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RECREATIONAL BOAT SAFETY COLLISION RESEARCH: COLLISION ACCIDENT--ETC(U)
JAN 77 R MACNEILL, J BOWMAN, B SMITH DOT-CG-40672-A
UNCLASSIFIED MSR-77-51 USCG-D-40-77 NL

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RECREATIONAL BOAT SAFETY COLLISION RESEARCH: COLLISION ACCIDENT INVESTIGATIONS JULY 1976 - DEC 1976

JANUARY 1977

FINAL REPORT

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U. S. DEPARTMENT OF TRANSPORTATION
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16. Abstract

In an effort to better identify accident causes and to serve as an input to the development of an effective collision research program, the Coast Guard initiated a program to investigate twelve pleasure boat collision type accidents during calendar year 1976. Current research efforts are directed towards investigating visibility, control station design and noise as factors which may be related to collision accidents; therefore, the selection of accidents investigated were based on initial indications that one of the above mentioned parameters could have been influential in causing the accident.

This report contains the following:

- A synopsis of the accident reporting system;
- The methodology used to screen and select accidents for investigation;
- An overview of the type of data acquired during the investigation;
- A summary of important parameters of each boat involved;
- Narrative summaries of each selected accident; and
- Complete reports of each accident investigated.

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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly).

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

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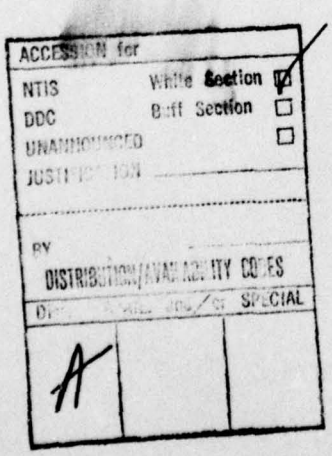

RECREATIONAL BOAT SAFETY COLLISION RESEARCH: COLLISION ACCIDENT INVESTIGATIONS JULY 1976 - DECEMBER 1976

1.0 INTRODUCTORY SUMMARY

In an effort to better identify accident causes and to serve as an input to the development of an effective collision research program, the Coast Guard initiated a program to investigate twelve pleasure boat collision type accidents during calendar year 1976. Current research efforts are directed towards investigating visibility, control station design and noise as factors which may be related to collision accidents; therefore, the selection of accidents investigated were based on initial indications that one of the above mentioned parameters could have been influential in causing the accident.

This report contains the following:

- A synopsis of the accident reporting system.
- The methodology used to screen and select accidents for investigation.
- An overview of the type of data acquired during the investigation.
- A summary of important parameters of each boat involved (see Table 1).
- Narrative summaries of each selected accident.
- Complete reports of each accident investigated.

Noise and visibility/control station design problems, as well as operator stressors, were identified as contributing to the causes in the collisions investigated. These causal factors are summarized below.

Causal Factors Summary

Noise

Three of the collisions may have been avoided if the noise level on one of the two boats had been lower. In two cases, the hittor would have been heard prior to impact and in one case the hittor would have heard the cries from the hittee prior to impact.

Identification No.	No. of Boats	Boat Number	Boat Type	Hull Type	Hull Material	Length Overall Ft/Meters	Horsepower	Speed mph/kph	POB	Persons wearing PFDs Prior to Collision	Did Operator Have Formal Boating Instruction	Operator's Age	Operator's Boating Experience (Hours)	Fatalities	Injuries	Property Damage
76-01	2	1	Runabout	Tri-Hull	Fiberglass	14.2/4.3	60	15/24.1	3	1	No	14	20-500	0	0	500
		2	Cruiser	Deep-V	Fiberglass	21.2/6.5	165	0	3	0	Yes	51	500	0	0	113
76-02	2	1	Runabout	Semi-V	Fiberglass	14/4.3	50	0	2	0	No	19	100	0	0	200
		2	Cruiser	Tri-Hull	Fiberglass	21/6.4	160	15/24.1	8	0	No	50	UNK	0	0	50
76-03	2	2	Cruiser	Semi-V	Fiberglass	35/10.7	460	20/32.2	2	0	Yes	38	500	0	0	Neg
		2	Runabout	Semi-V	Fiberglass	19/5.8	140	0	2	0	Yes	39	500	0	1	4000
76-04	2	1	Open Boat	Tri-Hull	Fiberglass	15/4.6	85	40/64.4	1	0	No	16	100-500	0	0	100
		2	Open Boat	Tri-Hull	Fiberglass	14/4.3	70	Slow	4	0	No	34	500	0	1	1900
76-05	1	1	Runabout	Semi-V	Fiberglass	17/5.2	140	12/19.3	2	0	No	58	100	0	1	
76-06	2	1	Cruiser	Tri-Hull	Fiberglass	20.8/6.3	175	17/27.4	5	0	Yes	29	150	0	2	700
		2	Runabout	Deep-V	Fiberglass	17.6/5.4	165	24/38.6	2	0	No	24	500	0	0	30
76-07	1	1	Runabout	Semi-V	Fiberglass	18/5.5	225	30/48.3	1	0	No	34	500	0	1	190
76-08	2	1	Runabout	Semi-V	Fiberglass	21/6.4	325	2/3.2	3	0	Yes	45	500	0	2	250
		2	Runabout	Deep-V	Fiberglass	19.6/6	165	15/24.1	1	0	No	36	500	0	0	
76-09	1	1	Cruiser	Semi-V	Fiberglass	23.3/7.1	255	15/24.1	4	0	No	31	100	0	1	40
76-10	2	1	Runabout	Round	Wood	18/5.5	60	2/3.2	2	0	Yes	32	500	0	0	75
		2	Ctr. Console	Deep-V	Fiberglass	23/7	225	15/24.1	2	0	No	28	500	0	0	145
76-11	2	1	Runabout	Semi-V	Wood	15.5/4.7	40	0	4	0	No	43	500	0	3	60
		2	Cruiser	Deep-V	Fiberglass	24/7.3	330	15/24.1	4	0	No	35	500	0	0	10
76-12	2	1	Bass Boat	Semi-V	Kevlar	17/5.2	150	55/88.5	2	2	Yes	30	500	0	0	50
		2	Bass Boat	Semi-V	Kevlar	15/4.6	135	58/93.3	2	2	No	33	100-500	0	0	50

Operator's Boating Experience (Hours)	Fatalities	Injuries	Property Damage	Time of Accident	Weather	Water Surface Condition	Stressors						Human Engineering Problems			
							Fatigue	Glare	Noise	Wind	Alcohol	Panic	Bow High - Obstruct Visibility	Glare From Stern Light	Noise	Other Human Engineering Problems
20-500	0	0	500	1510	Clear	Calm	x									Couldn't turn and reduce throttle too
500	0	0	113													Tried to blow horn, hit wrong button
100	0	0	200	1700	Clear	Light Chop										Reached for horn, couldn't find it in time
UNK	0	0	50				x	x					x			
500	0	0	Neg.	1040	Storm	Rough							x			Inadequate windshield wiper
500	0	1	4000												x	
100-500	0	0	100	1800	Partly Cloudy	Calm						x				No
500	0	1	1900									x				No
100	0	1	0	1810	Clear	Calm		x								Difficult to see over bow when seated
150	0	2	7000	1210	Clear	Calm	x	x					x			
500	0	0	300				x	x						x		
500	0	1	1900	1530	Clear	Calm					x					No
500	0	2	2500	1215											x	
500	0	0	0										x			
100	0	1	400	2110	Clear	Calm		x			x			x		
500	0	0	750	2130	Clear	Calm		x						x		
500	0	0	1450										x		x	
500	0	3	600	1501	Clear	Choppy										
500	0	0	100										x			
500	0	0	500	1903	Clear	Calm	x	x	x	x	x					No
100-500	0	0	500				x	x	x	x	x					Control station limits operator's ability to look to starboard

TABLE 1. SUMMARY OF 1976 COLLISION ACCIDENTS INVESTIGATED

Visibility/Control Station Design

- Six cases of reduced visibility due to the bow being too high. Reconfiguring the relationship between the height of the bow and the operator's eye position would have improved visibility.
- One case where the control station configuration limited the operator's ability to turn and look to starboard.
- One case where the wiped area of the windshield was very small.
- Two cases where the collision could have been avoided if the hittee could have reached the horn in time. A standardized horn location would have helped.
- Two cases where the hittor couldn't turn and reduce the throttle at the same time. A foot throttle could have reduced maneuvering time by the amount necessary to avoid impact.

Operator Stressors (identified as contributing to the cause of seven of the ten accidents)

- Fatigue was identified in six cases.
- Glare was identified in eight cases including three cases where the white 360° stern light obstructed visibility.
- Noise as a stressor was identified in two cases and as a contributor to the collision in three more cases.
- Wind in the eyes of the operator was identified in two cases.
- Alcohol was identified in four cases.
- Panic was identified in two cases.

Other details about the boats and the people involved in the collisions as well as weather and operator stressor information are summarized in Table 1.

2.0 ACCIDENTS RECEIVED FOR CONSIDERATION

In order to conduct the collision investigations in a timely manner, it was necessary that Wyle be informed quickly of as many accidents as possible. The present Boating Accident Report System is unsatisfactory for this effort, due to the length of time required for most reports to reach Coast Guard Headquarters, and the tendency for persons not to report non-fatal accidents. Therefore, Coast Guard Headquarters directed Coast Guard units to report specified types of small boat collisions via a WATS line reporting system. Each call received at Wyle Laboratories was given a cursory review by a qualified accident investigator. If it appeared that the accident had a possibility of meeting the criteria for further investigation, the reporting Coast Guardsman was called back in an attempt to get further information. Calls were then made to victims, witnesses, police, rescue squad members, etc., until it was concluded that the case was or was not worthy of further investigation. Generally, one or two calls produced sufficient information on which to base a decision.

Details of this system and the accidents received via this system can be found in WATS Accidents Reported in 1975 — A Summary of the Accident ALERT Reports, by A. Shikoh, and J. Bowman, prepared by Wyle Laboratories for the Coast Guard.

In summary, 193 collision accidents were reported via the WATS line reporting system from 1 January 1976 to 15 December 1976. From these, twelve were selected for in-depth investigations.

3.0 COLLISION SCREENING

3.1 Screening Criteria

Criteria for selection of accidents came from the results of Phase II of the Collision Research effort [1], and included:

- Only collisions involving power boats.
- Collisions where human engineering problems involving the control station may have contributed to the cause and specifically:
  - Collisions where visibility problems due to control station or boat design problems may have contributed to the cause;
  - Collisions in which operator fatigue due to noise may have contributed to the cause; and
  - Collisions where other operator stressors such as glare and alcohol may have been a contributory factor.

3.2 Screening Procedure

The collision accident investigators screened the data on all collisions reported to Wyle over the WATS line. The owners/operators of boats involved in collisions that seemed to meet the criteria delineated in 3.1 above were contacted to determine:

- If initial assumptions as to the involvement of the criteria were correct.
- Their willingness to cooperate in the investigation.
- The availability of their boats.
- The geographical distances between accident site, owners/operators' homes and their boats.
- The ability to schedule interviews with all concerned in a one or two day time span.

If the above five parameters were positive, the investigation was initiated.

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[1] MacNeill, R., et al. Recreational Boat Safety Collision Research — Phase II, Vol. I. Final Report to USCG. Contract DOT-CG-40672-A, July 1976.

Since Wyle was looking for a particular set of accident parameters as detailed in Section 3.1 above, many of the collisions were discarded by the accident investigator prior to any call-backs. It is estimated that this group represents approximately 80% of the total group of collisions. Another 10% of the total number of collisions reported were discarded after the initial calls. Five percent of the total number of collisions reported were discarded because of extenuating circumstances such as impending law suits, not able to contact sufficient number of participants or victims, etc. The remaining six percent were investigated.

4.0 DATA ACQUIRED THROUGH INVESTIGATION

The information that is contained in each of the seven sections of an accident report is as follows:

- Section 1.0 Boat Occupant Data

This section gives the following information for each of the occupants on board at the time of the accident.

Sex	Weight	Boating Experience	PFD Worn
Age	Swimming Ability	Formal Boating Instruction	

In addition to the aforementioned information, a brief narrative of the operator's background is generally included.

- Section 2.0 Environment

This section gives a description of the environment at the time of the accident. Generally, the reporting Coast Guard Station or local weather service was called to obtain local conditions at the time of the accident.

- Section 3.0 Narrative of the Accident

This section is subdivided into three sections: Pre-Accident, Accident, and Post Accident.

The Pre-Accident section describes the operator's and other occupants' activities prior to the accident. It attempts to establish the operator's level of fatigue by discussing his activities for approximately 24 hours before the accident. Fueling and boat preparation procedures are also discussed. All activities up until accident initiation are included in this section.

The subsection entitled Accident discusses the actual accident scenario. Boat, occupant, and water actions are discussed describing the sequence of events during the collision.

The Post Accident section discusses persons' and boat conditions just after the accident and related operations whether self-rescue by the occupants or rescue by another vessel.

- Section 4.0 Vessel Data

This section gives a description of the boat involved in the accident. Human engineering problems with the control station as well as any modifications to the boat hull are described.

- Section 5.0 Psychological and Human Factors

This section deals with qualities of the accident that relate to the psychological attitudes or human decisions/factors of the occupant. Accident proneness of an operator may be designated here. The fact that the operator may be physically fatigued or emotionally stressed are pointed out in this section.

- Section 6.0 Probable Cause of Accident

The precise causes of the accident are summarized here. If the cause is an opinion of the investigator formulated from interviewing, it is noted as an opinion.

- Section 7.0 Dynamics/Analysis of the Accident

This section deals with the major events of the accident itself. Each event of the occupant action, boat motion, or water action on the boat or occupants is given in chronological order.

Each investigation is written as a separate report and submitted for USCG review. Section 5.0 of this report gives a brief summary of the 12 collisions investigated for this effort.

4.1 Data Bias

As part of the collision accident investigation research conducted during 1975[1], some effort was expended to compare WATS collision statistics with CG-357 collision statistics in order to identify sample biases. In fact, it was determined that WATS reported data contained relatively fewer smaller boat collisions and relatively more larger boat collisions. This is understandable in light of the fact that WATS reports come from Coast Guard stations which are generally located along coast lines. Because the 1975 research effort expended in the data comparison area did not yield any important results, it was not repeated in the 1976 effort. Interested readers may obtain a copy of the referenced document[2] for more detailed data comparisons.

[2] MacNeill, R. and S. Cohen. Recreational Boat Safety Collision Research - Phase II, Volume II. Final Report to the U.S. Coast Guard. Contract DOT-CG-40672-A. July 1976.

5.0 SUMMARY OF 12 COLLISIONS INVESTIGATED IN-DEPTH

76-01 The accident occurred at midafternoon on a holiday weekend. Several boats were underway in a cove adjoining Barnegat Bay, New Jersey. A 21 ft 2 in. (6.5 m) cruiser was stopped while one of its four occupants jumped into the water to ski. A 14 ft 2 in. (6.5 m) runabout, driven by the 14 year old son of its owner and with two other boys on board, had just picked up its skier. The operator became concerned that a larger (third) boat approaching from astern might collide with them, so he throttled ahead while he and the other occupants kept watch on the larger boat. When he eventually looked ahead, it was too late to avoid a collision with the cruiser's bow. Because the runabout was in a turn, it hit the cruiser with its side. The runabout's after hull side was split open, the deck pulled away from the gunwale, and the steering jammed; but the operator was able to beach it nearby. No one was injured. CAUSAL FACTORS: Inexperience, immaturity, fatigue.

76-02 Two boats were involved in waterskiing in a protected bay late in the afternoon on a sunny day. A 14 ft (4.3 m) runabout with two POB was sitting still in the water while two people 75 ft (22.9 m) behind were donning their skis. At the same time, a 21 ft (6.4 m) tri-hull I/O powered boat with a cuddy cabin and eight POB was pulling away from the shore with two skiers behind. The operator of the 14 ft (4.3 m) runabout saw the cabin boat coming at him, stood on his seat and waved his arms. When the collision seemed imminent, he and his passenger dove into the water, away from their boat, which was struck broadside, just aft of amidships. The boat sank in chest deep water with the cabin boat resting on top of it. No one was injured. CAUSAL FACTORS: Reduced visibility due to glare and bow high attitude. Also, inability of hittee to locate and actuate horn.

76-03 A 19 ft (5.8 m) runabout was at anchor one-half mile (0.8 km) off shore. Both occupants were sitting facing aft under a canvas cockpit cover. Another boat, a 35 ft (10.7 m) cabin cruiser, was traveling somewhere between 15 and 25 mph (24.1 and 40.2 kph) heading for harbor and trying to beat a storm front heading in from the west. It had started to rain and the wind had picked up to 25 mph (40.2 kph). The operator of the cabin cruiser never saw the runabout. He ran over the bow, severing the deck and upper portion of the hull sides from the

rest of the boat. One of the occupants of the runabout abandoned the boat. The other one didn't have time.

The cruiser passed completely over the runabout, turned and came back to pick up survivors. A Coast Guard rescue boat was less than one-half mile (0.8 km) away and also came to the scene of the accident. The runabout floated and was towed into harbor. One injury was sustained. CAUSAL FACTORS: High operator anxiety level, reduced visibility due to small area of wiped windshield, and high noise levels on the hittee's boat due to rain on the cloth top.

76-04 The two boats involved in the accident were being test run to check the operation of the outboard motors. A 14 ft (4.3 m) bass boat with four POB was returning to the launch ramp on a canal southwest of New Orleans. At the same time, a 15 ft (4.6 m) bass boat with one POB was leaving the launch ramp at full throttle. At a bend in the canal, the operator of the 14 ft (4.3 m) bass boat saw the other boat coming toward him and made a left turn to try to avoid a possible head-on collision.

The operator's turn was not sharp enough, and the 15 ft (4.6 m) bass boat hit the 14 ft (4.3 m) bass boat on the starboard side immediately in front of the console. The operator was struck by the 15 ft (4.6 m) bass boat, suffering head injuries, concussion, and shattered cheekbone. CAUSAL FACTORS: Speed, panic on both operators' parts, failure to observe right of way.

76-05 Two boats were pulling water-skiers in a protected cove on a very busy lake late in the day. One skier fell. The driver of her boat circled and stopped in such a way that she had the handle of the tow line again. Before she could be pulled up, another boat approached heading directly into the setting sun. The driver of the first boat waved a red flag indicating a downed skier. The driver of the approaching boat waved, acknowledging that he saw the flag, but never saw the skier. He slowed enough that his skier dropped into the water while he visually searched for the downed skier. Just before hitting her, he saw the tow line floating across his bow. The skier received a broken leg and cuts. CAUSAL FACTORS: Failure to stop upon seeing red downed skier flag, glare/reflection ahead.

76-06 This collision was a two-boat collision occurring at 0100 and involving a 21 ft (6.4 m) cuddy cabin cruiser and an 18 ft (5.5 m) open runabout. The 21 ft (6.4 m) boat (Boat No. 1) had five persons on board, while the 18 ft (5.5 m) boat (No. 2) had two people aboard. The Boat No. 1 owner was going for a ride after preparing his boat for a four to five day lake vacation. He had proceeded across the bay and was approaching the northern shore when the collision occurred with Boat No. 2 striking Boat No. 1 amidship on the starboard side.

Boat No. 2 penetrated the side of Boat No. 1. Three POB were thrown overboard. Two were injured. All persons climbed aboard Boat No. 2 where they stayed until the Coast Guard arrived. Damage was estimated at $7300. CAUSAL FACTORS: Failure to observe rules of road, glare from stern light, inattention, bow high attitude, glare/reflection ahead.

76-07 At approximately 1530 on a clear day an 18 ft (5.5 m) runabout arrived at a marina on the Saginaw River in Bay City, Michigan, after a fishing trip in Saginaw Bay. The owner/operator fueled the boat and decided to go on a short cruise up the river before putting the boat in its storage slip. After traveling approximately four mi (6.4 km), the operator turned the boat around and started back toward the marina at a speed of approximately 30 mph (48.3 kph). After traveling approximately 1/4 mi (0.4 km), the operator stated that the steering wheel suddenly turned hard to starboard. Before he could react to the sudden turn, the boat ran bow on into a concrete pier. The operator's head hit the instrument panel, knocking him unconscious. After regaining consciousness, he got out of the boat and pulled it a short distance to shore. The operator was taken to a local hospital by ambulance. The boat was towed back to the marina by a Coast Guard vessel. CAUSAL FACTORS: Alcohol, inability to maneuver quickly enough.

76-08 Two families, each with their own boat, were picnicking on a lake for the day. After the children had been dropped off on a beach, the two owners left to check the tachometer setting of one of the boats against the speedometer reading of the other. While heading back to the beach after 20 minutes of speed checks, the first boat, a low profile 20 ft (6.1 m) day cruiser, made a 180° turn and slowed down quickly. The second boat, also 20 ft (6.1 m) in

length, made the turn while slowing down to 15 mph (24.1 kph) and hit the wake of the first boat. The wake threw the driver of the second boat out of the seat and onto the floor. The second boat swerved toward the first boat and ran up on its port transom corner, over the cockpit and exited the starboard side. Two people were injured, neither severely.
CAUSAL FACTORS: Boat at bow high attitude, seat too low (per Control Station Design Guideline under development).

76-09 A man invited three friends for an evening ride on his 24 ft (7.3 m) I/O cruiser. They ate, left at 1700, and cruised around the lake for four hours. At 2100, he attempted to enter the mouth of the river leading to his marina. A ship had hit one of the light marking the entrance. He ran parallel to shore, past the river entrance at about 15 mph (24.1 kph), and hit a breakwater. The boat went up onto the breakwall and slid back down into the water. The engine stalled and couldn't be re-started, and one passenger was injured. The Coast Guard towed the boat in. CAUSAL FACTORS: Alcohol, visibility obscured by cabin top and 360° white light.

76-10 Many boats were engaged in drift fishing in an inlet at night. The operator of an 18 ft (5.5 m) runabout removed the bulb from his 360° sternlight because of the glare. Later he noticed a 23 ft (7 m) center console fishing boat heading toward him from astern. He replaced the bulb and waved his hands over the light to attract attention. Because the fishing boat was running at such a bow high attitude, the standing operator couldn't see the runabout in front of him. The runabout operator jumped overboard just before the fishing boat ran up and over his transom. The runabout sunk. There were no injuries.
CAUSAL FACTORS: Design of stern light, visibility from the helm, and engine noise level.

76-11 At approximately 1530 on October 2, 1976 a man (operator), his wife and two small children in a 15-1/2 ft (4.7 m) runabout arrived at a fishing spot on Lake Erie located near the mouth of an inlet. Shortly after the anchor was deployed, a cabin cruiser was observed by the runabout occupants coming toward them. The operator of the runabout noticed that the cruiser's bow was up so high that he could not see anyone aboard; therefore, a collision was imminent.

The cruiser hit the runabout amidships and travelled over it. The runabout sank immediately and capsized. The occupants were rescued by nearby boats. One occupant was severely injured. The cruiser sustained minor damage (< $ 100) and the runabout was destroyed. The runabout was valued at $600. CAUSAL FACTORS: Restricted forward visibility, inattention, long reaction/response time.

76-12 Approximately three minutes after a fishing tournament began, one bass boat travelling about 60 mph (96.6 kph) swerved in front of another bass boat. The two collided. One went out of control, turned sharply and capsized. Both occupants of the capsized boat were wearing PFDs and were picked up by a following boat within minutes. The overturned boat floated level and was towed to a nearby beach where it was righted and bailed. Both operators were fatigued and both had allegedly consumed alcoholic beverages prior to the start of the tournament. CAUSAL FACTORS: Speed, glare, fatigue, alcohol, noise.

APPENDIX A. COLLISION NO. 76-01

ACCIDENT INVESTIGATION REPORT

Date of Investigation: 13 July 1976

Date of Accident: 5 July 1976

Investigation: Collision No. 76-01

SUMMARY — WYLE ACCIDENT NO. 76-282

The accident reported herein was a collision of a fiberglass 14' 2" (4.3 m) bowrider runabout powered by a 60 hp outboard motor and a drifting 21' 2" (6.5 m) cruiser. The runabout suffered extensive damage and the cruiser sustained only minor damage. There were no injuries or fatalities.

The accident occurred at midafternoon on a holiday weekend. Several boats were underway in a cove adjoining Barnegat Bay, New Jersey. The cruiser was stopped while one of its four occupants jumped into the water to ski. The runabout, driven by the 14 year old son of its owner and with two other boys on board, had just picked up its skier. The operator became concerned that a larger (third) boat approaching from astern might collide with them, so he throttled ahead while he and the other occupants kept watch on the larger boat. When he eventually looked ahead, it was too late to avoid a collision with the cruiser's bow. Because the runabout was in a turn, it hit the cruiser with its side. The runabout's after hull side was split open, the deck pulled away from the gunwale, and the steering jammed; but the operator was able to beach it nearby. The cruiser followed to insure that all on board were safe.

1.0 BOAT OCCUPANT DATA

RUNABOUT

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFD Worn/Used Before	PFD Worn/Used After
Operator	M	14	90 lb 40.8 kg	Good	20-500 hr	None	No	No
Passenger	M	16	130 lb 59.0 kg	Good	20-500 hr	Unknown	No	No
Skier	M	11	83 lb 37.6 kg	Good	0- 20 hr	None	Type III	Type III

The operator and skier are the boat owner's sons, and the three of them were interviewed together. The 16 year old passenger was not available. The owner has a body and speed shop at which he employs both sons in the summer (the 11 year old works only part time). The boat operator is short for his age, and appeared to be of average intelligence and physical ability. Both boys are quite active and full of energy. They were well-mannered, obedient, and could be described as "nice kids." The runabout was the family's first boat, and had been purchased from relatives a year ago. The operator drove the boat frequently last season, always with an adult aboard, but only because it was necessary for someone to drive him to the boat's mooring. In April of this year, the family took a summer home with a boat dock on Barnegat Bay. After a few rides together in the new area, the owner allowed the operator to take the boat out alone. Since then the 14 year old has operated the boat several days a week after work, and on weekends, venturing up to several miles from home on the Bay. The owner prohibits the boat from being navigated on the ocean. The operator claims to wear his Type III PFD at all times when alone in the boat and about half the time otherwise, depending on the activity and distance from home. When asked for his complaints regarding the device, he mentioned that it was clumsy and did not allow him to move around. His parents bought the devices because the boys refused to wear Type IIs because they felt choked by them.

CRUISER

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFD Worn/Used Before	PFD Worn/Used After
Operator	M	51	200 lb 90.7 kg	Swims	500 hr	Local Marina	No	No
Skier	M	21	135 lb 61.2 kg	Swims	20-500 hr	None	Ski belt	Ski belt
Passenger	M	20	135 lb 61.2 kg	Swims	Unknown	Unknown	No	No
Passenger	F	19	100 lb 45.4 kg	Swims	20-500 hr	Unknown	No	No

The only one on board the cruiser to be interviewed was the owner/operator. He has been boating for six or seven years, and has owned one other boat previously, a 14' (4.3 m) runabout. He is a construction operating engineer, but has been unemployed for several months. He appeared to be of average intelligence and physical ability. He took a good deal of pride in his boat, and seemed to be safety conscious: the boat displayed a current Auxiliary CME decal: and he claims to never allow the gas tank to go below one-quarter full and to always personally check the engine compartment for fumes before starting, rather than merely running the blower. He mentioned never having run out of gas while boating and, other than this instance, never to have been in a car or boat accident. His boating instruction was given over a seven week period at a local marina, in conjunction with his purchase of the boat.

2.0 ENVIRONMENT

The day was sunny, the air temperature was in the 80°F (20°C) range, winds southerly at 10 knots, and the water surface calm except for a slight chop from the moderate concentration of boating activity in the cove. The water depth was between three feet (0.9 m) and six feet (1.8 m).

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

The cruiser operator had been out crabbing earlier in the day. He had been underway from his home, where the boat was moored, for only five or 10 minutes before the accident. He had intended to take his three passengers waterskiing. He ran his boat at slow speed into the cove, shifted to neutral, and drifted ahead while a passenger payed out the towline. The operator saw the runabout at a distance he estimated to be 300 yards (274.3 m). At that time it was stopped, and a skier was reboarding. (Refer to Figure 3 for a general view of the accident area.) According to the operator's estimate, there were four or five other boats engaged in waterskiing in the cove. He mentioned being surprised that there were not more accidents along Barnegat Bay due to the high volume of traffic during the summer.

The three occupants of the runabout had been on the ocean fishing between 0700 and 1400 that day on a 22' (6.7 m) boat owned and operated by the father of the 16 year old passenger. After coming home to eat and change clothes, they went out in the family's runabout to go waterskiing. According to the operator, the boat handled normally prior to the accident. The first to ski was the 11 year old; the other two sat on their wearable PFDs. The skier had only been up for a short time when he fell and landed on the tow line, which stung his arm. He was taken aboard, and their intention was to head in toward shore and let the other passenger ski for awhile. The skier began to haul in the 75' (22.9 m) tow line so it would not interfere with other boats or skiers. By the operator's estimate, there were 15 to 20 other boats in the cove, about half of which were involved in waterskiing.

3.2 Accident

(Refer to Figure 1 for the location of occupants in each boat.) According to the cruiser's operator, the runabout's operator accelerated while looking behind him. The cruiser's operator then turned and spoke to his water skier. After the skier jumped into the water, the operator turned back to see the runabout, its operator still looking astern, in a wide left turn and on a collision course with his boat. He reached hurriedly for the horn switch on the control

panel to alert the runabout, but threw an identical light switch by mistake. He watched as the other operator turned and noticed the situation. He did not attempt to move his own boat, explaining that he was unsure of his skier's position in the water. The collision occurred at 1510 as the starboard bow and after starboard side of the runabout hit the stem and bow of the cruiser. The runabout's operator was heard to say, "I didn't see you" twice as his boat passed down the starboard side of the cruiser.

According to the runabout's operator, a larger boat (about 22' (6.7 m) in length) was inbound from the Bay and heading directly toward his boat as it lay stopped in the water. To avoid the boat, he accelerated to about 2500 rpm (approximately 15 mph (24.1 kph) while he and the others watched it over the stern. The first one to notice the cruiser was the operator: when out of danger from the boat astern, he "turned around to see where I was going." He recalls turning left to avoid the cruiser but did not change the throttle setting until after the collision. His estimate of the time between noticing the cruiser and impact was five seconds. (Refer to Figure 2 for a diagram of the accident site and probable boat paths.)

3.3 Post Accident

No one on board either boat was injured, although the runabout's occupants were knocked to the left inside their boat. The operator quickly regained control of the boat, and after making a right turn around the cruiser, stopped to check the damage to his boat. Water was seen entering a hole in the starboard quarter. The operator started off for home, about a mile away (1.6 km) by water, and found that the flooding decreased as the boat gained speed, but that the steering was damaged such that the boat would only turn right. He then beached the boat a short distance away. The cruiser operator followed and had his skier go ashore to insure that everyone was safe. The runabout was later hauled out onto a trailer by its owner. The boat had not been repaired as of the date of the investigation. The insurance company settlement was pending; but it is believed that the boat will be declared a total loss. The owner had already purchased a brand new 15' (4.5 m) closed bow runabout and equipped it with the motor from the damaged boat.

3.4 Time Sequence of Accident Events

0700	-	Runabout fishing in ocean; cruiser crabbing
1400	-	Both parties lunch and prepared to ski
1445	-	Runabout departs to ski area and skis
1500	-	Cruiser departs to ski area; plays out tow line
1510	-	*Collision; damage and injuries assessed*
1515	-	Runabout unable to reach home; beached

4.0 VESSEL DATA

Cruiser

This boat is a 1974 Bayliner, Skagit model, constructed of FRP and powered by a 165 hp Mercury inboard/outdrive. It was in excellent condition except for several scratches and gouges at the bow, said to have occurred in this accident. (Details of the boat and its damage are visible in Figures 4-7.) A local marina estimated the cost of repairs to the bow at $ 113. The horn and navigation light controls were identical toggle switches located adjacent to each other on the instrument panel. Each was identified by an attached nameplate.

Runabout

This boat is a 1973 Scott Boat Co. model 1468 tri-hull bowrider constructed of FRP and equipped with a 60 hp 1974 model Chrysler outboard motor. The boat's dimensions are 14'2" (4.3 m) length overall, 63" (160 cm) maximum bean, and 20" (50.8 cm) transom height. In general, the boat seemed to be lightly constructed of minimum thickness material. It appeared to have been maintained in average condition prior to the accident. Damage consisted of a fractured and torn away area of the starboard hull side just forward of the transom, several fractures in the motor well and upper transom, separation of the riveted connection of the hull side and upper deck structure around the boat's perimeter except for the port side, and distortion of the steering control rod and sleeve near the motor connection. Details of the boat and its damage are visible in Figures 8 to 12. During inspection of the boat, sharp corners and edges were noted on the walk-through windshield. When the investigator mentioned this condition during the interview, the operator exhibited a partially healed wound on his leg, which he said occurred as he was passing through the windshield opening sometime prior to the accident when the boat was tied up at a fuel dock.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The young operator of the runabout enjoyed driving the boat as much as possible. His mother mentioned that he had gone through $ 60 worth of gas in one week. Due to the excitement boating generated for him, and considering his age, he might very likely take risks that a more mature individual would not.

Although the operator was in his second season of boating, his lack of experience at driving an automobile in traffic could have been a factor in his poor response to the stress situation confronting him.

Fatigue was likely a factor in this accident: the operator had already been out on the ocean for seven hours that day, and considering the glare, heat, and motion present in that environment, a decrease in reaction time was probable.

If the runabout had been equipped with a foot throttle, the operator may have been able to turn and slow down at the same time and, thus, may have avoided the collision. This is strictly an opinion of the investigator.

The cruiser operator did not take any action until just before the collision, when he attempted to warn the other operator with the horn. Use of the horn as an immediate warning device, called for in the Rules of the Road, is not uncommon. Especially in view of this accident, it would seem that the horn control should be readily distinguishable and recognizable.

6.0 PROBABLE CAUSE OF ACCIDENT

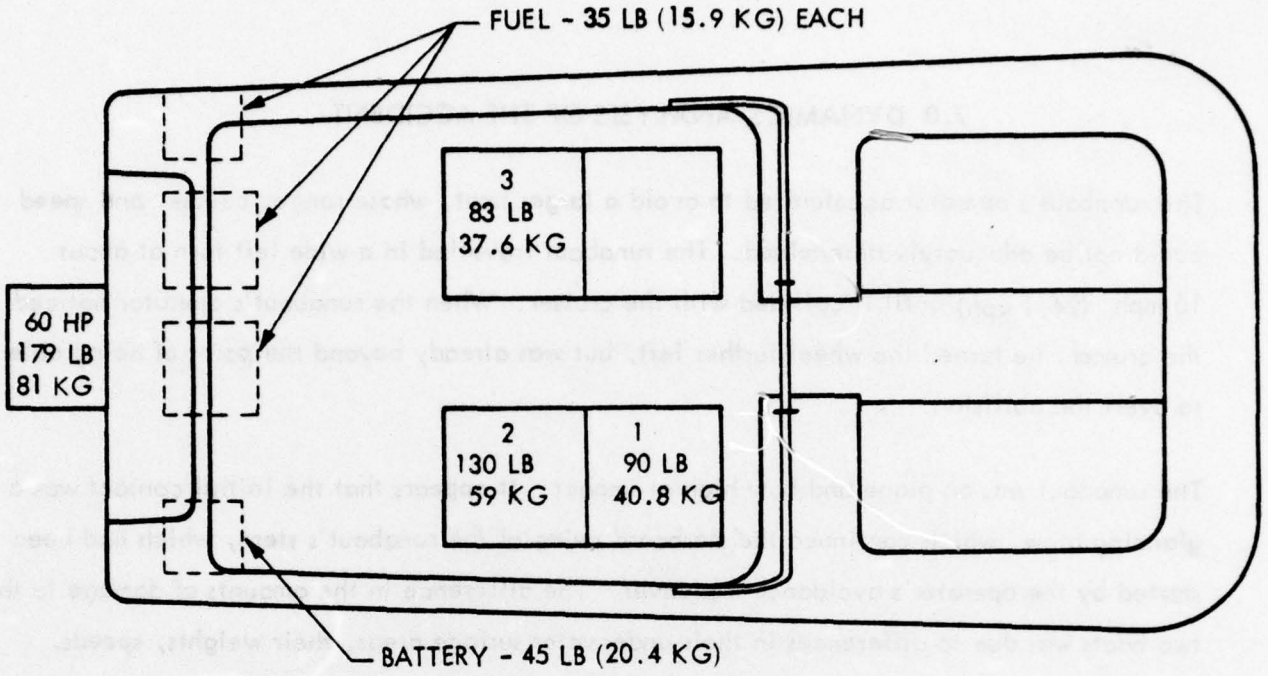
It is considered that this accident resulted from the failure of the runabout's operator to deal effectively with a crisis situation due to inexperience, immaturity and fatigue.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

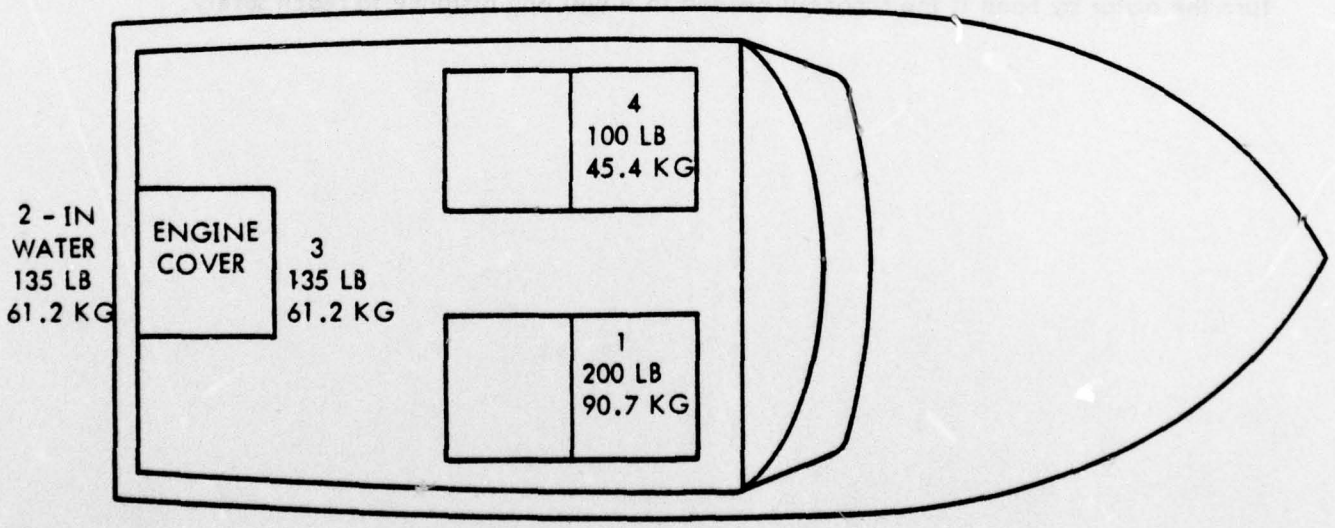
The runabout's operator accelerated to avoid a larger boat, whose range, course, and speed could not be adequately determined. The runabout travelled in a wide left turn at about 15 mph (24.1 kph) until it collided with the cruiser. When the runabout's operator noticed the cruiser, he turned the wheel further left, but was already beyond the point of being able to avert the collision.

The runabout was on plane and bow high at impact. It appears that the initial contact was a glancing blow, which continued the starboard swing of the runabout's stern, which had been started by the operator's avoidance maneuver. The difference in the amounts of damage to the two boats was due to differences in their underwater surface areas, their weights, speeds, types of construction, and hull thicknesses.

The runabout's steering was affected as the sleeve and control cable were displaced to port by the impact. It would probably have been necessary to disconnect the steering gear and turn the motor by hand if the runabout needed to travel any distance to reach safety.



