



**National Transportation Safety Board
Operations/Human Factors Group Factual
Technical Review Version**

1. **Accident Information**

Accident No.: DCA-10-MM-025

Description: Towing Vessel *Caribbean Sea*, and barge *The Resource*, allision with the Amphibious Passenger Vehicle (APV), *DUKW 34*

Location: Delaware River, Philadelphia, Pennsylvania (Lat 39° 56' 86" North, Long 075° 08' 30" West)

Date: July 7, 2010

Time: 14:37 (EST)

2. **Group Representatives**

National Transportation Safety Board
Group Chairman: Larry D. Bowling
Office of Marine Safety
490 L'Enfant Plaza East, SW
Washington, D.C. 20594

Party: U.S. Coast Guard
LT Ann MW Bassolino, USCG
Marine Casualty Investigating Officer
U.S. Coast Guard Sector Delaware Bay
One Washington Avenue
Philadelphia, PA 19147

Party: U.S. Coast Guard
CWO Matthew A. Bordeaux, USCG
Boat Forces Manager
U.S. Coast Guard Sector Delaware Bay
One Washington Avenue
Philadelphia, PA 19147

Party: K-Sea
Captain Tom Sullivan
Chief Operating Officer

One Tower Center Boulevard, 17th Floor,
East Brunswick, NJ 08816

Party: K-Sea
Richard P. Falcinelli
Executive Vice President
One Tower Center Boulevard, 17th Floor,
East Brunswick, NJ 08816

Party: Herschend Family Entertainment Corporation
Bill DeAtley
Safety Specialist, Ride The Ducks
399 Indian Point Road
Branson, MO 65616

Party: Ride The Ducks, International, LLC
Bethany Miller
Director of Fleet Operations
5445 Triangle Parkway
Suite 200
Norcross, GA 30092

3. Summary of the Accident

On Wednesday, July 7, 2010, the empty 250-foot-long sludge barge *The Resource*, being towed alongside the 78.9-foot-long towing vessel M/V *Caribbean Sea*, allided with the anchored 33-foot amphibious passenger vehicle (APV) *DUKW 34* in the Delaware River near Philadelphia, Pennsylvania. The *DUKW 34*, operated by Ride The Ducks International, LLC, carried 35 passengers and 2 crewmembers. On board the *Caribbean Sea* were 5 crewmembers. Following the allision, the *DUKW 34* sank in about 55 feet of water. Two passengers were fatally injured, and 26 passengers suffered minor injuries. No one on the *Caribbean Sea* was injured.

4. Details of the Investigation

The Operations Group gathered data related to the operational aspects of the vessels involved, interviewed witnesses, and conducted a voyage of the accident route aboard the towing vessel *Caribbean Sea* with the sludge barge *The Resource* in a hip tow to observe visibility and handling characteristics of the towing vessel and sludge barge underway. The group also examined crew training and performance, navigational systems, rest and work cycles, and shore-side and vessel safety procedures. All times noted in this document, unless otherwise stated, are eastern daylight time (EDT) based on the 24-hour clock.

5. Ride The Ducks International, LLC

5.1. Corporate Information and Safety Management Practices

The amphibious tour operator, Ride The Ducks International, LLC, (RTDI) was originally founded in 1977 by an entrepreneur in Branson, Missouri, as a small sightseeing business.¹ In 2001, RTDI partnered with the Herschend Family Entertainment Corporation (HFEC), which later became the sole owner of RTDI in 2004. RTDI currently operates a fleet of more than 90 APVs and carries more than 1,200,000 passengers annually on amphibious tours at seven locations. Three of these locations, Branson, Missouri; Philadelphia, Pennsylvania; and San Francisco, California, are owned by RTDI. The other four locations are independent licensees.² In San Francisco, the company also operates a classic cable car fleet of more than 40 vehicles that perform strictly land tours of the city. At the time of the accident, the company was an active member of the Passenger Vessel Association (PVA), and all of the company's operations were domestic.

The parent corporation, HFEC, owns, operates, and manages 24 themed entertainment properties across 9 states.³ One of the properties is the passenger vessel *Showboat Branson Belle*, a dinner and excursion vessel certificated by Coast Guard to carry 750 passengers for hire.⁴ RTDI and HFEC corporate headquarters are both located in Norcross, Georgia.

RTDI opened its Philadelphia operation in 2003. The 15 APVs at that location operate from March through November, as weather permits. On the date of the accident, the RTDI team consisted of 7 Coast Guard licensed masters, 5 CDL licensed drivers, and 13 personnel serving in other positions.⁵

5.2. Policy on crew usage of cellular or wireless devices

RTDI personnel in Philadelphia used company-issued cellular telephones with direct-connect radio capability for internal communications during operational periods, except when driving a company vehicle. A cellular telephone was assigned to each APV unit in operation and to certain other RTDI personnel based upon position held. APVs were outfitted with marine VHF radios for communication with other vessel traffic; however APV-to-APV communications were made utilizing the direct-connect radio function.

Per RTDI corporate policy, the DUKW captains and drivers were allowed to carry personal cellular telephones as long as they were kept on vibrate or silent mode and were never used on tour or in sight of guests, except in an emergency.⁶ Locally, RTDI in Philadelphia had policy in place which stated personal cell phones were not to be used at work, and could not be used or displayed at the ticket booth, while on the curb, or while on the DUKW with guests.⁷ In the event employees needed to use their cell phones, they were required to obtain permission from a manager or supervisor and to remove themselves from the guest's view to make a call.

6. K-Sea Transportation, Incorporated

6.1. Corporate Information and Safety Management Practices

¹ www.ridetheducks.com

² Per the NTSB interview of RTDI President, September 9, 2010.

³ www.hfecorp.com.

⁴ The *Showboat Branson Belle* (Official Number 1029918) was built in 1995, and is 195 feet in length, 74 feet in breadth, and has a draft of 12.7 feet. The vessel is 94 Gross Registered Tons (GRT), with 400 HP ahead and is limited to operations upon the Table Rock Lake in Missouri.

⁵ RTDI Operations Manger E-mail to NTSB dated December 29, 2010. RTDI in Philadelphia employs 18 Captains of which 12 are Commercial Driver License certified. Additionally, they employ 11 drivers who are CDL certified only.

⁶ RTDI Captain's Operations Manual 2010, dated February 20, 2010.

⁷ RTDI Philadelphia Standard Operating Procedures 2010 dated February 25, 2010.

K-Sea Transportation, Inc. (K-Sea Transportation) provides marine transportation and distribution and logistics services to oil companies, oil traders, and oil refiners domestically and internationally.⁸ The company was founded in 1999 and is headquartered in East Brunswick, New Jersey, with offices in Staten Island, New York; Philadelphia, Pennsylvania; Norfolk, Virginia; Seattle, Washington; and Honolulu, Hawaii. The company owns and operates 78 tugboats, 73 barges, and has approximately 850 personnel.⁹ During the fiscal year that ended June 30, 2009, the fleet transported approximately 150 million barrels of refined petroleum products for customers, including BP, Conoco Phillips, Exxon Mobil, and Tesoro.¹⁰ Approximately 83% of its barrel-carrying capacity was double-hulled, and all but two of the company's tank vessels operate under the United States flag.

Although the *Caribbean Sea* was operated upon domestic waters, K-Sea Transportation does operate some of their other vessels upon international waters, making them subject to the provisions of the Safety of Life at Sea convention (SOLAS), including the International Safety Management (ISM) Code. The company was issued a (5-year Document of Compliance (DOC) by the American Bureau of Shipping (ABS) on October 18, 2008, and had successfully completed its first annual verification audit on October 21, 2009.¹¹ K-Sea Transportation was also a member of the American Waterways Operator's (AWO) industry association and had successfully completed a third-party audit of that organization's Responsible Carrier Program on March 7, 2010.¹² The towing vessel *Caribbean Sea* was 1 of 13 tugboats operating out of the company's New York Division, and at the time of the accident was staged at the company's River Associates office in the Philadelphia Naval Business Center.¹³

6.2. Policy on crew usage of cellular or wireless devices

The *Caribbean Sea* was outfitted with multiple VHF marine radios for communication with other vessel traffic. For daily internal communications between the vessels in the fleet and shore-side personnel, K-Sea Transportation used a company-issued cellular telephone that was assigned specifically to the vessel and was stored in the wheelhouse where it was to be used and monitored by the master or mate on watch. Expected use of the company telephone and other electronic devices on board that had the potential for distraction of vessel personnel while on duty, such as a company-issued computer, were addressed by a procedure in the company's Safety & Quality Management System (SQMS).¹⁴ While the procedure required each watch officer to maintain a focused watch, it allowed use of the company telephone, provided that it did not distract from operations or interfere

⁸ www.k-sea.com

⁹ K-Sea Transportation, "List of Barges" dated 5/2010 and "List of Vessels" dated 5/2010. Also, see NTSB interview of K-Sea Transportation, Chief Operations Officer, on July 12, 2010.

¹⁰ www.google.com/finance

¹¹ ABS Document of Compliance issued to K-Sea Transportation on October 18, 2008.

¹² AWO Responsible Carrier Program certificate issued to K-Sea Transportation on March 7, 2010.

¹³ The Philadelphia Naval Business Center was once known as the Philadelphia Naval Shipyard before the U.S. Navy ended most of its activities there in late 1995. The former naval base is now home to several maritime based companies, including K-Sea Transportation. K-Sea Transportation acquired a company formerly known as River Associates and its assets in September of 2006, and did not rename that office location.

¹⁴ K-Sea Corporate Common Procedures Manual (CPRM) 07.14, Duty Distraction Prevention, Version 3, dated March 17, 2010.

with normal or emergency communications. The carriage or use of personal cellular telephones and other personal electronics while on watch was prohibited.

Prior to the issuance of that procedure, the company's Chief Operations Officer (COO) had issued several memorandums to the fleet addressing the use of cellular telephones. The first, issued on March 22, 2002, prohibited the carriage of a personal cellular telephone by vessel crewmembers on deck and while on watch and restricted the use of personal cell phones to an enclosed area of the vessel. On February 10, 2004, the COO issued another memorandum to the fleet that addressed the company's expectations for the crew to comply with rules and regulations at each marine terminal at which the vessels moored and again noted restrictions regarding cellular phone use.¹⁵

On July 17, 2006, the COO issued a third memorandum to the fleet that restated the company's policy prohibiting the carriage of cellular telephones on watch and that included a synopsis from a recent casualty report regarding the grounding of the containership *Berit*, which was attributed to the Second Officer's distraction because of text messaging.¹⁶ This particular memorandum, along with other memorandum issued in 2006 and 2007, were presented at 2-day seminar the company held for individuals serving in the position of mate upon company vessels.¹⁷ The accident mate attended this seminar and received a Certificate of Completion.¹⁸

7. Delaware River

7.1. Waterway Information

The Delaware River is a major river of the United States and extends 410 miles from its tributaries in the Catskill Mountains of New York to the Atlantic coast.¹⁹ The river constitutes, in part, the boundary between the states of Pennsylvania and New York and the states of Delaware and New Jersey. It is the entire boundary between the states of Pennsylvania and New Jersey. The river is considered navigable by deep-draft, oceangoing vessels and by towing vessels with barges as far inland as Trenton, New Jersey, where the federally maintained shipping channel ends.²⁰

The shipping channel in the Delaware River is maintained by the US Army Corps of Engineers (ACOE), and ACOE involvement in that channel dates to the late 1800s when the controlling depth was 18 feet.²¹ Currently, from the sea and continuing approximately 109 nautical miles (nm) to Newbold Island, New Jersey, the navigable shipping channel has a controlling depth of 40 feet, while the width of the channel gradually narrows upriver.²² For the first 35 nm, the channel width is 1,000 feet. From that point to an area known as Eagle Point Range where the Schuylkill River feeds into the river, the channel is 800 feet wide. From that point to the Walt Whitman Bridge, the channel narrows to 400 feet. The channel width remains at 400 feet from that location, through the Penn's

¹⁵ K-Sea Memorandum TS 04-04, dated February 10, 2004.

¹⁶ K-Sea Memorandum TS 11-06, dated July 17, 2006. The synopsis provided a summary and analysis of the grounding of the 9981 Gross Ton, German flagged containership, M/V *Berit* (IMO #9237371) on Trindelen Bank, near Gedser, Denmark on January 5, 2006. See Marine Accident Investigation Branch (MAIB) report #17/2006 for more details on that casualty.

¹⁷ K-Sea Mates Seminar 2007, Agenda Topics for November 7 and 8, 2007.

¹⁸ K-Sea Certificate of Completion, Mates Seminar 2007, dated November 19, 2007.

¹⁹ www.state.nj.us/drbc

²⁰ National Oceanographic and Atmospheric Administration (NOAA) Chart 12314, Edition 32, February 2008

²¹ www.nap.usace.arm.mil/cenap-pl/drmc.htm

²² NOAA Chart 12313, Edition 52, December 2008, NOAA Chart 12312, Edition 55, August 2009, NOAA Chart 12311, Edition 45, December 2008

Landing area, and up to Newbold Island, New Jersey, where both the water depth and channel width are further reduced.

The portion of the Delaware River where the accident happened is subject to Federal jurisdiction. The primary Federal agency for marine safety, search and rescue, law enforcement, and security on the waterway is the U.S. Coast Guard. The Mariners Advisory Committee for the Bay & River Delaware, an organization formed in 1964 by the Delaware Bay and River Pilots Association and local maritime stakeholders, is active in the area and makes recommendations to the Coast Guard and ACOE on suggested improvements, navigational aid placement, and other areas which may enhance safe navigation.²³ Additionally, the Maritime Exchange for the Delaware River and Bay, an organization originally chartered in 1882 to promote trade, harbor development and enhance local maritime practices, provides the maritime community with various commercial, navigational and maritime security needs.²⁴

7.2. Risk Assessment and Waterways Management

In December 2000, the Coast Guard and stakeholders from the local maritime communities held a 2-day, Port Risk Assessment Workshop (PAWSA) to examine the risk present at that time and evaluate the need for waterway management improvements.²⁵ The workshop was terminated midway through the second day when the participants raised concerns that the PAWSA risk assessment process was unsuitable to their needs and they expressed a “strong fear” that workshop results would be used to the commercial disadvantage of the Port of Philadelphia. The “Summary of Philadelphia Waterway Navigational Attributes” section of that report indicates the traffic in the shipping channel was deemed to be of moderate risk—about 3,000 ship arrivals per year—and forecasted that tug and tow traffic would increase marginally.²⁶ The Coast Guard in Philadelphia has not conducted any similar waterways risk assessment since the 2000 PAWSA.

The Coast Guard does not use an active vessel traffic management system, such as a Vessel Traffic Service, on the Delaware River. It does employ passive measures on vessels navigating in the river via an established Regulated Navigation Area (RNA). The RNA extends from the mouth of the Delaware Bay, up the Delaware River through the downtown Philadelphia area to an imaginary line that crosses the river between Trenton, NJ, and Morrisville, Pennsylvania.²⁷ That RNA restricts vessels with drafts greater than 55 feet from entering those waters without Coast Guard permission, and imposes other specific restrictions upon vessels based on cargo carried, location of operation, or type of operation.

²³ www.macdelriv.org

²⁴ www.maritimedelriv.com

²⁵ Philadelphia Port Risk Assessment Workshop (PAWSA) report, December 11 & 12, 2000. The PAWSA process grew out of changes that took place during the 1990s in the Coast Guard (USCG) Vessel Traffic Service (VTS) acquisition program and the 1997 Appropriations Bill which directed the Coast Guard “to identify minimum user requirements for new VTS systems in consultation with local officials, waterways users and port authorities” and also to review private / public partnership opportunities in VTS operations. As of June 2005, over 35 ports have completed the PAWSA process.

²⁶ The participants of the workshop defined the geographic bounds of the port area to include; “From the Traffic Separation Lanes seaward of the Delaware Capes through Delaware Bay and River northward to Trenton, NJ. Includes the Chesapeake & Delaware Canal (to the Maryland border) and navigable portions of the Schuylkill River (to Fairmount Dam), Salem River & Canal, and the Christina River.

²⁷ Title 33 Code of Federal Regulations (CFR), Part 165.510.

According to data obtained from the Maritime Exchange for the Delaware River and Bay, in 2009 there were a total of 3,843 recorded vessel arrivals at either the anchorage or at marine facilities on the river, and 1,048 of those vessel arrivals were recorded at the 22 facilities located to the north of the confluence of the Schuylkill River.²⁸ Per data collected by instrumentation located near the accident site, around the time of the accident, the water level in the river was approximately 1.2 foot below Mean Tide Level (MTL), and the current was ebbing around 1.4 knots.²⁹ The river at that location has a Mean Range (MR) of 6.1 feet.³⁰

7.3. Port Stakeholder Input to the Coast Guard

Within several weeks of the allision between the *Caribbean Sea/ The Resource* and *DUKW 34*, two Coast Guard-licensed mariners voluntarily contacted Coast Guard Sector Delaware Bay and provided written statements regarding vessel operations in the vicinity of Penn's Landing. In one statement, a mariner reported a near miss with two APVs while attempting to moor an Articulated Tug and Barge (ATB) alongside the pier at Penn's Landing on July 6, 2010.³¹ The other mariner's statement relayed concerns that the larger towing and passenger vessels that share the local waterway with APVs often treat the APVs and their operators with disdain.³² The Coast Guard has been unable to verify either of these claims, and neither the Coast Guard nor RTDI had been made aware of these claims previously.

8. Amphibious Passenger Vehicle DUKW 34

8.1. Background

In April 1942, the U.S. Army ordered an amphibious vehicle prototype that could transport military personnel and material on both land and water.³³ Naval Architects worked with engineers at General Motors Corporation (GMC) to build the craft, basically mounting a steel hull, propulsion system, and other specialized equipment on the company's existing 2 ½ ton 6x6 truck chassis. The acronym DUKW came from the GMC nomenclature in which the "D" indicated the first year of manufacture; the "U" indicated a utility vehicle; the "K" indicated all-wheel drive; and the "W" indicated a rear tandem axle. The prototype was accepted by the U.S. Army, and production began at the GMC plant in Pontiac, Michigan, in November 1942. The craft was rated to carry 25 personnel with equipment or 5,000 pounds, on land, and 50 personnel or 10,000 pounds on the water. GMC built 21,147 DUKWs.

²⁸ 2010 Annual Report, and Report of Vessel Arrivals North of the Schuylkill River dated August 17, 2010, Maritime Exchange for the Delaware River and Bay. Also see www.mxops.org.

²⁹ National Oceanic and Atmospheric Administration (NOAA), hydrograph station PHBP1, located at Pier 12, and Physical Oceanographic Real Time System Data (PORTS) station, #8545240, located at the US Coast Guard, Sector Philadelphia dock. MTL is the average of high water, and low water levels.

³⁰ MR is the difference in height between mean high water and mean low water.

³¹ Statement of Mariner, dated July 17, 2010.

³² Statement of Mariner, dated July 26, 2010.

³³ www.history.gmheritagecenter.com

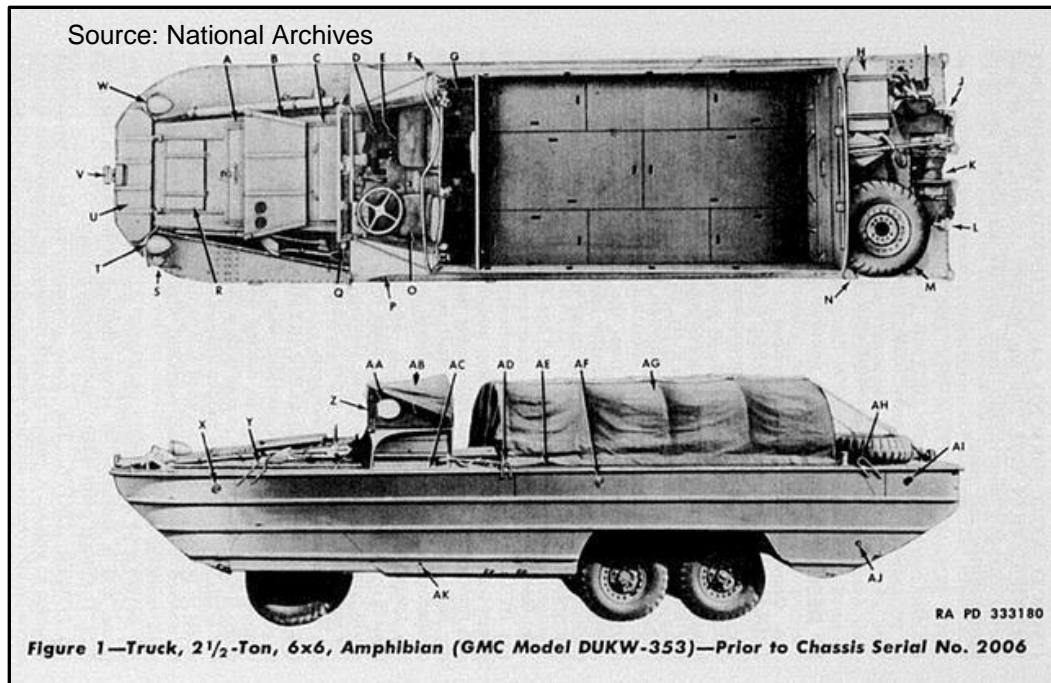


Figure 1 - Military version of the DUKW

After the war ended in 1945, some of the craft were transferred to the Coast Guard. Others served in various civil defense functions. The first documented use of a DUKW for commercial passenger use occurred in 1946 in Wisconsin Dells, Wisconsin, where a military version of the craft purchased at a surplus auction was used to conduct tours of the sandstone formations along the Wisconsin River.³⁴

The *DUKW 34* was not a modified version of the original military craft; rather it was a “stretch” DUKW that used very few components of an original DUKW other than the chassis. The APV was fabricated between February 2002 and October 2003 at Amphibious Vehicle Manufacturing (AVM), in Branson, Missouri.³⁵

8.2. Coast Guard oversight of DUKW operations in Philadelphia, Pennsylvania

On April 27, 2003, the Director of Operations for RTDI sent the Chief, Inspection Department, at Coast Guard Sector Delaware Bay an e-mail proposing operation of amphibious sightseeing excursions on the Delaware River. The e-mail provided the proposed route of travel.³⁶ The proposal indicated that all voyages would begin at the RTDI ramp located between Pier 11 and the Ben Franklin Bridge, then continue into the channel and proceed southward along Penn’s landing for not more than 1 nm, or adjacent to Pier 38. In this portion of the channel, the nearest channel markers are located approximately 1 nm upriver, and 4 nm downriver. None of the channel markers are visible from the APV route because of the bend in the channel.

The APVs would then return along the same track line and exit the water at the RTDI ramp, with the entire time traveled on the water not to exceed 30 minutes. The initial proposal also stated that the

³⁴ www.dellsducks.com/history

³⁵ Amphibious Vehicle Manufacturing in Branson, Missouri, was merged into Ride The Ducks, International, LLC in 2005.

³⁶ RTDI e-mail of April 27, 2003, and enclosure (a) Detail of Chartlet – Intended Route.

APV's distance from the east end of the piers would not exceed 300 yards and that the vessels "shall stay well clear of the shipping lane traffic upon the Delaware River." The proposed course, along with tentative areas identified as potential passenger egress areas where the APV could be beached or moored in the event of an emergency, were identified on a chart extract enclosed with the e-mail. The following day, RTDI provided the Coast Guard with a letter request to have New-to-Zone (NTZ) inspections performed on five DUKWs.³⁷ Each APV had an existing Certificate of Inspection (COI) issued by other Coast Guard zones and had been relocated to Philadelphia to make up the initial fleet of APVs.

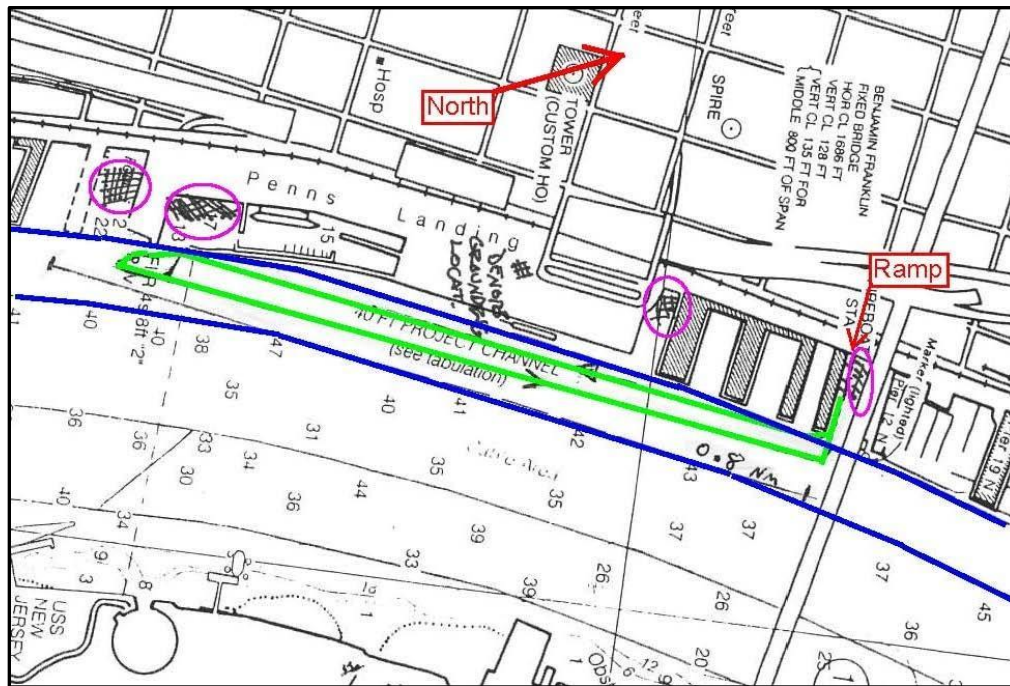


Figure 2 - Chart extract regarding proposed route of DUKW travel with information and highlight added by the NTSB for explanation purposes. The navigational channel boundaries have been overlaid in blue. The proposed route for the DUKW operation have been overlaid in green, and the proposed emergency grounding and egress areas have been circled in magenta.

RTDI began operations in Philadelphia on Memorial Day 2003.³⁸ During that first year, the Coast Guard limited the APVs to a route of operation between the Benjamin Franklin Bridge, and Pier 31, not more than a 1,000 feet from shore, and the duration of each waterborne excursion was not to exceed 30 minutes. Each APV was authorized to be operated with one licensed Master, and allowed to carry up to 38 passengers.

On January 22, 2004, Coast Guard Sector Delaware personnel met with RTDI personnel regarding safety concerns raised during the first year of operation. The Coast Guard's concerns included two instances of loss of propulsion due to floating debris, delayed notification of marine casualties, marginal results during man overboard drills attributed to the single crewmember combined with the

³⁷ RTDI letter to Sector Delaware Bay dated April 28, 2003.

³⁸ RTDI letter to Commander, Fifth Coast Guard District March 26, 2004.

APV's slow maneuvering, and incidents of children being allowed to sit at the helm.³⁹ Prior to the 2004 operational season, the Coast Guard increased the required manning level to include one deckhand, reduced both the number of passengers allowed to 37 persons and the distance from shore the APV was authorized to operate from 1,000 feet to 300 feet, and mandated the carriage of a VHF marine radio.⁴⁰ The requirement for RTDI to operate the APVs with a deckhand went into effect on April 10, 2004.⁴¹

The manning requirement to carry a deckhand was appealed by RTDI on March 26, 2004, to the Commander, Fifth Coast Guard District where the decision was upheld on April 8, 2004.⁴² On that same date, RTDI appealed the decision of the Commander, Fifth Coast Guard District to the Commandant. On May 13, 2004, the Chief, Office of Compliance, at Coast Guard Headquarters denied the appeal.⁴³

A local news station broadcasted a video on May 28, 2004, in which a local reporter was shown operating a DUKW while underway in the Delaware River.⁴⁴ The video was obtained by a Coast Guard Investigator, who then contacted RTDI management regarding the matter. RTDI management indicated it had not enforced the policy of prohibiting passengers from sitting at the helm station and in the jump seat since the concern first arose in January 2004 because it had not been written into the APVs COI. On June 9, 2004, an RTDI manager issued a memorandum to all DUKW captains stating that a directive was issued to RTDI management prohibiting all passengers from sitting at the helm station and warned of the potential for Coast Guard action against the license of any captain who failed to comply with the directive.⁴⁵ The Coast Guard Investigator did not pursue the matter further. On July 28, 2004, RTDI requested further clarification from the Coast Guard regarding passengers in APVs operating station area while underway, and the Coast Guard restated its position that passengers may not operate the APV any time during a voyage.⁴⁶

On June 23, 2004, RTDI management requested that personnel from Sector Delaware Bay participate in a joint effort to assess the risk factors for RTDI operations on the Delaware River, using a risk assessment guide developed by the Coast Guard and PVA.⁴⁷ The Coast Guard declined to participate in the risk assessment due to other operational commitments and resource constraints but agreed to review the assessment report once it was completed.⁴⁸ RTDI sent the Coast Guard a second request to participate in a joint risk assessment on July 13, 2004. The Coast Guard again declined to participate due to resource constraints but indicated that Coast Guard personnel may assist in the future with this effort if resources became available.⁴⁹ When asked by the NTSB in January 2011 to

³⁹Sector Delaware Bay letter to Commander, Fifth Coast Guard District dated April 2, 2004, and RTDI internal document, "Timeline concerning deckhand directive, undated.

⁴⁰NTSB telephonic interview summary of Chief, Inspections Department dated October 25, 2010, and various DUKW COIs.

⁴¹Sector Delaware Bay letter to RTDI dated March 31, 2004.

⁴²Commander, Fifth Coast Guard District letter to RTDI dated April 8, 2004.

⁴³Commandant letter to RTDI dated May 13, 2004.

⁴⁴Sector Philadelphia MISLE Activity #2094258 dated May 28, 2004.

⁴⁵RTDI Memorandum dated June 9, 2004.

⁴⁶RTDI Letter to Coast Guard Sector Delaware Bay dated July 28, 2004, and Coast Guard Sector Delaware Bay Letter to RTDI dated September 14, 2004.

⁴⁷RTDI Letter to Coast Guard Sector Delaware Bay dated June 23, 2004.

⁴⁸Chief, Inspections and Investigations E-mail to RTDI dated June 25, 2004.

⁴⁹RTDI Letter to Coast Guard Sector Delaware Bay dated July 8, 2004 and Chief, Inspections and Investigations E-mail to Coast Guard District 5, dated July 13, 2004.

produce the actual risk assessment, neither the the Coast Guard nor RTDI were able to locate records indicating that this risk assessment was ever performed.

8.3. Required Manning

In Philadelphia, RTDI APVs were operated on the road portion of the tour either by an individual with a CDL and passenger endorsement or by an individual holding both a CDL (with passenger endorsement) and an appropriate Coast Guard master's license. The latter could operate the APV on the water as well as land. If the drivers/captains did not perform their own tour narration, another company employee would be carried on board to perform that function. Communication between the crew on board the APVs and the shore-side staff were conducted as needed using company-provided cellular telephones with direct-connect radio capability.

The manning requirements found on *DUKW 34*'s COI and the other APVs in the Philadelphia fleet only apply when the APV is operating upon waters subject to the jurisdiction of the Coast Guard. If the operator only possessed a CDL, another Coast Guard licensed master would board the APV before it entered the river at the company's ramp located at the intersection of Race Street and Christopher Columbus Boulevard, just south of the Benjamin Franklin Bridge. The CDL holder may then serve as the deckhand, or tour narrator, depending on their qualifications.

On the day of the accident, the *DUKW 34* operator had both a valid CDL and a valid Coast Guard Master's license, and he also performed his own tour narration. To fulfill the Coast Guard manning requirements, the deckhand required by the COI would board the APV at the ramp before it entered the water and then disembark the APV after the water portion of the tour was completed.

8.4. Coast Guard Inspection History of *DUKW 34*

The *DUKW 34* was a Small Passenger Vessel (SPV) under 100 gross tons, and subject to annual inspection by the Coast Guard.⁵⁰ Vessel inspectors from Coast Guard Sector Upper Mississippi River located in St. Louis, Missouri, (formerly known as a Marine Safety Office) performed the plan review, construction oversight, and initial inspection of *DUKW 34*, which led to the issuance of the original Certificate of Inspection (COI) and Stability Letter to the APV on September 18, 2003.⁵¹ The COI required the APV to be manned by one Coast Guard licensed master and allowed the carriage of a total of 38 passengers. The Stability Letter indicated the APV had adequate stability for 39 persons upon protected waters and was based on the satisfactory results of a stability test conducted on a "sister" APV on September 30, 2002.⁵² RTDI relocated the APV to the Fort Lauderdale, Florida, area where inspectors from Coast Guard Sector Miami successfully performed

⁵⁰ Applicable regulations are found in Title 46, Code of Federal Regulations (CFR), Parts 175 through 185.

⁵¹ Coast Guard MISLE activity #1876214 dated September 18, 2003. A properly issued COI and an approved stability letter are required by law, prior to operation as a SPV carrying more than six passengers, one of which is for hire. COIs for this particular class SPV are issued for 5 year intervals, with annual inspections due within 3 months, before or after, each anniversary date of the certificate. The Stability Letter was issued to the vessel upon the test results of a nearly identical, or "sister" vessel, *MO8424ES*. It could not be determined whether 160 lbs, or 140 lbs, was used as the assumed passenger weight during the actual stability test of the sister vessel, *MO8424ES*.

⁵² At that time, documents issued to the vessel used the state registration number, *MO1448EJ*, or the Coast Guard number, *35318940*. Stability Letters are valid indefinitely, as long the conditions on the vessel remain substantially unchanged. A simplified stability test was not performed by Coast Guard inspectors on the vessel itself, instead, the stability letter was based upon the test results of a nearly identical, or "sister" vessel, *MO8424ES*. It could not be determined whether 160 lbs, or 140 lbs, was used as the assumed passenger weight during the actual stability test of the sister vessel, *MO8424ES*.

an NTZ inspection on the APV on December 3, 2003. The vehicle then began operations on an inland portion of the waterways.⁵³ In March 2004, vessel inspectors conducted a damage survey of the APV and noted fractures in the hull plating near the APV's propeller shaft caused by the rudder assembly striking the launch ramp. The APV was removed from service, and successful repairs were made. The business in Fort Lauderdale was subsequently closed, and the APV was pulled from certificated small passenger service and sent back to AVM in Branson, Missouri.⁵⁴ Around April 29, 2004, vessel inspectors from St. Louis approved a redesigned rudder assembly configuration, and the APV was relocated to Philadelphia, Pennsylvania, where vessel inspectors from Coast Guard Sector Delaware Bay completed the APV's second inspection for certification on May 28, 2004. A new COI was issued at that time.

The APV remained in continuous certificated service in Philadelphia until late summer of 2008. On September 13, 2008, a Coast Guard inspector noticed that the APV was overdue for the required annual inspection, which was to have been completed within a 90 day window of the anniversary date of the COI, or no later than August 28, 2008.⁵⁵ A two-person Coast Guard team comprising one investigator and one inspector visited to the RTD maintenance facility on October 8, 2008, to follow up on the matter. At that time, company representatives informed the Coast Guard team that *DUKW 34* had experienced a problem with a bearing in its transfer case around the first of September while in operation on the road, and since it was no longer needed for the remainder of the operational season, the APV had been taken out of service. The Coast Guard team collected the COI issued to *DUKW 34* before departing the location, and on November 3, 2008, the Chief, Prevention Department, issued a letter to RTDI informing the company that the APV's COI had been deactivated because the APV had missed the required annual inspection.⁵⁶ The matter was not pursued further by Coast Guard investigators.⁵⁷

On March 12, 2009, inspectors from Sector Delaware Bay completed a COI examination and issued the APV's third COI, which authorized the carriage of 37 passengers and required both a master and a deckhand, for a total of 39 persons. The APV was authorized to resume certificated service at that time. On March 19, 2009, the Coast Guard Marine Safety Center issued a revised Stability Letter to the manufacturer, AVM, stating that *DUKW 34* met the stability requirement for the carriage of a maximum of 40 persons, 38 of which may be passengers, based upon the assumed passenger weight of 185 pounds.⁵⁸ The last annual inspection of *DUKW 34* began on March 12, 2010, and was completed by Coast Guard inspectors on March 31, 2010. The APV was determined to be fit for service.⁵⁹ Inspectors identified three deficiencies on the initial visit. The deficiencies required repair of the APV's propeller engagement system, relocation of a coolant overflow hose on the port muffler, and the removal of unused starter solenoid wire. All deficiencies were cleared before the inspection was completed.

⁵³ Coast Guard MISLE activity #2036135 dated April 2, 2004.

⁵⁴ Coast Guard MISLE activity #2036352 dated March 19, 2004.

⁵⁵ Coast Guard MISLE activity #3340883 dated October 8, 2008.

⁵⁶ Sector Delaware Bay letter of November 10, 2008, to RTDI Philadelphia

⁵⁷ Title 46 CFR, Part 4.05(1)(a)(4) requires owners/operator to report to the nearest Coast Guard office, all failures or occurrences, regardless of cause, which impair any aspect of a vessel's fitness for service.

⁵⁸ Coast Guard Marine Safety Center letter (16710/P013362) of March 19, 2009, to AVM.

⁵⁹ Coast Guard MISLE activity #3703045 dated March 25, 2010.

9. Towing Vessel *Caribbean Sea*

9.1. Background

The uninspected towing vessel *Caribbean Sea*, formerly named the *Vivian L. Roehrig*, has twin screws and was built in 1961 by Equitable Equipment Company, Madisonville, Louisiana, for coastwise towing service. The vessel is a tugboat, having a rounded bow and single deck, with a two-level accommodation space. The main wheelhouse is located forward, on the upper level of the accommodation space, and a second, smaller wheelhouse is located above the main wheelhouse on tower structure. The lower wheelhouse is heated and has air conditioning. The upper wheelhouse is heated, but does not have air conditioning.

A mast is located just aft of the second wheelhouse on a hinge system so that it may be lowered if necessary. The reported air draft is 45 feet with the mast up, and 35 feet with the mast lowered.⁶⁰ The vessel was acquired by K-Sea Transportation on June 5, 2008, as part of the company's acquisition of Roehrig Maritime, LLC.⁶¹ Prior to the acquisition, on April 18, 2008, a marine surveyor performed a top-side survey of the vessel and deemed it to be in satisfactory operational condition.⁶² Around June 8, 2008, the vessel was dry-docked at Caddell's Shipyard in Staten Island, New York, where same marine surveying firm performed a hull examination and identified damage or distortion in both the port and starboard rudder systems.⁶³ Repairs were made to the rudder systems, and a new Certificate of Documentation (COD) was issued to the vessel on June 9, 2009, reflecting the change of ownership from Roehrig Maritime, LLC, to K-Sea Transportation.⁶⁴

The vessel worked various jobs until December of 2009, at which time it was taken out of service because of lack of work. It remained out of service until June 23, 2010. On that date, the *Caribbean Sea* replaced the *Falcon* on the run between the City of Philadelphia's Water Department Northeast Water Pollution Control Plant on the Delaware River, to the city's Biosolids Recycling Center (BRC) located upon the Schuylkill River.⁶⁵ The vessel remained in that assignment until the time of the accident.

9.2. Manning of the *Caribbean Sea*

The vessel is manned by a one licensed master, one licensed mate, two deckhands and one licensed engineer. The company had defined the expectations from each position generally and while watchstanding.⁶⁶ On every deck watch, there was to be one licensed individual and one deckhand, with the licensed individual having ultimate responsibility for safe navigation, radio guard, lookout, and radar observation.

⁶⁰ Air draft refers to the distance from the surface of the water to the highest point on the vessel, which on the *Caribbean Sea* is the uppermost portion of the second wheelhouse.

⁶¹ K-Sea Company Growth Timeline, undated.

⁶² Meyerrose and Company, Inc, inspection report M-5681, dated April 18, 2008

⁶³ Meyerrose and Company, Inc, inspection report M-5757, dated June 18, 2008

⁶⁴ K-Sea Transportation Survey Report, *Caribbean Sea*, dated July, 8, 2010.

⁶⁵ City of Philadelphia, Contract #10-0108 dated July 17, 2009.

⁶⁶ K-Sea Transportation Vessel Procedures Manual, Chapter 2, Organization and Responsibility, section 2.2, Vessel Personnel Duties, and Chapter 6, Vessel Operations, section 6.3, Watchstanding.

At the time of the accident, the vessel was in operation or standing by 24 hours a day, with the navigational watch divided into two watches, with each watch performing 6 hours of work, followed by 6 hours off.⁶⁷ In such a two-watch system, also known as a “square watch,” the master and deckhand No. 1 have the “front watch,” which is a 6-hour watch from 0600 to 1200, then another 6-hour watch from 1800 to 2400.⁶⁸ The mate and deckhand No. 2 are on the “back watch” from 1200 to 1800, and again from 2400 to 0600. The engineer did not stand a navigational watch rotation and was on duty from 0700 to 1900 each day. This rotation was normally maintained for 2 weeks, at which time a crew change would take place.

10. Tank Barge *The Resource*

10.1. Background

The tank barge, *The Resource*, is an uninspected, un-manned, and non-self-propelled vessel built in 1989 by Trinity Marine Group, Nashville, Tennessee. The tank barge and another nearly identical tank barge called *The Recycler*, were designed and built specifically for the City of Philadelphia’s Water Department to transport wastewater biosolids, or “sludge,” generated from the city’s Northeast Water Pollution Control Plant on the Delaware River to the city’s Biosolids Recycling Center (BRC) located on the Schuylkill River.⁶⁹ The tank barge is raked on each end, and has four cargo tanks with a total combined capacity of 1,000,000 gallons at a loaded draft of 15 feet 4 inches. The tank barge is classed by the American Bureau of Shipping (ABS) and was limited to river service.⁷⁰ At the time of the accident, the tank barge was owned by the City of Philadelphia.

10.2. Contractual Agreement

On June 17, 2009, the City of Philadelphia awarded K-Sea Transportation an annual contract to perform the scheduled movements of both *The Resource* and *The Recycler* between the two water facilities.⁷¹ On July 1, 2009, K-Sea Transportation began making the scheduled runs using the towing vessel *Solomon Sea* as the first vessel on the project. From that date and up until the *Caribbean Sea* assumed the responsibility for the barge transits on June 23, 2010, several other company-owned and -operated vessels were used on the project, including the *Labrador Sea*, *Bering Sea*, *Inland Sea*, *Solomon Sea*, and *Falcon*.⁷²

The city provided a weekly schedule of anticipated barge movements, and the number of scheduled trips in any 24-hour cycle between the two locations ranged from one load, or one discharge, to two or more loads and discharges. The schedule on the day of the accident called for one loading and two discharges.

10.3. Previous accident involving *The Resource*

⁶⁷ Title 46 U.S. Code, (USC), Section 8904(a) requires all towing vessels at 26 feet in length or greater to be operated by a licensed individual. Title 46 USC, Section 8104(g) permits the licensed individual and crewmembers working on towing vessels engaged in a voyage of less than 600 miles to be divided into 2 watch sections, when at sea. Title 46 USC, Section 8104(h) prohibits licensed individuals working on towing vessels of this length from working more than 12 hour in any consecutive 24 hour period, except in the event of an emergency.

⁶⁸ American Waterways Operators (AWO) letter to the NTSB dated January 14, 2011.

⁶⁹ City of Philadelphia, Contract #10-0108 dated July 17, 2009.

⁷⁰ ABS Certificate of Classification issued July 6, 2006.

⁷¹ City of Philadelphia, Contract Award #100108 dated June 17, 2009. The contract had provisions for three additional one year renewal periods at the City’s discretion.

⁷² K-Sea Transportation, Customer Freight Report, dated July 1, 2009 through July 7, 2010.

On February 1, 2005, around 1945, an empty *The Resource* was being pushed up the Delaware River by the towing vessel *Brooklyn McAllister* on a starboard hip tow approximately one-half mile south of the Walt Whitman Bridge, en route to the City of Philadelphia's Water Department, Northeast Water Pollution Control Plant.⁷³ The starboard bow of *The Resource* struck the stern of the towing vessel *Capt. Conner*, which was also navigating upriver with the barge *SWOB-059* configured in a starboard hip tow, causing damage to both the stern and the aft superstructure of the *Capt. Conner* and the starboard bow of *The Resource*. There were no reported injuries or pollution associated with this casualty. The Coast Guard investigated this casualty and found that both vessel operators were negligent. The Incident Brief section of the report specifically noted that each individual failed to maintain a proper lookout and failed to take action to avoid the collision. The *Brooklyn McAllister* was not outfitted with an upper wheelhouse at the time of the incident.

11. Vessel operations on day of the accident

11.1. Pre-Accident: *Caribbean Sea* & *The Resource*

On July 7, 2010, at 0001, the *Caribbean Sea* was at the City of Philadelphia's Water Department Northeast Water Pollution Control Plant on the Delaware River, standing by for the loading of the tank barge *The Resource* to be completed.⁷⁴ At 0510, the vessel got underway with the loaded tank barge made fast to its starboard side, en route to the BRC facility on the Schuylkill River, a journey of about 11.7 nm.⁷⁵ The vessel (with *The Resource* in tow) arrived at BRC around 0805 and secured the tank barge to the facility for discharge. It then shifted to the River Associates dock, located approximately 1 nm downriver. It arrived there around 0900 to reposition one of the company's smaller lube oil barges, to take on water and supplies, and to perform a crew change for the position of mate.⁷⁶

The accident mate had served on board the *Caribbean Sea* from June 24, 2010, through June 30, 2010, and reported back to the vessel on the date of the accident around 1100 to assume duty and begin a 2 week tour of duty. The master and the mate had never worked together before on the *Caribbean Sea*, however both individuals knew each other from service on other company vessels. At 1200 hours, the mate, and deckhand No. 2, assumed the vessel's navigation watch. At that time, the vessel was shifted from the River Associates dock to the BRC to begin preparation for the transit back to the Northeast Water Pollution Control Plant. Temperatures in the Philadelphia area on this day were forecast to be record-setting, with the high of 103° F being the fourth hottest temperature in the city since 1874.⁷⁷

Deckhand No. 1 had lunch and then proceeded to his stateroom to sleep. The master stated to the NTSB that while the mate, deckhand No. 2 and the engineer were making up the vessel to the tank barge at the BRC, he and the mate were together in the lower wheelhouse. At that time, he said he informed the mate of his expectations for his preferred configuration of the tow and his expected use of the upper wheelhouse when transiting with a light barge. Specifically, he said he informed the mate that he preferred the propellers of the *Caribbean Sea* to be positioned a little farther aft of the

⁷³ Coast Guard Marine Information for Safety and Law Enforcement (MISLE) activity #2285120 dated February 1, 2005. The towing vessel *Brooklyn McAllister* was owned and operated by *McAllister Towing*.

⁷⁴ Daily Log from the *Caribbean Sea* dated July 7, 2010.

⁷⁵ *Caribbean Sea* Voyage Plan dated July 1, 2010.

⁷⁶ Testimony of Master, *Caribbean Sea*, July 10, 2010.

⁷⁷ www.phillyweather.net.

stern of *The Resource* than had been previously configured, which, in the master’s opinion, improved control of the barge and reduced the amount of rudder offset needed to steer the vessel in a straight line.⁷⁸ He said he also conveyed his expectation for the mate to use the upper wheelhouse for the transit northbound with the barge in the light condition because of the restricted visibility in the lower wheelhouse caused by the freeboard of the tank barge. He said the mate responded, “No problem. You don’t have to worry, that’s normal. That’s where I would be.” Shortly thereafter, between 1230 and 1245, the master went to his stateroom to rest. There was no written company policy regarding what wheelhouse to navigate from when the sludge barge was empty, and the master had not written his direction into the standing orders of the vessel.

Around 1315, the mate got the vessel underway with the emptied tank barge made fast to its starboard side, in route to the Northeast Water Pollution Control Plant. Deckhand No. 2 stated to the NTSB the he observed the mate in the upper wheelhouse at that time.⁷⁹ Once underway, deckhand No. 2 began performing day work, and the engineer returned to activities in the engine room. The mate did not delegate any responsibility for maintaining a lookout to either deckhand No. 2 or the engineer. The mate made the following two entries in the vessel’s daily log, which is kept inside the vessel’s lower wheelhouse: “1315 Underway w/Lt Barge The Resource from SW Sludge Dock”, and “1430 Made Rounds – Engine Room & Security, All Secure @ NE Sludge Dock w/ The Resource”.⁸⁰ The vessel had not actually been secured at the dock, and according to the vessel’s Automatic Identification System transmission at 1436, was still underway in the channel near Penn’s Landing on a course over ground of 13° and with a speed over ground of 5 knots.⁸¹ At 1437, the raked bow of *The Resource* struck the stern of anchored *DUKW 34* and pushed the *DUKW 34* forward briefly, then below the water’s surface.

11.1.1. Mate’s personal cellular telephone records

On August 25, 2010, the NTSB obtained the mate’s personal cellular telephone records from the service provider. Those records indicated the device had been used on the date of the accident.⁸² As shown in table 1 below, the records indicated 13 outbound calls to 5 different telephone numbers, 2 outbound calls to personal voice mail, and 6 incoming calls from 2 of the 5 telephone numbers were made or received by that cellular telephone during the time period of 1200, when the mate assumed the navigation watch, and 1437, the time of the accident on July 7, 2010. The last activity from that device which preceded the accident was an outbound call made at 1432, which lasted for 6 minutes, or until approximately 1438.

Table 1 - Mate's personal cellular telephone call record

Time Recorded	Outgoing/Incoming	Call Type	Duration in Minutes	Source or Destination
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⁷⁸ The arrangement of the tank barge in a hip tow, along with the effect of wind and current, caused the centerline of the vessel to be offset a few degrees to port from the direction of actual travel. This is commonly referred to as “crabbing” or “crabbing effect”.

⁷⁹ NTSB Interview of Deckhand #2, *Caribbean Sea*, July 12, 2010.

⁸⁰ Daily Log, *Caribbean Sea*, July 7, 2010.

⁸¹ Coast Guard Enterprise GIS data for the *Caribbean Sea*, July 7, 2010, 18:35.56 (Zulu), Latitude 39° 56’ 52.59” North, and Longitude, 075° 08’ 18.01” West.

⁸² T-Mobile USA Subpoena Response 2010-108131, to the NTSB dated August 25, 2010.

1222	Outgoing	Voice	1	Spouse's Cell
1227	Incoming	Voice	4	Father's Cell
1250	Outgoing	Voice	7	Spouse's Cell
1318	Incoming	Voice	1	Spouse's Cell
1321	Outgoing	Voice	1	Spouse's Cell
1324*	Outgoing	Voice mail	3	-----
1324*	Incoming	Voice	5	Spouse's Cell
1330	Outgoing	Voice	1	Home Telephone
1331	Outgoing	Voice	7	Mother's Cell
1338	Outgoing	Voice	4	Mother's Home
1342	Outgoing	Voice	2	Mother's Home
1349	Outgoing	Voice	1	Mother's Home
1358	Outgoing	Voice mail	2	-----
1401	Incoming	Voice	4	Mother's Home
1406	Incoming	Voice	2	Mother's Home
1408	Outgoing	Voice	2	Mother's Home
1419	Outgoing	Voice	1	Spouse's Cell
1420	Incoming	Voice	3	Spouse's Cell
1423	Outgoing	Voice	2	Mother's Home
1425	Outgoing	Voice	6	Father's Cell
1432	Outgoing	Voice	6	Mother's Home

* Denotes call waiting function utilized

On August 11, 2010, the NTSB issued two safety recommendations to the Coast Guard which addressed risk posed by the use of cellular telephones and other wireless devices while operating vessels.⁸³ One of the recommendations, M-10-3, recommended the issuance of a safety advisory to the maritime industry to promote awareness of this risk, and also encourage the voluntary development of operational policies to address the risk. On October 29, 2010, the Coast Guard issued Marine Safety Advisory 01-10, which met the intent of the NTSB recommendation.⁸⁴

11.2. Pre-Accident: *DUKW 34*

On the day of the incident, the master of *DUKW 34* reported to the RTDI maintenance facility around 0840 to prepare the unit for operation and to complete the required "RTDI Captain's/Driver's Pre-Trip Inspection" form on the APV.⁸⁵ Per RTDI procedures, all captain's and drivers were required to perform inspections of each APV prior to and after each operational period the unit was in service and to document these inspections on an RTDI form, which was to remain at the

⁸³ NTSB letter to Commandant dated August 11, 2010.

⁸⁴ Coast Guard Marine Safety Advisory, 01-10, Distracted Operations, Don't let it be you!, dated October 29, 2010.

⁸⁵ NTSB interview of Master, *DUKW 34*, July 9, 2010.

maintenance facility.⁸⁶ Any deficiencies that would prevent the safe and legal operation of a vehicle were to be brought to the attention of the maintenance manager and corrected prior to operation with passengers. The master said that on the day of the accident, he completed the pre-trip inspection and found no concerns or discrepancies. He said he departed the facility around 0945 in the APV en route to the Independence Visitor's Center (IVC), where he arrived around 1000.⁸⁷ NTSB investigators were unable to locate a completed pre-trip inspection form for *DUKW 34* for July 7, 2010, but other completed pre- and post-trip inspection forms were recovered from the salvaged APV, including the pre- and post-trip inspection forms completed by the master on the day preceding the accident. Those forms indicated that no deficiencies had been noted during either inspection.

The IVC is the staging area where passengers embark the APV to begin the tour and disembark the APV after the tour is complete. Each tour takes a route along roads in the downtown Philadelphia area that have sites of historical or other sightseeing interest. The waterborne portion of the tour begins at a ramp located between Pier 11 and the Ben Franklin Bridge. The tour continues into the Delaware River southward along Penn's landing for not more than 1 nm before returning along the same track line where the APV exits the water and returns to the IVC. The entire tour takes about 70 minutes, with the on-road portion of the tour approximately 50 minutes in duration, and the waterborne portion of the tour approximately 20 minutes in duration.⁸⁸

At 1030, the Master began his first tour of the day with *DUKW 34* with 37 passengers on board, which is the maximum number of passengers allowed by the APV's COI. The tour was completed around 1140, and according to the master, the tour was uneventful.⁸⁹ Around 1205, the master began his second tour of the day with *DUKW 34*, with 37 passengers on board, and that tour was also completed uneventfully around 1315. The master then took a break to eat lunch in the employee break room before returning to the *DUKW 34*.

Just before 1330, a fellow employee serving as an "Ambassador" had collected tickets and loaded passengers on the *DUKW 34* for the third tour of the day.⁹⁰ A total of 35 passengers were on board, which included one group of 13 Hungarian students, 2 Hungarian teachers, and 7 American citizens who were acting as hosts or chaperones. The master performed a pre-departure safety brief, and around 1335, the APV departed the IVC and began the on-road portion of the tour. About 1415, the APV arrived at the RTDI ramp, picked up the deckhand, and entered the Delaware River to begin the water portion of the tour. Another APV operated by RTDI, *DUKW 44*, carrying 32 passengers also entered the water shortly after *DUKW 34*.

The master and the deckhand both stated that when the APV entered the water, the master made a *securité* call on VHF channel 13 to alert marine traffic to the presence of the APV. He also sounded the horn. The NTSB was unable to verify this VHF marine radio call either went out or was

⁸⁶ RTDI Fleet Operations Manual 2010, dated January 2, 2010.

⁸⁷ RTDI Philadelphia Supervisor on Duty (SOD) Ridership form dated July 7, 2010, and NTSB interview of Master, *DUKW 34*, dated July 9, 2010.

⁸⁸ RTDI Philadelphia Standard Operating Procedures 2010, dated February 25, 2010.

⁸⁹ NTSB interview of Master, *DUKW 34*, July 9, 2010

⁹⁰ In addition to greeting the passengers at the point of loading, the RTDI personnel serving in the position of "Ambassador" are responsible for taking tickets at the IVC while loading the vessel, and performing the passenger count to assure that all passengers who purchased tickets for the scheduled trip are on board, and perform the functions of a deckhand if they are assigned to the ramp area where the vessel enters the water.

received. After the APV made a starboard turn to begin the southern transit along Penn's Landing, the master allowed the deckhand to take control of the APV. The master then took a position adjacent to the helm in the jump seat and continued the tour narration, which included voice and background music. Another Ride the Ducks APV, *DUKW 44*, was maneuvering southward on the same route, about 100 to 150 feet behind *DUKW 34*. The master stated that he assumed the deckhand would be responsible for maintaining a lookout at that point. In his interview with the NTSB, the deckhand stated that the responsibility for lookout was shared between the master and himself.⁹¹

At 1425, and after the APV had turned around and began the northbound portion of the water tour, the master noted what appeared to be smoke coming from the starboard engine compartment vent, and he thought there was a fire in that space.⁹² He reassumed a position in the helm seat from the deckhand, and the deckhand took the jump seat again. The deckhand asked the four passengers in the first row of seats if they would like to step back to avoid the smoke. The master then began a series of actions to mitigate the situation per the company's fire and loss-of-propulsion emergency procedures.⁹³ Specifically, he stated that he secured both port and starboard engine compartment vents, the APV's ignition switch, the emergency fuel shutoff, and the forward hatch. The master stated that he did not discharge the APV's fixed CO2 system because of uncertainty about whether there was actually a fire and his concern that some of the extinguishing agent could migrate into the passenger space. The master also stated he made a call on VHF marine radio, "probably on channel 13," to alert other vessels in the vicinity to the situation on board *DUKW 34*. He said he then used the direct-connect radio to contact the manager-on-duty at the IVC to inform her of the situation and to request that another *DUKW* be dispatched to tow the disabled APV. The NTSB was unable to verify that VHF marine radio call either went out from the APV or was received by any source at or about 1425.

The master aboard *DUKW 44*, which had been transiting northward in a position just aft and to starboard of *DUKW 34*, turned his APV to the right and went downriver under power so that he could maneuver his APV alongside the drifting *DUKW 34* to offer assistance. The crew on board *DUKW 34* declined the offer, and *DUKW 44* then continued northbound toward the RTDI ramp.

The master directed the deckhand to go to the bow of the *DUKW 34* to ready and deploy the anchor (which had 200 feet of line attached) to prevent the APV from drifting further with the river's current.⁹⁴ At 1427, the manager-on-duty, not wanting to distract the master from his duties, then called the deckhand's direct-connect radio to obtain more details on the event and the needs of the crew.⁹⁵ At 1429, the deckhand deployed the anchor, which initially dragged along the river bottom before securely taking a set. While waiting for the anchor to set, at about 1431, the deckhand sent a text message to his girlfriend about the situation on the APV. In his statement to the NTSB, the deckhand stated, "So I'm out there and I'm just - like I said, I'm - like if he's inside facing the guests, he's looking south so he's got an eye. I'm out. I'm on the bow. I'm looking north now. I got a eye out

⁹¹ NTSB interview of Deckhand, *DUKW 34*, July 9, 2010.

⁹² NTSB interview of Master, *DUKW 34*, July 14, 2010.

⁹³ RTDI Captain's Operations Manual dated February 20, 2010 has specific procedures identified that the Master must take in the event of a fire or loss of propulsion while underway.

⁹⁴ 33 CFR, Part 110 Anchorage Regulations, Section 157(b) Delaware Bay and River, prohibits anchoring outside of designated anchorages except in cases of great emergency, or to anchor in such a manner as to obstruct or endanger the passage of any vessel.

⁹⁵ NTSB interview of RTDI Philadelphia, Manager on Duty, July 11, 2010.

there. You know, it's kind of like - and it's a mutual type thing. That's what it all is. So I'm up there and I remember texting my girlfriend.” The master did not instruct the deckhand to maintain a lookout when he directed the deckhand to go the bow of the APV.

Once the APV’s anchor contacted the bottom of the river, *DUKW 34* continued to drift approximately 155 feet, before the anchor set in the sandy sediment and took hold.⁹⁶ At 1433, *DUKW 34* was anchored in the navigational channel, roughly 321 feet from the bulkhead of Penn’s Landing, near Grand Plaza. Staff calculated that, when the anchor set, the APV had drifted approximately 0.13 nm at an average speed in excess of 1 knot from the point at which the master secured the ignition. Per the company’s procedure, the master was required to continue to monitor traffic and the APV’s freeboard, and wait for the tow *DUKW*.

The master and the deckhand both stated that around this time, they saw the towing vessel and barge heading northbound. The master testified that he wasn’t sure of the exact position of the towing vessel and barge at that time, but he believed it was downriver and passing a moored tall ship known as the *Gazela Primeiro*. The deckhand testified that he estimated the distance between the vessels at that time to be about 1nm. The master stated that he made another callout on VHF radio channel 13 to alert marine traffic of the situation on board *DUKW 34*, and that, based upon his visual perspective of the towing vessel and barge at that time, he believed that the towing vessel was pushing the barge away and that his radio call had been heard. The NTSB was unable to verify that VHF marine radio call either went out from the APV, or was received by any source, around 1433. The master then began to apply duct tape to two access plates on the port and starboard sides of the control panel where the “smoke” was still entering the passenger space. During this process, the manager-on-duty used the direct-connect radio to inform the master that *DUKW 46* was being dispatched to perform a tow of *DUKW 34*. Coast Guard regulations and RTDI company policy required that the casualty be reported to the nearest Coast Guard office, once the immediate safety concerns on board were addressed.⁹⁷ Neither the master of *DUKW 34* or shore-side RTDI personnel informed the Coast Guard of the situation on board the APV at any time prior to the accident.

Once the master had duct-taped the access plates to reduce the “smoke” from entering the passenger compartment, the four passengers who had relocated aft were informed they could return to their seats in the front of the APV. About that time, the master said he noted that the towing vessel and barge had not changed course to avoid the *DUKW*.

Just before the allision, around 1435, the master attempted three times in succession to contact the *Caribbean Sea* on VHF radio, channel 13.⁹⁸ Another vessel, the passenger ferry *Freedom*, also attempted to raise the towing vessel after the attempts by the master of *DUKW34*, and there was no response from the *Caribbean Sea*. The master stated that he then ordered the passengers to don their lifejackets and to get off of the APV.⁹⁹ Prior to the allision, the deckhand jumped from the starboard

⁹⁶ New Jersey State Police, Marine Services Bureau, Side Scanning Sonar data captured July 9, 2009, indicates that the anchor drag marks in the river bottom were about 155 feet long.

⁹⁷ See 33 CFR, Part 160.215, Notice of Hazardous Condition and 46 CFR, Part 4.05-1, Notice of Marine Casualty. Also see RTDI Philadelphia Standard Operating Procedures, dated February 25, 2010, Water Incidents; RTDI Captains’ Operations Manual dated February 20, 2010, Loss of Propulsion; and RTDI Fleet Operations Manual dated January 2, 2010, Safety, Section 2.2 USCG Form 2692, List of Reportable Incidents.

⁹⁸ VHF Radio broadcast recorded by the Burlington County Bridge Commission, Tacony-Palmyra Control Tower

⁹⁹ 46 CFR, Part 185.508, Wearing of Lifejackets requires the master of the vessel to have passengers don lifejackets during emergencies, fire, loss of propulsion and when the vessel is to be towed.

bow of the *DUKW 34* into the water. The master and all passengers were unable to evacuate the APV and remained in the cabin area, under the canopy, as the barge struck and overrode the vessel. The master did not attempt to restart the APV's engine prior to the allision. Upon learning about the accident, the RTDI General Manager called the Coast Guard to notify the agency of the incident.

11.2.1. Deckhand's personal cellular telephone records

On February 10, 2011, the NTSB obtained the deckhand's personal cellular telephone records from the service provider, and those records indicated the device had been used on the date of the accident.¹⁰⁰ As shown in table 2 below, the records indicated two outbound and two inbound text messages were made or received by that cellular telephone, to single cellular telephone owned by a friend of the deckhand during the time period he was on the bow of *DUKW 34*.

Table 2 - Deckhand's personal cellular telephone call record

Time Recorded	Outgoing/Incoming	Call Type	Duration in Minutes	Source or Destination
1431*	Outgoing	Text Msg	0	Friend's Cell
1435*	Incoming	Text Msg	0	Friend's Cell
1435*	Incoming	Text Msg	0	Friend's Cell
1436*	Outgoing	Text Msg	0	Friend's Cell

* According to the service provider for the records, the timestamp for all text messages prior to October 12, 2010, are either central or eastern time, and no method was available to determine which of these two time zones the time stamps referred to. However, the NTSB obtained the cellular telephone records from the recipient of the deckhand's messages, and all times recorded by that individual's service provider were eastern time, indicating that the times associated with these messages are EDT.

11.3. Post-Accident: *Caribbean Sea & The Resource*

At the time of the allision, deckhand No. 2 and the engineer were seated at the crew table located on the port side of the galley. The deckhand and the engineer noticed a reduction in rpm of the vessel's engines and thought it had arrived at the destination. When the deckhand got up from the table, he looked out one of two portholes and noticed what appeared to be people in the water, off the port side of the vessel. Both he and the engineer exited the galley area and proceeded to the aft main deck area, where they observed multiple persons and debris passing down the port side of the vessel with the river current.¹⁰¹ The engineer went to alert the master of the situation. He climbed to the top of the engine room space using a ladder on the exterior of aftermost bulkhead, and then ran forward towards an exterior door leading into an area just outside the master's stateroom.¹⁰² When he opened the door to enter the passageway that runs between the lower wheelhouse and the master's stateroom, he saw the mate standing in front of the master's stateroom door and noted the stateroom

¹⁰⁰ T-Mobile USA Subpoena Response 2010-108131, to the NTSB dated August 25, 2010.

¹⁰¹ NTSB Interview of Engineer, *Caribbean Sea*, July 10, 2010

¹⁰² The Master's stateroom is located on the upper level of the accommodation space and just aft of the vessel's main wheelhouse.

door was partially open. He did not recall hearing any conversation between the master and the mate, nor did he exchange communications with either the mate or the master. He stated to the NTSB that the mate appeared to have an expression of “disbelief, like is this really happening”, but seemed alert.

The master stated that around 1437, he had been awakened by the mate knocking upon his stateroom door.¹⁰³ When he opened the stateroom door, the mate was standing there and indicated that he “ran over a DUKW boat.” The master put on his clothing, which he stated to the NTSB included shorts, sandals, and a blue t-shirt, and then he proceeded to the upper wheelhouse where he assumed control of the *Caribbean Sea* from the mate. The master stated the control for the vessel’s throttle was active in the upper wheelhouse, and the radar and both VHF radios were on when he arrived there.¹⁰⁴ One VHF radio was on channel 13, and the other VHF radio was on channel 16. The radar was either on a ½ nautical mile, or a ¾ nautical mile range setting.

He said he attempted to contact the Coast Guard on channel 16 to inform them of the accident, but a local passenger ferry, *Freedom*, was already communicating with the Coast Guard on that channel regarding the casualty. The master swung the vessel and tank barge around to starboard and held position while the engineer and deckhand No. 2 maintained lookout from the deck of *The Resource*. Due to the current in the river and the limited maneuverability of the tug and barge combination, the master stated he was unable to assist other vessels in the recovery of persons in the water.

Sometime after 1520, the *Caribbean Sea* was boarded by Coast Guard personnel from Sector Delaware Bay, and two Coast Guard investigators jointly interviewed the mate in the galley around 1544.¹⁰⁵ The mate first informed the investigators he was in the upper wheelhouse at the time of the allision and that he had not seen the DUKW before the accident. He said that he did not hear, see, or feel anything prior to seeing people in the water. He further stated that he did not hear any radio calls or see any targets on the *Caribbean Sea*’s radar.¹⁰⁶

Later in the interview, the mate indicated that he had seen a DUKW somewhere near the Ben Franklin Bridge when the *Caribbean Sea* was underway in the vicinity of Pier 38, but he could not determine its heading. He recalled the last time he saw a DUKW prior to the allision was as the *Caribbean Sea* was near the southern end of the main pier at Penn’s Landing, and at that time, the DUKW was out the channel on the starboard (east) side. The mate did not indicate to the Coast Guard Investigators that he attempted to raise the DUKW using the *Caribbean Sea*’s VHF marine radio, and the NTSB investigators were unable to locate any recorded outbound radio calls made from the *Caribbean Sea* to *DUKW 34*, or any other DUKW, during the accident voyage.

Later that night, the mate, via the attorney provided to him by K-Sea Transportation, invoked his Fifth Amendment right and refused to provide further statements or testimony to investigators, including those from the NTSB. One of the senior members of management with K-Sea

¹⁰³ NTSB Interview of the Master, *Caribbean Sea*, July 10, 2010.

¹⁰⁴ The throttle control system for the vessel is activated at only one of the two wheelhouses at any time. It must be transferred manually to the preferred steering position by activating an air control valve.

¹⁰⁵ Coast Guard Investigating Officer interview summaries of Mate signed on July 11, 2010, and July 13, 2010.

¹⁰⁶ Per 33 CFR , Parts 26.03 and 26.04, Vessel Bridge to Bridge Radio Telephone Regulations, and 47 CFR, Part 80.148, Telecommunication, towing vessels over 26 feet in length are required to maintain a watch on VHF radio channels 13 and 16 while underway on the navigable waters of the United States.

Transportation did provide a statement to the NTSB which indicated he had met briefly with the mate that evening, at the mate's request. At that meeting, the mate informed the senior manager that while on watch, he had been made aware of a situation in which his young son had experienced a life-threatening emergency during a medical procedure taking place that day and that he had become consumed with dealing with this family crisis.¹⁰⁷ The mate had not made this situation known to the master of the *Caribbean Sea*, any of the other vessel crew members, or other K-Sea Transportation managers, prior to that time. K-Sea Transportation informed the NTSB that although the company does not have any written policy regarding this type of situation, the company covers such matters during employment interviews and new-hire processing. Company representatives stated had the mate informed anyone of this situation, that he would have been immediately removed from duty, without the need for a formal watch relief.¹⁰⁸ The company provided examples from the last 18 months where mariners had requested and been relieved of duty because of family emergencies.

The actual allision, and some of the events preceding and following the accident, was captured in both still photographs and video footage. The video was captured by an organization located in Camden, New Jersey, which was monitoring vessel movement on the Delaware River on behalf of the U.S. Army. After the allision, deckhand No. 2 and the engineer can be seen briefly on the stern of the *Caribbean Sea*, and several frames later, another individual can be seen climbing the ladder to the upper wheelhouse. The individual climbing the ladder was wearing a white T-shirt.

12. Post-Accident corporate actions and developments

12.1. Ride The Ducks, International, LLC

RTDI suspended all APV tour operations in the Philadelphia area on the date of the accident and remained out of operation for the remainder of the 2010 season. RTDI, working with the City of Philadelphia and Coast Guard Sector Delaware Bay, explored the possibility of operating APVs upon the Schuylkill River, in lieu of the Delaware River for the upcoming 2011 season, but that route change was not approved by the city. The company has opened its own internal investigation, and that investigation remains open.

12.2. K-Sea Transportation, Incorporated

K-Sea Transportation remains under contract with the City of Philadelphia to move the sludge tank barges between the two water department facilities, but the company has replaced the *Caribbean Sea* with another company vessel and relocated the *Caribbean Sea* to New York. The company has opened its own internal investigation, and that investigation remains open.

13. Personnel

13.1. Master - DUKW 34

13.1.1. Age: The master was 58 years old at the time of the accident.

13.1.2. Maritime licenses and certificates: The master was operating under the authority of his second issuance of a Coast Guard master's license for steam or motor vessels of not more

¹⁰⁷ NTSB interview of K-Sea Transportation, Executive Vice President dated July 12, 2010.

¹⁰⁸ K-Sea Transportation E-mail dated August 13, 2010 to NTSB regarding Emergency Watch relief.

than 50 gross tons, upon near coastal waters, issued on March 20, 2008.¹⁰⁹ He obtained his original Coast Guard Master's license on May 23, 2003, which was limited to steam or motor vessels of not more than 25 gross tons, upon near coastal waters, shortly after completion of Coast Guard approved license and preparation training courses at Sea School.¹¹⁰ According to his merchant mariner's physicals, he had uncorrected vision in both the right and left eye of 20/200, correctable to 20/20, and each Coast Guard license was issued with the following endorsement, "Corrective lenses to be worn with spare glasses carried on board".¹¹¹ A video taken by a passenger on board *DUKW 34* prior to the APV's departure from the IVC showed the master wearing glasses during the safety briefing.

13.1.3. Training, Education and Background: The master was first employed by RTDI on March 1, 2004, in the position of captain. He remained in that position for 2 months, after which he operated his own charter fishing vessel and worked on other charter fishing vessels based in Cape May, New Jersey. He was rehired by RTDI in spring 2009 and worked the 2009 season and the 2010 season up until the time of the accident.

RTDI had corporate and local office safety, operational and emergency procedures and required all employees, based upon the position held, to attend annual preseason and periodic training sessions.¹¹² The position of APV master was deemed by RTDI to be a safety-critical position, and all APV masters were required to sit with supervisors or other persons designated as safety trainers to review and acknowledge the company- and Coast Guard-required emergency procedures on a quarterly basis. These procedures included actions to be taken in the event of loss of steering, loss of propulsion, man overboard, abandon ship, and fire. The master also completed a 3-day preseason training session on March 24, 2010, which included 2 days of classroom instruction and 1 day in the field covering Coast Guard-required emergency drills and U.S. Department of Transportation vehicle inspection refresher training.¹¹³ The master also completed two position safety standards review sessions—on April 30, 2010, and May 1, 2010—and a quarterly review of on-water emergency drill procedures on June 25, 2010.¹¹⁴

13.1.4. Fatigue Data: In the days preceding the accident, the master worked Sunday, July 4, and he indicated it was a hot and long day and that he was tired after work. He could not tell investigators exact times because he documented everything in his personal log book, which was at the bottom of the Delaware River. He stated that on Monday, July 5, he awoke around 0830. He said he performed various tasks around the house and then went to bed around 2100 or 2130. When asked how he slept that night, he replied "I usually sleep

¹⁰⁹ Coast Guard Master's license for steam or motor vessels of not more than 50 gross tons, upon near coastal waters, issued on March 20, 2008, by Coast Guard National Maritime Center, Martinsburg, WV.

¹¹⁰ Sea School completion certificate for Master of Motor Vessels of Not More Than 100 Gross Ton, and Assistance Towing Endorsement course dated April 23, 2003. Coast Guard Master's license for steam or motor vessels of not more than 25 gross tons, upon near coastal waters, issued on May 23, 2003, by Coast Guard Regional examination Center, Baltimore, MD.

¹¹¹ Coast Guard Form 719K (Rev03/04) dated February 11, 2008, and Coast Guard Form 719K (Rev 01/02) dated March 24, 2003.

¹¹² RTDI Safety Procedures Manual dated February 16, 2010

¹¹³ RTDI Safety Critical Position 2010 Training Agenda (master) and RTDI APV master's training schedule.

¹¹⁴ RTDI United States Coast Guard Second Quarter Emergency Training sign off sheet dated June 25, 2010, and RTDI "Safety Critical" Positions Safety Standards documentation form for APV master.

pretty good.” On Tuesday, July 6, he did not have to report to work until 1100, so he “slept in a little later.” His last tour that day departed the IVC at 1800, and he got back to the IVC at 1920. He then made his commute home, which took about 20 to 25 minutes. He stated he was tired that night because “it’s hot, and it’s a long day.” He did not remember the exact time he went to bed that night, and he indicated that he may have watched some of the Phillies baseball game on television prior to going to sleep. On Wednesday, the day of the accident, he stated he awoke around 0600 feeling rested.

13.1.5. Medical: He is a self-reported non-smoker and a light-to-moderate alcohol user. He indicated his last use of alcohol before the accident was a glass of wine consumed on Monday, July 5. He claimed to be free from use or addiction to dangerous drugs. On his last Coast Guard merchant mariner’s physical in 2008, he reported no illnesses or disabilities. He did disclose he was previously treated for depression and that he had been prescribed Prozac, but was no longer receiving treatment. He also disclosed an acid reflux problem and use of the prescription drug Nexium. On a medical examination form associated with a Commercial Driver’s License (CDL) application in 2004, he checked the “NO” box for the symptom titled, “*Sleep disorders, pauses in breathing while asleep, daytime sleepiness, loud snoring*”, and when asked by the attending Physician during that physical regarding his sleep patterns, he denied excessive tiredness.¹¹⁵ He also disclosed his use of Nexium and Prozac on that form.

13.1.6. After the accident, he was treated and released that same evening at Pennsylvania Hospital where he was diagnosed with abrasion of his forearm, and provided with a Tetanus and Diphtheria shot.¹¹⁶ He was informed to follow up with his family physician within 3 -5 days.

13.2. Deckhand - DUKW 34

13.2.1. Age: The deckhand was 18 years old at the time of the accident.

13.2.2. Maritime licenses and certificates: The deckhand did not hold a Coast Guard license or Merchant Mariner’s Document, as neither credential is required by law or regulation.

13.2.3. Training, Education and Background: The deckhand was hired by RTDI as an “Ambassador” in spring 2009 and worked the 2009 season and the 2010 season up until the time of the accident in that position.¹¹⁷ He self-reported that he had marine experience on small boats, stating that he had been around the maritime industry since he was a child because his father is a Coast Guard-licensed mariner. He further indicated that his father had previously been employed by K-Sea Transportation and was employed by RTDI at the time of the accident.

13.2.4. The deckhand position was also deemed a safety-critical position by RTDI, and the deckhand completed a 2-day preseason training session on April 14, 2010. The session included 1 day of orientation held in a classroom and second day of combined classroom and field training covering Coast Guard-required drills and RTDI safety standards based

¹¹⁵ DOT, Federal Motor Carrier Safety Administration (FMCSA) form 646-F dated March 4, 2004.

¹¹⁶ Pennsylvania Hospital Emergency Medical Department report of July 7, 2010 (Master – DUKW 34).

¹¹⁷ All RTDI personnel serving in the position of Ambassador are trained as deckhands.

upon his position.¹¹⁸ The deckhand also completed three more reviews of the company safety standards on April 30, May 2, and June 2, 2010.¹¹⁹

13.2.5. Fatigue Data: In the days preceding the accident, the deckhand was off Sunday, July 4, through Tuesday, July 6. He spent both Sunday and Tuesday relaxing around a swimming pool and had “a good night’s sleep” on both nights. That Monday night, he recalled going to sleep around 2330 or 2400 and said he awoke the following day sometime between 1100 and 1300. Tuesday was uneventful, and he recalled going to sleep around 2330 or 2400 that night as well. He said he awoke sometime around 0730 on Wednesday, the date of the accident, so that he could report to work at 0900. He did not recall how rested he felt that morning, but indicated he was “normally always pretty good, I’m a morning person.”

13.2.6. Medical: He is a self-reported, smoker who smoked about one half of a pack of cigarettes each day. He stated he did not consume alcohol, and was not using any prescription or non-prescription drugs. He said his vision was better than 20/20.

After the accident, he was treated and released that same evening at Pennsylvania Hospital where he was diagnosed with muscle strain and emotional shock.¹²⁰ He was directed to use over-the-counter Tylenol or Motrin and to follow up with his family physician within a week.

13.3. Mate – *Caribbean Sea*

13.3.1. Age: The mate was 34 years old at the time of the accident.

13.3.2. Maritime licenses and certificates: The mate was operating the under the authority of his first issuance of a Coast Guard mate’s license for steam or motor vessels of not more than 200 gross tons, upon near coastal waters, mate of towing vessels upon near coastal waters, and radar observer (unlimited), issued on November 13, 2006.¹²¹ The mate also held a Merchant Mariner’s Document (MMD) as an able bodied (AB) Seaman, limited to service on non-lifeboat equipped vessels, wiper, and steward or food handler.¹²²

13.3.3. Training, Education and Background: On October 16, 2000, the mate received his first MMD as an ordinary seaman (OS) wiper and food handler and began his maritime career in late December 2000 with K-Sea Transportation, Inc, as an OS/deckhand.¹²³ From that date until mid 2006, he served on various vessels in the company fleet and progressed from OS, to AB/deckhand. On May 15, 2006, he submitted a licensing package to the Coast Guard Regional Examination Center (REC) in New York requesting permission to sit for the mate, near coastal steam or motor vessels of not more than 200 gross tons license, and that

¹¹⁸ RTDI Safety Critical Position 2010 Training Agenda (deckhand) and RTDI deckhand training schedule.

¹¹⁹ RTDI “Safety Critical” Positions Safety Standards documentation form for APV deckhand.

¹²⁰ Pennsylvania Hospital Emergency Medical Department report of July 7, 2010.

¹²¹ Coast Guard license for mate of steam or motor vessels of not more than 200 gross tons, upon near coastal waters, Mate of Towing Vessels upon near coastal waters, and radar observer (unlimited), issued on November 13, 2006, issued by Coast Guard Regional Examination Center, New York, NY.

¹²² Coast Guard Merchant Mariner’s Document issued to the Mate as a wiper, lifeboatman limited to service on non-lifeboat equipped vessels, and any unlicensed deck rating, including Able Bodied Seaman on January 27, 2009, by Coast Guard Regional Examination Center, New York, NY.

¹²³ Coast Guard Merchant Mariner’s Document issued to the Mate as an ordinary seaman, wiper, and food handler on October 16, 2000, by Coast Guard National Maritime Center, Martinsburg, WV.

request was approved on July 21, 2006. After this Coast Guard approval, the mate attended and completed several licensing courses at Quality Maritime Training (QMT) in St. Petersburg, Florida—specifically, the QMT 56 hour Operator of Uninspected Passenger Vessels (OUPV) course, which was completed on September 16, 2006; a 24-hour QMT OUPV upgrade to master 100 gross ton course, which was completed on September 21, 2006; and the 36-hour master 100 gross ton upgrade to master 200 gross ton course, which was completed on September 29, 2006.¹²⁴

The company had its own mate trainee program, which established minimum levels of competency, awareness, and training that were required to be met or completed prior to being considered for promotion to the position of mate¹²⁵ The mate began that program on January 24, 2007, aboard the *Falcon* and completed the training on March 5, 2007, on the *Davis Sea*. On March 7, 2007, he began his first service in the position of mate on the *Davis Sea*, and he continued to serve aboard various company vessels at that rank until the time of the accident.¹²⁶ Additionally, the company required that monthly safety meetings held on each company vessel. On June 1, 2010, while on board the *Falcon*, the mate participated in a training regarding maintaining situational awareness.¹²⁷

He had previously served as mate on the *Caribbean Sea* from October 21, 2009, through November 2, 2009, and then again on June 24, 2010, through June 30, 2010. In total, he served 118 days as mate on either the *Falcon* or the *Caribbean Sea* when the vessels were assigned to the tank barge movements.¹²⁸

13.3.4. Fatigue Data: Shortly after the accident, the mate allowed two Coast Guard investigators to interview him aboard the *Caribbean Sea*. Later that evening, he invoked his right to the Fifth Amendment and has refused to be interviewed by NTSB or other investigators. The mate was off duty from July 1, 2010, until the date of the accident; however a complete 72 hour work/rest profile is unknown. There was no physician-noted or self-reported sleep disorders found in the mate’s medical records.

13.3.5. Medical: According to his merchant mariner’s physicals and current Coast Guard license, the mate had an existing physical waiver noted for a thyroid problem and was prescribed Levoxyl (levothyroxine) tablets, .125 mg per day.¹²⁹ K-Sea Transportation’s SQMS required all marine personnel to obtain an annual physical examination, and the mate’s last company-required physical before the accident was completed on April 21, 2010.¹³⁰ The mate was determined at that time by a physician to be medically and psychologically fit for duty and was required to continue taking Levoxyl tablets at the

¹²⁴ Quality Maritime Training, LLC, course completion certificates issued September 16, 21 and 29, 2006.

¹²⁵ K-Sea Transportation Vessel Procedures Manual, Chapter 3, Personnel Policies & Procedures, section 3.6, Personnel Development.

¹²⁶ K-Sea Personnel Action Form dated January 24, 2007. The *Davis Sea*, ON 651977 is a 2000 hp, 95 gross ton towing vessel. The vessel is 77’ long, 26’ beam and has 9’ draft.

¹²⁷ K-Sea Transportation, Safety Meeting Report from the *Falcon* dated June 1, 2010.

¹²⁸ K-Sea 2009 and 2010 “Attendance Sheets” for mate.

¹²⁹ Coast Guard Merchant Mariner’s License & Document (MMLD) file for Mate provided to NTSB 20100707.

¹³⁰ K-Sea Transportation Vessel Procedures Manual, Chapter 3, Personnel Policies & Procedures, section 3.3, Physical Examination and Anderson-Kelly Associates Physicians Preliminary Report dated April 21, 2010.

prescribe dosage to maintain his fitness for sea duty status. He had uncorrected vision of 20/20 in both eyes.

13.4. Master – *Caribbean Sea*

13.4.1. Age: The master was 31 years old at the time of the accident.

13.4.2. Maritime licenses and certificates: The master was operating under the authority of his Coast Guard license of master of towing vessel's upon oceans. The license was also endorsed as second mate of steam or motor vessels of any gross tons upon oceans, and radar observer (unlimited). It was issued on April 26, 2007.¹³¹ This was his second issuance of a Coast Guard license. The master also held an MMD as a person in charge/medical care provider, AB, and tankerman/person in charge.¹³²

13.4.3. Training, Education and Background: The master graduated from Maine Maritime Academy with a Bachelor of Science in Marine Transportation in 2002. He received his first issuance of a Coast Guard license as third mate, steam or motor vessels of any gross tons upon oceans, and radar observer on April 29, 2002. On January 13, 2004, he obtained an endorsement on the original license for service as master of towing vessels upon oceans and was hired by K-Sea Transportation as a mate on April 28, 2004.¹³³ On January 17, 2007, the Coast Guard approved him to take the deck and general examination required to upgrade his license to master of steam or motor vessels of not more than 1,600 gross tons upon oceans, and that examination was completed on March 18, 2008. The appropriate endorsement was added to his license.¹³⁴ Prior to working for K-Sea Transportation, the master served as a third mate on sea going vessels operated by Polar Tankers, and then a deckhand on vessels operated by Weeks Marine where he gained towing vessel experience. He had assumed his first position as master on board the *Caribbean Sea* on July 3, 2010, 4 days before the accident. In total, he had served 8 days as either mate or master aboard the *Caribbean Sea* with the vessel assigned to the tank barge movements.¹³⁵

13.4.4. Fatigue Data: The master had reported to the *Caribbean Sea* on June 30, 2010, and had been participating in the two-watch rotation—originally as mate—and was assigned the back watch from 1200 to 1800 and from 0001 to 0600. On Saturday, July 3, 2010, he began serving in the position of master and transitioned to the front watch, 1800 to 2400 and 0600 to 1200. He remained in that duty rotation up until the time of the accident. He indicated he got the majority of his rest during his off-duty period between 0001 and 0600 and that he also slept well during the afternoon off-duty period. He was a self-reported non-smoker and

¹³¹ Coast Guard license for master of towing vessel's upon oceans. The license was also endorsed as second mate of steam or motor vessels of any gross tons upon oceans, and radar observer (unlimited), issued on April 26, 2007 by Coast Guard Regional Examination Center, Boston, MA.

¹³² Coast Guard Merchant Mariner's Document issued to the master as a Person in Charge/Medical Care, Tankerman/Person in Charge (Dangerous Liquids) and any unlicensed deck rating, including Able Bodied Seaman on April 26, 2007 by Coast Guard Regional Examination Center, Boston, MA.

¹³³ Endorsement to License serial number 997232 by Coast Guard Regional Examination Center, Boston, MA, dated January 13, 2004.

¹³⁴ Endorsement to License serial number 1187239 by Coast Guard Regional Examination Center, Boston, MA, dated March 18, 2008.

¹³⁵ K-Sea 2009 and 2010 "Attendance Sheets" for master.

was not taking any prescription medications at the time of the NTSB interview. There were no physician-noted or self-reported sleep disorders found in the master's medical records.

13.4.5. Medical: Around the end of April 2009, the master had been diagnosed with Hodgkin Lymphoma and had taken a medical leave of absence from the months of May through November that same year. He had been prescribed Xanax at that time as a remedy to help cope with anxiety of his medical condition. The master completed treatment for the cancer on October 29, 2009, and was cleared by the treatment center to return to sea.¹³⁶ The master's last company-required physical before the accident was completed on November 12, 2009, and he was determined at that time by a physician to be medically and psychologically fit for duty.¹³⁷ He testified before the NTSB that he quit taking Xanax and returned to work as mate on board the *Norwegian Sea* on December 9, 2009.

14. Chemical Testing

14.1. Caribbean Sea

K-Sea Transportation uses the consortium American Maritime Safety (AMS), Inc., for the company's chemical testing program, and the *Caribbean Sea* crew members, were enrolled in the program.¹³⁸ A local K-Sea Transportation employee certified by AMS to collect urine specimens and perform alcohol swab testing performed an alcohol screening of the accident mate at 1611 and collected a urine specimen.¹³⁹ The specimen collector used a Q.E.D. A150 brand saliva test swab test on the mate, which yielded a negative result for the presence of alcohol.¹⁴⁰ This same individual also collected urine specimens from and performed saliva swab testing for alcohol on the other four crewmembers of the *Caribbean Sea* between 1632 and 1739. The results of those saliva tests were negative for the presence of alcohol. The urine specimens collected from the mate and all crew members were sent to MedTox Laboratories, Inc., for testing and were later confirmed by a Medical Review Officer (MRO) to be negative for the presence of dangerous drugs.¹⁴¹

14.2. DUKW 34

Sometime after the initial search and rescue effort, alcohol tests were performed by local Coast Guard personnel on the master and the deckhand using an Alco-Sensor IV breath-alcohol testing unit.¹⁴² The exact time of the alcohol test on each individual is not known, however, it is known the testing took place after 1442 and before urine specimens were collected from individual as discussed below. The test results on both individuals were negative for the presence of alcohol.¹⁴³

On the day of the accident, a specimen collection technician collected urine specimens from the deckhand at 1804 and from the master at 1812. The urine specimens were sent to LabCorp for

¹³⁶ Dana-Farber Cancer Institute letter to K-Sea Transportation dated November 9, 2009.

¹³⁷ Anderson-Kelly Associates Physicians Preliminary Report dated November 12, 2009.

¹³⁸ American Maritime Safety (AMS), Inc., Vessel Certificate of Enrollment, date of expiration December 31, 2010.

¹³⁹ NTSB interview of K-Sea Operations Assistant, Philadelphia Yard dated July 12, 2010. AMS, Inc Drug & Alcohol Specimen Collection Training for Vessel Supervisor's Certificate dated May 18, 2010.

¹⁴⁰ Q.E.D. A150 brand saliva alcohol test swabs manufactured by American Bio Medica, meet both the DOT standards, and the Coast Guard maritime requirements for alcohol testing. See www.americanbiomedica.com

¹⁴¹ I. M. T. MRO Report – Federal, dated July 9, 2010, specimen ID#s Y20608182, Y20608183, Y20608184, Y20608185 and Y20608186.

¹⁴² For more information on this system, see www.alcopro.com.

¹⁴³ Coast Guard statements of Alco-Senor IV test results for Master and Deckhand, dated July 7, 2010.

testing. The results for both individuals were both reported as negative for the presence of dangerous drugs by an MRO on July 9, 2010.¹⁴⁴ Per the MRO, the deckhand's specimen was determined to be a dilute specimen.

14.3. Federal Aviation Administration (FAA) Civil Aeronautical Medical Institute (CAMI)

On July 14, 2010, the U.S. Department of Transportation transferred regulatory control to the Coast Guard for bottle A of the split urine specimens taken from the master and the deckhand on *DUKW 34*, and from the mate on the *Caribbean Sea*, in order for the specimens to be properly transferred to the Federal Aviation Administration's Civil Aeronautical Medical Institute (CAMI) for toxicology testing.¹⁴⁵ On August 10, 2010, the specimen from the deckhand on the *DUKW 34* was reported negative for the presence of drugs or ethanol. On August 11, 2010, the specimen from the mate on the *Caribbean Sea* was reported negative for ethanol, with acetone detected in the specimen at the level of 11 mg/dl. The mate's specimen was then scheduled for retesting. On September 2, 2010, the laboratory report from the second test of the mate's specimen indicated quinine to be present in the urine.¹⁴⁶ On September 2, 2010, the specimen from the master on *DUKW 34* was reported negative for the presence of ethanol, with levels of quinine present in the urine.

15. Casualty Data

15.1. Amphibious Passenger Vehicles

At a recent Amphibious Vehicle Summit held by the PVA, the Coast Guard presented casualty data on the 143 amphibious vehicles in service as inspected SPVs.¹⁴⁷ Within this group of SPVs, there were a total of 117 reported casualties from the years 2002 through 2009, with 87 of those casualties being attributed to propulsion or steering. WWII-era APVs accounted for 67 of the total reportable casualties in that time frame and for 53 of the 87 propulsion- or steering-related events. The average casualty rate per 100 vehicles for the 143 amphibious vehicles was 10.2, as compared to the average casualty rate per 100 vessels of 5 for the other 5,450 non-amphibious inspected SPVs. During this time period noted, there were no fatalities noted on board any Coast Guard-inspected APV's in the United States and its territories.

15.2. Uninspected Towing Vessels

According to data provided to the NTSB from the AWO, referenced earlier, crew fatalities in the towing vessel industry declined from an average of 19 fatalities per year during the period 1994 through 1999, to 11 fatalities per year during the period 2000 through 2009. Additionally, in a joint study published by the AWO and the Coast Guard on towing industry safety statistics, it was

¹⁴⁴ Worknet Occupational Medicine, Results of Controlled Substance tests, batch id 20100709, specimen ID#s 0158689323 and 0158689315.

¹⁴⁵ E-mail from Chief, Coast Guard Drug and Alcohol Program Manager, Coast Guard 545, dated July 14, 2010, to NTSB Office of Marine Safety.

¹⁴⁶ See www.jag.cami.jccbi.gov/toxicology for more information regarding acetone and quinine presence in urine specimens. Acetone occurs naturally in the blood and urine of diabetics or with certain diets. Acetone is one of the solvents abused in "glue-sniffing." Quinine is an anti-malarial used in the treatment of malarial and leg cramps. It is also an additive in tonic water.

¹⁴⁷ Coast Guard Office of Investigations & Casualty Analysis, "Amphibious Vessel Casualties in Perspective" presented at the PVA, Amphibious Vehicle Summit, held December 1 – 3, 2010, in New Orleans, Louisiana. Amphibious Vehicles were defined in this presentation to include DUKW –Truck, WWII DUKW-Stretch, WWII DUKW- Fleet, Hydra-Terra, LARC and Trolley Boat type craft.

reported that approximately 89% of all towing vessel casualties are considered to be low-severity incidents, with 7% of those casualties considered medium-severity incidents, and the remaining 4% being considered high-severity incidents.¹⁴⁸

16. Navigation Rules

The Delaware River is an inland waterway of the United States, and the Inland Navigation Rules Act of 1980 is applicable.¹⁴⁹ Both the *DUKW 34*, and the *Caribbean Sea* were required by these rules to maintain a proper lookout at all times.¹⁵⁰ The *Caribbean Sea* was outfitted with radar equipment in both the upper and lower wheelhouses. The use and systematic observation of radar equipment is required by these rules to determine if a risk of collision exists or is developing.¹⁵¹ Additionally the rules require that the effectiveness of any actions taken to avoid collision be carefully checked until the other vessel is past and clear.¹⁵² The rules define the term “vessel not under command” to mean a vessel that, through some exceptional circumstance, is unable to maneuver and unable to keep out of the way of another vessel.¹⁵³ All power-driven vessels are required to keep out of the way of a vessel not under command.¹⁵⁴

In 1982, the NTSB issued a recommendation to the Coast Guard that an interpretative ruling be published to inform mariners on when to apply the narrow-channel rule of the Inland Navigation Rules Act.¹⁵⁵ That recommendation was closed by the NTSB on August 1, 1988, with unacceptable action taken by the Coast Guard. As of this date, there is no definition of a “narrow channel” or “fairway,” and no general guidelines or for applying the narrow-channel rule 9(a)(i). Also, there were no local Coast Guard policies, Federal regulations, or other doctrine applicable to the segment of the waterway where the accident occurred which deemed that portion of the Delaware River as a narrow channel.¹⁵⁶

¹⁴⁸ Coast Guard and American Waterways Operators Safety Partnership National Quality Steering Committee publication of August 4, 2010. See page 11 for definitions of a low, medium or severe incident.

¹⁴⁹ The Inland Navigation Rules Act of 1980, took effect on December 24, 1981

¹⁵⁰ Inland Steering and Sailing Rules, Subpart I – Conduct of vessels in any condition of visibility, Rule 5, Lookout.

¹⁵¹ Inland Steering and Sailing Rules, Subpart I – Conduct of vessels in any condition of visibility, Rule 7, Risk of Collision.

¹⁵² Inland Steering and Sailing Rules, Subpart I – Conduct of vessels in any condition of visibility, Rule 8, Action to Avoid Collision.

¹⁵³ Inland Steering and Sailing Rules, General, Rule 3, General Definitions, section (f) Vessel not under command.

¹⁵⁴ Inland Steering and Sailing Rules, Subpart II – Conduct of vessels in sight of one another, Rule 18, Responsibilities between vessels.

¹⁵⁵ NTSB Recommendation to Coast Guard M-82-032 dated June 30, 1982.

¹⁵⁶ 33 CFR 89.25 identifies certain “waters specified by the Secretary” upon which rule 9(a)(ii), would apply.