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U.S. DEPARTMENT
OF TRANSPORTATION

UNITED STATES
COAST GUARD

MARINE CASUALTY REPORT

UNINSPECTED TOWING VESSEL FRANK PALLADINO JR O.N. 619166 AND GREAT LAKES BARGE KELLSTONE I O.N. 274472 COLLISION WITH A PLEASURE CRAFT (OH 0164 YU) IN THE SOUTH PASSAGE OF LAKE ERIE, ON 1 OCTOBER 1994, WITH AN INJURY AND MULTIPLE LOSS OF LIFE.

U.S. COAST GUARD
ONE-MAN FORMAL INVESTIGATION REPORT
REPORT NO. USCG 16732/24DET94/MC94020576

U.S. Department of Transportation
United States Coast Guard

Commanding Officer
U.S. Coast Guard
Marine Safety Office

110 Mt. Elliott Avenue
Detroit, MI 48207-4380
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16732/24DET94
MC94020576
26 June 1995

From: One-Man Formal Investigation
To: Commandant (G-MMI-1)

Via: Commander, Ninth Coast Guard District (m)

Subj: MARINE CASUALTY REPORT: UNINSPECTED TOWING VESSEL *FRANK PALLADINO JR* (O.N. 619166) AND GREAT LAKES BARGE *KELLSTONE I* (O.N. 274472) COLLISION WITH A PLEASURE CRAFT (OH 0164 YU) IN THE SOUTH PASSAGE OF LAKE ERIE, ON 1 OCTOBER 1994, WITH AN INJURY AND MULTIPLE LOSS OF LIFE.

1. Enclosure (1) is the marine casualty Report of Investigation. It includes the Summary, Preliminary Statements, List of Figures, List of Tables, List of Acronyms, Findings of Fact, Conclusions, Recommendations, Appendices, List of Exhibits, and References for the report.

2. Enclosure (2) is the marine casualty Record of Investigation. It includes the transcripts and exhibits referenced in the Preliminary Statements and Findings of Fact for the report.

3. Enclosure (3) is the Administrative File. It includes the correspondence and media articles collected during the proceedings.

M. W. MASTENBROOK

Encl: (1) Report of Investigation (Original + 4 copies)
(2) Record of Investigation (Original + 1 copy)
(3) Administrative File

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SUMMARY

At 1317 hours, on Saturday, 1 October 1994, the uninspected towing vessel FRANK PALLADINO JR and the empty self-unloader Great Lakes barge KELLSTONE I collided with a 21-foot Mach 1 pleasure craft, in the South Passage of Lake Erie. The 100-foot towing vessel was in the notch of the 394-foot barge for a combined length over all of 456 feet. The tug and barge combination was traveling at a speed of six knots from the Detroit River towards its destination, Kelley's Island, OH. On board the Mach 1 were an adult male, an adult female, and two teenage boys.

Prior to the accident, the Mach 1 had a 15-pound navy stockless anchor out off the stern and the four persons onboard were perch fishing off the stern, in open water, among a pack of approximately 15 other recreational vessels. The wind was from out of the northeast at about eight or nine knots and the visibility was good. The persons on the Mach 1 had been fishing at anchor, in 24 to 26 feet of water in the South Passage, since sometime after 0800 hours that morning. Their vessel had dragged anchor once and had been repositioned after more anchor line was added. The concentration of recreational vessels in the area had been greater earlier that morning, but then thinned out after a light, misty rain developed around noon.

When the barge was approximately 10 feet away from the Mach 1, one of the boys jumped overboard without a lifejacket. Evidence suggests the other boy also jumped. The two adults remained on board. The portside of the Mach 1 was hit by the barge's bow and dragged along the surface of the water for 100 or more yards; however, the Mach 1 did not sink and was not capsized. A nearby pleasure craft, observing the accident take place, immediately sent a Mayday call over VHF-FM Channel 16. Within minutes of the accident, there were approximately 15 private boaters on-scene to render assistance. A 22-hour, organized search effort for the two missing boys then commenced involving the private boaters, U.S. Coast Guard, U.S. Coast Guard Auxiliary, three State and local boating law enforcement agencies, and five fire department dive teams. The adult female was later admitted to a local hospital for strained back muscles. The adult male sustained a small cut from some broken glass. There were no other reported injuries on either vessel.

The responders continued to search throughout the rest of the week for the missing boys during their patrols of the South Passage area. The bodies of both boys were found about a week after the accident. One body was found just under a statute mile away from the accident site, while the other body was found just over 4 statute miles away.

On 3 October 1994, the Commander of the Ninth Coast Guard District convened a One-Man Formal Investigation to determine the cause of the casualty and to make recommendations for preventing similar occurrences in the future.

PRELIMINARY STATEMENTS

1. This One-Man Formal Investigation was convened pursuant to 46 U.S.C. 6301, 46 CFR 4, and by order of the Commander, Ninth Coast Guard District. The accident met the criteria for both a *Significant Marine Casualty* and a *Serious Marine Incident* because it involved an injury, two deaths, and important safety issues. Captain Michael W. Mastenbrook, USCG was designated as the Investigating Officer in this matter. Lieutenant Junior Grade Bernard C. McDonald, USCGR (also an Investigating Officer) was subsequently designated as the Recorder by Captain Mastenbrook. On 2 October 1994, prior to the taking of testimony in formal hearings, LTJG McDonald visited the FRANK PALLADINO JR, KELLSTONE I, and Mach 1 in furtherance of the investigation. [CG83; I TR, pp. 4-5; II TR, pp. 18, 19; 46 CFR 4.03-1; 46 CFR 4.03-2(a)(1) and (a)(2); 46 CFR 4.03-30; 46 CFR 4.07; COMDTINST M16000.10, par. 3.A.5.c.(4)]

2. One formal opening hearing and three formal investigation hearings were convened in the Federal Building, in Toledo, Ohio. The opening hearing was held on 5 October 1994 with all prospective Parties in Interest and their counsel, the Chairperson, and the Recorder. Discussed were the rules for media coverage, the authority and purpose of the investigation, powers of the Investigating Officer, designation and rights of the Parties in Interest, and the convening date and time of the investigation hearings. Lastly, a moment of silence was observed in respect for the then missing persons (subsequently found dead of drowning). The investigation hearings were held on 11 and 12 October 1994, and again on 16 November 1994. A total of 17 witnesses were examined under oath. A complete verbatim transcript of the hearings, consisting of four volumes and 903 pages, was prepared by a Certified Electronic Reporter and is a part of the Record of Investigation. Initial and adjunctive investigative, administrative, logistical, and other support was provided by Coast Guard Marine Safety Office Toledo, Ohio. All designated Parties in Interest were represented by professional counsel except the step-grandfather of the deceased Michael Burghard, who appeared on his own behalf. [I-IV TR; 46 CFR 4.03-10; 46 CFR 4.07]

3. The Canadian Coast Guard Radio Station at Sarnia, Ontario monitored and recorded all of the communications on VHF-FM Channels 16 and 22 for this accident. Real-time recordings were made on 20-track, reel-to-reel audio tapes using a Dictaphone 5000 recording system. Six of the 20 tracks were dedicated for Channel 16 audio alone from the station's six remote control sites. Upon request from the U.S. Coast Guard Investigating Officer, Sarnia Radio made certified audio cassette tape copies of its reel-to-reel tapes of the accident. These copies were also made at real-time speed in order to assist transcription. A partial transcript of parties and transmission times accompanied the cassette copies from Sarnia Radio and is included as an exhibit in this report. A complete verbatim transcript of the communications on audio cassette tapes, consisting of one volume and 70 pages, was prepared by a Certified Electronic Reporter and is a part of the Record of Investigation. [CG76; Audio TR]

4. Time Zones Unless noted otherwise, all times in this report are based on the 24-hour clock and are in local time for Ohio, on 1 October 1994. At the time of the casualty, the United States was on Daylight Savings Time and Lake Erie was on Eastern Daylight Savings Time (EDST). The area of the South Passage in which the casualty took place was therefore in time zone $^{+}4$ which was 4 hours behind Greenwich Mean Time (GMT). On 30 October 1994, EDST ended and Lake Erie went on Eastern Standard Time (EST), time zone $^{+}5$, which was 5 hours behind GMT.

5. Distances The convention on the Great Lakes is to refer to distances in statute miles and not in nautical miles. A statute mile is 1,760 yards, 5,280 feet, or about 0.87 nautical miles. The word *miles*, when used without a modifier in this report, will refer to statute miles. [USCP 6, 1994, p. 2; Maloney, 1994, pp. 40, 485]

6. Abbreviated Names For purposes of eliminating excessive text in this report, certain names will be abbreviated. The towing vessel FRANK PALLADINO JR and barge KELLSTONE I will be referred to as the *tug* and *barge*, respectively. The pleasure craft OH 0164 YU will often be referred to as the *Mach 1*, or, where understood, the *pleasure craft*. The South Passage of Lake Erie will be referred to as the *South Passage*. Scott Point Shoal Lighted Buoy 1 (LLNR 5520) will be referred to as the *Scott Point Shoal buoy*. Starve Island Reef Lighted Buoy 2 (LLNR 5525) will be referred to as the *Starve Island Reef buoy* [CG14; Light List, 1994, p. 55].

7. The words *pilothouse* and *bridge* are used interchangeably in this report.

8. Use of the word *collision* versus *allision* in this report does not connote that the Coast Guard has definitively determined that the Mach 1 was underway at the time of the accident. The word *collision* is an all-inclusive term used for the "[s]triking together of two objects, one of which may be stationary." [Black, 1990, pp. 75, 264]

LIST OF FIGURES

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LIST OF ACRONYMS

ABS	American Bureau of Shipping
Audio TR	Audio Transcripts (from Canadian Coast Guard Radio Sarnia)
CAPT	Captain
CFR	Code of Federal Regulations
CG	Coast Guard Exhibit
COMDTINST	Commandant Instruction
CREW	Tug and Barge Crewmember Exhibit
CSA	Canadian Shipowners Association
DOB	Date of Birth
DR	Dead Reckoning
EDST	Eastern Daylight Savings Time
EST	Eastern Standard Time
FWD	forward
G-MMI-1	USCG Commandant, Marine Investigation Division, Casualty Review Branch
GMT	Greenwich Mean Time
GPS	Global Positioning System
HP	Horsepower
IALA	International Association of Lighthouse Authorities
IBT	Inland Bulk Transfer, Inc. Exhibit
IMO	International Maritime Organization
ISO	International Organization of Standards
ITB	Integrated Tug and Barge
K	Kellstone, Inc. Exhibit
LCA	Lake Carriers' Association
LLNR	Light List Number
LOA	Length Over All
LTJG	Lieutenant Junior Grade
MMD	Merchant Mariner's Document
MSO	Marine Safety Office
MVI	USCG Commandant, Merchant Vessel Inspection and Documentation Division
NM	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NVC or NVIC	Navigation and Vessel Inspection Circular
ODNR	Ohio Department of Natural Resources
PFD	Personal Flotation Device
REC	U.S. Coast Guard Regional Exam Center
RPM	revolutions per minute
SSN	Social Security Number
STBD	starboard
TR	transcript page from hearings (preceeded by volume number)
U.S.C.	United States Code
USCG	U.S. Coast Guard
USCGC	U.S. Coast Guard Cutter
USCGR	U.S. Coast Guard Reserve
USCP 6	"U.S. Coast Pilot 6: Great Lakes"
UTC	Coordinated Universal Time
VHF-FM	Very High Frequency - Frequency Modulation

PART I - FINDINGS OF FACT

Chapter 1 - Vessel and Equipment Data

a. Towing Vessel (*see also* Figures 1 - 1 and 1 - 2)

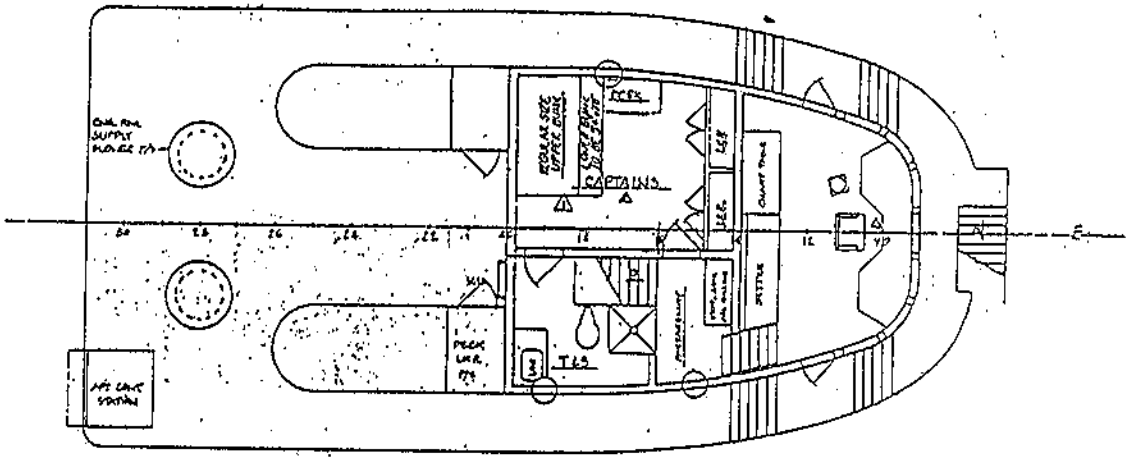
Name:	FRANK PALLADINO JR (ex LADY IDA)
Official Number:	619166
Radio Call Sign:	WBO 5107
Flag:	USA
Hailing Port (on stern):	Cleveland, OH
Service:	Towboat/Tugboat
Trade License:	Coastwise, Great Lakes
Gross Tons:	88
Net Tons:	67
Registered Length:	94.0 ft (28.65 m)
Length Over All (LOA):	100.0 ft (30.48 m)
Length Between Perpendiculars (LBP):	95.44 ft (29.09 m)
Registered Breadth:	32.0 ft (9.75 m)
Extreme Breadth:	32.0 ft (9.75 m)
Registered Depth:	10.6 ft (3.23 m)
Designed Draft (Summer):	10 ft, 10-1/2 in (3.31 m) (+2 in or 5.08 cm for fresh water)
Built:	1980; Houma, LA
Hull Number:	Modern Marine Power 28
Hull Material:	Steel
Propulsion Type:	Twin diesel direct
Propeller Type(s):	Twin, non-steerable Kort Nozzles, controllable pitch with three blades
Propeller Diameter(s):	79.2 in (201.16 cm)
Shaft Horsepower:	2,640
RPM at Normal Speed:	355
RPM at Full Astern:	375
Flank Speed:	Estimated to be 12.5 knots (14.4 mph)
Rudder Type(s):	Twin steering rudders (not flanking)
Bollard Pull:	39.5 tons
Anchor Type and Weight:	One navy stockless; 2,000 lbs (907.2 kg)
Anchor Chain Length:	8 shots or 720 ft (219.46 m)
Last Drydocked:	March 1993; Nicholson Dry Dock, Detroit, MI
Load Line Certificate:	ABS Oceans; A1 Towing Service
Master:	Chad J. Verret
Documented Owner:	Inland Refuse Transfer, Inc., 30675 Solon Road, Solon, OH 44139; (216) 349-2611
Total Interest Owned:	100%
State of Incorporation:	Ohio
Actual Owner:	Inland Bulk Transfer, Inc., 3203 Howard Avenue, Newburgh Heights, OH 44105; (216) 883-7200
Operator:	Inland Bulk Transfer, Inc., 3203 Howard Avenue, Newburgh Heights, OH 44105; (216) 883-7200

b. Barge (*see also* Figure 1 - 4)

