Mobile (EOD) dive teams were assigned to dive at the locations of previously established targets. On discovery that items at their assigned target locations required recovery (as opposed to a false echo or a biologic target), divers usually provided an independent GPS position reading for the item to be recovered. The divers who filed dive report 724-2 were assigned to dive target 2686.7P at latitude 40 38 41.29, longitude -72 39 15.25. The position that they supplied on the dive report for the box-like structure they discovered while diving this target was latitude 40 31 41.53, longitude -72 39 13.90. This position corresponds to a location approximately 6 nautical miles south of the southern boundary of the Red zone, and is clearly in error. However, the error must lie in the minutes of latitude given on the dive report. Because they were assigned to dive a target at 40 38 41.29, longitude -72 39 15.25, it is reasonable to conclude that the independent GPS reading the divers intended to report was latitude 40 38 41.53, longitude -72 39 13.90. This conclusion is justified because this position is the identical independent position that other divers gave for target 2686.7P on dive report 724-16.

It is concluded that the keel beam was recovered from a position very near latitude 40 38 41.53, longitude -72 39 13.90. because this closely corresponds to the position determined in November, 1996, it is further concluded that dive report 724-2, along with the videotape record of this dive, provide independent support for the recovery position of the keel beam.

Because the videotape clearly shows that LF14A was located on the sea floor a short distance (about a 2½-minute swim) from RF1, the recovery position of LF14A can be further confirmed by verifying the recovery position of RF1. It was stated above that dive report 724-16 corresponds to target 2686.7P. The diver sketch and dimensions provided on this report are similar to RF-1. The object was described as 15-feet long, 5-feet tall, and 8-feet long; and the sketch notes that the metal is curled. This description is consistent with RF1. The Target table notes that the tag A004 was assigned to an object recovered from target 2686.7P. The structures group assigned log number RF1 to the item with tag A004. The position given in the Tags table for A004 is latitude 40 38 41.29, longitude -72 39 15.25. This very closely corresponds to the position given in dive report 724-16 of latitude 40 38 41.53, -72 39 13.90. It is concluded that the recovery position given in the Tags table for RF1 is accurate. It is also concluded that this information provides further, independent evidence that LF14A was recovered from close proximity to this position.

Finally, another source of independent information about the recovery location of RF1 is available. It was not uncommon for undersea items to be identified more than once, sometimes by different search techniques. This often resulted in multiple target numbers for the same item. Target number LLS38 was a laser line scan target established at latitude 40 38 41.25, longitude -72 39 14.89. Investigators examining this laser line scan image in the Calverton hangar on October 8, 1997, concluded that the item depicted is RF1. Jim Wildey (NTSB), Dan Rephlo (TWA), Kurt Hobschaidt (ALPA), and Bob DeSantis (FBI) concurred in this determination. The

laser line scan navigational system relies on a dual redundant differential GPS system to validate navigation information. When an image is captured, the latitude/longitude will only print if both systems agree (within tolerance), otherwise an error message is printed. Because latitude 40 38 41.25, longitude -72 39 14.89 is printed on the image of LLS38, it is concluded that RF1 was recovered from this position.

LF14B & LF14C

Pictures of LF14B and LF14C were taken by FBI photographer D.J. Brown as the parts were being unloaded at Shinnecock on August 8, 1996. Bob Harrowel (Boeing) remembers that a portion of LF14C was wedged into LF14B through a puncture on LF14B, and that a significant effort was required for hangar staff to separate them. These two pieces are seen wedged into one another in the FBI photos. It is concluded that LF14B and LF14C were found at the same location.

In the photos, no tags are visible on LF14B or LF14C, but pieces with green tags C219, C252, and C231 are clearly visible with LF14B and LF14C first in a Mike boat, and then being unloaded from the Mike boat. Based on these pictures, LF14B and LF14C were given green 2000-series tags. C2481 was assigned to LF14B. C2479 and C2480 were assigned to LF14C, which is currently in two pieces because it broke during the reconstruction project.

Joe Rzeszotko (ALPA) did most of the research on LF14B & LF14C and wrote a memo dated March 6, 1997, concurring with the decision to tag both pieces green.

LW5 and LW6 (A2018)

Structures log number LW5 was assigned to the lower surface of the left wing tip, and log number LW6 was assigned to the upper surface of the left wing tip. LW5 and LW6 were recovered as one piece of wreckage, but were apparently not assigned a ship tag. After its arrival in the hangar, it was assigned red hangar tag A2018. The item is part of FBI lot number 8/06/96-46. Twenty-eight items recovered by mobile dive teams working in the Red zone were logged in by the FBI and assigned to lot 8/06/96-46; however, substantial pieces of the left fuselage recovered from the Green zone were discovered in the hangar marked with lot number 8/06/96-46. Examples of such items include C146 (LF27B), C147 (LF28B), C148 (LF48), C149 (LF27), C154 (LF28A), C139 (LF13B) C154 (LF28A), and C155 (no log number). Like the left wing tip, many of these pieces were too large to have been recovered by a mobile dive team. These are ship-tagged pieces with reliable recovery position data. These pieces were all recovered from the Green zone at latitude 40 39 47.00, longitude -72 37 27.90. The left wing tip may have also been recovered from this position.

The discovery of ship-tagged items from the Green zone in lot 8/06/96-46 that had not been logged in the FBI evidence logs caused the data center to begin treating lot 8/06/96-46 as a mixed lot for hangar tagging purposes. Consequently, a white tag was added to A2018 to denote that its recovery position is unknown. (Refer to the section on *Hangar tag validation project* beginning on page 57 for more information about hangar tagging procedures).

RF21

B561 was recovered from the Red zone (latitude 40 38 21.75, longitude -72 38 27.64), but was incorrectly assigned a yellow tag (an out-of-area tag). The structures group assigned log number RF21 to B561, and described the part as "body crown fuselage" from FS 960. The target number for B561 is LLS314, which was established in the Red zone at latitude 40 38 21.75, longitude -72 38 27.64. The yellow tag B561 was removed and a red tag A2031 was placed on the part to match the associated target location.

RF35

A421 was assigned structures group log number RF35, but became commonly known as the "TR piece." This piece was recovered form a position just south of the original southern boundary of the Red zone. RF35 was cut in the hangar, and the cut portion was hangar-tagged as A2068. In the data base, A421 is described as "right side fuselage with 4 windows FS 860-940 STR 19R-25R," and A2068 is described as "right side fuselage with letters "TR" S6R-19R FS 855-960."

This piece was located during a sonar search conducted by the *Pirouette* on August 8, 1996. It was assigned target number 232. Finding a piece just south of the Red zone was unexpected, and Rick Horgan (Oceaneering) remembers finding the "TR piece" in this location. It was recovered on August 14, 1996, by a mobile dive team on two dives, so two diver logs were filed (814-1 and 814-2). The dimensions and sketches given on these logs closely match the part. The location of target 232 (latitude 40 37 58.5, longitude -72 38 51.2) closely agrees with the position given for the recovery of A421 on the wreckage log (latitude 40 37 54.37, longitude -72 38 53.54), and on dive report 814-1 (latitude 40 37 58.60, longitude -72 38 51.10). The position given on dive report 814-2 (latitude 40 38 30.71, longitude -72 38 39.22) is dissimilar from any other position in the paper trail, and is assumed to be in error. This position is in the Red zone, but located about 2,800 feet from the average of the other three positions. The piece was correctly assigned a red tag, and no changes were made.

