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CAPSIZING/SWAMPING ACCIDENT INVESTIGATIONS FOR 1975 SEASON.(U)
SEP 76 C SAUTKULIS, B SMITH, J BOWMAN DOT-CG-40672-A
UNCLASSIFIED MSR-76-45 USCG-D-17-77 NL

1 OF 5
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CAPSIZING/SWAMPING ACCIDENT INVESTIGATIONS FOR 1975 SEASON

SEPTEMBER 1976

FINAL REPORT

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DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD
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C. Sautkulis, B. Smith, J. Bowman

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16. Abstract

From several hundred boating accidents, thirty-three (33) were selected for in-depth investigation.

This report summarizes the criteria for selection of those to be investigated, the investigation procedures, and the accident data obtained for the 33 in-depth investigations. In order for the reader to obtain an overview without reading all the appendices, a brief summary of each of the 33 inviestigations is included.

Each of the individual accident reports is presented in full as appendices.

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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

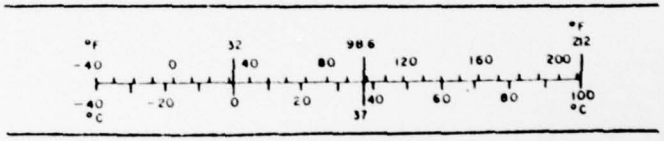
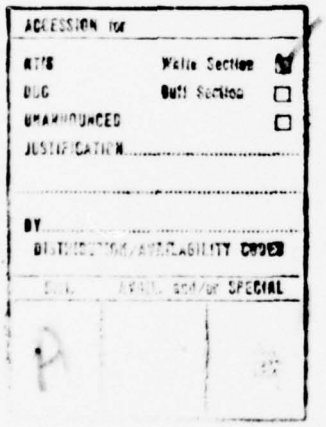


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CAPSIZING/SWAMPING ACCIDENT INVESTIGATIONS FOR 1975 SEASON

1.0 INTRODUCTORY SUMMARY

As part of the Coast Guard's responsibilities to insure the design safety of recreational boats sold to the public, a program to investigate loading-related accidents was initiated by them. To aid in evaluating these accidents, an accident investigation program was also initiated. This report documents and summarizes the accident investigation effort started in 1975 and ended in June 1976. The accidents investigated in this task consisted of capsizings and swampings.

A brief summary of each of the 33 accidents is given along with a summary (Table 1) of some of the accident information. The information obtained from these investigations is to be used as input into a major task relating to safe loading (as well as being used as input into other on-going tasks).

Each of the 33 accidents is presented as an Appendix to this report. Each of these individual accident reports contains the following sections with applicable information:

- 1.0 Boat Occupant Data
- 2.0 Environment
- 3.0 Narrative of Accident
- 4.0 Facts from the Boat Inspection
- 5.0 Psychological and Human Factors
- 6.0 Probable Cause of Accident
- 7.0 Dynamics/Analysis of the Accident

This report presents the methodology used to select accidents for investigations and the procedures used to obtain the desired information.

2.0 ACCIDENTS RECEIVED FOR CONSIDERATION

Candidate accidents for investigations were received via a special WATS line reporting system. Coast Guard Headquarters directed local Coast Guard groups to call a specified telephone number and report accidents related to the study being performed. The telephone number was that of the special WATS line installed at Wyle for the purpose of receiving these accident alerts.

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, there were 313 Capsizing/Swamping accidents reported to Wyle via the WATS line for the 1975 season. In addition to these 313, some capsizing/swampings from 1976 were investigated under this task. From these accidents, 33 were selected for in-depth investigations as described in the following sections.

3.0 SCREENING OF ACCIDENTS

3.1 Screening Criteria

From all of the capsizing/swamping accidents received, a relatively small number had to be selected for investigation. Several criteria were established as guidelines for selection of accidents to be investigated. These guidelines were based on the anticipated use of the information obtained from the investigations. Since these investigations were to be used as input for the Safe Loading Standard evaluation, boats which were regulated by this standard were of prime consideration for investigations. Other characteristics that were considered included:

- Capsizing/Swamping — primary accident cause
- Gross Overloading — assessed low priority
- Boat — available for inspection
- Survivor/Witnesses — available for questioning
- Geographic Location — optimize transportation logistics, cost via multiple investigations per trip

3.2 Screening Procedure

Once Wyle received an accident report, it took several calls to screen the accident and make an appointment for a visit and interview. Since timely reporting of accidents was essential, the Coast Guard groups reporting the accidents would report them without waiting to obtain information other than that first received. In screening the accidents Wyle would call back the reporting station and obtain any additional information which they may have obtained. Survivors and witnesses were then called and asked about the accident. If it was felt that the accident warranted investigating, an appointment was made for a personal interview and boat inspection. Data forms used during the interview are contained in Appendix A.

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 brief 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 what attitude the boat is taking, why it is taking that attitude (flooding, capsizing, etc.), and what the occupants are doing as the accident is taking place.

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

- Section 4.0 Facts from the Boat Inspection

This section gives a description of the boat involved in the accident. Capacity plate values are given when the boat has a capacity plate. Any modifications to the boat hull are also 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 on an ego trip, trying to perform extraordinary feats with his boat, or is using poor judgment in the boat handling, is pointed out in this section.

- Section 6.0 Probable Cause of Accident

The precise cause of the accident is 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 33 accidents investigated for this effort.

Investigation Number	Hull Type	Bow Construction	Length Overall (ft/meters)	Maximum Beam (ft/meters)	Hull Material	Type Power	Displayed Horsepower	Horsepower On Board	Displayed Persons Capacity (lb/kg)	Persons On Board (lb/kg)	Displayed Maximum Weight Capacity (lb/kg)	Total Weight On Board (lb/kg)
75-01	Flat	Open	12/3.65	4/1.22	Aluminum	-	-	-	-	370/168	-	441/200
75-02	Tri-Hull	Open	16/4.88	6.42/1.96	Fiberglass	Outboard	115	65	900/408	699/317	1860/844	1188/539
75-03	Warped Plane	Decked	15/4.57	-	Wood	Outboard	-	75	-	275/124.74	-	670/304
75-04	Semi-V	Decked	23/7.01	9.5/2.89	Fiberglass	Inboard	-	-	-	625/283.5	-	-
75-05	Flat	Decked	18/5.48	5/1.52	Wood	Outboard	-	20	-	813/368.78	-	1000/454
75-06	Tri-Hull	Open	14/4.27	5/1.52	Fiberglass	Outboard	40	50	-	365/165.6	620/281	635/288
75-07	Tri-Hull	Open	15.58/4.75	-	Fiberglass	Outboard	-	50	-	635/288.04	-	Free Water
75-08	Tri-Hull	Decked	17/5.18	5.71/1.74	Fiberglass	Outboard	-	-	-	340/154.2	-	-
75-09	Semi-V	Open	18/5.48	-	Fiberglass	Outboard	-	135	-	315/143	-	650/295
75-10	Semi-V	Open	19/5.79	-	Fiberglass	Outboard	-	90	-	295/134	-	585/265
75-11	Tri-Hull	Open	16.33/4.98	6.17/1.88	Fiberglass	Outboard	120	50	900/408	165/75	1350/612	385/175
75-12	Semi-V	Decked	17/5.18	-	Fiberglass	Outboard	125	100	-	148/67	1400/635	488/221
75-13	Semi-V	Decked	16/4.88	-	Fiberglass	Outboard	-	60	-	295/133.81	-	620/281
75-14	Semi-V	Decked	13/3.96	-	Wood	Outboard	-	5	-	438/198.68	-	565/256
75-15	V-Hull	Decked	18/5.49	-	Fiberglass	Outboard	-	60	-	160/72.58	-	584/265
75-16	Tri-Hull	Decked	15/4.58	-	Fiberglass	Outboard	-	40	-	490/222.26	-	880/399
75-17	Deep-V	Decked	16/4.88	7/2.13	Fiberglass	(3)	-	270	-	140/63.50	-	140/63.5
75-18	Flat	Open	12/3.66	4.17/1.27	Fiberglass	Outboard	-	6	-	290/131.54	-	416/188.7
75-19	Semi-V	Decked	14/4.27	-	Aluminum	Outboard	-	33	-	580/263.09	-	1034/469
75-20	Flat	Open	10/3.05	-	Aluminum	-	-	-	-	310/140.61	-	355/161
75-21	Semi-V	Open	15/4.58	-	-	Outboard	-	30	-	490/222.26	-	790/358
75-22	Semi-V	Open	13.5/4.11	-	Aluminum	Outboard	20	9.5	-	375/170	765/347	522/237
75-23	Semi-V	Decked	16/4.88	-	Fiberglass	Outboard	-	50	-	500/227	-	768/348
75-24	Flat Bottom	Open	15/4.57	4.5/1.37	Wood	Outboard	-	15	-	320/145	-	455/206
75-25	Semi-V	Decked	20.75/6.32	-	Fiberglass	(3)	-	160	-	475/215	-	500/227
75-26	Semi-V	Decked	19/5.8	7.58/2.31	Fiberglass	(3)	-	120	-	540/245	-	-
75-27	Tri-Hull	Open	15/4.57	-	Fiberglass	Outboard	-	55	-	635/288.04	-	920/417
75-28	Flat	Open	14/4.27	4/1.22	Aluminum	Outboard	20	10	430/195	475/215.46	830/376	518/269
75-29	Flat	Open	14/4.27	-	Aluminum	Outboard	-	10	-	420/190.5	-	583/264
75-30	Tri-Hull	Open	15.08/4.6	6.42/1.96	Fiberglass	Outboard	90	50	990/449	140/64	1440/653	518/231
75-31	Semi-V	Decked	16.75/5.11	6.63/2.02	Fiberglass	Outboard	-	90	-	490/222	-	830/376
75-32	Deep-V	Decked	20/6.1	7.58/2.31	Fiberglass	Outboard	-	140	-	505/229	-	1251/567
75-33	Semi-V	Decked	14.8/4.52	6.16/1.88	Fiberglass	Outboard	80	125	-	555/252	1450/658	1000/454

(1) 1 - Water over bow
2 - Water over transom
3 - Water over side
4 - Reduced freeboard due to load distribution
5 - Capsize by single wave

(2) IL - Inverted and level
IB - Inverted, bow high
UL - Upright and level
UB - Upright, bow high
S - Sunk

(3) Inboard/Outdrive

Displayed Persons Capacity (lb/kg)	Persons On Board (lb/kg)	Displayed Maximum Weight Capacity (lb/kg)	Total Weight On Board (lb/kg)	Estimated Speed (at time of accident)(mph/kph)	Persons On Board (number)	Persons Wearing PFDs (number)	Persons With Formal Boating Instruction (number)	Operator's Age	Operator's Boating Experience (hours)	Mechanism of Capsize (1)	Fatalities (number)	Final Attitude of Boat (2)
-	370/168	-	441/200	Anchored	2	0	0	34	> 500	3	1	S
00/408	699/317	1860/844	1188/539	15/24	5	3	0	42	> 500	1	0	IL
-	275/124.74	-	670/304	20/32.2	2	0	0	67	40 Yrs	5	0	UL
-	625/283.5	-	-	-	3	0	1	43	> 500	5	0	IL
-	813/368.78	-	1000/454	-	5	0	0	39	< 50	2	0	UL
-	365/165.6	620/281	635/288	Anchored	2	0	1	50	> 500	2	0	UB
-	635/288.04	-	Free Water	5/8	4	4	2	24	100	1	0	IL
-	340/154.2	-	-	-	2	0	0	46	> 500	5	0	IL
-	315/143	-	650/295	Drifting	2	2	0	55	> 500	2	0	UL
-	295/134	-	585/265	Drifting	2	1	1	36	50	2	0	IL
00/408	165/75	1350/612	385/175	Drifting	1	0	1	51	250	5	0	IL
-	148/67	1400/635	488/221	Drifting	1	0	1	61	>500	5	0	IL
-	295/133.81	-	620/281	-	2	0	1	23	500	2	0	IB
-	438/198.68	-	565/256	Drifting	2	0	0	29	> 300	3	1	UL
-	160/72.58	-	584/265	Idling	1	0	1	46	< 200	2	0	IB
-	490/222.26	-	880/399	17/27.4	5	3	1	45	> 500	1	0	IL
-	140/63.50	-	140/63.5	37/59.5	1	0	0	23	> 500	-	0	-
-	290/131.54	-	416/188.7	-	2	0	1	33	> 500	5	0	IL
-	580/263.09	-	1034/469	Drifting	4	1	0	25	> 200	2	0	IB
-	310/140.61	-	355/161	-	2	0	0	70	Very Little	3	1	IL
-	490/222.26	-	790/358	5/8	3	0	0	34	> 500	2	0	S
-	375/170	765/347	522/237	18/29	2	0	0	58	> 500	5	0	IL
-	500/227	-	768/348	Drifting	3	3	0	24	> 500	2	0	IB
-	320/145	-	455/206	15/24	2	0	0	46	500	5	0	IL
-	475/215	-	500/227	20/32	3	3	2	50	500	1	0	IB
-	540/245	-	-	-	3	0	1	47	> 50	2	1	IL
-	635/288.04	-	920/417	-	4	2	0	42	200	1	0	IL
30/195	475/215.46	830/376	518/269	-	4	4	0	42	> 500	1	0	IL
-	420/190.5	-	583/264	5/8	2	0	0	49	> 500	3	1	IL
90/449	140/64	1440/653	518/231	5/8	1	0	0	31	500	1	0	IB
-	490/222	-	830/376	Drifting	3	1	0	46	500	2	0	IB
-	505/229	-	1251/567	Anchored	3	0	0	31	> 300	2	0	IL
-	555/252	1450/658	1000/454	Drifting	4	0	1	22	< 500	2	0	IB

TABLE 1. SUMMARY OF 1975 CAPSIZING/SWAMPING ACCIDENTS

5.0 SUMMARY OF IN-DEPTH INVESTIGATION

Included here are brief narrative summaries taken from the 33 accidents that have been investigated for the 1975 Capsizing/Swamping Accident Investigation task.

75-01 At approximately 0710 the first part of May 1975, two men were fishing from an anchored 12 ft aluminum flatbottom boat with no motor. The boat was anchored near rapids in a fast flowing river. The operator was sitting in the aft seat, and the passenger was sitting in the forward seat. The inexperienced passenger allowed the boat to turn broadside to the current while deploying the bow anchor. The water built up on the boat side and started flowing freely into the boat. The boat flooded and was completely submerged by the swift current. The occupants got out of the boat and started walking ashore. The passenger stepped in a hole approximately 20 ft from shore and drowned. The operator made it to shore safely. The occupants were not wearing PFDs.

75-02 At approximately 1600 in mid-May 1975, three adults and two children were returning from a river fishing trip in a 16 ft fiberglass tri-hull bowrider powered by a 65 horsepower outboard motor. The boat was traveling at half throttle when the motor abruptly stopped. The stern wake combined with one to two ft swells raised the stern, causing the bow to slice into a wave, partially swamping the boat. The occupants tried to bail out the water, but abandoned the effort when the boat completely filled with water. The boat rolled over to a stable upside-down position. The occupants held to the boat for approximately 11 hours until rescued. All occupants were wearing PFDs.

75-03 At approximately 0800 in late April, 1976, a man and his wife set out on a fishing trip from a marina located near Morehead City, N. C. The couple traveled east on the island side of Shackleford Banks to a point near Morgan Island (approximately nine miles). They fished in various locations on the way to Morgan Island. The fishing was poor on the inland side, and they decided to go to the ocean side of Shackleford Banks. They traveled through the inlet to the ocean side and started west back toward the marina. After fishing in several locations, they stowed the fishing gear and started back to the marina. At a point

approximately 1-1/2 miles off the ocean side of Shackleford Banks and one mile east of Beaufort Inlet, they observed a large wave approaching from the ocean side (port). At this time the boat was traveling approximately 20 mph. The sea conditions were widely spaced, smooth swells approximately 1-1/2 to 2 ft in height. Before the operator had time to react, the wave capsized the boat, throwing both occupants into the water. The couple stayed with the boat until it drifted close to shore (approximately 50 yards) where they left the boat and swam to shore.

75-04 A 23 ft inboard cabin boat was entering a breaking inlet when the operator noticed a large boat overtaking him 10 yards to port. The operator slowed down from his safe position on the back of a six-foot wave for fear that the two boats would collide in the narrow inlet ahead. A wave caught up to him and his boat broached and slowly capsized.

The two people on the flying bridge were thrown into the water. The third person in the cabin was trapped under the boat. The trapped cabin occupant swam out from under the boat and joined the operator at the bow. They both hung onto the boat. The other person that was on the flying bridge was picked up by a commercial fishing boat and transported to shore. He was admitted to the local hospital with what was diagnosed as heart palpitations. The two on the bow of the boat were rescued. The Coast Guard towed the boat into shore.

75-05 Two families went to a New Jersey coast resort town for a weekend of relaxation. Each arose early, drove 70 miles to the resort town, rented fishing boats and went fishing. Even though they both signed an agreement with the rentor stating that they would not venture into the ocean, they both did.

Both operators were inexperienced, had never owned a boat, and in fact, had operated a boat less than 10 times in their lives. They were drift fishing with their engines off at the mouth of the inlet when one boat drifted into a shoal area with breaking waves. Waves entered over the transom and swamped the boat. Four of the five people on board donned PFDs. All five left the boat and were picked up by other boats in the area. The Coast Guard towed the rental boat back to its owner.

75-06 On Monday evening in mid-April 1975, two men were shrimping with cast nets from an anchored 14 ft fiberglass bass boat powered by a 50 hp outboard motor. The operator was standing in the bow and the passenger was standing in the aft section. The passenger noticed that water was flowing over the transom into the boat. He moved to the bow in an attempt to increase the transom freeboard and stop the ingress of water. The water continued to come into the boat until it was completely flooded. The boat sank until it was in an upright attitude with only the bow out of the water. The occupants swam approximately 20 ft to shore, holding to life cushions. No wearable PFDs were aboard.

75-07 Four men had been camped overnight on a peninsula to which they had boated. During the night a storm came up which, in addition to blowing down their tent and soaking them, partially filled their beached boat with water. They left for home the next day even though the weather was not very good. After pulling the drain plug, the owner thought water still remained in the boat due to its resting at a heel angle. While underway all four occupants donned PFDs. A large boat passed them, causing their boat to be swamped by a large wake. All were rescued by a passing boat.

75-08 The skipper of a commercial fishing boat since 1958 recently bought his first small boat. He enjoys scuba diving and wanted a floating platform from which he could dive. Prior to re-entering an inlet on the Massachusetts coast, he found that the seas were breaking badly over a sand bar at its entrance. Because he was afraid of hitting his propeller on the sand bar, he instructed his companion to go forward and sit on the bow of his 17 ft runabout in an attempt to keep the stern up. His friend agreed, sat on the bow, and was washed off by a wave. The boat passed over him, the propeller cut his head, and he surfaced behind the boat.

The operator saw the blood, shut off the engine and jumped overboard to save his friend. The operator helped the injured friend to the side of the boat, boarded the boat, and was about to help his friend into the boat when a wave capsized the boat. The two men swam to a nearby fishing boat which took them to shore. The boat was found at sea a week later and was towed in by the Coast Guard.

Both men were wearing wet suits. They were not wearing PFDs.

75-09 One morning in mid-July, 1975, at approximately 0900, failure of the outboard motor to start on an 18 ft bowrider allowed an unexpected wind to push the boat onto a rock jetty. The two occupants managed to push the boat off the jetty and onto an adjacent beach. Waves broke over the boat, filling it 1/3 full of water. The boat was towed off the beach by the Coast Guard and then it swamped completely. Both occupants boarded the Coast Guard boat.

75-10 One morning in mid-June, 1975, a man and his wife were fishing in an inlet area. They were drifting with the engine off, then decided to start trolling. The engine failed to start, and the operator dropped anchor to keep from drifting too far in the current. As he turned toward the stern, a large breaking wave "10 to 15 ft high" broke over the stern of his boat. Successive waves filled the boat with water and it capsized. Both occupants were rescued by a nearby boat.

75-11 One afternoon in mid-June, 1975, the owner of an 18 ft bass boat with a 50 hp outboard set out to fish in a inlet area. He was drift fishing near an area that was known to produce large breaking waves rather quickly. When near this area, his attention was taken by a fish he had just caught. He drifted into this area and his boat was overturned by a 10 ft high breaking wave. He was rescued by a nearby boat.

75-12 One afternoon in late July, 1975, the owner/operator of a 17 ft outboard attempted to pull a grounded boat off the beach. The area was too rough for a boat of this size with 5 to 6 ft high surf. Nevertheless, he attempted the rescue. Failure of his engine at a critical moment caused his boat to be capsized by one of the waves, trapping him between his overturned boat and the beach. Four men on the beach lifted his boat, and he got out from under it. The Coast Guard was called, and they pulled both boats off the beach.

75-13 At approximately 1530 in late June, 1975, a man and a teenage boy set out from a mooring area on an inlet destined for a point approximately one mile up the inlet. The purpose of the trip was to assist a friend who was having trouble with his small boat motor. Their intentions were to go to the friend's boat, attempt to repair the motor and, if unsuccessful, tow the boat back to the mooring area. Upon arriving at their destination, the operator got out of his boat into the anchored boat of his friend and began working on the motor. The passenger stayed in the involved boat and tied a short line from the starboard stern cleat to the bow cleat of the anchored boat which was approximately 50 yards from shore. The wind velocity was 10 knots and the water was choppy (1 to 1-1/2 ft) with a 2.2 knot current. After working on the motor approximately 20 minutes, the operator noticed that the chop was coming over the transom into his boat. He instructed the passenger to start the motor and maneuver the boat around into a position where the water would not come into the boat. The battery in the involved boat ran down and would not turn the motor over. The passenger went aft in an attempt to manually start the motor. Soon after he moved aft, the boat flooded (over the stern). After flooding, the boat sank by the stern and capsized coming to rest upside-down in a bow high attitude. The passenger was rescued by pulling him aboard the other boat. The involved boat was retrieved by a Coast Guard boat from a nearby rescue unit.

75-14 At approximately 1300, two men set out on a fishing trip from a launch ramp located on Torch Lake in northwestern Michigan. The men fished for approximately 3-1/2 hrs in various locations within two miles of the launch ramp. The men then decided to anchor the boat approximately 25 ft from shore and fish. The operator was seated in the stern and the passenger was seated in the forward seat on the port side. The operator moved forward, got the anchor and deployed it over the port side immediately in front of the seated passenger. The operator and passenger weight on the port side caused sudden heeling to a point where water was coming over the gunwale, throwing both men out of the boat. The men were not wearing PFDs. The boat rolled back to the upright position, and the passenger managed to get back into the boat. He threw the operator a PFD, but he did not grab it. The operator drowned, and his body was recovered at the accident location.

75-15 At approximately 1210, the owner/operator of the involved boat (the only occupant) set out on a fishing trip from a marina located in southern Connecticut. He traveled approximately two miles from the launch ramp and approximately one mile offshore where he fished for approximately two hours. After catching a number of fish, he started pulling in the anchor in preparation to return to the marina. The anchor line was tied to the bow cleat. He was standing on the bow, pulling in the anchor line. Due to the wind and chop on the water, he was unable to break the anchor loose from the bow position. He untied the anchor line from the bow cleat and walked to the transom on the port side holding the anchor line. He was unable to break the anchor loose from this position. He then started the motor and attempted to back the boat over the anchor. With the motor in reverse at idle, he attempted to pull the anchor up from the port stern position. As the boat backed over the anchor location, he was still unable to free the anchor. He quickly tied the anchor line to the port stern cleat and started forward to put the motor in neutral. Before he could get to the helm, the anchor line became tight and pulled the port stern down to the point that water started flowing freely over the port gunwale at the stern. The boat rapidly filled with water and started sinking by the stern. The operator grabbed an AK-1 PFD and jumped in the water. The boat completely swamped and rolled slowly to port until it was in an upside-down, bow high position. The operator was rescued by a small fishing boat that was nearby. The boat was retrieved by a Coast Guard rescue vessel.

75-16 At approximately 1300, two boats set out on a fishing trip from a launch ramp located in southern Maryland. The involved boat contained a man, his wife and three children. The two boat party traveled approximately eight miles from the launch ramp and approximately three miles offshore where they fished for about four hours. Within a few minutes after getting underway back to the launch ramp, the operator noticed that the boat transom freeboard was lower than normal and there was water in the transom area. At this point, he instructed his wife to move forward to increase the transom freeboard. The boat was on-plane and cruising at 15-20 mph. When the wife moved forward, the bow went down, causing the boat to swamp. The occupants stayed in the swamped boat until rescued by a nearby boat that was in the fishing party. No injuries or fatalities resulted in this accident. Water in the inner hull was most likely the cause of this accident.

75-17 After work, a young man fueled his 16' deep-v runabout and took it out into a glassy smooth ocean. He enjoyed the thrill of jumping waves and wakes, so he cruised quite close to the beach where the surf created some interesting waves. He would parallel the waves, then turn the boat into the wave just prior to impact. The boat would leap out of the water and re-enter in the trough.

According to a witness in another vessel, the boat cleared a particular wave and flew so high that the beach was visible under the keel of the runabout. The boat came down on its side. The steering mechanism within the outdrive unit broke, and the boat went into a high speed spin. The lone occupant was thrown across the cockpit. His shoulder hit the coaming, and his face hit the grab rail surrounding the cockpit, resulting in a broken clavicle and a broken jaw. He was knocked unconscious and fell into the aft portion of the cockpit. The boat continued to spin for a couple of minutes, then suddenly stopped. Apparently, water had been forced into the gas tank through the vent through-hull fitting. The cruiser owner called the Coast Guard and towed the stricken vessel to shore. A waiting ambulance took the vic to the hospital, and the boat was towed to the Coast Guard Station.

75-18 After eating dinner at his parents' waterfront home, a man and his teenage sister decided to go fishing on his parents' cabin cruiser. His wife took the children home. He couldn't find the keys for the cruiser, so the two went fishing in the cruiser's dinghy, a 12 foot fiberglass open boat.

They headed out the inlet into the ocean and fished just outside the surfline about 1/4 mile from shore.

A wave suddenly turned the boat over. It floated flat, upside-down. They donned PFDs and hung onto the upside-down boat for about an hour. Then they righted the boat, bailed it, and climbed aboard. An offshore wind blew them to sea. They huddled together in the bottom of the boat all night to attempt to keep warm. At 0730 a fishing boat spotted them, called the Coast Guard, and they were rescued.

There were no serious injuries as a result of the capsizing.

75-19 At approximately 0530, a party consisting of two men and two women set out on a clam digging trip from a launch ramp located in east central Maine. The party traveled approximately two miles across the bay to an island where they dug clams for approximately two hours. When they started back, it was discovered that the sheer pin was broken on the starboard motor. Also, they observed that the wind velocity had increased, and the water was much rougher than it had been when they arrived on the island. When they got underway (5-7 mph) back across the bay, the bow was pointed into the wind and waves at an angle of approximately 30 degrees off the starboard side. A considerable amount of water spray was coming over the starboard bow into the passenger compartment. Approximately 10 minutes after getting underway, the operator noticed that a considerable amount of water was in the stern. He instructed the two females aboard to climb on the bow to prevent the stern from sinking. At about the time the women were positioned on the bow, the motor stopped. The boat slowly turned to port until the transom was into the wind and waves. The waves started breaking over the transom and in a very short time, water was flowing freely over the transom. The boat filled with water and started sinking by the stern. The occupants got out of the boat into the water, with three of the occupants each holding a flotation cushion and one wearing an AKH PFD. The people manually capsized the boat so air would be entrapped in the bow section, which would keep the boat afloat. The people held onto the bow line for approximately one hour. After this time, a male and female passenger left the boat and swam ashore, leaving the operator and other female passenger with the boat. They returned in approximately two hours with a rescue boat. The operator and female passenger that had stayed with the boat were taken to the hospital, treated for exposure and shock, and released. A Coast Guard vessel towed the involved boat back to the launch ramp.

75-20 At approximately 1630, two men set out on a fishing trip on a small lake located in southern Michigan. The men rowed the boat approximately two hours. The fishing gear was stowed and the anchor pulled aboard in preparation to get underway back to the launch ramp.

The owner had rowed the boat to the fishing area, and his companion was to row back. The owner was seated in the bow seat, and his companion was seated in the center seat, starboard side. The owner stood up and started moving to the stern. When he reached amidship, he stepped over the center seat, placing his right foot on the port side just aft of the center seat. The boat capsized, and both men fell into the water. No PFDs were in the boat. The companion immediately started swimming ashore (approximately 150 ft away). When he was within approximately 50 ft of shore, he heard the owner call for help. He grabbed some reeds that were nearby, turned around, and saw that the owner was approximately 20 ft from the overturned boat and was having a hard time keeping his head above water. The companion called to the owner and told him the boat was behind him and to try to swim to the boat. The owner went under, and shortly thereafter, the companion saw the top of his head come up. The owner submerged again and did not return to the surface. The companion called to a fishing party in a nearby boat for help. The boat rescued him and took him back to the ramp where the local police were called. The owner's body was recovered approximately one hour after the accident in the location of the capsizing. The boat was towed back to the launch ramp by the local police.

75-21 At approximately 0100, a fishing party consisting of three adult males set out on a fishing trip from a launch ramp located in southwestern Michigan. The party traveled approximately two miles from the launch ramp and 3/4 mile off shore, where they fished for approximately 45 minutes. The men were trolling north and south at a speed of three to five mph. The trolling track was approximately 1/8 mile long and ran parallel to the shoreline. The boat was headed into two to three ft swells with the operator at the helm on the starboard side, one passenger in the opposite seat, port side and one passenger standing in the stern. The stern passenger shouted to the operator that water was coming over the transom. The operator turned around at about the time two large waves broke over the transom into the boat, partially flooding the aft section. Before the operator had time to react to the flooding situation, waves started breaking over the transom in quick succession, completely swamping the boat. The operator applied full power, but simultaneously the motor stopped due to water intake. The boat started sinking rapidly by the stern. The occupants jumped

out of the boat and held to the side until it was apparent that the boat was completely sinking. The boat submerged, leaving the occupants treading water with no PFDs. There were approximately 200 small fishing boats in the area. The occupants shouted for help, but their calls were ignored. Some of the nearby boat operators cursed at the occupants and warned them to stay clear of their fishing lines. After the occupants had been in the water approximately five minutes, the operator of a nearby cabin cruiser who had witnessed the sinking came to their aid and took them aboard. A Coast Guard rescue vessel came to the accident site after being called on the cabin cruiser's marine radio. The occupants were taken aboard the CG vessel and transported to a nearby CG station. At the time of the interview, the involved boat had not been recovered.

75-22 One morning in late August, 1975, two men were fishing in a 13 ft 6 in. aluminum boat powered by a 9-1/2 hp Evinrude motor. The operator heard a noise and when he turned, he saw a "six foot high" breaking wave coming at the boat. He tried to outrun the wave, but it caught the boat, throwing the stern into the air and catapulting him 20 ft from the boat. The passenger stayed in the partially swamped boat just as the operator had swum back to it. Both were rescued by a nearby Coast Guard boat.

75-23 At approximately 0900, three men were fishing in a 16 ft runabout powered by a 50 hp outboard motor. They were using fuel at a faster rate than anticipated, so the operator decided to mount a four hp engine, which was on board, on the transom. He shut off the 50 hp engine and moved aft. The waves swung the boat stern into the waves and the waves began breaking over the transom.

Neither engine would start, and the waves caused progressive flooding resulting in the boat being swamped. All occupants were rescued by two nearby boats and taken to a nearby Coast Guard station where they were treated for hypothermia.

75-24 Two men were returning from a fishing trip in a 15 ft flatbottom wood rented boat. As they were heading back to the mouth of the river from the ocean, a large breaking wave approached the boat. The operator turned the boat bow into the wave. The wave turned the boat bow-over-stern backwards, causing it to land upside down, trapping the two occupants beneath it. They both swam out from under the boat and held onto it. They found it difficult to hold onto the boat as it was being rolled by the waves. They decided to swim for shore but were rescued before they left the boat.

75-25 Three people on board a 20 ft inboard/outdrive left the mouth of a river and went into the ocean under marginally safe conditions. An hour later after conditions had become worse, they attempted to negotiate the river channel. Wind, waves, current, and obscured vision contributed to their being taken to an area with large breaking waves. Several successive waves swamped and capsized the boat, trapping the three occupants beneath the boat. One of the occupants swam out from under the boat and to shore. The other two remained under the overturned boat and drifted to shore, where they were rescued by the Coast Guard.

75-26 The owner of a 19 ft Aristocraft I/O planned an offshore fishing trip with two other men. The three arose early on a Saturday morning, launched the boat in protected waters and entered the ocean through a breaking inlet. By the time the operator noticed that the inlet was very rough, it was too late to turn around. Once into the ocean, the three men decided that it was too rough for comfortable fishing and decided to come back in at the next inlet south, because it has a reputation of being somewhat smoother than the inlet they went out. The owner circled the inlet and went in, riding the back of a wave. Another wave caught up to them and broke over the transom. The bow went under, the boat pitchpoled and capsized. The standing operator was thrown out. The two passengers who were trapped inside the boat grabbed PFDs, came out from under the boat, and held onto the bow rail with the owner. The boat drifted into shallow water where all three were able to stand. "Help" was heard from the person in the rear. Seconds later he was face down, dead. All three were picked up by the Harbor Police. The boat washed up on shore and was later salvaged.

75-27 At approximately 1545, four adults, two male and two female, set out for a pleasure ride in a bay located in southern Louisiana. The male operator was able to maneuver the boat at full throttle most of the time, but had to throttle back occasionally because of rough water. The operator was seated at the helm on the starboard side, the male passenger was seated in the port seat adjacent to the operator, and the female passengers were seated in the forward bow seat.

The party rode around in the bay for approximately 15 minutes, at which time the operator slowed the boat to idle speed and made a sharp 180 degree turn to port. After completing the turn, the operator saw that the boat was headed bow on into a wave approximately two feet in height. As the boat approached the wave, the operator applied full throttle to bring the bow of the boat up onto the wave. The wave came over the bow and the boat rapidly submerged, bow first. After completely filling with water, the boat rolled to starboard until it was upside-down in a level position. The operator was trapped underneath the boat and was disoriented. The other occupants pulled him out from under the boat. The occupants stayed with the boat for approximately 20 minutes until rescued by a Coast Guard Auxiliary boat. The boat was righted, the water pumped out, and towed to shore by the rescue vessel.

75-28 At approximately 0945, four persons set out from a launch ramp located in southeastern Texas destined for an oyster boat that was working approximately 15 miles away from the launch ramp and approximately two miles off the shore of Galveston Bay. The party included one adult male, two teenage males, and an eight year old female. The purpose of the trip was to take the children aboard the oyster boat to observe the working operation.

Approximately 20 minutes after getting underway, a wave came over the bow, partially swamping the boat. The operator slowed the boat to idle speed, and the occupants started bailing the water out of the boat. Within one minute after the bailing operation was started, a second wave came over the bow, completely swamping the boat. The boat started rolling to port; and the occupants, all wearing PFDs, exited the boat on the port side. The boat came to rest upside-down in a near level attitude. The occupants held to the boat for approximately two hours before being rescued by a tug boat. After being in the water approximately 30 minutes, the eight year old either lost consciousness or fell asleep. After approximately

one hour and 30 minutes, the adult and one of the teenagers started losing feeling in the lower part of their bodies. They were unable to walk for approximately five minutes after being rescued. The eight year old was treated at a local hospital for exposure and released.

75-29 At approximately 1800, two male adults set out from a launch ramp located in south central Kentucky destined for a fishing area approximately 1/2 mile away to set out a trot line. After arriving at the fishing area, the men spent approximately 45 minutes setting out and baiting the trot line. They started back toward the launch ramp at a speed of 10 - 15 mph. As the boat neared the inlet where the launch ramp was located, darkness had set in and only the outline of the shoreline could be seen sharply. Other objects in the water such as stumps, debris, etc. could be faintly seen. As the boat entered the inlet, the operator reduced speed to 4-6 mph. Approximately 400 yards from the launch ramp, the boat impacted an unknown object in the water. The impact occurred on the starboard bow, which rolled the boat to port, submerging the port gunwale. The boat flooded and rolled to port until it was upside-down in a near level attitude. As the boat rolled, the occupants exited the boc over the port side. The men held to the capsized boat and started swimming to shore (approximately 50 yards away). After swimming a few yards, the boat seemed to be hung on something and would not move. The men left the boat and started swimming for shore. When the passenger reached shore, he could not see or hear the operator. The passenger walked around the inlet to the operator's truck. The operator had taken the ignition key, and the passenger was unable to start the truck. He stayed in the truck until the next morning, then walked approximately two miles to a highway where he caught a ride to a telephone where he called the local rescue squad. The operator's body was found approximately 20 yards from the boat, toward the shore. The boat anchor had fallen out when the boat capsized, which kept the boat at the accident site during the night. No PFDs were aboard the involved boat.

75-30 At approximately 1200 in early April, 1976, four adult men in two boats set out on a fishing trip in a bay located in southeastern Virginia. Two people were in each boat. The party traveled approximately 15 miles across the bay to a fishing area arriving at approximately 1245. The party stopped fishing at approximately 1900 and started back across the bay to the launch ramp. After traveling about 10 miles at 3/4 to full throttle, the motor on the involved boat abruptly stopped. The motor was easily restarted but would not run above fast idle rpm (four to five mph). The party decided to transfer the passenger of the involved boat to the other boat and go on to the launch ramp and get the boat trailers in position to remove the boats from the water. The other boat started toward the launch ramp with the involved boat following at fast idle speed. After the other boat was out of sight, the operator of the involved boat noticed that water was occasionally splashing over the bow into the boat as he negotiated the two to three foot swells. At approximately 2000, the boat had traveled no more than 1/2 mile from the point where the other boat had started toward the ramp. At this point the operator stated that the boat was riding on the crest of a wave and was being pushed bow down on the front side of the wave similar to a surf board. The force of the wave pushed the bow of the boat into the trough, causing the bow to slice into the base of the next wave. Water came over the bow until the boat was approximately half flooded. The operator grabbed an empty cooler and started bailing the water out of the boat. Within a one minute period, water started flowing freely over the starboard aft section, and the boat started rolling to starboard. As the boat started to capsize, the operator grabbed a PFD and jumped over the starboard side. The boat came to rest upside-down in a bow high attitude. The operator donned the PFD and climbed on top of the overturned boat. Initially the boat was approximately four and a half miles off shore, but during the night, it drifted to within one mile of the shore. The operator considered trying to swim for shore, but decided against it due to the cold temperature of the water and the unpredictable currents. The boat drifted into a river channel and was spotted by a passing barge at approximately 0530. The Coast Guard was notified of the capsized boat, and a nearby vessel that was involved in the search responded to the call. The operator was taken aboard the Coast Guard rescue vessel and the involved boat was towed to the launch ramp.

75-31 At about 0745 on a Saturday in early June, 1976, three men set out on a trawling and fishing trip on Lake Pontchartrain, Louisiana. They trawled for shrimp for about one to two hours, and during that time the waves increased from about two to four feet (0.6 to 1.2 meters). Unable to keep up speed while headed into the waves, the operator turned and headed with the seas at his stern. While proceeding at slow speed, the trawl snagged on an unknown obstruction on the bottom, causing the boat to come to a complete stop. At that time, the boat was about two to three miles (3.2 to 4.8 kilometers) from the nearest shore. The operator went to the stern to try to pull his boat back over the trawl to retrieve it, despite the high seas and lack of a motorwell. Waves began to enter the boat over the transom as he was hauling in one lead to the trawl. At about this time, one passenger, a non-swimmer, moved onto the decked-over bow. The operator ceased trying to recover the trawl due to the increasing amount of water in the cockpit and attempted instead to power ahead to break the trawl loose. That action was not successful and, in fact, only pulled the stern down further. After boarding seas killed the engine, the operator got onto the bow to improve the boat's trim, while the second passenger began to bail out the cockpit with a washtub. As the boat swamped further, the passenger quickly pulled all six PFDs from under the bow and handed them up to the non-swimming passenger. He then emptied the two ice chests on board and secured their covers for use as flotation aids.

The boat went down further by the stern and then capsized, rolling to starboard. The two persons on the bow pushed clear as the boat rolled over, but the other occupant was trapped beneath the hull for a short time. The boat floated inverted, bow up; and the men were able to use it and the ice chests to support their weight until about 30 minutes later when they were rescued by a passing boat whose attention they attracted by waving an orange PFD. The capsized boat was recovered later by a Coast Guard Auxiliary vessel.

75-32 At approximately 0900 on a day in mid-April, 1976, a man (boat operator) and his wife set out from a launch ramp located in southeastern North Carolina destined for a scuba diving area approximately 19 miles (30.6 km) from the ramp. On the way to the diving area, the couple stopped and picked up a friend (teenage female). The party then proceeded to the diving area, arriving at approximately 0930. The boat was anchored by

the bow on the lee side of a jetty in approximately 15 ft (4.6 m) water. The operator and his wife put on wet suits, air tanks, and weight belts in preparation to dive in the area. The teenager was to stay in the boat. The operator noticed that water was splashing over the transom into the motor well. He turned on the bilge pump and observed that water was coming out of the discharge hole. A short time later, he noticed that the water level in the transom area had raised to the point that it was visible in the passenger compartment. The boat started to list to starboard, and water started flowing freely over the transom and forward section of the motor well into the passenger compartment. The operator tried to start the motors, but apparently the battery had shorted. The operator told the two passengers that they would have to get out of the boat because it was going to sink. The operator and his wife took off their diving gear, and the wife went into the cabin to get a PFD for the teenage passenger. As she entered the cabin, the boat started sinking by the starboard stern and simultaneouly began to roll to starboard. As the boat rolled, the teenage passenger held onto the operator and they floated out of the boat. The boat continued to roll until it was in an upside-down, near level position. The wife got out of the cabin of the overturned boat through the forward hatch, bringing with her a PFD for the other passenger. The teenager put on the PFD, and the occupants held to the boat for approximately 15 minutes until rescued by a nearby pleasure boat. The involved boat was towed to a marina where it was righted and the water evacuated.

75-33 At about 1400 on a Friday in mid-April, 1976, three men and a woman, all friends about 20 years old, set out onto the main body of Lake Pontchartrain, Louisiana, to water ski and try out a new shrimp trawling net, purchased just the day before. No one in the group had previous experience at trawling. They went out about 1/2 to 3/4 of a mile (0.8 - 1.2 km) from shore and had just begun a second drag when the net caught on an unidentified obstruction while the boat was headed in the same general direction as the four ft (1.2 m) waves. The boat stopped dead in the water. While the occupants were pulling the boat back over the net, waves began to enter the boat over the transom. The occupants bailed out the boat, and then three of them moved to the stern to again attempt to dislodge the net. Seas over the transom quickly swamped the boat. As it went down by the stern, all occupants jumped out and into the water. The boat capsized and floated inverted

with the bow out of the water. None of the occupants used PFDs, although several had been stored up under the bow. The four persons either straddled or hung onto the boat. No other vessels were in sight. After they had been in the water several minutes, one of the men, the best swimmer, began swimming for shore. Upon arrival, he ran over a mile (1.6 km) to the launch ramp and found a small boat operator who went and rescued the others. They had been in the water for about two hours. The boat was recovered shortly after by a Coast Guard patrol boat.

APPENDIX A. DATA FORMS USED FOR INTERVIEWS

CAPSIZING/SWAMPING ACCIDENT INVESTIGATION FORM

Investigator(s): _____ Date: _____

_____ Accident No.: _____

Investigation No.: _____

Hull Information

Manufacturer: _____ Model/Year _____

HIN (Or Other Identifying Number) _____

Model Name (Or Number) _____

Stability Warning Label: Yes _____ No _____

Length Overall: _____ Max. Beam Gunwale _____

Max. Beam Chine _____

Depth Amidships: _____ Max. Transom Width _____

Transom Height: _____ Max. Weight Capacity _____

Max. Persons Capacity _____ Max. HP Capacity _____

Hull Weight _____ LCG _____

VCG _____ TCG _____

Hull Type _____ Hull Material _____

Type Construction _____

_____

Bilge Construction (Decked, Open, etc.) _____

_____

Comments: _____

_____

_____

Sketch Motor Well Area and Transom (Include Dimensions):

Estimate Quantities and Indicate Location of Flotation:

Note Any Modifications To Boat:

PROPULSION AND STEERING

PROPULSION

Type Propulsion

Outboard ___

Inboard ___

I/O ___

Non-Mechanical ___

Propulsor

Propeller ___

Water Jet ___

_____ ___
(Other)

No. of Propulsors _____

Location _____

_____

ENGINE

Manufacturer _____ Serial No. _____

Horsepower _____ Weight _____ Age _____

How Attached to Boat _____

STEERING TYPE

Propulsor ___

Rudder ___

_____ ___
(Other)

Rudder No. _____

Location _____

Type Helm _____ Location _____

Type Throttle _____

Comments: _____

_____

_____

Respondant's Connection with Accident _____

Occupant Information

Operator/ Passenger	Age	Weight	Swimming * Ability	Boating † Experience	Formal Boating Instruction	PFDs Worn
1.						
2.						
3.						
4.						
5.						
6.						

* 1) Non Swimmer
2) Fair
3) Good
4) Excellent

† 0 - 20 hrs
20 - 500 hrs
Over 500 hrs

Narrative of Accident (include events just prior to accident, people's positions and actions during accident, include times between events and time to rescue, rescue operation, and final attitude of the boat). Be sure to note human factors - alcohol, etc. Probe activity of occupants during the past 24 hours - look for accident proneness/auto accidents. Note any obvious personality traits - feeling toward boating safety, PFDs, weather, etc.

OPERATOR

Age: _____

Swimming Ability: – Excellent _____, Good _____, Fair _____, Non Swimmer _____.

Formal Boating Instruction:

_____ None
_____ USCG Aux.
_____ U.S. Power Squadron
_____ American Red Cross
_____ State
_____ Other (indicate)

Operator's Experience:

This (type of) boat –

1) Number of years experience _____.

2) Average number of hours per year _____.

Operating Experience:

All boats –

1) Number of years experience _____.

2) Average number of hours per year _____.

Length of ownership of this boat: _____.

Length of ownership of any boat: _____.

Educational/Background:

Purpose of trip _____

Elapsed time from beginning of trip to accident _____

Approximate distance from beginning of trip _____

Approximate distance from shore at time of accident _____

Approximate distance from other boats at time of accident _____

WEATHER

____ Clear
____ Cloudy
____ Fog
____ Rain
____ Snow
____ Hazy
Comment _____

Were there any changes in the weather from the time of departure until time of accident?

WATER CONDITIONS

____ Calm
____ Choppy
____ Rough
____ Very Rough
____ Strong Current
Comment _____

Type Body of Water _____
Depth of Water _____
Wave height _____

TEMPERATURE — Estimate _____, Recorded _____

____ Air

____ Water

WIND

____ None
____ Light (0 - 6 mph)
____ Moderate (7 - 14 mph)
____ Strong (15 - 25 mph)
____ Storm (over 25 mph)
____ Comment _____

VISIBILITY

____ Good
____ Fair
____ Poor

WEATHER ENCOUNTERED WAS —

____ As forecast
____ Not as forecast
____ No forecast obtained

Was the boat adequately equipped with CG approved lifesaving devices? ____ yes, ____ no.

Were they accessible? ____yes, ____ no.

OPERATION AT TIME OF ACCIDENT

____ Cruising
____ Approaching Dock
____ Water Skiing
____ Racing
____ Towing
____ Being towed
____ Drifting
____ At Anchor
____ Tied to Dock
____ Fueling
____ Fishing
____ Hunting
____ Skin Diving or Swimming
____ Other (specify) _____

TYPE OF ACCIDENT

_____ Grounding	_____ Falls Overboard
_____ Capsizing	_____ Falls in Boat
_____ Flooding	_____ Hit by Boat or Propeller
_____ Sinking	_____ Other (specify) _____

WHAT, IN YOUR OPINION, CAUSED THE ACCIDENT? EXPLAIN BELOW.

____ Weather Conditions	____ Fault of Other Person
____ Excessive Speed	____ Fault of Hull
____ No Proper Lookout	____ Fault of Machinery
____ Overloading	____ Fault of Equipment
____ Improper Loading	____ Other (specify) _____
____ Hazardous Waters	

GEAR AND SUPPLIES

Identify, indicate quantities and location of any fishing, hunting, recreation, safety or other gear on board.

FOR JOHNBOATS ONLY

STABILITY EVALUATION

SUBJECTIVE EVALUATION RATING: ___1, ___2, ___3, ___4, ___5.

LONGITUDINAL POSITION OF OFFSET WT APPARATUS:

TCG OF OFFSET WT APPARATUS FOR CAPSIZE CONDITION:

APPENDIX B

ACCIDENT INVESTIGATION REPORT

Date of Investigation: June 11, 1975

Date of Accident: May, 1975

Investigation: Capsizing/Swamping No. 75-01

SUMMARY — WYLE ACCIDENT NO. 75-113

The accident reported herein involved a 12 ft aluminum flatbottom johnboat powered with a 4 horsepower outboard motor. The type of accident was a swamping with a subsequent sinking of the boat, resulting in the drowning of one of the two people on board.

At approximately 7:10 p.m. the first part of May 1975, two men were fishing from an anchored 12 ft aluminum flatbottom boat. The boat was anchored near rapids in a fast flowing river. The operator was sitting in the aft seat and the passenger was sitting in the forward seat. The inexperienced passenger allowed the boat to turn broadside to the current while deploying the bow anchor. The water built up on the boat side and started flowing freely into the boat. The boat flooded and was completely submerged by the swift current. The occupants got out of the boat and started walking ashore. The passenger stepped in a hole approximately 20 ft from shore and drowned. The operator made it to shore safely. The occupants were not wearing PFDs.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn
Operator	M	34	160	Very Good	Over 500 hrs.	No	No
Passenger	M	23	210	Non-swimmer	None	No	No

2.0 ENVIRONMENT

The sky was clear with the exception of a few scattered cumulus clouds and the visibility was good for that time of day (7:10 p.m.). The air temperature was 58°F and the water temperature was 54°F as recorded by the Virginia State Investigating Officer. The water conditions from the time of launching until the accident occurred were strong river current (6 mph estimated) with ripples of up to 1 ft around rock ledges. No other boats were in the area. The accident occurred on the Shenandoah River in Northwestern Virginia. At the time of the accident, the boat was anchored near a ripple created by a rock ledge near mid stream (approximately 100 ft from shore).

3.0 NARRATIVE OF ACCIDENT

The following narrative was formulated from an interview with the owner/operator of the involved boat and State investigating officer.

3.1 Pre-Accident

The owner/operator (A) had known the passenger (B) for approximately one year. B was a house painter and had met A while doing paint work at the funeral home where A was employed as a mortician/funeral director. Through conversation, B, a novice fisherman, discovered that A was an avid fisherman and on several occasions during the nine months preceding the accident, had asked A to take him fishing. A wanted to take B fishing but a trip could never be arranged due to the work schedule of the two men. On Friday, in early May, 1975, B contacted A and asked if a fishing trip could be arranged for the weekend. A told B that he would be

on call Saturday but could possibly go Sunday. A had to work Sunday and the trip was postponed until Monday afternoon at 1730. A and B worked at their normal jobs Monday with B working until 1700 and A until 1800. After A ran an errand for his wife and changed clothes, both men left A's house for the river at approximately 1830. On the way to the river (15 minute drive), A asked B if he would rather fish from the bank since the river was very high and the current was swift. B replied, "Will it be too much trouble to get the boat in the water?" A realized that B was disappointed over the possibility that they would be unable to go out in the boat, so he told B that the boat was stored at a cabin near the river and they would take the boat. They picked up the boat at the cabin and were at the launch area around 1850.

3.2 Accident

The boat was launched and the motor installed and the fishing equipment stowed in the boat. The men left the launch area and headed up stream at approximately 1900. There was no water in the boat at the beginning of the trip. The men travelled for approximately 250 yards and anchored the boat in the middle of the river near a ripple created by a rock ledge that extended diagonally across the full width of the river. The boat was anchored from the bow and stern (6-8 ft anchor line) with the long axis of the boat approximately 45° to the current. The water depth in this area ranged between 4 - 6 ft with a few holes over 6 ft. Also, there were scattered rock formations protruding above the surface. The height of the ripples ranged from a few inches up to approximately 1 ft (refer to Figure 1 and Photographs 1 and 2 for details of accident area).

A was sitting in the center of the rear seat and B in the center of the middle seat. A began to get his fishing rod ready for casting and at the same time was asking B if he knew why the boat had to be anchored so its long axis was at an angle to the current. B replied that he didn't know why and A explained that the current was swift and if the boat was anchored broadside to the current, water could pile up on the up-river side of the boat and come over the gunwale. A then asked B if he knew how to get the boat's long axis perpendicular to the current (he was trying to instruct B on how to maneuver the boat in calmer water, but did not say this). B replied, "No," so A told him that the proper procedure would be to pull in the

bow anchor. During this time A was working with his fishing rod and was not looking at B. A felt the bow of the boat swinging around with the current, looked up and saw that B had started pulling in the bow anchor. A realized that B had obviously misunderstood his instructions and thought he should pull in the bow anchor at that time. A shouted, "Not now!" and B dropped the anchor line. When the bow anchor line became tight the boat was broadside to the current. Water immediately began coming into the boat over the starboard side and in a very short time completely filled the boat. At this point, approximately 10 minutes had passed since launching the boat. Gear started washing out of the boat and A could see that B was beginning to panic, so he attempted to reassure B by telling him that everything would be all right and to stay with the boat because it would not sink. At this time the two men were still seated in the boat. The boat started sinking slowly until the water was chest high to the seated men. At this point B informed A that he could not swim and A told him not to worry, he would pass him a life cushion (apparently the life cushion at B's feet had been washed out of the boat). A threw a life cushion toward B, but he did not catch it and it was washed out of reach. As the boat sank further, it became very difficult for the men to stay in one location within the boat. A realized that he had to assist B in some way before they were washed out of the boat or the boat capsized. A decided to take off his jacket and try to get a sleeve to B for him to hang on to. He realized that if the jacket was wet, it would be more throwable, so he submerged himself, saturating the jacket, removed it and threw a sleeve to B, holding on to the other sleeve. During this time A was constantly talking to B trying to keep him calm.

A decided that the boat was going to completely sink, so he told B to get out of the boat on the port side and they would walk to shore. From the time the anchors were deployed until the two men got out of the boat was estimated to be approximately two minutes. Both men got out of the boat on the port side and were able to touch bottom, but it was difficult for them to keep their footing due to the swift current. A instructed B to hold onto the sleeve and he would lead him to shore. A decided to try to make it back to the area where the boat had been launched. He based his decision on the following:

- It would be very difficult for them to keep their footing if they tried to walk perpendicular to the current to either shore.

- He was unfamiliar with the river bottom adjacent to the nearest shore and felt there might be deep holes in that area.
- He felt it would be easier for them to keep their footing if they went with the current back toward the launch area.
- He was thoroughly familiar with the river bottom at the launch area and knew it was safe.

The two men started toward the launch area and soon discovered that it was easier for them to keep their footing if they hopped along with the current rather than trying to walk. A was talking to B all the time trying to keep him calm. After travelling approximately one-half the distance to the launch area, B was calmed down to the point that he was able to laugh and joke about their situation. Approximately 25 ft from shore and 100 ft upstream from the launch area, A stepped in a hole that was over his head. He drifted with the current to a ledge where he stood up. At this point A realized that if B stepped in the same hole he would probably panic. He told B to hold his breath and he would pull him to the ledge. B apparently panicked at this point and jerked the jacket out of A's hand. A visually scanned the area downstream but did not see B surface. At this time it was still daylight and the visibility was good (approximately 1915). A made his way a few yards along the ledge and grabbed a limb extending from a tree on shore. He hand-walked the tree limb to shore.

3.3 Post Accident

A walked along the shore for approximately 10 minutes trying to locate B. After this time he decided that B had probably drowned and he must go for help. He got in his car and drove to the nearest house with a telephone and called the local Rescue Squad (approximately 1940). The Rescue Squad arrived on the accident scene at approximately 2000 and the State Investigating Officer arrived at 2020.

The body of the victim was recoverd 6 days later approximately one-quarter mile downstream from the launch area. An autopsy was performed by a licensed MD at a local County hospital. There were no cuts or bruises on the body and the official cause of death was recorded as drowning.

The boat was recovered the next morning by the Investigating Officer. The boat was upside-down approximately 40 ft downstream from where it had been anchored. The boat was completely submerged, but occasionally the bow would come out of the water, making it possible to find the location. The bow anchor was gone, but the stern anchor was caught on a ledge and was holding the boat in place.

According to the investigating officer, no alcohol had been consumed by the two men on the day of the accident.

TIME SEQUENCE

1830 - Occupants left operator's home for cabin.

1845 - Arrived at cabin and loaded boat on truck and started to river.

1850 - Arrived at launch area.

1850-1900 - Launched boat and loaded fishing gear.

1900 - Left launch area.

1900-1905 - Paddled upstream approximately 250 yds and anchored boat by bow and stern.

1905-1910 - Occupants prepared fishing gear.

1910 - Passenger pulled bow anchor line allowing boat to turn broadside to current and boat flooded.

1910-1914 - Men started walking ashore in 4-6 ft water and swift current.

1914 - Passenger stepped in hole and disappeared.

1915 - Operator reached shore.

1915-1930 - Operator visually scanned river for passenger.

1930 - Operator left accident site to get help.

1945 - Operator arrived at country home and called rescue squad.

2000 - Rescue Squad arrived at accident site.

2020 - State accident investigator arrived at accident site.

Boat and passenger's body recovered next day.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a typical flatbottom johnboat used exclusively for fishing. The only damage that was evident was a broken bow handle. A home made handle which appeared considerably stronger than the original had been installed prior to the inspection.

The flotation material consisted of a styrofoam block (32" x 12.5" x 4.75") placed under the stern and center seat at the time of manufacture. There was an open space under the bow seat but no evidence could be found that flotation material had been installed in that location (which is not unusual for that age boat). (Refer to Photographs 3 and 4).

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

5.1 Operator/Owner

From the interview it was obvious that the owner was an experienced johnboat operator and fisherman. He had at least 450 hrs of johnboat operating experience and seemed to be very knowledgeable concerning operating in various types of waters. He seemed to know the limitations of his equipment as well as his own limitations. He commented that he knew the river was hazardous to an inexperienced boater and particularly a non-swimmer; but, he did not know the extent of the passenger's boating experience or his swimming ability until the accident occurred. He said he probably would not have taken the boat had he known these facts about the passenger beforehand. He expressed complete confidence in his ability to safely get out of any situation that might occur on the river in the accident area, either alone or with others with whom he had fished and knew their boating and swimming ability. In other words, he felt that he did not make a mistake by taking the boat out; but, he did make a mistake by taking out a passenger that he knew little about. After looking at the accident area, the investigators of this accident would have to agree that a person with only fair swimming ability should be able to reach shore safely after a boating incident of this type in that particular area of the river.

It was evident from the interview that the owner was of average intelligence and no abnormal personality traits could be detected. His formal education consisted of high school, two years

college with an Associate degree and a Funeral Director/Embalmer trade school. He is a member of the Bass Fishermans Association and is a subscriber to several national boating and fishing magazines.

During the interview his answers were very precise and his recall of events and times before, during, and after the accident were very descriptive and as far as could be verified, very accurate.

The following comments illustrate the organization and planning of this individual:

- He placed the fuel tank over the drain plug at the transom so the drain plug could not be inadverdently pulled out.
- He knew it would be nearly dark when they quit fishing; so, he went up river realizing it would be safer to drift and fish downriver and arrive at the launch area at dark rather than go downriver and come back upriver.
- He placed a life cushion in front of himself and the passenger for easy access.
- He anchored the boat at a 45° angle to the current so water would not come over the side.
- He submerged his jacket to saturate it with water so it would be more throwable.
- He guessed the air and water temperature within $4^{\circ}F$ of the recorded temperature.
- According to the State Investigating Officer, he pinpointed the location of the accident within five feet of where it actually happened.

The following comments are not an attempt to place blame or to show negligence on the part of the operator. From the facts available, the operator used good judgment and did everything that could be expected of him concerning operating the boat and his rescue attempt after the boat swamped. The comments are simply to point out certain details leading up to the accident that do not seem to fit this individual's character, such as:

- He took his boat with a fishing companion, knowing nothing of his swimming ability, into an area that was known to be hazardous for non-swimmers. Why did he neglect to find out the swimming ability of his companion before he launched the boat?

- He had two approved AK-1 PFDs; yet, he elected to take the flotation cushions. Why, particularly since he did not know the swimming ability of his passenger?
- He had no flashlight on board; yet, he knew it would be dark when they returned to the launch area.

5.2 Passenger

From the interview with the owner/operator and the investigating officer, it is reasonable to assume that the passenger was of average intelligence and education. Little was known about his background because he had lived in that area only one year. The owner stated that he had noticed on several occasions that the passenger would eagerly do things that obviously frightened him, such as, do paint work on tall buildings and deliberately try to hide his apprehensions. Going out in a boat into hazardous waters not wearing a PFD would probably be considered normal behavior for this individual.

6.0 PROBABLE CAUSE OF ACCIDENT

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

- The boat was taken out in water conditions that required any person concerned with the operation of the boat to be a skilled boatsman. The passenger who was assisting the operator had no boating experience.
- The inexperienced passenger pulling up the bow anchor caused the boat to swamp and started the chain of events that resulted in the fatality.
- The passenger would have probably survived the boat sinking had he been wearing a PFD.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

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

The boat was at anchor at the time of the accident; therefore, underway boat characteristics would not be considered a factor in this accident.

It was not unusual for this type boat to swamp under the circumstances; however, it was somewhat unusual for it to sink in an upright and level attitude without capsizing.

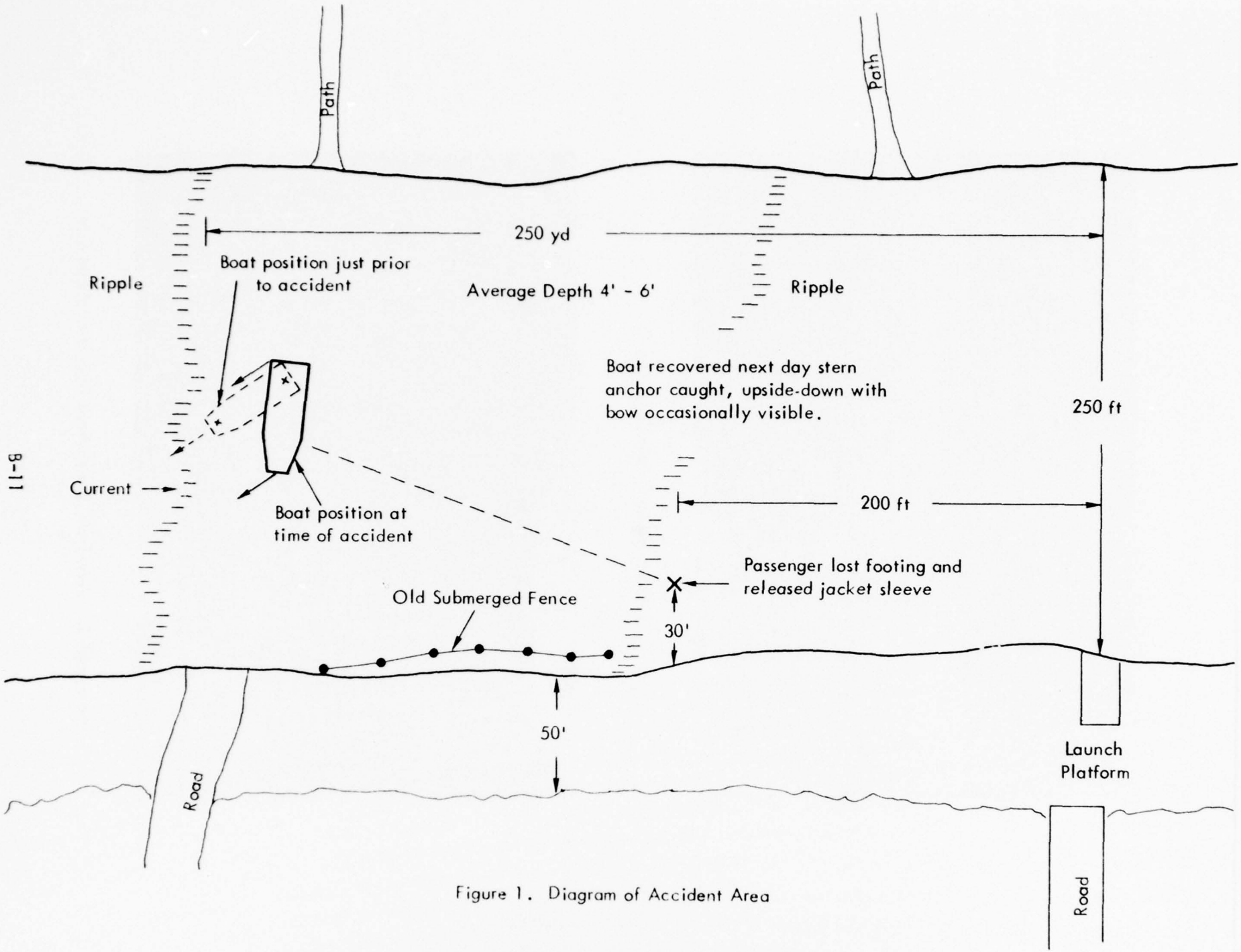
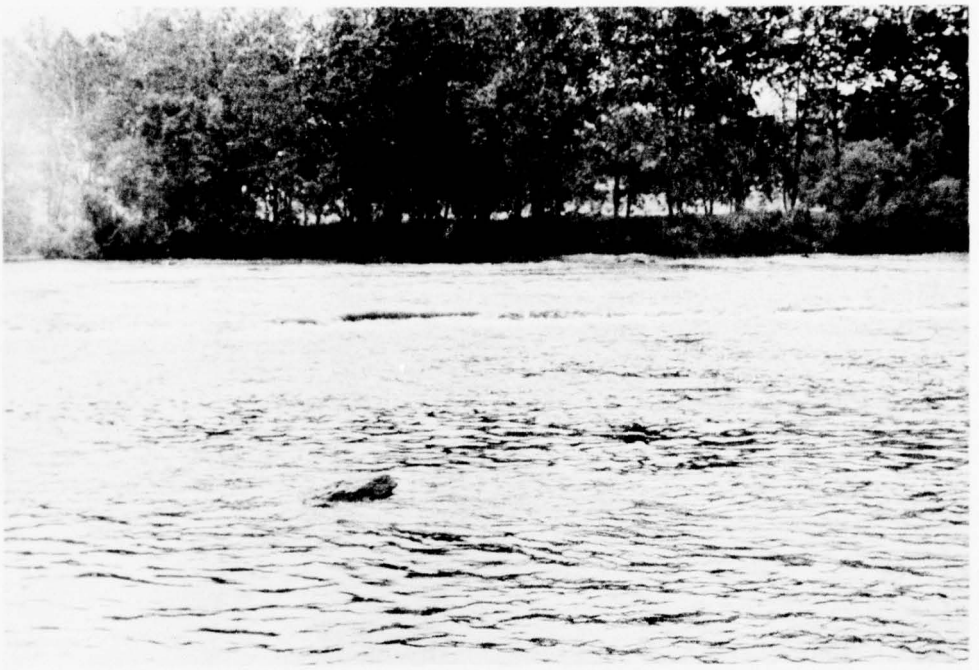


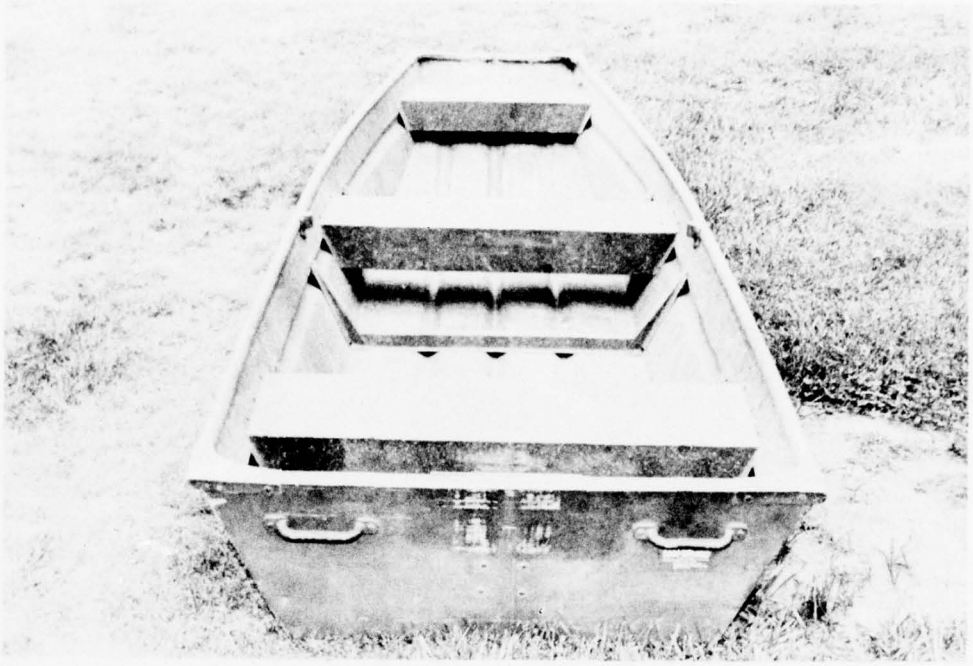
Figure 1. Diagram of Accident Area



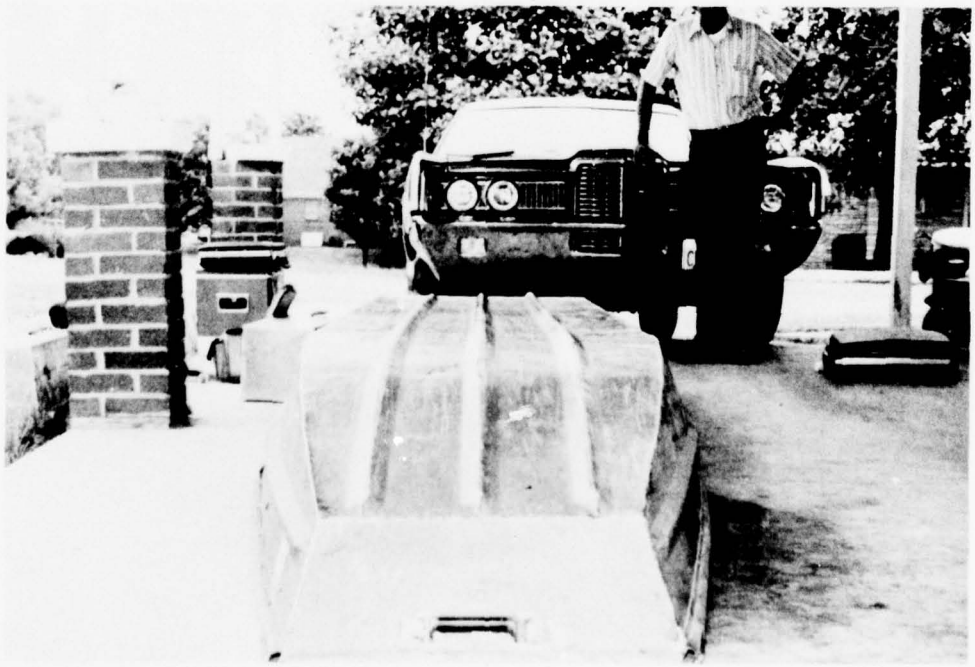
Photograph 1. Accident Site



Photograph 2. View from Launch Area Toward Accident Site



Photograph 3. Involved Boat



Photograph 4. Involved Boat

APPENDIX C

ACCIDENT INVESTIGATION REPORT

Date of Investigation: June 12, 1975

Date of Accident: Mid-May, 1975

Investigation: Capsizing/Swamping No. 75-02

SUMMARY — WYLE ACCIDENT NO. 75-100

The accident reported herein involved a 16 ft fiberglass tri-hull bowrider boat powered by a 65 horsepower outboard motor. The type of accident was a swamping with a subsequent capsizing of the boat, resulting in minor injuries to one of the five people on board.

At approximately 1600 in mid-May, 1975, three adults and two children were returning from a river fishing trip in a 16 ft fiberglass tri-hull bowrider powered by a 65 horsepower outboard motor. The boat was traveling at half throttle when the motor abruptly stopped. The stern wake combined with 1-2 ft swells raised the stern, causing the bow to slice into a wave, partially swamping the boat. The freeboard was reduced to the point that waves were splashing over the transom into the boat. The occupants tried to bail out the water, but abandoned the effort when the boat completely filled with water. The boat rolled over to a stable upside-down position. The occupants held to the boat for approximately 11 hours until rescued. All occupants were wearing PFDs.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn
Operator	M	42	169	Fair	Over 500 hrs	None	No
Passenger	M	45	170	Fair	Over 500 hrs	None	No
Passenger	F	41	120	Fair	Over 500 hrs	None	Yes
Passenger	M	14	120	Poor	-----	--	Yes
Passenger	F	13	120	Poor	------	--	Yes

1.1 Owner/Operator

From the interview with the owner/operator, it was assumed that his formal education probably consisted of grade school. His occupation was appliance repairman, so he probably had attended an appliance repair trade school. He seemed to be of average intelligence and have at least average knowledge of boat operations and safety precautions to be exercised while operating a boat.

1.2 Passengers

The two adult passengers seemed to be of lesser intelligence than the operator and were considerably less knowledgeable in boat operations.

2.0 ENVIRONMENT

The sky was clear and the visibility was excellent. The air temperature was warm and the water temperature was comfortably warm. The involved boat was approximately three miles off shore at the time of the accident. The water conditions from the beginning of the trip until the accident occurred were 1-2 ft rolling swells. No other boats were in the immediate area. Distant boats and the shore line could be seen.

3.0 NARRATIVE OF ACCIDENT

The following narrative was formulated from an interview with the owner/operator and passengers of the boat involved.

3.1 Pre-Accident

A fishing party consisting of the Owner/Operator of the involved boat, his wife, two children, and a relative started out from the owner's home by automobile at approximately 0700 in mid-May, 1975 destined for a marina approximately 60 miles away. The marina was located on the James River in eastern Virginia. According to the owner, the people in the fishing party had stayed home the night before the accident and had all retired to bed by 2300. The party arrived at the marina at approximately 0830. The boat was launched and supplies including fish bait, two cartons of soft drinks, and an eight pack of beer were purchased at the marina store. The boat drain plug was installed just prior to launching the boat, so there was no water in the boat at the beginning of the trip.

The party left the launch ramp at approximately 0900 for a fishing spot located approximately 15 miles down river. Gear aboard was as noted in Figure 1 and the weather as in section 2.0. The operator stated that the motor started running rough shortly after leaving the marina, and it was difficult to maintain sufficient speed to keep the boat on plane. After traveling approximately 10 miles, the motor completely stopped. The operator suspected the trouble was in the carburetor, so he disassembled the carburetor and cleaned the needle valves. While the operator was working on the motor (approximately one hour), the other occupants fished. After the operator finished cleaning the carburetor, the motor started (approximately 1100), and the party started in the direction of their original destination. After traveling approximately four miles, the motor stopped again apparently due to foreign material in the carburetor. The operator disassembled the carburetor and cleaned the needle valves. The other occupants fished while the operator was working on the motor, which took approximately one hour. After getting the motor started again, the party decided it was getting too late to continue on to their original destination and decided to fish in that area until it was time to start back to the marina. At approximately 1530 the fishing gear was stowed, and the party

started back to the marina. Refer to Figure 2 for sketch of the area showing current, water conditions, etc.

3.2 Accident

After traveling approximately four miles at approximately half throttle (just on plane) the motor abruptly decreased in rpm to near idle, causing the boat to slow down very quickly. As the boat slowed to maximum displacement speed, the stern was raised by a 1-2 foot wave. When the stern came up, the bow went down and sliced bow-on into a 1-2 foot wave, causing a large amount of water to break over the bow into the boat (the time was approximately 1600).

At the time of initial water ingress, the occupants of the boat were seated as follows:

- 169 lb owner/operator (1) - At the wheel, amidships, starboard side.
- 170 lb male passenger (2) - Rear seat, starboard side
- 120 lb wife (3) - Bow seat, port side
- 120 lb male child (4) - Rear seat, port side
- 120 lb female child (5) - Bow seat, starboard side

The port seat amidships had been removed for reupholstery and was not in the boat at the time of the accident.

When (1) saw that water was coming into the boat, he turned on the bilge pump and instructed (5) to move to the rear of the boat, thinking that this would allow the bow to come up enough to stop water from coming into the boat. At this point the motor had stopped, and the bilge pump was not operating (probably the battery had shorted out). (5) moved to the rear, but water continued to come into the boat (whether water ingress at this point was over the bow or stern is not known). The boat continued to take on water until the water level was within six inches of the top of the gunwale. At this point the boat was in a near level position and seemed to be unstable in the roll axis. (1) instructed the other occupants to move to the centerline of the boat to keep the boat from capsizing. (1) and the other occupants moved to the centerline and assumed a standing position and kept the boat upright by shifting their

weight when the waves made the boat roll from side to side. The boat did not seem to sink any further after the occupants stood up.

(1) thought the boat might capsize at this point, so he put on an approved AK1 PFD. The other occupants were wearing approved AK1 PFDs at the time the boat swamped. (1) had noticed that when (4) and (5) had put on their PFDs at the launch area one side of (4)'s PFD was collapsed and one side of (5)'s PFD was hard. According to (1), these PFDs had never been used and had been removed from the manufacturer's shipping package at the launch area.

The boat was relatively under control, and (1) instructed the other occupants to look for something to bail water. (1) and (2) started bailing water with small stereo speaker enclosures from the boat. After bailing for a short time, (1) and (2) simultaneously moved to the starboard side to be in a better position to empty the bailing containers. When they moved to the side, the boat started rolling slowly to starboard. By the time (1) and (2) noticed the boat was rolling, the starboard gunwale was submerged. The boat continued to roll slowly until it was in a near level and upside-down position. As the boat rolled through approximately 45 degrees, the occupants exited the boat on the starboard side. The time from initial water ingress to capsizing was 15 minutes or less. When the occupants got in the water, (1) noticed that (5) had submerged and did not return to the surface. He went under water, grabbed her, and brought her to the surface. He observed that the PFD (5) was wearing would not hold her above water, so he removed and discarded it, assuming the faulty PFD was just added weight. The PFD (1) was wearing supported him and (5) sufficiently. The faulty PFD (4) was wearing seemed to provide sufficient flotation, but (2) grabbed him, fearing the PFD would lose its buoyancy. After the boat came to a stable upside-down position, all the occupants climbed on top of the boat except (2), who held onto the motor with only his head out of water. The boat was fairly stable and supported the weight of the occupants very well. As waves broke over the boat, the people slid along the bottom fore and aft in order to keep the stern out of the water so that (2) who was hanging onto the motor would not be submerged. Refer to Figure 3 for position of occupants on boat bottom. (1) held onto (4) and (5) to keep them on top of the boat. After a few minutes on top of the boat, (1) discarded his PFD because it restricted his movements.

3.3 Post Accident

The operator was confident that the boat would remain afloat. From the time the boat swamped he had cautioned the other occupants to stay with the boat because it would not sink, and the best thing to do would be to stay with the boat until rescued. The adult members of t' party discussed the possibility of trying to upright the boat, but decided it would be hazardous to attempt since the two children could not swim. After capsizing, the current carried the boat down river toward the bridge for approximately two miles. The current then changed and carried the boat back toward the launch area. At approximately 0130 on the day after the accident, the boat had drifted close enough to the marina area that the occupants could see people on shore. The current changed again, and the boat started drifting back toward the bridge. Refer to Figure 2 for accident area.

At approximately 2200 on the day of the accident, the operator of the marina suspected that the fishing party had run into trouble. He notified the C. G. unit at Norfolk, Virginia of the overdue party. The C. G. broadcast this information over marine radio and sent out two or three boats to search for the party. The party told the marina operator that their destination was the Buckaro area; so, the C. G. concentrated their search in that area. The occupants could see the C. G. boats searching during the night but never came close enough to be signaled.

At approximately 0100 gasoline fumes started escaping from under the boat. The fumes were so concentrated that the two children became nauseated. The operator stated that the male child went into a state of semi-consciousness apparently from inhaling the gasoline fumes. Each occupant remained in essentially the same location on the boat during the night.

A tug boat traveling down river had received the C. G. broadcast concerning the overdue fishing party and was scanning the river with a high intensity light. At approximately 0330 the day after the accident, the tug boat sighted the party near buoy 20 and took them aboard. The party was taken ashore by a C. G. boat that had been called after the rescue. The occupants were examined at a local hospital and released.

The boat was recovered by the Norfolk C. G. unit shortly after the occupants were rescued. The unit also took possession of the faulty PFDs.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was stored outside at the owner/operator's residence. The boat appeared to be in above average condition and apparently had been properly maintained. The upper portion of the port seat amidship had been removed for a new cover and only the base remained. All the seats including the bench seats in the bow had recently been recovered. The forward bow seat originally incorporated a cover that fit over an 18 x 24 inch storage compartment opening. The opening was fabricated such that the cover fit into a recess making the compartment somewhat watertight. When the seat was recoverd, the cover had been removed and replaced with a plywood cover that fit over the opening rather than fitting into the recess. Therefore, a large amount of any water that came into the boat over the bow would seep into the opening and into the bilge. Two one-inch diameter holes had been drilled through the forward section of the bow seat support, which would allow water coming over the bow to drain into the bilge slowly. The purpose of the holes could not be determined.

The motor controls were of the single lever throttle control and push button shift. The control box was mounted to the sole on the starboard side near the operator's feet. The motor controls and steering system operated properly. The boat was equipped with running lights, and a high intensity spot light was mounted on the starboard side forward of the windshield.

TIME SEQUENCE

0700	Party left operator's home for marina.
0830	Arrived at marina/launch ramp.
0830-0900	Purchased supplies, loaded and launched boat.
0900	Left marina for fishing area.
1000	Motor stopped.
100-1100	Operator worked on motor and passengers fished.
1100	Motor started and party proceeded to fishing area.
1115	Motor stopped again.
1115-1215	Operator worked on motor and passengers fished.
1215-1530	Party fished in area where motor had stopped the second time.
1530	Party started back to launch ramp/marina.
1600	Motor decreased in rpm and wave came over bow.
1600-1615	Boat continued to take on water. Occupants kept boat upright by shifting body weight.
	1 and 2 moved to the starboard side, causing the boat to capsize.
1615	Occupants assumed position on and around boat as shown in Figure 3.
1615-0130	Boat drifted toward bridge.
0130-0130	Current changed and boat drifted toward marina.
0330	Party sighted by tug boat and taken aboard.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

Although the operator had over 20 years boating experience, he was unfamiliar with the proper operation of a bowrider in rough water. The other boats he had owned and operated were of the closed bow type. He had purchased this boat only three months before the accident occurred and was still on the learning curve concerning its characteristics. It was evident after talking to the people who were aboard that the owner/operator was definitely in charge of the group, and they did exactly what he instructed them to do during and after the swamping. The actions of the operator probably saved the lives of one or more of the passengers. Although most of his actions were correct, discarding his PFD under the circumstances did not seem to be a wise thing to do.

The capacity plate specified a maximum capacity of 1860 lb; however, from a knowledge of this type of boat*, the loading was near and possibly exceeded the maximum weight capacity as defined by the Safe Loading Regulation. Under the circumstances, it is difficult to determ if the load distribution in the boat could have been better.

There is no evidence to indicate that alcohol was a factor in this accident. However, the operator stated that an eight pack of beer had been purchased before the start of the trip, and six beers were in the cooler at the time of the accident. Almost eight hours passed between the start of the trip and the accident; therefore, if the beer had been purchased to drink, it seems unusual that only two had been consumed by late afternoon.

* Data obtained from compliance test boats of the same size and hull shape.

6.0 PROBABLE CAUSES OF ACCIDENT

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

- Possible overloading of the boat, reducing the freeboard. A low freeboard at the bow in this type boat in other than relatively calm water is hazardous.
- The walk-through windshield allows any water that comes over the bow to flow into the main passenger area.
- Abrupt engine stoppage, leaving the operator with no available power to properly negotiate the 1-2 ft waves.
- The occupants stood up in the boat after it filled with water, which made the boat more unstable and should have caused the boat to ride considerably lower in the water.
- The operator and one passenger simultaneously moved to one side of the boat, which caused an unbalanced condition and capsized the boat.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The following is presented based on the narrative, the boat load distribution, evidence found in the boat inspection, and knowledge of boat handling characteristics.

The swamping and subsequent capsizing of this boat was typical under the conditions that existed at the time of the accident. On plane under the power that was available from the rough running engine, the trim angle would be quite high with the load distribution as shown in Figure 1 (as high as 10 to 15 degrees).

When the engine stopped, the boat decelerated quickly; and immediately following, the bow dropped until the hull was in a displacement mode. As the boat slowed and the bow came down, the stern wake combined with a following sea pushed the stern up. At this point, the bow was in a trough, and the force of the stern wake pushed the bow into the next wave, causing water to come over the bow into the boat. The boat took on a considerable amount of water from the first wave. Although it cannot be verified by the occupants, after the initial ingress of water and the passenger moved aft, the freeboard at the stern was probably reduced to the point that additional water came into the boat from over the transom.

After the boat filled with water, it became unstable in the roll axis. The instability was caused by the location of the flotation material within the boat, which was installed under the deck. With no flotation material along the sides, the boat would have a natural tendency to turn upside-down when submerged and loaded to its maximum weight capacity. The fact that the occupants were able to stand indicates that the boat had considerably more flotation than is presently required by regulation. Also, air pockets along the gunwale and under the cockpit stations at the walk-thru would help considerably (for a short time at least).

When the two occupants moved to the starboard side, the boat capsized and rolled upside-down in one continuous motion at a roll rate slow enough to allow the occupants to exit and clear the boat before being trapped underneath.

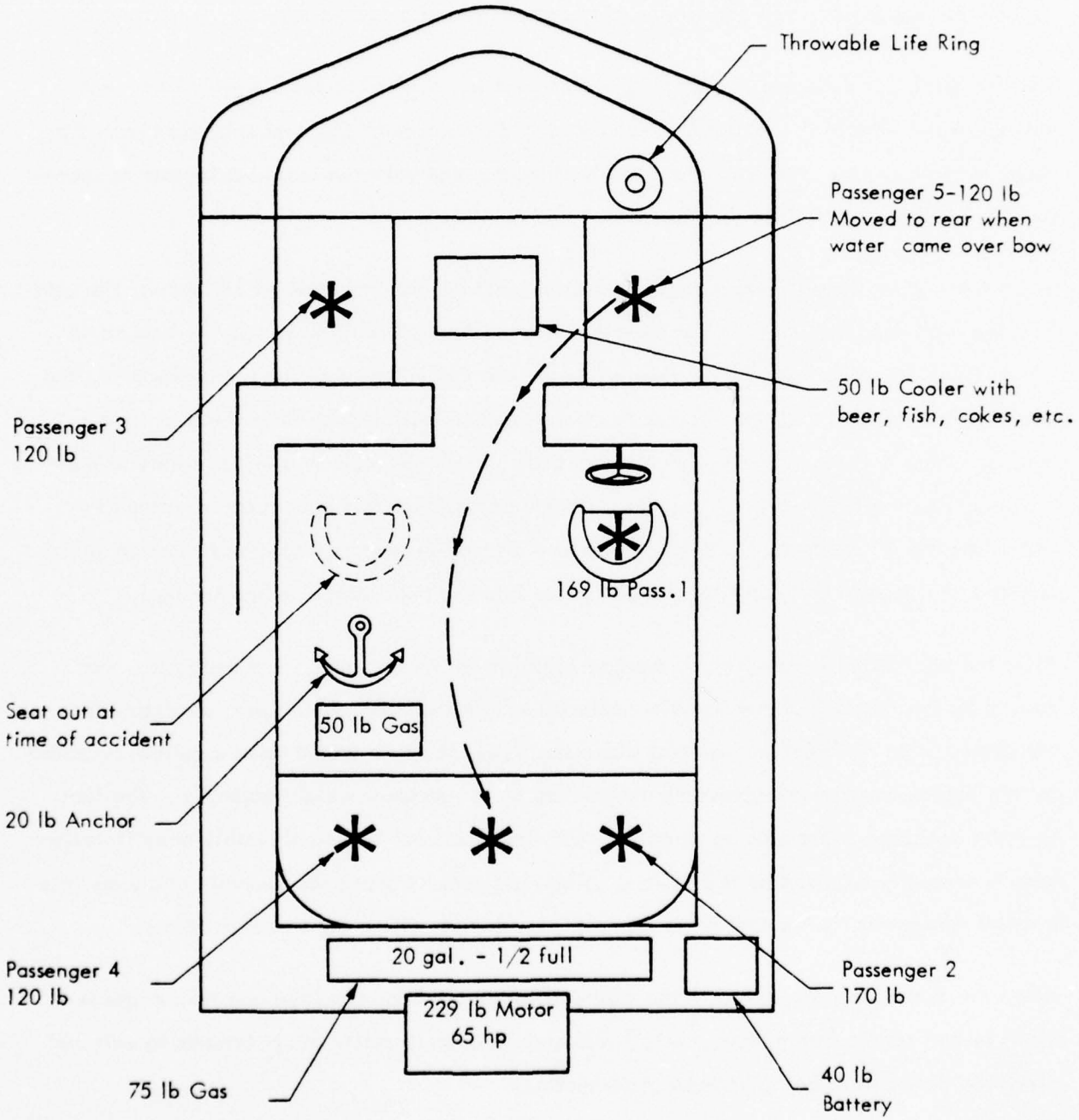


Figure 1. Gear Aboard the Involved Boat

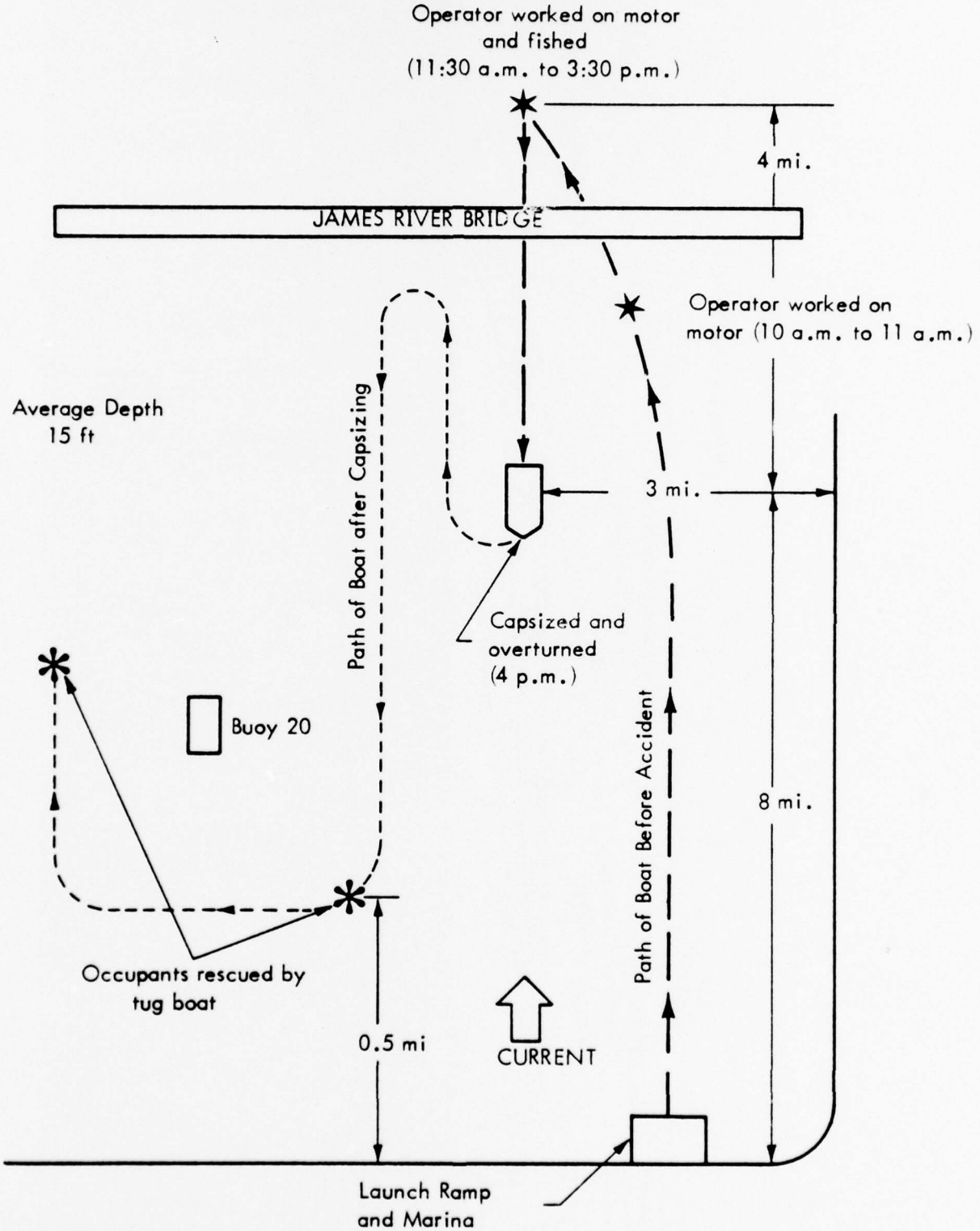


Figure 2. Accident Area

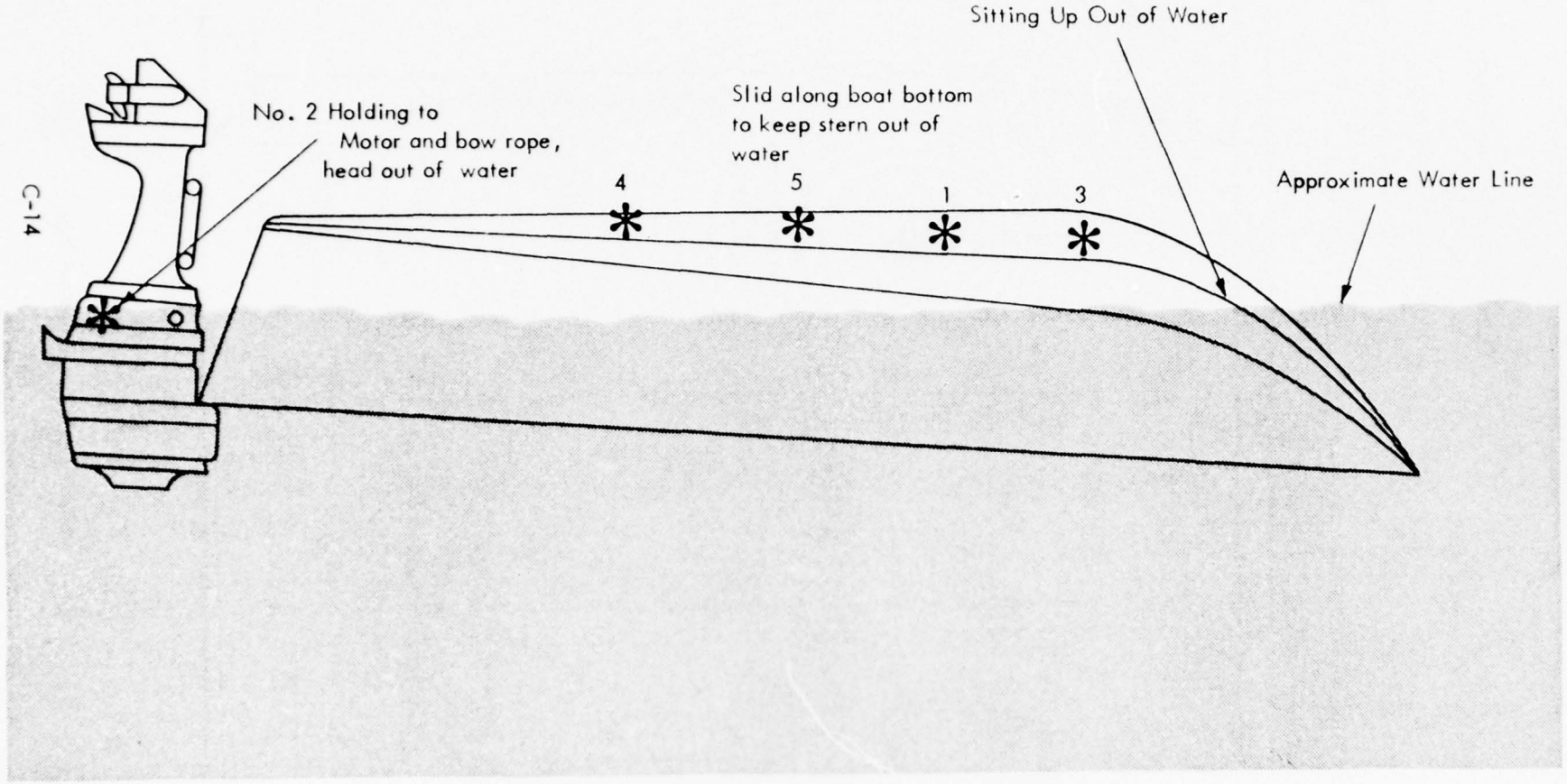


Figure 3. Location of Occupants on Boat Bottom



PHOTOGRAPH 1



PHOTOGRAPH 2



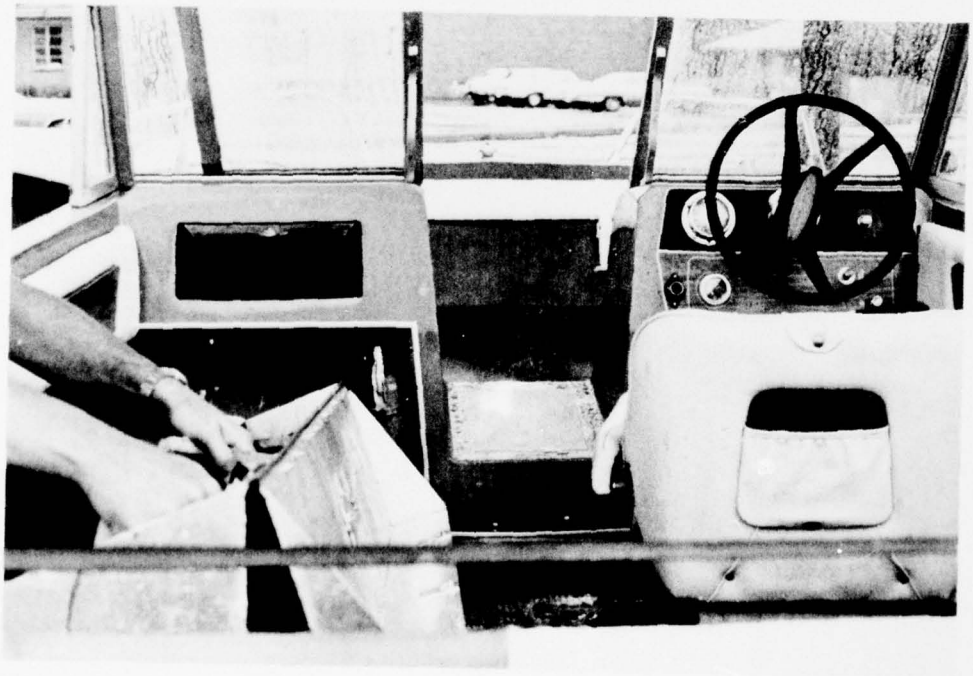
PHOTOGRAPH 3



PHOTOGRAPH 4



PHOTOGRAPH 5



PHOTOGRAPH 6

APPENDIX D

ACCIDENT INVESTIGATION REPORT

Date of Investigation: July 15, 1975

Date of Accident: April, 1975

Investigation: Capsizing/Swamping No. 75-03

SUMMARY — WYLE ACCIDENT NO. 75-074

The accident reported herein involved a 15 ft wooden runabout boat powered with a 75 horsepower outboard motor. The type of accident was a capsizing and falls overboard resulting in minor injuries to the two people on board.

At approximately 0800 on the day of the accident, a man and his wife set out on a fishing trip from a marina located near Morehead City, N. C. The couple traveled east on the inland side of Shackleford Banks to a point near Morgan Island (approximately 9 miles). They fished in various locations on the way to Morgan Island. The fishing was poor on the inland side, and they decided to go to the ocean side of Shackleford Banks. They traveled through the inlet to the ocean side and started west back toward the marina. After fishing in several locations, they stowed the fishing gear and started back to the marina. At a point approximately 1-1/2 miles off the ocean side of Shackleford Banks and one mile east of Beaufort Inlet, they observed a large wave approaching from the ocean side (port). At this time the boat was traveling approximately 20 mph. The sea conditions were widely spaced smooth swells approximately 1-1/2 to 2 ft in height. Before the operator had time to react, the wave capsized the boat throwing both occupants into the water. The couple stayed with the boat until it drifted close to shore (approximately 50 yards) where they left the boat and swam to shore.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator	M	67	155	Excellent	40 years	None	No
Passenger	F	57	120	Fair	20 years	None	No

From the interview it was apparent that the operator and passenger were experienced, calm water boat operators and fishermen. They each had over 500 hrs boating experience in inland rivers and lakes and coastal waters near shore. Neither of them had ever been more than one-half mile off shore in a small boat.

The operator and passenger were college graduates and seemed to be of above average intelligence. Also, their physical condition seemed to be considerably above average for their age.

During the interview, their recall of events before, during and after the accident was very descriptive and, with the exception of the estimation of the distance from shore and wave height and force, seemed to be accurate. The operator had apparently been in previous situations that required a great amount of physical endurance and little regard for pain. For instance, he stated that his nose had been broken many times and he did not consider this injury severe enough to require medical treatment.

2.0 ENVIRONMENT

The sky was clear and the wind was estimated to be 0 to 6 mph. The air temperature was estimated at 85°F, and the water temperature estimated at 65°F. The water conditions in the area where the accident occurred were 1 to 2 ft, smooth rolling swells. The involved boat was approximately one mile off shore at the time of the accident. No other boats were in the area.

3.0 NARRATIVE OF ACCIDENT

The following narrative was formulated from an interview with the owner/operator and passenger of the boat involved.

3.1 Pre-Accident

The owner/operator and the passenger (his wife) owned a summer home near the accident area and had been staying there for approximately one month prior to the accident. They had spent the past five summers here and were very familiar with the waters in this area. On the night before the accident, they had gone to bed at approximately 2200 and arose the next morning at approximately 0630 to prepare for the fishing trip.

They left with the boat from the summer house at around 0730, and arrived at a marina (approximately 5 miles distance) at about 0745. The boat was launched, gear stowed, and the ten gallon fuel tank topped off.

At approximately 0800, they left the marina and headed east up the inland waterway between Shackleford Banks and Harkers Island. Gear aboard was as shown in Figure 2, and the weather as noted in Section 2.0. The couple fished in various locations on the inland-side of Shackleford Banks until they arrived at a point near Morgan Island (east end of Shackleford Banks) approximately nine miles from the marina. At this point they had caught no fish and decided to see if the fishing was better on the ocean-side of Shackleford Banks. At this time it had been approximately two hours since they had left the marina. They traveled to the ocean-side by way of Barden Inlet and started west back toward the marina. They were traveling parallel to Shackleford Banks and approximately one mile off shore. They stopped several times to fish but caught no fish. The water conditions were 1 to 2 ft smooth, rolling swells with long wave periods. After approximately 45 minutes from the time they started west, they decided to return to the marina because the fish were not biting.

3.2 Accident

The fishing gear was stowed and they got underway back to the marina at a speed of approximately 20 mph. After traveling for approximately ten minutes, the operator and passenger almost simultaneously noticed a large wave approaching from the ocean (port) side which he described as being 25 ft high and looked like the pipe-line waves seen on the TV program Hawaii Five-O. The operator was seated at the helm on the starboard side and the passenger was seated directly across on the port side. The operator shouted to his wife, "Hang on, here comes a big wave." Before the operator had time to react, the wave hit the boat broadside (port side) violently rolling the boat to starboard into the wave curl to a position approximately 90 degrees from the horizontal. The occupants were then catapulted horizontally out of the boat landing approximately 25 ft from the boat. Only a few seconds lapsed from the time the wave was sighted until the occupants were in the water. The operator and passenger stated that the force that threw them out of the boat was very severe. The occupants hit something on the boat when they were thrown out resulting in minor injuries. They did not know what they hit. The operator received minor cuts and bruises on the head, shoulders and arms, and the passenger received minor cuts and bruises on the lower right leg and foot. The occupants landed in the water close to each other and noted that they were approximately 50 ft behind the boat and at the same distance off shore as the boat. The passenger noticed that the operator was bleeding from the face and thought he could be seriously injured. She told him not to panic and they would swim back to the bank. He replied that he was not seriously hurt, and he was certainly not going to panic. The two swam to the boat and found it upright and approximately half full of water. The passenger climbed over the gunwale into the boat and got the throwable life ring. The life cushions and PFDs had been washed out of the boat and were not in sight. The passenger jumped back into the water because she could see the boat was sinking. The two held to the starboard gunwale until the passenger shouted, "We had better get away from the boat because it is about to capsize." The operator put his left arm through the life ring and the passenger put her right arm through, and they swam a few yards away from the boat. At this point approximately five minutes had lapsed since the occupants were thrown from the boat. After swimming a few yards they turned to see the boat sinking by the stern until the bow was pointed vertical. The boat then rolled to starboard until it was upside-down with only the bow section out of the water.

3.3 Post-Accident

The two swam back to the boat and both held to the bow with one hand and the life ring with the other hand. The operator was still bleeding from the face, and the passenger became very concerned about his condition although the operator had repeatedly told her he was not badly injured. The passenger thought that the blood could attract sharks which could attack them or they could drift out to sea, so she decided to swim to shore for help. The operator told her that he had always been told never to leave a boat as long as it was afloat therefore he felt they should stay with the boat. The passenger insisted that she was going to swim for help, and the operator told her she was not going to leave the boat even if he had to physically restrain her from leaving. The passenger then decided that she should do what the operator instructed her to do. After a short time the two could see that the boat was being washed toward shore. The anchor had fallen overboard when the boat capsized and the 50 ft anchor line was tied to the starboard stern cleat. The boat would drift until the anchor dug in, then it would stay in place until a wave pushed the boat, pulling up the anchor, then drift until the anchor dug in again. This continued until the boat was washed ashore. The occupants did not attempt to untie the anchor line because the stern was under water. There were no other boats in the area. The operator waved at an airplane overhead after they had been in the water approximately 20 minutes, but apparently his signal was not seen.

After approximately 40 minutes from the time the occupants had been thrown out, the boat had drifted into the breakers approximately 200 yards off shore with the occupants still holding to the bow. It became very difficult for the occupants to stay with the boat due to the high waves. The passenger was thrown over the bow by a wave and became entangled in thrown fishing lines that were attached to the bow. She was washed approximately 50 ft from the boat where the lines in which she was entangled became taut. At this time she became very frightened because she thought she would probably drown before she could free herself from the lines. When she was thrown over the bow she released the life ring and she had no PFD. She was able to free herself in a short time and swam to a point where she walked ashore. The operator stayed with the boat holding to the life ring until the boat was washed ashore (approximately the same time as the passenger reached shore).

The operator and passenger were taken back to the marina by a small boat whose owner was on the beach near the point where the involved boat washed ashore. A nearby Coast Guard Station was notified, a rescue boat dispatched and the involved boat towed to the marina. The passenger was taken to a local hospital, examined and released. The operator did not consider his injuries severe enough to go to the hospital. He stated that he received a broken nose which he set himself. Refer to Figure 1 for a chart of the accident area.

TIME SEQUENCE

0630	Occupants arose and started preparing for fishing trip.
0730	Departed summer home for marina.
0745	Arrived at marina launch ramp.
0745-0800	Launched boat, stowed gear aboard and topped off fuel tank.
0800	Left marina and headed up inland waterway.
0800-1000	Fished in various locations in inland waterway.
1000-1010	Traveled from inland waterway to ocean side of Shackleford Banks.
1010-1045	Fished at various locations on ocean side.
1045	Wave hit boat broadside throwing occupants from the boat over the side. Boat was filled approximately half full with water.
1045-1047	Occupants swam to boat and got a throwable life ring out of boat.
1050	Boat completely filled with water and capsized.
1050-1130	Boat drifted into breakers near beach. Passenger was thrown over bow by wave and became entangled in fishing lines attached to the boat. Passenger also released life ring.
1130-1140	Passenger freed herself from fishing lines and swam ashore. Operator held to boat and washed ashore.
0100	Boat taken in two by C. G. rescue vessel to nearby marina.

4.0 FACTS FROM THE BOAT INSPECTION

The boat hull was of the warped plane design with a semi-v bow flaring into a near flat-bottom approximately one-third aft of the bow. The boat had been constructed from one-quarter inch plywood. After manufacturing, a one-sixteenth inch fiberglass cloth cover had been installed over the entire exterior surface. The boat structure appeared to be sound but there was ample evidence that it had been poorly maintained.

There was no flotation material installed in the boat, which is not unusual for that age boat. Refer to Photographs 1 through 4 for boat condition.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The involved boat was not equipped with a windshield at the time of the accident. The operator stated that water spray would come over the bow into the operator's face even in fairly calm water. The operator's visibility was probably somewhat impaired by the water spray which may have been the reason that he and the passenger did not see the wave until it was too late to take corrective action.

The operator had never been offshore that far in a small boat. His boating experience had been in inland waters and close to shore in the area where the accident occured. Therefore he had most likely never encountered waves greater than 3 to 4 ft. He admittedly was very startled when he saw the wave; therefore, considering his lack of experience in offshore waters, the wave he described as being 25 ft high could have looked that large to him but actually may have only been 5 ft high.

Referring to the chart of the accident area, there is a shoal approximately one-half mile offshore running parallel to the shore line. It is this writer's opinion that the boat was in this area at the time of the accident and the wave that capsized the boat was generated by the shoal.

6.0 PROBABLE CAUSE OF ACCIDENT

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

- The operator had no experience in operating a small boat this far offshore. Therefore, he did not know the corrective action to take to avoid capsizing when he encountered a wave of this magnitude. He should not have been this far offshore in this boat with his limited experience in this type water.

- Water spray over the bow probably restricted the visibility of the operator and passenger to the point that they did not see the wave until it was upon them.

- Capsizing of the boat when hit broadside by a wave of this magnitude (probably 5 to 6 ft) was typical. The height and force of the wave was probably exaggerated by the occupants.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

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

From the estimated weight of the equipment on board, it is assumed that the boat was not overloaded at the time of the accident. It can also be assumed that the boat was running essentially transversely level with a positive trim angle of approximately 7 degrees. This running angle would allow adequate visibility from the helm. The visibility was restricted only by the water spray over the bow.

When the occupants saw the wave, the boat was running parallel to the wave. Apparently the operator was so surprised and startled that he made no effort to maneuver the bow into the wave or any avoidance maneuver. The wave impacted the boat on the port side. The boat then rolled to starboard up the wave to a high heel angle. At this point the occupants either fell out or were thrown out of the boat. The boat went over the wave crest and rolled

back to an upright position. The wave partially swamped the boat (approximately one-half full). The boat remained upright until it completely swamped, then it went down stern first until the long axis was in a vertical position. As the boat went down, air was entrapped under the closed bow, which probably prevented the boat from sinking completely. The boat then rolled to an upside down, bow high position where it remained until it was washed ashore.

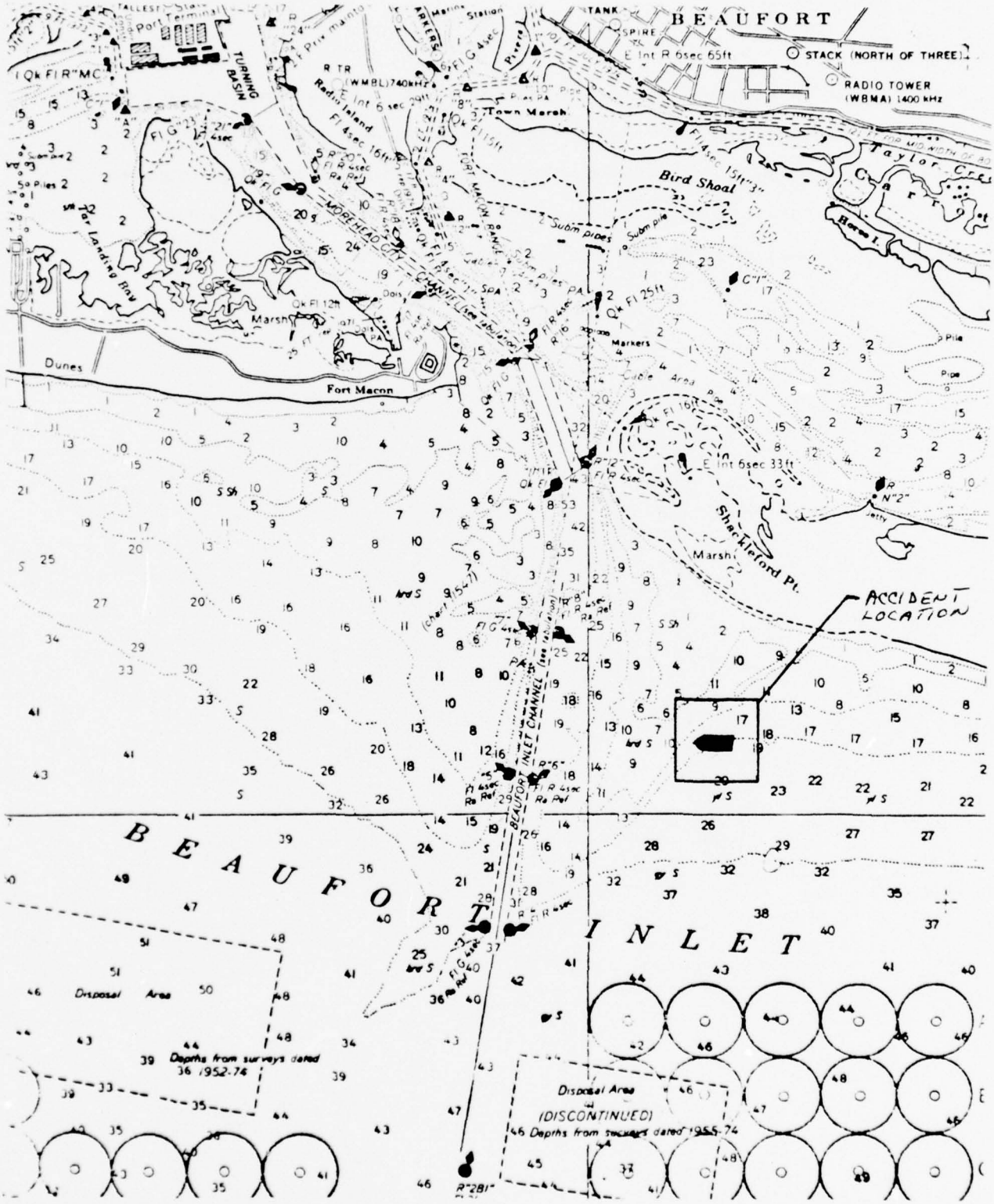


Figure 1. Chart of Accident Area

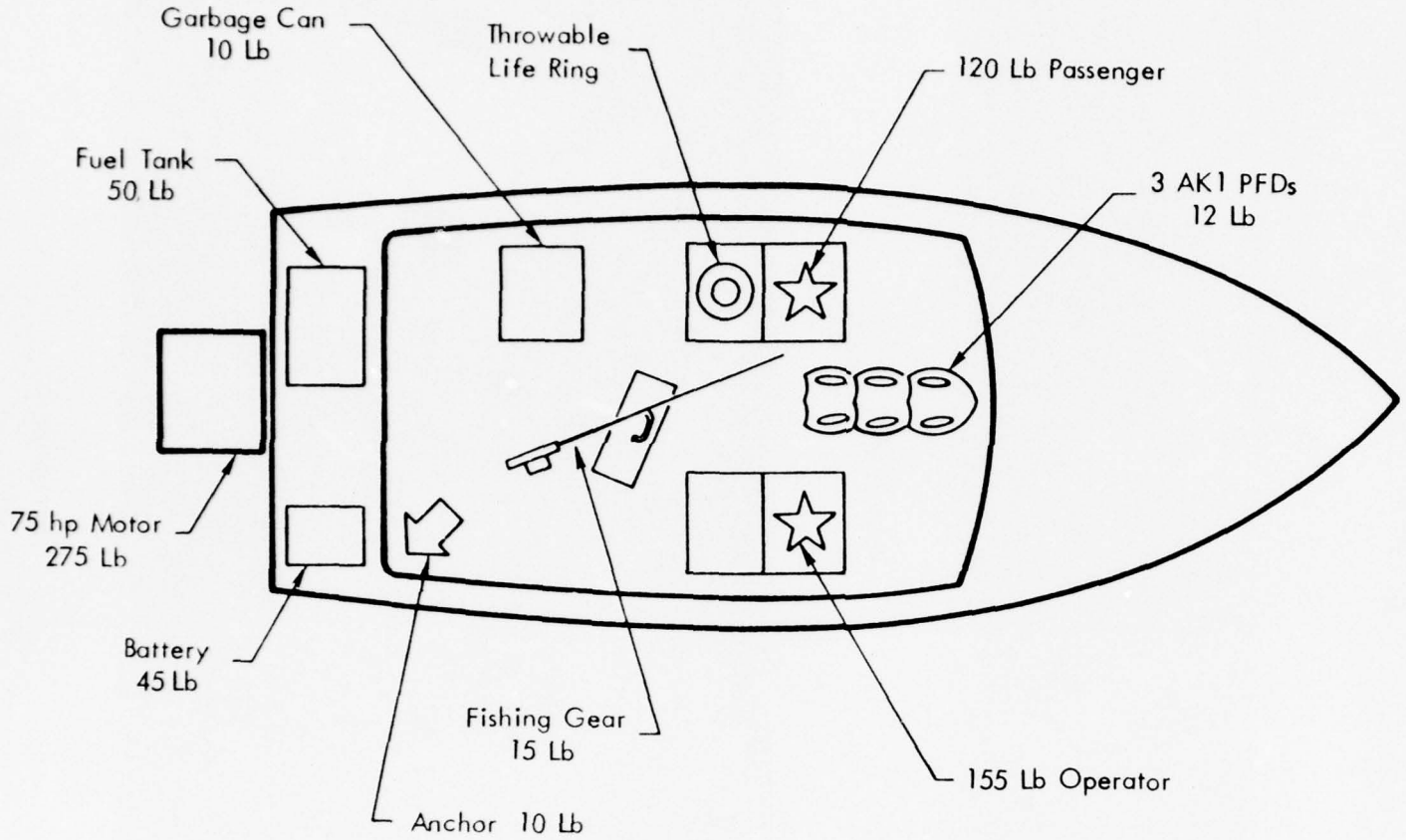
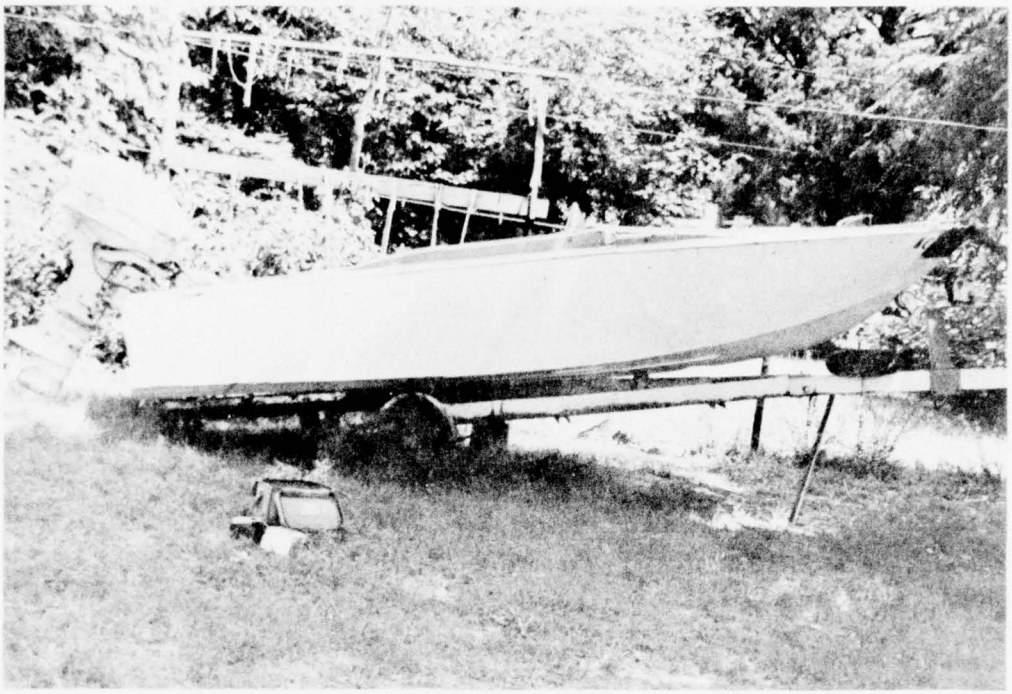
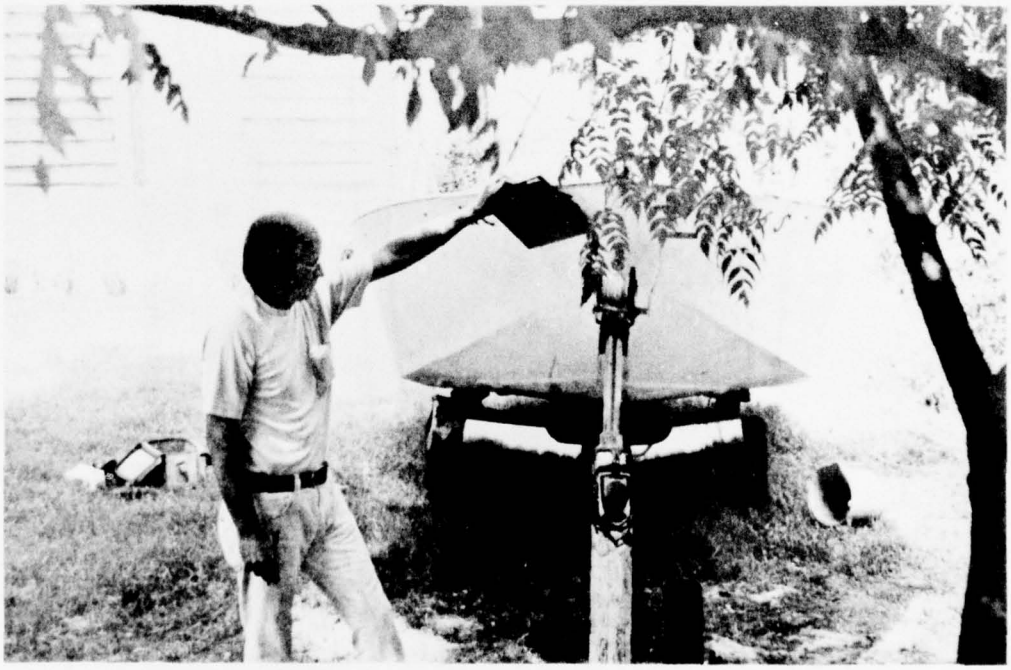


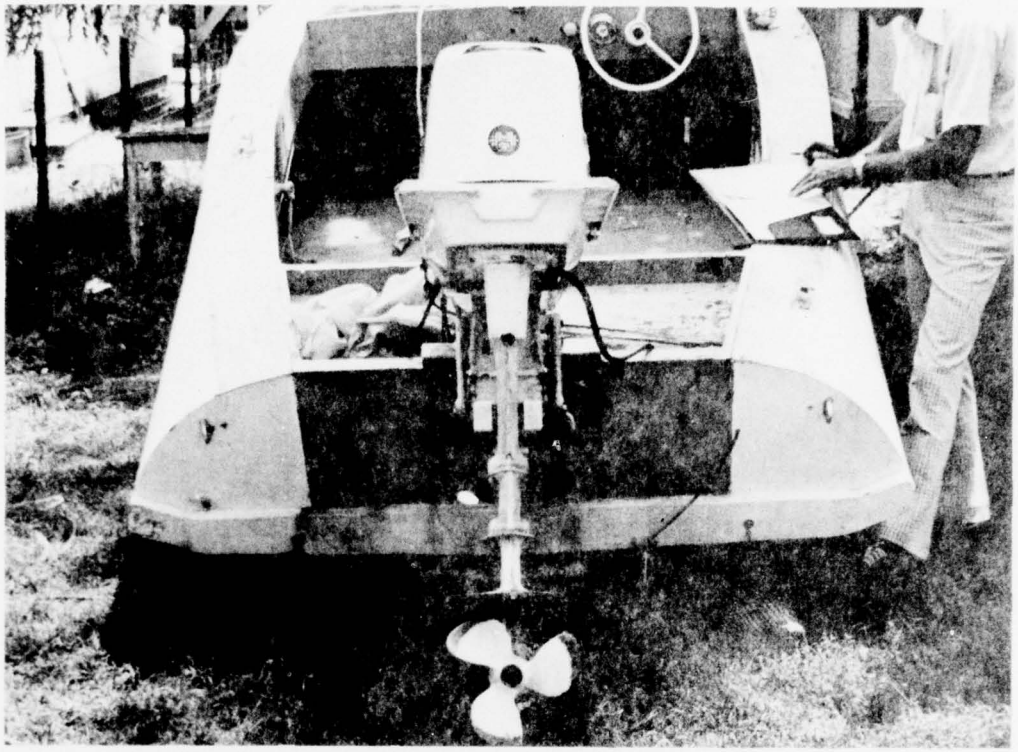
Figure 2. Equipment Load Distribution of Involved Boat



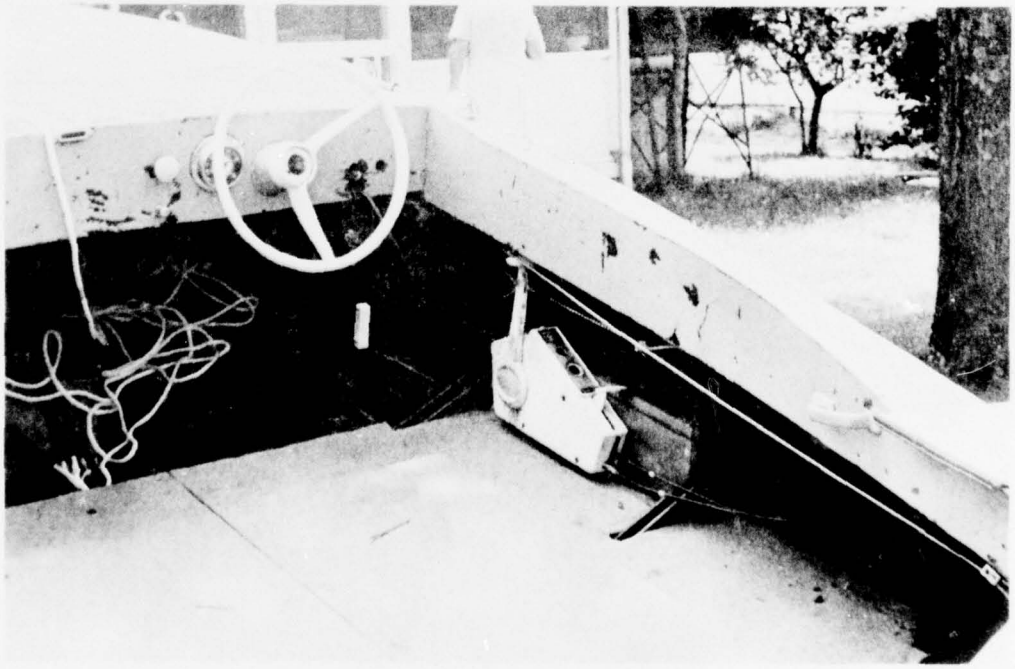
Photograph 1



Photograph 2



Photograph 3



Photograph 4

APPENDIX E

ACCIDENT INVESTIGATION REPORT

Date of Investigation: August 12, 1975

Date of Accident: July, 1975

Investigation: Capsizing/Swamping No. 75-04

SUMMARY — WYLE ACCIDENT NO. 75-341

A 23-foot inboard cabin boat was entering a breaking inlet when the operator noticed a large boat overtaking him ten yards to port. The operator slowed down from his safe position on the back of a six-foot wave for fear that the two boats would collide in the narrow inlet ahead. A wave caught up to him and his boat broached and slowly capsized.

The two people on the flying bridge were thrown into the water. The third person in the cabin was trapped under the boat. The trapped cabin occupant swam out from under the boat and joined the operator at the bow. They both hung onto the boat. The other person that was on the flying bridge was picked up by a commercial fishing boat and transported to shore. He was admitted to the local hospital with what was diagnosed as heart palpitations. The two on the bow of the boat were rescued. The Coast Guard towed the boat into shore.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator	M	43	225	Fair	>500	Power Squadron Course	No
Passenger	M	45	210	Fair	Very Little	No	No
Passenger	M	45	190	Fair	50 hr	No	No

The owner/operator of the boat is a college graduate with mechanical engineering experience in the aerospace industry. He was laid off from his job and now is in business for himself doing mechanical and electrical contracting. He is an avid fisherman and has used his boat almost every weekend from April through December for the past six years. He knows the characteristics of his boat and was familiar with the inlet through which he was about to pass.

Little is known about the passengers. They were his fishing buddies and had been on the boat many times before.

2.0 ENVIRONMENT

The temperature was in the 70's, with showers. The wind was moderate from the south. There were 10- to 15-foot swells in the ocean, with 6-foot swells close to shore. Visibility varied with the amount of rain that was falling.

3.0 NARRATIVE

The following account of the accident was compiled from conversations with the boat owner/ operator and the Coast Guard rescue personnel.

3.1 Pre-accident

The owner had scheduled a fishing expedition for a particular Saturday. His boat was kept on its trailer at a fishing club at a shore resort town about 65 miles from his home. Because he wanted to get an early start in the morning, he drove down to the fishing club on Friday evening and went to bed early.

His two fishing companions left their houses early Saturday morning and met the owner at the launch site at 0600. They launched the boat and were headed out the inlet by 0700. The owner put the boat on a southeast course for 14 miles. Once at the fishing site they trolled until noon when they started in. The weather was lousy and they hadn't caught anything. About five miles from shore they ran across a school of blues and fished over the school until about 1500.

Throughout the day it had been raining off and on, and there were 10- to 15-foot ocean swells to contend with. All three men aboard were ready to head in at this time. As they approached the inlet the operator turned on his CB radiotelephone and asked for a report on the conditions of the inlet. Someone on another boat responded and told him that there were breaking waves in the inlet but it "wasn't bad." The plan was to get on the back of a swell heading for shore and ride it through the inlet.

At this point the three men were distributed throughout the boat as follows: the owner was operating the boat from the flying bridge, one other passenger was sitting beside him on the flying bridge, and the third occupant was in the cabin on the port side.

The operator had adjusted the throttle to maintain a constant position on the back of a swell and was proceeding towards the inlet when he noticed a large cruiser slowly passing him about 10 yards to port. He was afraid that the two boats might collide at the narrow inlet entrance ahead so he reduced his throttle to allow the other boat to pass. His boat slipped back into the trough. He looked back and saw that the next swell hadn't begun to break so he felt he could safely let it pass by him. He would then be safely behind the cruiser and could follow it into the inlet. Unfortunately, just as the swell was catching up to the boat it began to crest and break. The owner attempted to power away from it but was unable to do so due to the swift reverse current encountered just ahead of the wave.

3.2 Accident

The breaker lifted the transom and turned the boat to starboard. The starboard chine rose and the boat slowly rolled over. The owner said that at the time he told himself that this couldn't be happening—the wave wasn't big enough to turn a 23-foot cabin cruiser over.

The boat turned completely over and deposited the two people that were on the flying bridge into the water. The owner landed within 20 feet of the overturned boat and immediately looked around for the others. He spotted the other occupant of the flying bridge about 70 feet away, didn't see the third person and assumed that he was trapped under the boat. The owner swam to the bow of the boat, stood on the bow rail, which was under water, and put his finger through the towing eye. He found that he could stand and support himself upright quite easily this way.

3.3 Post-accident

The occupant of the cabin had been trapped when the boat capsized and had swum up into an air pocket where he remained until the boat stabilized out. He could see light coming from somewhere below him and after assuring himself that the boat was not going to bounce on the bottom and squash him on the way out, he dove for the light. He surfaced near the owner and swam to the bow area of the boat. He was afraid of being washed off of the bow rail if he stood on it so he sat on the rail. In this position his head was above water when the boat was in a trough but was underwater each time a wave passed over the boat.

The third person, in the meantime, was about 70 feet away from the boat and didn't see the other two surface. In addition, he was located behind the boat so that when the two attached themselves to the bow they were obscured by the hull. He thought that the other two had drowned and became hysterical.

The operator of a large party boat on its way out the inlet saw the capsize and saw the third person floundering in the water. He continued on, cleared the inlet, then turned around to come back to help in the rescue. He picked up the third person with great difficulty. The water was so rough and his topsides were so high that it took quite a while to get the person on board. Actually that person was in the water somewhere between 15 and 20 minutes. Once aboard it was determined that the person was experiencing some sort of heart failure. An ambulance was called, and the party boat returned through the inlet to the Coast Guard dock where a waiting ambulance rushed that person to the hospital. Throughout this period of time he was convinced that the other two were dead and could not be convinced otherwise.

A smaller boat got close enough to the stricken vessel to throw the survivors a line. The owner figured that he was in better shape than his companion so he allowed his companion to go first. Two lines were then passed to the operator. He tied one to the bow eye and was pulled back to the rescue boat by the other. The rescue boat attempted to pull his boat off of the sandbar onto which it had drifted but couldn't as his boat was now hard aground. The rescue boat then took the owner and his companion to the Coast Guard Station. On the way in they passed the 44-foot Coast Guard boat that was on its way out to rescue them. They communicated with the Coast Guard vessel. The owner expressed a desire to get the boat off of the sand bar. The Coast Guard said they would make an attempt.

Three attempts were made. Since the boat was hard aground and upside-down, quite a bit of force was required to move it. The Coast Guard vessel first attempted to pull it by the bow eye. The bow eye pulled out of the stem. They then wrapped a line around the propeller shaft. It pulled out of the boat. A chain was wrapped around the rudder post and connected to the Coast Guard vessel. The rudder post held and the boat was pulled off of the sand bar. However, quite a bit of damage was done to the boat during this process. The flying bridge was destroyed, the transom was split, and the cabin top was damaged. The boat was taken to the Coast Guard Station, righted, and hauled.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a 23-foot semi-v, single-engine inboard, sport fishing cabin cruiser with a flying bridge. It had a 9' 6" beam and a tunnel drive arrangement that places the propeller above the keel line.

The flying bridge had been torn off during the salvage attempt, the transom was cracked, and there was minor gelcoat damage on all hull surfaces. All rails were damaged and it was evident that the cabin structure had been stressed.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The operator made his big mistake when he did not check behind him before becoming committed to a particular wave. The large boat that passed close to port wasn't going much faster than he was, therefore it was right behind him when he made his commitment.

Perhaps he didn't scan the immediate area because of fatigue. He had been driving the boat in inclement weather and high seas for over eight hours. In addition, he was wearing foul weather gear. The hoods on the foul weather gear limit visibility to the rear when the wearer turns his head aft. It is quite possible that he could have glanced aft but because of the visual obstruction due to his hood did not see the overtaking cruiser.

The second mistake, of course, was slowing down and dropping off of the back of the wave. His timing for this maneuver was apparently all wrong since he did it just as the roller behind him broke. This means that he apparently came over the sand bar just as he throttled back. He said that he hit the throttle when he saw the wave begin to break. Perhaps his reaction time would have been quicker if he hadn't been fatigued and perhaps he would have noticed the breaker faster if he had not been wearing the hooded foul weather gear.

A deep-v hull becomes unstable when the center of gravity moves forward and up. This hull had a 17-1/2 degree deadrise aft with a warped plane bottom design. Therefore, the deadrise increased constantly to the fairly sharp entry. Two heavy people were sitting on the flying bridge with one forward in the cabin. The live load, then, was shifted forward and up, when it should have been shifted aft and down for maximum stability. In other words, the owner should have told his crew to go below and sit in the fishing cockpit while the boat traversed the inlet.

The owner knew that the inlet was breaking. He had called ahead on his C.B. radiotelephone to check the conditions. He should have had his crew don PFDs for the trip through the inlet. Even if the boat hadn't capsized, a violent motion set up by a wave could have thrown someone overboard.

Looking back at the errors which set up the capsize, it appears as if an education program of some sort could help to prevent the errors and, hence, the accident. Very careful watch keeping should be stressed before reaching the point of making the commitment when entering a breaking inlet. The effects of changing the location of the center of gravity on boats, especially deep-v sport fishing boats, should be stressed. Most people have never had the terrifying experience of a deep-v boat with a high center of gravity suddenly flopping over on one chine while travelling in perfectly calm water. In a following sea this

phenomenon is deadly. At least one major boat manufacturer discontinued production of a popular 28-foot, deep-v sport fisherman because of this dangerous trait. Finally, an education program showing the disastrous results of backing off of a wave in a breaking sea condition could help to eliminate those errors.

6.0 PROBABLE CAUSES OF ACCIDENT

First, the operator didn't see the overtaking vessel until the vessel was close aboard to port. Next, he elected to back off of the wave that he was on instead of attempting to negotiate the inlet beside the overtaking vessel. These two factors set up the situation where the wave overtook the boat.

The boat itself was improperly loaded for safely negotiating a breaking inlet. The entire live load was forward with two heavy adult males atop the cabin on the flying bridge. Their combined, clothed weight approached 500 pounds.

The combination of the wave overtaking the boat and the improper loading of the boat caused it to broach and capsize.

7.0 DYNAMICS/ANALYSIS OF ACCIDENT

The broad stern was picked up by the overtaking wave. The bow, being heavily loaded due to all three men being forward, was deep in the water. The relatively small rudder on this boat is housed within the tunnel and became ineffective in steering the boat in an attempt to prevent the broach.

The boat broached with the capsize becoming inevitable because of the high center of gravity. From the owner's statement it became evident that the wave didn't completely do the job of capsizing the boat. It happened too slow. Apparently the wave started the rolling motion, but because the center of gravity was so high and so far forward the boat became unstable and continued to slowly roll over.

A time history of the capsize appears below:

Hours	Minutes	Second	
		00	Boat backed off of wave
		10	Wave overtook boat
		15	Boat capsized
	2	00	Owner swam to bow
	3	00	Cabin occupant surfaced
	3	30	Cabin occupant held on to bow
	15	00	Third person picked out of water
	25	00	Cabin occupant rescued off of bow
	30	00	Owner rescued from bow
	40	00	Coast Guard arrived at boat
4	30	00	Coast Guard pulled boat off of sand bar.

8.0 MISCELLANEOUS

An inspection of the bilge of the boat uncovered three potentially dangerous conditions that had nothing to do with this accident but are worthy of mention.

First, the blower hose looped down into the depths of the bilge then back up to the top of the stringer where it was secured with a plastic cable clamp. Water can fill the lowest portion of the hose and remain there unnoticed for the life of the boat. When this happens it renders the blower useless (see Figure 7).

Second, there is only one clear area forward of the engine to stand while servicing the engine (see Figure 8). The water inlet for the engine is located directly in the middle of this area. Figure 9 shows that it is quite possible that one will stand on the inlet hose while servicing the engine. Note that there is no sea cock. If the hose breaks it opens a 1-1/4 inch hole into the bilge.

Third, a fuel consumption meter had been installed in the fuel line. The natural place for entering the line was at the joint between the copper tubing from the tank and the flexible line to the fuel pump. Unfortunately that is in the area that one steps onto when entering

the bilge for servicing the engine. As a result the fuel lines were quite susceptible to damage.

The first two problems could be remedied by regulation if they are found to occur frequently. The third could be attacked by regulation or education.

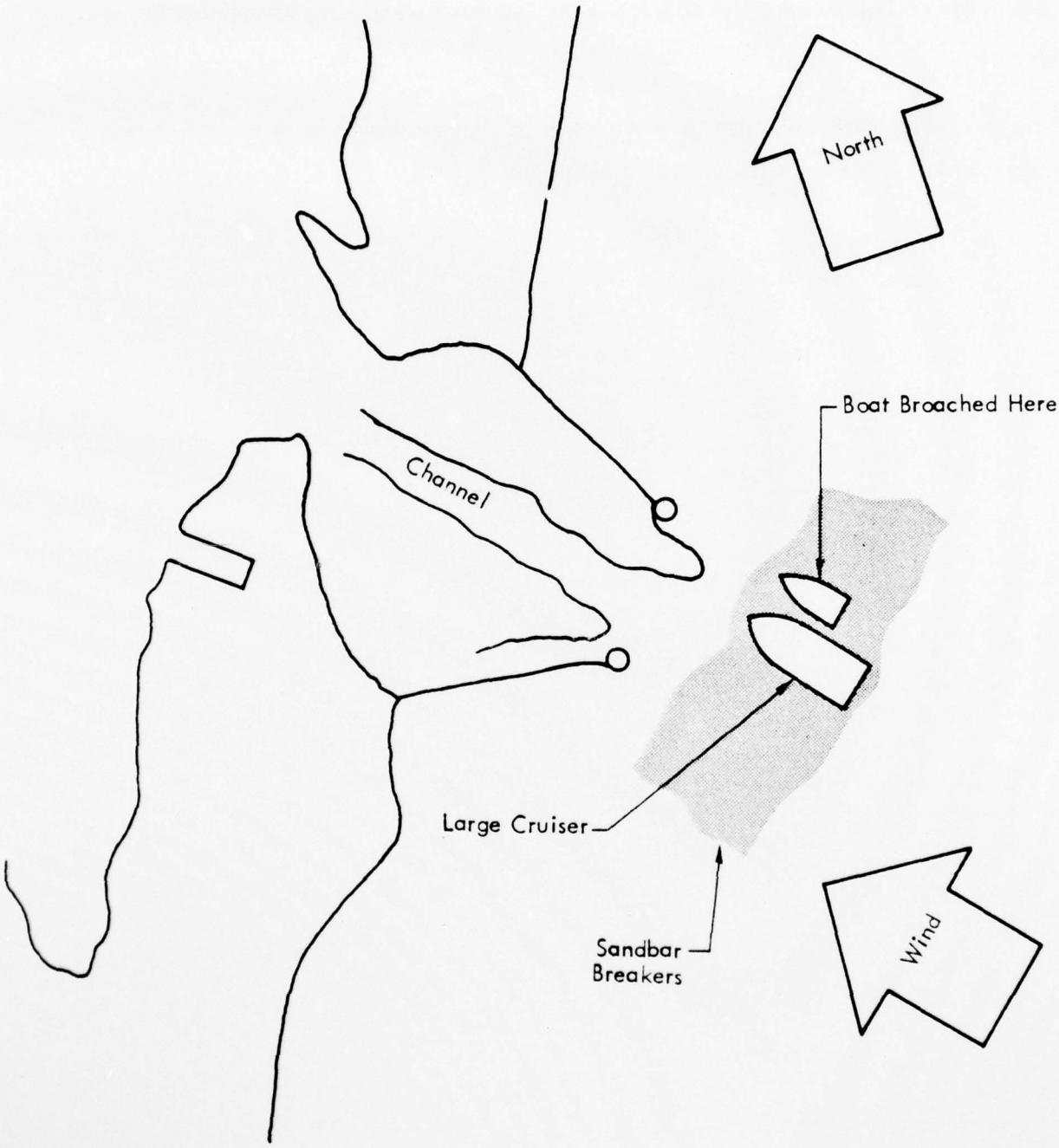


Figure 1. Accident Area Diagram

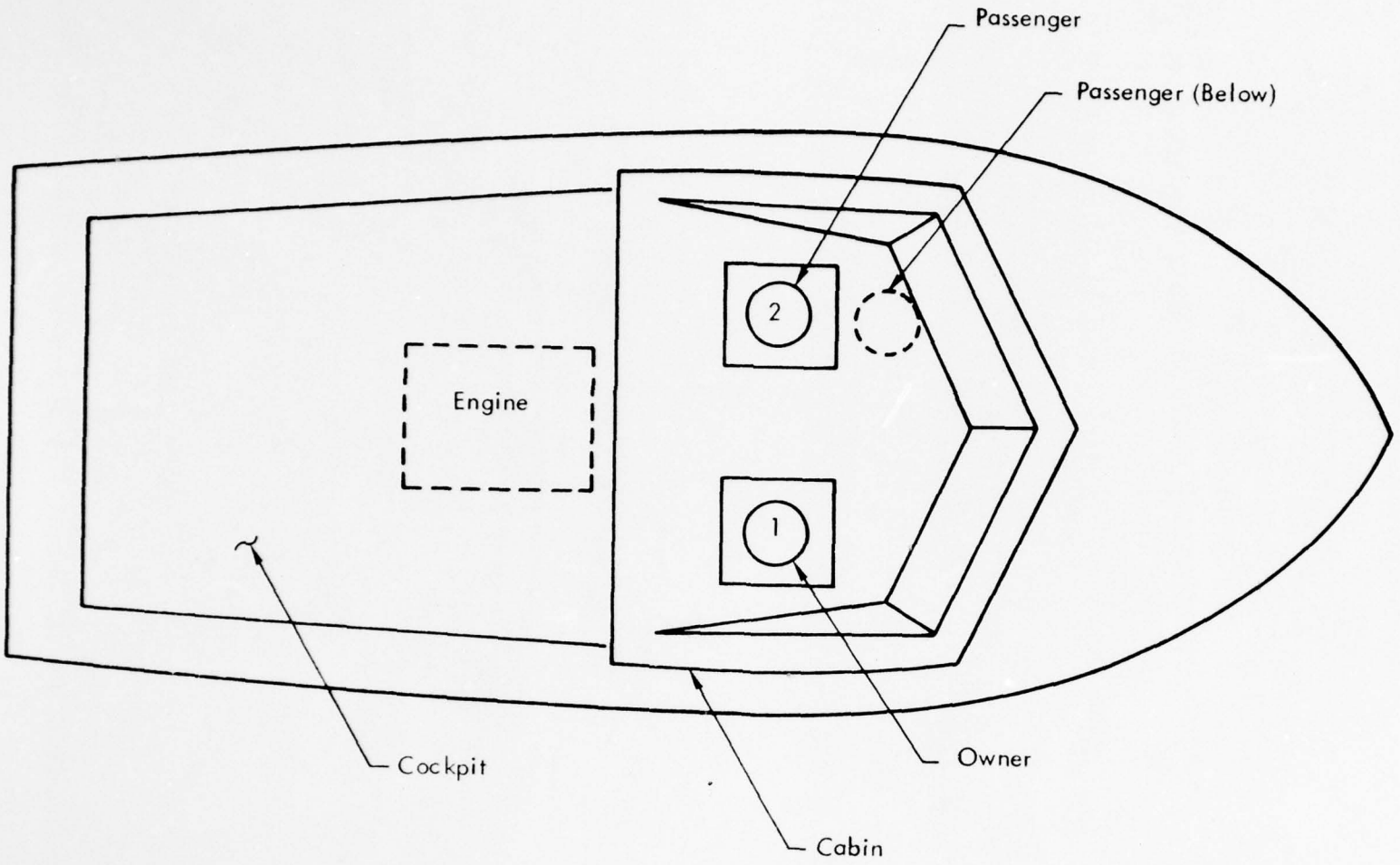


Figure 2. Plan Of Boat



Figure 3. Profile



Figure 4. Bow



Figure 5. Stern



Figure 6. Cabin And Lower Control Station

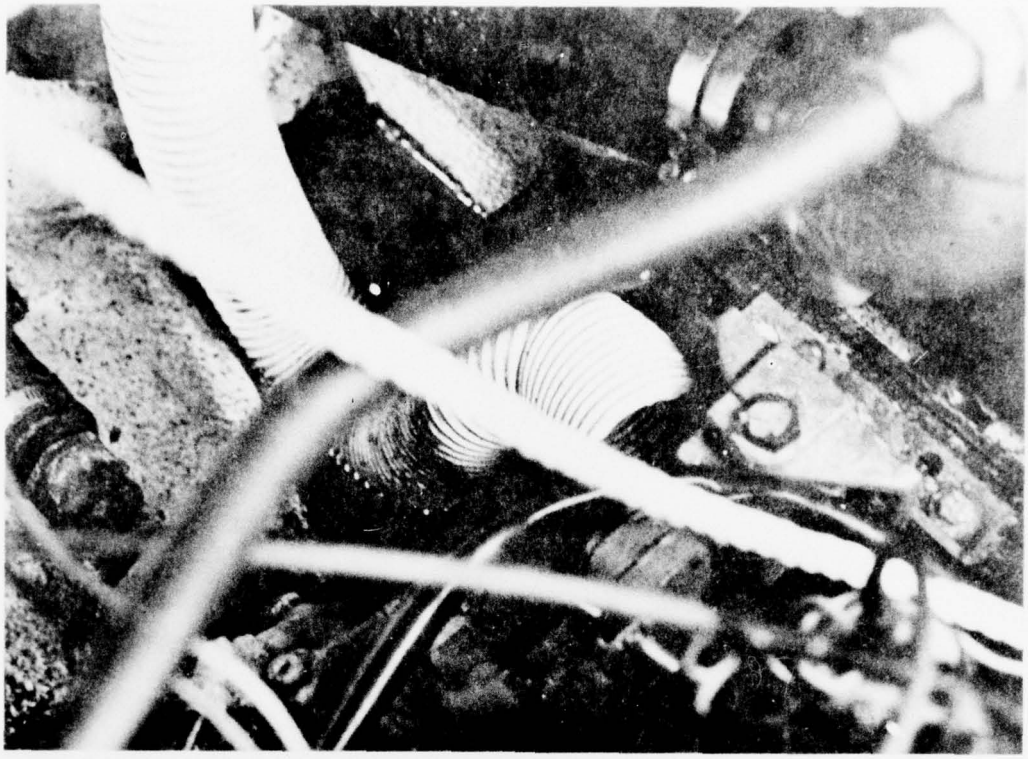


Figure 7. Blower Intake Hose - Note Loop That Can Catch And Hold Water

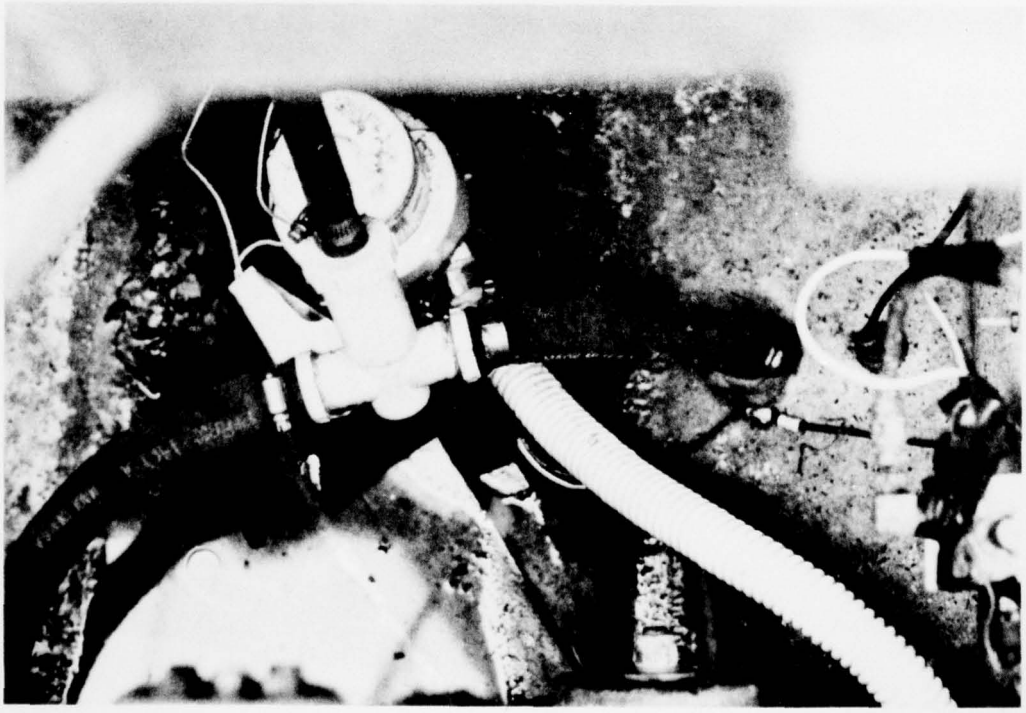


Figure 8. Water Inlet. Note No Seacock

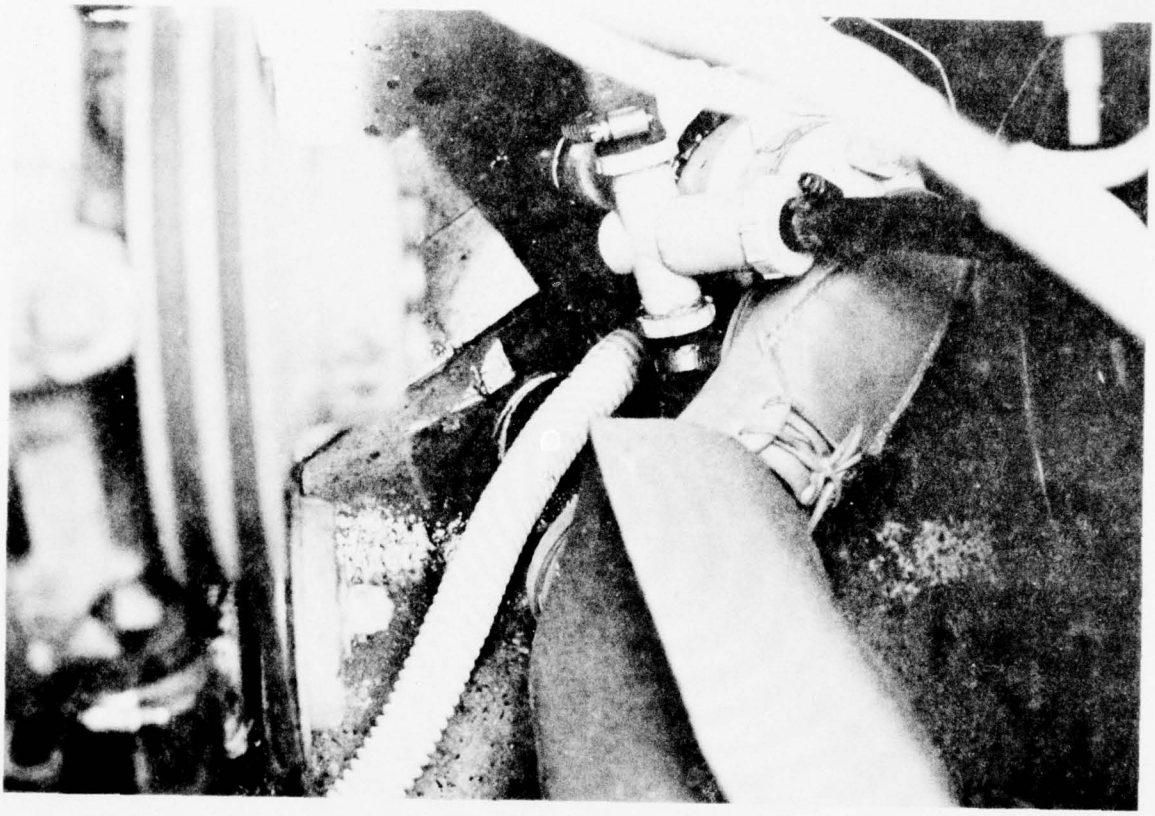


Figure 9. Water Supply Line Susceptible To Damage

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CAPSIZING/SWAMPING ACCIDENT INVESTIGATIONS FOR 1975 SEASON.(U)
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APPENDIX F

ACCIDENT INVESTIGATION REPORT

Date of Investigation: August 10, 1975

Date of Accident: July, 1975

Investigation: Capsizing/Swamping No. 75-05

SUMMARY — WYLE ACCIDENT NO. 75-365

Two families went to a New Jersey coast resort town for a weekend of relaxation. Each arose early, drove 70 miles to the resort town, rented fishing boats and went fishing. Even though they both signed an agreement with the rentor, stating that they would not venture into the ocean, they both did.

Both operators were inexperienced, had never owned a boat, and, in fact, had operated a boat less than 10 times in their lives. They were drift fishing with their engines off at the mouth of the inlet when one boat drifted into a shoal area with breaking waves. Waves entered over the transom and swamped the boat. Four of the five people on board donned PFDs. All five left the boat and were picked up by other boats in the area. The Coast Guard towed the rental boat back to its owner.

1.0 OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator	M	39	230	Good	< 50	No	No
Passenger	M	14	135	Good	< 50	No	No
Passenger	M	11	113	Fair	< 50	No	No
Passenger	M	16	165	Good	< 50	No	No
Passenger	M	14	170	Good	< 50	No	No

One man and four children were in the boat at the time of the accident. The gentleman managed a trucking outfit and lived in a lower middle class section of a major city. He was courteous and helpful as was the rest of his family throughout the interview; however, from the contradictions, it was evident that he was attempting to hide something; i.e., the fact that he was in the ocean instead of the bay.

2.0 ENVIRONMENT

The weather was clear, the temperature at the time of the accident was in the high 70's, and the wind was from the south/southwest at 15 mph. The tide in the inlet was midway between high and low and was ebbing. There was a swift current in the inlet with breaking waves over the bars at the inlet's mouth.

3.0 NARRATIVE OF ACCIDENT

The following narrative was compiled from interviews with the person who rented and operated the boat that capsized, his two sons, his wife, the manager of the boat rental establishiment, and Coast Guard rescue personnel.

3.1 Pre-Accident

Two families arose at 0530 and drove 70 miles to a resort town on the New Jersey coast. Their intention was to spend the weekend at the seashore with a fishing trip planned for Saturday and swimming on Sunday. Upon their arrival at the resort area, the men dropped off their wives at their motel and proceeded to attempt to rent a fishing boat for each of the families. Boats were available and the male members of both families proceeded to fish.

They both signed agreements before renting the boats that stipulated boundaries beyond which they were not supposed to venture. These boundaries clearly limited the boating activity to the relatively protected bay area. The boats that they rented were 18 feet long, plywood, flat bottomed outboard powered boats that are indigenous to the area. They are quite stable, plane easily if not loaded down, and except for a visibility problem over the cabin, are quite safe for inexperienced bay fishermen.

However, these people, who had been boating less than ten times in their lives didn't abide by the rental agreement and ventured out the inlet into the ocean. According to the operator of the boat that swamped, he was not in the ocean, but was in the bay near the inlet. His sons put up some disagreement about not being in the inlet which was quickly squelched by their father. He claimed that their method of fishing included shutting off the engine and drifting with the current. They would then restart and go back against the current, shut down and continue drifting again.

The operator complained that the boats didn't run properly. The outboard on his friend's boat was quite difficult to start, and his boat was quite difficult to handle. Its bow went way up in the air, and the bow would swing from side to side. The transom would then be so low that wakes twice entered the boat over the transom. He said that when underway, the transom on his boat was quite a bit lower than the transom on his friend's boat. The outfit that rented the boat didn't include a bailer with the boat, so they tried scooping it out by hand, then gave up.

The operator mentioned that he was fishing off a certain beach which, according to the chart, is at the mouth of the inlet. That statement was immediately followed by one which placed him inside the inlet.

At any rate, he and his friend drifted through the swiftly ebbing inlet and up onto a shoal area that was breaking. His words to describe it were, "All of a sudden the water was all churned up." He couldn't explain what could have caused the water to be "all churned up," but he knew that he wanted to get out of there. He pulled the starter cord a couple of times when, according to him, two big waves came over the transom. It was then about 1030 or 2-1/2 hr after they left the dock.

3.2 Accident

The occupants were located as follows:

1. Operator in stern attempting to start motor.
2. 14 year old son on port side of cockpit.
3. 16 year old friend on starboard side of cockpit.
4. 14 year old friend on starboard side of cabintop.
5. 11 year old son on bow.

As the current carried the boat onto the bar, the first two breakers came over the transom and flooded the cockpit. The boat lurched, the 11 year old boy fell off of the bow, followed by the anchor which was laying on the bow and the 14 year old, who dove in to safe his brother. No one in the boat had on a PFD. The two boys made it back to the boat just as it got hit by another wave. This one tipped the boat up so far that the gas tank fell out of the cockpit. The 11 yearold's legs became entangled in the hose, but he and his brother were able to free the legs of the hose. PFDs were tossed to the boys in the water. They donned them. At this point they found that they could stand between waves, but the undertow pulled them away. The other two boys, still in the boat, donned PFDs and were instructed by the operator to leave the boat which was not firmly anchored on the bar and was pitching and rolling quite fiercely. The operator told them to jump overboard and swim to the beach, an estimated 100 yards away. The boys in the water drifted away towards a cabin cruiser which was close by, just off of the bar. They climbed aboard the cruiser. The other two boys saw that their friends were safe aboard a large vessel and swam for the boat instead of shore.

Their friends in the meantime, were within sight but were unable to start their engine. At least 6 other boats were in the area, but none of them would venture near enough to the bar to be of any use to those on board the stricken vessel.

The boat was thrashing around so much that the operator made the decision that he would be safer in the water. He jumped overboard, sans PFD, and floated away.

3.3 Post Accident

The cruiser that picked radioed the Coast Guard who were on the scene at about the time that the operator jumped overboard. They pulled up close to the operator and offered him a PFD prior to attempting to get him aboard. He refused it. They got him aboard, proceeded out to the vessel, got a line on it, cut the anchor line, and towed the vessel off of the bar. Once in calm water, they pumped out the cockpit and returned it to the rental docks. The cruiser brought the boys in, and the friend got his engine started and made it in also.

The Coast Guard was upset with the operator for getting himself into that kind of a situation and especially for leaving the boat, the manager of the boat rental establishment was upset because his motor was full of salt water, and the operator was upset because he felt that he got a lousy rental boat. Other than that, no damage was done except for the loss of one PFD and some fishing equipment.

4.0 FACTS FROM THE BOAT INSPECTION

The boat incurred no damage. The engine was removed, flushed, and put back into service immediately. The boat has four boxes in the cockpit that are supposed to be flotation chambers. However, the top to one box was loose. This investigator pried it up enough to see that it contained no flotation material. The manager of the rental boat establishment became noticeably disturbed when questioned about the flotation and requested that the investigator leave the premises immediately.

The boat was constructed of plywood and covered with one layer of fiberglass cloth. The hull was that of a Garvey, a flat bottomed, square sided boat that looks somewhat like a huge

johnboat. This particular Garvey was 18 ft long, and 5 ft wide, with a 2 to 3 inch draft unloaded. It had a small cuddy cabin forward, and four seat boxes in the cockpit area. See Figures 1, 2, and photographs.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

Obviously, the operators of both boats were inexperienced. The operator of the boat that swamped either didn't realize that he had drifted onto a sandbar with breaking waves, or wasn't willing to admit it. This investigator believes that the operator was aware that he went past the boundaries imposed upon him by the rental agency but didn't realize that he was about to drift onto the bar.

If that is true, then the problem becomes one of education. He didn't understand the consequences of passing the boundaries, nor of the effects of an ebbing tide in a narrow inlet. He was irresponsible in allowing his son to venture out onto the bow of the boat without donning a PFD. Possibly an educational program designed to get to and make an impression on the occasional boater would have made him aware of the inherent dangers. If so, he probably would not have gotten into that situation.

He was not aware of the fact that his passengers should have stayed with the boat rather than swim for shore ... again education.

6.0 PROBABLE CAUSE OF ACCIDENT

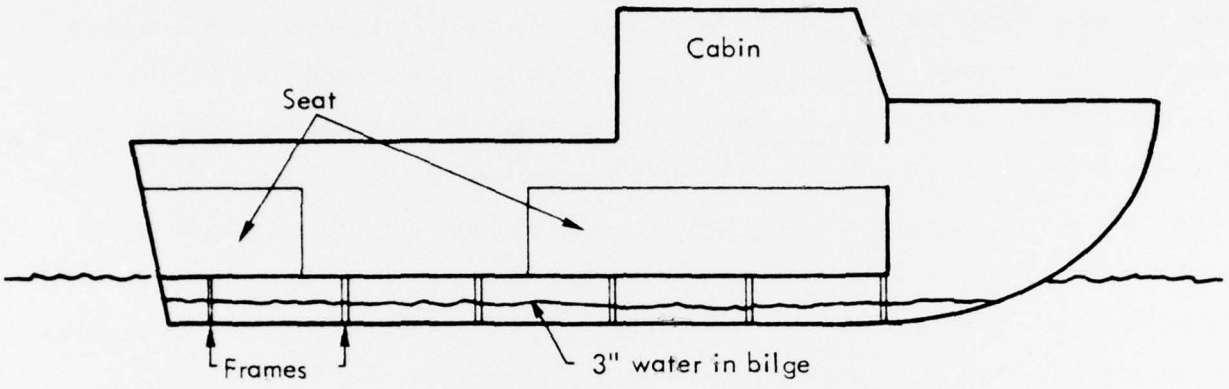
The inexperienced operator allowed the boat to drift onto a breaking bar ... i.e, inattention. The so called "inattention" was probably education oriented since it is quite probable that the operator would not have placed his life and those of his children and friends in jeopardy on purpose.

7.0 DYNAMICS/ANALYSIS OF ACCIDENT

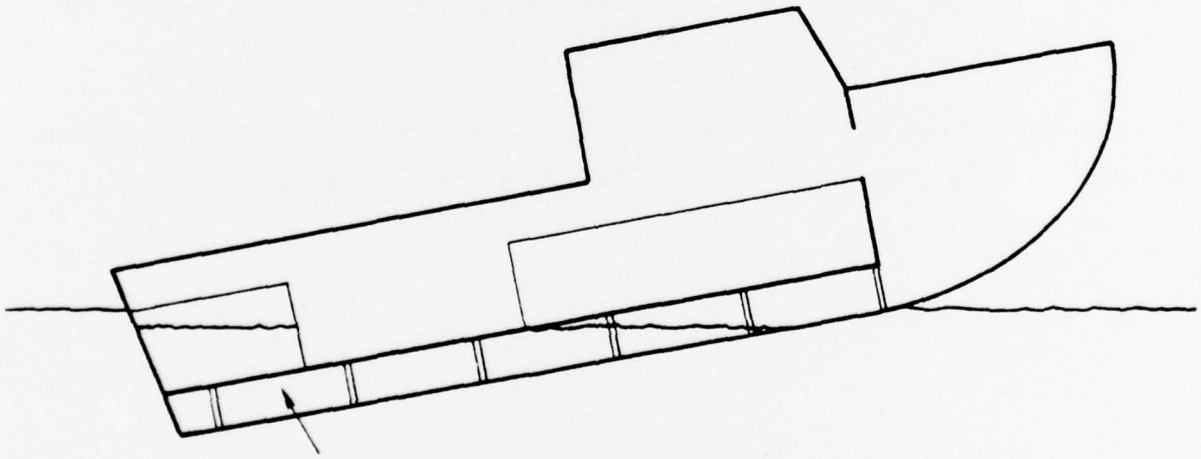
From the description of the handling characteristics of the boat by its operator, it is evident that there was an accumulation of water in the space between the cockpit floor and the bottom of the hull. (See Figures 1 and 2 for construction details.) The 20 horsepower outboard would have been able to push this type of boat up onto a plane with one or two people aboard. It is questionable if it could plane with five aboard. However, the fact that the transom was so low in the water when the operator opened up the throttle and the boat kept swinging from side to side (coupled with a noticeable list to the side that the bow was swinging towards) confirms the suspicion that there was quite a bit of free water in the bilge.

When inspected, the boat was back in operation and was at dock ready to be rented. There was about three inches of water in the bilge, with no good way to get it out. The water was noticeable by going forward and looking into the storage area under the foredeck. If the water covered the flatbottom 14 ft long, five ft wide, and was three in. deep through, the bilge would have 17.5 cu ft or 1120 lb of water. If that much water had been in the boat at the time of the subject rental, the reportedly poor performance could be explained. See Figure 1.

Water entering the cockpit during the incident was contained within the cockpit. The Coast Guard only had to dewater the cockpit to put the boat back to its original condition.

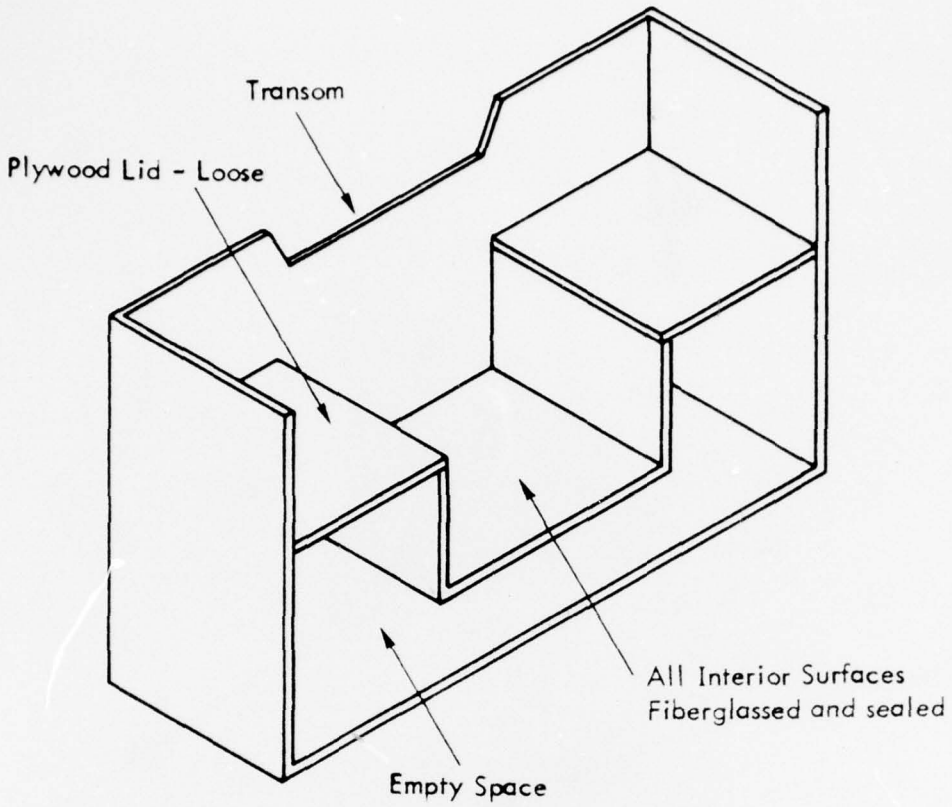


Boat at rest

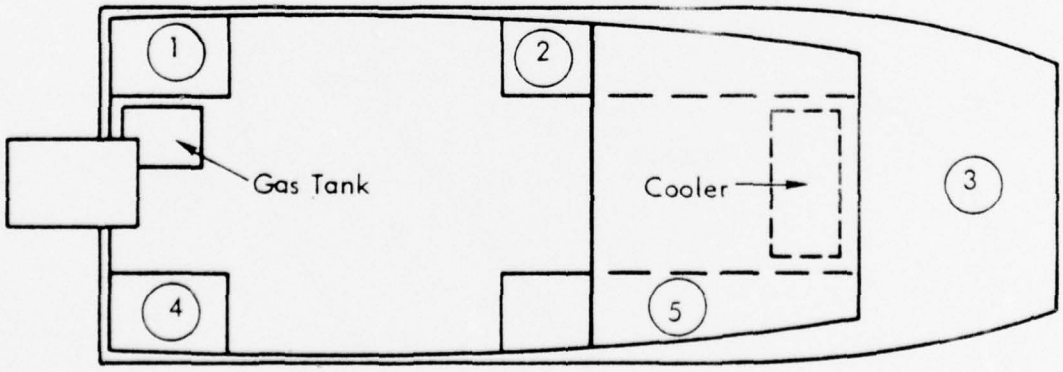


Boat underway, note that water in bilge moves aft - fills up area under aft seat

Figure 1. Configuration of Boat



Construction Detail - Aft



Circles show position of passengers at time of accident.

Figure 2. Configuration of Boat

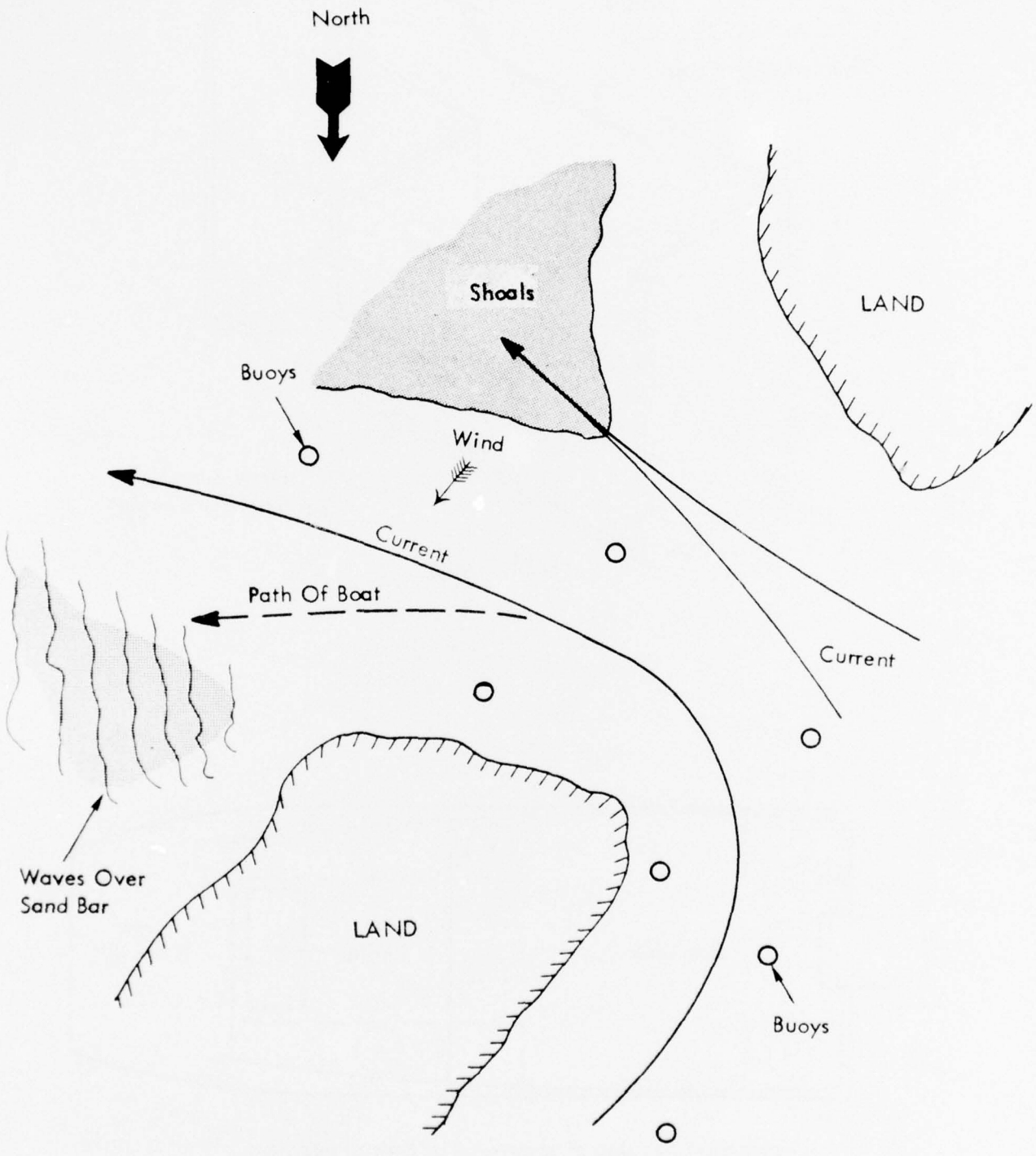
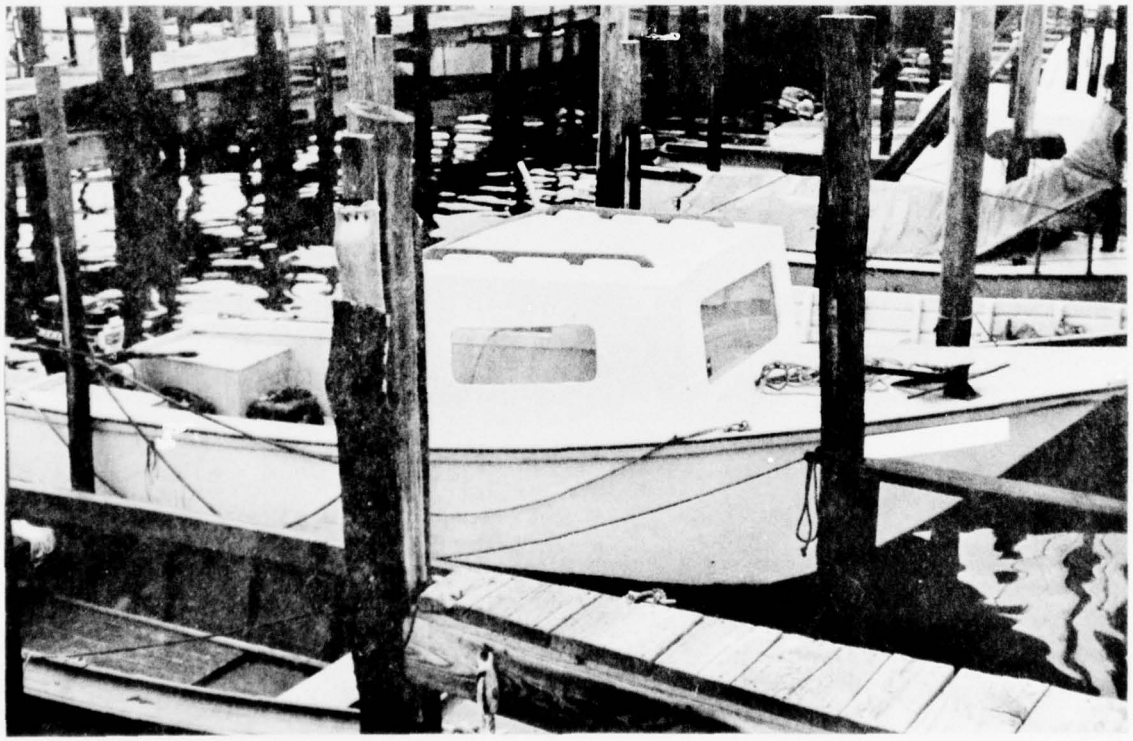


Figure 3. Accident Area Diagram





Photos 1 and 2 - 18' Garvey

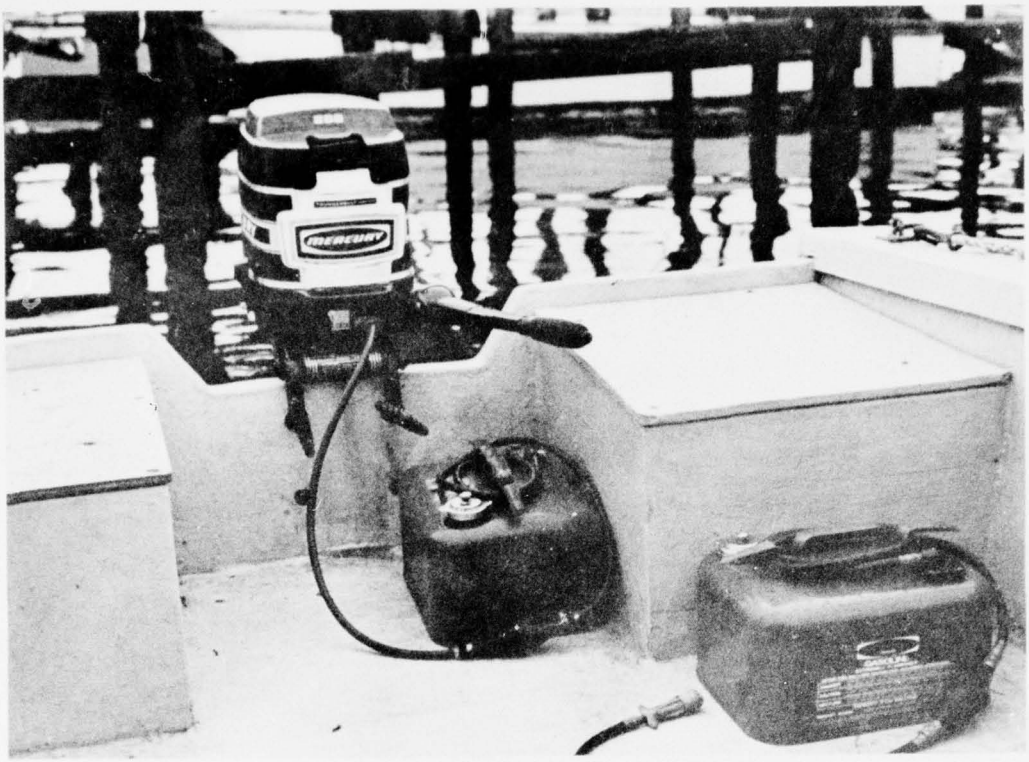


Photo 3 - Cockpit Area Aft

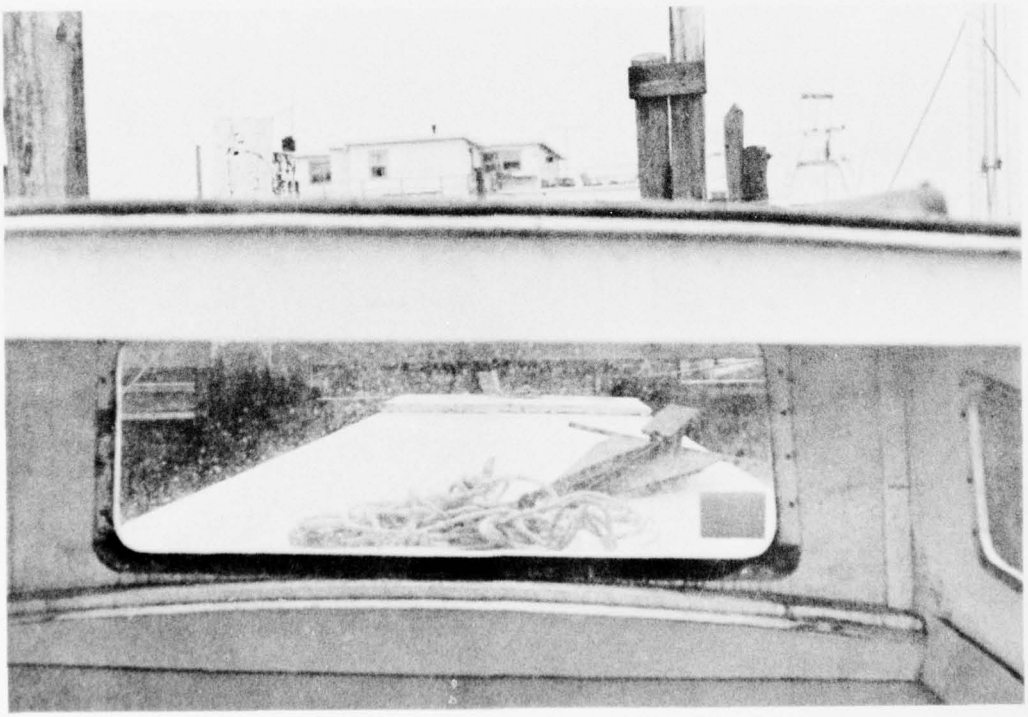


Photo 4 - Visibility From Seated Helm Position

APPENDIX G

ACCIDENT INVESTIGATION REPORT

Date of Investigation: July 3, 1975

Date of Accident: April, 1975

Investigation: Capsizing/Swamping No. 75-06

SUMMARY — WYLE ACCIDENT NO. 75-032

On Monday evening in mid-April, 1975, two men were shrimping with cast nets from an anchored 14 ft fiberglass bass boat powered by a 50 horsepower outboard motor. The operator was standing in the aft section. The passenger noticed that water was flowing over the transom into the boat. He moved to the bow in an attempt to increase the transom freeboard and stop the ingress of water. The water continued to come into the boat until it was completely flooded. The boat sank until it was in an upright attitude with only the bow out of the water. The occupants swam approximately 20 ft to shore holding to life cushions. No wearable PFDs were aboard.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator (A)	M	55	185	Excellent	Over 500 hr	Yes	No
Passenger (B)	M	50	180	Good	400-500 hr	No	No

Operator's personal characteristics:

- Economic level would be considered upper middle class
- Owner of discount fabric shop in central Florida
- Presently semi-retired from similar occupation in NE United States
- Formal education includes high school

2.0 ENVIRONMENT

The accident scenario included the time from approximately 1830 to 2230 EST. The sky was clear throughout this period, visibility was excellent until dark (approximately 2000). Wind was 6-8 mph from the southeast. Water conditions were 10-15 in. chop with little tide action. Air temperature was 63° F and water temperature, 68° F as reported by the local television station. The local area was crowded at the time of the accident, several boats 15 to 20 ft apart, all shrimping with cast nets.

3.0 NARRATIVE OF ACCIDENT

The following narrative was formulated from interviews with the operator and passenger of the involved boat.

3.1 Pre-Accident

Operator (A) and Passenger (B) have been friends for the past 5-6 years, both are semi-retired and reside in the same town. A was in the process of moving to a new house for which he employed B as his realtor. Since A was a self-professed fisherman, and both A and B lived near the ocean, little work was required to develop a friendship around fishing trips. It had become standard procedure for A and B to get together at least weekly for a fishing trip. B

had previously owned a small runabout and had sold it several years previous, thus A's boat was being used for fishing. A's boat was stored in his garage at home and trailered to the launch area to be used.

On the morning of the accident A had not anticipated a fishing trip but by afternoon, he had changed his mind and contacted B at his office. A left work early (about 1630) in order to run an errand and eat before picking up B around 1900. After A picked up B, they drove directly to the launch area. The launch area was located approximately four miles south of Titusville, Florida at the Titusville Causeway.

Upon launching, A and B immediately proceeded to the Titusville railroad bridge; the boat was not checked for water in the false bottom. This bridge is approximately two miles north of Titusville and permits rail service between Cape Canaveral and the mainland. The road leading to the bridge tender (draw type bridge) is restricted to the public due to NASA activities, thus the bridge is only accessible by water.

3.2 Accident

Twenty minutes after leaving the launch area (approximately 1945), A and B arrived at the railroad bridge. The weather was as described previously. Once in the narrow strait leading under the bridge (see Figure 1), the water became very choppy. Wave heights of approximately 18 in. were reflecting off the piling, lining the strait. The boat was tied by two stern lines and anchored at the bow as shown in Figure 2. A took a position near the bow and B positioned himself about two feet forward of the transom. Both A and B were shrimping with cast nets, A on the port side and B on the starboard side. Both men were standing up and casting at will. The shrimp were running good, so A and B were kept busy. The shrimp that were caught were being dumped into two large baskets, laundry type, about a bushel size. Location of the baskets during shrimping are shown in Figure 3. Just as A was pulling in his net after casting it, B was running toward the bow of the boat. A thought .."he was trying to get some of my shrimp," so clowning around he told B to go back to his end of the boat. To this, B replied "but we are sinking." The boat sank within 20 to 30 seconds, until it became hung on the two stern lines (water depth about 40 ft). A told B to grab the

shrimp baskets to keep them from floating away. Since the stern sank first, the front basket started sliding to the aft end of the boat. A grabbed a life cushion which was floating next to him and then went to help B hold onto the baskets. Before A got to B, B let go of both baskets, which were sinking, to grab the second life cushion. Both A and B were within 20 ft of the piling lining the strait, so they swam to the piling while they yelled to the bridge tender for assistance. The bridge tender (not available for interview) lowered a ladder which A and B used to climb out of the water. The only equipment saved at this point was the two life cushions. The time was around 2130; it had been dark for approximately two hours.

3.3 Post Accident

The bridge tender did not have anything for A and B to dry off with or a change of dry clothes, so he allowed them to use his car. B drove A to the launch ramp from which A followed B back to return the bridge tender's car. Upon return of the car, A drove B home and then went home himself. Agreement was made to get together in the morning to try to recover the boat and equipment. A arrived home around 2300.

The next morning a boat was borrowed to attempt recovery of the boat. The boat was located, hanging from the stern lines with the bow resting on the bottom. The boat was still in the upright position.

TIME SEQUENCE

1900	Operator and passenger left for launch ramp.
1915	Arrived at launch ramp, launched boat and loaded gear aboard.
1920	Departed ramp for shrimp casting area.
1945	Arrived at shrimp area and anchored boat.
1945-2130	Occupants net cast for shrimp.
2130	Boat started taking water over transom and completely swamped within 20-30 seconds.
2130-2135	Occupants swam 20 ft to pilings holding to life cushions.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a 1972, 14 ft Thunderbird, not presently in production. The only damage apparent at the time of inspection was deterioration of the steering control lever. The boat had been sold by A just after the accident, and the present owner had installed different fishing seats; this is the only modification performed by the present owner. The boat is of spray mold construction with an air filled false bottom. The only flotation was the false bottom, which was equipped with drain holes. Water stain mark on the boat indicated that the boat had remained in the water for an extended time period with excessive weight in the aft (see Figure 4). This is contradictory to storage information ascertained by the interview. The only other modification was performed by A after the accident and consisted of restricting water flow through the hole necessary for the steering mechanism (see Figure 5).

The water stain mark can be explained only if the boat was continuously operated in an aft heavy configuration. The aft heavy configuration could be attributed to engine overloading. Maximum rated HP was 40, but a 50 HP engine was used.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

Certain information about the character of the operator became obvious from the interview with him and his passenger. The operator felt threatened by the investigation of this accident. Upon initial contact, A was hesitant about a personal interview. After calling him back upon his request, he agreed to an interview. When the passenger was contacted, he was very cooperative. The experience as related by both A and B was identical except for the exact time of the accident. The choice of descriptive words indicated that they had possibly discussed the accident just prior to the interviews.

The operator was of average intelligence, his personality could be characterized as very ego centered. Formal education consisted of high school. He mentioned a Ph.D. in audiology, but later said "that was an honorary Ph.D., of course." His boating experience was characterized as "every type boat possible from a 48 ft twin diesel to a 14 ft bass boat." He had been "boating for 35 years and was prepared for any type accident."

The operator's place of business was very sloppy, indicating very little organization. The lack of organization and sense of ego might very well have led to the accident. The operator's resistance to the interview may be attributed to a desire not to admit negligence on his part.

6.0 PROBABLE CAUSE OF THE ACCIDENT

The probable cause of the accident would most likely be inattention on the part of the operator. In particular:

- Accumulation of water in the bilge
- Improper weight distribution within the boat; heavy engine - excess water
- Wave action at the time and location of the accident.

This accident could have been avoided by appropriately anchoring the boat. The stern lines used restricted the movement of the stern, thus allowing waves to wash over the transom.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The boat was launched at 1900 EST on an evening in mid April, 1975. The bilge was not checked for water and could possibly have accumulated water in the false bottom. From the period between launching (1900) and the accident (2130), water had been accumulating in the bilge, due to the very low stern. Both A and B were shrimping from forward and aft, respectively. Weight in the form of shrimp had been accumulating due to the shrimping activity. When the freeboard had been reduced sufficiently due to the extra weight, a wave reflected off the sea wall and washed over the stern. Once the stern started down, the shift in the center of gravity was sufficient to sink the boat very quickly.

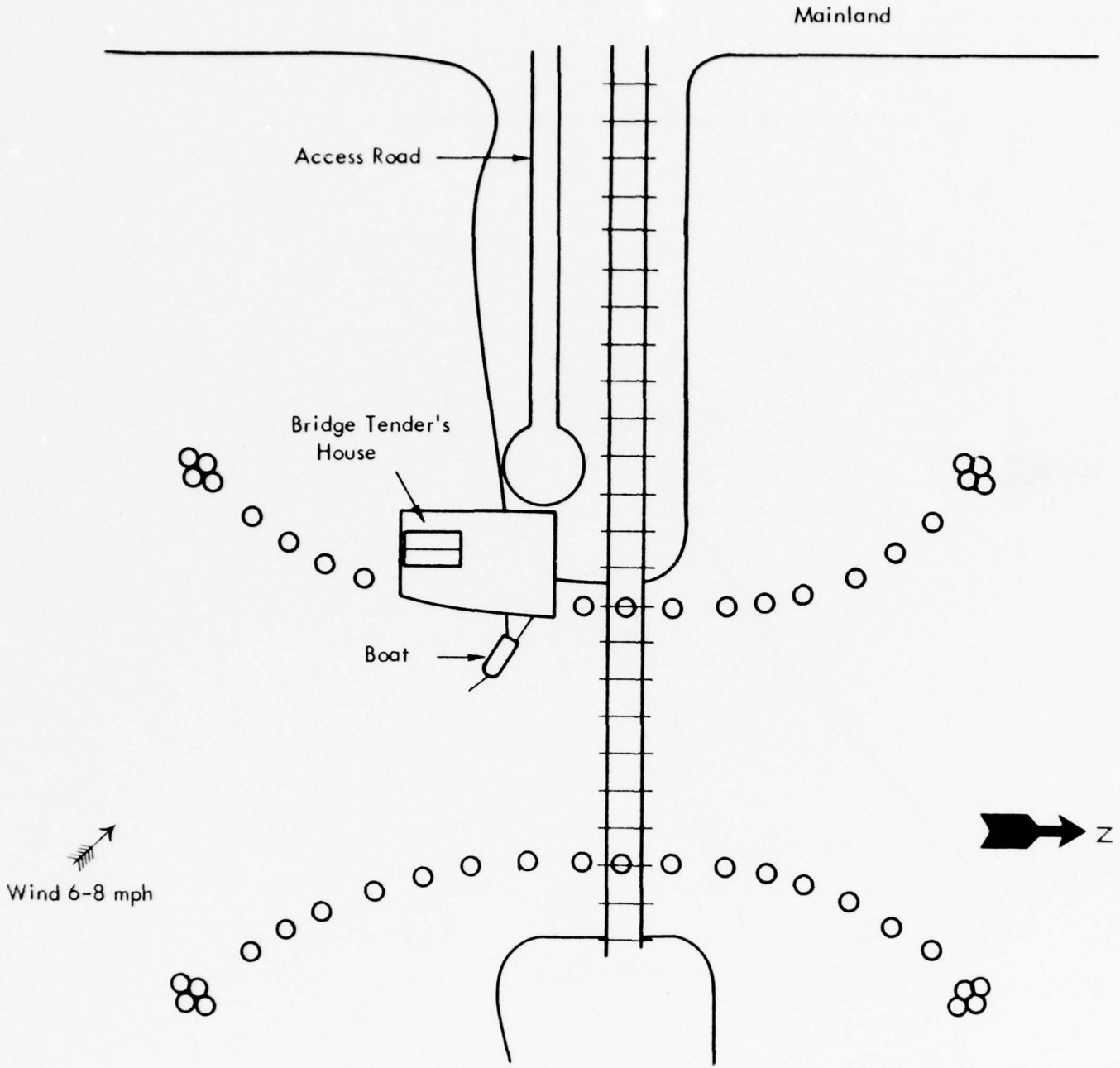


Figure 1. Accident Location

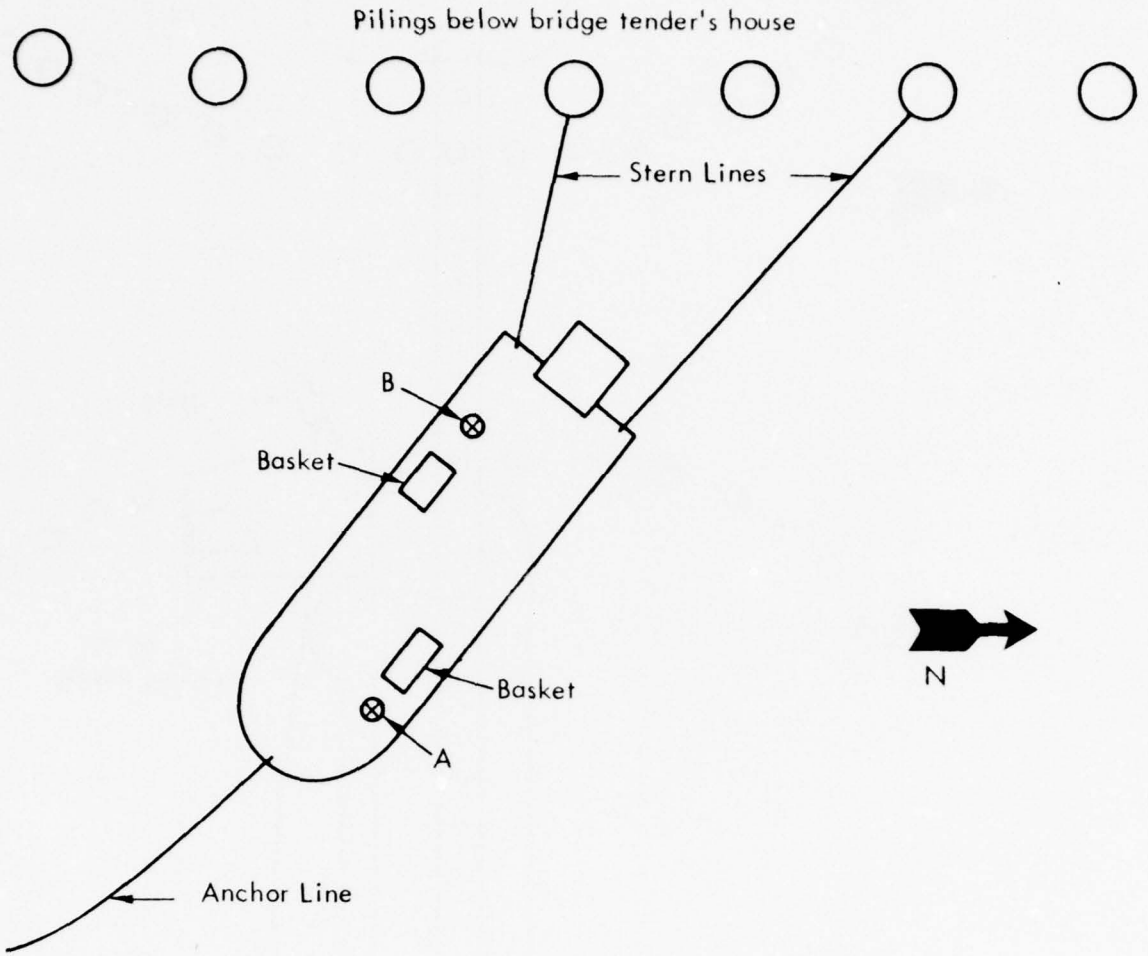
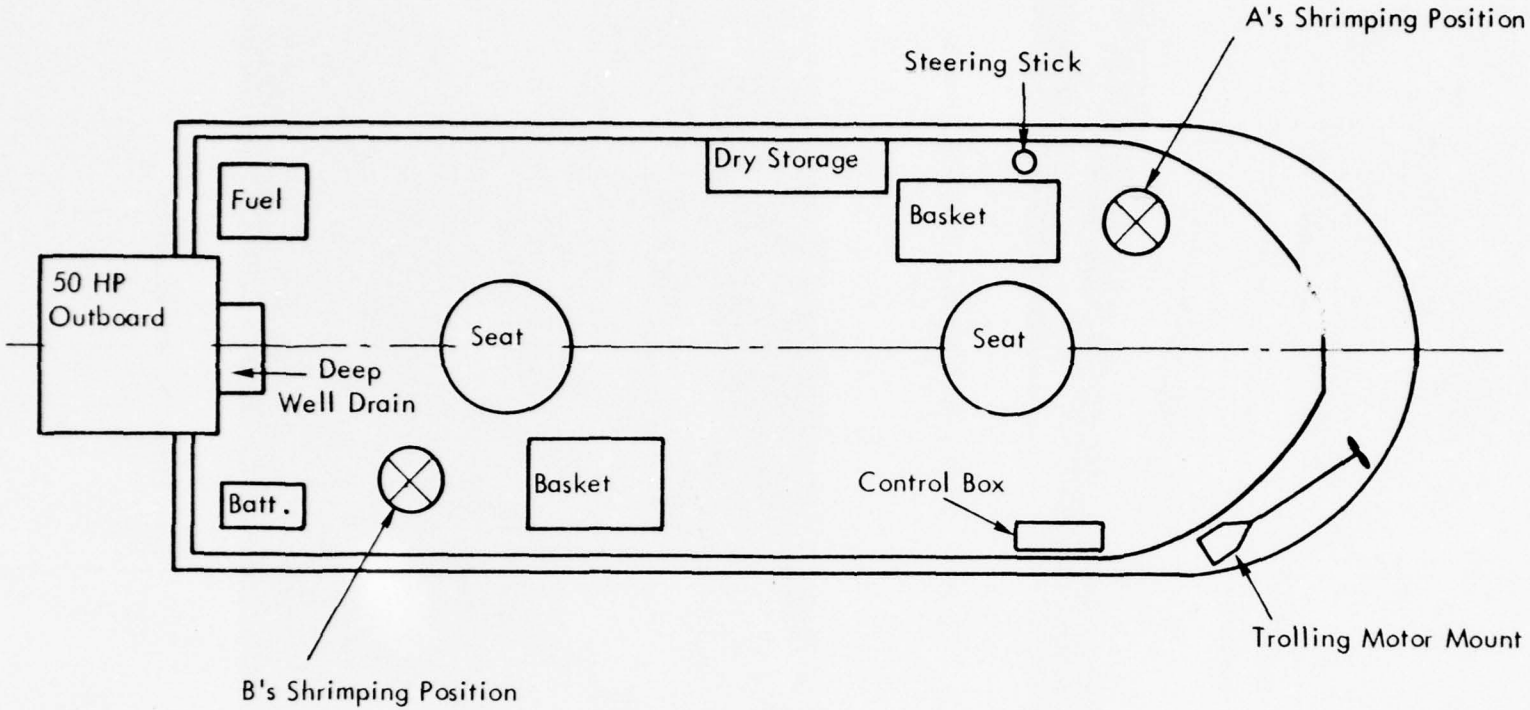


Figure 2. Boat In Anchored Position



SCALE: 1/2" ≃ 1'-0"

Figure 3. Boat Arrangement

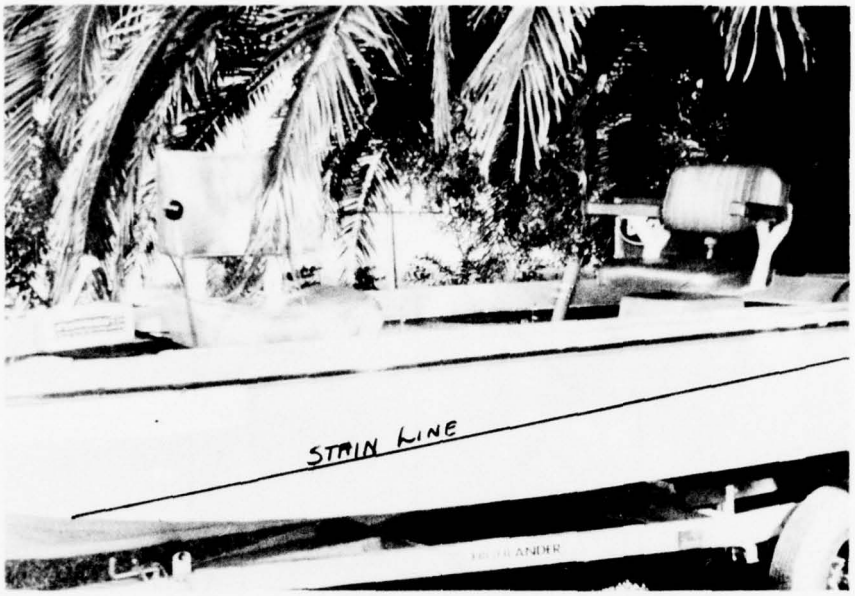


Figure 4. Stain Line Indicating Improper Loading

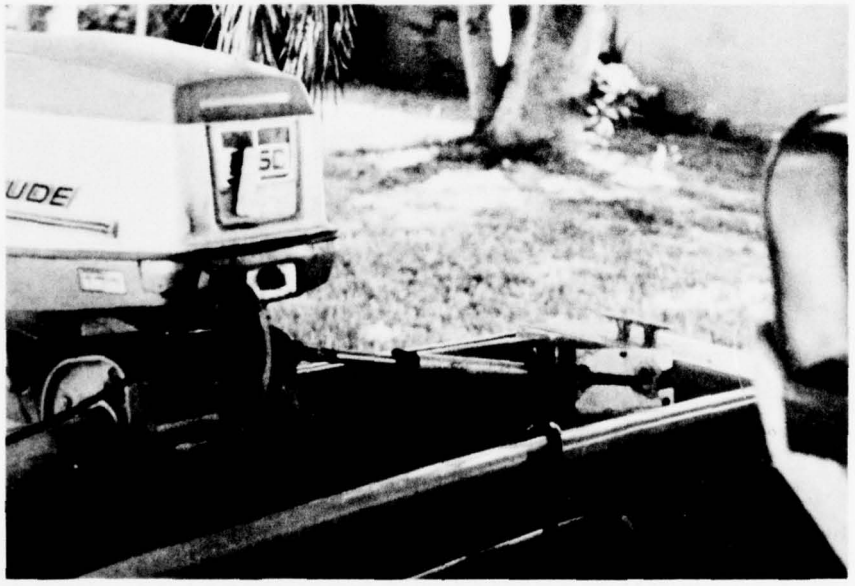


Figure 5. Modification

APPENDIX H

ACCIDENT INVESTIGATION REPORT

Date of Investigation: June 19, 1975

Date of Accident: May, 1975

Investigation: Capsizing/Swamping No. 75-07

SUMMARY — WYLE ACCIDENT NO. 75-129

Four men had been camped overnight on a peninsula to which they had boated. During the night, a storm came up which, in addition to blowing down their tent and soaking them, partially filled their beached boat with water. They left for home the next day even though the weather was not very good. After pulling the drain plug, the owner felt water still remained in the boat due to its resting at a heel angle. While underway, all four occupants donned PFDs.

A large boat passed them, causing their boat to be swamped by a large wake. All were rescued by a passing boat.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator	M	24	145	Excellent	100 hr.	Power squadron	Yes
Passenger/ Owner	M	24	155	Good	100 hr.	Power squadron	Yes
Passenger	M	23	165	Good	—	No	Yes
Passenger		24	170	Fair	—	No	Yes

1.1 Passenger/Owner

From an interview with the owner of the boat, we learned that he is a novice boat operator. His experience consists of approximately 85 hours of operating the boat involved in the accident. He has completed a Power Squadron boating instructions course and appears to be knowledgeable with respect to the safe operation of his boat.

2.0 ENVIRONMENT

The sky was cloudy with visibility of 10 miles. The air temperature was 54° with the wind out of the ENE at 18 knots. Sea conditions were 1 ft waves out of the east.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

The following narrative was formulated from an interview with the owner/passenger of the involved boat.

3.1 Pre-Accident

The owner and his three companions all lived in the same neighborhood, had grown up together and had gone to school together. One Saturday in late May, 1975, they decided to go on an overnight camping trip. They listened to weather predictions before they left. The forecast was for favorable conditions. The camping gear was loaded into the boat and they motored to a peninsula where they set up camp. Contrary to the forecast they had listened to,

a storm came up that evening bringing rain and fierce winds. The four campers struggled with their tent several times during the night and by morning they and their sleeping bags were thoroughly soaked by the rain.

On Sunday morning the men observed the sea conditions and judged them to be rather dangerous but decided to try to make it home rather than spend more time on the cold, wet peninsula.

3.2 Accident

The boat was beached and heeled to one side. The owner pulled the drain plug but due to the heel angle, considerable water probably remained in the bilge. The boat had no bilge pump. The drain plug was replaced and, with the help of about six other campers, the boat was pushed down the beach into the water.

The owner of the boat was concerned that water remained in the bilge; therefore, one of his companions was operating the boat while he tried to determine the quantity of water in the bilge. He reported that the boat felt sluggish and judged that it might have been overloaded due to the rain soaked tent and sleeping bags and water in the bilge. After being underway for approximately 15 minutes, all four occupants put on PFDs. They were encountering short, choppy waves which posed no danger of breaking into the boat.

They had been underway for approximately 25 minutes and had traveled two miles when a 27 ft cruiser passed them traveling in the opposite direction. The owner of the bowrider reported that this larger boat was traveling quite fast and gave them only about 10 ft of clearance while passing. Almost immediately, the bowrider struck the wake of the larger boat. Three waves broke into the bow, forcing the bow down and causing the entire boat to swamp.

When the boat swamped, the occupants all stood up but remained in their positions. The boat sank until the water was approximately knee deep. One of the bow cushions broke loose and floated back to the passenger area. Three of the occupants moved toward the cushion to secure it and give it to the "fair" swimmer. When they moved, the boat began to roll. They immediately retreated to their original positions. Then one man reached carefully for the cushion and secured it for his friend.

After approximately 15 minutes in the water, they signaled a charter fishing boat which picked them up. Three of the occupants were pulled from the bowrider with ropes. When the forth occupant moved to the gunwale to be pulled out, the boat began to roll. As he was rescued, the bowrider capsized and remained in an inverted and level attitude.

3.3 Post Accident

The occupants of the charter boat gave blankets and coffee to the accident victims and recovered much of their camping equipment and one of the back-to-back seats which had broken loose from the bowrider.

They next delivered the victims to the Coast Guard Station. The Coast Guard recovered the bowrider.

4.0 FACTS FROM THE BOAT INSPECTION

Considerable damage was evident on the 15'7" bowrider. The windshield was broken off and there were several gashes in the gelcoat. Also, both of the back-to-back seats broke loose from the deck of the passenger area. It is believed that all of this damage occurred as a result of the accident, and is not considered to be a contributory cause of the accident. (See Figures 1 through 4). The 50 hp motor had been removed.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The four occupants of the boat involved in this accident spent the night preceding the accident camped out on a small peninsula. During the evening a storm came up bringing rain and fierce winds. Several times during the night, their tent was blown down by the wind and the campers had to go out in the wind and rain to set it back up. By morning, the campers and their sleeping bags were thoroughly soaked. The weather and sea conditions remained treacherous, but the campers decided to take a chance with the sea rather than stay on the peninsula where they were cold and uncomfortable. At the time of departure, the occupants were quite fatigued as a result of a lack of sleep and a long period of discomfort due to being cold and wet. This fatigue is believed to have been a contributory factor in the accident.

The accident occurred when a larger boat passed the bowrider traveling in the opposite direction and created a wake which swamped the bowrider. The owner reported that he and the operator saw the other boat approaching them. He feels that the accident resulted because the larger boat failed to give them adequate clearance.

A contributory cause of this accident is the fact that the two boats passed so closely. Either of the operators could have changed course and probably avoided the accident. The operator in the larger boat may have been unable to see the small bowrider. If this is true, there is an engineering problem associated with the large boat which is a factor. The larger boat could not be identified; therefore, this possibility could not be investigated.

The operator of the bowrider saw the larger boat approaching them. His failure to take any evasive action is a contributory human error. The level of fatigue of the operator, as discussed earlier, is believed to be the cause of this human error.

The owner/passenger of the bowrider seemed to feel that neither he nor the operator had made a mistake. He felt that the accident was totally caused by the larger boat and could not have been prevented by anyone in his boat.

6.0 PROBABLE CAUSE OF ACCIDENT

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

- The boat owner reported that the oncoming 27 ft boat gave them only 10 ft of clearance in passing them. He also reported that his boat was traveling at 3/4 throttle and the 27 footer was moving very fast. It would have been easier for the 27 footer to steer away from the bowrider but it seems evident that the operator of the bowrider could have steered away from the cruiser had he been attentive enough.

- The operation of a bowrider in these sea conditions is marginally safe. Much of the operator's skill and attention are required to respond to weather and water conditions. The additional problem of encountering other boats and their wakes may over extend the operator's ability.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

Following are the major events of this accident.

- Rain fills the boat with water.
- The drain plug is pulled, but due to a heel angle on the beached boat all the water is not drained out.
- The occupants set out for home.
- They all don PFDs.
- A large boat passes them creating a large wake.
- The wake brakes over the bow into their boat.
- The boat takes a bow down attitude and swamps.
- A passing boat rescues all occupants.

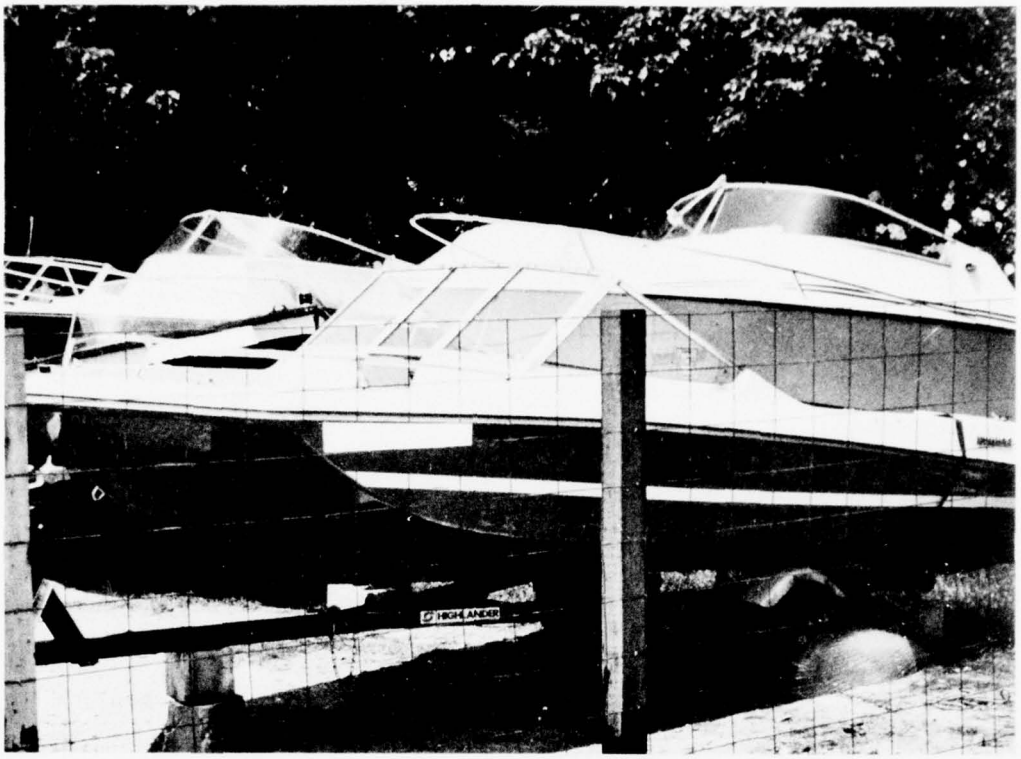


Figure 1. Profile Of Involved Boat

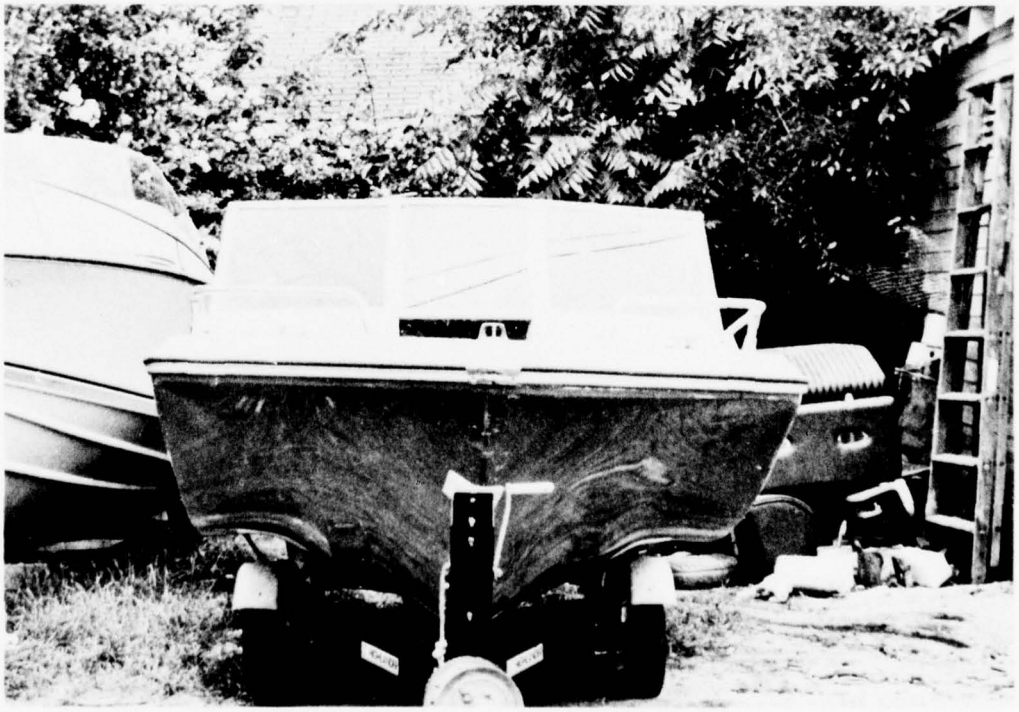


Figure 2. Bow View

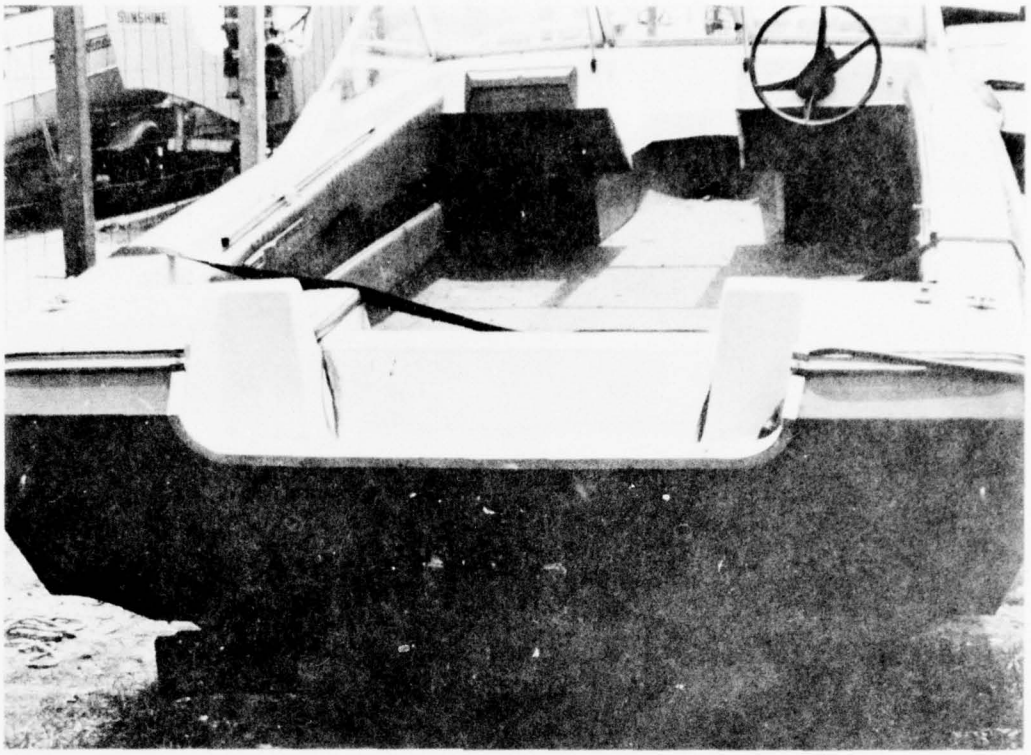


Figure 3. Stern View

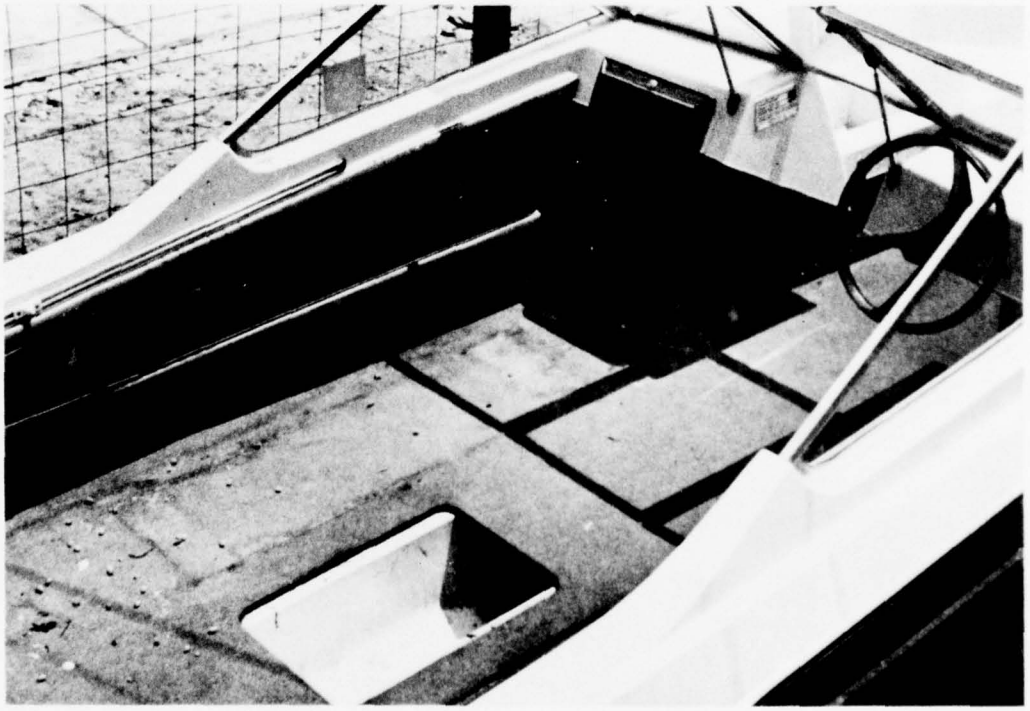


Figure 4. Interior View

APPENDIX I

ACCIDENT INVESTIGATION REPORT

Date of Investigation: August 13, 1975

Date of Accident: June, 1975

Investigation: Capsizing/Swamping No. 75-08

SUMMARY — WYLE ACCIDENT NO. 75-197

The skipper of a commercial fishing boat since 1958 recently bought his first small boat. He enjoys scuba diving and wanted a floating platform from which he could dive. Just prior to re-entering an inlet on the Massachusetts coast, he found that it was breaking badly over a sand bar at its entrance. Because he was afraid of hitting his propeller on the sand bar, he instructed his companion to go forward and sit on the bow of his 17 ft runabout in an attempt to keep the stern up. His friend agreed, sat on the bow, and was washed off by a wave. The boat passed over him, the propeller cut his head and he surfaced behind the boat.

The operator saw the blood, shut off the engine and jumped overboard to save his friend. The operator helped the injured friend to the side of the boat, boarded the boat, and was about to help his friend into the boat when a wave capsized the boat. The two men swam to a nearby fishing boat which took them to shore. The boat was found at sea a week later and was towed in by the Coast Guard.

Both men were wearing wet suits. They were not wearing PFDs.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFD Worn
Operator	M	46	165	Expert	> 500 hrs	None	No
Passenger	M	47	175	Expert	< 50 hrs	None	No

The owner/operator is a professional boat captain and currently runs a 65 ft fishing boat for seven months out of the year. He has been doing this since 1958. Until this summer he had never owned a small boat and had very little experience with them. He bought the boat to use as transportation to the offshore diving spots so that during his time off he could pursue his favorite hobby of scuba diving.

The passenger was an expert swimmer and, in fact, swam 1 to 2 miles a day to keep in shape. He too loved to scuba dive.

2.0 ENVIRONMENT

At the time of the accident, the air temperature was about 70° and the water temperature was 50°. The inlet was breaking with some waves reportedly reaching 8 to 10 ft in height. The wind was moderate at about 10 to 12 mph from the west. A strong current was running in the inlet in the same direction as the wind.

3.0 NARRATIVE OF ACCIDENT

The following narrative was compiled from interviews with the owner of the boat, a telephone interview with the passenger, and an interview with the rescuing Coast Guard personnel.

3.1 Pre-Accident

The owner and his passenger got up early on the morning of the accident and trailered their boat to a launch ramp about one hour away. They were launched by 0900. The engine gave them trouble before they got to the inlet, so they turned around and took it to a local marina for repair. They finally exited the inlet at about 1230 and ran about 10 miles up the coast

to a good diving spot. They dove, moved the boat, and dove some more. At around 1400 they experienced more engine trouble and decided to go in. The water was cold, as was the air temperature, so both people left their full wet suits on, on the way in.

When they reached the inlet area, they noticed that there were breakers around its perimeter. The owner remembered that there was a shallow sand bar off the inlet and figured that it must be near low tide. He became concerned that the foot of his outboard engine would hit the sand bar if he tried to ride a wave in, so he instructed his passenger to go forward and sit on the bow. He figured that this would push the bow down which, in turn, would keep the stern up. His friend went forward and he chose a wave to ride in over the bar. The speed that he chose to ride through the breakers area was not sufficient to keep ahead of the waves; therefore, one wave passed by the boat. The combination of the stern rising over the oncoming wave and some wash coming over the foredeck caused the passenger to slide forward off the deck.

3.2 Accident

The passenger fell into the water ahead of the boat. The operator didn't have time to respond by making an attempt to shut down the engine or maneuver out of the way of the fallen passenger. The operator searched the area aft of the boat for his friend and saw him pop to the surface some 25 to 50 ft aft of the boat. His friend's head was bloody. He had been wearing a wet suit with a hood. The hood was missing. Since the operator didn't know the extent of his friend's head injuries, he jumped overboard in a rescue attempt. It was now about 1600. The friend was pulled over to the boat which was now broadside to the waves. The operator climbed into the boat and was going to start it up, then pull his friend aboard. He didn't have time. The next wave capsized the boat.

He and his friend swam about 200 yards towards shore, hailed a small fishing boat, boarded the boat and were taken to a public dock. An ambulance was called and the two were taken to the hospital.

3.3 Post Accident

The friend remained in the hospital with multiple lacerations and possible concussion, but the owner was released and immediately tried to find his boat. At about 2030 that night, the owner spotted the boat upside-down about one mile to sea. At that point, the Coast Guard was notified of the accident and the fact that the boat was afloat offshore. No attempt was made to salvage it at that time. One week later, the boat was spotted eight miles offshore and was towed in. The owner picked up the boat and has repaired the relatively minor damage. The windshield was replaced, the seat was replaced, and a new outboard engine was purchased for the boat.

The passenger recovered and was subsequently released from the hospital. Five PFDs stowed under the foredeck were still there when the boat was salvaged.

4.0 FACTS FROM THE BOAT INSPECTION

The boat sustained relatively little damage. The windshield had broken and the outboard was useless after being submerged in salt water for a week. The only hull damage was some gelcoat chips on the starboard chine which apparently happened during the rescue attempt.

Dimensions of the boat were: LOA 14' 9-3/4", beam 5' 8-1/2", and displacement 600 lbs. Hull and deck construction were single skin fiberglass with a plywood cockpit floor and wood stringers. The hull was a modified tri-hull design with a fairly sharp entry flattening out to a semi-v hull aft with 16-1/2 degrees deadrise from amidships aft. The dropped tri-hull chines are carried higher than normal forward which probably resulted in a softer ride than is normally experienced in boats of the tri-hull or cathedral hull design. The boat was narrow by "normal" boat standards; however, the fact that the boat was a few inches narrower than "normal" probably had nothing to do with the fact that it capsized.

The owner had removed the port seat assembly and had installed lines in that area for securing diving tanks. Three of these tanks were secured to the cockpit coaming at the time of the accident (see Figure 1).

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

It seems as if there were three basic mistakes made by the operator and passenger.

1. The operator made the mistake of thinking that his passenger could hold on to a slippery deck while entering an inlet with 8 to 10 foot breaking seas.
2. The passenger made the mistake of accepting the command to go up onto the foredeck.
3. The operator made the mistake of allowing a following wave to catch and pass him.

The operator had limited small boat experience and apparently thought in terms of the expected dynamics of his large commercial fishing boat. Moving weight forward in that boat may or may not have helped, but the passengers that would have gone forward would be protected by bulwarks and bow rails. In addition, the effects of the waves would have been less in the larger boat. The terrific undertow or outward rushing current that is experienced by a small boat just prior to the oncoming wave would not have sucked the large boat into the wave, because it would probably have been supported by more than one wave. Therefore, the forward movement of the wave would have negated the effect of the aft moving current between the waves. He may never have experienced that phenomenon and, therefore, may not have increased the throttle accordingly to counteract for it.

In essence, here was an experienced seaman who was totally inexperienced in the dynamics of small boat operation.

Sending his friend forward onto the slick foredeck could be called stupid. At any rate, it was a poor decision. Perhaps fatigue played a part in making a decision such as that. The operator had been up since 0600 and had been on the water for 7 hours. In addition to being physically fatigued from scuba diving, the operator was stressed by the fact that he had experienced engine trouble throughout the day. He knew his engine was acting up and had to be concerned about the possibility of engine failure while in the inlet. Perhaps the same person would have made a different type of decision if he were not as fatigued.

There didn't seem to be any major human factors problems with the boat. It was laid out similar to the normal runabout with more or less normal cockpit geometry.

The two men were in 50 degree water for about 15 minutes but experienced no discomfort since both were wearing full wet suits. Five PFDs were aboard but none were used. The operator stated that wet suits performed the task of keeping people afloat much better than PFDs. Their basic advantages are mobility, and insulation qualities.

6.0 PROBABLE CAUSE OF THE ACCIDENT

The boat capsized because it was broadside of a large breaking wave. However, the cause of the situation that led to that boat being broadside to the wave was one of human error discussed in 5.0, above. Three errors were made:

1. The command to sit on the forward deck.
2. The acceptance of the command.
3. Negotiating the inlet at too slow a speed.

These three errors caused the passenger to fall overboard. When the operator abandoned the boat to rescue the injured passenger, the boat assumed a position broadside to the seas. The capsize followed.

Basic boating safety courses should cover the three errors that were made here. Therefore, education would be the probable technique for reducing accidents with similar causes.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

Not too much can be said here that hasn't already been covered. The transom was lifted by a wave which caused the passenger to slide off the bow. The fact that the stern was up as the passenger passed under the boat probably accounted for the relatively minor injuries sustained. It didn't broach, but continued on a straight course even though the operator's attention was focused on locating his passenger.

The capsize was predictable when the boat was abandoned. The outward rushing current between waves turned the boat broadside to the waves. Any normally configured boat in this size range would have capsized under these conditions. Perhaps the operator realized this which would account for him attempting to start the engine prior to helping his injured friend aboard.

A time based reconstruction of the accident would look like this:

Min	Sec.	
	00	Passenger falls off foredeck
	02	Passenger struck by propeller
	06	Operator spots passenger in water
	08	Operator determines passenger is injured
	10	Operator shuts off engine
	12	Operator jumps overboard
1	00	Operator reaches passenger
2	30	Operator returns to boat
2	50	Operator climbs into boat
3	05	Boat capsizes
15	00	Passenger and owner climb aboard fishing boat

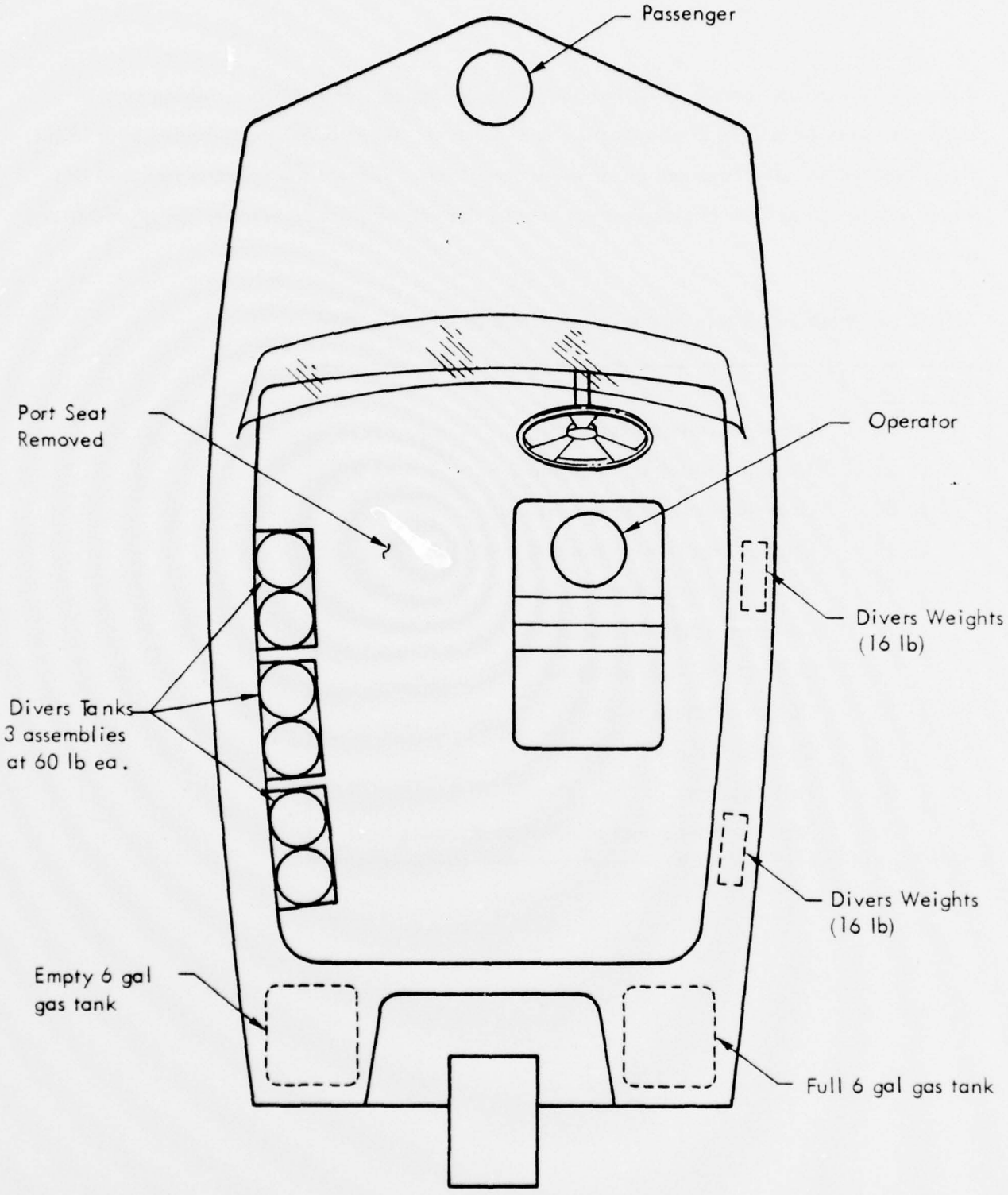


Figure 1. Boat Configuration

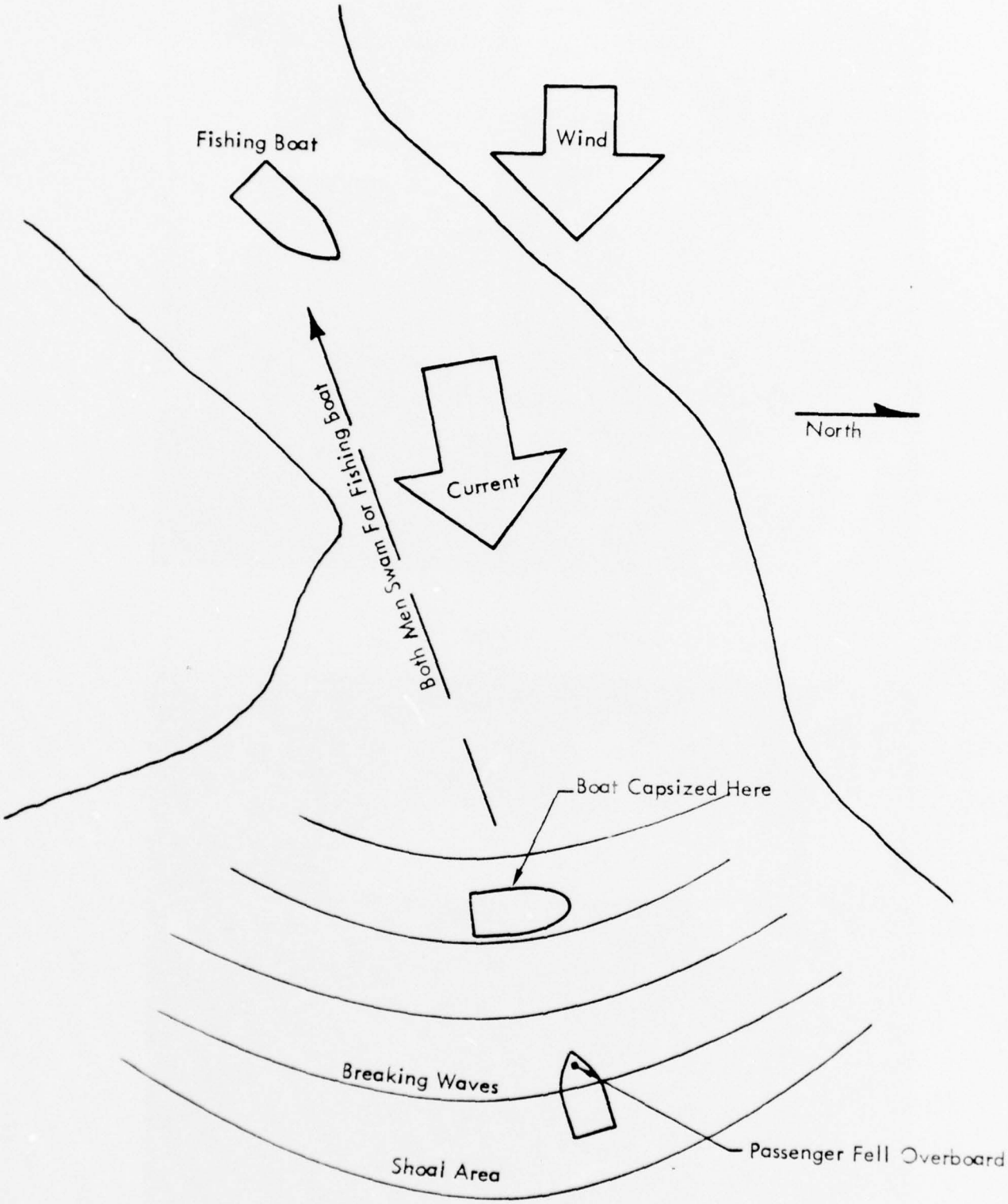


Figure 2. Area Diagram

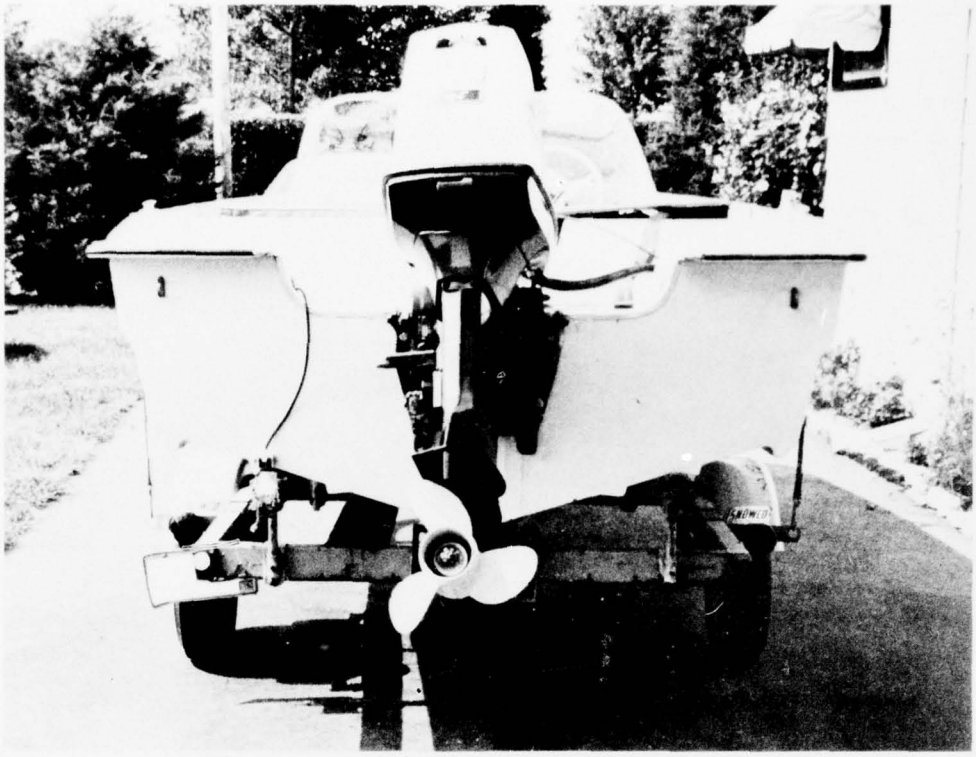


Figure 3. Stern View



Figure 4. Bow View

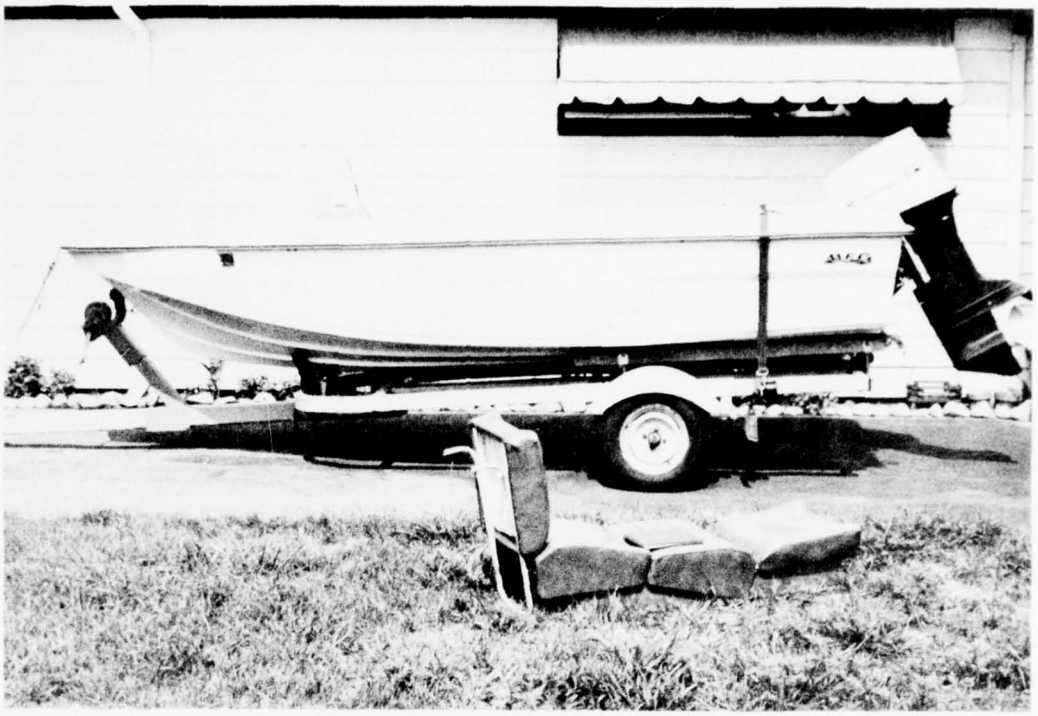


Figure 5. Profile - Note Windshield and Outboard Motor Were Replaced Since Accident.

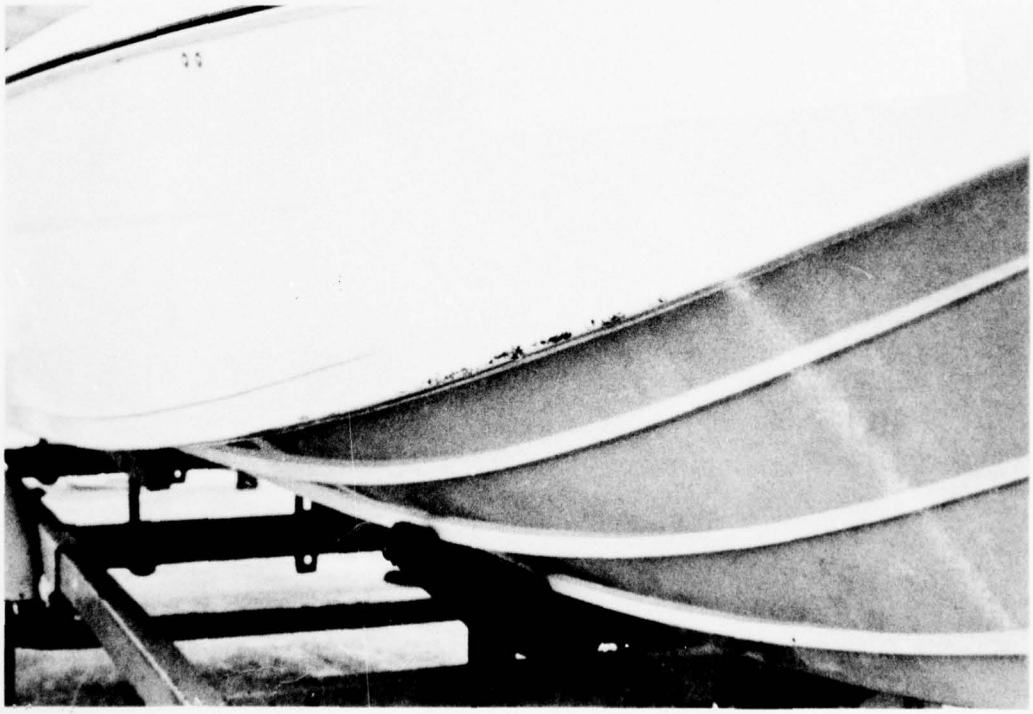


Figure 6. Gelcoat Damage

APPENDIX J

ACCIDENT INVESTIGATION REPORT

Date of Investigation: August 12, 1975

Date of Accident: July, 1975

Investigation: Capsizing/Swamping No. 75-09

SUMMARY — WYLE ACCIDENT NO. 75-342

One morning in mid July, 1975, at approximately 0900, failure of the outboard motor to start on an 18 ft bowrider allowed an unexpected wind to push the boat onto a rock jetty. The two occupants managed to push the boat off the jetty and onto an adjacent beach. Waves broke over the boat, filling it 1/3 full of water. The boat was towed off the beach by the Coast Guard and then it swamped completely. Both occupants boarded the Coast Guard boat.

1.0 BOAT OCCUPANT DATA

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Owner	M	55	165	Poor	>500 hr	No	Yes
Brother-in-law	M	55	150	Poor	Passenger only	No	Yes

The owner of this boat works as an electrical component salesman. Prior to purchasing the boat which was involved in this accident, he had owned another runabout which was 16 ft in length. He bought his first boat 9 or 10 years ago and bought his present boat, new, in 1971. Before owning a boat, the operator previously had rented small boats on weekends and on vacations. He had no formal boating education, but had obtained several boating safety books from the Coast Guard and felt that what he learned from these was sufficient in the line of boating education. The owner's brother-in-law, who was the other occupant, did not own a boat and his boating experience was limited to being a passenger.

2.0 ENVIRONMENT

The wind was calm and the temperature was in the 80's prior to the accident. Small craft warnings were up and stormy weather was expected. The stormy weather did come up and contributed to the accident.

3.0 NARRATIVE OF THE ACCIDENT

The following narrative was formulated from an interview with the owner/operator of the involved boat.

3.1 Pre-Accident

On the night before the accident, the owner of the involved boat and his wife visited his sister and brother-in-law. It was during this visit that the owner asked his brother-in-law if he wanted to go fishing the next day (Sunday). The owner had been going fishing every Sunday for the past couple of months. The owner's brother-in-law agreed to go with him

the next day and they decided to start at about 0730 the following morning. The owner said that whenever he plans to go fishing early in the morning, he retires early the previous night. He said he did retire early the evening before the accident, and he and his brother-in-law went to his boat at the marina at about 0800. They loaded their tackle box, fishing rods and cooler on board, then pumped out the bilge. The owner then put on a PFD and told his brother-in-law to put one on also. The owner said that he always makes all occupants of his boat wear PFDs. The type worn that day were of the tie-up vest type. They left the mooring slip and stopped to gas up, get bait and sandwiches. They then proceeded to East Rockaway Inlet off Long Island where they began drift fishing on the bay side of the inlet (see Figure 1). Drift fishing was his normal way of fishing in this area. There were 4 or 5 other boats in the area that were trolling at the time.

After drifting eastward for about an hour, the operator noticed that he began drifting westward, but could not figure out why. The tide had not changed, nor had there been a wind blowing. He then noticed that a passing boat that was trolling had hooked onto one of his fishing lines. The line that was caught was on a pole that was in a poleholder. He was fishing with heavy gear and the line had wrapped around the bow of his boat and the other boat was actually pulling his boat along in the water. He called to the other boat, but the occupants did not hear him. He then took the fishing pole out of the pole holder and worked the line free. He noticed that he had been pulled close to a rock jetty, so he reeled in his fishing line and instructed his brother-in-law to reel his line in too. He then tried to start his engine to get further away from the jetty. His engine failed to start and at that moment a very strong wind came up.

3.2 Accident

Before he could get the engine started, the wind had pushed the boat broadside into the jetty. Both occupants jumped out of the boat onto the jetty and pushed the boat off of the rocks. The wind then caused the boat to be washed up on an adjacent beach. The boat was bow-up on the beach with the stern quartering into the oncoming seas. The owner tried to hail about a dozen passing boats before one of them acknowledged his call and called the Coast Guard. The Coast Guard arrived in about 10 minutes. By this time, the waves hitting the transom of the boat had filled the boat about 1/3 full of water.

Several lifeguards from the beach helped the owner and his brother-in-law turn the boat bow out to sea while another lifeguard swam out to the Coast Guard boat, got a line and swam back in. The owner tied the line to a cleat on the bow of his boat and began bailing it out. The Coast Guard pulled the boat away from shore before it was bailed out. The water in the boat caused the transom to sit low in the water as the boat was towed, causing more water to enter the boat.

3.3 Post Accident

The Coast Guard pulled the swamped boat alongside it and the two occupants boarded the Coast Guard boat. As they were attempting to dock the swamped boat, it capsized. It was then righted and pumped out. Damage to the boat and motor was $2953.15 as billed by a local marina.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a 1971 Model International 18. The motor had been removed from the boat, but it was learned that it was a 1974 model 135 horsepower Johnson outboard.

Figures 2 and 3 show the fiberglass hull involved in this accident. Repairs had not been performed and the broken windshield and location for the missing seat are visible in the photographs. There did not appear to be any major damage to the surface of the hull.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The event that directly caused this accident was failure of the engine to start. The operator said he takes good care of his engine and had just had it serviced prior to the season. He said that at times if he gets a bad tank of gas (he claims that sometimes some places he gets gas have bad gas), the engine will be hard starting and it will need to be cranked over many times before starting. Had he been paying closer attention to the position of his boat as he attempted to free his entangled fishing line, he may have attempted to start his engine sooner and have gotten it started before being driven onto the rock jetty. He was also aware that stormy weather was predicted for that afternoon and he should have been more cautious about

going out that day, since oftentimes storms do not keep to their predicted timetable. More prudent judgment might possibly have prevented this accident.

6.0 PROBABLE CAUSE OF ACCIDENT

If the engine had started on the first attempt, this accident could have been prevented. Failure of the engine to start can be considered the major cause of this accident. Secondary is the fact that the operator allowed his boat to drift too close to the jetty while freeing his entangled fishing line. Further distance from the jetty might have given him time to get the engine started and avoid the jetty.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The operator said that from the time he tried to start his engine until the unexpected wind pushed his boat into the rock jetty was only seconds. This did not allow him time to check his engine or drop anchor to keep from crashing into the rock jetty. As the boat hit the jetty, both occupants jumped out of the boat onto the jetty to fend the boat off of the rocks. They pushed the boat off the rocks and onto an adjacent beach. This kept the boat from being beaten against the rocks and possibly being broken to pieces. After the boat had filled approximately 1/3 full of water and the Coast Guard had tied a line to it, it should have been bailed out before being towed. The operator felt that the boat could have been bailed out if the Coast Guard had waited before towing it away. The operator felt that if he had a bull horn, he could have told the Coast Guard to wait, but as it was, they could not hear what he was yelling to them. Towing the boat with water in it caused it to take on more water and totally swamp.

Following are major events of the accident:

- Two men fishing allowed their boat to be towed near a rock jetty by tangled fishing lines.
- The engine failed to start as they attempted to move away from the rock jetty.
- A sudden wind forced the boat against the rock jetty.

- Both occupants pushed the boat from the rocks.
- The boat then washed up onto the beach where it filled with water from waves breaking over the transom.
- The Coast Guard pulled the swamped/grounded boat off the beach and towed it to a marina dock.

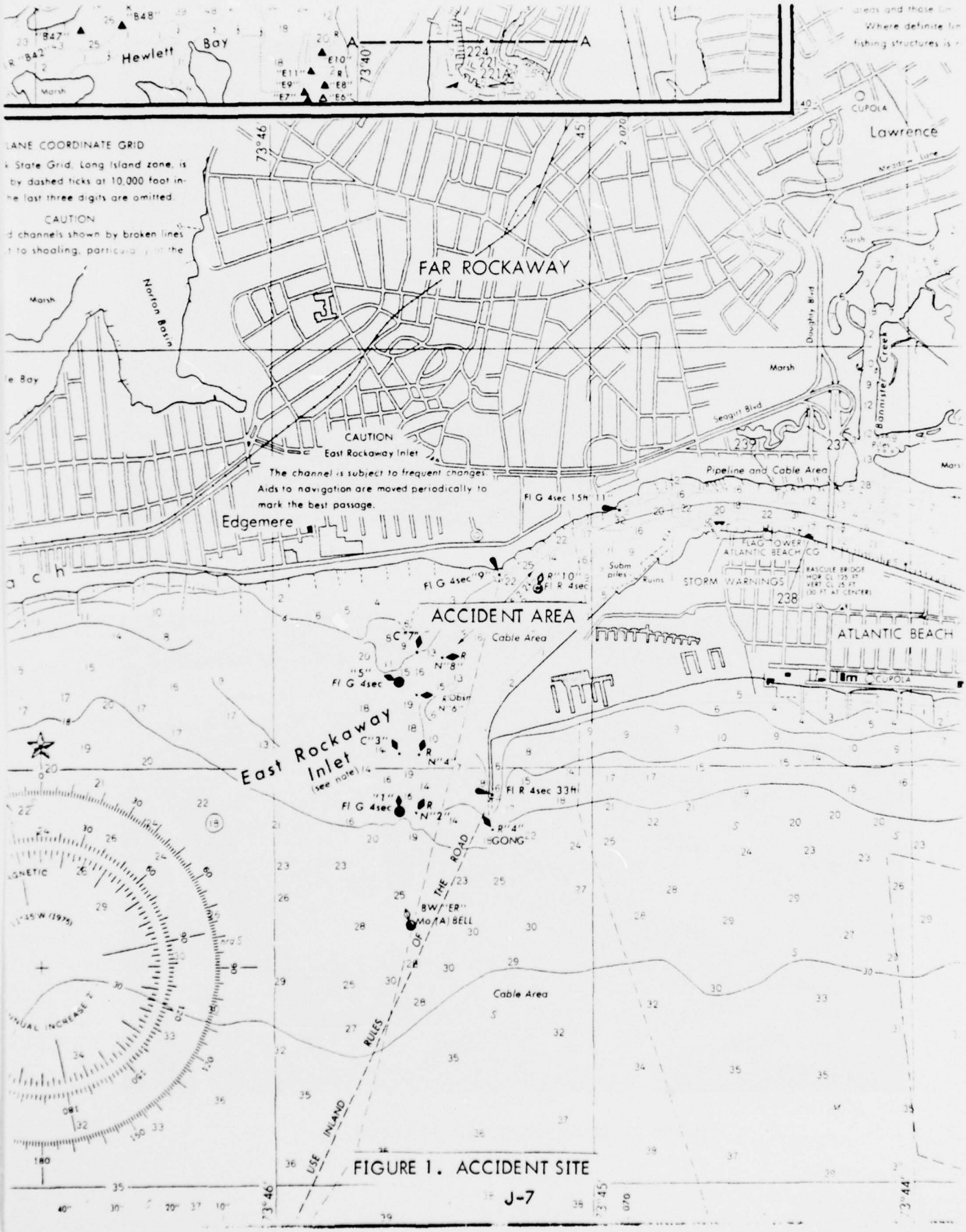


FIGURE 1. ACCIDENT SITE

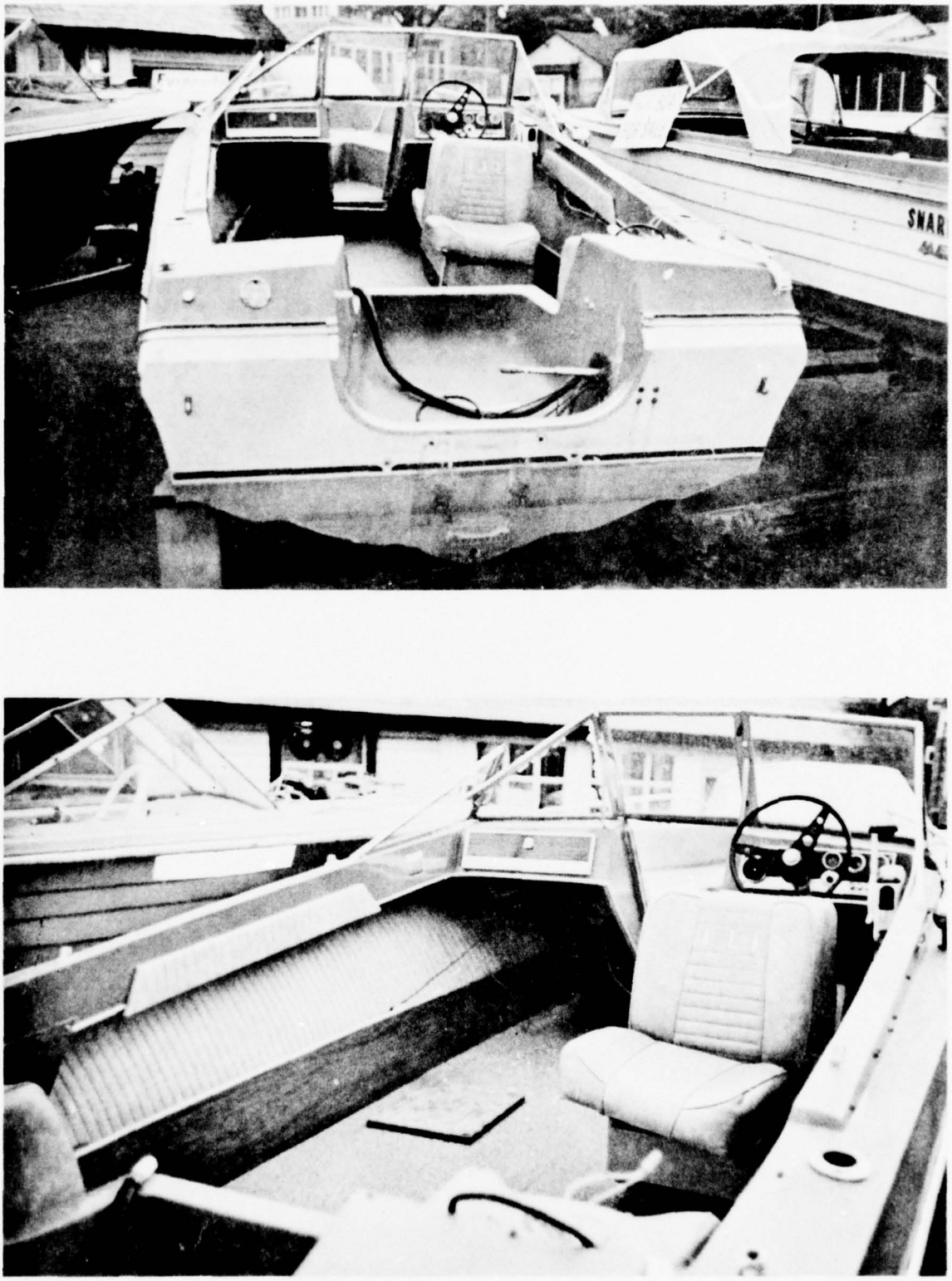


FIGURE 2. BOAT INVOLVED IN ACCIDENT





FIGURE 3. BOAT INVOLVED IN ACCIDENT

APPENDIX K

ACCIDENT INVESTIGATION REPORT

Date of Investigation: August 11, 1975

Date of Accident: June, 1975

Investigation: Capsizing/Swamping No. 75-10

SUMMARY — WYLE ACCIDENT NO. 75-209

One morning in mid-June, 1975, a man and his wife were fishing in an inlet area. They were drifting with the engine off, then decided to start trolling. The engine failed to start, and the operator dropped anchor to keep from drifting too far in the current. As he turned toward the stern, a large breaking wave "10 to 15 ft high" broke over the stern of his boat. Successive waves filled the boat with water and it capsized. Both occupants were rescued by a nearby boat.

1.0 BOAT OCCUPANT DATA

Occupant	Age	Sex	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFD Worn
Owner	36	M	175	Good	50 hrs	Yes	No
Wife	30	F	120	Non-swimmer	50 hrs	No	Yes

The owner of this boat has been a life insurance agent since November 1972. Previous to this, he spent approximately 10 years working on board passenger liners and cargo ships. He began as an Able Bodied Seaman and worked his way up to Chief Mate before he left for the insurance business. Prior to the purchase of this boat, all of his boating experience had been limited to large ships. He did have some formal instruction which consisted of a 15 day course in the use of ships' lifeboats, which were small craft; however, his experience in actually operating small craft was limited to this boat, which he purchased on April 12, 1975. His use of this boat was primarily on weekends for fishing, which gave him a total of approximately 50 hr of operating this boat. His wife had no boating experience prior to the purchase of this boat and spent the same amount of time as the owner in this boat; however, she did not operate the boat, but was a passenger.

2.0 ENVIRONMENT

The weather the morning of the accident was pleasant. Winds were calm with seas of approximately four ft gentle swells. Temperature was in the 80's and there were no craft warnings up. At the time of the accident, the weather was the same except a changing tide had caused a current of approximately five mph in the area.

3.0 NARRATIVE OF THE ACCIDENT

The following narrative was formulated from an interview with the owner/operator of the involved boat.

3.1 Pre-Accident

The operator of the boat was still influenced by his past experience as chief mate on the passenger liner. He would chart his course on marine charts before he began each journey, even if he was not going outside the bay. After charting his course for the trip, he drove to his boat at about 1000 Saturday morning. His boat was kept in the water at a marina. Gear that was always kept on board was a flashlight, flares, a fire extinguisher and four AK-1 type life jackets. Gear that was brought on board that day was a tool box (20 lb), water jug (5 gal), tackle box, and two fishing rods and reels. Before leaving the marina, the boat was gassed up and the bilge was checked for water. The owner's wife donned one of the PFDs and the others were left under the forward cabin compartment.

They then left the marina and headed across the bay to Fire Island Inlet on the south shore of Long Island (see Figure 1). They went through the inlet and into the ocean approximately one mile off shore and began trolling. There were several other boats fishing in the area, and the owner stated that he did not go to any location unless there were other boats in the area. This made him feel safer. After fishing for approximately 1/2 hr and not catching any fish, he noticed that some of the other boats were heading back to the inlet. Not wanting to be left alone and also wishing to find a better fishing spot, he began trolling towards the inlet. After reaching the inlet and going inside to the bay area, he shut off the engine and began casting instead of trolling. After casting for about 10 min., he decided to start trolling again and tried to start the engine. The motor would not start and the owner noticed that he was drifting with the current. (The owner stated that the first time he had the boat out the engine would not start and the manufacturer had replaced the faulty component.) When the motor would not start and the owner realized he was drifting with the current, he dropped the anchor. As he turned from the bow of the boat toward the stern, he saw a 10 to 15 ft high breaking wave about to come over the stern of his boat.

3.2 Accident

Before he could do anything, the wave broke over the stern of the boat, filling it approximately 1/3 full of water. The boat also listed to starboard at this point. He then began to yell for help and also began giving the four blast trouble signal with the boat's horn. During this time, his wife had taken another life jacket from the front storage area and put it on over the top of the one she was already wearing. She did not get it fastened completely, but it stayed on her. A second breaking wave broke over the boat and filled it to about 1/2 full with water. At this point, the owner grabbed one of the life jackets from the storage area and attempted to put it on. It was tangled in its own fastening lines and he could not get it on straight. One of the lines was choking him slightly, but he left the jacket on anyway.

A nearby boat saw that he was in trouble and attempted to rescue him. The rescue boat threw a line to the swamped (and still upright) boat and the owner made it fast to a forward cleat. The owner then released the anchor and the rescue boat attempted to pull the swamped boat to shore. The small rescue boat did not have enough power to pull the swamped boat against the current, so the owner of the swamped boat released the tow line. The swamped boat then slowly rolled over to starboard and the occupants floated out as the boat assumed an inverted, approximately level attitude. The owner had heard that this model of boat would not sink, so he elected to stay with it. He held onto his wife as they clung to the side of the boat near the transom.

A 33 ft cruiser made several attempts to throw a life ring to them, but only came close. The owner felt that he could have reached the life ring if he had left his wife and swam for several feet, but he did not want to leave his wife. The life ring was finally thrown within reach, and they grabbed it and were pulled alongside the 33 ft cruiser. The rescue boat had a ladder down the side of it and the owner of the capsized boat helped his wife onto it as the occupants of the cruiser also helped her aboard. He then climbed on board the rescue vessel himself. He estimated his total time in the water at about 30 to 35 minutes.

3.3 Post Accident

The rescue vessel took the owner and his wife to the Coast Guard Station. The Coast Guard towed the accident boat to the marina where it was kept. The owner has sold the boat, but plans to buy a similar one next season.

4.0 FACTS ABOUT THE BOAT

The boat had been sold prior to the investigation and was not available for inspection. It was learned from the owner that the boat was a 1973 model 19 ft Mako with a 1974 90 hp Chrysler outboard motor. Figure 2 is a sketch of the interior arrangement of the boat as described by the owner. The arrangement shown is not typical of a Mako. When asked if Mako ever made a boat with an arrangement as shown, they (Mako) said that they have never made a boat with back to back seats as described. There are three possible conclusions that could be drawn. First, the boat was modified by a previous owner; second, the boat really wasn't a Mako; and third, the owner was confused when he made the sketch of the boat. Due to the nature of this accident, it was felt that further investigation to determine the type of boat was not necessary.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

There are several errors on the part of the owner that seem to have led to the accident. The major problem which instigated the accident was failure of the engine to start. The owner had little reason to suspect that the engine would not start since it was a new engine and a previous malfunction had been repaired.

He was, however, in an area that is known to have waves of this sort occur. Had he been aware that this type of wave condition existed, he might have been more cautious about shutting off his engine in this area. Better knowledge of the peculiarities of the area could possibly have prevented this accident.

6.0 PROBABLE CAUSE OF ACCIDENT

If the type of waves that swamped this boat are actually as big as the owner of this boat claimed they were, then the waves indeed were the major cause of this accident. Lack of knowledge of the area can also be considered a cause. Failure of the engine to start may be considered as an equipment failure which led to the accident.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The event which led to the accident was the failure of the engine to start. The owner reacted by dropping anchor to keep the boat from being swept too far away by the current. There is the possibility that anchoring in a current caused the boat to squat lower in the water, thus reducing the freeboard and allowing the wave to more easily break over the transom. However, the owner said that the anchor line was not taut when he turned and saw the wave. His estimate of the wave to be 10 to 15 ft high could have been an exaggeration or a bad estimate on his part. He did say that he had to look up to the top of the wave while he was standing, so it could very well have been that high.

Once the first wave broke into the boat filling it 1/3 full of water, he responded by calling for help to nearby boats and blasting his horn in the four blast trouble signal. He said it did not appear that the other boats in the area realized that he was in trouble for quite some time (several minutes). If boats in the area knew what four horn blasts meant, rescue might have come sooner (if they heard the horn).

The owner's movement in the boat to release the tow line from the first rescue boat could have initiated the capsize of the boat. It was a very slow capsize which allowed the occupants to just float out with little fear of being trapped beneath the boat.

His decision to stay with the boat after it capsized was a wise one. He had heard through word of mouth that his boat would not sink. Had he not heard this, he said he would have left the boat immediately, fearing that it would pull him down as it sank, as large ships do.

When the life ring was thrown close to him, he could have left the boat to get to it, but he didn't. This was a wise decision, because he could have become separated from his boat and then the rescue boat would have had two areas to try to rescue people from (his wife at the boat and him somewhere downstream). As it was, the rescue vessel could effect a successful rescue with minimum danger to the occupants.

The following are major events of the accident.

- The operator of the boat and his wife were casting for fish in a bay near the inlet to the ocean.
- They stopped casting and the operator attempted to start the engine of the boat.
- The engine failed to start.
- The operator realized he was drifting with the current and dropped anchor to keep from drifting.
- Before the anchor line became taut, a "10 ft high breaking wave" broke over the stern of the boat, filling it 1/3 full of water.
- Operator's wife donned a second PFD as operator yelled for help.
- Second wave broke over the boat.
- Operator attempted to don PFD, but it was tangled.
- Nearby boat attempted rescue.
- Rescue boat was too small to tow swamped boat. — Released swamped boat.
- Swamped boat capsized and occupants floated out.
- Occupants clung to side of the overturned boat near the transom.
- A life ring was thrown from a 33 ft cruiser which proceeded to rescue both occupants.

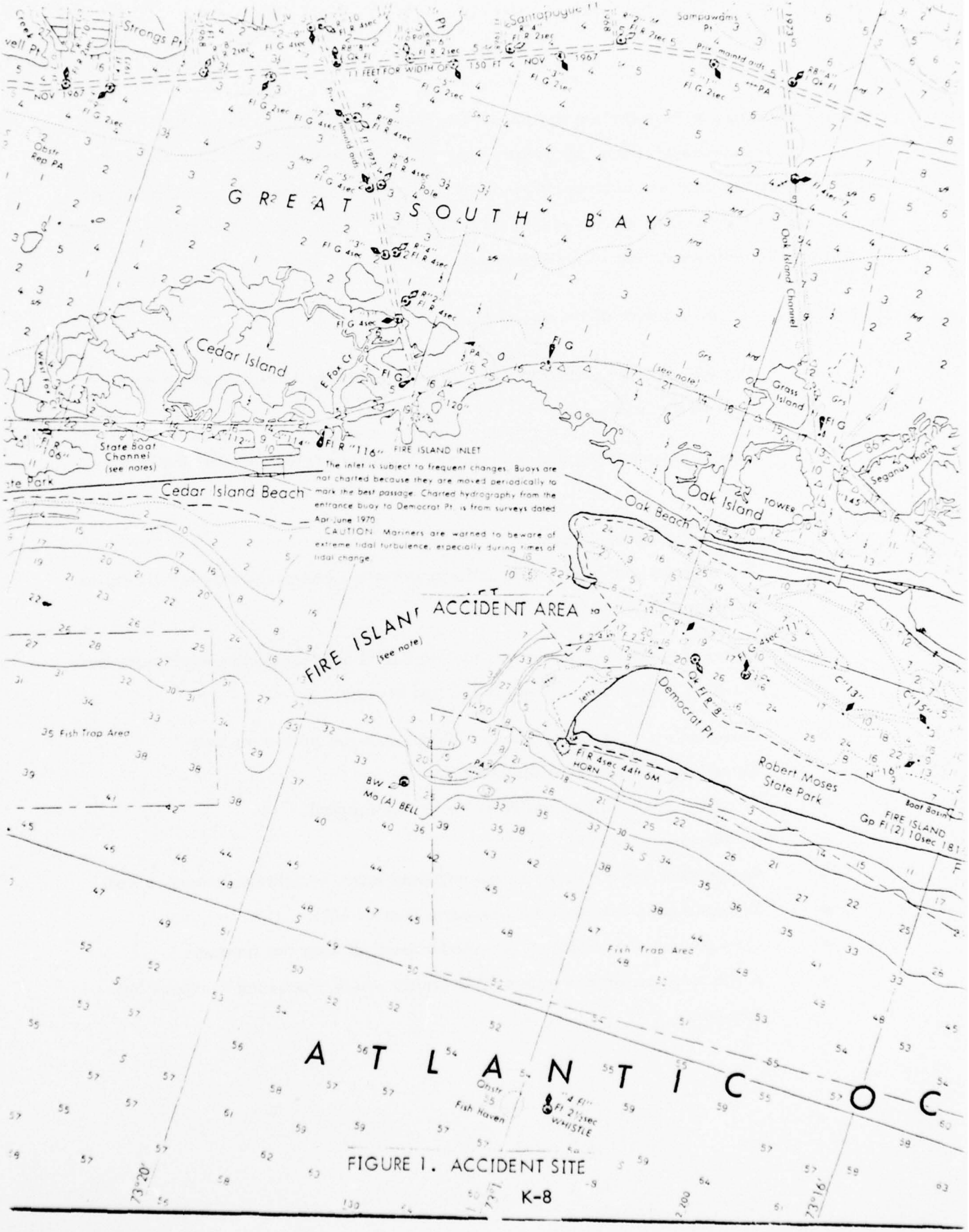


FIGURE 1. ACCIDENT SITE

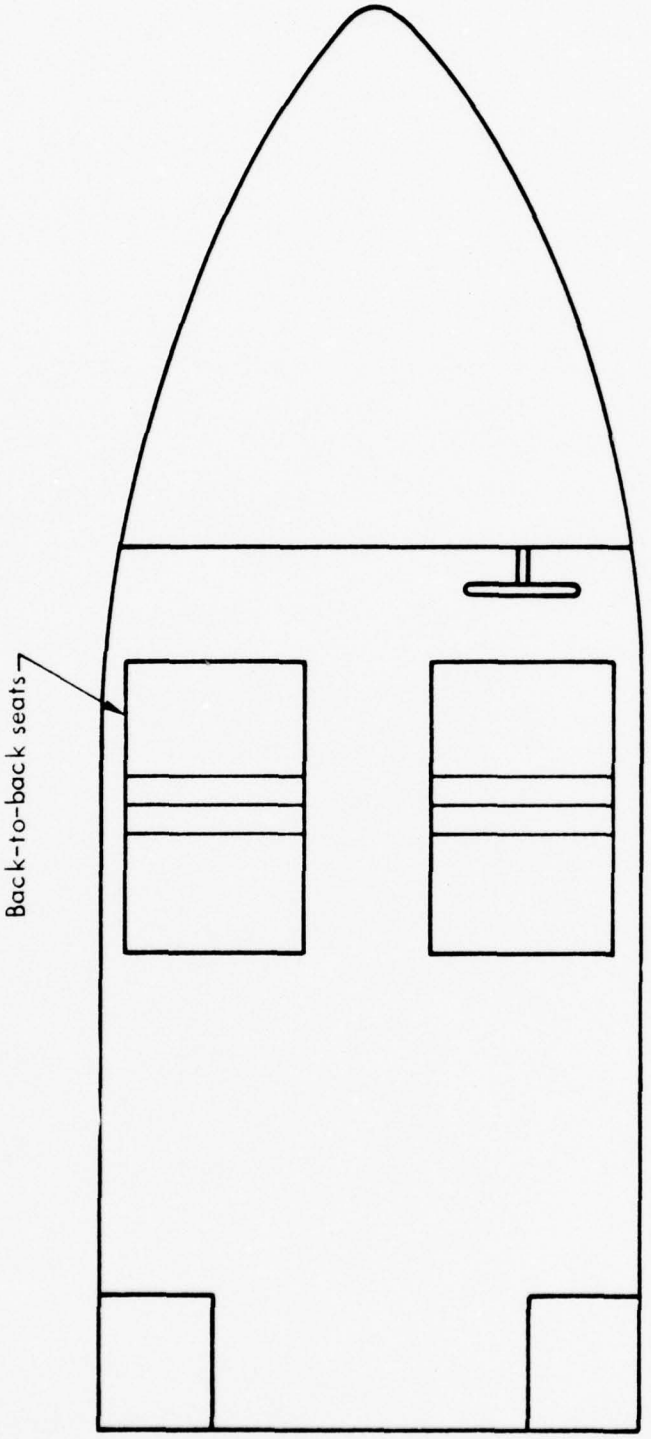


Figure 2. Sketch of Plan View of Accident Boat

APPENDIX L

ACCIDENT INVESTIGATION REPORT

Date of Investigation: August 12, 1975

Date of Accident: June, 1975

Investigation: Capsizing/Swamping No. 75-11

SUMMARY — WYLE ACCIDENT NO. 75-219

One morning in mid-June, 1975, the owner of an 18 ft bass boat with a 50 hp outboard set out to fish in an inlet area. He was drift fishing near an area that was known to produce large breaking waves rather quickly. When near this area, his attention was taken by a fish he had just caught. He drifted into this area and his boat was overturned by a 10 ft high breaking wave. He was rescued by a nearby boat.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFD Worn
Owner	M	51	165	Fair	250 hrs	Yes	No

The owner of the boat had owned and operated a boat for two years. Prior to this, his experience in boating was limited to that of a passenger.

Since he has owned a boat, he said he has boated three or four times a week during the summer. He has owned his present boat for four months. The 250 hrs was estimated from this information.

He took the Coast Guard Auxiliary Boating Course and felt it was a very useful course.

2.0 ENVIRONMENT

Air temperature was in the 80's, and the water temperature was warm as described by the occupant who fell in. Except for the area where the accident occurred, the water was calm.

3.0 NARRATIVE OF ACCIDENT

The following narrative was formulated from an interview with the owner/operator of the boat.

3.1 Pre-Accident

At approximately 0900, on a day in mid-June, 1975, the owner of the involved boat drove to the marina where he kept his boat (10 miles from his house). He loaded his fishing gear on board, unlocked the forward storage area where he keeps two or three life jackets (Sears buoyant vests) and checked the bilge for water.

He then headed across the bay and through Fire Island inlet on the south shore of Long Island (see Figure 1) to the ocean, about 350 yds past the mouth of the inlet. He drift fished in this area for about one hour, drifting for about 500 yds, then starting the engine and running back

to the beginning of the drifting area. The end of the area where he was drifting was an area that is known to have large breaking waves develop at certain times of the tide change. The operator of the boat said that waves of this sort were developing at a rate of about one every five minutes, rising to a height of 8 to 10 feet. He knows this to be a dangerous area and was careful not to drift into it while fishing.

At the end of one of the drift cycles, the owner started his motor and began reeling in his line to go back to the start of his drifting area. As he was reeling in his line, he thought he had a fish hit his bait. This took his mind from operating the boat out of the area where the breakers were. The motor was running, but was not in gear. As he turned while reeling in his line, he saw a 10 ft high breaking wave about to hit him broadside.

3.2 Accident

The wave hit the boat and turned it upside-down. The occupant came up under the overturned boat. He pushed himself down under the water in order to get out from under the boat. When he surfaced, the boat was 75 to 100 ft away from him. He felt that another wave had hit the boat while he was underwater and carried it away. When he saw he was away from the boat, his first thought was to get back to the boat. Another wave came and he rode this wave toward the boat. After this wave broke, it left him beside the boat. He does not remember how, but he got himself on top of the overturned boat.

3.3 Post-Accident

There were many other boats in the area at the time and the operator feels that a passing charter fishing boat saw him overturn. The charter boat did not acknowledge seeing him either by coming to his aid or calling the Coast Guard.

The first boat to attempt a rescue was a 32 to 35 ft cabin cruiser which came by in about 10 min. This boat was caught by a breaker and almost overturned. Another boat in the area saw the cabin cruiser take an extreme heel and came by to see if anyone had fallen overboard. It was when the boat came to see to the cabin cruiser that the operator first saw the overturned boat. He came by and threw an AK-1 Type PFD to the occupant on the overturned boat. The occupant donned the PFD. The rescue boat which was a 16' runabout then

came by closer to the overturned boat. The occupant on the overturned boat jumped into the water, swam two strokes and was alongside the rescue vessel. The two occupants of the rescue vessel grabbed the man in the water and pulled him into their boat.

The Coast Guard was notified and came by in about 30 minutes. They found the boat and towed the boat to the Coast Guard station. Damage to the boat and motor was $1,450.

4.0 FACTS ABOUT THE BOAT

The boat was a 1973 model Winner bass boat with forward and after casting decks. It was of fiberglass construction and of tri-hull design. It had a 50 hp Johnson outboard motor. Figure 2 is a photo of a 1974 model. It is understood that the only differences are small interior arrangement changes. Circumstances at the time of the investigation did not permit a visual inspection of the boat. The following characteristics are for the 1974 model:

Length — 16' 4"	Beam — 74"
Max. Wt. Capacity — 1350 lbs	Persons Capacity — 900 lbs
Maximum HP — 120	

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The owner/operator of the boat knew the area he was in to be a dangerous one. He said he would never go to that area if he had passengers on board. It appears then that he is less cautious when alone in the boat. Catching fish appears to be more important to him than his personal safety. He had been out for about three hours, so fatigue could have had some influence on his judgment. He let his attention be distracted by the fish he had just caught. This distraction was enough to allow his boat to be capsized by one of the breaking waves in the area.

Had the operator used better judgment and kept further from this area or paid closer attention to operating the boat while near this dangerous area, the accident could have been prevented.

6.0 PROBABLE CAUSE OF ACCIDENT

Poor judgment on the part of the operator was the cause of this accident. He knew the area was dangerous, but fished near there anyway. Drifting into an area that has 10 ft high breaking waves would cause most boats of this size to capsize or swamp.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

An analysis of the accident itself is rather simple. A large 10 ft high breaking wave hitting an 18 ft open bass boat broadside would, in most cases as in this case, cause the boat to capsize. It is also very likely that an occupant of the boat could end up under the overturned boat.

In the case where a person does wind up under an overturned boat, it is to his benefit if he does not have on a PFD (if he can swim). It would be more difficult for a person with a PFD on to go beneath the surface of the water to get out from under the boat than for a person not wearing a PFD. In this case, the occupant did not have a PFD on and easily got out from under the boat. His first thought upon surfacing was to get back to the boat because he knew it would not sink. This indicates that he still was in control of his senses and did not panic. After the accident, the operator appears to have used correct judgment in climbing on top of the overturned boat and donning the PFD thrown to him by the occupants of the rescue boat.

The operator of this boat said that the only thing he will do differently in the future is keep a PFD more handy. He will still fish in this area, and will not wear a PFD.

Following are major events of the accident:

- Operator was drift fishing in an inlet area.
- The area had large breaking waves forming at approximately 5 min. intervals.
- The operator caught a fish which took his mind from operating the boat.
- A large "10 ft high breaking wave" hit his boat broadside.
- The boat inverted and the operator surfaced beneath the overturned boat.

- He pushed himself underwater and away from the boat. When he surfaced, he was 75 to 100 ft away from the boat (another wave carried the boat away while he was beneath the surface).
- He swam to the boat and climbed onto the bottom of it.
- He was rescued by a nearby boat.

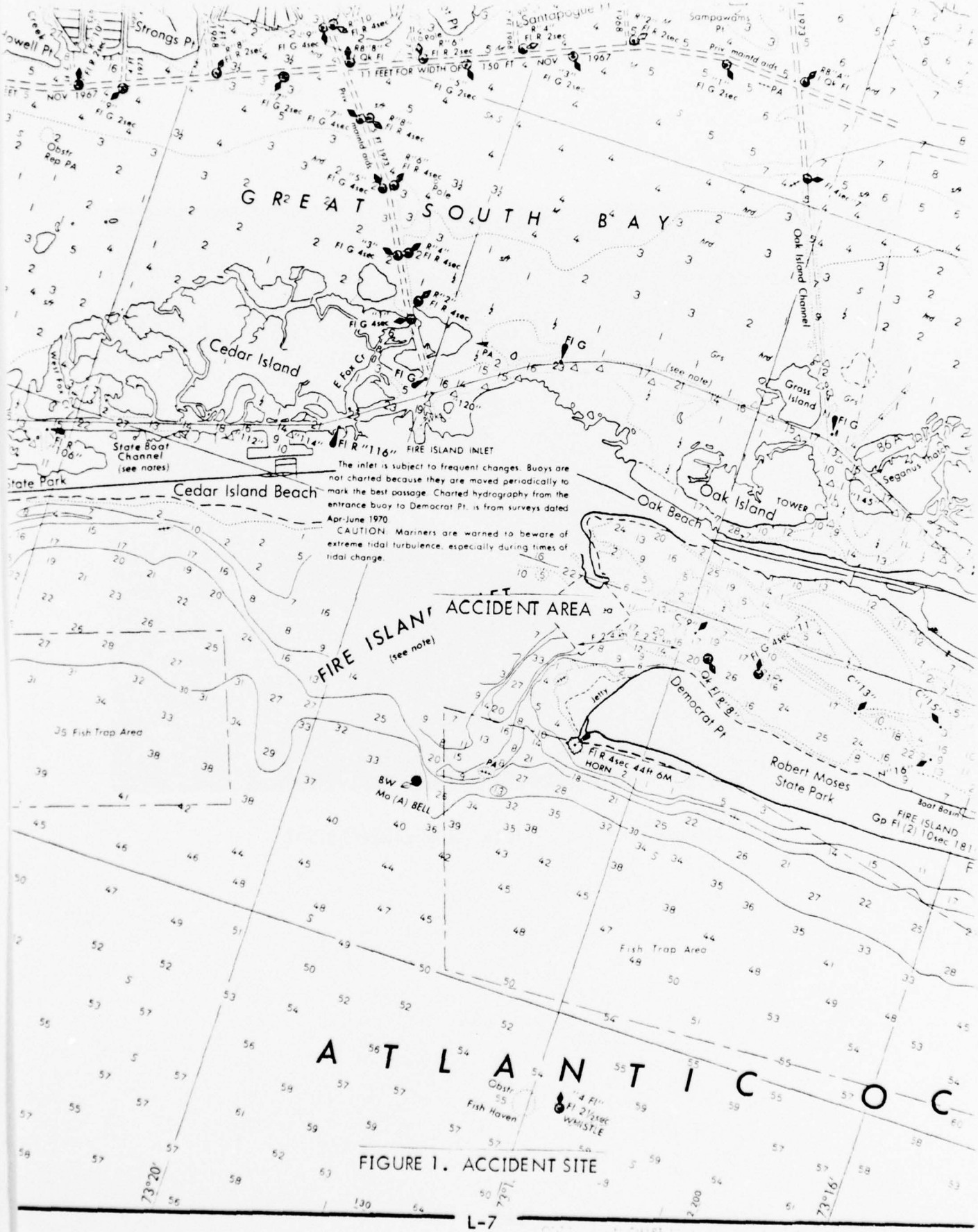


FIGURE 1. ACCIDENT SITE



FIGURE 2. BOAT SIMILAR TO ACCIDENT BOAT

APPENDIX M

ACCIDENT INVESTIGATION REPORT

Date of Investigation: August 13, 1975

Date of Accident: July, 1975

Investigation: Capsizing/Swamping No. 75-12

SUMMARY – WYLE ACCIDENT NO. 75-427

One afternoon in late July, 1975, the owner/operator of a 17 foot outboard attempted to pull a grounded boat off the beach. The area was too rough for a boat of this size with 5 to 6 ft high surf. Nevertheless, he attempted the rescue. Failure of his engine at a critical moment caused his boat to be capsized by one of the waves, trapping him between his overturned boat and the beach. Four men on the beach lifted his boat and he got out from under it. The Coast Guard was called and they pulled both boats off the beach.

1.0 BOAT OCCUPANT DATA

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFD Worn
Owner	M	61	148	Fair	>500 hr	Power Squadron	No

The owner/operator has worked as an art photographer for 20 years. He has been boating for 36 years. Most of his boating experience has been in small outboard boats. He has completed three Power Squadron courses: Piloting, Seamanship, and Advanced Piloting. He was also a Safety Officer in the Power Squadron for three years.

2.0 ENVIRONMENT

Weather was warm with air temperature in the 80's. The wind was calm. There was a hurricane 200 miles off shore which caused 5 to 6 ft swells to come into this area.

3.0 NARRATIVE OF ACCIDENT

The following narrative of the accident was formulated from an interview with the owner/operator of the involved boat and the manager of the marina where the owner kept his boat.

3.1 Pre-Accident

After work on Friday, the operator drove approximately 100 miles from where he lives to where he keeps his boat. The morning of the accident before going boating, he went marketing. He and his wife left the marina in the boat about 1200. They had lunch at a shore side restaurant and then proceeded to a nearby wildlife sanctuary. His wife is a bird watcher, so he generally leaves her at the sanctuary, he noticed a boat aground on the beach off the southeast coast of Massachusetts (see Figure 1). The boat was on the ocean side of a point of land. There was no wind or wind waves, but there were 5 to 6 ft swells forming into breaking waves as they reached the beach. These swells were caused by a hurricane located

approximately 200 miles offshore. The operator of the boat called the Coast Guard and told them that he was going to attempt to pull the boat off the beach. He says he frequently rescues boats in waters too shallow for the Coast Guard's 44 ft boat. According to the manager of the marina where the subject boat was kept the occupants of the boat that was beached tried to wave the attempted rescue boat away. They said the water was too rough for a boat that size. Nevertheless, the operator of the boat still attempted a rescue. He tied a line onto a boat cushion and floated it into the other boat. The operator of the grounded boat fastened the line to his boat. As the operator of the rescue boat turned toward his helm station, his engine stopped running. He tried to start it as long as he dared (the waves were pushing him toward shore), then grabbed his anchor and turned seaward to throw it over the side.

3.2 Accident

As he turned to throw the anchor seaward, a large wave turned his boat upside-down. The boat overturned on top of him, trapping him beneath it. The water was shallow and the gunwales were against the bottom in the sand. There was enough air entrapped in the overturned boat to allow him to breathe under there. There were four men on the beach in that area. They came to his aid and lifted one side of the boat enough for him to get out from under it. After he got out from under the boat, the four men turned the boat upright.

3.3 Post Accident

After the operator got out from under his overturned boat, he realized that his wife would be waiting for him. He then ran across the point of land, through swamp and underbrush to where he left her. After telling his wife what happened, he got a ride back to the accident area from another boat. Meanwhile, the operator of the first grounded boat radioed the Coast Guard and told them what happened. The Coast Guard sent an outboard to the scene. It had arrived when the operator of the overturned boat returned. The Coast Guard also sent a 44 ft boat which got to the scene shortly after the operator returned. The 44 footer first pulled the boat that was first grounded free of the beach and then attempted to pull the boat

that had overturned off the beach. This boat was upright now, but it was full of sand. Much of this sand needed to be dug out before the boat could be pulled off the beach. Most of the sand was dug out and the boat was pulled off the beach. There was still sand in the boat which caused it to list and take on water as it was being towed. It took about five hours to get the boat back to the marina. Losses to the boat included loss of two radios and two antennas, broken windshield and damaged engine. Cost to replace the engine was $2000. No estimate on damage to the boat was available.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a 1968 Wellcraft, Model Number DR1700V. Capacities as marked on the capacity plate are maximum horsepower 125 and capacity 1400 lb. Engine on board was a 1968 100 horsepower Mercury. Figures 2 and 3 show the boat involved in the accident. The engine attached is the new replacement engine. Figure 4 shows the location of the fire extinguisher in the boat. When the two radios which the operator normally carries are in place, the fire extinguisher is almost inaccessible. The owner keeps seven floatable cushions and six AK-1 type PFDs on board.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

Quoting the manager of the marina where the owner/operator of the accident boat keeps his boat...."That man is an idiot. He is an egomaniac type out for the excitement of helping people." The operator himself said that he has helped many boats in trouble.

It appears that he was out for more excitement in attempting the rescue of the grounded boat. There was no danger to the occupants of the grounded boat, they were all safely on the beach. The water was much too rough for a small boat, and the owner of the grounded boat tried to wave him off. Nevertheless, he attempted the rescue anyway. Poor judgment and desire for excitement led to the boat being capsized.

A point of interest to note is that the operator only wears a PFD if he is alone offshore. If a passenger is on board, he does not wear one.

6.0 PROBABLE CAUSE OF ACCIDENT

It was the desire for excitement and poor judgment that brought the operator and his boat into a position that was very hazardous. He might have been able to complete the rescue attempt if the engine had not stalled and failed to start. He should never have gotten himself into a position where a slight error or malfunction could possibly prove fatal. The operator said that he may have kicked a fuel line loose when he was walking about in the boat. This could have been what caused the boat to stall and not start. The fuel line and tank were not available for inspection in their pre-accident condition.

It was failure to get the boat under power in a breaking surf that caused the boat to be capsized. It was poor judgment and possibly an ego trip which caused the boat to be in a breaking surf.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The accident itself happened in a matter of seconds. A large (5 to 6 ft) breaking wave hit a seventeen ft outboard boat and capsized it. The operator was obviously in a dangerous area where a small error could cause a major problem. The error was failure of the engine. (The first error was operating the boat in this area at all.)

Had the operator used more prudent judgment and not gotten himself into such a dangerous position, this accident would not have occurred.

Major events are as follows:

- Operator spots boat aground.
- Operator notifies Coast Guard that he is going to attempt to pull the boat off shore.
- People on the beach from grounded boat attempted to wave attempted rescue boat away — said water was too rough.
- Operator floated to shore a line tied to a boat cushion.

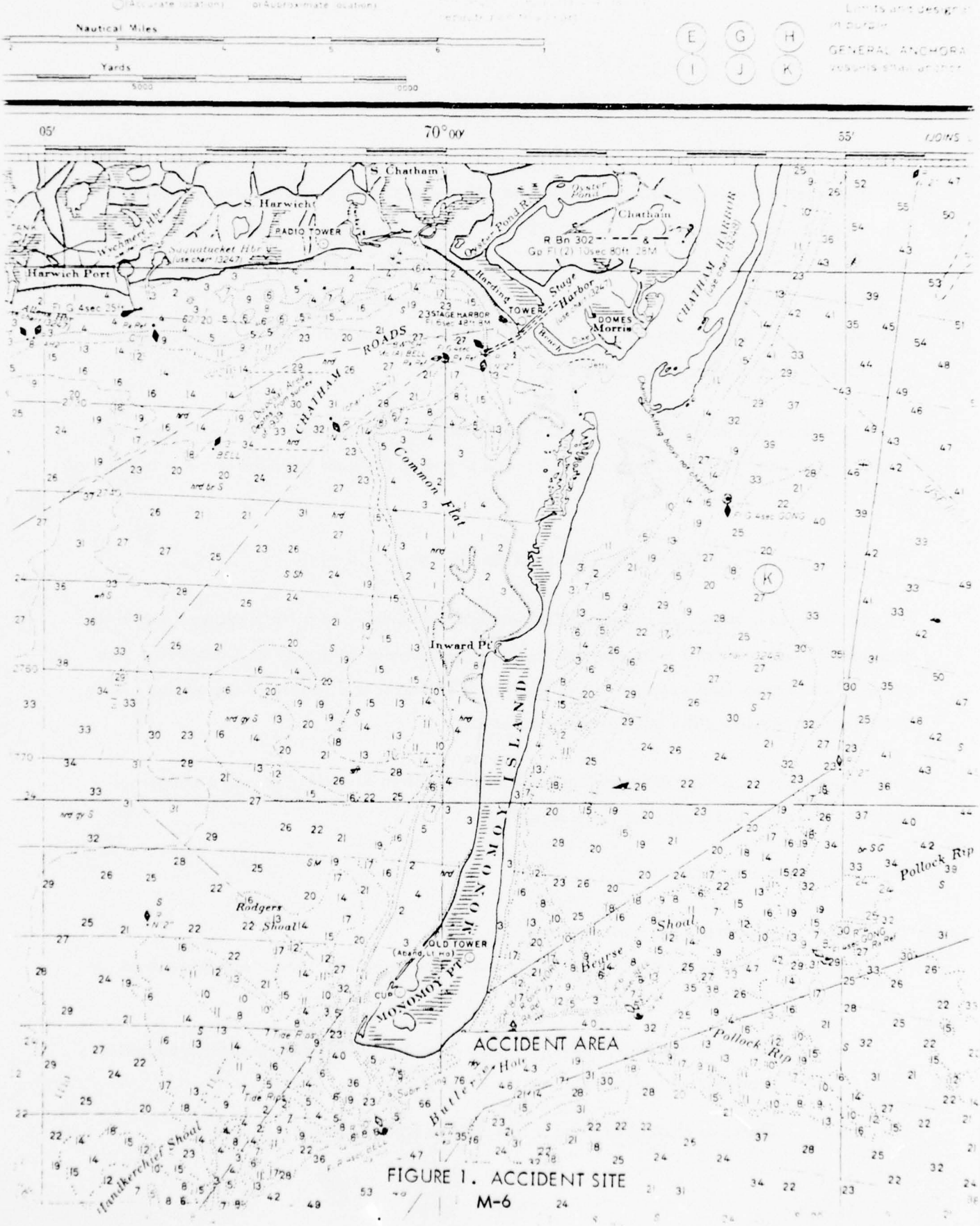


FIGURE 1. ACCIDENT SITE

M-6

- Operator of grounded boat fastened line to his (grounded) boat.
- Rescue boat engine stopped.
- Operator attempted to restart the engine - failed.
- Operator attempted to throw out his anchor to prevent his boat from being washed aground.
- Large wave hit his boat, turning it over and trapping him between overturned boat and the beach.
- Persons on beach lifted boat to allow him to escape.
- Coast Guard notified and sent rescue boats which pulled both boats off the beach.
- Total time from engine failure to occupant escaping out from under boat was several min. maximum.



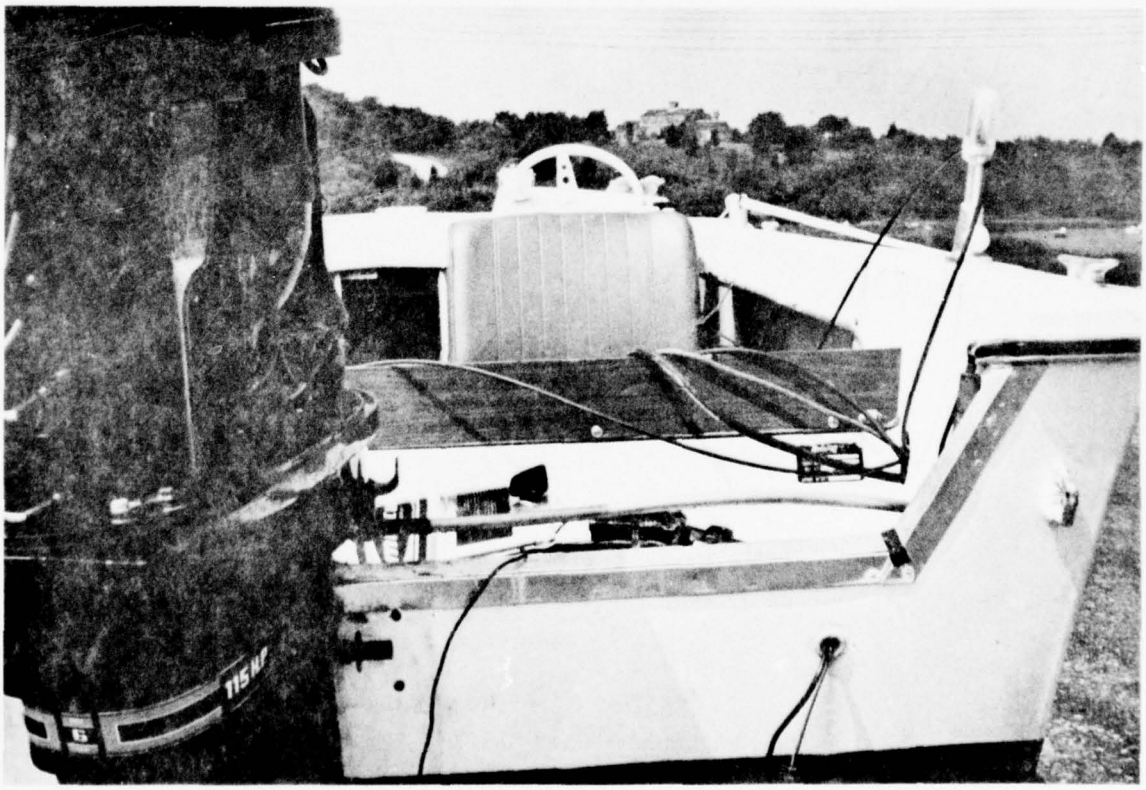


FIGURE 2. BOAT INVOLVED IN CAPSIZING/SWAMPING

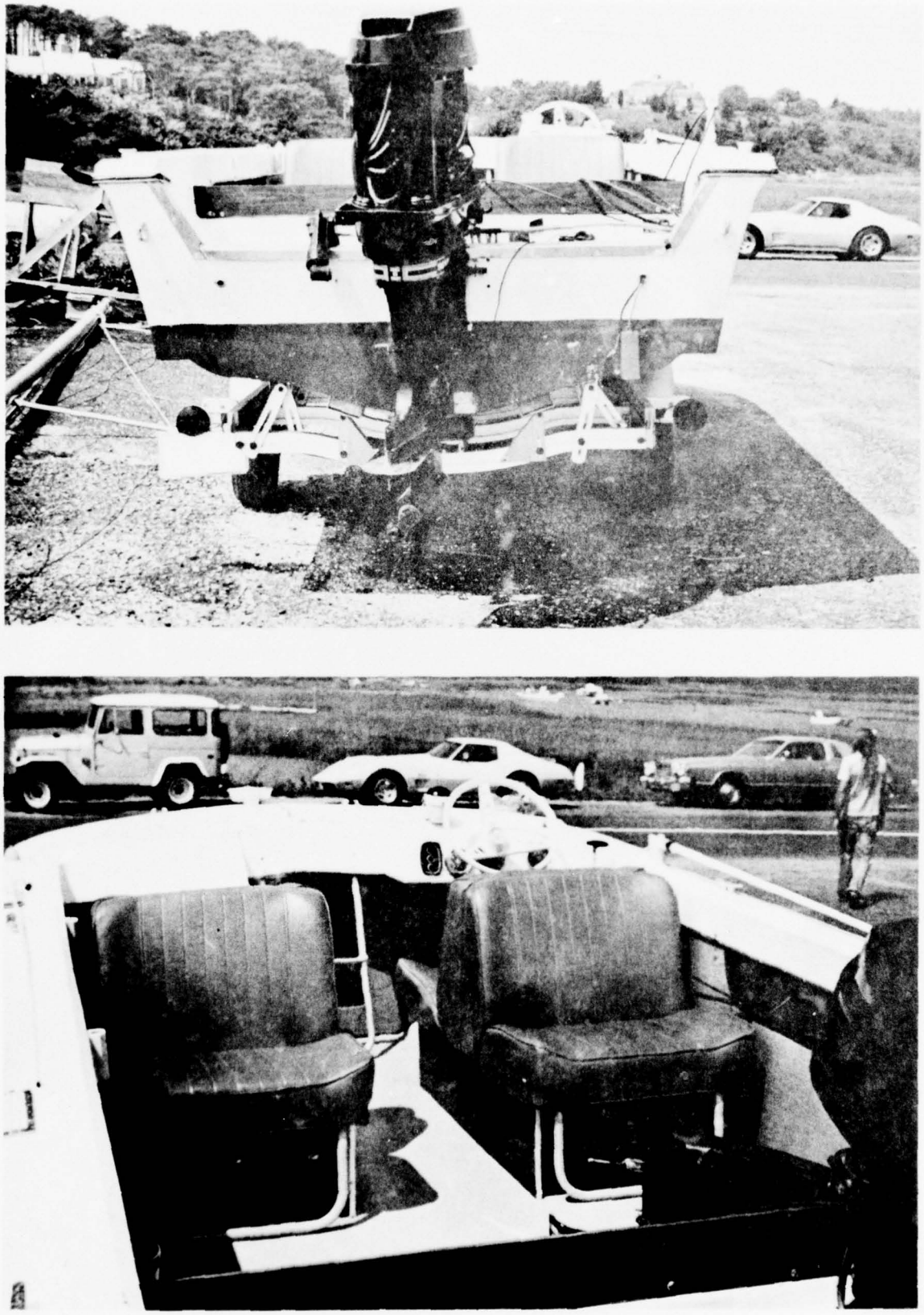


FIGURE 3. BOAT INVOLVED IN CAPSIZING/SWAMPING

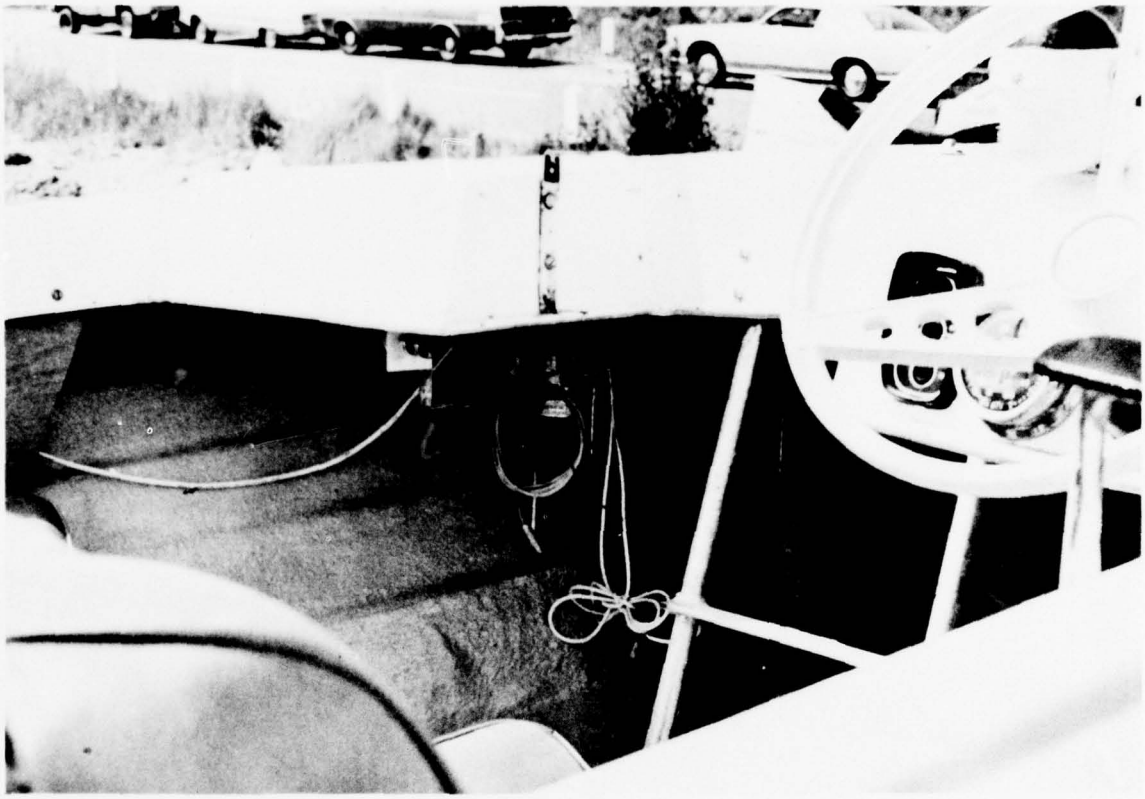


FIGURE 4. LOCATION OF FIRE EXTINGUISHER IN ACCIDENT BOAT

APPENDIX N

ACCIDENT INVESTIGATION REPORT

Date of Investigation: August 11, 1975

Date of Accident: Mid-June, 1975

Investigation: Capsizing/Swamping No. 75-13

SUMMARY — WYLE ACCIDENT NO. 75-237

The accident reported herein involved a 16 ft semi-v ski boat powered with a 60 horsepower outboard motor. The type of accident was a swamping with a subsequent capsizing of the boat, resulting in no injuries or fatalities.