RUNABOUT



CRUISER

FIGURE 1. CONFIGURATION OF VESSELS

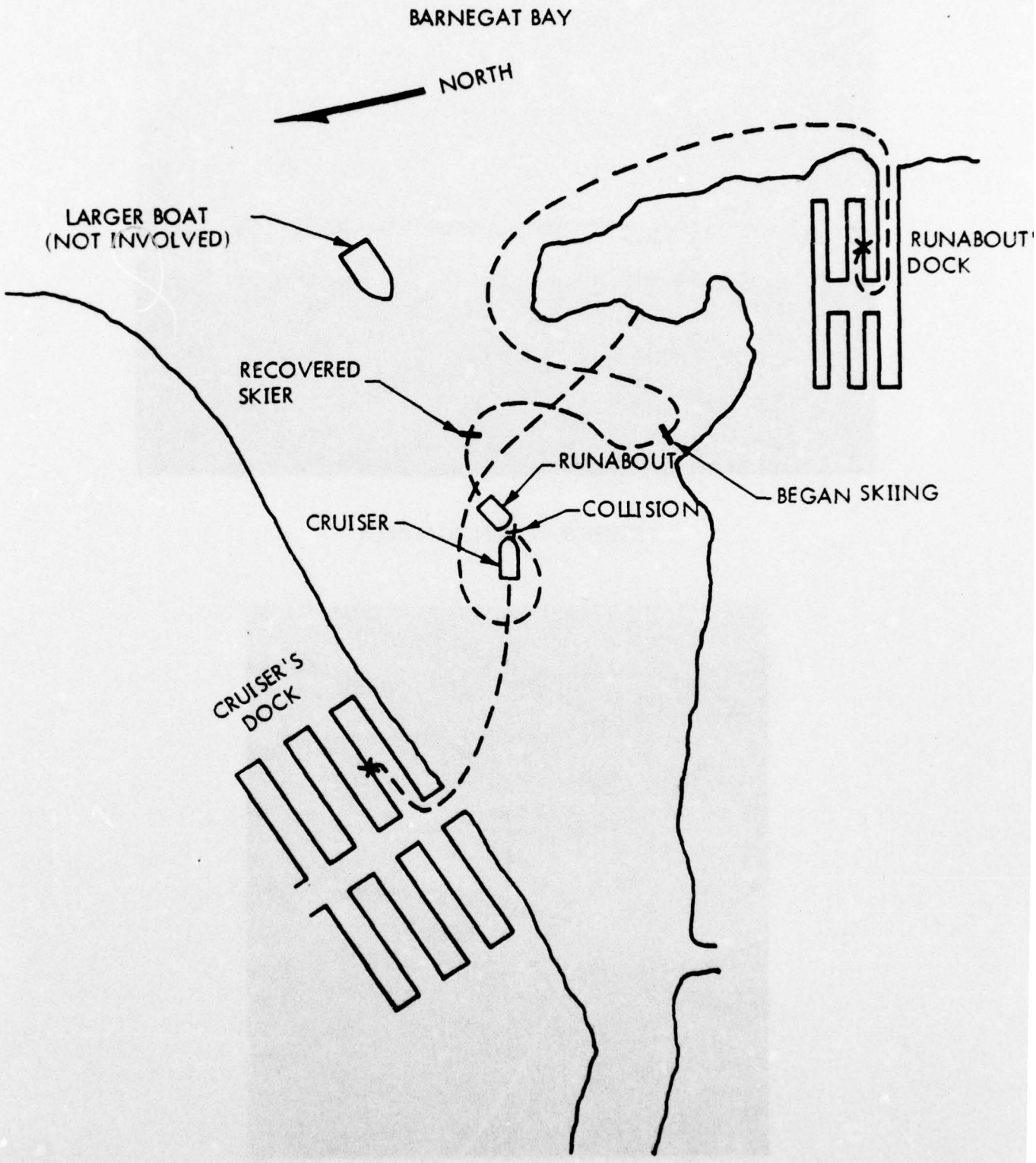


FIGURE 2. COLLISION AREA DIAGRAM

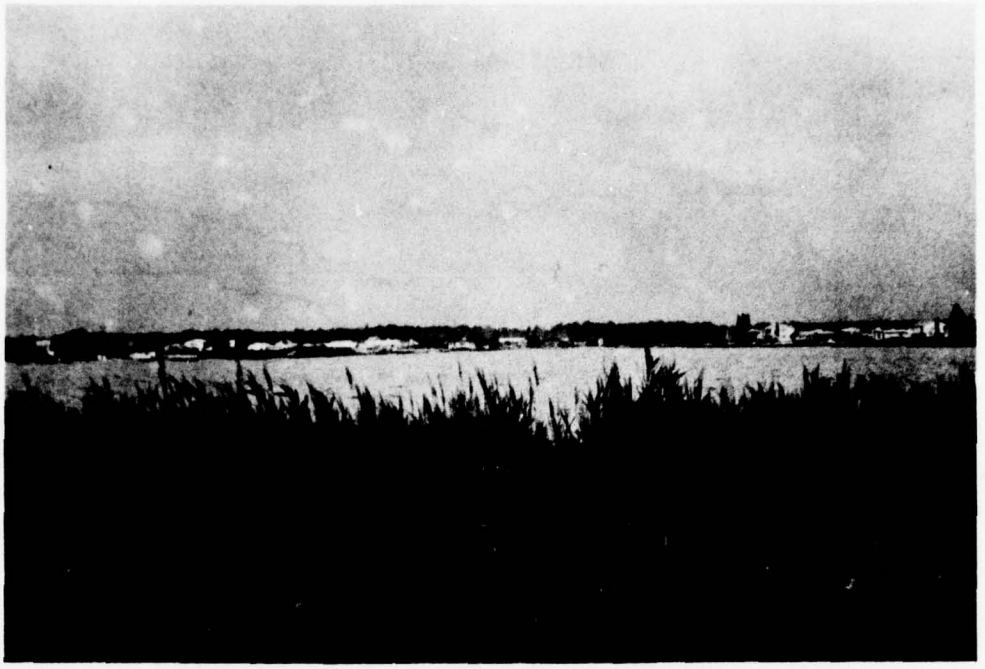


FIGURE 3. COLLISION AREA

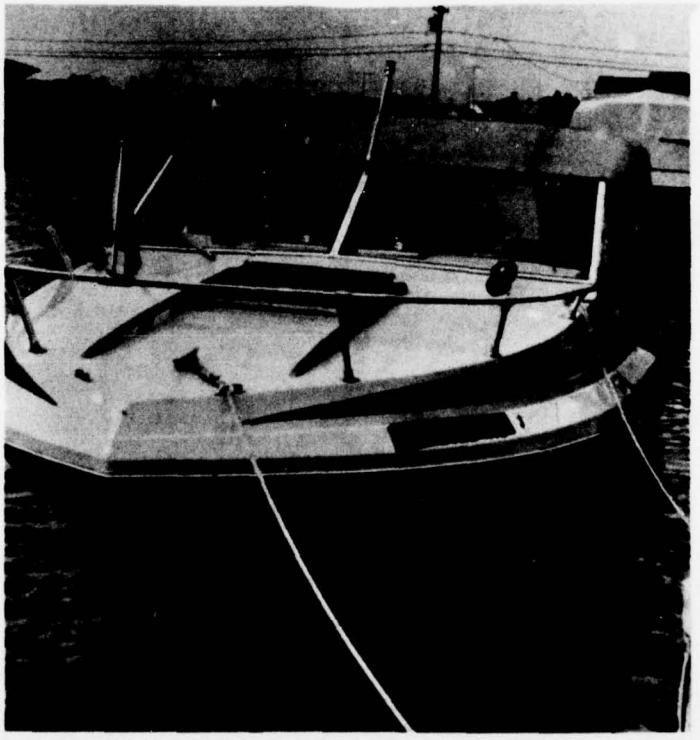


FIGURE 4. 21' (6.5 M) CRUISER. NOTE SCRATCH AND GOUGE AT STEM

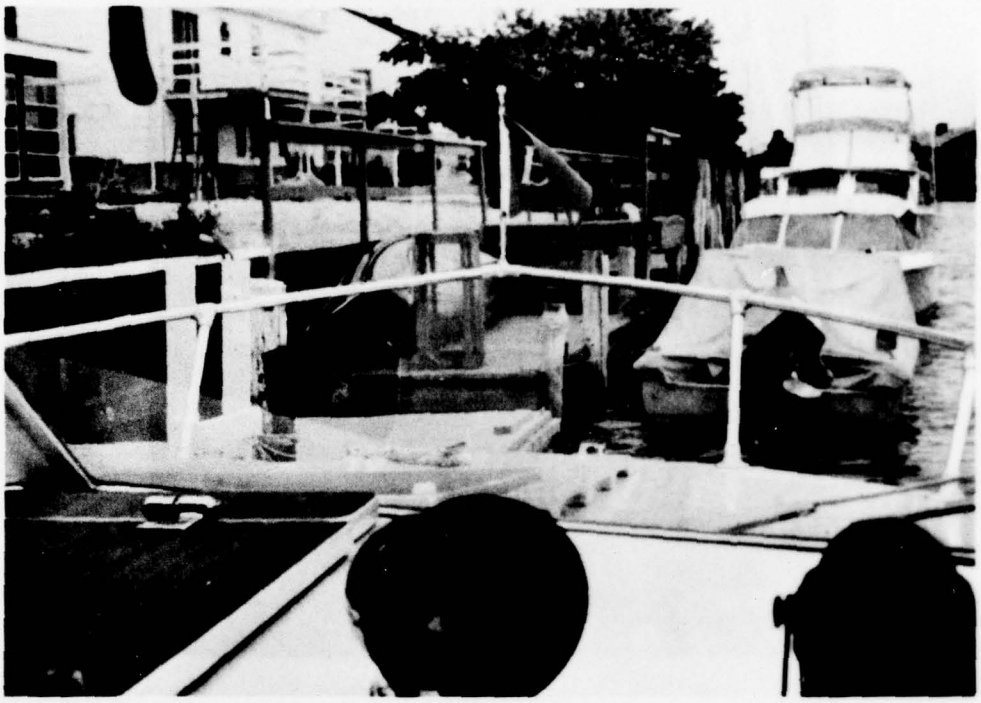


FIGURE 5. 21' (6.5 M) CRUISER. VIEW FROM HELM

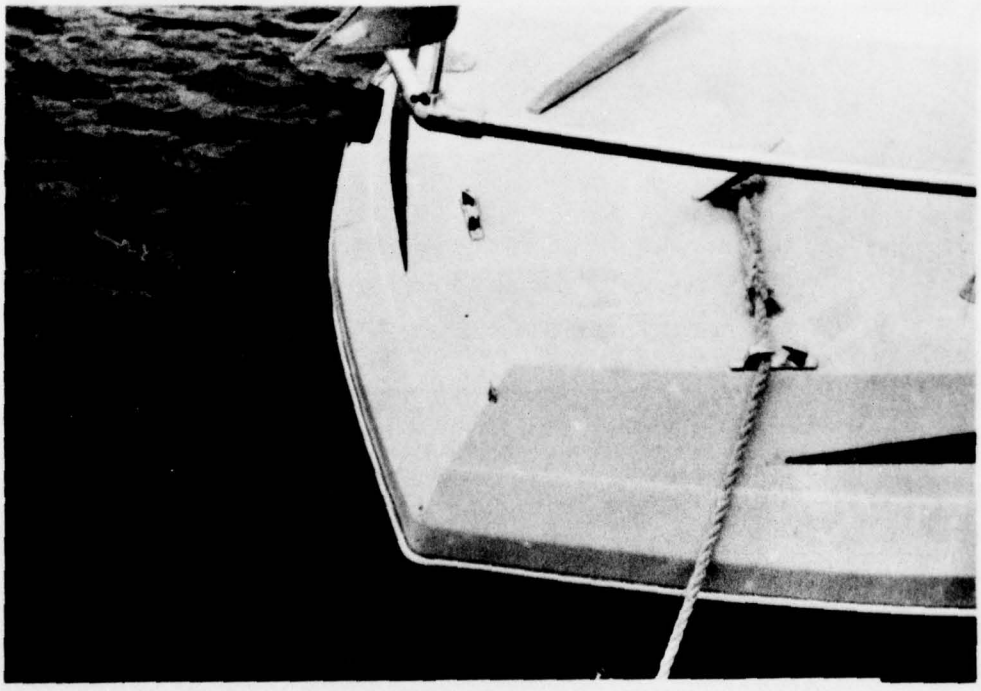


FIGURE 6. 21' (6.5 M) CRUISER. DETAIL OF BOW DAMAGE

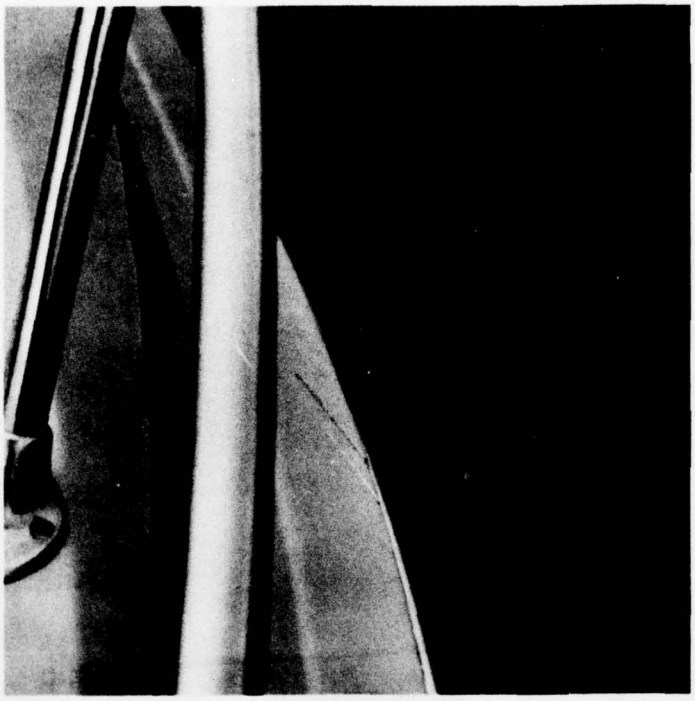


FIGURE 7. 21' (6.5 M) CRUISER. DETAIL OF DAMAGE ON STARBOARD BOW

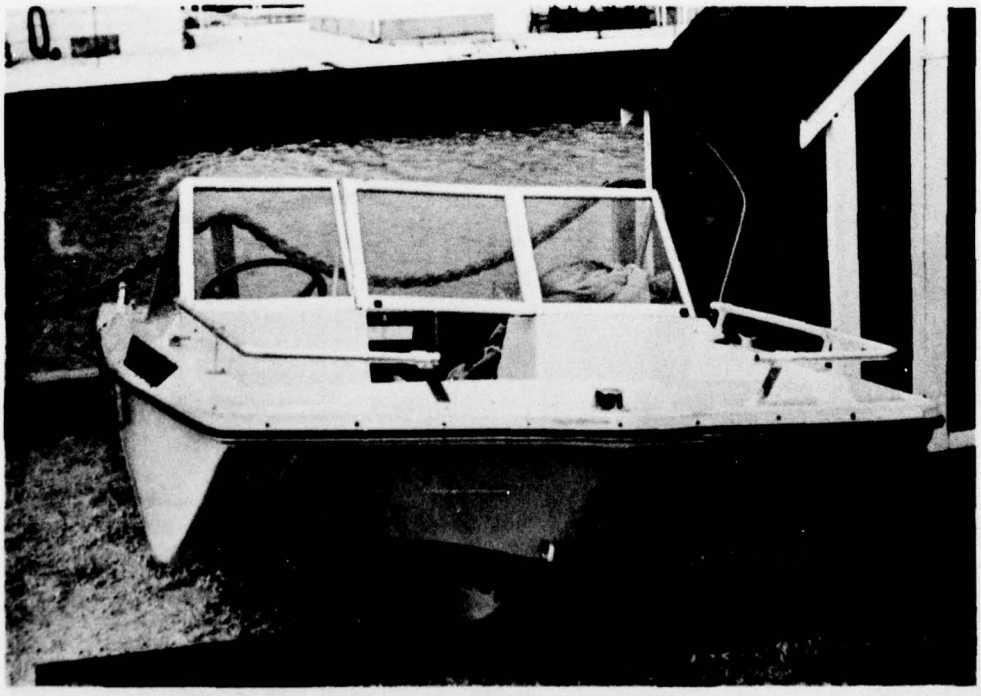


FIGURE 8. 14' (4.3 M) RUNABOUT. NOTE OPEN RIVET HOLES ABOVE RUB RAIL WHERE DECK POPPED LOOSE

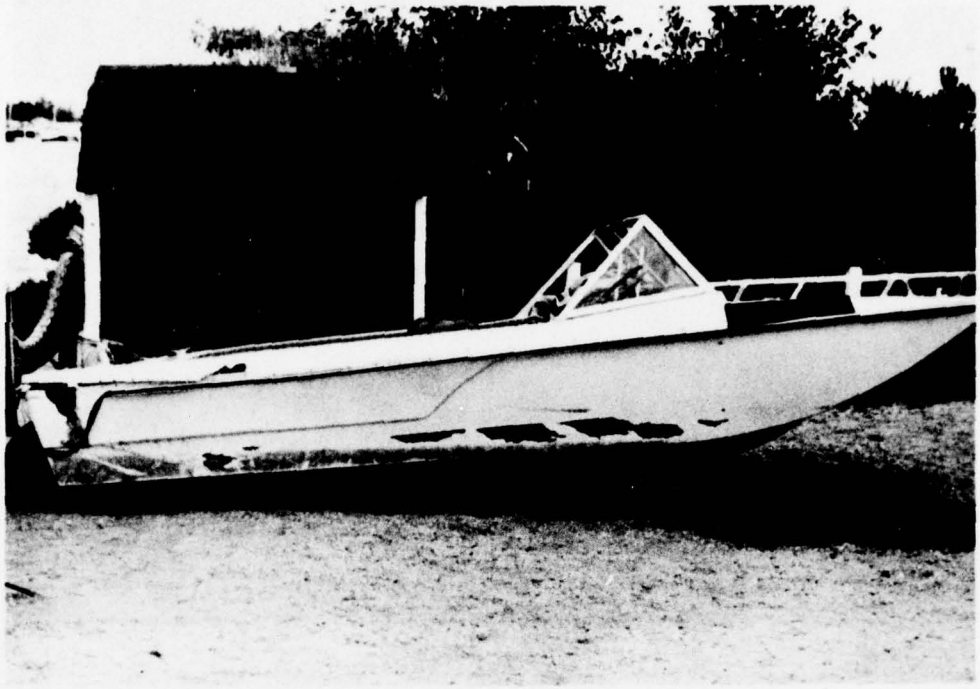


FIGURE 9. 14' (4.3 M) RUNABOUT

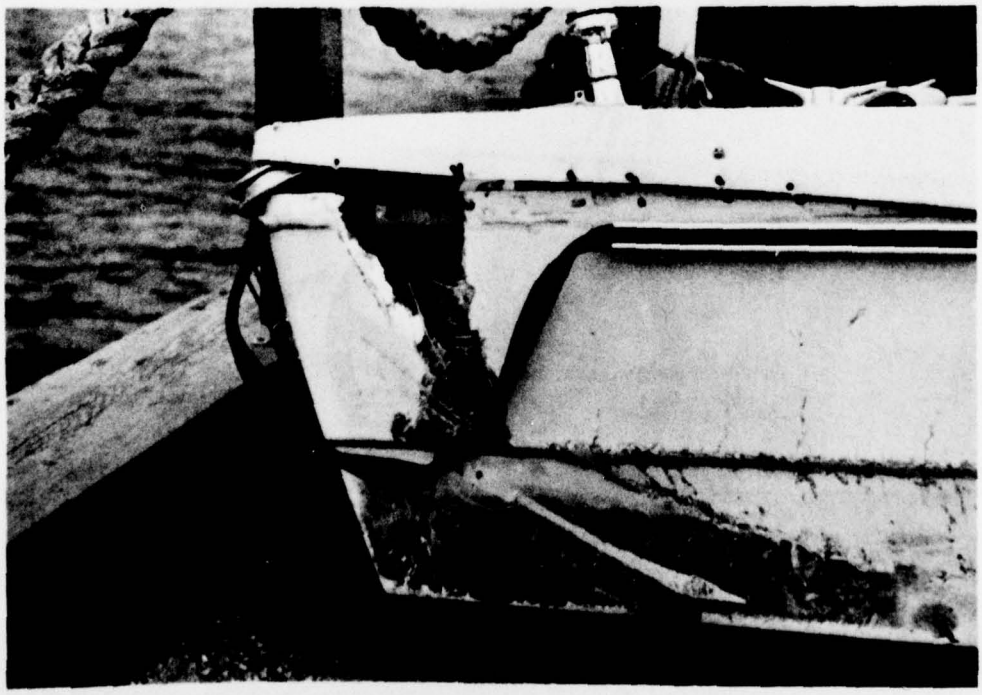


FIGURE 10. 14' (4.3 M) RUNABOUT. DETAIL OF STARBOARD QUARTER DAMAGE

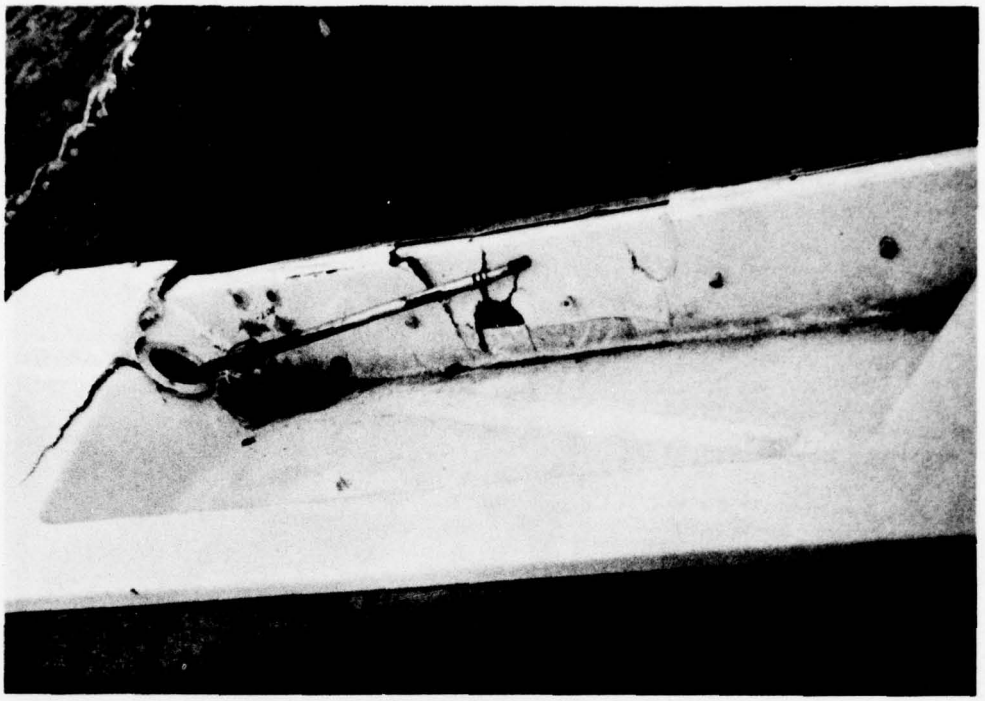


FIGURE 11. 14' (4.3 M) RUNABOUT. DETAIL OF MOTOR WELL, TRANSOM AND STEERING CONTROL DAMAGE

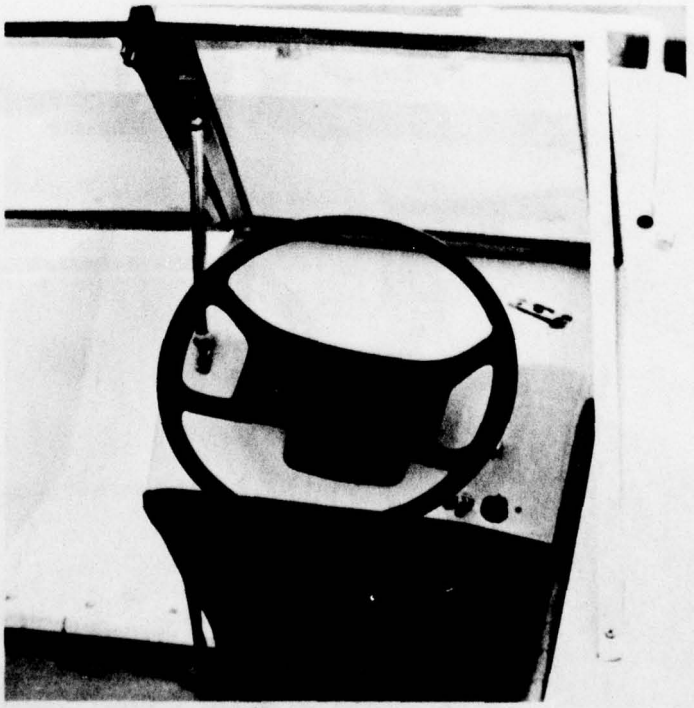


FIGURE 12. 14' (4.3 M) RUNABOUT CONTROL STATION. NOTE SHARP WINDSHIELD EDGES AND CORNERS

APPENDIX B. COLLISION NO. 76-02

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 8, 1976

Date of Accident: August 21, 1976

Investigation: Collision No. 76-02

SUMMARY — WYLE ACCIDENT NO. 76-471

Two boats were involved in waterskiing in a protected bay late in the afternoon on a sunny day. A 14 ft (4.3 m) runabout with two POBs was sitting still in the water while two people 75 ft (22.9 m) behind were donning their skis. At the same time, a 21 ft (6.4 m) tri-hull I/O powered boat with a cuddy cabin and eight POBs was pulling away from the shore with two skiers behind. The operator of the 14 ft (4.3 m) runabout saw the cabin boat coming at him, stood on his seat and waved his arms. When the collision seemed imminent, he and his passenger dove into the water, away from their boat, which was struck broadside, just aft of amidships. The boat sank in chest deep water with the cabin boat resting on top of it. No one was injured.

Because of personal reasons, the owner/operator of the 21 ft (6.4 m) cabin boat cancelled this interview at the last moment; therefore, the story has been reconstructed based on interviews with all four people on the runabout, the Coast Guard representative on the scene, the Pennsylvania Fish Commission officer, and a witness.

1.0 BOAT OCCUPANT DATA

14 ft (4.3 m) Runabout

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator[1]	M	19	140 lb (64 kg)	Very good	> 100 hrs	No	No	Yes
Passenger[1]	F	21	110 lb (50 kg)	Good	Very little	No	No	Yes
No. 1[2]	M	22	160 lb (73 kg)	Very good	< 100 hrs	C.G. Aux	No	No
No. 2[2]	F	17	110 lb (50 kg)	Good	< 10 hrs	No	Yes	Yes

21 ft (6.4 m) Cabin Boat

The operator was 50 years old and had two other adults with him as well as five children for a total of eight POBs. He was pulling two skiers.

The runabout operator is a high school graduate now working and going to school part time. The operator of the cabin boat is employed as an architect.

2.0 ENVIRONMENT

The day was clear and sunny with an air temperature of 84°F (29°C) and a water temperature of 72°F (22°C). The wind was light from the north-northeast and the water had a light chop due to the boat traffic in the area. Visibility was officially reported at five miles (8 km).

[1] People remaining in boat.

[2] People in water.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

The following account of the accident was constructed from interviews with the four people associated with the 14 ft (4.3 m) runabout, the Coast Guard representative on the scene after the accident, the Pennsylvania Fish Commision representative now handling the case, and an eye witness.

After an uneventful morning, two brothers picked up their girlfriends for an afternoon of waterskiing. They launched their boat near a protected bay just after 1500 and proceeded to ski. They skied, rested, sunned, and boated in the area until 1700. At that time, they were approximately 50 yds (45.7 m) from shore and aligned parallel to the beach. The port side of the boat was closest to the beach. The boat was dead in the water with the engine idling. The owner/operator was sitting at the helm on top of the back of the seat. His passenger was sitting directly behind him facing aft. In the water 75 ft (22.9 m) behind the boat were two skiers in the process of donning their skis.

Meanwhile, a 21 ft (6.4 m) tri-hulled boat with a cuddy cabin powered by a single 160 hp inboard/outdrive was facing directly away from the beach about 100 ft (30.5 m) from the shoreline. Two skiers were behind in the water and ready to go. The boat accelerated, pulling the skiers up and was moving through the water at a bow high trim angle. The high trim angle was partially due to the heavy load on board (estimated to be over 1000 lbs (453.6 kg)), the fact that he was pulling two adult skiers up, and the fact that boats of that type normally experience high "hump" angles even when running light and not pulling a load. The operator claimed that he never saw the runabout.

The operator of the runabout had been watching the cabin boat. Just minutes before the accident, the boat was forward of his boat. He claimed that the wind caused the cabin boat to drift towards his boat. Just prior to the accident, the runabout operator turned his attention to his skiers.

One of the skiers behind the runabout also was watching the cabin boat as it accelerated. He thought it was going to go between him and his 14 ft (4.3 m) tow boat. He felt that it would cut the tow lines. Both he and his companion began to swim away from danger.

Meanwhile, the operator of the 14 ft (4.3 m) runabout saw the cabin boat coming at him and immediately felt that he should signal the operator of the approaching boat. He made a quick visual check for his hand operated air horn, saw it, grabbed for it and missed. He didn't think he had time to reach for it again, so he stood up and waved his arms to attract attention. The boat kept coming. He couldn't see whether the operator was looking forward or not because the boat was aligned with the sun. He didn't think he could see much of the windshield, just bow and bottom paint. He told his passenger to jump overboard. She jumped aft of the boat. He dove forward and stayed at the bottom for a few seconds.

3.2 Accident

When he surfaced, he saw the cabin boat on top of his boat. His passenger surfaced, and he swam to her to check her condition. The PFDs which were stored on the floor between the seats floated away from the runabout as it sank. He grabbed two PFDs and gave one to his passenger. They both donned them even though they were in chest deep water.

The operator of the 14 ft (4.3 m) runabout was disturbed that it "took him a couple of minutes to turn his engine off." Actually, the operator of the cabin boat thought that he had run aground. He didn't feel an impact, but felt a deceleration similar to that experienced when running aground. Upon realizing that he had run into and was on top of a boat, he shut off his engine, jumped overboard, and pushed his boat off the runabout, apparently trying to determine if anyone was on board.

3.3 Post-Accident

According to the operator of the 14 ft (4.3 m) runabout, the cabin boat operator said, "I saw you earlier." The runabout's stern sank until the motor hit bottom. The bow remained afloat. Two dogs, also on board the runabout, were trapped under the deck in the bow. Their owners pulled them to safety.

The operator of a third boat saw the accident, retrieved his skier, then came over to offer assistance. He loaded the floating debris from the runabout aboard his boat, then towed the runabout to the launching area. The two male crew members from the runabout, the two male crew members from the cabin boat, and the man who towed the runabout in, dragged the runabout ashore and drained it. They refloated it, put it on its trailer, and took it to the local Coast Guard station to fill out papers.

3.4 Time Sequence of Accident Events

1100	-	Cabin Cruiser departed marina
1130	-	Occupants of cabin cruiser skied
1200	-	
1300	-	
1400	-	
1500	-	Runabout launched
1530	-	Runabout occupants skied
1600	-	
1700	-	Collision
1800	-	Pulled runabout onto beach
1830	-	Proceeded to Coast Guard station to file report

4.0 VESSEL DATA

21 ft (6.4 m) Cabin Boat

This was a 1966 model fiberglass tri-hulled boat made by MFG. It was 21 ft (6.4 m) long, with a 91 in. (231.1 cm) beam, and weighed approximately 2510 lb (1138.5 kg). It was powered by a 160 hp Mercruiser inboard/outdrive. When inspected at dock, it was found to be in excellent condition for its age. It was equipped with a radiotelephone and all necessary Coast Guard equipment. In fact, it had a 1976 Coast Guard Auxiliary inspection sticker.

The boat was loaded with fishing equipment, two coolers, several waterskis, PFDs, ski vests, and other paraphernalia. The deck forward of the cabin was recessed as a sitting area. No one was sitting there at the time of the accident. Visibility from the helm was subjectively judged as excellent. When seated in the helm seat, this investigator felt as if he could see the water some 20 to 25 ft (6.1 to 7.6 m) forward of the bow. No damage was evident when the boat was inspected. What damage there was, was under the static waterline. Figure 1 shows a plan view of the boat. Figure 2 is a profile, Figures 3 and 4 are views looking forward from inside the boat and Figure 5 is a shot of the bow.

14 ft (4.3 m) Runabout

The runabout was a 14 ft (4.3 m) Glastron also built in 1966. It had a beam of six feet (1.8 m) and was powered by a 50 hp Mercury outboard motor. It sat very low in the water and was obviously designed as a low racy speedboat. Even though it had what appeared to be a very adequate motor well, the owner claimed that water washed into the cockpit if he stopped fast. The boat presented a very low profile to the oncoming cabin boat.

The port coaming was crushed in a six inch (15.2 cm) area where the stem of the cabin boat impacted it. Scratches and bottom paint from the cabin boat were evident where the three separate hulls contacted the coaming and the engine. The port seat had been knocked loose and the engine mount was twisted slightly. The gel coat was cracked for about four feet (1.2 m)

under and outboard of the coaming where the fiberglass structure had bent. No structural damage could be found in that area. In fact, the only apparent structural damage was a bent aluminum gunwale guard rail and the six inch (15.2 cm) portion of crushed coaming mentioned above.

Figure 6 shows a plan view of the boat. Figure 7 is a profile and Figure 8 shows the damage sustained. Figure 9 is an artist's concept of the scene prior to the collision.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

This is a difficult area to write about because the hittor wouldn't talk; however, there are some apparent problems that can be discussed. The operator of the cabin boat was obviously looking aft at times prior to the collision. In doing so, he was looking directly into the sun. Each time he turned to look forward, his vision was impaired for a few seconds while the pupils were dialating. He knew he had a heavy load on board; enough that acceleration was affected to the point that it was difficult to get two people up at once. In a telephone conversation with the operator of the cabin boat, he said that one of the skiers was a novice. Because of these facts, he was probably paying more attention to them than usual.

Stressors of another sort may have played an important role in the fact that the cabin boat operator didn't see the runabout. It was late in the day. The boat was loaded with people including children. Nerves may have been frayed. He may have been anxious to get the skiing over with so he could get home. All of these assumptions would have led to the operator paying less attention to the water area ahead of him.

In addition, the added weight increased the "hump" angle of the boat. Because the canvas top was up, he couldn't stand in such a way that he could see over the windshield. It is unknown whether he could see the horizon or the water in front of him prior to the collision. Only by measuring the trim angle and visibility envelope on a similar boat under similar conditions could this be determined.

Therefore, there were at least three psychological and human factors problems associated with the hittor and his boat:

1. The glare from the sun.
2. The probability that he was paying more attention to the skier than the path of his boat.
3. The probable loss of visibility due to the high trim angle.

The operator of the runabout may have avoided the collision if he could have blown his horn. It was on the floor. He grabbed for it once and missed. He didn't think there was time to grab for it again.

Perhaps boat steering wheels should have horn buttons similar to automobiles. Automobile drivers are conditioned to push the center portion or the spokes of the steering wheel to sound an alarm. That conditioning could probably be carried over to boats. Certainly, it would have been quicker for this operator to reach down and blow the horn or push it with a foot while waving his arms.

6.0 PROBABLE CAUSE OF ACCIDENT

The hittor said he saw the runabout some time prior to the collision. The hittor was perpendicular to the beach with the wind on his port side. He saw the runabout to starboard. He didn't notice his drift to starboard. After noticing the runabout to starboard, the cabin boat drifted and aligned itself with the runabout which may have been moving ahead very slowly also. This practice is normal to keep the ski rope taut while the skiers get ready.

By the time the cabin boat got underway, the bow was high enough that the operator may not have been able to see the runabout. His reduced visual capability due to pupil contraction from looking into the sun added to the problem.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The runabout was struck broadside (see Figure 9) by the lower portion of the stem of the cabin boat. As the cabin boat slid up and over the runabout, it pushed the port corner of the runabout underwater causing it to swamp. That, coupled with the fact that the runabout had a double wall construction in the lower portion of the hull sides, was the reason that the runabout sustained relatively little damage.

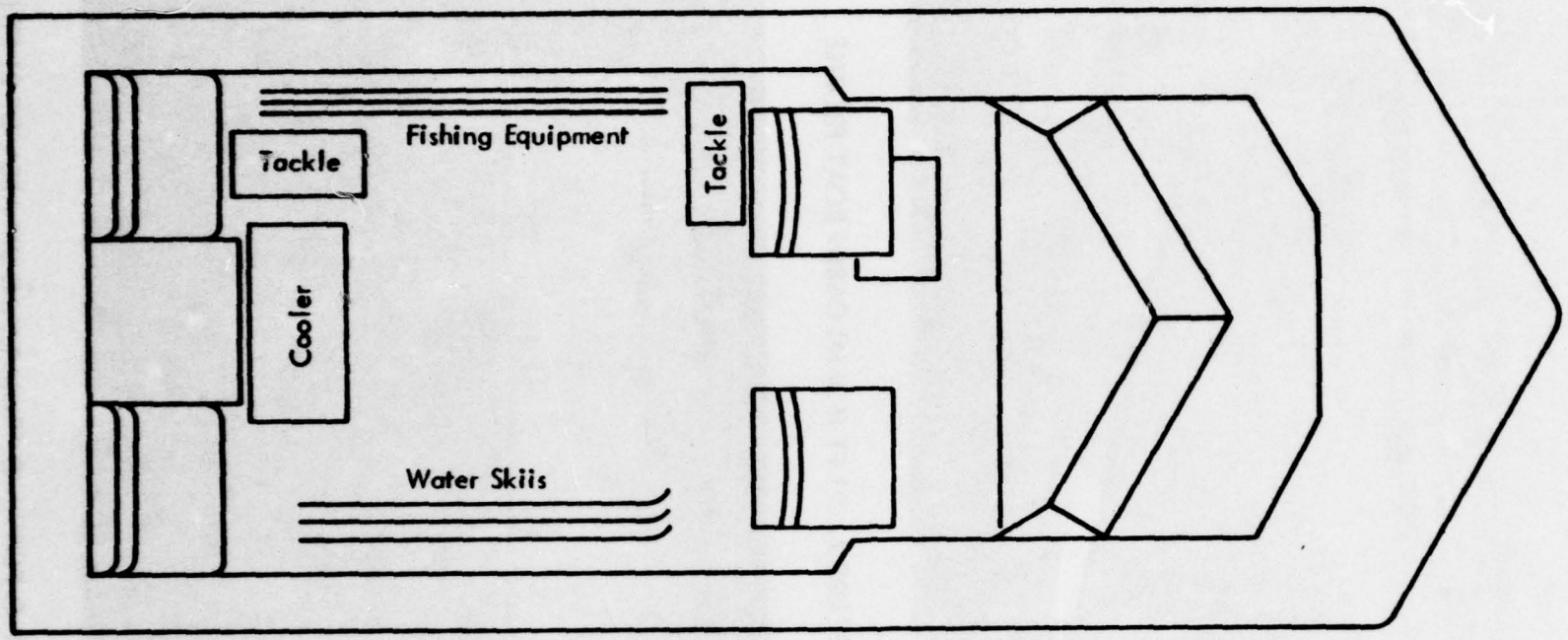


FIGURE 1. 21 ft (6.4 m) CABIN BOAT - PLAN VIEW

FIGURE 2. 21 FT (6.4 M) CABIN BOAT PROFILE

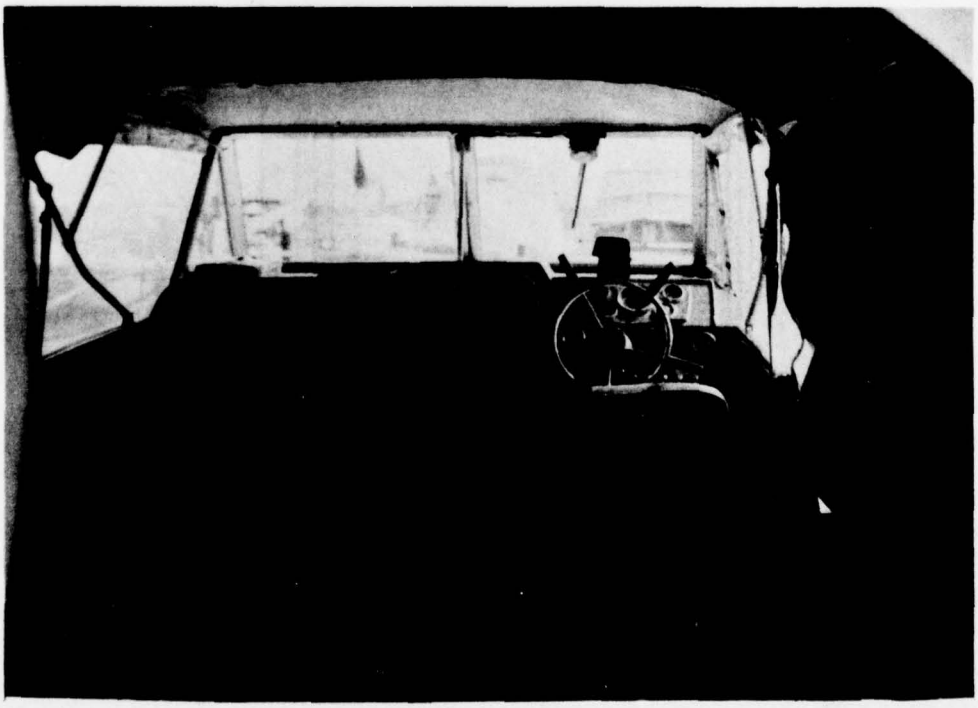


FIGURE 3. VIEW LOOKING FORWARD FROM TRANSOM AREA OF 21 FT (6.4 M) CABIN BOAT

FIGURE 4. VIEW FROM CONTROL STATION (SEATED) ON 21 FT (6.4 M) CABIN BOAT

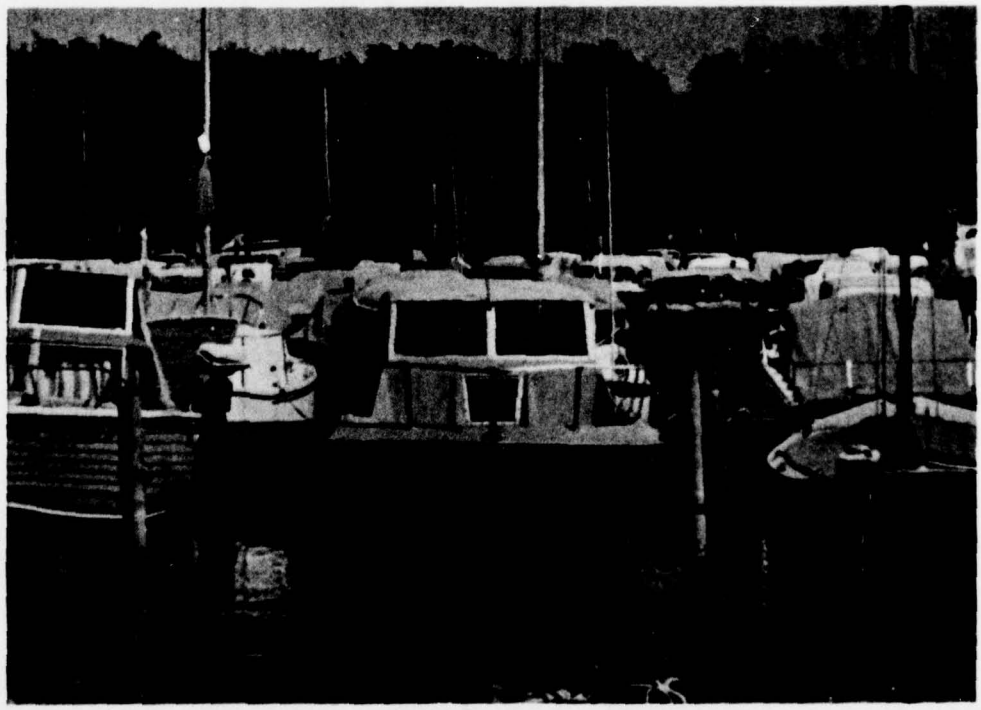


FIGURE 5. BOW OF 21 FT (6.4 M) CABIN BOAT

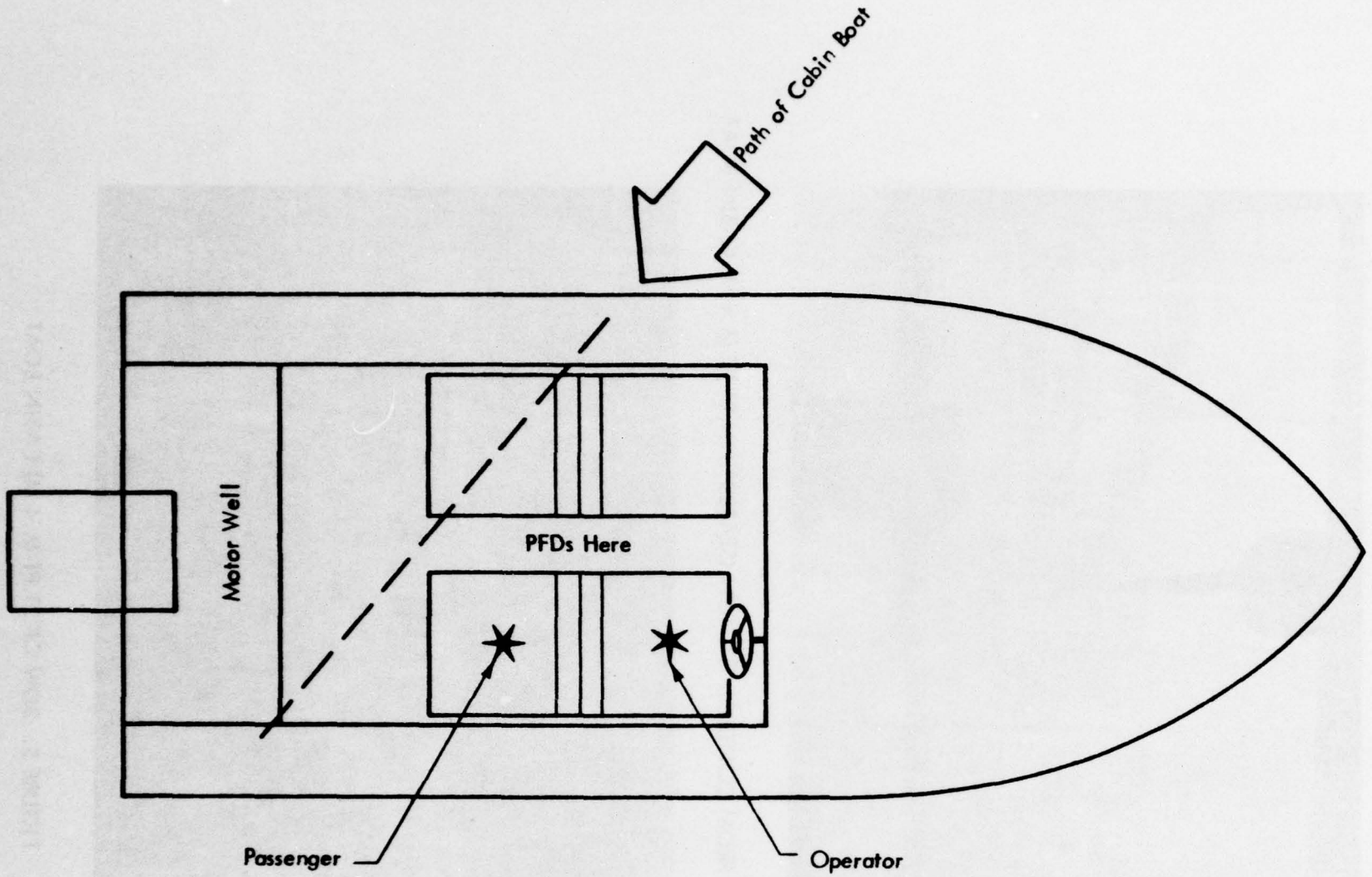


FIGURE 6. 14 ft (4.3 m) RUNABOUT - PLAN VIEW

FIGURE 7. 14 FT (4.3 M) RUNABOUT - PROFILE

FIGURE 8. GUNWALE DAMAGE

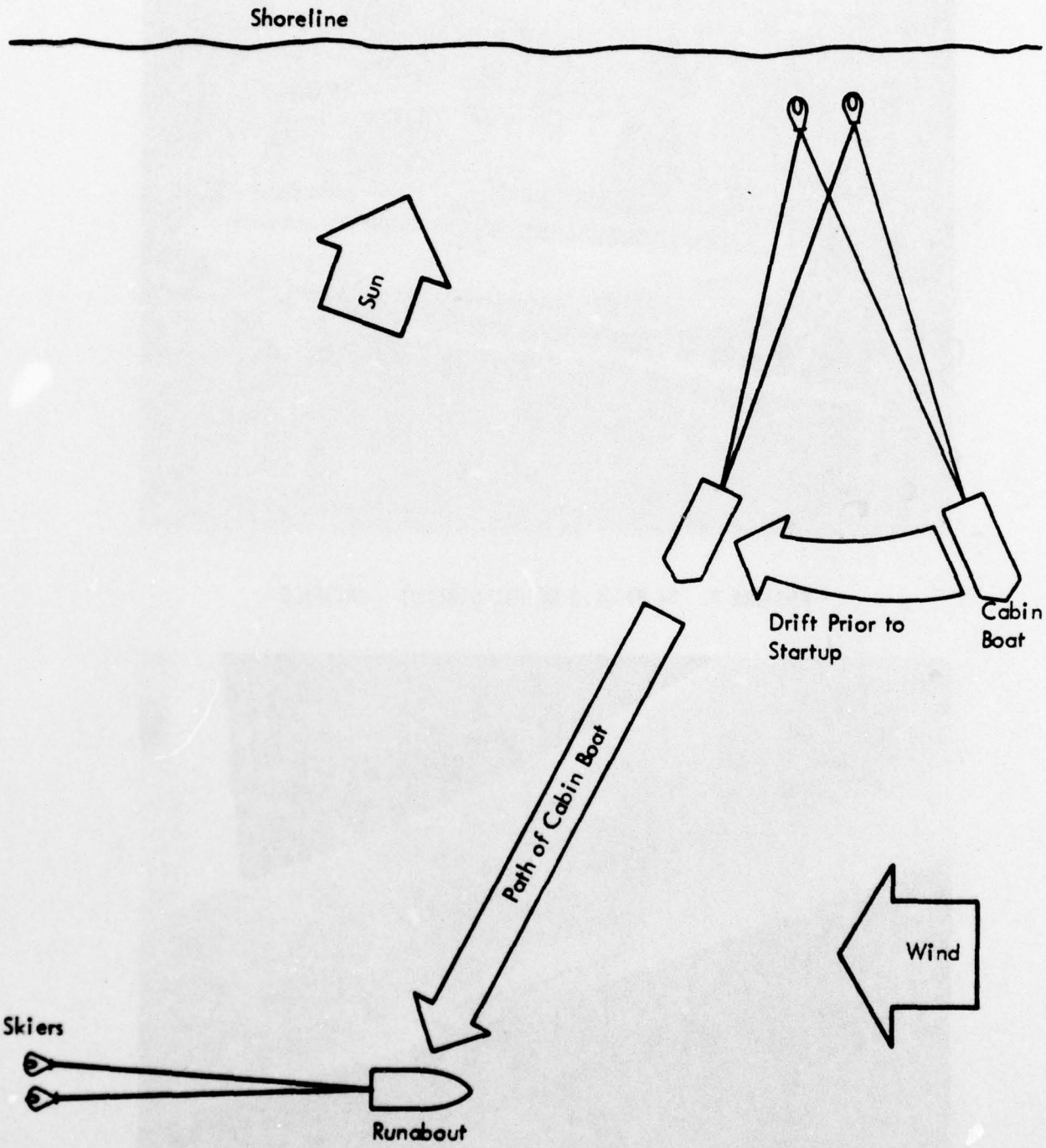


FIGURE 9. COLLISION AREA

APPENDIX C. COLLISION NO. 76-03

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 9, 1976

Date of Accident: August 28, 1976

Investigation: Collision No. 76-03

SUMMARY — WYLE ACCIDENT NO. 76-501

A 19 ft (5.8 m) runabout was at anchor one-half mile (0.8 km) off shore. Both occupants were sitting facing aft under a canvas cockpit cover. Another boat, a 35 ft (10.7 m) cabin cruiser, was traveling somewhere between 15 and 25 mph (24.1 and 40.2 kph) heading for harbor and trying to beat a storm front heading in from the west. It had started to rain and the wind had picked up to 25 mph (40.2 kph). The operator of the cabin cruiser never saw the runabout. He ran over the bow, severing the deck and upper portion of the hull sides from the rest of the boat. One of the occupants of the runabout abandoned the boat. The other one didn't have time.

The cruiser passed completely over the runabout, turned and came back to pick up survivors. A Coast Guard rescue boat was less than one-half mile (0.8 km) away and also came to the scene of the accident. The runabout floated and was towed into harbor. One injury was sustained.

1.0 BOAT OCCUPANT DATA

Cabin Cruiser

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	38	170 lb (77 kg)	Good	> 500 hrs	Pwr. Sqd.	No	No
Passenger	F	7	75 lb (34 kg)	Good	None	No	Yes	Yes

The operator of the boat is a partner in a large family business and a member of the yacht club. Boating is his primary hobby. He was voted "Yachtsman of the Year" last year. He likes fast boats and formerly owned a 19 ft (5.8 m) race boat previously owned by a power-boat racer of international fame.

Runabout

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	39	190 lb (86 kg)	Good	> 500 hrs	Pwr. Sqd.	No	Yes
Passenger	M	35	160 lb (73 kg)	Good	> 500 hrs	No	No	Yes

The owner/operator is a stock broker and also is a member of the yacht club. His hobby is fishing. The boat seems to be a tool for use in pursuing his hobby.

2.0 ENVIRONMENT

Squalls were forecast on the day of the accident; however, the morning started out bright and sunny. By 1030 clouds built up on the horizon and the squall line advanced over the lake. The air temperature was in the low 80°F (27°C) range and the water temperature was 72°F (22°C). Just prior to the accident, the front moved over the area. Winds were steady at 25 knots (46.3 kph) with recorded gusts to 50 knots (92.6 kph). Rain was heavy and the surface of the water built to two feet (0.6 m) with spray whipping off the top of the waves. The storm lasted only 10 to 15 minutes. The sun came out after the squall passed.

The operator and passenger of the runabout involved in the accident claim they were one-half mile (0.8 km) from shore and that they never lost sight of the beach, so visibility had to have been at least one-half mile (0.8 km).

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

At 0900 the owner/operator of a 35 ft (10.7 m) double cabin, cabin cruiser set out to take his boat to the next large port along the shore of the lake. He took his seven year old daughter with him. His wife had taken the car to his intended destination. They cleared port and headed west along the shoreline. He had heard on his VHF radiotelephone weather band that squalls were forecast. Upon sighting the squall line, the owner felt that he should return to port and wait out the storm. At that time, he would make the decision whether to set out for his destination again or wait for another day. He turned around and headed back to port. The frontal system was catching up to him from behind. When he got to within one-half mile (0.8 km) of the entrance to the harbor, the front caught up with him. It was raining heavily with winds normally at 25 knots (46.3 kph) and gusting to 50 knots (92.6 kph). The canvas top was up, covering the helm area, and the windshield wiper was running. He claimed to be going 12 to 15 knots (22.2 to 27.8 kph). The people that he hit say he was going at least 25 knots (46.3 kph). Just prior to the collision, he passed a Coast Guard rescue boat towing a stricken vessel into port.

Meanwhile, two men left their homes at 0700, went to the same yacht club, boarded their 19 ft (5.8 m) runabout and set out for a day of fishing. They tried a few spots and finally, at about 1030, anchored about one-half mile (0.8 m) offshore and about one-half mile (0.8 m) west of the harbor entrance. They purposely stayed close to the harbor entrance because their portable FM radio had warned them of the approaching squall. They noticed the frontal system approaching and finally, after it began to rain and blow quite severely, decided to go in. The canvas top was up. Both men were sitting in the lounge seats facing aft. The boat owner, sitting in the starboard seat reeled in his line, swung around into the center aisle, stood up under the canvas top, and stepped forward to start the engine. As he grabbed the wheel, he must have noticed movement in his peripheral vision. He looked up to see the bow of a boat coming straight at him from the port side, about 30 degrees off the bow and about 50 ft (15.2 m) away.

There wasn't time for him to do anything but jump overboard. He dove through an opening between the side supports of the canvas top. On his way out, his only words were, "Get out of my way." He said there just wasn't time to warn his friend. His friend turned to see the bow of the boat approaching and only had time to reach for a life cushion (Type IV PFD) when the impact occurred.

3.2 Accident

The runabout was anchored by the aft end of the bow rail on the port side. The stem of the cruiser hit the runabout about one foot (0.3 m) to port of the center of the bow. The impact caused the runabout to rotate in a clockwise direction which caused the cruiser to pass through only the bow area of the runabout as opposed to passing over the entire boat. The forward deck of the runabout broke off and the forward section of the hull broke and bent down. The passenger said the aft portion of the runabout must have raised up out of the water. He remembers extending his arm to push the side of the cruiser away from him. At that point, he was knocked to the aft end of the boat with such a force that it rendered him unconscious for what was probably one to three minutes.

3.3 Post-Accident

As the owner/operator dove into the water, he heard and felt the impact. The side of his boat caught up with him and pushed him down into the water. He dove deep and stayed under as long as he could to assure that the boat would pass over him. When he surfaced, he saw that the cruiser had slowed down and was turning around to come back. He could see his boat floating in the distance, approximately 50 ft (15.2 m) away. His concern at that point centered on his passenger, whom he couldn't see. He began to swim towards his boat.

Meanwhile, the cruiser operator had turned his boat around and approached the swimmer. The passenger in the runabout regained consciousness and remembered lying on the cockpit sole with water around his head and neck. He stood up and saw the swimmer, the cruiser, and a Coast Guard boat with a tow approaching the accident scene.

According to the swimmer, the cruiser operator never offered to throw a PFD. In fact, he seemed to be so upset that the swimmer feared he might be run over again.

By this time, the storm had passed and the winds had subsided somewhat. The runabout passenger threw a Type IV PFD to the swimmer who continued to swim towards and eventually boarded the drifting runabout.

The Coast Guard boat transferred its tow to the cabin cruiser, then maneuvered alongside the runabout. The runabout was lashed to the side of the Coast Guard boat and the runabout occupants were transferred into the boat. They proceeded into the yacht club harbor, followed by the cabin cruiser pulling the tow.

3.4 Time Sequence of Accident Events

0700	-	Owner and passenger of runabout left homes
0730	-	Runabout left marina
0800	-	Owner and passenger of cabin cruiser left home
0815	-	Runabout occupants fished
0900	-	Cabin cruiser left marina
1000	-	Clouds built up on horizon
1030	-	Runabout anchored at collision site
1035	-	Squalls advanced over lake
1040	-	Collision
1045	-	Coast Guard on scene
1100	-	Sun came out
1115	-	Runabout towed to marina

4.0 VESSEL DATA

Cabin Cruiser

The cruiser was a 1974 model 35 ft (10.7 m) Chris Craft Double Cabin Cruiser. Its beam was 13 ft 1 in. (4 m), it weighed 17,229 lb (7814.9 kg), and it was powered by twin 230 hp inboard gasoline engines.

The owner had a photograph taken of the boat travelling at approximately 20 mph (32.2 kph). The running angle was traced from the photograph and measured four and one-half degrees from the static load waterline. The running angle and approximate visibility angle were used to determine the closest point forward of the boat that the operator could have seen the water if the boat had been operating at that running angle. Results showed that the water would have been obscured for a distance of 185 ft (56.4 m) forward of the operator or 163 ft (49.7 m) forward of the bow of the cruiser (see Figures 1 and 2).

Runabout

The runabout was a model V900 18 ft 8 in. (5.7 m) in length with a beam of 86 in. (218.4 cm). It was manufactured by Galaxy in 1975 and was powered by a 140 hp OMC inboard/outdrive.

The forward portion of the deck of the runabout was completely severed. The hull to deck joint was broken to aft of amidships on both sides. The hull sides forward were split and torn open down to below the waterline on both sides leaving just the stem protruding up towards the bow. The windshield was crushed and shattered glass thrown throughout the cockpit. The gas tank, located forward under the deck, was dislodged from its mountings. In addition, the fill hose was pulled off. The tank stayed with the boat and didn't look as if it had leaked. (See Figures 3, 4, 5, and 6.)

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The operator of the cabin cruiser was distracted by the environmental conditions and by the Coast Guard rescue boat. He was anxious to get into port before the storm caught up with him. He was watching lightning bolts in the sky over the shore line to his right. It had just begun to rain rather heavily and the wind had picked up, which may have changed the control characteristics of his boat.

His wife had gone on to his expected destination. He may have also been concerned with the logistics of informing her of his return to home port. He mentioned the fact that he had contemplated another attempt at making the passage after the storm blew over.

This discussion leads to the assumption that the cruiser operator was distracted from his primary visual tracking and control task by the severe environment, another boat in the area, and the thought processes involving changes in plans.

The windshield wiper motor was mounted on the top of the frame of the center pane of a three piece windshield. The blade actually wiped an area of about two square feet (0.2 sq m) out of a total windshield area of almost 20 sq ft (1.9 sq m). Because the helm is located several feet aft of the windshield, the cone of visibility through the wiped area was very small. In fact, the horizontal arc of visibility through the widest area of wiped windshield works out to be about 19 degrees. However, the widest portion of wiped area is well above the horizon when viewed from the seated operator position, so the effective horizontal arc of visibility was less than 19 degrees. Figure 7 shows what the view from the helm may have looked like.

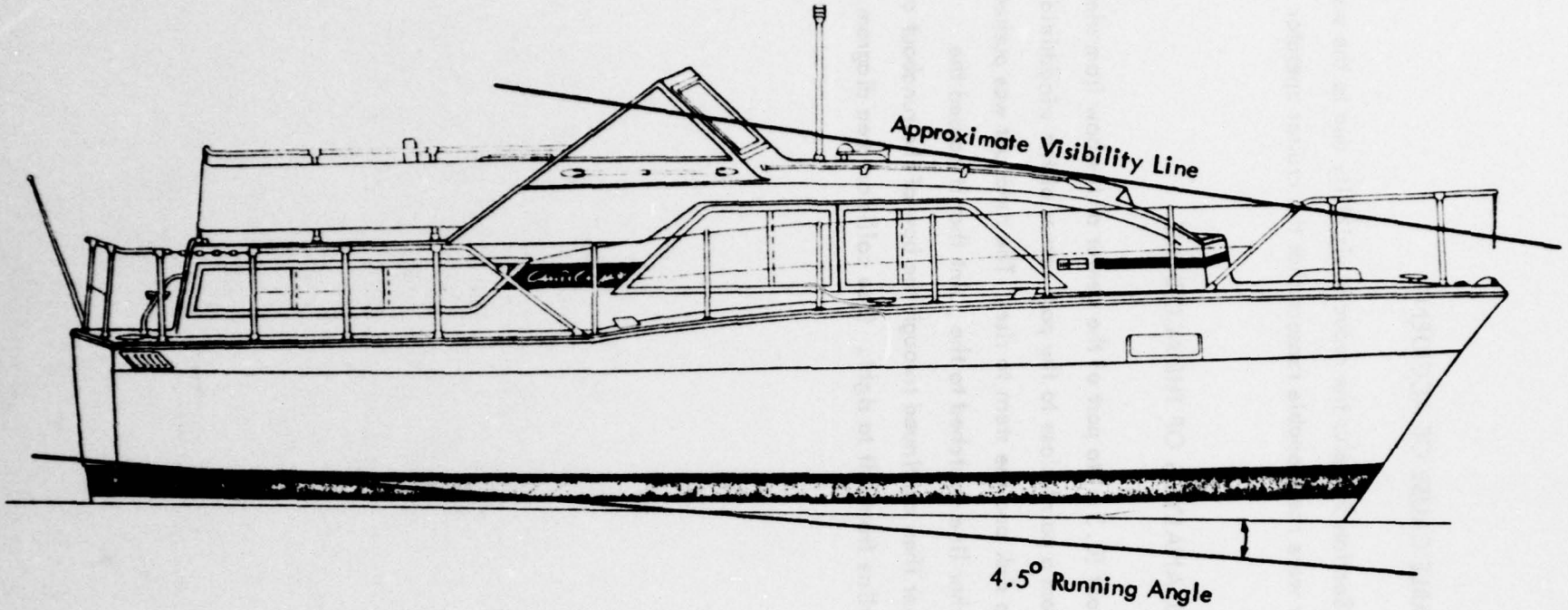
The occupants of the runabout didn't hear the cruiser approaching because of the noise of the rain on the canvas top over their heads.

6.0 PROBABLE CAUSE OF ACCIDENT

The effect of the stressors mentioned in Section 5.0 plus the reduced visibility due to the small area of windshield cleaned by the wiper were the probable reasons that the cruiser operator never saw the runabout.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The cruiser hit the runabout about one foot (0.3 m) to port of the center of the bow from almost head on. The runabout was anchored from a point close to the port corner of the windshield. The impact caused the runabout's bow to sink and the stern to rise. The runabout was pushed sideways for some distance until the anchor line stretched to the point that it caused the runabout to rotate clockwise. The cruiser then continued through the bow of the runabout at approximately right angles to the centerline from left to right. (See collision area diagram, *Figure* 8.)



SPECIFICATIONS

	U.S. STD.	METRIC
SLEEPING CAPACITY	4	4
LENGTH	35'1"	10.69 m
BEAM	13'1"	3.98 m
DRAFT	35½"	90 cm
FREEBOARD, FORWARD	67½"	1.71 m
FREEBOARD, AFT	45½"	1.15 m

	U.S. STD.	METRIC
HEIGHT FROM WATERLINE (Clearance)		
With Mast Up	12'3"	3.73 m
With Mast Lowered	10'8"	3.15 m
WEIGHT (est.)	17,229 lbs.	7 815 kg
FUEL CAPACITY	150 gals.	568 l
FRESH WATER CAPACITY	55 gals.	208 l

HULL —	Material	Fiberglass
	Method	Hand Layup
	Finish	Gelcoat, Glossy
DECKS —	Material	Fiberglass
	Method	Hand Layup
	Finish	Gelcoat, Glossy & Textured
SUPERSTRUCTURE —	Material	Fiberglass
	Method	Hand Layup
	Finish	Gelcoat, Glossy & Textured

FIGURE 1. PROFILE OF CRUISER

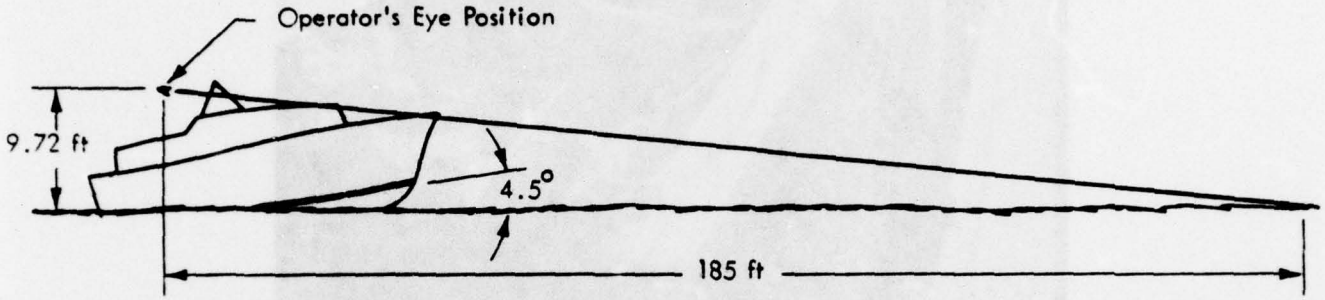


FIGURE 2. VISIBILITY FROM CRUISER

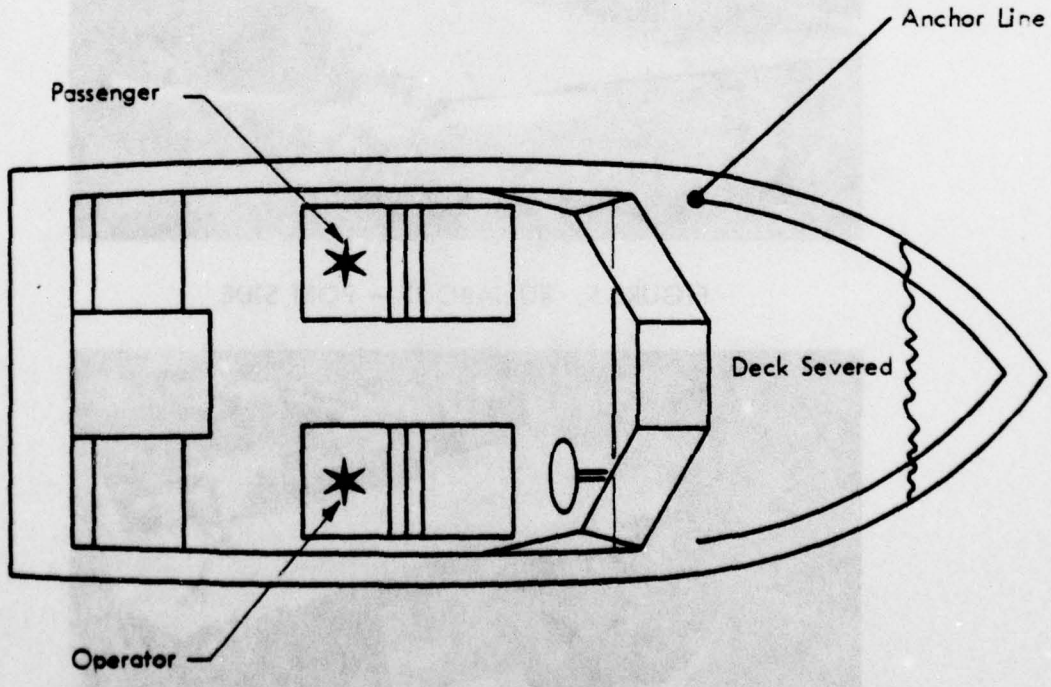


FIGURE 3. ARRANGEMENT PLAN — HITTEE

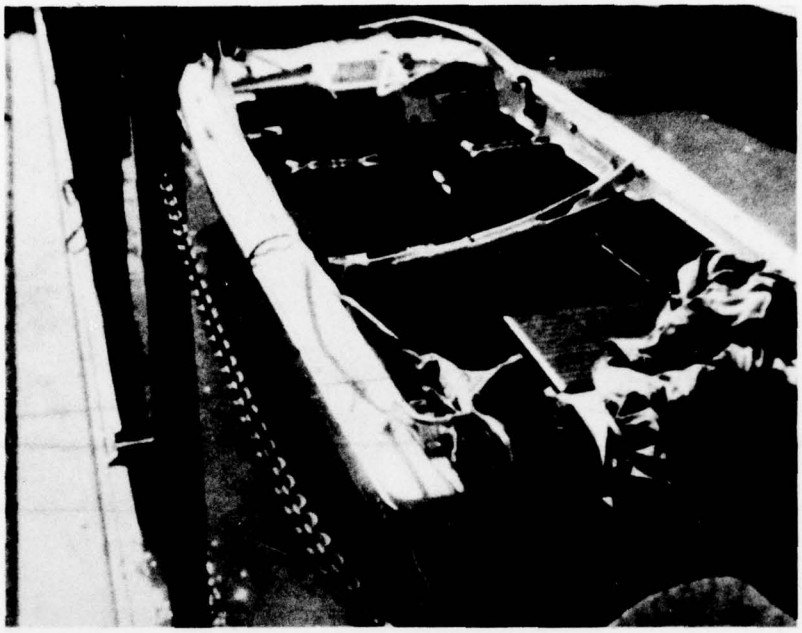


FIGURE 4. RUNABOUT — VIEW FROM STERN

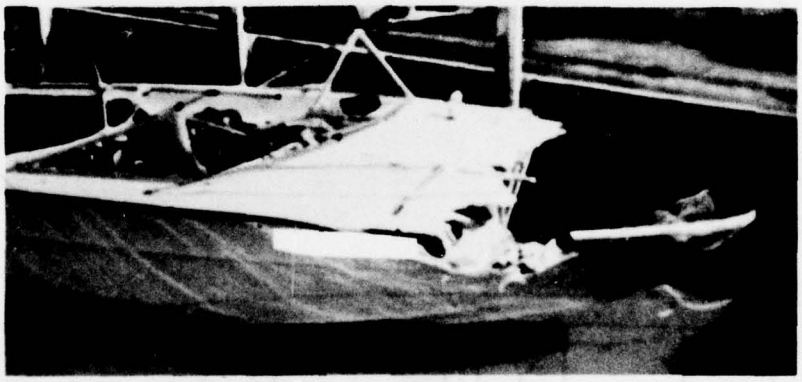


FIGURE 5. RUNABOUT — PORT SIDE

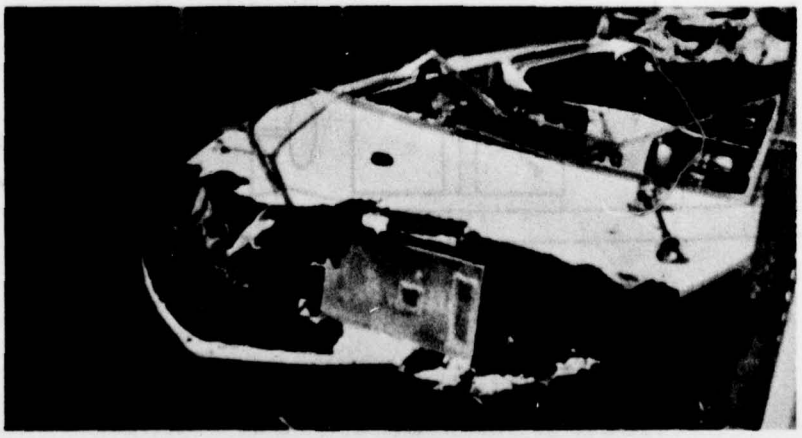


FIGURE 6. RUNABOUT — BOW

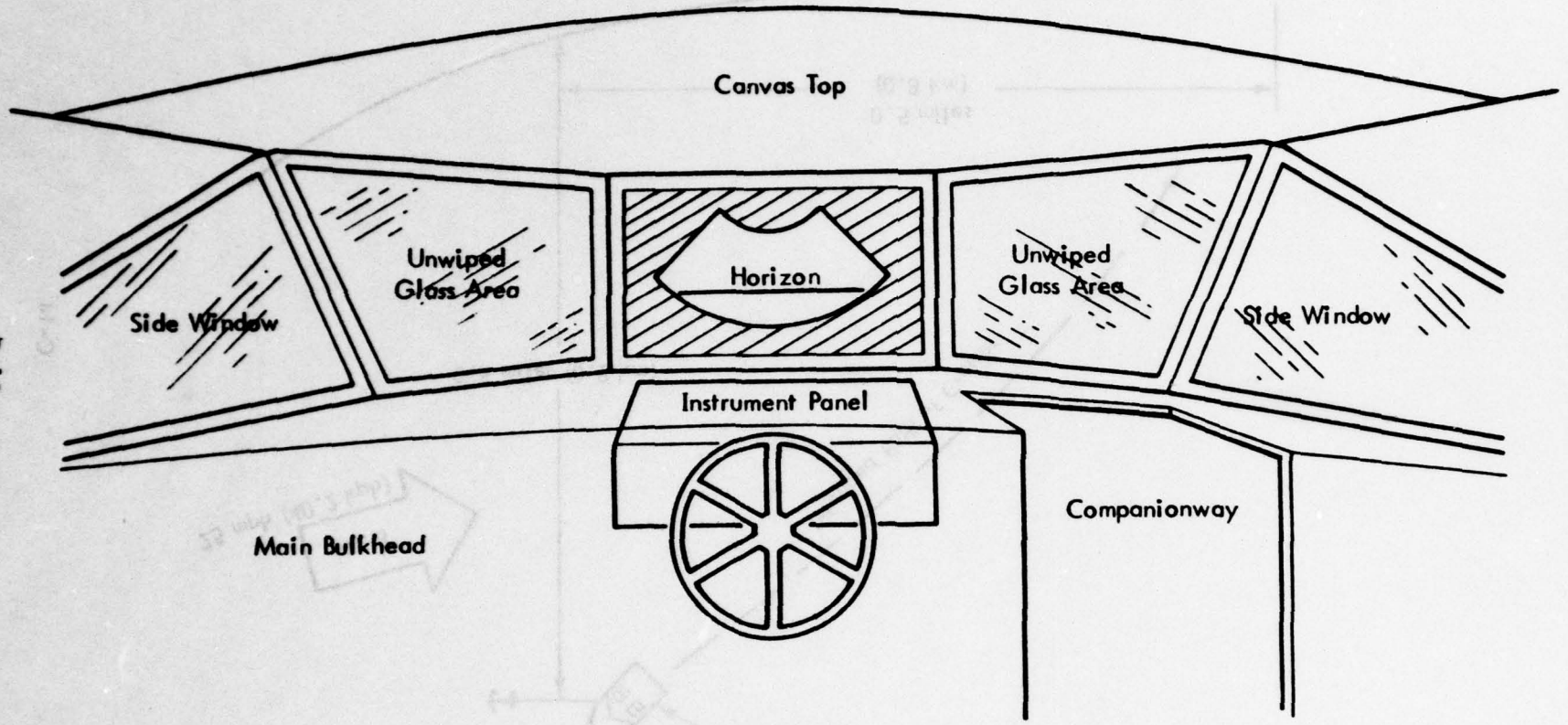


FIGURE 7. VIEW FROM HELM SEAT

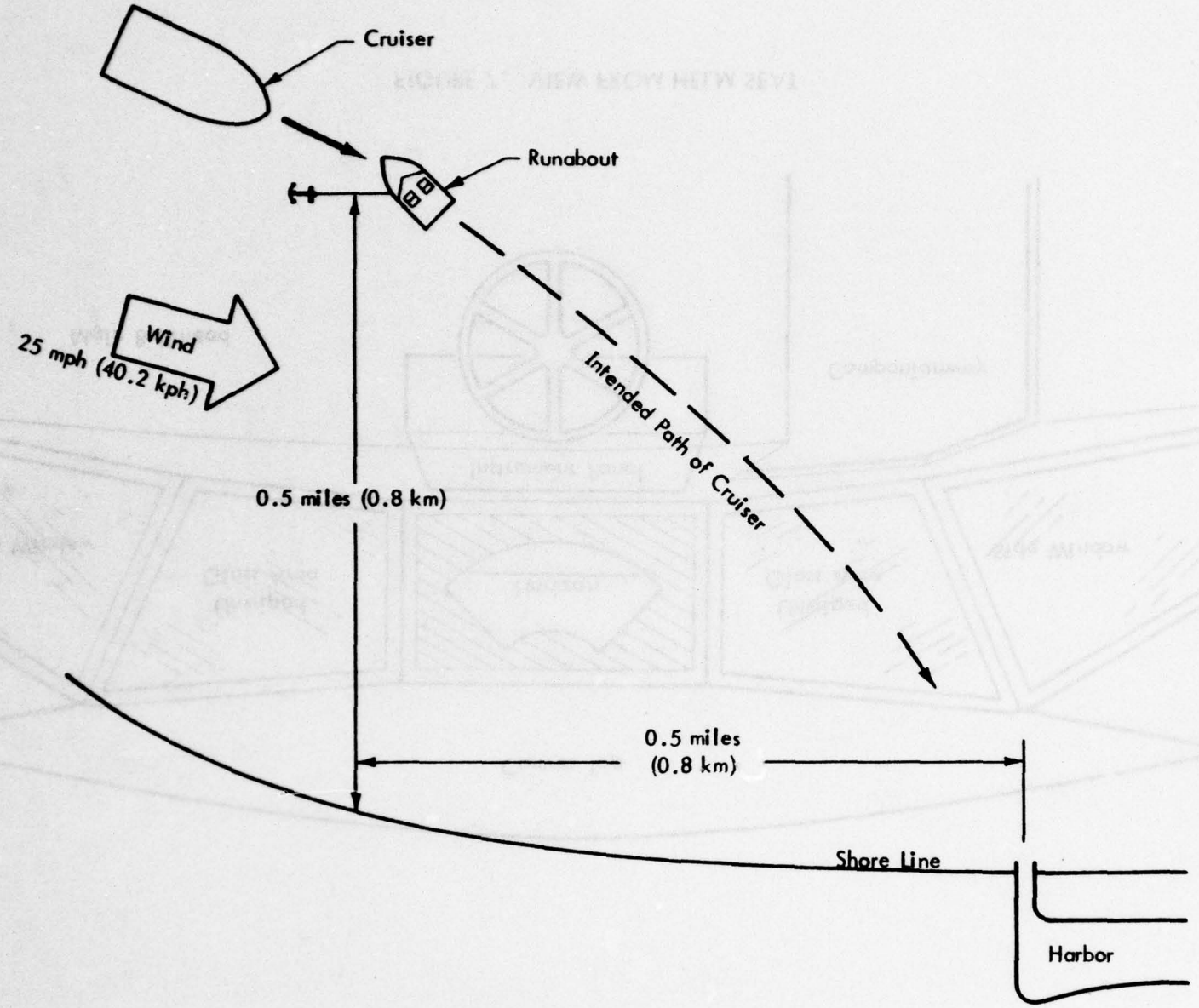


FIGURE 8. COLLISION AREA DIAGRAM

APPENDIX D. ACCIDENT NO. 76-04

ACCIDENT INVESTIGATION REPORT

Date of Investigation: August 6, 1976

Date of Accident: June 24, 1976

Investigation: Collision No. 76-04

SUMMARY — WYLE ACCIDENT NO. 76-259

The accident reported herein involved a 14 ft (4.3 m) bass boat powered by a 70 horsepower outboard motor and a 15 ft (4.6 m) bass boat powered by an 85 horsepower outboard motor. The type of accident was a collision resulting in serious injuries to the operator of the 14 ft (4.3 m) boat. Estimated damage to the two boats was approximately $2,000.

The two boats involved in the accident were being test run to check the operation of the outboard motors. A 14 ft (4.3 m) bass boat with four POBs was returning to the launch ramp on a canal southwest of New Orleans. At the same time, a 15 ft (4.6 m) bass boat with one POB was leaving the launch ramp at full throttle. At a bend in the canal, the operator of the 14 ft (4.3 m) bass boat saw the other boat coming toward him and made a left turn to try to avoid a possible head-on collision.

The operator's turn was not sharp enough, and the 15 ft (4.6 m) bass boat hit the 14 ft (4.3 m) bass boat on the starboard side immediately in front of the console. The operator was struck by the 15 ft (4.6 m) bass boat, suffering head injuries, concussion, and shattered cheekbone.

1.0 BOAT OCCUPANT DATA

15 ft (4.6 m) Bass Boat (Boat No. 1)

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	16	125 lb (56.7 kg)	Good	100-500 hrs	No	No	No

The operator was a high school student and was of average intelligence and physical ability. He possessed at least an average knowledge of small boat operation for an individual his age. Most of his experience had been under the supervision of his father who was a more experienced operator.

14 ft (4.3 m) Bass Boat (Boat No. 2)

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	34	240 lb (108.9 kg)	Good	Over 500 hr	No	No	No
Passenger	M	11	105 lb (47.6 kg)	Fair	None	No	No	No
Passenger	M	8	65 lb (29.5 kg)	Poor	None	No	No	No
Passenger	F	3-4	45 lb (20.4 kg)	None	None	No	No	No

The operator was employed as a mechanic at a local marina. He had not fully recuperated from the injuries he sustained in the accident, and his mental and physical ability at the time of the accident is unknown. Although he stated that he was a very experienced operator, he seemed to be the type individual that would panic when confronted with an emergency situation.

2.0 ENVIRONMENT

The day was partly cloudy with an air temperature of approximately 90°F (32°C) and a water temperature of approximately 80°F (27°C). There was no wind and the water was calm with no current. The water depth of the canal was 10 to 12 ft (3.0 to 3.7 m). Visibility was good.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

Shortly after arriving home from work, a father and son decided to take their boat out to test the motor, which had just been rebuilt. They launched the 15 ft (4.6 m) bass boat (Boat #1) at approximately 1700 and ran the boat up and down the canal for about an hour. At about 1800 they decided to go home and took the boat back to the launch ramp. The son then asked to run the boat one more time.

He left the ramp area at full throttle, going around a left-hand bend and approaching a right-hand bend in the canal. Figure 1 shows the accident area and the approximate distance between the accident site and the launch ramp.

Meanwhile, a 14 ft (4.3 m) bass boat (Boat #2) was approaching the launch ramp with four people, one adult and three children, on board. The operator of Boat #2 saw Boat #1 coming toward the right-hand bend at full throttle and felt that Boat #1 would not be able to make the turn, but would run into his path. Therefore, to avoid what he felt would be a head-on collision, the operator turned left. The turn was not sharp enough, since Boat #1 did make his intended course, and actually Boat #2 essentially entered #1's path.

3.2 Accident

Gear aboard was as shown in Figures 12 and 13 and the weather as noted in Section 2.0.

Boat #1 struck Boat #2 on the starboard side, immediately in front of the console. The inset in Figure 1 shows the angle that Boat #1 hit Boat #2. Because of the speed at which Boat #1 was traveling, the boat went over Boat #2 and landed in the water on the port side. The operator of Boat #2 was struck by Boat #1 as it passed over the console and was knocked unconscious. The three children in Boat #2 were seated on the deck in the bow section and were not injured.

3.3 Post Accident

The operator of Boat #1 came back around to the starboard side of Boat #2 to determine the condition of the occupants. He noticed the operator was lying on the deck in the aft section unconscious, and the children were in the bow unharmed. The owner of Boat #1 had heard a crash and knew that his son had hit something. He asked the operator of a small runabout that was at the dock to take him out to see what had happened. He arrived at the accident site and helped his son put the occupants of Boat #2 into Boat #1. He then drove Boat #1 to the launch ramp. According to the operator of Boat #2, he suffered head injuries, a concussion, a shattered cheekbone, and severely bruised right shoulder. He was taken to a local hospital within 30 minutes after the accident.

3.4 Time Sequence of Accident Events

Boat No. 1		
1700	-	Operator and son launched boat
1700-1800	-	Ran boat up and down canal
1800	-	Returned to ramp and son took boat out alone
1801	-	Boat arrived in accident area
Boat No. 2		
1630	-	Launched boat and headed up canal
1630-1801	-	Traveled up and down canal
1801	-	Occupants saw Boat No. 1 coming toward them at fast speed
Accident		
1801-1802	-	The operator of Boat No. 2 initiated a left turn to avoid collision
1802	-	Boat No. 1 collided with Boat No. 2
1803	-	The operator of Boat No. 1 maneuvered his boat back around alongside of Boat No. 2
1803-1805	-	Passengers in Boat No. 2 tried to revive the unconscious operator of Boat No. 2
1805	-	Owner of Boat No. 1 arrived and helped his son put the operator and passengers of Boat No. 2 aboard Boat No. 1
1807	-	Boat No. 1 arrived at ramp
1807-1830	-	First aid was administered to the operator of Boat No. 2
1830	-	The operator of Boat No. 2 was taken to local hospital

4.0 VESSEL DATA

15 ft (4.6 m) Bass Boat (Boat #1)

This was a 1975 model fiberglass tri-hull boat made by Manatee. It was 15 ft (4.6 m) long, with a 5.9 ft (1.8 m) beam. It was powered by a 1973 85 hp Johnson outboard motor which had been rebuilt by the owner. The boat was a center console model with a seat across the bow.

The boat was loaded with minimal equipment, a 12 gallon (45.4 l) gas tank and the battery. Visibility was judged by the owner to be good at the speed at which the operator was traveling. Damage was slight, scratches to the bow bump rail and gelcoat. Figure 2 shows a profile; Figures 3 and 4 are views of the damage. Figure 5 is the view looking forward from the operator's seat, and Figure 6 is a view of the bow. Additional data obtained during the investigation were as follows:

Model — 1550T
Max. Persons Capacity - 450 lb (204.1 kg)
Max. Weight Capacity - 875 lb (396.9 kg)
Max. Horsepower - 85
Max. Transom Width Gunwale - 66 in. (1.7 m)
Max. Transom Width Chine - 55 in. (1.4 m)
Transom Height- 20 in. (0.5 m)
H.I.N. - MNT04353M75J

14 ft (4.3 m) Bass Boat (Boat #2)

This was a 1975 model fiberglass tri-hull boat manufactured by Seacharmer. It was 14 ft (4.3 m) long, with a 6.2 ft (1.9 m) beam. It was powered by a 1970 70 hp Chrysler outboard motor. The boat had a side console located on the starboard side at amidships.

The boat was loaded with an 18 gallon (68.1 l) gas tank and the battery. It had a built-in ice chest on the port side and a built-in thwart at the bow. Damage was extensive; the steering wheel was torn completely out of the console. The console had a large hole and crack running from the top to the deck. The lever was broken off the control box. The starboard side sustained several cracks in the fiberglass, one of which was approximately 18 in. (45.7 cm) long. Figures 7 and 8 show the views of the starboard side. Figure 9 is a view from the stern, and Figure 10 is a view from the bow. Figure 11 shows the damage to the control box. Refer to Figures 12 and 13 for load distribution in the boats at the time of the accident.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

It was probable that, due to inexperience in being faced with a collision situation, both operators panicked. The operator of Boat #1 told his father that he had seen Boat #2, but not in time to avoid the collision. He stated that he threw the motor into reverse, but this only caused the motor to jump out of the water.

The operator of Boat #2 stated that he wanted to avoid a head-on collision which he felt was eminent because of the speed at which Boat #1 was traveling. He made a left turn, but it was not sharp enough to avoid a collision. Both saw each other and tried to guess what the other was going to do. #1 was surprised that #2 turned instead of keeping his original course to pass port-to-port. #2 thought that #1 would slide around the turn.

6.0 PROBABLE CAUSE OF ACCIDENT

The following are the probable causes:

- The excessive speed at which Boat #1 was traveling. Just leaving a launch ramp area and in an area of curves in the canal, the operator should have been traveling slower.
- Panic on the part of both operators, probably due to inexperience in coping with a collision situation.
- Failure to observe rules of the road.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The hull design and load distribution in Boat #1 would have made it run in a near level attitude at any speed over 20-25 mph (32.2-40.3 kph). Damage to the bow bump rail shows that the boat was in a near level attitude on impact, which indicates that the boat was traveling at a high speed. No marks could be found on the port side of Boat #2; therefore, Boat #1 went airborne high enough to clear the port side. It is believed that the boat speed had to be near maximum (approximately 40 mph (64.4 kph)) to have sufficient momentum to clear the port side of Boat #2 after impact with the starboard side.

The operator of Boat #1 stated that he had the motor in reverse prior to the collision. Due to the high speed on impact, the motor was most likely in forward gear or was shifted to neutral at approximately the same time as the impact.

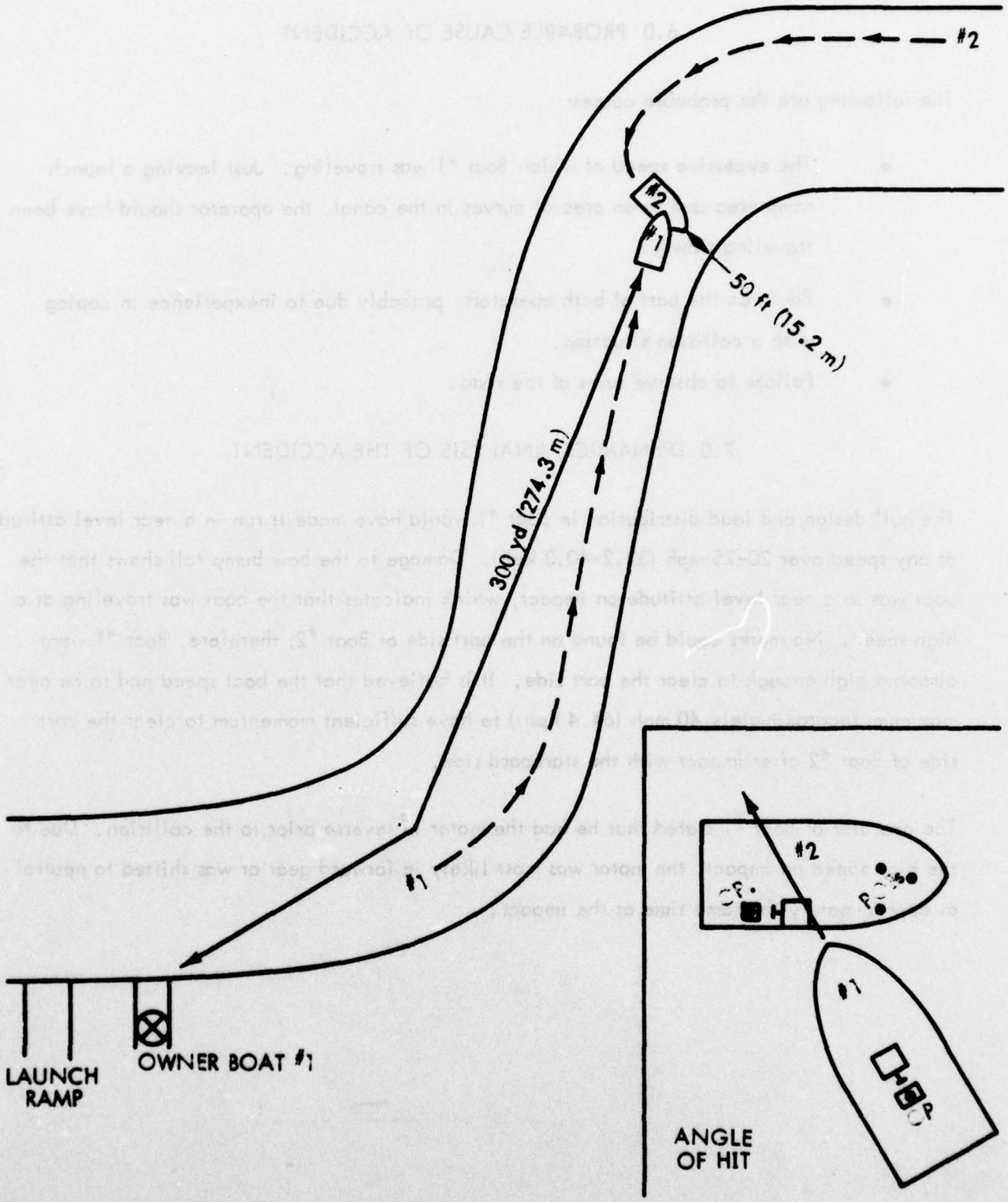


FIGURE 1. ACCIDENT AREA

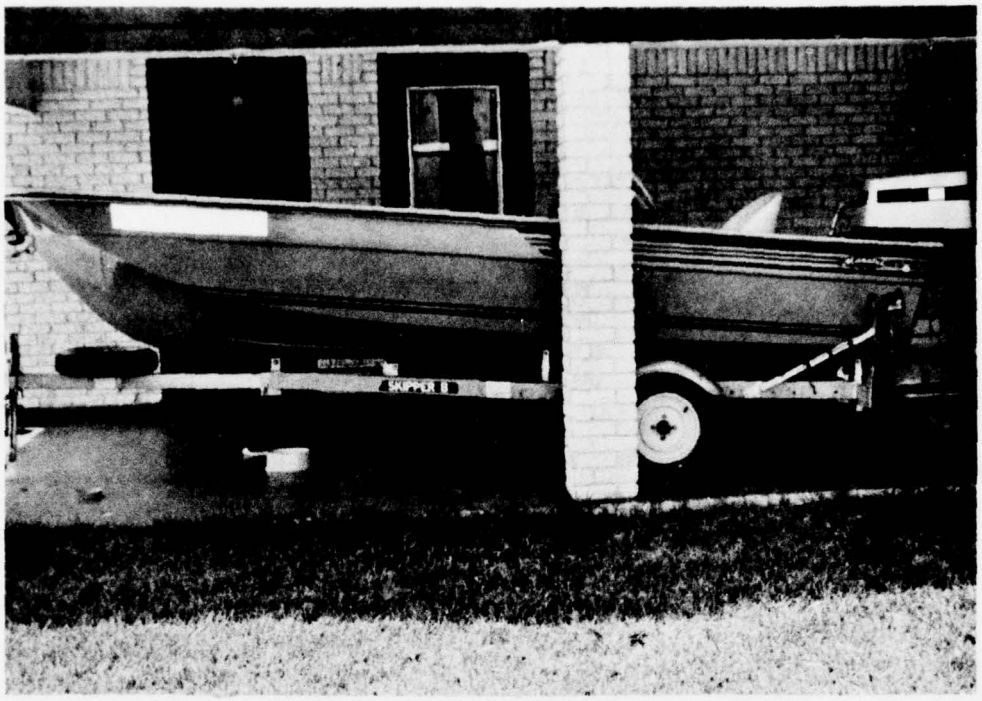


FIGURE 2. PROFILE OF BOAT #1

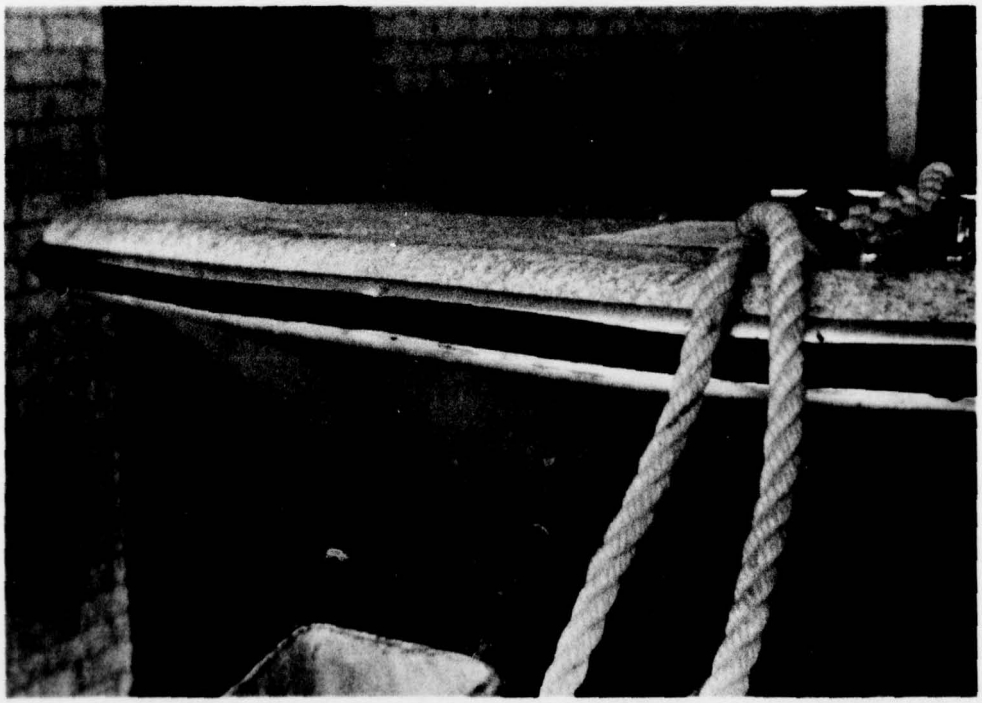


FIGURE 3. DAMAGE TO BOAT #1

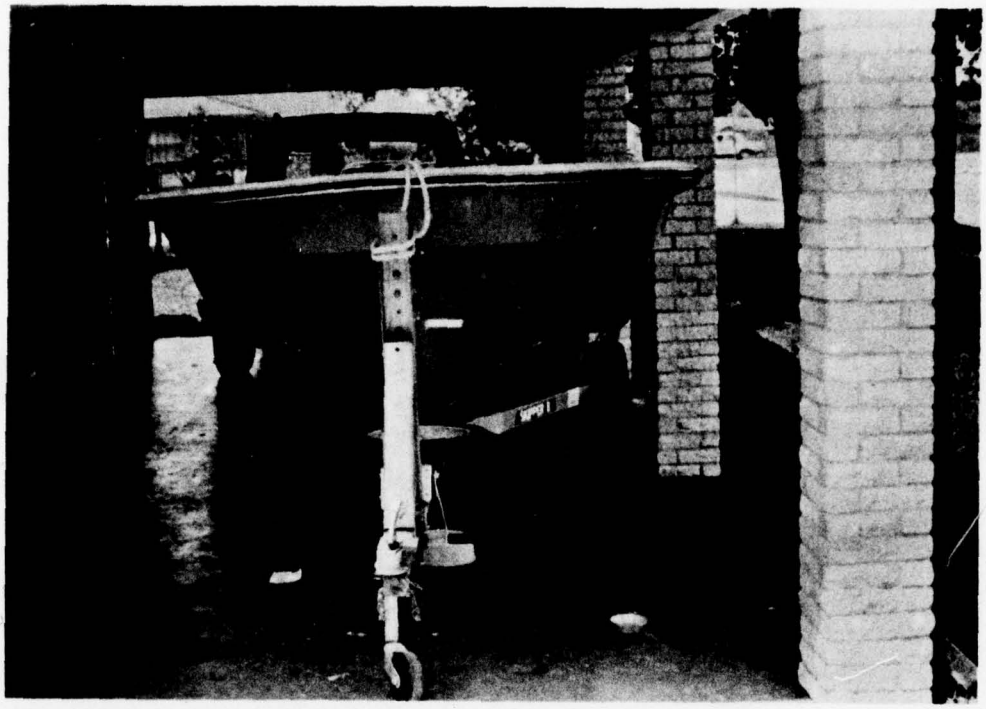


FIGURE 6. BOW OF BOAT #1

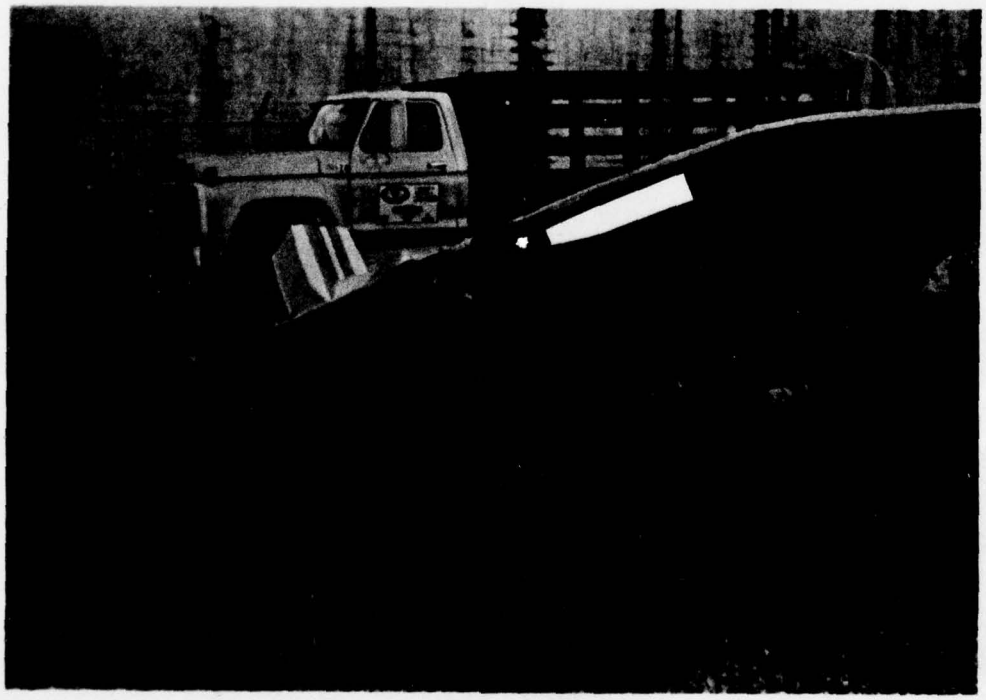


FIGURE 7. STARBOARD SIDE OF BOAT #2

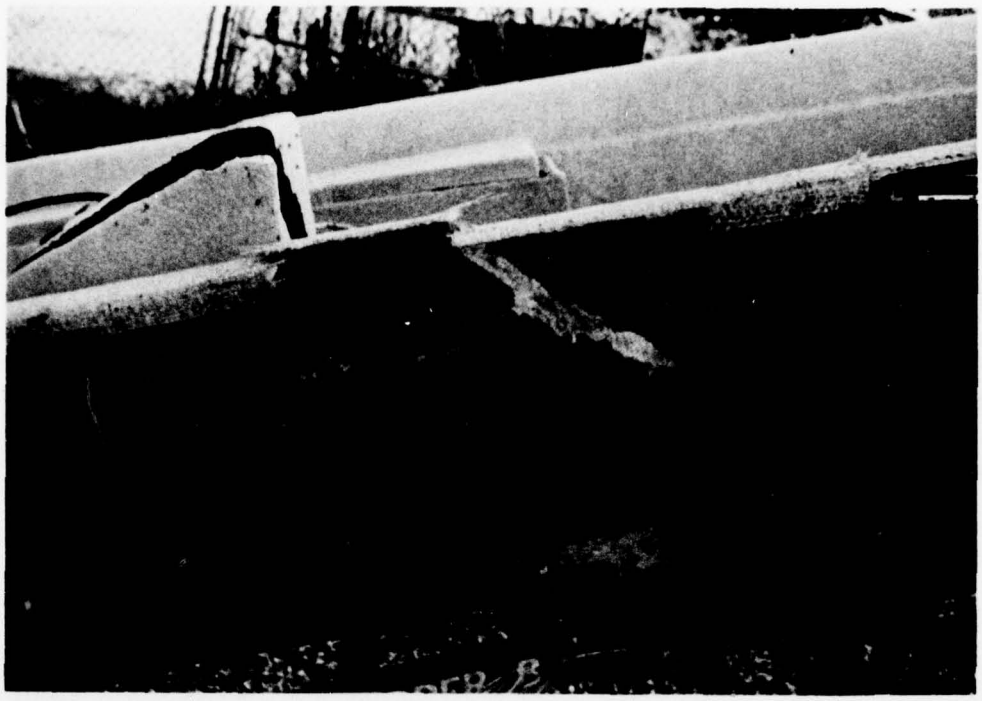


FIGURE 8. DAMAGE TO STARBOARD SIDE OF BOAT #2

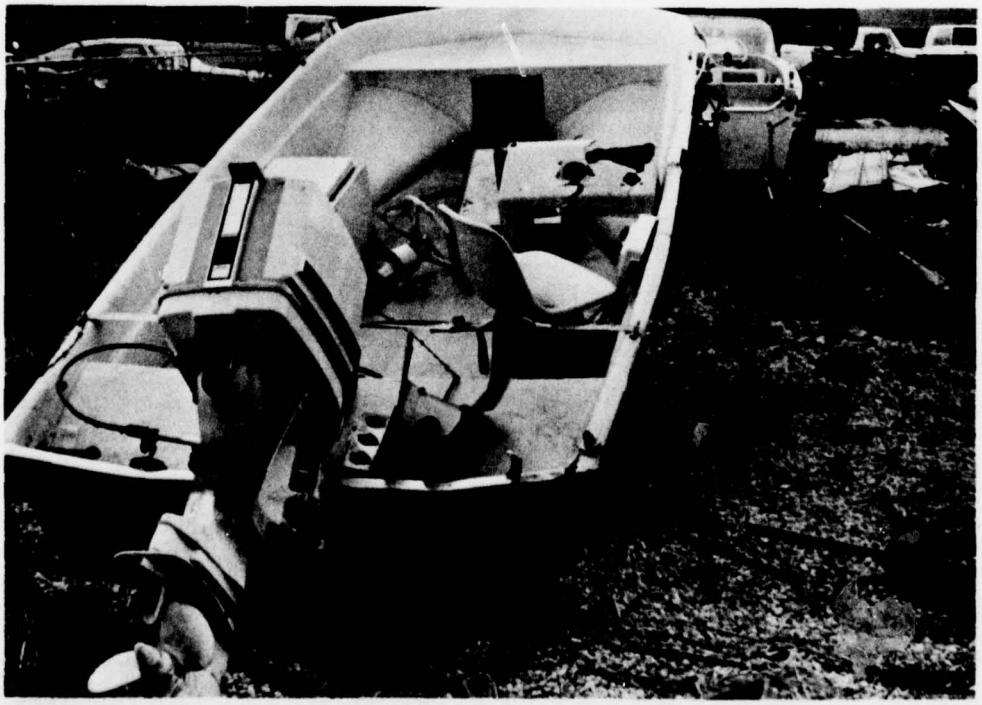


FIGURE 9. STERN OF BOAT #2

FIGURE 10. BOW OF BOAT # 2

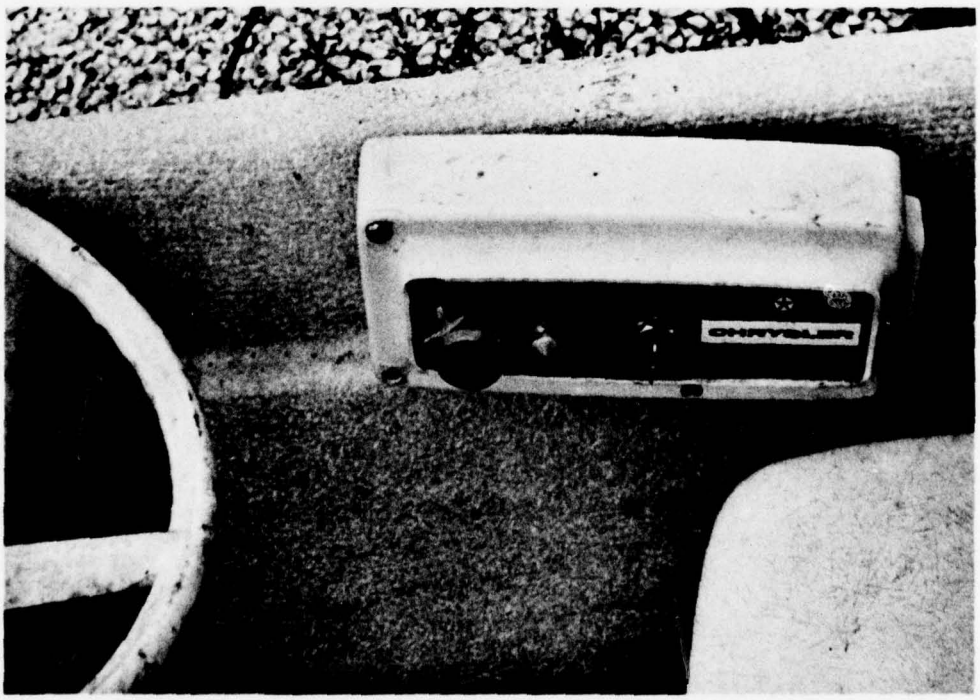


FIGURE 11. DAMAGE TO CONTROL BOX OF BOAT #2

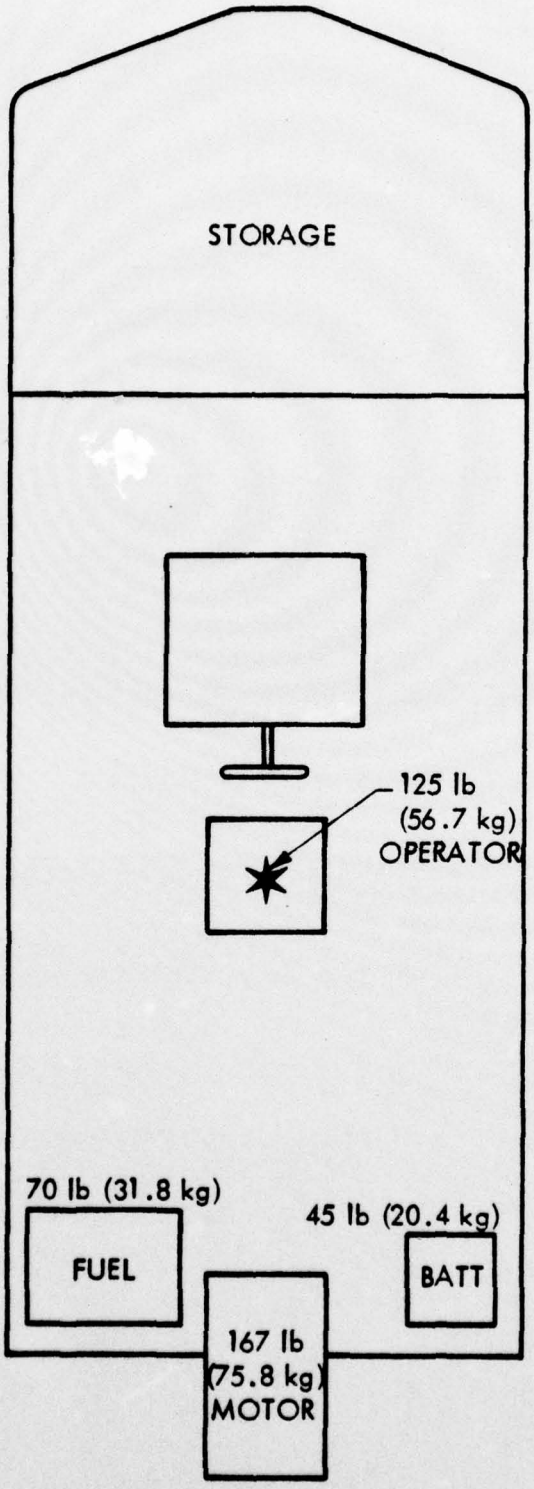


FIGURE 12. BOAT LOAD DISTRIBUTION AT TIME OF ACCIDENT (BOAT 1)