LF74

LF74 was originally tagged with green tag Z3453. The wreckage log for Z3453 does not give a recovery position, but gives target number PS2034. This target number does not exist in the Target table; however, target PS20384 does exist, and it corresponds to LF74.

The initial description given in diver report 923-46 for target PS20384 was, "8'x6' section of skin," which was assigned tag Z3453. A sketch of the recovered item matches the part on the hangar floor. The recovery position given is latitude 40 38 05.24, longitude -72 38 37.29. This position is in the Red zone, but the piece was incorrectly assigned a green tag (an out-of-area tag). LF74 was retagged with red tag X2201 to reflect the correct debris field.

RF67 (C1674 & C1696)

In the reconstruction, RF67 has one green tag (C1674) attached to the wire bundle. This wire bundle is firmly attached to the fuselage skin that makes up RF67. In the structures notes, RF67 is identified as tag number C1696 and C1674. Bob Whitington (Boeing) made a sketch of this piece. On this sketch tag C1696 is clearly seen. The recovery positions and FBI lot numbers for C1674 and C1696 are identical. Apparently, this piece was tagged twice.

RF84, RF87, RF88, RF89, RF91, RF107

All of these pieces were tagged in the hangar. Because they were not ship tagged, no wreckage logs are on file, and no dive reports or underwater videotape documentation has been identified that corresponds to any of these pieces. Consequently, no specific recovery position can be determined for these items.

All of these parts are associated with FBI lot number 8/04/96-66. They were assigned red 2000-series tags as follows: RF84 (A2030), RF87 (A2032), RF88 (A2025), RF89 (A2020), RF91 (A2021), RF107 (A2022). Some structures group members questioned whether the correct debris field color code was assigned to these pieces because adjacent parts with similar damage were recovered from the Yellow zone.

All 25 tagged parts associated with lot 8/04/96-65 (the prior shipment) were from the Yellow zone, but all 30 parts in lot 8/04/96-66 were from the Red zone. Mobile dive teams were working both the Red and Yellow zones on August 4, 1996, and is possible that untagged parts were mixed up, but there is no evidence of this in the paperwork. In accordance with the final hangar tagging validation effort (see *Hangar tag validation project* beginning on page 57) lot 8/04/96-66 is a valid, red lot, and there appears no reason to exempt these items from that validation effort.

RF117 (Z4076)

In the structures notes, part RF117 is shown to have been tagged as T6019. This is a green trawler bag tag associated with FBI lot number 11/11/96-20, not a single-item tag. The correct tag number series for a item recovered from the Green zone by a trawler is the Z4000 series. As a result, RF117 was given tag C4076. Two updated wreckage logs (C4075 and C4076) were forwarded to the data center for RF117 by Gary Graham (IAM Local 1997). Both UWLs described the part as "FS 920-980 STR 0-5R, skin with stringer."

On March 22, 1997, Philip Goodwin (Oceaneering) examined this piece with Gary Graham. It was found tagged as C4076. Consequently, C4075 was removed from the data base. The correct tag number for RF117 is Z4076.

RF169B

RF169B was given green hangar tag C2492 using C457 as the source tag. RF169B is marked with FBI lot number 8/24/96-2. Tag C457 is in the Tags table, but no description is

entered. There is no wreckage log for C457, nor is there any reference to C457 in the Target table. The FBI evidence log contains one chain of custody handling form for lot 8/24/96-2. On this form two things of interest are written: (1) "P/U from Moriches Coast Guard Station 8/24/96" and (2) "Green tag C457." This form does not contain any recovery position information. Consequently, a white tag was added to C2492, and the debris field in the data base was changed to White. The debris field for tag C457 was also changed to White. See note concerning the use of single source lots for hangar tagging in the *Validity determinations* section on page 59.

RW1 and RW4 (E2013)

Structures log number RW1 was assigned to the upper surface of the right wing tip, and log number RW4 was assigned to the lower surface of the right wing tip. RW1 and RW4 were recovered as one floating piece of wreckage and assigned tag E2013. A photograph of E2013 appeared on the cover of the July 29, 1997, edition of *Time* magazine. In the magazine photograph, E2013 is seen floating prior to recovery.

On the morning of July 18, 1996, the U.S. Coast Guard cutter *Juniper* dispatched the *Rude* to recover the wing tip, which had been spotted by a private vessel. At 0740 on that day, the *Rude* arrived at the right wing tip at 40 39 19.74, longitude -72 37 02.28. The crew attempted to hoist the wing tip aboard, but discovered that it was too large to bring aboard the *Rude*. Consequently, the *Rude* began towing the part to the *Juniper*. The Juniper's log entry for 0800 confirms this. It reads, "Rudy [sic] recovered 35 ft piece of wing inundated with fuel towing to our Pos. Just U/W ETA approx. 30 min." The *Juniper* used its heavy lift crane to bring the right wing tip aboard.

Inquiries were made with the U.S. Coast Guard, the National Oceanic and Atmospheric Administration (NOAA), and the Woods Hole Oceanographic Institute regarding the use of wind and current data to determine the splashdown position of the right wing tip. However, given the protracted float time, such a "flotsam hindcast" could not be created with any precision.

RW7, CW104, CW301, and CW707

According to the Tags table, the item that received structures group log number RW7 was originally assigned yellow tag B004, but that tag is no longer on the piece. There is no wreckage log on file to support the recovery position of B004, but, according to an early Q/A list, the tag was assigned to latitude 40 39 03.00, longitude -72 38 32.00, a position in the Yellow zone.

This piece was cut to facilitate the installation of portions in the center wing tank reconstruction. The cut portion received structures group log numbers CW104, CW301, and CW707. Further, green hangar tag C2151 was assigned to the cut portion. August 1, 1996, is given in the Tags table given as the date the record for tag B004 was entered into the table. Because it was believed that the piece was recovered by the *Grasp*, on September 9, 1996, members of the data team determined the position of the *Grasp* on August 1, 1996, and used this position (latitude 40 39 45.00, longitude -72 37 27.00) as the recovery position for RW7. This information was entered into the record for C2151. This qualified C2151 as an exempt hangar

tag, thus it was not studied during the final hangar tag audit (see *Exempt tags* on page 64). The recovery position of RW7 was questioned again after the data base was frozen. At this time, "7/27/96" was observed written in black marker on the portion that was cut from RW7 and mounted in the reconstruction. Although this date predates the establishment of the FBI lot numbering system described on page 17, it must be concluded that this item came into FBI custody on July 27, 1996, and thus was recovered prior to August 1, 1996. Therefore, although the position entered into the data base might be accurate, the means used to determine it was invalid.

Regardless, Bob Swaim (NTSB) remembers this piece being recovered by the *Grasp* at about the same time as CW704 (which received yellow tag B003) was recovered (see the section on *CW704A and CW704B* on page 48 for more information). This was discussed during the September 18, 1997, weekly investigation conference call, and given Swaim's eyewitness testimony, it was the consensus of the investigative team that the piece was, in fact, recovered from the Green zone, and that was no further research was warranted concerning this piece. It is concluded that, although the position stored in the Tags table may not be accurate, it was appropriate to assign a green tag to RW7, CW104, CW301, and CW707.

Hangar tag validation project

This section explains the process by which 2000-series hangar tags were validated during the audit that was completed on April 23, 1997. Refer to the *Hangar tags* section beginning on page 31 for more information about hangar tags.

The overall purpose of this project was to ensure that consistent rules were used to make debris field color code assignments for non-exempt hangar-tagged items. These assignments, which represent *probable* debris fields of recovery, were made using associations with FBI lot numbers. It is recognized that because FBI lot numbers were not assigned for the purpose of tracking recovery information, there are several sources of error that cannot be fully eliminated from this process. The most common source of error involves mixed lots. Parts from different debris fields could be mixed together during water transportation between vessels and to the docks, during ground transportation to the hangar, and in the hangar before being assigned a lot number. Mixed lots can be detected when ship-tagged items are involved, but cannot be detected when untagged items from different debris fields are mixed. Further, data center staff have discovered several items on the hangar floor that have lot numbers that differ from those they were assigned in the FBI evidence logs. Mixed loads and incorrect lot numbers do not affect the validity of ship tags, but they do affect the validity of debris field color codes assigned to items using FBI lot number associations. This validation project details the efforts taken to determine which lots were mixed and to resolve, were possible, aspects of the FBI lot numbering process that pose difficulties for the hangar tagging operation. However, there is no reason to believe that every such problem was detected. For this reason, and because no item-specific recovery paperwork exists to validate hangar tags, debris field color codes assigned using FBI lot number associations cannot be regarded with confidence.

Ship tags underwent numerous validation and auditing processes described previously, but to audit the hangar tags required two major validations (1) the FBI lot validation, and (2) the hangar tag validation. Each will be discussed in detail.

FBI lot validation processes

To assess the validity of FBI lots for hangar tagging, the following tasks were accomplished:

- Resolution of any out-of-area tags in each FBI lot,
- resolution of tags listed in more than one FBI lot,
- plotting of FBI lot maps,
- final determination of the validity of each lot, and
- selection of an appropriate source tag for each lot.

Each of these will be discussed below.

Out-of-area tag audit

Throughout the investigation, several out-of-area (OOA) tags were brought to the attention of data center staff, usually because the item was of enough importance to the investigation that hangar staff requested a special validation study of the piece (refer to the *Out-of-area tag problem* section beginning on page 38). When OOA problems were found, they were corrected by replacing the ship tag with a new 2000-series tag of the correct color (refer to the discussion of *LF74* on page 53 or *RF21* on page 53 for specific examples of OOA tags that were corrected by retagging). Each of these changes was documented separately in data center files (see Case 5: Debris Retagged for Debris Field Correction, which is discussed at the end of this document). Because the determination of FBI lot validity was based on the recovery position of each ship-tagged object in each lot, it was critical to resolve all remaining OOA tags.

To find these problem ship tags, a plot was made of only those tags whose alphabetic prefix (A, B, C, X, Y, Z, or W) was in conflict with its recovery position in the data base. Inspection of this plot revealed 159 remaining OOA tags. Most OOA tags were associated with the orange debris field. Prior to formally establishing the orange area, many red and green tags were assigned to items recovered from the area north of the Red zone and west of the Green zone.

A validation study of each of the recovery position data for each of the 159 OOA tags was conducted using wreckage logs, diver logs, ROV logs, and material in the data center. This OOA study revealed 11 tags (4 red tags and 7 green) needing recovery position corrections within the same debris field. These corrections were made in the data base. These are recovery position corrections only, and do not involve tag color. Part 1 of *Appendix 11: Out-of-area corrections made during hangar tag audit* provides a list of the 11 items affected by these corrections.

Table 8 summarizes the remainder of the OOA corrections, all of which involved debris field color code changes.

Table 8: Out-of-area tag corrections involving debris field color code changes.

	Old tag color				
Correct color	**Red**	**Yellow**	**Green**	**Orange**	**Total**
Orange	11	0	52	--	63
Green	15	0	--	4	19
Yellow	10	--	2	0	12
Red	--	25	28	1	54
Total	36	25	82	5	148

A total 0f 148 incorrectly color-coded ship tags were found as a result of this study. A detailed list of affected items appears in *Appendix 11: Out-of-area corrections made during hangar tag audit* (for tags corrected to orange see Part 2, for green see Part 3, red Part 4, and yellow Part 5). Refer to Figure 1 on page 12 for a depiction of the debris fields by color code.

Five tags assigned to items recovered from south of the Green zone and east of the Red zone required special handing. Because the Orange zone was not defined until well into the dive operation, only 1 of these items received an orange tag (W5006). The remainder received red tags: A267 and A271 were assigned to items recovered from just east of the Red zone, and X1115 and X1116 were assigned to items recovered from just south of the Green zone. It was decided that the red tags that were assigned to items just outside the Red zone would remain red, and the red tags assigned to items recovered just outside the Green zone would be changed to Green. Further, the lone orange tag was changed to red because its recovery position was fewer than 1,000 meters from the Red zone boundary.

Six tags assigned to items recovered from just east of the Green zone also required special handling: Three were green tags and were not changed (Z5041, Z5038, Z3791); 1 was a red tag that was changed to green (X1124), and 2 were orange tags that were changed to green (W5008 and W5010). The special handling described in this and in the previous paragraph effectively limited the Orange zone for the purpose of the dive operation to the area north of the Red and Green zones (as mentioned in the section *Tag colors* on page 13).

Duplicate tags listed in the FBI log-to-tag table

Each ship tagged item should have been logged into in the FBI log book only once upon receipt in the hangar. However, in the FBI lot-to-tag table created by the data center in November, 1996, it was found that 104 tags were listed more than once (46 were due to keyboard entry error, 41 were due to duplicate paperwork or manual handwriting errors on the wreckage logs, and 17 were due to different objects being assigned the same tag number). These items were resolved so that maps plotted for this validation effort truly showed what which tags were associated with each lot (more information concerning the FBI lot-to-tag table and its role in creating lot maps is found in the *2000-series tags* section beginning on page 31, and more information about resolving tag duplications is found in the *Tag duplication study* section beginning on page 40).

FBI lot maps

Once the OOA and duplicate tags issues were resolved, a separate recovery location map of all the ship tags in each lot was plotted using the FBI lot-to-tag table. A single map was also plotted for each of the ship-tagged items that were listed in the FBI logs as the sole ship-tagged item in a lot. These maps appear in *Appendix 12: FBI lot maps created during hangar tag validation project.*

Validity determinations

As each FBI lot map was studied, it was assigned a status code of Valid, Mixed, Single or Floater. Lots consisting of floating debris are not valid for assigning 2000-series tags, and were not studied further. Lots containing a single ship-tag (single source lots) are considered valid for

hangar tagging purposes if there is no ambiguity or tagging irregularities concerning the single item.[31]

The determination of the status of each remaining lot was based on the percentage of ship tags recovered from a the lot's predominant debris field. If 90 percent or more of the items within a lot were recovered from the same debris field, the lot was assigned a status code of Valid; otherwise, it was assigned the code Mixed.[32] The FBI lots and their status codes are listed in *Appendix 13: FBI lot number summary.* Status code changes relative to the FBI lot number summary produced on November 15, 1996, are summarized below:

- 15 lots were upgraded from *Mixed, Mixed?,* or *Valid?* to **Valid,**
- 14 lots were downgraded from a *Valid, Valid?* Or *Mixed?* to **Mixed**, and
- 7 single-item lots were downgraded to non-useable, because recovery positions could not be determined for these items.

Considering all 249 FBI lots, 109 were found to be valid lots, and 39 lots were found to be unusable for 2000-series tagging because they are mixed or floater lots (two of these floater lots were single-item lots). Of the remaining 101 single-item lots, two were found to be invalid (8/04/96-54, and 8/05/96-3). These two lots will be discussed in detail because some items have been assigned color-coded hangar tags based on them. Two other lots, 8/08/96-14 and 10/03/96-4 will also be discussed in detail.

Lot 8/04/96-54

Lot number 8/04/96-54 is not valid for sourcing untagged wreckage because of an apparent FBI paperwork error on August 4, 1996. That day was one of several days that FBI ERTs created lots that consisted of only one ship tagged item. If most of the single-item lots assigned on the same day contain items recovered from the same debris field, it is reasonable to assume that the lots can be used for assigning that debris field color code to any untagged wreckage that received a lot number in the sequence. This is not the case with this lot, because its "nearest neighbors" (8/04/96-55, and -56) were single-item lots from the Green zone, and 8/04/96-54, and -57 are single-item lots from the Yellow zone. Further, at least six untagged pieces of lot 8/04/96-54 have been found on the hangar floor (some fairly large) that are not mentioned in the FBI evidence log books, which note "small debris" for this lot. If the ERTs had

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[31] The terms "single-item lot" and "single-source lot," refer to the same kind of lot: An FBI lot that contains only one ship tag. Such a lot may contain more than one item, but it only contains only one ship tag.

[32] It should be noted that had a 100 percent rule been used (instead of the 90 percent rule) it would not have produced 100 percent reliable debris field color code assignments. This level of certainty is not possible for non-exempt hangar tags because no definitive recovery information is available for these items. The 90 percent rule was adopted, in part, because the debris field color code assignments made for hangar tags prior to this project appeared, on average, to have been made using an unwritten 90 percent rule. But, because each lot was re-assessed for validity each time a new tagging decision was made, this rule was not consistently applied. The hangar tag validation study solidified the rule and ensured that it was consistently applied.

been assigning a unique lot number each piece that day, it is difficult to imagine how these six pieces, some rather large, could go unrecorded. Some unknown paperwork error occurred when these parts were received. This makes this lot unusable for 2000-series tagging. Table 9 summarizes the color-coded 2000-series tags that are sourced to lot number 8/04/96-54.

Table 9: Color-coded 2000-series tags sourced to lot 8/04/96-54.

Lot #	Tag #	Log #	Description
8/04/96-54	B2046	LF143	FS 1480 bulkhead LBL 57.5
8/04/96-54	B2083	LF82M	FS 1620-1650 STR 42L-44L
8/04/96-54	B2104		FS 740 floor beam segment
8/04/96-54	B2048	RF151	FS 1480 bulkhead web RBL 4.5-43.5 WL 128-155.9
8/04/96-54	B2019		fuselage skin w/red paint
8/04/96-54	B2087	RF39B	FS 1720-1740 STR 23R-26R
8/04/96-54	B2054		seat 36 (9) armrest

Lot 8/05/96-3

Lot number 8/05/96-3 is not valid for hangar tagging purposes because of duplicate tags. The FBI logs list B163 as the only tag in this lot (see the *B163 tag duplications* section on page 46). Seat 4 (9) has lot number 8/05/96-3 and tag number B2069 on it. This 2000-series tag was applied during a floor audit of the cabin interior hangar. Because it was thought that B163 had become unattached from seat 4 (9), the updated wreckage log used to assign tag B2069 gives B163 as the source tag. However, during the 2000-series validation floor audit, tag additional B163s were found loose on the hangar floor. It might have been possible to resolve the duplicate tagging problem if the tags had remained attached to recovered items. Given that they were found unattached to any item, and the wreckage log for tag B163 gives the description, "dumb waiter, misc. debris," lot number 8/05/96-3 is not valid for 2000-series tagging. Table 10 summarizes the color-coded 2000-series tags that are sourced to lot number 8/05/96-3.

Table 10: Color-coded 2000-series tags sourced to lot 8/05/96-3.

Lot #	**Tag #**	**Log #**	**Description**
8/05/96-3	B2069		seat 4 (9)
8/05/96-3	B2075	LG6	nose landing gear door
8/05/96-3	B2086	RF112B	FS 450-440 STR 34R-43R

Lot 8/08/96-14

Problems associated with FBI evidence logging procedures on August 8, 1996, caused data center staff to evaluate lots created on this day carefully. The entire right wing was recovered by the *Grasp* on August 7, 1996. Paperwork was sent to the hangar, and the FBI ERTs logged these items (tags C183-C190) as lot 8/08/96-15. A second ERT submitted a second log sheet for the same tags, plus some others. This second sheet was logged-in as lot 8/08/96-30,

despite the earlier form that assigned the items to lot 8/08/96-15. Regardless, lot number 8/08/96-14 was written in black marker on the items with tags C183-C190. Lot 8/08/96-14 had already been assigned to another group of parts.

It was concluded that lot numbers 8/08/96-15 and -30 are valid for hangar tagging (even though the incorrect lot number was applied to the right wing parts, there is no doubt about their recovery locations, and both lots -15 and -30 are green lots). However, the -14 lot was assigned primarily to parts recovered from the Red zone, and would be considered a valid red lot, if not for the part marking error. Essentially, when faced with a non-ship-tagged item with lot number 8/08/96-14 written on it, one does not know if this piece actually belongs to this (red) lot or to one of the green lots (-15 or -30). Although a case could be made that lot 8/08/96-14 could be considered valid for hangar tagging any untagged parts marked with this lot that are *not right wing parts*, such a determination would be a significant departure from the rules used to determine the validity of the other lots. For these reasons, it is concluded that lot 8/08/96-14 is invalid for hangar tagging purposes. Table 11 summarizes the color-coded 2000-series tags sourced to lot 8/08/96-14.

Table 11: Color-coded 2000-series tags sourced to lot 8/08/96-14.

Lot #	Tag #	Log #	Description
8/08/96-14	A2054	CW911	CW SWB #1 section
8/08/96-14	A2062	CW530C	support rod potable water tank p/n 65B54725-1, piece of tank flange
8/08/96-14	C2147	CW201	lower CW skin, RH FWD STR 1-21

Lot 10/03/96-4

Poor handwriting apparently led to data entry errors in the FBI lot-to-tag table that was used to generate the FBI lot maps. Tags Z1763-Z1771, which are listed in Table 7 on page 43, were apparently entered into this table as Z2163-Z2771 respectively. These errors do not affect the Tags table, but do affect the lot map produced for lot 10/03/96-4. On this map, tags Z2163-Z2771 are plotted in the Green zone. These tags are not associated with lot 10/03/96-4, and should not appear on this map. However, tags Z1763-Z1771 *are* associated with lot 10/03/96-4 and should have been plotted with this lot. Based on 90% rule, which was applied to items plotted on this map, lot 10/03/96-4 was found to be a mixed lot. Because the nine tags that were plotted in error are associated with recovery positions in the Green zone, and the nine tags that should have been plotted are also from the Green zone, this determination was correct. Lot 10/03/96-4 is a mixed lot, not considered valid for hangar tagging purposes. Only one color-coded hangar tag was assigned to an item from lot 10/03/96-4, and that item appears in Table 12.

Table 12: Color-coded 2000-series tags sourced to lot 10/03/96-4.

Lot #	Tag #	Log #	Description
10/03/96-4	Z2814	CW1023	rear spar stiffener at RBL 46, complete

Source tag selection

During these validation efforts, it was noted that some previously-selected source tags referred to either personal effects or to human remains. A decision was made to review all source tags using the following rules:

- Human remains and personal effects should not be used as source tags;
- Source tags should refer to substantial items, when possible;
- The source tag for a each lot should have a recovery position that is as close as possible to the approximate geographic center of the ship-tagged items recovered in that lot.

Using these rules, the source tags were reviewed for each lot. Where necessary, new source tags were selected. A summary of these source tags noting all changes compared to the November 15, 1996, summary, is listed in *Appendix 14: Source tags.*

Hangar tag validation

Once the FBI lot validation was complete, the 1,190 hangar tags assigned during the field investigation were subjected a validity check to ensure that the debris field and position information recorded for each in the data base is as accurate as possible.

Exempt tags

All records were reviewed that would indicate if the object received its position by a valid method other than via FBI lot number—such tagged objects are exempt from further validation efforts. Such methods determining a recovery position using dive videotapes, recovery paperwork, or consulting boat labels.[33] This study revealed 143 exempt tags.[34,35] These exempt tags were not validated as part of this study, but are listed in *Appendix 15: Exempt 2000-series*

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[33] The term "boat label" refers to any label, marking, or other article (other than a metal tag) attached to a recovered item by salvage crews to communicate recovery position information. Occasionally, salvage crews communicated recovery position information by writing target numbers and recovery positions on plastic caution tape or paper tags attached to salvaged items.

[34] This includes 87 tags in the 2000-series that were issued as ship tags by the SLWT (see the *Hangar tags* section on page 31 for more information).

[35] It is likely that additional items that should have been exempted from this validation project were not identified because explicit information was not provided on the updated wreckage logs that originally assigned tags these items. By requiring definitive recovery histories, data center staff were conservative in conferring exempt status on a hangar-tagged items.

tags. The summary of recovery position sources at the end of this document explains exempt 2000-series tags in more detail.[36]

Lot number corrections

Because each of the debris field color codes assigned to non-exempt tags would be re-determined using FBI lot number association, it was important to ensure that lot numbers in the data base for each 2000-series tag were as accurate as possible. Data entry of these lot numbers only began in earnest during early November, 1996, so this information was not in the data base for many 2000-series tags assigned in the summer and fall of 1996. To help close these gaps, all updated wreckage logs were reviewed for any mention of lot number, and, where found, this information was entered into the data base.

During this validation study, it was discovered that often the source tag cited in the data base did not actually belong to the lot given for the previously-untagged item. These instances, plus those 2000-series tags for which no lot number was found in paper records, produced a list of 366 objects for which no lot number was available. A search for each of these items on the hangar floor was conducted between April 9-12, 1997 by data center and ALPA staff. Lot numbers were entered for each of the 300 objects located.

Final impact of this validation study

Corrections in the data base (not directly involving tag color) were found to be necessary for the following:

- FBI lot number corrections: 391
- Source tag corrections: 716
- Description corrections: 165

Finally, new debris field color codes assignments were made for each of the tags subject to this audit using the revised FBI lot summary. Each non-exempt 2000-series tag audited is listed in *Appendix 16: Non-exempt 2000-series tags* along with any debris field color code changes made. Each of the debris field color codes assigned to the non-exempt tags was made using association with an FBI lot number. Where a lot number was not available, the tag was assigned a debris field color code of white. Table 13 summarizes the findings of the validation effort with regard to debris field color codes.

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[36] The cabin documentation group has reported that definitive recovery information exists for at least one additional item (a passenger seat) that was treated as a non-exempt tag during this validation effort. Consequently, the data management team is planning to meet with the cabin documentation group to update data center records and resolve tag color issues.

Table 13: Summary of the impact of the hangar tag audit.

New color	No Change	Old tag color Red	Yellow	Green	White	Total
Floater	35	1	0	0	0	36
Orange	4	0	0	0	0	4
White	115	2	4	54	--	175
Green	614	0	0	--	98	712
Yellow	36	1	--	2	33	72
Red	23	--	1	1	19	44
Total	827	4	5	57	150	1043

Note: Four tags taken out of circulation for corrective action (prior to this validation study) are not reported in the above table.

After all data base editing requirements were defined in an audit spreadsheet, they were incorporated via an electronic merging process. No updated wreckage logs were generated during this process, because this documentation serves to justify the changes made. Further the appropriate comments were entered into the Tags table for any record affected.

Note that no retagging or renumbering was done following this validation; rather, a simple change of debris field color code in the data base was used instead. However, during the week of April 21, 1997, ALPA staff attempted to locate each of the items in need of debris field color code change. If located, a strip of color-coded electrical tape was affixed to the metal 2000-series tag to reflect the new debris field color code.

Summary of recovery position information sources

Some figures were created to help explain the sources of information used during the hangar tag validation project. For each of the following cases, refer to the figure in the *Additional figures* section having the same title. The first case described below details the determination of recovery position information for non-exempt 2000-series tags—the items that were the focus of this hangar tag validation project. Because these data are based on FBI lots and assigned source tags, they represent only probable recovery positions. Cases 2, 3, and 4 explain the exempt 2000-series tags. Because recovery data for these tags was not determined by an FBI lot number association, the positions given in the data base represent actual positions. Finally, Case 5 describes validation of OOA ship tags.

Case 1: Via FBI lot number

Debris was received in the hanger in lots or shipments, each having a specific lot number assigned by the FBI. The format of the lot number is the date received, plus a 1 to 3 digit number, for example "8/05/96-2." FBI ERTs wrote this lot number directly on each item received in this shipment it, whether or not the object had a ship tag.

For each lot, the tagged objects were plotted on separate maps. Validity determinations and source tag assignments described elsewhere in this document were made for each lot using these maps. Non-tagged debris having valid lot numbers were assigned the recovery coordinates of this source tag if it was assigned a 2000-series hangar tag.

Case 2: On-boat identification

Occasionally, a direct reference to recovery position or a target name is either written on or attached to the part by boat personnel in a manner other than a ship tag. These have been referred to as "boat labels." Such a reference allows a precise recovery position to be assigned to the object.