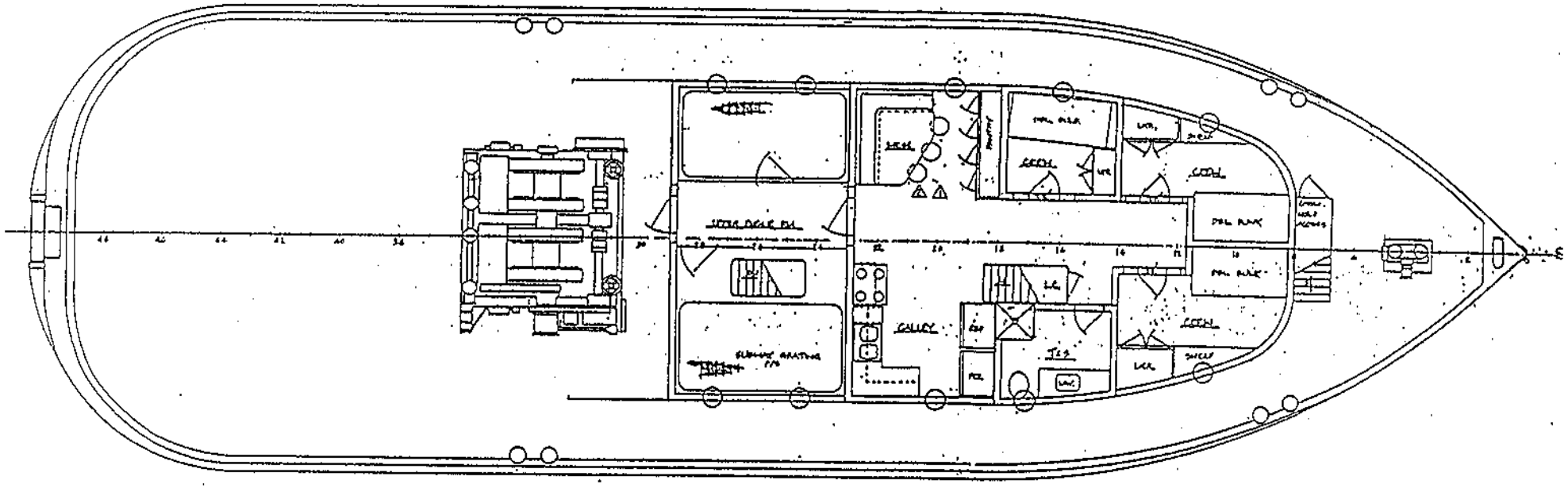
Name:	KELLSTONE I (ex C-1, ex VIRGINIA)
Official Number:	274472
Flag:	USA
Hailing Port (on stern):	Kelly's Island, OH
Service:	Freight Barge
Cargo:	Limestone aggregate
Average Weight of Full Load of Aggregate:	10,350 tons (summer marks)
Trade License:	Coastwise, Great Lakes
Gross Tons:	6,280
Net Tons:	5,024
Light Ship Displacement:	2,699
Registered Length:	390.00 ft (118.87 m)
Length Over All (LOA):	394.00 ft (120.09 m)
Length Between Perpendiculars (LBP):	374.00 ft (113.99 m)
Registered Breadth:	71.00 ft (21.64 m)
Registered Depth:	27.00 ft (8.22 m)
Designed Draft (Summer):	19 ft, 4-1/4 in (5.89 m)
Depth of Notch:	38 feet (11.6 m)
Notch Depth Percent:	9.7% of barge LOA
Built:	1957; Todd Shipyards Corp., Houston, TX
Converted:	1991
Hull Number:	(original builder's hull number could not be identified)
Hull Material:	Steel
Propulsion Type:	None
Bowthruster Horsepower:	350
Last Drydocked:	1991; Mobile, AL
Certificate of Inspection:	None (*see also* section on *Great Lakes Barges,* p. 5 - 20)
Load Line Certificate:	ABS Great Lakes
Documented Owner:	Kellstone, Inc., Attn: August Palladino, 3203 Harvard Avenue, Cleveland*, OH 44105 (216) 883-7200
Total Interest Owned:	100%
State of Incorporation:	Ohio
Actual Owner:	Kellstone, Inc., 3203 Harvard Avenue, Newburgh Heights, OH 44105
Operator:	Kellstone, Inc., 3203 Harvard Avenue, Newburgh Heights, OH 44105

*City as stated on Certificate of Documentation.

M/V FRANK . ALLADINO JR



UPPER DECKHOUSE AND PILOTHOUSE



MAIN DECK

FIGURE 1 - 1

M/V FRANK PALLADINO JR

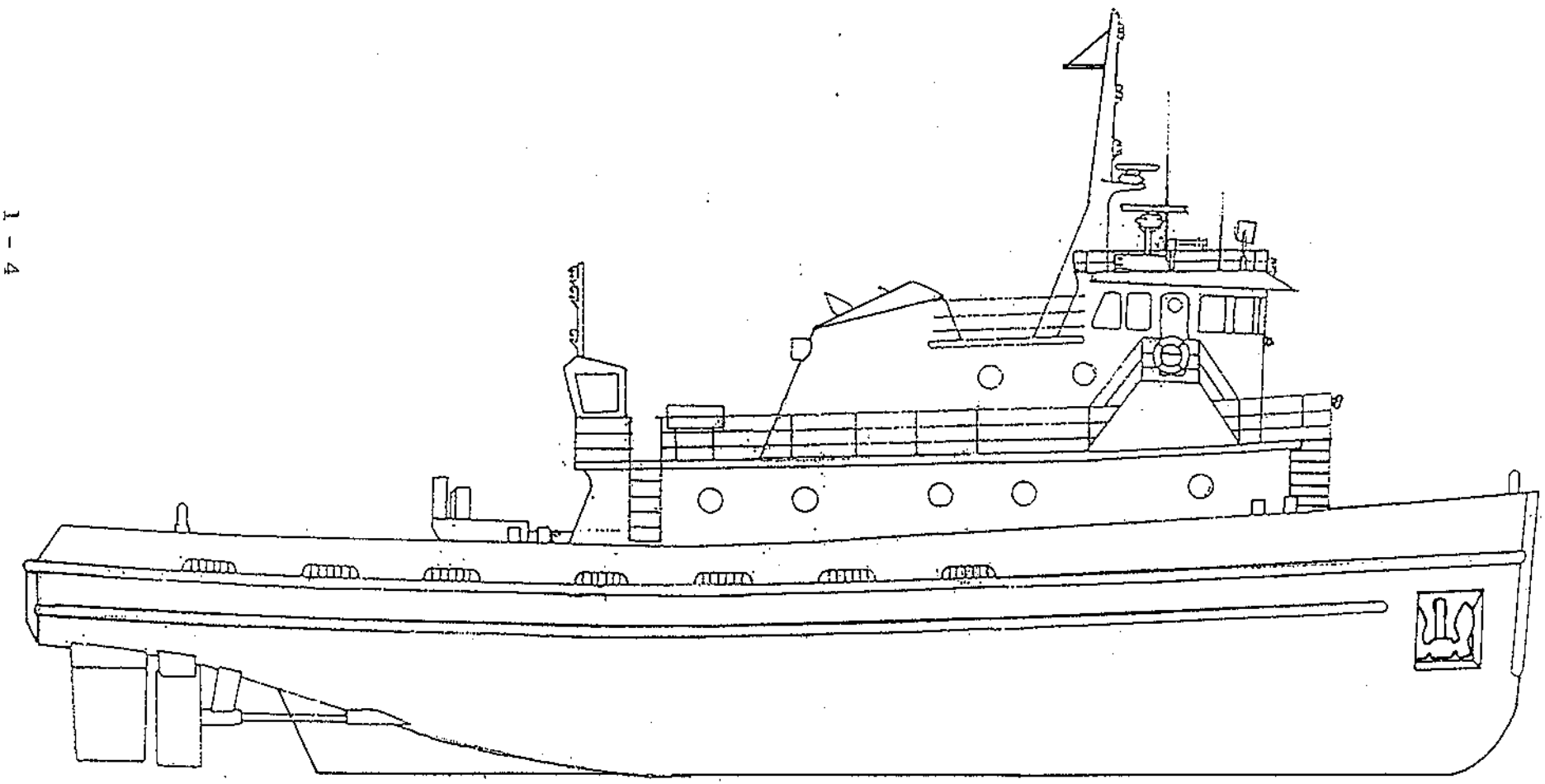


FIGURE 1 - 2

c. Pleasure Craft (*see also* Figures 1 - 3 and 1 - 4)

Name:	(unnamed)
Registration Number:	OH 0164 YU
Hull Identification Number:	FLI52200L687
Service:	Pleasure
Built:	1987
Manufacturer:	Felt Industries, Inc., 600 West 10th Avenue, Monmouth, IL 61462 (out of business)
Make:	Mach 1
Model:	MV 2100 CC Explorer
Length:	20 ft, 9 in (6.32 m)
Beam:	8 ft (2.43 m)
Deadrise:	20°
Weight (approx):	2,900 lbs (with 230 HP engine)
Hull Material:	Fiberglass
Capacity:	10 persons or 1, 840 lbs
Propulsion Type:	6-cylinder, 4.3 Litre 2V (262 cu. in.) OMC Cobra™ gasoline inboard/outboard
Full Throttle RPM:	4200 - 4600
Crankshaft Horsepower:	175
Shaft Horsepower:	150
Builder Certification:	National Marine Manufacturers Association (NMMA)
Last Safety Inspection:	0758 hours, 1 October 1994, by Ohio DNR
Registered Owner:	Virginia S. Ostrom

1. A 1988 brochure for the vessel was faxed to the Investigating Officer by Mr. Ed Undercoffer of Envision Boats, Inc., Monmouth, IL. Mr. Undercoffer worked in the Mach 1 manufacturing plant at the time the 1987 model year was being built. This brochure lists standard features, specifications, and optional equipment available in 1988, which are similar to those offered in 1987. [CG57]

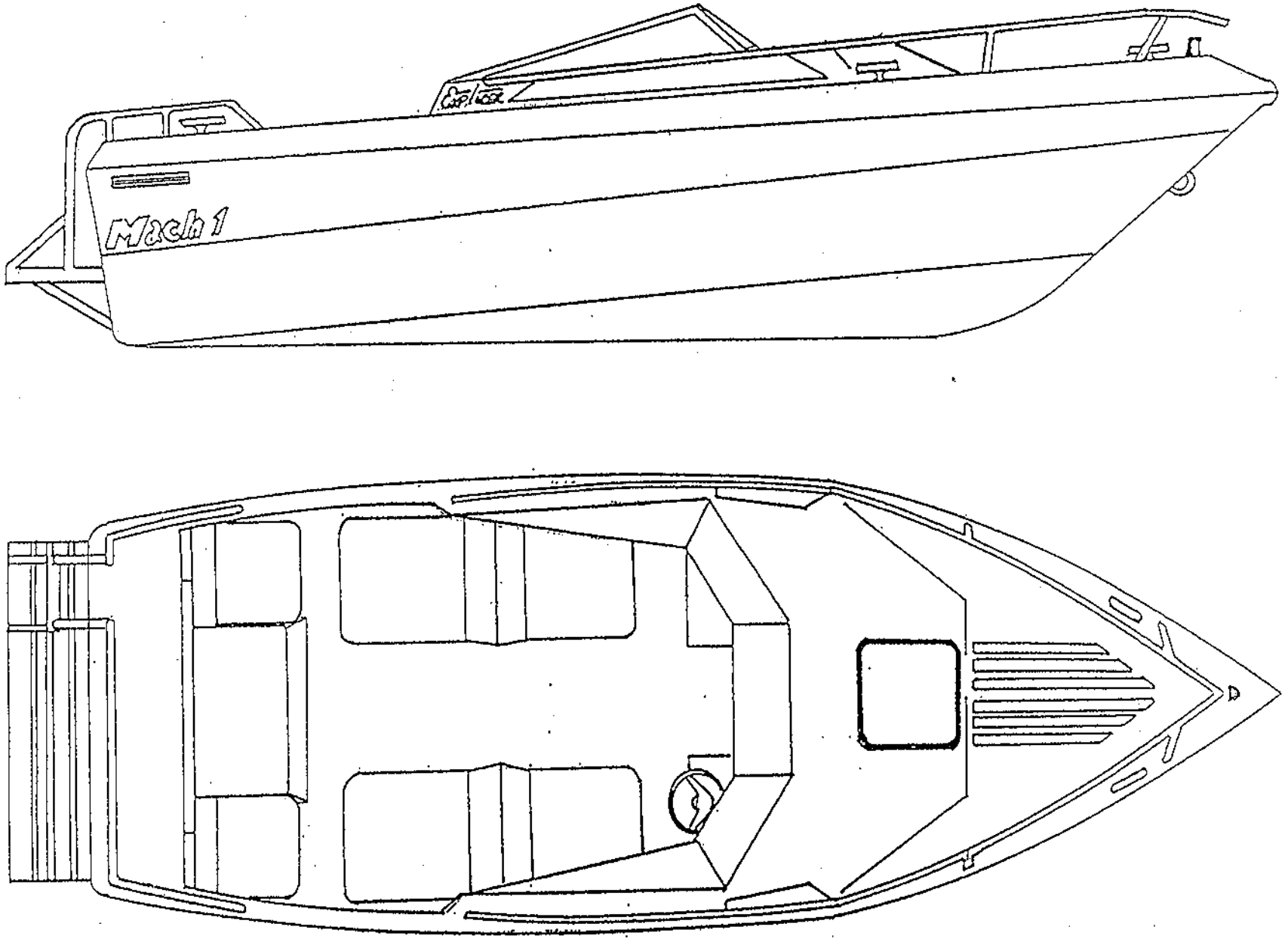
d. Navigation Equipment

1. The tug had two, 3 cm band, relative motion, heads-up only display radars installed on the bridge (i.e., Ship's Head Up Relative Motion display). There was no heading input to either radar as the tug had no gyrocompass. Therefore, both radars were unstabilized. A Furuno FR-7040D was mounted on the starboard side ceiling. It had an 8 X 10.5 in (20.32 X 26.67 cm) scope. A Furuno FR-805D was mounted on the port side floor, beside the operator's chair. It had a 9 X 10.5 in (22.86 X 26.67 cm) scope. The upper radar antenna on the mast was 36.6 ft (11.15 m) above the designed waterline and was for the ceiling-mounted radar. The lower radar antenna on the mast was 30 ft (9.14 m) above the designed waterline and was for the floor-mounted radar. [CG65A, pp. 5-6]

2. The ceiling-mounted Furuno [FR-7040D] was on and operational at the time of the accident. The floor-mounted Furuno [FR-805-D] needed repairs and therefore was not on and not operational. Both the 3/4 and 1-1/2 mile range scales were used on the ceiling-mounted radar at the time of the accident. [Paraphrase of verbal statement by Captain Verret to LTJG McDonald on 2 October 1994]

3. There are no radar blind spots with the tug in the notch of the barge. [IV TR, pp. 634, 635]

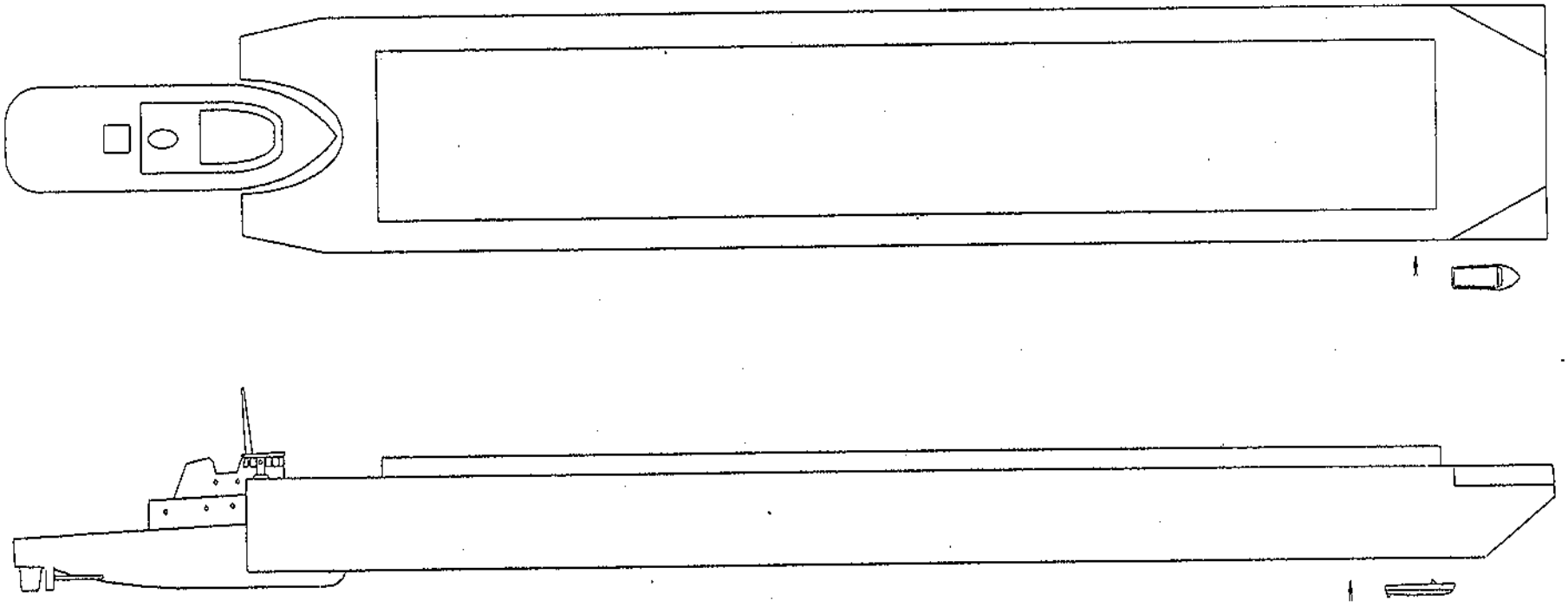
1987 MACH 1 MV 2100 CC EXPLORER



Drawing by: MK3 Eric Emerson, USCG
NOT TO SCALE

FIGURE 1 - 3

Tug: FRANK PALLADINO, JR. (ON 619166)
Barge: KELLSTONE I (ON 274472)
Pleasure Craft: OH 0164 YU



Outside dimensions to scale, all other dimensions estimated.
Drawing by: CWO3 W.A. Jackson II, USCG (10/4/94)

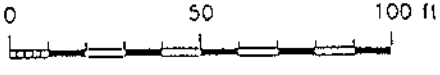


FIGURE 1 - 4

4. The tug had a SI-TEX GPS-7 receiver on board. [CG65A, p. 5]

5. The tug had a Rivertronics rate of turn indicator on board. [CG65A, p. 5]

6. The tug had a Kattlenberg T2/332 whistle installed on the outside, top center of the bridge. It had a fundamental frequency between 250 to 450 Hz and a range of audibility of 130+ decibels for 1 NM or more. Captain Verret sounded the whistle for LTJG McDonald on 2 October 1994. [CG65A, p. 5]

7. It takes approximately 13 seconds for the rudder to go from hard left to hard right, and approximately 13.5 seconds from hard right to hard left. [CG65A, p. 5; Test conducted by LTJG McDonald on 02 October 1994]

8. The tug did not have a Loran-C receiver on board. [CG65A, p. 5]

9. Binoculars are kept in the pilothouse of the tug. [IV TR, p. 635]

e. Magnetic Compass

1. The tug had a Ritchie SP-6 magnetic compass installed on the centerline of the bridge console. It had no bearing azimuth circle or azimuth ring; however, it could be used by a mariner to take bearings. [CG65A, p. 4]

2. The Compass Deviation Card displayed on the bridge of the tug was dated "12-10-85" by Cliff Dantin, and was for the M/V LADY IDA (later named the FRANK PALLADINO JR). The company that performed the compass adjustment was: Dantin's Electric Service, 120 West 167th Street, Galliano, LA 70354; Phone 632-7259. The compass deviation card of the tug was computed for the tug alone. [CG7; CG65A, p. 4]

3. Neither Inland Bulk Transfer Company nor Kellstone, Inc. knew when the deviation of tug's magnetic compass had been last determined. They believe that it was possibly in 1980 [sic, 1985], when the compass deviation card was made. [CG65A, p. 13]

4. The tug did not have a compass logbook. [CG65A, p. 5]

5. The following examples of "good marine practices" regarding magnetic compasses were taken from nautical publications:

> "Before your compass can be used its deviation has to be measured. Much of this deviation can be removed by compensation, but some deviation may remain. This has to be measured and recorded so that compass directions can be corrected to magnetic directions, and magnetic directions to compass directions." [Maloney, 1994, p. 382]
>
> "To use your compass well you must learn to convert directions of any one type to any other type, and you must be able to do so quickly and accurately. These conversions have to be performed on headings, on courses and on bearings." [Maloney, 1994, p. 378]
>
> "* * * iron and steel vessels are subject to changes in deviation upon large changes in latitude." [Maloney, 1994, p. 374]

"Deviation can be measured by steering the boat on one or more known headings toward charted visual targets and noting the difference between the magnetic course according to a chart and the course according to the compass. This process is called 'swinging ship.' * * * When swinging ship, headings are checked at frequent and regular intervals, traditionally every 15°." [Maloney, 1994, p. 383]

"Deviation much over 6° can present serious problems in rough weather, even when deviation is carefully recorded for each heading. It is much better to compensate the compass so that the deviation is as small as possible (sometimes zero) on most headings." [Maloney, 1994, p. 385]

"You may need more than one deviation record in order to account for varying magnetic environments." [Maloney, 1994, p. 390]

"The final deviation table can be prepared as a direct reading table of critical values. It can be used with confidence if care is taken to see that the magnetic environment is not altered. Be sure to check the table each year." [Maloney, 1994, p. 390]

6. Self-propelled vessels of 1,600 or more gross tons are required to have a "current magnetic compass deviation table or graph or compass comparison record for the steering compass, in the wheelhouse." This provision does not apply to barges which are non-self-propelled vessels. The FRANK PALLADINO JR was only 88 gross tons; however, the tug and barge combination was 6,368 gross tons. [33 CFR 164.35(c); CG11, p. 1; CG12, p. 1]

f. Navigation Publications & Charts

1. The tug had approximately 300 navigation charts on board. These included charts from the entrance of the St. Lawrence Seaway to the Detroit River, with harbor charts for Detroit, MI; Toledo, OH; Lorain, OH; Cleveland, OH; Fairport, OH; Buffalo, NY; Niagara River, NY; and Hamilton, Ontario. Among these charts, were Chart 14830 (23rd Edition, Mar 21/92) and Recreational Chart 14842 (8th Edition, May 17/86). At the time of the casualty, Recreational Chart 14842 was in its 9th Edition (Mar 21/92). [CG5; CG6A; CG6B; CG6C; CG65A, p. 6; IBT1]

2. The charts on the tug had hand written markings on them for distances in nautical miles and speeds in knots. [CG5; CG6A]

3. The tug had a Light List (year not noted), 1992 U.S. Coast Pilot 6, and Navigation Rules (year not noted) on board. [CG65A, p. 6; On board observation by LTJG McDonald on 02 October 1994]

4. The tug maintained an engine room logbook, but did not have a bell book. [CG65A, p. 7]

5. "The navigator should maintain and consult suitable publications and instruments for navigation depending on the vessel's requirements. This shipboard equipment is separate from the aids to navigation system, but is often essential to its use. The following publications are available from the U.S. Government to assist the navigator: Light List, United States Coast Pilot, Local Notices to Mariners, and Notice to Mariners." [33 CFR 62.21(c)]

Chapter 2 - Personnel Information

a. Towing Vessel

Name:	**Chad Joseph Verret**
Assigned Position:	Master
Casualty Role:	Master
Gender:	Male
Age:	29
USCG License:	Serial Number 683645, Issue 3-3 "Master Near Coastal Steam and Motor Vessels of Not More Than 1600 Gross Tons, Also, Master Ocean Steam and Motor Vessels of Not More Than 200 Gross Tons, Also, Mate Ocean Steam and Motor Vessels of Not More Than 1600 Gross Tons, Also, Radar Observer - Unlimited (Radar Observer Expires September 1991)."
Issued:	5 February 1991 - REC New Orleans, LA
Expires:	5 February 1996

Name:	**Robert Edward Coleman**
Assigned Position:	Mate
Casualty Role:	Operator
Gender:	Male
Age:	56
USCG License:	Serial Number 680010, Issue 6 "Master Great Lakes or Inland Steam or Motor Vessels of Not More Than 100 Gross Tons, Not Including Waters Governed Solely By International Regulations for the Prevention of Collision at Sea, 1972; First Class Pilot on Vessels of Not More Than 300 Gross Tons Upon the Great Lakes Between Bar Point and Cape Vincent; also, Operator of Uninspected Towing Vessels Upon the Great Lakes and Inland Waters, Not Including Waters Governed Solely By International Regulations for the Prevention of Collision at Sea, 1972."
Issued:	24 February 1994 - REC Toledo, OH
Expires:	24 February 1999
Radar Endorsement:	None

Name:	**David Miles Marracino**
Position Assigned:	Deckhand
Casualty Role:	Bow lookout on barge
Gender:	Male
Age:	33
USCG License:	None
USCG MMD:	Document Number 190-50-3108 "Ordinary Seaman, Wiper, Steward's Department (FH)"
Issued:	13 March 1992 - REC Toledo, OH
Expires:	13 March 1997

b. Pleasure Craft

Name:	**Virginia Sue Ostrom**
Casualty Role:	Owner and Operator
Gender:	Female
Age:	45*
Residence (State):	Ohio
USCG License:	None
USCG MMD:	None

*Virginia Ostrom was 45 years old at the time of the accident. ODNR "Boating Accident Report" #94-D6-117W listed her age as "53" and year of birth as 1941. ODNR "Watercraft Accident Investigation" report #94-D6-117W listed her year of birth as 1994. In a phone conversation on 9 March 1995, attorney Thomas Mathews (counsel for Ostrom and Crane), stated to LTJG McDonald that according to his records, Ostrom was born in 1949 and was 45 years old at the time of the accident. [CG18, p. 1; CG19, p. 1; CREW2, pp. 1, 2; II TR, p. 142]

Name:	**William Ray Crane, Jr** (Ostrom's fiancé)
Casualty Role:	Passenger
Gender:	Male
Age:	44
Residence (State):	Ohio
USCG License:	None
USCG MMD:	None

Name:	**Ian Michael Crane** (William Crane's son)
Casualty Role:	Passenger
Gender:	Male
Race:	Caucasion
Height:	70 inches
Weight (approx):	160 pounds
Age:	14
Date of Birth:	19 August 1980
Birthplace:	Mt. Vernon, Ohio
Time/Date of Death:	≈1351 hours, 01 October 1994 (by coroner)
Cause of Death:	Accidental drowning, death within minutes
SSN:	277-84-9542
Marital Status:	Single
Next of Kin:	Father - William Ray Crane, Jr. Mother - Alesia Fay Marietta
Usual Occupation:	Unemployed
Residence (State):	Ohio
Highest Education:	8th grade
USCG License:	None
USCG MMD:	None
Swimmer?:	Yes
Registrar for Certificate of Death:	Ottawa County Health Department, Ohio
Registrar's No.:	108

Name:	**Michael Alan Burghard** (Ian Crane's friend)
Casualty Role:	Passenger
Gender:	Male
Race:	Caucasion
Height:	71 inches
Weight (approx):	175 pounds
Age:	15
Date of Birth:	28 July 1979
Birthplace:	Mansfield, Ohio
Time/Date of Death:	≈1351 hours, 01 October 1994 (by coroner)
Cause of Death:	Accidental drowning, death within minutes
SSN:	275-76-0481
Marital Status:	Single
Next of Kin:	Father - unknown Mother - Kelly Lee (Burghard) Henry
Usual Occupation:	Unemployed
Residence (State):	Ohio
Highest Education:	9th grade
USCG License:	None
USCG MMD:	None
Swimmer?:	Yes
Registrar for Certificate of Death:	Ottawa County Health Department, Ohio
Registrar's No.:	107

Chapter 3 - Casualty Scene

a. Bridge Visibility

1. A cardboard tube of blueprints for the tug was given by Captain Verret to LTJG McDonald, while the latter was onboard the tug, on 2 October 1994. Captain Verret stated that he had them in his home on Kelly's Island. In this tube, was found a blueprint marked as "Outboard Profile Plan." A piece of tracing paper was taped over the superstructure of the tug with some drawing on it. The drawing depicted a theoretical modification to the tug which was studied in Cleveland, OH, in 1993. Consideration was given to add a raised pilot control station as an alternative to ballasting the barge. However, the company concluded that ballasting the barge was preferable to operating from an upper control station. [CG2, CG3, CG65A, p. 14; Figure 3 - 1; Figure 3 - 2]

2. The height of eye of a 5-foot, 11-inch person standing at the conning station on the bridge deck of the tug was 24 feet (7.32 m). According to Captain Coleman's USCG license file, his height was 5 feet, 11 inches. [CG2; CG3; CG16; Table 3 - 1; Figure 3 - 3]

3. The height of eye of a 5-foot, 11-inch person standing on the roof of the bridge of the tug was 32 feet (9.75 m). According to Captain Verret's USCG license file, his height was 5 feet, 11 inches. [CG2; CG3; CG16; Table 3 - 1; Figure 3 - 3]

4. The height of eye of a 5-foot, 11-inch person standing in the raised conning station (proposed) of the tug was 38.5 feet (11.73 m). [CG3; CG16; Table 3 - 1; Figure 3 - 3]

5. International Maritime Organization (IMO) Resolution A.708(17) contains the following navigation bridge visibility guideline: "[t]he view of the sea surface from the conning position *should* [emphasis by the Investigator] not be obscured by more than two ship lengths, or 500 m, whichever is less, forward of the bow to 10° on either side irrespective of the ship's draught [sic], trim and deck cargo." The Resolution further states that "[t]he guidelines only apply to ships constructed after 2 January 1992 [the FRANK PALLADINO JR was constructed in 1980] where bridge duty is regularly maintained. * * * When ships of unconventional design cannot comply with the guidelines, Administrations should consider arrangements that provide a level of visibility that is as near as possible to the level recommended in these guidelines."

6. The International Organization of Standards (ISO) issued the following requirements and guidelines for the field of vision on a ship's bridge under International Standard ISO 8468: 1990(E): "[t]he view of the sea surface from the conning position *shall* [emphasis by the Investigator] not be obscured by more than two ship lengths or 500 m, whichever is less, forward of the bow to 10° on either side irrespective of the ship's draught [sic], trim and deck cargo (e.g. containers)." These requirements and guidelines apply "to seagoing ships [the FRANK PALLADINO JR is not a seagoing ship] where bridge duty is regularly maintained. Where there are physical limitations in applying this International Standard to small ships or to ships of unusual design, the general principles should still apply."

7. The following Federal regulations, as a result of the Final Rule published in 55 FR 32244 (8 August 1990), contain the ship navigation bridge visibility requirement of "the lesser of two ship lengths or 500 meters (1,640 feet)[:]" 33 CFR 164 and 46 CFR 32, 72, 92, 108, and 190. [These provisions do not apply to the FRANK PALLADINO JR]

8. The waterline distance forward of the bow obscured from the conning station for the tug in the notch of the empty (ballasted) barge was 3,724 feet (1,135 m) or 8.17 tug/barge lengths. [Table 3 - 1; Figure 3 - 3; Figure 3 - 4]

9. The distances of the horizon for heights of eye of 24 feet (7.32 m), 32 feet (9.75 m), and 38.5 feet (11.73 m) were 6.6 miles, 7.6 miles, and 8.35 miles, respectively. [Bowditch II, 1981, p. 132]

10. Captain Verret estimated that there was a 25° arc [or 12.5° to port and starboard] of impaired bridge visibility off the bow of the barge. [Paraphrase of verbal statement by Captain Verret to LTJG McDonald on 02 October 1994]

11. "As the main deck of these barges when empty is from 35 feet to 40 feet above the surface of the water, tug captains were unable to see ahead from the tug's regular pilothouse. Upper pilothouses were added and are now the vogue for this work." [Blank, 1989, p. 83]

12. It is an acceptable marine practice to post a bow lookout with suitable communication. "If the tug's pilot cannot see over his tow, knowledgeable personnel with a walkie-talkie should be stationed on the head of the towed unit to advise him of aids to navigation." [Blank, 1989, p. 317]

PORTION OF EXISTING OUTBOARD PROFILE PLAN FOR THE M/V FRANK PALLADINO JR

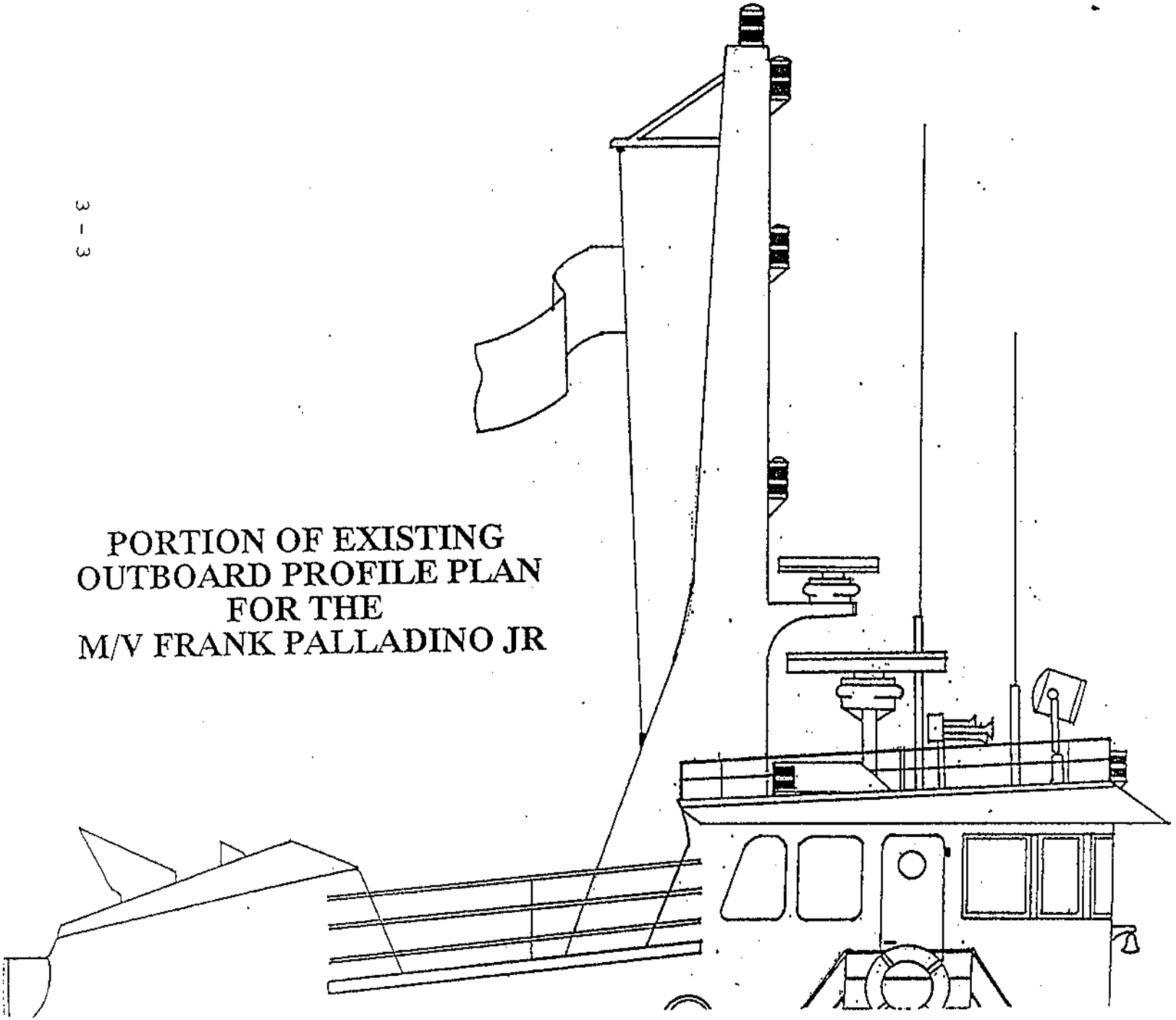


FIGURE 3 - 1

PORTION OF "THEORETICAL"
OUTBOARD PROFILE PLAN
FOR THE
M/V FRANK PALLADINO JR

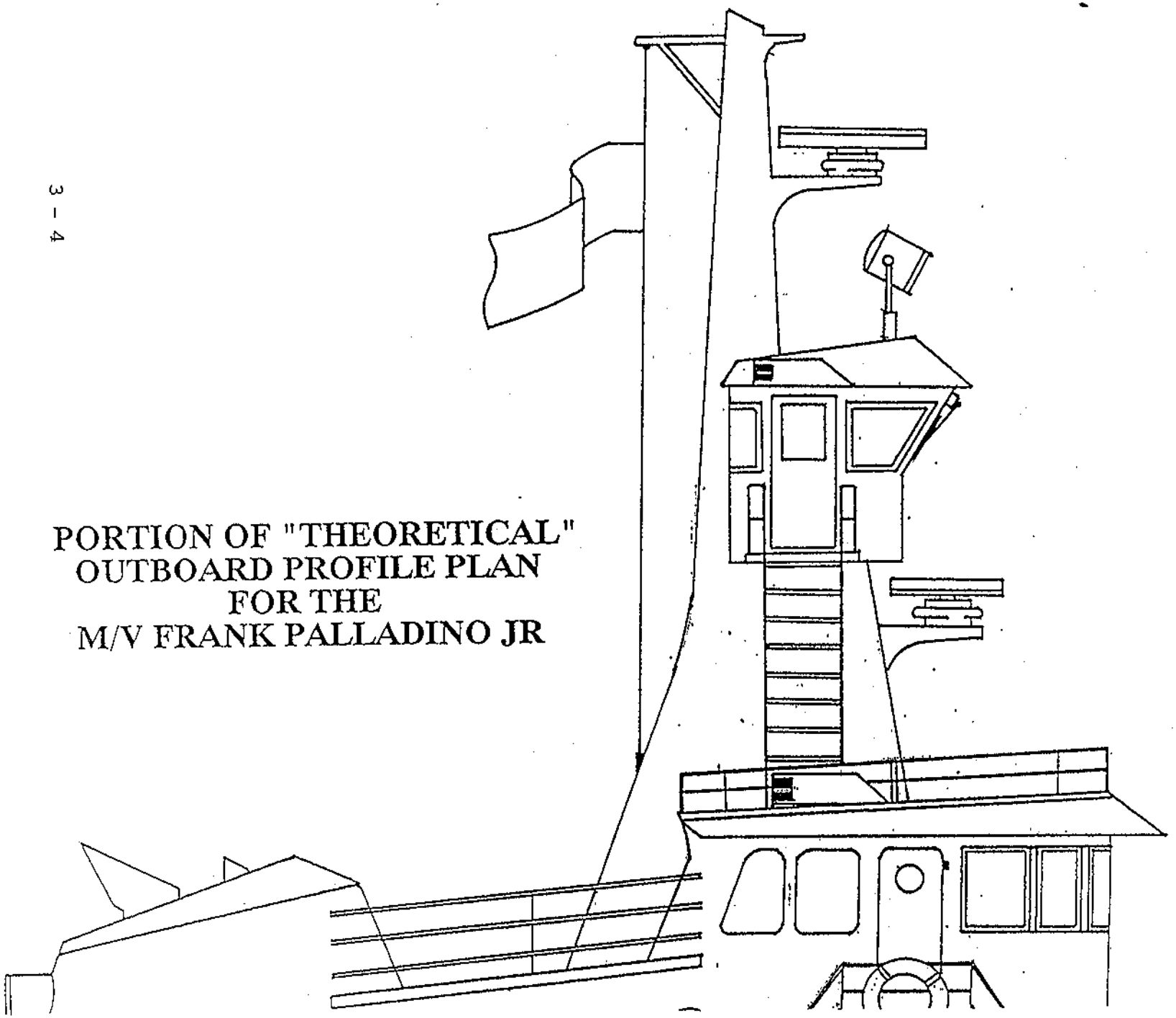


FIGURE 3 - 2

TABLE 3 -1. Waterline distance forward of the bow obscured from the conning station for the towing vessel FRANK PALLADINO JR in the notch of the empty Great Lakes barge KELLSTONE I. The length over all (LOA) for the combination is 456 feet (138.99 m). Two tug/barge lengths is equal to 912 feet (277.98 m).

Observer Height of Eye (HE) (feet)	Waterline Distance Obscured From Conning Station: Total Distance (DW) (feet)	(yards)	Distance Forward of the Bow (feet)	(yards)
(1) DO_1 = 342 ft, HO = 22 ft				
24[A]	4,104	1,368	3,724	1,241
25	2,850	950	2,470	823
26	2,223	741	1,843	614
27	1,847	616	1,467	489
28	1,596	532	1,216	405
29	1,417	472	1,037	346
30	1,283	428	903	301
31	1,178	393	798	266
32[B]	1,094	365	714	238
(2) DO_2 = 345 ft, HO = 22 ft				
33	1,035	345	652	217
34	978	326	595	198
35	929	310	546	182
36	887	296	504	168
37	851	284	468	156
38	819	273	436	145
38.5[C]	805	268	422	141
39	792	264	409	136
40	767	256	384	128

A = Observer on bridge, B = Observer on roof of bridge, C = Observer in raised conning station (proposed)

(1) The term DO_1 describes the *existing* horizontal distance between observer height of eye, either on the bridge or on the roof of the bridge, and the hatch coaming obstruction on the bow of the barge. The term HO describes the height of the hatch coaming obstruction on the bow of the barge from the waterline.

(2) The term DO_2 describes the horizontal distance between observer height of eye in the raised conning station (proposed) and the hatch coaming obstruction on the bow of the barge. The term HO describes the height of the hatch coaming obstruction on the bow of the barge from the waterline.

Sources: CG1; CG2; CG3; CG10; CG16; Plant, 1986, p. 54

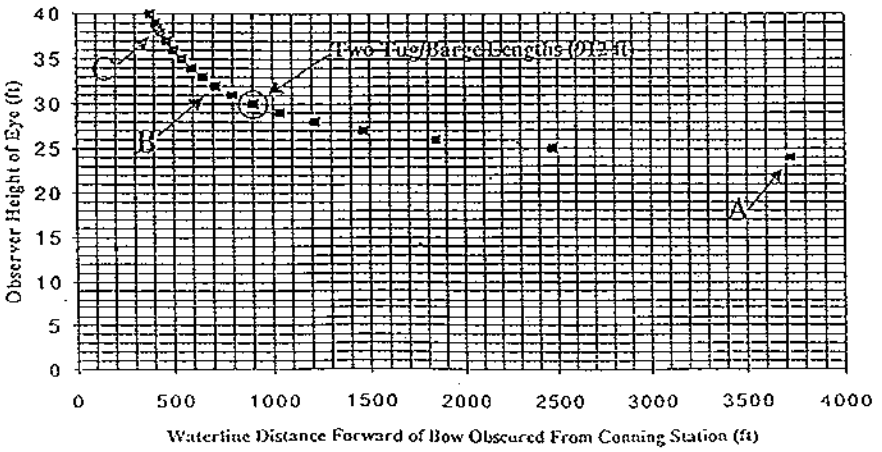


FIGURE 3 - 3

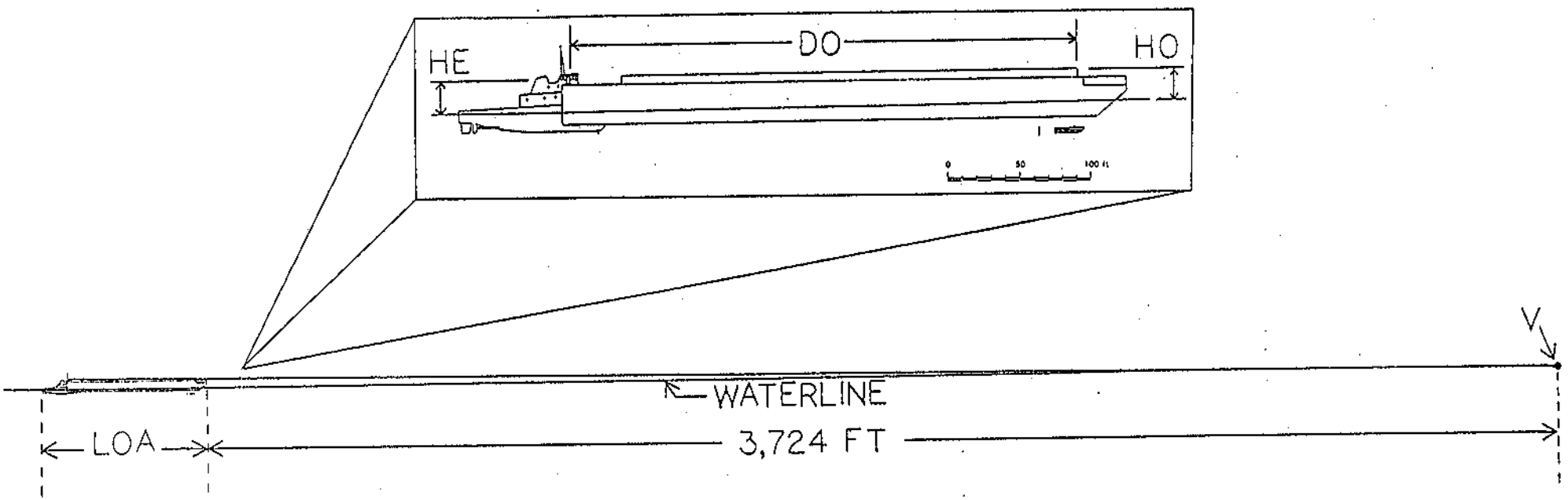


FIGURE 3 - 4. Waterline distance forward of the bow obscured from the conning station for the towing vessel FRANK PALLADINO JR in the notch of the empty Great Lakes barge KELLSTONE I. Calculations were done using vessel blueprints and the following formula: $DW = [(DO)(HE)](HE-HO)^{-1}$. The waterline distance forward of the bow obscured from the conning station was then determined by the difference between the observer distance from the bow of the barge and the value DW.
Sources: CG1; CG2; CG3; CG10; CG16; Plant, 1986, p. 54

LEGEND

LOA =	Length over all
HE =	Observer height of eye above waterline at conning station
HO =	Height of hatch coaming obstruction above waterline
DO =	Distance of hatch coaming obstruction from HO measured parallel to waterline
V =	Point where waterline is visibile from observer at conning station
DW =	Observer distance to point V

b. Environmental Conditions (Weather and Sea)

1. The sky was overcast with clouds building to the northeast. There was a steady, light "misty" rain. Later, during the search for the missing boys, it was raining harder. [CG18, p. 2; CG19, p. 1; CG45; CG46; CG43C; CG43D; II TR, pp. 25, 30-32, 147, 166, 182, 183, 189; III TR, p. 309]

2. All sources, except one, indicated that the prevailing [meteorological] visibility was good and not impaired by the rain. Estimates ranged from 5 to 10 nautical miles (5.8 to 11.5 miles). Captain Verret, however, stated that the visibility was fair. Kelley's Island, the mainland, Marblehead, Mouse Island, South Bass Island, Starve Island Reef Buoy, and Scott Point Shoal Buoy were still visible to the Mach 1 at the time of the casualty. The farthest of these was Marblehead, which was approximately 6 miles away. [CG18, p. 2; CG19, p. 1; CG45; CG47; CG77; CG81, p. 53; II TR, p. 183; II TR, pp. 31, 166, 182, 183; III TR, p. 441; Light List, 1994, p. xxxiv]

3. The terms "moderate" or "good" are descriptions used for [prevailing meteorological] visibility distances more than 3 nautical miles (3.5 miles). [IBT1, back page; Light List, 1994, p. xxxiv]

4. It could not be accurately determined what the sea state was like at the time of the accident. Witness estimates ranged from 6 inches (15.24 cm) to 4 feet (1.2 m) with choppy waves. Virginia Ostrom stated that the wave height was decreasing at the time of the accident. [CG18, p. 2; CG19, p. 1; CG43C; CG43D; CG47; CG81, p. 55; II TR, pp. 30, 32]

5. The barometric pressure was 29.83 inches of Mercury (1010 millibars). It was steady before, during, and after the accident. [CG47]

6. A Distress Situation Report (SITREP), issued 4 hours and 23 minutes after the accident, from U.S. Coast Guard Group Detroit, MI, estimated the wind direction to be from the northwest. A SITREP issued 10 hours and 38 minutes after the accident, from U.S. Coast Guard Station Marblehead, OH, estimated the wind direction to be from the north-northeast. More boaters on-scene at the time of the accident estimated the wind direction to be from the northeast, rather than from the northwest. Two divers on-scene after the accident estimated the wind direction to be from the north-northeast; a third one estimated it to be from the northwest. Marine Weather Reports from Marblehead, OH, for 1200 and 1400 hours, estimated the wind direction to be from the southwest. [CG43B; CG43C; CG43D; CG47; CG81, pp. 53, 55; II TR, pp. 30, 146; III TR, pp. 302, 303, 308, 418]

7. A Distress Situation Report (SITREP), issued 4 hours and 23 minutes after the accident, from U.S. Coast Guard Group Detroit, MI, estimated the wind speed to be 15 knots [17.3 mph]. A SITREP issued 10 hours and 38 minutes after the accident, from U.S. Coast Guard Station Marblehead, OH, estimated the wind speed to be 9 knots [10.4 mph]. Divers on-scene after the accident estimated the wind speed to be between 10 and 20 knots [11.5 and 23 mph]. ODNR Officer Johnston, also on-scene after the accident, estimated the wind speed to be between 7 and 14 mph [6.1 and 12.2 knots]. Marine Weather Reports from Marblehead, OH, for 1200 and 1400 hours, estimated the wind speed to be 8 knots [9.2 mph]. William Crane stated he believed that "maybe the wind speed had diminished a bit because it was - - it seemed like it was a little choppier earlier [before the accident]." [CG18, p. 2; CG19, p. 1; CG43C; CG43D; CG47; CG81, pp. 53, 55; II TR, p. 30]

8. The air temperature was 66° F (18.9° C). [CG18, p. 2; CG19, p. 1; II TR, p. 31]

9. According to divers on-scene, the lake bottom around the accident site was covered with approximately 6 inches of "silt and numerous zebra mussel-covered rocks." According to a 1980 (revised in 1989) sediment map of the lake bottom, the area at the accident site is comprised of at least 10% sand, mud, and gravel. For the entire island region, however, the bottom surface is comprised of only 6% bedrock, 9% gravel, 26% sand, and 59% silt/clay mud. Visibility through the water was between 10 and 25 feet. The water temperature at the surface was 68° F (20.0° C) and the water temperature at 30 feet deep (9.14 meters) was 59° F (15.0° C). [CG6A; CG6C; CG18, p. 2; CG19, p. 1; CG43B; CG43C; CG43D; CG74, pp. 6, 51; CG82; Chart No. 1; Maloney, 1994, p. 263; III TR, p. 464]

10. Depths in the Great Lakes are referred to Low Water Datum (LWD). The LWD for Lake Erie is an elevation 569.2 feet (173.5 meters) above mean water level (MWL) at Rimouski, Quebec, on International Great Lakes Datum 1985 (IGLD 1985). At the time and place of the accident, the water surface elevation of Lake Erie was between 572.18 and 572.39 feet (174.400 and 174.468 m) above MWL, or 2.98 and 3.19 feet (0.90 and 0.97 m) above LWD, respectively. The charted depth of the water at the accident site was between 21 and 23 feet (6.4 and 7.0 m). **The actual depth of the water at the accident site was therefore between 24 and 26 feet (7.3 and 7.9 m).** [CG6A; CG6C; CG13; CG73 (interpolation used); CG74, pp. 4, 48; IBT1, sheets 28 and 31; IBT2; USCP 6, 1994, p. 134]

11. At 0800 hours on the day of the accident, the current at or near the accident site was in an easterly direction at approximately 0.17 knots (0.2 mph). Using a formula for the speed of surface wind driven currents, this current speed is consistent with a surface wind of 5.7 knots (6.6 mph). According to a diver on-scene approximately 2 hours after the accident, there was a surface current in an easterly direction. He did not know the speed, but described it as being "moderate." There was no bottom current as evidenced by suspended clouds of silt disturbed by divers. On Lake Erie, winds from any direction will normally drive surface currents downwind, while subsurface currents are often opposed to the wind. To compensate for the loss of surface water blown downwind, a returning flow of water is created along the bottom. A moderate northeast wind at the accident site would *generally* cause a south-southeast surface current. On 4 October 1994, with winds at about 10 to 20 knots (11.5 to 23.0 mph), the surface current was 20 feet in one minute (0.23 mph or 0.2 knots) as evidenced by an unspecified floating object. [CG43B; CG43C; CG43D; CG74, pp. 8, 54; CG82; Plant, 1986, p. 46]

c. South Passage of Lake Erie

1. "Extensive waterborne commerce is carried out between the ports on Lake Erie as well as to and from the other lakes. The bulk of the commerce on Lake Erie radiates from the mouth of the Detroit River to the various ports on the lake, to the Niagara River, and to the Welland Canal. Most of the vessel traffic proceeds from the Detroit River through the north part of the island region and Pelee Passage. This is the most important channel of the lake." [CG13; USCP 6, 1994, p. 134; Figure 3 - 5]

2. "The shallowness and orientation of Lake Erie make it susceptible to SW and NE winds, which can quickly raise dangerous seas and, if persistent, create a dangerous surge problem at both ends of the lake." [CG13; USCP 6, 1994, p. 135]

3. "For about 25 miles west from a line between Point Marblehead on the south shore and Point Pelee on the north shore, Lake Erie is rendered foul by a group of islands and shoals. The main route for large vessels is through Pelee Passage in the north part of the area, but other passages of limited capacity are also available to the south." [CG13; USCP 6, 1994, p. 168; Figure 3 - 5]

4. "The South Passage extends along the south shore of Lake Erie, bounded by Point Marblehead and Catawba Island on the south and Kelly's Island, South Bass Island, and Green Island on the north." [CG13; USCP 6, 1994, p. 168; Figure 3 - 5; Figure 3 - 6]

5. An ODNR Watercraft Accident Investigation report has coded blocks for its entries. The codes for "Traffic" are: "1-none;" "2-light;" "3-moderate;" and "4-heavy." The codes for "Zone of Operation" are: "1-open;" "2-no wake;" "3-no boats;" "4-10 mph;" "5-ski;" "6-speed;" "7-channel;" and "8-other_____." According to the report from ODNR Officer Johnston, the [vessel] Traffic near the accident was "moderate" and the Zone of Operation was "open [water]." [CG18, p. 2]

6. Kellstone, Inc. has a dock on the west side of Kelly's Island. [CG6B; CG13; USCP 6, 1994, p. 168; Figure 3 - 6]

7. "South Bass Island Light [LLNR 5530], 74 feet [22.56 m] above the water, is shown from a white skeleton tower with a red and white diamond-shaped daymark on the southwest point of the island." [CG13; CG14; USCP 6, 1994, p. 169; Figure 3 - 5; Figure 3 - 6; Figure 3 - 7]

8. "Starve Island, 1 mile north of Starve Island Reef, is on a shoal bank off the southeast side of South Bass Island. The shoal extends from South Bass Island to an 8-foot [2.44 m] spot 0.5 mile southeast of Starve Island." [CG13; USCP 6, 1994, p. 169; Figure 3 - 6; Figure 3 - 7]

9. "Mouse Island Reef, with a least depth of 9 feet [2.74 m], is on the southwest side of the vessel route, 1 mile WNW [292.5°T] of Scott Point Shoal." [CG13; USCP 6, 1994, p. 169; Figure 3 - 6; Figure 3 - 7]

10. "South Shoal and American Eagle Shoal lie on the northeast side of the vessel route through South Passage." [CG13; USCP 6, 1994, p. 168; Figure 3 - 6; Figure 3 - 7]

11. "Starve Island Reef, with a least depth of 7 feet [2.13 m], is on the northeast side of the vessel route and is marked off its west side by Starve Island Reef Lighted Buoy 2 [LLNR 5525]." [CG13; CG14; USCP 6, 1994, p. 169; Figure 3 - 6; Figure 3 - 7]

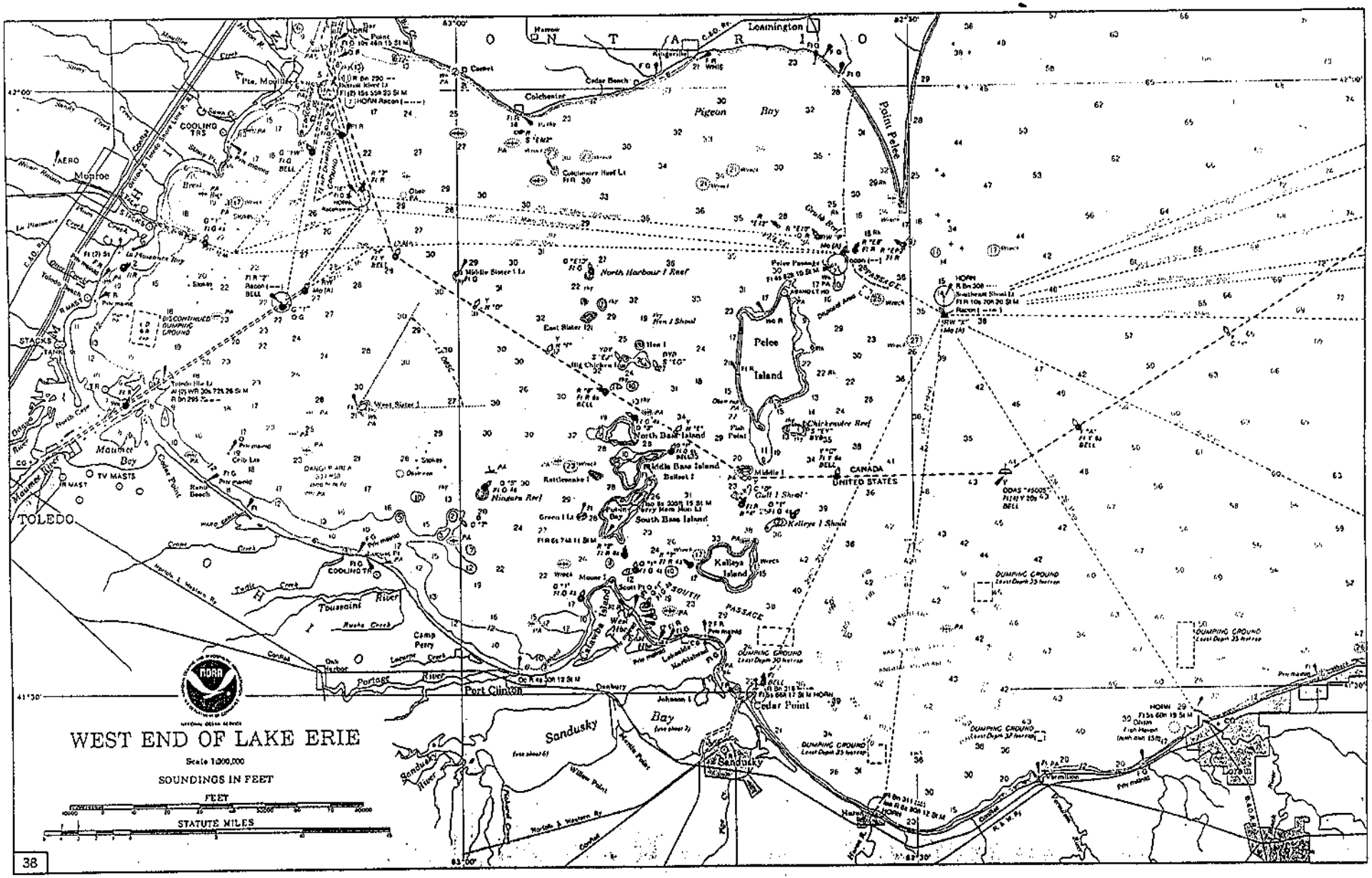

WEST END OF LAKE ERIE
Scale 1:200,000
SOUNDINGS IN FEET
FEET
STATUTE MILES
38
14842 9th Ed., Mar. 21/92
ONTARIO
Leamington
Pigeon Bay
Point Pelee
Colchester
Monroe
Maumee Bay
TOLEDO
Toussaint River
Portage River
Port Clinton
Sandusky
Bay
Cedar Point
Sandusky
Vermilion
Pelee Island
North Bass Island
Middle Bass Island
South Bass Island
Kelleys Island
CANADA
UNITED STATES

FIGURE 3 - 5

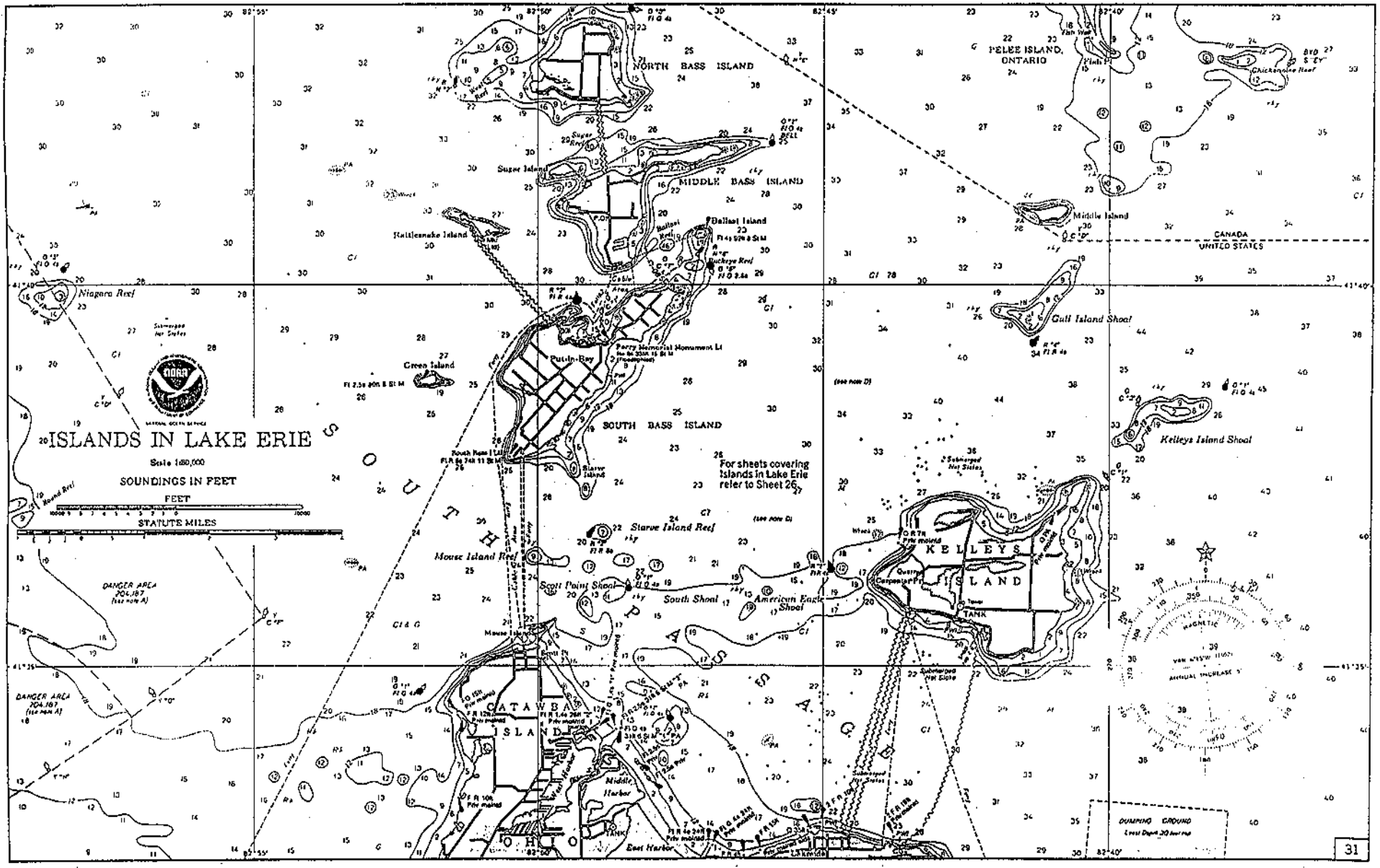

ISLANDS IN LAKE ERIE
Scale 1:80,000
SOUNDINGS IN FEET
FEET
STATUTE MILES
NORTH BASS ISLAND
MIDDLE BASS ISLAND
SOUTH BASS ISLAND
PELEE ISLAND, ONTARIO
CANADA
UNITED STATES
Niagara Reef
Rattlesnake Island
Sugar Island
Ballast Island
Green Island
Put-in-Bay
Gull Island Shoal
Kelleys Island Shoal
Starve Island Reef
Mouse Island Reef
Scott Point Shoal
South Shoal
American Eagle Shoal
KELLEYS ISLAND
CATAWBA ISLAND
Middle Harbor
East Harbor
DANGER AREA 204.187
DUMPING GROUND
For sheets covering Islands in Lake Erie refer to Sheet 26
SOUTH PASSAGE
31
14842 9th Ed., Mar. 21/92

FIGURE 3 - 6

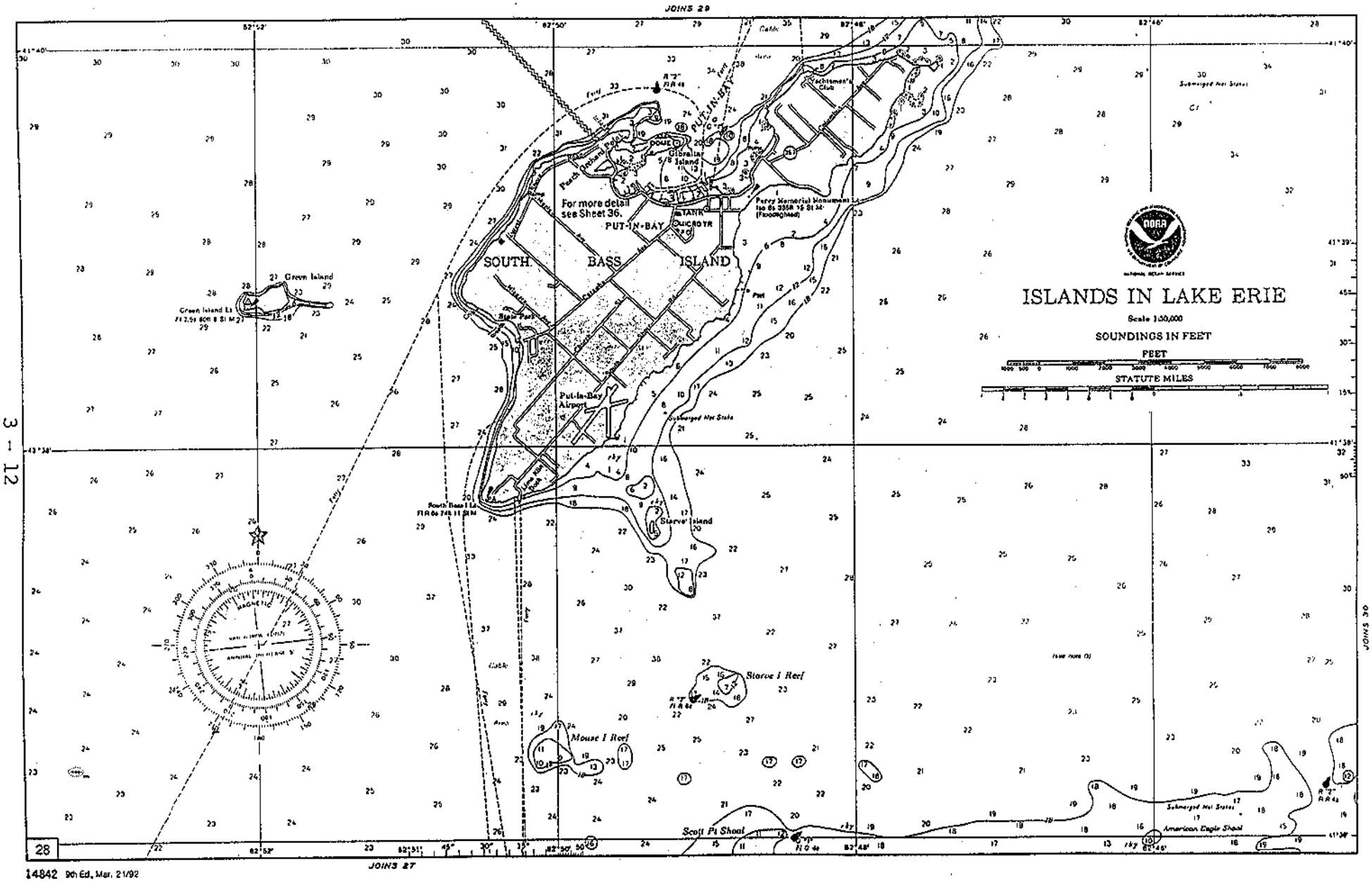

JOINS 29
JOINS 27
JOINS 30
For more detail see Sheet 36.
PUT-IN-BAY
SOUTH BASS ISLAND
Green Island
Put-in-Bay Airport
Starve Island
Starve I Reef
Mouse I Reef
Scott Pt Shoal
American Eagle Shoal
ISLANDS IN LAKE ERIE
Scale 1:30,000
SOUNDINGS IN FEET
FEET
STATUTE MILES
28
14842 9th Ed, Mar. 21/92

FIGURE 3 - 7

12. "Scott Point Shoal , west of South Shoal on the southwest side of the vessel route, is rocky and has a least depth of 11 feet [3.35 m] at the northeast end where it is marked by a Scott Point Shoal Lighted Buoy 1 [LLNR 5520]." [CG13; CG14; USCP 6, 1994, p. 169; Figure 3 - 6; Figure 3 - 7]

13. "Green Can Buoy 1 marks the extent of the bank east of Long Point, the northeast point of Kelly's Island. A rock, covered 12 feet [3.66 m], is marked on the south side by Rock Shoal Lighted Buoy 2 [LLNR 5595] 0.6 mile WNW [292.5°T] of Carpenter Point." [CG6B; CG13; CG14; USCP 6, 1994, p. 168; Figure 3 - 6]

14. "Although it is obstructed by numerous shoals, a depth of 16 feet [4.88 m] can be carried through the South Passage." [CG13; USCP 6, 1994, p. 168]

15. "A blue tint is shown in water areas on many charts to accentuate shoals and other areas considered dangerous for navigation when using that particular chart. Since the danger curve varies with the intended purpose of a chart, a careful inspection should be made to determine the contour depth of the blue tint areas." [USCP 6, 1994, p. 19]

16. Sheet 28 of Recreational Chart 14842 (Scale 1:30,000) shows no blue tint between the Starve Island Reef and Scott Point Shoal buoys or between the 8-foot (2.44 m) spot and Starve Island Reef. However, the smaller scale Chart 14844 (Scale 1:40,000) shows extensive blue tint between these two buoys, but very little between the 8-foot spot and Starve Island Reef. The blue tint on Recreational Chart 14842 is for water 1 to 6 feet (0.30 to 1.83 m) deep, light blue tint for water 6 to 12 feet (1.83 to 3.66 m) deep, white for water over 12 feet (3.66 m) deep. [IBT1; Figure 3 - 7]

17. There is a charted distance of 1.0 mile (5,280 feet) between the Starve Island Reef and Scott Point Shoal buoys. There is a charted distance of 0.82 mile (4,330 feet) between the 12-foot depth contours and 0.58 mile (3,062 feet) between the 18-foot depth contours at these two buoys. The 71-foot width of the barge KELLSTONE I represents only 1.3% of the width between the two buoys, 1.6% of the width between 12-foot depth contours, and 2.3% of the width between 18-foot depth contours. [CG6A; CG6C; CG65A, p. 7; IBT1; Chart 14844; Figure 3 - 6; Figure 3 - 7]

18. According to the 1994 U.S. Coast Pilot 6, there is a deepwater passage about 0.4 mile (2,112 feet) wide between the 8-foot (2.44 m) spot and Starve Island Reef. There is a charted distance of 0.52 mile (2,746 feet) between the 12-foot depth contours and 0.42 mile (2,218 feet) between the 18-foot depth contours. The 71-foot width of the barge KELLSTONE I represents only 3.4% of the width of the deepwater passage, 2.6% of the width between 12-foot depth contours, and 3.2% of the width between 18-foot depth contours. According to a bathymetric map of the South Passage, the deepest sounding in the island region is 62 feet (18.9 m) and was made in a small depression north of Starve Island Reef. This 62-foot depression, called the Starve Island Deep, is in the deepwater passage; however, it is not charted. [CG6A; CG6C; CG13; CG65A, p. 7; CG82; IBT1; USCP 6, 1994, p. 169; Chart 14844; Figure 3 - 6; Figure 3 - 7]

19. "The Lake Carriers' Association (LCA) and the Canadian Shipowners Association (CSA) have recommended, for vessels enrolled in the associations, separation of routes for upbound and downbound traffic in Lake Erie." [CG13; CG78; IBT22; IBT23M; USCP 6, 1994, p. 135; Figure 3 - 5]

20. The latest editions of Recreational Chart 14842 and Charts 14830 and 14844 have LCA/CSA recommended routes printed on them. These routes are marked as dashed black lines with courses and distances in magenta lettering above the lines. There are no LCA/CSA recommended routes through the South Passage. The *historic* LCA/CSA recommended route of 302° T through the South Passage was removed sometime between 1952 and 1974. Also on these charts, are ferry routes that cross the eastern and western entrances to the South Passage. These routes are marked as dashed magenta lines with the word "Ferry" in black lettering above each line. [CG5; CG6A; CG6C; CG13; CG78; IBT22; IBT23M; USCP 6, 1994, p. 135; Chart No. 1, p. 14; Figure 3 - 5]

21. The following note for buoys was in the introductory pages of Recreational Chart 14842 [IBT1]:

> "Buoys - The "highway" markers of the water channels are the numbered buoys. These take several sizes and shapes such as cans (squat cylinders) and nuns (cylinders with conical tops) and are placed along the sides of a channel, at turns, at points where channels divide, at harbor and marina entrances, and to mark certain obstructions, such as shoals and other underwater hazards. * * * Identification of such aids while you are cruising not only directs or warns you but also gives you an excellent check of your position. * * *."

22. Recreational Chart 14842 and Charts 14830 and 14844 have the following warning printed on them [IBT1]:

> "The prudent mariner will not rely solely on any single aid to navigation, particularly on floating aids. See U.S. Coast Guard Light List and U.S. Coast Pilot 6 for details."

23. The following is a list of fixed aids to navigation that were available in the northwest portion of the South Passage where the accident took place [CG6A; CG6C; CG14; Figure 3 - 5; Figure 3 - 6]:

(a) Green Island Light (LLNR 5535): "Fl 2.5s 80ft 8 St M"
(b) South Bass Island Light (LLNR 5530): "Fl R 6s 74ft 11 St M"
(c) Perry Memorial Monument Light (LLNR 5670): "Iso W 6s 335ft 15 St M"
(d) Entrance Channel Light 1 (LLNR 5380): "Fl G 4s 31ft 6 St M '1' PA"
(e) Entrance Channel Light 2 (LLNR 5385): "Fl R 2.5s 31ft 6 St M '2' PA"

24. "The purpose of the aids to navigation in the South Passage are [sic] to mark a channel, that historically, has been used by both commercial and recreational interests for many decades. While aids to navigation in the waters of the United States endeavor to assist in safe navigation, masters and pilots may deviate from the prescribed buoy and beacon signals in the interest of safe and prudent navigation." [CG78, p. 2]

26. ODNR Officer Johnston made the following statements in regards to the historical commercial use of the South Passage [IV TR, pp. 745-747]:

> "[I]t would be my opinion over the last 15 years in the South Passage that commercial traffic is really very, very minimal, and as a matter of fact, I remember seeing a tug one time going through there after I was up here for awhile and I thought that's an unusual thing, I think, to see, is a tug going through the South Passage. * * * You would see - - there's a sand dredge that would come through once in awhile, which wasn't that way, and at one time I did see a ship come through there, okay, and that's one time. Now you would see ships pull in to Marblehead there at the stone dock, you would see them pull in there. That was a regular thing to pull in there, but they came from the east, okay, not necessarily through -- not from down through the South Passage."

27. ODNR Officer Johnston made the following statements in regards to the historical recreational use of the South Passage [IV TR, pp. 751-754]:

> "As far as recreational use goes, it's always been very high. In my past 15 years it's always been very high. If you draw a line, basically, from Catawba here, you know, at Catawba Island up around here, you know, to Green Island, from here to here and you go from Marblehead over to here to this side of the east side of Kelly's Island and everything in between there, that's a very high usage. It always has been in those areas. That's always been heavily used by pleasure boats, fishing, you know, fishing in those areas and so forth, and just traversing those areas, going back and forth. * * * There will usually be anchored boats out around Scott Pointe [sic] and Starve Island area just due to the reefs being there, the people would be fishing. * * * [Y]ou get around any point of an Island [sic] you're going to encounter anchored boats because most of the points of Islands [sic] have good fishing habitat. * * * Especially in the fall time. * * * [Y]ou'll find more anchored on the weekend."

28. The Chief of the Ninth Coast Guard District Aids to Navigation Branch made the following conclusion in regards to the *historic* South Passage (i.e., with the historic LCA route and all of the historic buoys in place):

> "Considering the proximity of reefs and shallow water along the east-west axis of trackline, combined with the deeper draft vessels using the LCA trackline during that period, I would consider these aids to navigation described above to mark a narrow channel." [CG78, p. 1; Table 3 - 2]

29. The Chief of the Ninth Coast Guard District Aids to Navigation Branch made the following conclusion in regards to the *current* South Passage (i.e., with the historic LCA route and all of the historic buoys either repositioned or removed):

> "Considering our knowledge of the waterway users of South Passage and the fact that no one has recommended any changes to this system, I continue to support the notion that this waterway is not a narrow channel or fairway and the aids to navigation are adequate. The channel does not exhibit the shallower depths, stronger currents, sharper bends, restricted maneuvering room and bank suction and cushion created by the passage of other vessels commonly associated with narrower channels." [CG78, p. 3]

30. "According to the U.S. Army Corps of Engineers, Buffalo District, they have never, [n]or do they plan to, sound or dredge the area of South Passage." [CG78, p. 3]

d. Aids to Navigation

1. "Aids to navigation are placed along coasts and navigable waters as guides to mark safe water and to assist mariners in determining their position in relation to land and hidden dangers. Each aid to navigation is used to provide specific information. Several aids to navigation are usually used together to form a local aid to navigation system that helps the mariner follow natural and improved channels. Such aids to navigation also provides continuous system of charted marks for coastal piloting. Individual aids to navigation are used to mark landfall from seaward, and to mark isolated dangers. Lateral marks are buoys or beacons that indicate the port and starboard sides of a route to be followed. Virtually all U.S. lateral marks follow the traditional 3R rule of 'red, right, returning.' This means, when returning from sea, keep red marks on the right-hand (starboard) side of the vessel." [CG61]

2. "In the Great Lakes, the conventional direction of buoyage is generally considered westerly and northerly, except on Lake Michigan, where southerly movement is considered as returning from sea." [Light List, 1994, p. vii]

3. "All solid red and solid green aids are numbered, with red aids bearing even numbers and green aids bearing odd numbers. The numbers for each increase in the Conventional Direction of Buoyage. Numbers are kept in approximate sequence on both sides of the channel by omitting numbers where necessary." [33 CFR 62.43(a)]

4. Table 3 - 2 contains aids to navigation that were found on outdated U.S. Army Corps of Engineering Chart Nos. 36 (1952) and 364 (1955) [IBT22; IBT23M]:

TABLE 3 - 2

AIDS TO NAVIGATION IN SOUTH PASSAGE OF LAKE ERIE
[USACOE Chart Nos. 36 (1952) & 364 (1955); CG78]

Aid to Navigation Name	Characteristic	Latitude (N)	Longitude (W)	Month/Year Removed
Starve Island Lighted Buoy	(R 4) Fl R	41° 37' 13"	082° 49' 10"	01/69
Starve Island Reef Middle Ground Lighted Buoy	(HB) I Qk Fl W [red over black]	41° 36' 50"	082° 49' 08"	N/A
Mouse Island Buoy	(BC 3)	41° 36' 45"	082° 50' 00"	01/69
Scott Point Shoal Lighted Buoy	(B 1) Fl G	41° 36' 02"	082° 48' 24"	N/A
South Shoal Lighted Buoy	(R 2) Fl R	41° 35'40"	082° 47' 16"	08/58
Rock Shoal Lighted Buoy	(R 2) Fl R	41° 36' 14"	082° 44' 46"	N/A
American Eagle Shoal Buoy	(BC 1)	41° 36' 02"	082° 45' 00"	unknown

5. The Chief of the Ninth Coast Guard District Aids to Navigation Branch made the following conclusion in regards to the changing of one buoy and the permanent removal of three buoys in the South Passage:

> "Changing Starve Island Reef Lighted Buoy from an obstruction [sic] buoy to a lateral (red) buoy numbered 2, and in conjunction with Scott Point Shoal Lighted Buoy 1, a lateral (black) buoy were in accordance with the Light List for the Great Lakes which states, 'In the Great Lakes, the conventional direction of buoyage is generally considered westerly and northerly, except on Lake Michigan....' Based on the standard practice of placing red buoys on the starboard side of the channel and green buoys on the port side delineated a channel in the South Passage. **At a point between the buoys, a channel exists** [emphasis by LTJG McDonald]. It is 5,500 feet in width and 17 feet at its least depth. Starve Island Reef Lighted Buoy 2 marks the southernmost extension of reefs south of South Bass Island and Scott Point [Shoal] Lighted Buoy 1 marks the northernmost extension of reefs. **Because of the width of the channel, the position of the aids to navigation in relationship to the navigation hazards, I am inclined not to consider this passage a narrow channel or fairway from any direction for the type vessels commonly using this passage today** [emphasis by Investigator]." [CG78, p.2; Table 3 - 2]
>
> "* * * I assume the overall cause for the permanent removal of the buoys mentioned above was due to the disuse of, and the removal of the LCA trackline in the South Passage. The removal of the trackline no longer supported the need for all five buoys. The Coast Guard, recognizing the South Passage as a viable route for commerce, marked a channel with the minimal of aids necessary to allow safe navigation through the passage." [CG78, p. 2; Table 3 - 2]

6. "Middle ground" is defined as a "shoal in a fairway having a channel on either side." [Bowditch II, 1981, p. 856]

7. The lighted, horizontally banded red-black buoy at Latitude N 41° 36' 50" and Longitude W 082° 49' 08", on U.S. Army Corps of Engineering Chart Nos. 36 (1952) and 364 (1955), were Middle Ground Buoys. The buoy had an interrupted quick flashing white light and red over black horizontal bands. According to the former United States System of Buoyage (pre-1982 and pre-IALA), these characteristics indicated that the channels to the left and right were of equal importance; therefore, the buoy could be passed on either side. [IBT22; IBT23M; Bowditch I, 1984, pp. 1356, 1364, 1371; Table 3 - 2]

8. Starve Island Reef Lighted Buoy 2 (LLNR 5525) is a 4-foot tall red nun buoy that marks the west side of a reef. Its light characteristics are: "Fl R 6s." [CG5; CG6A; CG6C; CG13; CG14; K7; IBT2; Chart No. 1, p. 10; USCP 6, 1994, p. 169; Figure 3 - 6; Figure 3 - 7]

9. Scott Point Shoal Lighted Buoy 1 (LLNR 5520) is a 4-foot tall green can buoy that marks the northeast side of a shoal. Its light characteristics are: "Fl G 4s." [CG5; CG6A; CG6C; CG13; CG14; K8; IBT2; Chart No. 1, p. 10; USCP 6, 1994, p. 169; Figure 3 - 6; Figure 3 - 7]

10. "* * * [T]he accuracy classification for Starve Island Reef Lighted Buoy 2 and Scott Point [Shoal] Lighted Buoy 1 is 'Charlie' which is 75 yards. This classification represents a desired position tolerance based on area type, risk type, channel width and typical vessel width to beam ratio. The USCGC BRAMBLE position checked these aids on 09 May 94 and determined Scott Point Shoal Lighted Buoy 1 to be 5.93 yards and Starve Island Reef Lighted Buoy 2 to be 1.42 yards within the location of their assigned positions." [CG78, p. 2]

11. The U.S. Coast Guard Aids to Navigation Team in Sandusky, Ohio did a position check of the Scott Point Shoal and Starve Island Reef buoys on 2 October 1994. According to the team, the buoys were working properly. [CG85]

12. "Mariners must NOT rely on buoys alone for determining their position. Storms and wave action can cause buoys to move." [CG61]

13. The last Waterways Analysis Management Study (WAMS) for the South Passage was on 11 August 1992. The study, advertised in Local Notice to Mariners 09/92 dated 08 May 1992, solicited user comments from various sources, both commercial and recreational, on the adequacy of the aids to navigation in Fairport, Lorain, Huron Harbors and the Erie Islands. The aids to navigation in the South Passage are inclusive to this study. No comments regarding recommended changes to aids to navigation in the South Passage were received, therefore, no changes resulted from the WAMS. The next WAMS is due 01 September 1997. [CG78, p. 3]

Chapter 4 - Casualty Sequence

1. The tug and barge departed the Rouge River Osburn Dock in Detroit, MI at 0615 hours, on 1 October 1994, for Kelly's Island, OH. [CG8; CG45; CG46; CG49; IV TR, p. 730]

2. The length over all of the combined unit (i.e., tug in the notch of the barge) was 456 feet (138.99 m). [CG1; CG2; CG10]

3. The tug was monitoring VHF-FM Channels 13 and 16. [Paraphrase of verbal statement by Captain Verret to LTJG McDonald on 2 October 1994]

4. The tug had no ballast water on board. [CG65A, p. 4]

5. The barge had 22 ft, 10 in (6.95 m) (+4 in or 10.16 cm) of ballast water on board. [CG65A, p. 9]

6. Table 4 - 1 lists the departure drafts of the tug and barge [CG45; CG46]:

Table 4 - 1. Departure drafts at 0615 hours, on 1 October 1994

DRAFT LOCATION	FRANK PALLADINO JR (feet)	(meters)	KELLSTONE I (feet)	(meters)
FORWARD	12.0	3.66	9.67	2.95
AFT	11.5	3.50	13.0	3.96

7. The following 10 persons were crewmembers on board the tug and barge [CG18; CG45; CG46; CG49; CG51]:

(a)	Captain Chad J. Verret	Master
(b)	Captain Robert E. Coleman	Mate
(c)	Marc Kelch	Cook
(d)	Joe Matsko	Engineer
(e)	Chris Amity	Barge Supervisor
(f)	Joe Mineado	Deck Hand
(g)	Jason Malone	Deck Hand
(h)	Jeff Nickles	Deck Hand
(i)	David M. Marracino	Barge Maintenance
(j)	Jason Miller	Deck Hand

8. At 0752 hours, the Mach 1 was given a Vessel Safety Inspection at the Mazurik ramp in Danbury Township, OH by ODNR Watercraft Officer Jeffrey Nehls. A written warning was issued to the vessel operator, Virginia S. Ostrom, on Form DNR 8254. On board the Mach 1 were four persons: William R. Crane, Jr., Virginia S. Ostrom (William's fiancée), Ian M. Crane (William's son), and Michael Burghard (Ian's friend). There were four Adult Type III PFDs and one Adult Type IV PFD. All five PFDs were noted as acceptable. Table 4 - 2 represents the inspection items noted in the warning issued by Officer Nehls. [CG18, p. 2; CG35; II TR, pp. 49, 144, 145, 168, 169; IV TR, p. 744]:

TABLE 4 - 2. Reproduction of data on the ODNR Vessel Safety Inspection ticket issued to the Mach 1 at 0752 hours, on 1 October 1994.

VESSEL SAFETY INSPECTION STATE OF OHIO			
Acceptable Items			
YES	NO	N/A	ITEM DESCRIPTION
X			Numbers properly displayed
X			Ohio license displayed
X			Valid certificate of numbers
X			Personal Flotation Devices (PFD)
X			Fire extinguisher(s)
X			Anchor and line
	X		Distress signal
X			Flame arrestor properly installed
	X		Ventilation - engine
X			Ventilation - fuel tank
X			Sound Producing Device
		X	Required lights (night only)
		X	Muffler
		X	Legal Sanitary System

9. The Mach 1 was launched after its ODNR Vessel Safety Inspection was completed. William Crane was the operator of the boat. They decided that since they were going to fish for perch, they would go out near the shoals at Starve Island. At a location halfway between the Starve Island Reef Lighted Buoy 2 (LLNR 5525) and Scott Point Shoal Lighted Buoy 1 (LLNR 5520), they dropped a 15-pound navy stockless anchor off the starboard quarter. There was an approximate 46 to 47-foot rode (55 feet minus the line for an approximate 3-foot freeboard and the 5 to 6 feet of line on deck), which included a 5-foot length of chain near the anchor. The anchor did not hold too well at this location and they dragged anchor. Also, waves were splashing over the stern and into the boat. They moved and anchored again, but near a pack of boats closer to the Scott Point Shoal buoy than to the Starve Island Reef buoy. This time, they anchored off the port bow cleat with an additional 15 feet of mooring line. After tying off the anchor line at the port bow cleat, approximately 5 or 6 feet of the line was laying on the deck. With a freeboard of approximately 3 feet, this left a total rode of approximately 61 to 62 feet in the water. According to Mr. Crane, the Mach 1 stopped dragging anchor. [CG9M; CG15; IBT10; II TR, pp. 49, 50, 53, 73, 144, 145, 147, 159, 166, 198; III TR, p. 465; USCP 6, 1994, p. 169; LTJG McDonald's proportional measurement of rode using beverage can as reference in CG9M; LTJG McDonald's proportional measurement of freeboard using known vessel length as reference in CG9I]

10. The Mach 1 originally had a VHF-FM radio on. However, Virginia Ostrom turned it off because the static and traffic got so bad that it had a constant screechy sound. She also got "tired of listening to a lot of the stuff." [II TR, pp. 79, 129, 164, 178]

11. The tug and barge were downbound in the Detroit River with the assistance of the TUG MALCOLM (Call Sign WY5853). At 0723 hours, the TUG MALCOLM gave a radio traffic report to Canadian Coast Guard Vessel Traffic Center Sarnia that they were at the Grassy Island Light (LLNR 7785). The radio traffic report of the tug and barge indicates they were at the Detroit River Light (LLNR 6885) at 0857 hours; however, the logbook of the FRANK PALLADINO JR states 0915 hours. [CG48; CG49; Light List, 1994, pp. 68, 77]

12. The tug and barge (without the TUG MALCOLM) traveled in a southeasterly direction across the western end of Lake Erie, from the Detroit River Light through the East Outer Channel, to a waypoint 0.20 NM (0.23 miles) southwest of Green Island Light (LLNR 5535) at Latitude N 41° 38.5' and Longitude W 082° 52.2'. [CG5; CG6A; CG13; CG18; CG37; CG65A, p. 12-13; K4; USCP 6, 1994, p. 169; Light List, 1994, p. 55; IV TR, p. 730]

13. The tug and barge were traveling at 6 knots (6.9 mph or 202.4 yds/min or 607.2 ft/min) according to their GPS receiver. Both propellers were at 80% pitch and 350 RPM. [CG18; CG45; CG46; CG50; Paraphrase of verbal statement by Captain Verret to LTJG McDonald on 2 October 1994; IV TR, p. 730]

14. When the barge is loaded and the tug is in the notch, the normal cruising speed is between 5 and 6 knots. When the barge is empty, the speed is between 6 and 7 knots. [IV TR, p. 626]

15. When the barge is loaded and the tug is in the notch, the speed for bare steerageway is between 2 and 3-1/2 knots. Aric Barrett, another Mate employed on board the tug (he was not on board at the time of the accident), stated that bare steerageway is probably lower for an unloaded condition, but he did not know for sure. [IV TR, p. 626]

16. The engines of the tug were controlled directly by the person at the conning station on the bridge. [CG65A, p. 3]

17. A light, misty rain started in the vicinity of the anchored Mach 1 at or about 1157 hours. Because of the rain, Virginia Ostrom and William Crane put the canvas canopy up on the Mach 1. The canopy only covered the front two seats of the Mach 1 and was open on the sides. [CG57; IBT4; II TR, pp. 25, 30-32, 107, 147, 166, 182, 189, 198, 199]

18. Captain Robert Coleman assumed the bridge watch from Captain Chad Verret at 1200 noon, approximately one hour above Green Island. [Verbal statement by Captain Verret to LTJG McDonald on 2 October 1994]

19. David Marracino was on the bow of the barge as a lookout and had a portable VHF-FM radio. He was in frequent contact on Channel 8 with both Captain Coleman at the conning station on the bridge of the tug and Captain Verret, standing on the roof of the tug's bridge. [CG18; CG29; III TR, pp. 364-366, 369, 377, 378, 383; IV TR, pp. 720, 730]

20. As bow lookout, David Marracino frequently used his radio to communicate to Captain Coleman on the bridge about the locations, descriptions, and movements of boats in the area. He did not give maneuvering recommendations to Captain Coleman. [III TR, p. 365, 366, 369, 383]

21. There were two packs of boats approximately 3 miles west of the North and Middle Bass Islands. Many boats were traveling back and forth between the two packs. One pack began at about the Canadian border and ended at an imaginary line due west of Rattlesnake Island. The other pack was south of the first one. The course of the tug and barge went between the two packs of boats. To avoid hitting the boats, the tug and barge had to make many course changes. [III TR, p. 365; CG29; CG37]

22. Captain Coleman made a left turn at the Green Island Light waypoint at or about 1240 hours; whereby, entering the South Passage. He lined up on a course of 131.5° T, towards Scott Point Shoal Lighted Buoy 1 (LLNR 5520), with the "help" [word used by Coleman] of David Marracino on the bow of the barge and Captain Verret on the roof of the tug's bridge. Captain Verret thought his location on the roof would be a good lookout spot because of the number of boats in the area. [CG5; CG6A; CG13; CG37; CG65A, pp. 12-13; CG77*; Figure 4 - 1*; Figure 4 - 2*; Figure 4 - 3; USCP 6, 1994, p. 169; K4; Light List, 1994, p. 55; IV TR, p. 731]

23. The distances of the visible horizon for David Marracino, Captain Coleman, and Captain Verret were 6.4 miles, 6.6 miles, and 7.6 miles, respectively. [CG2; CG16; Bowditch II, 1981, p. 132]

24. Captain Coleman's visibility at the conning station on the bridge of the tug was obscured at waterline distances less than 1,368 yards or 0.78 miles away (4,104 feet). Captain Verret's visibility from the roof of the bridge was obscured at waterline distances less than 364.7 yards or 0.21 miles away (1,094 feet). [Table 3 - 1; Figure 3 - 3; Figure 3 - 4]

25. The Mach 1 was anchored approximately 4.2 miles away, on a line-of-sight bearing of approximately 125° T, from the tug and barge's Green Island waypoint. From where the Mach 1 was anchored, however, the southern point of South Bass Island obscured their sight of Green Island. [CG31; CG77; Figure 4 - 1; Figure 4 - 2; II TR, p. 31; III TR, pp. 395, 401, 402; Audio TR, p. 3]

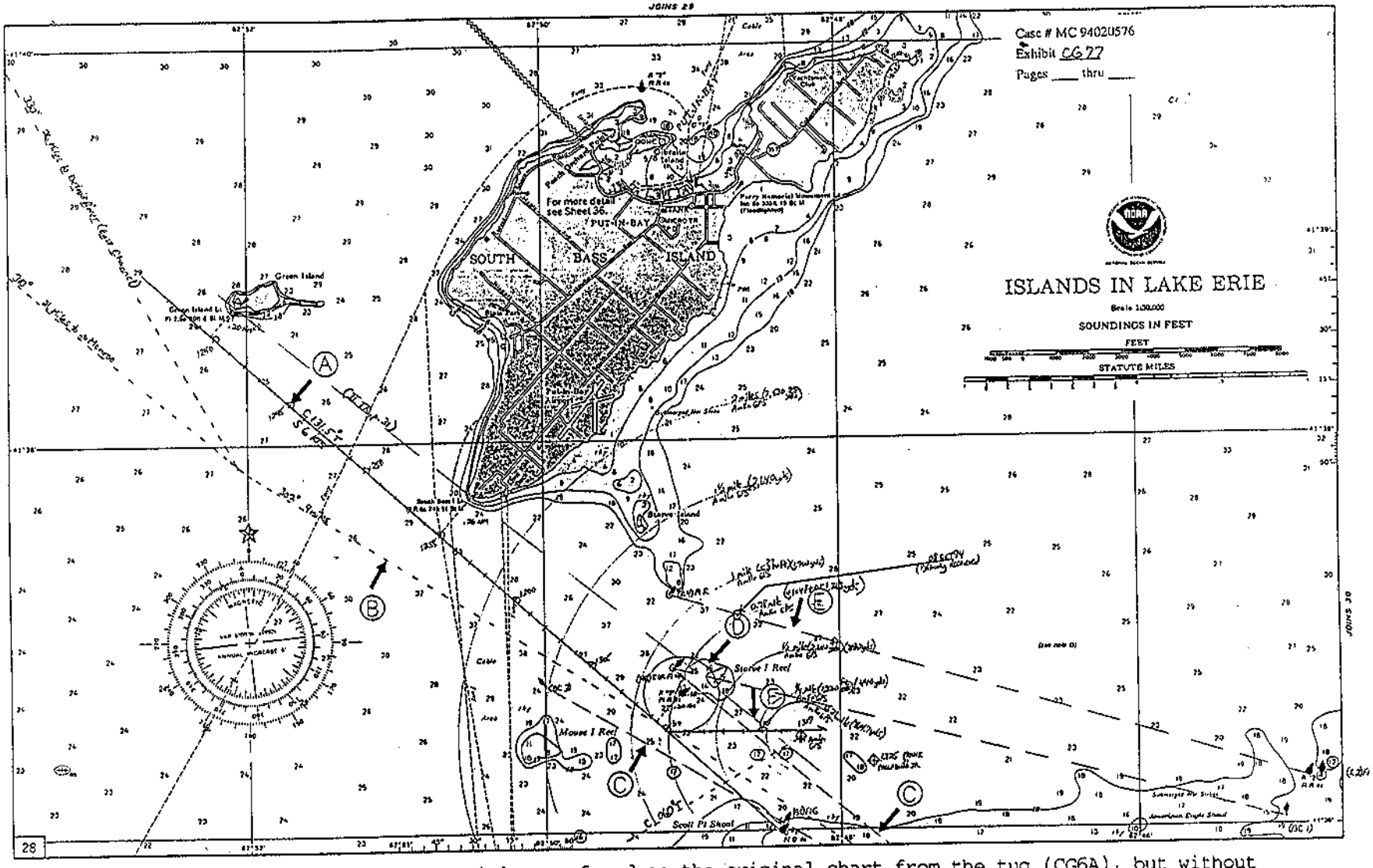
26. At or about 1247 hours, the tug and barge made radio contact with the nearby motor vessel JET EXPRESS II on Channel 16. The tug and barge were just south of Green Island. [CG76, p. 8; IV TR, p. 847]

27. The tug and barge were abeam South Bass Island Light at or about 1255 hours. The anchored Mach 1 was approximately 2.4 miles away. [CG77; Figure 4 - 1; Figure 4 - 2]

28. Somewhere at or after South Bass Island Light, the tug and barge bridge crew (i.e., either Captain Verret or Captain Coleman) told David Marracino that they could not tell the boats from the buoys, and that he keep a lookout. At this time, however, an earwitness on Channel 8 could only hear statements made from Captain Verret and Coleman. The earwitness' vessel was out of range of Mr. Marracino's radio. [CG29; III TR, pp. 365-366; IV TR, p. 720]

29. Captain Robert Coleman stated that the tug's radar was on, but he was not watching it. Captain Coleman's reason for not watching the radar was that there were too many boats in the area to tell the boats apart from the buoys. [CG50]

*Coast Guard Exhibit 77, Figure 4 - 1, and Figure 4 - 2 are reconstructions by LTJG Bernard McDonald, USCGR of the accident sequence on a copy of Sheet 28 of Recreational Chart 14842, "Islands in Lake Erie." LTJG McDonald plotted the tug and barge trackline as found on Coast Guard Exhibit 6A and the Mach 1 position as determined by Facts 4.25 and 4.51. The time of the accident was determined by Fact 4.48 as 1317 hours and the speed of the tug and barge was determined by Facts 4.13 and 4.14.



LEGEND: A = Tug and barge trackline position as found on the original chart from the tug (CG6A), but without times and DR markings.
B = LCA recommended routes as found on USACOE Chart Nos. 36(1952) & 364(1955).
C = Dashed lines connecting historic aids to navigation on USACOE Charts (above)(Drawn by LTJG McDonald).
D = Turn radius and bearing as found on original chart from tug (CG6A).
E = (same as letter C above)
F = Tangent bearing of Green Island & South Bass Island. The Mach 1 was located somewhere northeast of this bearing as evidenced by Fact 4.25.

Figure 4 - 1

APPROXIMATE PRE-COLLISION DR TRACK OF THE TUG AND BARGE IN THE SOUTH PASSAGE

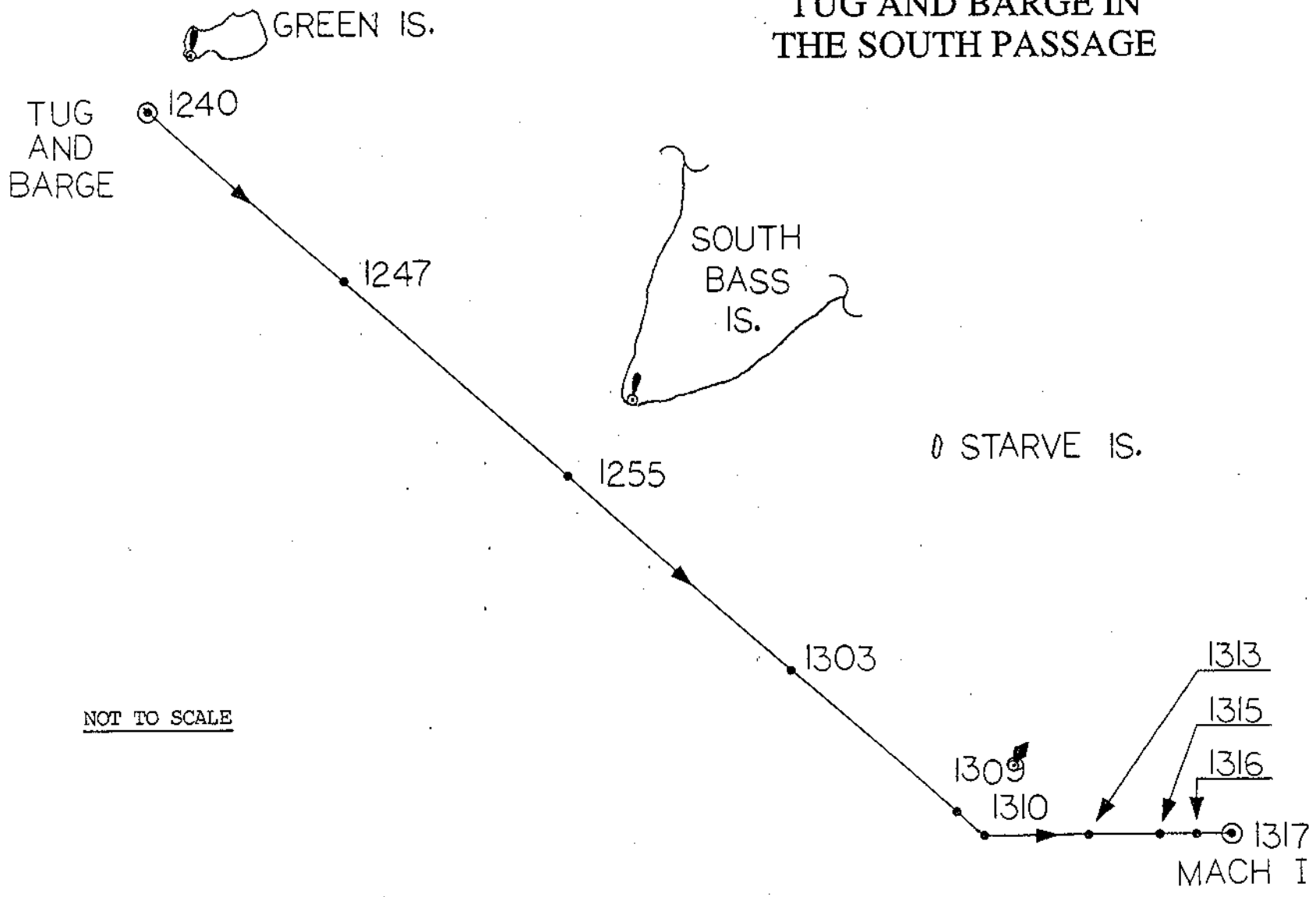


Figure 4 - 2

30. David Marracino saw the Mach 1 at or about 1303 hours, at approximately 1-1/2 miles away. This was about 14 minutes before the accident. [CG38; CG77; Figure 4 - 1; