Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

MARINE TRANSPORTATION SAFETY INVESTIGATION REPORT M22P0259

CAPSIZING AND SUBSEQUENT SINKING

Passenger vessel *Island Bay*
Carpenter Bay, Haida Gwaii, British Columbia
10 September 2022

Canada

ABOUT THIS INVESTIGATION REPORT

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Summary

On 10 September 2022, the *Island Bay* was on an ecotour with 2 crew members and 5 passengers on board when the crew reported that the vessel was taking on water. The crew and passengers subsequently abandoned the vessel in Carpenter Bay, Haida Gwaii, British Columbia. During the abandonment, 1 passenger was washed away and was rescued. Crew and passengers evacuated to the shore in Carpenter Bay with the vessel's rigid hull inflatable boat. The *Island Bay* capsized, partially sank, and drifted aground. The crew and passengers were rescued from the shore that afternoon. The vessel was later salvaged and transported to Prince Rupert, British Columbia.

1.0 FACTUAL INFORMATION

1.1 Particulars of the vessel

Table 1. Particulars of the vessel

Name of vessel	*Island Bay*
Official number	372375
Port of registry	Prince Rupert, British Columbia (BC)
Flag	Canada
Type	Passenger
Gross tonnage (registered)	10.75
Registered length	9.91 m
Builder	Raider Aluminum Ltd.
Year built	1979
Construction material	Aluminum
Propulsion	8V71 Detroit Diesel engine (177 Kw) driving a single-screw propeller
Crew (Operators)	2
Passengers	5
Owner and authorized representative	Archipelago Ventures Ltd., Victoria, BC

1.2 Description of the vessel

The *Island Bay* (Figure 1) was a vessel of closed construction with a welded aluminum hull and fitted with paravane roll-dampening devices (commonly referred to as paravane stabilizers).

The vessel was fitted with a deckhouse that was raised from the main deck by approximately 55 cm. Inside the deckhouse was the helm station, the galley, and the forecastle. The deckhouse had accommodations for 8 people. The forecastle had an emergency exit with a watertight hatch onto the forward deck.

The helm station was located forward on the starboard side and was equipped with a radar, a depth sounder, an electronic chart plotter, a very high frequency radiotelephone with digital selective calling (VHF-DSC), an autopilot, and a GPS (global positioning system), as well as a console with switches for navigational lights and 4 bilge pumps.

The main deck had freeing ports on either side, approximately 15 cm above the waterline. The main deck also had storage lockers on the port and starboard side, next to the non-watertight galley door. A float-free emergency position indicating radio beacon (EPIRB) was fitted to a railing on the top of the deckhouse. A ladder provided access to the top of the deckhouse, which had another helm station, an 8-person life raft with a hydrostatic release mechanism, crab and prawn traps, 2 aluminum storage boxes, and an aluminum bench seat containing 8 lifejackets. An aluminum extension aft of the top of the deckhouse was fitted with a rack for kayaks and personal flotation devices (PFDs). A rigid hull inflatable boat

(RHIB) was tied to the vessel's starboard stern. The RHIB was used to transport passengers and as an emergency recovery boat.

Figure 1. A picture of the *Island Bay* showing the rigid-hulled inflatable boat, rack for kayaks and personal flotation devices, kayaks, paravane stabilizers, flying bridge, and deckhouse (Source: Royal Canadian Mounted Police, with TSB annotations)

The hull was divided by 4 watertight bulkheads into the following sections: the forward compartment, the engine compartment, a compartment containing the fresh water tank and 3 fuel tanks, the steering gear compartment containing the auxiliary fuel tank, and the lazarette containing a generator.

The forward, engine, and tank compartments were accessed through hatches inside the deckhouse. The steering gear compartment was accessed through a watertight hatch on the main deck. The lazarette was accessed through 3 non-watertight hatches on the stern deck. The stern deck was raised by about 25 cm from the main deck.

1.2.1 Vessel bilge pumping system

The vessel was fitted with 4 submersible Xylem Rule 2000 bilge pumps, which were functional at the time of the occurrence. The pumps were used to remove water from the bilges by way of individual through-hull overboard discharges.

Two pumps were in the engine compartment, along the centre line of the keel (forward and aft), with the overboard discharges located on the vessel's port side. The forward overboard discharge was 45.7 cm above the waterline and was fitted with a globe shut-off valve.[1] The aft overboard discharge was 7.5 cm above the waterline was fitted with a globe shut-off valve and a check valve.[2]

One bilge pump was located in the steering gear compartment with an overboard discharge on the vessel's starboard side. The overboard discharge was located 8 cm above the waterline and fitted with a check valve.

Another bilge pump was in the lazarette compartment with an overboard discharge on the vessel's port side. The overboard discharge was located 46 cm above the waterline and fitted with a shut-off globe valve.

At the time of the occurrence, the switches for all 4 bilge pumps were set to automatic. This setting turns the pumps on when the bilges fill with enough water to activate the float switches. All globe shut-off valves were in the open position.

1.3 History of the voyage

On 08 September 2022, at approximately 1230,[3] 5 passengers boarded the *Island Bay* at Rose Harbour, Haida Gwaii, British Columbia (BC),[4] for a 6-day tour of Haida Heritage Sites, ending at Sandspit, Haida Gwaii. The vessel's 2 operators, who were on board from a previous voyage, welcomed the new group of passengers. Operator 1 gave passengers a tour of the vessel and a safety briefing prior to departure. The safety briefing included identifying the locations of life jackets and the life raft, as well as person-overboard procedures. The 1st and 2nd days of the tour were conducted locally around Rose Harbour.

On 10 September, the planned voyage was from Rose Harbour to Ikeda Cove and then anchoring in Bag Harbour (Figure 2). At approximately 0600, the operators listened to the local weather forecast and sea conditions via VHF radio. They then discussed the weather and decided to depart as planned so that they could transit with the tidal current flowing in a direction similar to the wind. Both operators deployed the vessel's paravane stabilizers while passengers rested inside the deckhouse. Operator 1 untied the vessel from the mooring buoy, then went to the helm and placed the vessel on autopilot. Operator 2 was on watch.

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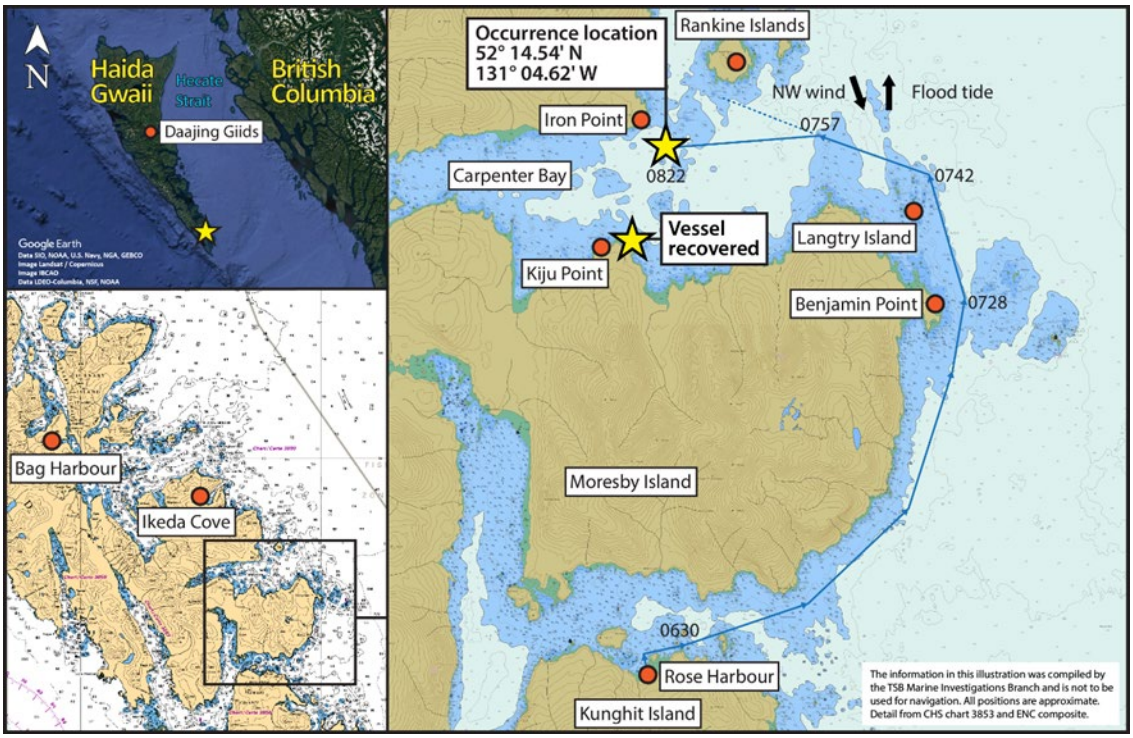
1 A shut-off globe valve allows for a 2-way flow of water when it is open and prevents water from flowing when it is closed.

2 A 1-way check valve allows water to flow in only 1 direction; therefore, it allows bilge water to be pumped out of the hull while preventing water from flowing into the vessel.

3 All times are Pacific Daylight Time (Coordinated Universal Time minus 7 hours).

4 All locations are in the province of British Columbia, unless otherwise indicated.

Figure 2. Vessel track and occurrence location (Source of main image: Canadian Hydrographic Service electronic navigation chart composite, with TSB annotations. Source of inset image 1: Google Maps, with TSB annotations. Source of inset image 2: Canadian Hydrographic Service chart 3853, with TSB annotations)



Initially, the wind and the seas conditions were calm. At around 0728, when the vessel approached Benjamin Point, the tidal current started flooding north, opposing the northwest wind. At approximately 0742, the vessel passed Langtry Island and approached the entrance to Carpenter Bay. The wind increased to about 30 knots with 1 to 2 m seas on the vessel's starboard bow, and the vessel began to develop a port heel of approximately 10°. At about this time, Operator 1 began to steer manually and reduced the vessel's speed.

From Langtry Island the vessel proceeded northwest toward Ikeda Cove. The wind was gusting, creating large waves. As the wind pushed on the starboard side of the vessel's deckhouse, the port heel increased and water shipped on deck through the vessel's port-side freeing ports. At approximately 0757, the operators revised their plan and turned to port for anchoring in Carpenter Bay.

Upon turning to port, the vessel was subjected to strong gusts from the northwest and 2 m waves on the beam of the vessel. As the vessel approached the channel between Rankine Islands and Iron Point, the operators observed wind gusts of 40 to 50 knots and the waves were estimated at 3 to 4 m. The port heel increased such that passengers had to brace themselves and objects inside the deckhouse fell from counters and bookshelves. Some of the bilge discharges on the vessel's port side were submerged; water began shipping on deck and the vessel developed a port list.

As the *Island Bay* proceeded into Carpenter Bay, Operator 1 was occupied with manoeuvring the vessel in the sea conditions. Operator 2 went from the helm to the deckhouse door to check the deck. There, Operator 2 saw that the amount of water on the main deck was increasing as the vessel continued to list to port. At this point, the bilge alarm sounded. Operator 2 realized that the vessel was not righting and ordered everyone to abandon the vessel onto the RHIB. Operator 2 then went onto the stern deck to get PFDs from the kayak rack and put them in the deckhouse for the passengers to don as they prepared to exit the deckhouse. Operator 2 and 4 of the passengers donned PFDs; 1 of the passengers was unable to don a PFD before it was washed away. The strong wind pushed the RHIB to the *Island Bay's* port side.

Operator 2 pulled the tow line attached to the RHIB to position the RHIB at the vessel's starboard quarter while Operator 1 called the Canadian Coast Guard (CCG) on VHF channel 16, giving the CCG the vessel's location and a brief description of the situation. Operator 1 then further slowed the vessel and went to assist Operator 2. Operator 2 entered the RHIB and positioned it on the vessel's starboard side. By this time, the list had increased to the point that water covered approximately a third of the deck and the port-side bulwark was under water. Passengers exited the deckhouse to the main deck through the galley door.

The passengers struggled to access the RHIB as adverse weather conditions, the vessel's rolling motions, and the water on deck hindered their movement. The evacuation of passengers from the vessel to the RHIB was paused at one point as 1 passenger entered the water and was carried away from the vessel. Operator 2 retrieved the passenger with the RHIB and returned to the vessel to resume the evacuation. Operator 1 was the last person to board the RHIB. The *Island Bay*'s main engine was still running as Operator 1 abandoned the vessel without a PFD.

When both operators and all 5 passengers were on board the RHIB, they headed to the north shore of Carpenter Bay. Once on shore, the operators built a fire and kept themselves and the passengers warm. Around 1400, the CCG ship *Cape Kuper* arrived, rescued the passengers and operators, and brought them to the village of Daajing Giids.

Following the abandonment, the *Island Bay* continued to downflood, partially sank, and drifted aground. On 16 September 2023, the *Island Bay* was recovered at Kiju Point, placed on a barge, and taken to Wainwright Marine Services Ltd. in Prince Rupert.

1.4 History of the vessel

The *Island Bay* was built in 1979 by Raider Aluminum Ltd. and was registered as fishing vessel under the name *Surfbird.* The *Surfbird* was built with accommodations for 2 crew members. The original owners used the vessel under contract to Fisheries and Oceans Canada (DFO) to conduct fisheries guardian services, such as monitoring fish stocks in Haida Gwaii.

In 1993, the vessel's stability was assessed with a roll period test[5] that indicated the vessel had sufficient stability in its condition at the time. The vessel underwent extensive modifications in 1998. These modifications included increasing the vessel's overall length, extending the deckhouse, and increasing the accommodations from 2 persons to 8 persons. The vessel's stability was not reassessed following these modifications.

In March 2001, the owner of the vessel attempted to enroll the vessel in Transport Canada's (TC's) Small Vessel Monitoring and Inspection Program (SVMIP) as a passenger vessel.[6] As part of the enrollment, the vessel was inspected by a TC marine safety inspector. The owner was given a list of items to be actioned before the enrollment could be completed, which included the following:

- Install fire extinguishing systems in the engine compartment.
- Install a smoke and heat detector in the accommodation.
- Install bilge pumps and high-water bilge alarms in the steering gear compartment and the lazarette.
- Raise the bulwark height to approximately 1 m.

In April 2001, the vessel was sold to Archipelago Ventures Ltd.[7] through a boat broker, and the new owners began using it for ecotourism.[8] No record of the modifications was provided to the new owners. In May 2001, TC inspected the vessel again, issued a notice of inspection, and enrolled it under the SVMIP program with the following restrictions to the operation:

- Voyage restrictions: operation to be conducted within 10 miles of the shoreline.
- Weather restrictions: operations to be conducted in suitable weather only.
- Capacity restriction: maximum of 8 people on board (minimum of 1 crew member).

In June 2003, Archipelago Ventures Ltd. changed the vessel's name to *Island Bay* and retained the registration type (fishing vessel). The vessel continued to carry out ecotourism voyages.

In March 2012, the *Island Bay* was enrolled in the Small Vessel Compliance Program (SVCP) as a small passenger vessel. The SVCP is a voluntary program that assists vessel owners in

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5 A roll period test is a simplified method of testing the stability of smaller vessels that provides one measure of a vessel's stability. The *Island Bay*'s condition at the time of this roll period test is unknown.

6 Transport Canada's Small Vessel Monitoring Inspection Program was later renamed the Small Vessel Compliance Program (SVCP) for non-pleasure craft.

7 Archipelago Ventures Ltd. is a commercial charter and adventure tour service provider, and used the *Island Bay* to take passengers on ecotours, and as a water taxi within the Gwaii Haanas National Park Reserve and Haida Heritage Site.

8 The International Ecotourism Society defines ecotourism as "responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education"; The International Ecotourism Society, "What is Ecotourism?" at https://ecotourism.org/what-is-ecotourism (last accessed on 20 August 2024).

understanding the complexity of their obligations under the *Canada Shipping Act, 2001* (CSA 2001) and associated regulations. The owner responded to the SVCP questionnaire, indicating that the vessel had not been modified, that it was watertight, and that the vessel's stability documentation (roll period test) was carried on board.

Before confirming enrollment in the SVCP, TC informed the owner via email that if the vessel was to carry passengers it had to be registered as a passenger vessel. Following confirmation from the vessel owners that the registration type would be changed, TC enrolled the vessel in the SVCP and issued a blue decal indicating the enrollment.

In April 2012, the owner applied to register the vessel as a passenger vessel. A tonnage measurer measured the vessel and issued a report indicating the vessel and propulsion types; the report sections for the vessel's dimensions and gross tonnage were left blank. TC issued a new certificate of registry indicating the new vessel type (passenger) and the original vessel dimensions and gross tonnage.

In June 2017, Archipelago Ventures Ltd. was sold to new owners, along with the vessel. The *Island Bay* continued to operate as an ecotourism vessel in Gwaii Haanas National Park Reserve and Haida Heritage Site. As the owner, Archipelago Ventures Ltd. was also the vessel's authorized representative (AR);[9] the 2 owners of the company (Operator 1 and Operator 2) were the operators of the vessel at the time of the occurrence.

The operators conducted annual maintenance on the vessel themselves, such as changing zinc anodes, testing the bilge pumps and associated valves, and painting the hull.

1.5 Environmental conditions

The marine weather forecast for the southern half of Hecate Strait for the morning of 10 September was winds of 20 to 30 knots and waves 1 to 2 m in height, building to 2 to 3 m in the afternoon. The local weather conditions for Cape St. James were reported as "unavailable" the morning of the occurrence. The nearest functioning weather reporting stations were at Cumshewa Island and South Hecate Strait; each station is approximately 45 nautical miles (NM) away from Rose Harbour. The morning of the occurrence, both stations reported winds of 10 to 13 knots. The air and water temperature at South Hecate Strait were both approximately 13 °C.

The operators experienced gusting winds of 40 to 50 knots and waves of 3 to 4 m while crossing the entrance to Carpenter Bay.

The tidal current for the area of the occurrence was forecast to change to oppose the wind direction at 0808.[10]

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9 Subsection 14(1) of the *Canada Shipping Act, 2001* indicates that every Canadian vessel must have a person, known as the authorized representative (AR), who is responsible for acting with respect to all matters relating to the vessel that are not otherwise assigned by regulation to another person. Under Canadian law, a corporation is a separate legal person.

10 Fisheries and Oceans Canada, "Tidal and water levels stations, Rose Harbour," at https://tides.gc.ca/en/stations/09713/2022-09-10?tz=PDT&unit=ft. (last accessed on 15 August 2024).

1.6 Personnel certification and experience

In 2017, each operator of the *Island Bay* obtained a Master, Limited for a Vessel of Less Than 60 Gross Tonnage certificate of competency issued by TC, which was valid for the vessel while operating in BC coastal waters not more than 10 NM from shore. Each operator took a Master, Limited course to prepare for the TC exams required to obtain their certificate.[11]

Operator 1 completed a Marine Emergency Duties (MED) A2 course in November 2016 and held Small Vessel Operator Proficiency (SVOP),[12] Restricted Operator Certificate – Maritime (ROC-M), and Small Vessel Machinery Operator – Restricted (SVMO-R) certificates that were issued between 2016 and 2017. Operator 1 had about 25 years of experience working on commercial vessels, primarily as a deckhand.

Operator 2 was issued an SVOP certificate in November 2016. Operator 2 had about 5 years of experience as a deckhand on commercial fishing vessels. Before purchasing the vessel, Operator 2 was a deckhand for 2 voyages with the *Island Bay*'s previous owner.

Both operators had worked on board the *Island Bay* since becoming owners of Archipelago Ventures Ltd. in 2017.

1.7 Vessel certification

As a commercially operated passenger vessel with a gross tonnage (GT) of 15 or less and carrying 12 or less passengers, the *Island Bay* was required to meet applicable regulations and standards under the CSA 2001, including the *Small Vessel Regulations*, the *Marine Personnel Regulations*, and the *Navigation Safety Regulations, 2020*.

The *Island Bay* was not required to be certified by TC, and was therefore not required to be periodically inspected for certification.[13]

1.8 Vessel licences, inspections, and surveys

1.8.1 Gwaii Haanas business licence

Within the Parks Canada Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve, and Haida Heritage Site, many operators offer tourism

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11 A number of training providers across Canada are approved by TC to assist candidates in preparing for their exams. The training that the *Island Bay* operators participated in did not include instruction on stability.

12 A number of training providers across Canada are approved by TC to provide the Small Vessel Operator Proficiency (SVOP) course, as described in TP 14692. This document breaks down 26 hours of training by subject. The stability content is allotted 1 hour.

13 TC's 's, *Vessel Safety Certificate Regulations* indicate that vessels of 15 GT or less that carry more than 12 passengers, or vessels of more than 15 GT, are required to be inspected and certified by TC. See Transport Canada, SOR/2021-135, *Vessel Safety Certificate Regulations* (as amended 23 June 2021).

expeditions. Operators must obtain a park business licence to conduct business within Gwaii Haanas.[14]

To obtain a licence, vessel owners must ensure that vessel operators have obtained the required TC certificates of competency, that their vessel's registration is up to date, and that they have insurance coverage. The park expects operators to be compliant with all applicable regulations, pursuant to the CSA 2001, including vessel stability and life-saving equipment requirements. Licences are issued annually and operators must re-apply every year.

On 06 May 2022, Archipelago Ventures Ltd. was issued a park business licence to provide tours in Gwaii Haanas for the 2022 season.

1.8.2 Royal Canadian Mounted Police inspection

TC has delegated the authority to carry out vessel inspections on its behalf to many law enforcement services across the country,[15] including the Royal Canadian Mounted Police (RCMP) and Conservation and Protection, Fisheries and Oceans Canada, Pacific Region. The authorization is limited to ensuring compliance with requirements under Parts 2, 3, 4, and 11 of the CSA 2001, and regulations made under those Parts, with respect to vessels that are not more than 24 m in length, but not including requirements relating to the construction of vessels.

On 03 July 2022, the RCMP inspected the *Island Bay*. An RCMP officer boarded the vessel and completed a Small Fishing Vessel Inspection form, which was used for all small commercial vessel compliance checks performed by the RCMP. Although the standard operating procedure for West Coast Marine Services RCMP includes advising vessel operators of the purpose of a vessel inspection, the completed form did not indicate the purpose or scope of the inspection. The form indicated that the operators' ROC-M certificates and certificates of competency were not on board. The RCMP officer signed the form and gave it to the operators for their records.

1.8.3 Insurance survey

It is customary throughout the marine industry for vessels to be surveyed prior to being accepted for insurance coverage or renewal. The primary function of an insurance survey is to determine the condition of the vessel and its current and replacement values. Deficiencies identified during an inspection are reported to owners and underwriters, and corrective measures are often made a condition of insurance coverage.

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14 Parks Canada, "Tour operators: Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve, and Haida Heritage Site," at https://parks.canada.ca/pn-np/bc/gwaiihaanas/visit/voyagistes-operators (last accessed on 20 August 2024).

15 Government of Canada, *Canada Shipping Act, 2001* (S.C. 2001, c.26), subsection 12(1).

There is no mandatory accreditation for vessel surveyors, and surveyors are not required to follow specific standards.[16] Insurance underwriters do not have shared standards for the scope of vessel surveys, and so follow their own criteria. The result is that surveys vary between surveyors and companies, as do the criteria for obtaining insurance. Vessel stability characteristics and modifications may not be assessed, and latent defects may not be identified. Many insurance survey reports provide a disclaimer indicating that the sole purpose of the survey is to assist in determining a vessel's qualification for insurance coverage, and that the survey report should not be used for other purposes (i.e., should not be taken as a measure of a vessel's seaworthiness).[17]

The *Island Bay* was surveyed in March 2015 and in May 2022 for insurance purposes.

The 2015 survey was conducted while the vessel was afloat. The survey report recommended the installation of anti-siphon vented loops[18] in the bilge pumps located in the lazarette and steering gear compartments.

The 2022 survey report noted that the surveyor assessed the vessel against the following industry standards and guidelines:

- TC's TP 1332, *Construction Standards for Small Vessels* (referenced in the *Small Vessel Regulations*)
- American Boat & Yacht Council (ABYC) Standards
- National Fire Protection Association Fire Protection Standard for Pleasure and Commercial Motor Craft
- TC's *Safe Boating Guide*

The 2022 survey report identified a number of deficiencies that required the vessel owner's immediate attention for the continued safety and general seaworthiness of the vessel:

- Replace generator exhaust system.
- Install ground fault circuit interrupter outlet in mechanical space.
- Install inverter chassis ground wire per ABYC standards.
- Service steaming light.
- Remove polyvinyl chloride piping attached to seacock.
- Properly cap seacock.
- Install a CO detector in the forecastle.

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16 The investigation determined that the surveyor who surveyed the *Island Bay* in 2015, and the surveyor who surveyed the vessel in 2022, were members of recognized marine surveyor societies.

17 Previously reported in TSB marine transportation safety investigations M20P0229 and M12W0054.

18 A vented loop located at the correct height prevents back-siphoning of water so as to maintain watertight integrity.

Previous TSB investigations have found that in the absence of periodic safety inspections by TC, operators of commercial vessels may rely on independent surveys to determine the seaworthiness of their vessels.[19]

1.9 Vessel stability

The stability of a vessel is the tendency of a vessel to return to its original position after it has been inclined due to external forces such as wind or waves. The stability of a vessel is a fundamental component of seaworthiness; it is in the interest of all vessel owners and operators to understand stability and ensure that their vessel possesses a satisfactory degree of stability, to ensure its safety and the safety of the people on board.

The ability of a vessel to return to an upright position after being inclined by any external force depends on the locations of 3 points: metacentre (M), centre of gravity (G), and centre of buoyancy[20] (B) (Figures 3 and 4). M is the point at which an imaginary vertical line passing through B and an imaginary vertical line passing through G intersect at low angle. G is the point at which the weight of a vessel acts vertically downward. G remains fixed in its location unless weight moves as a result of rolling. B is the point at which the buoyant force of the water acts upward. In calm water, G and B are vertically aligned and in equilibrium.

Figure 3. Cross-section of a vessel in an upright position, illustrating stability (Source: TSB)

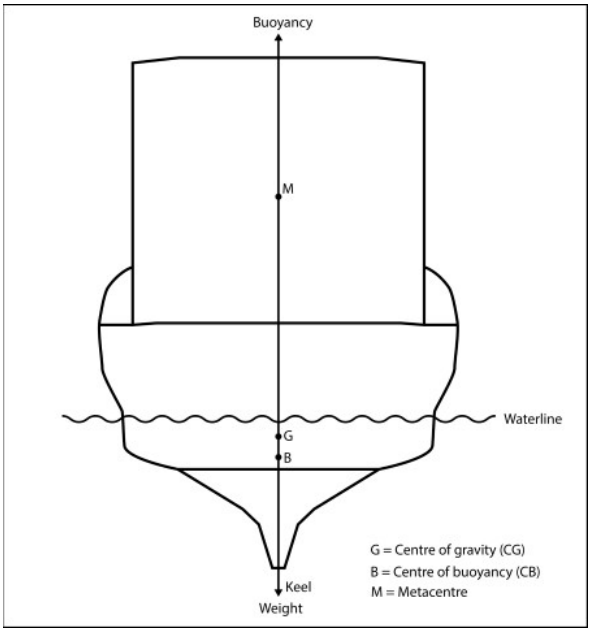
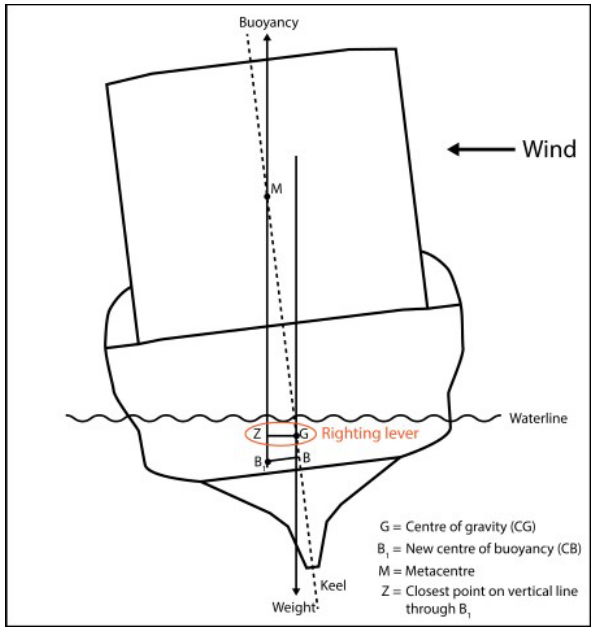


Figure 4. Cross-section of a vessel inclined by an external force, illustrating stability (Source: TSB)



When a vessel rolls, B will move because the immersed volume of the hull changes. The forces of B and G are still equal, and both continue to act vertically. The new location of B is labelled B_1. The perpendicular line between G and the vertical line through B_1 is called Z.

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19 TSB marine transportation safety investigation reports M15P0035, M12W0054, and M08W0189.

20 Buoyancy is an upward force exerted by a fluid that opposes the weight of a partially or fully immersed object. It is an upward thrust which enables bodies to float over a fluid without sinking.

The distance between G and Z is known as the righting arm, or righting lever (GZ). The righting lever and the vessel's weight create the righting moment, which is acting to return the vessel to the vertical position after it is inclined. In general, the righting lever increases to some maximum value and then decreases as the vessel heels further.

1.9.1 Operators' perception of vessel stability and safety

For vessels that have not been formally assessed for stability, an operator's perception of stability is often derived from the vessel's movements in different operating and sea conditions. However, an accurate determination of a vessel's stability can only be made through a formal stability assessment.

Loss of stability is a significant risk that must be managed when a vessel is in operation. However, this risk is not always understood by operators. Several factors contribute to operators' perception of risk.[21] Personal experience with hazardous situations can influence how dangerous the hazard is perceived to be; a person repeatedly performing a high-risk action without adverse consequences may eventually become desensitized to the risk.[22] Operators who believe they and their vessels are fully prepared for their intended operations may not identify the risk or fully understand the level of risk they face, and they may perceive little benefit to identifying hazards and mitigating the associated risks. The feeling of personal control over a situation can lessen anxiety and lead an operator to become more relaxed toward engaging in unsafe behaviours.[23]

Previous TSB investigations[24] have found that vessel operators' perception of vessel stability can be influenced by a number of factors, including

- previous accident-free years, which reinforce the belief in the safety and success of their operation and causes the operator to overestimate the vessel's stability;
- certificates, licences, and vessel examinations or surveys/inspections from governments, associations, and insurers that may be perceived more broadly as an overall indication of approval of the vessel's capacity to operate safely; and,
- operators' confidence in their own skills, actions, and experience.

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21 Risk is assessed potential for adverse consequences resulting from a hazard. It is the probability that, during a defined period of activity, the unsafe condition will result in an accident with definable consequences, i.e., it is the likelihood that the hazard's potential to cause harm will be realized.

22 J. Inouye, *Risk Perception: Theories, Strategies, and Next Steps* (National Safety Council, Campbell Institute), at https://www.thecampbellinstitute.org/wp-content/uploads/2017/05/Campbell-Institute-Risk-Perception-WP.pdf (last accessed 16 August 2024).

23 D. Krallis and A. Csontos, "From Risk Perception to Safe Behaviour" (Deloitte Touche Tohmatsu), at http://www.deloitte.com.au/media/docs/au_Deloitte_from_risk_perception_to_safe_behaviour.pdf (last accessed 20 August 2024).

24 TSB marine transportation safety investigations M21A0065, M20P0229, M19A0025, M09Z0001, M04N0086, M02W0147.

Prior to this occurrence, the *Island Bay* had

- over 20 years of successful voyages, in addition to the operators' past positive experiences with using paravane stabilizers to reduce the roll of the vessel;
- been approved by TC for an on-board capacity of 8 people, and to change its intended operations to a passenger vessel;
- a copy of the results of a roll period test that was conducted in 1993;
- been visited several times in the past by a TC inspector;
- been enrolled in TC's SVMIP and SVCP;
- been issued an inspection results form from the RCMP;
- been surveyed and approved for insurance; and,
- been licensed to operate in Gwaii Haanas.

1.9.2 Risk factors affecting stability

There are several factors that can adversely affect a vessel's stability, such as freeboard and reserve buoyancy, the effects of modifications to the vessel, and external forces created by wind and sea conditions.

1.9.2.1 Freeboard and reserve buoyancy

Freeboard is the distance between a vessel's waterline and its working deck. Reserve buoyancy is the volume of a vessel's enclosed space above the waterline that can be made watertight. An increase in freeboard also increases a vessel's reserve buoyancy, which creates better stability. Additional weight decreases freeboard, which in turn decreases reserve buoyancy.

Modifications were made to the *Island Bay* as part of a change in the vessel's intended operation from a fishing vessel to a Passenger vessel. These modifications added weight to the vessel, which reduced the freeboard and reserve buoyancy.

1.9.2.2 Vessel modifications

It is not uncommon for a vessel to be modified several times over its lifetime, and this is especially true for small commercial vessels and small fishing vessels.[25] If any of the modifications change the particulars of the vessel, they are required to be reported to the Chief Registrar.[26] Similarly, since coming into force in 2010, the *Small Vessel Regulations*

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25 TSB marine transportation safety investigation reports M21A0065, M19A0025, M17P0098, M12W0062, M12W0054, and M08W0189.

26 The *Canada Shipping Act* and its successor, the CSA 2001, required, and still requires, vessel owners / authorized representatives to notify the Chief Registrar of the Canadian Register of Vessels, Transport Canada, of any changes to the particulars listed in their vessel's certificate of registry. "If a Canadian vessel is altered to the extent that it no longer corresponds with its description or particulars set out on the certificate of registry, the authorized representative shall, within 30 days after the alteration, notify the Chief Registrar and provide the Chief Registrar with the relevant information and documents." See Government of Canada, *Canada Shipping Act, 2001*, S.C. 2001, c.26, subsection 58(2).

require the owner of the vessel to inform the Minister of Transport of a major modification.[27]

Modifications can contribute negatively to stability risk factors. Generally, modifications increase a vessel's total weight and reduce the initial freeboard and reserve buoyancy; the distribution of weight or change in hull shape will affect the vessel's ability to stay upright. Modifications may also compromise a vessel's watertight integrity, which increases the risk of downflooding. For these reasons, following the occurrence involving the fishing vessel *Tyhawk*, the Board recommended that vessel modifications be assessed, recorded, and reported to the Minister of Transport.[28]

The investigation determined that the *Island Bay* had undergone major modifications (Figure 5) since it was built, including the following:

- The overall length was increased to 12.58 m, with a hull extension at the stern of 1.85 m, while the beam remained the same. This extension increased the vessel's gross tonnage.
- The vessel's original deckhouse was replaced and extended.
- Three non-watertight hatches were installed to provide access to the added lazarette.
- The galley's original watertight door was replaced with a non-watertight door.
- The top of the deckhouse was converted into a flying bridge.
- Roll damping paravane stabilizers and associated rigging were installed.
- Six aluminum storage boxes were added throughout the vessel.
- A 0.5 m by 2.7 m aluminum swim grid was added.
- A kayak storage rack was added to the main deck, with kayaks sitting level with the top of the deckhouse.

The vessel's modifications increased its gross tonnage, overall length, and weight, and they changed its watertight integrity and stability. The investigation determined that the majority of the modifications were done in 1998. The investigation was not able to determine where any of the modifications were made, by whom, or if any standards were followed. The modifications were not reported to TC, and the certificate of registry continued to show the vessel's original particulars.

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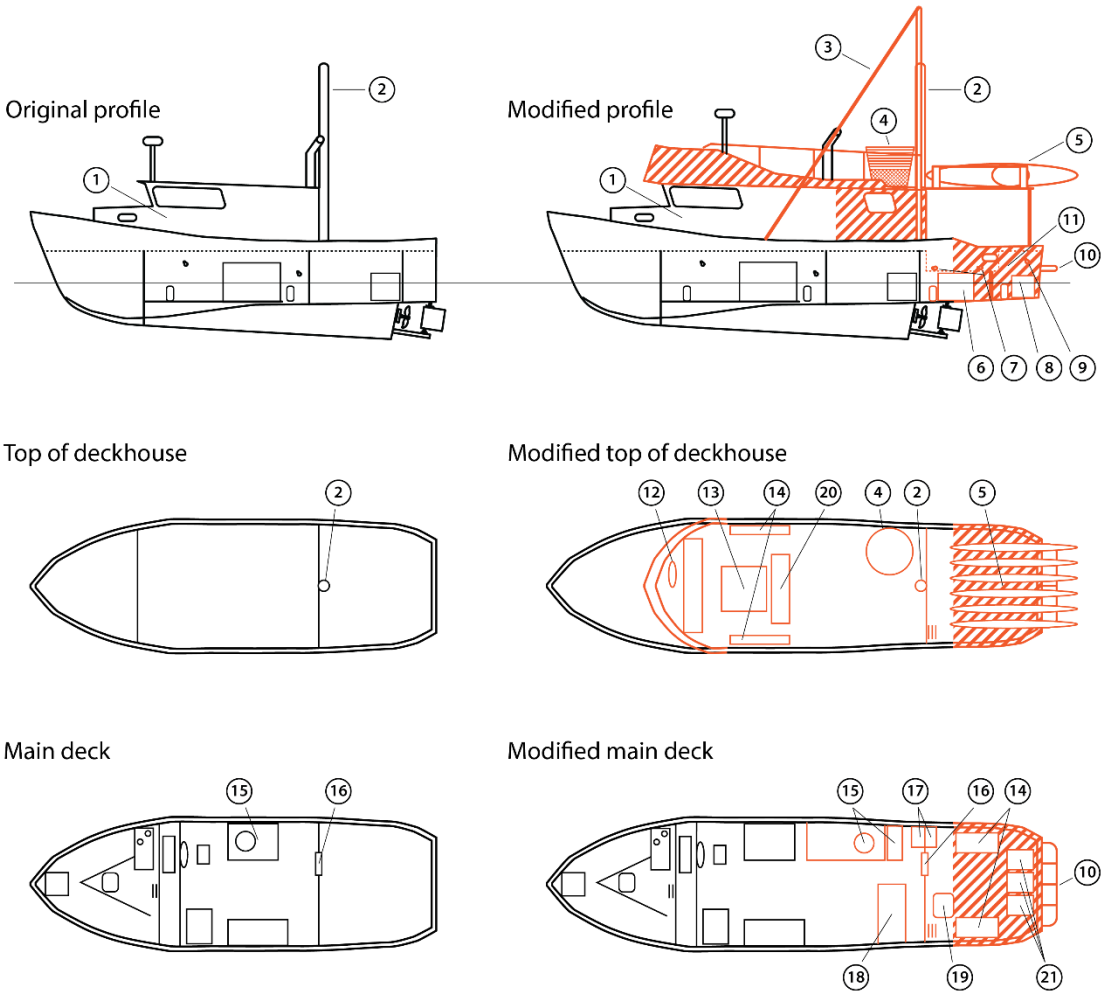
27 Transport Canada, SOR/2010-91, *Small Vessel Regulations* (as amended 20 December 2023), subsections 710(2).

28 TSB Marine Transportation Safety Investigation Report M21A0065.

The vessel changed ownership in 2001 and 2017, and in both cases the new owners were not aware of the extent of past modifications to the vessel's original design. The *Island Bay* had never undergone a full stability assessment, nor was it required to by regulation.[29]

Figure 5. Diagram comparing the *Island Bay*'s original design with its design after modifications (Source: TSB)



Legend: (1) Deckhouse, (2) Mast, (3) Stabilizers (port and starboard), (4) Traps, (5) Rack with kayaks and PFDs, (6) Auxiliary fuel tank, (7) Freeing ports, (8) Generator, (9) Lazarette bilge discharge, (10) Swim grid, (11) Lazarette, (12) Helm station, (13) 8-person life raft, (14) Storage lockers, (15) Sink and stove, (16) Galley door, (17) Closet, (18) Table/bunk, (19) Steering gear compartment hatch, (20) Storage for life jackets, (21) 3 non-watertight hatches on lazarette. Coloured and hashed items and areas represent additions.

29 The *Canada Shipping Act* was in force when the *Island Bay* was built. Although the Act did not contain any specific requirements related to vessel stability, section 391 required that owners and masters use all reasonable means to ensure vessels were seaworthy. See Government of Canada, *Canada Shipping Act*, RSC 1985, c S-9, at https://www.canlii.org/en/ca/laws/stat/rsc-1985-c-s-9/32084/rsc-1985-c-s-9.html (last accessed 20 August 2024).

1.9.2.3 Weight increase

The total weight of a vessel and its contents directly affects the centre of gravity (G), which is a key point that affects the vessel's ability to right itself. An increase in weight reduces a vessel's freeboard, which can reduce the vessel's stability. Reduced freeboard also brings the vessel's downflooding point(s) closer to the waterline. Accordingly, it is important to monitor changes in a vessel's weight over time. For small vessels (15 GT or less) where the weight of the vessel is relatively low to begin with, the addition of small amounts of weight over time, such as equipment and stores, can have a cumulative effect; this is a phenomenon known as weight creep.

The *Island Bay* had undergone major structural modifications, such as the hull and deckhouse extensions, that increased the vessel's weight. Several other additions also contributed to increasing the vessel's weight, such as equipment for ecotourism, including kayaks and associated storage rack.

1.9.2.4 Raised centre of gravity

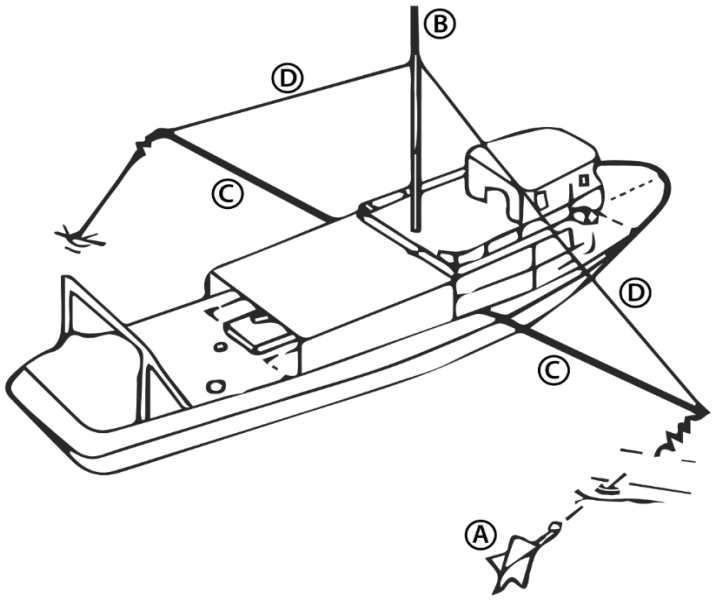
Although the effects of increases in vessel weight are important, the location of any weight increase is a critical factor in maintaining vessel stability. The addition of weight high up on a vessel, such as on the superstructure, can raise the centre of gravity. This raised centre of gravity affects the righting lever. A good practice of seamanship is to place heavy equipment as low as possible on board the vessel in order to maintain a low centre of gravity. A lower centre of gravity will increase the righting lever and improve vessel stability.

The modifications to the *Island Bay* for its new operation raised its centre of gravity.

1.9.2.4.1 Paravane roll-dampening devices

Paravane roll-dampening devices, commonly known as paravane stabilizers, consist of a delta-shaped fin suspended from the end of an outrigger pole, one on each side of the vessel, connected to the upper part of a paravane mast on the main deck (Figure 6). These devices raise a vessel's centre of gravity through the addition of topside weight (mast and rigging) and the dragging force created by the fins. These factors dampen the vessel's rolling motion, which improves the comfort of crew and passengers and creates the impression to some, including the operators of the *Island Bay*, that the vessel's stability is improved.

Figure 6. Illustration of paravane stabilizers (Source: TSB)



Legend: A) Delta-shaped fin, B) Mast, C) Outrigger poles, D) Rigging attaching outrigger poles to mast

The *Island Bay* was known to roll slowly and took time to return to an upright position. When its paravane stabilizers were deployed on a windy day, the vessel steadily heeled to one side.

In 2000, TC issued a Ship Safety Bulletin[30] warning vessel owners of the risks associated with using paravane stabilizers and that they do not improve the stability of a vessel. The investigation determined that the operators of the *Island Bay* were not aware of TC's publication.

1.9.2.5 Watertight integrity and downflooding

Watertight integrity is an important component of vessel stability. Watertight hull fittings and seals for doors and hatches prevent water from entering a vessel. Downflooding is the entry of seawater through an opening in a vessel's hull or superstructure due to heel, trim, or submergence of a vessel.[31] The accumulation of water from downflooding increases vessel weight and reduces vessel freeboard. A downflooding point is the lowest point where water can enter a vessel, and its location depends on a vessel's construction and its watertight integrity.

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30 Transport Canada, Ship Safety Bulletin 15/2000: The use of roll Damping paravane systems (paravane stabilizers)," 20 November 2000, at https://tc.canada.ca/en/marine-transportation/marine-safety/ship-safety-bulletins/bulletin-no-15-2000 (last accessed on 19 August 2024).

31 U.S. Coast Guard Marine Safety Center, *MSC Guidelines for Review of Passenger Safety Vessel Stability Subchapters K and H)* (27 October 2017), at https://www.dco.uscg.mil/Portals/9/MSC/PRG/PRG.H2-03.2017.10.27.Passenger_Vessel_Stability_(K-H).pdf?ver=2017-11-09-095449-127#:~:text=Downflooding%3A%20The%20entry%20of%20seawater,or%20submergence%20of%20the%20vessel (last accessed on 19 August 2024).

To avoid downflooding, TC's *Construction Standards for Small Vessels*[32] requires that a vessel's bilge pumping system be arranged to ensure that no back-siphoning can occur and water cannot enter the vessel through the pumps' discharges. There are a few ways this can be engineered; for example, vented loops or check valves can be used.[33]

The TSB calculated that when the vessel reached a 12° angle of heel to port, water began shipping onto the main deck through the freeing ports (Figure 7). At approximately 16° water began to downflood into the forward engine compartment and lazarette through the overboard discharges, accumulating in the vessel's port chine.[34] At 37°, water started flowing over the bulwarks and began to fill the lazarette through its non-watertight hatches, creating a further list and adding weight to the vessel. The deck edge along the deckhouse was also immersed at this angle.

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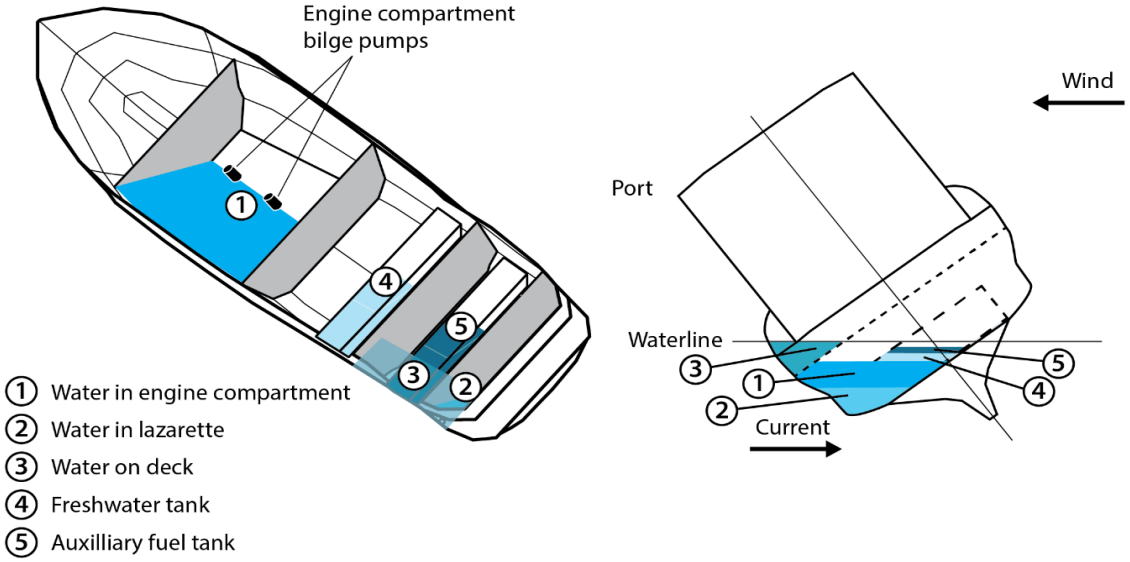
32 Transport Canada, TP 1332, *Construction Standards for Small Vessels*, 2010 Edition, section 9.3.3.2. at https://tc.canada.ca/en/marine-transportation/marine-safety/tp-1332-construction-standards-small-vessels-2010 (last accessed on 19 August 2024).

33 The manufacturer's instruction manual for Xylem Rule 2000 bilge pumps recommends using vented loops when installing the system, if the distance between the discharge outlets and waterline is less than 30 cm when upright. Xylem Inc., *Rule-Mate Instruction Manual* (2023), p. 9, at https://www.xylem.com/siteassets/brand/rule/resources/manual/rule-mate-iom-950-0528a_rev_g.pdf (last accessed 19 August 2024).

34 The chine of a vessel refers to the intersection point or line between the bottom of the hull (the underwater part of the vessel) and the sides (or topsides) of the hull where the hull of the vessel changes direction or curvature.

Figure 7. Diagram illustrating water ingress on the *Island Bay* with a 37° angle of heel and list to port (Source: TSB)



1.9.2.6 Free surface effect

When weight is able to move freely with the motion of a vessel, whether in tanks, on deck, or from water accumulated in the hull by downflooding, it shifts the vessel's centre of gravity toward the low side of the vessel, which increases the amount of time it will heel over before returning to vertical. This free motion of weight is described as free surface effect. The severity of free surface effect increases with the amount of weight and the distance it moves. Free surface effect can easily reduce a vessel's righting lever to the point where the vessel capsizes.

The investigation determined that approximately 50% of the stored water and fuel in the tanks on the *Island Bay* had been consumed before the occurrence. The investigation also determined that water had accumulated on deck just before the capsizing.

1.9.2.7 External forces

1.9.2.7.1 Towing

The drag force of the load being towed varies depending on sea conditions, and it acts upon the point where the tow line is connected to the vessel. If the connection point is above the towing vessel's centre of gravity, then its centre of gravity will rise. If the connection point is near the vessel stern, then the force of the load will also reduce the aft freeboard, which increases the chances of deck edge immersion. If the sea is on the vessel's beam or quarter, there is a possibility that the tow force will shift off the centreline of the vessel.

At the time of the occurrence, the *Island Bay* was towing a RHIB while encountering wind and waves at approximately 90° relative to its heading (beam seas). The 5-metre RHIB[35] was secured to the stern railing of the starboard side of the vessel.

1.9.2.7.2 Effects of wind, tide, and sea conditions

The windage area of a vessel is normally above its centre of gravity and includes any surfaces that are directly exposed to the wind, such as a superstructure. The larger and higher the surface area exposed to the wind, the greater the effects on vessel stability. Wind velocity and direction relative to the vessel's heading also affect the windage force.

In this occurrence, the extension and raising of the vessel's deckhouse, and the extension of the stern, contributed to increasing the windage area.

Vessels travelling in a beam sea encounter waves that can create large roll angles and increase the amount of water shipped on deck, which increases the risk of the vessel capsizing. These large roll angles change the underwater shape of the hull that creates the buoyant force necessary to maintain the vessel in an upright position. Large roll angles also create the possibility of deck edge immersion, which can also contribute to the downflooding of a vessel and is more likely to occur if a vessel is operating with reduced freeboard or in adverse weather conditions.

Tides and currents also act as a force, normally below a vessel's centre of gravity, on the underwater portion of a vessel's hull. When windage force acts on a vessel from one side and the tidal current force acts on the opposite side, a capsizing force is created. During the occurrence voyage, the northwest wind was blowing perpendicular to the vessel's starboard side when the vessel turned to enter Carpenter Bay. The tide was flooding in a northerly direction, which opposed the northwesterly wind.

1.10 Authorized representatives

Since 01 July 2007, the CSA 2001 has placed the responsibility for vessel safety on the authorized representative (AR).[36] At the time of the occurrence, the AR was usually the owner (or 1 of the owners, in the case of joint ownership). AR responsibilities are listed under the Act and applicable regulations, and ARs must ensure that these regulations are complied with. For example, adequate stability needs to be maintained for a vessel's intended operations, critical safety elements need to be maintained, and changes to vessel particulars must be reported. Vessel ownership is the only requirement for becoming the AR of a vessel.[37]

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35 The RHIB weighed approximately 300 kg.

36 Government of Canada, *Canada Shipping Act, 2001* (S.C. 2001, c. 26, as amended 22 June 2023), section 106.

37 Since this occurrence, the *Canada Shipping Act, 2001* (CSA 2001) has been amended to introduce the concept of a "qualified person". In cases where the owner has entered into an agreement with a qualified person, that person can be identified as the AR.

It is important for ARs to be knowledgeable about regulatory requirements that apply to their vessels and to keep themselves informed of any updates. There are other domains that have a role similar to the AR, where 1 person is assigned certain responsibilities under federal or provincial legislation. To assist persons in these roles in meeting their responsibilities, some departments and safety associations have developed training, manuals, information bulletins, and online resources.[38] For example, in Newfoundland and Labrador, WorkplaceNL requires a workplace with less than 6 employees to have a workplace health and safety designate.[39] The safety designate's responsibilities are assigned under provincial legislation and are similar to that of a vessel's AR in that they are responsible for the health, safety, and welfare of the people employed in their workplace. The Newfoundland and Labrador Fish Harvesting Safety Association (NL-FHSA)[40] has developed a WorkplaceNL-approved free 6-hour online training that safety designates must participate in.

TC's reliance on ARs is not always achieving the intended results, and minimum regulatory requirements are not always being met. Through previous investigations, the TSB has determined that an AR's ability to adhere to minimum regulatory requirements is affected by their knowledge, experience, training, awareness, and an understanding of their responsibilities.[41]

1.10.1 Emergency preparedness

TC regulations regarding vessel emergency preparedness include, among other requirements, the carriage of life-saving equipment and distress-alerting devices, and the provision of procedures on how to safely operate the vessel and deal with emergencies.[42,43] ARs are responsible for ensuring that these requirements are met, and that

- those on board know the location of safety equipment and how to use it;
- passengers receive safety training; and,
- measures be taken to protect persons on board.

To alert search and rescue authorities in the case of vessel distress, TC requires small commercial vessels of less than 12 m in length on near coastal voyages, Class 2 (within

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38 Transport Canada, "Authorized Person Program and Bulletins", at https://tc.canada.ca/en/aviation/training-pilots-aviation-personnel/authorized-person-program-bulletins (last accessed 19 August 2023).

39 Government of Newfoundland and Labrador, *Occupational Health and Safety Act* (as amended 2022), section 42.1: Workplace designate.

40 Newfoundland and Labrador Fish Harvesting Safety Association (NL-FHSA), "Fishing vessel safety designates," at https://www.nlfhsa.com/fvsd (last accessed 19 August 2024).

41 TSB marine transportation safety investigation reports M20P0229 and M21A0065.

42 Government of Canada, *Canada Shipping Act, 2001* (S.C. 2001, c. 26, as amended 30 July 2019), subsection 106(1).

43 Transport Canada, SOR/2020-216, *Navigation Safety Regulations, 2020*, (as amended 06 October 2021).

25 NM from shore in coastal waters) to carry a personal locator beacon (PLB) or a float-free or manually activated EPIRB.[44]

In an emergency, having an operable EPIRB on board a vessel can substantially reduce the time required for search and rescue, and improve chances of survival. Previous TSB investigations[45] have found that carrying a distress-alerting device can contribute to saving lives. Between 2015 and 2021, 15 occurrences[46] were reported to the TSB, in which 34 people died where no distress alerting device signal was received from the vessel or its occupants.

At the time of the occurrence, the *Island Bay* carried life-saving equipment including PFDs, lifejackets, and an EPIRB. The investigation found no record of formal emergency procedures or safety drills for the vessel. A verbal safety briefing was provided to the passengers before the occurrence voyage. The investigation was unable to locate the EPIRB following the occurrence and was therefore unable to determine why an automatic distress signal was not received following the capsize.

1.11 Transport Canada

1.11.1 Regulatory surveillance

TC is the federal government department responsible for the regulatory program that oversees the safety of all vessels and marine personnel; this responsibility includes the development of regulations and standards for vessels and crews that specify the minimum safety requirements that must be met, which act as defences against known hazards within the marine transportation industry. TC is also responsible for enforcing those regulations and standards.

The CSA 2001 is the legislation that governs the safety of vessels and marine personnel. For commercial vessels of 15 GT or less there are no requirements for periodic safety inspection or certification. For these commercial vessels, TC considers vessel safety to be a responsibility shared between vessel owners, operators, industry, and government, where all have a supporting role to play.[47] TC and its enforcement partners work to raise safety awareness and understanding of the complex requirements among those who work on and with these small commercial vessels.

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44 Transport Canada, SOR/2020-216, *Navigation Safety Regulations, 2020*, (as amended 06 October 2021), section 209.

45 TSB marine transportation safety investigation reports M21A0315, M20A0258, M20A0160, M98F009, and M97W0236.

46 TSB marine transportation safety occurrences M21A0412, M21A0161, M20A0258, M20A0160, M19P0242, M19A0090, M19A0082, M18P0394, M18P0184, M18A0303, M18A0078, M18A0076, M16A0327, M16A0140, and M15A0189.

47 Transport Canada, TP 14070, *Small Commercial Vessel Safety Guide* (2010), at https://tc.canada.ca/en/marine-transportation/marine-safety/introduction-7 (last accessed 19 August 2024).

According to TC's Vessel Registration Query System, the total number of commercial vessels that are of 15 GT or less and not required to be certified by TC consists of approximately 29 400[48] registered vessels, in addition to approximately 16 000 with suspended registrations.[49] These small commercial vessels consist of approximately 50% fishing vessels, 30% workboats, 15% passenger vessels,[50] and 5% tugs. The investigation has determined that the number of vessels in the vessel registry does not accurately reflect the number of commercially active vessels in Canada.[51]

Since 2022, TC reports that it has increased its focus on small vessel compliance. TC has introduced new tools to support inspectors in their work including databases for inspection records and follow-ups, alongside comprehensive policies and procedures.

Regulatory compliance is the legal obligation of a vessel's AR, and compliance of small commercial vessels of 15 GT or less is monitored by TC inspectors through a program of risk-based inspections, which includes some of the inspections performed under a concentrated inspection campaign (CIC). TC national oversight activities from 01 April 2022 to 31 March 2023 included inspections of 981 commercial vessels that are of 15 GT or less, which represents 2 to 3% of the vessels that are not required to be certified. TC found extensive non-compliance with regulations and issued deficiency notices during 84% of inspections conducted.

In 2023, in the Pacific region, oversight activities for small commercial vessels of 15 GT or less included inspections of 212 vessels. Deficiencies were found among 50% of the vessels inspected. This oversight activity also represents 2 to 3% of the vessels that are not required to be certified within the Pacific region.

1.11.2 Concentrated inspection campaign

As part of its oversight, TC conducts CICs at least every 2 years. For its 2023 CIC, TC identified 3 types of vessels for inspection: passenger, tug, and fishing. The CIC focused on questions related to the safe operation of these vessels, including safety protocols, vessel registration, vessel modifications, and tug-tow ratios. TC inspectors also asked additional questions to vessel ARs during their inspections, to determine the reason for non-compliance.

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48 This number was taken from TC's Vessel Registration Query System, at https://wwwapps.tc.gc.ca/Saf-Sec-Sur/4/vrqs-srib/eng/vessel-registrations (last accessed 20 August 2024). Until recently, some of the vessels within the query system have had their registration automatically renewed. The investigation noted that there are active registrations for multiple vessels lost at sea.

49 Vessels may have their registration suspended for several reasons, including inaccurate contact information for the vessel AR and not renewing the vessel registration.

50 There may be some passenger vessels that are 15 GT or less and carry more than 12 passengers, and are therefore required to be certified.

51 The TSB examined the reliability of fishing vessel registrations in investigation M20A0160 by comparing DFO license data with TC registry data and showed a gap of approximately 4,000 small fishing vessels in NL alone. Without an equivalent data source for other types of commercial vessels, the TSB cannot determine the likely number of small non-fishing vessels that are operating commercially.

In total, 605 CIC inspections were conducted on all sizes of vessels in 5 regions. Of those vessels inspected, 217 were commercial vessels of 15 GT or less that do not require a periodic safety inspection for certification, and 388 were commercial vessels of more than 15 GT that do require a periodic safety inspection for certification.

In November 2023, TC provided an update in which it highlighted that

- 66% of all vessels inspected were issued deficiency notices related to non-compliance, although not all of the deficiencies found were related to the intended focus of the CIC, which was the safe operation of vessels.
- The primary reason for non-compliance was that ARs were unaware of the requirements. This was the predominant reason given by respondents with fishing vessels.

1.11.3 Small Vessel Compliance Program

TC recognizes that ARs need simplified and accessible tools to support them in complying with their regulatory responsibilities and to proactively verify their compliance. To this end, in 2011, TC launched its SVCP for passenger vessels. Currently, the program includes 3 types of vessels of less than 15 GT: passenger vessels and workboats, fishing vessels, and tugs. The program offers a simplified and consolidated explanation of applicable regulatory requirements, such as safety procedures, operations, equipment, maintenance, and emergency preparation for the ARs of these vessels.

TC does not routinely conduct inspections when a vessel enrolls in an SVCP. Enrollment is valid for a 5-year period during which the AR completes an annual report to attest the vessel's compliance with regulatory requirements, including reporting any damage and structural or mechanical changes in their annual compliance report, which is submitted to a local TC office for review.

TC acknowledges that the SVCP has some challenges:

- Not all small commercial vessels are registered with TC.
- ARs are unaware that the program is available or exists.
- Enrollment is voluntary.
- ARs may not understand how the program can enhance safety practices.
- ARs may view safety as a cost burden on operations.
- ARs may find enrollment and participation in the program cumbersome and complex.[52]

[52] Since launching the SVCP, TC has indicated that it has updated its original paper- and web-based application processes to make them more user-friendly. However, the TSB continues to hear from some ARs that enrollment and participation in the program is challenging.

- There is minimal industry participation in promoting the program.[53]

As of November 2023, TC records indicated that 4573 (about 16%) of the approximate 29 000 eligible small commercial vessels in Canada[54] were issued decals as part of the SVCP.

The *Island Bay*'s enrollment in the SVCP expired in 2017 and was not renewed. TC does not have a process to follow up when SVCP enrollment is not renewed.[55]

1.11.4 Stability requirements

Owners of all commercial vessels of 15 GT or less, such as the *Island Bay*, are not required to have a full stability assessment. For these commercial vessels, stability must be estimated at the design stage so that the designer or naval architect is confident the vessel will float safely once built.

The 2010 *Small Vessel Regulations* require that a vessel have adequate stability to carry out its intended operation, and that the owner or AR of that vessel demonstrate this to the Minister of Transport upon request.[56] The regulations specify that owners and ARs of vessels built before 01 April 2005, like the *Island Bay*, must ensure that their vessels are compliant with these critical safety elements as per the 2004 edition of the *Construction Standards for Small Vessels*.[57] The standards list several critical safety elements for small vessels, including: the weathertight integrity of the hull, decks, and superstructure; buoyancy and stability; underwater penetration of the hull; and bilge pump arrangements in all spaces. The AR of the *Island Bay* was not aware of the requirements contained in the regulations or the standards.

1.11.5 Stability knowledge requirements for Master, Limited certificates

TC requires that vessel operators have knowledge on a number of different topics, including stability. To obtain a certificate of competency, a candidate's knowledge of these topics is evaluated with a series of exams. For the Master, Limited certificate, candidates can be certified for a vessel of less than 60 GT or 60 GT or more. For vessels less than 60 GT, the stability-related subjects are

- the basic principles of stability;

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53 "Transport Canada's Small Vessel Compliance Program (SVCP)," presented in May 2022 to the Canadian Board of Marine Underwriters, at https://cbmu.com/sites/default/uploads/files/RDIMS-%2318290882-v4-SMALL_VESSEL_COMPLIANCE_PROGRAM_(SVCP)_-_CBMU_PRESENTATION.pdf (last accessed 19 August 2024). This presentation was delivered by TC to the Canadian Board of Marine Underwriters to encourage the marine insurance industry to help promote enrollment in the SVCP.

54 Eligible small commercial vessels are those with valid TC registration certificates.

55 As an ongoing part of SVCP program activity focusing on continuous improvement, in 2024 TC will be testing a uniform reminder process for SVCP renewals.

56 Transport Canada, SOR 2010-91, *Small Vessel Regulations* (as amended 23 June 2021), subsections 716(1) and 716(2).

57 Transport Canada, SOR 2010-91, *Small Vessel Regulations* (as amended 23 June 2021), Part 7, subsections 708(1) and 708(8).

- the practical application of stability principles to a vessel; and
- free surface effect.[58]

TC provides a list of references in TP 2293, *The Examination and Certification of Seafarers*, that all Master, Limited candidates may access to prepare for their exams. The reference list consists of the *Small Fishing Vessel Safety Manual*, "vessel stability booklets," "stability publications," and "training courses." [59] One of the references TC provides is over 20 years old, and some of the other references may not be applicable to the candidate's operation.

A number of training providers across the country provide the SVOP course. The SVOP course syllabus (TP 14692) explains that the course must provide participants with a basic understanding of hazards, and the knowledge and skills necessary to safely operate a small non-pleasure vessel under normal operating conditions. One hour is devoted to the topic of stability and emphasizes the importance of watertight integrity and reserve buoyancy, but does not specify how modifications to a vessel can affect stability.

In 2010, TC released the *Small Commercial Vessel Safety Guide* (TP 14070), which provides a plain-language summary of the regulatory requirements for owners and operators of small commercial vessels like the *Island Bay*. Among other topics, the guide reiterates the need to advise TC when a vessel undergoes major modifications and describes how to operate a vessel within its design limitations to maintain stability. The guide provides 5 warning signs of instability:

- The vessel's handling changes (the vessel seems more sluggish or rolls more slowly).
- The vessel is listing or trimmed more than usual.
- There is less freeboard than one would normally expect.
- The bilge pumps are working more frequently than usual.
- The bilge alarm is sounding.[60]

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58 Transport Canada, TP 2293, *The Examination and Certification of Seafarers*, Revision 8 (November 2021), Chapter 12, Table: "Specification of minimum standard of competence for a Master, Limited certificate,", Item 8, p. 192.

59 TC's plans to update its list of references of relevant technical publications once the new *Marine Personnel Regulations* are published in the Canada Gazette.

60 Transport Canada, TP 14070, *Small Commercial Vessel Safety Guide* (2010), Chapter 8: Warning Signs of Instability, at https://tc.canada.ca/en/marine-transportation/marine-safety/chapter-8-keep-your-vessel-stable (last accessed 19 August 2024).

Finding: Other

TC's list of references in TP 2293 has not been updated to include all relevant safety publications such as the *Small Commercial Vessel Safety Guide* (TP 14070).

1.12 Decision making and situational awareness

Decision making is a cognitive process to select a course of action between alternatives. In a dynamic environment, decision making can be time-critical. Decision making can be affected by several factors, notably goals and objectives, knowledge, experience, abilities, skills, and training. Situational awareness is a critical component of decision making and involves information-processing stages. Situational awareness refers to "the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future."[61]

An operator is constantly perceiving various factors as a voyage unfolds, developing an understanding of their meaning, and predicting the effects that these factors will have on the outcome of the voyage. Shortcomings during these stages of developing situational awareness may result in an incomplete or inadequate perception of the situation. Individuals can narrow their attention unintentionally, focusing on information and tasks that seem to be the most important at the time.

1.13 Previous occurrences

The TSB has previously conducted investigations into several occurrences, many of which involved small commercial vessels, with safety issues similar to those present in this occurrence involving the *Island Bay*.

The safety issues that are relevant to this occurrence include training and certification not providing mariners with the technical proficiency needed to fully understand the principles of stability and the effects of vessel modifications, vessel owners relying on insurance surveys as a measure of vessel safety, and TC regulatory oversight being reactive and reliant on ARs to understand their responsibilities and ensure regulatory compliance. A detailed list of previous occurrences can be found in Appendix A.

1.14 TSB recommendations

Several previous investigations into small commercial vessels have resulted in the Board issuing recommendations related to major modifications, regulatory surveillance, vessel registration, and stability information. Although these recommendations were made about fishing vessels and tugs rather than passenger vessels, this investigation found that the same issues are present in this occurrence involving the *Island Bay*.

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61 M. Endsley, "Toward a Theory of Situation Awareness in Dynamic Systems," *Human Factors: The Journal of the Human Factors and Ergonomics Society*, Vol. 37, Issue 1 (1995), p. 36.

1.14.1 Major modifications

In April 2021, the small fishing vessel *Tyhawk* capsized. One crew member died and, at the time the *Tyhawk* report was published (November 2023), the master remained missing. The investigation determined that the *Tyhawk*'s stability was compromised in part by the addition of a removable deck. Similar to the occurrence involving the *Island Bay*, the modifications made to the *Tyhawk* were not evaluated for their impact on the vessel's stability.[62] Regulators have a role to play in supporting the consistent identification of major modifications by providing specific, measurable, and understandable criteria. Therefore, the Board recommended that

> the Department of Transport introduce objective criteria to define major modifications to small fishing vessels and other small commercial vessels.
>
> **TSB Recommendation M23-06**[63]

At the time of report writing, TC's most recent response had been received in February 2024. The Board considers the response to Recommendation M23-06 to be **Satisfactory Intent.**[64]

To help ARs, masters, and TC inspectors verify that vessels are operating with adequate stability, the Board also recommended that

> the Department of Transport require that planned modifications to small fishing vessels and other small commercial vessels be assessed by a competent person and all records of modifications be maintained and made available to TC.
>
> **TSB Recommendation M23-07**[65]

At the time of report writing, TC's most recent response had been received in February 2024. The Board considers the response to Recommendation M23-07 to be **Satisfactory in Part.**[66]

1.14.2 Regulatory surveillance for tugs of 15 gross tonnage or less

In February 2021, the tug *Ingenika* sank.[67] The search and rescue operation located 1 surviving crew member on land and recovered the bodies of the 2 other crew members

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62 TSB Marine Transportation Safety Investigation Report M21A0065.

63 TSB Recommendation M23-06: Definition of major modifications to small fishing vessels and other small commercial vessels, at https://www.tsb.gc.ca/eng/recommandations-recommendations/marine/2023/rec-m2306.html (last accessed 05 September 2024).

64 Ibid.

65 TSB Recommendation M23-07: Assessment of major modifications to small fishing vessels and other small commercial vessels, at https://www.tsb.gc.ca/eng/recommandations-recommendations/marine/2023/rec-m2307.html (last accessed 05 September 2024).

66 Ibid.

67 TSB Marine Transportation Safety Investigation Report M21P0030.

from the water. Like the *Island Bay*, the *Ingenika* was a commercial vessel of 15 GT or less and was not subject to periodic safety inspections. Similarly, the occurrence involving the *Ingenika* highlighted the risks of inadequate regulatory surveillance, as well as issues with TC's reliance on ARs to understand and ensure compliance with regulations. The investigation found that without adequate surveillance, shortcomings in the safety management and operations of tugs of 15 GT or less will continue to go unaddressed, leading to accidents. Therefore, the Board recommended that

> the Department of Transport expand its surveillance program to include regular inspections of tugs of 15 gross tonnage (GT) or less to verify that these vessels are complying with regulatory requirements.
>
> **TSB Recommendation M23-01**

At the time of report writing, TC's most recent response had been received in June 2023. The Board considers the response to Recommendation M23-01 to be **Satisfactory in Part**.[68]

1.14.3 Vessel registration

In May 2020, the fishing vessel *Sarah Anne*, with 4 people on board, was reported overdue. A search was launched and the bodies of all 4 crew members were eventually recovered. The vessel was not found.[69] Like the *Island Bay*, the *Sarah Anne* had been registered with TC, but the vessel particulars on the registration certificate were not kept up to date.

Given that current and accurate TC registration is the first step in safety oversight of commercial fishing vessels, the Board recommended that

> the Department of Fisheries and Oceans require that any Canadian vessel that is used to commercially harvest marine resources have a current and accurate Transport Canada registration.
>
> **TSB Recommendation M22-01**

Since this recommendation was issued, the TSB has followed up annually with TC on action being taken to address it. At the time of report writing, TC's most recent response had been received in November 2023. The Board considers the response to recommendation M22-01 to be **Satisfactory in Part**.[70]

1.15 TSB Watchlist

The TSB Watchlist identifies the key safety issues that need to be addressed to make Canada's transportation system even safer.

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68 TSB Recommendation M23-01: Regulatory surveillance for tugs of 15 gross tonnage or less, at https://www.tsb.gc.ca/eng/recommandations-recommendations/marine/2023/rec-m2301.html (last accessed on 20 August 2024).

69 TSB Marine Transportation Safety Investigation Report M20A0160.

70 TSB Recommendation M22-01: Requirement for Transport Canada vessel registration prior to Fisheries and Oceans Canada issuance of fishing licence, at https://www.tsb.gc.ca/eng/recommandations-recommendations/marine/2022/rec-m2201.html (last accessed on 20 August 2024).

Regulatory surveillance is a Watchlist 2022 issue.

In Canada, there are an unknown number of commercial vessels of 15 GT or less that are not required to be certified and are therefore not subject to periodic regulatory surveillance, like the *Island Bay*. TC uses a risk-based inspection program to oversee these vessels. However, in 2022 and 2023, only 2 to 3% of these vessels were inspected.

ACTION REQUIRED

The issue of **regulatory surveillance in marine transportation** will remain on the Watchlist until TC provides more oversight of the commercial vessel inspection process by demonstrating that its surveillance and monitoring are effective in ensuring that ARs and recognized organizations are ensuring vessel compliance with regulatory requirements, and until TC demonstrates an increase in proactive surveillance.

Safety management is a Watchlist 2022 issue.

At the time of report writing, small passenger vessels carrying 12 or fewer passengers were exempt from regulations requiring a safety management system. Although Section 106 of the CSA 2001 requires that vessels have written safety procedures, the investigation determined that the *Island Bay*, like many other small commercial vessels, did not have written procedures on how to safely operate the vessel and deal with emergencies.

ACTION REQUIRED

The issue of **safety management in marine transportation** will remain on the Watchlist until

- TC implements regulations requiring all commercial operators to have formal safety management processes; and
- operators that do have a safety management system demonstrate to TC that it is working—that hazards are being identified and effective risk-mitigation measures are being implemented.

1.16 TSB laboratory reports

The *Island Bay*'s bilge pumps and valves were sent to the TSB Engineering Laboratory, in Ottawa, Ontario, for testing. The TSB laboratory assessed the functionality of the pumps and valves, and determined the angle of vessel heel at which downflooding began.

The TSB completed the following laboratory reports in support of this investigation:

- LP012/2023 – Bilge pumps analysis
- LP110/2022 – 3D modelling and analysis

2.0 ANALYSIS

This analysis will focus on the underlying causes and contributing factors to this occurrence, specifically the vessel's watertight integrity, the effects of modifications on the *Island Bay*'s initial stability, and additional risk factors that contributed to the loss of stability and sinking. The analysis will also discuss factors that affected the operators' perception of vessel stability and influenced their decision making.

In addition, this analysis will examine the effectiveness of Transport Canada's (TC's) oversight and the importance of authorized representatives' (ARs) understanding of their responsibilities with regards to applicable regulatory requirements.

2.1 Vessel's initial stability reduced

A vessel is designed for an intended purpose, and its stability is estimated at the design stage so that it will float safely once it is built. However, over a vessel's lifetime, modifications may be made to the vessel or its equipment to meet operational needs. These modifications can negatively impact the vessel's stability.

For example, the addition of equipment, gear, and other materials can cause significant changes in weight and/or weight distribution that affect the vessel's centre of gravity and its righting ability. Without a full stability assessment, the effects of these modifications are unknown, and the vessel may operate with reduced stability, which can compromise the safety of the vessel and its crew. This is why modifications need to be recorded, reported, and assessed for their effects on vessel stability.

This investigation determined that throughout the *Island Bay*'s lifetime a series of modifications were made to the vessel due to changing operational needs. The *Island Bay* was extended at the stern. An extension was made to the deckhouse and there were additions of permanent storage, equipment, and gear. This increase in weight reduced the vessel's freeboard, which resulted in a decrease of the vessel's downflooding height.

The deckhouse extension also increased the vessel's windage area, making it vulnerable to heeling when exposed to the strong broadside winds that affected the vessel during the occurrence voyage.

The cumulative effect of the modifications raised the vessel's centre of gravity. This compromised the vessel's ability to right itself when heeled by the external forces such as wind and tidal current. The degree to which these modifications affected the vessel's stability was not known because documentation about the previous owner's modifications had not been passed to the occurrence owners and no stability assessment had been conducted since those modifications were made. In the absence of documentation about the modifications, the operators in this occurrence were unaware of the changes made to the *Island Bay* and any subsequent effects on its stability.

Without a full stability assessment, the *Island Bay* did not have a stability booklet that the operators could reference to determine the vessel's stability limits. In addition, the modifications made to the vessel throughout its lifetime were not reported to TC.

Furthermore, maintenance records were not transferred with the sale of the vessel, nor is there a requirement to do so. Consequently, the operators were unaware of the extent of the modifications to the vessel, did not understand how these affected the vessel's initial stability, and were making operational decisions without knowledge of the vessel's stability limits.

Finding as to causes and contributing factors

The cumulative effects of modifications to the *Island Bay* reduced the vessel's initial stability, making it susceptible to heeling, downflooding, and capsizing.

2.2 Vessel heeling, downflooding, and capsizing

As the *Island Bay*'s transited from Langtry Island across the entrance of Carpenter Bay, British Columbia, the windage force on the vessel's broadside, combined with the force of the opposing tidal current and the use of paravane stabilizers, caused the vessel to develop a port heel. The operators of the *Island Bay* regularly experienced a heel while the paravane stabilizers were deployed in windy conditions, so the port heel was considered normal and acceptable. The operators' previous experience with the vessel in this condition reduced their awareness of the additional effects of wind and sea conditions on the vessel during the transit.

As the vessel continued across the entrance to Carpenter Bay, the severity of heel surpassed what the operators regularly experienced, prompting them to revise their original plan and head into the sheltered waters of the bay. Once the vessel turned to port, the different heading meant that there was an increased force of the wind blowing perpendicular to the vessel's starboard side. This, combined with the tidal current in the opposing direction, worsened the heel. As the *Island Bay* continued its voyage, the wind speed increased up to an estimated 50 knots, which caused the vessel to heel even further. At the same time, a stronger towing force was created by the actions of wind and wave on the rigid hull inflatable boat.

The persistent heel allowed water to ship onto the main deck through the freeing ports. As the heel reached approximately 16° to port, the very low downflooding heights allowed water to enter the forward engine compartment and the lazarette through the bilge pump overboard discharges.

Water accumulated in the port chine of the vessel's engine compartment and lazarette; because of the continuous heel and placement of the bilge pumps along the vessel's centre line, the pumps could not remove the water from the chine.

The downflooding gave the vessel a list to port in addition to the wind- and wave-induced heel. The accumulating water increased the vessel's weight, which further decreased the freeboard and reserve buoyancy. In addition to the accumulated water in the bilge, the remaining fresh water and fuel was able to move freely within the vessel's tanks and likely

created free surface effects that shifted the vessel's centre of gravity and increased the vessel's port list.

Although conditions were deteriorating, the cues in the situation were not sufficiently compelling for the operators to alter course again. With estimated arrival to sheltered water only minutes away and a calm anchoring point within sight, the operators were focused on manoeuvring the vessel in the sea conditions and reaching sheltered waters.

Finding as to causes and contributing factors

The continued course toward the sheltered waters within Carpenter Bay sustained the vessel's exposure to broadside sea conditions and windage, which made the vessel heel and made it more susceptible to water ingress.

In this occurrence, the operators' plan to reach sheltered waters within Carpenter Bay was influenced by their understanding of the vessel's stability, previous sea experience, and past successful voyages. However, this experience did not provide them with the technical proficiency needed to fully understand the stability implications of the water ingress and therefore appreciate the urgency of the unfolding situation.

As the vessel's deck edge became immersed and water flowed over the bulwarks, the vessel's ability to right itself was reduced. The presence of water accumulating on the deck prompted the operators to reassess their understanding of the situation, which led Operator 2 to go onto the back deck. There, Operator 2 realized that the amount of water on the main deck was increasing and that the vessel was in the process of capsizing. At the same time, the bilge alarm sounded. This new information was compelling enough to convince the operators to abandon their plan of reaching sheltered waters and commence abandoning the vessel. The *Island Bay* eventually lost its reserve buoyancy and capsized during the abandonment.

Finding as to causes and contributing factors

A combination of forces from wind, waves, and the tide caused the vessel to develop a significant heel and ship water on deck. The accumulated water then caused the vessel to list, exacerbating the heel, both of which led to downflooding. Consequently, the *Island Bay* lost its reserve buoyancy and capsized.

2.3 Perception of vessel safety

An operator's perception of the safety of their vessel, including vessel stability, will affect operational decisions. This perception is influenced by a number of factors such as an operator's knowledge, experience, and training. This perception is also influenced by certificates, licences, and vessel surveys from governments, associations, and insurers, all of which may be perceived more broadly as overall approval of the capacity to operate safely. Operators who believe they are fully informed of the risks in their work environment are more likely to take risks because of this perceived knowledge. As a result, during operations they often accept or take risks to a greater degree than is acceptable to regulators, crew members, or passengers.

In this occurrence, the operators' perception of the *Island Bay*'s safety and its stability was likely influenced by several factors:

- The operators had acquired TC certificates of competency for operating their vessel, and they had taken additional training that was not required, such as the Small Vessel Operator Proficiency (SVOP) course.
- The operators were aware that the vessel had undergone some type of stability assessment, and the operators regularly used the paravane stabilizers with the understanding that they improved the vessel's stability.
- The *Island Bay* had been approved by TC for an on-board capacity of 8 people and to operate as a passenger vessel. The vessel then operated for nearly 20 years as a passenger vessel without incident.
- The operator's formal application to change the vessel's registration type from fishing vessel to passenger vessel was reviewed and accepted by the Chief Registrar of TC's Canadian Register of Vessels.
- The operators conducted annual maintenance on the vessel.
- The *Island Bay* was registered with TC, had been accepted into the Small Vessel Compliance Program (SVCP), and had been granted a business licence issued by Parks Canada.
- As part of operating within Gwaii Haanas, the *Island Bay* had undergone an inspection by the Royal Canadian Mounted Police (RCMP).
- The *Island Bay* was surveyed and accepted for insurance coverage, which gave the owners the impression that the vessel was safe for its intended operation.

Aside from the safety deficiencies cited in the insurance survey and the RCMP report, these factors validated the owners' perception of the vessel's safety and stability, leading them to conclude that the vessel was safe to operate and stable.

Additionally, these factors confirmed for the operators that they had sufficient knowledge, experience, and competency to operate their vessel.

Finding as to risk

If operational decisions are made according to a perception of vessel safety rather than validated limits, a vessel may be operated with compromised safety.

2.4 Responsibility for safety

Success in reducing exposure to hazards relies on the partnership between the industry and government agencies, where regulators provide support and work together with ARs to identify systemic hazards and ensure that the associated risks are being mitigated. This requires a balanced approach to how safety is managed, recognizing that regulations (as defences against hazards) provide only a minimum level of safety. As demonstrated in previous TSB investigations and recommendations, TC oversight alone has not been effective in improving safety in the small commercial vessel fleet operations, nor has

delegating all responsibility to ARs. At the same time, TC's SVCP – TC's only program to provide the support ARs of small vessels need – is not effectively providing support due to low enrollment and minimum industry support in promoting the program, cumbersome processes, and issues with awareness among ARs that the program exists.

TC does not periodically inspect commercial vessels 15 GT or less, and so there is no required interaction between TC and a vessel's AR beyond maintaining the vessel's registration. Regulatory oversight for small commercial vessels like the *Island Bay* is therefore infrequent. Unlike the vast majority of small commercial vessels, TC had visited the vessel multiple times and had interacted with its owners over the vessel's lifetime, providing opportunities for TC to work with the AR to identify that the *Island Bay* had undergone major modifications and required a full stability assessment to evaluate the effects thereof:

- The owners applied to enroll the *Island Bay* in the Small Vessel Monitoring and Inspection Program as a passenger vessel. As part of that enrollment, TC inspected the vessel on 2 occasions. Following the inspections, TC issued the vessel a notice of survey that allowed the *Island Bay* to operate as a passenger vessel without formally changing the vessel type on the certificate of registry.
- The owners applied to enroll the vessel in the SVCP and completed the enrollment questionnaire indicating that the vessel had not been modified, that it was watertight, and that the vessel's stability documentation was carried on board. The investigation determined that some of this information was incorrect, indicating that TC's review process did not verify the accuracy of the owner's responses and ensure regulatory compliance, including with Section 708 of the *Small Vessel Regulations*. The operators of the *Island Bay* did not renew the vessel's enrollment in the SVCP and TC did not follow up as to why.
- During the *Island Bay*'s SVCP enrollment process, TC recognized that the *Island Bay* was operating as a passenger vessel and therefore required that the vessel's certificate of registry change from a fishing vessel to a passenger vessel. The owners subsequently applied to TC's Chief Registrar for a vessel type change. The Chief Registrar reviewed the application and issued the vessel a new certificate of registry with the original vessel particulars rather than the vessel's particulars at the time, indicating that modifications made to the vessel were not identified.

The stability risk factors found in this occurrence were not identified in any of the interactions between TC and the *Island Bay*'s AR. The vessel therefore continued to operate with stability risk factors present, such as vessel modifications that negatively impacted vessel stability, compromised watertight integrity (without back-siphoning prevention and watertight hatch covers), and without ever having undergone a full stability assessment.

Although the operators of the *Island Bay* were not completely aware of the role and responsibilities of an AR, they were careful in their attempts to operate their vessel safely. The operators had been issued Master, Limited certificates of competency, which demonstrates that they had gained the stability knowledge required to pass the TC exams.

However, meeting this requirement did not provide the operators with the technical proficiency to identify stability risk factors and ensure the vessel had adequate stability for its intended operation. Meeting minimum regulatory requirements may therefore not always be sufficient to ensure the safety of a vessel, its passengers, and its crew.

Since launching the SVCP in 2011, TC has expanded the program to help assist ARs understand and meet their regulatory responsibilities. Since 2022, TC has recognized the importance of enhancing measures to ensure regulatory compliance among small commercial vessels and reports that it has focused on improving oversight tools, inspection databases, verifying vessel registrations and onboard safety procedures, tracking vessel modifications, and reviewing tug-tow ratios. However, the effectiveness of these initiatives is not yet certain. These initiatives also do not include increased collaboration or contact with ARs as a means of supporting them in understanding their role and meeting their responsibilities. Further, the SVCP continues to be voluntary, and there is no required interaction between TC and ARs beyond vessel registration.

In contrast, other organizations have recognized the importance of providing support to people who, like ARs, have been assigned safety responsibilities. Many departments and agencies have developed and provided guidance to and, in some cases, training for these roles.

TC's current oversight regime holds ARs legally responsible for compliance with safety requirements as stated in the *Canada Shipping Act, 2001* and associated regulations. However, TC has yet to exhibit a level of oversight that ensures the regulatory compliance of commercial vessels that are not required to be certified. Further, TC itself has recognized that enhancements to the current regime are needed.

Finding as to risk

If TC's oversight and programs for commercial vessels that are not required to be certified continue to be insufficient to support ARs in understanding their responsibilities, there is a risk that ARs will operate without an adequate level of safety.

3.0 FINDINGS

3.1 Findings as to causes and contributing factors

These are conditions, acts or safety deficiencies that were found to have caused or contributed to this occurrence.

1. The cumulative effects of modifications to the *Island Bay* reduced the vessel's initial stability, making it susceptible to heeling, downflooding, and capsizing.

2. The continued course toward the sheltered waters within Carpenter Bay sustained the vessel's exposure to broadside sea conditions and windage, which made the vessel heel and made it more susceptible to water ingress.

3. A combination of forces from wind, waves, and the tide caused the vessel to develop a significant heel and ship water on deck. The accumulated water then caused the vessel to list, exacerbating the heel, both of which led to downflooding. Consequently, the Island Bay lost its reserve buoyancy and capsized.

3.2 Findings as to risk

These are conditions, unsafe acts or safety deficiencies that were found not to be a factor in this occurrence but could have adverse consequences in future occurrences.

1. If operational decisions are made according to a perception of vessel safety rather than validated limits, a vessel may be operated with compromised safety.

2. If Transport Canada's oversight and programs for commercial vessels that are not required to be certified continue to be insufficient to support authorized representatives in understanding their responsibilities, there is a risk that authorized representatives will operate without an adequate level of safety.

3.3 Other findings

These items could enhance safety, resolve an issue of controversy, or provide a data point for future safety studies.

1. Transport Canada's list of references in TP 2293 has not been updated to include all relevant safety publications such as the *Small Commercial Vessel Safety Guide* (TP 14070).

4.0 SAFETY ACTION

4.1 Safety action taken

The Board is not aware of any safety action taken following this occurrence.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 26 June 2024. It was officially released on 12 September 2024.

Visit the Transportation Safety Board of Canada's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the key safety issues that need to be addressed to make Canada's transportation system even safer. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

APPENDICES

Appendix A – Previous occurrences

Previous occurrences involving commercial vessels of 15 GT or less, including small fishing vessels, with similar issues found in the investigation into the *Island Bay* occurrence:

M21A0065 (*Tyhawk*) – In April 2021, the fishing vessel *Tyhawk*, with a master and 4 crew members on board, departed from Chéticamp, Nova Scotia, to the fishing grounds to set crab traps. En route to the fishing grounds, the vessel capsized. The master and 1 crew member were swept away from the vessel; all 4 crew members were eventually rescued, but the master could not be located. One crew member was later pronounced dead.

This investigation resulted in 3 recommendations and highlighted the risks of making vessel modifications without an understanding of vessel stability from a formal stability assessment.

M21P0030 (*Ingenika*) – In February 2021, the tug *Ingenika*, with 3 crew members on board, was towing the loaded barge *Miller 204* in Gardner Canal when the tug sank approximately 16 nautical miles (NM) west-southwest of Kemano Bay, British Columbia (BC). The barge subsequently drifted and went aground about 2.5 NM southwest from where the tug sank. The search and rescue operation located 1 surviving crew member on land and recovered the bodies of the 2 other crew members from the water. The barge was recovered; the tug was not found.

This occurrence highlighted the risks of inadequate regulatory surveillance, as well as issues with Transport Canada's (TC's) reliance on authorized representatives (ARs) to understand and ensure compliance with regulations.

M20P0229 (*Arctic Fox II*) – In August 2020, the fishing vessel *Arctic Fox II*, with 3 crew members on board, reported taking on water. The crew abandoned the vessel approximately 77 NM west-southwest of Bamfield, Vancouver Island, BC. The United States Coast Guard and the Canadian Coast Guard (CCG) initiated search and rescue operations. The 1 surviving crew member was located in the vessel's life raft, and the bodies of the master and the other crew member were recovered from the water.

This occurrence highlighted issues with TC's reliance on ARs to understand, and ensure compliance with, regulations.

M20A0160 (*Sarah Anne*) – In May 2020, the fishing vessel *Sarah Anne*, with 4 people on board, departed St. Lawrence, Newfoundland and Labrador, to fish snow crab in Placentia Bay. The Marine Communications and Traffic Services Centre in Placentia, Newfoundland and Labrador, received an overdue report that evening. A search was launched using several vessels and aircraft. The bodies of 3 crew members were recovered the following day. The body of the 4th crew member was recovered from the shore on 06 June 2020. The vessel was not found.

This occurrence highlighted the importance of maintaining current and accurate vessel registration with TC.

M19A0025 (*Captain Jim*) – In January 2019, the workboat *Captain Jim*, with 2 crew members and 1 passenger on board, began taking on water and became disabled 2.8 NM from Eastern Passage, Nova Scotia. A short time later, the vessel rapidly sank. One of the crew members and the passenger managed to board the vessel's life raft, and were then rescued by a Halifax Harbour pilot boat and taken to Halifax, Nova Scotia. Divers located the body of the remaining crew member inside the vessel's wheelhouse later that day.

This occurrence highlighted the negative effect of reduced freeboard on a vessel's stability as a result of vessel modifications. The report also indicates that the occurrence master's sea time did not provide the technical proficiency needed to fully understand the stability implications of water ingress in the vessel's hull.

M17P0098 (*Catatonic*) – In April 2017, the sport fishing passenger vessel *Catatonic* took on water and partially sank near Tofino, BC. The operator and 4 passengers were recovered from the water by 2 assisting vessels, and were transferred to a local hospital. Two of the vessel occupants were later pronounced dead. The vessel was eventually towed, dewatered, and secured at a local dock in Tofino.

This occurrence highlighted the importance of regulatory compliance and fully understanding the effects of vessel modifications.

M12W0062 (*Pacific Siren*) – In May 2012, the small fishing vessel *Pacific Siren*, loaded with prawn fishing gear, heeled to starboard and capsized off Banks Island, BC. All 3 crew members abandoned the vessel into a small inflatable boat and were stranded on Banks Island for 9 days until they were rescued by the CCG.

This occurrence highlighted the importance of understanding the cumulative effects of added weight above a vessel's centre of gravity, assessing vessel modifications, and issues with not having a full vessel stability assessment. The investigation also determined that the occurrence master's stability training was not sufficient to provide him with the technical proficiencies needed to fully understand the principles of stability, and recognize the adverse consequences of using paravane stabilizers.

M02W0147 (*Cap Rouge II*) – In August 2002, the fishing vessel *Cap Rouge II* was bound for the entrance of the Fraser River, BC. When the vessel was approximately 2 NM south of Sand Heads Light, it capsized with 7 persons on board. Two persons abandoned the vessel and climbed into a skiff being towed by the fishing vessel. Five persons, including 2 children, remained within the overturned hull and drowned.

This occurrence highlighted the importance of having a stability assessment and the adverse consequences of limited knowledge of the basic principles of stability. The investigation determined that the risks from vessel modifications and towing the skiff were not considered.

M02C0030 (*Lady Duck*) – In June 2002, the amphibious vehicle *Lady Duck* took on water while on the Ottawa River during a combined land and water-borne sightseeing tour of the National Capital Region. The vehicle sank rapidly by the bow in 8 m of water. Of the 12 people on board, 6 passengers, the driver, and the tour guide escaped from the vehicle and were recovered by private craft on the scene at the time of the sinking. Four passengers, trapped within the sinking vehicle, drowned.

This occurrence highlighted the complexity of regulations, standards, and programs that apply to small passenger vessels, which reduces the effectiveness of the regulatory framework to help ensure safety.