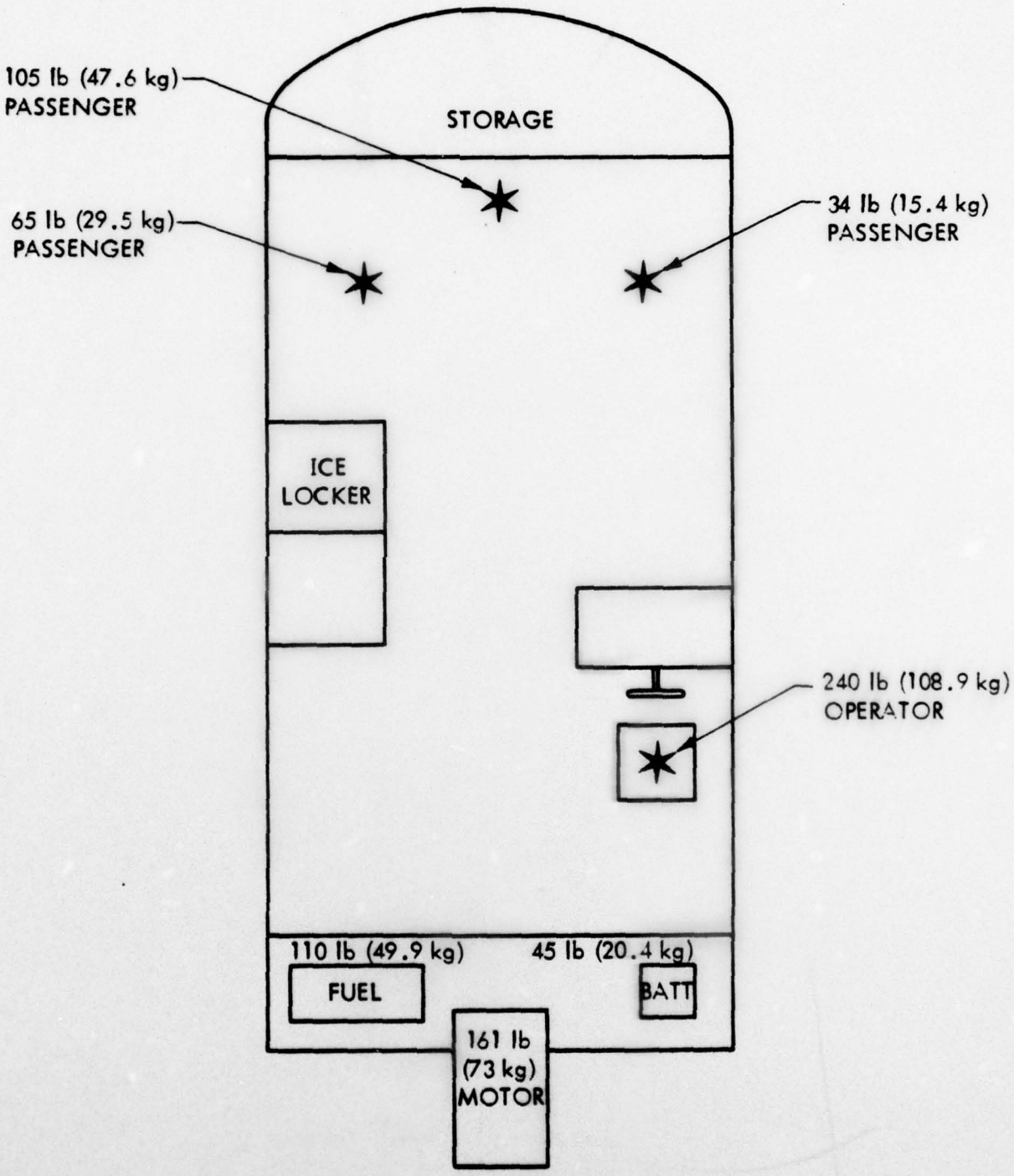


FIGURE 13. BOAT LOAD DISTRIBUTION
AT TIME OF ACCIDENT (BOAT 2)

APPENDIX E. ACCIDENT NO. 76-05

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 22, 1976

Date of Accident: July 4, 1976

Investigation: Collision No. 76-05

SUMMARY — WYLE ACCIDENT NO. 76-552

Two boats were pulling water-skiers in a protected cove on a very busy lake late in the day. One skier fell. The driver of her boat circled and stopped in such a way that she had the handle of the tow line again. Before she could be pulled up, another boat approached heading directly into the setting sun. The driver of the first boat waved a red flag indicating a downed skier. The driver of the approaching boat waved, acknowledging that he saw the flag, but never saw the skier. He slowed enough that his skier dropped into the water while he visually searched for the downed skier. Just before hitting her, he saw the tow line floating across his bow. The skier received a broken leg and cuts.

1.0 BOAT OCCUPANT DATA

Hittor

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	58	170 lb (77 kg)	Good	100 hr	No	No	No
Passenger	M	24	180 lb (82 kg)	Good	Very Little	No	No	No

The operator is a retired builder who lives in an exclusive waterfront community along the shore of a mountain lake. He is a member of the board of directors of the privately owned lake and is well aware of the regulations and problems surrounding the crowded and somewhat dangerous water-skiing conditions prevalent on weekends. The passenger and skier were college students and friends of his daughter. No one ever wore PFDs on the boat.

2.0 ENVIRONMENT

The weather was clear and the wind was calm. The air temperature was in the high 70°F range (24° to 26°C) and the water temperature was in the low 70°F range (21° to 23°C). At the time of the accident the sun was low in the sky, directly in front of the hittor's boat.

Because there were so many boats on the lake that day, the water surface was considered to be rough by both parties. Both of them waited until late in the day to go boating and both selected a deserted cove for their boating activities.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

Both parties wanted to go skiing throughout the day but didn't because they felt that there were too many boats on the lake and it was too rough and too crowded for skiing. Finally at 1730 both owner/operators succumbed to social pressures and took their families and guests skiing. Since it was a holiday, neither owner/operator had done much during the day. It isn't known how much in the way of alcoholic beverages were consumed by the operators throughout the day.

The hittee had five people aboard including two adult males and three children and was pulling a 12 year old female on skis. She fell and he circled, proceeded around behind her, then went forward of her and stopped. This maneuver was done in order to position the floating ski rope handle near her. She grabbed the handle and was positioning her skis for another take off. She was wearing an orange ski vest. Anyone observing her would see her dark hair, orange vest, and dark skis. The operator of the boat pulling her was about to move forward slowly to put tension on the line when he saw two boats coming towards his skier from behind. They were running parallel with each other and parallel to the shoreline. The one farthest from the shore was passing the one closest to shore. It seemed that the boat farthest from shore would pass outside his skier but the inside boat seemed to be heading right for her. He raised the red flag and waved it frantically. The operator of the inside boat raised his hand to indicate that he saw the flag or possibly the skier. His boat slowed down but he was still heading for the skier. It was obvious that he wasn't sitting in his seat because his entire torso area could be seen above the bow and his head was above the windshield. The operator of the stopped boat said that he considered an attempt to snatch the skier up, but since she was a novice he thought that she would fall before she got up. Just before the collision, he and the others in his boat waved, shouted, and pointed towards the downed skier.

The operator of the oncoming boat was sitting on his right leg while his left leg was extended into the aisle for support. This put his head above the windshield for better visibility. He said he always boated this way because of the crowded conditions on the lake. He said that he had been out for about 20 minutes. One of his two passengers was skiing while

the other was sitting on an aft facing seat observing the skier. He swung into the cove to escape the crowd and the rough water generated by them. The shore was to his right and another ski boat was passing him close aboard on his left. He mentioned that he felt the boat passed too close. He was some 50 ft (15.2 m) outside of a line of buoys that mark a speed zone close to the beach for swimmer protection. As he straightened out in the cove, he found he was heading directly into the sun. Visibility of the water surface was especially bad since the tall pines and hill tops in the background cast their shadows on the lake making it appear black.

Another boat (not involved in this accident) was pulling a skier at the same time in the same cove. After the skier fell, the driver had difficulty finding him because of the glare and black water condition. That operator picked up his skier and got off the lake immediately.

The boat approaching the downed skier had slowed slightly prior to entering the cove and pulled back on the throttle even more when he observed the occupants of a runabout waving their hands and holding a red ski flag which meant there was a skier in the water. Their boat was off to his right and facing parallel to him. He waved to acknowledge the red flag and scanned several times for the skier, but didn't see one. (In the meantime, the other ski boat passed him to his port, the wake of the boat passing over the downed skier.)

The oncoming boat was now going so slow that the skier couldn't stay up on his skis. The operator estimated his speed at 12 mph (19.3 kph). He saw a ski rope floating on the water at an angle across his bow. At that same instant he heard a thud against his bow and knew what had happened.

3.2 Accident

The bow struck the girl's right femur and broke it. As the boat passed over her, she rolled along the bottom and exited under the transom. The propeller cut her buttocks and thigh. She floated, face up, awaiting rescue.

3.3 Post-Accident

The operator of her ski boat circled, stopped the boat near her, shut it off, and jumped overboard. After she got next to the boat, the second adult male on board pulled her into the boat. The operator mentioned that he could not have gotten her into the boat if he had been the only adult aboard. Both boats headed for the marina. An ambulance was called, as was the sheriff.

3.4 Sequence of Events in the Accident

1730	-	Both boats left slips
1745	-	Both boats pulled skiers
1810	-	Collision
1820	-	Victim pulled from water
1830	-	Victim taken to hospital

4.0 VESSEL DATA

The hittor's boat was representative of the typical 17 ft (5.2 m) runabout. It was made by Glasspar in 1964, was 17.5 ft (5.3 m) long and six feet (1.8 m) wide, and was powered by a 140 hp I/O. When sitting in the seat with one leg tucked under one's bottom, one can see comfortably over the windshield. Figure 1 shows the configuration of the boat. Figure 2 is a photo of the hittor's boat.

Since the hittee's boat was not involved, no information is presented except that it was a 20 ft (6.1 m) 1976 Century runabout.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The hittor was sitting on one leg because he couldn't see very well if he sat in the seat properly. This has been designated as a problem in other accidents for various reasons including the fact that operators couldn't reach controls in time to avoid collisions, etc. However, the fact that the operator was looking over the windshield probably increased his chances of seeing the fallen skier. Since he was only out for 20 minutes and going only 12 mph (19.3 kph) at the time of the collision, the wind effect in his eyes has been considered negligible.

The girl would have been easier to spot if:

- her PFD had been a light, bright color,
- her skis had been a light, bright color,
- she had been wearing some sort of brightly colored head gear, and/or
- the occupants of her boat had pointed towards her sooner.

The occupants of the ski boat dead in the water waved a red flag indicating that a skier was in the water. The hittor responded in a way that can be considered "normal" since so many boaters do it, but is actually a dangerous habit. He responded to the flag by waving, then began to scan for the skier while continuing on his course. In fact, he should have stopped after his first scan of the area revealed that no skier was visible. Educational programs may help here.

6.0 PROBABLE CAUSE OF ACCIDENT

The hittor should have stopped after he acknowledged the red flag and didn't see the skier. He was aware of the poor visibility problem and overcrowded condition on the lake.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The hittor's boat was dropping off plane and was probably traveling at hump speed when it struck the skier. If it had been going slower, she probably would have been pushed aside and could have escaped unhurt.

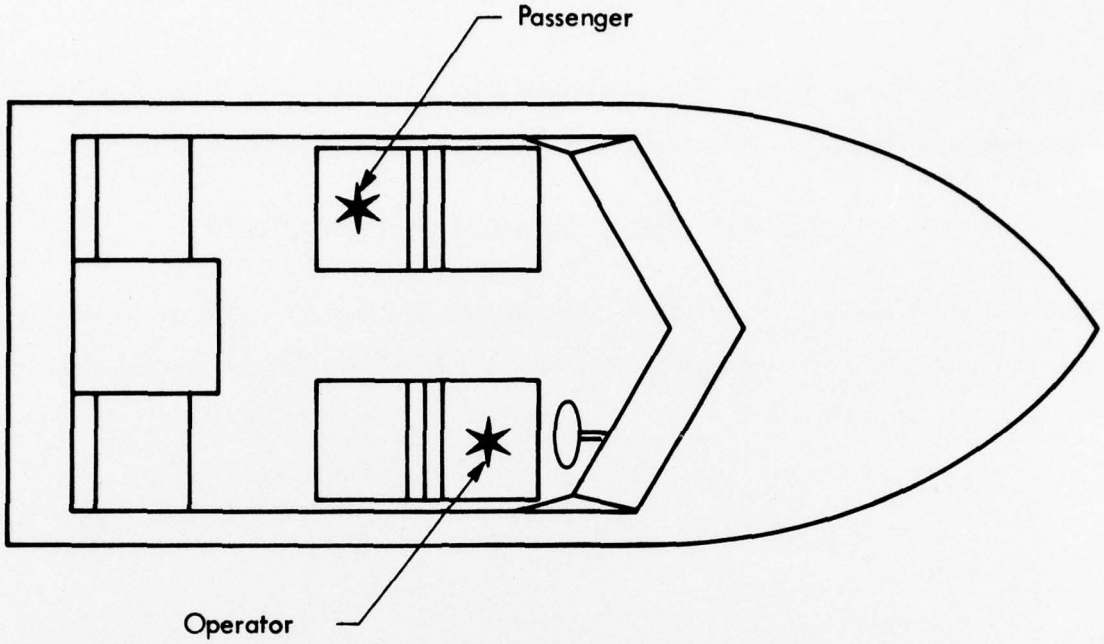


FIGURE 1. CONFIGURATION OF HITTOR'S BOAT

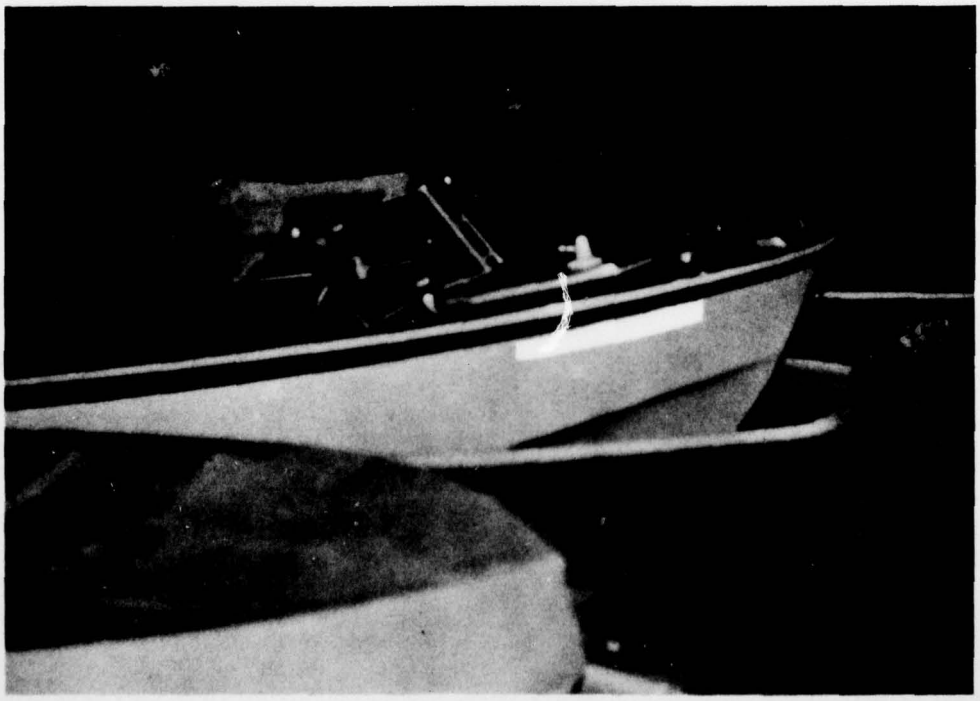


FIGURE 2. HITTOR'S BOAT

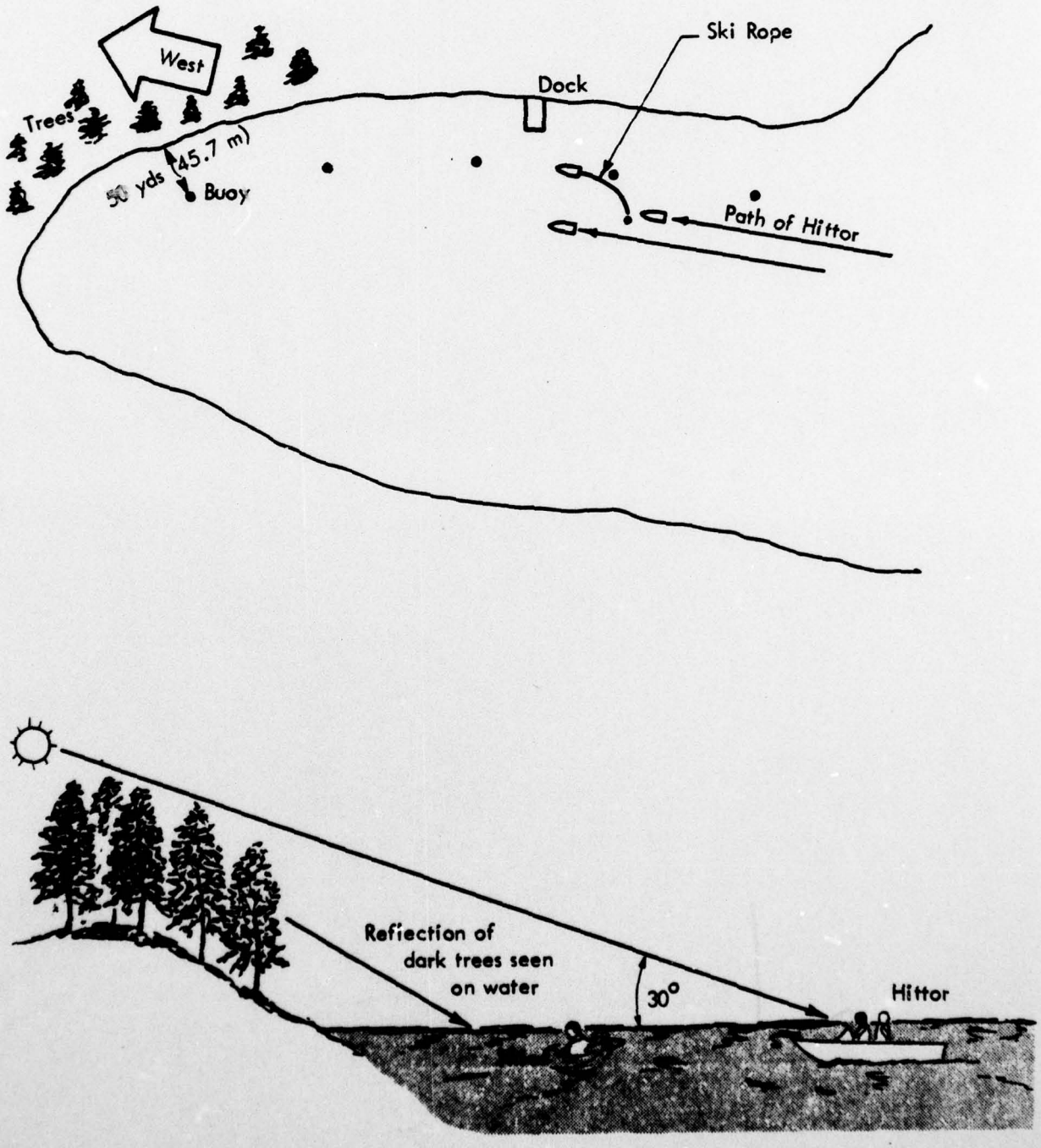


FIGURE 3. COLLISION AREA DIAGRAM

APPENDIX F. ACCIDENT NO. 76-06

ACCIDENT INVESTIGATION REPORT

Date of Investigation: August 22, 1976

Date of Accident: August 3, 1976

Investigation: Collision No. 76-06

SUMMARY — WYLE ACCIDENT NO. 76-392

This accident occurred at 0100 in a large bay off Lake Erie. It was a two boat collision involving a 21 ft (6.4 m) cuddy cabin cruiser and an 18 ft (5.5 m) open runabout. The 21 ft (6.4 m) boat (Boat No. 1) had five persons on board, while the 18 ft (5.5 m) boat (No. 2) had two people aboard. The owner of Boat No. 1 was going for a ride after preparing his boat for a four to five day lake vacation. He had proceeded across the bay and was approaching the northern shore when the collision occurred with Boat No. 2 striking Boat No. 1 amidships on the starboard side.

Boat No. 2 penetrated the side of Boat No. 1. Three POB were thrown overboard. Two were injured. All persons climbed aboard Boat No. 2 where they stayed until the Coast Guard arrived. Damage was estimated at $7,300.

1.0 BOAT OCCUPANT DATA

1.1 21 ft (6.4 m) Cuddy Cabin Boat (No. 1)

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	29	185 lb (83 kg)	Good	150 hrs	CG/RC	No	No
Owner	M	37	185 lb (83 kg)	Good	100 hrs	None	No	No
Passenger	F	22	100 lb (45 kg)	Poor	10 hrs	None	No	No
Passenger	M	13	120 lb (54 kg)	Good	Little	None	No	No
Passenger	M	8	60 lb (27 kg)	Fair	Little	None	No	No

The owner of this boat was a stock broker, had recently moved here, and had only 10-15 hrs experience in these waters. He was a private pilot and had just taken possession of this boat, although he had had use of it for several weeks. He was of average intelligence and had operated boats aboat 100 hrs.

The operator had more experience in these waters, was apparently of average intelligence and had taken two boating safety courses.

1.2 18 ft (5.5 m) Runabout Boat (Boat No. 2)

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	F	24	118 lb (53 kg)	Excellent	500 hrs	None	No	No
Passenger	M	≃40	Unknown	Unknown	Unknown	Unknown	No	No

The owner of this boat was quite involved in boating activities in this area. She was a skilled worker, of average intelligence, knew all the local Coast Guard personnel, was a scuba diver, rescue squad member, and spent all her available time on, in, or around her "pride and joy" boat which she had owned a little over a year.

2.0 ENVIRONMENT

The weather was clear, good visibility, air temperature ≃60°F (16°C), no wind or waves. The water depth was approximately 30 ft (9.1 m) in a moonlit bay. There were "a few" other boats on the bay at the time of the accident - just after midnight.

3.0 NARRATIVE DESCRIPTION OF THE ACCIDENT

3.1 Pre-Accident

3.1.1 Boat No. 1

Having taken a week off from work, a father and two sons had spent several hours late on Monday preparing their new boat for an extended (four to five day) vacation trip around Lake Erie. After dinner the trio had returned to the boat to finish packing gear and to check motors, radio and other equipment at the local public dock area. Meeting two friends, a male and female, they decided to take a ride around the bay before retiring — it was late in the evening (nearing midnight).

The two sons climbed into the cabin and each lay on one of the bunks and fell asleep as the boat got underway. The owner was still stowing some of the gear and was in the aft port section of the boat. The male guest was operating the boat to accommodate the owner. The female passenger was seated in the port (raised) seat opposite the operator. According to the operator and the owner, their navigation lights were ON. The convertible top was up (but no stern curtains).

The evening was warm and it was a moonlit night. After they had proceeded about 3/4 of the way across the two mi. (3.2 km) wide bay, they turned left from a northerly heading to nearly west about a half-mile (0.8 km) off shore (on their starboard side). They were cruising "just above hump speed" — estimated at 16-18 knots. Both the operator and female passenger noticed "the red light" of another boat off their starboard side — then "lost it." They again saw the red light just a "second or so" before they collided with another boat on their starboard side at the operator's seated position.

3.1.2 Boat No. 2

A 24 year old female boat owner had not worked on Monday and, as was her practice, had had her boat launched from the storage marina for cruising about the bay and lake area. She had bought the boat a year earlier and, according to others, had spent most of her available leisure time either cleaning, working on, or riding on her boat (the boat was obviously well cared for). After spending most of the afternoon on the water (she liked to listen to her new marine radio), she returned to her marina dock. Later she met an "older gentleman friend" and voluntarily took him for a ride about the bay — "simply for pleasure." Again, she returned to the dock and discharged her passenger. Still, because of the "beautiful night" she called another friend (who had just gotten off work). The friend arrived around 23:30 and the two rode across the bay to another marina. Deciding to return shortly after midnight, they proceeded out of the marina and headed south across the bay toward home at cruise speed (estimated at 22-25 knots). Neither saw the other involved boat until "just before the collision" when they saw a "green light right in front of them."

3.2 Accident

Passengers were located in Boat No. 1 and Boat No. 2 as shown in Figures 1 and 2. An accident area diagram is shown in Figure 3. The weather was as noted in Section 2.0.

Both operators saw the other boat just prior to impact. Boat No. 1 was struck broadside just aft of the cuddy roof and just at the helmstation. The hull side of Boat No. 1 was contacted about one ft (0.3 m) below the gunwale on the starboard side. Boat No. 2 continued through Boat No. 1, striking the seated operator, fracturing his right leg in two (or three) places. As the penetration continued, the cuddy cabin roof (and bow cover) were lifted and pushed outward. The female passenger sitting beside the operator was struck and the operator and the passenger were carried overboard to port, breaking her right leg also. The impact (and port motion of Boat No. 1) threw the owner of Boat No. 1 over the starboard side of his boat. Boat No. 2 came to rest atop Boat No. 1 with bow and stern about equally hanging over each side of Boat No. 1. The bow of Boat No. 2 had several heavy pieces of Boat No. 1's roof on its bow. Both occupants of Boat No. 2 were thrown slightly forward, but were not hurt. The two boys were awakened by the crash but neither was hurt. The owner of Boat No. 1 had bruised ribs.

3.3 Post Accident

With the realization that a collision had occurred, and with three injured people in the water (sans PFD), the operator of Boat No. 2 immediately broadcast a mayday over her marine radio. The Coast Guard station (two to three mi. (3.2-4.8 km) away) responded to her call. She remained on the radio until the Coast Guard arrived (about five to seven minutes) and directed them to their position.

The owner of Boat No. 1 realized he was in the water ("with a prop on my chest") and could see the stern light of Boat No. 2. He managed to find the ladder for Boat No. 2 and started to climb aboard as soon as he realized an accident had occurred. The two (sleeping) boys on Boat No. 1 stood up (in water due to smashed side of boat) and climbed into Boat No. 2 just aft of the helmstation. Meanwhile, the female passenger of Boat No. 1 (and the operator) were trying to get (over debris) back to the boat. The female made "repeated requests for help" of the passenger on Boat No. 2 (whom she could see). He "finally" helped her over the port side into Boat No. 2. The last to make his way back to the boat was the operator of Boat No. 1, who was conscious but he could "feel little except pain" in his right leg and thought that he was badly hurt. He also was helped aboard Boat No. 2 over the port side. Within less than five minutes, all were aboard and "safe." The Coast Guard arrived within "a couple of minutes."

All persons were transported to the public dock where an ambulance was waiting (brought by radio communications). The hospital was only a few blocks from the public dock. All except the operator of Boat No. 1 and the female passenger were released. At the time of the investigation, both were still in the hospital but were expected to be released soon. (The operator was actually released 21 August 1976; the female was still in "traction" at the time.)

After transporting the people, the Coast Guard separated the two boats and towed them to the Coast Guard station.

3.4 Time Sequence of Accident Events

Boat No. 1

1700-1250	Owner and sons worked on boat preparing for trip.
2355	Boat departed marina with owner, his sons, and an adult male and female friend aboard. Male friend was operating boat while owner was stowing gear. Boat speed was 16-18 knots.
2355-2400	Traveled approximately 3/4 mi. (1.2 km) across bay.
2400	Operator and adult female saw red light of another boat, then lost it.
2401	Operator and adult female again saw red light of another boat on collision course with them.

Boat No. 2

1700-2100	Owner/operator cruised around bay listening to marina radio.
2100-2200	Stayed around marina talking to friends.
2200-2230	Owner/operator and male friend cruised around bay.
2230-2300	Stayed around marina and called male friend who had just gotten off work.
2300-2330	Stayed at marina waiting on friend to arrive.
2330	Owner/operator and friend departed marina for cruise across bay to another marina.
2330	Arrived at marina across bay.
2330-2359	Operator and friend stayed around marina.
2359	Departed marina to return to operator's marina dock.
2359-2401	Traveled out channel into bay at 22-25 knots.
2401	Operator and passenger saw green light of another boat directly ahead only a few yards ahead.

Accident	
2401	Boat No. 2 impacted Boat No. 1 near amidships on the starboard side. Boat No. 2 came to rest on top of Boat No. 1. Operator and adult female of Boat No. 1 knocked over the port side. Owner of Boat No.1 knocked over starboard side.
2401-2402	Operator of Boat No. 2 broadcasted mayday over marine radio. Nearby Coast Guard station responded and dispatched rescue vessel.
2402-2405	The owner, operator, and owner's two sons climbed aboard Boat No. 2.
2405-2407	Female passenger of Boat No. 1 was helped aboard Boat No. 2.
2407-2409	Operator of Boat No. 2 directed Coast Guard vessel to accident scene by marine radio.
2409-2415	Occupants of both boats taken to public dock where occupants of Boat No. 1 were taken to nearby hospital.
2415-0100	Boats separated by Coast Guard rescue personnel and towed to marina.

4.0 VESSEL DATA

At the time of the investigation neither of the boats had been repaired.

4.1 21 ft (6.4 m) Cuddy (Boat No. 1)

This boat was built by MFG and was a Gypsy 21E2-CRU2E with LOA 20 ft 10 in. (6.3 m) and maximum beam of 7 ft 11 in. (2.4 m). Capacities stated were: 2535 lb (1149 kg) persons capacity; 2665 lb (1208 kg) maximum weight capacity (see Figure 4). The boat was powered by an OMC 175 hp I/O and (according to the HIN) was built in November 1975.

Damage to this boat was very extensive as shown in Figures 5 through 10. Figure 11 was taken from the brochure of the manufacturer (convertible top and passenger seat not shown). The boat was considered a total loss (about $ 7,000 after salvage of engines and drives, etc.).

4.2 18 ft (5.5 m) Runabout (Boat No. 2)

This boat was a Silverline model Comoro 18 V. The LOA was 17 ft 7 in. (5.4 m) with a beam of 85 in. (2.2 m) at the transom and weighing approximately 2000 lb (907 kg). Maximum persons capacity was 985 lb (446.8 kg); maximum weight capacity was 985 lb (446.8 kg) (capacity label, Figure 12). The boat was powered by a 165 hp Mercruiser I/O. Photographs of the boat are shown in Figures 13 through 18. According to the HIN, the boat was built in Model Year 1974 (probably September or November — the letter designation for the month was not readable).

Damage to the boat consisted of damaged bump rail on bow and slightly down the port side; extending several feet down the starboard side. The bow light was damaged, the horn was missing (starboard side) and the bow cleat was torn out (starboard side). The windshield was "pushed back" about two in. (5.1 cm) (probably by Boat No. 1's roof or gunwale). The total damage was estimated at $ 250-$ 300. The boat was equipped with a compass and marine radio (antennae missing).

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RECREATIONAL BOAT SAFETY COLLISION RESEARCH: COLLISION ACCIDENT--ETC(U)
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UNCLASSIFIED MSR-77-51 USCG-D-40-77 NL

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5.0 PSYCHOLOGICAL AND HUMAN FACTORS

From interviews, boat examinations, and site examinations, it appears that several factors contributed to the accident. First of all, it occurred late at night after all personnel had been up all day and (especially Boat No. 2) had had a considerable amount of time on the water or other fatiguing activity. The operator of Boat No. 2 was traveling south and probably had some glare/reflection of the moon off the water. The operator of Boat No. 1 had been heading toward land (north) with lights in the background on shore. He then turned west toward a different set of shore lights — confusion? The convertible roof was up on Boat No. 1 and the boat was running at a high trim angle ("just above hump speed"), which would limit his forward view. Boat No. 2 was headed toward a very populated area with many lights on the shore ahead of her. In her stated normal driving position, she would have been looking through the windshield, which means that her stern light was probably a factor (reflection in windwhield) in not seeing Boat No. 1's lights. This is especially true since the type navigation lights on the 21 footer (6.4 m) would show only the starboard light (that could go unnoticed).

Finally, the activity of the owner, and conversations with the passenger could have added some distraction to the operator of Boat No. 1 for short periods of time — he was aware that another boat (red light) was in the vicinity.

6.0 PROBABLE CAUSE OF THE ACCIDENT

The following are considered probable causes of the accident:

- Failure to observe rules of the road — Boat No. 1 was burdened.
- Light from Boat No. 2's stern light "blinding" operator.
- Inattention while underway at night at "planing" speeds.
- High trim angle/visibility problems with 21 ft (6.4 m) cabin boat with top up — helm station design.
- "Low" illumination of Boat No. 1's light.
- Moonlight/glare or reflection on the water ahead of Boat No. 2.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

As discussed in Section 3.0, the boats collided with the bow of Boat No. 2 striking the starboard side of Boat No. 1 amidships. The fact that Boat No. 1 was essentially destroyed and Boat No. 2 suffered relatively little damage is due to the fact that the strongest portion of Boat No. 2 (pointed bow) struck the weakest portion of Boat No. 1 (side amidships).

As Boat No. 2 punctured through the side and started to rip through Boat No. 1, it struck both the operator and passenger of Boat No. 2, knocking them overboard. Also, the windshield and bow of the boat crashed into and lifted/ripped the cabin roof and bow cover loose from Boat No.1 with parts of the superstructure remaining on the bow of Boat No. 2 and parts going overboard. The windshield of Boat No. 2 protected the occupants of Boat No. 2 from the debris ensuing. That the sleeping boys were not injured is due to the fact that they were just forward of the steering console/cabin bulkhead which deflected Boat No. 2 slightly aft.

The fact that Boat No. 2 "punctured" the side of Boat No. 1 (and not higher) is responsible for only lower extremity injuries to the two Boat No. 1 guests. Head injuries could have rendered either or both unconscious and probably resulted in drowning.

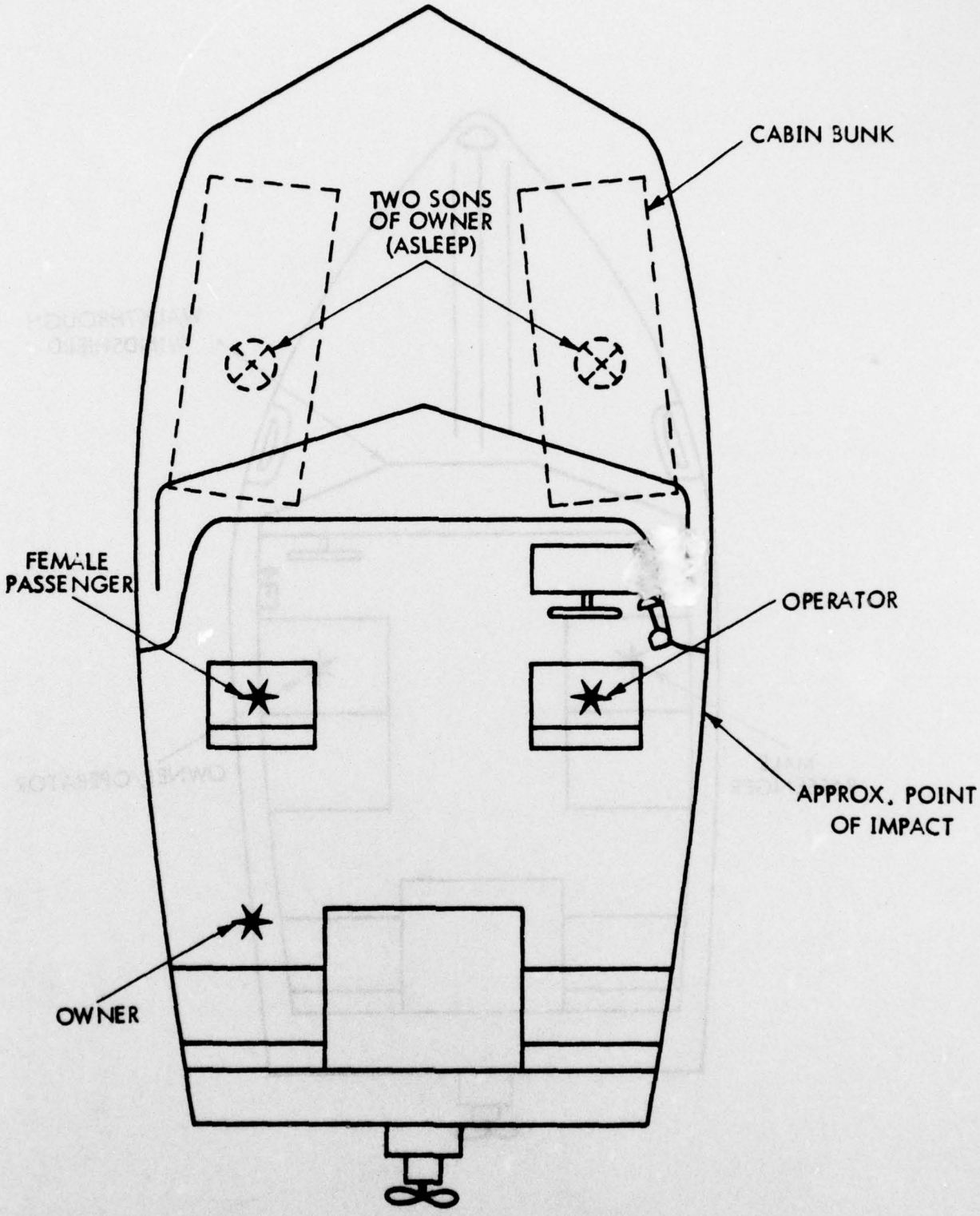


FIGURE 1. BOAT NO. 1 OCCUPANT LOCATIONS

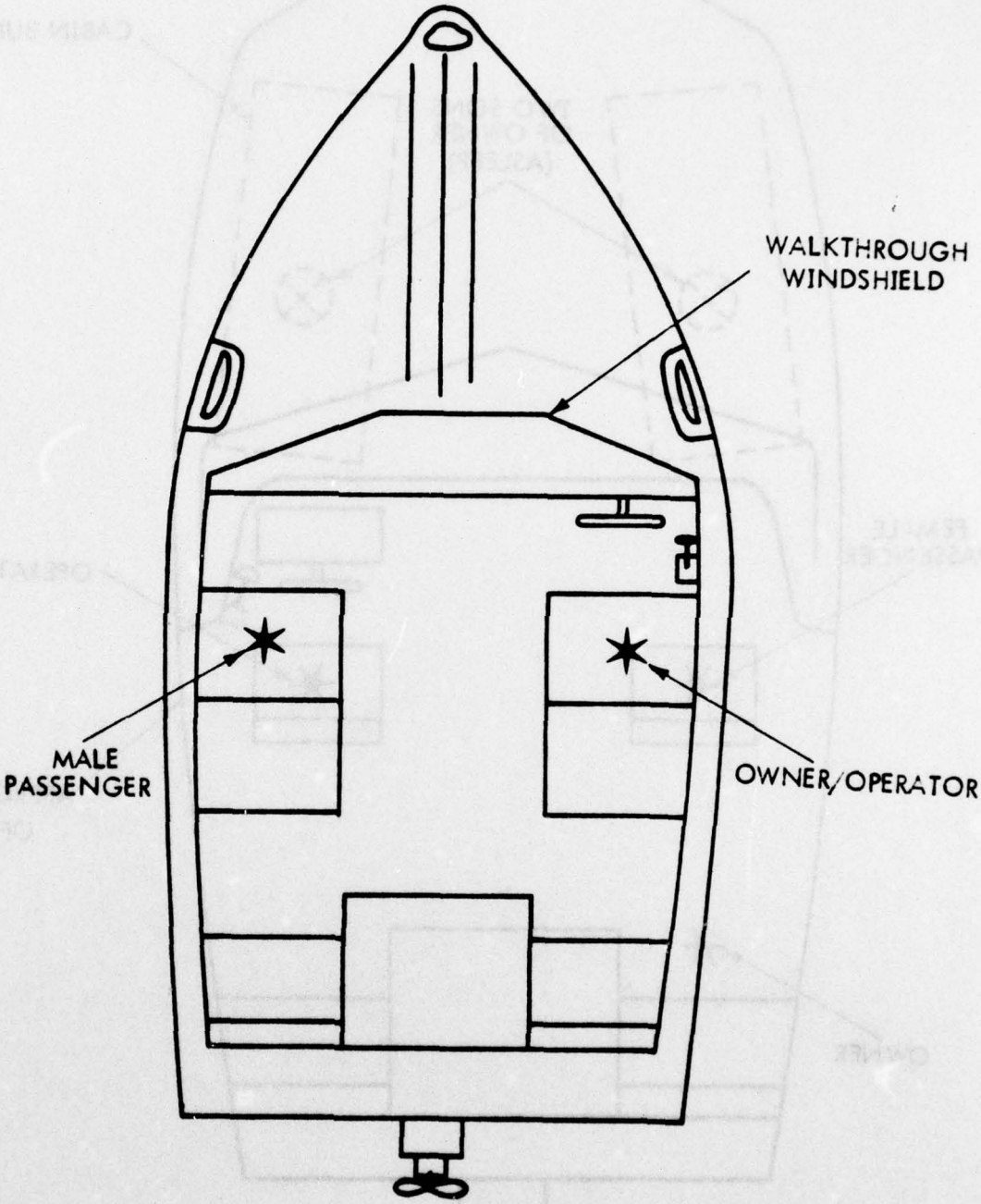


FIGURE 2. BOAT NO. 2 OCCUPANT LOCATIONS

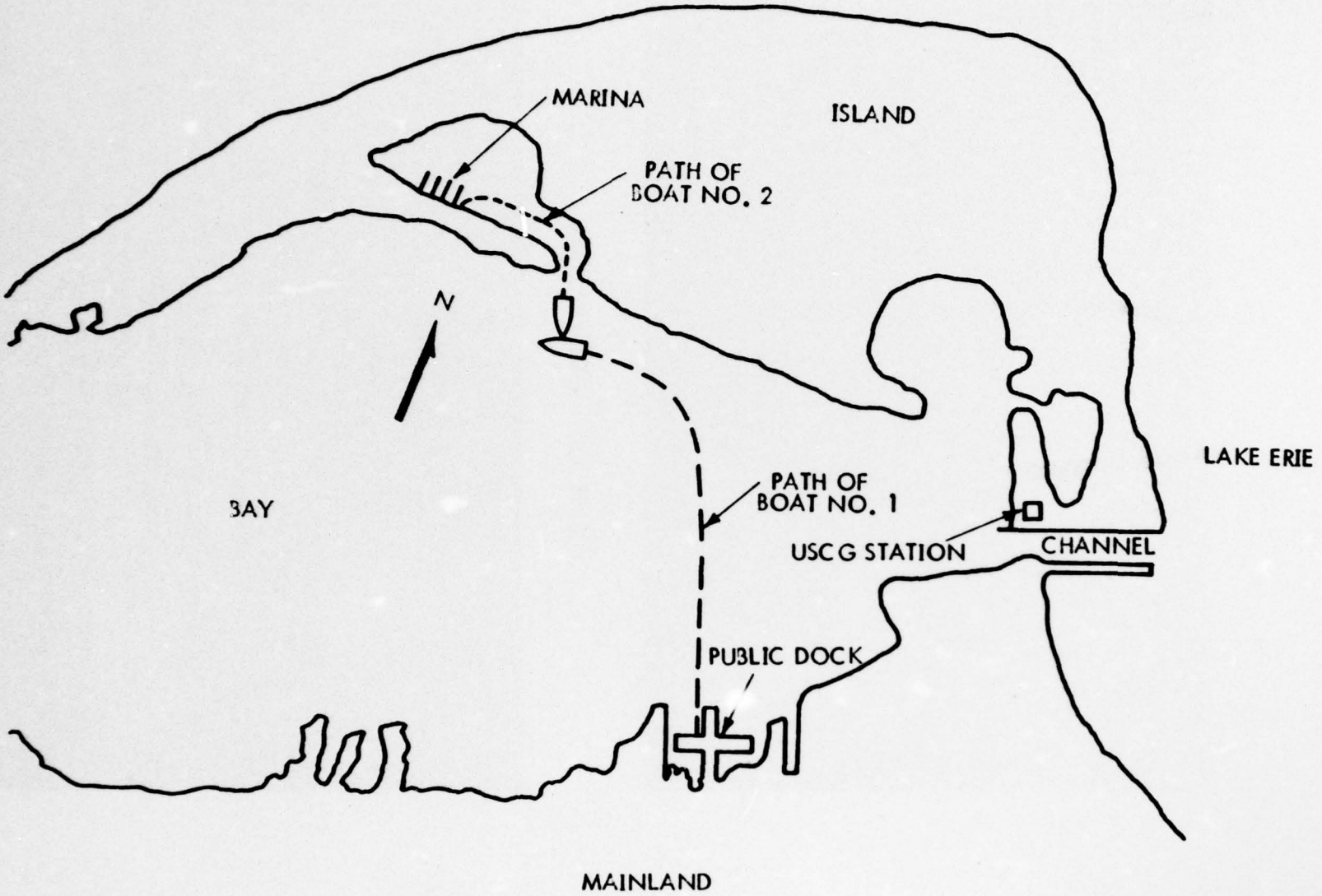


FIGURE 3(A). ACCIDENT AREA

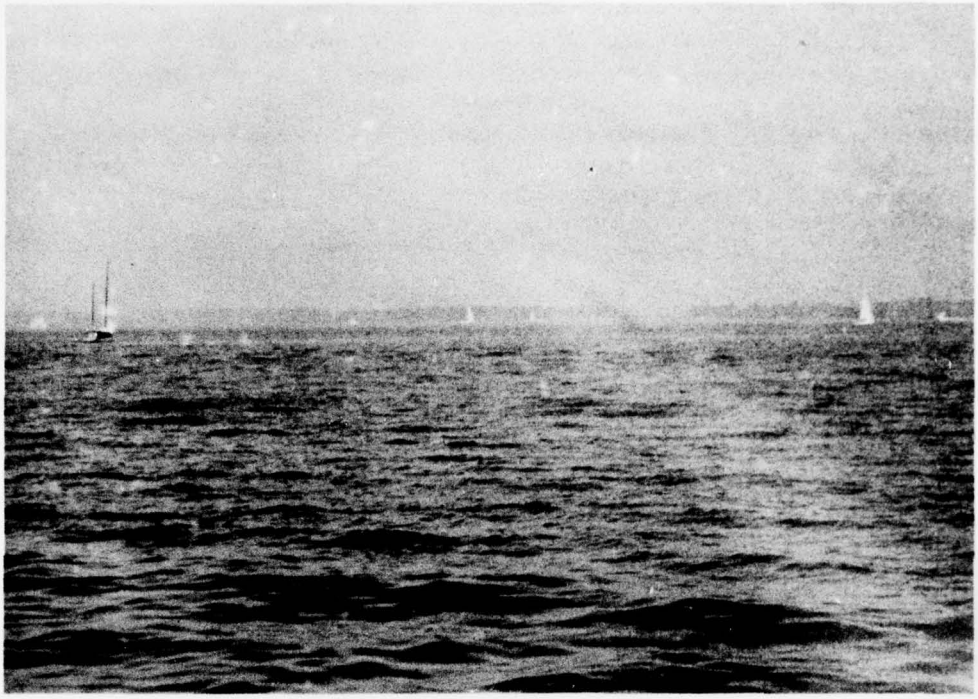


FIGURE 3(B). ACCIDENT AREA

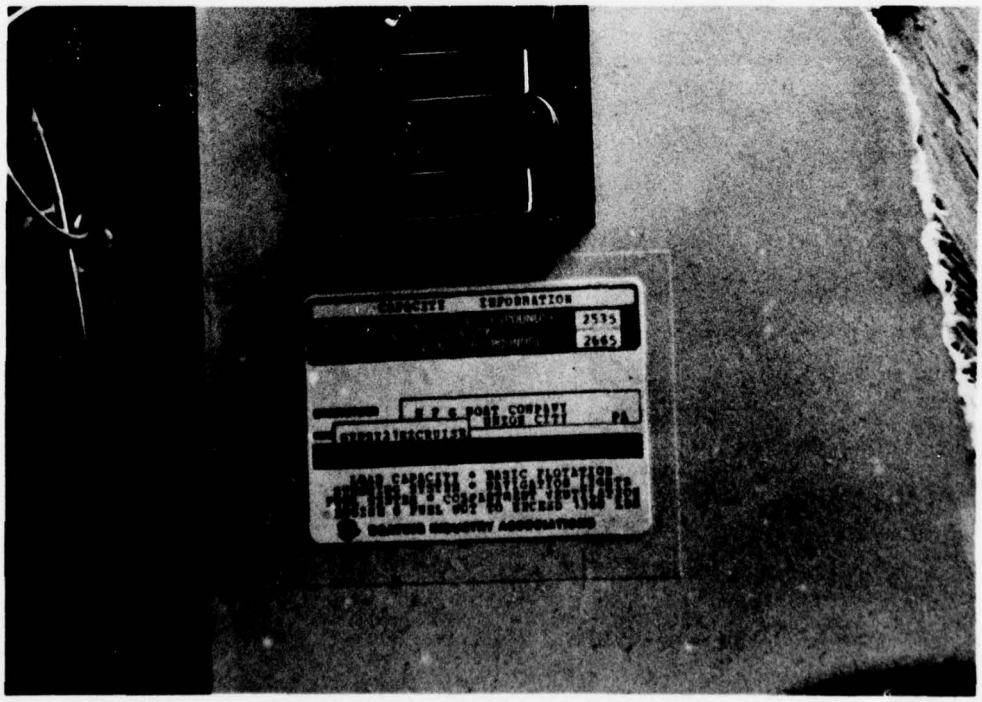


FIGURE 4. BOAT NO. 1 CAPACITY PLATE

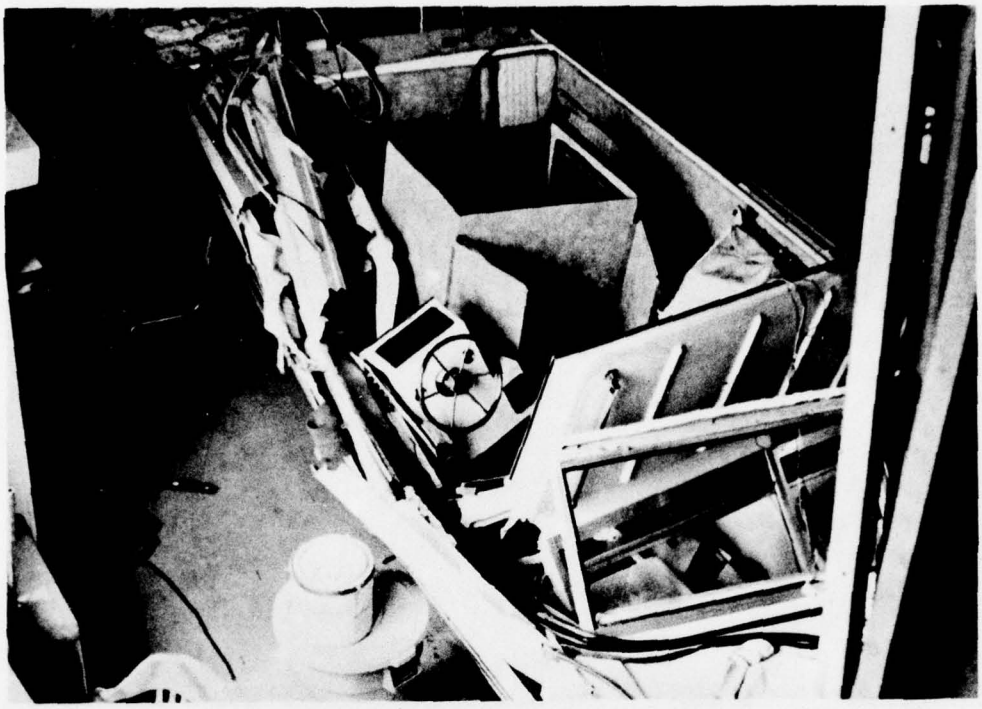


FIGURE 5. DAMAGE TO BOAT NO. 1

FIGURE 6. DAMAGE TO BOAT NO. 1

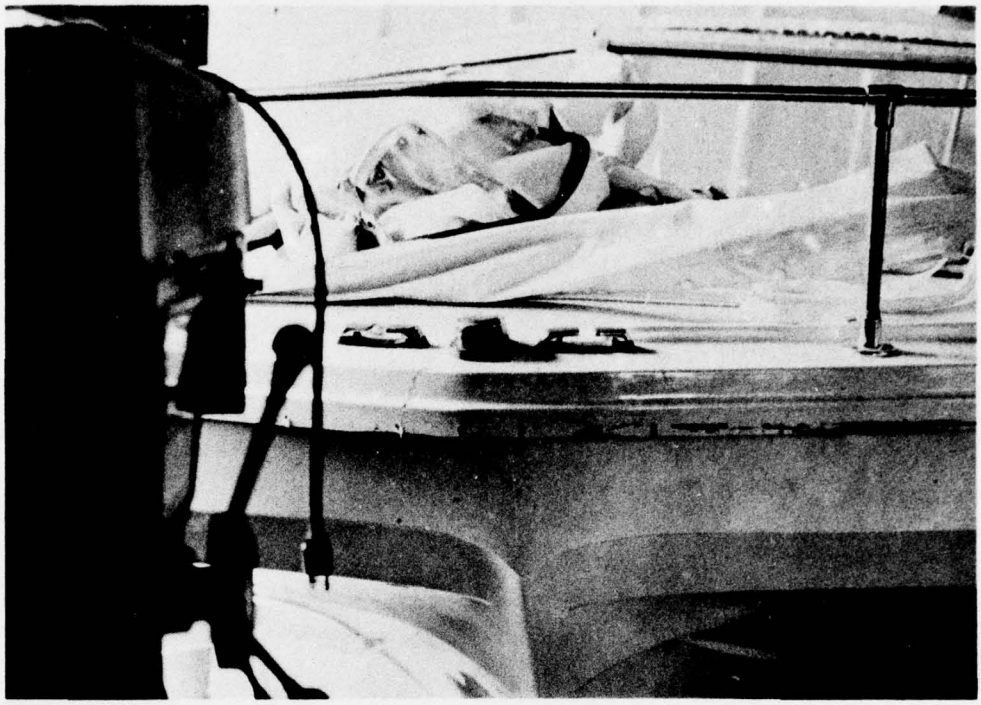


FIGURE 7. DAMAGE TO BOAT NO. 1

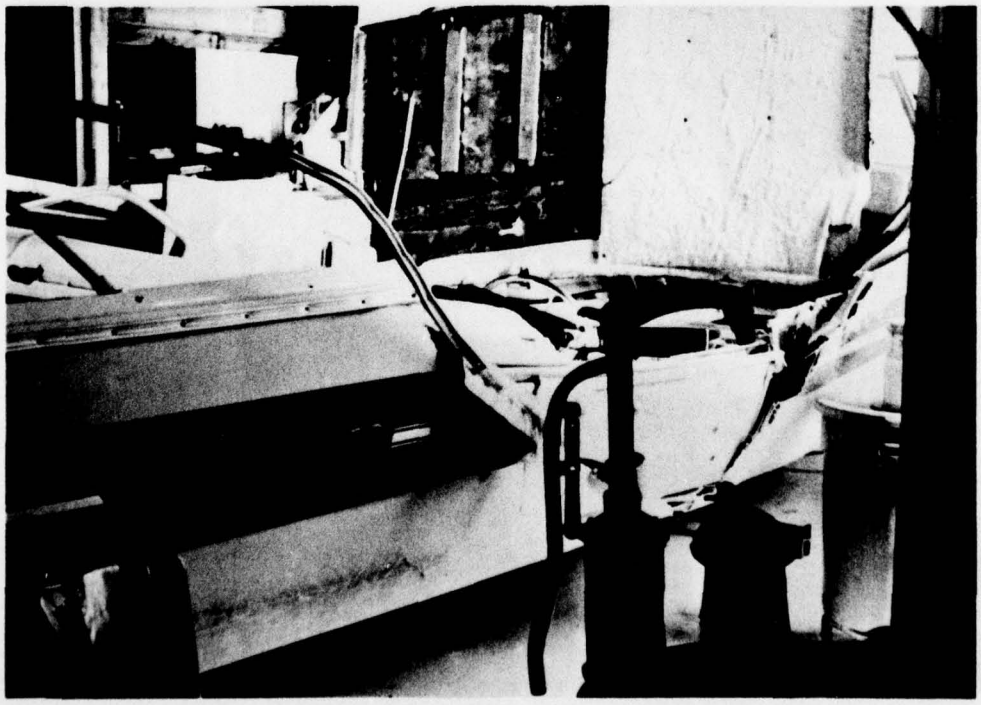


FIGURE 8. DAMAGE TO BOAT NO. 1

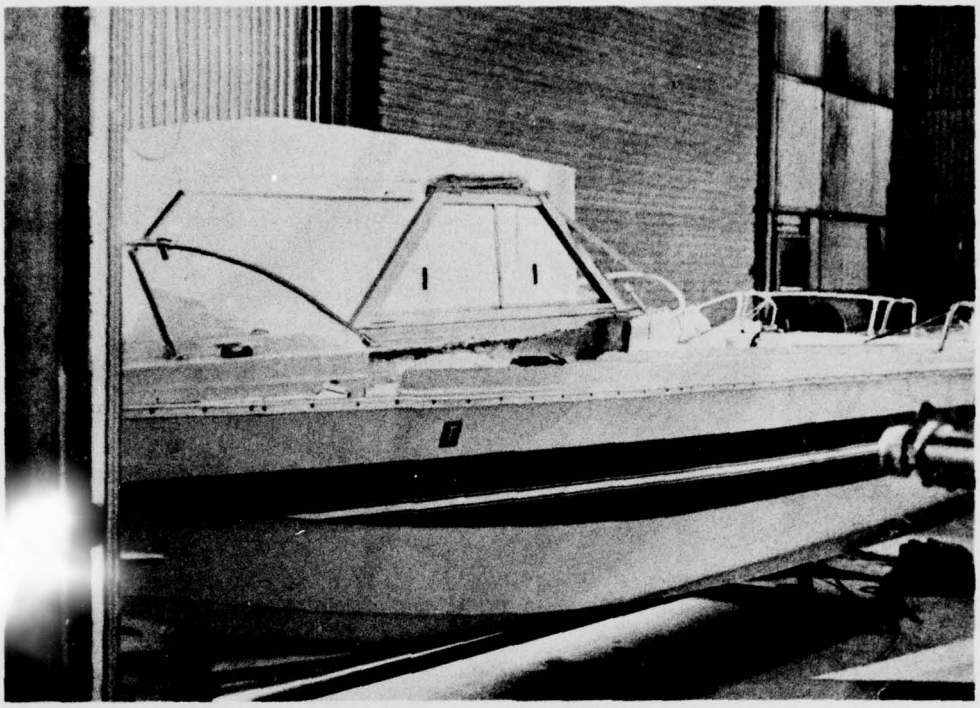


FIGURE 9. DAMAGE TO BOAT NO. 1

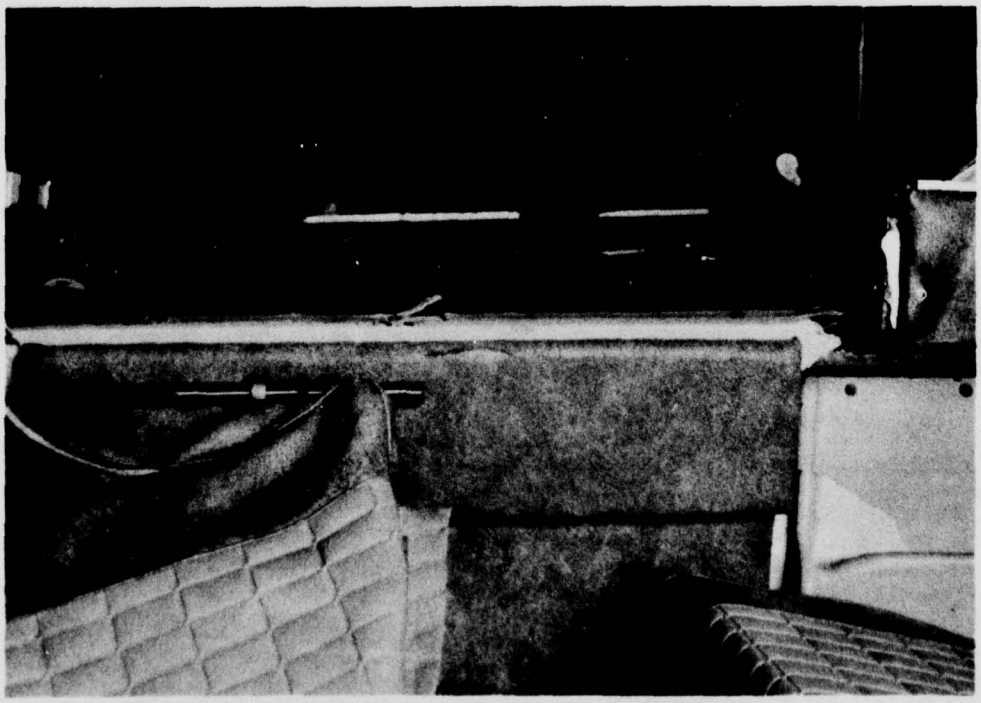


FIGURE 10. DAMAGE TO BOAT NO. 1

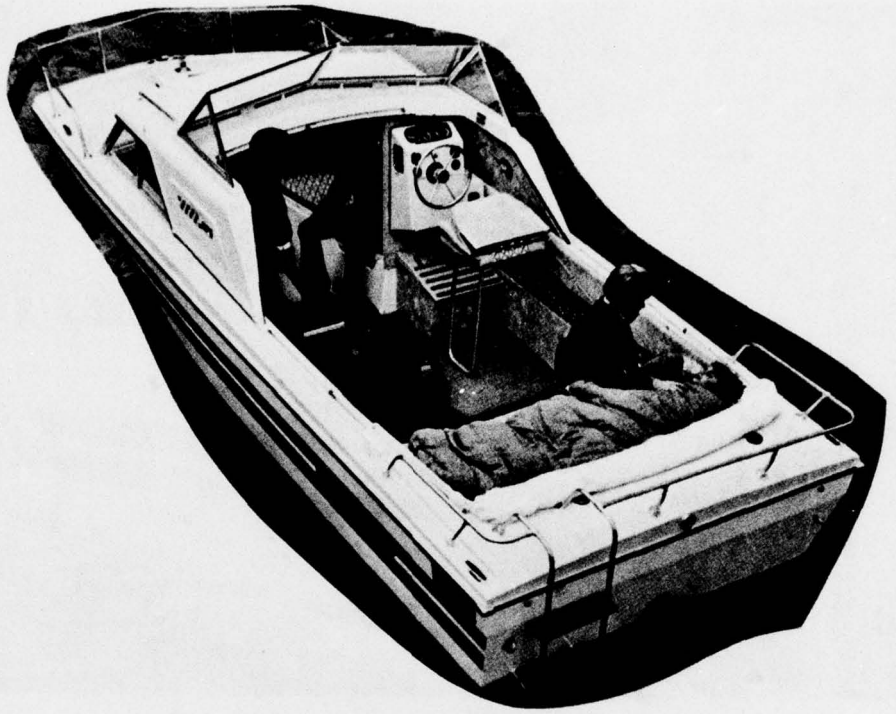


FIGURE 11. BROCHURE PICTURE OF MFG GYPSY 21 FOOTER

FIGURE 12. BOAT NO. 2 CAPACITY PLATE

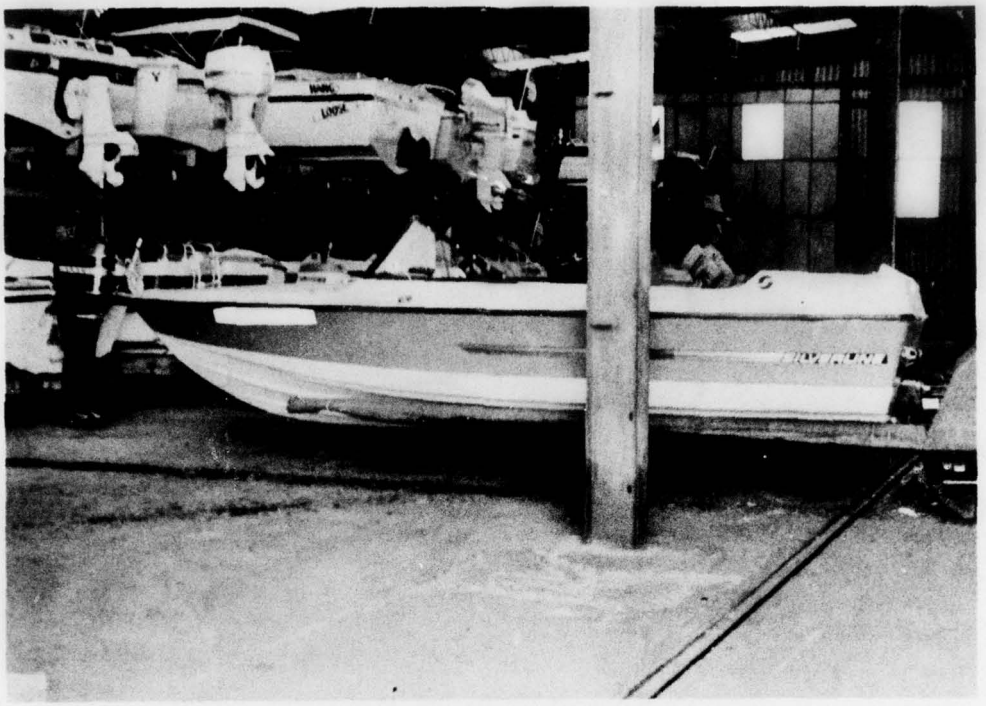


FIGURE 13. BOAT NO. 2

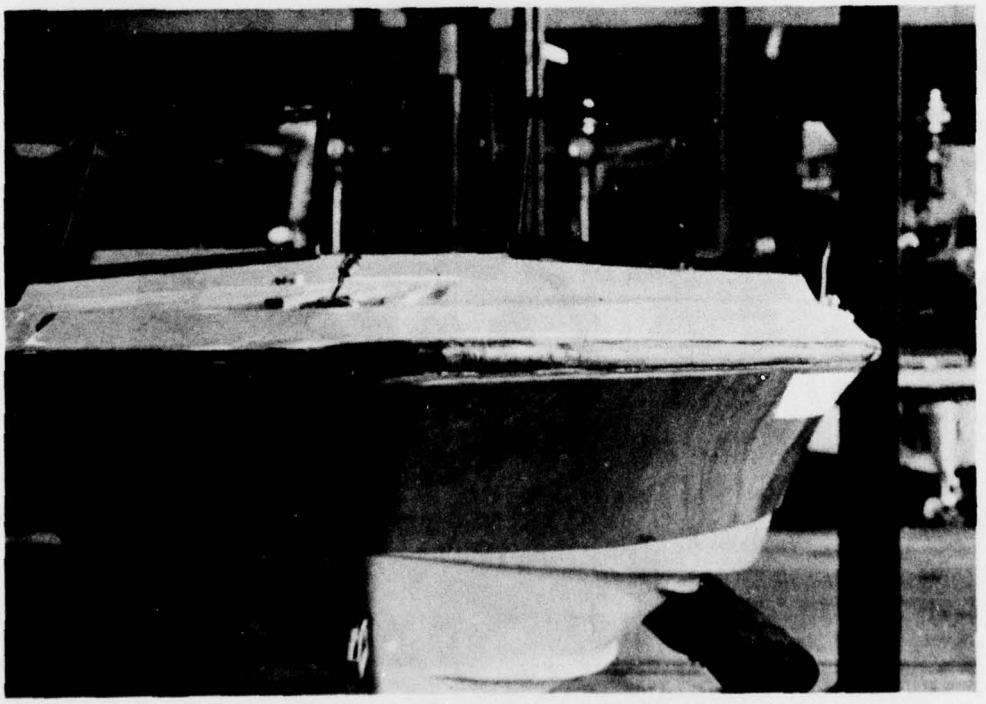


FIGURE 14. BOAT NO. 2

FIGURE 15. BOAT NO. 2

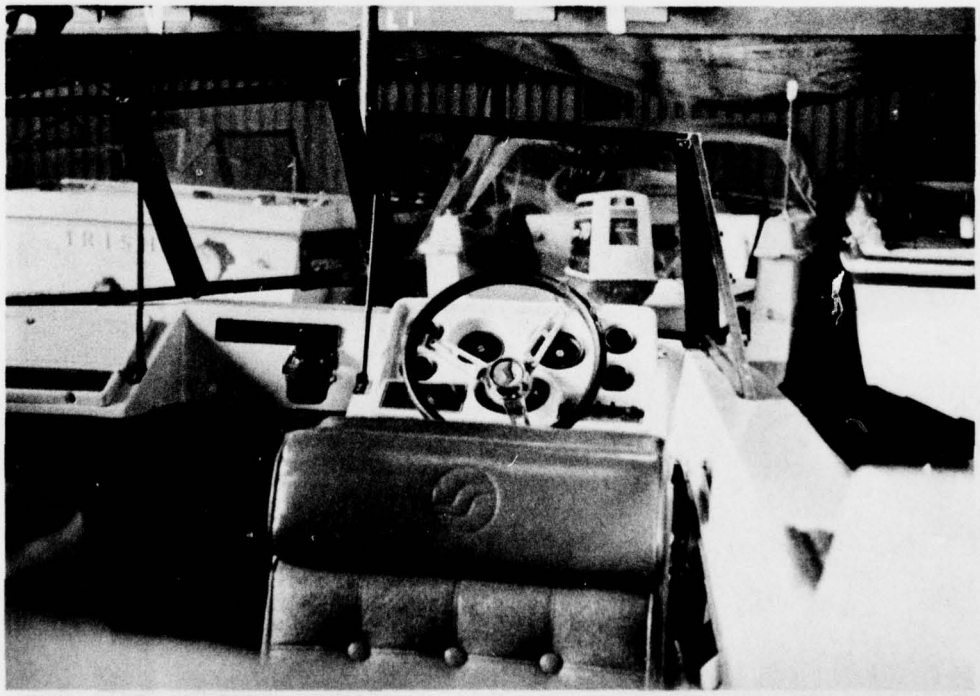


FIGURE 16. BOAT NO. 2

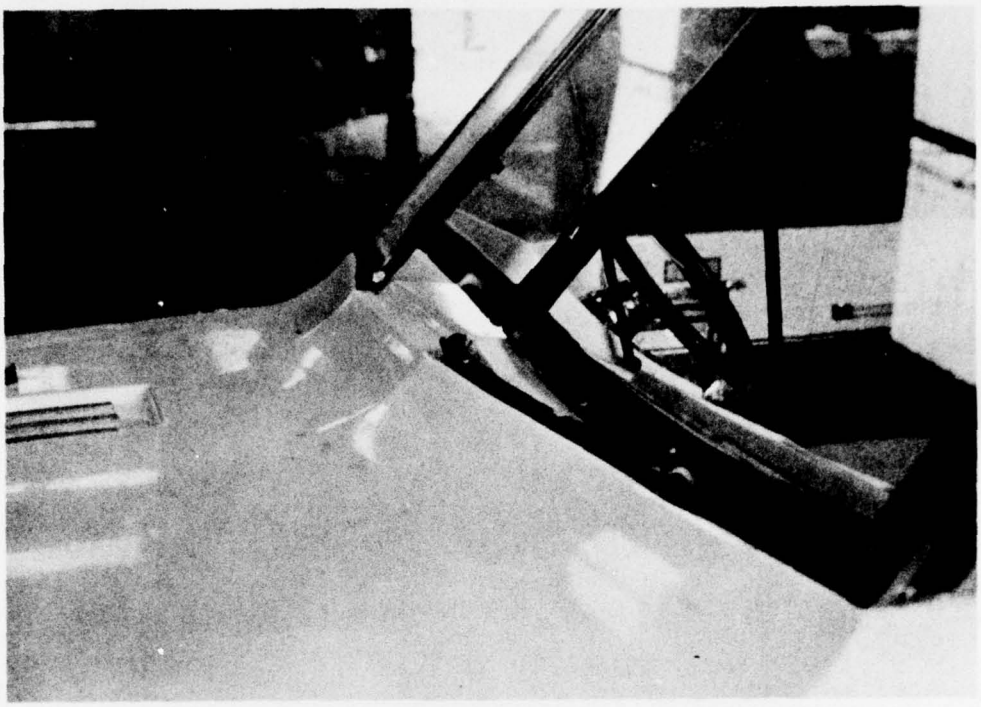


FIGURE 17. BOAT NO. 2

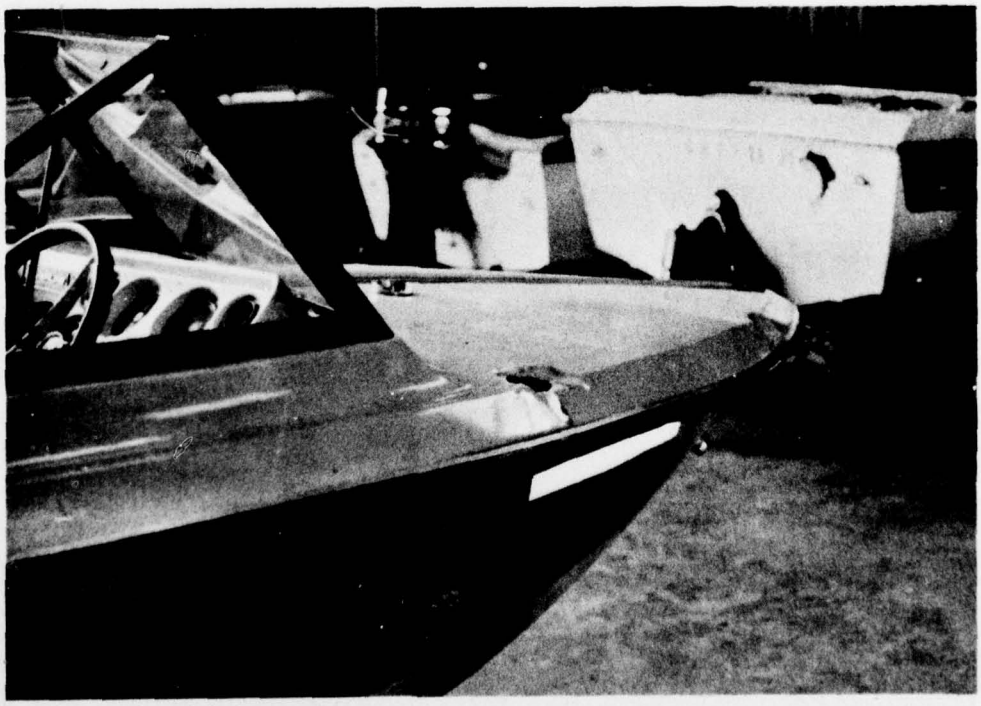


FIGURE 18. BOAT NO. 2

APPENDIX G. ACCIDENT NO. 76-07

ACCIDENT INVESTIGATION REPORT

Date of Investigation: October 13, 1976

Date of Accident: October 2, 1976

Investigation: Collision No. 76-07

SUMMARY — WYLE ACCIDENT NO. 76-577

The accident reported herein involved an 18 ft (5.5 m) inboard/outdrive runabout boat powered by a 205 hp engine. The type of accident was a single boat collision with a fixed object, resulting in severe facial lacerations to the operator (sole occupant). The damage to the boat was estimated to be $1,900.

At approximately 1530 on October 2, 1976, the involved boat arrived at a marina on the Saginaw River in Bay City, Michigan, after a fishing trip in Saginaw Bay. The owner/operator fueled the boat and decided to go on a short cruise up the river before putting the boat in its storage slip. After traveling approximately four mi (6.4 km), the operator turned the boat around and started back toward the marina at a speed of approximately 30 mph (48.3 kph). After traveling approximately 1/4 mi (0.4 km), the operator stated that the steering wheel suddenly turned hard to starboard. Before he could react to the sudden turn, the boat ran bow on into a contrete pier. The operator's head hit the instrument panel, knocking him unconscious. After regaining consciousness, he got out of the boat and pulled it a short distance to shore. The operator was taken to a local hospital by ambulance. The boat was towed back to the marina by a Coast Guard vessel.

1.0 BOAT OCCUPANT DATA

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	34	205 lb (93 kg)	Good	>500 hrs	None	No	No

The owner/operator was a high school graduate and worked at a local automobile assembly plant. He seemed to be of average intelligence and physical ability. From the interview it was apparent that he was an experienced fisherman and seemed to possess at least an average knowledge of small boat operation. He stated that he had operated small pleasure boats all his adult life and had owned a boat for the past seven years. He had owned the involved boat for approximately one year. He was a former Coast Guard enlisted man and stated that he had read several Coast Guard publications concerning small boat operations.

2.0 ENVIRONMENT

The sky was clear and the visibility was good. The wind was from the south at 7-14 mph (11.3-22.5 kph) and the water was calm. The recorded air temperature was 73°F (23°C), and the estimated water temperature was 68°F (20°C). The water depth in the impact area was three to four ft (0.9 - 1.2 m).

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

During the week of the accident, the owner/operator worked the third shift (2200-0630) at his regular place of employment. He had made plans with a friend who also worked the third shift to go on a fishing trip after getting off work on October 2, 1976. After completing their shift, the friend decided not to go on the trip because he was not feeling well. The operator decided he would go alone, but felt he should get a few hours sleep before going out. He went home and slept about two hours, getting up at approximately 1130. He drove the nearly one mi (1.6 km) to the marina on the Saginaw River where his boat was stored, arriving at approximately 1200. The boat was fueled and the fishing gear was loaded aboard. He got underway from the marina at 1215, destined for a fishing spot located about 20 mi (32.2 km) from the marina and five mi (eight km) off shore in Saginaw Bay, arriving at approximately 1300. He anchored the boat and fished until around 1530. He stated that during this time he ate a small amount of C-rations, drank a canteen of water and approximately 3/4 of a bottle of wine. The fishing gear was stowed and he traveled back to the marina, arriving at 1615. The 18 gal. (68.1 l) fuel tanks were filled to 3/4 full. After fueling, the operator decided to take a cruise up the river before putting the boat in its storage slip. He left the marina at approximately 1625 and traveled about four mi (6.4 km) at 25-30 mph (40.2-48.3 kph). He then turned around and headed back to the marina at the same speed.

3.2 Accident

Gear aboard was as shown in Figure 1 and the weather as noted in Section 2.0.

After traveling approximately 1/4 mi (0.4 km), the operator stated that the steering wheel suddenly turned hard to the right, causing the boat to turn sharply to starboard. The boat position at this time was parallel to a concrete pier (approximately 30 ft (9.1 m) off the starboard side). The operator stated that he heard the steering system hit the starboard stop immediately after the wheel started to turn. He grabbed the steering wheel at the bottom with

his right hand and started turning it to the left to bring the boat around to port parallel with the pier. Simultaneously, he leaned to the port side and started ducking under the instrument panel, because he was only a few yards from the pier and knew a collision with the pier was imminent. The boat impacted the concrete pier bow on at 25-30 mph (40.2 - 48.3 kph). The operator stated that he had turned the steering wheel approximately 1/2 turn to the left and had lowered his head to the approximate center of the instrument panel before the impact. On secondary impact his head hit the instrument panel, knocking him unconscious.

3.3 Post Accident

When he regained consciousness, the boat had drifted approximately 50 yds (45.7 m) down river adjacent to a shallow cove. He deployed the anchor to stop the drift of the boat and started looking ashore for someone who could call for help. He sighted two people on the pier approximately 100 yds (91.4 m) away and shouted to them to call the Coast Guard. He was bleeding profusely from facial lacerations and knew he had to get medical attention as soon as possible. Approximately five minutes after he called for help, a city policeman arrived at the pier. There were no boats in the area and the operator decided to get out of his boat and tow it ashore in the cove. He got out of the boat in approximately three ft (0.9 m) of water, grabbed the anchor line and pulled the boat approximately 50 yds (45.7 m) to shore. When he arrived on shore, an ambulance was waiting which took him to a local hospital. Approximately 400 stitches were required to close the facial wounds. The boat was towed to the marina by a Coast Guard vessel. Refer to Figure 2 and 3 for accident area.

3.4 Time Sequence of Accident Events

2200 Oct. 1 - 0630 Oct. 2	Worked third shift.
1200	Arrived at marina.
1200-1215	Fueled boat and loaded gear aboard.
1215	Departed marina for fishing area.
1300	Arrived at fishing area.

1300-1530	Fished from anchored boat.
1530	Got underway back to marina.
1615	Arrived at marina and fueled boat.
1625	Left marina for cruise up river.
1630	Turned around and started back toward marina.
1631	Boat impacted pier.
1632	Operator regained consciousness, anchored boat, and called for help.
1637-1640	Pulled boat ashore.
1645	Transported to hospital by ambulance.

4.0 VESSEL DATA

The boat was an 18 ft (5.5 m) 1972 model IMP inboard/outdrive powered by a 1972 225 hp Chevrolet engine. It was a V-hull bowrider of fiberglass construction. The capacity plate attached to the boat specified a maximum persons capacity of eight people at 150 lb (68 kg) each, a maximum weight capacity of 1600 lb (725.7 kg), and a maximum horsepower of 245. The impact resulted in major structural damage to the bow as shown in Figures 4, 5, and 6. The secondary impact of the operator's head with the instrument panel tore out the rear view mirror and broke the key off in the ignition as shown in Figure 7. The back-to-back port seats were separated at the top as shown in Figure 8. The skeg on the lower unit was broken off as shown in Figure 9. Overall boat views are shown in Figures 10-13.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The operator stated that he had consumed 3/4 of a bottle of wine over a five hour period preceding the accident. During this period he also ate C-rations and drank approximately one quart (0.9 l) of water. If he in fact consumed only 3/4 of a fifth of wine, his blood/alcohol content would have most likely been below 0.10 percent (legally drunk according to most state laws), and his judgment and reactions would probably have not been noticeably impaired. However, quoting the police offier on the scene when the operator was taken to the hospital, "he was feeling no pain," meaning he was definitely intoxicated, as far as the officer was concerned. No alcohol level tests were performed on the operator after the accident. It is very possible that his abnormal mental state was caused by the injuries sustained during the accident and not by alcohol.

The operator stated that he had poor forward visibility in the involved boat below a speed of 20 mph (32.2 kph), but excellent forward visibility above that speed. Also, he stated that his visibility was not impaired by glare on the day of the accident. Therefore, visibility is not considered a factor in this accident.

6.0 PROBABLE CAUSE OF ACCIDENT

The following items are most likely the major factors in causing this accident:

- Alcohol is certainly considered a factor. The blood/alcohol content is unknown, but it is possible that the level was sufficient to severely impair the operator's judgment and reaction at the time of the accident. He admittedly consumed 3/4 of a fifth of wine, and it is reasonable to assume that he could have consumed more wine or other liquids containing alcohol.
- Considering the body of water, the boat speed, and the distance from shore just prior to the accident, the operator should have had his hand on the throttle. Had he been steering with his left hand with his right hand on the throttle, he would most likely have been able to retard the throttle as soon as the boat started to turn, which would have quickly slowed the boat speed, probably avoiding the collision with the pier.
- The lower unit skeg was broken which would indicate that the outdrive could have hit a submerged object. However, it is considered unlikely that this would have caused the boat to turn abruptly. The skeg could have been broken by pounding on the rocky bottom of the cove area after the accident.
- It is possible that the operator simply lost control due in inattention, distraction, etc., and was unable to regain control before colliding with the pier.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The following is presented, based on the narrative and knowledge of the boat characteristics.

Comparing this boat with those of similar power plants and hull designs (safe powering tests performed by Wyle Laboratories), it is assumed that the boat was running essentially transversely level with a positive trim angle of approximately four degrees. This running angle would allow adequate forward visibility from the helm. The operator's visibility was not restricted by glare or the boat structure, and he should have been able to see any object of significant size that was protruding out of the water in his path (refer to Figure 14 for approximate running angle).

The operator was steering with his right hand when the boat suddenly turned to starboard. He did not have time to grab the wheel with his left hand and retard the throttle with his right hand before impact with the pier. The boat impacted the pier bow on. There was visual evidence that the operator was thrown forward into the approximate center of the instrument panel.

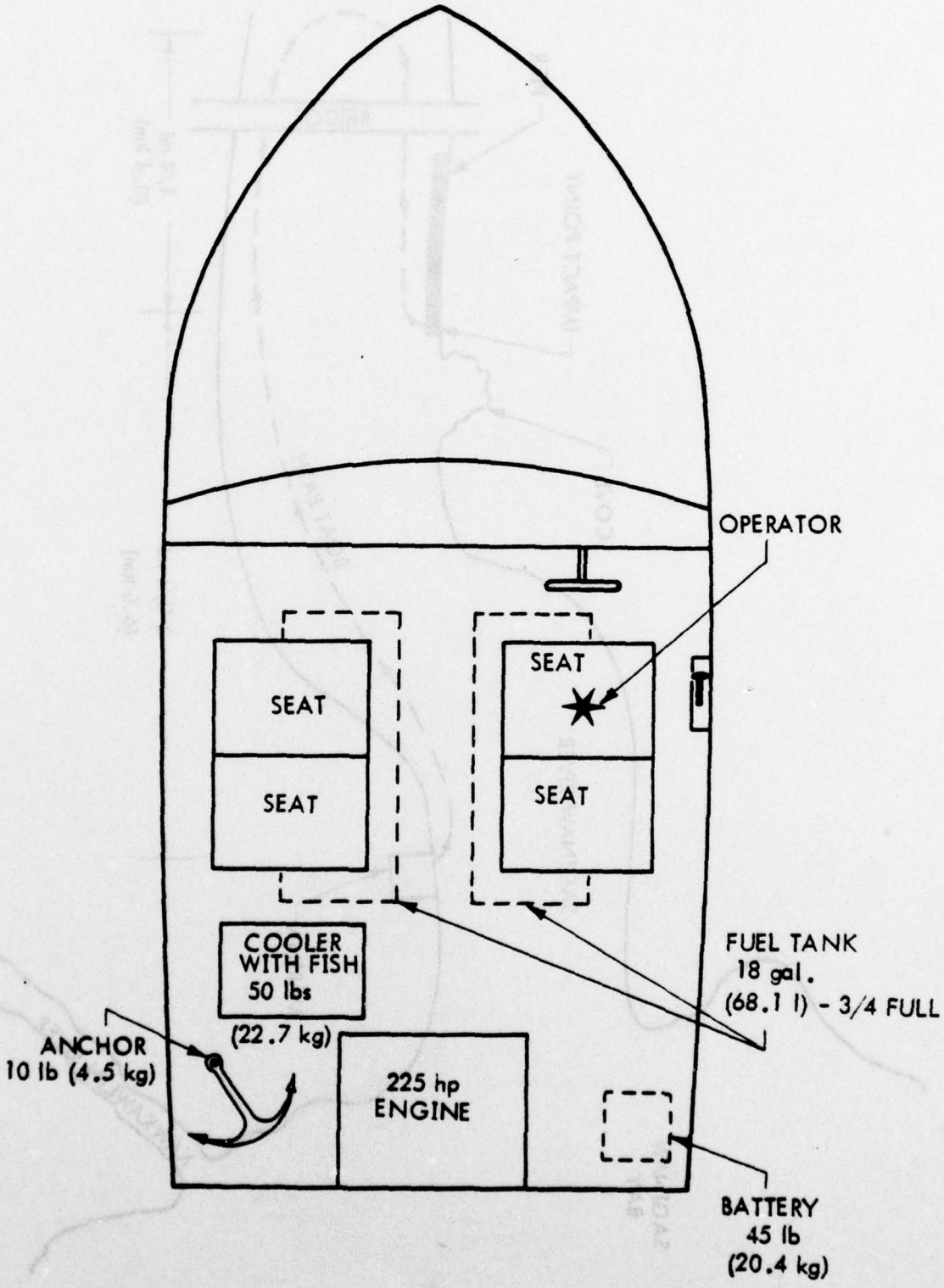


FIGURE 1. BOAT LOAD DISTRIBUTION AT TIME OF ACCIDENT

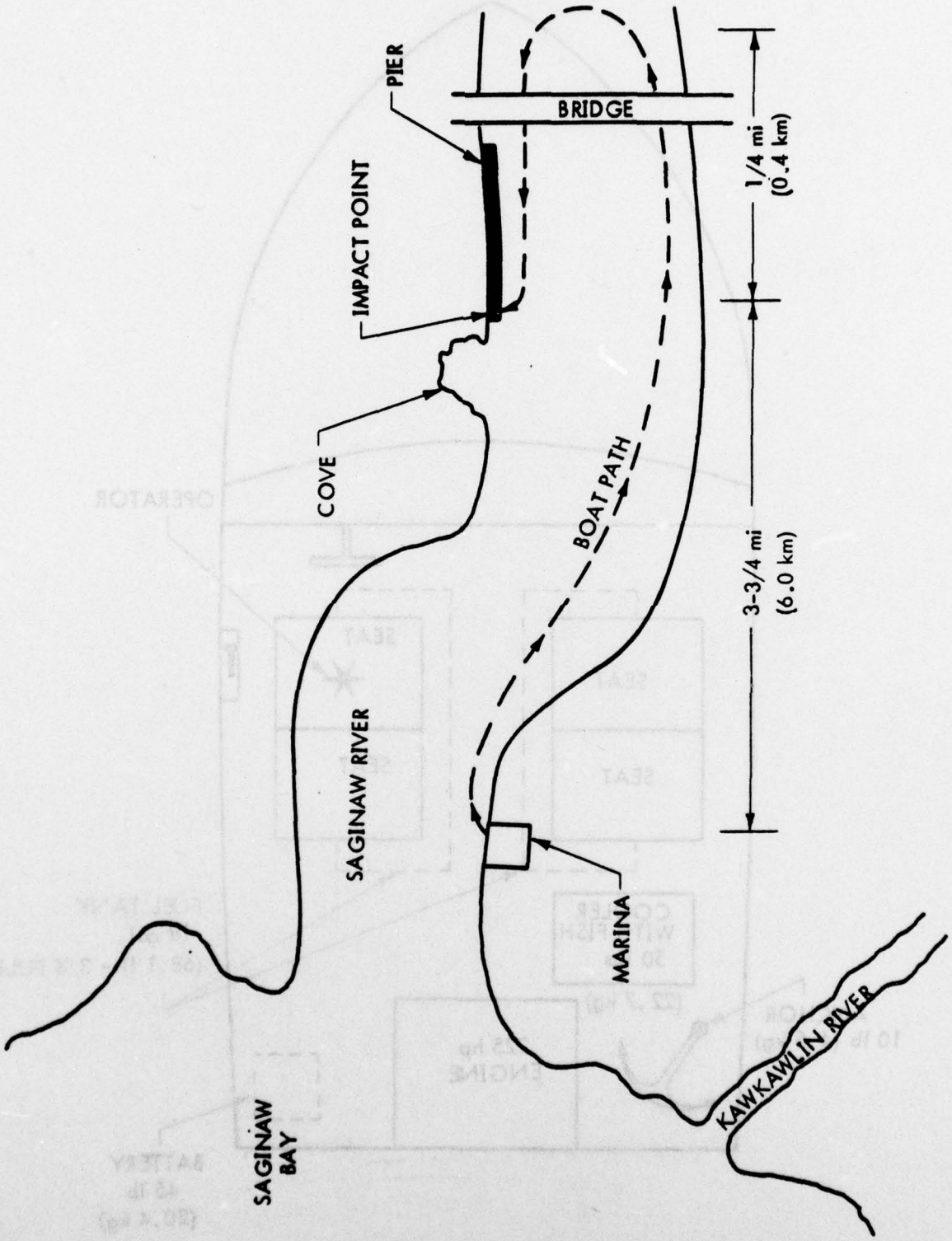


FIGURE 2. SKETCH OF ACCIDENT AREA

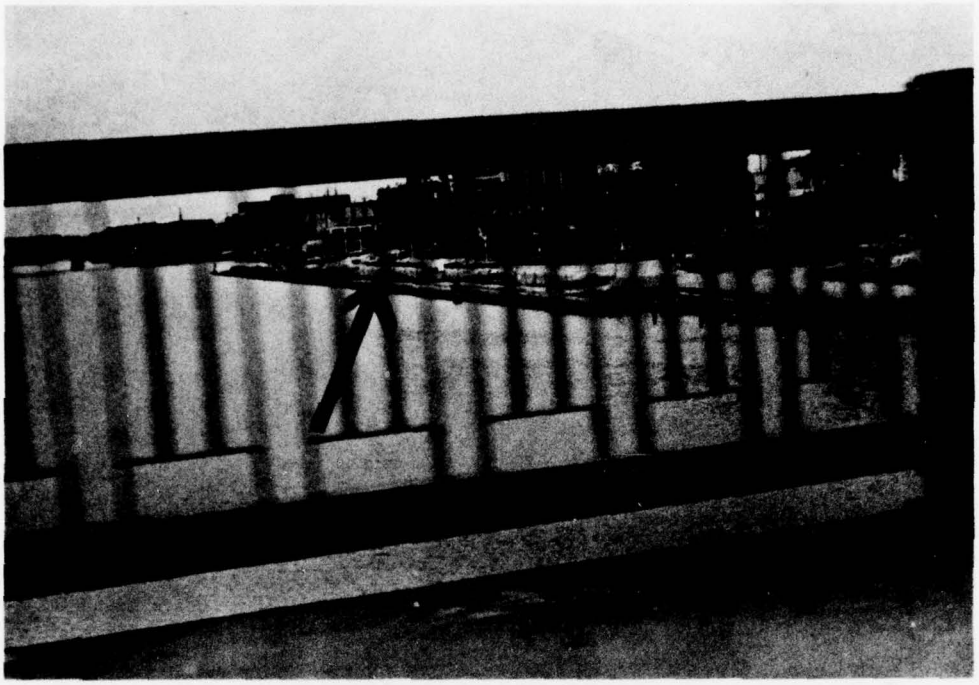


FIGURE 3. BOAT IMPACT AREA

FIGURE 4. STRUCTURAL DAMAGE TO BOW

FIGURE 5. STRUCTURAL DAMAGE TO BOW (STARBOARD SIDE VIEW)

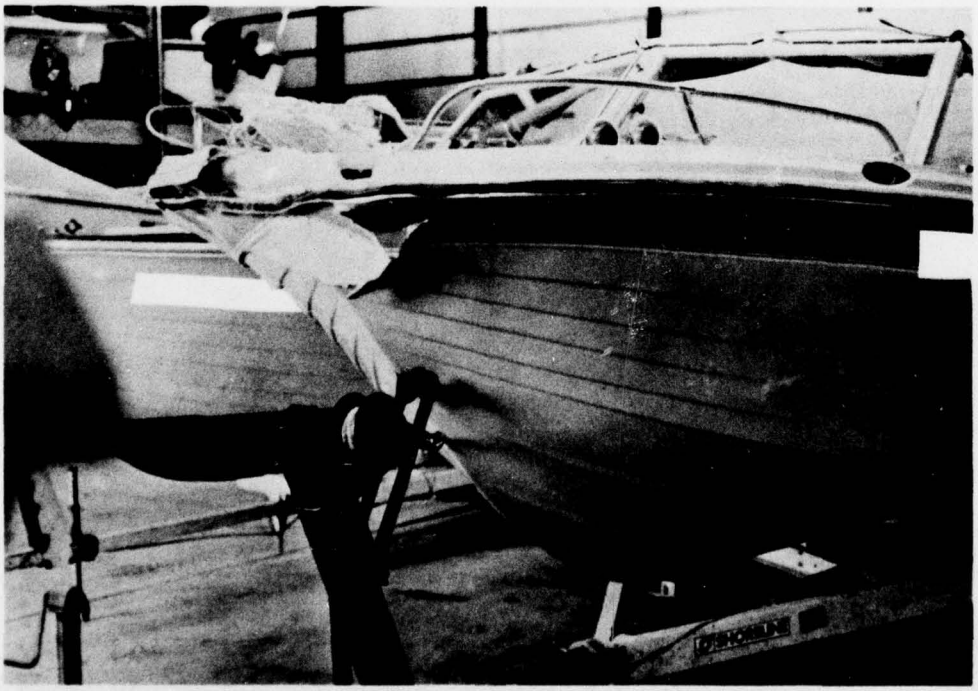


FIGURE 6. STRUCTURAL DAMAGE TO BOW (PORT SIDE VIEW)

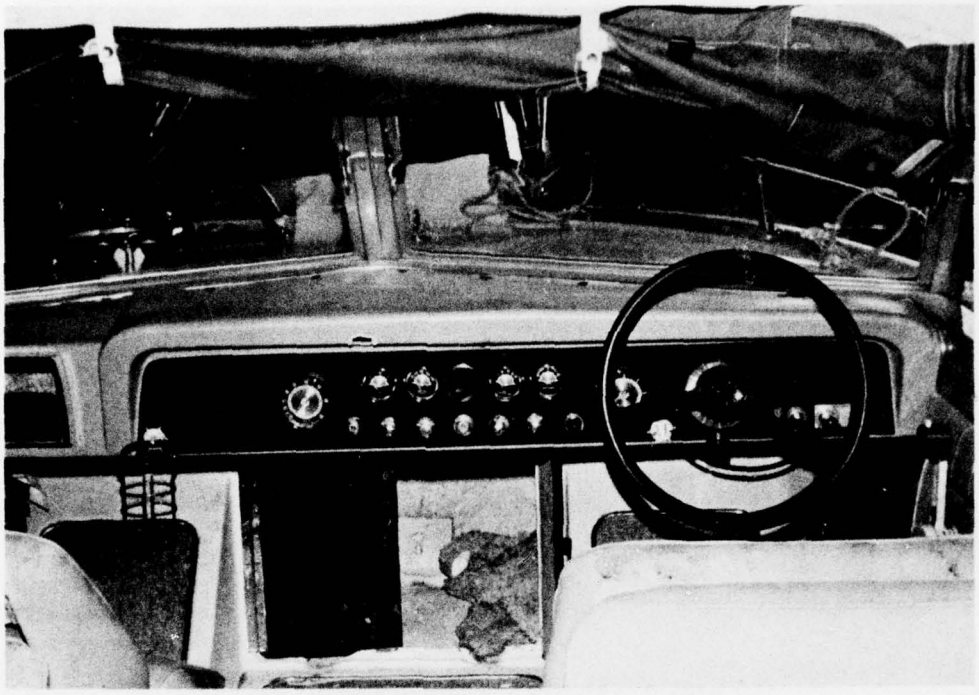


FIGURE 7. DAMAGE TO INSTRUMENT PANEL

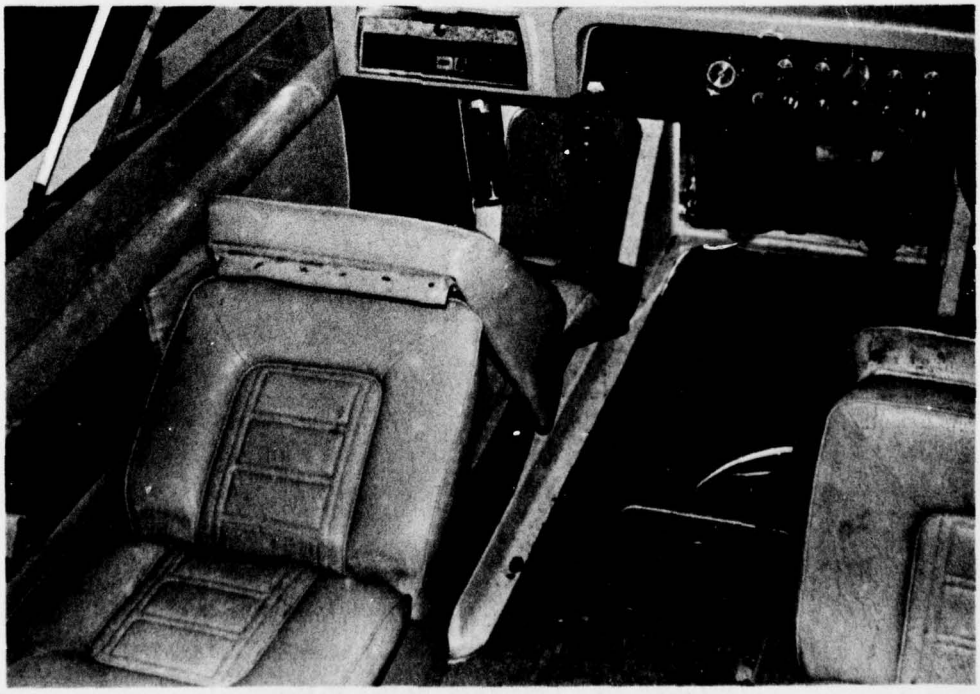


FIGURE 8. DAMAGE TO PORT SIDE SEATS

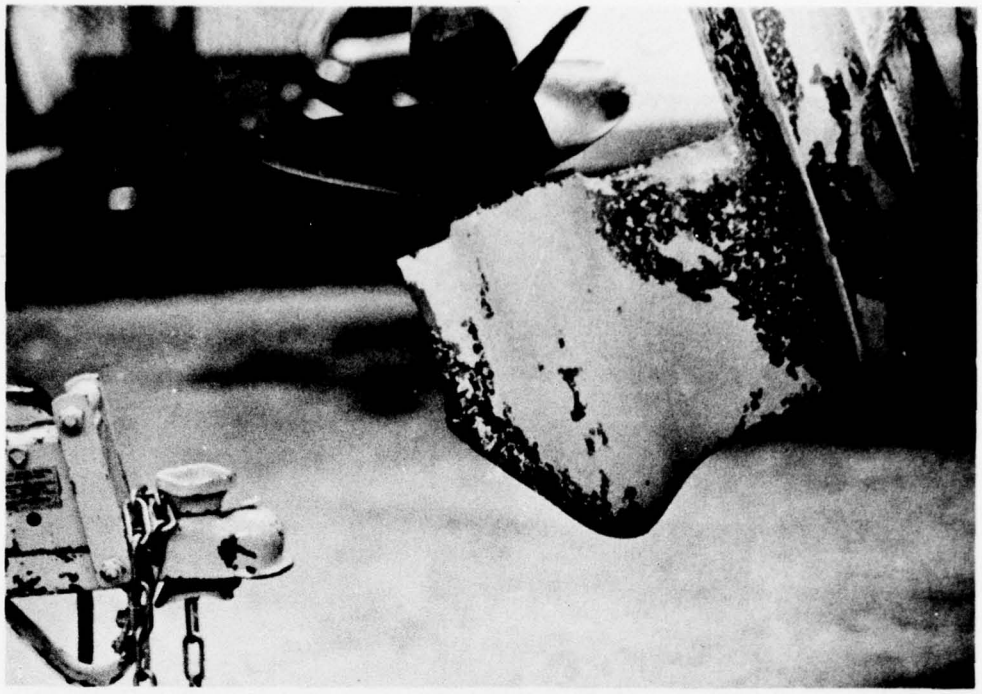


FIGURE 9. BROKEN LOWER UNIT SKEG

FIGURE 10. OVERALL BOAT VIEW

APPENDIX H. ACCIDENT NO. 76-08

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 21, 1976

Date of Accident: August 12, 1976

Investigation: Collision No. 76-08

SUMMARY — WYLE ACCIDENT NO. 76-551

Two families, each with their own boat, were picnicking on a lake for the day. After the children had been dropped off on a beach, the two owners left to check the tachometer setting of one of the boats against the speedometer reading of the other. While heading back to the beach after 20 minutes of speed checks, the first boat, a low profile 20 ft (6.1 m) day cruiser, made a 180° turn and slowed down quickly. The second boat, also 20 ft (6.1 m) in length, made the turn while slowing down to 15 mph (24.1 kph) and hit the wake of the first boat. The wake threw the driver of the second boat out of the seat and onto the floor. The second boat swerved towards the first boat and ran up on its port transom corner, over the cockpit and exited the starboard side. Two people were injured, neither severely.

1.0 BOAT OCCUPANT DATA

Boat No. 1 - Hittee

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	45	180 lb (82 kg)	Good	> 500 hrs	Yes	No	No
Pas. No. 1	M	27	160 lb (73 kg)	Unknown	None	No	No	No
Pas. No. 2	F	38	140 lb (64 kg)	None	< 100 hrs	No	No	No

The owner/operator is employed as a sheriff's deputy and had been boating for many years. He is in the Coast Guard reserves and spends his two week active duty each year patrolling the water area in which the accident occurred.

Passenger No. 1 was a friend of the owner. Passenger No. 2 was the wife of the operator of the other boat.

Boat No. 2 - Hittor

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	36	230 lb (104 kg)	Good	> 500 hrs	No	No	No

The owner/operator works as a police detective. He has extensive boating experience and is a close friend of the owner of Boat No. 1.

2.0 ENVIRONMENT

The accident occurred just before noon on a sunny, warm, windless day. The air temperature at the time of the accident was 85°F (29°C). The water temperature was 78°F (26°C). The water surface was calm except for the wakes from the boats involved.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

Both boat owners were vacationing at their river front cottages throughout the week. They had planned a family outing that would include picnicking and the development of a speed vs. rpm curve for one of the boats.

Boat No. 1, a new boat, was equipped with a speedometer. Since the second boat had no speedometer, the men planned to run side by side. The operator of Boat No. 1 was to signal the operator of the second boat at each five mile (8 km) interval so the tachometer readings could be noted.

Both owners noted that the river traffic was quite heavy that morning. They decided to trail their boats to the lake, above the dam, where the traffic would probably be considerably less dense. At approximately 0930, the families departed for the lake. The boats were launched by 1030 and a shoreside camp was set up by 1100. Since Boat No. 1 was new, the owner gave the other adult members of the party a ride in it around the lake while the children played on the beach. They returned to the beach, and the owner of Boat No. 2 took his boat out. They noted that no other boats were in the vicinity. Boat No. 1 followed with its owner/operator (left front seat), his friend (right front seat), and the wife of the owner/operator of Boat No. 1 aboard (right front seat facing aft). They ran side by side for approximately 20 minutes and were returning to the area of the campsite. Boat No. 1 was some 40 to 50 ft (12.2 to 15.2 m) to starboard of Boat No. 2. Boat No. 1 made a sharp turn to starboard and slowed quickly from 25 mph (40.2 kph) to an idle. The operator of Boat No. 1 turned to see Boat No. 2 following, slowing down slightly as he progressed through the turn.

3.2 Accident

Boat No. 1 had come off plane and had settled down into the water. In doing so, it had created a rather large wake and was pulling a series of rather steep stern waves. The owner of Boat No. 1 estimated the size of the wake to be between three and four feet (0.9 and 1.2 m). Boat No. 2 hit No. 1's port wake. The investigator estimated the wake to be approximately two feet (0.6 m).

The combination of the bow striking the port wake and the directional stability being affected by the large swells aft of Boat No. 1 caused the bow of Boat No. 2 to suddenly swerve to starboard. When that happened, the operator, who was sitting in the starboard seat with one hand on the throttle and one hand on the wheel, was thrown into the floor in the aisle between the seats. The bow of the boat continued to turn to the right until the boat was parallel with the wake.

The male passenger in Boat No. 1 saw the boat swerve and actually saw its operator fall from the seat. He turned around, hollered, grabbed the female passenger by the arm and swung her down between the seats. He then ducked. Meanwhile, the operator of Boat No. 1 turned to his left to see, "(a) bow pointed way up in the air." He said that he never did hear the other boat. At that instant, Boat No. 2 hit Boat No. 1 on the port cockpit coaming about 3.5 ft (1.1 m) forward of the transom. As Boat No. 2 climbed up onto Boat No. 1, its port chine struck the operator of Boat No. 1 on the back of the head, driving his face into the steering wheel. The boat continued forward and struck the female in the middle of the back. The male passenger turned around in his seat and struck the side of Boat No. 2 in an attempt to push it away.

Boat No. 2 continued to pass over the cockpit. Broken spots on the cockpit coaming of Boat No. 1 indicate that the bow of Boat No. 2 exited the starboard side of Boat No. 1 approximately seven feet (2.1 m) forward of the transom. The stern of Boat No. 2 exited about three feet (0.9 m) from the transom of Boat No. 1.

According to the operator of Boat No. 2, he fell when the boat swerved and had almost gotten to his feet when the collision occurred, which caused him to fall again. As the boat slid off Boat No. 1, he again stood up and shut off the engine. His boat came to rest about 15 ft (4.6 m) from Boat No. 1.

3.3 Post-Accident

The three people on board Boat No. 1 quickly determined that there were no serious injuries and that they weren't sinking. They signalled to the operator of Boat No. 1 that they were OK and decided to go back to the cove as quickly as possible.

The operator of Boat No. 1 had head injuries consisting of lacerations on both the back and the front of his head. The female had been hit on the back and was sore. Her back was scraped with bottom paint embedded under the skin. The male passenger sustained no injuries.

Both parties decided to pack up and leave immediately and get the operator of Boat No. 1 to the hospital for the cut on his head. Boat No. 2 was left at a slip on the lake. Boat No. 1 was hauled out and trailered back to the city for repair. The occupants went to the Coast Guard base, filled out reports, and continued on to the hospital where they were treated and released.

3.4 Time Sequence of Events in the Accident

0800	-	Awoke
0930	-	Departed for lake
1000	-	Arrived at lake
1030	-	Launched boats
1100	-	Set up camp
1115	-	Boated
1145	-	Ran tack/speed checks
1215	-	Collision
1315	-	Filled out report at Coast Guard base
1400	-	Treated at hospital

4.0 VESSEL DATA

Neither boat was available for inspection. However, the deck of Boat No. 1 had been replaced by the factory after the collision and was available for inspection at the factory. Marks on the coaming and deck reinforced the operator's recollection of the dynamics of the collision. Boat No. 2 was not damaged; however, the propeller had to be replaced.

Boat No. 1 was a 1976 21 ft (6.4 m) Day Cruiser manufactured by Eliminator Boats. It is 21 ft (6.4 m) long, 7.5 ft (2.3 m) wide, and is powered by a 325 hp inboard engine driving a water jet. The boat was specially built for the owner with added hull reinforcements and other refinements that, according to the owner, brought it up to "Coast Guard specifications." The entire deck had to be replaced at a cost of approximately $2500.

Boat No. 2 was a 1973 Bayliner Admiralty model powered by an OMC 165 inboard/outdrive. The boat is 19 ft 7 in. (6 m) long, has a 7 ft 7 in. (2.3 m), and weighs 2250 lb (1020.6 kg). It was equipped with a hardtop. A 1976 model boat was inspected which was reported to be identical to the 1973 model. The control station was well designed except for the fact that there was insufficient clearance between the seat and the cabin top. Because the boat rode at such a bow high attitude while getting up on plane, the owner said he often stood in the center opening with his head forward of and above the cabin top during the transition mode.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

Stressors such as heat, alcohol, and fatigue were not involved. The hittor was well rested and sober. Glare was present, but probably wasn't a factor in the accident.

The operator of Boat No. 2 had Boat No. 1 in sight through his side window just before he fell out of his seat. But because he was slowing down and because the boat was probably running bow high at that speed (15 mph (24.1 kph)), he didn't see the wake that he hit.

As a check on the visibility from the seated operator's station, measurements were taken and were compared to the visibility standard in the Coast Guard Voluntary Design Standard now under development. In order to comply with the standard, the seat would have to be raised six inches (15.2 cm) which would entail a total redesign of the control station.

6.0 PROBABLE CAUSE OF THE ACCIDENT

The two operators were friends, had been boating together for quite some time, and were in the process of converging to discuss the results of the speed vs. tachometer reading tests that they had just completed. The operator of Boat No. 2 cut too close behind Boat No. 1. The wake caught the bow and swung it to the right, causing the operator to fall out of his seat. The boat continued to surf along the wake until it hit Boat No. 1.

Poor forward visibility from the helm contributed to the cause. The operator couldn't see the wake forward.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

At the bow high attitude, the bow was cantilevered out of the water. Because the length of the waterline was decreased, the resistance to turning when a transverse force was applied to the bow was greatly reduced. Because the boat was decelerating, there was no forward thrust from the propeller that would have helped to propel it through the wake. Instead, the three to four ft (0.9 to 1.2 m) wake contacted the side of the hullside at the bow and forced it to the right. The operator was located approximately six ft (1.8 m) forward of the center of rotation; therefore, he was thrown to his left into the aisle.

The boat continued at a bow high attitude and mounted the cockpit area of Boat No. 1. The momentum carried it completely over the other boat.

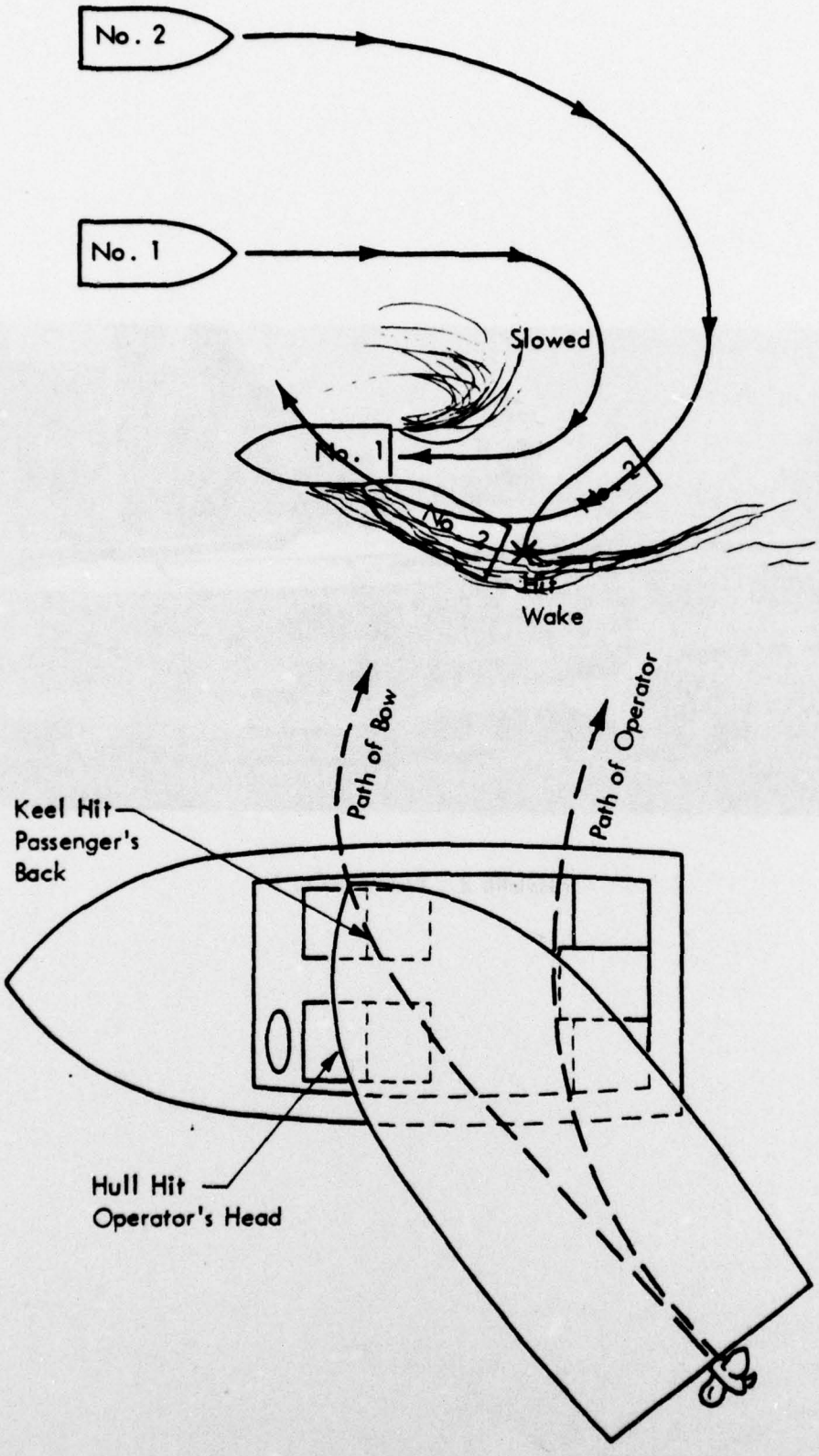


FIGURE 1. COLLISION AREA DIAGRAM

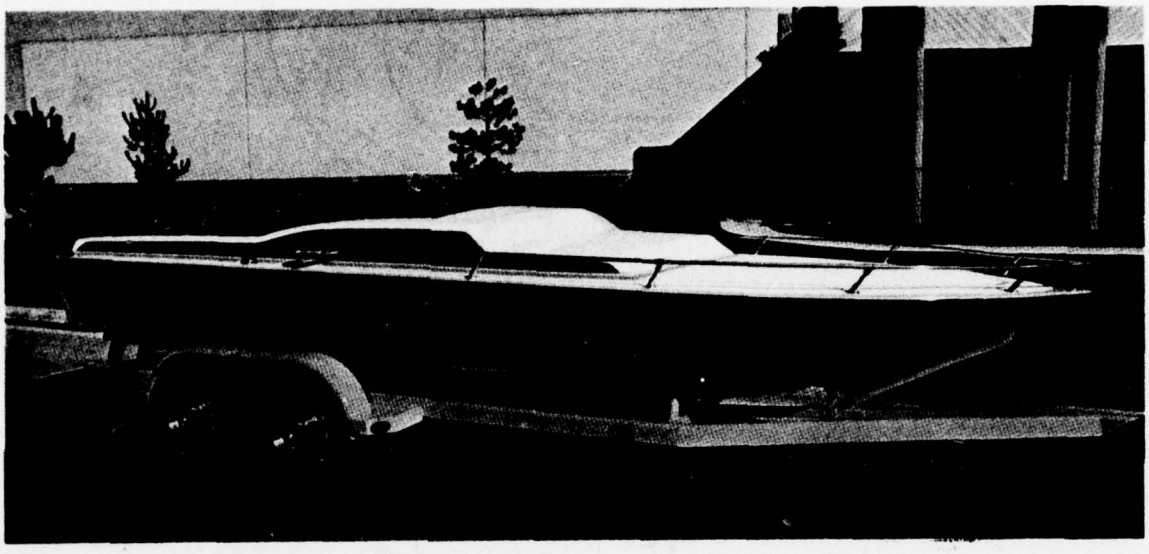


FIGURE 2. BOAT NO. 1

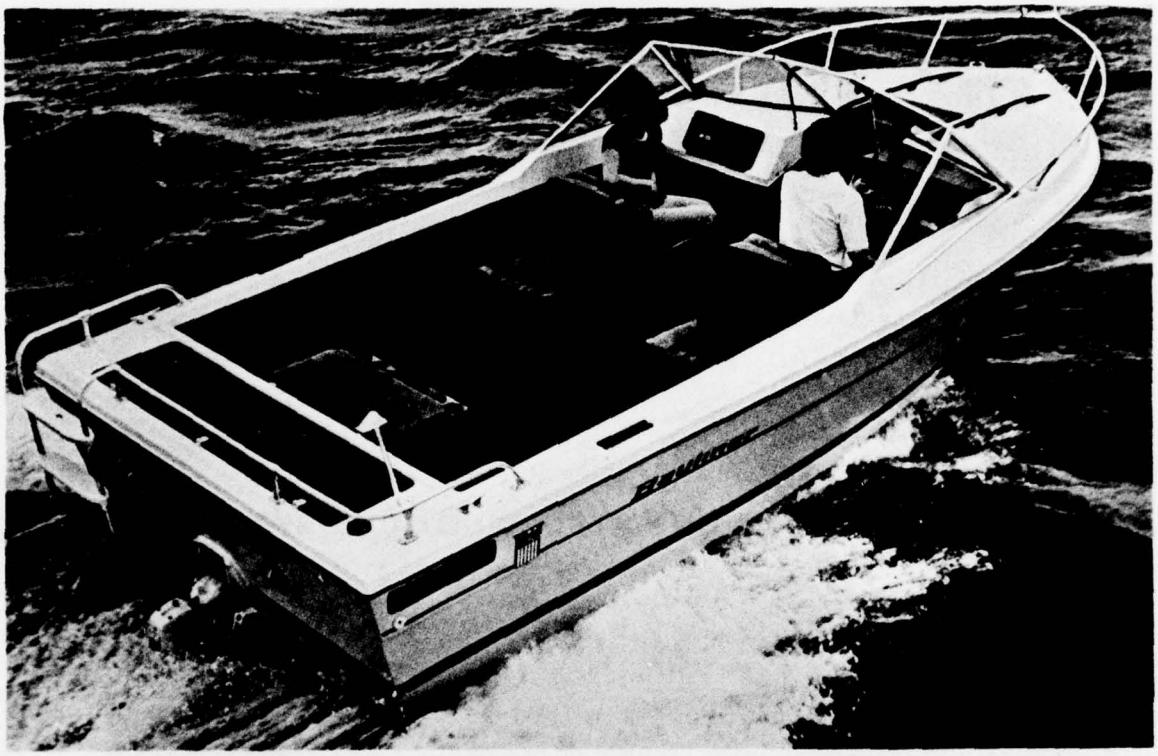


FIGURE 3. BOAT NO. 2

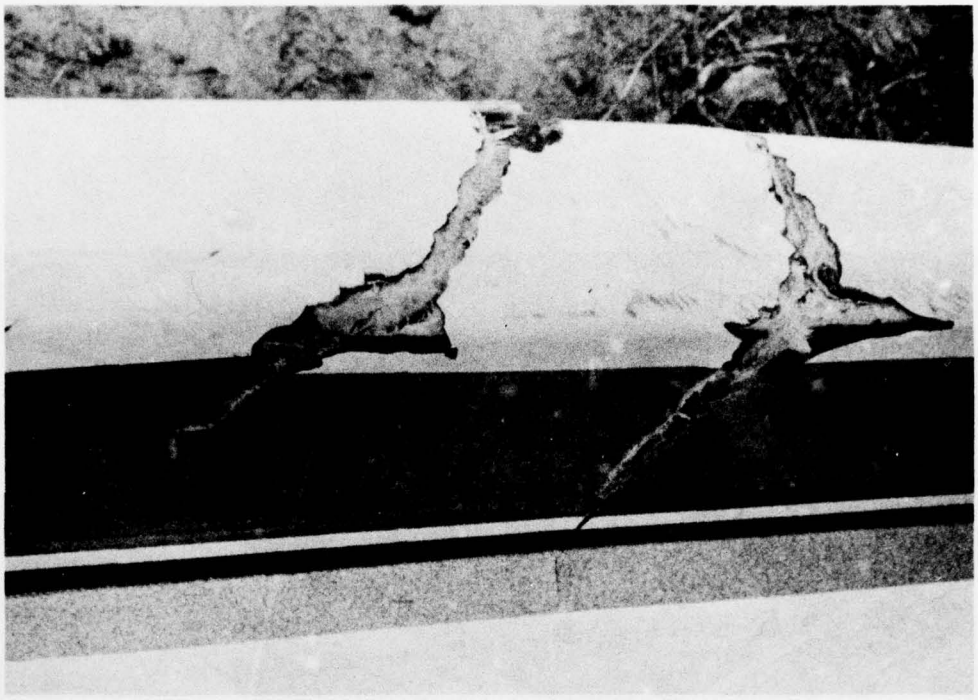


FIGURE 4. BOAT NO. 1 - DAMAGE ON PORT COAMING CAUSED BY BOW OF BOAT NO. 2

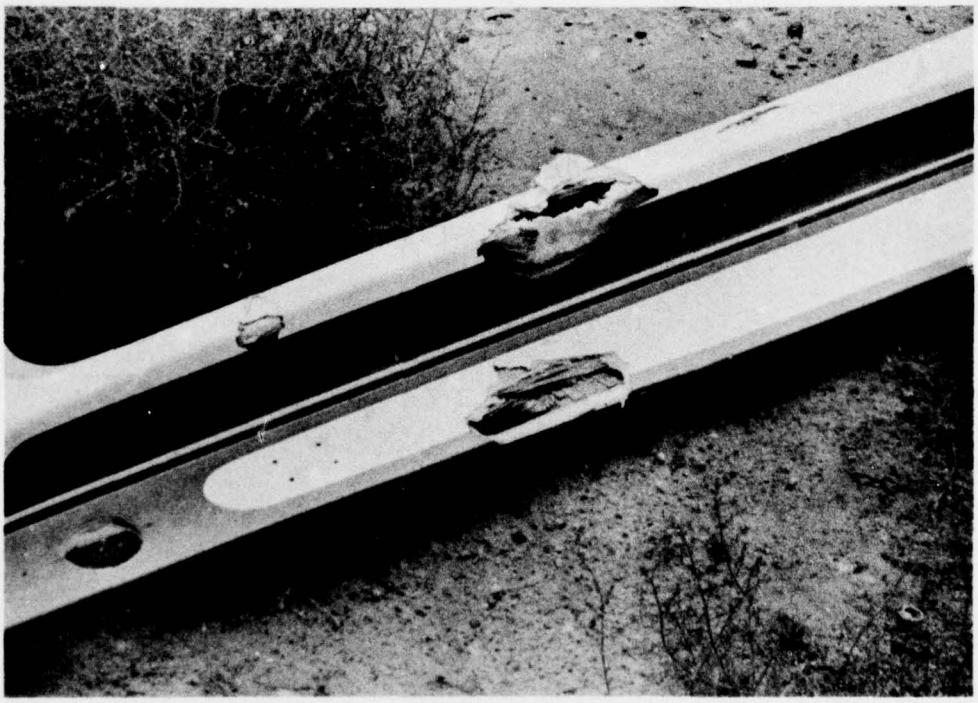


FIGURE 5. BOAT NO. 1 - DAMAGE ON STARBOARD COAMING CAUSED BY PROPELLER OF BOAT NO. 2

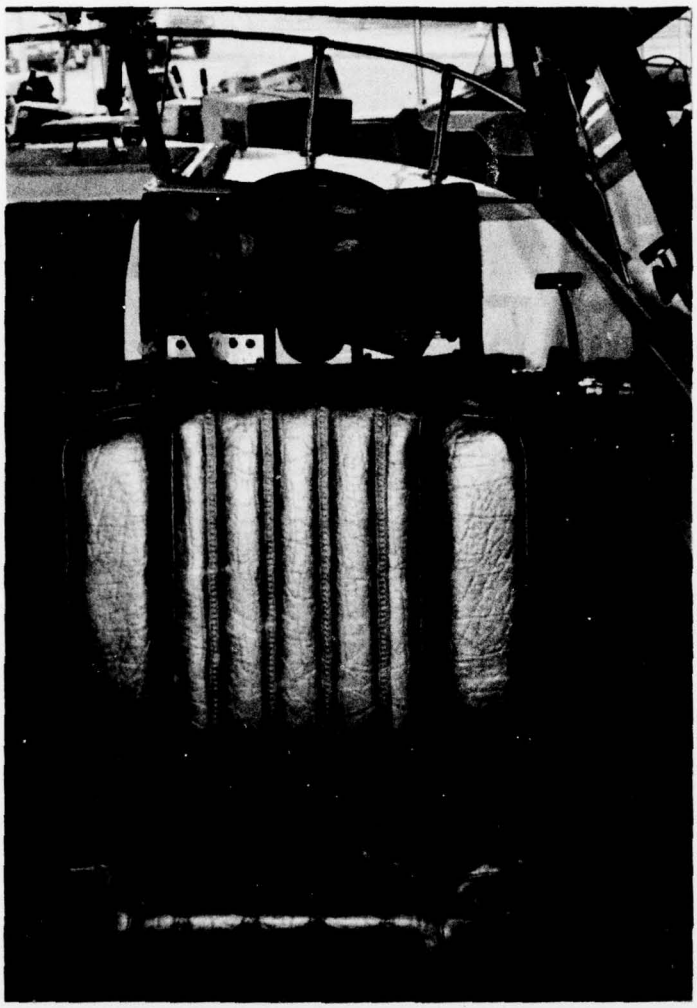


FIGURE 6. CONTROL STATION - BOAT NO. 2

APPENDIX I. ACCIDENT NO. 76-09

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 30, 1976

Date of Accident: September 23, 1976

Investigation: Collision No. 76-09

SUMMARY — WYLE ACCIDENT NO. 76-553

A man invited three friends for an evening ride on his 24 ft (7.3 m) I/O cruiser. They ate, left at 1700 and cruised around the lake for four hours. At 2100, he attempted to enter the mouth of the river leading to his marina. A ship had hit one of the lights marking the entrance. He ran parallel to shore, past the river entrance at about 15 mph (24.1 kph) and hit a breakwater. The boat went up onto the breakwall and slid back down into the water. The engine stalled and couldn't be re-started, and one passenger was injured. The Coast Guard towed the boat in.

1.0 BOAT OCCUPANT DATA

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	31	150 lb (68 kg)	Good	> 100 hr	No	No	No
Pas. No. 1	M	20	150 lb (68 kg)	Yes	First Time	No	No	No
Pas. No. 2	M	31	170 lb (77 kg)	Yes	> 100 hr	No	No	No
Pas. No. 3	M	21	170 lb (77 kg)	Yes	< 100 hr	No	No	No

The owner/operator worked as a technician and had owned several boats. Most of his boating experience was in the area of the accident. His passengers were from work and from the marina where he kept his boat. In fact, one of the passengers was the marina owner.

2.0 ENVIRONMENT

The air temperature was in the 60°F (16°C) range. A light to moderate wind was blowing from the north which created a choppy condition on the water surface. Sunset was at 1847. The moon was in the new moon phase and set at 1832. At the time of the accident (2100), both the sun and moon had been below the horizon for two and one-half hours. The weather was clear, but it was obviously very dark.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

The owner of a 24 ft (7.3 m) cabin cruiser invited three friends for an evening boat ride. He worked all day at his job as a technician, finished work at 1530, ate dinner, and went to the marina. He and his three passengers left the marina at 1700, proceeded down the river, exited into the lake and headed generally northeast away from shore. They made a big loop and at approximately 2050 approached the mouth of the river. The area is protected with breakwaters on the north and east and has ten lighted aids to navigation marking the breakwater, channel, and river entrance (see Figure 1).

He rounded the southern tip of the breakwall and headed northeast towards the mouth of the river. He knew that the flashing red north pier light marking the right side of the river entrance was out due to being damaged by a ship earlier in the month. As he and one passenger searched for the mouth of the river, he slowed the boat down to about 12 to 15 mph (19.3 to 24.1 kph).

He claimed that the night was very dark. The water was choppy making it difficult to read reflections as an aid to collision avoidance. The shore ahead of him was dark anyhow which made it very difficult to see the mouth of the river. He wasn't using a chart, but was using only his memory of the harbor configuration. The boat was equipped with a powerful remote operated searchlight, but he didn't use it.

3.2 Accident

The boat passed the mouth of the river by one-half mile (0.8 km) and hit the breakwater which rises about two feet (0.6 m) above the water surface. The passenger sitting on the port forward seat was thrown forward and suffered a laceration under the chin.

Because the boat was running at "hump speed" and, therefore, at a high running angle, the stem well below the waterline hit the breakwall and was crushed, allowing water to enter the boat. The boat continued up onto the breakwall, turned to the left and slid back down into the water on the same side of the breakwall.

3.3 Post-Accident

The engine stalled when the boat hit the seawall and couldn't be re-started after the accident. The owner/operator assessed the damage and noted that water was entering the forward portion of the boat. After the bilge pump was turned on, the water rose to about a foot above the forward cabin sole and remained at that level. The owner/operator called the Coast Guard on his VHF radiotelephone. A Coast Guard vessel arrived in about ten minutes. The boat was towed to the Coast Guard station and the injured passenger was taken to the hospital.

Another boat was in the area, but its occupants refused to offer aid to the stricken vessel. Coast Guard personnel on the scene claimed that the injured passenger was intoxicated and that liquor was evident on the owner/operator's breath. The next day the owner/operator returned to the Coast Guard station, drove his boat to a launch ramp, and hauled it away for repairs.

3.4 Time Sequence of Events in the Accident

1530	-	Owner/operator finished work
1600	-	Owner/operator ate dinner
1700	-	Boat trip commenced
1847	-	Sunset
2100	-	Boat entered harbor area
2110	-	Collision with seawall
2140	-	Coast Guard arrived
2250	-	Boat secured at Coast Guard dock

4.0 VESSEL DATA

The boat was a 1976 Thompson Voyager, 23 ft 4 in. (7.1 m) long, eight feet (2.4 m) wide, weighed 4500 lb (2041.2 kg), and was powered by a single 255 hp inboard/outdrive.

Figure 1 is the collision area diagram. Figure 2 shows the arrangement of the boat. Figure 3 shows the damaged forefoot. Figure 4 is an advertising photo of that model. Figure 5 shows the profile.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The operator and his passengers had been drinking. It is unknown how much the alcohol affected his decision making processes, but it is known that:

1. There were more than enough lighted aids to navigation in operation to permit him to enter the mouth of the river safely.
2. The operator was familiar with the harbor area.
3. The operator knew the light was out.

If alcohol had not been present, he may have:

1. slowed down or stopped when he became disoriented (couldn't find the mouth of the river),
2. used the other lighted aids to navigation to guide him into the mouth of the river,
3. not become disoriented to begin with, and/or
4. used his searchlight.

From the human engineering standpoint, he may not have been able to see the breakwall in front of him because:

1. The high trim angle may have put the cabin top above the horizon as seen from the operator's seated eye position.
2. The forward facing white light glares on the forward cabin top.
3. Visibility through the windshield is reduced due to glare from the white light.
4. Instrument lights may have created a glare into the operator's eyes.

6.0 PROBABLE CAUSE OF THE ACCIDENT

1. The operator's judgment was impaired because he had been drinking alcoholic beverages.
2. The view forward was obscured by the cabin top and glare from the white light over the windshield frame.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

Because the boat was operating at a bow high attitude, the forefoot was at such an angle that it enabled the boat to slide up onto the breakwall. Thus, much of the energy was absorbed by the friction of the starboard portion of the bottom of the boat as it rode up onto the breakwall. Had the boat been going slower, it would have been running at a flatter angle. The stem may have been crushed, thus opening a larger hole for water to enter. If the boat had been going faster, it would also have been running flatter with the same results.

The boat hit the breakwall at an angle, and, therefore, was deflected as it rose up onto the wall enabling it to re-enter the water on the same side of the breakwall.

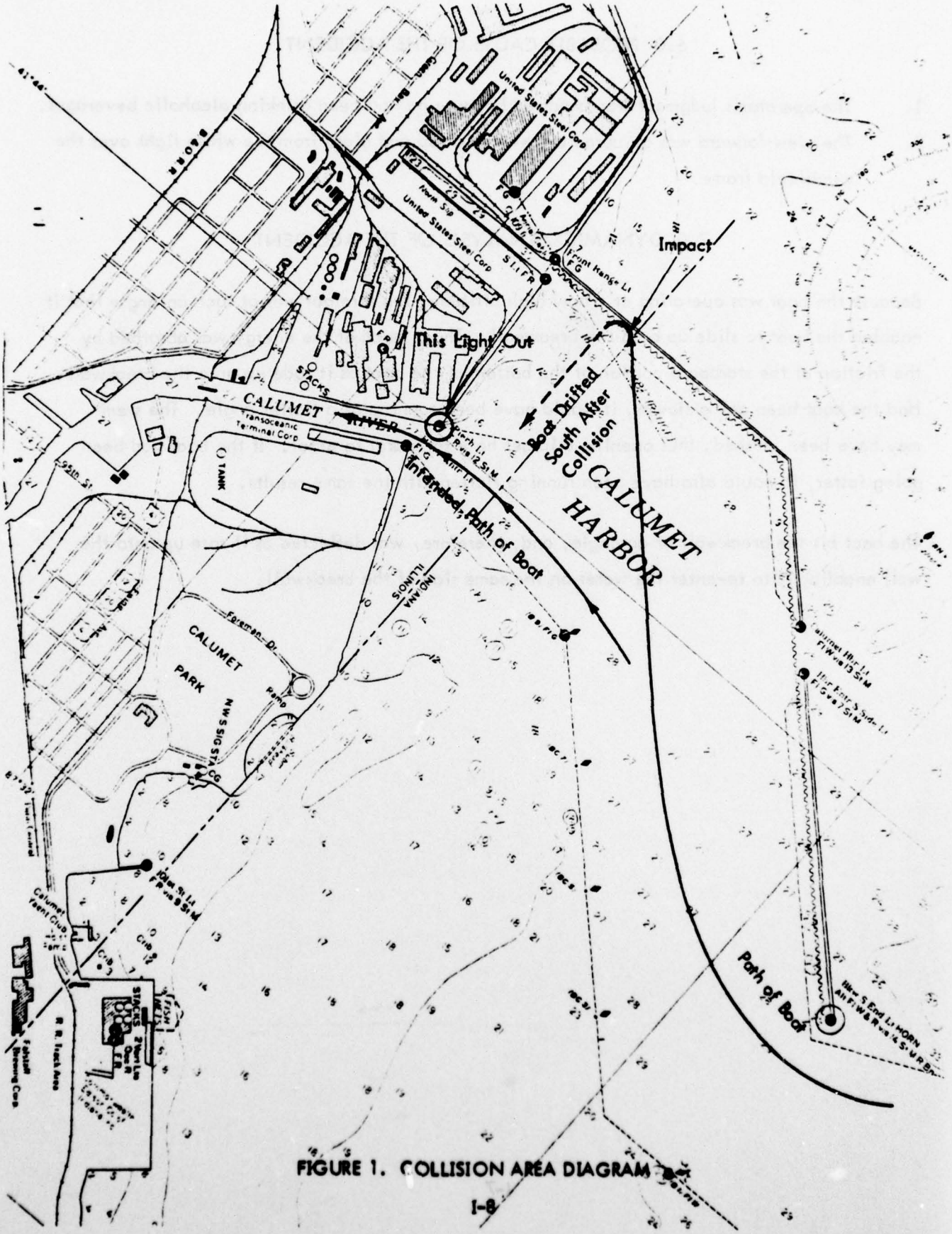


FIGURE 1. COLLISION AREA DIAGRAM

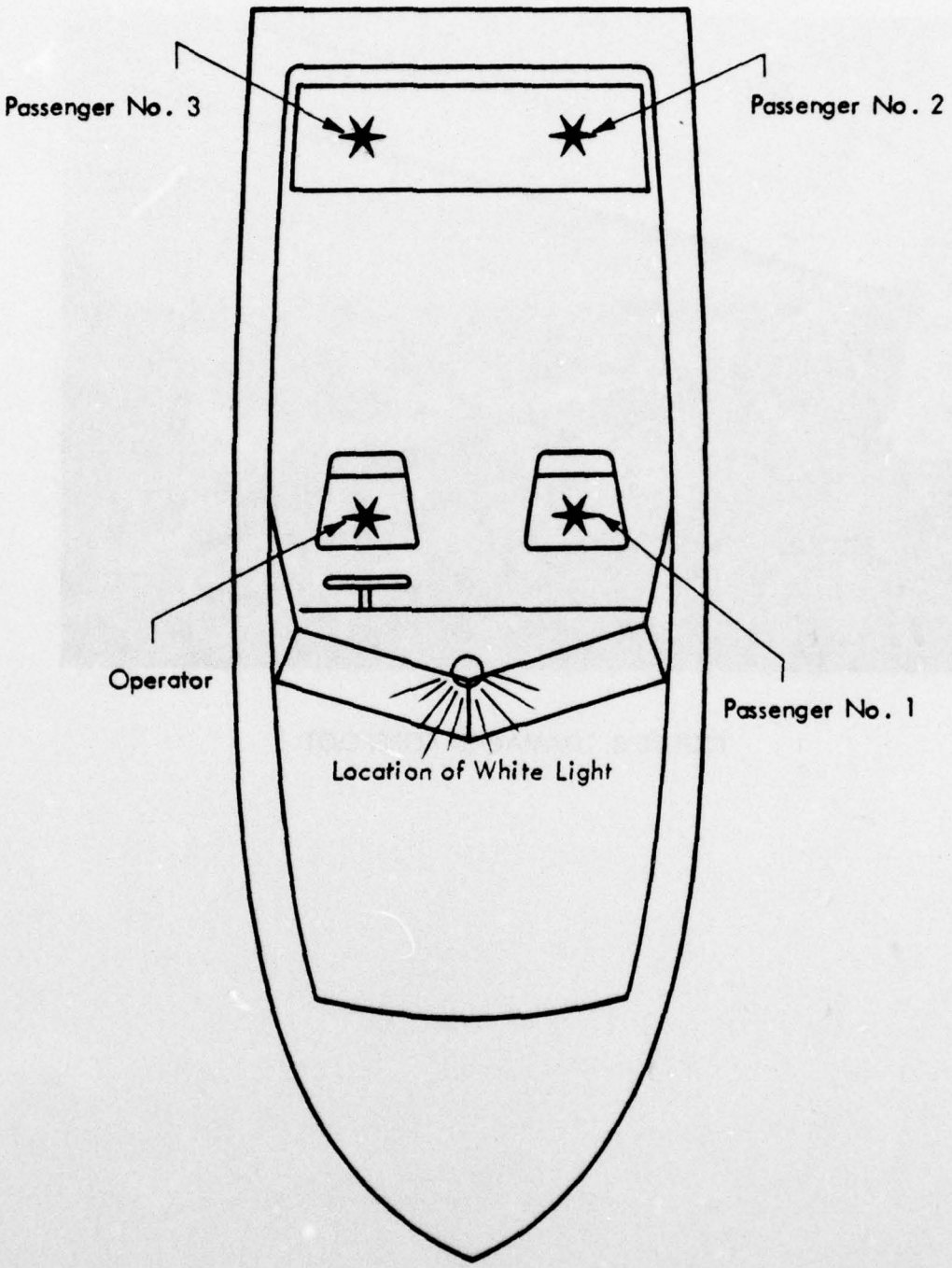


FIGURE 2. ARRANGEMENT PLAN

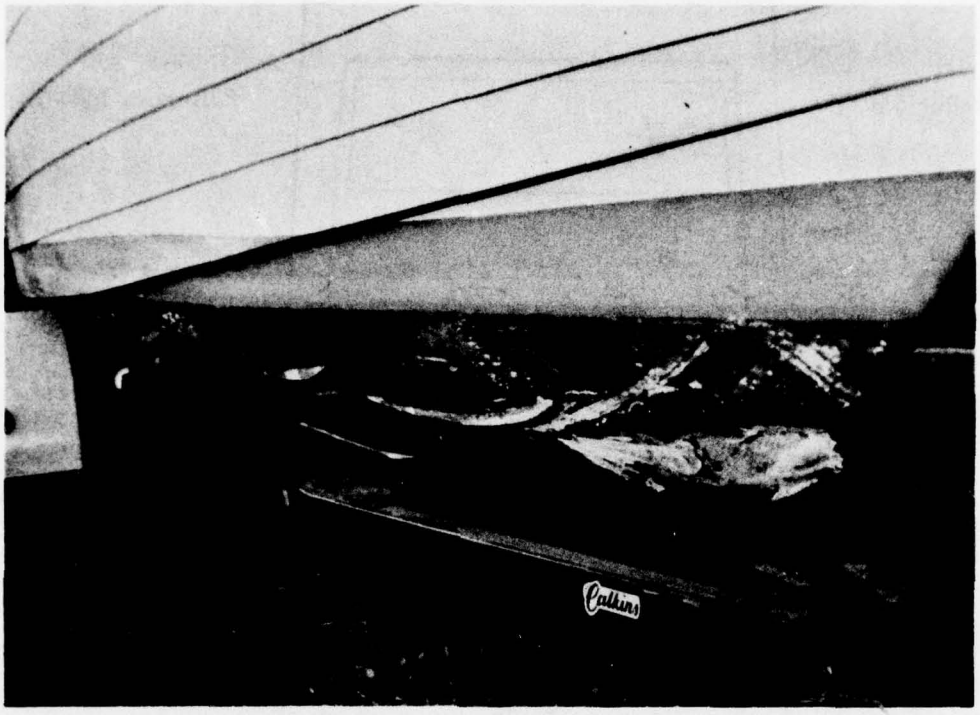


FIGURE 3. DAMAGED FOREFOOT

FIGURE 4. ADVERTISING PHOTO OF SAME MODEL BOAT

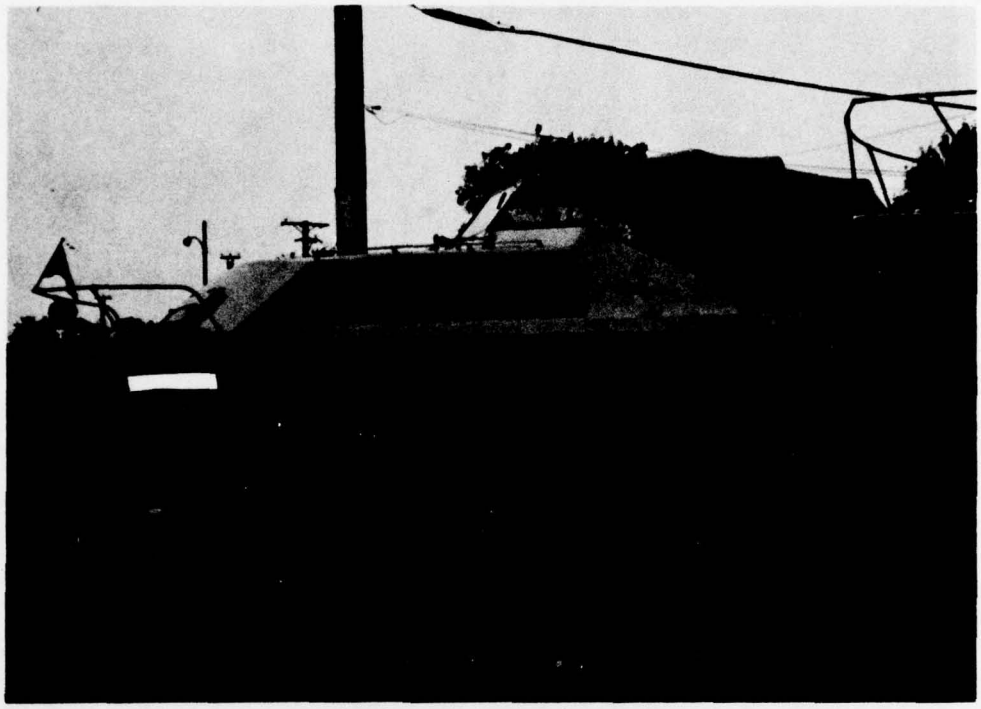


FIGURE 5. PROFILE

APPENDIX J. ACCIDENT NO. 76-10

ACCIDENT INVESTIGATION REPORT

Dates of Investigation: 21 August and 2 September 1976

Date of Accident: 17 August 1976

Investigation: Collision No. 76-10

SUMMARY — WYLE ACCIDENT NO. 76-449

The accident reported herein was the collision of a 23 ft (7 m) open sport fishing boat and a drifting 18 ft (5.5 m) wooden runabout. The larger boat suffered relatively minor damage, but the smaller vessel sank and has not been recovered. There were no injuries or fatalities.

Many boats were engaged in drift fishing at The Race on Long Island Sound at night. The operator of the 18 ft (5.5 m) runabout removed the bulb from his 360° sternlight because of the glare. Later he noticed a 23 ft (7 m) center console fishing boat heading toward him from astern. He replaced the bulb and waved his hands over the light to attract attention. Because the fishing boat was running at such a bow high attitude, the standing operator couldn't see the runabout in front of him. The runabout operator jumped overboard just before the fishing boat ran up and over his transom. The runabout sank. There were no injuries.

1.0 BOAT OCCUPANT DATA

Wooden Runabout

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	32	105 lb (48 kg)	Good	>500 hr	USPS	No	No
Passenger	M	24	220 lb (100 kg)	Good	<20 hr	None	No	No

Only the operator of this boat was available for interview. He is single, employed as a shipyard engineer, holds a private pilot's license, and has a high degree of interest in water-related activities. (He had a large fiberglass sailboat under construction in his yard.) He holds a Coast Guard ocean operator's license and has served under it as captain of charter boats. He reports being involved with boats for over ten years and has owned several sailboats and dinghies, but the boat involved in the accident was the first powerboat he had owned, having been purchased at the beginning of the season. He used the boat for non-commercial fishing, lobstering, and scuba-diving in Long Island Sound. This season was his first on that body of water, and he estimated that he had operated there about 20 or 25 times. His experience at The Race was more limited, though, as he had only fished there about five or six times. (He mentioned at the very beginning of the interview that he did not have much experience at that location.)

This operator seemed to be of above-average intelligence and physical ability, and reported being in good health. He said that he wore a PFD only in rough water, chiefly on sailboats, but mentioned wearing one earlier this season when he purposely allowed his boat to drift into the rip at The Race so that he could become familiar with the particular conditions there.

The passenger in this boat is employed as a shipfitter at the shipyard in which the operator works. They had previously gone out together in the boat on a few occasions. The passenger has never owned a boat.

Sport Fishing Boat

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	28	138 lb (63 kg)	Good	> 500 hr	None	No	No
Passenger	F	26	160 lb (73 kg)	Non-Swimmer	> 500 hr	None	No	No

Again, only the operator was able to be scheduled for an interview. He is employed at his father's auto body shop, is married (to the passenger), and has two children. He seems to be of average intelligence and physical ability, and reports being in good health, notable in the areas of hearing and eyesight. He is rather short in height, about 5 ft 3 in. (1.6 m). He has owned seven boats throughout the years, each one larger than the last, since his start in boating in 1968 with a 16 ft (4.9 m) model. Almost all of his experience has been on Long Island Sound, including The Race, where he reported operating about four times a week during the boating season. Most of his boating time has been spent fishing during the evening and at night. His wife usually accompanied him, and had handled their boats on a regular basis.

The operator admitted having been involved in one other boating accident, in which he collided with a boat at night, but which resulted in no damage to either craft. He was reluctant to elaborate, but did answer that it did not involve his current boat or a problem with visibility.

2.0 ENVIRONMENT

Weather at 2130, the time of the accident, was clear skies, calm seas outside the rip, light winds, and excellent visibility (except that the sky was dark: sunset had occurred at about 2000 and the moon had not yet risen). The current was ebbing at near its maximum velocity of 2.6 knots. The air temperature was 71°F (22°C). The water temperature was not determined, but was described by the operator of the runabout as "nice," although he felt chilled during the ride to shore after the accident. The water depth at the accident site was about 30 to 60 ft (9.1 - 18.3 m).

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

Wooden Runabout

The owner/operator and his passenger had worked at their jobs on the day of the accident. They had not gone out on the water the previous night, and had gotten a normal night's rest. The operator reported that neither he nor his passenger had consumed any alcoholic beverages on the day the accident occurred. They ate dinner, and then departed the boat's mooring, located within 3 mi. (4.8 km) of the operator's home, at about 2000. They were both dressed in street clothes, and the operator wore cowboy boots.

The operator said that there were no known handling, control, or equipment problems with his boat. Gear carried on the trip included fishing tackle; a fire extinguisher; two anchors and line; two Type I, two Type II, and one Type IV (buoyant cushion) PFDs, all stored under the bow; two additional buoyant cushions, located on seats in the passenger compartment; an electric horn; a lighted compass; a hand-held red flare; a diver's flashlight; and a small-craft series chart of the area. The operator's Irish setter was also aboard, and slept forward of the front seat during the trip.

They traveled directly to The Race, a voyage of about 6 mi. (9.7 km), and there followed the usual method, on an ebbing current, of fishing while drifting (engine usually off) with the current and toward the rip; and upon reaching the rough water, to run back up current about 300 to 600 ft (91.4 - 182.9 m). The operator sat in the forward part of the boat and his passenger sat aft. The operator initially made a few runs on the congested side of a lighted buoy (characteristic: quick flashing green), where he reported there to be about 20 other boats. He said that on one occasion he and another (unknown) operator happened to be looking at each other at the same time, whereupon the other operator turned off his boat's lights. This was interpreted to him to mean that as long as all boats drifting and running through the same area are aware of each other's presence, then running lights become unnecessary and may be turned off to minimize glare and annoyance to each boat's occupants. He said that

about three or four of the 20 boats had secured their lights, and that they were kept off even as the boats powered away from the rip. He said that this was not the first trip during which he had noticed this practice, but that he had never before extinguished his own lights.

After making several drifts on the more crowded side of the buoy, the operator moved to the other (east) side to avoid the congestion. He said that there were "every few" boats on that side. (Later in the interview he said that he thought his boat was alone on that side of the buoy.) He then made two drifts, with the lights on, without incident. After the second drift, he powered back up current the usual distance, stopped his engine, and began to drift, stern first.

Sport Fishing Boat

The owner/operator of this boat had been on vacation for almost two weeks. During that time, he and his wife would use their boat almost every night to fish in Long Island Sound, usually at The Race; and then would sleep late the next day. On the night before the accident, they had been out fishing from about 1700 to 0300. They slept until afternoon, ate a meal, and departed the boat's mooring, located about 15 mi. (24.1 km) from their home, between 1830 and 1900. The operator said that neither he nor his wife consumed any alcoholic beverages on the day the accident occurred.

They purchased the boat new (as a leftover) about one year ago. The operator reported that there were no apparent handling or control problems with it, other than the tendency for the bow to ride high and to obscure his forward vision before the boat got on plane. Gear carried on the trip included fishing tackle; a fire extinguisher; an anchor and line; four Type I or II PFDs, stored under the deck in a compartment forward of the console; and one buoyant cushion, location uncertain.

They traveled about 6 mi. (9.7 m) from the mooring to The Race. There they followed the usual fishing routine until the accident occurred. They fished on the less crowded side of the lighted buoy mentioned above. He said that there were about 15 to 20 boats on the congested side, and that they were about 200 to 300 yd (182.9 - 274.3 m) away from him. He did not know how many boats were on the same side of the buoy as he, only that he thought that none

were in his immediate operating area. According to this operator, at night boaters at The Race fish with their lights on. He said that he preferred fishing at night, not only because he thought that the fishing was better, but also because of the lesser amount of congestion and danger present than during the daytime, especially on weekends, when large numbers of boats were on hand.

3.2 Accident

Wooden Runabout

After starting his drift, the operator encountered a problem with his fishing tackle and was attempting to fix it. He said that the glare from his boat's white stern light blinded him such that he was having difficulty with the task. The light had bothered him on other occasions (but only while drifting and fishing, not while driving ahead), so he decided to remove the bulb. He said that he looked around briefly before doing so and did not notice any other boats in the vicinity. Another reason given for his action was that the practice would probably be familiar to any nearby boaters, in that they would have likely seen the several boats in the area which had already secured their lights. So, although he was thinking that it may have been "kind of stupid," he unscrewed the bulb, put it in his pocket, and shortly afterwards resumed fishing. At that time his boat was in the vicinity of the buoy.

Seconds later he saw the red and green bow lights of a boat about 100 yd (91.4 m) away and headed toward him from the rip. The operator wondered if the occupants of the other boat could see him; looking around his boat he quickly decided that his compass light and bow lights would not have been visible in the direction from which the other boat was approaching. He then got the bulb from his pocket and quickly replaced it in the fixture. The other boat kept coming, so he stood behind the light and waved his hands in front of it, hoping that the other operator would notice him or his signal. He recalled not being alarmed about the other boat at first, thinking that it was approaching so that its occupants could ask about how the fishing was in that location or that it would pass close by his boat, as boats fishing at The Race frequently do. As the boat kept coming toward him, though, he stood up on the narrow upper deck at the stern and yelled toward it. In a few seconds it had approached close enough

for him to notice that its trim and hull shape precluded its operator from seeing his boat. Deciding that collision was imminent, he jumped overboard to port, aft. His passenger remained in the boat, but had moved onto the forward deck when he saw that a collision was about to occur. Neither man used or attempted to use a PFD. (The operator said that he knew he could swim, and that he would drift with the boats.) The time was about 2130 as the larger ran over the runabout's transom and starboard quarter. Its stem hit the passenger's shoulder just before its forward movement stopped, but he suffered only a bruise. He said afterwards that he didn't think that jumping overboard was the safest thing to do.

Sport Fishing Boat

This operator finished making a drift, and was about to power out of the rip. He stood at the controls; his wife stood alongside him to the right and held onto a grabrail on the console. He looked ahead to check for other boats, saw the buoy's light but no others, and accelerated moderately. He said that his boat rides with the bow quite high until the hull planes and that his forward visibility is blocked during that time. He estimated that his boat traveled about 200 ft (61 m) before the collision. He said that his engine was making about 2000 rpm at the time of the collision. He reported not seeing or hearing any sign of the smaller boat prior to hitting it. Upon making contact, which he described as similar to hitting a rock, his boat stopped. (He mentioned that he accelerated only moderately when coming out of the rip because it was not very rough that evening and, therefore, more power was unnecessary.) His wife lost her balance and lunged forward upon impact, and while so doing grabbed the antenna and pulled its mounting brackets away from the console on which they were mounted. She did not fall to the deck, and was not injured.

3.3 Post Accident

Just after impact, the larger boat's operator shifted to neutral and started the bilge pump, in case his boat had been holed. Seeing a person in the water, he yelled, asking why the boat's lights weren't on. That person, the runabout's operator, swam to the stern of the larger boat and was helped aboard by its operator. Meanwhile, a large quantity of water had entered the

runabout over the transom, and it began to sink by the stern. Its passenger jumped into the water, and also swam to the safety of the larger boat. The runabout's operator then noticed his dog, climbing up onto his boat's bow, at that time the only part remaining out of the water. He jumped back into the water (without a PFD) and led the dog to the other boat, where it was lifted aboard. Its owner remained in the water and began to gather up some gear which had floated free from his boat. He was able to recover several items, but the water had become rough as he and the boat drifted into the rip. During this time his boat had sunk, having remained afloat only a few minutes after the collision. As he drifted into the rip, he was "knocked around" by the rough water, and the others lost sight of him. He grabbed his diver's flashlight, which was floating nearby, signalled the boat with it, and was soon picked up. During the interview, he said that he had forgotten that he would drift into the rip when he decided to remain in the water to gather the gear.

Once everyone was on board, the sport fishing boat's operator headed for shore, where the accident was reported to the local Coast Guard station. Several days after the accident, the runabout's operator and some friends dove in the area of the sinking, but were unable to locate the boat. They surmised that the strong current had carried the boat some distance away or had destroyed it.

3.4 Time Sequence of Events in the Accident

1830	-	Sport fishing boat departs mooring to fish
2000	-	Sunset; runabout departs mooring to fish
2130	-	Collision
2135	-	Runabout sinks
2140	-	All POB on cruiser; reported accident to Coast Guard

4.0 VESSEL DATA

Wooden Runabout

This boat sank as a result of the accident and has not been recovered. Information regarding it was provided by its owner/operator and was amplified by a sales brochure from his files, which is reproduced as Figure 1. The boat was a 1953 model Lyman Islander, constructed of wood and powered by a 60 hp inboard gas engine. It was 18 ft (5.5 m) in length and 6 ft 8 in. (2 m) at maximum beam. Steering was controlled by either of two side-facing wheels along the starboard side. The engine controls were located within reach of either steering position. The boat was equipped with an electric bilge pump, but was not provided with separate means of flotation. It was fit out with navigation lights for Inland Rules: a combination red and green light forward and an all-around white light aft, mounted atop the flagstaff at the starboard quarter.

Sport Fishing Boat

This boat is a 1974 model Seacraft SF23, HIN: SECF3190M74F, constructed of FRP and powered by an OMC inboard/outdrive of 225 hp. It is 23 ft (7 m) in length and 8 ft (2.4 m) at maximum beam. Its maximum persons capacity is 1200 lb (544 kg) and maximum weight capacity 1600 lb (726 kg). Steering and engine controls are mounted on a center console. The boat was equipped with an electric bilge pump, VHF-FM radiotelephone, and a depth finder. Visible damage, said to have been sustained in this accident, includes light to moderate fiberglass damage (without hull penetration) along the keel, a broken skeg on the lower unit, bent propeller blades, a broken seal in the lower unit, and broken antenna mounts. Cost to repair the damage was estimated at $1450. Otherwise, the boat appeared to be in good condition. Details of its interior and exterior at the time of the investigation may be seen in Figures 2 through 7.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

Glare bothering the runabout operator's vision was the prime human factor involved in this case. Although his boating training and experience should have predisposed him otherwise, the operator intentionally engaged in a recognized unsafe practice in order to avoid personal irritation. Among the various possible design solutions available for this problem, the operator suggested a circular shield mounted beneath the stern light, a method he discovered following the accident to have been used by several of his boater friends who fish at The Race.

The sport fishing boat's operator faced familiar boating problems: obstructed forward visibility and a high noise level. His short height may have added to the visibility problem, and is among suspected factors involved in his previous collision. Although it involves engaging in a good deal of speculation, perhaps the typical boat's non-adjustable operator's seat or platform (unlike an automobile or aircraft's) handicapped this rather short individual. Solutions to the noise level problem, on the other hand, could be approached from the "hittee's" standpoint: perhaps a standard requirement for a sufficiently loud warning device (e.g., a compressed gas-powered horn) would tend to compensate for the high noise levels (from various sources, only some of which lend themselves to regulation: e.g., engines vs parties/radios/conversation) likely to be present on some boats.

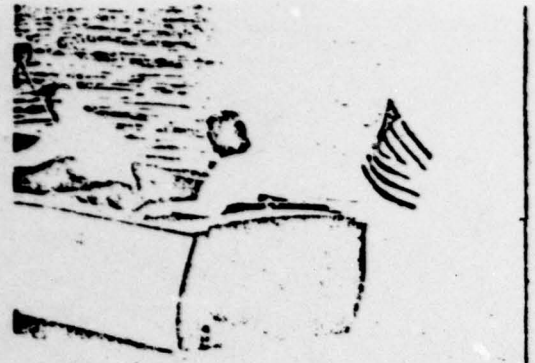
6.0 PROBABLE CAUSE OF ACCIDENT

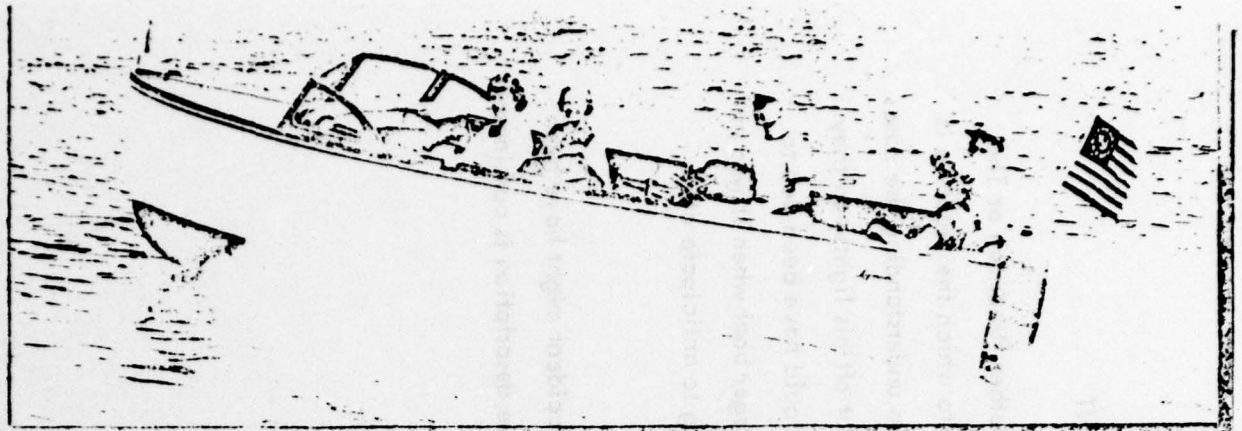
The probable cause of this accident is considered to be the design of the runabout's stern light and the sport fishing boat's helm station visibility and engine noise level, when considered from the point of view of operating safety. Although the runabout's operator might be clearly negligent in this case because he extinguished the stern light, the dilemma he faced might have been avoided through effective regulation or design.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The two operators differed as to their expressed expectations as to whether fishermen at The Race might secure their running lights at night. Although the extent to which the practice is carried on was not resolved, this factor is not considered significant in understanding the case: the runabout's operator had not seen the larger boat at the time he shut off his lights, so they had no "understanding" in the matter. Failure to see the other boat could have been due to a hasty check by the runabout's operator, difficulties in seeing the larger boat when it was in and beyond the waves of the rip, or inexperience on his part in failing to anticipate other boats approaching from the rip.

Without the runabout operator's frank admissions of his actions, this accident might have been much more difficult to reconstruct. As it stands, though, the narrative description is considered to reflect the actual course of events.





ISLANDER

FOR SPORT! FOR FISHING!

To own an Islander is to be all set for every kind of boating pleasure. With an Islander a whole world of fun and adventure is unlocked by that shiny ignition key.

Some days you may feel like setting out for a specific destination and covering a lot of distance. The Islander will carry you steadily, safely, at a comfortable speed.

At other times you want to throttle down for fishing, especially trolling. The Islander is designed for that, too to be manageable at reduced speeds.

Whether you are trolling or still fishing, picnicking, or just drifting and enjoying the weather, you appreciate the wide-open roominess of this exceptionally versatile inboard. Many inboards are designed a lot like sport cars. Once you slip down into the seat, you "stay put." But in The Islander there's a lot of square-footage to move around in. You can stretch your legs, change skippers, choose a different seat, or retire to the stern and enjoy a snack or a nap.

The Islander has proved itself a model for off-shore fishing and "outside" use in coastal waters . . . It's the big buy in big boats.

1953 ISLANDER SPECIFICATIONS

SUBJECT TO CHANGE WITHOUT NOTICE

Length 18' **Beam O.A. 6'-8"** **Draft 1'-6"**
Freeboard forward 3' **Freeboard aft 2'-4"**
Power—Gray Sea Scout, Rubber Mounted (25 HP) **Speed—Approx. 14-15 M.P.H.**
Optional Power—Gray Lugger-112 (33 HP) **Speed—Approx. 17-18 M.P.H.**
Optional Power—4 Cylinder (60 HP) Motors (see price list) **Speed—Approx. 22-24 M.P.H.**
Seating Capacity 8 Persons **Shipping Weight Approx. 1700 lbs.**
Keel and all structural parts—clear white oak.
Transom—Philippine mahogany—reinforced.
Planking—$^3/_8$"—5 ply waterproof marine plywood, laid in uniformly narrow strakes.
Decks—Mahogany plywood.
Seats and trim—Spanish cedar or Philippine mahogany.
Fastenings—copper, brass and Everdur.
Finish—white topsides, copper bronze bottom, inside below seat risers brown, seats, decks and all trim varnished.

EQUIPMENT

Bronze rudder, drum type steerer connected to quadrant by bronze core tiller cord, bronze propeller, bronze strut with rubber strut bearing, $^7/_8$" naval brass propeller shaft, half oval brass stem band, half oval rail banding, fore and aft lifting rings, bow chocks, electric running lights, electric signal horn, ignition lock, ammeter, oil gauge, storage battery, 2 dock lines, 17 gal. gasoline tank, all deck fittings chrome plated, shipping cradle.

J-12

FIGURE 1. SALES BROCHURE
(best quality available)

FIGURE 2

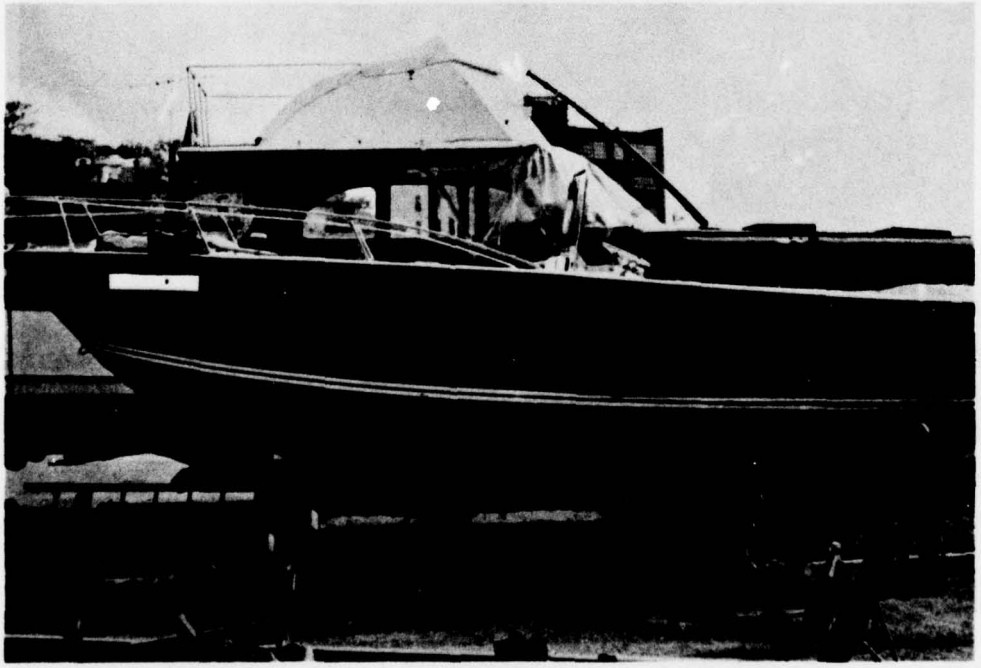


FIGURE 3

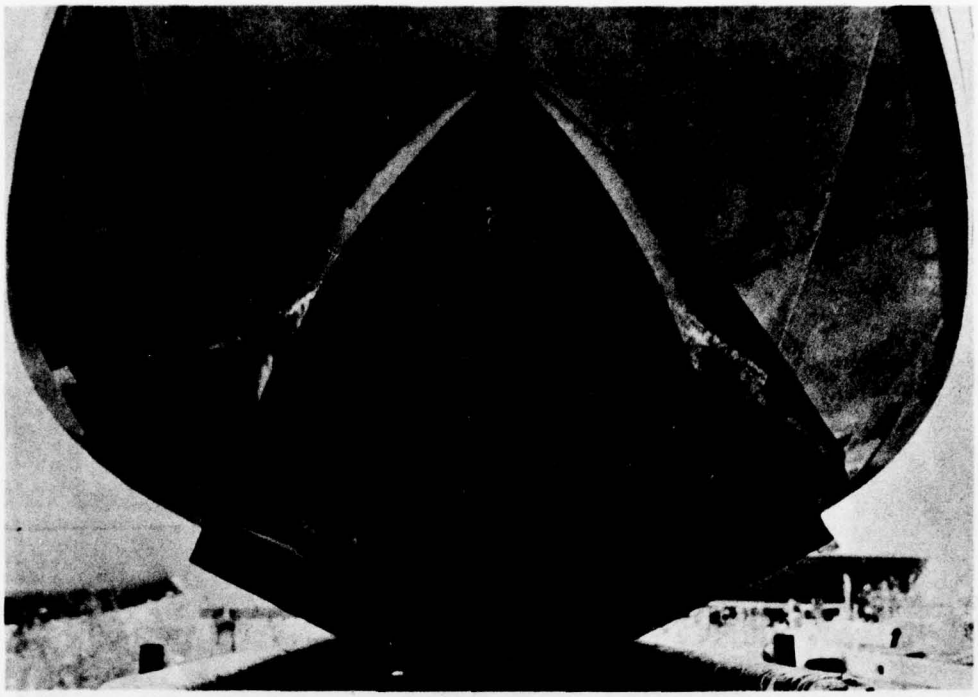


FIGURE 4

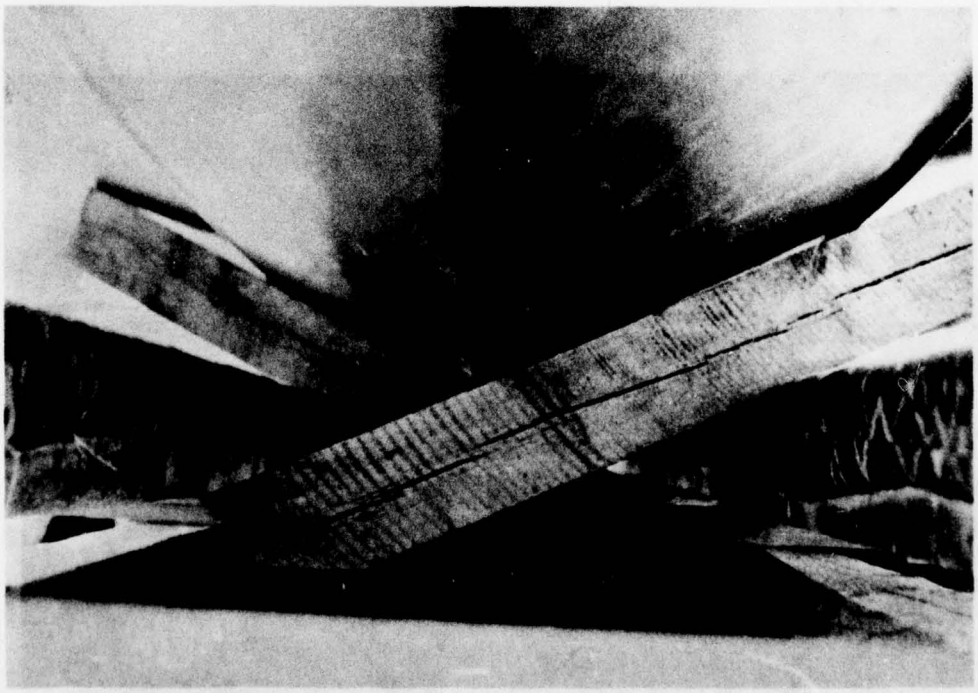


FIGURE 5

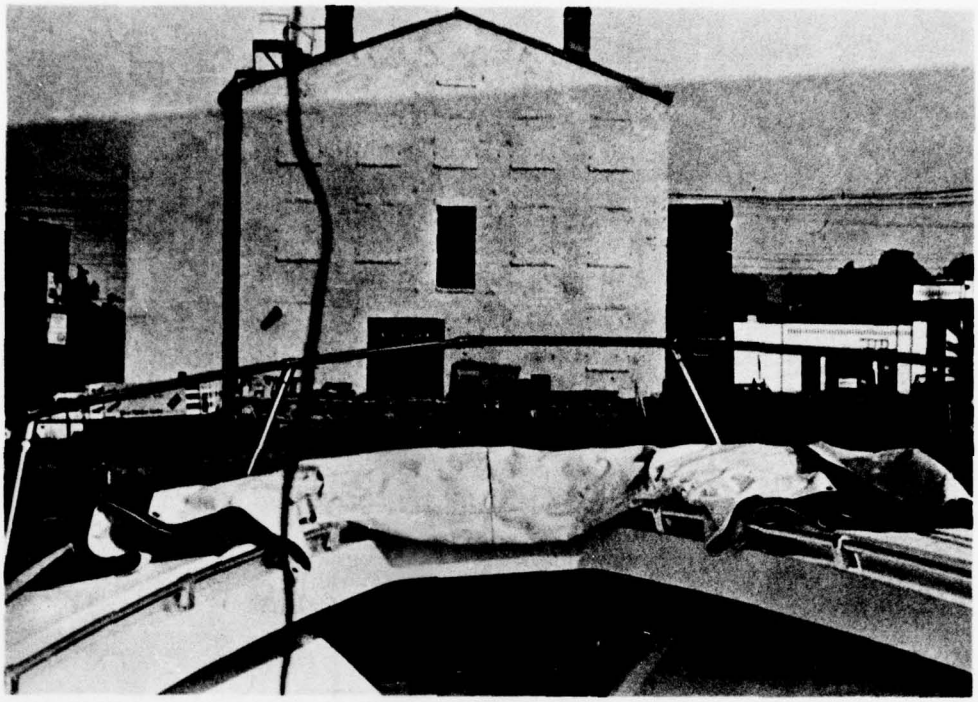


FIGURE 6

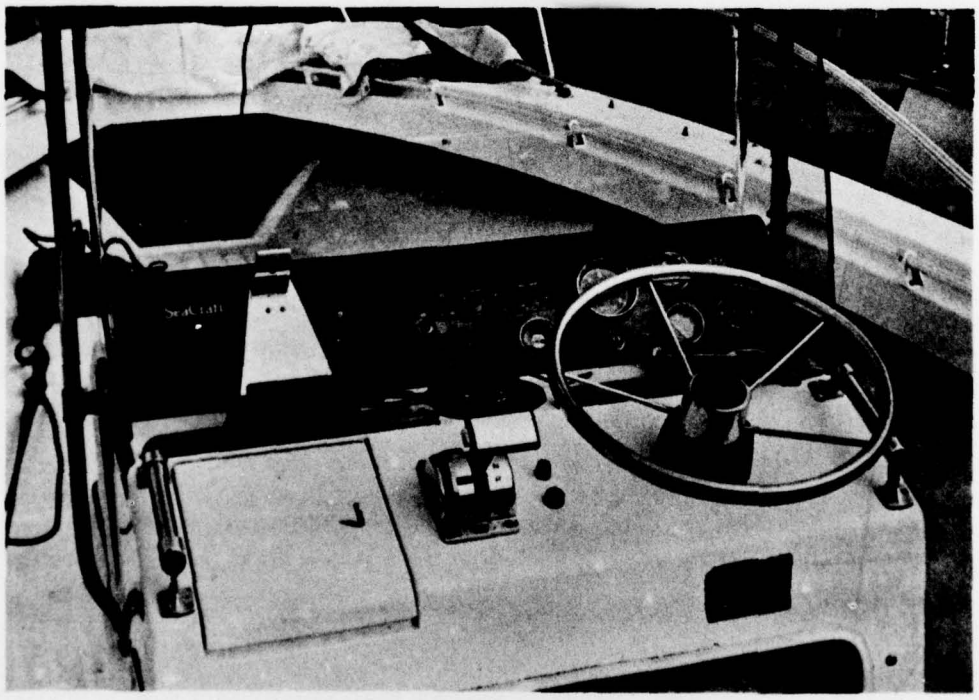


FIGURE 7

APPENDIX K. ACCIDENT NO. 76-11

ACCIDENT INVESTIGATION REPORT

Date of Investigation: October 15, 1976

Date of Accident: October 2, 1976

Investigation: Collision No. 76-11

SUMMARY — WYLE ACCIDENT NO. 76-585

The accident reported herein was a collision involving a 24 ft (7.3 m) inboard/outdrive cabin cruiser and a 15-1/2 ft (4.7 m) outboard runabout.

At approximately 1530 on October 2, 1976 a man (operator), his wife and two small children in a 15-1/2 ft (4.7 m) runabout arrived at a fishing spot on Lake Erie located near the mouth of an inlet. Shortly after the anchor was deployed, a cabin cruiser was observed by the runabout occupants coming toward them. The operator of the runabout noticed that the cruiser's bow was up so high that he could not see anyone aboard; therefore, a collision was imminent.

The cruiser hit the runabout amidships and traveled over it. The runabout sank immediately and capsized. The occupants were rescued by nearby boats. One occupant was severely injured. The cruiser sustained minor damage (< $ 100) and the runabout was destroyed. The runabout was valued at $ 600.

1.0 BOAT OCCUPANT DATA

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn/Used Before	PFDs Worn/Used After
Boat No. 1 (15-1/2 ft (4.7 m) Runabout)								
(1) Operator	M	43	138 lb (62 kg)	Good	>500 hrs	None	No	Yes*
(2) Passenger	F	36	135 lb (61 kg)	Poor	Very little	None	No	Yes*
(3) Passenger	M	9	60 lb (27 kg)	Poor	Very little	None	No	Yes*
(4) Passenger	F	7	50 lb (23 kg)	Poor	Very little	None	No	Yes*
Boat No. 2 (24 ft (7.3 m) I/O)								
(1) Operator	M	35	150 lb (68 kg)	Non-swimmer	>500 hrs	None	No	No
(2) Passenger	F	34	115 lb (52 kg)	Fair	<100 hrs	None	No	No
(3) Passenger	F	6	40 lb (18 kg)	Non-swimmer	None	None	No	No
(4) Passenger	M	8	60 lb (27 kg)	Non-swimmer	None	None	No	No

* Held to PFD after accident, but did not put it on.

1.1 Boat No. 1 Owner/Operator

He had completed three years of high school and worked as a metal pattern maker for a local automobile manufacturing plant. He seemed to be of average intelligence and to possess at least an average knowledge of small pleasure boat operation. It was evident from observing the well kept condition of his boat and the handiwork done around his home that he was very good with his hands; however, his physical condition seemed to be below average for his age.

1.2 Boat No. 1 Passengers

The operator's wife and children were of average intelligence and physical ability. The wife did not like boating and very rarely went out on a boat. The children were very fond of boating and usually accompanied the operator on fishing trips. The passengers were unfamiliar with small boat operation.

1.3 Boat No. 2 Operator/Owner

He was a high school graduate and worked as a laborer for a construction company. He had been employed by the construction company only a short time. Most of his working life had been spent as a musician and night club entertainer. He seemed to be of average intelligence and physical ability and seemed to be very knowledgeable concerning the operation of small cabin cruiser class boats. It was apparent from the well kept condition of his boat that he was very conscientious concerning the appearance and operation of his boat.

1.4 Boat No. 2 Passengers

According to the operator, the adult female had operated the involved boat many hours during ski and fishing outings. She was of average intelligence and physical ability. The children were unfamiliar with boat operation and had only been in a boat a few times.

2.0 ENVIRONMENT

The sky was clear and the visibility was good. The wind was from the northeast at 15-25 mph (24-40 kph) and the water condition was one to two ft (0.3 - 0.6 m) rolling swells. The recorded air temperature was 70°F (21°C) and the estimated water temperature was 65°F (18°C). Water depth at the accident site was approximately 25 ft (7.6 m).

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

Boat No. 1

The owner/operator (1) stated that he and the passengers had gone to bed early on the night before the accident and had gotten a normal night's sleep. During the morning of the accident, Saturday, October 2, 1976, (1) worked around his home mowing the lawn and trimming shrubs. At approximately 1300 (1) and the passengers ate lunch and decided to go on a fishing trip. The weather seemed excellent for an outing and the wife (passenger 2), who rarely went fishing, decided she would go on the trip.

After lunch (1) loaded the fishing gear in his boat which was stored in his garage. He stated that he checked the boat and motor thoroughly before removing the boat from the garage. (1) connected the boat trailer to his pickup truck and he and his family including a nine year old son (3), and a seven year old daughter (4) left for the marina approximately five miles (8 km) away at approximately 1400. They arrived at the marina located on the Rocky River near Lakewood, Ohio, at approximately 1415. The boat was launched and the two six gal. (22.7 l) fuel tanks were filled. They departed from the marina, down river, toward Lake Erie at approximately 1445. At 1500 the boat was in Lake Erie 300 yd (274.3 m) from the mouth of the Rocky River. The party decided to anchor the boat and fish in that area. There were numerous other small fishing boats anchored from 100 to 200 yd (91.4 - 182.9 m) further out in the lake. Before the occupants started getting the fishing gear, (2) observed Boat No. 2 coming out of the river headed toward their location. (2) watched the approaching boat a short time, then informed (1) of the other boat and remarked that it was going to hit their boat if it didn't change course. When (1) was informed of the approaching boat, he had his back toward the mouth of the river and had to turn around to see the boat. When he first saw the boat, it was approximately 100 yd (91.4 m) away, coming directly toward them in a bow high attitude. The bow was raised so high that (1) could not see the occupants aboard. (1) watched the boat until it was about 100 ft (30.5 m) from his boat. At this point he realized a collision was imminent. He shouted to his passengers to get down on the deck

of the boat because the approaching boat was going to ram them. (3) and (4) lay down on the deck in the aft section of the boat. (1) quickly stepped over the seat and lay down between (3) and (4). (2) remained in the front port seat.

Boat No. 2

The owner/operator stated that he had slept at least eight hours on the night before the accident. On the morning of the accident, he worked around his home until 1200. His girl friend and her two children came over to his house at 1215. It was a nice warm day and the two adults decided to take the children on a picnic/boating outing. A picnic lunch was prepared and the party left the operator's house at approximately 1300, destined for a yacht club on the Rocky River in Lakewood, Ohio, where the operator's boat was moored. They arrived at the yacht club at approximately 1330, ate the picnic lunch and stayed around the club until 1450. The party and the children's small dog then boarded the boat and headed down the river toward Lake Erie at a speed of 5-10 mph (8-16 kph). The party reached the mouth of the river at approximately 1500. The operator turned the boat approximately 15° to port and headed out into the lake gradually advancing the throttles to approximately 2000 rpm. The operator was seated at the helm and stated he could not see over the bow. The adult female had been seated on the port side seat adjacent to the operator, but had gone aft to check on the children, who were seated on the motor cover holding the dog.

3.2 Accident

Gear and people aboard were approximately as shown in Figures 1 and 2, and the weather was as noted in Section 2.0. The operator of Boat No. 2 stated that he was gradually applying power to come up on plane in order to give his passengers a comfortable ride and to prevent scaring the dog, since it was its first ride on a boat.

Approximately 300 yd (274.3 m) from the mouth of the river, the boat hit something, which the operator thought was a log. At the point of impact, the adult female had moved forward and had started to sit by the operator in the helm seat. The impact caused her to fall forward into the cabin door, slightly bruising her left knee. The other occupants were not moved from their original position. The operator shut off the engines immediately after the impact

because he felt the outdrives were probably damaged. The boat stopped approximately 200 ft (61m) from the impact area. The operator looked around and saw people and gear from Boat No. 1 in the water. He stated that he then realized that he had hit another boat.

Boat No. 1 was hit at approximately amidships between the back-to-back seats. Boat No. 2 went bow on through the starboard side of Boat No. 1, over the port side and into the water. Passenger 2 was hit by Boat No. 2 and knocked into the water on the port side. (1), (3), and (4) remained in the bottom of the boat until Boat No. 2 had passed over. (1) stated that he felt the keel or chine of Boat No. 2 sliding over his back as it passed over his boat.

3.3 Post Accident

Boat No. 1 sank almost immediately after the collision leaving the occupants nothing to hold to for flotation. (1) spotted several PFDs that had floated out of the boat and managed to tread water long enough to push (3) and (4) to where they could grab them. (2) managed to grab a PFD shortly after entering the water. After (1) was sure that (3) and (4) were firmly holding to PFDs, he grabbed two AK-1 PFDs and put one under each arm. Within two minutes after the accident, numerous small boats in the area arrived in the accident area to render assistance. The operator of Boat No. 2 maneuvered his boat back to the accident area and pulled (1) aboard his boat. (3), who had grabbed the aft facing wooden seat that had been torn out of the boat and discarded his PFD, and (2) and (3), who were holding to AK-1 PFDs, were taken aboard a small pleasure boat that had come to assist. By the time the occupants were out of the water, a police boat that had been notified by radio had arrived on the scene. The occupants were transferred to the police boat and taken ashore where they were transported to a local hospital by a rescue squad vehicle. The final attitude of Boat No. 1 was upside down with approximately 1/3 of the bow section above water. The boat was towed ashore by a small police boat.

Injuries sustained by the occupants of Boat No. 1 were as follows:

No. (1)	Bruised jaw, left shoulder and back
No. (2)	Bruised under left arm and left side

No. (3) No injuries

No. (4) Three broken ribs on left side, deep lacerations on upper left arm, severely bruised left hip, and punctured lung, left side. Hospitalized for approximately three weeks.

3.4 Time Sequence of Accident Events

Boat No. 1

1400	Occupants departed for launch ramp.
1415	Arrived at launch ramp.
1415-1445	Launched boat, filled fuel tank and departed from ramp toward fishing spot.
1500	Arrived at fishing spot and anchored boat.
1501	Occupants observed Boat No. 2 coming toward them.

Boat No. 2

1300	Occupants departed for yacht club.
1330	Arrived at yacht club.
1330-1450	Ate picnic lunch and stayed around yacht club.
1455	Left yacht club for Lake Erie.
1500	Arrived at mouth of Rocky River.
1501	Approximately 100 yd (91.4 m) from mouth, operator started increasing speed to bring boat up on plane.
1501-1502	Boat No. 2 impacted Boat No. 1.
1502-1504	Boat No. 1 occupants swam around and grabbed flotation devices.
1504-1505	Occupants of Boat No. 1 taken aboard other rescue boats.
1505-1510	Occupants of Boat No. 1 taken ashore and transferred to waiting ambulance.
1515	Occupants of Boat No. 1 arrived at hospital.

Refer to Figure 3 for sketch of the accident area.

4.0 VESSEL DATA

Boat No. 1

The boat was a 15-1/2 ft (4.7 m) 1962 Model Pen Yan runabout powered by a 1962 40 horsepower West Bend outboard motor. It was a semi-V closed bow of 3/4 in. (1.9 cm) wood lapstrake construction. The OBC plate attached to the boat specified a maximum weight capacity of 1305 lb (592 kg) and a maximum horsepower capacity of 60. The collision resulted in major structural damage to the starboard side as shown in Figures 4 and 5. Moderate damage to the port gunwale is shown in Figure 6. The aft facing seat was torn loose from the deck on impact. Prop marks on the forward facing seat are shown in Figure 7. Bow view is shown in Figure 8.

Boat No. 2

The boat was a 24 ft (7.3 m) 1972 Model Searay I/O cabin cruiser powered by two 1972 model 165 horsepower Mercury engines. The outdrives were Mercruisers incorporating power trim. Trim tabs were also installed on the transom. The hull was a deep-V of fiberglass construction. There was no capacity plate attached to the boat. The collision resulted in no damage to the boat above the static water line. The hull below the static water line could not be inspected, but it is assumed that only minor gelcoat damage existed. Refer to Figures 9 and 10 for overall boat views.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

During the interview, the operator of Boat No. 1 became very emotional and seemed to be somewhat confused concerning the details of the accident. Considering his behavior during the interview, it was concluded by the investigators that this individual would most likely react slowly or incorrectly to an emergency situation. Given sufficient time to analyze a situation thoroughly, he would probably act slowly, but correctly. Whether he had a normal amount of time to maneuver his boat to avoid a collision is unknown.

The operator of Boat No. 2 seemed to be overconfident in his equipment and his operating ability. Although he was a non-swimmer, he stated that he often raced his boat, loved rough water operation and would not hesitate to take his boat out in a storm. From the appearance of his boat, he was very proud of it and liked to impress his passengers and others by running at high speed and jumping waves in rough water conditions. He stated that he was very safety conscious; however, the manner in which he operated his boat would hardly be considered consistent with good safety practices.

According to the reconstructed pre-accident conditions, fatigue, alcohol, or other stressors were not involved in this accident. Since Boat No. 2 was headed nearly north in mid-afternoon, sun glare is not considered a factor.

The helm station of Boat No. 2 was at least above average in design. The static trim angle is shown in Figure 11; also, note operator's forward view in Figure 12.

The main problem is the high trim angle effected during planing or at relatively low speeds. A further note: the boat (No. 2) was equipped with trim tabs which, if used properly, could probably lower the bow in these conditions — apparently, it was not used.

6.0 PROBABLE CAUSE OF ACCIDENT

The following items are most likely the major factors in causing this accident.

- Restricted forward visibility of Boat No. 2's operator is considered the major factor. He stated that he could not see over the bow when seated and traveling at the speed at the time of the collision with Boat No. 1 (2000 rpm and less than 20 mph (32 kph)). Refer to Figures 11 and 12 for static trim angle and seated operator eye level visibility at the helm.

- Inattention on the part of Boat No. 2's operator is considered a major factor. He stated that he always stood at the helm while coming up on plane so he could see over the bow. At the time of the accident, the operator was seated and the boat was not on plane. It is possible that the operator was seated because he was distracted by one of the passengers or was preoccupied with boat control.

- It is possible that the operator of Boat No. 1 had sufficient time to maneuver his boat out of the path of the oncoming boat, but did not act until it was too late.

- According to the investigating officer, the occupants of the involved boats had not been drinking and no alcohol was found on board. Therefore, alcohol is not considered a factor in this accident.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The bow of Boat No. 2 impacted the starboard side of Boat No. 1 near amidships and essentially perpendicular to the longitudinal axis. The impact ripped a large section out of the starboard side of Boat No. 1. The forward momentum of Boat No. 2 carried it across Boat No. 1 and into the water on the port side. As Boat No. 2 traversed across Boat No. 1, its weight pushed No. 1 down, causing it to begin flooding immediately. The bow of Boat No. 2 raised after impact, causing it to jump over Boat No. 1 as was evident from the minimal damage to the port side of Boat No. 1. Apparently, Boat No. 1 was pushed under water or sank immediately because the occupants of Boat No. 2 did not see it within seconds after the collision. Within a short time after sinking, Boat No. 1 rolled upside down and the bow section resurfaced.