At approximately 1530 in mid-June, 1975, a man and a teenage boy set out from a mooring area on an inlet destined for a point approximately one mile up the inlet. The purpose of the trip was to assist a friend who was having trouble with his small boat motor. Their intentions were to go to the friend's boat, attempt to repair the motor, and if unsuccessful tow the boat back to the mooring area. Upon arriving at their destination, the operator got out of his boat into the anchored boat of his friend and began working on the motor. The passenger stayed in the involved boat and tied a short line from the starboard stern cleat to the bow cleat of the anchored boat which was approximately 50 yards from shore. The wind velocity was 10 knots, and the water was choppy (1 to 1-1/2 ft) with a 2.2 knot current. After working on the motor approximately 20 minutes, the operator noticed that the chops were coming over the transom into his boat. He instructed the passenger to start the motor and maneuver the boat around to a position where the water would not come into the boat. The battery in

the involved boat ran down and would not turn the motor over. The passenger went aft to attempt to manually start the motor. Soon after he moved aft, the boat flooded (over the stern). After flooding, the boat sank by the stern and capsized, coming to rest upside-down in a bow high attitude. The passenger was rescued by pulling him aboard the other boat. The involved boat was retrieved by a Coast Guard boat from a nearby rescue unit.

1.0 BOAT OCCUPANT DATA

Operator / Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator	M	23	160	Exc	500 Hrs	None	No
Passenger	M	15	135	Exc	200 Hrs	USCG Aux.	No

The operator was a self-employed auto body shop repairman. His formal education consisted of high school with an automotive mechanics and body repair trade school. He seemed to be of average intelligence and physical ability. He was very familiar with the bay and particularly the waters in the area of the accident. He often did things on impulse with little or no pre-planning, such as going fishing, skiing, etc., with his friends on very short notice without considering the weather or water conditions. He very frequently went out on the bay with his boat when the water conditions were such that the boat would take on water over the gunwales and transom. In the past he had always been able to keep the boat from flooding by using the bilge pump.

The passenger was a high school student and seemed to be of average intelligence. During the interview it was apparent that he had considerably more boating experience than most people his age. He was very familiar with the water in the area of the accident.

2.0 ENVIRONMENT

The sky was hazy with an estimated visibility of 5 miles. The recorded wind velocity was 10 knots from the southwest with a recorded eastward current of 2.2 knots. The recorded air temperature was 70°F, and the recorded water temperature was 68°F. The water was choppy with wave heights of 1 to 1-1/2 ft.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

On the day of the accident the operator had gone to work at approximately 0800 and worked at his normal occupation (auto mechanic and body repairman) until approximately 1500 with a one-hour break at noon time. At approximately 1400 the operator received a phone call from a friend who was having trouble with an outboard motor on a small runabout boat. The friend's boat was moored at a local mooring, and he was unable to get the motor started. The operator told the friend that he would come down to the marina around 1500 and see if he could repair the motor.

The operator left his place of business at approximately 1500 and arrived at the marina where his own boat was moored at approximately 1515. The marina where his friend's boat was located was approximately one mile up the bay. As the operator was stowing his tools in the boat, a neighborhood boy that he knew came by and asked if he could come along. The operator told the boy he could go and probably help if they had to tow the friend's boat back down the bay.

The operator and passenger left the marina and arrived at the friend's boat at approximately 1535. The operator stopped his boat alongside the friend's boat, which was anchored approximately 50 yards offshore. The operator tied a short ski rope from the starboard stern cleat of his boat to the bow cleat of the other boat. He then got his tools, boarded the other boat, and began working on the motor (28 hp Johnson). He instructed the passenger to stay in his boat and hold the two boats apart, so they would not wash into each other. The friend who was aboard his boat assisted the operator in troubleshooting the motor.

3.2 Accident

After working on the motor approximately 20 minutes with no success, the operator noticed that the chops were breaking over the transom of his boat, flooding the passenger compartment. He instructed the passenger to start the motor, untie the boats, and maneuver his boat around, so the bow would be facing into the waves. The passenger went to the helm and attempted to

start the motor. By this time the waves were splashing onto the motor. The passenger kept the starter engaged until the battery went down to the point that it would not turn the motor over. The operator instructed the passenger to move aft and try to manually start the motor. The passenger moved aft and was about to start pulling the rope starter when the stern started going down, flooding the boat rapidly. As the stern and motor submerged, the passenger jumped over the stern into the water. The stern continued to sink until the rope between the two boats became tight. At this point, the stern was approximately four ft below the surface. The weight of the sinking boat pulled the bow of the other boat down to the point that the chops were breaking over the forward gunwale. The operator instructed the passenger who was still in the water to untie the rope between the boats, because he was afraid the weight of the sinking boat would cause the other boat to sink. The passenger untied the rope from the bow cleat of the other boat, which allowed the stern of the sinking boat to go down until the transom came to rest on the bottom (depth approximately 10 ft). The boat then rolled slowly to starboard until it was upside-down, bow high, with the stern touching the bottom. Approximately one minute lapsed from the time the passenger moved aft until the stern went down, completely flooding the boat.

3.3 Post Accident

The operator and friend helped the passenger aboard the other boat, and the operator continued working on the motor. Within a few minutes he repaired the motor and it was started. It was decided that they would try to pull the sunken boat with the friend's boat back to the marina. The bow of the sunken boat was tied to the stern of the other boat and towing was attempted. The towing effort was aborted after it was decided the water was too rough. The operator went ashore and called the Coast Guard Station located approximately one mile away. A Coast Guard boat arrived in approximately 10 minutes and took the involved boat in tow to the CG Station. On the way to the CG Station, the boat was righted, pulled up on plane, and the water emptied from the passenger compartment. After arriving at the CG Station, the motor and gear were removed and the boat towed to the marina by the CG boat. Refer to Figure 1 for sketch of the accident area.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a typical sports model runabout. At the time of the investigation the boat was moored without the motor. It is estimated that the transom freeboard with the 60 hp motor attached would be approximately four inches. The design of the transom was such that any water that came over the transom would come into the passenger compartment. There was no capacity information attached to the boat. The boat received only minor gelcoat damage as a result of the accident. The involved boat is shown in Photograph 1.

At the time of the investigation, there was a considerable amount of water in the inner hull. There was no means for determining the exact amount at the boat location.

There was foam in place as flotation material in the bow area. It could not be determined if there was flotation material installed in the inner hull.

5.0 EQUIPMENT ON BOARD (FROM INTERVIEW)

1 60 hp Evinrude Motor, 1969 Model	229.0 lb
1 6 gal. Fuel Tank (3/4 full)	41.0 lb
1 Battery	45.0 lb
1 Anchor	10.0 lb
Total Estimated Weight	325.0 lb

Refer to Figure 2 for boat load distribution at time of accident.

6.0 PSYCHOLOGICAL AND HUMAN FACTORS

It was obvious from the inspection that the involved boat was not suited for rough water operation due to the low transom freeboard. To worsen this condition, the freeboard was most likely further reduced on the day of the accident because of water in the inner hull. The operator was aware that the boat had an inner hull and knew where the drain plugs were located, but very rarely checked this compartment for water. He did not check it on the day of the accident. The boat was moored uncovered, so it is very likely that water was in the inner hull. A bilge pump was installed in the transom drain well, but it would not evacuate the water in the inner hull unless the drain plugs were out. The operator stated that there was water in the inner hull everytime it was checked.

7.0 PROBABLE CAUSE OF ACCIDENT

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

- The boat was tied off so the stern was directly into the 1 to 1-1/2 ft chops. The low transom freeboard allowed the chops to break over the transom into the passenger compartment. The transom freeboard was probably lower than normal due to water in the inner hull. The low freeboard, inner hull water weight and passenger weight in the stern reduced the freeboard to the point that water ran freely over the transom, flooding the boat.

- The swamping may have been prevented had the boat been tied off in a manner which would have positioned the bow into the waves.

- A number of swampings occur every year due to water in the inner hull. Several boat owners that have been interviewed were not aware that their boat had an inner hull. The majority of boats incorporating an inner hull have no means for checking for water other than removing the drain plugs. A simple means (other than removing the drain plugs) of visually checking for water in the inner hull should be considered in future boating safety standards.

8.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The following is presented, based on the narrative, the boat load distribution, and knowledge of the boat characteristics:

According to the estimated weight in the boat at the time of the accident, the boat was not overloaded.

The boat was tied to another boat in a manner that positioned the stern directly into the 1 to 1-1/2 ft waves. The waves started breaking over the transom into the passenger compartment. There was most likely a considerable amount of water in the inner hull. Due to the hull design, most of the water in the inner hull would be forward with the passenger positioned amidships. When the passenger moved aft, the stern went down sufficiently to allow the water to flow to the stern. The passenger weight combined with the weight of water in the inner hull and the weight of the water that had come over the transom into the rear of the passenger compartment caused the stern to go down to the point that water flowed freely over the transom, flooding the boat.

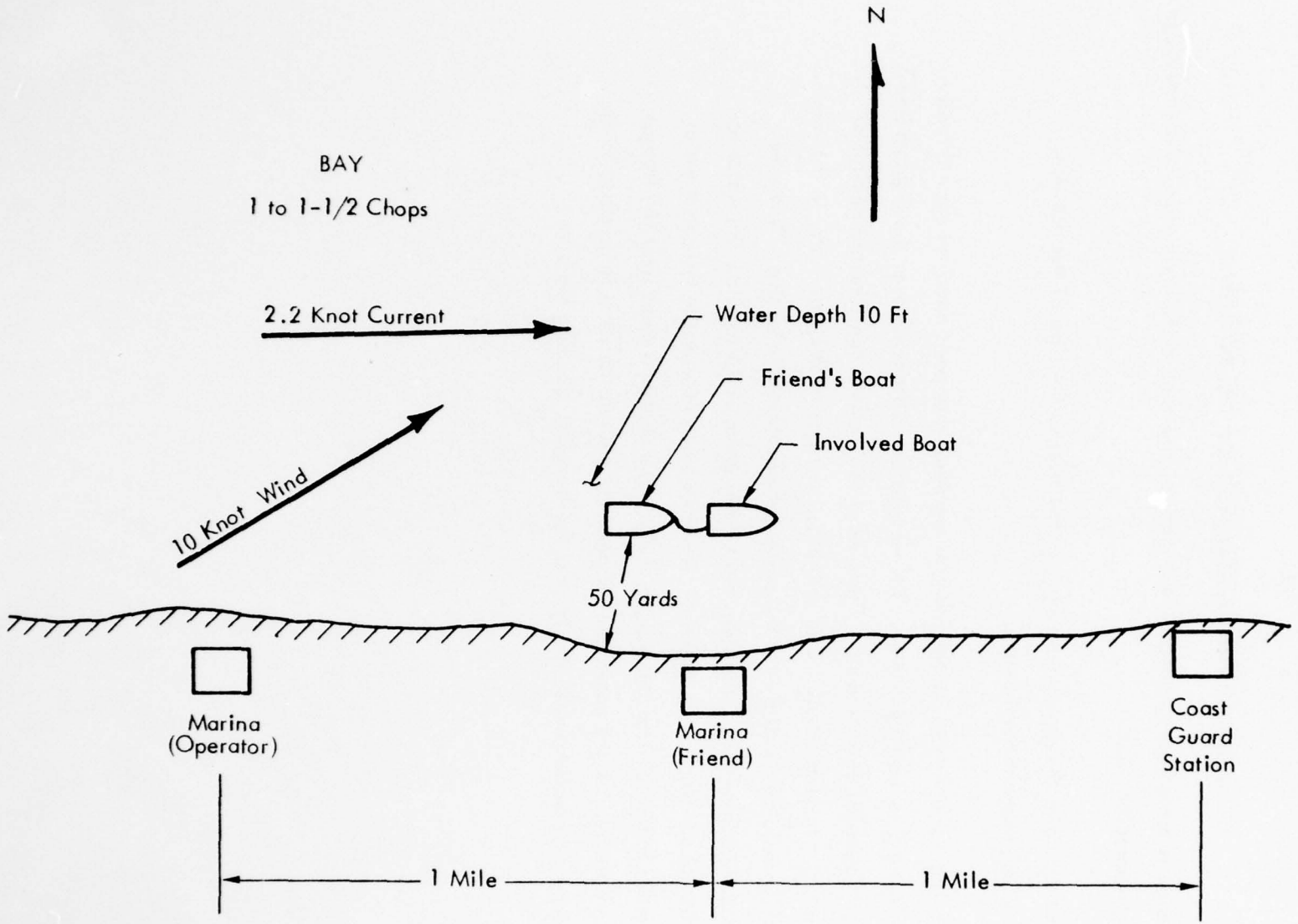


Figure 1. Sketch of Accident Area

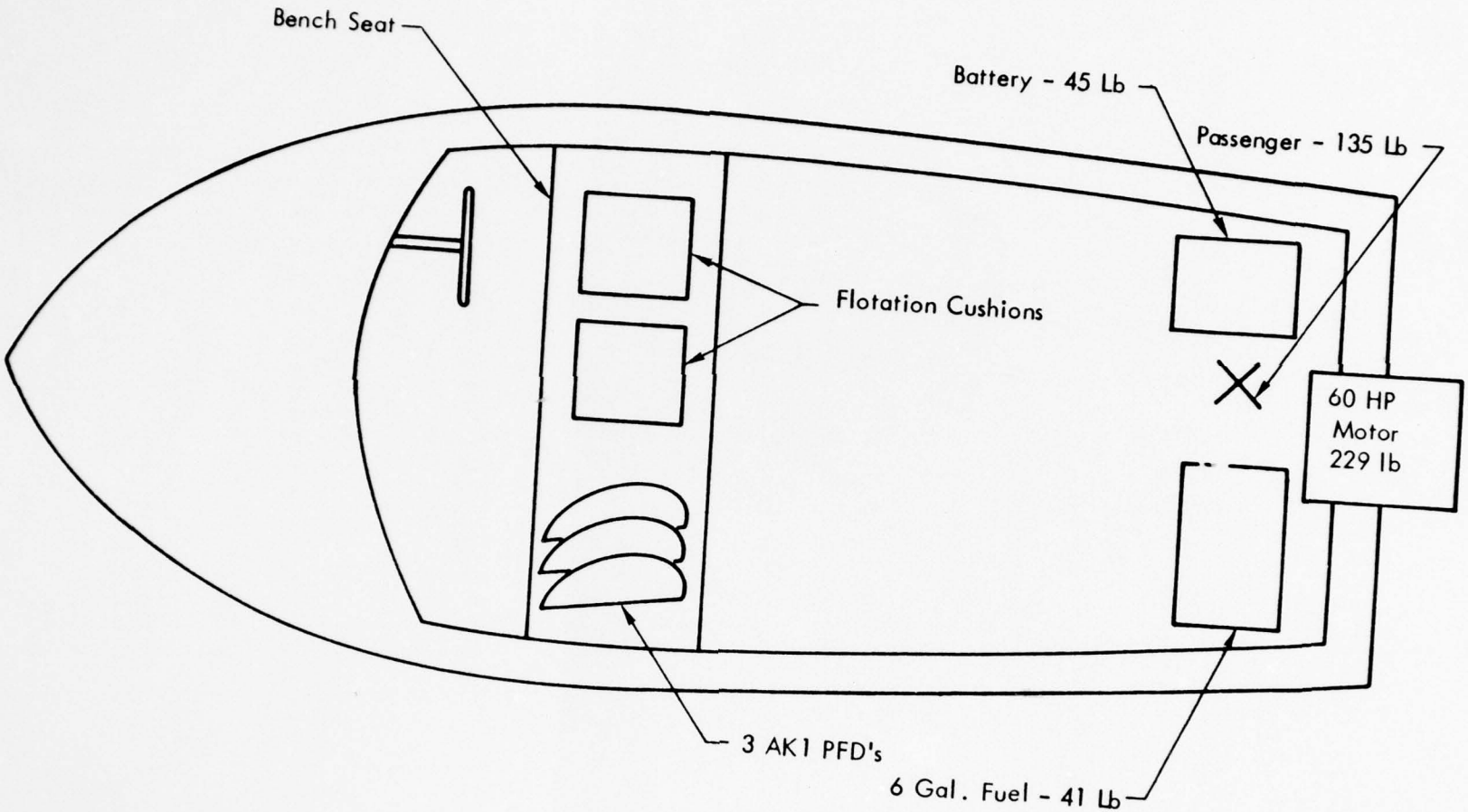


Figure 2. Load Distribution at Time of Accident



Photograph 1. Involved Boat

APPENDIX O

ACCIDENT INVESTIGATION REPORT

Date of Investigation: July 21, 1975

Date of Accident: July, 1975

Investigation: Capsizing/Swamping No. 75-14

SUMMARY — WYLE ACCIDENT NO. 75-400

The accident reported herein involved a 13 ft wooden runabout boat powered with a five horsepower outboard motor. The type of accident was a fall overboard and partial swamping due to excessive heeling of the boat (caused by occupant movement) resulting in the drowning of one of the two people on board.

At approximately 1300 in mid-July, 1975, two men set out on a fishing trip from a launch ramp located on Torch Lake in northwestern Michigan. The men fished for approximately 3-1/2 hrs in various locations within two miles of the launch ramp. The men then decided to anchor the boat approximately 25 ft from shore and fish. The operator was seated in the stern and the passenger was seated in the forward seat on the port side. The operator moved forward, got the anchor and deployed it over the port side immediately in front of the seated passenger. The operator and passenger weight on the port side caused sudden heeling to a point where water was coming over the gunwale, throwing both men out of the boat. The men were not wearing PFDs. The boat rolled back to the upright position and the passenger managed to get back into the boat. He threw the operator a life jacket, but he did not grab it. The operator drowned and his body was recovered in the accident location.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFD Worn
Operator	M	29	210	Non-swimmer	> 300 hr	None	No
Passenger	M	61	228	Poor	>300 hr	None	No

1.1 Operator/Owner

After talking with several of the operator's relatives and the state investigating officer, it is assumed that he was of normal intelligence and physical ability. From his handiwork observed on the boat, it was apparent that he was a very thorough and precise individual when it concerned his work. He was an experienced fisherman and boater (particularly in the involved boat) and was very familiar with the area where the accident occurred. Although it was common knowledge that he was a non-swimmer, he never wore a life preserver when out in a boat.

1.2 Passenger

The passenger was a retired steel smelter plant employee and his formal education probably consisted of grade school. His mental alertness and physical condition seemed to be above average for his age. His recall of events prior to, during, and after the accident were very descriptive and as far as could be verified, very accurate. He was obviously an experienced fisherman and boater (particularly in the involved boat). He was very familiar with the area where the accident occurred. He was a very poor swimmer, and due to this fact, apparently had no guilt feeling about not being able to save the operator's life. He felt that he did everything possible to save the operator's life, but expressed a deep regret that he and the operator were not wearing PFDs.

2.0 ENVIRONMENT

The sky was clear and the visibility was good. The air temperature was warm and the water temperature was comfortably warm. The water condition from the time of launching until the accident occurred was choppy with waves of less than six inches. The wind was light and variable.

3.0 NARRATIVE OF ACCIDENT

The following narrative was formulated from an interview with the passenger of the involved boat and the Michigan State Investigating Officer.

3.1 Pre-Accident

The owner/operator was a nephew of the passenger and the two men had fished together a number of times over the past six years. Also, they had used the involved boat for fishing trips many times during the past six years. The area where the accident occurred was very familiar to both men.

The men planned a fishing trip for an afternoon in mid-July, 1975. The operator worked at his usual job (laboratory technician) at a nearby hospital until noon on the day of the accident. The passenger was retired and spent the morning around his home getting the boat and fishing gear ready.

The men had lunch and left the passenger's home at approximately 1230, arriving at a launch ramp approximately 15 miles away at approximately 1300. The boat was launched and the men set out on the fishing trip shortly after 1300. They drift fished for approximately 3-1/2 hrs within a two mile area of the launch ramp. They then decided to anchor the boat approximately 25 ft from shore and fish from the anchored boat. A sand bar extended out approximately 20 ft from shore with the water gradually increasing in depth to 3 ft at the end of the sand bar. The bottom then dropped off sharply with a water depth of 10 ft.

3.2 Accident

The operator stopped the boat over the drop off. The boat was positioned parallel with the drop off and the shore line, with the starboard side facing the shore. The operator was seated in the stern on the starboard side and the passenger was seated in the forward seat on the port side. When the boat stopped, the operator stood up and moved to the stern, got the anchor and returned forward to a position immediately in front of the seated passenger. The operator then leaned over to drop the anchor over the port side. In doing so, the boat rolled to port quickly, throwing the operator and passenger out of the boat. The boat rolled far enough to allow water to come into the boat over the port gunwale. Approximately six inches of water came into the boat. After the occupants were in the water, the boat rolled back to an upright position. Immediately after the men were thrown out, the operator was located approximately 10 ft from the boat and the passenger was approximately three ft from the boat. The passenger was a poor swimmer, but managed to swim back to the boat. When he reached the boat, he grabbed the transom port side and was able to touch bottom with his feet. He turned around and saw that the operator was struggling to keep his head above water and was calling to him for help. The passenger reached in the boat, got an AK1 PFD and threw it to the operator. The PFD landed within easy reach of the operator, but he did not grab it. The operator then completely submerged and did not return to the surface.

3.3 Post Accident

Although the passenger could touch bottom, the water was too deep for him to have good footing. He pulled himself along the gunwale to amidship and climbed over the port gunwale into the boat. He then bailed the majority of the water out of the boat using an empty bait container. He started the motor and travelled approximately one mile diagonally across the lake to a hotel where he had an individual call the local rescue squad and the local police.

An off duty state trooper and three friends in a boat near the hotel were told of the accident, and proceeded immediately to the accident site. They searched for the body for approximately 30 minutes with negative results. After this time scuba divers from the rescue squad arrived on the scene and found the body in approximately 30 minutes. The body was located on the bottom in 10 ft of water near the drop off and in the same place where the passenger said he last saw him.

The body was taken to a local hospital and examined. The official cause of death was listed as drowning. Refer to Figure 1 for chart of accident area.

Time Sequence

*	1230	Occupant and passenger left passenger's home.
*	1300	Arrived at ramp and launched boat.
*	1630	Occupants fall overboard while anchor was being deployed.
*	1631	Passenger reached boat and threw life preserver to operator.
*	1632	Passenger got in boat and started bailing water.
*	1636	Passenger started to hotel for help.
* *	1650	Passenger arrived at hotel and notified authorities.
*	1655	Party of 4 left hotel for accident site, by boat.
*	1700	Search party arrived at accident site.
* *	1735	Scuba divers from rescue squad arrived at accident site.
* *	1805	Body recovered by divers.

* Estimated

* * Official

4.0 FACTS FROM THE BOAT INSPECTION

The boat hull was of the warped plane design with a semi-v bow flaring to a near flatbottom approximately one-third aft of the bow. The boat appeared to have been properly maintained and was in excellent condition for its age. No flotation material was installed in the boat which is not unusual for that age boat.

A homemade throttle control had been installed at the helm on the starboard side. The motor was not equipped with a remote forward and reverse selector. The throttle control incorporated an idle cutoff mechanism which made the gear/throttle system adequate for that horsepower motor. Refer to photographs 1-6.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

As far as could be determined, no alcohol was consumed by the operator or passenger on the day of the accident. The passenger stated that he and the operator had a normal night's sleep the night before the accident and they had not been out long enough to be mentally or physically fatigued. From the information available, it appears that the major factor in this accident was simply poor judgment on the part of the operator concerning weight distribution while he was deploying the anchor.

6.0 PROBABLE CAUSE OF ACCIDENT

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

- The two heavy occupants on the same side of this narrow beam boat is considered the major factor which contributed to this accident.
- The operator probably would have survived the accident had he been wearing a PFD.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The following is presented, based on the narrative, the load distribution, evidence found in the boat inspection, and knowledge of boat handling characteristics.

The underway characteristic of this boat is not a factor since the accident occurred while the boat was being anchored.

The capsizing of this boat was typical under the load distribution that existed at the time of the accident. The seats that the occupants were sitting in were only approximately five inches above the bottom of the hull which placed the vertical center of gravity (occupants seated) low enough to allow adequate lateral stability. When the operator stood, the vertical center of gravity was raised considerably, and when he leaned over the port side to deploy the anchor, the roll moment created by his movement caused the boat to heel sufficiently to cause the occupants to fall out.

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CAPSIZING/SWAMPING ACCIDEN' INVESTIGATIONS FOR 1975 SEASON.(U)
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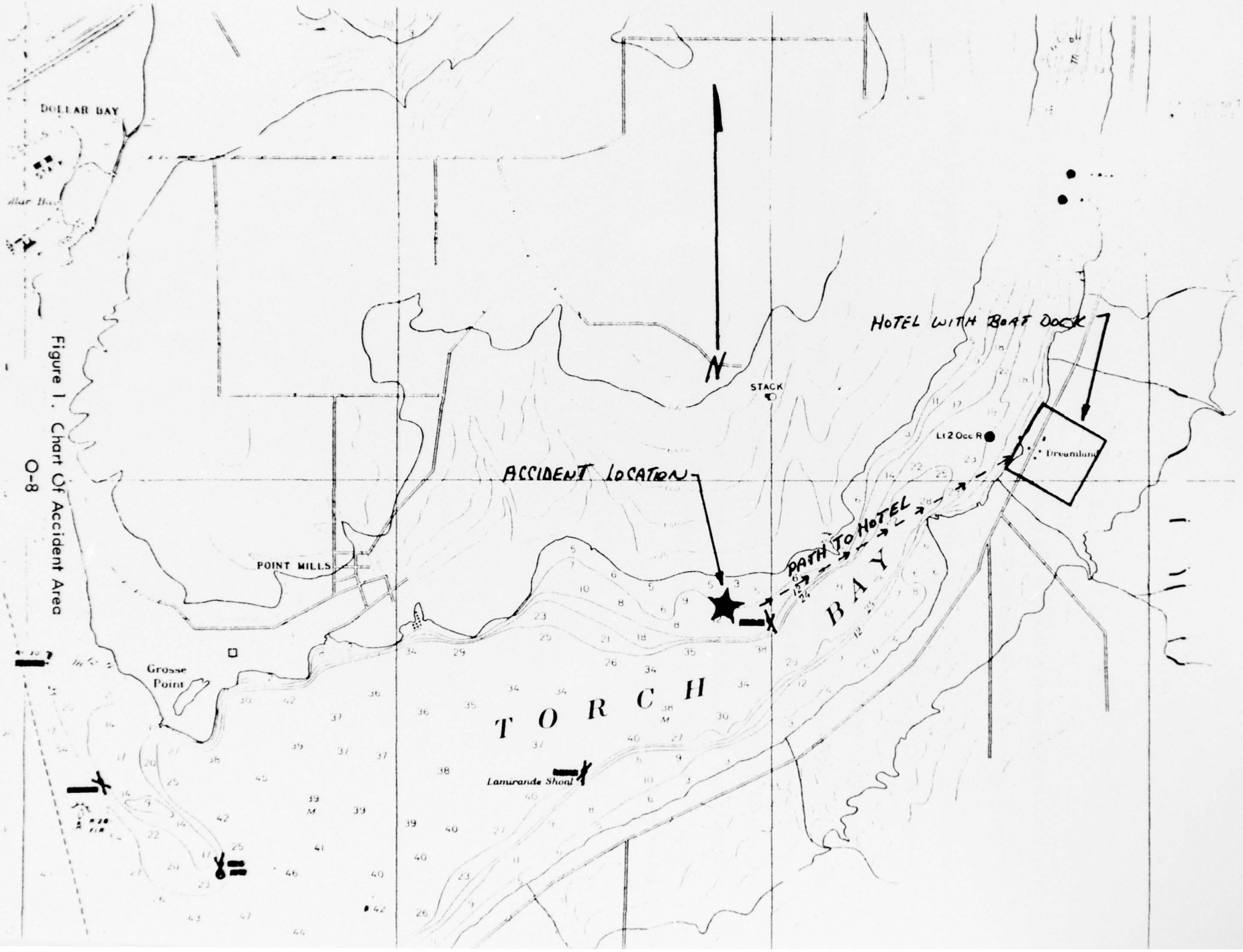


Figure 1. Chart Of Accident Area

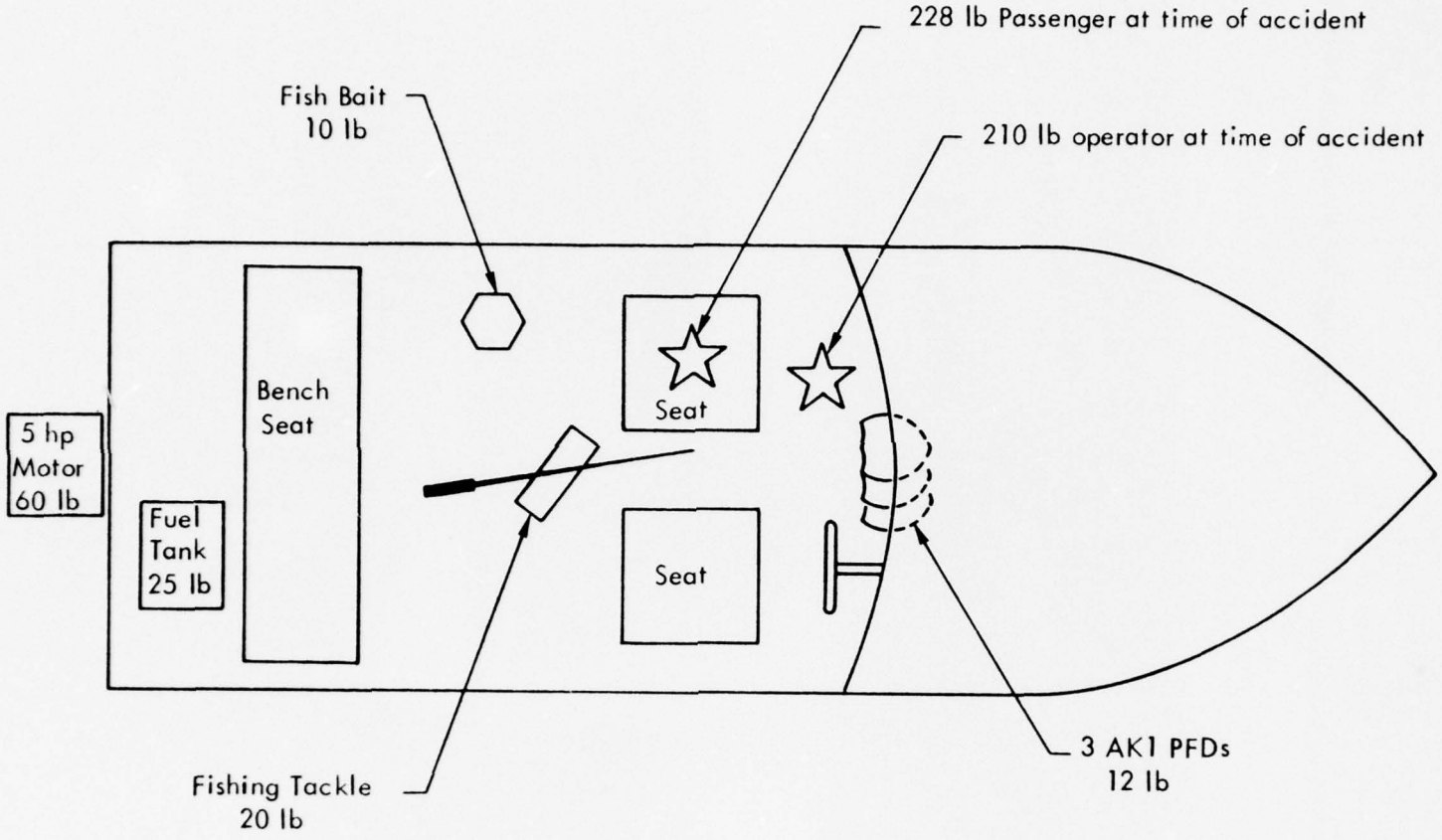
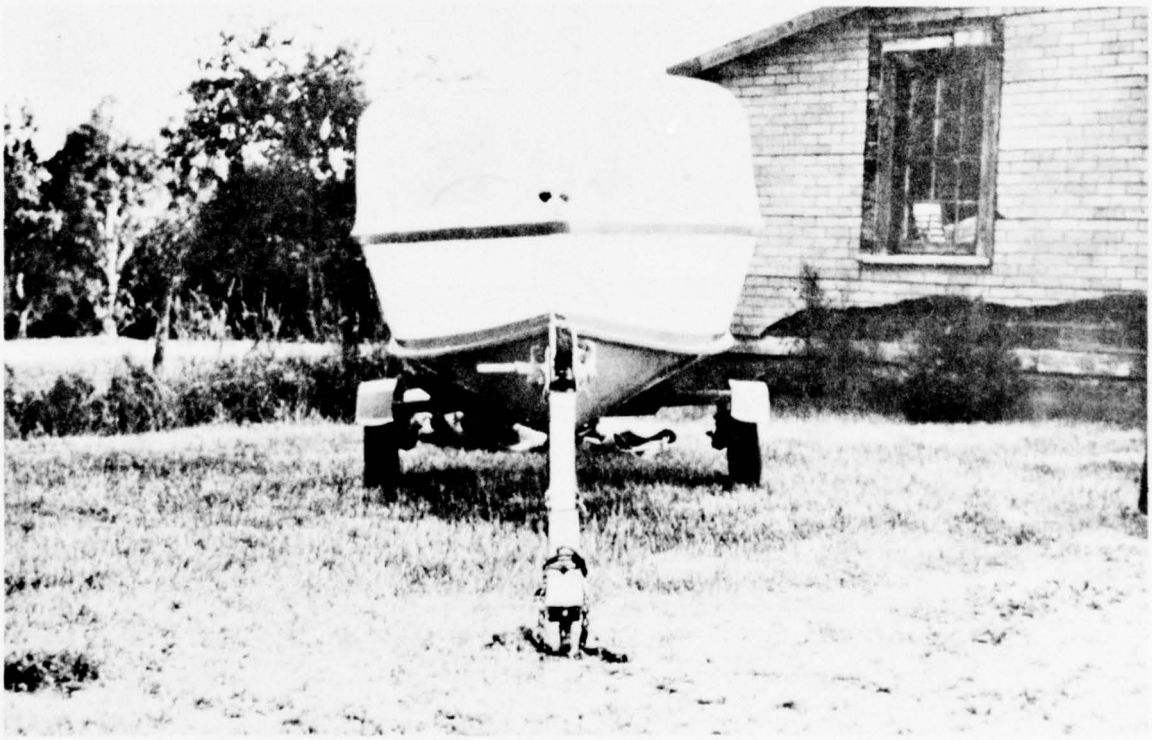


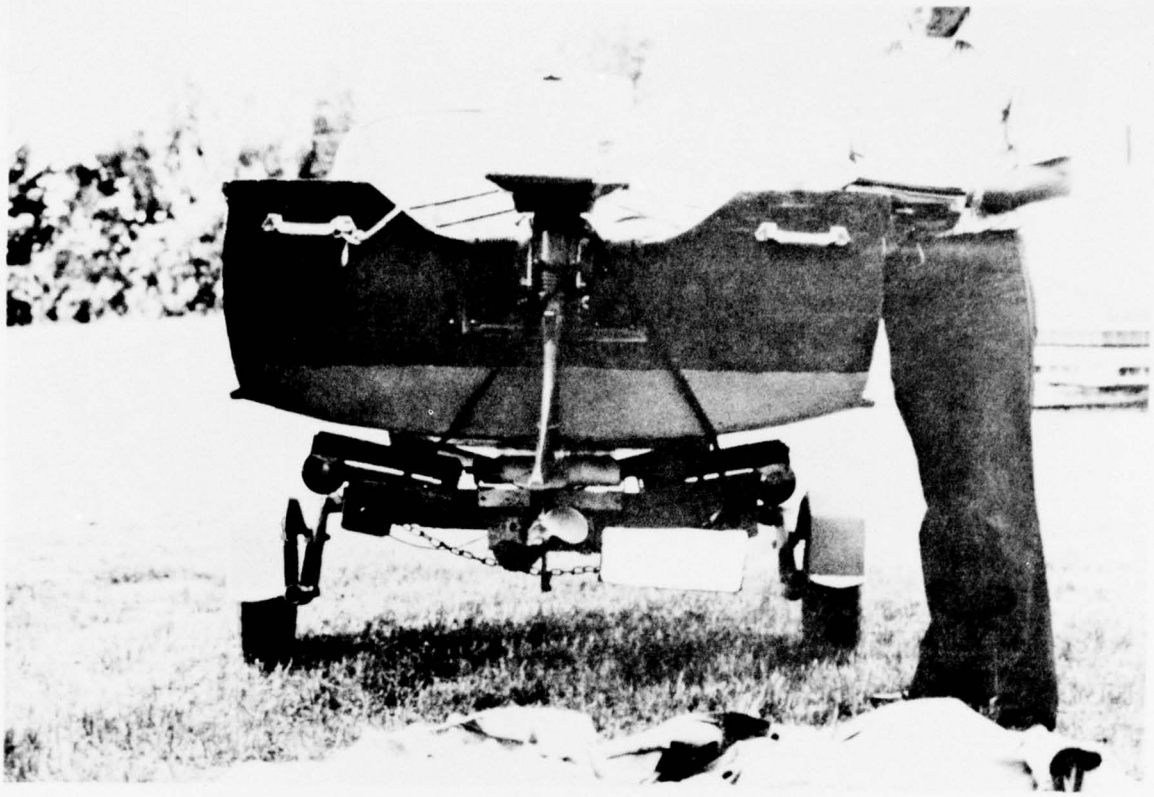
Figure 2. Boat Configuration



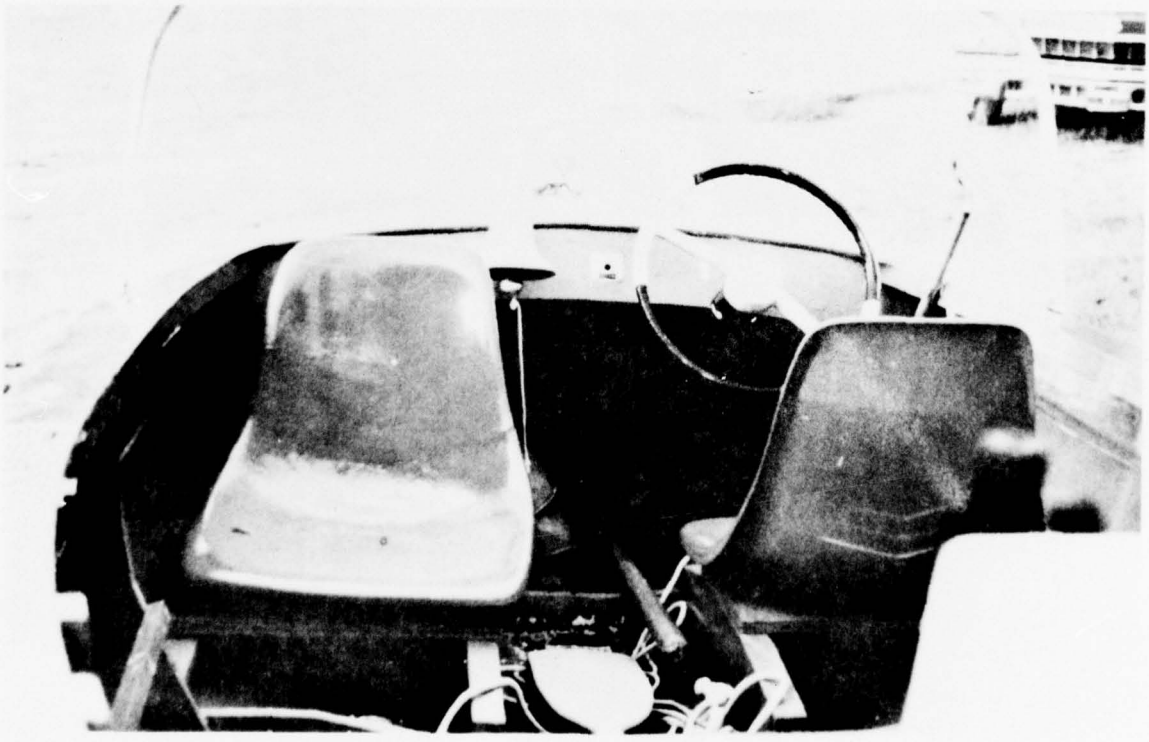
Photograph 1



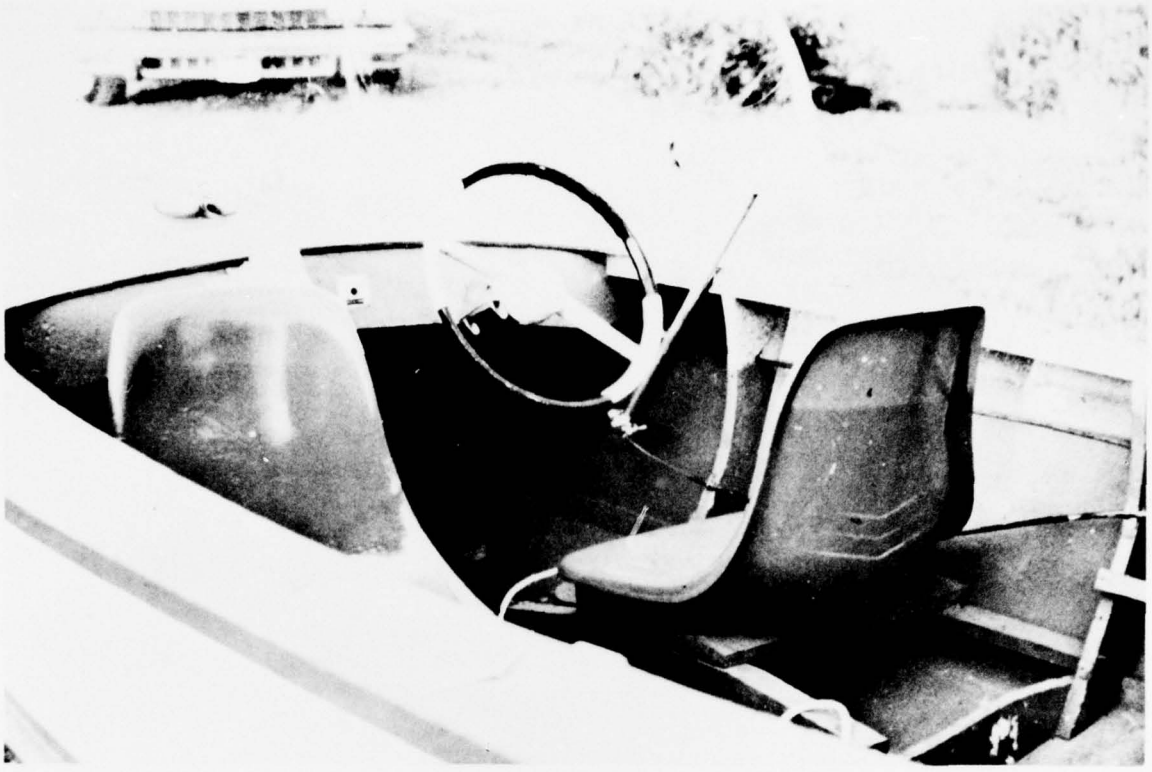
Photograph 2



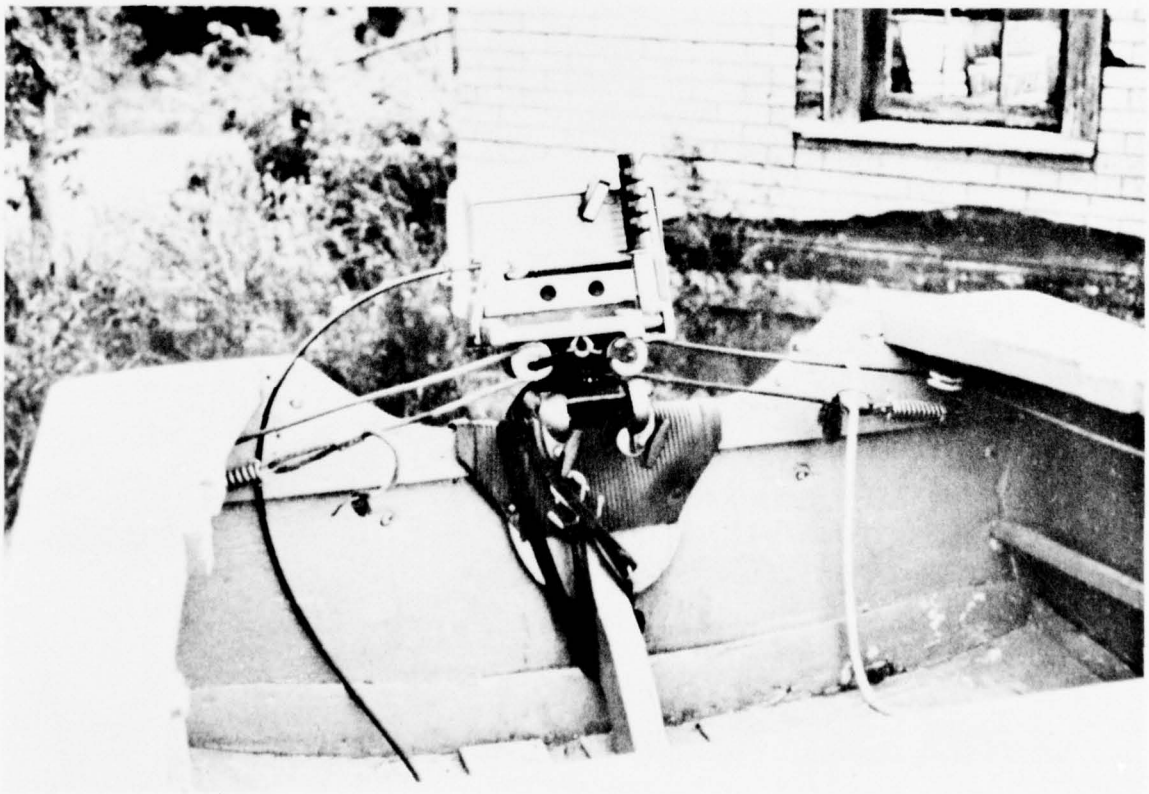
Photograph 3



Photograph 4



Photograph 5



Photograph 6

APPENDIX P

ACCIDENT INVESTIGATION REPORT

Date of Investigation: August 12, 1975

Date of Accident: Mid-June, 1975

Investigation: Capsizing/Swamping No. 75-15

SUMMARY – WYLE ACCIDENT NO. 75-220

The accident reported herein involved an 18 ft v-hull runabout powered with a 60 hp outboard motor. The type of accident was a swamping with a subsequent capsizing of the boat resulting in no injuries or fatalities.

At approximately 1210 in mid-June, 1975, the owner/operator of the involved boat (the only occupant) set out on a fishing trip from a marina located in southern Connecticut. He traveled approximately two miles from the launch ramp and approximately one mile offshore where he fished for approximately two hours. After catching a number of fish, he started pulling in the anchor in preparation to return to the marina. The anchor line was tied to the bow cleat. He was standing on the bow pulling in the anchor line. Due to the wind and chops on the water, he was unable to break the anchor loose from the bow position. He untied the anchor line from the bow cleat and walked to the transom on the port side holding the anchor line. He was unable to break the anchor loose from this position. He then started the motor and attempted to back the boat over the anchor. With the motor in reverse at idle, he attempted to pull the anchor up from the port stern position. As the boat backed over the anchor location, he was still unable to free the anchor. He quickly tied the anchor line to the port stern cleat

and started forward to put the motor in neutral. Before he could get to the helm, the anchor line became tight and pulled the port stern down to the point that water started flowing freely over the port gunwale at the stern. The boat rapidly filled with water and started sinking by the stern. The operator grabbed an AK1 PFD and jumped in the water. The boat completely swamped and rolled slowly to port until it was in an upside-down, bow high position. The operator was rescued by a small fishing boat that was nearby. The boat was retrieved by a Coast Guard rescue vessel.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn
Operator	M	46	160	Good	< 200 hrs	Pwr. Sqd.	No

The owner/operator was a college graduate and worked as a mechanical design engineer in his own firm. From the interview, it was apparent that he was not an experienced boat operator or fisherman. He stated that the majority of his knowledge concerning boat operation had been acquired through a power squadron course that he had attended. He usually went fishing with an experienced boat operator and fisherman, and this was the first time he had been out alone in other than calm water conditions.

2.0 ENVIRONMENT

The sky was obscured and the wind was estimated to be 7 - 14 mph from the SE. The water was choppy (1 - 1-1/2 ft) with a strong current. The air temperature was estimated at 70° F. and the water temperature at 60° F.

3.0 NARRATIVE OF ACCIDENT

3.1 Pre-Accident

On the morning of the accident, the operator arose at approximately 0730 after a normal night's sleep. He did not intend to work that day, and decided to go fishing. The more experienced fishing friend that usually went with him on fishing trips was out of town, so he planned to go alone. He left his residence at approximately 1100 for a marina approximately two miles away where his boat was moored. After arriving at the marina, an employee of the marina transported him and his fishing gear by pontoon boat out to his boat. Upon boarding his boat, he noticed that the transom drain well was full of water. He had observed in the past that when the drain well was filled with water, there was always a considerable amount of water in the inner hull. On previous outings, he had evacuated this water by getting the boat on plane and having a companion pull the inner hull plugs and transom drain plug, siphoning the water out. This day, he was alone and became concerned about how he could perform the water evacuation process with no help. He decided to wait and see how the boat handled before deciding how to evacuate the water. He worked with his fishing gear for approximately 30 minutes and got underway to the fishing location at approximately 1210. After leaving the marina harbor, he accelerated to an on-plane speed of approximately 25 mph. The boat seemed to have good handling characteristics and sufficient freeboard, so he decided it would not be necessary to evacuate the water in the inner hull. He arrived at the fishing location (two miles from the marina and one mile offshore) at approximately 1220. He anchored his boat from the bow, so the bow would be pointed into the wind and waves. After fishing for approximately 1-1/2 hrs, he had caught all the fish he wanted and decided to return to the marina. He stowed the fishing gear and went forward to pull in the anchor. Standing on the bow top, he untied the anchor line from the bow cleat and began pulling in the anchor. From this position, he was unable to break the anchor loose from the bottom due to the force of the wind, waves and current pushing the boat away from the anchor location. Holding to the anchor line, he worked his way around the port side to the stern. Standing in the passenger compartment at the stern on the port side, he was still unable to free the anchor. He decided if he started the motor and backed the boat to a position directly above the anchor, he could pull straight up on the anchor line and the anchor should release.

3.2 Accident

Gear aboard was as shown in Figure 1, and the weather as noted in Section 2.0. Holding to the anchor line, he went to the helm, started the motor and began backing up at idle speed. He returned to the stern port side at the time the boat was directly over the anchor. He pulled on the anchor line, but he could not free the anchor. At this point, he became uncertain as to what action he should take, but he knew he had to get the motor in neutral or lose his anchor. He quickly tied the anchor line to the port stem cleat and started toward the helm. Before he arrived at the helm, the anchor line became tight and the boat started a moderate clockwise spin. This sudden movement of the boat caused him to lose his balance and fall against the port gunwale. After turning approximately 45 degrees, the anchor line pulled the stem down to a point that water was flowing freely over the port gunwale near the stern. Within 10 seconds after the initial ingress of water, the aft section of the passenger compartment was completely swamped. At this point, the motor stopped due to water intake and the stern started to sink.

The operator grabbed an AK1 PFD that was on the rear facing seat, port side and jumped into the water over the port gunwale. The boat continued to sink stem first until the boat was completely swamped. It then rolled slowly to port to an upside-down, bow-up position.

3.3 Post Accident

The operator grabbed a boat paddle that had washed out of the boat and began waving the paddle to attract the attention of nearby boats. A fishing party in one of the nearby boats saw his signal and started toward him. While the rescue boat was coming to his aid, he managed to put on the PFD he was holding. Within five minutes after the operator jumped in the water, he was pulled aboard the rescue boat. The rescue boat took him back to the marina where he called the nearest Coast Guard station. A Coast Guard vessel located his boat and towed it to the marina. Refer to Figure 2 for a sketch of the accident area.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a typical v-hull, closed bow runabout. It had been moored uncovered at a local marina. It appeared to be in very good shape for a 1966 model. Prior to the accident, the owner had installed two inch thick slabs of styrofoam under the bow top. At the time of the investigation, these slabs had been removed because the owner planned to install foam-in-place material. The owner also plans to install foam-in-place flotation material in the inner hull. Refer to Photographs 1 - 4.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The operator was aware that there was a considerable amount of water in the inner hull at the start of the trip. He stated that he continued the trip without evacuating the water, not because he was over-confident in his ability to operate the boat, but because the seemingly normal handling characteristics gave him a false sense of security.

He had never been alone in an anchored boat in the sea conditions that existed on the day of the accident. He did not know the correct procedure for retrieving the anchor, nor did he know what to expect if he exercised poor judgment.

6.0 PROBABLE CAUSES OF ACCIDENT

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

- Inexperience on the part of the operator is considered the major contributing factor. His poor judgment while trying to pull in the anchor caused the flooding.
- The weight of the water in the inner hull made the boat more susceptible to capsizing.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

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

According to the estimated weight in the boat at the time of the accident, the boat was not overloaded. However, considering the weight of the water in the inner hull, the maximum weight capacity was greatly exceeded.

Prior to the accident, the operator noticed no adverse handling characteristics. On-plane with the operator seated at the helm, the boat handling and stability probably seemed normal. Had other occupants been aboard moving about, he would likely have noticed a decrease in roll stability and a change in handling characteristics.

With the motor in reverse, when the anchor line became tight, the boat swung around in reaction to the anchor line force that was being applied to the port stern. After the boat started turning, the downward force on the port side increased. As the boat heeled, the water in the inner hull flowed to the port side and the operator fell to the port side. The water weight and operator weight on the port side reduced the anchor line force required to pull the port stern down. The combination of weight in the boat and the force being applied by the anchor line reduced the freeboard to zero allowing water to flow over the gunwale flooding the boat.

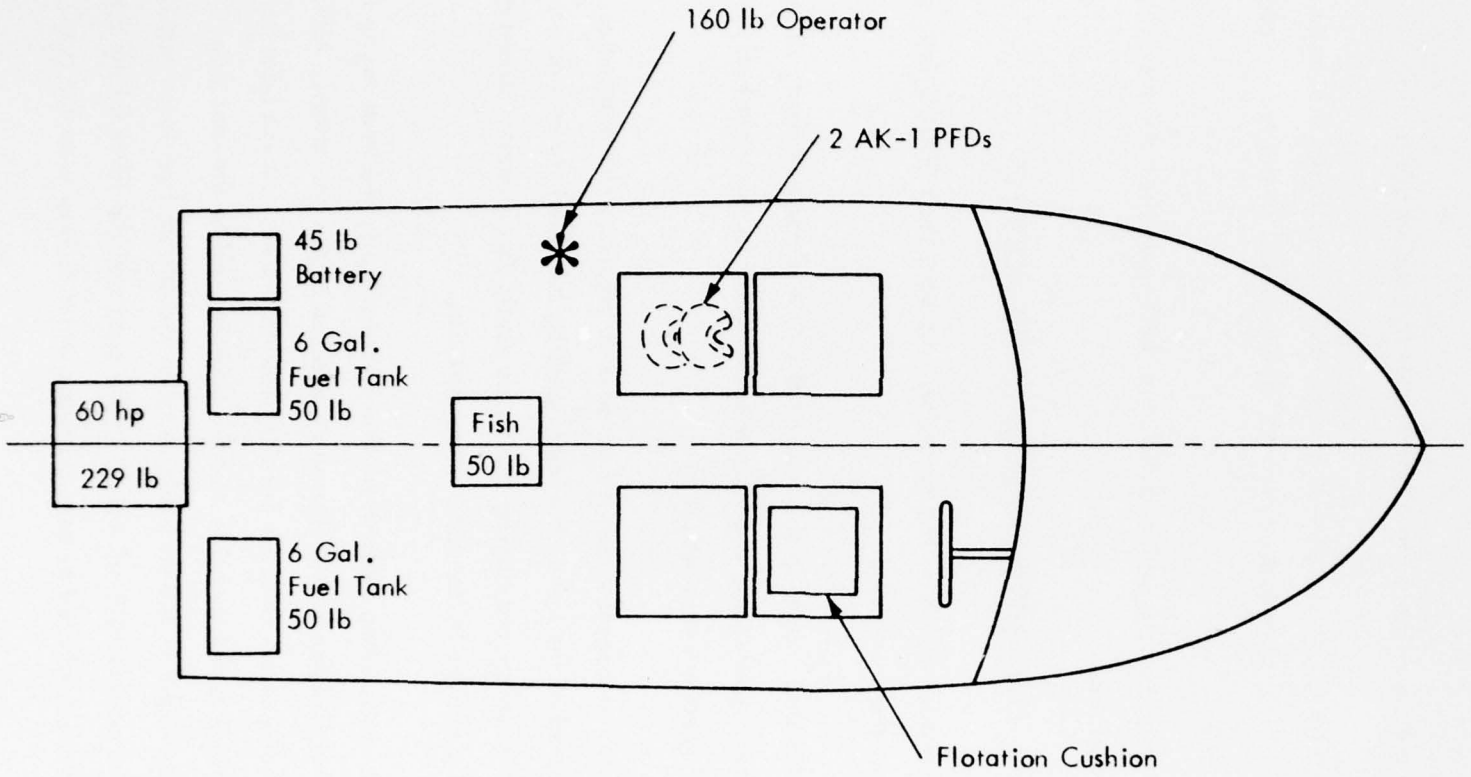


Figure 1. Boat Load Distribution at Time of Accident

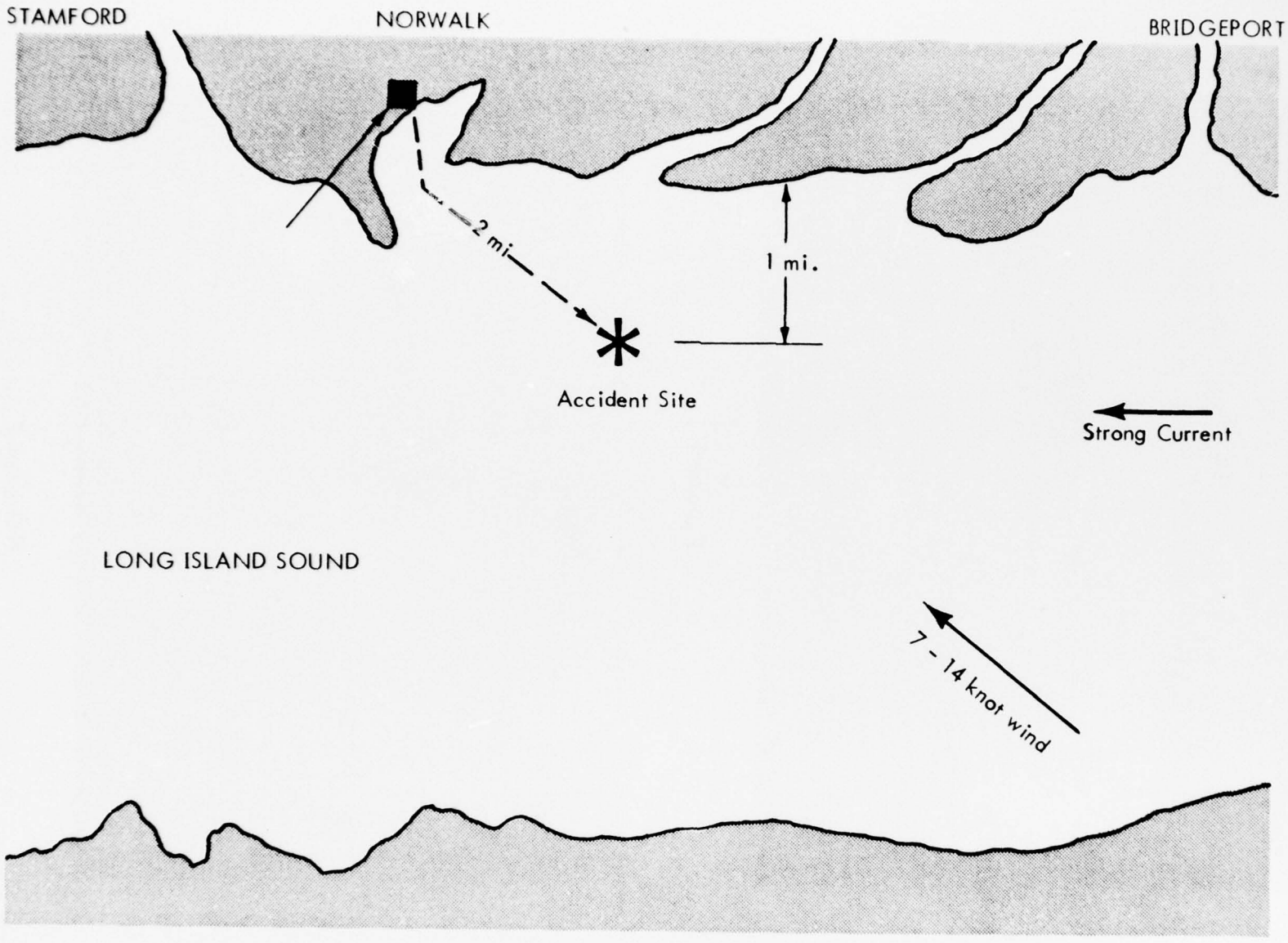
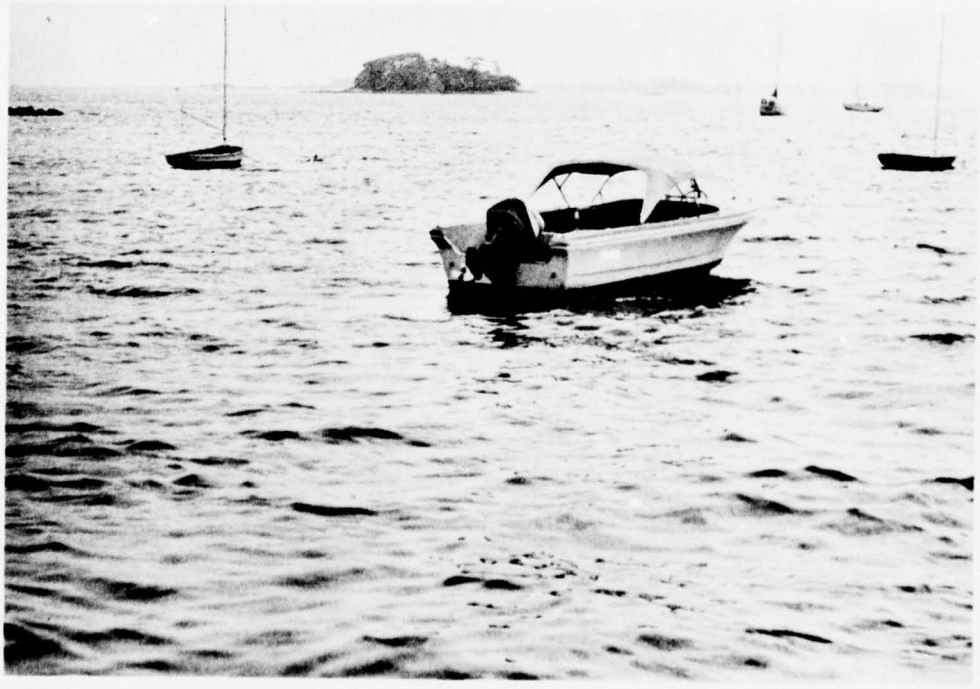


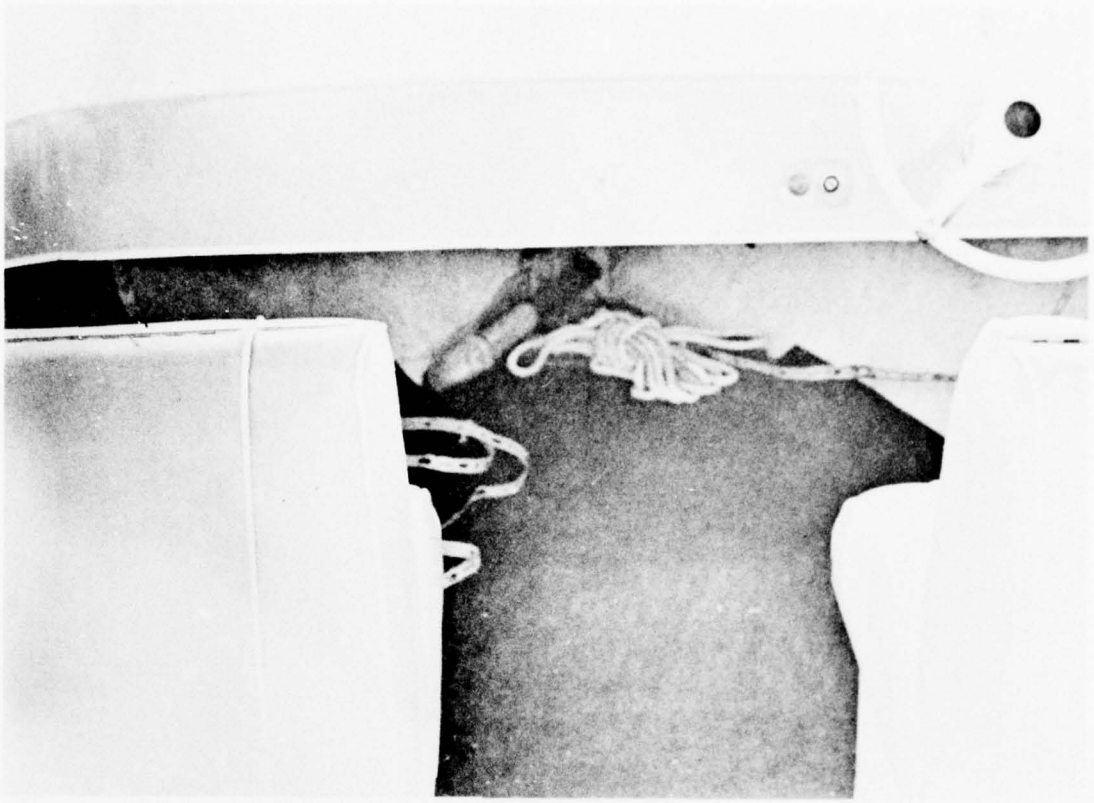
Figure 2. Accident Area



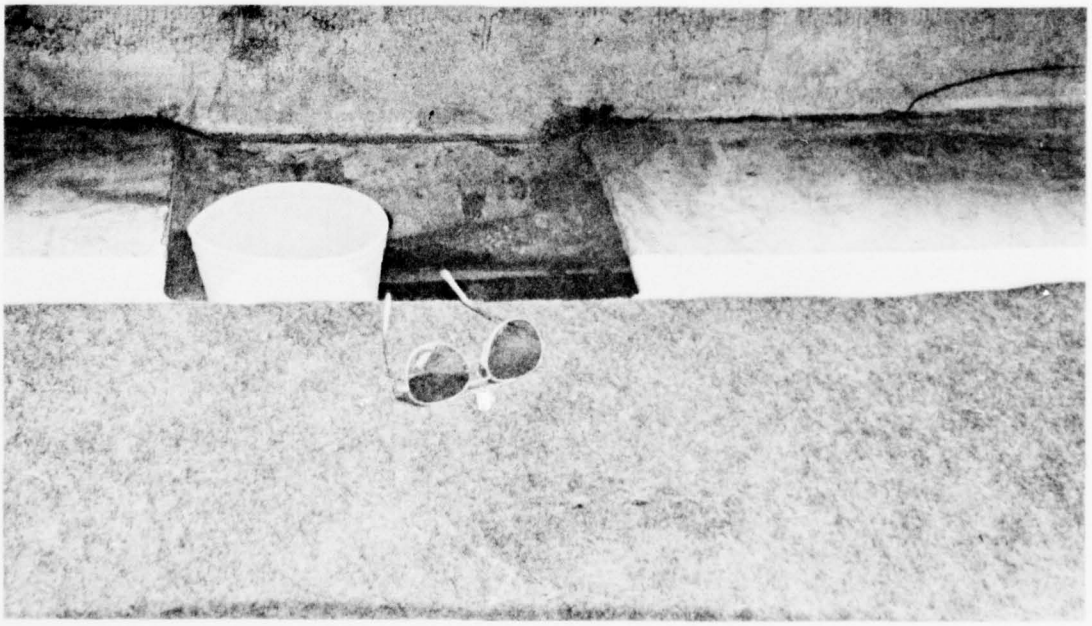
Photograph 1



Photograph 2



Photograph 3



Photograph 4

APPENDIX Q

ACCIDENT INVESTIGATION REPORT

Date of Investigation: July 16, 1975

Date of Accident: Mid-June, 1975

Investigation: Capsizing/Swamping No. 75-16

SUMMARY – WYLE ACCIDENT NO. 75-216

The accident reported herein involved a 15 ft tri-hull bowrider boat powered with a 40 horsepower outboard motor. The type of accident was a swamping with a subsequent capsizing of the boat, resulting in no injuries or fatalities.

At approximately 1300, two boats set out on a fishing trip from a launch ramp located in southern Maryland. The involved boat contained a man, his wife, and three children. The two parties traveled approximately eight miles from the launch ramp and approximately three miles offshore where they fished for approximately four hours. Within a few minutes after getting underway back to the launch ramp, the operator noticed that the boat transom freeboard was lower than normal and there was water in the transom area. At this point, he instructed his wife to move forward to increase the transom freeboard. The boat was on-plane and cruising at 15-20 mph. When the wife moved forward, the bow went down, causing the boat to swamp. The occupants stayed in the swamped boat until rescued by a nearby boat that was in the fishing party. No injuries or fatalities resulted in this accident. Water in the inner hull was most likely the cause of this accident.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator	M	45	155	Good	Over 500 hr	* USCG	No
Passenger	F	47	145	Good	20-500 hr	No	No
Passenger	F	11	75	Fair	None	No	Yes
Passenger	F+	9	65	Non-swimmer	None	No	Yes
Passenger	F	8	50	Non-swimmer	None	No	Yes

* Operator was retired Coast Guard Coxswain. He was a Coast Guard Boat Safety Inspector and had several USCG courses on operation of boats up to 40 ft.

1.1 Owner/Operator

From the interview it was apparent that the owner was an experienced operator of large inboard boats (25-40 ft) of the class used by the Coast Guard for search and rescue operations. He was not very knowledgeable concerning pleasure boats in the 20 ft and under class. For example, he did not know that the inner hull had drain plugs.

Apparently, he did know the correct action to take to save lives after the boat swamped, with one exception; he was not aware of the fact that the boat would not have flooded as rapidly and probably would not have completely swamped to the gunwale if the occupants had sat on the floor with only their head and shoulders above the water, reducing the boat loading.

The owner was a mechanic by trade and seemed to be of average intelligence. His formal education consisted of high school with several USCG service schools on boat operation and maintenance. At the time of the interview, he had completed one year of a two year college course on air conditioning and refrigeration repair and service.

During the interview, his recall of events before, during and after the accident were very general. Specific details concerning the accident were gained through direct questioning by the interviewers.

1.2 Passengers

The owner was the sole manipulator of the boat controls before and during the accident. The passengers did exactly what the owner directed them to do after the flooding occurred. Therefore, the psychological and physical aspects of the passengers were not factors in this accident.

2.0 ENVIRONMENT

The sky was clear and the wind was estimated to be 7-14 mph. The air temperature was estimated at 85°F and the water temperature estimated at 70°F. The water was choppy with wave heights of 1-1.5 ft. The water depth at the accident site was approximately 25 ft.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

On the day before the accident, the operator set up a fishing trip. The fishing party was to include the operator, his wife and three children in the operator's boat and a son-in-law and his family in a 20 ft outboard.

The operator and his family went to bed early the night before, and got up at approximately 0900 on the day of the accident to prepare for the fishing trip. The two families with their boats left the operator's house at approximately 1130. They arrived at a launch ramp in southern Maryland (approximately 20 miles distance) at approximately 1230. The fishing gear, food and drinks, including beer, was stowed and the two boats were launched at approximately 1300. The external transom drain plug was installed in the involved boat just prior to launching, so there was no water visible in the outer hull. However, the operator was not aware that there were drain plugs for the inner hull and they had not been removed since he bought the boat (30 days). There was probably a considerable amount of water in the inner hull when the boat was launched.

The two boats travelled together down inland waterways for approximately 4 miles and then approximately 4 miles out into Pocomoke Sound at a cruise speed of 10-15 mph. The party arrived at the fishing spot at approximately 1400, the boats anchored and the occupants started fishing. The operator did not notice any adverse boat handling characteristics or unusually low freeboard on the trip out. The party fished for approximately 4 hours during which time several cans of beer were consumed by the operator.

3.2 Accident

The anchor was pulled in, the fishing gear stowed, and the two boats started back toward the launch ramp at approximately 1800. Gear aboard was as noted in Section 5.0 and Figure 2, and the weather as in Section 2.0. The involved boat was behind the 20 ft outboard cruising at 15-20 mph. After traveling for 1-3 minutes, the operator noticed a considerable amount of water in the transom area and that the transom freeboard was considerably less than normal. He instructed his wife (occupant no. 2) to move to the forward passenger area, assuming that

this would cause the bow to go down which would increase the transom freeboard. The wife moved to the bow and immediately thereafter, the bow went down and water started coming over the bow into the boat. When the operator noticed that water was coming into the boat, he abruptly reduced power. After the boat stopped, water continued to come into the boat from over the bow. The operator instructed the occupants to move to the longitudinal centerline of the boat so the boat would not capsize. The occupants kept the boat in a fairly level attitude by shifting their weight longitudinally and laterally.

The occupants in the front boat noticed the trailing boat was in trouble and turned around and pulled up on the port side of the flooded boat. The operator moved to the starboard side and the wife to port in order to keep the boat from capsizing while they transferred the children to the other boat. The children were transferred one at a time over the port side into the rescue boat. After the children had been transferred, the wife moved to the port side with the operator. The boat then began to list heavily to port. The operator and wife quickly go into the rescue boat. After all the occupants were out of the flooded boat, it completely submerged and slowly rolled to port until it was upside-down in a level attitude with the keel out of the water. When the boat capsized, most of the loose articles inside the boat, including the anchor, fell out. The anchor line was tied to a stern cleat and the anchor kept the boat from drifting away from the accident area.

3.3 Post-Accident

The rescue boat picked up the floating items that had been in the involved boat and attempted to tow the capsized boat to shore. After towing the boat a few yards, it was decided that the water conditions made it dangerous to attempt towing the boat. The tow line was released and the party went to a nearby Coast Guard Station for help. A Coast Guard boat towed the capsized boat to the nearest marina where it was righted and taken out of the water. Refer to Figure 1 for chart of accident area.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a typical tri-hull open bowrider It had been stored outside at the owner's residence. It appeared to be in good shape for a '72 model. There was a 1' x 6" patch on the starboard gunwale forward of amidship and a 1' x 1' patch on the floor, starboard side in the forward passenger compartment. The owner did not know how these areas were damaged as the repairs had been made by a previous owner. A six inch longitudinal crack in the hull under the bow had been repaired by the owner after the accident. The steering and motor controls operated properly. Refer to Photographs 1, 2 and 3 for overall boat views and Photograph 4 for repaired area of the hull.

5.0 EQUIPMENT ON BOARD (FROM INTERVIEW)

1	40 HP Evinrude Motor, 1973 Model	140.0 lb
2	6 Gal. Fuel Tanks (one full and one 3/4 full)	90.0 lb
1	Battery	45.0 lb
1	Cooler	30.0 lb
	Fish	50.0 lb
1	Anchor	15.0 lb
	Fishing Gear	20.0 lb
	Total Estimated Weight	390.0 lb

6.0 PSYCHOLOGICAL AND HUMAN FACTORS

The operator stated that on the night before the accident, he had gotten a full night's sleep and had been up less than eight hours on the day of the accident; therefore, physical or mental fatigue would not be considered a factor in this accident. However, he admittedly consumed several beers (probably 4-6) during the four hour period preceding the accident, which could have affected his awareness to a hazardous situation and his reaction to that situation. He was not aware of water in the boat until the stern started riding lower than normal and he observed water in the transom area. His reaction to this situation was to abruptly reduce power which caused the water in the boat to displace forward, causing the bow to go under. Had he not been drinking, his assessment of the emergency could have led him to react in a manner which would have prevented the swamping.

7.0 PROBABLE CAUSE OF ACCIDENT

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

- It is reasonable to assume that a considerable amount of water was in the inner hull at the time of the accident. After the accident, the owner found a longitudinal crack in the boat hull approximately 6 in. long located under the bow on the port side. He did not know what caused the crack. At the time of the investigation, the crack had been repaired and it could not be determined if the crack was completely through the hull. It is possible that the inner hull was flooded through this crack. The next day after the accident, a neighbor of the owner showed him the location of the inner hull plugs. The plugs were removed and a large amount of water came out of the inner hull.

- Although the owner stated that he was not drunk, he admittedly had consumed several beers. He would have probably been aware of the low transom freeboard and water in the boat sooner had he not been drinking.

- Complete swamping of the boat probably would not have occurred had the boat been of the closed bow configuration.

8.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

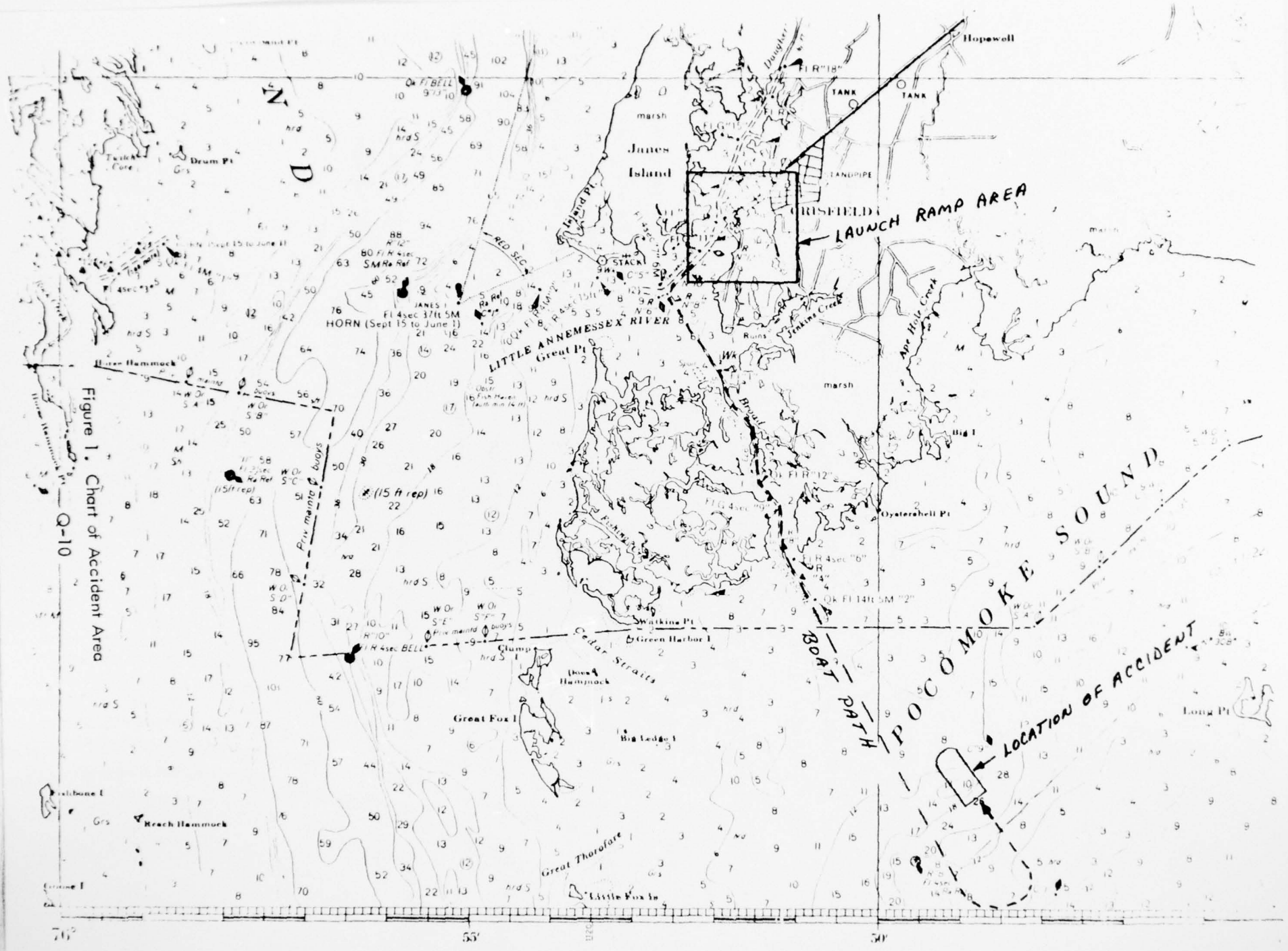
The following is presented, based on the narrative, the boat load distribution, and knowledge of the boat characteristics.

According to the estimated weight in the boat at the time of the accident, the boat was not overloaded.

Prior to the accident, the boat was on plane at a speed of 15-20 mph. The operator noted that the stern was lower than normal and immediately thereafter, noticed water in the transom drain well. There was not sufficient visible water to cause the decreased freeboard; therefore, the majority of the water had to be in the inner hull.

When the 145 pound passenger moved forward, her weight was apparently sufficient to cause the bow to lower to the point that the water in the inner hull started flowing to the bow. Her weight plus the water weight caused the bow freeboard to be reduced to zero allowing water to come into the boat. When the operator noticed that water was coming into the boat, he abruptly reduced the throttle, decelerating the boat, causing the water in the inner hull to be displaced even more to the forward section of the bow. The additional water weight caused the bow to go down further and allowed additional water to come into the boat. After the freeboard had been reduced sufficiently by the occupant and water weight, the 1-1.5 ft waves broke over the gunwales, stern and bow completely swamping the boat.

The occupants were able to keep the swamped boat upright and level by shifting their weight. The boat did not capsize until the occupants moved to the port side as they exited the boat during rescue.


LAUNCH RAMP AREA
LOCATION OF ACCIDENT
BOAT PATH
POCOMOKE SOUND
LITTLE ANNEMESSEX RIVER
CRISFIELD
James Island
Hopewell
Great Fox I
Great Thorofare
Cedar Straits
Reach Hammock
Janes I
HORN (Sept 15 to June 1)
Fl 4sec 37ft 5M
Oystershell Pt
Long Pt
Watkins Pt
Green Harbor I
Great Pt
Drum Pt
Twilight Cove
Jenkins Creek
Apr Hole Creek
Broad Creek
Fishing Creek
Daugherty Creek
Island Pt
Big I
Big Ledge I
Little Fox Is
Clump
Piles
marsh
TANK
STACK
RUINS
Qk Fl BELL
Qk Fl 14ft 5M "2"
FLR "18"
FLR "12"
FLR 4sec "6"
FLR "4"
FLR 10"
Fl 4sec BELL
Fl 4sec "9"
FLG 4sec "9"
Fl 4sec 15ft 5M
80 Fl W 4sec
SM Ra Ref
Ra Ref
Ra Refl
(15 ft rep)
Prim mainte buoys
W Or S "C"
W Or S "D"
W Or S "E"
W Or S "B"
W Or S "A"
hrd S
hrd
Grs
Shells
Sand
Mud
Oys
Wk
Ruins
Pipe
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Ferry
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Daym
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Q-10
Figure 1. Chart of Accident Area

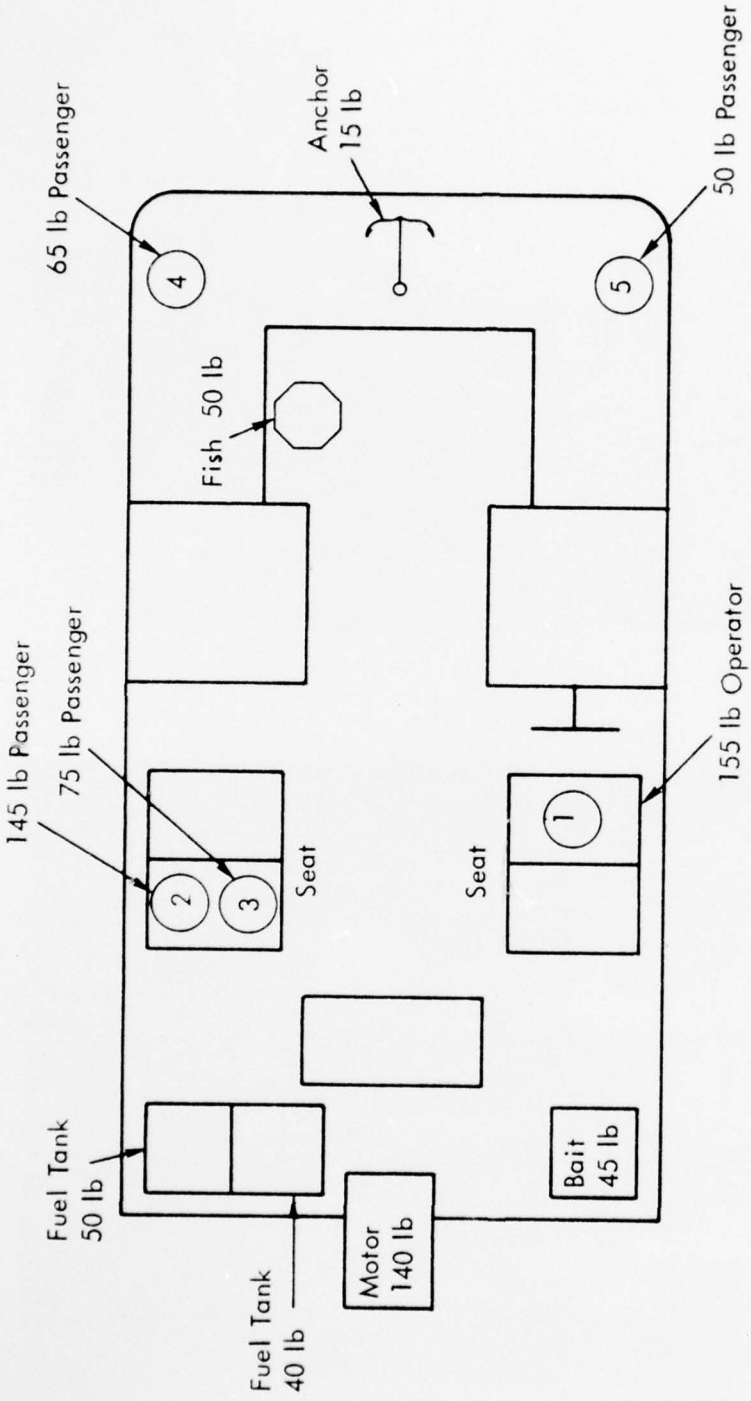


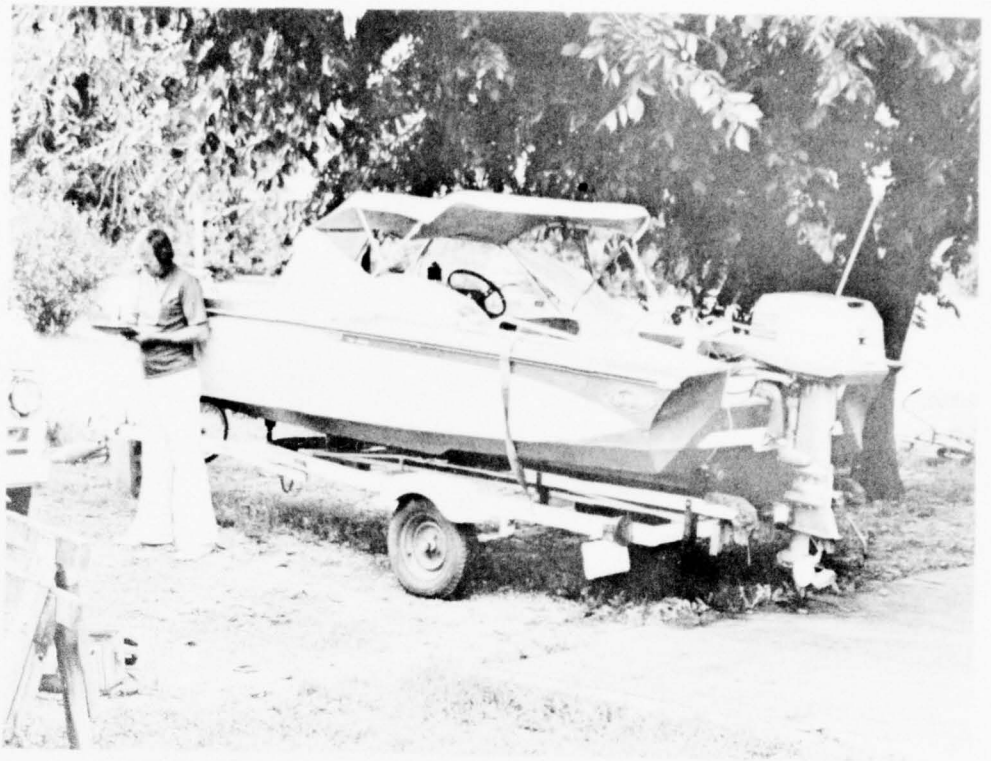
Figure 2. Location of Passengers and Equipment



Photograph 1



Photograph 2



Photograph 3



Photograph 4

APPENDIX R

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 16, 1975

Date of Accident: Mid-August, 1975

Investigation: Capsizing/Swamping No. 75-17

SUMMARY — WYLE ACCIDENT NO. 75-537

This accident was reported as a material failure/capsizing. However, upon investigation, it was found that the boat never actually capsized. Therefore, it may be considered as a material failure resulting in personal injury.

After work, a young man fueled his 16' deep-v runabout and took it out into a glassy smooth ocean. He enjoyed the thrill of jumping waves and wakes, so he cruised quite close to the beach where the surf created some interesting waves. He would parallel the waves, then turn the boat into the wave just prior to impact. The boat would leap out of the water and re-enter in the trough.

According to a witness in another vessel, the boat cleared a particular wave and flew so high that the beach was visible under the keel of the runabout. The boat came down on its side. The steering mechanism within the outdrive unit broke, and the boat went into a high speed spin. The lone occupant was thrown across the cockpit. His shoulder hit the coaming, and his face hit the grab rail surrounding the cockpit, resulting in a broken clavicle and a broken

jaw. He was knocked unconscious and fell into the aft portion of the cockpit. The boat continued to spin for a couple of minutes, then suddenly stopped. Apparently, water had been forced into the gas tank through the vent through-hull fitting. The cruiser owner called the Coast Guard and towed the stricken vessel to shore. A waiting ambulance took the victim to the hospital, and the boat was towed to the Coast Guard Station.

1.0 BOAT OCCUPANT DATA

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Driver	M	23	140	Good	>500 hrs	No	No

The driver of the boat was the son of a wealthy family who lived in a waterfront home in a popular boating community. He had completed all but one semester of his college curriculum for a degree in Business Administration. Last spring, he quit college and went to work at a local marina as a mechanic and helper. He enjoyed fast boats, wake hopping, and apparently he would pass quite close to the transoms of boats as he jumped their wakes. As a result, he had accumulated several warnings and at least one violation.

2.0 ENVIRONMENT

The weather was clear and there was almost no wind. It was a warm evening, perfect for boating. The air temperature was around 80 and the water temperature was in the mid to high 70's. The surface of the ocean was flat, except near the beach where three foot waves were breaking some 75 to 100 feet off shore.

3.0 NARRATIVE

The following narrative was compiled from interviews with the boat driver, his father, and two witnesses.

3.1 Pre-Accident

A 23 year old man worked all day at a marina doing basically manual labor, i.e., hauling boats, painting, sanding, and some mechanical repair work. He came home at about 1730 and immediately went for a ride in his 16' deep-v inboard/outdrive powered runabout. He filled the tank at the marina where he worked and continued on out the inlet from the protected bay to the ocean. He cruised north for a while then turned around and cruised south, past the inlet and continued parallel to the beach. According to him, he was running about 200 yards off the beach in flat, calm water at 3300 rpm, which would have been about 35 to 40 mph.

That is all he remembers. His father, a medical doctor, said that it is not uncommon for someone involved in an accident to forget what happened just prior to the accident.

Meanwhile, two men in a cabin cruiser were returning from a fishing trip. They were heading north, a half a mile or so off the beach when they spotted the runabout heading south. The runabout was in the surf, very close to the beach. The cruiser driver who was driving from his flying bridge called his companion up from the cabin area to watch the runabout crash through the waves. Apparently, the runabout driver would run parallel with the beach then turn sharply into an oncoming wave. The boat would fly through the air and land in the trough behind the wave.

3.2 Accident

As the passenger arrived on the flying bridge of the cruiser, he and the driver saw the runabout disappear behind a wave then come up through it. The runabout shot straight into the air and flew so high that both witnesses said they could actually see the beach under the bottom of the runabout. It flew through the air then came down on its side in a gigantic mountain of

spray. It reappeared out of the spray and leaped into the air again. It landed and leaped again then landed and proceeded to turn in a tight counterclockwise circle.

By this time, the cruiser operator knew that the operator of the boat was in trouble. He opened up the throttle on his cruiser and proceeded towards the stricken craft in an attempt to help the victim.

Although the victim doesn't remember the accident, he and his father reconstructed a probable answer to the question of how he got injured. He made the assumption that the steering mechanism suddenly broke while he was going 35 to 40 mph on a flat calm sea. (He wouldn't admit to jumping waves near the beach.) The boat suddenly swerved to port in such a tight turn that the vent located high on the hullside sucked in water. At the same time, centrifugal force threw the driver against the right side of the cockpit. His shoulder hit the coaming, and his jaw impacted the cockpit railing. He then fell down into the aft portion of the cockpit, unconscious.

3.3 Post Accident

The cruiser operator could see no one at the helm of the runabout and assumed that the driver had been thrown out of the boat. He continued past the circling boat to the area where the boat first landed on its side. The runabout suddenly came to a stop. The cruiser operator motored over to the runabout and found the operator lying on the floor in the aft portion of the cockpit. He was obviously unconscious and was bleeding from the mouth and nose quite profusely. The cruiser driver radioed the Coast Guard and told them they would tow the victim to shore. The passenger jumped into the runabout and noticed that the victim was having trouble breathing. He reached into the victim's mouth and freed his tongue, which was about to be swallowed.

The boat was towed to shore. Swimmers helped hold the boat off of the beach while an ambulance crew took the victim off of the boat. The cruiser towed the boat out of the surf and was going to tow it to the Coast Guard Station. Along the way, they met a Coast Guard rescue boat coming out to the accident scene. The runabout tow line was transferred to the Coast Guard rescue boat, and the cruiser continued on its way.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a 16' - 7-1/2" deep-v inboard/outdrive powered runabout. It had a 7'0" beam and weighed about 1400 lb. The engine was a 270 hp Holman-Moody marine conversion coupled to a Volvo 270 outdrive. The boat was made entirely of fiberglass with one cast part forming the hull and a second part forming deck and cockpit.

The boat had obviously been treated quite roughly. The fiberglass was cracked and crazed around the gunwales, and in the cockpit area. The flame arrestor had been removed because the engine was difficult to start. Hence, prior to start-up, a small amount of gasoline was poured into the carburetor from a pint can stored in the bilge. Luckily, there have been no explosions to date.

The stainless rail surrounding the cockpit was dented at the point that the victim thought that he hit his head, which supported the victim's theory of how he became injured.

The steering system was inspected. When the steering wheel was turned, the push-pull cable operated smoothly and actually moved the tiller through its normal arc. The tiller, in turn, was securely fastened to the top of the vertical steering shaft. When the tiller turned, it also turned the top portion of that shaft.

The bottom end of the vertical steering shaft is connected to a yoke assembly that grips the outdrive unit. When the shaft rotates, so does the yoke and hence the outdrive is forced to turn. However, in this case, a rotation of the top portion of the shaft did not produce any movement to the yoke or outdrive unit.

Further inspection found that the upper portion of the shaft, which should be tightly fitted in a bushing sleeve assembly was actually quite loose. The yoke portion of the assembly was also obviously loose in the area of the vertical shaft. From the inspection, it was quite obvious that the tiller and upper part of the shaft was no longer connected to the yoke and lower portion of the shaft. The questions that remain are those of determining just where the shaft broke and what, if anything, could or should be done to strengthen the part. The boat is due to be repaired, and at that time the part will be sent to Wyle Laboratories for evaluation.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The story that was presented by the boy and his father was probably less than the truth. Here was a kid that had been in trouble previously for hot rodding his boat and especially for jumping wakes dangerously close to the transoms of boats. He enjoyed leaping out of the water in his boat. He told this investigator that his boating generally consisted of looking for rough water, then jumping the waves in that rough water.

It would not be uncommon for a person of his age and socio-economic strata to fantasize an ocean racing situation as he would pound out through the rollers of the inlet, or the waves in the ocean. Major ocean races are held each year in his area which gives him a first hand look at the excitement of the gala affair. In fact, the owners, drivers, and their race boats are paraded through the streets of his town on the day before the big races. The most famous race driver of all designed his boat. It is quite possible that he was caught up in the glory, sex, excitement, etc. of the whole scene.

Or maybe he just enjoyed the thrill of jumping waves. There is a technique that must be mastered in order to have the boat perform at its optimum. The throttle and the wheel must be manipulated in a certain way as the boat is powering up towards the crest. The throttle must be pulled back at the instant of flight and reapplied just prior to re-entry, etc. Possibly, he was just caught up in mastering the technique involved.

At any rate, he went looking for rough water. The inlet was calm. The ocean was calm. The only rough water was close to the beach where a rather small surf was breaking. He apparently drove his boat into that surf and was jumping those waves. There were swimmers and surfers in the area. Luckily, none of them were run over.

Unfortunately for the boy, he made an error in his wave jumping technique as he powered through the last wave. Whether it was a steering error, a throttling error, or a speed error, isn't known, but the boat rotated in the air and landed on its side in the water.

Fatigue may have had some effect on the accident. The boy had worked outside all day and had attained some level of fatigue. He probably would have been in the same surf whether he was rested or fatigued, but his reaction time may have been significantly lengthened due to fatigue.

6.0 PROBABLE CAUSE OF ACCIDENT

The cause of the accident was reckless operation of the boat.

7.0 DYNAMICS/ANALYSIS OF ACCIDENT

The driver of the runabout was running parallel to the beach with the beach to his right, and the waves coming at him from the left. As a wave approached, he must have turned to the left somewhat, thereby forcing his boat to smash through the wave and jump clear of the water.

As the boat smashed through the last wave, something happened that was different than the previous waves that the boat had smashed through, because according to the witnesses the boat flew quite a bit higher this time. It is estimated that the keel of the boat was about 10 feet above the water at the apex of the flight. The boat rotated counterclockwise while in the air and landed on its port chine. The throttle must have been advanced either fully or close to it, because the boat immediately accelerated and cleared the water again, and again for the third time. Upon re-entering the water for the third time, the boat suddenly turned left and went into tight left hand circles.

We don't know when the steering broke. It could have broken as the boat smashed through the last wave. In fact, it could have been weakening as the boat was smashing through prior waves. The driver complained that there was about a 6 inch play in the steering system, and that the steering cable end support continuously worked loose and had to be tightened on a weekly basis. It was loose when inspected. Therefore, there was excessive play in the steering prior to the breakage. If it had been showing signs of weakening, the driver would probably not have felt it.

Or the steering could have broken upon impact on the first, second, or third landing. It wasn't until after the third impact with the water that the boat went into its spin.

The probability exists that the driver was uninjured during the smash through the wave and the first impact with the water. The boat landed on its port side. The control station is on the port side of the cockpit. As the boat came to an abrupt stop, the driver would have impacted the left side of the cockpit. But he didn't. He was thrown across the cockpit and impacted the right coaming and rail. Therefore, it is felt that the operator was at the helm when the boat impacted the first time, and probably stayed in the vicinity of the helm until the boat suddenly swerved to the left and went into the tight circle. At that point, centrifugal force threw him across the cockpit and into the coaming.

Water entered the gas tank and shut off the engine. A quart and a half of water was drained from the tank after the accident. The assumption has been made that it entered through the gas tank hullside vent opening located forward of the cockpit high on the port hullside. The boat owner assumed that it entered the vent opening when the boat impacted the water on its port chine. However, the boat was on its side in the water for only a matter of a second or two, hardly enough time for an appreciable amount of water to be sucked or forced through a three-eighths inch diameter tube. Therefore, the investigator believes that the majority of the water was sucked into the vent line as the boat was turning in high speed counterclockwise circles. A deep-V boat leans into a turn much more than those boats with flatter hulls. It is not uncommon to bury a gunwale in a very sharp turn. In this case, the throttle was set at full or nearly so, and the outdrive was swung to its extreme left turn position. The gunwale would have been under water or close to it; therefore, the vent opening would have been under water. As the engine used gas from the tank, a suction was pulled on the vent line which slowly brought water into the tank. The water dropped to the bottom of the tank and eventually was pumped into the carburetor. The engine then stopped.

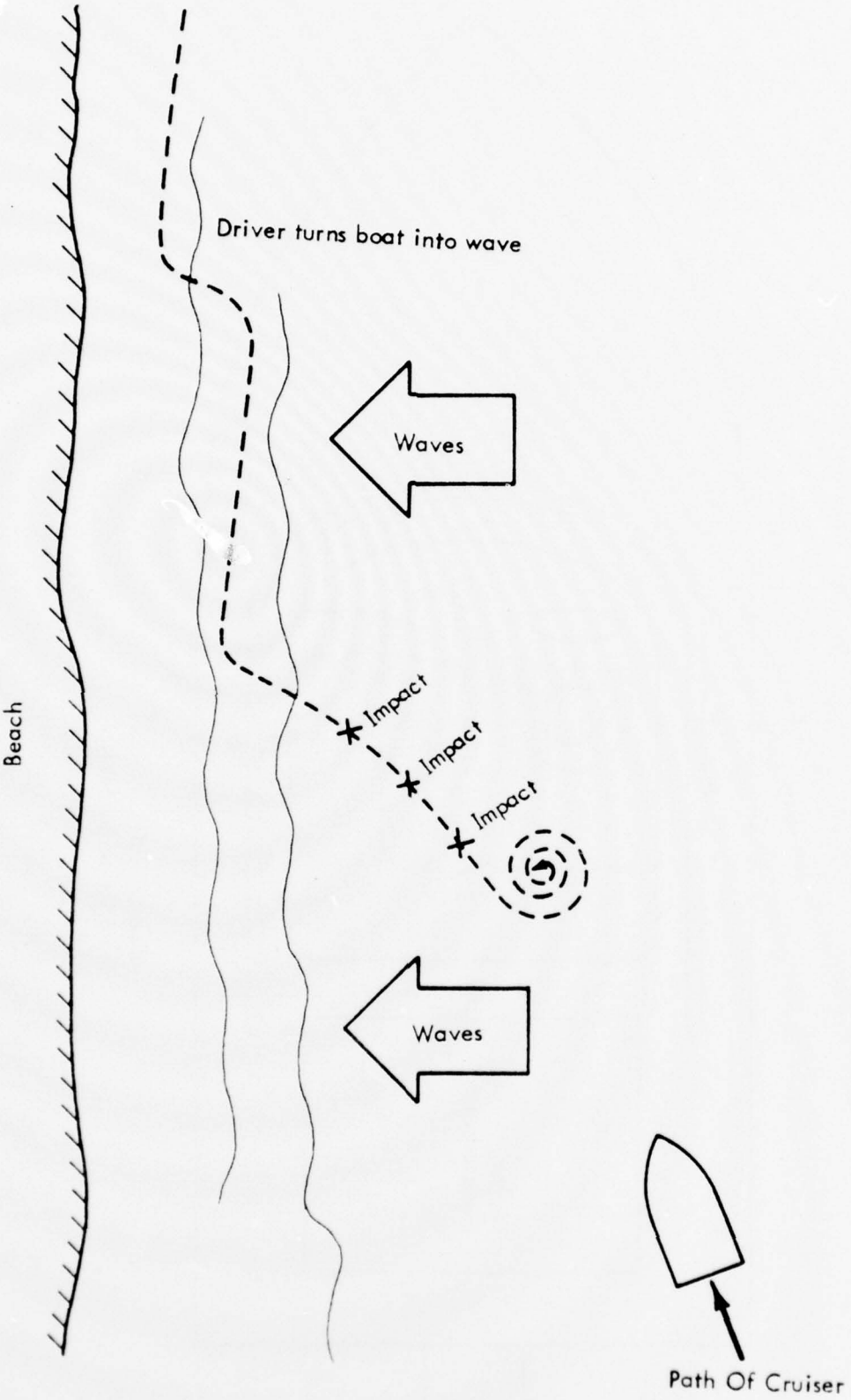


Figure 1. Accident Area Diagram

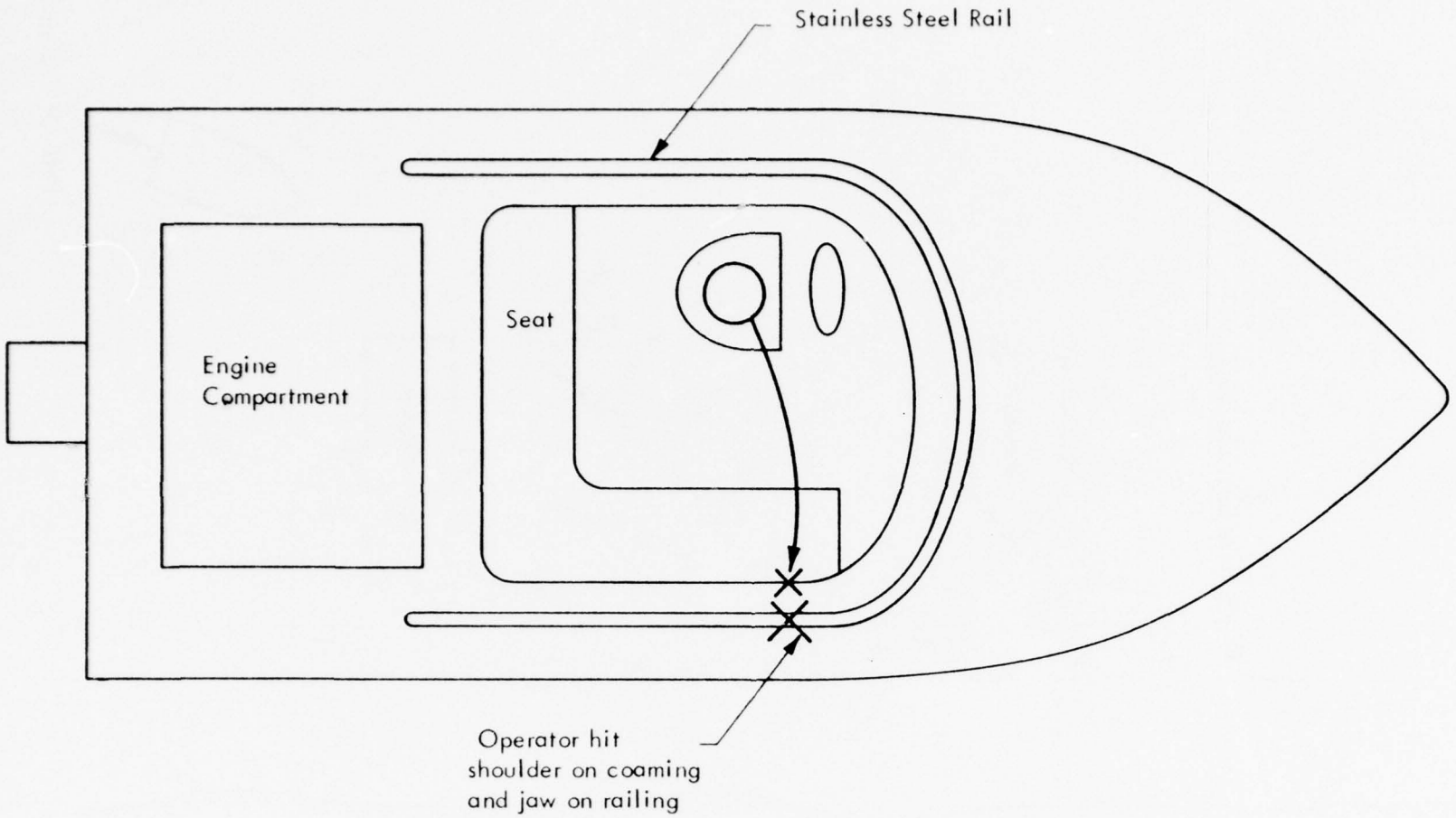


Figure 2. Runabout - Plan View



Figure 3. Advertising Photo of Runabout

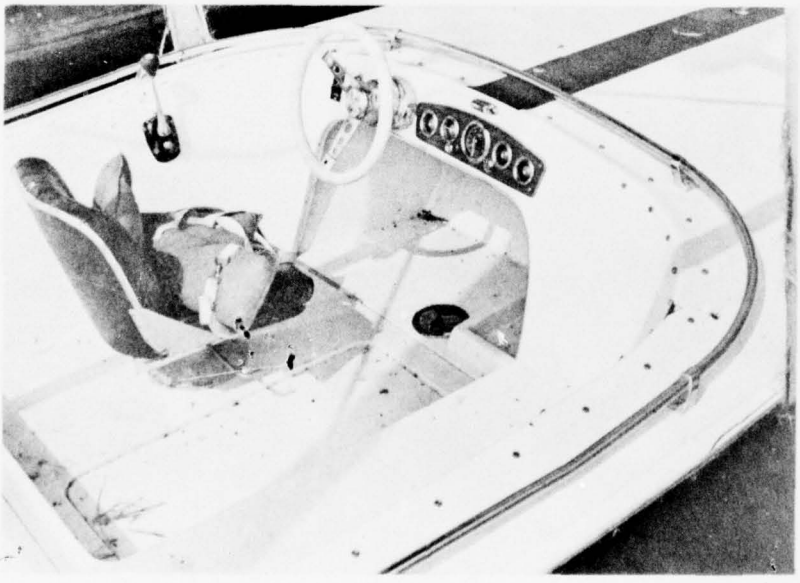


Figure 4. Cockpit Area - Runabout - Note Kink In Rail Where Operator's Jaw Impacted. Also Note Cracks In Fiberglass

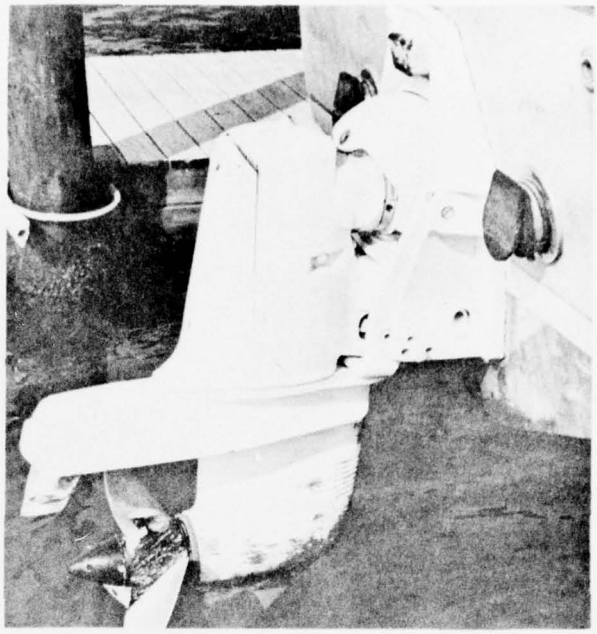


Figure 5. Outdrive Unit - Runabout

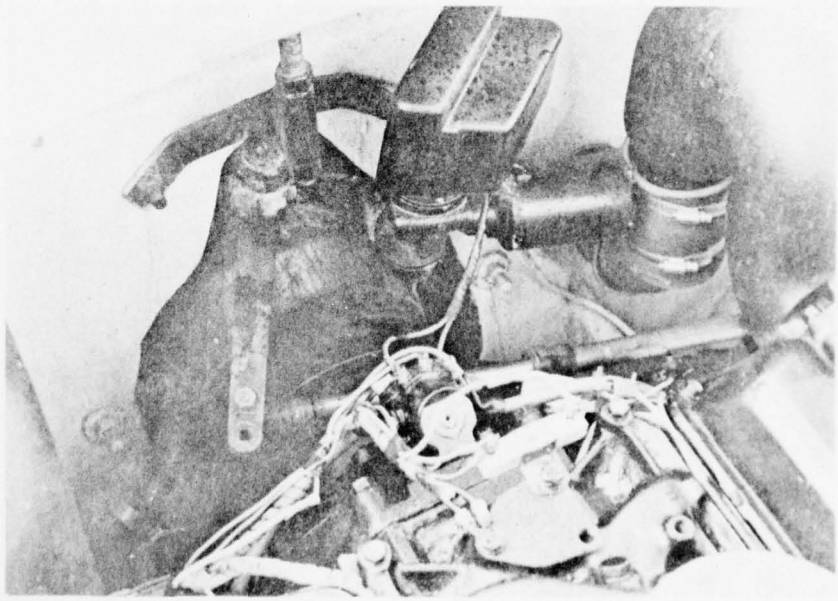


Figure 6. Aft Portion Of Engine Compartment Showing Tiller And Steering Rod

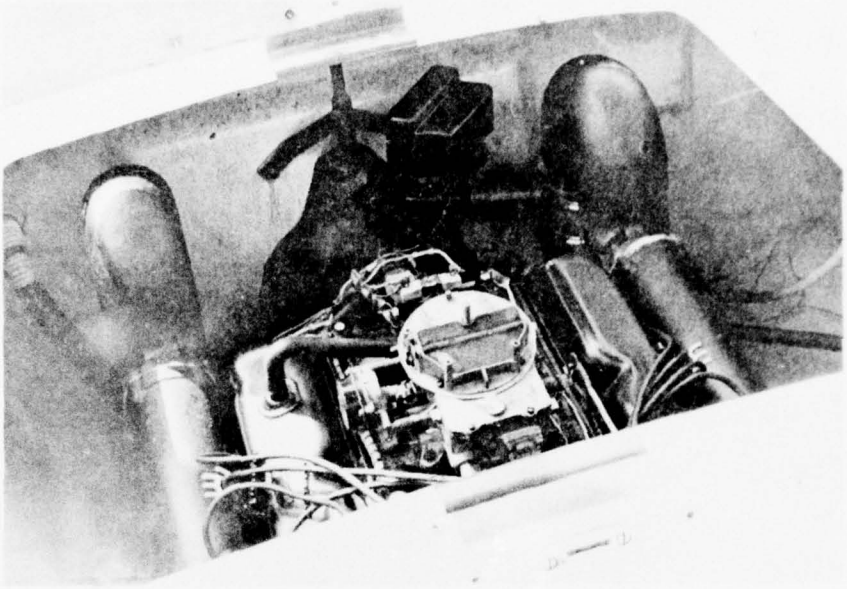


Figure 7. Engine Compartment Showing Flame Arrestor Permanently Removed From Carburetor

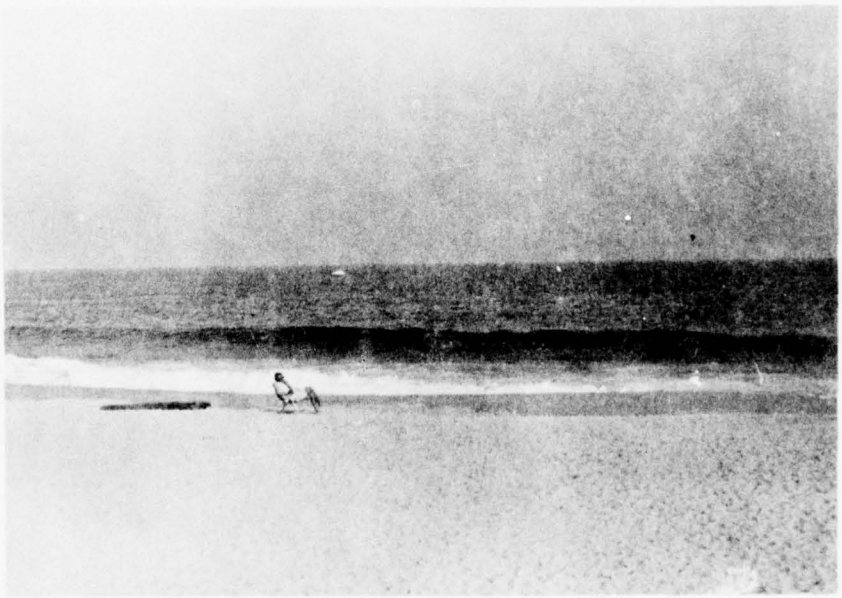


Figure 8. Beach Area Near Accident Site, Showing How Close Boat Would Have Been To Shore In Surf

APPENDIX S

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 17, 1975

Date of Accident: Mid-August, 1975

Investigation: Capsizing/Swamping No. 75-18

SUMMARY — WYLE ACCIDENT NO. 75-540

After eating dinner at his parents' waterfront home, a man and his teenage sister decided to go fishing on his parents' cabin cruiser. His wife took the children home. He couldn't find the keys for the cruiser, so the two went fishing in the cruiser's dinghy, a 12 foot fiberglass open boat.

They headed out the inlet into the ocean and fished just outside the surf line about 1/4 mile from shore.

A wave suddenly turned the boat over. It floated flat, upside-down. They donned PFDs and hung onto the upside-down boat for about an hour. Then they righted the boat, bailed it, and climbed aboard. An offshore wind blew them to sea. They huddled together in the bottom of the boat all night to attempt to keep warm. At 0730 a fishing boat spotted them, called the Coast Guard, and they were rescued.

There were no serious injuries as a result of the capsizing.

1.0 BOAT OCCUPANT DATA

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator	M	33	170	Excellent	>500	Yes, see below	No
Passenger	F	17	120	Excellent	300	No	No

The operator was a young family man who works as carpenter and painter. He had extensive boating experience and had mated for a commercial fishing boat for quite a while. He was obviously knowledgeable about boat handling and boats in general.

2.0 ENVIRONMENT

At the time of departure, the air temperature was 75 degrees, and the weather was clear. The temperature dropped into the mid to low 60's during the night, and it rained for a short period of time. The following morning was clear. Winds were light out of the northwest throughout the night and early morning. Water temperature was about 68 degrees.

3.0 NARRATIVE OF ACCIDENT

The following narrative was compiled from an interview with the boat operator and his wife.

3.1 Pre-Accident

The operator didn't work on the day of the accident, and instead just "kind'a took it easy." He and his family had been invited to his parents' house for dinner that night. After dinner he and his sister decided to go fishing in the family's inboard cruiser. The weather was good, it was clear, and there wasn't much wind. The wind that was present was blowing off shore, so the sea close to the beach was calm.

His wife decided she would take the children home and put them to bed instead of going along on the fishing trip. It was too much of a hassle to bed the children down on the boat, then wake them up, take them home, and bed them down again.

The trip was delayed for some period of time, because the ignition keys to the boat couldn't be found. His mother called his wife to see if she knew where they might be, and said if she didn't call back to assume that the keys had been found. There was no call back. The wife assumed that the keys were found and went to bed.

Actually, the keys weren't found that night. Instead, the two gave up the search and decided to go out fishing in the cruiser's dinghy, which also served as a fun little boat for the family and children to canals and rivers in the area. The boat was fiberglass, was 12 feet long and was equipped with a six horsepower outboard engine. They loaded a small anchor and 100 feet of line into the forward area, the tackle box into the aft floor area and put the five gallon gas can in the middle. The sister sat on the middle seat, and the operator sat on the aft thwart.

They proceeded out the inlet at about 2130 and noticed that it was unusually calm. The wind and current were running in the same direction. The operator made a mental note to get in before the tide ebbed. They reached the outer extremity of the inlet, turned north, and paralleled the coast for a couple of miles. He idled the engine and began to fish. They were about 1/4 of a mile off shore at the time.

Just prior to the accident, the boat was parallel to the shore line and was pointing generally south. The occupants were in the same location in the boat, but were shifted slightly off center towards the beach. The boat was listing somewhat to starboard.

The ocean swells were estimated to be about 18 inches high and were parallel to the beach.

3.2 Accident

At about 2215 a small wave hit the boat at about 45 degrees off of the port bow. It wasn't very big, but the operator said it was definitely a wave as opposed to the normal swells they had been experiencing. The port side of the boat raised just enough to throw the seated occupants off balance. They fell out of the boat to starboard. The boat capsized.

The operator swam away from the boat for what he estimated to be a distance of 10 feet. He wanted to get away from the engine which was still running. He called for his sister who suddenly appeared with the PFD, a flotation cushion, and the bailing bucket. She donned the PFD and gave him the cushion. The engine stopped and the two of them swam over to the boat, climbed up on it, and lay across the bottom of the boat.

3.3 Post-Accident

Neither occupant considered the possibility of swimming to shore. They were going to stay with the boat. They hung onto the boat for about an hour. The seas began to build until they were about three feet. They then decided to right the boat and attempt to bail it out. They righted the boat. One held the weather gunwale up while the other bailed with the bailing bucket. The boat was bailed, they climbed in, and immediately felt quite cold. They both got into the middle of the boat, between the seats, and huddled together while curled upon the "floor." Every so often the operator would yell for help, but since the wind was blowing off shore, he didn't think anyone would hear him. They both slept on and off throughout the night. Neither considered the possibility of attempting to paddle to shore, because they weren't sure which way shore was. There were fishing boats on the horizon all around them, so there were lights on the horizon all around them. Without a compass, they became disoriented and couldn't identify shore lights.

At about 0300 it began to rain. The operator held up the bailing bucket and collected a small amount of water.

At daybreak they found that they could see shore. The operator moved to the bow of the boat, lay on his stomach with his head over the bow, and paddled, using the bailing bucket as a propulsion device until 0730. At that time, a charter fishing boat came out of the inlet towards them. They waved clothing until they were spotted. The boat came over, and the captain wanted to take them aboard. The operator said he would stay with his boat and requested that the captain call the Coast Guard. The captain obliged. A coat was thrown to the operator, and a blanket was thrown to his sister. A gallon jug of fresh water was also given to the victims.

The charter boat stood about 200 yards off until the Coast Guard rescue boat arrived.

The Coast Guard arrived in half an hour and pulled the victims and their boat aboard the rescue craft. At that time, they were 6.5 mi off the coast. Upon arrival at the Coast Guard station, the operator was given a good stiff drink and they were given a hearty breakfast and dry clothes.

It is interesting to note that throughout the night, they weren't missed, because both the operator's wife and his sister's mother were asleep and, of course, didn't realize that they didn't come home.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a high production 12' fiberglass boat with a 4'2" beam and a displacement of 120 lbs. Maximum weight capacity for this boat is 799 lbs. Two people, the motor, and gear added up to 416 lbs and is broken down as follows:

Operator	170
Passenger	120
6 hp motor	51
5 gal of gas	40
anchor & line	12
tackle box	10
Paddle	3
PFDs	5
Misc.	5
Total	416

Obviously, the boat was not overloaded; at least not by the legal definition.

The interview took place at night, so no photo's were taken. An advertisement photo is included as Figure 3.

The boat appeared to be in average condition for its age. The operator said that a bow light had been clamped to the bow on the night of the accident and had fallen off when the boat capsized. No evidence of a light or clamping marks were visible on the craft.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The operator didn't feel bad about venturing into the ocean in such a small boat at night. In fact, he said that he would do it again. He felt that the wave that capsized the boat was a freak wave, and the probability of another capsize was slim. He wasn't cocky about it, but gave an air of assuredness about his ability to handle that type of boat in that kind of an environment. He said that his only real mistake was in not securing the anchor line to the cleat in the bow of the boat. If it had been secured, the boat would have anchored itself when it capsized. They would not have drifted and could have paddled to shore.

It was interesting to note that neither occupant was wearing a PFD, and in fact there was only one wearable on board. When the boat capsized, the operator thought only of making sure he was out of the way of the propeller while his sister thought only of finding and getting the two life preservers. As it was, the bailing bucket floated, and she grabbed and hung onto it too.

The movie "Jaws" has in some way affected most of the people who have seen it. While in the water, the operator's greatest fear was not of drowning, but of being eaten by a shark. He had seen "Jaws" some three weeks prior to the accident.

One cannot say that at the time of the accident the boat was improperly loaded. In a small boat, it is impossible to always keep the live load perfectly centered. Unfortunately, a wave that wasn't seen because of darkness hit the boat at a time when the live load was shifted towards the opposite side of the boat.

6.0 PROBABLE CAUSE OF ACCIDENT

The boat should not have been out in the ocean at night. It was too small and not equipped with proper running lights. However, the above didn't cause the capsizing.

The cause must be stated as an unseen wave approximately two feet high, striking the port bow of the boat while the live load was shifted to the starboard aft portion of the boat.

7.0 DYNAMICS/ANALYSIS OF ACCIDENT

A time history of the accident is as follows:

2130	Departed
2145	Cleared inlet
2150 to 2215	Fished
2215	Boat capsized
2220 to 2330	Occupants laid over inverted hull
2330	Occupants righted boat and began to bail
0130	Occupants entered, bailed out boat
0300	Rained
0530	Occupants began to paddle towards shore
0730	The boat sighted by charter fishing boat
0800	Coast Guard arrived on scene and took occupants aboard

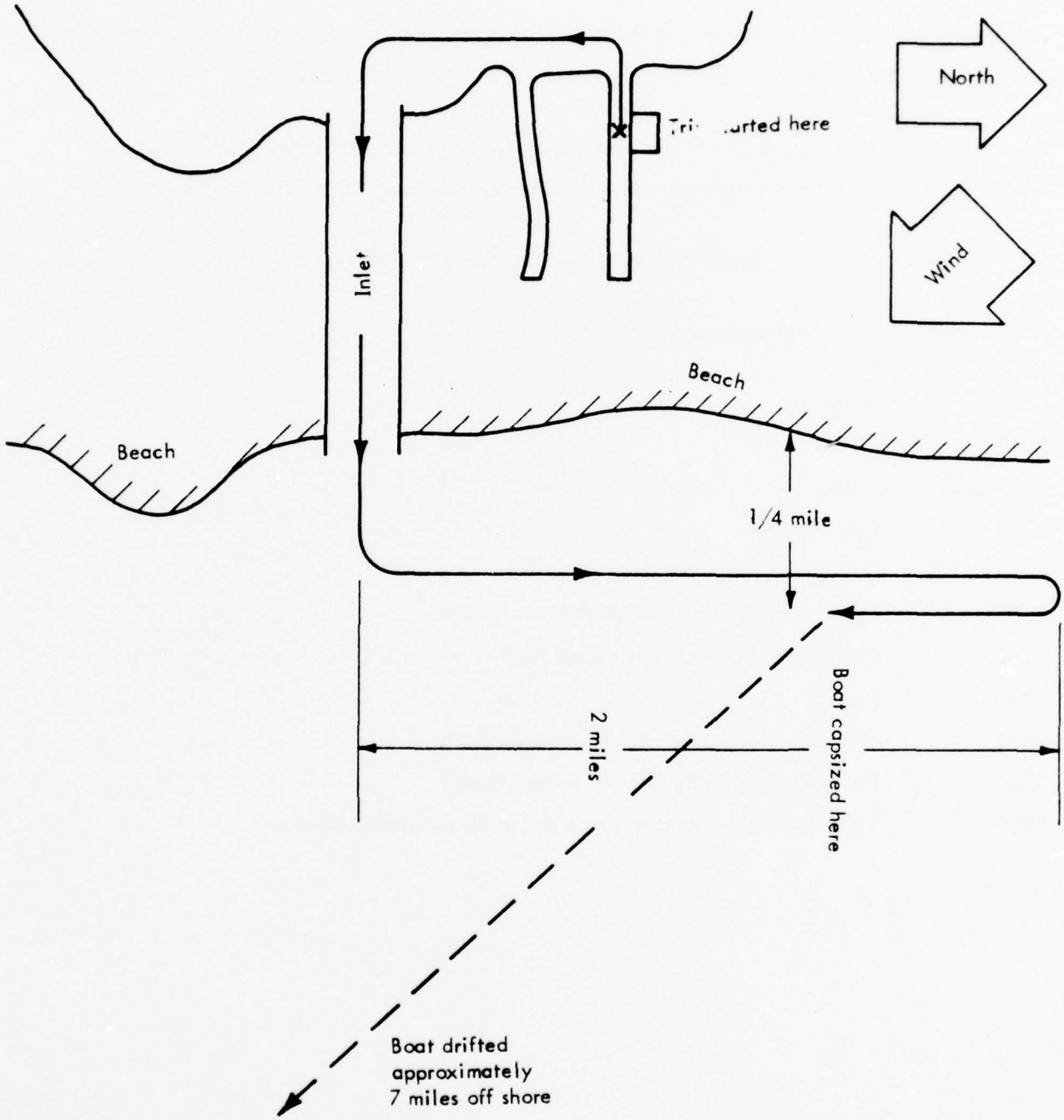


Figure 1. Accident Area Diagram

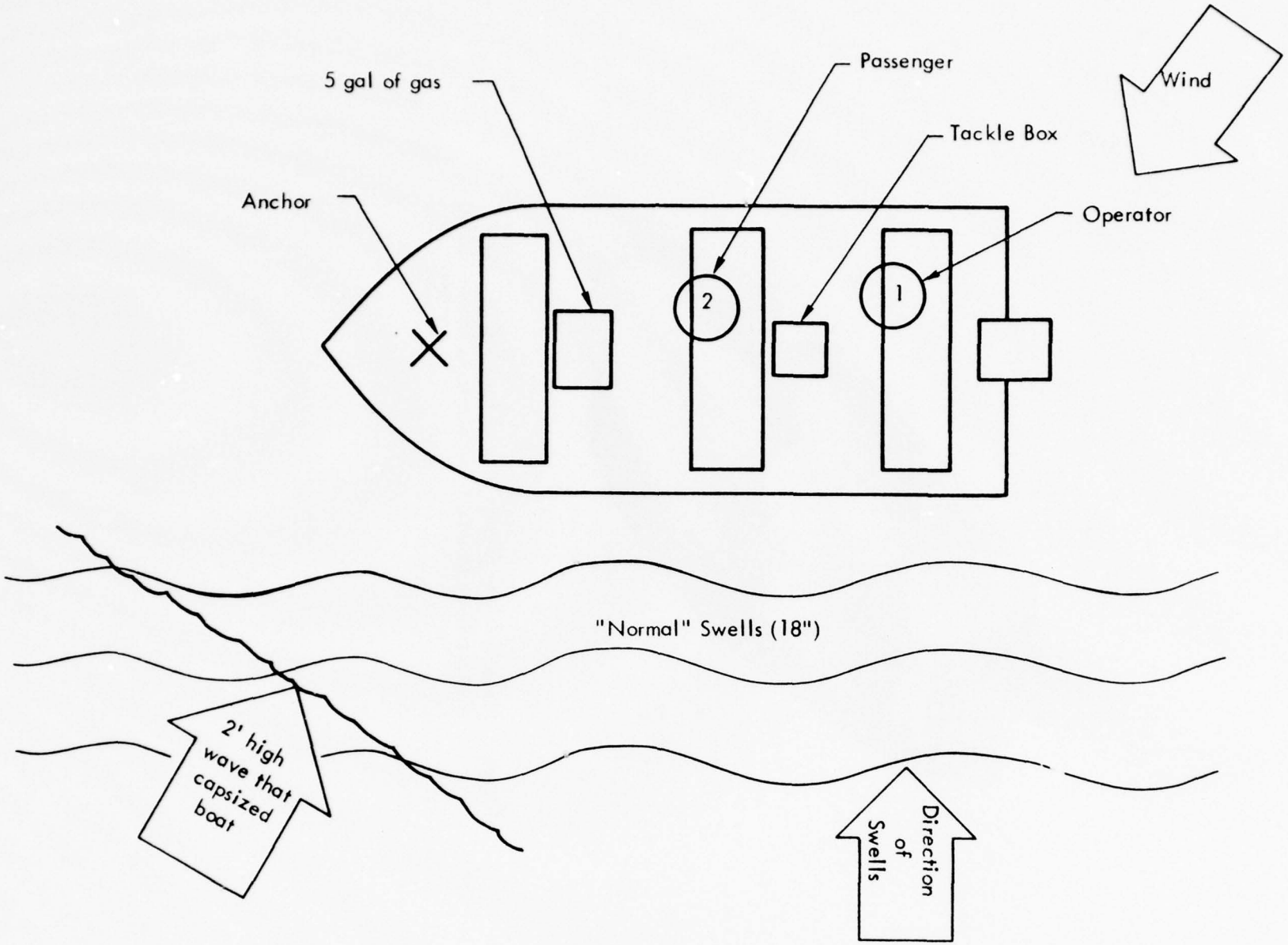


Figure 2. Boat Configuration & Data At Time Of Capsize

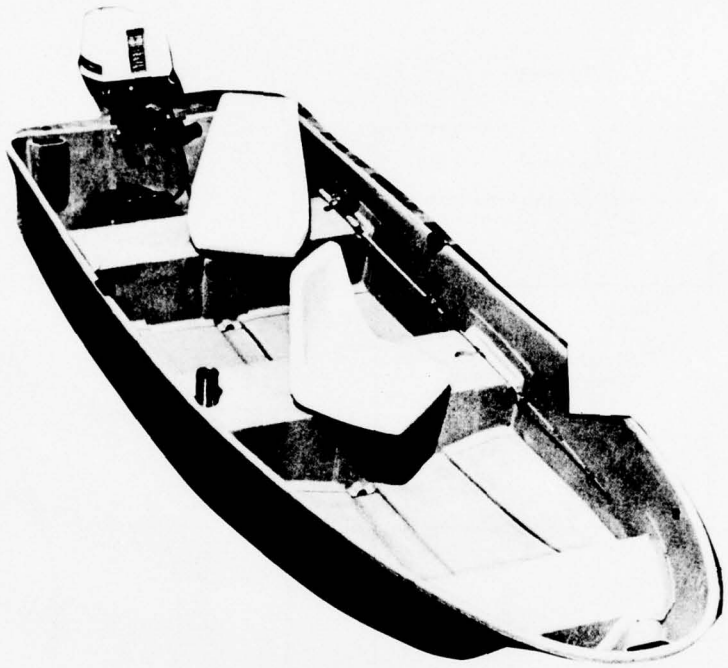


Figure 3. Involved Boat (Note: Actual Boat Did Not Have Swivel Seats Mounted To Thwarts As Shown Above)

APPENDIX T

ACCIDENT INVESTIGATION REPORT

Date of Investigation: August 13, 1975

Date of Accident: Late July, 1975

Investigation: Capsizing/Swampina No. 75-19

SUMMARY — WYLE ACCIDENT NO. 75-434

The accident reported herein involved a 14 ft semi-v runabout powered with an 18 horsepower and a 15 horsepower outboard motor. The type of accident was a swamping, resulting in minor injuries to two of the four people on board.

At approximately 1730 in late July, 1975, a party consisting of two men and two women set out on a clam digging trip from a launch ramp located in east central Maine. The party traveled approximately 2 miles across a bay to an island where they dug clams for approximately 2 hours. When they started back, it was discovered that the sheer pin was broken on the starboard motor. Also, they observed that the wind velocity had increased, and the water was much rougher than it had been when they arrived on the island. When they got underway (5-7 mph) back across the bay, the bow was pointed into the wind and waves at an angle of approximately 30 degrees off the starboard side. A considerable amount of water spray was coming over the starboard bow into the passenger compartment. Approximately 10 minutes after getting underway, the operator noticed that a considerable amount of water was in the stern. He instructed the two females aboard to climb on the bow to prevent the stern from

sinking. At about the time the women were positioned on the bow, the motor stopped. The boat slowly turned to port until the transom was into the wind and waves. The waves started breaking over the transom and in a very short time, water was flowing freely over the transom. The boat filled with water and started sinking by the stern. The occupants got out of the boat into the water, with three of the occupants each holding a flotation cushion and one wearing an AK1 PFD. The people manually capsized the boat so air would be entrapped in the bow section, which would keep the boat afloat. The people held onto the bow line for approximately one hour. After this time, a male and female passenger left the boat and swam ashore, leaving the operator and other female passenger with the boat. They returned in approximately two hours with a rescue boat. The operator and female passenger that had stayed with the boat were taken to the hospital, treated for exposure and shock, and released. A Coast Guard vessel towed the involved boat back to the launch ramp.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator	M	25	160	Fair	>200 hr	None	No
Passenger	F	24	150	Non-swimmer	Very little	None	Yes
Passenger	M	26	160	Excellent	>100 hr	None	No
Passenger	F	31	110	Excellent	Very little	None	No

Prior to the investigation, arrangements had been made to meet with all of the occupants which had been in the involved boat. When the investigator arrived in the area, the operator and two of the passengers had temporarily moved to another location.

The interview was conducted with Occupant No. 4 (31 year old female).

From the interview, it was apparent she knew very little about operating a boat and had no interest in learning. She seemed to be of average intelligence and had a very good recall of events prior to, during, and after the accident.

She was a high school graduate and worked as a waitress in a small local restaurant. She had known the other occupants for at least seven years. The following information was given by her.

Occupant # 2

She was a high school graduate of normal intelligence. She did not work and was the wife of occupant no. 3. At the time of the accident, she was approximately six months pregnant. She knew very little about operating a boat, and was always a passenger when in a boat.

Operator & Occupant # 3

These two men were high school graduates and were employed as common laborers with a construction company. They were very familiar with the waters in the accident area. They had

each owned several runabout boats (under 18 ft) and were considered good operators. Most of their boating experience had been in the inland waterways near their home. The interview was conducted in the neighborhood of the occupants. It was obvious from the surroundings that all of the occupants were in the lower income class.

2.0 ENVIRONMENT

The sky was clear and the wind was estimated to be 15 knots. The air temperature was estimated at 75°F and the water temperature estimated at 48°F. The water was choppy with 1-3 foot waves.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

The clam digging outing had been arranged a week prior to the accident. The party was to include the operator, occupant no. 3 and 4. Occupant no. 2 had not planned to go, because she was pregnant.

On the night before the accident, the occupants played cards at the operator's home until approximately 2100. According to the passenger interviewed, there was no alcohol consumed that night or the day of the accident. All the occupants went to bed before 2200 and arose at approximately 0400 to prepare for the trip.

The weather seemed to be very good, so occupant no. 2 decided she would go on the trip.

The party left the owner's home at approximately 0500, arriving at the launch ramp approximately 15 miles away at approximately 0530. The boat was launched, and the party headed diagonally across the bay to an island where they planned to dig for clams. The party arrived at the island at approximately 0545 and dug clams until approximately 0745. The clams (approximately 200 lb) in a large container were loaded into the boat and the party prepared to go back to the launch ramp. During the time they were on the island, the wind had increased from light to approximately 15 knots, and the water condition had changed from

light chops to swells of 1-3 ft. The occupants climbed aboard, the motors were started, and they got underway. Immediately after getting underway, the operator noticed that the starboard motor was not developing thrust. The motors were placed in neutral, and a quick inspection revealed that the sheer pin on the starboard motor was broken. The motor was tilted to raise the foot out of the water and they again got underway.

Traveling at a slow speed (5-7 mph), a considerable amount of water spray was coming over the starboard bow into the passenger compartment. Occupant no. 2 was a non-swimmer and decided to put on the AK1 PFD. The boat was traveling into the wind and waves at an angle of approximately 30 degrees off the starboard bow. Approximately two minutes after getting underway, the operator decided to dump the clams to decrease the weight in the boat. The boat was stopped and the two male occupants dumped the clams over the side. After getting underway again and traveling for another 2-3 minutes, the operator noticed that a considerable amount of water was in the aft section of the boat, and the waves were breaking over the transom. He instructed the two female occupants to climb on top of the bow to increase the transom freeboard. Shortly after the female occupants were positioned on the bow top, the motor stopped. It is not known if the motor stopped due to water intake. After the motor stopped, the boat drifted in a counterclockwise direction until the transom was pointed into the wind and waves. The boat began to flood rapidly by waves breaking over the transom.

3.2 Accident

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

The two male occupants began bailing water, using the clam container and a one gallon plastic container. The men soon discovered that water was coming into the boat faster than it could be evacuated, so the bailing operation was stopped. The aft section of the boat filled with water and the boat started sinking by the stern. The operator instructed the passengers to grab a flotation cushion and jump in the water. The female occupants, No. 2 wearing an AK1 PFD and No. 4 holding a flotation cushion, slid into the water off the starboard bow. The male occupants, holding flotation cushions, went in the water over the starboard side.

The stern continued to sink until the bow was up approximately 45 degrees. At this point, the operator told the passengers that the boat would have to be capsized to entrap air in the bow section, or the boat would completely sink. The occupants manually rolled the boat to starboard until it was in an upside-down, bow high position. The waves were pitching the bow up and down and the entrapped air was escaping. The operator instructed the passenger to hold to a line that was tied to the bow eye, so the bow would stay submerged.

3.3 Post Accident

The occupants stayed with the boat for approximately one hour by holding to the bow line. Approximately 15 minutes after the accident, a ferry boat came by at a distance of approximately 50 yd, but apparently did not see the capsized boat. According to the passenger interviewed, the ferry boat passed the capsized boat five times during the first hour, but did not see them or the captain elected not to render assistance. Also, a sail boat passed within 50 yd of the capsized boat approximately 30 minutes after the accident, but apparently did not see them. After the accident, the operator instructed the passengers to move around in the water, thinking this would keep their body temperature up and prevent shock.

After approximately one hour from the accident, the occupants decided their chances of being rescued by another boat was slim, and they would die from exposure if they did not get out of the water. The occupants decided that the two best swimmers should try to swim ashore and get help. It was decided that No. 3 and 4 were the better swimmers and would have a better chance of making shore (approximately 1-1/2 miles). No. 2 was a non-swimmer, and they felt it would be too risky for her to leave the boat. No. 1 was not sure if he could swim ashore. Occupant 3 and 4 started swimming ashore after No. 3 removed his boots and No. 4 exchanged her flotation cushion for the AK1 No. 2 was wearing. No. 4 felt she would have a better chance of making it ashore if she was wearing the AK1. Approximately half way to shore, No. 3 became very exhausted and told No. 4 to continue on and get help, and he would continue as soon as he had rested. When No. 4 reached the shore, she could not see No. 3 and feared he had drowned. She found a trail near the beach and followed it approximately two miles to a cabin where she found a young couple with a boat that were willing to help. She and the couple drove back down the trail in the couple's jeep, looking

for No. 3. They found him walking up the trail approximately 1 mile from the cabin. No. 3, 4 and the couple drove to a pier near the cabin, boarded the couple's boat and headed out to look for No. 1 and 2. The owner of the rescue boat called the Coast Guard on marine radio and reported the accident.

The capsized boat with 1 and 2 still holding to the bow line was found approximately 1/2 mile down the bay from where 3 and 4 had left it to swim ashore. From the time 3 and 4 left the capsized boat for shore until 1 and 2 were rescued was approximately two hours. No. 1 and 2 were taken aboard and wrapped in blankets. No. 2 seemed to be in fair condition, but No. 1 was in a semi-conscious state. The rescue boat took the occupants to the launch ramp, and No. 1 and 2 were taken to a local hospital. No. 1 and 2 were treated for shock and exposure for a period of 4 hours and released.

The capsized boat was located and brought back to the launch ramp by a Coast Guard vessel. Refer to Figure 2 for sketch of accident area.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a typical semi-v hull runabout used primarily for fishing. The boat and motors looked to be in very poor condition. Metal components on the boat, motor, and steering system were badly corroded. The steering cable was frayed and corroded in numerous places. Refer to photographs 1-7.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

As far as could be determined, the actions on the part of the operator to keep the boat from swamping were correct. No doubt, he exercised poor judgment in continuing the trip across the bay after he saw that the water conditions were hazardous.

The operator was not aware of the correct action to prevent hypothermia. He instructed his passengers to exercise and move about to keep their body temperature high. If he had instructed them to stay motionless, their predicted survival time would have been increased by approximately 25 percent. There are other protective measures that could have been taken

which would have increased their predicted survival time an additional 25 percent. The people in this accident did survive; however, according to research studies, their predicted survival time in 48°F water temperature is less than two hours. Using the correct survival technique, the time can be increased to approximately 3-3/4 hours.

The operator's forward visibility was no doubt impaired by the water spray over the forward section of the boat. This impairment could have been great enough to prevent the operator from maneuvering the boat into the wind and waves in a manner which would have kept the ingress of water into the boat at a minimum.

6.0 PROBABLE CAUSE OF ACCIDENT

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

- Overloading is considered the primary cause of this accident. According to the estimated weight aboard prior to the flooding, the boat was overloaded by at least 25 percent.

- The inoperative condition of one motor and stoppage of the operating motor is certainly a contributing factor in this accident. The trip across the bay possibly could have been accomplished, had both motors been operating properly.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

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

According to the estimated weight in the boat at the time of the accident, the boat was at least 25 percent overloaded. With the load distribution, it is assumed that there was very little transom freeboard. The transom design was such that any water that came over the transom would go into the passenger compartment.

The passenger stated that prior to the flooding, all the occupants became soaking wet from the water spray over the forward section. Therefore, it can be assumed that there was enough water in the boat at the time of motor stoppage to reduce the transom freeboard to near zero. When the stern drifted into the waves, water started flowing freely over the stern, swamping the boat.

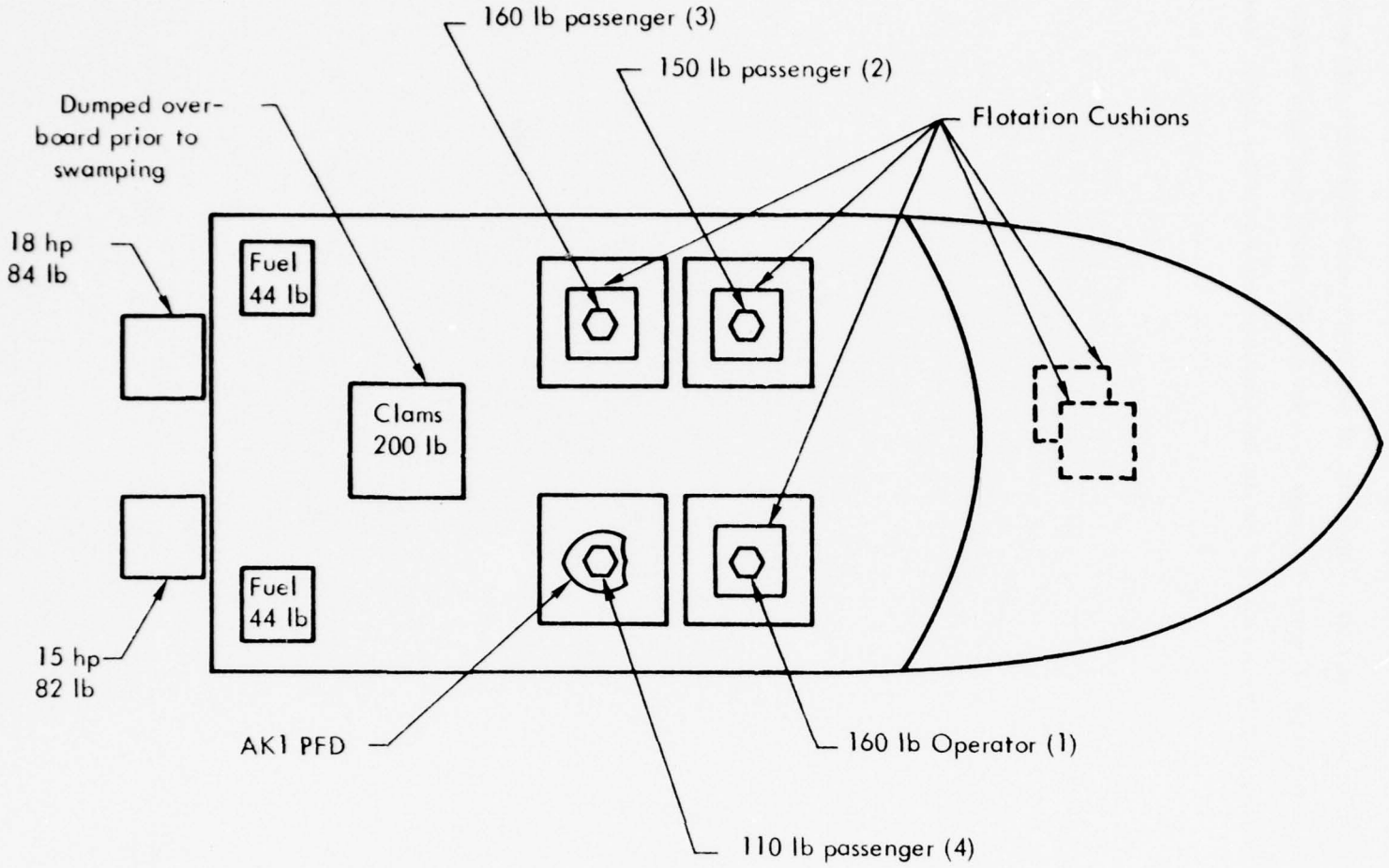


Figure 1. Load Distribution At Time Of Accident

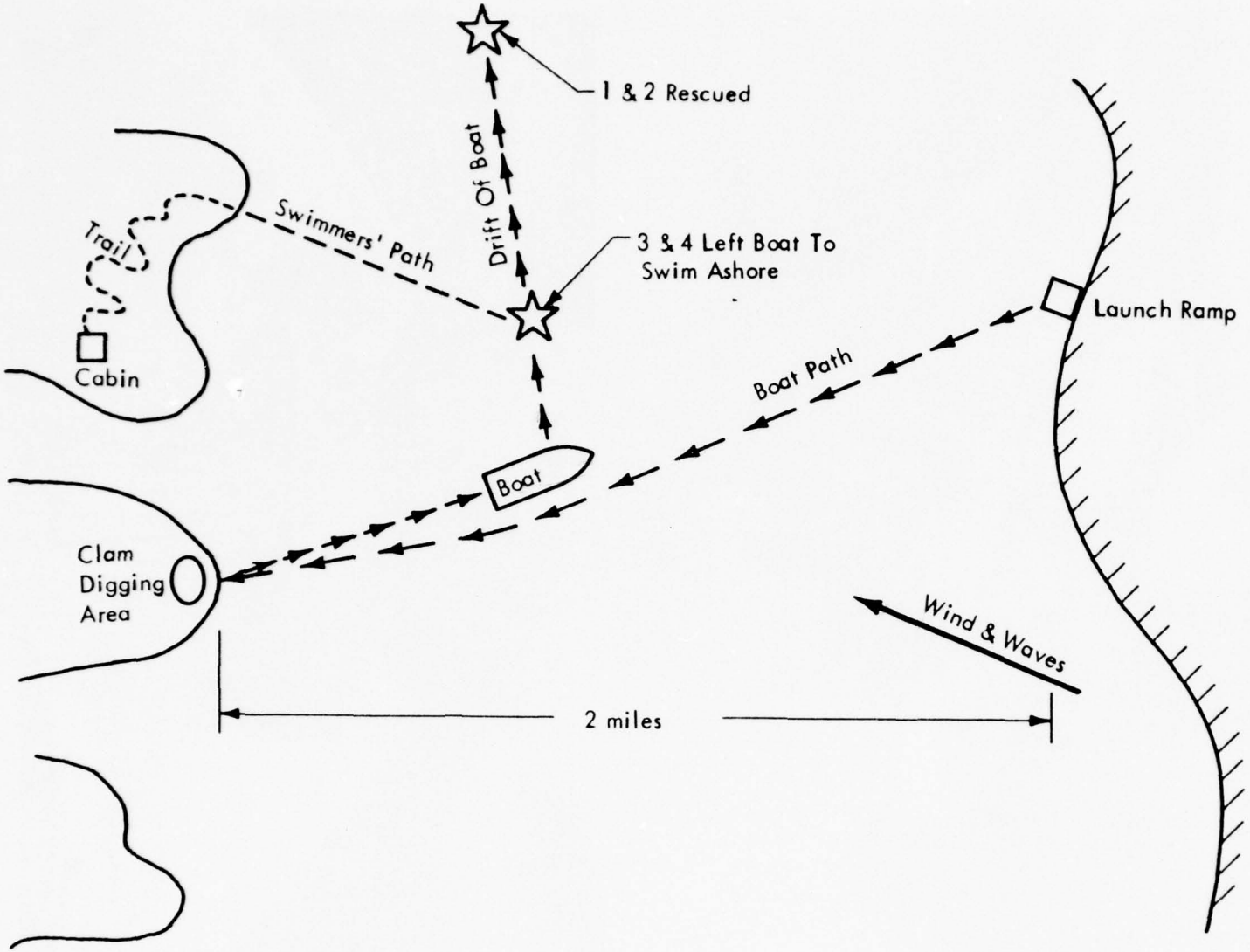
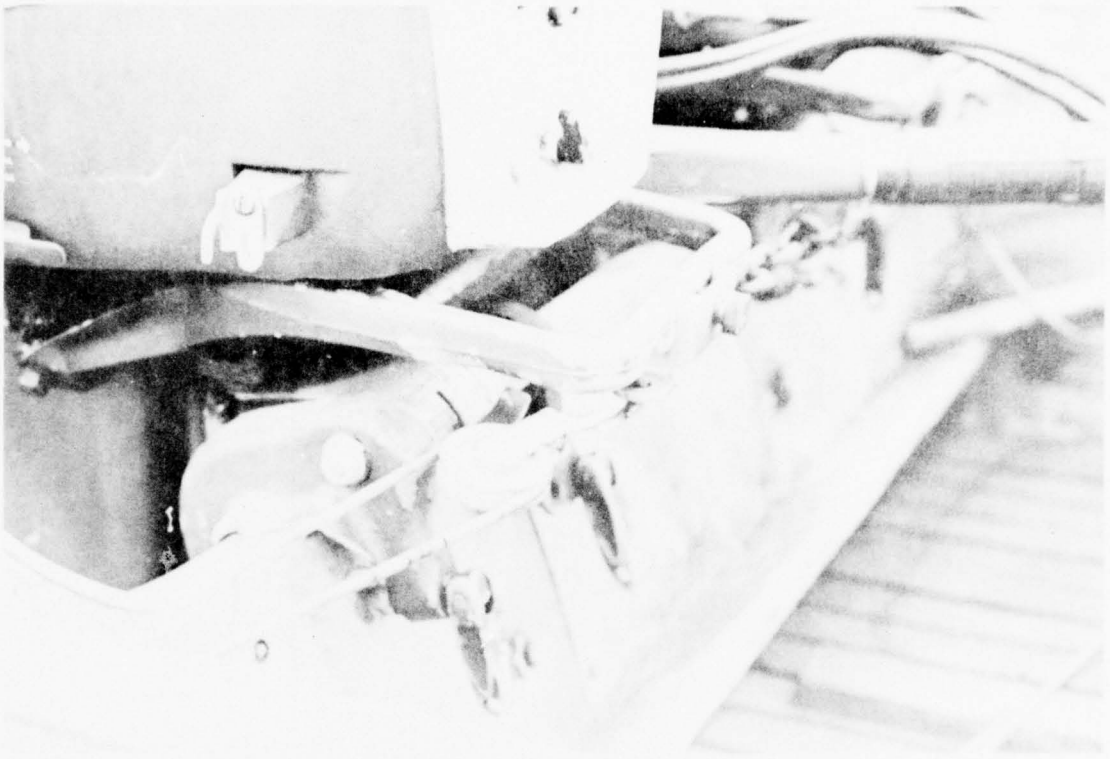
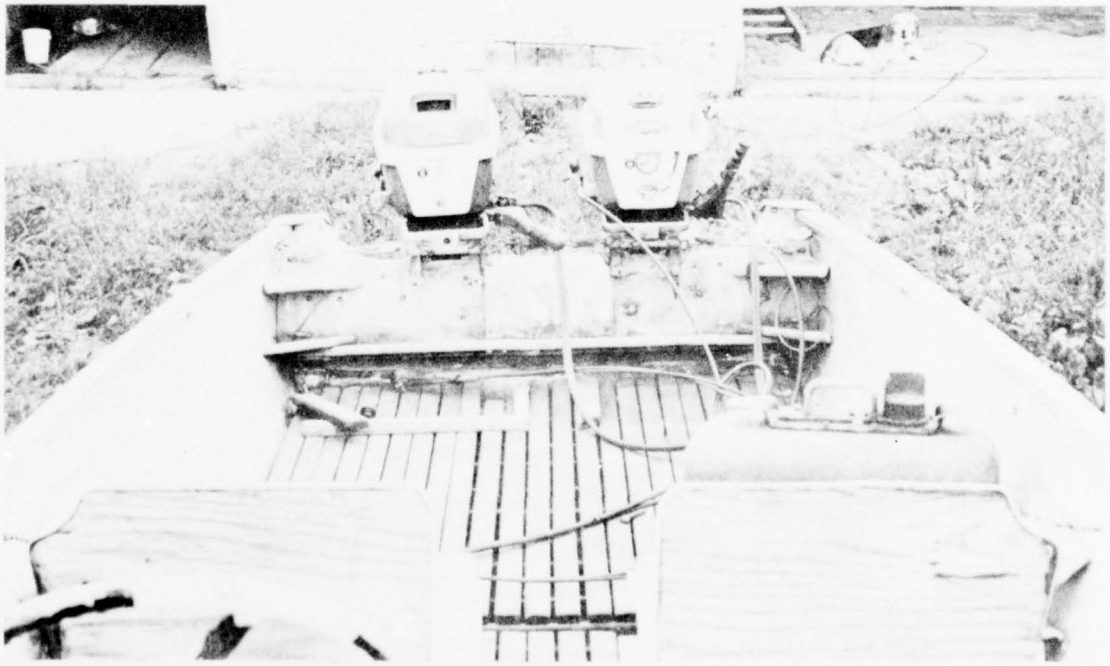


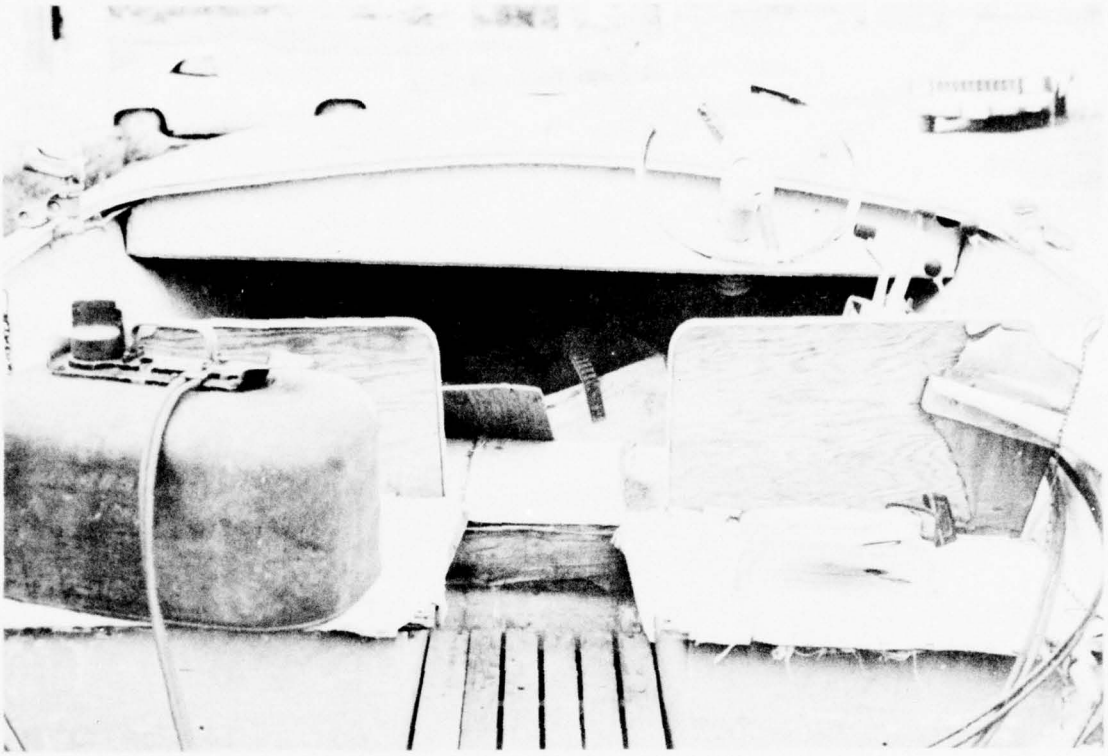
Figure 2. Accident Area



Photograph 1



Photograph 2



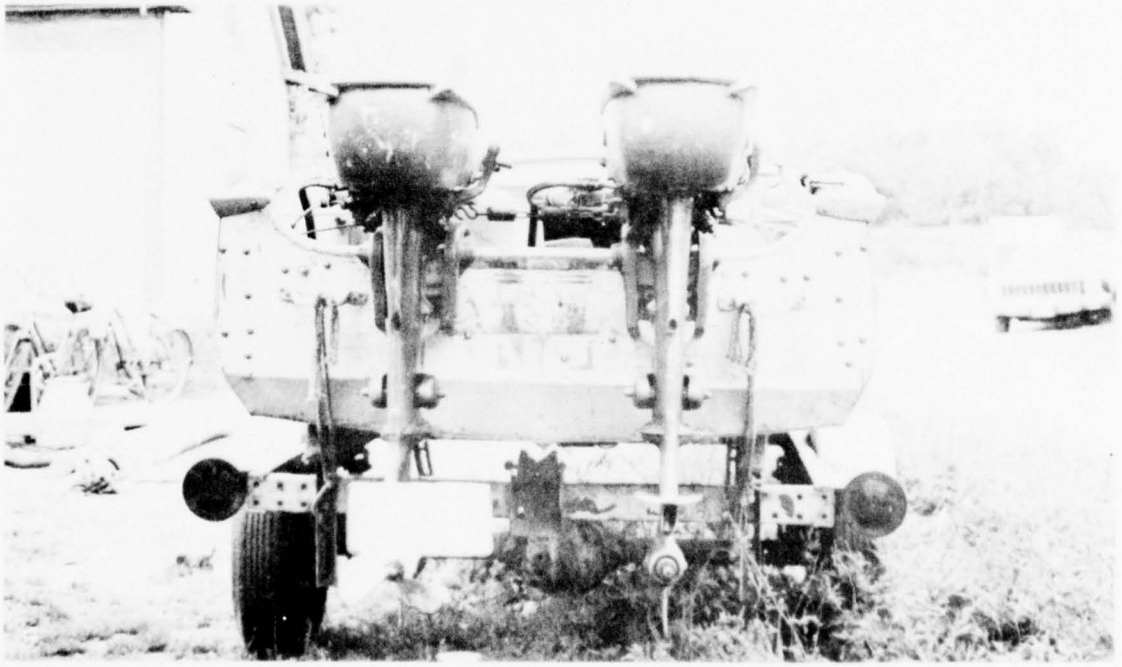
Photograph 3



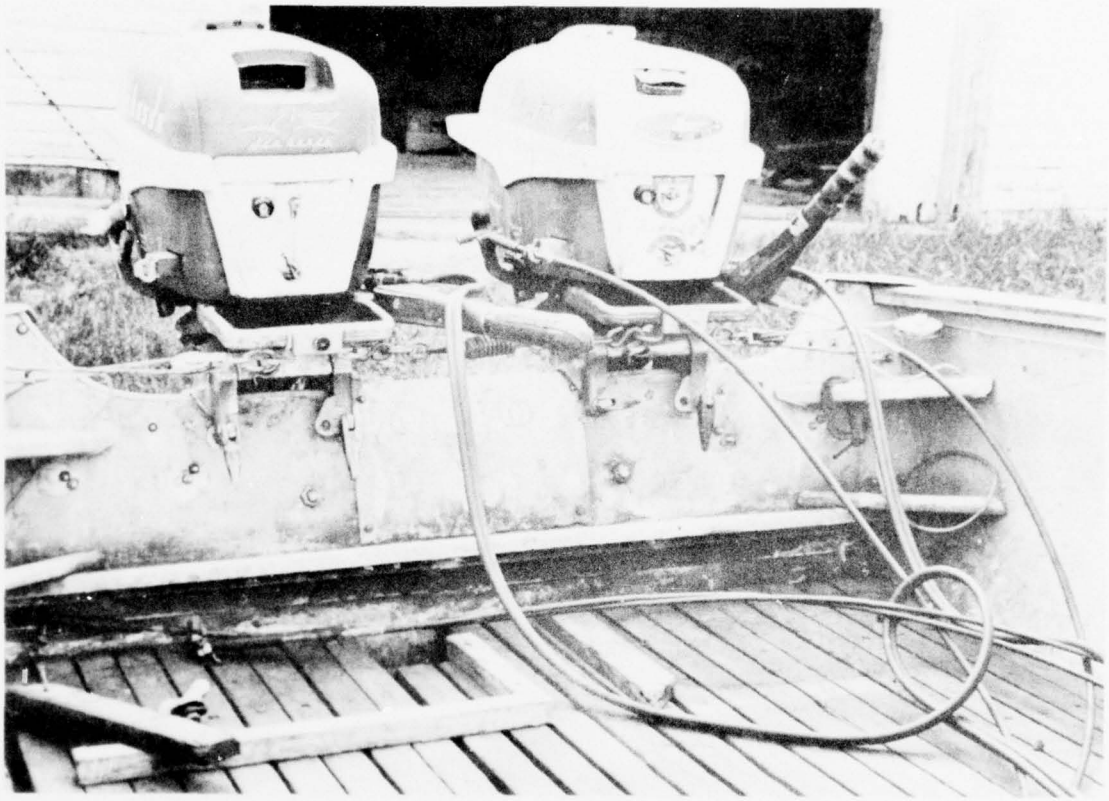
Photograph 4



Photograph 5



Photograph 6



Photograph 7

APPENDIX U

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 18, 1975

Date of Accident: Late July, 1975

Investigation: Capsizing/Swamping No. 75-20

SUMMARY — WYLE ACCIDENT NO. 75-447

The accident reported herein involved a 10 ft aluminum johnboat (no motor attached). The type of accident was a capsizing of the boat, resulting in the drowning of one of the two people aboard.

At approximately 1630 on a day in late July, 1975, two men set out on a fishing trip on a small lake located in southern Michigan. The men rowed the boat approximately 1/2 mile from the launch ramp where they anchored the boat and fished for approximately two hours. The fishing gear was stowed and the anchor pulled aboard in preparation to get underway back to the launch ramp.

The owner had rowed the boat to the fishing area, and his companion was to row back. The owner was seated in the bow seat, and his companion was seated in the center seat, starboard side. The owner stood up and started moving to the stern. When he reached amidship, he stepped over the center seat, placing his right foot on the port side just aft of the center seat. The boat capsized, and both men fell into the water. No PFDs were in the boat. The companion immediately started swimming ashore (approximately 150 ft away). When he was

within approximately 50 ft of shore, he heard the owner call for help. He grabbed some reeds that were nearby, turned around, and saw that the owner was approximately 20 ft from the overturned boat and was having a hard time keeping his head above water. The companion called to the owner and told him the boat was behind him and to try to swim to the boat. The owner went under, and shortly thereafter, the companion saw the top of his head come up. The owner submerged again and did not return to the surface. The companion called to a fishing party in a nearby boat for help. The boat rescued him and took him back to the ramp where the local police were called. The owner's body was recovered approximately one hour after the accident in the location of the capsizing. The boat was towed back to the launch ramp by the local police.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator	M	70	150	Poor	Very Little	None	No
Passenger	M	66	160	Excellent	Very Little	None	No

1.1 Operator/Owner

The owner was a retired college chemistry professor. According to his family and friends, his mental and physical condition was above average for his age. His swimming ability was thought to be excellent; however, after the accident, he was unable to swim approximately 20 ft to the boat.

He had owned the involved boat for approximately three months. He had been fishing with it three or four times. It was the only boat he had ever owned. Most of his boating experience had been as a passenger and very little as an operator.

1.2 Passenger

The passenger was a retired college philosophy professor. He was also an ordained minister of the Methodist Church. His mental and physical condition seemed to be average for his age. From the interview, it was apparent that he was not an experienced boat operator. Most of his boating experience had been as a passenger, very little as an operator. He had been out in a johnboat two times, both times in the involved boat.

2.0 ENVIRONMENT

The sky was hazy with poor visibility. The wind and water was calm. The recorded air temperature was 65°F and the recorded water temperature 68°F. The water depth at the accident site was 10-15 ft.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

On the day before the accident, the operator (1) called the passenger (2) and set up a fishing trip for the next afternoon.

No. 1 was an animal lover and provided shelter for approximately 150 animals, mostly stray dogs and cats at his home. He spent the morning and part of the afternoon on the day of the accident around his home, taking care of the animals. No. 2 worked at his office preparing for a lecture until approximately 1500.

At approximately 1600 No. 1 loaded the boat on his truck and drove to the home of No. 2, arriving at approximately 1615. The two men then drove to the lake approximately five miles away, arriving at approximately 1630. The boat was launched, the fishing gear stowed, and they headed for a fishing spot approximately 1/2 mile away. No. 1 said he would row to the fishing spot and No. 2 could row back. No. 1 rowed from the center seat with No. 2 positioned on the rear seat. They arrived at the fishing spot at approximately 1650. The anchor was put out and the men fished for approximately two hours.

3.2 Accident

The anchor was pulled in, the fishing gear stowed, then they started to get in position to row back to the launch ramp. Gear aboard was as listed in Figure 1, and the weather as noted in Section 2.0. No. 1 was seated in the forward seat, and No. 2 seated in the center seat. No. 1 told No. 2 that he would move to the rear seat so it would be easier for No. 2 to row. No. 2 moved to the starboard side so No. 1 could pass. No. 1 stood up and started moving aft. When No. 1 reached amidships, he stepped over the center seat, placing his right foot on the extreme port side immediately aft of the center seat. As his weight shifted to his right foot, the boat quickly heeled to port, dumping both men into the water. Apparently, the boat completely submerged, rolled over, and returned to the surface in an upside-down level attitude. As soon as No. 2 was in the water, he started swimming for shore, approximately 150 ft away. No. 1 had stated many times that he was a good swimmer, so No. 2 thought

he had also started swimming ashore and was close behind him. After No. 2 swam for approximately 100 ft, he heard No. 1 call to him for help. No. 2 felt he was too exhausted to go back and help No. 1. He grabbed some reeds or other vegetation nearby and turned to look for No. 1. He located No. 1 in the area where they had fallen in the water, and the boat was approximately 20 feet beyond No. 1, floating in an upside-down level attitude. He called to No. 1 and told him the boat was behind him, swim to it. No. 2 could see that No. 1 was having a hard time keeping his head above water. Within a few seconds, No. 1 disappeared under water and shortly thereafter the top of his head surfaced, then submerged again and did not return to the surface.

3.3 Post Accident

No. 2 found that he could touch bottom with his feet, but it was mud and would not support his weight. He was able to keep his head above water by hanging to the vegetation. He felt he was too exhausted to swim ashore until he had rested. He noticed a fishing party in a boat across the lake and called to them for help. The occupants did not see the capsized boat or No. 2 and thought the calls were coming from shore. No. 2 continued to call until the party saw him and came to his aid. No. 2 was pulled aboard the boat and was taken back to the launch ramp where the local police were called. The body of No. 1 was found where he had disappeared within one hour after the accident. The boat was towed back to the launch ramp by the local police. There were no PFDs aboard at the time of the accident (forgotten and left at home). Refer to Figure 2 for sketch of accident area.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a typical flatbottom johnboat used exclusively for fishing. There was no visual damage, and the boat appeared to be in excellent shape. The flotation material consisted of a styrofoam slab installed under each seat at the time of manufacture. Refer to Photographs 1-5.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

These two men were obviously very well educated; yet, they were unaware of some of the basic rules pertaining to the operation of small boats, for example:

- The capacity plate attached to the boat specified a maximum persons capacity of 215 lb and a maximum weight capacity of 250 lb. The estimated weight in the boat at the time of the accident was 355 lb. Either the men ignored the information on the plate, did not know its importance, or did not see the plate.

- They went out in an unstable boat not wearing PFDs and no PFDs were aboard.

- They were not aware that the boat had flotation material and would have probably provided sufficient flotation for them to reach shore by holding to the boat.

The men were unfamiliar with the instability of this size johnboat; however, the previous outing they had been on in this boat should have taught them that it was too unstable to attempt standing up and walking around.

6.0 PROBABLE CAUSE OF ACCIDENT

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

- The men were unfamiliar with the proper operation of a johnboat and were unaware of the instability characteristics. The operator attempting to walk from the bow to the stern caused the capsizing.

- The boat was overloaded at the time of the accident; however, this is not considered a major factor, since the water was calm. The overloaded condition most likely increased the boat's stability under the existing conditions.

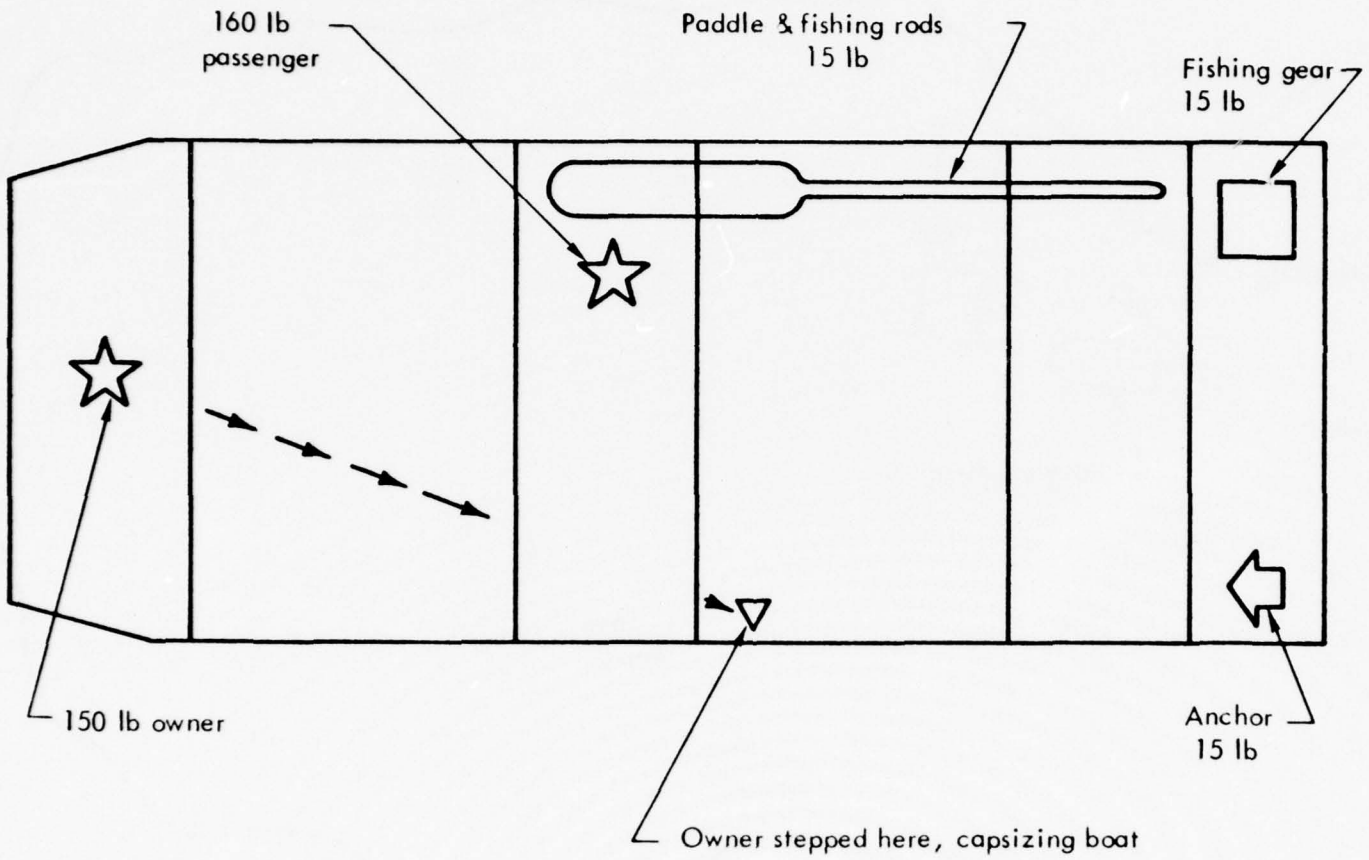


Figure 1. Load Distribution At Time Of Accident

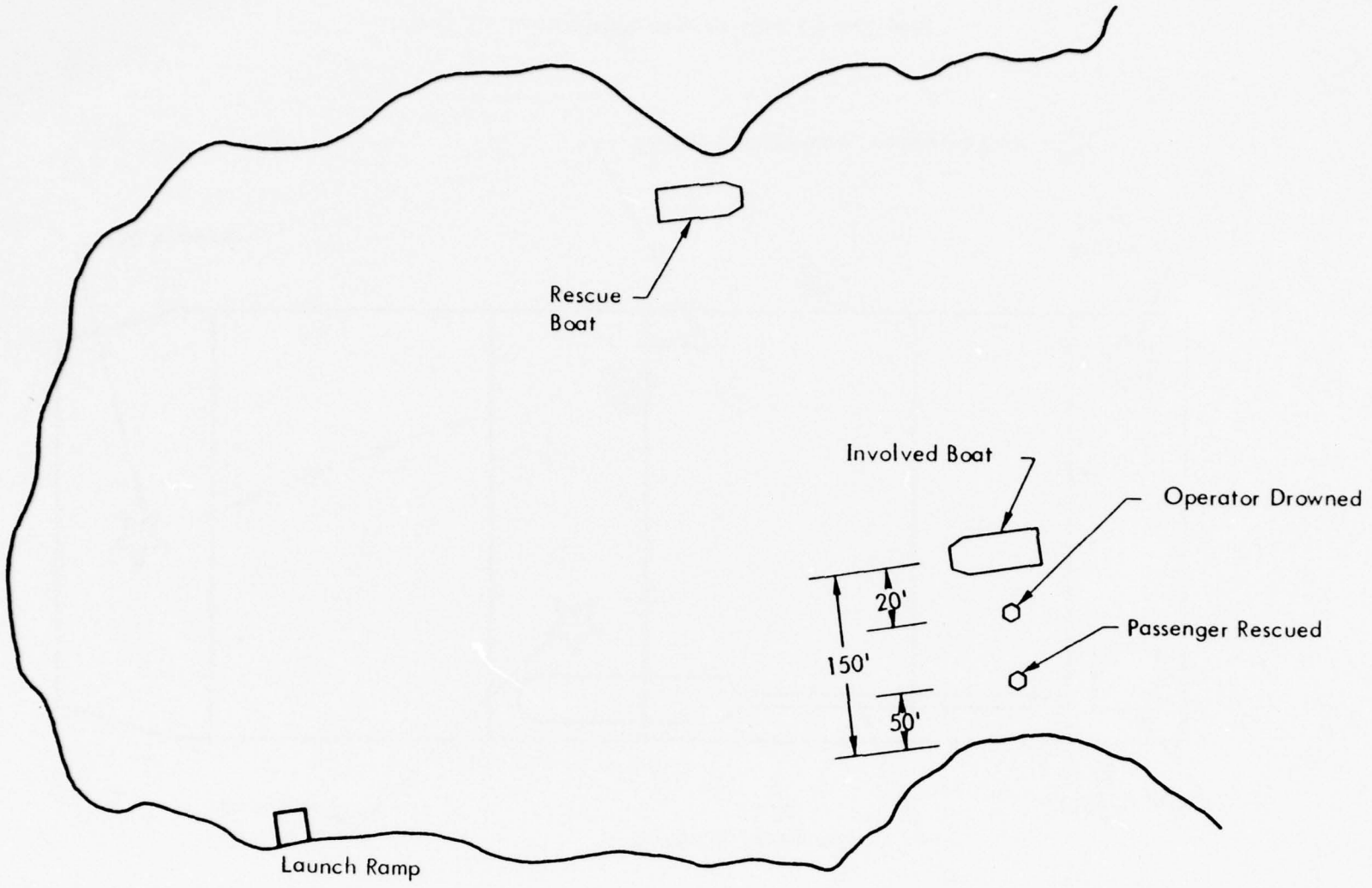
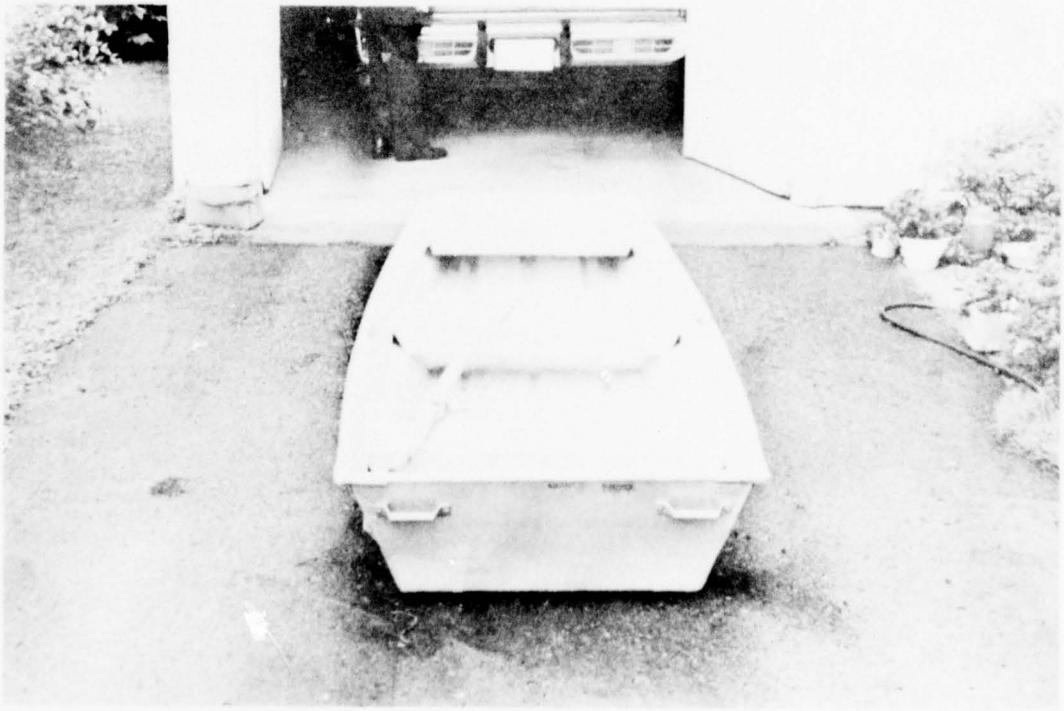


Figure 2. Accident Area



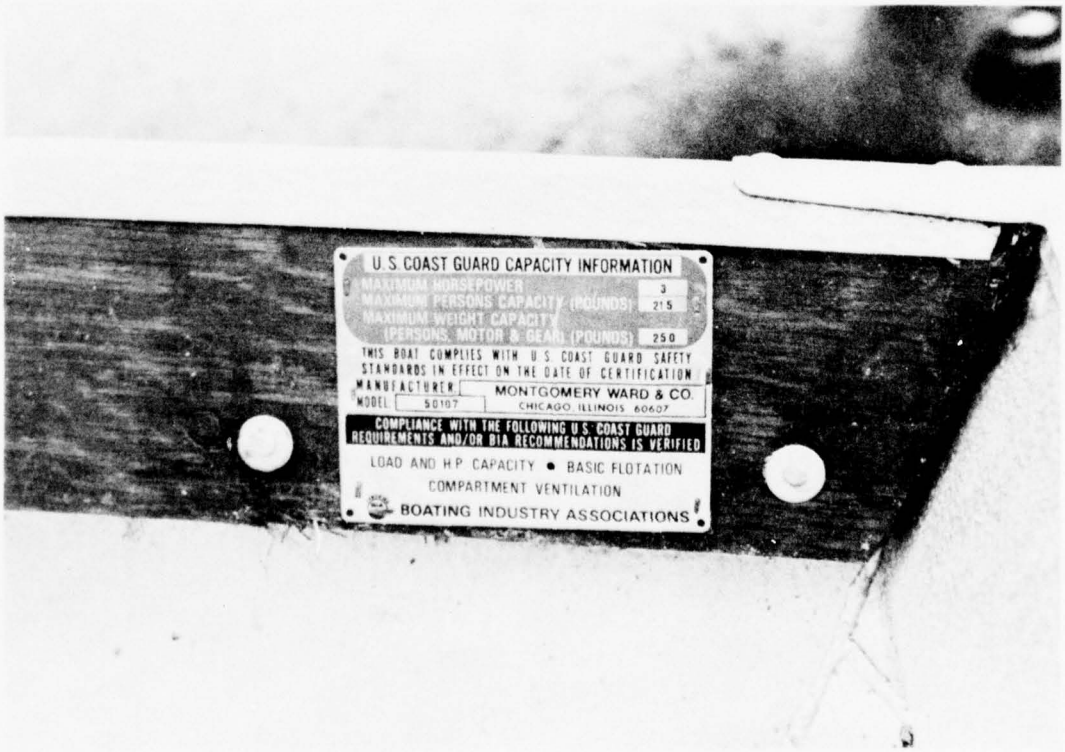
Photograph 1



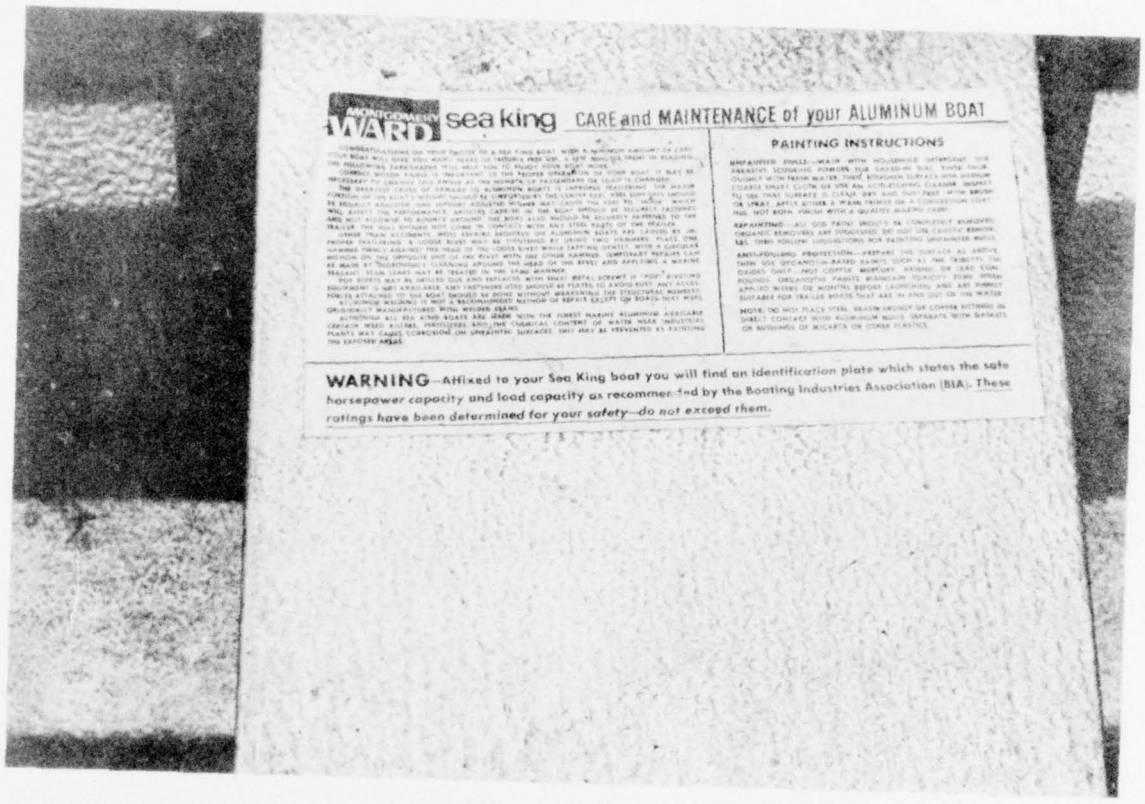
Photograph 2



Photograph 3



Photograph 4



MONTGOMERY WARD sea king CARE and MAINTENANCE of your ALUMINUM BOAT

PAINTING INSTRUCTIONS

WARNING—Affixed to your Sea King boat you will find an identification plate which states the safe horsepower capacity and load capacity as recommended by the Boating Industries Association (BIA). These ratings have been determined for your safety—do not exceed them.

Photograph 5

APPENDIX V

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 19, 1975

Date of Accident: Early July, 1975

Investigation: Capsizing/Swamping No. 75-21

SUMMARY — WYLE ACCIDENT NO. 75-617

The accident reported herein involved a 15 ft semi-v runabout powered with a 30 horsepower outboard motor. The type of accident was a swamping with a subsequent sinking of the boat, resulting in no injuries or fatalities.

At approximately 0700 on a day in early July, 1975, a fishing party consisting of three adult males set out on a fishing trip from a launch ramp located in southwestern Michigan. The party traveled approximately two miles from the launch ramp and 3/4 mile off shore, where they fished for approximately 45 minutes. The men were trolling north and south at a speed of three to five mph. The trolling track was approximately 1/8 mile long and ran parallel to the shoreline. The boat was headed into two to three ft swells with the operator at the helm on the starboard side, one passenger in the opposite seat, port side and one passenger standing in the stern. The stern passenger shouted to the operator that water was coming over the transom. The operator turned around at about the time two large waves broke over the transom into the boat, partially flooding the aft section. Before the operator had time to react to the flooding situation, waves started breaking over the transom in quick succession, completely

swamping the boat. The operator applied full power, but simultaneously the motor stopped due to water intake. The boat started sinking rapidly by the stern. The occupants jumped out of the boat and held to the side until it was apparent that the boat was completely sinking. The boat submerged, leaving the occupants treading water with no PFDs. There were approximately 200 small fishing boats in the area. The occupants shouted for help, but their calls were ignored. Some of the nearby boat operators cursed at the occupants and warned them to stay clear of their fishing lines. After the occupants had been in the water approximately five minutes, the operator of a nearby cabin cruiser who had witnessed the sinking came to their aid and took them aboard. A Coast Guard rescue vessel came to the accident site after being called on the cabin cruiser's marine radio. The occupants were taken aboard the C.G. vessel and transported to a nearby C.G. station. At the time of the interview, the involved boat had not been recovered.

1.0 BOAT OCCUPANT DATA

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator	M	34	165	Excellent	> 500 hrs.	None	No
Passenger	M	34	165	Good	> 500 hrs.	None	No
Passenger	M	20	160	Good	Very little	None	No

1.1 Owner/Operator

From the interview, it was apparent that the operator was an experienced small boat operator and fisherman. Over the past 15 years, he had owned and operated three outboard runabout boats (under 20 ft) and a small sailboat. Most of his boating experience had been along the eastern side of Lake Michigan. He seemed to be of average intelligence and physical ability. His recall of the accident was mainly focused on the refusal of the nearby boat operator to give assistance after his boat sunk. Details of the accident were obtained through direct questioning by the interviewers.

1.2 Passengers

The passengers of the involved boat were not available for interview at the time of the investigation. However, as far as could be determined, they were of normal intelligence and physical ability. The 34 year old passenger was an experienced boat operator and fisherman and was very familiar with the waters in the accident area. The 20 year old passenger was considered a novice boat operator and fisherman.

2.0 ENVIRONMENT

The sky was clear and the wind estimated to be 7-14 mph from the ESE. The recorded air temperature was 55° F and the recorded water temperature, 67°F. The water was choppy with 2-3 ft swells. The water depth at the accident site was 55 ft.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

During the first week in September, 1975, the owner and two of his co-workers had discussed a fishing trip for the weekend. On Friday, they decided to plan the trip for Sunday, and planned to leave the owner's home at 0500. Knowing that they must get up early, the operator and passengers went to bed early on the night before the accident. The owner arose at approximately 0430 on the morning of the accident and started preparing for the fishing trip. The passengers arrived at the owner's home shortly before 0500 and the party departed for the launch area approximately 10 miles away at 0530. The party arrived at the launch area at approximately 0615 after stopping for breakfast. The boat was launched, the fishing gear loaded aboard, and the party got underway to the fishing area at approximately 0630. After traveling approximately two miles from the launch area and 3/4 mile off shore, the boat was stopped and the men deployed their fishing lines. There were approximately 200 small fishing boats in the immediate area. The men trolled north and south along a course approximately 1/8 mile long which was parallel to the shore line.

3.2 Accident

The men were trolling south into quartering wind and waves at a speed of 3-5 mph. Gear aboard was listed in Figure 1, and the weather as noted in Section 2.0. At this point, the elapsed time from launch was approximately 1-1/2 hours. The operator (1) was seated on top of the seat back, starboard side, one passenger (2) was seated in the same position on the port side, and the other passenger (3) was standing in the aft section of the boat. (3) shouted to (1) that water was coming into the boat over the stern. (1) turned to look aft at about the same time that two large waves broke over the transom into the passenger compartment, partially swamping the boat. He turned to apply full power, hoping that he could stop the ingress of water and get the boat on plane so the water could be siphoned out through the transom drain. As he advanced the throttle, the motor stopped due to water intake. The waves then started breaking over the transom in rapid succession until the passenger compartment was completely

flooded. As soon as the boat flooded, the stern started sinking very fast. The operator instructed the passengers to get out of the boat. (1) got out of the boat over the starboard side, (2) over the port side, and (3) over the transom. The stern went down so rapidly that the PFDs were washed up under the bow and were not accessible to the occupants at the time they exited the boat. The boat continued to sink until approximately 3/4 of the boat was submerged, bow up. It appeared that the boat was not going to completely sink, so the men decided to hold to the bow for support. As soon as the men got into the water, they began calling to nearby fishing boats for help. The occupants in the nearby boats were so intent on fishing that they either ignored the men's call for help or told them they were concerned with fishing and would not help them. Some of the boat operators cursed at the men and warned them to stay clear of their deployed fishing lines.

NOTE:

At the time of the investigation, the interviewers thought that the occupants may have done something to antagonize the nearby fishermen prior to the sinking and that could have been the reason they were refused aid. However, after talking with the personnel of the Coast Guard unit that went to the accident site, it was learned that this type situation had occurred several times in the past. The type of fish that were being caught on the day of the accident only come in at certain times of the year for a brief period. After the fishermen deploy their fishing gear, which is time consuming, they are unwilling to pull in their fishing lines to render assistance to a boat in trouble.

3.3 Post Accident

The men held to the bow section for approximately three minutes. During this time, they noticed that air was escaping from the bow and the boat was slowly sinking. After approximately three minutes the boat completely submerged and did not return to the surface. The operator of a nearby cabin cruiser had witnessed the sinking and the refusal of nearby boats to render assistance to the men in the water. He called the Coast Guard on marine radio as soon as he saw the boat was in trouble. The cabin cruiser operator asked the small fishing

boat operators to pull in their fishing lines so he could maneuver his boat through the small boats and rescue the men in the water. The small boat occupants refused to comply with the cruiser operator's request. Approximately two minutes after the boat submerged, the cabin cruiser operator maneuvered his boat through the mass of boats, breaking several lines and outriggers. The occupants of the involved boat were taken aboard the cabin cruiser where they waited for the Coast Guard rescue vessel. A Coast Guard vessel arrived on the scene and transported the occupants to a nearby Coast Guard station. The boat had sunk in 55 ft of water and at the time of the investigation, had not been recovered.

Refer to Figure 2 for sketch of accident area.

4.0 FACTS FROM THE BOAT INSPECTION

The boat had not been recovered and was not available for inspection at the time of the investigation. According to the owner, the boat was in excellent condition and had not been modified in any way since manufacture. There was no flotation material installed in the boat. The boat had no motor well, therefore, any water that came over the transom went directly into the passenger compartment. Refer to Figure 1 for the boat load distribution at the time of the accident.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The operator had owned the involved boat for two years. He had never trusted the safety of the boat because of the stern design (no motor well). He was not surprised at the boat swamping, because he had subconsciously thought that this could eventually occur. He and the passengers were aware that the water conditions were too rough on the day of the accident to go out in the involved boat. However, their desire to go fishing overshadowed their apprehension concerning the safety of the boat. The operator stated that they would probably have gone even if the water conditions had been much worse. Their reasoning was, if the water conditions were too hazardous, they could safely return to shore in the boat. As far as could be determined, no alcohol was consumed by the occupants on the day of the accident.

6.0 PROBABLE CAUSE OF ACCIDENT

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

- It is reasonable to assume that the involved boat should not have been operated in water conditions that existed on the day of the accident. The stern design was such that any water that came over the transom would go directly into the passenger compartment. At a speed of three to five mph, two to three ft waves would likely break over the transom unless above average boating operating techniques were employed.

- The boat was swamped from water coming over the transom. Complete swamping would probably not have occurred had the stern section incorporated a motor well with the top of the forward section higher than the top of the transom.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

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

According to the estimated weight in the boat at the time of the accident, the boat was not overloaded. The operator drained the water from the boat, including the inner hull prior to launch on the day of the accident, so there was no water in the boat at the beginning of the trip.

The boat was traveling south at an estimated speed of 3-5 mph (possible 5-7 mph). If the boat speed exceeded five mph, the bow would have been pushed up by the bow wave, decreasing the transom freeboard in relation to the 2-3 ft waves from the ESE. The weight of the passenger and gear in the aft section further decreased the transom freeboard. It is assumed that the initial engress of water was caused by quartering waves breaking around the port stern, then over the transom into the passenger compartment. By the time water was

observed in the boat, the transom freeboard had been reduced sufficiently to allow water to flow freely over the transom. The operator stated that the inner hull drain plugs were in, and as far as he knew, the inner hull was completely sealed. If this was true, the inner hull air chamber would have provided sufficient buoyancy to keep the boat at least partially afloat. Since the boat did completely sink, the inner hull could not have been sealed.

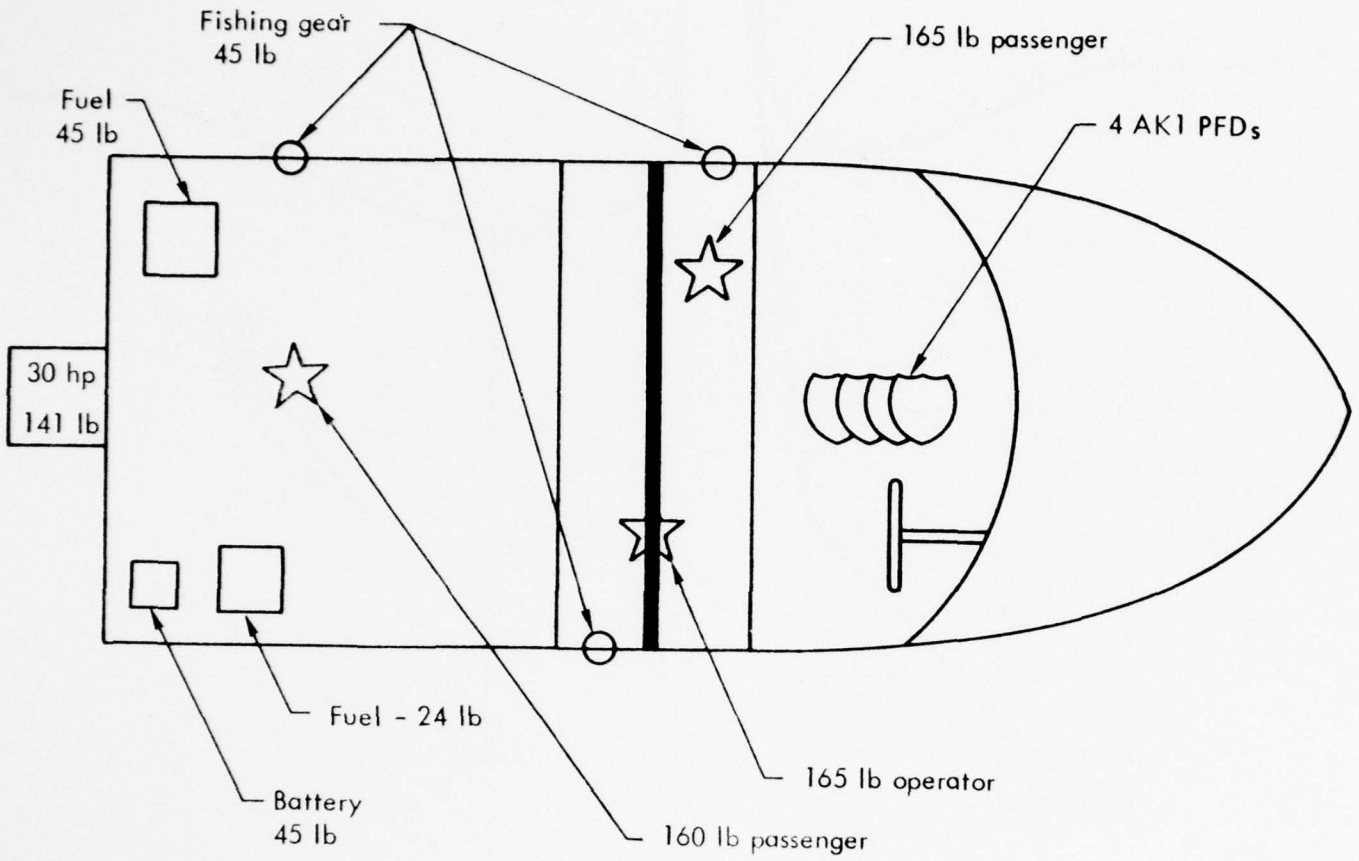


Figure 1. Load Distribution At Time Of Accident

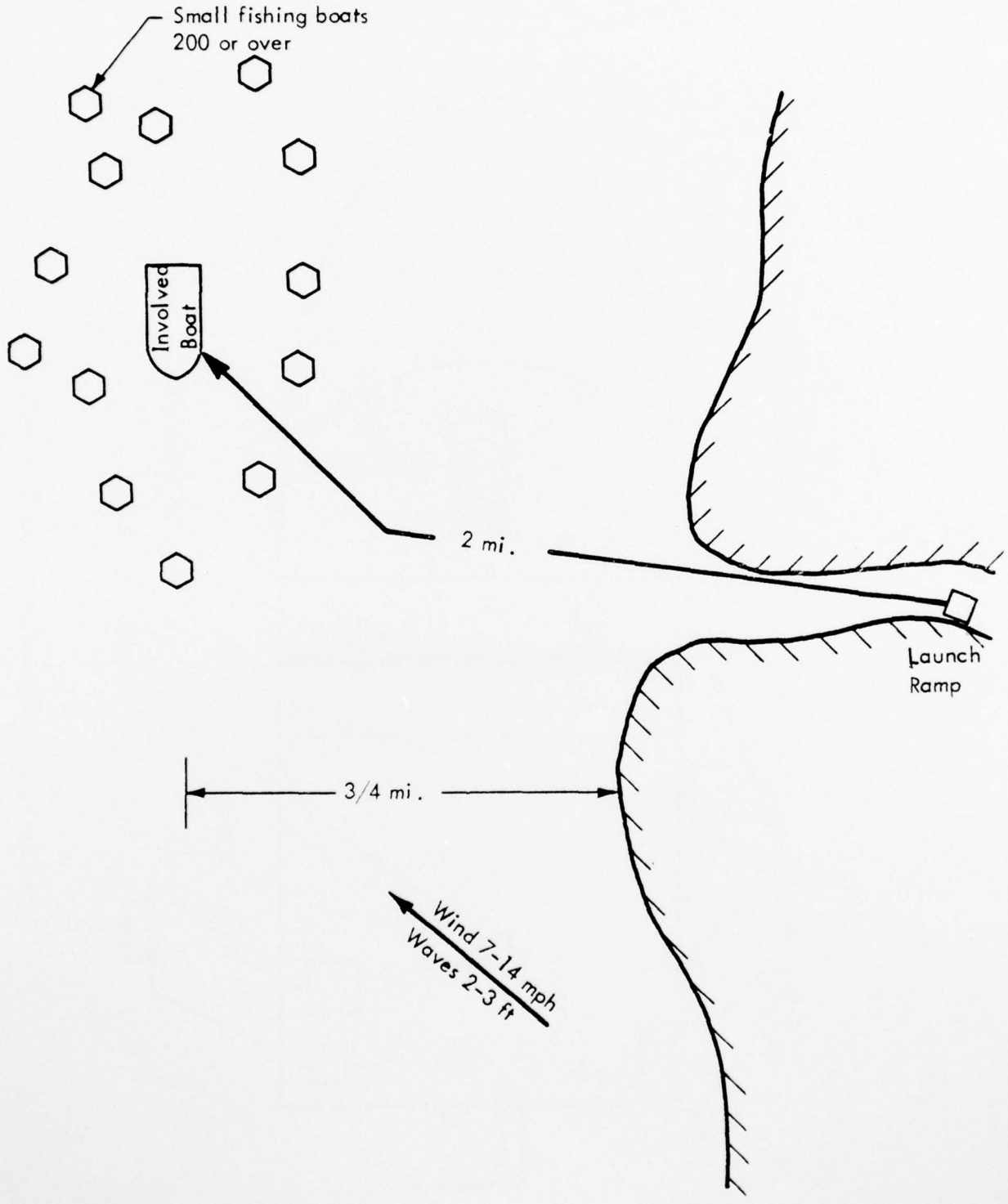


Figure 2. Accident Area

APPENDIX W

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 20, 1975

Date of Accident: Late August, 1975

Investigation: Capsizing/Swamping No. 75-22

SUMMARY — WYLE ACCIDENT NO. 75-572

One morning in late August, 1975, two men were fishing in a 13 ft 6 in. aluminum boat powered by a 9-1/2 hp Evinrude motor. The operator heard a noise and when he turned he saw a "six foot high" breaking wave coming at the boat. He tried to out run the wave, but it caught the boat, throwing the stern into the air and catapulting him 20 ft from the boat. The passenger stayed in the partially swamped boat until another wave capsized the boat just as the operator had swum back to it. Both were rescued by a nearby Coast Guard boat.

1.0 BOAT OCCUPANT DATA

Occupant	Age	Sex	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn
Owner/ Operator	58	M	180	Excellent	> 500 Hr	Yes	No
Passenger	72	M	195	Non-Swimmer	> 500 Hr	No	No

The passenger was retired from the Navy and had over 50 years of boating experience in all sizes of boats. It is interesting to note that with all of this experience on the water he never learned to swim.

The owner/operator had taught swimming and life-saving for 27 years and considered himself to be an excellent swimmer. He purchased this boat new in 1970 and boats with it about once a month. For approximately eight years before this he had owned a small lightweight aluminum boat.

2.0 ENVIRONMENT

There were no craft warnings up and the weather was clear. Air temperature was about 70°. Wind was moderate at 7 to 14 mph. Seas were 3 to 5 ft gentle swells.

3.0 NARRATIVE OF ACCIDENT

The following narrative was formulated from an interview with the owner/operator of the involved boat and the Coast Guard.

3.1 Pre-Accident

The owner and his wife were on vacation and living in a mobile home approximately 380 miles from their permanent residence. The passenger on board was a friend of the owner and was staying at the same mobile home park. They spent much time fishing together in the same area that the accident occurred. The morning before the day of the accident, they had been fishing in the same area. That afternoon, they went to a county fair in the area. They both went home and retired at about 2200 or 2300 the night before the accident.

The morning of the accident, the owner/operator had breakfast at about 0700. The passenger came over and asked what time they were going fishing. The owner said as soon as he finished eating, so the passenger went to his trailer to get ready. When the owner finished eating, he drove to the passenger's trailer and picked him up.

They then drove to the launch area which was about five miles away. They went into the supply store and got some bait. They loaded the gear on board which consisted of two tackle boxes, two fishing rods and reels, a six gallon fuel tank for the 9-1/2 hp outboard motor, six AK1 type PFDs and two floatable seat cushions.

They then proceeded to a point near the mouth of the Klamath River (Figure 1) on which they launched the boat. They trolled to the mouth of the river which took approximately 1/2 hour. Once outside the river, the operator headed his boat into the current. There was an outgoing tide and he set the engine speed so that his ground speed was 0 (although he was still moving relative to the water).

The area that they were in was being patrolled by the Coast Guard. The Coast Guard positions their patrol boat off shore and keeps the fishing boats from going out into dangerous waters. When conditions are rough, they prevent small boats from going out at all.

The owner of this boat kept his boat between the Coast Guard patrol boat and the shore.

3.2 Accident

They had been fishing in this area for 15 or 20 minutes when the owner/operator heard a noise behind him. He turned and saw a breaking wave approximately six feet high coming toward them. He opened the throttle on the engine all the way hoping to escape from the wave. He said he missed getting away by about a foot.

He described the wave as a "sneaker", which is a breaking wave that forms suddenly from one of the swells. These "sneakers" had been breaking out past the Coast Guard patrol boat, but there hadn't been any between the patrol boat and the shore.

This particular "sneaker" was about six feet high and caught the boat from the stern. It threw the end of the boat into the air, catapulting the owner/operator, who was sitting on the aft seat, out of the boat (see Figure 2). He hollered to the passenger to hold onto the boat, because he knew the passenger was a non-swimmer and that the boat would support him. The owner/operator was thrown 15 to 20 feet to the front and side of the boat. The boat had not capsized at this point, but had filled about half full of water. The owner/operator swam back to the boat. Just as he reached it, another wave capsized it. He pushed himself away from the boat as it came over towards him, but the passenger was caught under the overturned boat. He came out from under the boat within several seconds. Even though he was a non-swimmer, he remained calm and held onto the boat.

3.3 Post Accident

The owner/operator grabbed the keel on the overturned boat and pulled himself on top of the boat. The Coast Guard boat came alongside in about 30 seconds. The owner/operator on top of the overturned boat pointed to the passenger in the water indicating to the Coast Guard that they should rescue him first. The Coast Guard pulled the passenger from the water and the owner/operator boarded the Coast Guard boat. The owner/operator said the water was warm, but when he got on board the Coast Guard boat he got very cold and started shivering because of the wind.

The Coast Guard righted the overturned boat and towed it to the dock where they left it. The two occupants then packed up and went back to their trailers.

4.0 FACTS FROM THE BOAT INSPECTION

Manufacturer: Valco
Model Name: V13
Length: 13' 6"
Maximum Horsepower: 20

Model Year: 1970
Model Number: S051030
Maximum Capacity: 765 lbs
Horsepower On Board: 9-1/2 hp, 1970 Evinrude

The boat was of aluminum construction as can be seen in Figures 3 and 4. Figure 4 shows some repair work done on the stern of the boat. The boat was chained to the fence, so it could not be photographed on the inside.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The owner/operator had two boating mishaps in previous years. One time while trolling in this same area with many other boats, a fishing line with a metal spreader bar for separating fish hooks while trolling became entangled in his propeller causing his engine to stall. The owner/operator says that the line that his engine got caught in should not have been so far behind the boat from which it came in an area as crowded as that one was at the time. He felt it was the fault of the operator of the other boat for his getting his engine tangled. The Coast Guard towed him to shore where he got the line untangled and his engine started again.

The other mishap was a collision with the Coast Guard patrol boat. Figure 5, positions 1, 2 and 3, show the way most boats would troll up to the Coast Guard patrol boat, make a turn while trolling (position 2) and then continue trolling. At position 2, the boats would be broadside to any oncoming waves (from the ocean). The owner/operator did not like being broadside to the waves at trolling speed, so he would reel in his line at position 1 and then proceed at a faster speed through position 2 to position 3 and then start trolling again. This time, as he opened the throttle on the engine after reeling in his line at position 1 and began the turn, his hand slipped off the steering handle on the engine causing his boat to crash into the Coast Guard patrol boat. Damage consisted of a small hole in the engine cover of the outboard engine.

These two incidents could indicate a slight tendency toward accident proneness. On the day of the accident, he had been out for about an hour, so stress and fatigue from the elements were most likely not factors in the accident. His boat was in the area that the Coast Guard had considered safe, so there was little reason for him to suspect that anything would happen. There could have been an error on the part of the Coast Guard patrol boat in deeming this area safe, or it could have been changing conditions which turned this safe area into one that proved not so safe. There does not appear to be any judgment or operation error on the part of the operator.

6.0 PROBABLE CAUSE OF ACCIDENT

As near as can be determined, the accident was caused by a breaking wave overtaking a small boat, thro[illegible]g the operator out of the boat and filling the boat half full of water. A following wave then capsized the boat. This wave could be considered "freak" in that it wasn't like one of the regular swells that were present in the area. Breaking waves of this type are known to occur near and sometimes in this area, so it was not a totally "freak" phenomenon.

7.0 ANALYSIS OF THE ACCIDENT

The operator opened the throttle on the engine to try to get away from the breaking wave. He didn't make it, and when the wave hit the aft end of the boat, it sent the boat up into the air, catapulting the operator about 20 feet away into the water. The passenger who was sitting forward was not thrown out of the boat, but stayed with it. The engine had stopped due to water intake. The boat was about half full of water and the operator was about 20 feet from the boat in the water. The operator swam back to the boat, and just as he reached it, another wave capsized the boat. The boat must have been turned broadside to the waves in order for another wave to capsize it like it did. The operator grabbed the high gunwale as it came over and pushed himself away from the boat. The operator said it came over rather slowly. The passenger was trapped beneath the boat as it overturned. The operator was worried at this point because the passenger could not swim. He was about to go under to look for him when he came up. It was actually only a few seconds that the passenger was under the overturned boat.

The operator then grabbed the keel of the boat and pulled himself on top of the overturned boat. He instructed the passenger, who was holding onto the side of the boat, to do the same. By this time, the Coast Guard patrol boat, which had been about 75 feet away, was alongside them and took them on board. Total elapsed time from when the wave first reached the boat to when the occupants boarded the Coast Guard boat was only several minutes.

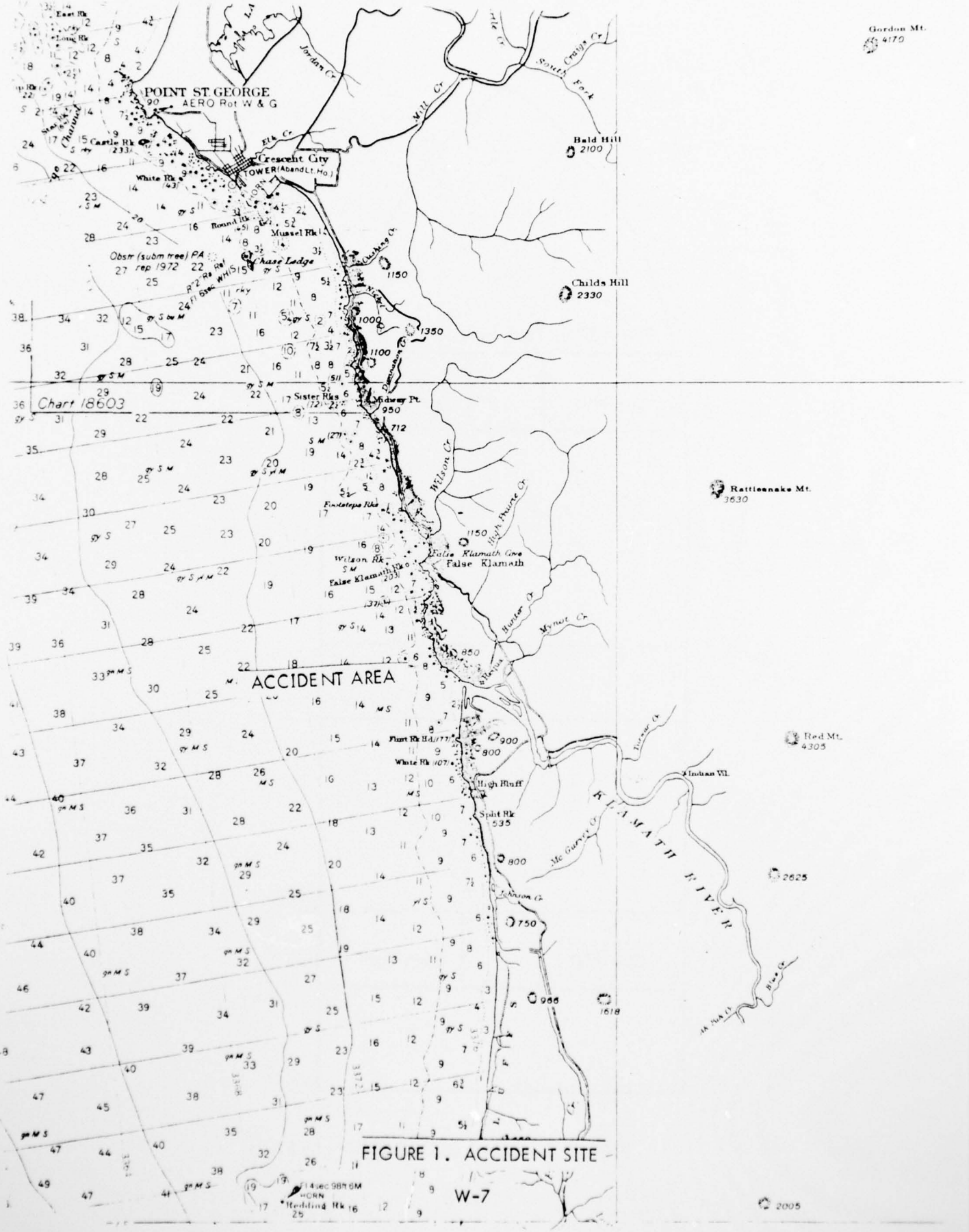


FIGURE 1. ACCIDENT SITE

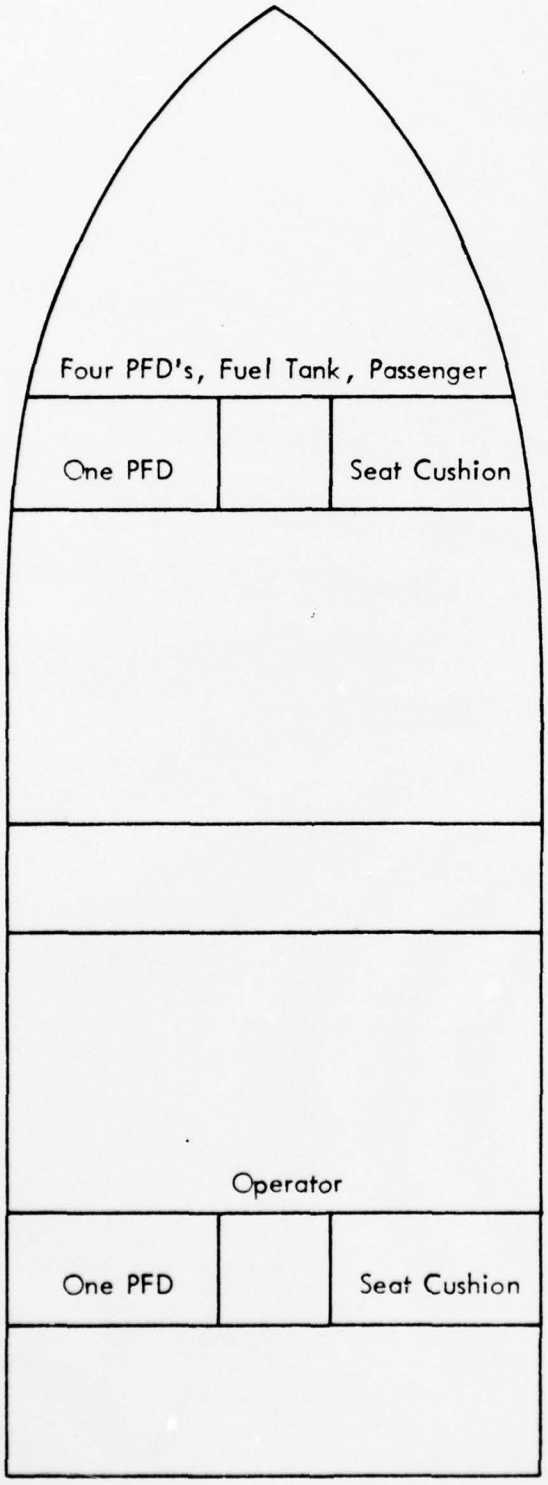
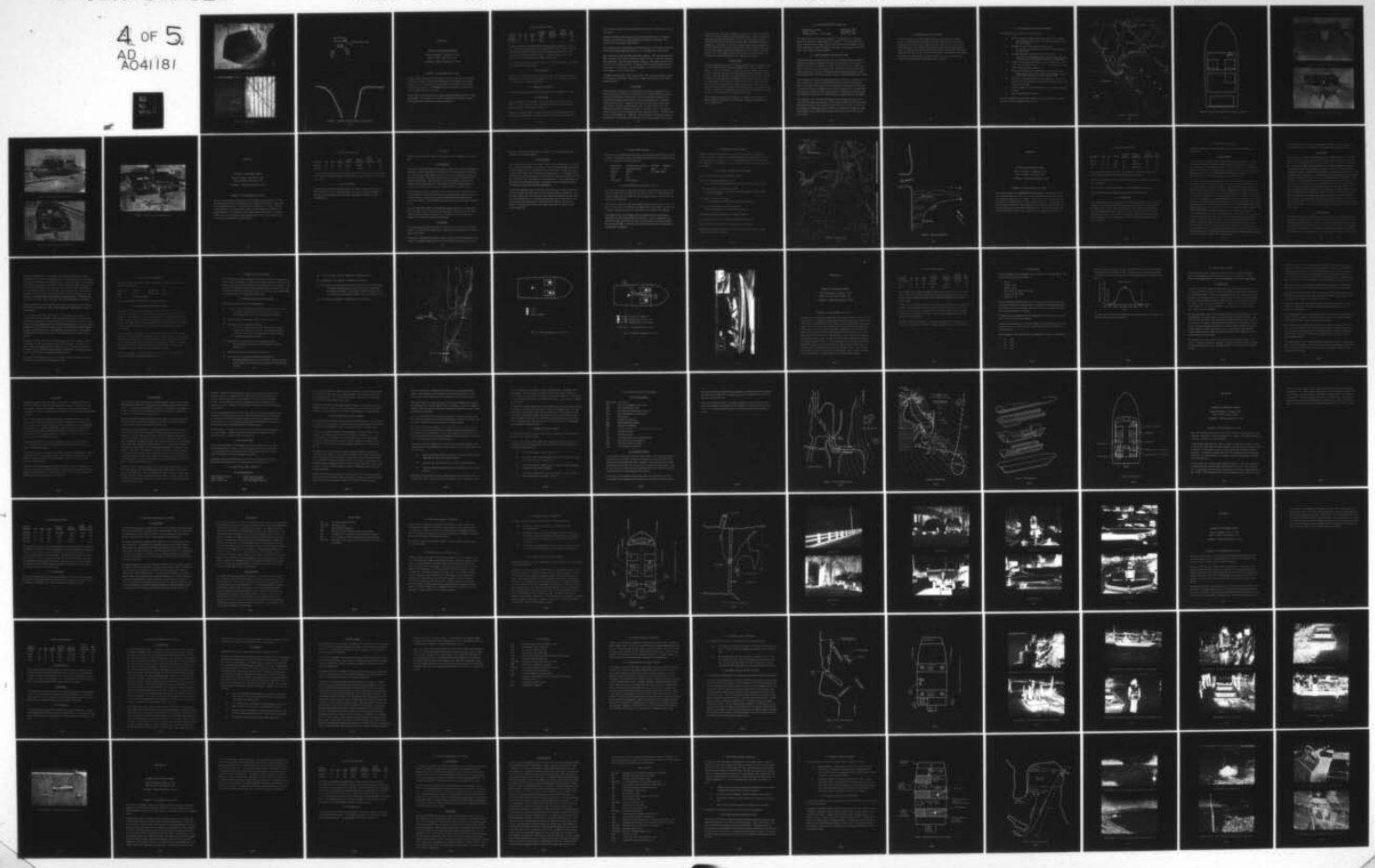


FIGURE 2. LOAD DISTRIBUTION SKETCH

AD-A041 181 WYLE LABS HUNTSVILLE ALA F/G 13/12
CAPSIZING/SWAMPING ACCIDEN INVESTIGATIONS FOR 1975 SEASON.(U)
SEP 76 C SAUTKULIS, B SMITH, J BOWMAN DOT-CG-40672-A
UNCLASSIFIED MSR-76-45 USCG-D-17-77 NL

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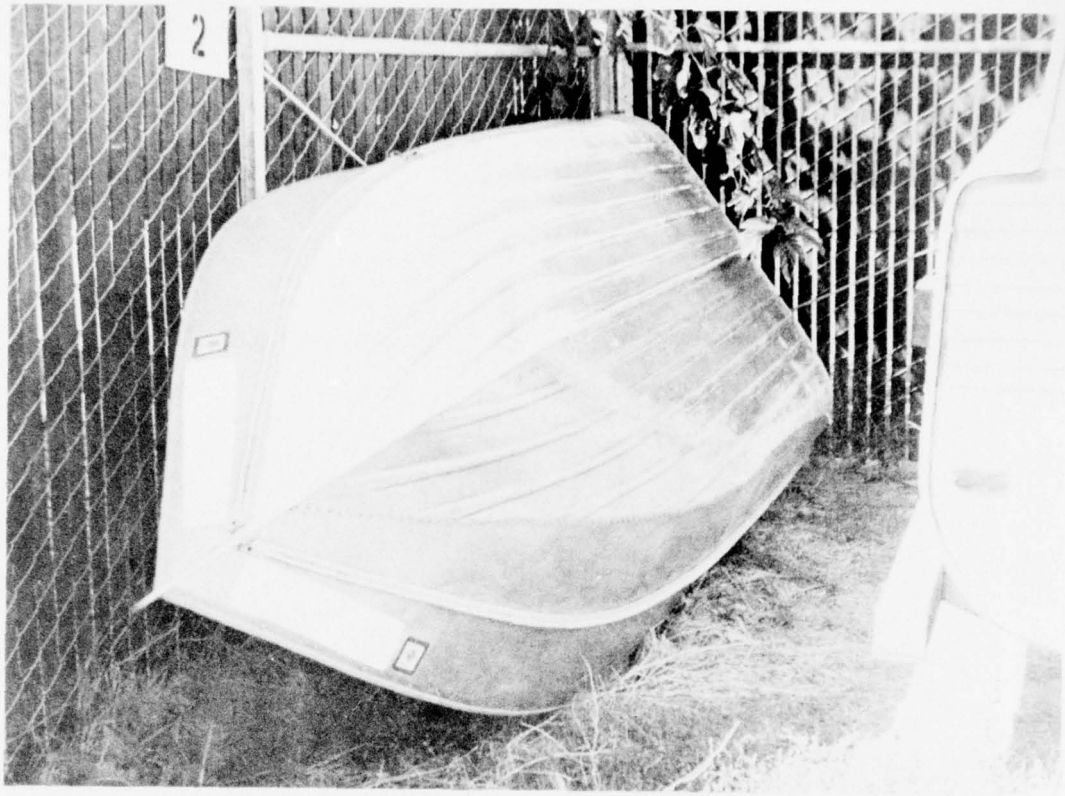


FIGURE 3. INVOLVED BOAT

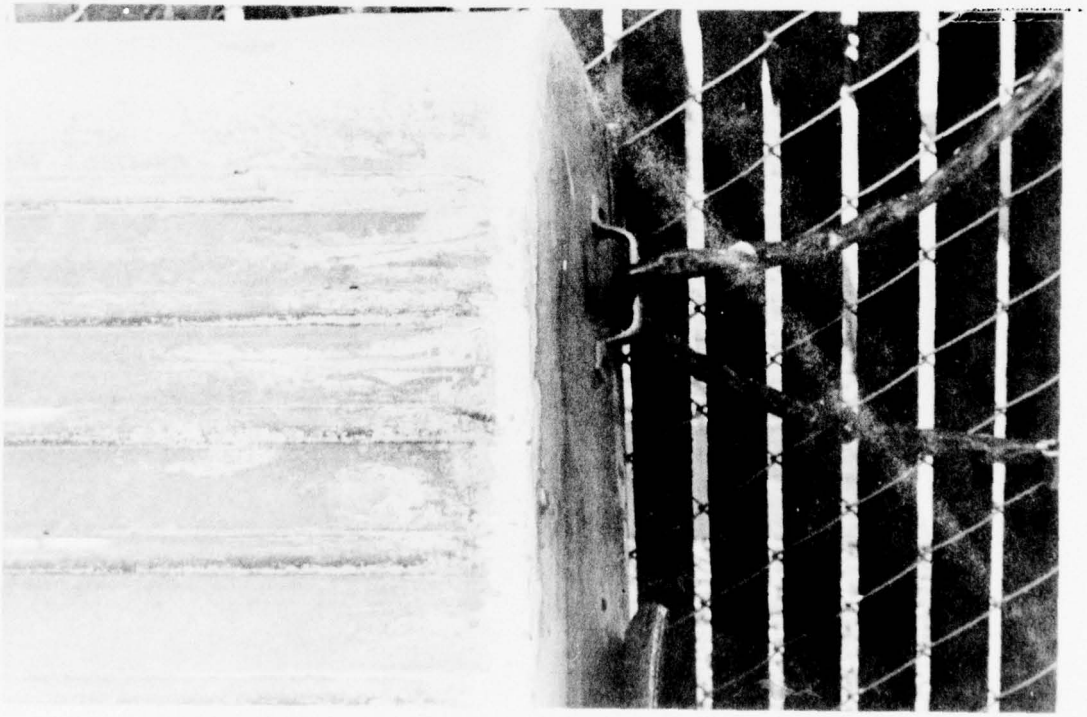


FIGURE 4. INVOLVED BOAT

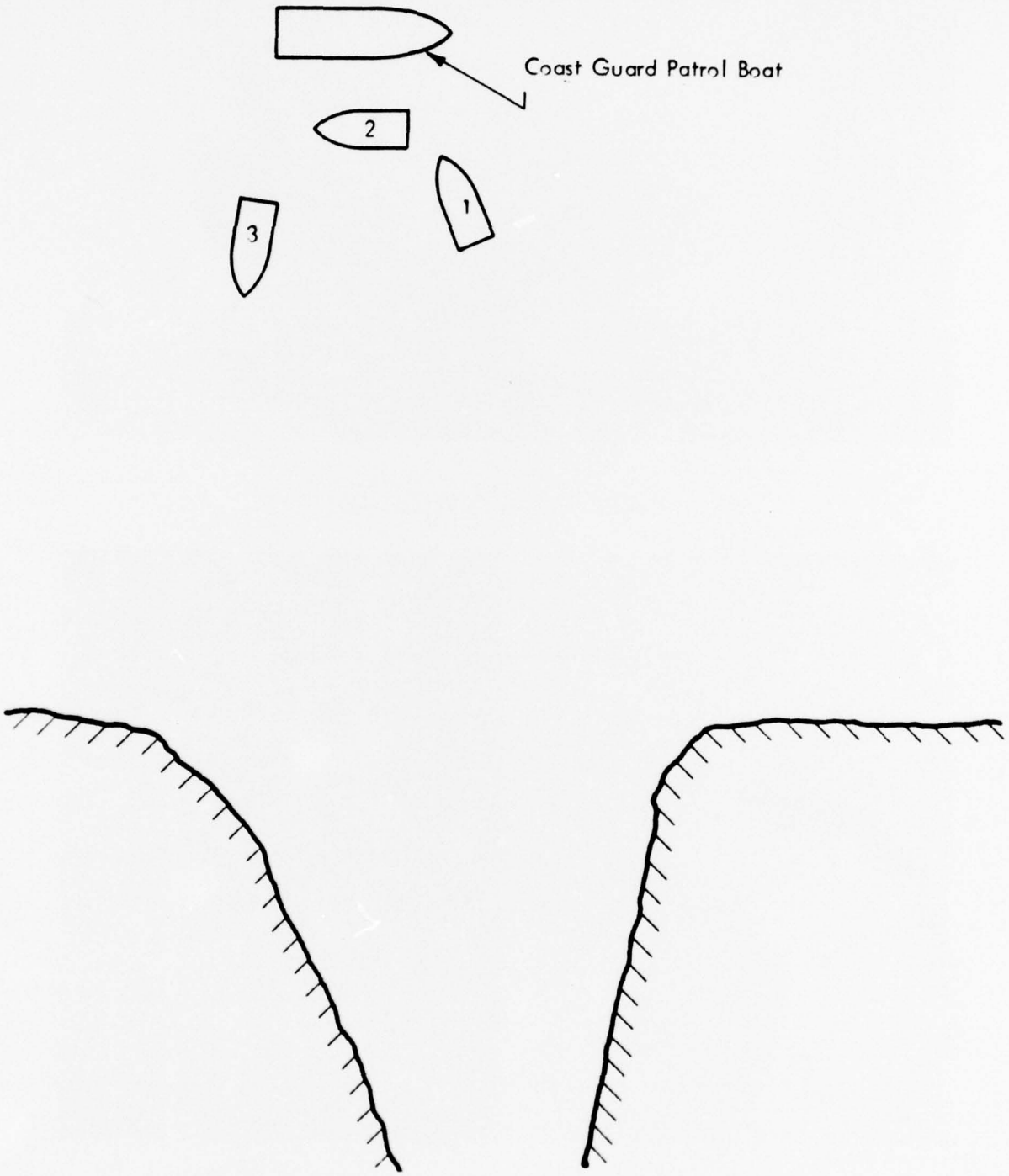


FIGURE 5. TYPICAL TURNING PATTERN WHILE TROLLING

APPENDIX X

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 19, 1975

Date of Accident: Early August, 1975

Investigation: Capsizing/Swamping No. 75-23

SUMMARY — WYLE ACCIDENT NO. 75-513

At approximately 0900, three men were fishing in a 16 foot runabout powered by a 50 hp outboard motor. They were using fuel at a faster rate than anticipated, so the operator decided to mount a 4 hp engine, which was on board, on the transom. He shut off the 50 hp engine and moved aft. Oncoming waves swung the boat stern into the waves and the waves began breaking over the transom.

Neither engine would start and the waves caused progressive flooding resulting in the boat being swamped. All occupants were rescued by two nearby boats and taken to a nearby Coast Guard station where they were treated for hypothermia.

1.0 BOAT OCCUPANT DATA

Occupant	Age	Sex	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn
Operator	24	M	175	Good	> 500 Hr	No	Yes
Passenger 1	24	M	180	Fair		-	Yes
Passenger 2	23	M	145	Fair	-	-	Yes

The operator works as a construction worker and plans to return to college in a couple of years. He has been operating this boat, which is owned by his father, for about 14 years. His activities had mostly been limited to skiing on freshwater inland lakes and rivers. This had been his second time out on the ocean. He had been boating in other boats previous to this. They had all been the runabout outboard type.

The two passengers did not show up for the interview, so their boating experience and formal boating instruction was not determined.

2.0 ENVIRONMENT

Seas were 2 to 4 ft gentle swells and wind was light. There were no craft warnings up. Air temperature was in the 50's and water temperature was cold. The local Coast Guard station did not have a record of the water temperature.

3.0 NARRATIVE OF ACCIDENT

The following narrative was formulated from an interview with the operator of the boat.

3.1 Pre-Accident

The owner had spent much of the previous day driving back home from a long weekend vacation. He got home at about 2000. One of the passengers came over that evening and spent the night. He lived about 30 miles away.

They got up about 0330 or 0400. They left the house before 0500 and trailed the boat for about 40 minutes to Bodega Bay in California (see Figure 1). They looked for a place to

launch the boat and got the boat launched at about 0700 or 0730. The drain plug was put in that morning.

Gear that was loaded on board was an extra 4 hp Evinrude outboard motor, a two gallon fuel tank, ice chest with two six packs of beer and some food, and fishing gear. The 24 gallon built-in fuel tank was about 3/4 full.

They had talked to one of the fishermen who had recently come in from fishing and were told that it had been pretty choppy outside the bay, but it was beginning to calm down now.

All occupants donned AK1 type PFD's before getting underway. There were also three extra PFDs in the boat. They went out of the bay and began trolling in an area where there were other boats fishing. They were seated as shown in Figure 2. After fishing for about an hour and a half, they started catching fish. The operator checked the fuel and realized that they were using fuel at a faster rate than he had anticipated. He decided to put the 4 hp engine on the transom and use it to conserve fuel.

The operator pointed the bow into the waves and shut off the motor, then moved aft to mount the 4 hp engine on the transom. The other two occupants stayed forward in their original positions (Figure 2).

3.2 Accident

While the operator was fastening the 4 hp engine to the transom and attempting to start it, the boat swung around so the stern was now into the waves. Water started coming over the transom and accumulating in the motor well. The 4 hp engine started momentarily, but did not run long enough to power the boat's bow into the oncoming waves. The operator realized that the boat was in a dangerous condition and moved forward to start the main engine from the control box near the operator's seat. The engine failed to start. The operator then moved aft to hand crank the engine in an attempt to start it. The passenger in seat 3, Figure 2, moved into the operator's seat to operate the controls. The engine failed to start by hand cranking, also. Meanwhile, each succeeding wave brought more water into the motor well. The drain holes in the motor well were not large enough to drain the water

from the motor well. As the water accumulated in the motor well, it made the boat heavier in the stern reducing the freeboard. Attempts at paddling the bow into the waves failed and water continued to come over the transom. At this time, the freeboard aft was reduced sufficiently to allow water to flow through the control cable cutouts (Figure 3) and into the passenger area. The operator was still aft by the engine toward the port side attempting to bail water from the boat. The passenger from the number 2 position in Figure 2 leaned over the back of the seat and attempted to help the operator bail. The boat heeled to port and filled with water. The occupants floated away from the boat, and the boat capsized. The boat floated bow bottom up with about two feet of the bow above the water.

3.3 Post-Accident

The three occupants held onto the bow of the boat and called for help. The operator climbed on top of the overturned boat and kneeled, straddling the keel. He took off his PFD and waved it in the air to attract attention. A nearby 16 foot runabout spotted them and also informed a large salmon fishing boat. Both boats approached the overturned boat to attempt a rescue. The occupants had been in the water for about 25 minutes by this time. The operator boarded the salmon boat and the two passengers were picked up by the smaller runabout. The two passengers in the runabout went up under the bow to try to get warm. The operator rescued by the salmon boat was placed in a heated cabin and given hot tea to drink. The salmon boat radioed the nearby Coast Guard station and directed them to the overturned boat. The three occupants of the overturned boat were then taken to the Coast Guard station. They were given hot drinks and hot showers as treatment for hypothermia.

The Coast Guard towed the boat in and dewatered it. Damage to the boat consisted of a partially damaged windshield and some scratched paint. Estimated cost to repair was less than two hundred dollars.

4.0 FACTS FROM THE BOAT INSPECTION

Manufacturer: Uniflite
Length: 16 feet
Horsepower on board: 50 hp Johnson

Model Year: 1960
No Capacity Plate
Model Year: 1960

Hull features can be seen from Figures 3 through 7. The drain holes for the motor well appear to be standard size, approximately 3/4 in. diameter. The control cable cutouts, Figure 3, are not excessively large, but water flow could be restricted through the use of rubber inserts that are commonly used today. There was no capacity plate or any marking which indicated maximum loading conditions.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The operator had been up for about six hours prior to the accident and had a good night's sleep before, so fatigue was probably not a major contributing factor to the accident. The operator's lack of boating experience in a seaway was probably the largest contributing fac He had much boating experience in inland waters, but this was only his second time operating a boat outside a bay in the ocean. His failure to realize the potential danger of shutting down the engine while in this area is what led to the eventual swamping/capsizing of his boat.

Once the danger was realized, he attempted to remedy the situation by turning the bow into the oncoming waves. A series of engine malfunctions prevented him from doing so and resulted in the capsizing of the boat. If the water could have drained faster from the motor well, water may not have accumulated there, reducing the freeboard aft. The operator said the holes were not blocked up, they were just too small. Perhaps larger drain plugs would have allowed the operator more time to start the engine and possibly prevent the swamping.

The combination of the extra motor, the operator and the passenger leaning back to bail water could have sped up the swamping. All this weight on the port side of the boat caused the boat to heel to port, allowing water to come over the side. The boat was filling with water through the control cable cutouts at this time, so a redistribution of passenger weight would probably not have helped since the engine would not run and the transom was still into the waves.

6.0 PROBABLE CAUSE OF THE ACCIDENT

The event which led to the eventual swamping of the boat was the stopping of the engine in a seaway. Other factors which contributed were the added weight of the second engine and the operator in the stern of the boat, insufficient drains to drain the motor well and uncovered control cable cutouts. It is not known if larger drains in the motor well would definitely have helped. Covering the control cable cutouts with rubber inserts as is commonly done today could have restricted the inflow of water. It is not known whether this would have delayed the swamping long enough to prevent the capsizing. The major cause of the accident is the operator failure to realize the potential danger of shutting off the engine in a seaway.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The following are major events in the accident scenario:

- Engine is shut down, so smaller engine can be attached to the transom.

  This should not have been done. The boat should always be under power in a seaway.

- Operator moves aft to attach second engine to transom.

  This in itself is not bad; however, the action of the boat turned this into a bad move.

- The boat swings around, putting the transom into the waves.

  This is bad. Waves breaking over the transom plus the added weight of the occupants and the extra engine lowered the freeboard aft.

- Operator realizes danger and attempts to remedy by bringing bow into the waves. The extra engine would not run, the boat was too heavy to paddle around and the main engine failed to start.

- Water came through the control cable cutouts into the passenger area.

  Rubber seals on these cutouts could have restricted water ingress and possibly allowed enough time to get the engine started.

- Weight from extra engine, operator, and one passenger on the port side toward the stern caused the boat to heel, allowing water to come over the aft port side of the boat.

- The boat swamped, the occupants floated away from the boat and the boat inverted.

- Nearby boats rescued the occupants.

Time from shutting down engine to boat swamping was only several minutes. Time from swamping to rescue was approximately 25 minutes.

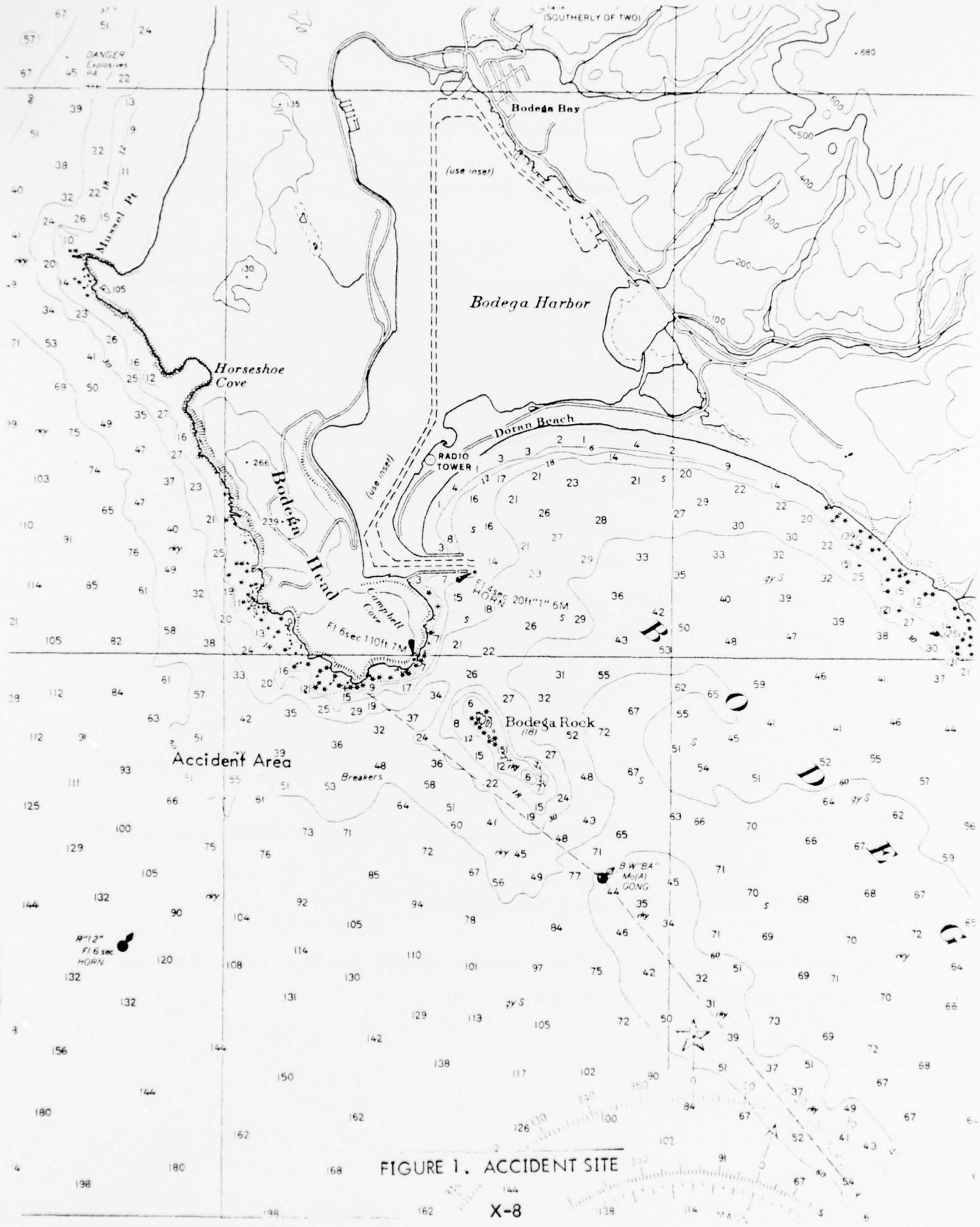


FIGURE 1. ACCIDENT SITE

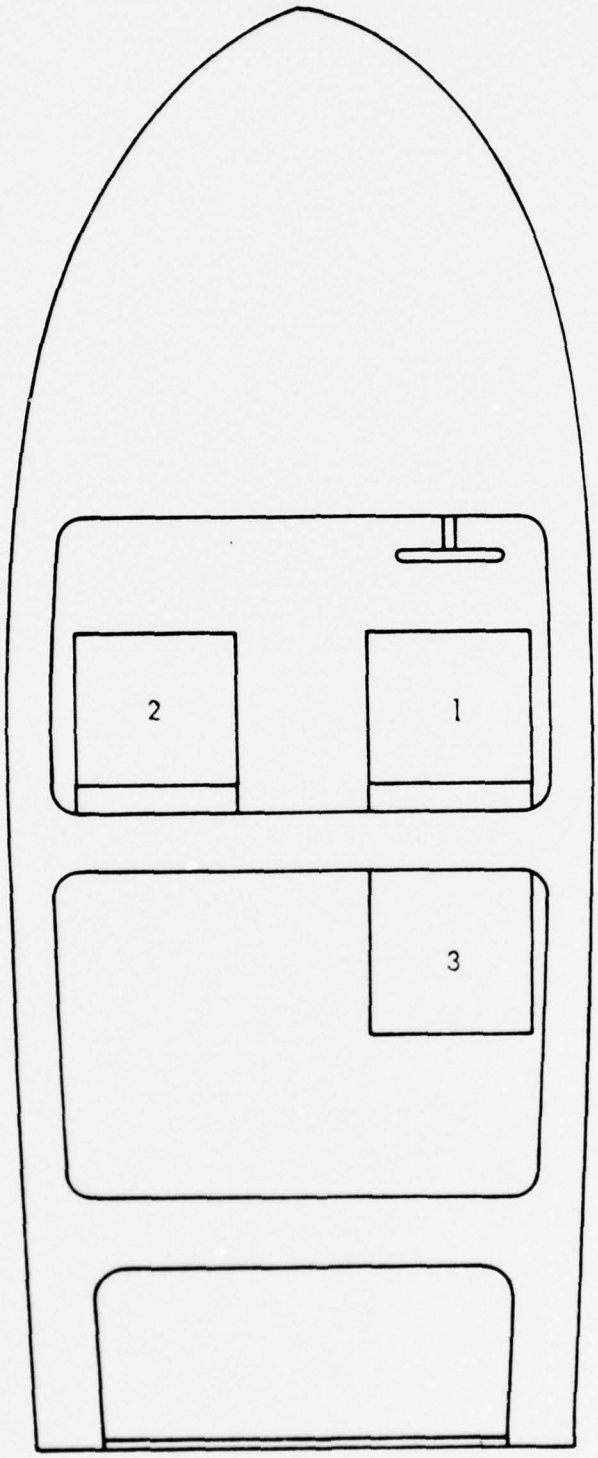


FIGURE 2. SEATING ARRANGEMENT OF BOAT OCCUPANTS

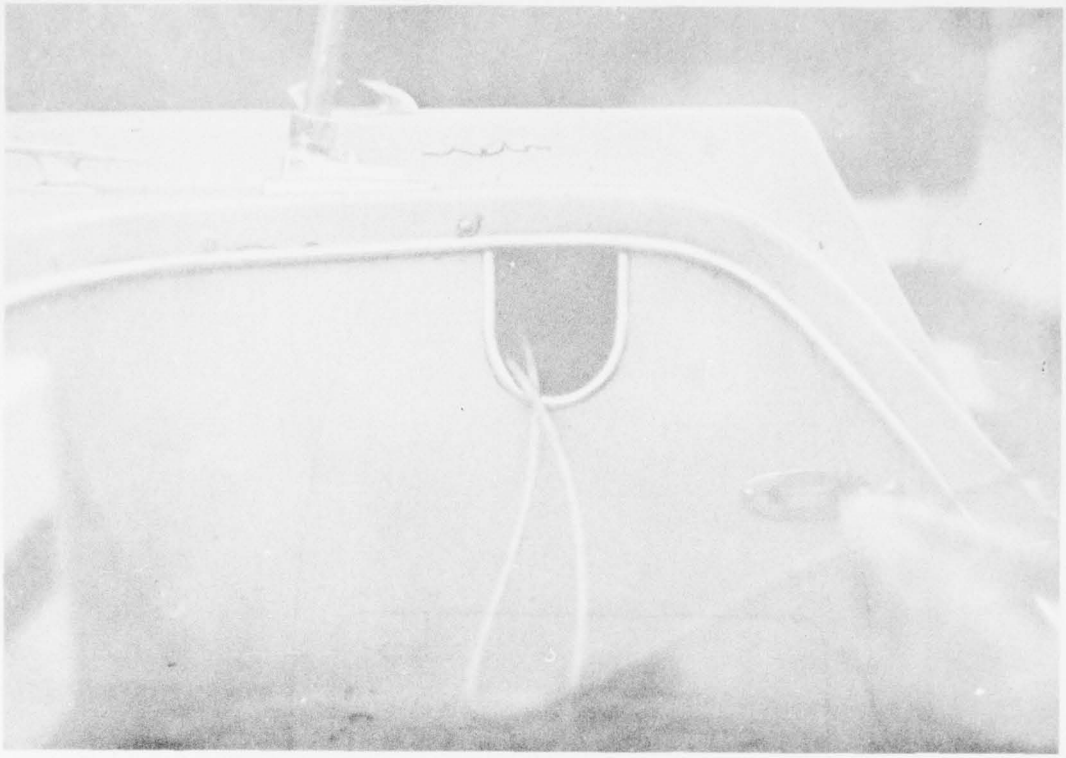


FIGURE 3. CONTROL CABLE CUTOUTS

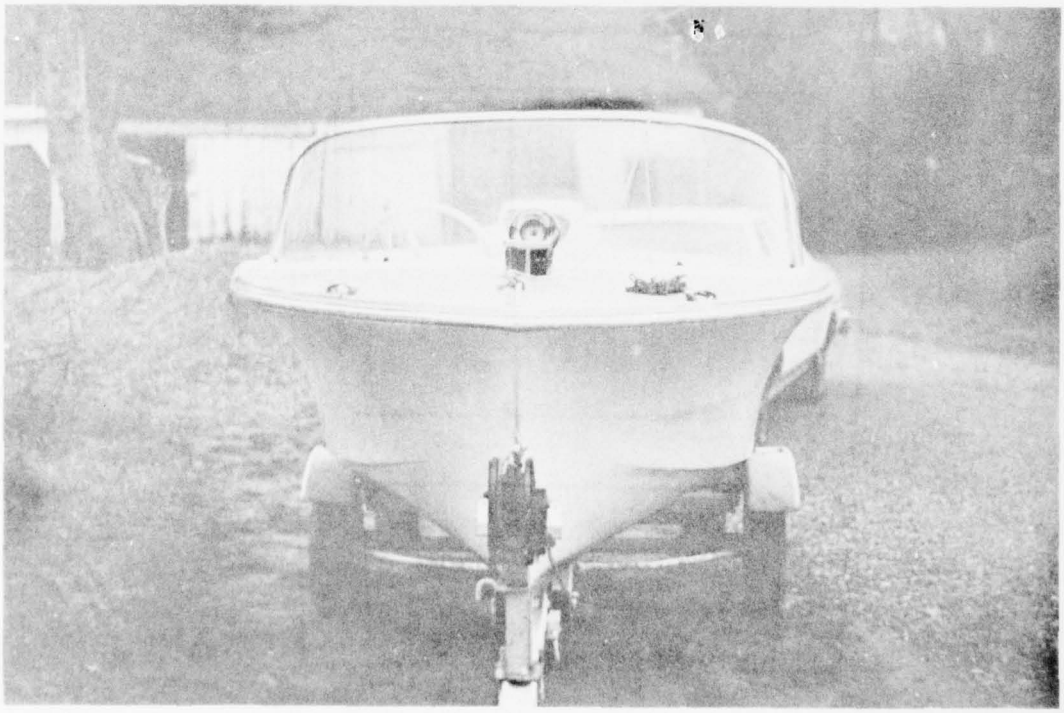


FIGURE 4. FRONT VIEW OF INVOLVED BOAT



FIGURE 5. SIDE VIEW OF INVOLVED BOAT

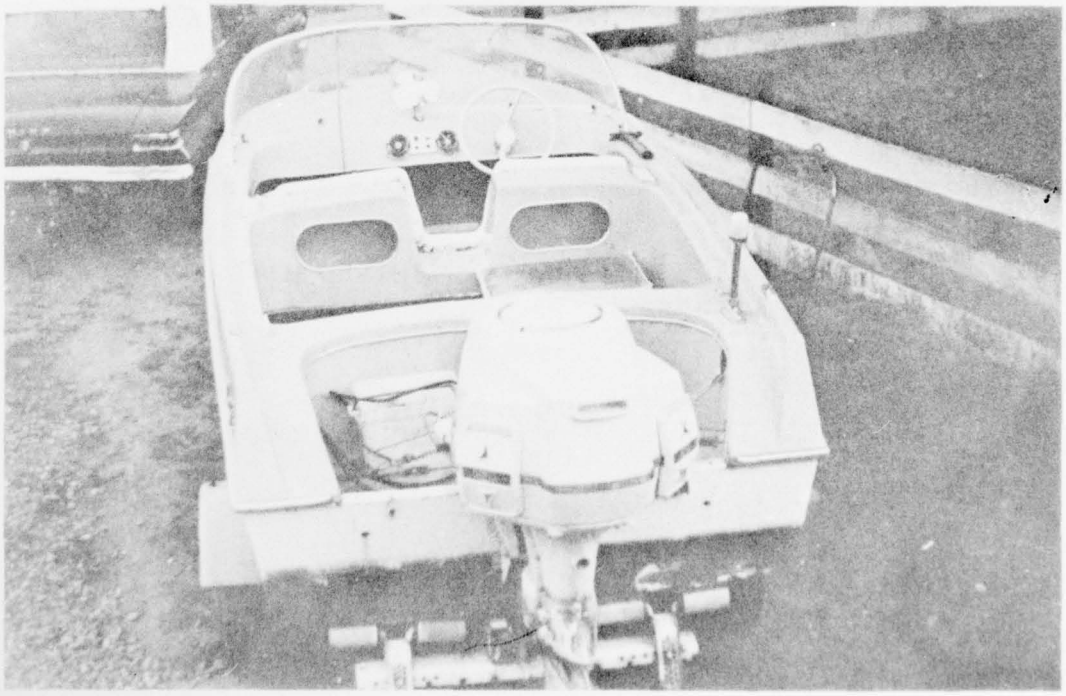


FIGURE 6. STERN VIEW OF INVOLVED BOAT

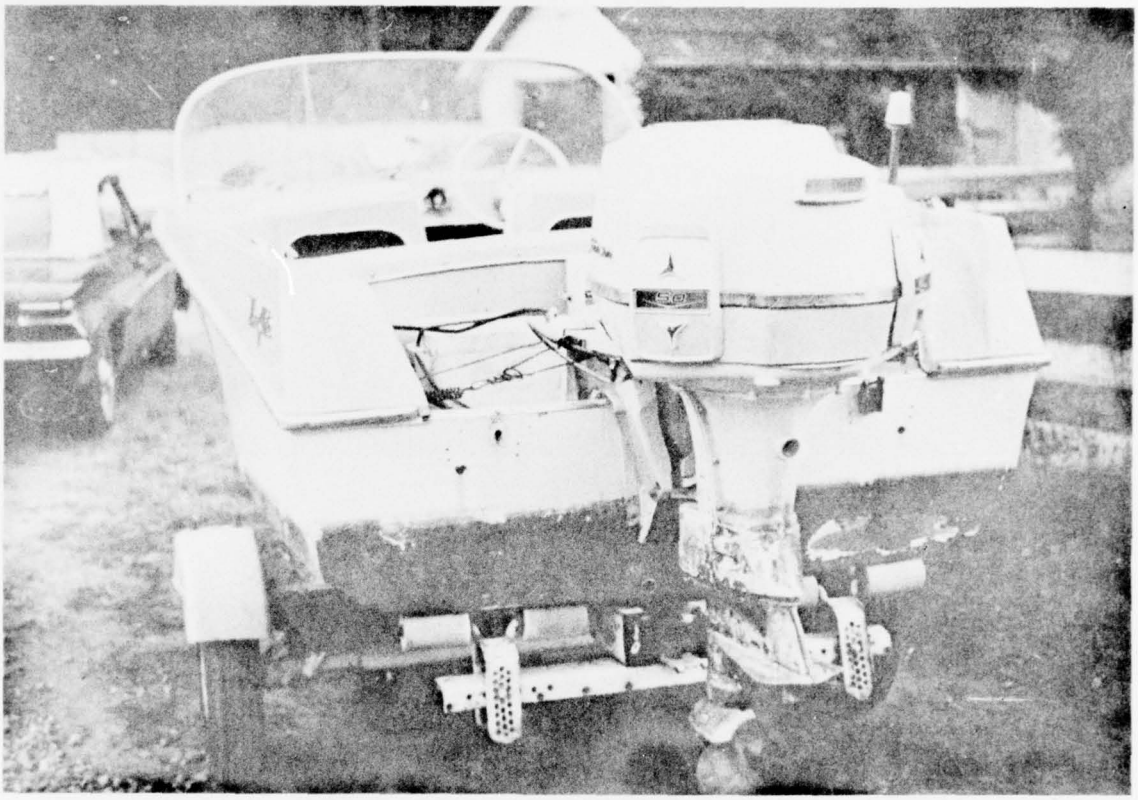


FIGURE 7. STERN VIEW OF INVOLVED BOAT

APPENDIX Y

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 18, 1975

Date of Accident: Mid-August, 1975

Investigation: Capsizing/Swamping No. 75-24

SUMMARY — WYLE ACCIDENT NO. 75-510

Two men were returning from a fishing trip in a 15 ft flatbottom wooden rented boat. As they were heading back to the mouth of the Chetca River in Oregon from the ocean, a large breaking wave approached the boat. The operator turned the boat bow into the wave. The wave turned the boat bow over stern backwards, causing it to land upside-down, trapping the two occupants beneath it. They both swam out from under the boat and held onto it. They found it difficult to hold onto the boat as it was being rolled by the waves. They decided to swim for shore but were rescued before they left the boat.

1.0 BOAT OCCUPANT DATA

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator	M	46	180	Good	500 Hrs	No	No
Passenger	M	28	140	Good	< 20 Hrs	No	No

The operator had been boating since he was about 16 years old. His boating activities consisted mainly of fishing. He had owned a 16 ft sport fishing boat which he sold about a month before the accident.

2.0 ENVIRONMENT

Air temperature was warm with moderate winds of 7 to 14 mph. Seas were fairly calm with gentle swells of 4 to 5 feet. Water temperature was not known, but the Coast Guard said 45 minutes was the expected survival time before serious physical damage would result from hypothermia.

3.0 ACCIDENT

The following narrative was formulated from an interview with the operator of the involved boat.

3.1 Pre-Accident

The operator worked the day before the accident at his regular job in an electrical appliance repair shop. He went to bed early the evening before the accident and got up about 0500. They left their house at about 0530 and drove about 100 miles to the place where they were going to rent the boat. They stopped along the way and ate breakfast, and arrived at the boat dock at about 2100. They brought their own motor and rented a 15 foot boat. The operator had rented boats here before. They loaded a fuel tank, fire extinguishers, two fishing poles, two seat cushions and two AK-1 type PFDs, and a tackle box on board.

They left the dock and drove for about 20 minutes to a point outside the mouth of the Chetco River (see Figure 1), where they started fishing. They fished for salmon for awhile, but did not catch anything. They decided to go fishing among the rocks off to one side of the river's mouth (Figure 2). They drift fished there for about three hours and caught a good deal of fish.

It was then about 1430 or 1500, and they decided to go back up the river. In order to get back to the mouth of the river from where they were fishing, they had to go about 1/2 mile off shore around some shallow reefs (Figure 2). During part of this course, the boat was parallel to the waves (waves hitting the boat broadside).

3.2 Accident

They were proceeding along the course shown in Figure 2 with swells about four feet high in the area. A couple of times the operator had to head into the oncoming waves which looked higher than the others.

The boat was at approximately the position marked X (Figure 2) when the large breaking wave was seen. The operator headed the boat into the wave and the boat went bow up over stern

backwards. (The boat was loaded as shown in Figure 3.) The boat landed upside-down, trapping the two occupants beneath it.

3.3 Post Accident

Both occupants swam out from under the boat. A seat cushion also floated out from under the boat. It had two rope handles, one on each side. The two occupants grabbed onto this seat cushion and made their way to the boat which was a few feet away. Another wave washed the operator off the boat, and he had difficulty swimming back to it. The passenger who was holding onto the boat passed the end of the seat cushion to the operator and pulled him to the boat. They tried to stay with the boat, but it kept rolling over. It was a wooden boat, and some of the trim was starting to come off. After being in the water for about 20 minutes, the passenger was beginning to suffer from hypothermia.

The boat was scraping them up as it continued to roll with the waves. They decided to swim for shore, but before they left the boat, they saw that another boat had spotted them. The other boat backed in and threw them a line. They climbed on board the rescue boat, which then called the Coast Guard. The Coast Guard came out and got the capsized boat. The rescue boat took both occupants to the Coast Guard station where they were given hot showers. The passenger had cold shivers for about 30 minutes after the shower, but did not need hospital care.

4.0 FACTS ABOUT THE BOAT

The boat was a rental boat and the rental station was approximately 100 miles away from the interview. The boat was not seen, but the following was learned from a telephone conversation with the operator of the boat rental station:

Manufacturer:	Knutdson (local to the area)	Hull Type:	Flatbottom
Model Year:	Approximately 1965	Beam:	4' 6"
Material:	Plywood	No capacity plate	
Length:	15 ft		
Depth:	30 in.		
HP on board:	15 hp Champion		

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The operator had fished in this area many times before. Most of the previous times, he had used his own boat, which was larger than the one he had rented. It is possible that he misjudged the capabilities of the smaller boat and attempted to operate in conditions that had been safe for his larger boat.

He either did not regard the conditions as dangerous, based on his experience with his own boat, or he may have just overestimated the capabilities of the rented boat. In either case, it was poor judgment which got him into the situation which resulted in the capsizing.

Even though the boat was still floating, the two occupants decided to swim for shore. Fortunately, they were rescued before they left the boat. They were approximately one half mile from shore, and in that cold water, they most probably would not have made it. They did not have PFDs on at the time of the accident nor did they have an opportunity to don them after the capsizing.

6.0 PROBABLE CAUSE OF ACCIDENT

Operating a boat in unsafe conditions was the cause of this accident. The operator was familiar with the area, but failed to realize the potential danger of operating in the area in a smaller boat than he was used to. A 15 ft skiff (rental boat) should not be assumed to be able to operate with the same safety in the same conditions as a 16 ft sport fisherman (operator's previous boat).

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The following are major events in the accident scenario:

The boat is being operated parallel to the waves.

This is an unsafe mode of operation and should only be done with extreme caution.

A large breaking wave is seen approaching the boat.

This was not a freak wave. Waves like this should be expected in the area where the boat was operating.

The operator turns the bow into the wave.

This is generally the best protective measure against a large wave.

The wave throws the boat bow up over stern backwards.

The wave was apparently more than the boat could handle.

The boat lands upside-down, trapping the two occupants beneath it.

The two occupants swim out from under the overturned boat and hold onto it.

They find it difficult to hold onto the boat and decide to swim for shore.

Before they leave the boat, they are picked up by a passing boat and are taken to shore where they are treated for hypothermia.

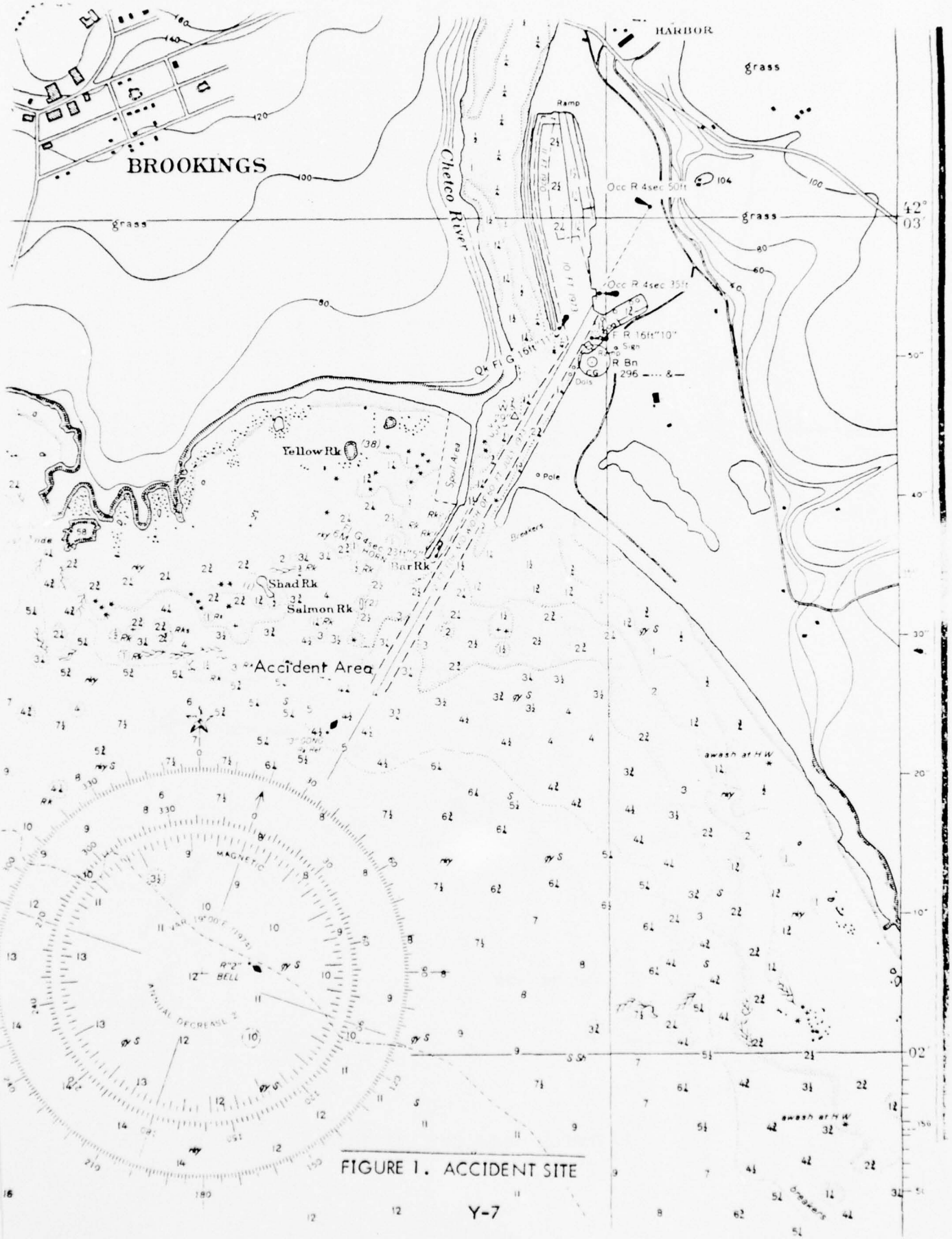


FIGURE 1. ACCIDENT SITE

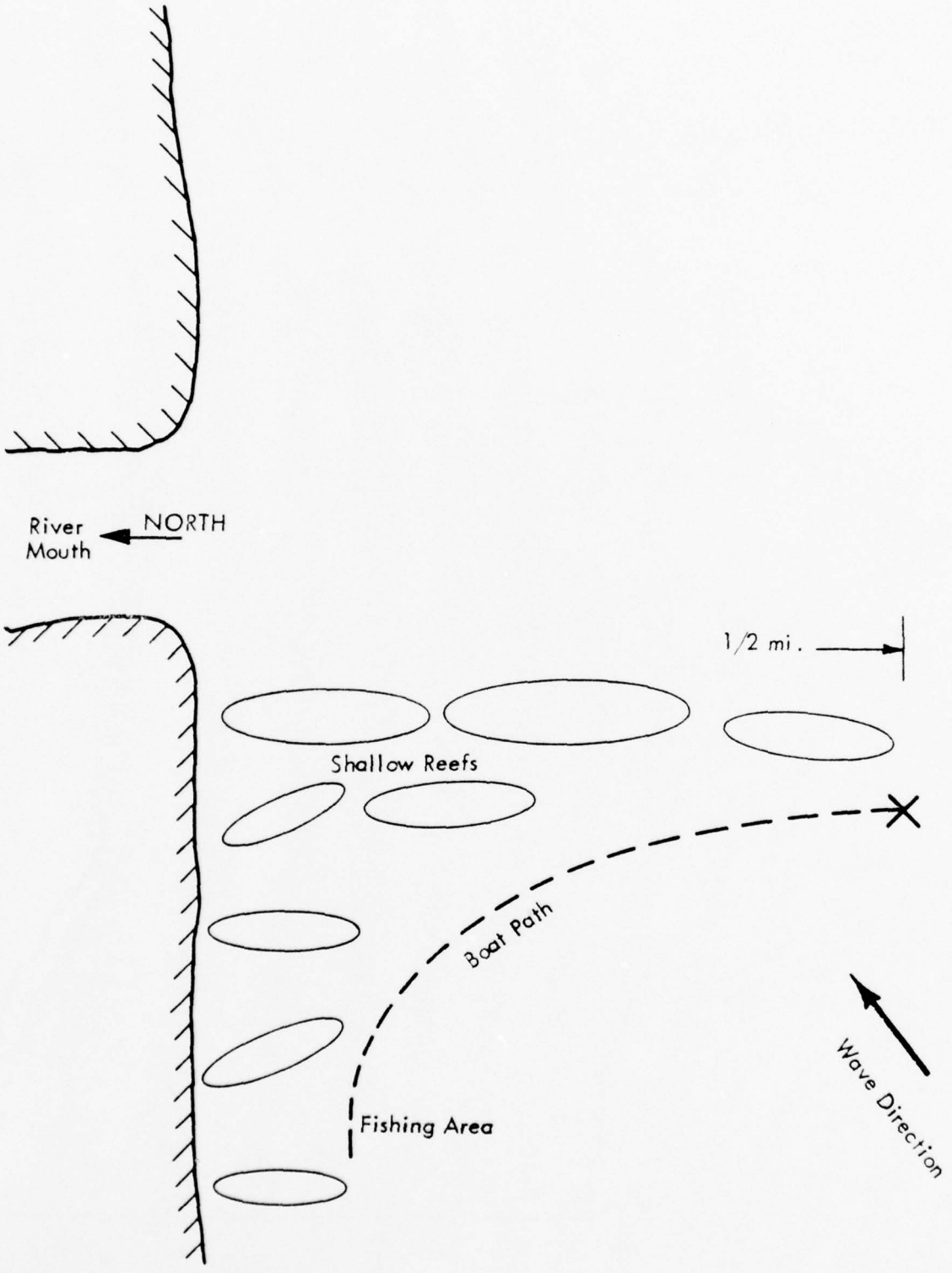


FIGURE 2. AREA OF OPERATION

APPENDIX Z

ACCIDENT INVESTIGATION REPORT

Date of Investigation: September 18, 1975

Date of Accident: Early August, 1975

Investigation: Capsizing/Swamping No. 75-25

SUMMARY — WYLE ACCIDENT NO. 75-508

Three people on board a 20 ft inboard/outdrive left the mouth of a river and went into the ocean under marginally safe conditions. An hour later after conditions had become worse, they attempted to negotiate the river channel. Wind, waves, current, and obscured vision contributed to their being taken to an area with large breaking waves. Several successive waves swamped and capsized the boat, trapping the three occupants beneath the boat. One of the occupants swam out from under the boat and to shore. The other two remained under the overturned boat and drifted to shore, where they were rescued by the Coast Guard.

1.0 BOAT OCCUPANT DATA

Occupant	Age	Sex	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Owner	50	M	170	Fair	500 hr	Yes	Yes
Brother	53	M	180	Fair	100-500 hr	No	Yes
Wife	42	F	125	Fair	Mostly pass.	Yes	Yes

The owner has been boating since 1965. His first boat was a 16 ft outboard which he had until he bought the boat he had the accident in about five years ago.

The owner's wife boated with the owner most of the time, but her experience was limited to that of a passenger

Both had taken the Power Squadron Piloting course approximately seven years ago.

The owner's brother had been boating as a boat operator for about five years.

2.0 ENVIRONMENT

There had been small craft warnings up early in the morning on the day of the accident. The Coast Guard was preventing small craft from going out of the mouth of the river and across the sand bar into the ocean. About mid morning, the craft warning was removed and the Coast Guard began allowing boats to go into the ocean. At this time, there were 7-10 ft gentle swells and a wind of 10 to 15 mph. The tide was coming in at this time. According to the Coast Guard, the water temperature was 47°F and air temperature was estimated at 50 to 60 degrees F.

3.0 NARRATIVE OF ACCIDENT

The following narrative was formulated from an interview with the owner/operator of the involved boat.

3.1 Pre-Accident

The day before the accident, the owner of the boat installed an extra gas tank in his boat. He spent most of the day installing the gas tank and getting his boat and camper ready for the trip the next day. That evening the owner, his wife, his brother, and his brother's girlfriend left for the Coast, which was about 120 miles away. They arrived at the Coast at about 2230 that evening. This is the normal series of events (except the installation of the fuel tank) that this group of people have gone through on previous occasions.

The next day (the day of the accident) they all went down to the bay and met friends of theirs who also had a boat. Early that morning, the Coast Guard had the bar area between the bay and the ocean closed to navigation (see Figure 1). Small craft warnings were also up. At about 0930 the two parties launched their boats. Fishing gear had been loaded on board the accident boat prior to launch. The owner's brother's girlfriend was not feeling well, so she did not go with them. The owner and his wife donned Sears buoyant vests and the owner's brother put on an AK-1 type PFD. The Coast Guard started letting boats across the bar at about 0930. The bar was a sand bar that had formed at the mouth of a river emptying into the ocean. Waves were estimated at 7-10 ft swells when they first went out. They fished approximately two miles offshore for about an hour. The wind came up and the waves began cresting and breaking. The operator decided that it was getting too rough to stay out. They had lost sight of the other boat they had gone out with. They decided that they should return to the river instead of looking for the other boat. They made it to the outer buoy that marked the entrance to the river. The operator lined up with the channel markers and proceeded toward the river channel. The tide was running in and the wind had increased speed. The wind and tide caused the boat to drift away from the marked channel. The boat was under power, going at approximately 20 mph. The operator said that he could not see where he was going a good part of the time because his boat had a hard top that prevented him from being able to stand up to look over the waves. See Figure 2 for seating arrangements.

Not being familiar with the area and not being able to see part of the time, coupled with running tide and wind, brought the boat into an area that had larger breaking waves.

3.2 Accident

The boat was now in an area that had large breaking waves heading shoreward. The operator estimated that they were approximately 1/2 mile offshore. He was riding along on the back side of one of the large breaking waves when, according to him, it just broke out from under him. When the wave broke out from under him, the bow of the boat dropped and the stern came up high enough so that the propeller came out of the water. This caused the boat to momentarily lose power, resulting in the boat broaching. The next wave hit the boat and turned it heading quartering into the waves. The operator tried to turn the boat directly into the waves and get out of that area. The waves in this area were estimated to be greater than 15 ft high by the operator. As he attempted to turn the boat into the waves, the first wave that hit the boat broke the left side windshield. This wave also filled the boat with a good deal of water. The next wave hit the boat from dead ahead and broke out the right side windshield. This wave completely flooded the boat and drowned out the engine. The operator had been cut by broken glass when the right windshield was broken. His wife, who was sitting in the forward port seat had leaned over to wipe the blood from his face when a third wave hit the boat. The boat was not under power at this time and had turned broadside to the waves. This third wave capsized the boat. The capsize threw the operator's wife across him and into the starboard side of the boat. All three occupants were beneath the overturned boat for some unknown period of time.

3.3 Post Accident

The operator's wife does not remember how, but she swam out from under the overturned boat. The operator's wife tried to hold onto the bow of the boat, but the waves were so rough she was afraid the boat might be thrown against her. As a large wave approached her, she pushed away from the boat and swam toward shore. The following is an account of what the operator can remember. The operator and his brother were both trapped beneath the overturned boat. The operator said he was under there for quite some time (could not estimate in minutes), and

then began swallowing water. The buoyancy from his PFD then floated him up under the forward cabin of the boat into an air pocket up there. He took a breath of air and went back under water towards the back end of the boat to look for his wife and brother. He encountered some difficulty in swimming with the PFD on, because it kept him up against the boat. He did not find anyone and was running short of air, so he went back forward to the air pocket. As he reached the air pocket, he saw his brother's foot in front of his face. His brother was trapped face down in the cabin. The operator pulled him loose, and he floated up into the air pocket. The operator thought that his brother was dead at this point. His brother's PFD had torn off by this time; it was an AK1 type. Figure 3 shows probable path of occupants.

The operator held his brother's head above water as they were both being washed toward shore along with the overturned boat. After a while, the operator's brother opened his eyes and began breathing.

The boat with the two occupants floated to shore. The occupants were still trapped in the forward cabin of the overturned boat. People in a camper on shore saw the overturned boat and called the Coast Guard. The Coast Guard sent two divers into the water to search around the boat. The divers pounded on the hull and the operator pounded back. One diver told the occupants to be still and that they would be rescued. The next thing the operator remembers is the bow rising and the stern sinking. He thought that the boat was sinking. What actually was happening was the boat was on a jetty and the Coast Guard had many people lifting the boat.

The operator's thoughts are not clear as to what happened next, but he remembers coming to on the beach. His wife was found about a half mile down the beach. She was driven to a nearby hospital, and the operator and his brother were taken by Coast Guard helicopter to a hospital. They were treated for shock and exposure (hypothermia). The operator's brother was in critical condition until approximately 2200 that evening.

The operator's watch stopped at 1110, which is the time he thinks he first went into the water. They were on shore being rescued at approximately 1200.

4.0 FACTS ABOUT THE BOAT

The boat was totaled in the accident and was not available for inspection. The following was learned from the owner:

Manufacturer:	Fibreform	Model Year:	1967
Length:	20' 9"	Model Name:	Continental
Power:	Mercruiser 160 I/O		

Figure 4 is a photograph of a similar boat by the same manufacturer.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

This was the first time the operator had boated in this particular area. Most of his boating had been done on inland waters. The area had been closed to navigation shortly before he had gone out. This indicates that conditions were marginally safe and extreme caution should be used. A novice to this area and these conditions should not have attempted operating in this area. The lifting of the craft warnings and opening of the area should not have been taken as an open invitation to safe boating in the area. Discretion on the part of the operator is very important.

The operator said he could not stand up to see the channel markers because of the hard top of his boat. This may be a possible design feature which could have contributed to the accident. It may also just be an excuse. The owner said his brother had been standing up aft of the top, so he could have given directions if he could see. If the waves were as large as the operator said they were, he probably could not have seen much better anyway. Operating a boat while standing up in those conditions was not a safe thing to do anyway.

His occasional glimpses of the channel markers should have told him he was off course and proper navigation technique might have kept him on course.

6.0 PROBABLE CAUSE OF ACCIDENT

The hard top which prevented the operator from standing up could be a contributing cause. The major cause was operating in an unfamiliar area under marginally safe conditions. The operator said that the wave he was riding the back of broke right out from under him. This is possible, it is also possible that he was traveling faster than the wave and actually rode over the top and started down the face of the wave. In either case, poor judgment and lack of navigational skills was the major cause of the accident.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

Following are the major events of the accident scenario:

- The boat with three people on board leaves the mouth of the river for the ocean.
  The operator was not familiar with the area, and conditions were only marginally safe; this trip should not have been undertaken.

- Conditions worsen and the operator decides to return to the river.

- The operator attempts to negotiate the channel.
  Wind, waves, running tide, and lack of knowledge of the area cause the boat to drift away from the channel. Only occasional glimpses of the markers, due to high waves and restricted overhead clearance in the boat, contribute to the problem.

- The boat drifts into an area where there are large breaking waves.
  Proper navigational skills on the part of the operator could have prevented this.

- The boat broaches then turns bow quarter into the waves.

- Two successive waves break the windshield and swamp the boat.
  The operator estimated the waves to be 15 ft high. It must be noted that people, especially in a critical situation, tend to over estimate the size of waves.

- A third wave capsizes the boat, trapping the three people beneath it.

- The operator's wife escapes from the boat and swims to shore.

- The operator and his brother remain beneath the overturned boat and drift to shore. The operator did not attempt to swim out from under the overturned boat after locating his brother. He was probably afraid of losing contact with his brother who was not physically capable of caring for himself at the time.

- All are taken to a hospital and treated for shock and hypothermia.

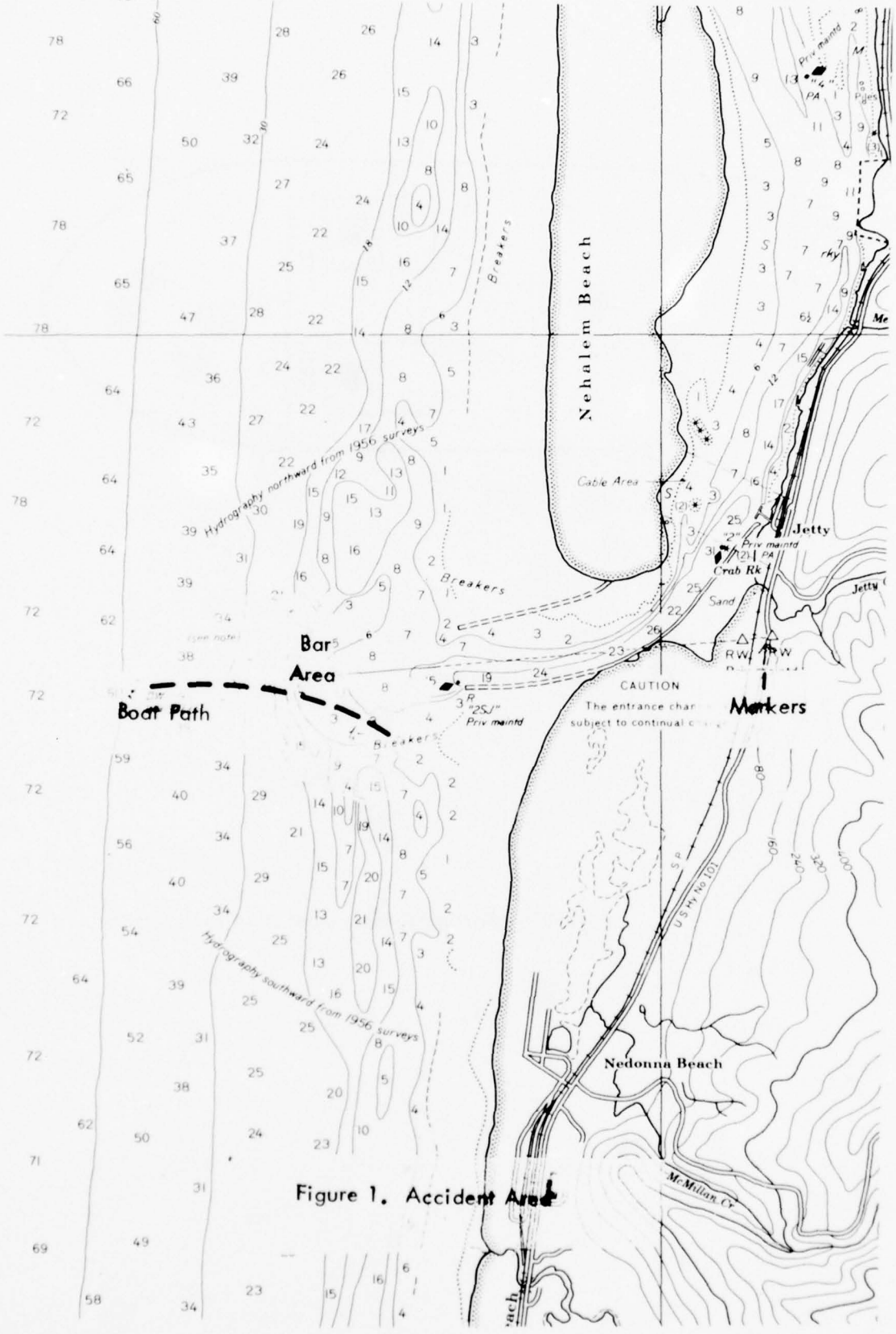
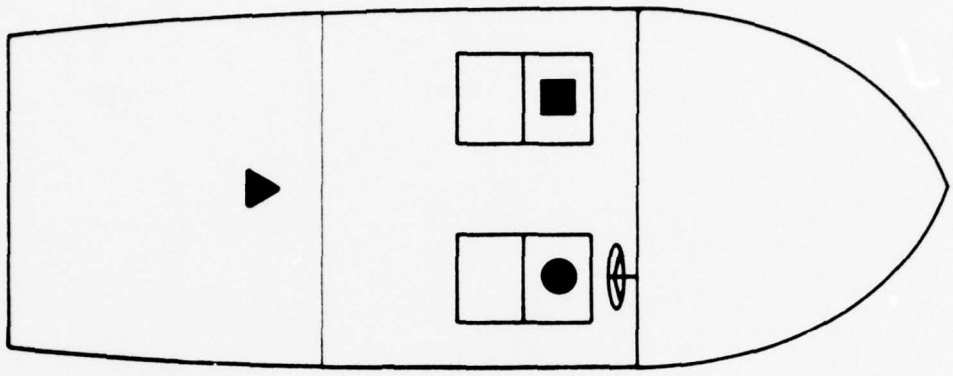


Figure 1. Accident Area



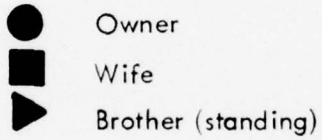
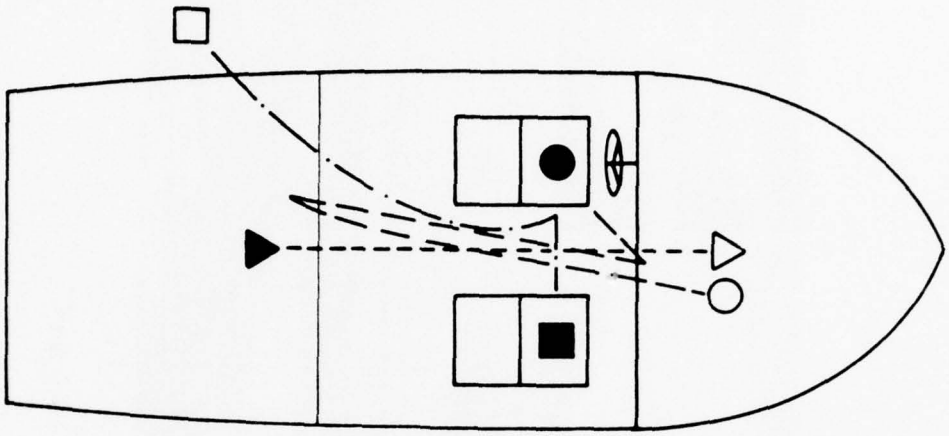


Figure 2. Seating Arrangement Prior to Accident



Path of Owner (Operator)

Probable Path of Owner's Wife

Probable Path of Owner's Brother

NOTE: Boat is in a capsized (inverted) condition.

Figure 3. Paths of Occupants (Boat Inverted)



Figure 4. Boat Similar to Accident Boat

APPENDIX AA

ACCIDENT INVESTIGATION REPORT

Date of Investigation: December 7, 1975

Date of Accident: Late November, 1975

Investigation: Capsizing/Swamping No. 75-26

SUMMARY — WYLE ACCIDENT NO. 75-796

The owner of a 19' Aristocraft I/O planned an off shore fishing trip with two other men. The three arose early, on a Saturday morning, launched the boat in protected waters and entered the ocean through a breaking inlet. By the time the operator noticed that the inlet was very rough, it was too late to turn around. Once into the ocean, the three men decided that it was too rough for comfortable fishing and decided to come back in at the next inlet south, because it has a reputation of being somewhat smoother than the inlet they went out. The owner circled the inlet and went in, riding the back of a wave. Another wave caught up to them and broke over the transom. The bow went under, the boat pitchpoled and capsized. The standing operator was thrown out. The two passengers who were trapped inside the boat grabbed PFDs, came out from under the boat, and held onto the bow rail with the owner. The boat drifted into shallow water where all three were able to stand. "Help" was heard from the person in the rear. Seconds later he was face down, dead. All three were picked up by the Harbor Police. The boat washed up on shore and was later salvaged.

1.0 BOAT OCCUPANT DATA

Occupant	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn
Owner/Oper.	M	47	165	Good	> 50 hr	C.G.Aux.	No
Pass. 1	M	38	185	Excellent	<100 hr	No	No
Pass. 2	M	40	190	Good	50-100 hr	?	No

All three POBs were employed as computer programmers for a large corporation. The owner/operator had limited boating experience and had owned his present boat for only six months. He was unwilling to discuss the accident with the accident investigators on advice from his insurance agent.

Passenger # 1 was quite helpful and seemed to understand the reasons for the investigation as he made several suggestions pertaining to possible ways of reducing the number of accidents of this type. He was raised in a coastal town where his father was a commercial fisherman. He had lived near the water all of his life. He did not have a college education, but was employed in a technical field.

Passenger # 2 was deceased; however, an interview was arranged with his brother-in-law, a yachtsman, who again was quite helpful in suggesting possible accident reduction techniques.

2.0 ENVIRONMENT

The Bahia Mar Marina in Fort Lauderdale provides a weather service to area boaters. Their records for the day of the accident show:

Seas - 5'
Visibility - 8 mi.
Weather - clear
Wind - 0730 15 knots, 1700 10 knots
Air temp - Lo 75°, Hi 80°
Water temp - 74°

The Fort Lauderdale Coast Guard didn't go out on any rescue missions on the day of the accident and, therefore, has no weather data. The officer from the Pompano Beach Harbor Patrol that rescued the survivors claimed that seas were running six to eight feet that day with winds out of the NE at 15 to 20 knots.

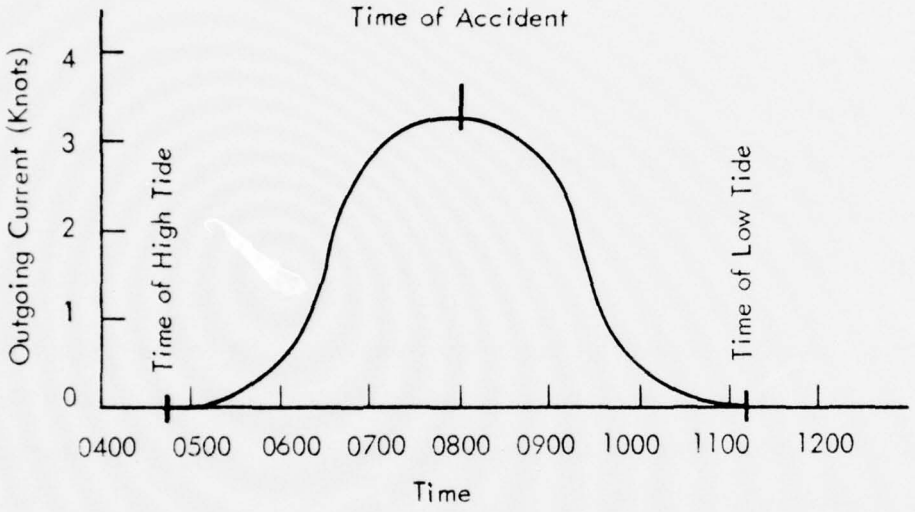
The Coast Guard and the Harbor Patrol both thought that storm warnings were up, but they didn't know if or where they were displayed.

A relative of the deceased went to the inlet immediately after the accident and said that it was breaking with six to eight foot waves. The seas beyond the inlet were about six feet with some breaking.

The Fort Lauderdale News listed the tides at the Hillsboro Inlet the day of the accident as:

Hi	0448
Lo	2309
Hi	1701
Lo	2333

The current direction and velocity through the mouth of the inlet varies with the tide and to a lesser extent with the phase of the moon. The capsize occurred at approximately 0800. As the graph below shows, the current at that time was approximately at its maximum ebbing speed.



This means that the current-induced waves due to the opposing directions of wind and current were maximum at the time of the accident.

3.0 NARRATIVE OF ACCIDENT

The following narrative was compiled from interviews with the surviving passenger and a relative of the deceased plus telephone interviews with the owner/operator, the Harbor Patrol, the local Coast Guard Unit, and the medical examiner, and from newspaper reports.

3.1 Pre-Accident

The owner of the 19' I/O planned an off shore fishing trip with two fellow workers four or five days prior to the actual outing. The three met at 0645 at a protected launch ramp along the intracoastal waterway. The owner who had already launched the boat waited for the two passengers who had stopped along the way to pick up donuts and coffee. The three proceeded down the intracoastal waterway towards the Boca Raton inlet. None of the three had listened to a weather forecast that morning. Passenger # 1 noted that the sun was shining and it wc windy enough to make him wear a light jacket over his shorts and shirt; however, there was only a light chop on the intracoastal.

We know from personal contact that at least two other fishermen arose that morning intent on fishing offshore, but elected to stay in because of the strong winds from the northeast. One of the fishermen turned on the radio to hear that winds would be 10-15 and the seas would be two to four feet. He looked at the palm trees and estimated the wind strength to be close to 20 mph. He knew from experience that the inlet would be breaking with that wind from the northeast and knew it would be dangerous to go out. He felt that the weather report was wrong or perhaps the local chamber of commerce was trying to make it appear better than it was for the sake of the tourist trade.

The Boca Raton inlet makes a sharp turn to the left just before it opens into the sea. (See Figure 1). Woods and dunes make it impossible to see around the corner; therefore, a boatman must partially expose himself to the rough water before he can actually see the conditions of the inlet.

These boaters turned the corner and according to Passenger # 1 "realized that it was pretty choppy." He went on to say that they had passed the point at which they could safely turn around before they realized that the inlet was probably too rough to traverse. They went on out past the breakers and then communicated about what to do. Passenger # 1 said that it really wasn't bad once they got out past the inlet. The boat rode the six to eight foot swells quite nicely; however, it was uncomfortable. They decided that it would be wise to come in.

The decision was made to proceed south to the Hillsboro Inlet, because it is supposed to be deeper and has the reputation of being less rough than the Boca Raton Inlet (See Figure 3).

Earlier as they were approaching the inlet, they noticed an 18 foot runabout following them. The boat was now nowhere in sight. They assumed that the operator saw how rough the inlet was when they went through it and decided to turn around.

Passenger # 2 rigged his line and trolled as the boat proceeded to the next inlet, a distance of about six to eight miles. Passenger # 1 didn't fish, because he felt that one line was enough in rough conditions.

The two passengers sat in the aft facing seats watching the fishing line as the boat approached Hillsboro Inlet. The operator, now standing behind the wheel with the hardtop pushed back, circled outside the inlet in order to observe the wave conditions.

Boats were indeed traversing the inlet; however, they were quite a bit bigger than their 19' I/O. In fact, it was 0800 and the charter fishing boats were just leaving on their morning runs. Just prior to his entering the inlet, the queen of the fleet, a large drift fishing boat, exited the inlet. Passenger # 1 remembered thinking that there would be a lot of seasick fishermen aboard that boat.

The operator decided to go in through the inlet and manipulated the throttle so the boat would ride in a trough. The operator was still standing and the other two remained in the aft facing seats. The line had been retrieved and the rod was stored. Passenger # 1 said that he was concerned but wasn't scared.

3.2 Accident

Passenger #1 reported the following scenario for the accident. It appeared as if one wave caught up with another, crested, and broke just above the transom. He didn't know if that were possible, but he felt that it happened. A large amount of water entered the boat and rushed forward. The bow went under and the stern was lifted. The boat pitchpoled and broached to starboard.

When the motion slowed down, Passenger #1 found that the boat was upside-down. He was inside the boat, standing on the hardtop with his head in the airpocket. The reflections of the sun off of the white sand under the boat provided enough light for him to see Passenger #2 standing behind him. They both grabbed a PFD stored in the side pockets outboard of the seats and under the gunwale. Passenger #2 put his PFD on. Passenger #1 held onto his, waited for the motion of the boat to slow down, then pushed himself down and out to the side. He came up beside the boat on the weather side.

He described the PFD as the AK-1 type, but said that one was blue and the other yellow. That created a question in the interviewer's mind since he had never seen an AK-1 type PFD in a color other than orange.

Upon surfacing, he saw the operator close to the boat. His face was bleeding badly. Because Passenger #1 knew that he was a good swimmer and felt that he was uninjured, he threw his PFD to the operator who put it on while treading water. He didn't seem to have much difficulty in donning the PFD.

It was a few minutes before Passenger #2 surfaced from under the boat with his PFD around his neck. It is not known if the PFD was fastened. Passenger #1 had begun to get concerned about the well being of his friend. All three swam to the forward section of the boat and grasped the bow rail which was about a foot under water.

3.3 Post Accident

One section of the bow rail slipped loose causing Passenger #2 to drift away from the boat. Passenger #1 drifted back and, while holding onto the remaining section of the bow rail, he extend[illegible] his feet enough so Passenger #2 could grab them. Passenger #2 was pulled back to the boat. Since they were lined up along the weather side of the boat, numerous waves crashed over their backs as they hung onto the rail.

Passenger #1 remembers seeing the outer channel marker float by to the north of their boat. He also remembered several large boats lingering in the area. They wanted to help, but couldn't get close enough to throw a life ring to the survivors.

A particularly large wave crashed over their backs and onto the boat with enough force to make all three of them let go of the hand rail. When they surfaced, they were quite a distance from the boat. Passenger #1 intended to swim back to the boat, but changed his mind when the owner who was three to four feet in front of him said, "I can stand. We can walk." Passenger #1 extended his feet down and found that he too could touch what appeared to be a sandy bottom. The water was about chest deep. A cry of "Help" was heard from Passenger #2 who was another three to four feet behind Passenger #1. Passenger #1 turned and said "we can walk." He related that "to the best of my memory, I seen him dropping down and start to take a couple of steps. I turned to see where the guy that was driving the boat was and I went from here down to about here in water (pointed to waist) and in the time that takes, and I turned and the other fellow was lying face down beside me. The life jacket was floating right there near him."

Apparently, quite a few people standing on shore saw the overturned boat and the survivors in the water, because as the 18 foot Pompano Beach Patrol boat passed by the commercial fishing docks near the inlet, the officers on board were told of the capsize. As they exited the inlet, they saw the three victims separated from their boat. Two waves crashed over the victims, after which all three heads surfaced. One victim came up floating face down after the third wave hit the three.

Passenger #1 immediately lifted Passenger #2's head out of the water by picking him up by the back of the shirt. He dragged the victim to the nearby reef where the two survivors clung to a steel pole marking the reef and attempted to revive the victim by pounding on his chest. Mouth to mouth resuscitation was impossible due to the fact that waves were crashing over the reef. Passenger #1 received multiple lacerations of the knees from kneeling on the coral reef.

The police boat approached them from the lee side. One officer jumped overboard and walked onto the reef. A life ring was thrown to him. After he secured the life ring to the deceased, he, the deceased and the owner returned to the policeboat where an immediate attempt was made to revive the victim. The boat circled and came back for Passenger #1 after which all three were taken to an awaiting ambulance at the commercial docks.

The boat washed up on the beach just south of the inlet and was hauled off shortly afterwards by a salvage company. Damage included a broken windshield and hardtop and cosmetic damage to the deck. The boat remained structurally sound.

4.0 PERSONAL INJURIES

The owner received a gash on his head between the point in time when the wave entered the boat and Passenger #1 surfaced. Since he was standing when the accident occurred, it is most probable that the force of the water pushed his head against either the windshield frame or the hardtop when the boat pitchpoled and capsized.

Passenger #1 received multiple lacerations on his knees from kneeling on the coral reef. Passenger #2 (the deceased) had a 1/2 inch diameter bruise over his right eye.

5.0 FACTS FROM THE BOAT INSPECTION

BOAT SPECIFICATIONS

Manufacturer: Aristocraft
Length: 19 feet
Beam: 7 feet 7 inches
Displacement: 1650 pounds
Power: 120 hp Mercruiser
Age: 1975 model; 6 months old

The boat was not available for inspection; however, Passenger #1, who had not seen the boat since the accident, heard that it was not badly damaged. It was washed up on the beach in the upside-down position. The windshield, hardtop, rails, light pole, etc. were damaged but the hull and deck remained structurally sound.

Because of the distribution of foam within the boat, the boat floated relatively level in the upside-down position. Figure 3 is a copy of the manufacturer's literature showing the foam distribution. Figure 4 is a plan view of the boat, showing passenger and cargo distribution.

6.0 PSYCHOLOGICAL OR HUMAN FACTORS

Passenger #1 was asked how bad it would have had to be to have made them turn around before they got to the point of no return. He said he didn't know but someone should put small craft warnings at inlets "for people like me who are too dumb to listen to a weather forecast."

A relative of the deceased did hear the weather forecast over a local radio station which echoed the usual forecast aimed at the multitude of tourists on the beaches, i.e., it will be a beautiful day on the beaches with two to four foot seas. Even the marine weather forecast that is obtained by calling a special telephone number was conservative in that five foot seas were predicted when three observers agreed that they were six to eight feet that morning.

The problem then is one of the quality of weather information available to those who are concerned enough to request it. The severity of conditions at inlets changes radically during a given day depending on the combination of the direction of the current through the inlets which is controlled by the tides, and the wind direction and strength. These conditions are so predictable that knowledgeable boatmen in the area mentally compute them prior to leaving their docks. Trips are planned around these conditions, including the times of exiting and re-entering the inlets.

Weather forecasters could be supplied with accurate estimates of the conditions of the inlets. At the least, the "official" marine weather forecast that is available by calling the "weather number" should give this information to those who are not able to mentally compute it.

Small craft warnings were in effect that day according to the rescuing police officer. However, these warnings were not displayed in the vicinity of the accident. In fact, there is no provision for displaying small craft warnings in the area of the two inlets.

The gas dock at Pier 66, a large marina about 12 miles south of Hillsboro Inlet, displays the red pennant which is the day signal for small craft warnings. In fact, it was displayed that day. That is the closest and only place in that portion of South Florida where the small craft warnings are displayed.

So, we have seen that the victims would have received false weather information if they had taken the time to get it and a warning of the dangerous conditions of the inlets wasn't presented to them prior to leaving the protected intracoastal waterway.

We have also said that knowledgeable boatmen compute the inlet conditions for themselves using inlet current direction and strength from available tide tables and wind directions and strength from direct observations. They know from experience what the wave conditions at the mouth of the inlet will be under any combination of the above water and wind conditions. These are the people who stayed home that day.

It appears obvious that knowledge of the conditions of the inlets must be imparted to the inexperienced and/or uneducated boaters in order to protect them from similar mishaps. This can be done by:

- Displaying warnings of dangerous conditions at some point where all boaters approaching an inlet will be certain to see them,
- Supplying inlet condition information to weather forecasting agencies,
- Educating inexperienced boaters about the simple methods of inlet condition prediction.

Passenger #1 was asked whether he knew if anyone panicked during or after the capsize. He said he didn't, himself, and didn't think either of the other two did. The operator's face

was full of blood, so it was impossible to read his facial expressions. Passenger #1 said of the deceased, "there was a look on his face that I had never seen before. Obviously, I had never been in a crisis situation with this guy and he looked scared to me." He continued, "I did not at any time feel scared once I came out of the boat. I was concerned as to getting out of the boat."

The question of how bad it would have had to have been for him to turn around prior to getting to the point of no return hasn't been answered. Certainly this operator could see the water ahead of him. He could feel the pitching and rolling motions of his boat beginning to get more severe. He could then compare the roughness of the water under the boat with that ahead of the boat. The surface of the water became rough gradually enough for him to be able to turn around prior to reaching the point of no return, but he didn't. Unfortunately, the owner/operator wouldn't talk with us.

7.0 PROBABLE CAUSE OF ACCIDENT

The boat slipped back into the trough enough to allow a combination of two breaking waves to break into the cockpit of the boat.

The water/wave conditions in the Hillsboro Inlet were dangerous for boats of that size. A person experienced with operating boats in short steep following seas could probably have avoided the mishap because he:

- Would not have been out there to begin with, or
- Would have chosen a different approach to the inlet that would have exposed him to far fewer waves. (See Section 8.0)
- Would have maintained a position higher on the back of the preceding wave to reduce the chances of being pooped.
- Would have stayed off shore for two or three more hours, knowing that the inlet would calm down considerably at ebb tide.

8.0 DYNAMICS/ANALYSIS OF ACCIDENT

8.1 Time Line Analysis

0500 (approx.)	Victims arose
0645	Three men congregated at launch ramp
0700	Boat exited Boca Raton Inlet
0750	Boat approached Hillsboro Inlet and circled
0755	Boat entered breakers surrounding inlet
0757	Boat capsized
0758	Passenger #1 exited boat
0800	Harbor Patrol Boat summoned
0802	Passenger #2 exited boat
0810	Owner and Passenger #1 in shallow enough water to stand
0811	Passenger #2 drowned
0812	Police boat on scene
0820	Police boat picked up owner and Passenger #2
0824	Police boat picked up Passenger #1
0830	Police boat entered inner harbor
0835	Victims loaded into ambulance

8.2 Analysis Of Accident

Two wave patterns were present at the time of the accident, a wind induced wave pattern which was the source of the six to eight foot off shore swells and a current induced wave pattern surrounding the mouth of the inlet. Generally, the off shore swells have a greater wave length and travel faster than the inlet waves which tend to be short and steep. When the wind is from the northeast, the two wave patterns approach the inlet from two directions causing a confused and unpredictable sea. (See Figure 2).

In this case, it is quite probable that the longer, faster ocean swell caught up with the current-induced wave following the boat and the two crested and broke over the transom.

The owner entered the inlet from the south. In doing so, he exposed the boat to the confused seas caused by the combination of wave patterns for quite a bit longer than if he would have entered the inlet from the north.

When using the northerly approach, one's boat is exposed to only the wind induced waves for most of the approach and is exposed to the confused sea for the minimum amount of time. The U. S. Power Squadron publishes a chart of the inlet showing the preferred approach to the inlet.

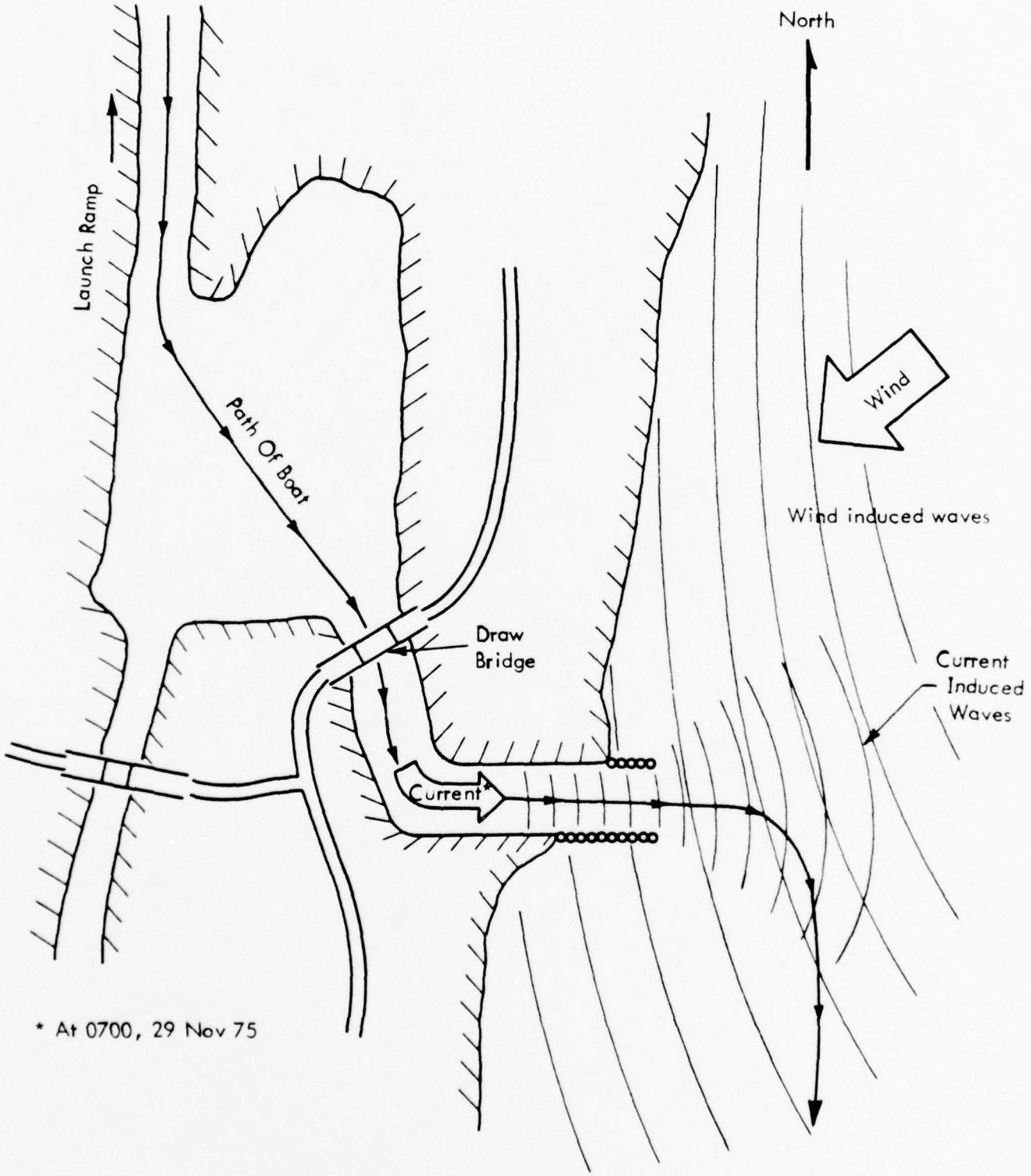


Figure 1. Sketch Of Boca Raton Inlet

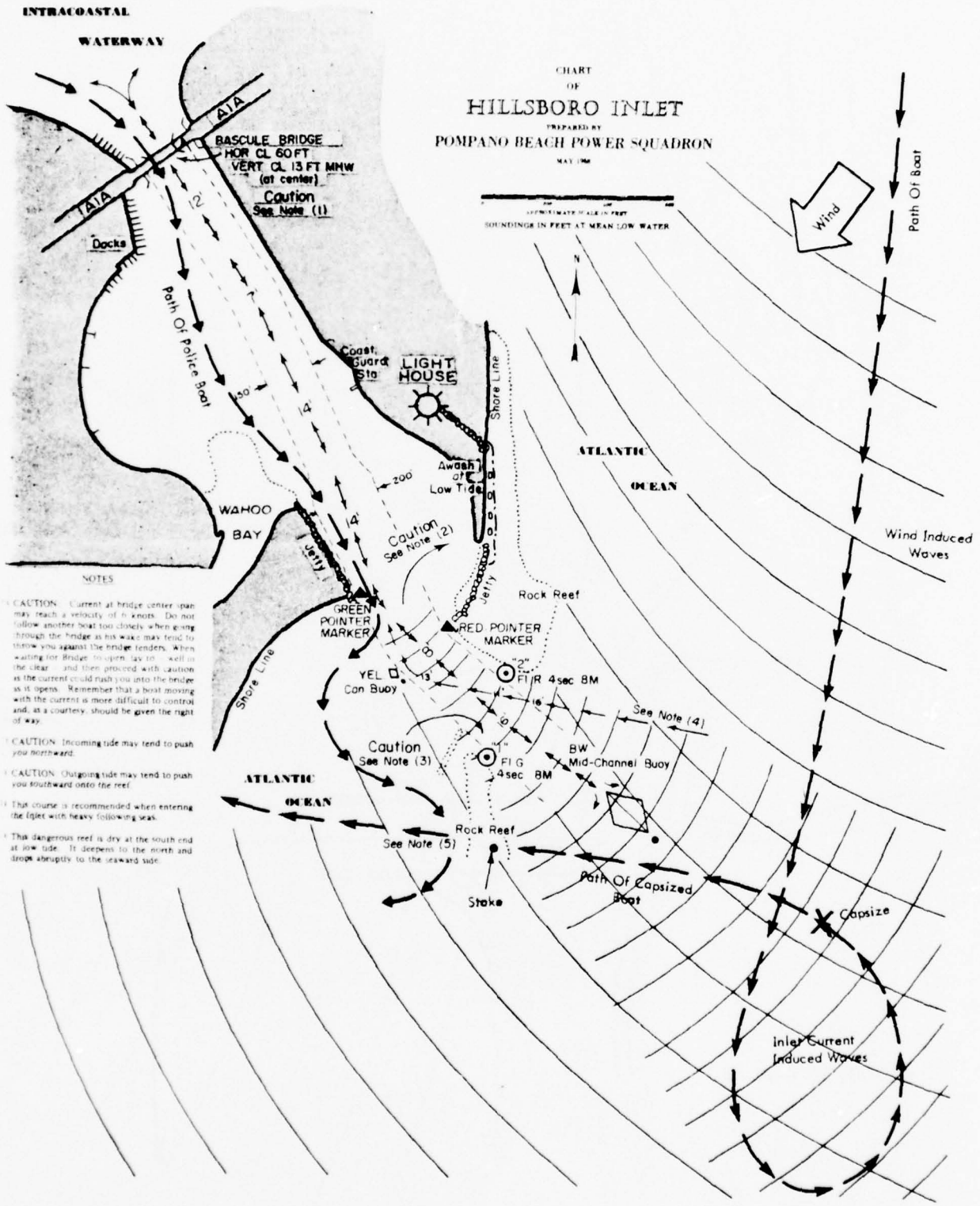


Figure 2. Hillsboro Inlet

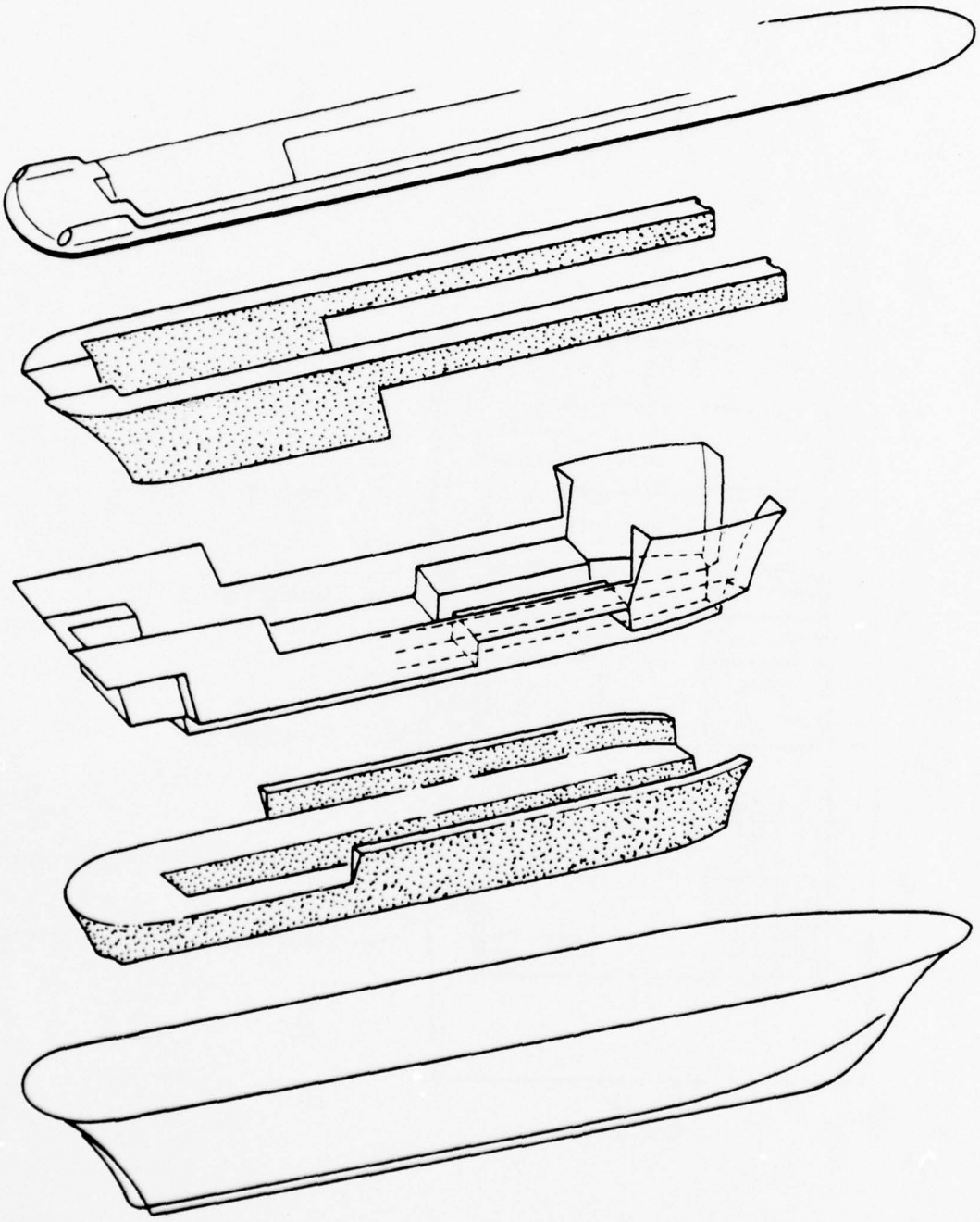


Figure 3. Foam Distribution

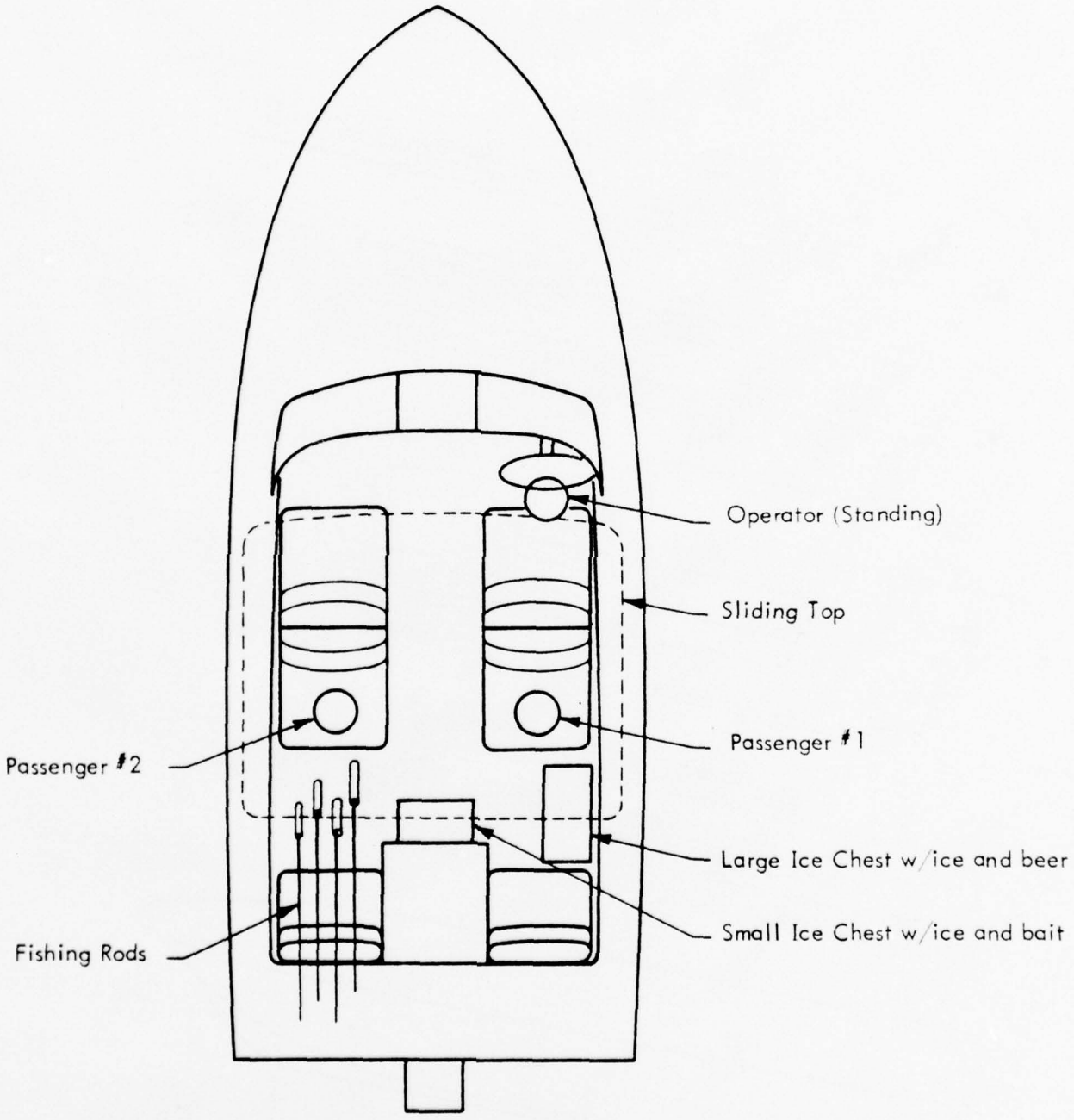


Figure 4. Boat Plan View

APPENDIX BB

ACCIDENT INVESTIGATION REPORT

Date of Investigation: November 8, 1975

Date of Accident: Late July, 1975

Investigation: Capsizing/Swamping No. 75-27

SUMMARY — WYLE ACCIDENT NO. 75-379

The accident reported herein involved a 14'9" tri hull, open bow runabout powered by a 55 horsepower outboard motor. The type of accident was a swamping with a subsequent capsizing of the boat, resulting in no injuries or fatalities.

At approximately 1545 in late July, 1975, four adults, two male and two female, set out for a pleasure ride in a bay located in southern Louisiana. The male operator was able to maneuver the boat at full throttle most of the time, but had to throttle back occasionally because of rough water. The operator was seated at the helm on the starboard side, the male passenger was seated in the port seat adjacent to the operator, and the female passengers were seated in the forward bow seat.

The party rode around in the bay for approximately 15 minutes, at which time, the operator slowed the boat to idle speed and made a sharp 180 degree turn to port. After completing the turn, the operator saw that the boat was headed bow on into a wave of approximately two feet in height. As the boat approached the wave, the operator applied full throttle to bring

the bow of the boat up onto the wave. The wave came over the bow and the boat rapidly submerged, bow first. After completely filling with water, the boat rolled to starboard until it was upside-down in a level position. The operator was trapped underneath the boat and was disoriented. The other occupants pulled him out from under the boat. The occupants stayed with the boat for approximately 20 minutes until rescued by a Coast Guard Auxiliary boat. The boat was righted, the water pumped out and towed to shore by the rescue vessel.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFDs Worn
Operator	M	42	195	non-swimmer	200 hr	None	No
Passenger	F	42	130	Good	200 hr	None	Yes
Passenger	M	34	160	Fair	unknown	--	No
Passenger	F	40	150	Fair	unknown	--	Yes

The owner/operator was the only occupant available for interview at the time the accident was investigated. According to him, the three passengers were of normal intelligence and physical ability. The owner/operator worked as a foreman for a large construction company and seemed to be of average intelligence and physical ability. He stated that he had been around small pleasure boats all his life, but had actually owned only one (the involved boat). His knowledge of boat operation had been gained through observing others and the trial and error method of self teaching. Most of his boating experience had been on small rivers; he had been boating on a large body of water only three or four times.

2.0 ENVIRONMENT

The sky was partially clouded and the recorded wind velocity was from the west at seven knots. The water was choppy (approximately two foot swells) with a strong current. The air and water temperature was comfortably warm. The water depth at the accident site was 12 ft.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

On the day of the accident, the operator went to work at his construction job at approximately 0730 and worked around the construction office until approximately 1300. The involved boat was stored outside at the construction office site. He was considering selling the boat and decided to wash and clean it to make it more presentable to prospective buyers.

He finished cleaning the boat at approximately 1430 at which time his wife and two friends came by the office. The operator and the three other people sat in the office and drank coffee and beer until approximately 1500 (the operator stated he had two beers). The boat had not been in the water for 2-3 months , and the party decided to take it on a short pleasure trip to see if it ran properly. The boat was towed to a nearby private launch ramp (approximately three miles away) where it was put in the water. The inner hull was not checked for water prior to launching.

The party got underway for the pleasure ride at approximately 1545. After getting underway, the operator noticed that the boat did not come up on plane as fast as normal. He stated that the stern seemed to be riding lower in the water than it had during previous outings with approximately the same weight distribution. At full throttle, the boat got on plane and the operator ceased to be concerned about the sluggish boat performance. The party rode around in the bay for approximately 15 minutes. Most of this time the engine was running at full throttle, but occasionally, the operator reduced throttle due to rough water conditions. The two female passengers donned Stearns life preservers shortly after getting underway to shield the upper parts of their bodies against water spray that occasionally came over the bow.

3.2 Accident

Gear aboard was as shown in Figure 1 and the weather as noted in Section 2.0. Approximately 15 minutes after launching, the boat was located near the center of the bay and approximately 150 feet on the upwind side of a causeway and state highway. The operator reduced the boat speed to idle and made a sharp 180 degree turn to port. After completing the turn, he noticed that the boat was headed bow-on into a wave approximately two ft in height. The operator was seated in the starboard seat at the helm, the other male passenger was seated adjacent to the operator in the port seat and the two female passengers were seated in the forward aft facing bow seat. As the boat approached the wave, the operator applied full power in order to raise the bow up over the crest of the wave. The bow sliced into the base of the wave and submerged, bow first, very rapidly. As the passenger compartment was flooding, the operator thinks he turned the steering wheel hard to starboard. Before the forward motion of the boat stopped, the boat violently rolled to starboard until it was upside-down in a near level attitude. The two passengers in the bow seat were washed out of the boat as it submerged. The passenger adjacent to the operator exited the boat on the port side before the boat had completely capsized. The operator was unable to exit the boat and was underneath when it came to rest upside-down.

3.3 Post Accident

The operator was disoriented and could not determine how to get out from under the boat. He was holding to a part of the boat and being a non-swimmer, did not want to let go due to fear of drowning. While he was trying to orient himself, the other occupants saw his legs extending out from under the port gunwale. The male passenger grabbed his legs and pulled him from under the boat. The occupants held to the boat for approximately 20 minutes until rescued by a Coast Guard Auxiliary boat. The accident was observed by a passing motorist who stopped a tractor-trailer and asked the driver to call for help on the CB radio installed in the truck. The driver called a local base station which, in turn, called the C.G. Auxiliary unit. The crew of the rescue vessel took the occupants aboard, righted the involved boat, pumped out the water, and towed it to the launch ramp. Refer to Figure 2 and Photograph 1 for accident area.

TIME SEQUENCE

1545	Got underway from launch ramp.
1545-1600	Rode around in bay.
1600	Boat swamped and capsized.
1601	Operator pulled from underneath boat by male passenger.
1605	Call made to C. G. Auxiliary unit via CB radio and telephone.
1620	C. G. Auxiliary rescue boat arrived and took occupants aboard.
1620-1630	Boat righted, water pumped out and towing operation back to launch ramp started.

4.0 FACTS FROM THE BOAT INSPECTION

At the time of the investigation, the operator had sold the involved boat. He asked the investigators not to contact the new owner concerning examination of the boat because he was unaware that it had been involved in a swamping/capsizing. Photographs 2 and 3 were taken with telephoto lens showing front views of the involved boat. Photographs 4 through 8 are views of a sister boat of the same make and model.

The boat was a typical tri-hull open bow runabout. It had been stored (covered) outside at the construction office.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

Although the operator stated that he had been around boats all his life, it was apparent that his knowledge was below average concerning boat operations, particularly operating in open water. His boating experience had essentially been limited to operating on small rivers and lakes. He had been the boat operator in open water only three or four times. He stated that he had been a passenger on a 27 ft pleasure craft in 1970 that was caught in a storm on a large lake. The boat and occupants survived the storm, but the experience caused him to be very apprehensive about operating a boat in open water. A draw bridge tender who witnessed the accident stated that the boat was being operated in what he considered a reckless manner immediately prior to the accident. Since the water conditions were not particularly rough, the operator may have been operating the boat in seemingly a reckless manner to overcome his apprehension of operating in other than calm water or to give his passengers the impression that he was an experienced operator.

6.0 PROBABLE CAUSE OF ACCIDENT

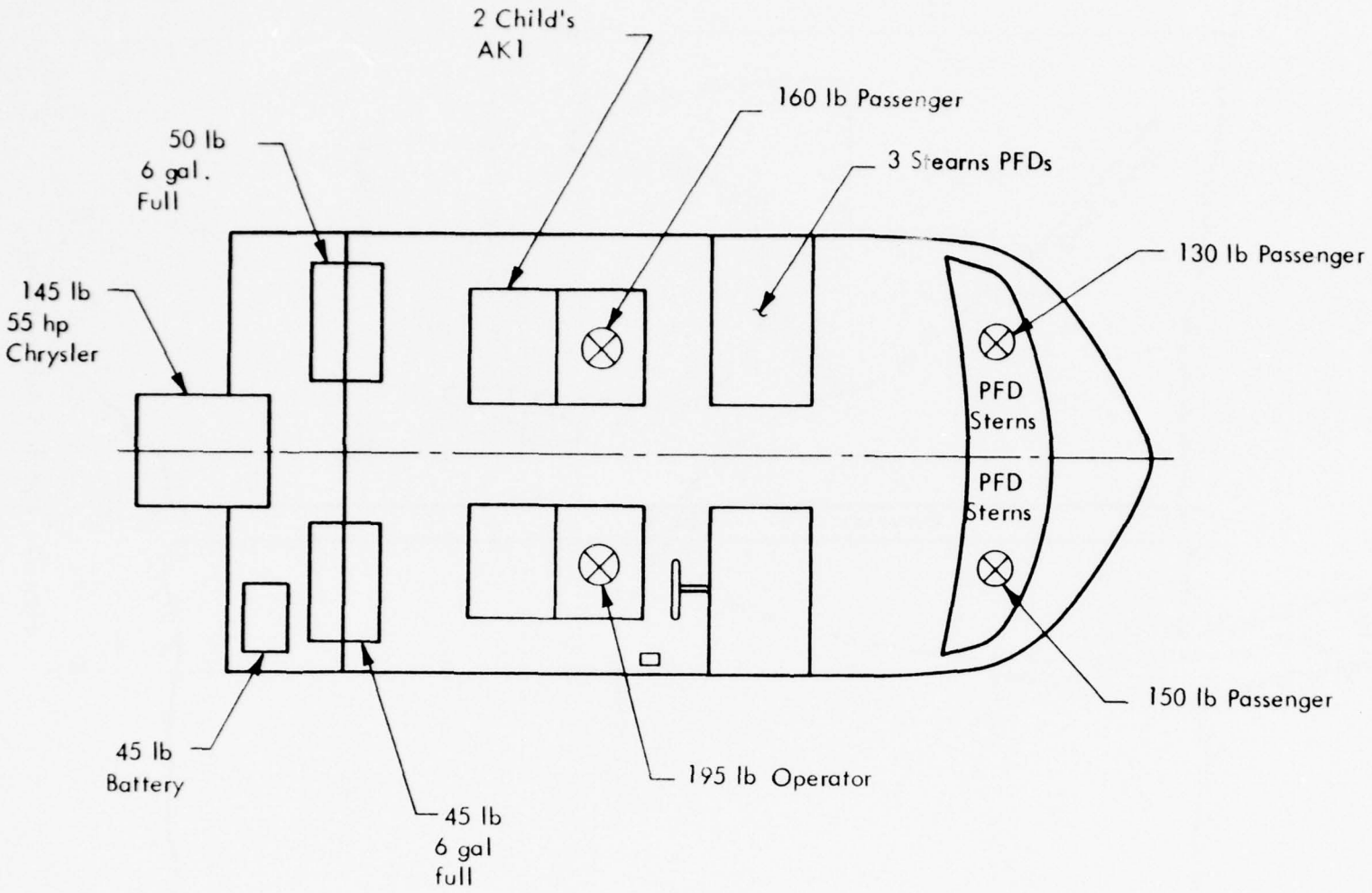
The following items are most likely the major factors in causing this accident:

- Inexperience on the part of the operator is considered the major contributing factor.
- The operator was not aware of the drain plugs for the inner hull and he stated that the boat would not come up on plane as fast as normal; therefore, it is reasonable to assume that there was a significant amount of water in the inner hull.
- The operator exercised poor judgment in allowing the two female occupants to ride in the most forward bow seat under the existing water conditions.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

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

According to the estimated weight in the boat at the time of the accident, the boat was not overloaded. However, considering the weight of the water that was probably in the inner hull, the maximum weight capacity was probably exceeded. When the operator reduced power to idle speed, the boat most likely was essentially horizontal about the lateral axis. With the boat in a level attitude, the construction of the bilge in this type boat would allow some of the water in the inner hull to accumulate in the bow section. When full power was applied to raise the bow, the weight of the passengers and water in the bow prevented the bow from raising sufficiently to avoid bow wash. After the bow had submerged, the thrust from the motor propelled the bow further into the water. The majority of the flotation material in this type boat is under the deck. When the operator turned the partially submerged boat to starboard, the boat heeled to starboard, and the location of the flotation material caused the boat to have a natural tendency to capsize.



BB-9

Figure 1. Boat Load Distribution at Time of Accident

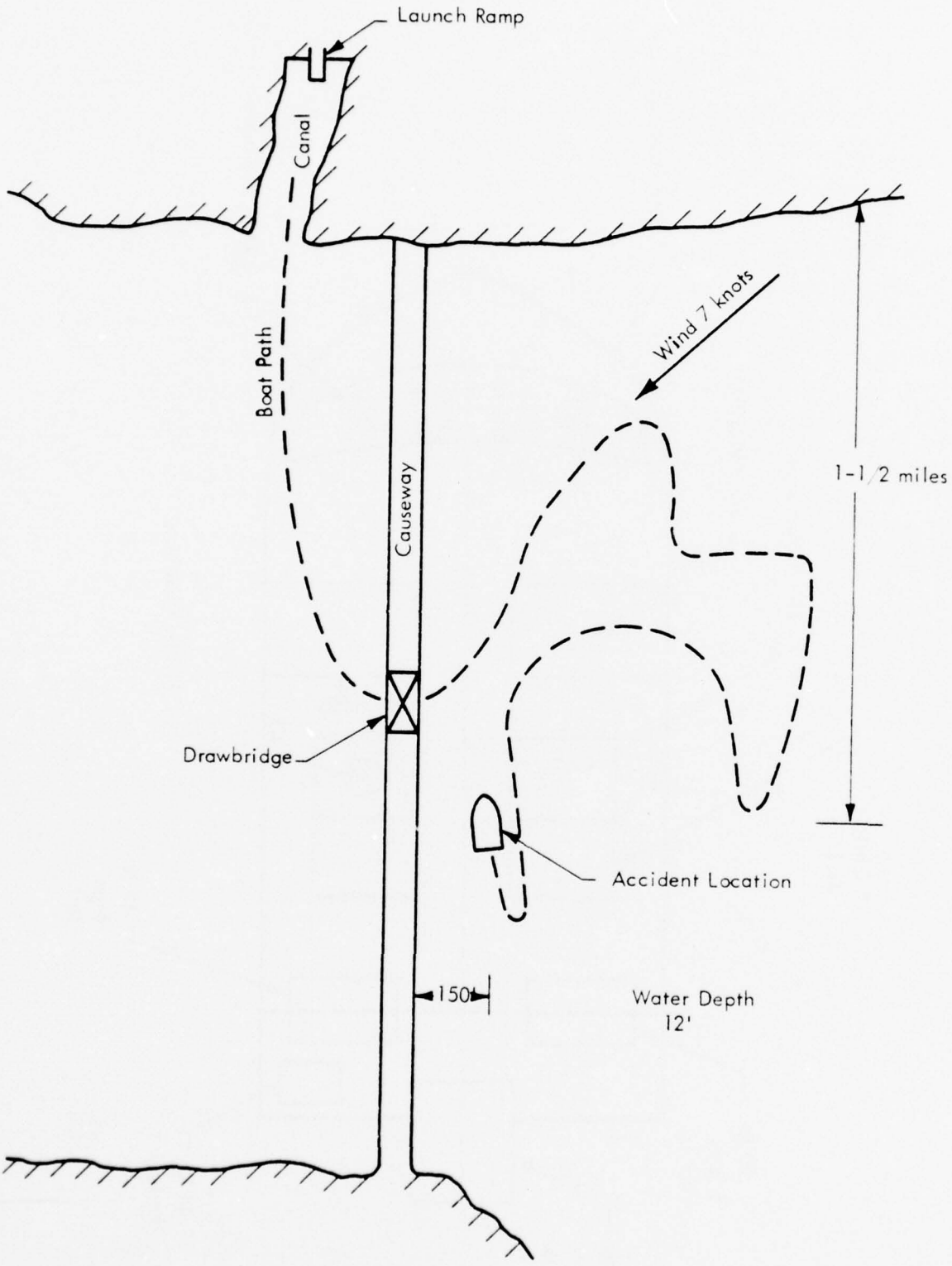


Figure 2. Sketch of Accident Area



PHOTOGRAPH 1



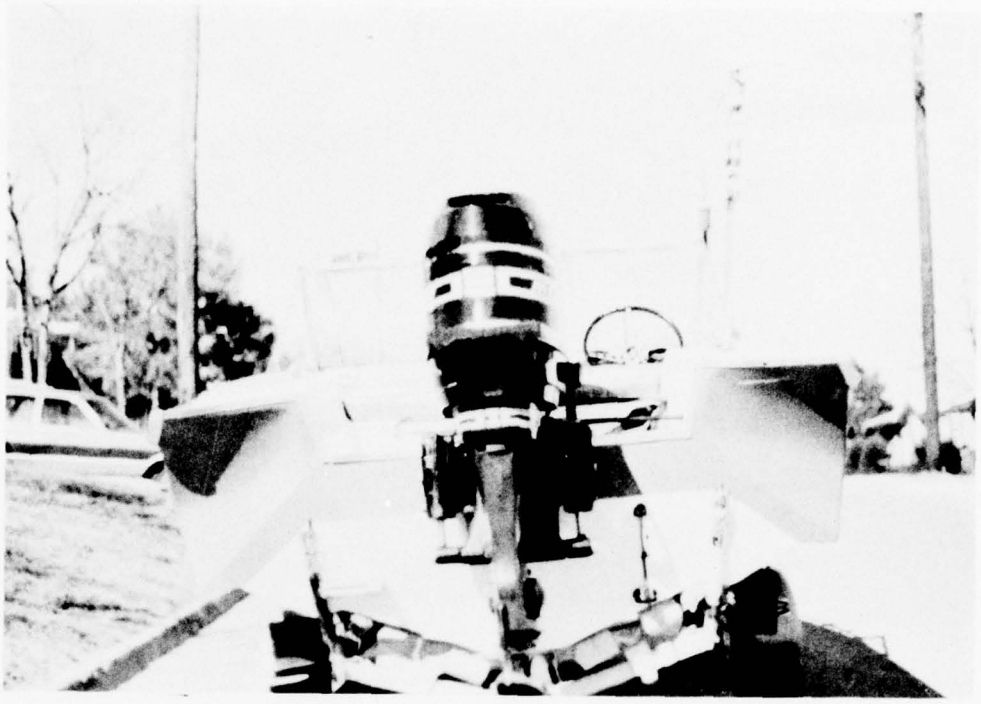
PHOTOGRAPH 2



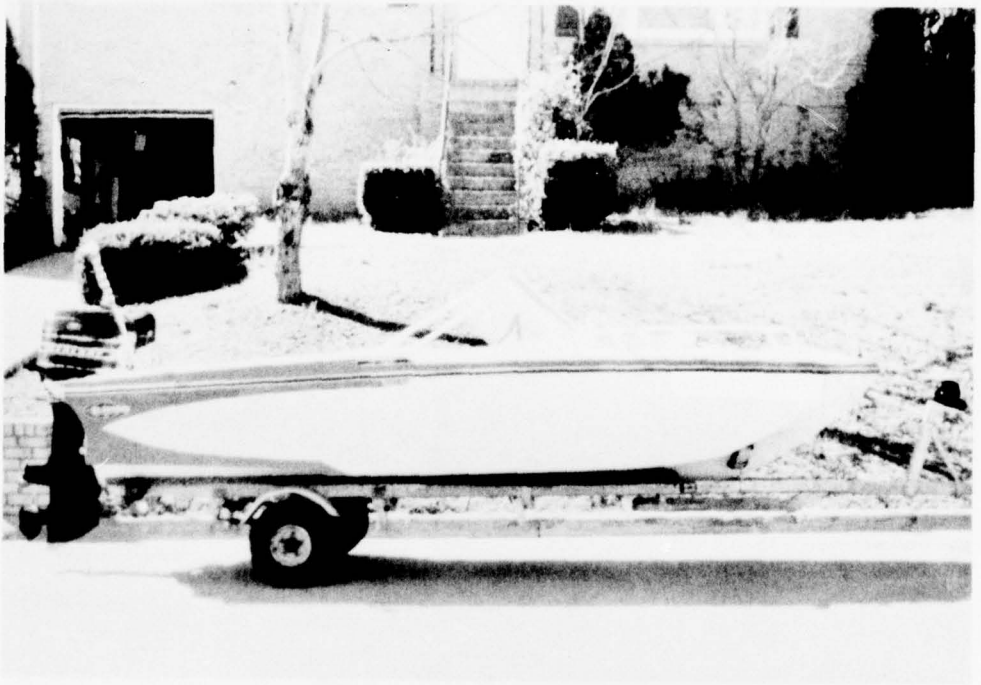
PHOTOGRAPH 3



PHOTOGRAPH 4



PHOTOGRAPH 5



PHOTOGRAPH 6



PHOTOGRAPH 7



PHOTOGRAPH 8

APPENDIX CC

ACCIDENT INVESTIGATION REPORT

Date of Investigation: March 3, 1976

Date of Accident: Late February, 1976

Investigation: Capsizing/Swamping No. 75-28

SUMMARY — WYLE ACCIDENT NO. 76-038

The accident reported herein involved a 14 ft aluminum flatbottom boat powered by a 10 horsepower outboard motor. The type of accident was a swamping with a subsequent capsizing of the boat, resulting in minor injuries and no fatalities.

At approximately 0945 in late February, 1976, four persons set out from a launch ramp located in southeastern Texas destined for an oyster boat that was working approximately 15 miles away from the launch ramp and approximately two miles off shore in Galveston Bay. The party included one adult male, two teenage males and an eight year old female. The purpose of the trip was to take the children aboard the oyster boat to observe the working operation.

Approximately 20 minutes after getting underway, a wave came over the bow partially swamping the boat. The operator slowed the boat to idle speed and the occupants started bailing the water out of the boat. Within one minute after the bailing operation was started, a second wave came over the bow completely swamping the boat. The boat started rolling to port and

the occupants, all wearing PFDs, exited the boat on the port side. The boat came to rest upside-down in a near level attitude. The occupants held to the boat for approximately two hours before being rescued by a tug boat. After being in the water approximately 30 minutes, the eight year old either lost consciousness or fell asleep. After approximately one hour and 30 minutes, the adult and one of the teenagers started losing feeling in the lower part of their bodies. They were unable to walk for approximately five minutes after being rescued. The eight year old was treated at a local hospital for exposure and released.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
1.Oper.	M	42	180	Good	>500 hrs	None	Yes
2.Pass.	F	8	65	Poor	Very little	None	Yes
3.Pass.	M	13	110	Good	Very little	None	Yes
4.Pass.	M	14	120	Good	Very little	None	Yes

1.1 Owner/Operator

The owner seemed to be of normal intelligence and physical ability. He was the owner/operator of a bait shop and sea food restaurant and the owner of a shrimp and oyster boat operation. He had owned and operated small to medium size outboard boats for the past 20 years. He had five years experience as the owner/operator of a commercial oyster boat. Most of his boating experience had been in open water (Gulf of Mexico).

1.2 Passengers

It was apparent from the interview that the boat-operating experience of the passengers was limited to an occasional fishing or pleasure ride outing accompanied by an adult operator. They possessed very little knowledge concerning safe boating operating procedures. They seemed to be of average intelligence and physical ability for their ages.

2.0 ENVIRONMENT

The sky was partially clouded and the estimated wind velocity was 7-14 mph. The water was choppy (approximately two ft swells) with a moderate current. The recorded air temperature was 68°F and the water temperature 59°F. The water depth at the accident site was 12 ft.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

On the day before the accident, late February, 1976, the operator (1) and his eight year old daughter (Passenger 2) stayed around the bait shop and sea food restaurant. During the day, relatives of (1) arrived from a city located approximately 120 miles away for a visit. Among the visiting party was (1)'s nephew (Passenger 3) and the nephew's friend (Passenger 4). No. 3 and 4 had never seen an oyster boat working and were anxious to observe the operation. An oyster boat owned by (1) was working in Galveston Bay, approximately 15 miles from the bait shop, and (1) discussed the possibility of taking the two boys out to the boat the next day. The passengers went to bed at approximately 2230 the night before the accident. The operator went to bed at approximately 2330. He stated that he drank 6-8 beers from 1600 until he went to bed. The operator and passengers arose at 0900 the next morning and the passengers ate breakfast. The operator had only coffee. After looking outside at the wind and water conditions, the operator decided that he would take the two boys and his daughter out to the oyster boat. The party left the operator's house at approximately 0935, arriving at the bait shop launch ramp at approximately 0940. The operator's wife and an employee had opened the bait shop at 0800 and were there when the party arrived. After arriving, the operator got three AK-1s for the passengers and a Black Sheep Type III PFD for himself from the bait shop storage room. He also got a fishing rod, thinking that he might do some fishing on the trip back from the oyster boat. He had planned to leave the boys on the oyster boat and return to the bait shop with his daughter in the involved boat.

The occupants donned PFDs, boarded the boat, and got underway from the launch ramp at approximately 0945. Approximately 15 minutes after getting underway, the boat was located approximately five miles from the launch area and 1-1/2 miles from shore. At this point, (1) noticed that the water conditions were getting rougher (1-2 ft swells) and water spray caused by bow impact with the waves was coming into the boat. Until this point, the boat had been running at 3/4 to full throttle. (1) reduced speed to 4-8 mph to prevent the boat from flooding. He considered turning back, but decided against it, since the boat would be headed into the waves and he felt there were too many people aboard to safely negotiate the waves.

He assumed that on the return trip from the oyster boat, only he and his daughter would be aboard and the bow would ride high enough to safely run into the waves.

3.2 Accident

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

The boat continued toward the oyster boat at slow speed for approximately five minutes which positioned the boat approximately six miles from the launch ramp and between 1-1/2 and 2 miles from shore. At this point, a wave came over the bow, partially swamping the boat. The occupants started bailing out the water using plastic bait containers. Approximately four inches of water was in the bottom of the boat. Within one minute after the first wave broke over the bow, a second wave came over the bow, completely swamping the boat. Immediately after flooding, the boat started rolling to port and continued to roll until it was upside-down in a near level attitude. As the boat capsized, the occupants exited the boat on the port side. No. 1, 2, and 4 held to the side of the overturned boat. No. 3 lay face down on the bow section with only part of his legs in the water. No. 1 decided that the occupants should stay with the boat until rescued. He based his decision on the following:

- They would probably be rescued before anyone could swim to shore and return with help. Also, he was not sure that any of the occupants could swim that far, even wearing a PFD.
- His wife knew where he was going and he was confident she would have a search initiated if he did not return in a reasonable length of time.
- There were numerous commercial fishing boats working in the bay, and he felt there was a good possibility that one of these vessels would spot them.
- He thought the tide would wash the capsized boat toward shore.

3.3 Post Accident

After being in the water a few minutes, the operator noticed that the AK-1 that (2) was wearing was not keeping her head far enough out of the water. He took the PFD he was wearing and put it on (2). He held onto (2) and the AK-1 she was wearing with his left arm and the side of the boat with his right hand.

(1), (3), and (4) attempted to right the boat, but discovered when they pulled down on the side to start the boat rolling, it would continue to roll through the upright position and again came to rest upside-down. After a few attempts, (1) decided it would be safer to let the boat remain upside-down.

The operator knew that it was possible for everyone to be overcome by the cold water if they were in the water long enough. He instructed the passengers to kick their feet and move around as much as possible, thinking this would prevent hypothermia.

After being in the water approximately 30 minutes, (2) said she was sleepy. (1) talked to her and tried to keep her awake, but within a few minutes she either passed out or went to sleep. She regained consciousness several times before being rescued, but seem to be in a dazed condition. For the first 1-1/2 hours in the water, (3) and (4) seemed to be suffering no ill effects from the cold water and were able to follow the operator's instructions. After approximately one hour in the water, (1) noticed that they were drifting away from the fishing boats and toward the mouth of the bay. Numerous boats were working in the upper part of the bay, but were too far away to signal for help. After approximately 1-1/2 hours, the operator began to lose feeling in his legs. (4) stated that he also began to lose feeling in his legs at approximately the same time, but said nothing about it until after they were rescued. (1) knew that it would only be a matter of time before everyone succumbed to hypothermia, but knew of nothing he could do to prevent it. After being in the cold water over 1-1/2 hours, he knew it would be futile for anyone to attempt to swim the 6-7 miles to shore for help. Approximately 1 hour and 45 minutes after capsizing, (1) sighted an anchor barge and tug boat, and the capsized boat was drifting in the general direction of the anchored vessels. As the boat drifted closer to the anchored vessels, (1) and (3) frantically called for

help and waved the AK-1 to attract attention. The capsized boat was spotted by a barge crewman as it drifted by at a distance of approximately 1/4 mile. The tug boat rescued the occupants after they had been in the water approximately two hours.

When the occupants were helped aboard the tug, (1) and (4) were unable to walk for approximately five minutes and stated that they had lost all feeling in their legs. (2) was in a semi-conscious state. (3) seemed to be in good condition. The occupants were taken ashore by the tug, and (2) was taken to a local hospital where she was treated for shock and exposure and released. Refer to Figure 2 and Photograph 1 for accident area. Photographs 2 and 3 show the occupants seated in the involved boat as they were immediately prior to the accident. Photographs 4 and 5 show the occupants wearing the PFDs as they were worn on the day of the accident.

TIME SEQUENCE

0900	Occupants arose and started preparing for trip.
0935	Left operator's house for bait shop.
0940	Arrived at bait shop/launch ramp.
0945	Got underway toward oyster boat.
1000	Water conditions worsened, operator reduced speed to 4-8 mph.
1005	First wave partially swamped boat.
1005-1006	Occupants attempted to bail water out of boat.
1006	Second wave completely swamped boat.
1006-1007	Occupants assumed position around and on boat.
1036	Occupant (2) became semi-conscious.
1200	(1) and (4) began to lose feeling in legs.
1215	Barge and tug boat sighted, occupants started calling for help and signalling with AK1s
1230	Occupants rescued by tug boat.
1345	(2) admitted to hospital.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a 1975 Quachita, Model No. 14DW powered by a 1969 model, 10 horsepower Mercury outboard motor. The hull was a typical flatbottom of riveted/welded aluminum construction. The overall length was 168.5 inches with a maximum transom width of 51.5 inches. The capacity plate specified a maximum weight capacity of 630 pounds, a maximum persons capacity of 430 pounds and a maximum horsepower capacity of 20. The boat appeared to be in good condition and no modifications had been made (see Photographs 6-9).

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

It was apparent from the interview that the owner/operator was the type individual that tried very hard to give people the impression that he possessed a great deal of general knowledge. When an area of discussion in which he had little knowledge was brought up, he would attempt to change the conversation to a subject in which he possessed at least a talking knowledge. It is the opinion of the investigators that this individual would go to great length to justify a possible error on his part. Example: according to the passengers aboard, there were no boats in the area of the accident (within two miles), yet the owner/operator stated that he was certain the wave that capsized the boat was the stern wake of a large vessel. He would not admit that he had exercised poor judgment in operating this type boat, loaded to near maximum weight capacity, in the water conditions that existed at the time of the accident. When he was told the proper procedures to be used to prevent hypothermia (opposite from his instructions to passengers), he made no comments and quickly changed the subject. It was obvious that he had a considerable amount of experience and knowledge concerning boat operations. Therefore, he either did not know his own limitations and the limitations of his equipment, or he was trying to cover up an error in judgment made on his part.

6.0 PROBABLE CAUSE OF ACCIDENT

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

- Poor judgment on the part of the operator is considered the major contributing factor. The water conditions exceeded the safe operating limits for this type boat.

- The load distribution was such that the boat was probably running in a near level attitude at 4-8 mph. Had the forward passengers turned and faced aft and shifted their upper body weight aft, the bow freeboard would have no doubt been increased significantly, which may have prevented the flooding.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

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

According to the estimated weight in the boat at the time of the accident, the boat was loaded to near the maximum weight capacity. The load distribution was such that the boat was most likely running essentially in a level attitude at 4-8 mph with a bow freeboard of 16-20 inches. The boat went over the crest of a 1-2 ft wave and headed bow first into the valley. When the bow reached the valley, there was insufficient bow freeboard to prevent the bow from slicing into the wave. The first wave partially swamped the boat which resulted in lowering the bow freeboard approximately four inches. The second wave entered the boat in the same manner as the first, completely swamping the boat. The flotation material was installed under the two aft seats. With the flotation material installed low in the boat and the center of gravity of the weight in the boat at a much higher level, the boat had a natural tendency to capsize when flooded. After the boat was upside-down, the flotation material and trapped air provided sufficient buoyancy to keep the boat afloat with the three occupants holding to the sides and the one occupant lying on the boat bottom.

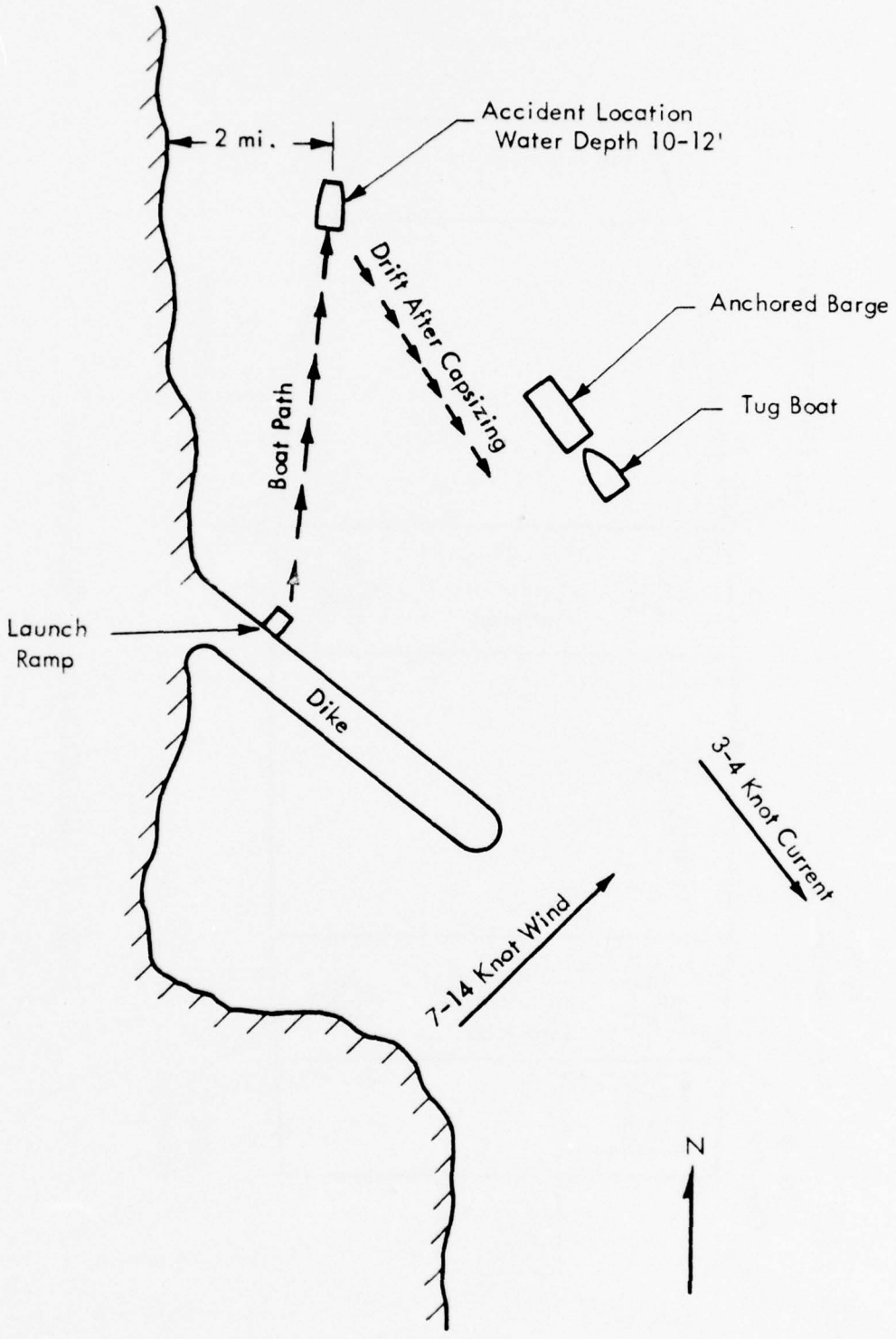


Figure 2. Sketch of Accident Area

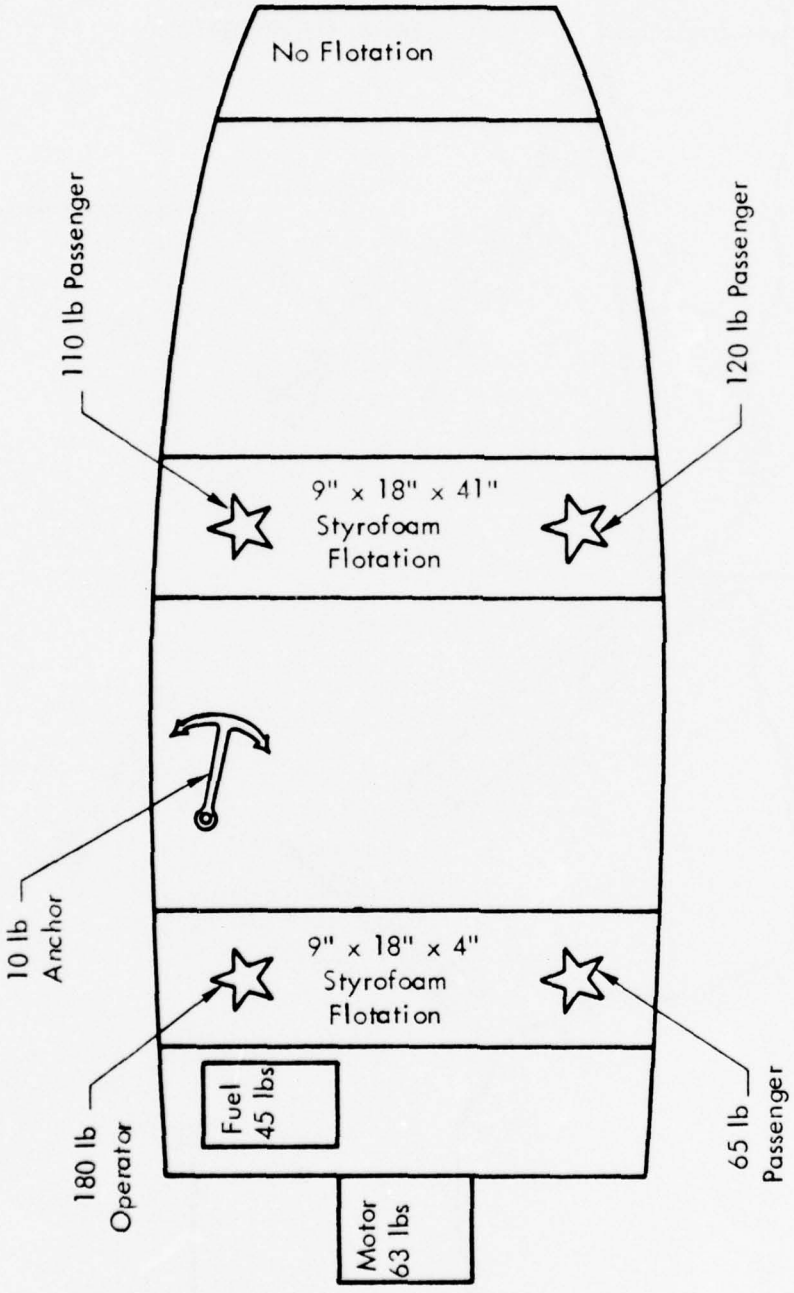


Figure 1. Load Distribution at Time of Accident



PHOTOGRAPH 1. VIEW FROM LAUNCH RAMP TOWARD ACCIDENT SITE



PHOTOGRAPH 2. OCCUPANTS SEATED IN INVOLVED BOAT



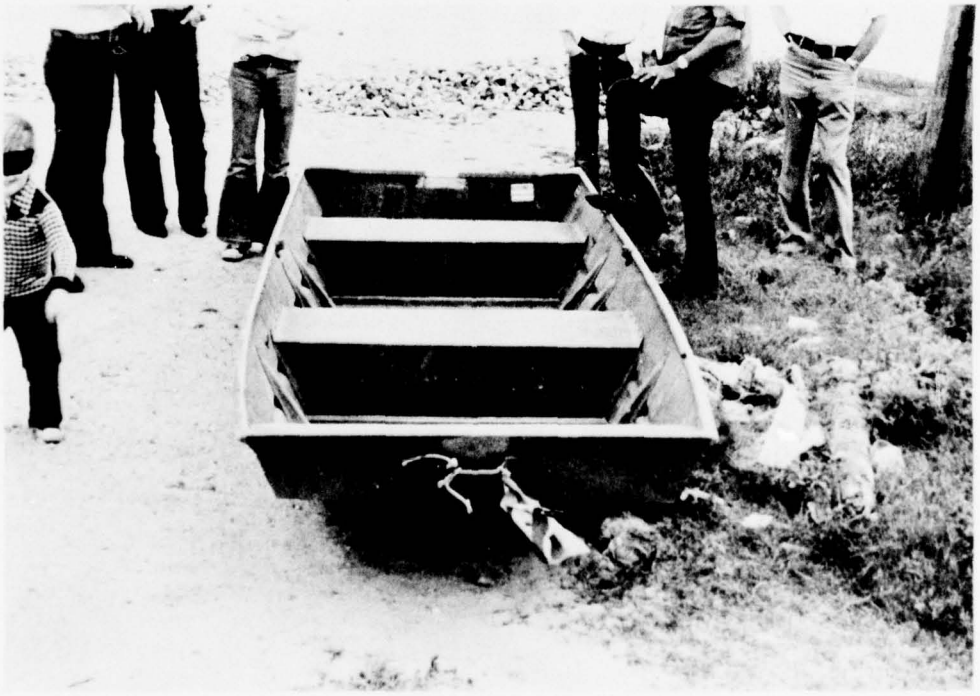
PHOTOGRAPH 3. OCCUPANTS SEATED IN INVOLVED BOAT



PHOTOGRAPH 4. OCCUPANT NO. 2 WEARING BLACK SHEEP TYPE III PFD



PHOTOGRAPH 5. OCCUPANTS NO. 3 & 4 WEARING AK-1 PFDS



PHOTOGRAPH 6. BOAT BOW VIEW



PHOTOGRAPH 7. BOAT STERN VIEW



PHOTOGRAPH 8. BOAT SIDE VIEW



PHOTOGRAPH 9. CAPACITY PLATE ATTACHED TO BOAT

APPENDIX DD

ACCIDENT INVESTIGATION REPORT

Date of Investigation: March 12, 1976

Date of Accident: Late February, 1976

Investigation: Capsizing/Swamping No. 75-29

SUMMARY — WYLE ACCIDENT NO. 76-040

The accident reported herein involved a 14' flatbottom johnboat powered by a 10 horsepower outboard motor. The type of accident was a collision with an unknown object with a subsequent swamping and capsizing of the boat, resulting in the death of one of the two occupants aboard.

At approximately 1800 in late February, 1976, two male adults set out from a launch ramp located in south central Kentucky destined for a fishing area approximately 1/2 mile away to set out a trot line. After arriving at the fishing area, the men spent approximately 45 minutes setting out and baiting the trot line. They started back toward the launch ramp at a speed of 10-15 mph. As the boat neared the inlet where the launch ramp was located, darkness had set in and only the outline of the shoreline could be seen sharply. Other objects in the water such as stumps, debris, etc. could be faintly seen. As the boat entered the inlet, the operator reduced speed to 4-6 mph. Approximately 400 yards from the launch ramp, the boat impacted an unknown object in the water. The impact occurred on the starboard bow, which rolled the boat to port, submerging the port gunwale. The boat flooded and rolled to port

until it was upside-down in a near level attitude. As the boat rolled, the occupants exited the boat over the port side. The men held to the capsized boat and started swimming to shore (approximately 50 yards away). After swimming a few yards, the boat seemed to be hung on something and would not move. The men left the boat and started swimming for shore. When the passenger reached shore, he could not see or hear the operator. The passenger walked around the inlet to the operator's truck. The operator had taken the ignition key and the passenger was unable to start the truck. He stayed in the truck until the next morning, then walked approximately two miles to a highway where he caught a ride to a telephone where he called the local rescue squad. The operator's body was found approximately 20 yards from the boat, toward the shore. The boat anchor had fallen out when the boat capsized, which kept the boat at the accident site during the night. No PFDs were aboard the involved boat.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFDs Worn
Operator	M	49	195	Good	>500 hrs	None	No
Passenger	M	63	225	Good	>500 hrs	None	No

The operator and passenger were brothers and had lived in the area where the accident occurred all their lives. They had been fishing in the accident area numerous times and were very familiar with the inlets and river in that area. Their formal education consisted of grade school and both had learned heavy equipment operation by on-the-job training. The operator was employed as a heavy equipment operator and the passenger was retired from that occupation. According to friends and relatives, the operator was of average intelligence and physical ability. The passenger seemed to be of average intelligence, but was physically handicapped by a leg injury that had necessitated the removal of his left knee cap.

2.0 ENVIRONMENT

The sky was clear and the visibility was restricted only by darkness. The wind was light and variable and the water was calm. The recorded air temperature was 46°F and the recorded water temperature was 42°F. The water depth at the accident site was 8-10 ft.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

On the day of the accident, the operator (A) did not go to work and spent the morning raking leaves in his yard and removing a stump from his property. At approximately 1000, the passenger (B) who was A's brother came to A's house to visit. The two men discussed and decided on a trip to set out a trot line that afternoon. B left A's house, went home and had lunch, and stayed around his house until returning to A's house at approximately 1500. The men spent approximately two hours making up the trot line and digging fishing worms.

According to B, each man drank two or three beers during this two hour period. The men left A's house at approximately 1700, heading to B's house to pick up the boat. They arrived at B's house at approximately 1720, loaded the boat and departed for the lake at approximately 1730. They arrived at the lake launch ramp at approximately 1750. They launched the boat, loaded the fishing gear and got underway to the fishing area, approximately one mile away, at approximately 1800. They arrived at the fishing area at approximately 1805 and began setting out and baiting the trot line. They finished putting out the trot line at approximately 1850 and got underway back to the launch ramp.

3.2 Accident

Gear and people aboard were as shown in Figure 1 and the weather as noted in Section 2.0. According to B, the men usually had PFDs aboard, but on this trip they had forgotten to bring them. The initial boat speed toward the launch ramp was 10-15 mph. As the boat approached the inlet where the launch ramp was located, only the outline of the tree-covered shore line could be seen distinctly. Objects such as stumps and brush in the water could be faintly seen. As the boat entered the inlet, the operator reduced speed to approximately 4-6 mph. At approximately 1900 with the boat approximately 400 yards from the launch ramp, the starboard bow hit an unknown object in the water. The bow slid upon the object and simultaneously the boat rolled to port until the stern, port side, was submerged. The boat flooded and continued to roll to port until it was upside-down in a near level attitude. As the boat rolled, A and B exited the boat over the port side. Approximately 30 seconds lapsed from initial water ingress until the boat was upside-down.

3.3 Post Accident

A told B to hold to the capsized boat and they would swim to shore using the boat for flotation. The men started swimming to shore holding to the boat. After moving the boat a few yards, it stopped as if it was caught on something. A and B thought the boat had caught on the object that was hit. A asked B if he felt he could swim the 50 yards to shore. B replied that he was sure he could and felt they had no other choice because they would surely freeze to death if they didn't get out of the water quickly. A and B left the boat at the same time and started swimming ashore, with B almost immediately in the lead. After swimming a few yards, B was able to kick off his loose fitting shoes and approximately half way to shore, his pants came down around his knees and he was able to kick them off. When B was approximately 20 yards from shore, he heard A call to him and ask if he was going to make it to shore. B did not turn around to look at A but could tell by his voice that he was a considerable distance behind him. B stopped swimming and without turning around, asked A if he was ok. A replied that he was doing fine and told B to keep swimming for shore. When B was approximately 10 ft from shore, he was able to stand on the bottom (water depth approximately 4 ft). He turned around and could see the dark outline of the boat but could not see A. He called to A, thinking that he could still be holding to the boat. After calling several times, he decided that A had drowned. He considered swimming out to look for A, but decided against it, since he did not know where he had gone down and also he was so exhausted that he didn't feel he could swim to the area of the boat and back. He made his way around the end of the inlet (approximately 500 yards) to A's truck which was parked near the launch ramp. When he got to the truck, he discovered that A had taken the ignition key and he could not start the truck. He had brought an extra pair of shoes which he put on and covered himself with a raincoat that A had stowed in the truck. He decided that the weather was too cold and he was too exhausted to start for help before the next morning. At daylight the next morning, he left the truck and walked approximately two miles to a highway where he caught a ride with a motorist to a nearby town. The local rescue squad was called and were at the accident site by 0700 the day after the accident. A's body was found shortly thereafter approximately 20 yards from the boat, toward the shore in approximately 8 ft of water. The rescue squad and county sheriff's department personnel could not find the object that the boat hit and

concluded that the object was probably a log that had since floated out of the area. No autopsy was performed on A's body, but the official cause of death was recorded as drowning. Refer to Figure 2 and Photographs 1-4 for accident area.

TIME SEQUENCE

1000-1200	Passenger visited with brother and made plans to go to lake.
1200	Passenger left brother's house for his home.
1500	Passenger returned to brother's house.
1500-1700	Two men prepared trot line and dug fishing worms.
1700	Left operator's house to pick up boat at passenger's house.
1720	Arrived at passenger's house and loaded boat.
1730	Left passenger's house for lake.
1750	Arrived at launch ramp.
1800	Launched boat and got underway to fishing area.
1805	Arrived at fishing area.
1805-1850	Set out and baited trot line.
1850	Started back to launch ramp.
1900	Boat hit unknown object in water.
1900-1901	Boat flooded and capsized.
1901	Men started swimming ashore, holding to boat.
1902	Men left boat and started swimming ashore.
1903	Operator called to passenger who was approximately 20 yds from shore.
1904	Passenger reached shore and started calling and looking for operator.
1904-1915	Passenger stood on shore trying to locate operator.
1915-1925	Passenger walked to truck.
1925-0530, the next day	— Passenger stayed in truck.
0530	Left truck for help.
0600	Caught ride to town and called rescue squad.
0715	Operator's body found by rescue squad.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a 1969 model Polarcraft flatbottom of riveted/welded aluminum construction. The overall length was 167.5 inches with a maximum transom width of 54.75 inches. Depth amidship was 14.25 inches, transom height 15.0 inches, maximum beam at gunwale 55.25 inches and maximum beam at chine 39.75 inches. The boat was powered by an old (probably 1950's) 10 horsepower Johnson outboard motor. The boat had been stored outside and showed evidence of bad deterioration, particularly on the steering system and throttle/gearshift controls (see photographs 5-7). The following modifications were made to the boat by the owner:

- Wooden vinyl covered console incorporating steering wheel and hub installed on starboard side approximately 2 ft forward of amidship.
- Gear selector/throttle quadrant installed on starboard side at amidships.
- Steering cables, pulleys, and gear/throttle controls installed along starboard side.
- Six inch thick foam padding strapped to starboard side of two aft seats.

Photographs 8-12 show boat exterior and interior at the time of investigation.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The two men involved in this accident had owned and operated flatbottom and runabout type boats all their adult life. From interviews with the passenger, friends, and relatives, it was obvious the men were very experienced boaters and fishermen. It was apparent that the passenger was very knowledgeable concerning the safe operating procedures for small johnboats. He readily admitted that some of the safety procedures were ignored on the day of the accident and felt he should accept the responsibility since he was the older and more experienced of the two men.

6.0 PROBABLE CAUSE OF ACCIDENT

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

- Operating after dark, particularly in a relatively narrow and dark inlet without a spot or flashlight is considered the major contributing factor. With the aid of a light, the occupants would have most likely seen the object in the water in time to avoid the collision.
- The wearing of PFDs would not have prevented the accident; however, if the operator had been wearing a PFD, he would have most likely survived the accident. Also, he was wearing heavy clothing, including an army type parka. The heavy coat restricted his movement and the saturated portion of the coat above water was probably too heavy for him to support.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

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

According to the estimated weight in the boat at the time of the accident, the boat was not overloaded, compared with similar hull designs tested for maximum weight capacity in the compliance test program. However, there was enough weight (occupants and gear) in the boat when shifted, to create a sufficient roll moment to capsize the boat. Considering the location of the scrape marks on the starboard bottom, it is reasonable to assume that the boat rolled to port at least 30 degrees after impact with the object. The occupants and gear no doubt shifted to the port side, which submerged the port gunwale and started the roll action that capsized the boat.

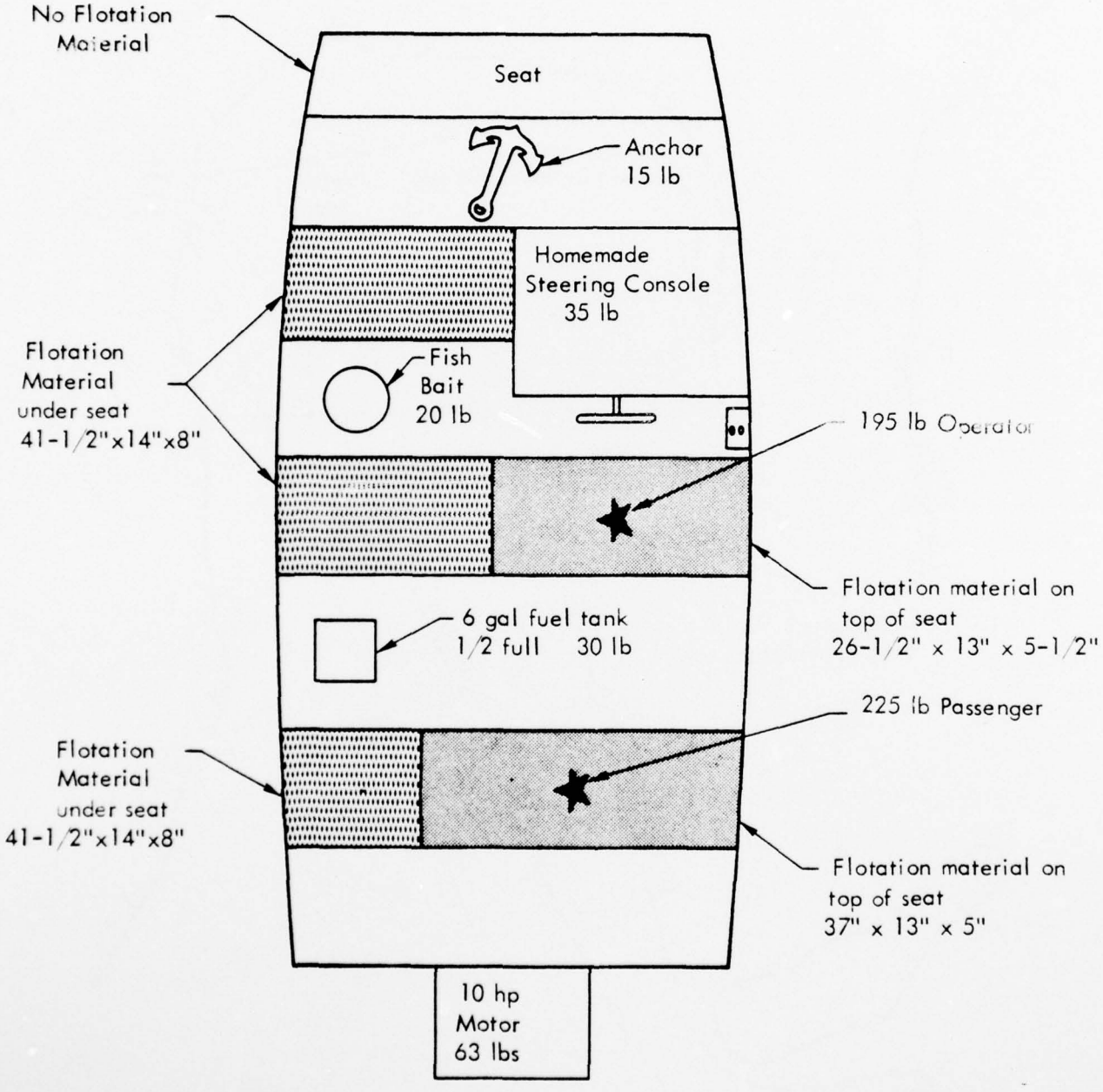


Figure 1. Load Distribution At Time of Accident

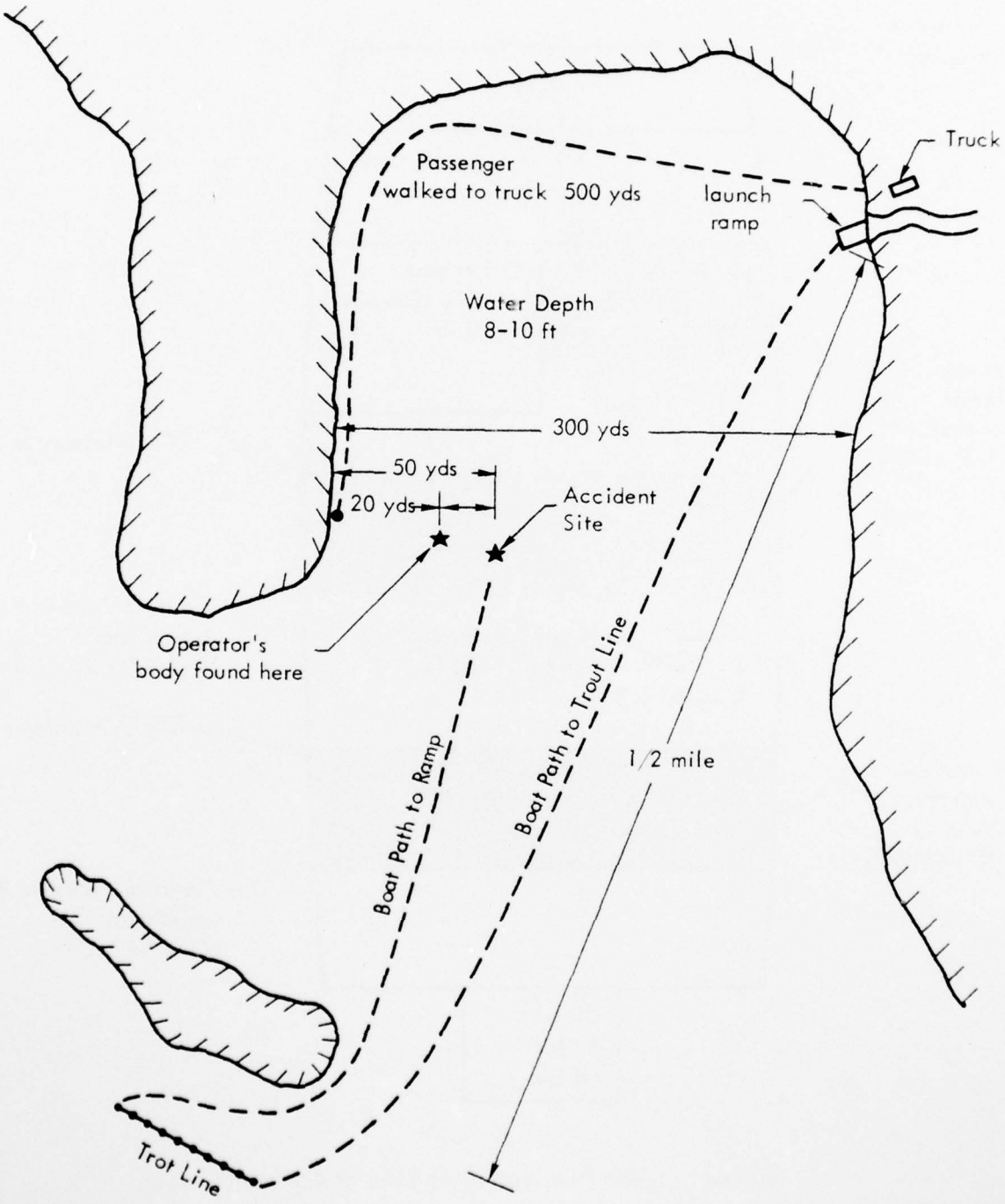


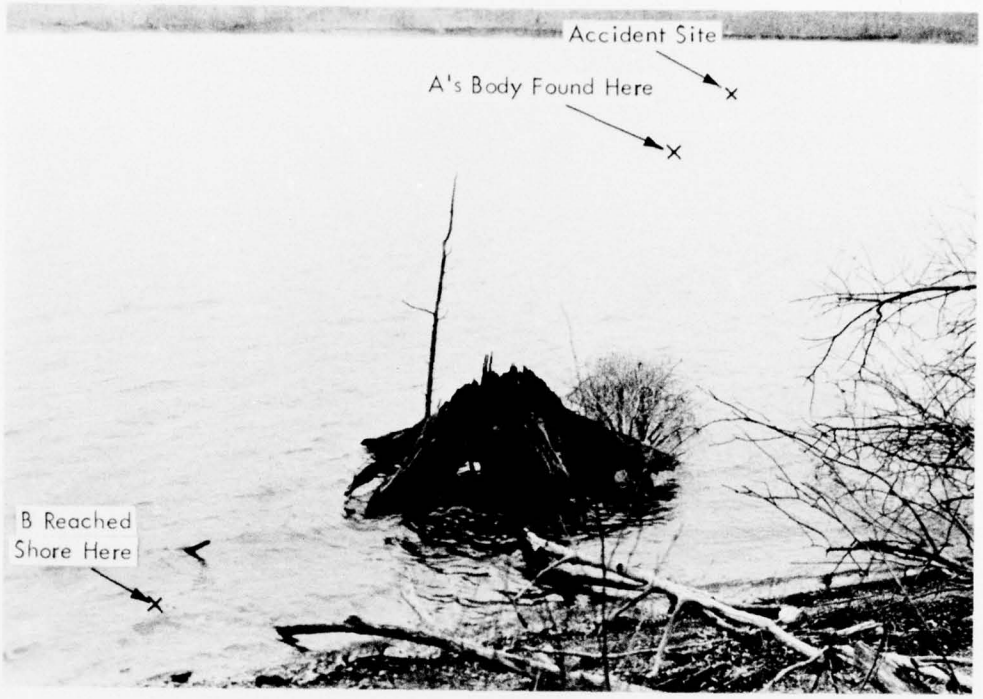
Figure 2. Sketch of Accident Area



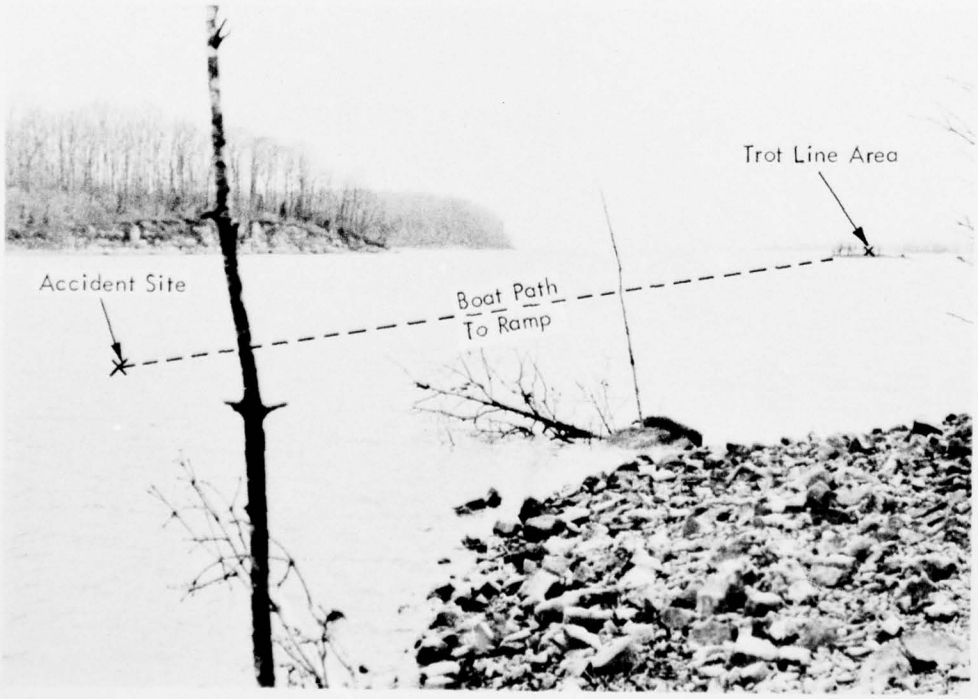
PHOTOGRAPH 1. VIEW OF ACCIDENT AREA FROM LAUNCH RAMP



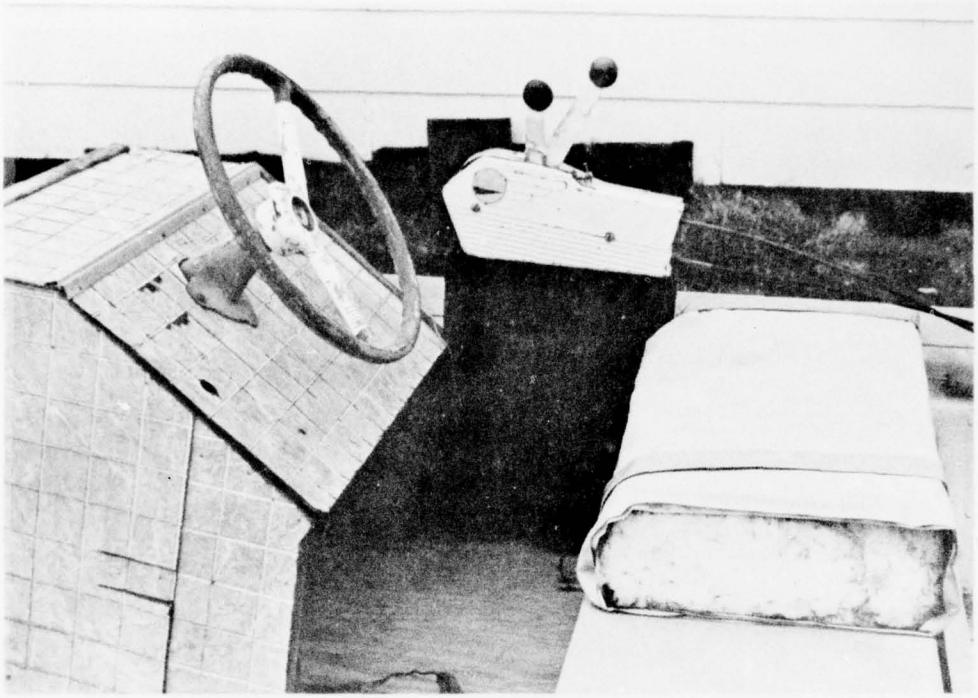
PHOTOGRAPH 2. VIEW OF LAUNCH RAMP FROM ACCIDENT SITE



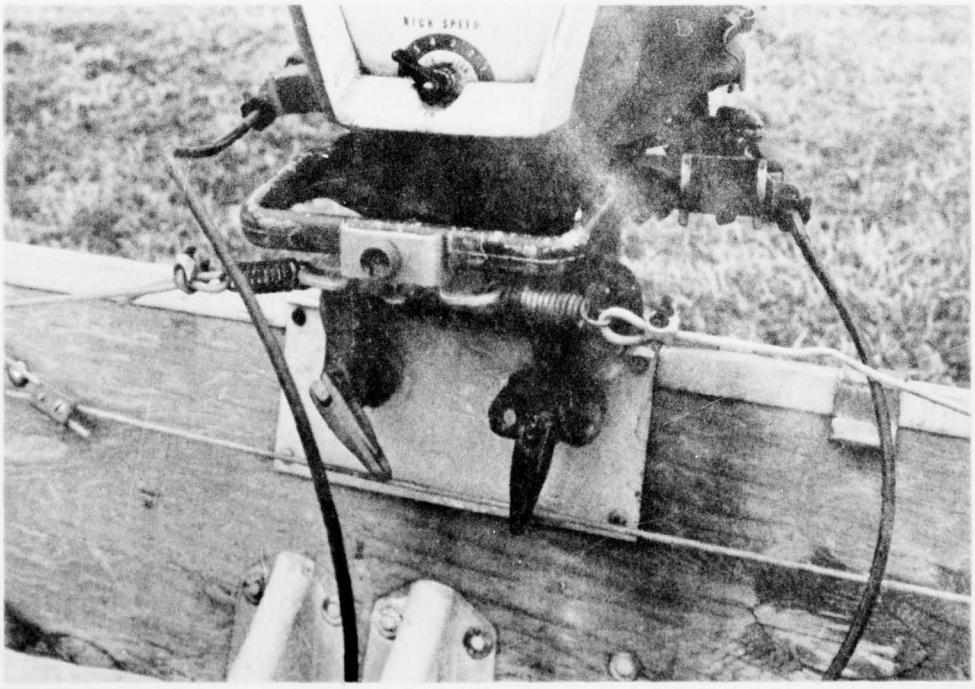
PHOTOGRAPH 3. ACCIDENT SITE



PHOTOGRAPH 4. VIEW OF TROT LINE AREA FROM ACCIDENT SITE



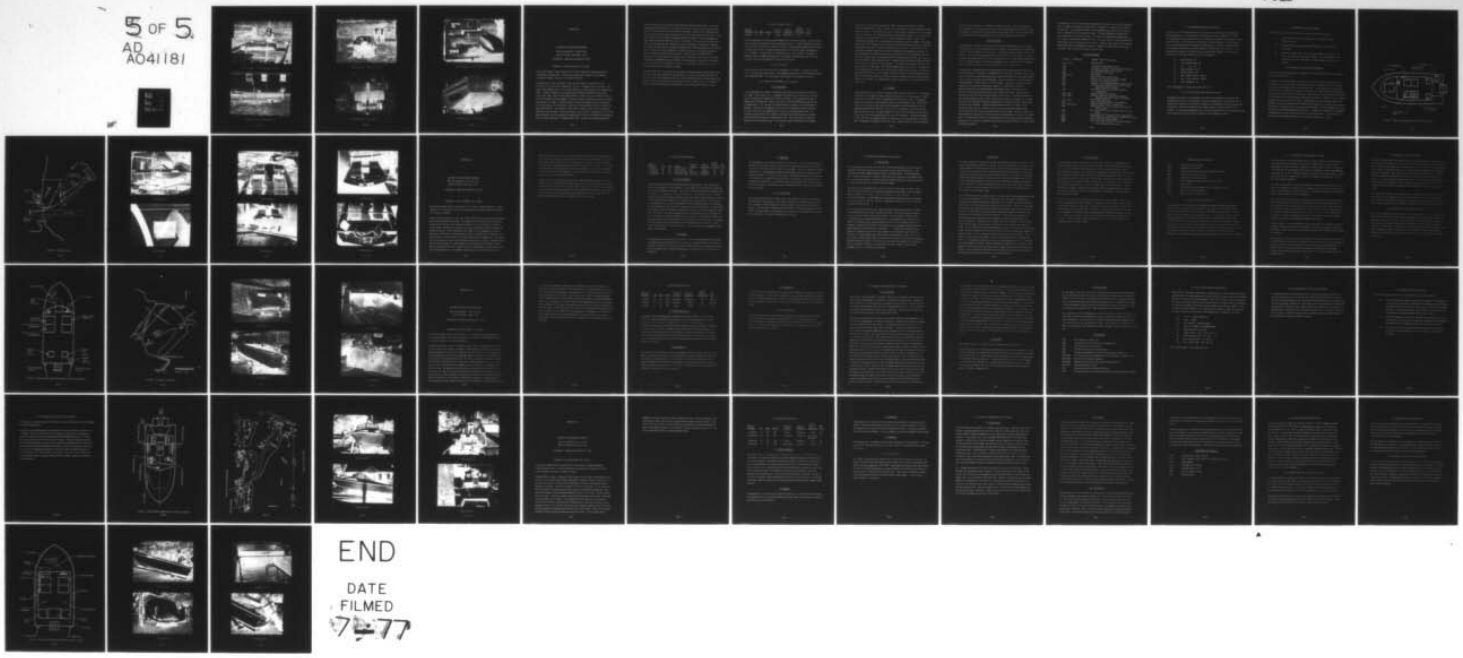
PHOTOGRAPH 5. THROTTLE/GEAR SHIFT CONTROLS



PHOTOGRAPH 6. MOTOR CONTROLS AND STEERING CABLES

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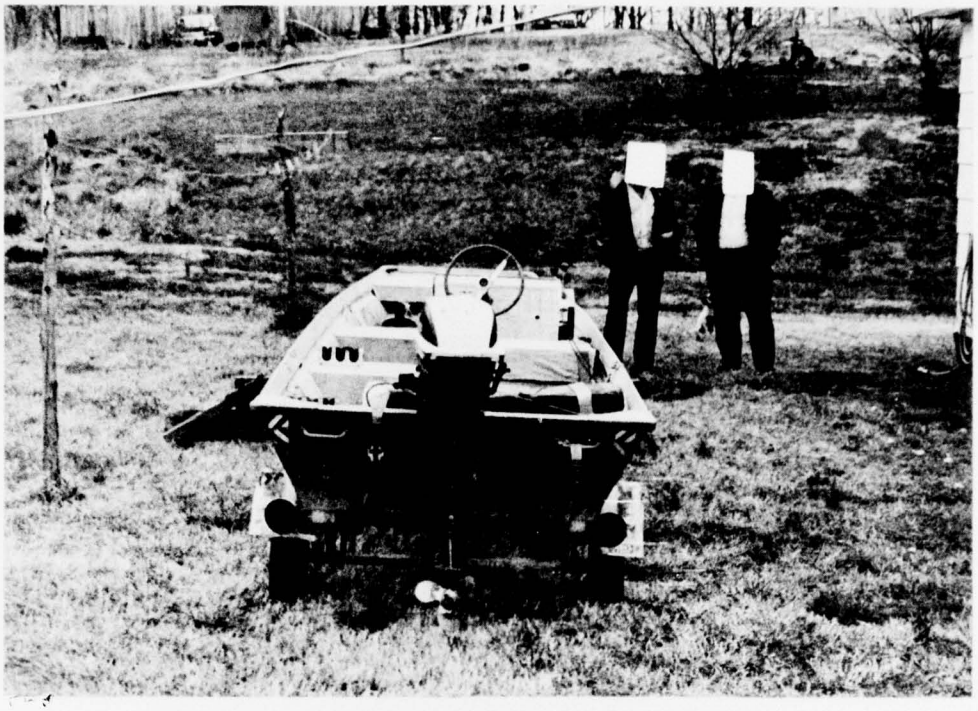
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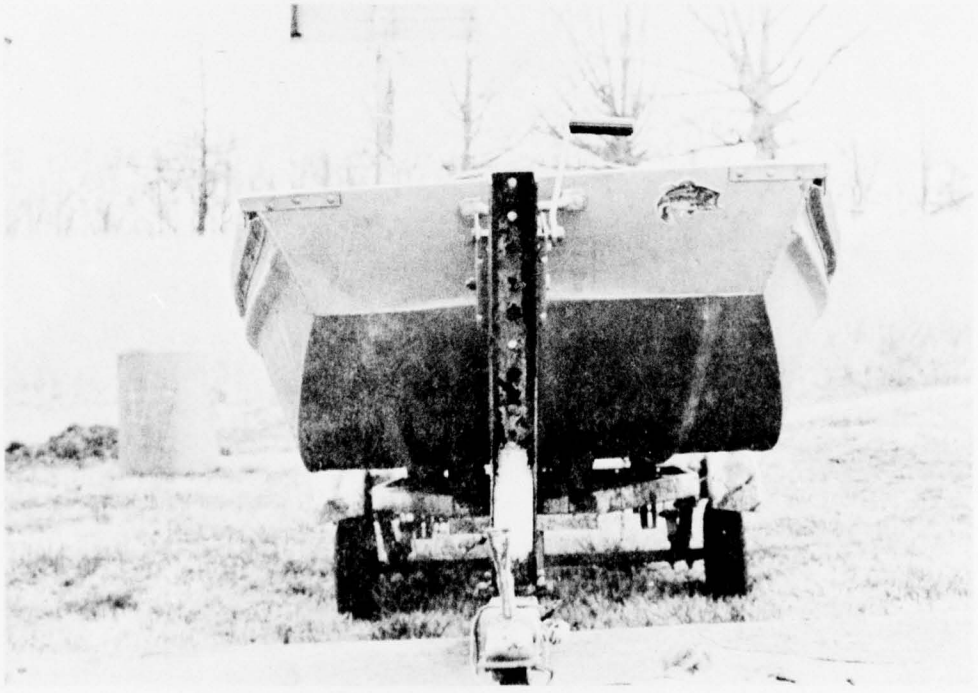
PHOTOGRAPH 7. STEERING CABLE ROUTING



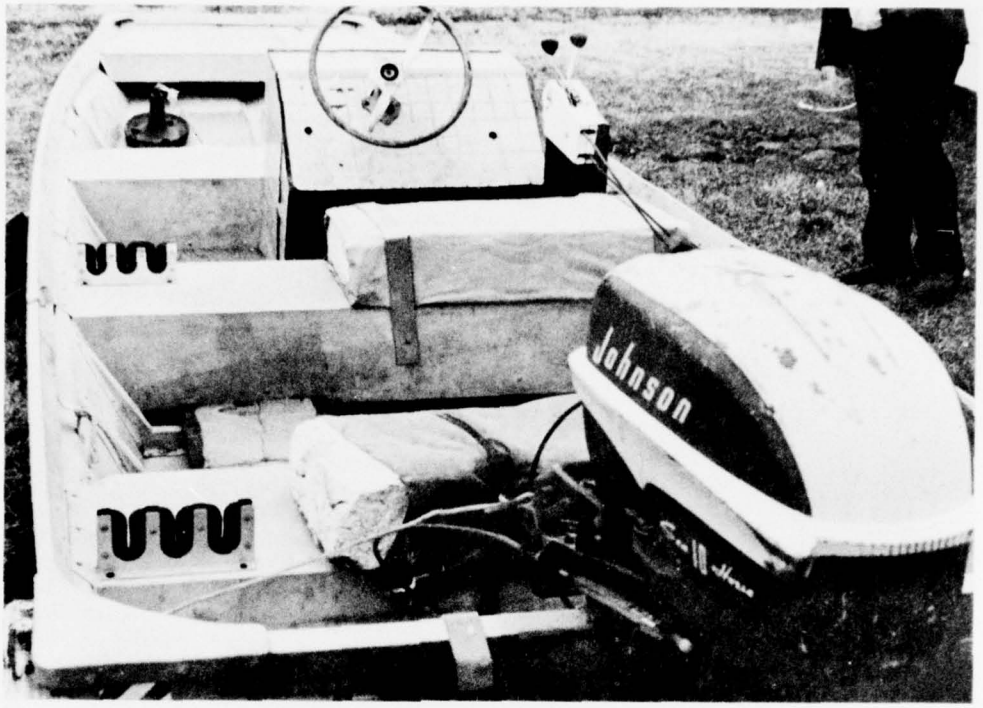
PHOTOGRAPH 8. BOAT SIDE VIEW



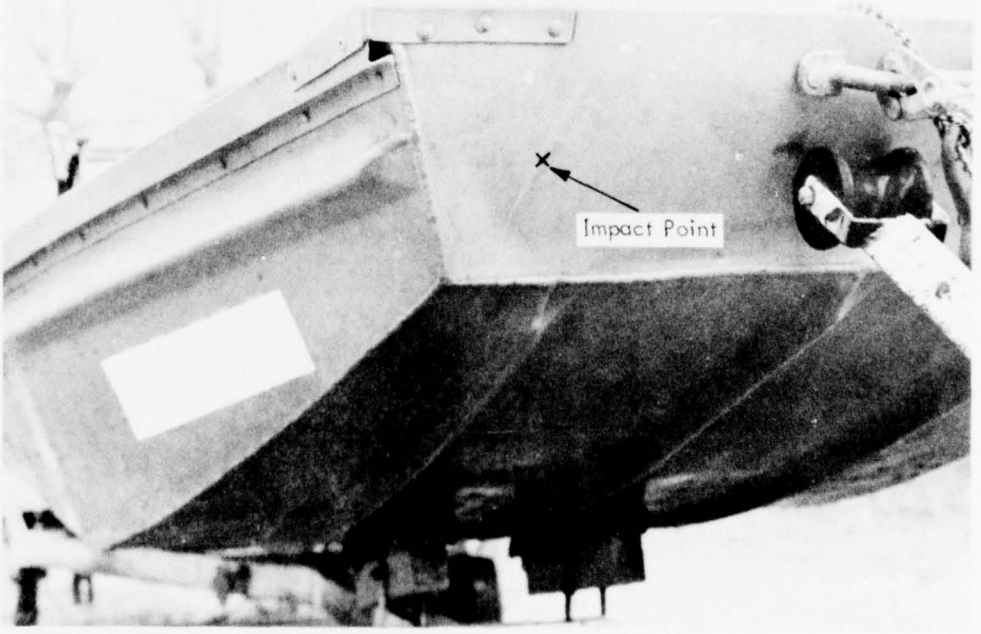
PHOTOGRAPH 9. BOAT STERN VIEW



PHOTOGRAPH 10. BOAT BOW VIEW



PHOTOGRAPH 11. BOAT INTERIOR VIEW



PHOTOGRAPH 12. DAMAGED AREA

APPENDIX EE

ACCIDENT INVESTIGATION REPORT

Date of Investigation: 24 April 1976

Date of Accident: Early April, 1976

Investigation: Capsizing/Swamping No. 75-30

SUMMARY — WYLE ACCIDENT NO. 76-063

The accident reported herein involved a 15 ft tri-hull, open bow runabout powered by a 50 horsepower outboard motor. The type of accident was a swamping with a subsequent capsizing of the boat, resulting in no injuries or fatalities.

At approximately 1200 in early April, 1976, four adult males in two boats set out on a fishing trip in a bay located in southeastern Virginia. Two people were in each boat. The party traveled approximately 15 miles across the bay to a fishing area arriving at approximately 1245. The party stopped fishing at approximately 1900 and started back across the bay to the launch ramp. After traveling approximately 10 miles at 3/4 to full throttle, the motor on the involved boat abruptly stopped. The motor was easily restarted but would not run above fast idle rpm (4 to 5 mph). The party decided to transfer the passenger of the involved boat to the other boat, go on to the launch ramp and get the boat trailers in position to remove the boats from the water. The other boat started toward the launch ramp with the involved boat following at fast idle speed. After the other boat was out of sight, the operator of the involved boat noticed that water was occasionally splashing over the bow into the boat as he negotiated the two to three foot swells. At approximately 2000, the boat had traveled approximately

one-half mile from the point where the other boat had started toward the ramp. At this point the operator stated that the boat was riding on the crest of a wave and was being pushed bow down on the front side of the wave similar to a surf board. The force of the wave pushed the bow of the boat into the valley causing the bow to slice into the base of the next wave. Water came over the bow until the boat was approximately half flooded. The operator grabbed an empty cooler and started bailing the water out of the boat. Within a one minute period water started flowing freely over the starboard aft section and the boat started rolling to starboard. As the boat started to capsize, the operator grabbed an AK-1 PFD and jumped over the starboard side. The boat came to rest upside-down in a bow high attitude. The operator donned the PFD and climbed on top of the overturned boat. Initially the boat was approximately four and a half miles off shore, but during the night it drifted to within one mile of the shore. The operator considered trying to swim ashore, but decided against it due to the cold temperature of the water and the unpredictable currents. He stated that his hands became so cold that it was difficult for him to hold to the boat.

The boat drifted into a river channel and was spotted by a passing barge at approximately 0530. The Coast Guard was notified of the capsized boat and a nearby Coast Guard vessel that was involved in the search responded to the call. (The Coast Guard had been notified approximately one hour after the capsizing and had searched all night with negative results.) The operator was taken aboard the Coast Guard vessel and the involved boat towed to the launch ramp.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFD's Worn
Operator	M	31	140	Good	400-500 hrs	None	No

The owner/operator was the sole occupant aboard at the time of the accident. He was a career Navy enlisted man and seemed to be of average intelligence. His formal education consisted of high school and several Navy mechanical schools. He had owned and operated two runabout type boats less than 20 ft in length and had between 75 and 100 hours operating experience in this type boat. The remainder of his experience was in small johnboats. He seemed to possess at least an average knowledge concerning runabout type boat operations in the type of water in which he was operating at the time of the accident.

2.0 ENVIRONMENT

The sky was clear and the wind was from the southeast at 7 to 14 mph. The water was choppy (2 to 3 ft swells) with a strong current. The recorded air temperature was 51°F and the recorded water temperature 53°F. The water depth at the accident site was approximately 25 ft.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

On the night before the accident, the operator was on duty at the naval station from 2300 until 0630. During the duty shift, the operator had made plans with three of his co-workers to go on a fishing trip at approximately 1200 the next day. He arrived home from work at approximately 0700 and went to bed. He got up at 1100 and started preparing for the trip. At approximately 1130 the three co-workers arrived at his home with a 16 foot outboard runabout. The party left the operator's home with the involved boat and the 16 foot boat arriving at the launch ramp approximately 10 miles away at approximately 1150. The two boats were launched with two people in each boat, geat stowed aboard and the party started toward the fishing area at approximately 1200. The fishing area was located approximately 15 miles acorss the bay. The two boats traveled across the bay at full speed

arriving at the fishing area at approximately 1230. The fish were biting and the party fished until approximately 1900. The gear was stowed and the two boats started back toward the launch ramp. The water conditions were such that the boats were able to run at full speed for the first 10 miles. At this point the water conditions became worse (2 ft to 3 ft swells) and the boats were throttled back to 1/2 - 3/4 speed to negotiate the swells. Shortly after encountering the rough water, the motor of the involved boat abruptly stopped. The operator made a quick visual inspection of the motor and fuel system and found nothing that would have caused the motor to stop. The motor restarted easily but would not run above fast idle rpm. The operator stopped his boat and instructed his passenger to get aboard the other boat. He told the operator of the other boat to go on to the launch ramp with the passengers and have them move the boat trailers to a launch ramp that was closer to their location, then return to assist him should his motor completely stop. The operator of the other boat agreed and started toward the launch ramp with the two passengers. The involved boat headed toward the closer launch ramp at fast idle speed. After traveling approximately one-half mile, the operator of the involved boat noticed that water was occasionally splashing over the bow into the boat as he negotiated the 2 to 3 ft swells. Before a significant amount of water had splashed into the boat, he noticed that the boat was riding on the face of a large wave and was being pushed along like a surf board. The wave gradually overtook the boat until it was riding on the crest of the wave.

3.2 Accident

Gear aboard was as shown in Figure 1 and the weather as noted in Section 2.0. The operator stated that the wave apparently broke dropping the boat bow first into the trough. The bow sliced into the next wave filling the boat approximately half full of water. The operator pulled the throttle back to idle, grabbed an empty cooler and began to bail. After bailing for a short time he noticed that water was flowing freely over the starboard stern into the passenger compartment and the boat was starting to list to starboard. The aft section completely filled with water. The motor stopped from water intake and the boat started sinking by the stern while simultaneously beginning a slow roll to starboard. The operator grabbed an AK-1 PFD that was located on the forward facing port seat and jumped over the starboard side. The operator was holding the PFD to his chest. Upon entering the water the buoyancy

of the PFD turned him face up. The boat continued to roll until it was in an upside-down bow high position with the port gunwale lying across the upper portion of the operator's legs. The operator kicked free of the overturned boat and donned his PFD. He then climbed on top of the forward section of the boat bottom with his body completely out of the water.

3.3 Post Accident

The operator found it difficult to stay on top of the overturned boat because his hands were so cold and waves were breaking completely over the boat. The outgoing tide caused the boat to drift to the east, parallel to the shore line. When the boat capsized the anchor fell out of the boat. The anchor line was approximately 15 ft long and was tied to the port stern cleat. The boat drifted approximately 1/2 mile to a shoal area where the water depth was approximately 12 ft. The anchor caught on the bottom and stopped the boat. The waves in the shoal area were one to two feet and the operator had no trouble staying on top of the boat.

At approximately 2100 the party that had gone ashore in the second boat decided that the involved boat had run into trouble. The operator of the other boat was unable to take his boat back out to assist the involved boat because his engine had started to run very roughly by the time he arrived at the ramp with the passengers. The party notified a local Coast Guard unit who immediately initiated a search for the missing boat. The operator could see the search vessels but they never came close enough to see him. At approximately 0100 the operator noticed that the tide had started in and decided to pull in the anchor, thinking that the incoming tide would cause the boat to drift toward shore. The boat started drifting to the west at an angle that was taking it closer to shore. The water was relatively calm and the operator was able to relax and maintain his position on the boat with no effort. He curled into a tight position pulling the upper portion of the PFD around his head and ears to keep as warm as possible. Sometime between 0100 and 0430 he fell asleep. When he awoke at 0430 (times from operator's watch) the boat was positioned approximately one mile from shore and was drifting north between two land masses. He knew where he was and considered swimming east to the nearest shore, but decided against it because of the cold water, the unpredictible currents in that area and the fact that he was physically exhausted. At this point, he could see the lights from the Coast Guard vessels searching in the area where the boat had capsized.

At approximately 0500 a large outgoing barge passed within one-quarter mile of the capsized boat. The operator shouted and waved his arms, but apparently his signals were not seen by the barge crew. At approximately 0530 a second outgoing barge passed within 50 yards and saw the capsized boat and the operator's signals. The barge stopped and radioed a small cruiser approximately one-half mile away. The cruiser was alongside the capsized boat in a few minutes and the operator boarded the cruiser. The Coast Guard was notified by radio and a rescue boat was on the scene within five minutes. The Coast Guard vessel took the operator aboard and towed the capsized boat to a marina. The boat was then righted and the water evacuated. Refer to Figure 2 for sketch of accident area.

3.4 Time Sequence

1100 Day 1 - 0630 Day 2	Operator worked at regular job
0700 - 1100	Operator slept
1130	Fishing party left operator's home
1150	Fishing party arrived at launch ramp and launched boats
1200	Two boats got underway to fishing area
1230	Boats arrived at fishing area
1230 - 1900	Party fished
1900	Boats started back to launch ramp
1915	Motor on the involved boat abruptly stopped
1913	Motor on involved boat restarted
1920	Passenger on involved boat boarded companion boat
1920	Companion boat headed for marina with involved boat following at idle speed
1940	Involved boat took water over bow, partially swamping boat
1940 - 1945	Operator bailed water from boat
1945 - 1947	Operator jumped over side and boat capsized, operator donned PFD and got on top of boat
1947 - 2100	Boat drifted to shoal area
2100	Coast Guard started search for involved boat
2100 - 0100 Day 3	Operator stayed on top of anchored boat
0100	Operator pulled in anchor and boat started drifting closer to shore
0430	Boat positioned one mile off shore between two land masses
0500	Barge passed within one-quarter mile of capsized boat
0530	Second barge saw capsized boat and radioed small cruiser
0535	Small cruiser took operator aboard
0545	Coast Guard vessel took operator aboard and started towing capsized boat to marina.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a 1973 molded fiberglass tri-hull open bowrider manufactured by Thunderbird Products Corporation. It was powered by a 50 horsepower Johnson outboard built in 1972. The boat had been stored outside at the owner's residence and appeared to be in good condition for a 1973 model. At the time of the investigation, the motor had been removed for repair but the throttle and gear controls seemed to operate properly. The boat incorporated a completely sealed double bottom with inside dimensions of approximately 14' x 48" x 9". It is assumed that this space was filled with foam-in-place flotation material. The following is additional hull information obtained during the investigation:

- Length overall: 181"
- Max. beam gunwale: 78"
- Max. transom width: 73"
- Depth amidships: 26.5"
- Transom height: 20.5"
- Max. Persons Capacity: 990 lb
- Max. Weight Capacity: 1440 lb
- Max. horsepower: 90

Refer to Photographs 1 through 6 for overall boat views.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The operator had worked the night before the accident and had slept only three hours after completing his work shift. He had been on the boat for approximately nine hours prior to the accident and stated that he was mentally and physically exhausted on the return trip from the fishing area. His mental and physical state could have been a contributing factor in this accident. His reaction and judgement were most likely impaired due to loss of sleep and fatigue which could have caused him to react incorrectly to the emergency situation.

6.0 PROBABLE CAUSE OF ACCIDENT

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

- Partial power failure of the outboard motor is considered the major contributing factor.
- Operator fatigue could have caused the operator to react incorrectly to the situation.
- Operating a bowrider of this size in the sea conditions that existed at the time of the accident was most likely hazardous. Had the boat been of the closed bow design, the initial partial swamping probably would not have occurred.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

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

According to the estimated weight in the boat at the time of the accident, the boat was not overloaded. Prior to the accident, the boat was traveling at a speed of four to five miles per hour due to a partial power failure of the outboard motor. At this speed the trim angle would have been near the maximum bow up attitude. When the wave broke, the bow started dropping into the valley between the waves with the stern being held up by the crest of the breaking wave. The bow high attitude allowed the boat to accelerate downward with sufficient force to completely submerge the bow on impact with the water. The open bow section of the boat flooded, then surfaced. Wave action caused the stern to assume a lower position than the bow which allowed the free water in the bow to flow to the aft section of the boat. The motor stopped due to water intake and waves started breaking over the transom. The operator started bailing but abandoned the operation when water started flowing freely over the stern quarter. The boat filled with water, rolled to starboard and came to rest in a bow high, upside-down position.

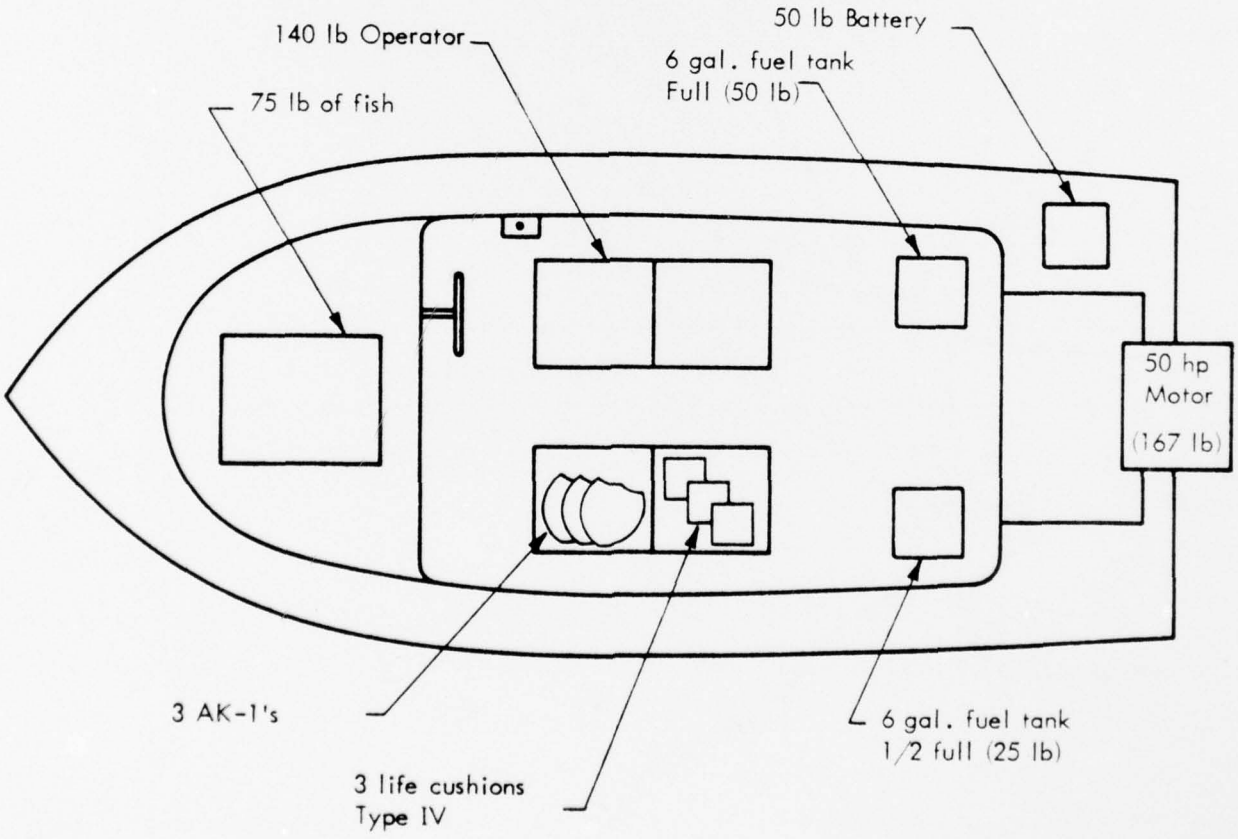


FIGURE 1. BOAT LOAD DISTRIBUTION AT TIME OF ACCIDENT

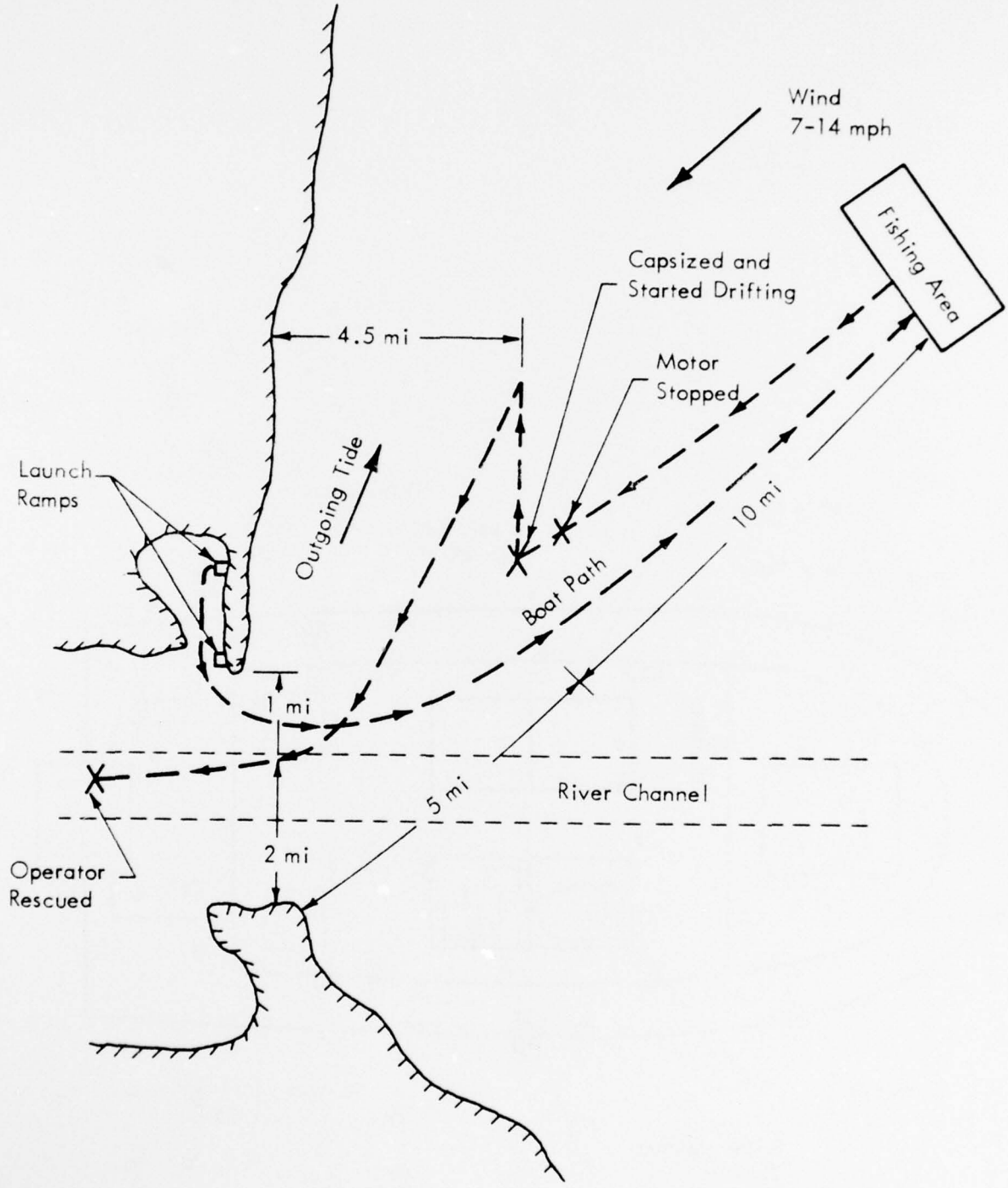
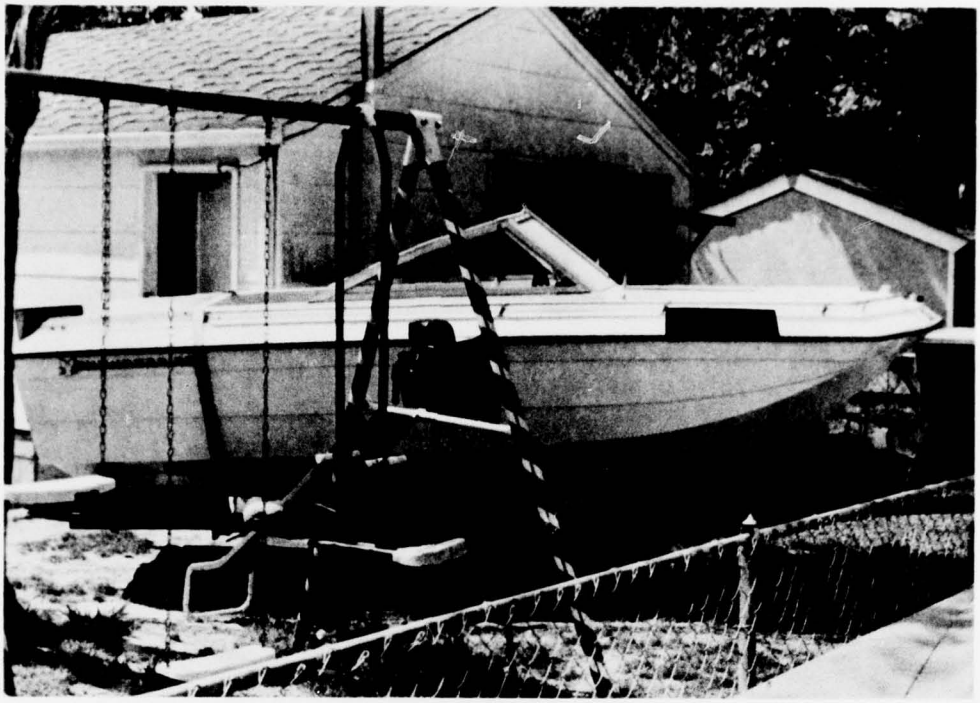
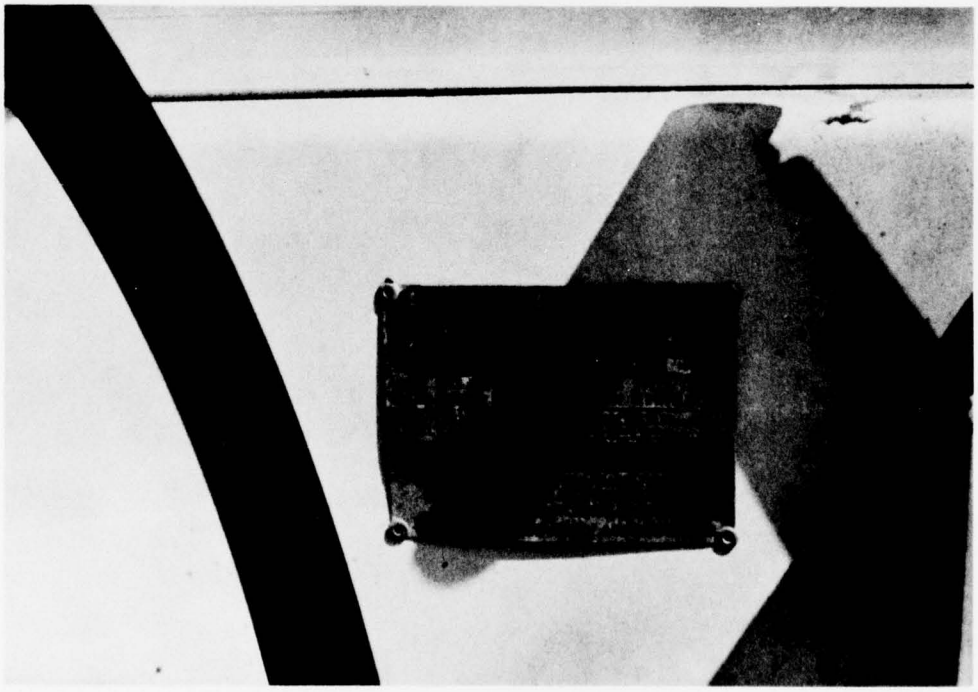


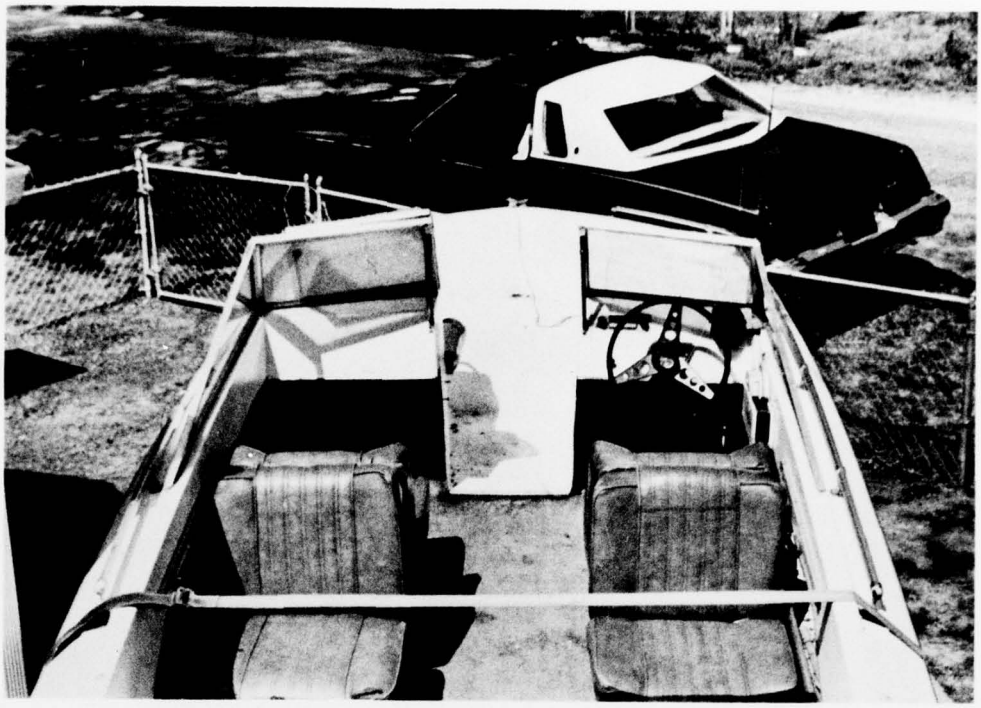
FIGURE 2. ACCIDENT AREA



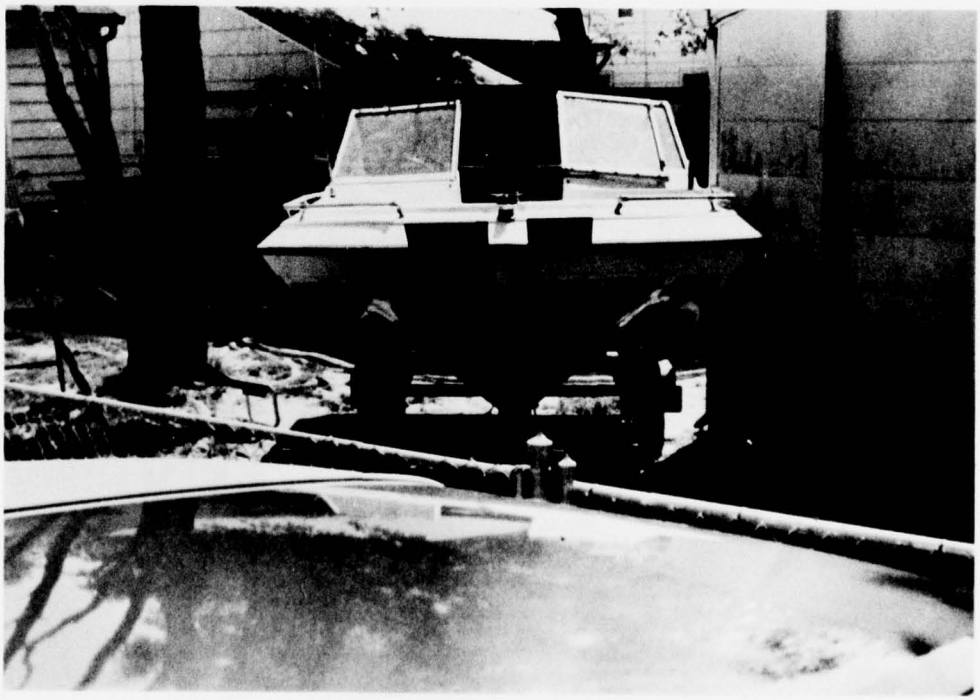
PHOTOGRAPH 1



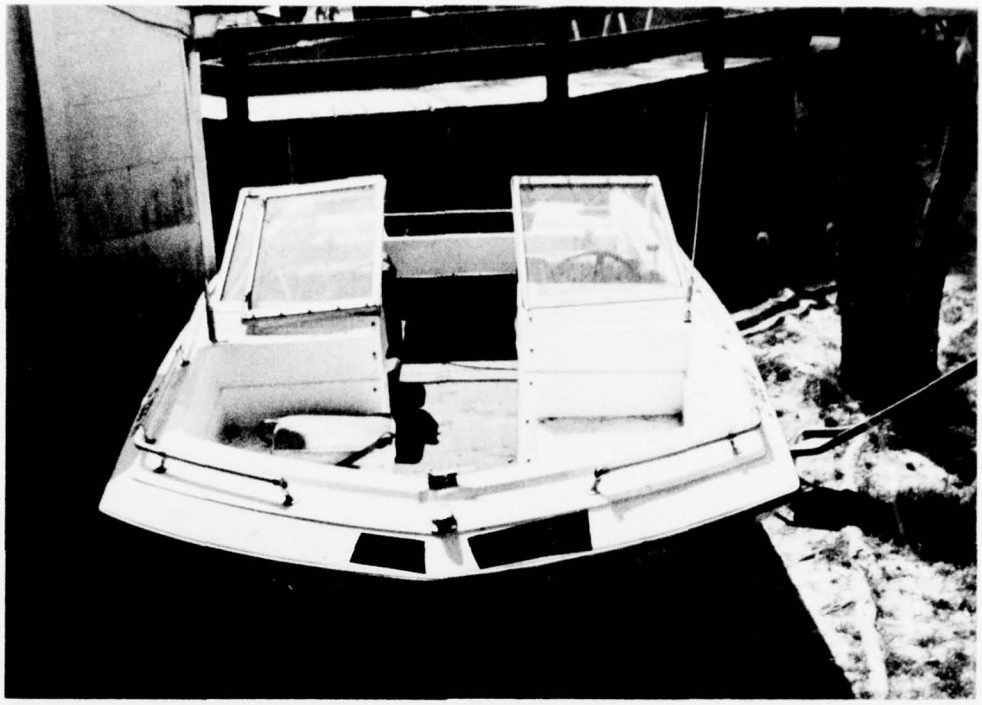
PHOTOGRAPH 2



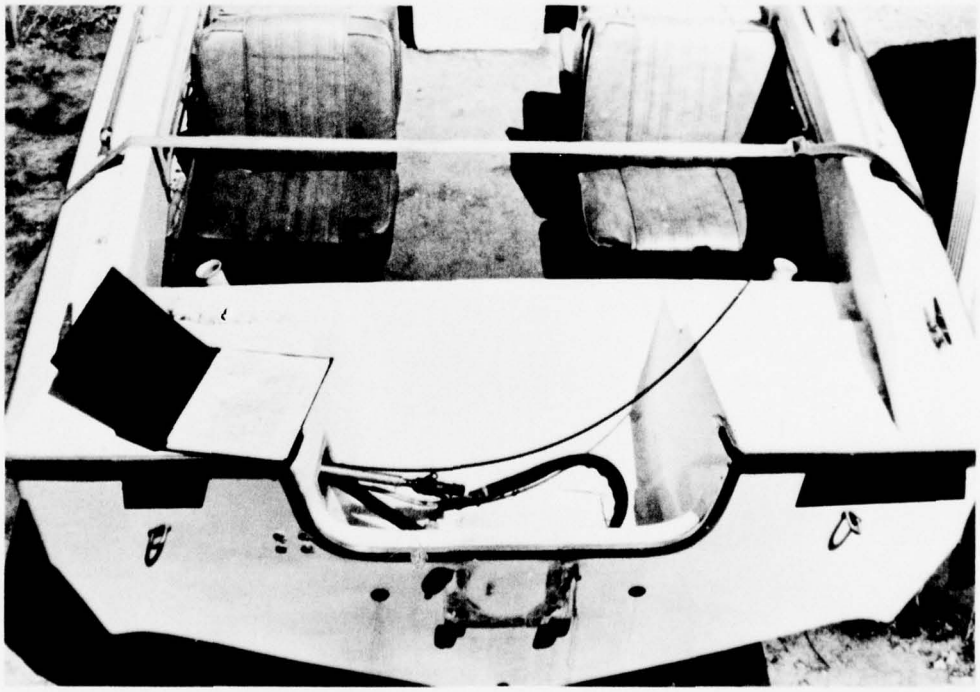
PHOTOGRAPH 3



PHOTOGRAPH 4



PHOTOGRAPH 5



PHOTOGRAPH 6

APPENDIX FF

ACCIDENT INVESTIGATION REPORT

Date of Investigation: Late June, 1976

Date of Accident: Early June, 1976

Investigation: Capsizing/Swamping No. 75-31

SUMMARY – WYLE ACCIDENT NO. 76-222

The accident reported herein involved a 16'9" (5.1 m) semi-v runabout powered by a 90 hp outboard motor. The type of accident was a swamping and subsequent capsizing, resulting in no injuries or fatalities.

At about 0745 on a Saturday in early June, 1976, three men set out on a trawling and fishing trip on Lake Pontchartrain, Louisiana. They trawled for shrimp for about one to two hours, and during that time the waves increased from about two to four feet (0.6 to 1.2 meters). Unable to keep up speed while headed into the waves, the operator turned and headed with the seas at his stern. While proceeding at slow speed, the trawl snagged on an unknown obstruction on the bottom, causing the boat to come to a complete stop. At that time, the boat was about two to three miles (3.2 to 4.8 kilometers) from the nearest shore. The operator went to the stern to try to pull his boat back over the trawl to retrieve it, despite the high seas and lack of a motorwell. Waves began to enter the boat over the transom as he was hauling in one lead to the trawl. At about this time, one passenger, a non-swimmer, moved onto the decked-over bow. The operator ceased trying to recover the trawl due to the

increasing amount of water in the cockpit and attempted instead to power ahead to break the trawl loose. That action was not successful and, in fact, only pulled the stern down further. After boarding seas killed the engine, the operator got onto the bow to improve the boat's trim, while the second passenger began to bail out the cockpit with a washtub. As the boat swamped further, the passenger quickly pulled all six PFDs from under the bow and handed them up to the non-swimming passenger. He then emptied the two ice chests on board and secured their covers for use as flotation aids.

The boat went down further by the stern and then capsized, rolling to starboard. The two persons on the bow pushed clear as the boat rolled over, but the other occupant was trapped beneath the hull for a short time. The boat floated inverted, bow up; and the men were able to use it and the ice chests to support their weight until about 30 minutes later when they were rescued by a passing boat whose attention they attracted by waving an orange PFD. The capsized boat was recovered later by a Coast Guard Auxiliary vessel.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instruction	PFD Worn
1. Operator	M	46	205 lb (93 kg)	Fair	500 hrs	No	No
2. Passenger	M	27	120 lb (54.4 kg)	Non-swim	20-500 hrs	No	Yes
3. Passenger	M	27	165 lb (74.8 kg)	Fair/Good	20-500 hrs	No	No

1.1 Owner/Operator

The owner seemed to be of normal intelligence and physical ability. He is employed as a fleet service manager for a beer distributor. He purchased the involved boat four years ago, and it is the only boat he has owned. Previously, he had about 20 years of occasional boating exposure as a passenger on fishing trips with friends. The majority of his boat operating experience has been in the Gulf of Mexico, and on such trips he would always go in company with a friend's (usually occupant No. 2's) boat for their mutual protection in case of accident or mechanical failure. The owner had boated in Lake Pontchartrain about ten times before, but had trawled there only a few times. He was not an experienced trawler. He had suffered a heart attack within the past year, but had since returned to work and was leading a normal life. He lived in a neat, well-maintained home in a middle-class suburb of New Orleans. Since the accident, he has accompanied friends who belong to the Coast Guard Auxiliary on their safety patrols, and is taking steps to become affiliated with the Auxiliary. He impressed the interviewer as being somewhat defensive and embarrassed about the accident - (One of his first comments was: "It might be my fault.") - and, it seemed that he exaggerated some details of the accident.

1.2 Passenger

This passenger was interviewed only very briefly. He is an oriental resident alien who owns a neighborhood bar and restaurant which the other two occupants frequent in the evening. He bought a new boat two years ago. He wears a PFD at all times while boating, and during the trip in question wore a Type II PFD belonging to the boat's owner. He does not drink intoxicants.

1.3 Passenger

This passenger was interviewed at the same time as the owner. He served three years in the Seabees as an equipment mechanic, but acquired no experience in ships or boats while in the service. At the time of the interview, he was employed as a service manager for a heavy equipment firm. He graduated from high school and seemed to have somewhat higher than normal intelligence. He has never owned a boat. His boating experience has chiefly been with the other two occupants and previous to that, with his father. He appeared to be of average physical ability and in good health. Although he was somewhat intoxicated at the time of the interview, his attitude was one of helpfulness; and the information he provided is felt to be reliable.

2.0 ENVIRONMENT

The sky was partly cloudy and visibility, good. The recorded wind velocity was between 14 and 20 knots, and increasing. Wind waves at the time of the accident were about four feet (1.2 meters), having increased from about two feet (0.6 meters) when the boat was launched. The recorded air temperature was 82°F (28°C), and the water temperature, 75°F (24°C). The water depth at the accident site is not certain, but was between 7 and 10 feet (2.1 m and 3.0 m). No small craft warnings were in effect.

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

On the day before the accident the three men, friends and fishing partners for several years, planned the trawling and fishing trip to the eastern portion of Lake Pontchartrain. Their last boating trip taken together had been about 3 or 4 weeks earlier. The owner/operator (No. 1) reports having gone to bed early, about 2100, and rising early, about 0330 or 0400, as is his usual daily practice. He had checked the weather forecast from a local radio station the night before the trip, but could not recall the forecast.

Activities of the two passengers (No. 2 and No. 3) prior to the trip are not known, except that the three men met at No. 2's restaurant for breakfast at about 0700. They left at about 0730 and trailered No. 1's boat to a launch ramp about 15 minutes drive away. No. 2 donned a Type II PFD. The other PFDs (one Type II and five buoyant cushions) were stowed up in the bow section. Both No. 1 and No. 3 reported that there was no water in the bilge prior to the start of the trip.

As the boat departed the launch ramp, persons and gear were distributed as shown in Figure 1. They headed directly for the lake, and upon arrival No. 1 and 3 agreed that the weather was not severe and should not cause them concern. The trawling gear, property of No. 1, was deployed a short while after entering the lake. It consisted of a net, 16 feet (4.9 m) in length; two weighted wooden spreader boards; and two 50 ft (15.2 m) leads, secured with snaphooks to eyebolts on the transom. The boards and net were dragged along the bottom at speeds slightly above idle (2-4 mph (3.2-6.4 kph)). The leads were shorter than those reported to normally be used for this type of operation, and allowed the trawl to pull the stern down to a greater degree than would ordinarily be experienced. About 1/2 to 3/4 of an ice chest of shrimp had been taken on several runs during the 1-1/2 to 2 hours the boat was underway before the accident. At first the runs were made while headed into the wind and waves, as indicated in Figure 2. During this time the only occupant to drink alcoholic beverages was No. 1, who had one can of beer.

3.2 Accident

The weather worsened during the time the boat was underway, as noted in section 2.0. No. 1 found it increasingly more difficult to maintain speed while headed into the wind and waves. Having headed up the shore for awhile anyway, he turned the boat around and made one run with the wind and waves at the stern. During the 20 minutes they trawled on the new heading before the accident occurred, no water entered the boat over the transom. Fishing gear had also been brought along for use that day, and the men had just decided to trawl for 10 minutes longer before beginning to fish when at about 0930 the trawl apparently snagged on a bottom obstruction. The boat stopped dead in the water, although the engine continued to run. At that time the boat was about 2 to 3 miles (3.2 to 4.8 km) from the nearest shore; and there were no other boats in sight.

No. 1 shifted the engine to neutral and went to the stern to pull the leads aboard and dislodge the trawl from the obstruction. As he was hauling in one of the leads, waves broke over the transom and began to fill the boat. Meanwhile, No. 3 moved to the operator's seat and instructed No. 2 to climb onto the decked-over bow, which he did. After No. 1 had hauled almost all the trawl lead on board, he noticed that a good deal of water had accumulated in the boat. He went back to the operator's station and powered ahead in an attempt to get the boat free by ripping the net off of the obstruction. Although the boat had power, he did not break it free, mentioning that the weight of the water in the boat made it very slow and unresponsive. Meanwhile, No. 3 began to bail with a washtub. He once tried to unhook the trawl leads, but was unable to overcome the strain exerted by the engine and waves. As No. 1 used more power while attempting to break free, the boat's stern went down further. He then climbed up onto the bow with No. 2 to improve the boat's trim while No. 3 continued to bail. Soon the engine quit as seas continued to come over the stern. No. 1 told No. 3 to get the ice chests ready, which he did by emptying them and securing their covers. He also grabbed all PFDs from under the bow and handed them to No. 2. The boat, then almost completely swamped, rolled to starboard until capsized. No. 1 held No. 2 and pushed themselves away as the boat rolled, and were about 3 feet (0.9 m) from it when they surfaced. No. 3 was trapped underneath the overturned boat for a short time, but swam out from under and found the two ice chests next to where he surfaced.

3.3 Post Accident

The boat floated inverted, with the bow up and out of the water. No. 3 grabbed the ice chests and swam over to the bow and the other occupants. No. 2 had become quite anxious, so No. 1 had him climb onto his shoulders up onto the bow where he remained, holding several PFDs, until rescued. No. 1 and No. 3 took positions on opposite sides of the bow and held the larger ice chest between them and over a barely submerged part of the hull. No. 3 also held onto the smaller ice chest with his other hand. Although No. 2 had become frightened and seasick, he was able to remain on the bow and out of the water. No. 3 mentioned having been concerned about No. 1 due to his heart attack within the past year. Neither had difficulty, though, in maintaining his position; and both expressed confidence that the combination of the boat and ice chest could hold them up indefinitely. They described the water temperature as warm.

Within a half hour, a small outboard boat, also trawling for shrimp, came into sight. No. 2 waved an orange PFD to attract its attention. Although the signal was seen, it was initially interpreted as a warning to keep clear. The waving was continued, and soon the three were taken on board and to the nearest shore. There No. 1 notified the Coast Guard of the situation by telephone. An Auxiliary vessel was dispatched and located the boat about two hours later. At that time it was about one mile (1.6 km) off the lee shore and no longer attached to its trawl. The trawl leads remained secured to the transom, but were severed at some undetermined point along their length.

APPROXIMATE TIME SEQUENCE

0700	Occupants met for breakfast
0730	Departed for launch ramp
0745	Launched boat and got underway for Lake Pontchartrain
0800	Commenced trawling into waves
0910	Headed about with waves at stern
0930	Trawl snagged and boat began to swamp over transom
0935	Boat capsized
0950	Occupants rescued by passing boat and transported to shore
1000	Operator notified Coast Guard
1200	Boat recovered by Auxiliary vessel

4.0 FACTS FROM BOAT INSPECTION

The boat was a 1961 model MFG semi-v runabout constructed of FRP with a steel framework. The hull featured artificial lapstrake design and spray rails. Its dimensions were 16' 9" (5.1 m) L x 79-1/2" (201.9 cm) B (max.) x 20" (50.8 cm) transom height. The boat had no motorwell or bilge pump, and no capacity plate. It was powered by a 1965 Johnson 90 hp outboard motor, which was bolted to the transom. Styrofoam block flotation was installed beneath the full length of the wooden deck and in the bow compartment. Damage resulting from the accident and recovery operations was the loss of all seats, the gas tank, and the stern navigation light; and minor damage to the rubrail. The boat was stored uncovered on its trailer in the owner's driveway, and was in good condition for its age. Refer to Photographs 1 through 4 for details of the interior and exterior at the time of the investigation.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The owner/operator's boating experience had been acquired chiefly in the Gulf of Mexico, where typical waves are longer and less choppy, although higher, than those normally encountered on Lake Pontchartrain, a large and very shallow body of water. Although during the interview he acknowledged that the lake "was dangerous." He also indicated that wave height did not make a substantial difference as long as the boat was headed in the same direction as the waves. Apparently, he does not yet appreciate this particular way that Lake Pontchartrain is dangerous.

The length of trawl leads used by the owner/operator was decided on the advice of a friend. However, several sources suggested to the investigators that 50 foot (15.2 m) leads were too short for the application, and might be dangerous. Perhaps not enough effort or thought had been put into the selection of trawling equipment.

One of the several courses of action available to the owner/operator when the trawl snagged was to simply unhook or cut the leads. During the interview he mentioned that the first thing he thought of was to try and save the trawl (worth perhaps $100). The seriousness of the situation obviously was not realized until it was too late. When he did decide to sacrifice the trawl, though, he found that he did not have his knife with him (it had been left up forward). In general, it appears that he was not well prepared for such an emergency, either by having a plan or the necessary emergency gear at hand.

Since the accident, the owner/operator has taken certain steps to be more safe in the future. In addition to becoming involved with the Auxiliary, as mentioned previously, he plans to install foam-in-place flotation high in the sides of his boat, and to use 100 ft (30.5 m) leads when trawling.

The passenger (No. 3) upon whom the boat overturned was surprised that it capsized, although he expected the boat to continue to be swamped. During the interview he mentioned that he had always heard to "stay with the boat" following an accident; but it appeared that his decision to do so in this case may have been particularly influenced by his felt need of being with the others at the accident site, due to No. 1's heart condition and No. 2's inability to swim.

6.0 PROBABLE CAUSE OF ACCIDENT

Trawling in following seas as encountered should not have been attempted. Doing so, due to lack of education or experience, is considered the major causative factor in this accident. The possibility that the trawl might become snagged was not remote. Even when the possibility did occur, though, the accident may have been avoided had the operator been better prepared to deal with the situation. These factors are subject to educational remedies; but it should be noted that trawling from a small boat is an activity common only in certain areas of the country. A national program to educate boaters concerning these dangers would probably not be cost effective; and hence the need for local and regional adaptation. The point might similarly be made with regard to hypothermia, distress signals, ocean inlet navigation, and so forth.

With respect to the boat, had it been equipped with a motorwell, swamping may have occurred more slowly, and the occupants may have had time to deal effectively with the situation. Level flotation would likely have minimized the danger associated with having to push clear of an overturning boat and with being trapped underneath, as was experienced in this case.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

Upon becoming snagged, the trawl became, in effect, a stern anchor. With the square stern held directly into the waves, water entered the passenger area, unprotected by a motorwell. Swamping was aided by the operator's position aft and by his exerting downward pressure on the stern by trying to pull the trawl aboard. Both factors combined to reduce the transom freeboard. The same effect resulted from the unsuccessful attempt to break the snag by powering ahead. Capsizing eventually occurred when the accumulation of water reduced stability sufficiently to permit the high live load (two persons in the bow, one standing) to cause the boat to roll.

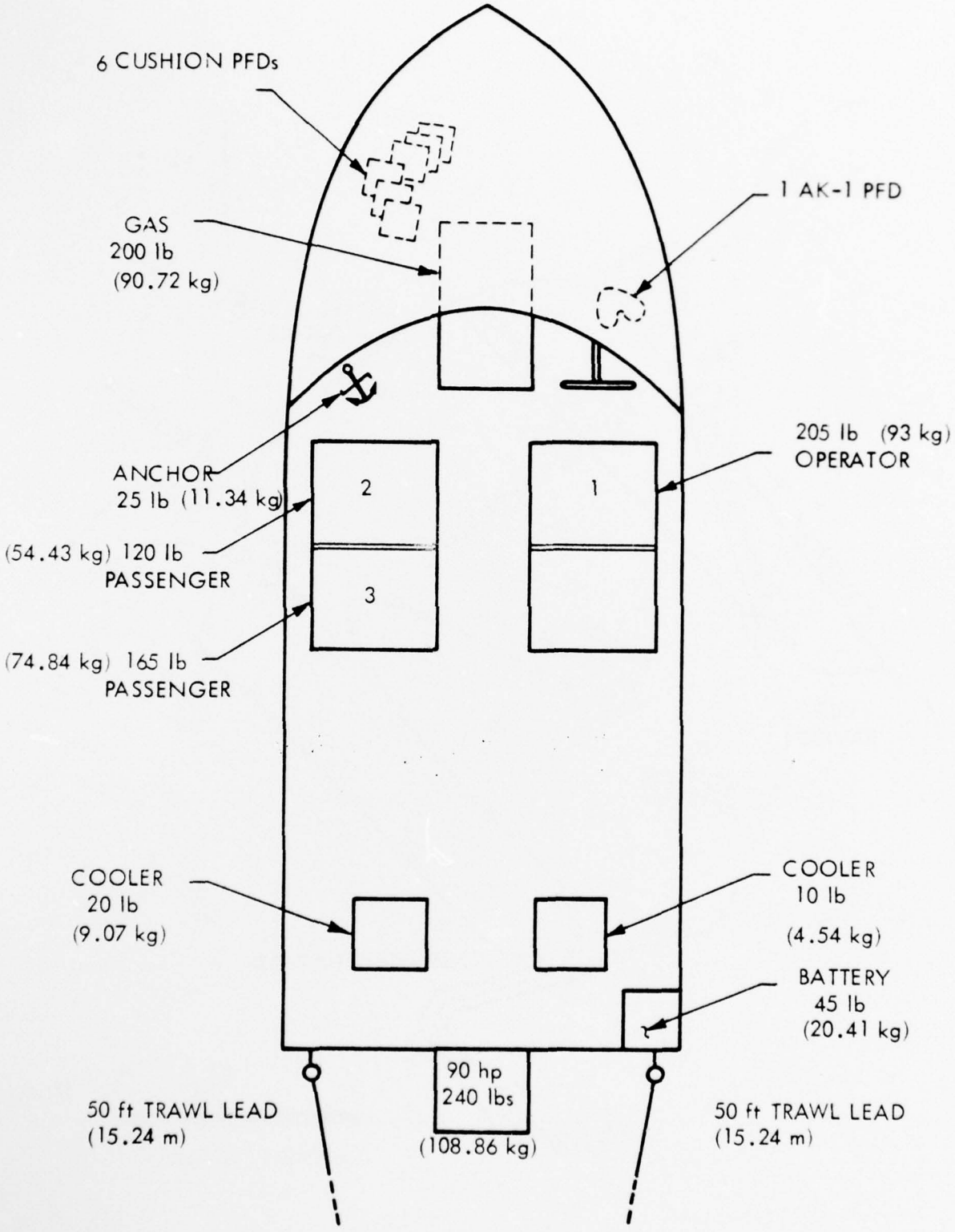


FIGURE 1. SEATING AND GEAR ARRANGEMENT PRIOR TO ACCIDENT

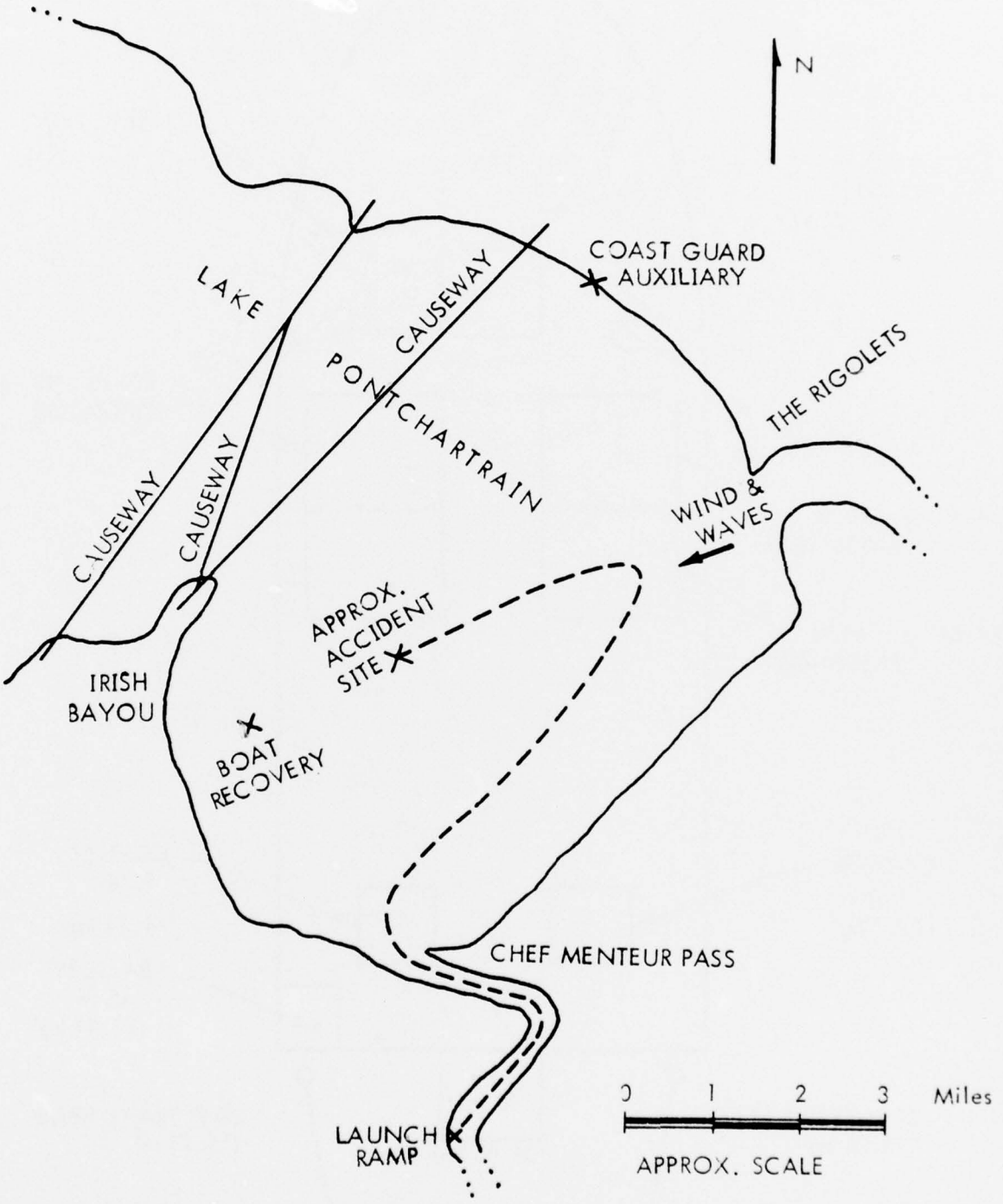
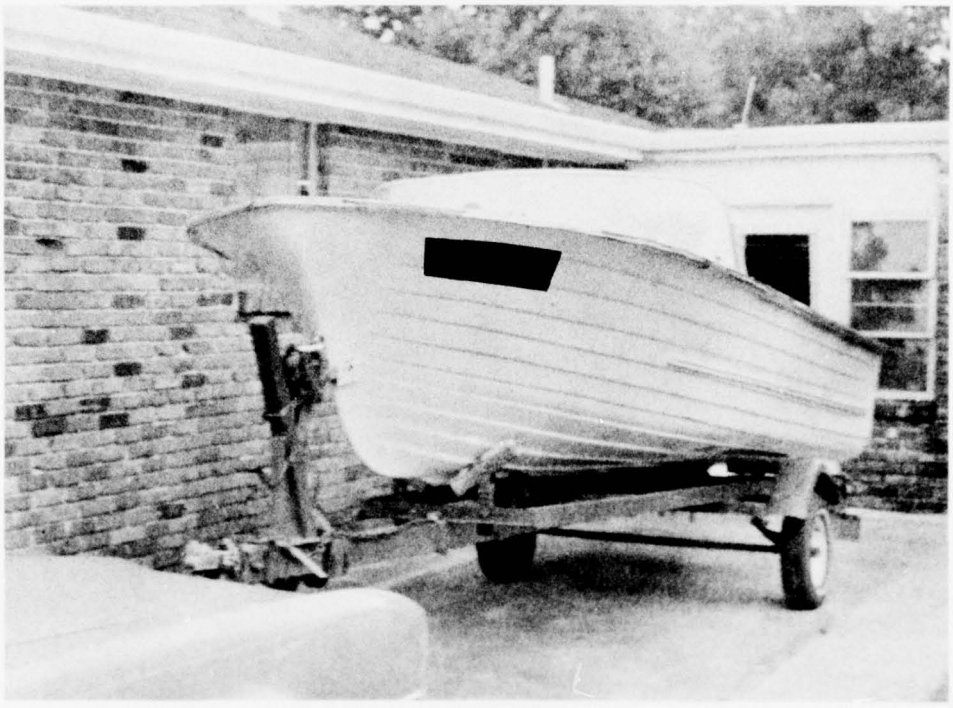


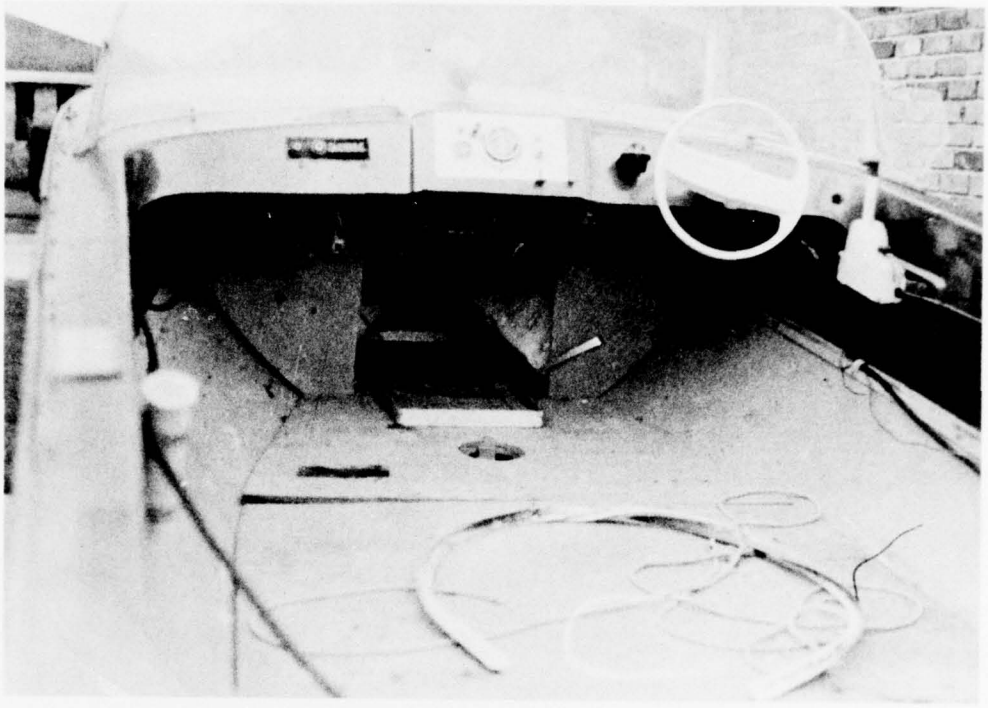
FIGURE 2. ACCIDENT SITE SKETCH



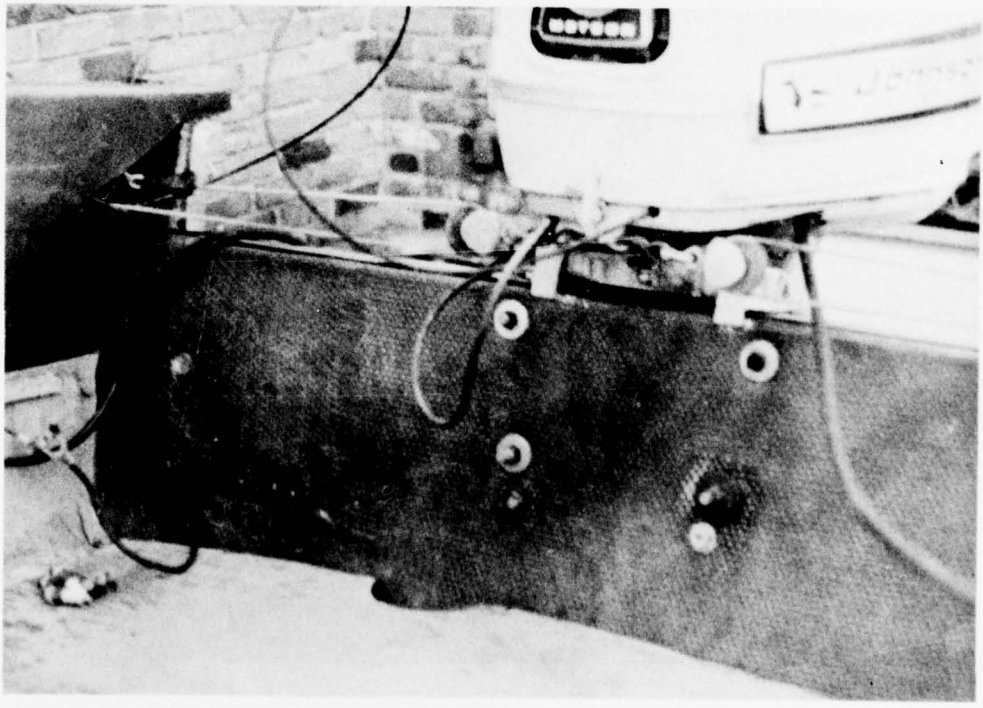
PHOTOGRAPH 1.



PHOTOGRAPH 2.



PHOTOGRAPH 3.



PHOTOGRAPH 4.

APPENDIX GG

ACCIDENT INVESTIGATION REPORT

Date of Investigation: April 23, 1976

Date of Accident: April, 1976

Investigation: Capsizing/Swamping No. 75-32

SUMMARY — WYLE ACCIDENT NO. 76-080

The accident reported herein involved a 20 ft (6.1 m) V-hull day cruiser powered by two 70 hp outboard motors. The type of accident was a swamping with a subsequent capsizing of the boat, resulting in no injuries or fatalities.

At approximately 0900 on a day in mid-April, 1976, a man (boat operator) and his wife set out from a launch ramp located in southeastern North Carolina destined for a scuba diving area approximately 19 miles (30.6 km) from the ramp. On the way to the diving area, the couple stopped and picked up a friend (teenage female). The party then proceeded to the diving area arriving at approximately 0930. The boat was anchored by the bow on the lee side of a jetty in approximately 15 ft (4.6m) water. The operator and his wife put on wet suits, air tanks, and weight belts in preparation to dive in the area. The teenager was to stay in the boat. The operator noticed that water was splashing over the transom into the motor well. He turned on the bilge pump and observed that water was coming out of the discharge hole. A short time later, he noticed that the water level in the transom area had raised to the point that it was visible in the passenger compartment. The boat started to list to starboard and water started flowing freely over the transom and forward section of the

motor well into the passenger compartment. The operator tried to start the motors, but apparently the battery had shorted. The operator told the two passengers that they would have to get out of the boat because it was going to sink. The operator and his wife took off their diving gear and the wife went into the cabin to get - PFD for the teenage passenger. As she entered the cabin, the boat started sinking by the starboard stern and simultaneously began to roll to starboard. As the boat rolled, the teenage passenger held onto the operator and they floated out of the boat. The boat continued to roll until it was in an upside-down, near level position. The wife got out of the cabin of the overturned boat through the forward hatch, bringing with her a PFD for the other passenger. The teenager put on the PFD and the occupants held to the boat for approximately 15 minutes until rescued by a nearby pleasure boat. The involved boat was towed to a marina where it was righted and the water evacuated.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFD Worn
(1) Oper.	M	31	240	Excellent	300-500 hrs	No	Wet suit
(2) Passen.	F	27	135	Excellent	< 100 hrs	No	Wet suit
(3) Passen.	F	15	130	Good	< 25 hrs	No	No

1.1 Owner/Operator (1)

He seemed to be of at least average intelligence and physical condition. He had owned a 19 ft (5.8 m) open outboard before he purchased the involved boat approximately 8 months before the accident occurred. He stated that his parents had owned outboard boats during the time he was growing up and he had learned to operate a boat at an early age. He seemed to possess an above average knowledge of small boat operation and safety procedures. He stated that he had been scuba diving in the area of the accident numerous times in conditions that were more severe than the day of the accident and had never encountered any problems. He was an experienced scuba diver which was evident by the photographs and marine artifacts displayed in his home.

1.2 Passenger (2)

She was the wife of the operator and was not available for interview at the time of the investigation. According to the operator, her physical ability was above average for her age. She was a Red Cross Safety Instructor and was very active in swimming and water safety youth programs sponsored by the local Red Cross Chapter. She was an experienced scuba diver and usually accompanied the operator on diving outings. The majority of her boating experience had been as a passenger rather than an operator.

1.3 Passenger (3)

She was a friend of the operator and his wife and was not available for interview at the time of the investigation. According to the operator, she was of normal intelligence and physical ability. Her boating experience was unknown, but the operator assumed from observing her on the outing that it was very little. It was the first time she had been out in a boat with the couple.

2.0 ENVIRONMENT

The sky was clear and the visibility good. The estimated air temperature was 75°F (24°C) and the estimated water temperature was 65°F (18°C). The wind was estimated to be 7-14 mph from the northeast and the water surface was smooth with 3-4 ft (0.9-1.2 m) gentle swells. The tide was incoming with very little current. The water depth at the accident site was approximately 15 ft (4.6 m).

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

On the day before the accident in mid-April, 1976, the owner/operator (1) of the involved boat and his wife (passenger 2) trailered the involved boat from their home in northwestern North Carolina to a resort area located in southeastern North Carolina. They arrived at the resort area at approximately 1400 after a drive of approximately six hours. They checked in a motel and spent the afternoon crabbing at a nearby pier. They went out to dinner and a movie that evening and went to bed at approximately 2230.

On the day of the accident, they arose at approximately 0800 and made preparations to go on a scuba diving excursion. The boat was trailered to a nearby marina where the scuba gear was stowed aboard and the boat launched. (1) stated that the transom plug was put in just prior to launching and there was no water in the boat. The couple got underway from the launch area at approximately 0830 destined for a residential dock of a friend approximately four miles (6.4 km) away. The young male friend and his girlfriend (passenger 3) were to go on the outing with (1) and (2). They arrived at the friend's dock at approximately 0845 and learned that the male friend was not feeling well and had decided not to go on the outing. (3) decided she would go, and the group got underway to the diving area at approximately 0900. They arrived at the diving area at approximately 0930. The boat was stopped approximately 50 yds (45.7 m) from a jetty on the leeward side. The boat was anchored with a grapling type and a standard anchor (safety anchor) with the 50 ft (15.2 m) grapling anchor line and the 60 ft (18.3 m) safety anchor line tied to the center bow cleat. The grapling anchor caught on rocks near the jetty, the anchor line became tight, and the boat became stationary. (1) turned on the bilge pump which he said was standard practice when his boat was anchored in other than calm water. He looked over the starboard side and saw water coming out of the overboard discharge. He stated that during the anchoring process he noticed that some water had splashed over the transom into the motor well, and he was certain that some of the water had drained through the engine control holes into the double bottom. This had happened numerous times before, and he was not concerned because he felt the bilge pump would quickly evacuate the water. (1) and (2) put on their wet suits, air tanks, and weight belts

in preparation to dive in the area. (3) was to stay aboard and observe. The water was clear and the bottom could easily be seen from the boat deck. Just prior to starting the dive, (1) noticed that a considerable amount of water was seeping into the aft section of the passenger compartment. Again he checked the bilge pump discharge and saw that water was being pumped out of the boat. At this point the boat had been anchored for approximately 15 minutes. The swells were gently raising and lowering the boat as they passed. (1) noticed that as the stern started to rise, the transom freeboard was reduced to the point that water was flowing over the starboard stern and into the passenger compartment. (1) told (2) they would have to cast off the anchor line and get the boat underway before it shipped enough water aboard to sink. (1) and (2) removed their diving gear and (2) went forward and cast off the anchor lines. Shortly after the anchor lines were cast off, a large swell came over the transom filling the boat approximately 1/3 full of water. (1) went to the helm and energized the starters, but by this time the battery had most likely submerged and was shorted because the starters did not turn over. (1) told (2) and (3) that the boat was going to sink and they must get out. (2) went into the cabin to get a PFD for (3). (1) and (2) were still wearing their wet suits.

3.2 Accident

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

As (2) entered the cabin, the starboard stern started sinking, and the boat started to roll very rapidly to starboard. The operator was seated at the helm, and (3) was seated in the adjacent seat on the port side. As the boat rolled and filled completely with water, (3) floated across to the starboard side and held onto (1). As the boat continued to roll, (1) and (3) floated out of the boat on the starboard side. The boat continued to roll until it was in an upside-down, near level attitude. The wet suit (1) was wearing provided sufficient buoyancy to support the weight of himself and (3).

3.3 Post Accident

(2) was trapped in the cabin, and (1) was concerned that she possibly would not be able to get out due to the buoyancy of the wet suit she was wearing, holding her in the cabin air bubble. (1) swam to the bow of the boat with (3) holding onto him. When he reached the bow, he could see (2)'s hair near the open forward hatch cover. He reached down through the hatch, grabbed (2)'s hair and pulled her body through the hatch to the surface. When (2) surfaced, she was holding an AK-1 PFD which was put on (3) and secured.

The occupants stood on the submerged bow guard rail and held to the bottom of the bow. A small cabin cruiser that had witnessed the accident, rescued the occupants within 15 minutes after the capsizing. The Coast Guard was notified by marine radio and a rescue boat was dispatched and was on the scene within 30 minutes. The CG rescue boat towed the involved boat to a marina where it was righted and the water evacuated. Refer to Figure 2 for accident area.

Time Sequence

0830	Got underway to friend's dock.
0845	Arrived at friend's dock and picked up passenger (3).
0900	Left friend's dock for diving area.
0930	Arrived at diving area and anchored boat.
0945	Operator noticed water building up in aft passenger compartment.
0945-0947	(1) and (2) removed diving gear and (2) went into cabin to get PFD for (3).
0947-0948	Boat filled with water and capsized.
0948-0949	Operator pulled (2) from cabin and AK-1 PFD put on (3).
0949-1004	Occupants stayed with boat.
1004	Occupants rescued by nearby cabin cruiser.
1034	Coast Guard rescue vessel arrived and started towing capsized boat to marina.

4.0 FACTS FROM THE BOAT INSPECTION

The boat was a 1974 model Sea Craft Day Cruiser powered by two 1974 model 70 hp Johnson outboard motors. The boat appeared to be in good condition except for the windshield bracket and forward guard rail which were damaged as a result of the accident. Extent of damage to the motors and electrical system could not be determined. No capacity plate was attached to the boat and no evidence could be found where a capacity plate had been installed. There was sufficient flotation material in the double bottom to support the weight of the boat and occupants. Additional hull information obtained during the investigation is as follows:

- H.I.N. — SECCO 136M 74H
- Model — Seafari
- Hull material — molded fiberglass
- Type hull — Deep-V with double bottom
- Bilge construction — decked
- Length overall — 19'6" (5.8 m 15.2 cm)
- Depth amidships — 28" (71.1 cm)
- Max. beam gunwale — 91" (231 cm)
- Max. transom width — 84" (213 cm)

Refer to Photographs 1-3 for overall boat views.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

The operator stated that he had been scuba diving in the accident area numerous times in water conditions that were much worse than on the day of the accident, and he was very surprised that the boat capsized. He knew that the transom design was such that water could get into the passenger compartment in rough water, but he was confident that the bilge pump was adequate to evacuate the water. Because of this over confidence in his equipment, he apparently took no corrective action to evacuate the water until it was too late. When the boat did capsize, he stated that he knew there was sufficient flotation material installed in the double bottom to prevent the boat from sinking.

6.0 PROBABLE CAUSE OF ACCIDENT

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

- Over confidence of the operator concerning his equipment is considered the major cause of the accident. He assumed that the bilge pump would evacuate the water fast enough to prevent an excessive amount of water to accumulate in the boat. On previous outings in similar conditions, the bilge pump had been adequate for keeping the bilge relatively free of water.
- The transom design was such that any significant amount of water that came over the transom would flow into the passenger compartment (see Photograph 4). The bilge pump was not adequate to evacuate the water from the bilge.
- The major portion of the weight in the boat was positioned aft of amidship, reducing the transom freeboard which made the stern more susceptible to ship water.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

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

According to the estimated weight in the boat at the time of the accident, the boat was not overloaded. However, a major portion of the weight was located aft of the longitudinal center of gravity which most likely reduced the transom freeboard significantly. The boat was riding up and down on the 3-4 ft (0.9-1.2 m) swells. The boat weight and equipment provided sufficient inertia to cause the hull to momentarily lag behind the rise of the wave which reduced the transom freeboard allowing water to spill over the transom into the motor well, then into the passenger compartment. The water weight eventually decreased the transom freeboard which allowed water to flow freely into the boat. When the boat flooded it had a natural tendency to capsize, because all of the flotation material was installed in the double bottom.

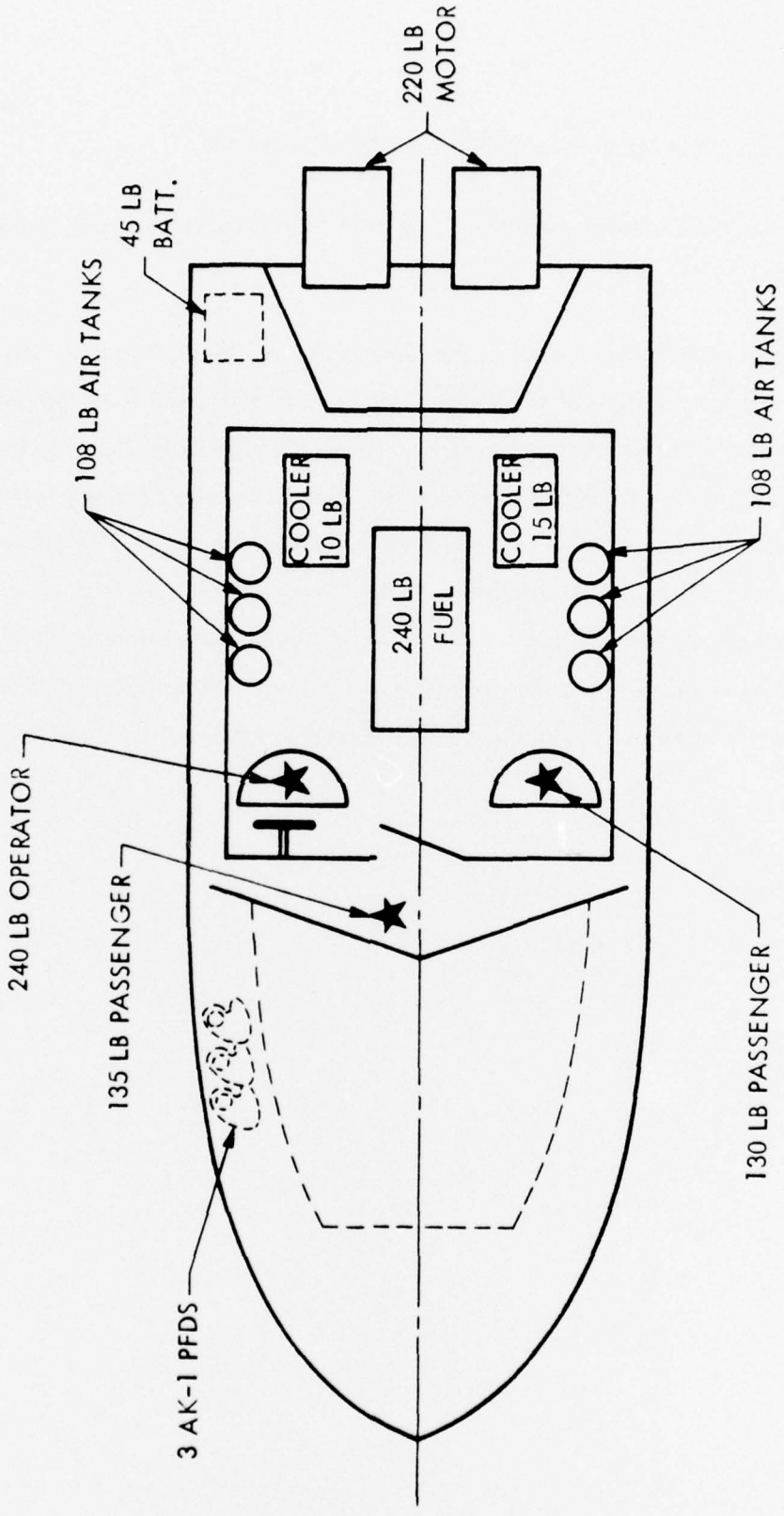


FIGURE 1. BOAT LOAD DISTRIBUTION AT TIME OF ACCIDENT

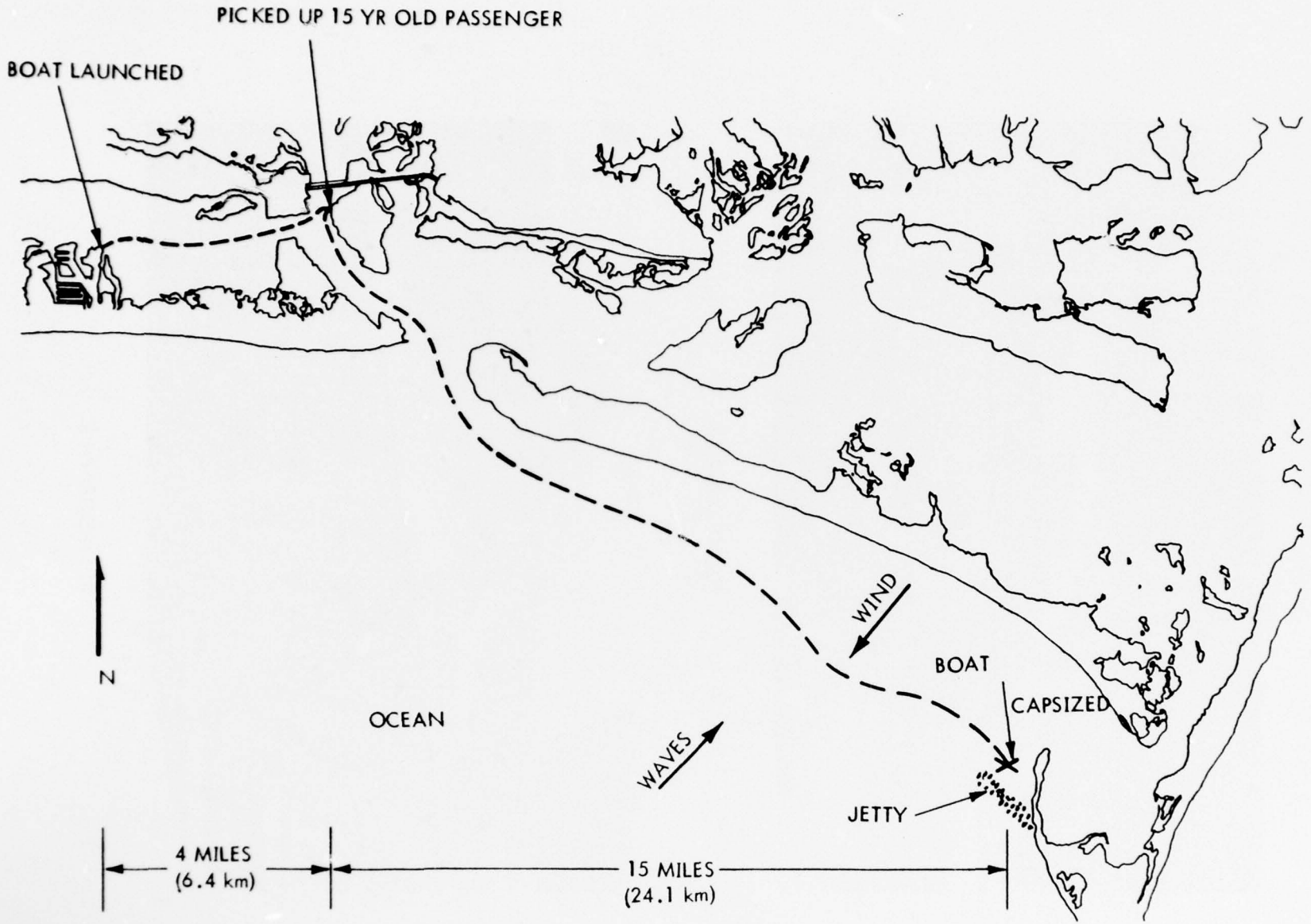
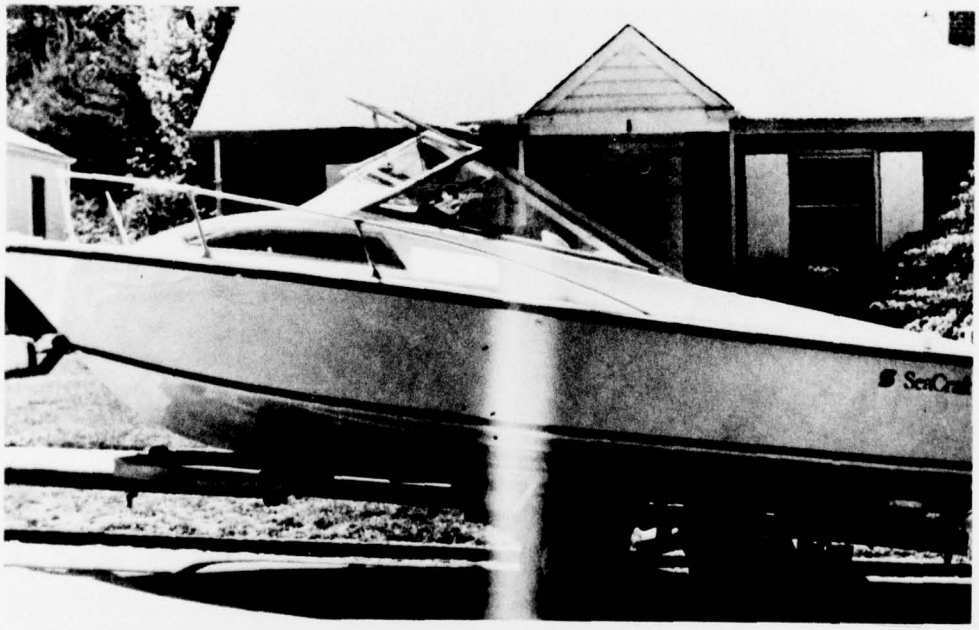


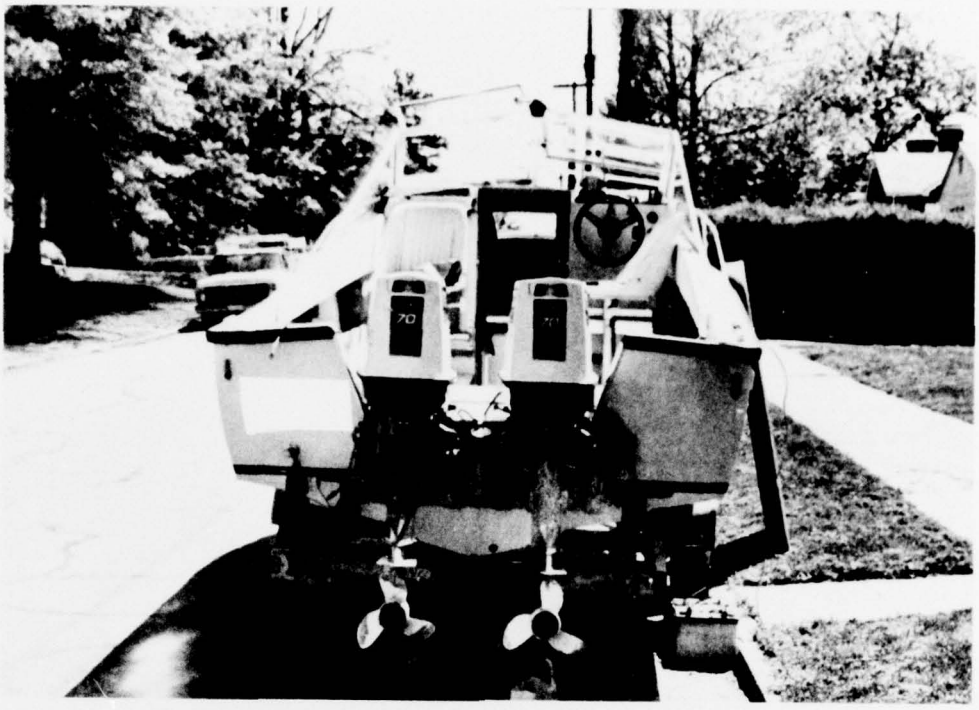
FIGURE 2. ACCIDENT AREA



PHOTOGRAPH 1



PHOTOGRAPH 2



PHOTOGRAPH 3



PHOTOGRAPH 4

APPENDIX HH

ACCIDENT INVESTIGATION REPORT

Date of Investigation: June, 1976

Date of Accident: Mid-April, 1976

Investigation: Capsizing/Swamping No. 75-33

SUMMARY —WYLE ACCIDENT NO. 76-073

The accident reported herein involved a 14'10" (4.52 m) semi-v runabout powered by a 125 hp outboard motor. The type of accident was a swamping over the transom and subsequent capsizing, resulting in no deaths or injuries.

At about 1400 on a Friday in mid-April, 1976, three men and a woman, friends about 20 years old, set out onto the main body of Lake Pontchartrain, Louisiana to water ski and try out a new shrimp trawling net, purchased just the day before. No one in the group had previous experience at trawling. They went out about 1/2 to 3/4 of a mile (0.8 - 1.2 km) from shore and had just begun a second drag when the net caught on an unidentified obstruction while the boat was headed in the same general direction as the 4' (1.2 m) waves. The boat stopped dead in the water. While the occupants were pulling the boat back over the net, waves began to enter the boat over the transom. The occupants bailed out the boat, and then three of them moved to the stern to again attempt to dislodge the net. Seas over the transom quickly swamped the boat. As it went down by the stern, all occupants jumped out and into the water. The boat capsized and floated inverted with the bow out of the water. None of the occupants used PFDs, although several had been stored up under the bow. The four persons either

straddled or hung onto the boat. No other vessels were in sight. After they had been in the water several minutes, one of the men, the best swimmer, began swimming for shore. Upon arrival, he ran over a mile (1.6 km) to the launch ramp and found a small boat operator who went out and rescued the others. They had been in the water for about two hours. The boat was recovered shortly after by a Coast Guard patrol boat.

1.0 BOAT OCCUPANT DATA

Operator/ Passenger	Sex	Age	Weight	Swimming Ability	Boating Experience	Formal Boating Instructions	PFD Worn
1. Operator	M	22	180	Good	20-500 hrs	None	No
2. Passenger	M	20	130	Excellent	20-500 hrs	Yacht club sail lessons	No
3. Passenger	M	21	140	Good	20-500 hrs	None	No
4. Passenger	F	19	105	Non-swimmer	0-20 hrs	None	No

1.1 Owner/Operator

The operator (No. 1) was a part-owner of the boat with his uncle, who was not aboard during the accident. The operator seemed to be of above-average intelligence and physical ability, and rather self-assured. He attended college for two years, is married, and is employed as a service representative for an agricultural electronics firm. He had owned the involved boat, his first, for 4 or 5 years and used it chiefly for waterskiing on smaller lakes and rivers. He had operated the boat on Lake Pontchartrain about six times previously, and had no experience using a trawling rig. This was his second boating trip of the season. During the interview he exhibited a good understanding of the factors which contributed to the accident, and was also aware, for instance, that the outboard motor exceeded his boat's capacity plate limitation.

1.2 Passenger

This passenger (No. 2) was the only occupant not interviewed. He is the brother of the other male passenger (No. 3), and was described as the athletic type: a good swimmer, waterskier, scuba diver, and small boat sailor.

1.3 Passenger

This passenger (No. 3) seemed to be of above-average intelligence and average physical ability. He had attended college for three years, but his current occupation is not known. He mentioned not having much wind due to being a heavy smoker. His boating experience has chiefly been as a passenger. He did not appear to be very knowledgeable regarding boats.

1.4 Passenger

This passenger (No. 4) appeared to be of average intelligence and physical ability. She had been out on a boat only once before, on a river. She is No. 3's girlfriend; her occupation is not known.

2.0 ENVIRONMENT

The weather, as recorded by the Coast Guard one hour after the accident, was cloudy; visibility, 8 miles (12.9 km); ESE winds at 25 knots; 4 foot (1.2 m) waves; air temperature, 84°F (29°C); and water temperature, 75°F (24°C). Water depth at the accident site was 9-12 feet (2.7-3.7 m). A small craft advisory was issued at 2100 the evening before the accident for increasing SE to S winds 20 to 25 knots before noon. The occupants described the weather when they launched the boat as "a little bit rough, a little choppy, ... kind of rough, ... seas 1 to 2 feet..." (0.3-0.6 m).

3.0 NARRATIVE DESCRIPTION OF ACCIDENT

3.1 Pre-Accident

On the day before the accident, No. 3 bought a new trawling rig, consisting of a 16' (4.9 m) long net, weighted spreader boards, and twin 75' (22.9 m) trawling leads, for $100. The three occupants interviewed reported having had a good night's sleep the night before the accident. In the morning, No. 1 and 3 assembled the trawling rig from the instructions supplied, as neither they nor the other occupants had any experience with trawling. They all had the day off due to a holiday, and decided to go out in the boat to water ski and try out the trawling rig, although they were aware that the legal trawling season was still several weeks away. That morning No. 1 bought a new battery for his boat and checked the starting system. He also opened the inner hull drains and found no water. The boat was trailered to a ramp not far from his apartment and launched at about 1400. The nearest small craft warning display was 8 miles (12.9 km) further along the lakeshore. No one in the group had checked the weather forecast or was aware that small craft advisories were in effect.

No. 1 headed the boat about 1/2 to 3/4 of a mile (0.8-1.2 km) out into the lake. Persons and gear were distributed as shown in Figure 1. The trawl leads were tied to handles on the transom, and the rig put over and dragged for about 200 yards (182.9 m) while the boat was headed west, with the wind and waves at the stern. The boat was stopped and the net hauled aboard, but it contained only two small fish. While stopped, several waves broke over the transom into the motor well, and a small quantity of water entered the passenger area through the control cable cutouts. The net was again put over, and trawling in the same direction as the waves was resumed. Although a six pack of beer was taken along, no one on board drank any alcoholic beverages that day prior to the accident.

3.2 Accident

After being underway for about 30 minutes, and while making the second drag, No. 1 began a wide left turn so as to come about and trawl into the waves. At that time the boat was about 1/2 to 3/4 of a mile (0.8-1.2 km) from shore; and no other boats were in sight. The operator was aware that the waves were overtaking his boat and "slapping against the stern." The occupants interviewed felt that the weather had worsened since the start of their trip. Just after beginning the turn, the boat came to a stop when the net caught on an unknown underwater obstruction. It swung around a little such that the waves were again coming directly at the transom. Waves entered the passenger compartment, both through the control cable cutouts and over the top of the motorwell. At first, No. 1 applied power to dislodge the net, but was unsuccessful. He then stopped the engine and went to the stern, port side, to try and pull the boat over the obstruction and dislodge the net, while No. 3 bailed the passenger compartment. No. 4 remained in the forward port seat; No. 2's actions at that time were not certain. Most of the water in the passenger area was able to be removed, but No. 1 was not able to pull the lead aboard. As the other two men moved aft to assist him, more water entered the boat over the transom. After a short while, No. 3 moved to the helm to power ahead to break the net loose while No. 1 got out his knife to cut the leads. Just as each was about to act, the boat went down quickly by the stern and rolled to port until capsized. As it did, all occupants except No. 4 jumped overboard. She held onto the windshield until she was in the water, and then pushed away from the rolling boat. During the swamping and capsizing, no one had attempted to get a PFD from under the bow.

3.3 Post Accident

The boat came to rest in an inverted, bow high attitude. After some scrambling around, the occupants managed to use the boat for support: No. 1 stood on some portion of the motor, No. 3 held onto the bow ring used with the trailer winch; and they both held onto No. 4, who lay "spread-eagled" on the bottom of the hull. No. 2 was in the water on the side of the boat, but within 2 or 3 minutes swam off for shore. He suggested that someone had to go, and then volunteered. After he left, the others maintained their positions on the boat until rescued. They reported feeling quite cold except when the sun occasionally shone

through; and No. 3 developed cramps. The only boat spotted during the time they were in the water was a small skiff, which passed by but apparently did not notice them or hear their shouts.

The swim to shore by No. 2 took over an hour; he made land over a mile west of the launch ramp. He ran back to it, and on the way asked some boys to call the Coast Guard. At the boat ramp he enlisted the aid of the owner of a small open boat to go out and rescue the others. The boat owner was hesitant to help on account of the weather, but then agreed. The Coast Guard patrol boat arrived on the scene after all occupants were back to shore, and towed their boat to the launch ramp. None of the occupants required medical attention.

Approximate Time Sequence

1400	Launched boat and got underway.
1430	Trawl snagged and boat began to be swamped over transom.
1440	Boat capsized.
1445	Passenger swam for shore.
1600	Passenger reached shore.
1630	Other occupants rescued.
1700	Boat recovered.

4.0 FACTS FROM BOAT INSPECTION

The boat involved was a 1968 model Starcraft "Caravelle V" semi-v fiberglass runabout. The length overall was 14'10" (4.52 m), maximum beam at gunwale was 74" (188 cm), maximum beam at chine 65" (165 cm), depth amidships 26" (66 cm), and transom height 21" (53.3 cm). The boat featured artificial lapstrake construction and a motorwell with open cutouts for control, fuel, and electrical lines. It was powered by a 1968 Mercury 125 hp outboard motor, bolted to the transom and controlled with a single lever throttle/gearshift. The BIA capacity plate attached allowed a maximum weight capacity of 1450 pounds and a maximum horsepower capacity of 80. Styrofoam block flotation was installed under the bow. On the day of the accident, no anchor or bilge pump was carried. The boat had been stored in a garage until this season, when it was kept on its trailer outside. The boat was maintained in good condition; no modifications had been made except for the addition of a power trim unit. During the accident and recovery, the boat sustained some damage: the seats, windshield, and six PFDs were lost; and several interior structural connections were fractured. Refer to Photographs 1 to 4 for details of the interior and exterior at the time of the investigation.

5.0 PSYCHOLOGICAL AND HUMAN FACTORS

It was apparent that the operator and at least one of the passengers (No. 3) were quite intent on trying out the new trawling gear: they risked being cited for shrimping out of season and they ignored the obvious adverse weather, as well as the water taken over the stern when they stopped and hauled up the net. In fact, the operator was quite excited about his first shrimping expedition, thinking it would be "fun, glamorous, an ice chest full of shrimp."

The failure to cut the trawl free in time to avoid swamping can be attributed to the desire to not sacrifice the new and valuable piece of gear, rather than to panic or confusion. There was plenty of time to recover from the situation, and the means was at hand.

6.0 PROBABLE CAUSE OF ACCIDENT

This accident involved several personnel errors and problems: the operator failed to check the weather forecast, in which he would have learned of small craft warnings; he ignored obvious adverse weather existing at the start of his trip; he bottom-trawled with a moderate following sea, due to lack of education and experience; and he failed to take prompt, corrective action once the boat stopped.

From the standpoint of the boat, no harm resulted from the motor being over the capacity plate horsepower recommendation: it was operated at slow speeds and the 125 hp motor did not weigh appreciably more than an 80 hp motor. The unshielded control cable cutouts in the motor well may have contributed to more rapid swamping, however.

7.0 DYNAMICS/ANALYSIS OF THE ACCIDENT

The trawl acted as a stern anchor when it became caught on the bottom. The wind and waves swung the boat around on the "anchor" until the stern was directly into the seas. The transom freeboard was decreased both when the operator attempted to power free from the snag and when he tried to pull the boat over it. Waves broke over the stern due to its square shape and reduced freeboard. Although the boat was not considered overloaded, a poor load distribution resulted when the three heaviest occupants moved aft. At that point a moderate quantity of loose water also flowed aft, and the transom freeboard was reduced enough to permit complete swamping.

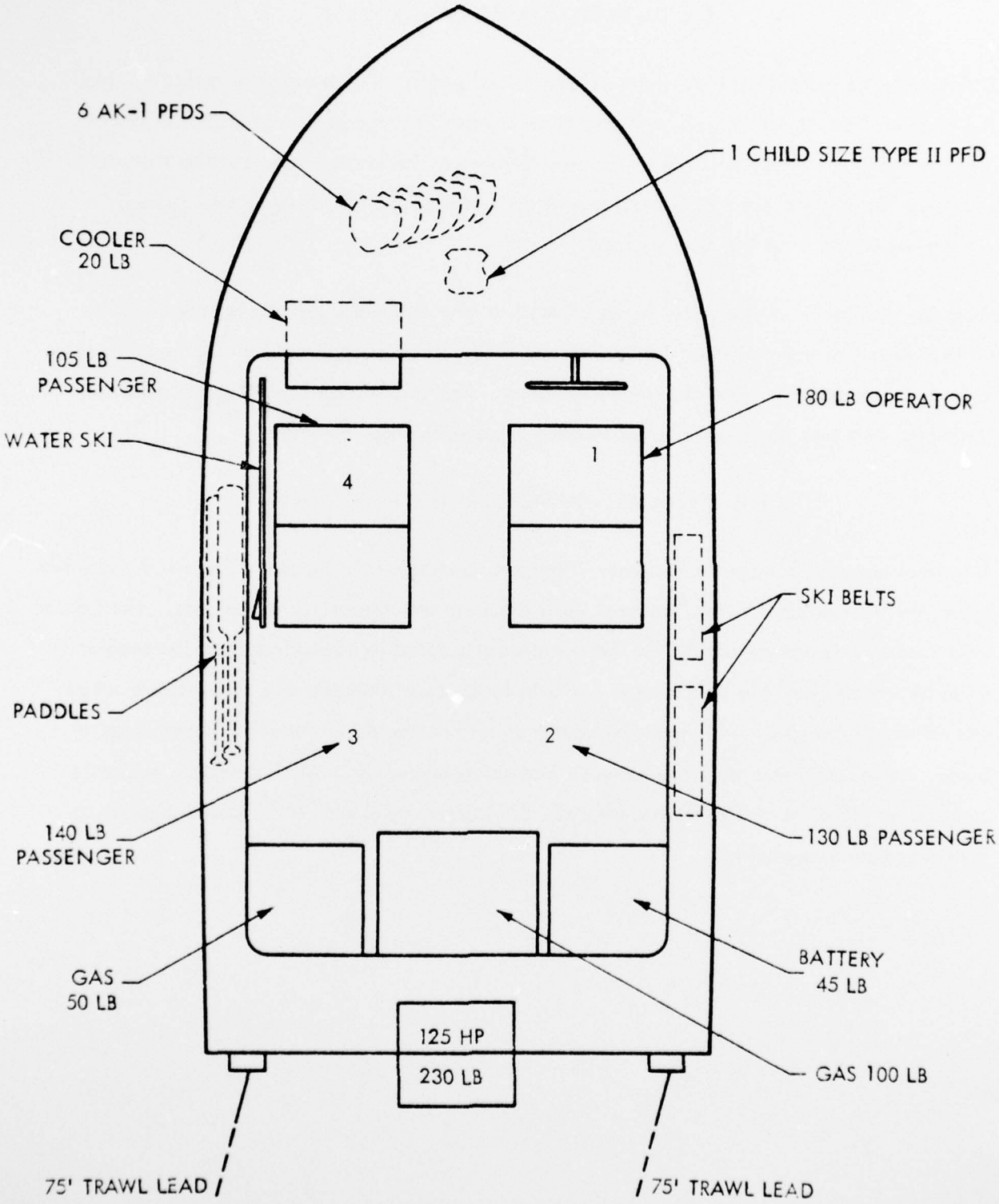


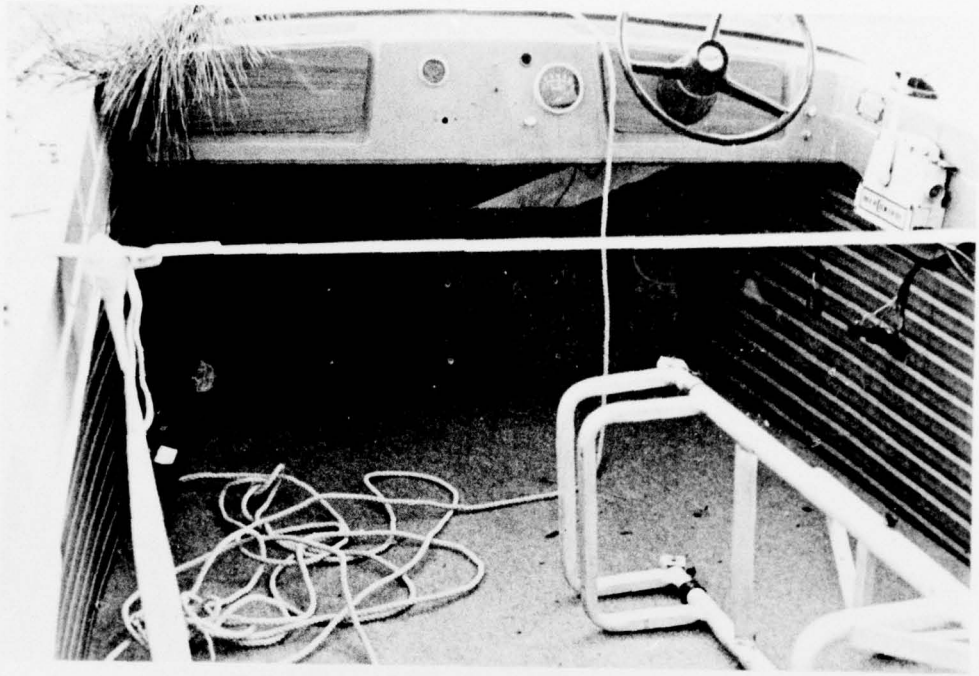
FIGURE 1. SEATING AND GEAR ARRANGEMENT PRIOR TO ACCIDENT



PHOTOGRAPH 1



PHOTOGRAPH 2



PHOTOGRAPH 3



PHOTOGRAPH 4

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