Case 3: Cut or removed from other debris

During the salvage and reconstruction efforts, it became necessary for some objects to be cut into more than one piece. Further, some objects were physically extracted from an entangled group of debris. A smaller object may have been received in a bag, net or box full of other items, but having only one tag assigned to the container. Finally, some parts simply broke. In all of these situations, the "parent object" (that which had the ship tag) had recovery position information that was directly applicable to any "child object(s)." The recovery position of the parent item or "source tag" was used for the previously-untagged item when it was assigned a hangar tag.

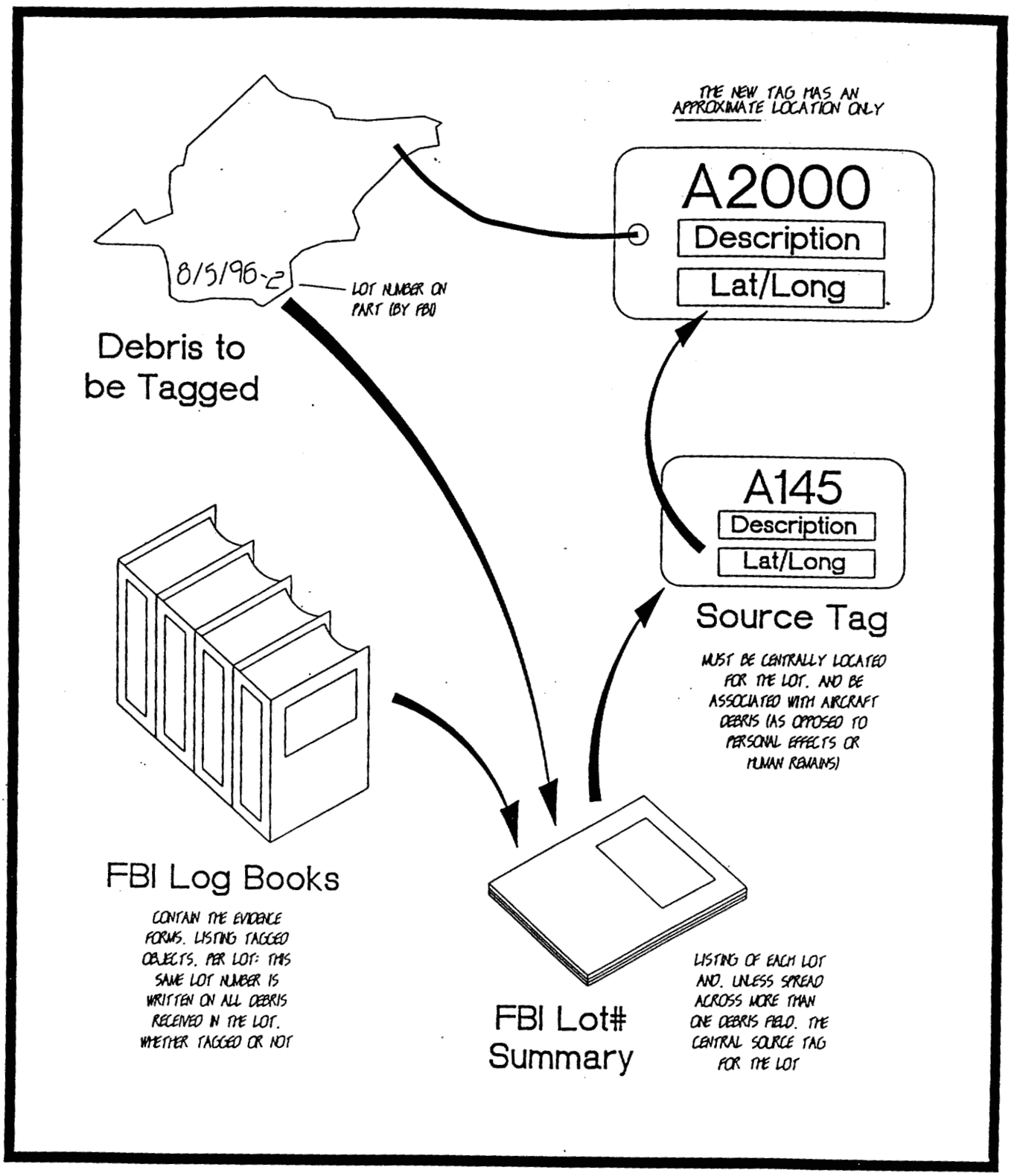
Case 4: Positive ID via recovery records

Diver logs contain sketches and part numbers, and can sometimes be matched to a non-tagged part for a positive identification and position information. The object may also be seen on underwater video tapes, or in FBI photographs while the object was still on a transfer vessel. In these situations, the position of the boat was researched for the time the photo or video was taken. For video ID, the exact location of the ROV was calculated, if possible, using known range and bearing from the ship's position at the time. This information was used when assigning 2000-series tags, if available.

Case 5: Debris retagged for debris field correction

As OOA ship tags were discovered and validated prior to this validation effort, their ship tags were removed and replaced with a correctly-colored hangar tag. These changes were documented by updated wreckage logs in the data center. Recovery position and other information was transferred to this new tag record; data base information remained the same except for the new tag number and color. This debris field correction effort was completed on an ad hoc basis until the remaining OOA tags were identified and corrected as part of the hangar tag validation project.

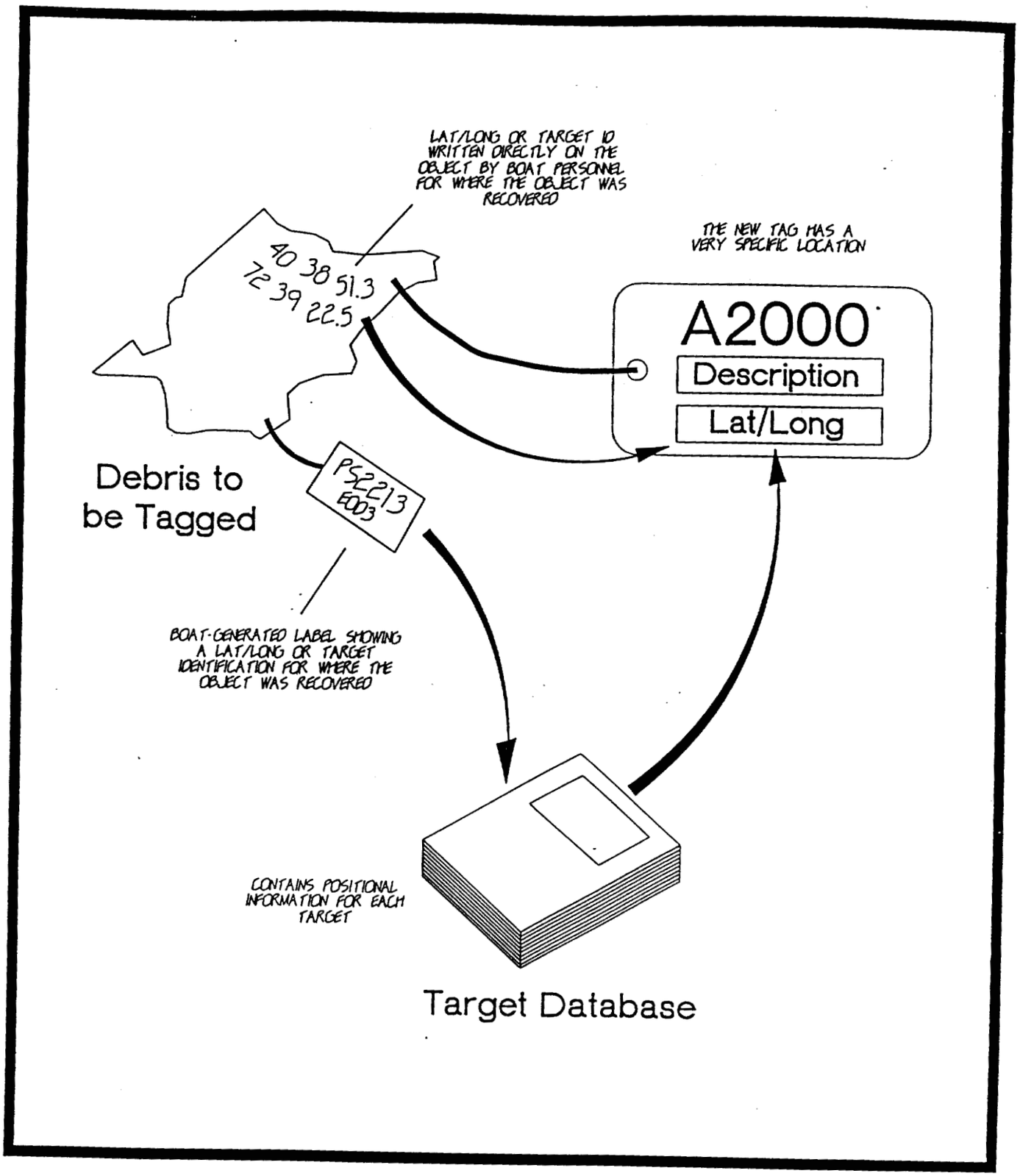
Additional figures



2000 Series Tagging
Case: Via FBI Lot Number

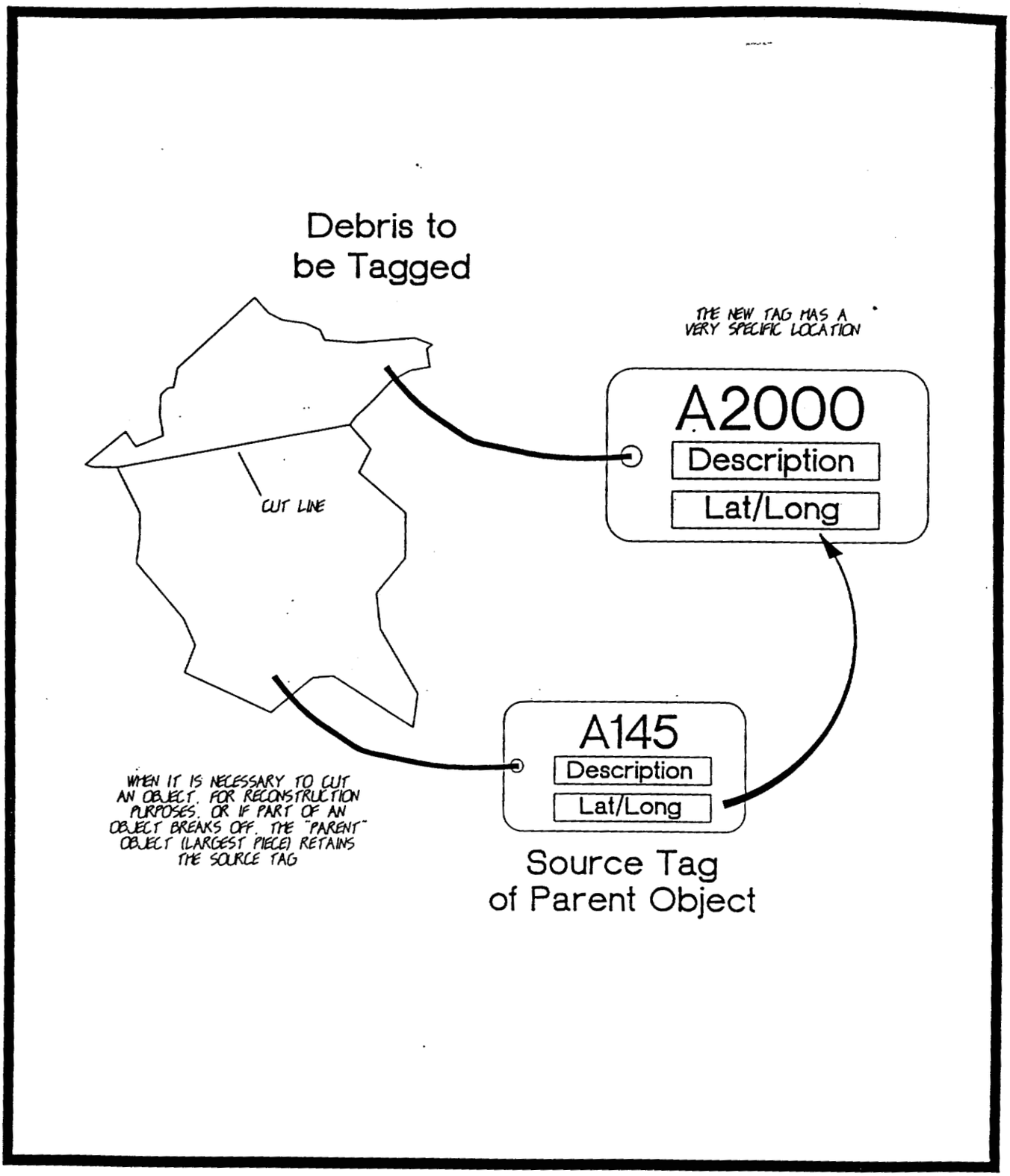
Source tag for a given lot# is at the approximate center of all tagged items received on that lot

(69)



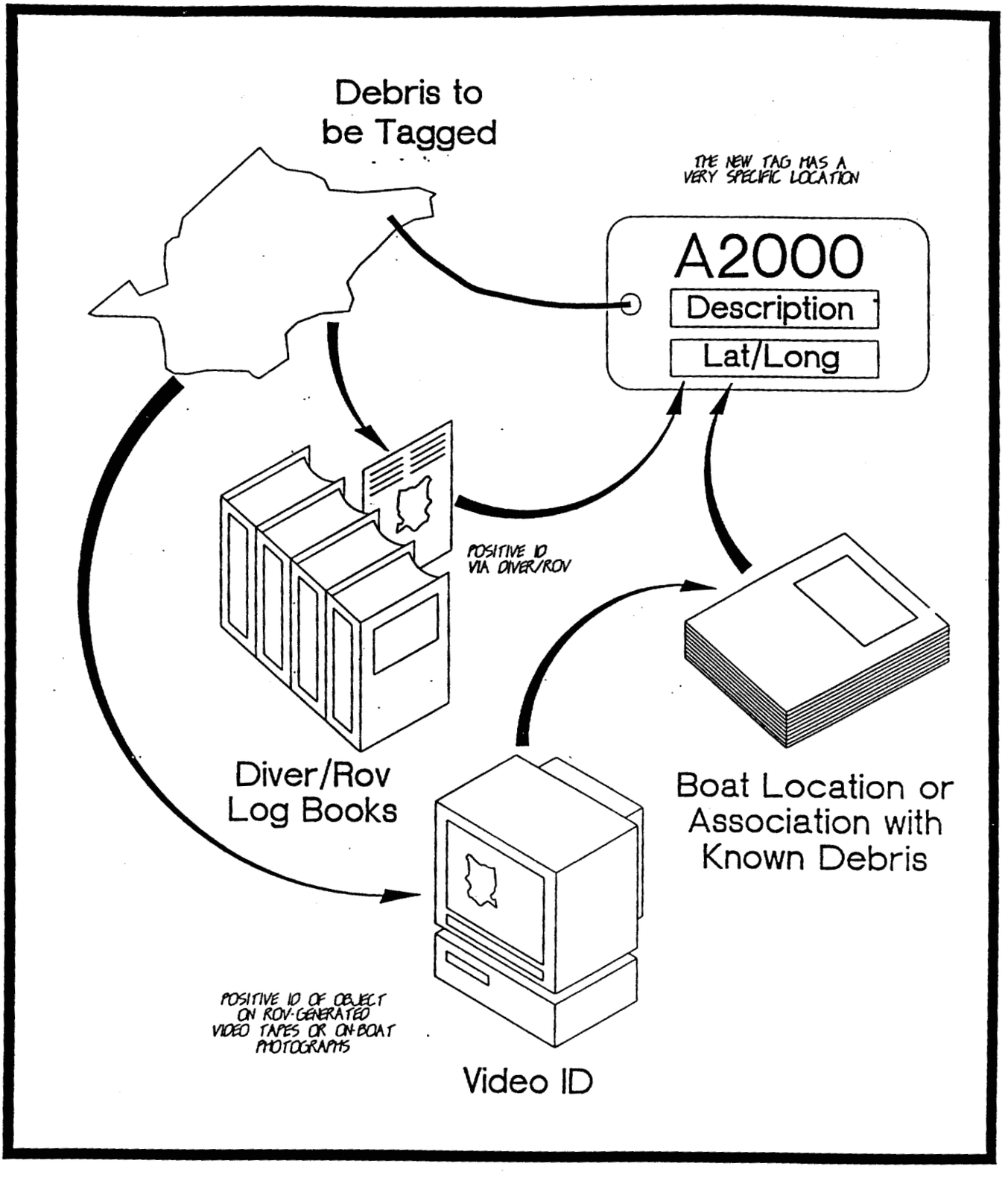
2000 Series Tagging Case: On-Boat Identification

Positional information for the non-tagged debris is written on or attached to the item while on the boat



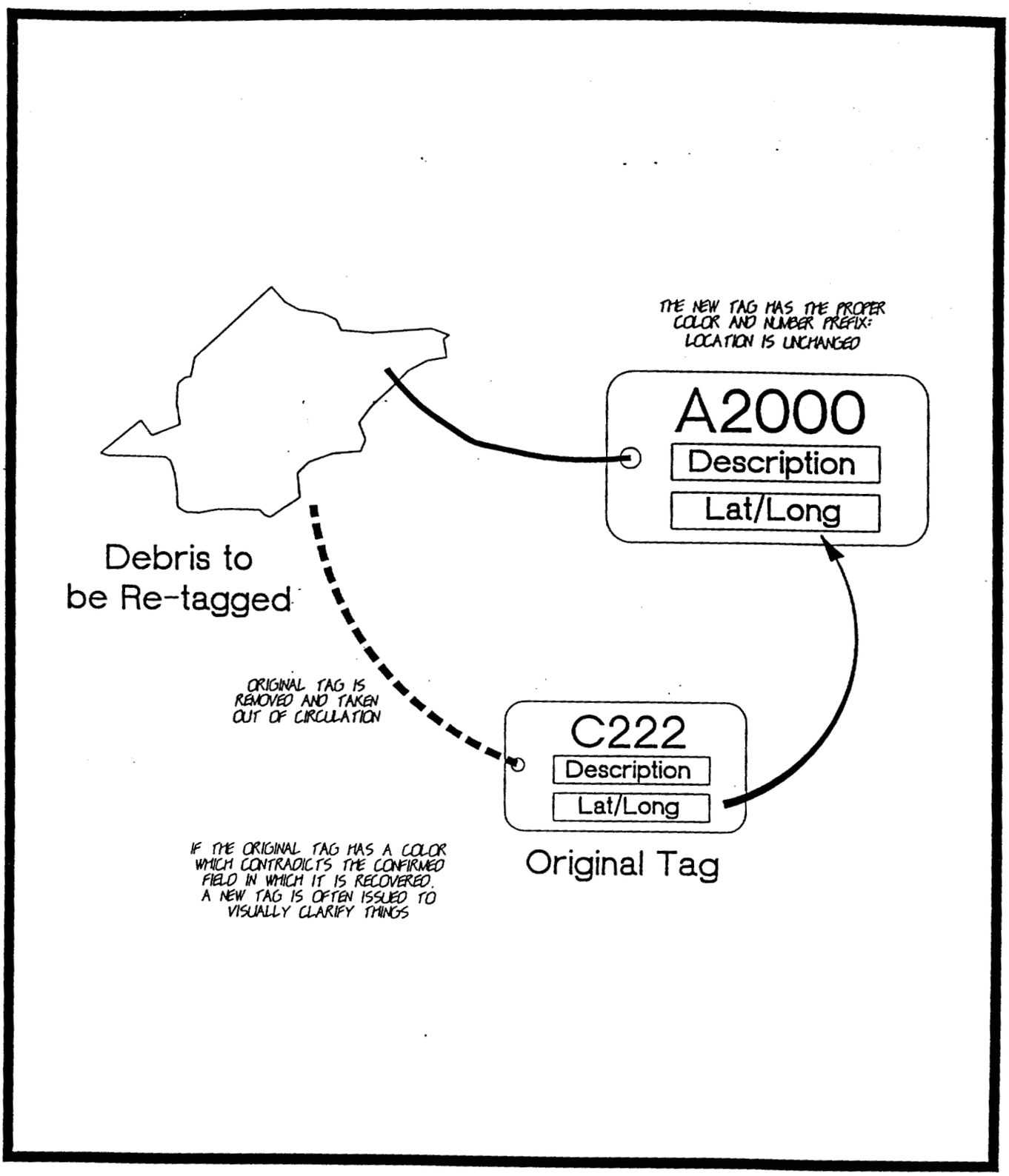
2000 Series Tagging
Case: Cut or Removed From Other Debris

Positional information for the non-tagged debris
is inherited from the debris it was part of



2000 Series Tagging
Case: Positive ID Via Recovery Records

Positional information for the tagged debris is gained from diver/ROV logs or video



2000 Series Tagging
Case: Debris Re-Tagged for Debris Field Correction

Positional information for the re-tagged debris is retained from the original tag data