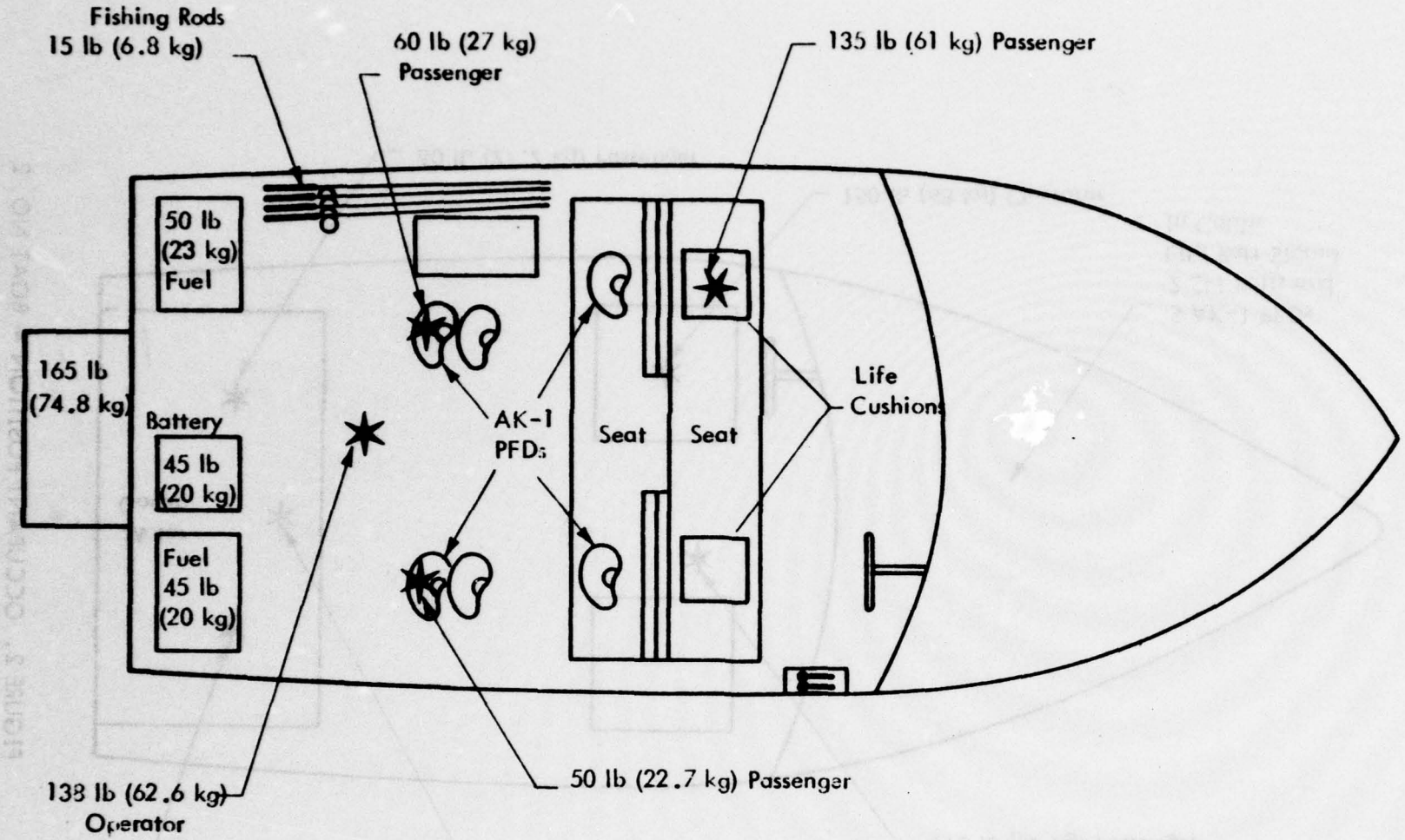


FIGURE 1. OCCUPANT LOCATION – BOAT NO. 1

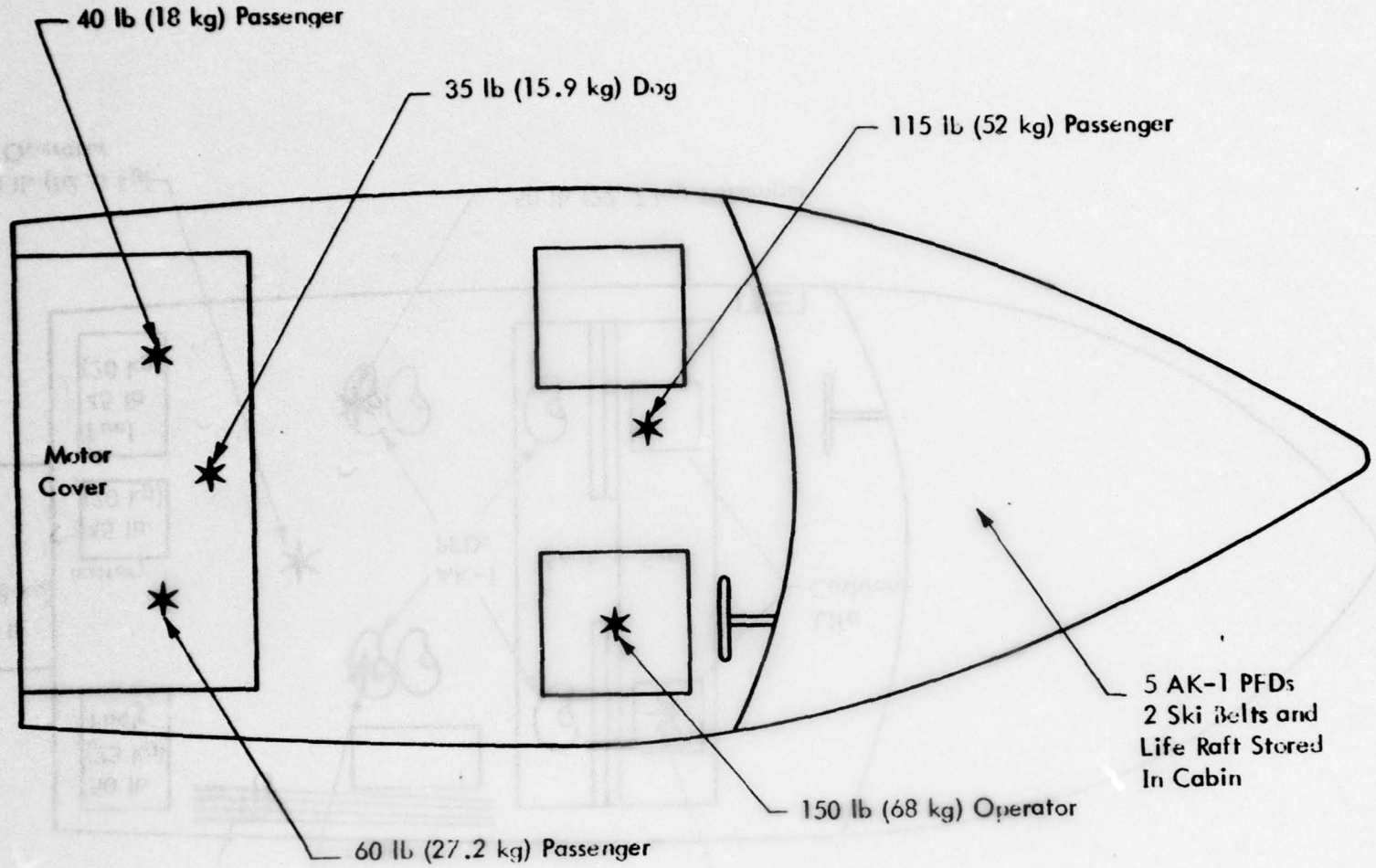


FIGURE 2. OCCUPANT POSITION — BOAT NO. 2

FIGURE 3. SKETCH OF ACCIDENT AREA

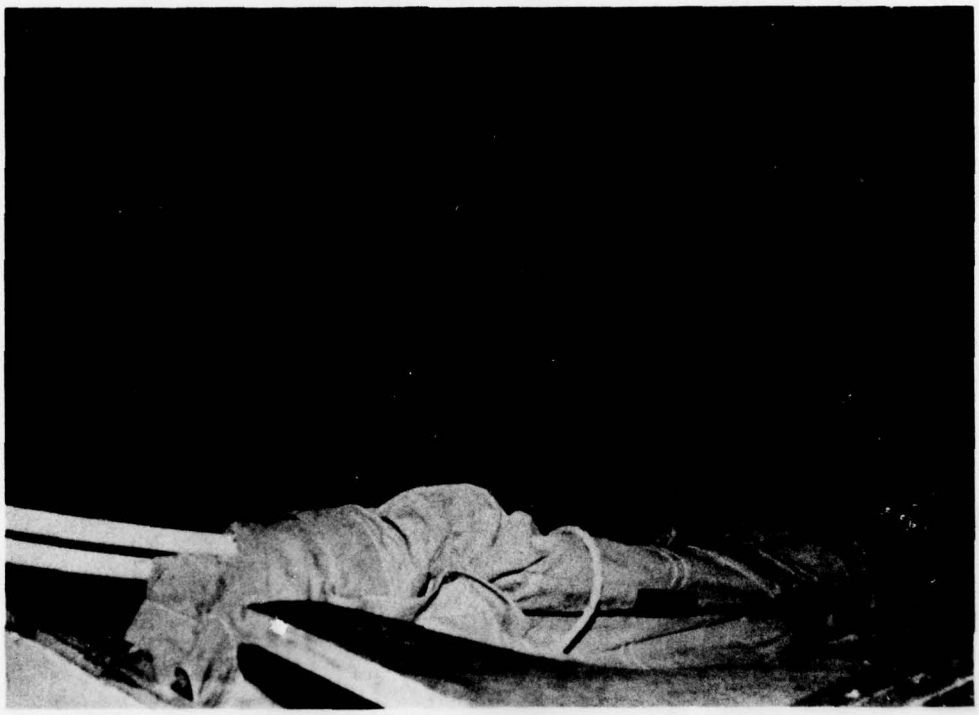


FIGURE 4. STRUCTURAL DAMAGE TO STARBOARD SIDE

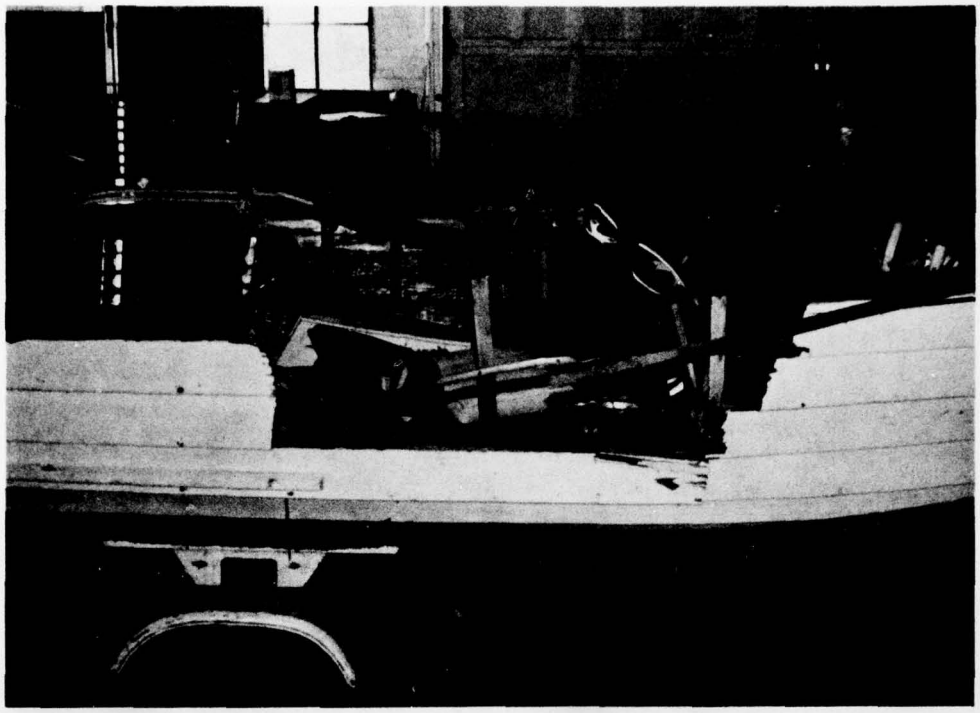


FIGURE 5. STRUCTURAL DAMAGE TO STARBOARD SIDE

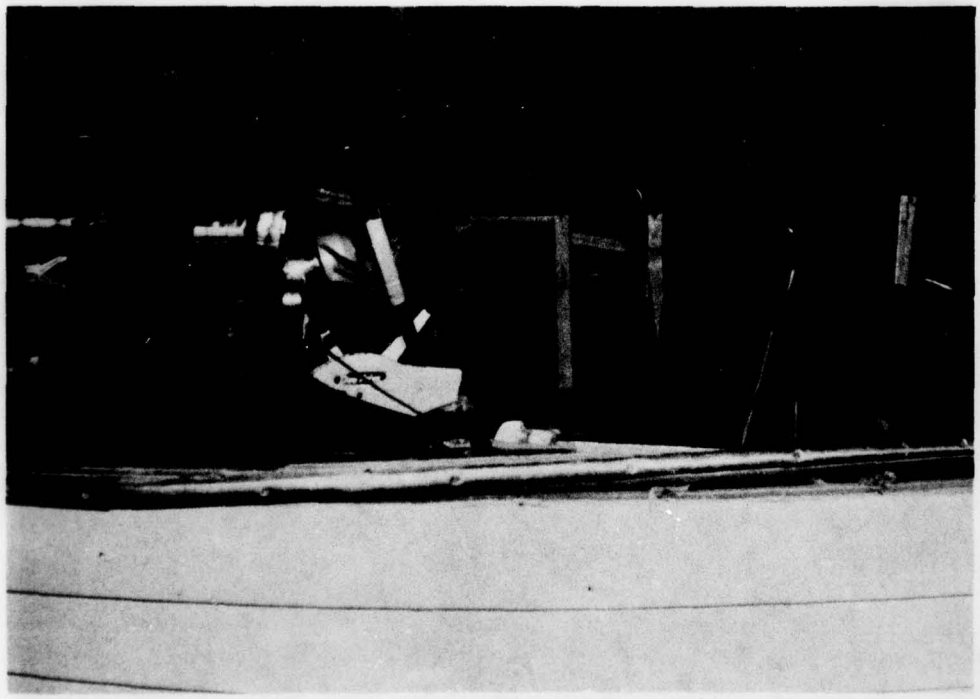


FIGURE 6. DAMAGE TO PORT GUNWALE

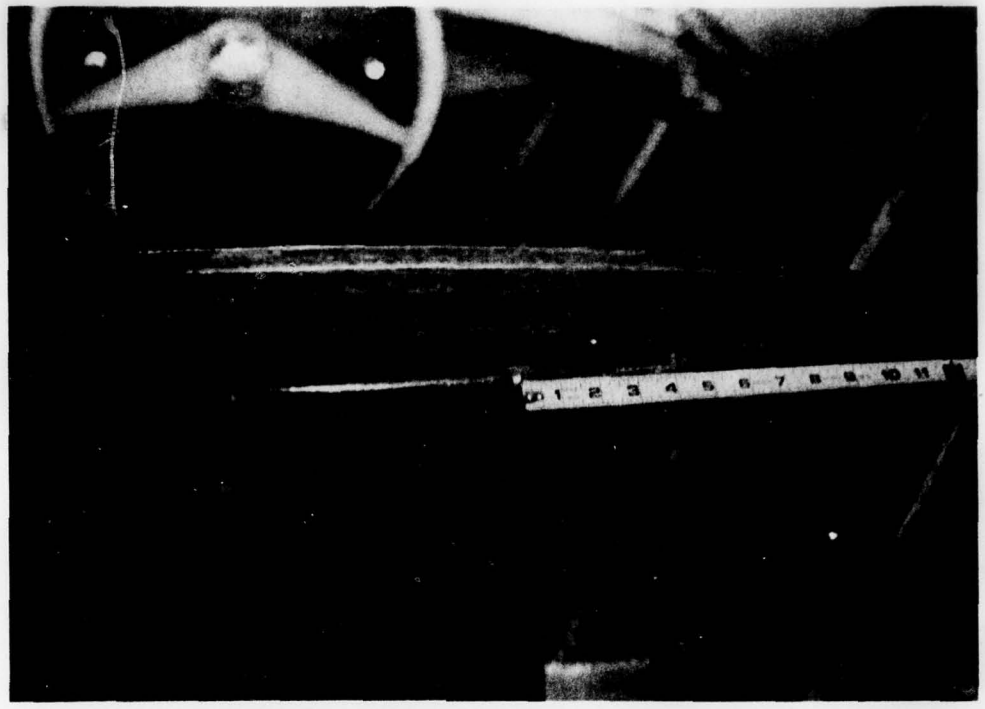


FIGURE 7. PROP MARKS ON FRONT FACING STARBOARD SEAT BACK

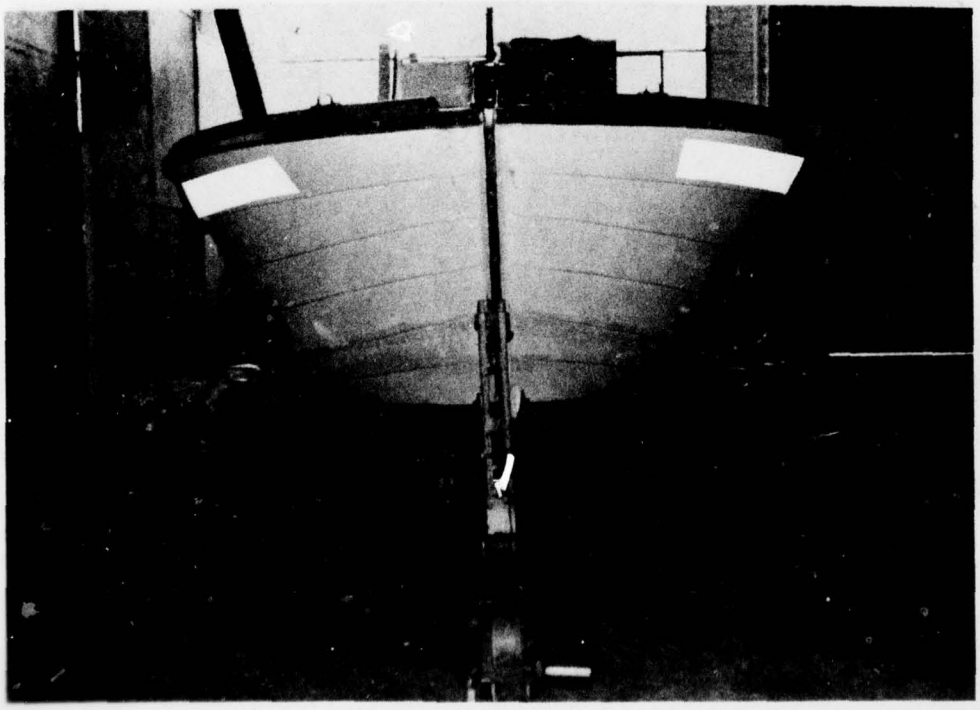


FIGURE 8. BOW VIEW

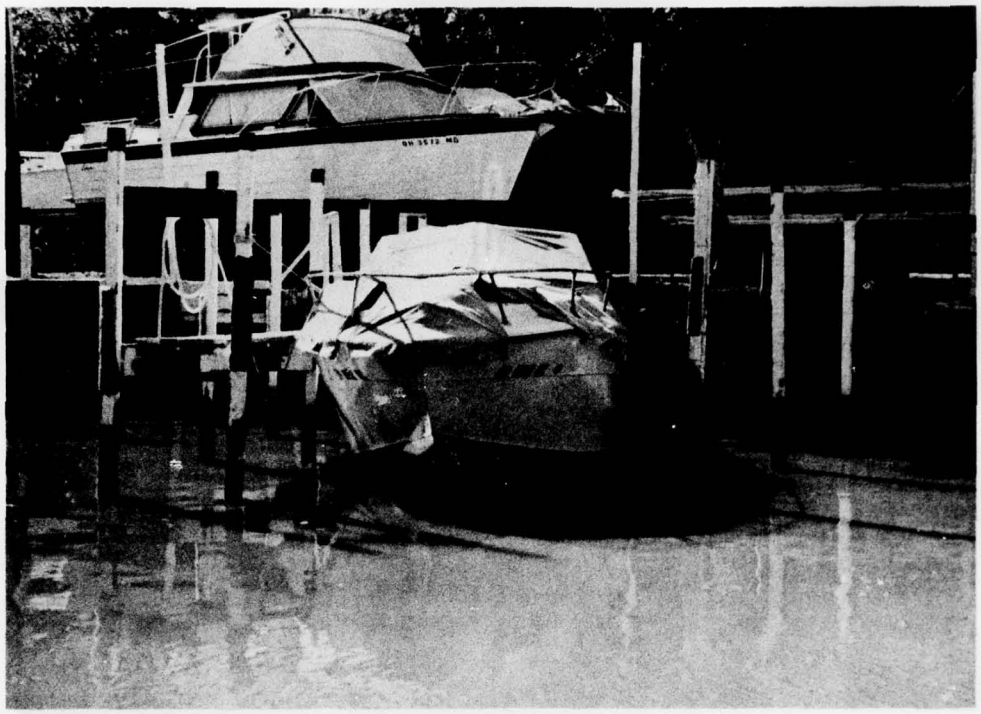


FIGURE 9. OVERALL BOAT VIEW

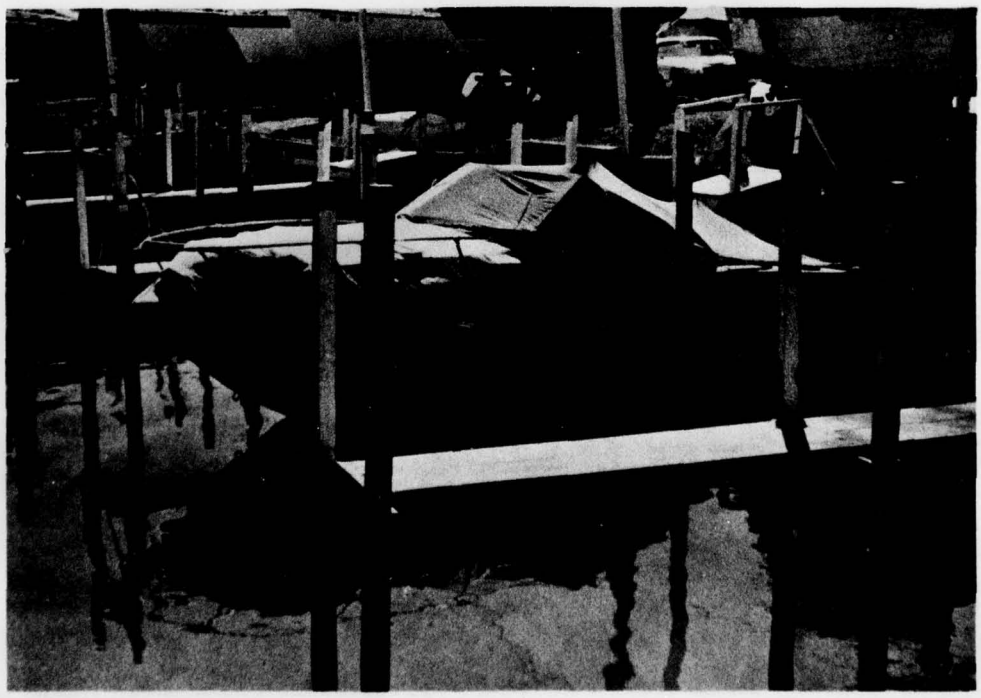


FIGURE 10. OVERALL BOAT VIEW

FIGURE 11. STATIC TRIM ANGLE (OPERATOR AT NORMAL SEATED HELM POSITION)

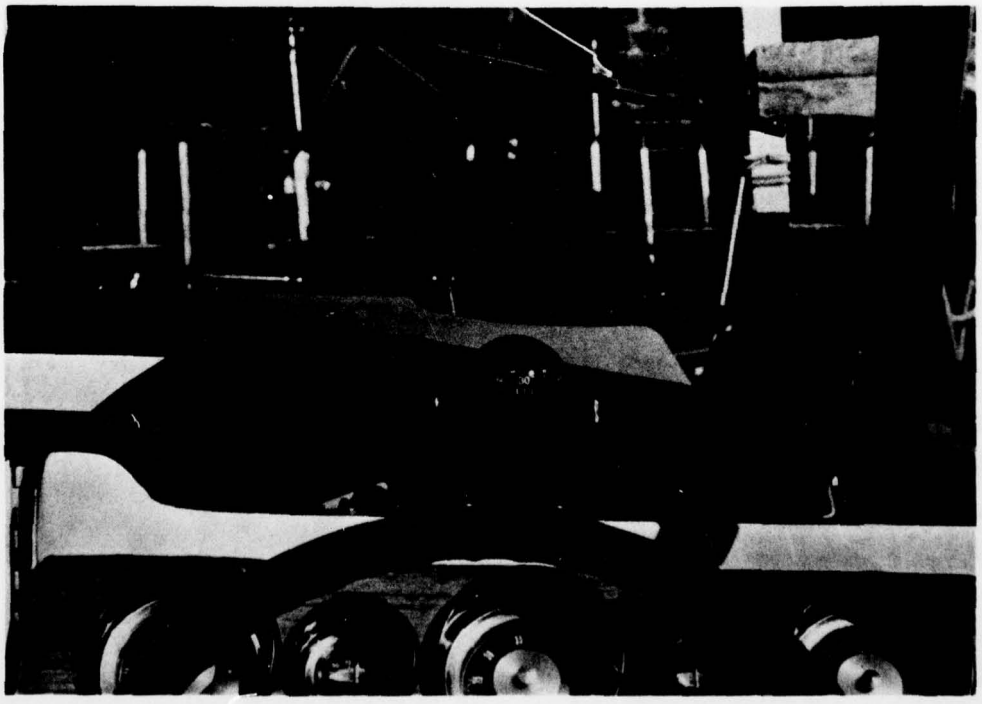


FIGURE 12. STATIC TRIM ANGLE (EYE LEVEL VISIBILITY WITH OPERATOR SEATED IN NORMAL HELM POSITION)

APPENDIX L. ACCIDENT NO. 76-12

ACCIDENT INVESTIGATION REPORT

Date of Investigation: December 1, 1976

Date of Accident: September 11, 1976

Investigation: Collision No. 76-12

SUMMARY — WYLE ACCIDENT NO. 76-624

The accident reported herein is a two boat collision involving a 15 ft (4.6 m) bass boat powered by a 135 hp outboard and a 17 ft (5.2 m) bass boat powered by a 150 hp outboard. There were no injuries. Property damage was approximately $ 1000.

Approximately three minutes after a fishing tournament began, one bass boat travelling about 60 mph (96.6 kph) swerved in front of another bass boat. The two collided. One went out of control, turned sharply and capsized. Both occupants of the capsized boat were wearing PFDs and were picked up by a following boat within minutes. The overturned boat floated level and was towed to a nearby beach where it was righted and bailed. Both operators were fatigued and both had allegedly consumed alcoholic beverages prior to the start of the tournament.

1.0 BOAT OCCUPANT DATA

Boat No. 1

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	30	190 lb (86 kg)	Average	> 500 hrs	Pwr Sqd	Yes	Yes
Passenger	M	28	185 lb (84 kg)	Above Avg	< 20 hrs	None	Yes	Yes

Boat No. 2

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn/Used Before	PFDs Worn/Used After
Operator	M	33	160 lb (73 kg)	Average	100-500 hrs	None	Yes	Yes
Passenger	M	30	170 lb (77 kg)	Can Swim	< 100 hrs	None	Yes	Yes

The owner of Boat No. 1, a high school graduate, is an experienced fisherman and boater. He is employed in a federal prison and could be considered as being in the lower middle income bracket. He has gone boating about twice a week for the past five years in several different bass boats. He had met his passenger for the first time just prior to the tournament. It was the first time that the passenger had been on a bass boat.

The owner of Boat No. 2 was also a bass boat buff. He is employed as a construction worker and has recently received the equivalent of a high school diploma. His passenger, an acquaintance, had little boating experience.

2.0 ENVIRONMENT

The air temperature at the time of the accident (1903 hrs) was about 70°F (21°C). The water temperature was about 72°F (22°C). The sky was clear, the wind less than 5 mph (8 kph) out of the east and the water was rippled where no boats had disturbed its surface. The accident happened about twenty minutes before sunset. One operator claimed that the sun was below the tree line; the other said it was still visible over the trees. Except for the glare present when looking directly into the sun, visibility was good for that time of day.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

The narrative has been compiled from interviews with both operators, the passenger on Boat No. 1, and a Missouri Water Patrol officer.

3.1 Pre-Accident

The owner/operator of Boat No. 1 launched his boat at 0900 and cruised, picnicked, and socialized throughout the day with a female companion and his brother-in-law. This was the second time he had used this boat. It was similar to his old one, but the hull was made of Kevlar which made it lighter and possibly faster. He gassed up late in the afternoon and proceeded to the shoreside area where the fishing tournament was to start at 1900. He ate, set up a campsite, and met his partner for the tournament (apparently partners for those without one are chosen by chance). Generally, he relaxed before the tournament.

The amount of alcohol consumed by the operator of Boat No. 1 is unknown. He claimed none. The owner of Boat No. 2 said they were both drinking beer throughout the afternoon. The water patrol officer claimed both operators had alcohol on their breaths but weren't noticeably intoxicated.

The owner/operator of Boat No. 2 worked all morning installing sheet rock in a dwelling. He went home at noon, picked up his boat, picked up his fishing partner, and headed for the lake. They launched at about 1300 and cruised for a while to burn off some gas. He claimed the tank was filled to the top and had begun to leak out of the vent due to expansion. He didn't like the smell of the fumes, so he ran the boat until the level of gas in the tank had dropped some. He then proceeded to the tournament area, tied up, and socialized until the beginning of the tournament. He consumed several beers throughout the afternoon and claimed that the owner of Boat No. 1 was one of his drinking partners that day.

The 16 participants in the tournament lined up in the river and all started when the tournament officials fired a flare at precisely 1900. The investigator likens it to a "Lemans" start in automobile racing. (The owner of Boat No. 1 claimed that tournament committees don't normally use that type of start anymore. Instead they start small groups or even individuals at specified

intervals.) Those with the fastest boats quickly got out in front of the pack and enjoyed smooth water. Those behind had to contend with rough water caused by the many wakes. The owner of Boat No. 1 said he was running at about 3/4 throttle to conserve gas because at full throttle his 150 hp outboard engine uses so much that he would not have had enough to get to his intended fishing spot 15 miles (24.1 km) down the lake and return. He was running at about 55 mph (88.5 kph) in a southeast direction with the shore close to his starboard side. His intention was to pass between a point of land and an island on his port. This maneuver would shorten the distance to his fishing spot somewhat.

Boat No. 2 was running slightly faster. He had remained to port of Boat No. 1 for the three miles (4.8 km) they had travelled from the start. Their path was leading them toward the island. A decision had to be made to turn left into the main body of the lake and go around the island leaving it to starboard or to turn right and cut through the narrow channel between the island and shore. The passenger, sitting in the port aft seat, suggested that they turn right and cut through the channel. Because communication of any type is difficult at such speeds, the actual transfer of information was limited to a poke on the shoulder and a few words hollered at full volume. The operator quickly looked to his right into the setting sun and turned sharply to avoid the island (see Collision Area Diagram, Figure 1).

3.2 Accident

During the quick glance to starboard into the sun, the operator of Boat No. 2 didn't see Boat No. 1 about 50 yd (45.7 m) off his starboard quarter. However, just before impact, he saw Boat No. 1 and swerved to his left.

The operator of Boat No. 1 knew that Boat No. 2 was beside him. But he didn't see Boat No. 2 turn. In fact, he didn't see Boat No. 2 until it was directly in front of his boat. The operator of Boat No. 1 turned to the right and pulled back on the throttle. Impact occurred between the port forward corner of Boat No. 1 and the starboard aft corner of Boat No. 2. The operator of Boat No. 2 slowed down and turned around. Meanwhile, Boat No. 1 made an uncontrolled sharp turn to starboard. The boat slowed and straightened out when it had turned about 180°. The boat hit its own wake and slowly rolled onto its port gunwale. The operator

said it had almost stopped at that point. He pushed himself off and entered the water. The passenger hung onto the boat and capsized with it. He then swam out from under the boat.

3.3 Post-Accident

The boat floated level in the upside-down position. Both occupants were wearing Type III PFDs and were picked up out of the water within three minutes by a boat that was following them. Boat No. 1 was towed to shore, easily righted and quickly bailed using its own electric bilge pump. It was then towed back to the launch ramp and hauled out. Neither occupant was injured.

3.4 Time Sequence of Events in the Accident

	Boat No. 1	Boat No. 2
0730		Left for work
0800	Left home for lake	Started work
0900	Launched boat	
1200		Finished work
1500		Launched boat
1700	Went to tournament site	Went to tournament site
1800	Set up camp, socialized	Set up camp, socialized
1900	Start of tournament	Start of tournament
1903	Collision	Collision
1906	People picked out of water	Circled back to collision site
1930	Boat righted	
2030	Boat put on trailer	

4.0 VESSEL DATA

Boat No. 1 was a 1975 17 ft (5.2 m) Hydra Sport bass boat with a hull made of Kevlar instead of fiberglass. The deck and interior were fiberglass. Maximum horsepower stated on the capacity plate was 115. The boat was powered with a 150 hp Mercury outboard. The owner claimed speeds well in excess of 60 mph (96.6 kph).

It was evident from the three foot (91.4 cm) long fracture in the deck and the stress cracks in the deck gelcoat that the side had been deformed several inches during the impact. However, the Kevlar hull showed no signs of damage except superficial gelcoat and skincoat damage where the hullside bent around an interior stiffner during impact. Cost to fix the damage was estimated at $ 500. It appeared that much of that cost will be in the metal-flake gelcoat repair, a cosmetic repair. See Figures 2 and 3.

Boat No. 2 was a 15 ft (4.6 m) Hydra Sport bass boat manufactured in 1976. It had a hull also made of Kevlar. Its capacity plate stated a maximum horsepower of 85. The boat was equipped with a 135 hp Johnson outboard engine. This boat is also capable of speeds in excess of 60 mph (96.6 kph). See Figure 2.

The damage had been repaired prior to the investigation; however, it reportedly was very similar to the damage sustained by Boat No. 1. The deck made of fiberglass had fractured, but the hull made of Kevlar wasn't damaged.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

Wyle investigators have become sensitive to identifying stressors that could have contributed to the cause of accidents. From that standpoint this collision could be considered to be a classic.

1. Operator No. 1 had been on the water all day. Operator No. 2 was boating all afternoon. Recent studies at Wyle have shown that boat operator performance is adversely affected with far less exercise and exposure than either operator actually received.

2. Both operators had been drinking alcoholic beverages. Those same studies referenced above showed significant adverse affects on operator performance after drinking. When drinking and fatigue were combined, the operators' performance in a visual tracking task became even worse. In fact, it is in the peripheral area of one's vision that alcohol and fatigue first affect the vision. Note that Boat No. 2 wasn't noticed until he was right in front of Boat No. 1.

3. Both operators were travelling at about 55 mph (88.5 kph) with no wind protection for their eyes. Their visibility was reduced; we know that people squint to protect the eyes when going that fast through the air which would tend to reduce peripheral as well as overall visibility capabilities.

4. The sun was setting or had just fallen behind the trees. According to the operator of Boat No. 2, Boat No. 1 was probably directly in the line of sight between Boat No. 2 and the sun. The white hull of Boat No. 1 would have been backlighted so it would have appeared gray. The deck was metal-flake gray and the motor was black. Therefore, the contrast ratio between the boat and the trees in the background was very low. That, coupled with having to look into the setting sun, accounts for why Boat No. 1 wasn't seen.

5. The combined wind noise, water noise, and machinery noise could have reduced both operators' performance. Certainly, neither could hear the other because of the excessive amount of noise on his own boat.

In summary, operator fatigue due to exposure and alcohol, wind, glare, and noise were all stressors acting on both operators that, individually, could have significantly reduced the operators' performance at his visual tracking task.

Control station design was also a factor in the accident in that the operator of Boat No. 2 couldn't turn as far starboard as he could to port. The foot well in the control station of his boat as well as other bass boats is designed so that only the right leg can be comfortably put there. The left leg must be placed outside of the foot well and in the center of the boat. This forces the lower portion of the operator's torso to be angled to port. The operator can then turn further to port than he can to starboard to check for boats.

An engineering representative of one bass boat manufacturer claimed that the fact that operators are forced to sit that way was good because they had their feet spread apart and, therefore, were in a more stable sitting position.

The operator of Boat No. 1 had his left hand on the wheel and his right hand on the throttle just prior to the collision. He pulled the throttle back some when he saw Boat No. 2 and turned the wheel at the same time. He had to remove his right hand from the throttle in order to continue to turn the wheel. Thus, he wasn't sure if he actually pulled the handle all the way back into the neutral/idle position. A foot throttle may have allowed him to use both hands for steering. If he could have turned sharper, the accident may have been avoided.

Primary emphasis is placed on speed in fishing tournaments similar to the one referenced herein. The participants of such events must feel that speed is of primary importance. Both boat owners knowingly overpowered their boats for the purpose of attaining higher speeds. The Water Patrol Officer claimed that there are no speed laws or overpowering laws in that state.

6.0 PROBABLE CAUSES OF THE ACCIDENT

The operator of Boat No. 2 swerved in front of Boat No. 1 thus causing the collision. Factors causing the operators of both boats not to see each other until it was too late were:

1. high speeds causing reduced visibility,
2. sun glare and lack of contrast (see 5.0),
3. fatigue due to exposure and alcoholic beverages, and
4. high noise levels on both boats.

In addition, a control station designed to limit the operator's ability to turn to starboard could have contributed to the cause of this collision.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The operators of both boats saw each other at approximately the same instant. Both swerved to avoid the collision. Impact occurred between the aft starboard side of Boat No. 2 and the port forward side of Boat No. 1. As a result of the impact and the steering input, Boat No. 1 swerved sharply to starboard, slowed down, contacted its own wake on its starboard side and rolled over to port. It all happened so fast that both occupants were not able to recall the details of heel angles during the sharp turn or even if they were heeled in towards the axis of the turn or out away from the axis. Thus, two possibilities exist:

1. As the boat made the sharp turn to starboard, it was heeled out away from the axis of the turn. Its own wake provided a turning moment that was sufficient to capsize the boat.

2. The boat was banked steeply towards the inside of the turn. As it came down off plane, it quickly snapped to the upright position and at that same instant it hit its own wake on the starboard side which amplified the roll rate and gave it momentum enough to capsize.

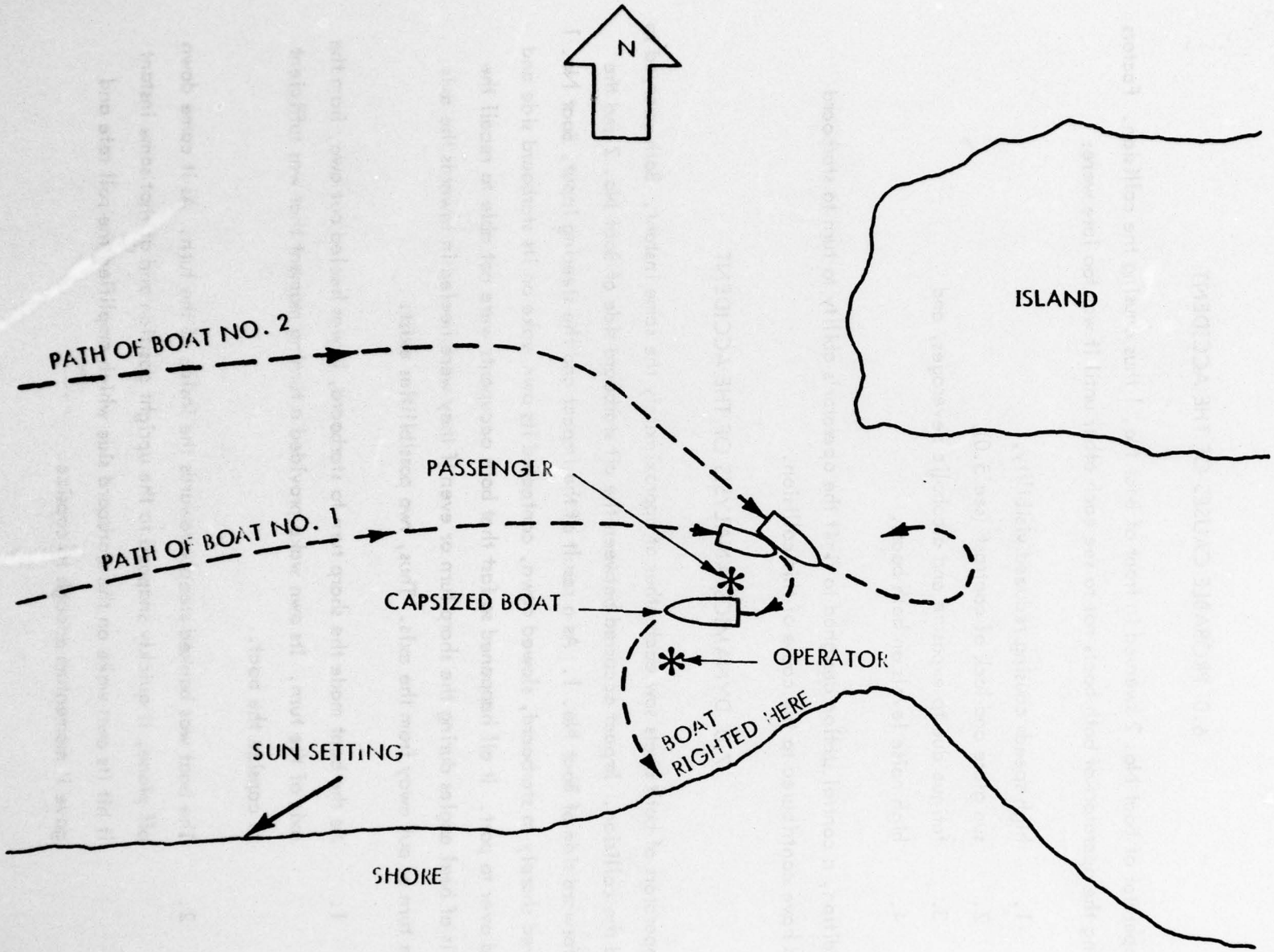
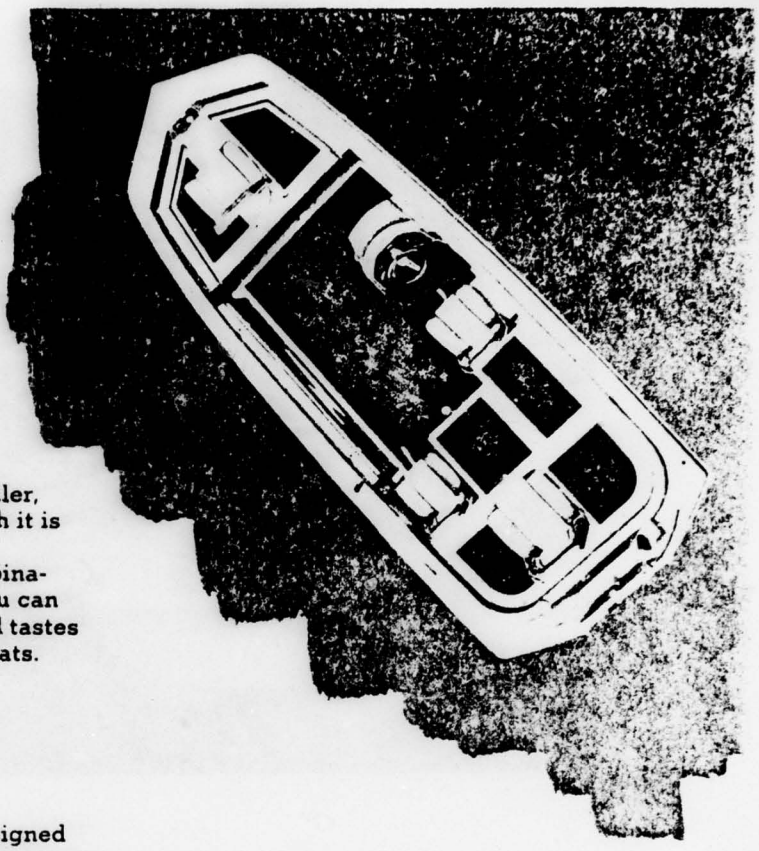


FIGURE 1. COLLISION AREA DIAGRAM

"model 150 HP"



The most efficient, economical fishing machine in the Hydra-Sports line is the 150 HP, a 15-footer rated for a maximum of 85 horsepower. What a job it does with its rated horsepower!

Almost 1,000 of these high-performance penny-pinchers are on the water today, pushed by outboards of 50 horses and up. When you consider all the cost-savings to be had – lower initial investment for boat and engine, better gas mileage, lower trailering costs – the 150 HP is one of the greatest bass boat bargains in the land.

It really pays dividends if you fish smaller, more protected waters, or waters in which it is difficult to maneuver a larger boat.

Available in a wide range of color combinations, in either fiberglass or Kevlar 49, you can customize the 150 HP to suit your personal tastes – just as you can customize any of our boats.

"model 170 HP"

For 1977, the running pad has been re-designed to provide more lift with heavy loads, so you can get the boat up on top for a smoother, faster ride.

The 170 HP has been the overwhelming choice of tournament anglers since its introduction last year. Bill Dance, Billy Westmorland, Glin Wells, Bobby Murray and many other champion fishermen have put their stamp of approval on this fast, roomy mid-size boat.

Look 'em over at your nearest dealer. But don't wait too long to make your decision. When they're gone, that's it!

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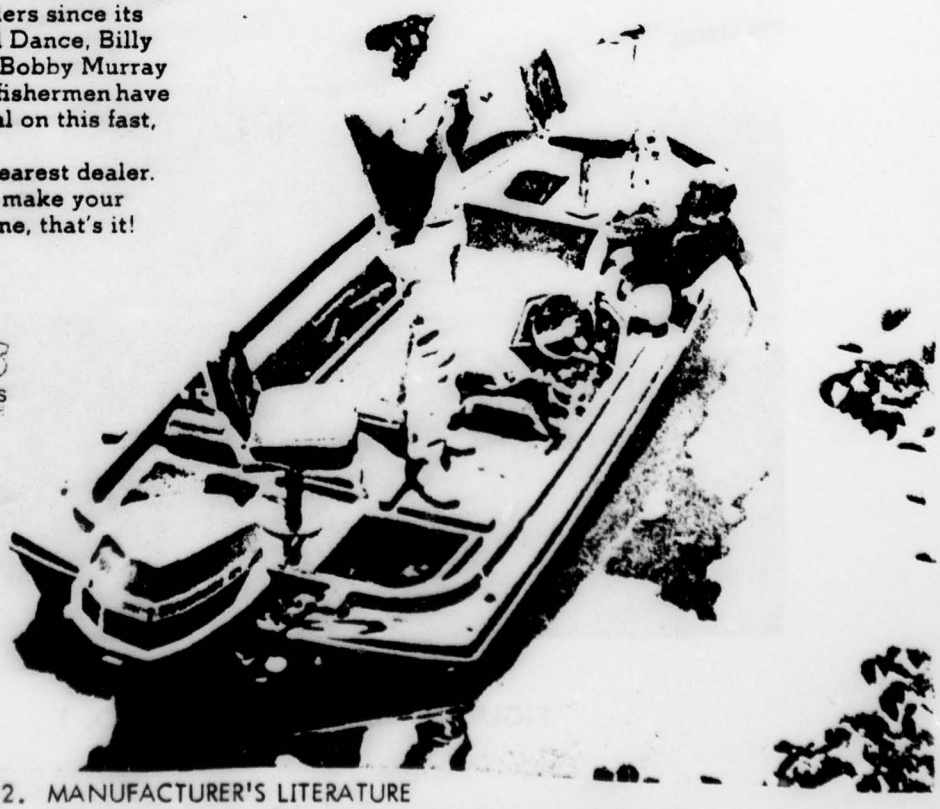

FIGURE 2. MANUFACTURER'S LITERATURE
(Boat at top is Boat No. 2; boat at bottom is Boat No. 1)

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RECREATIONAL BOAT SAFETY COLLISION RESEARCH: COLLISION ACCIDENT--ETC(U)
JAN 77 R MACNEILL, J BOWMAN, B SMITH DOT-CG-40672-A
UNCLASSIFIED MSR-77-51 USCG-D-40-77 NL

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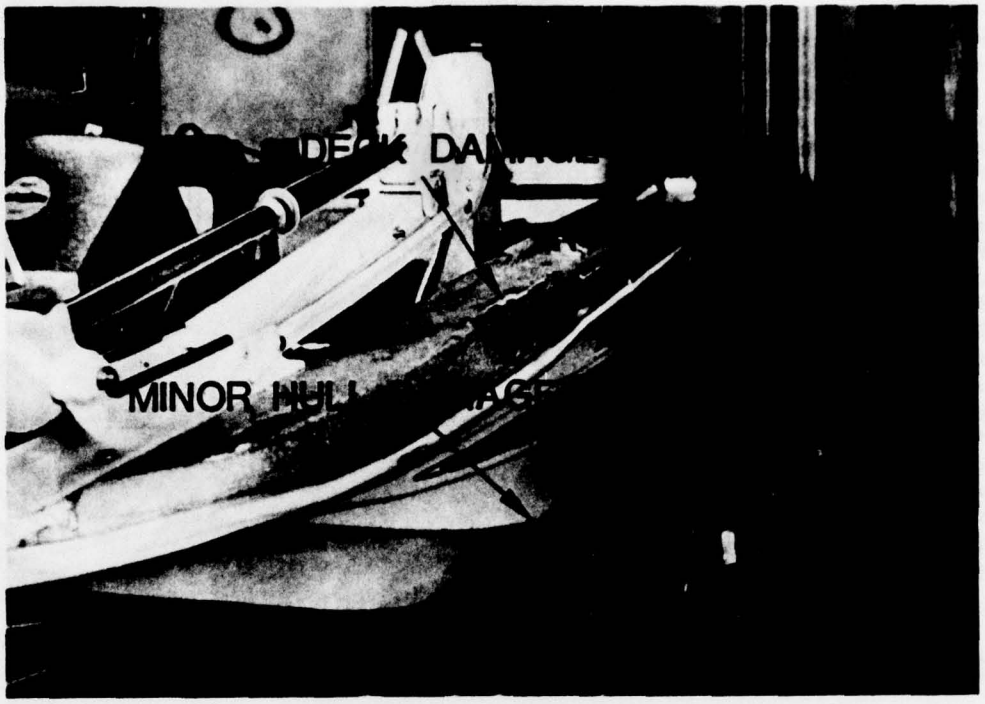

FIGURE 3. DAMAGE — BOAT NO. 1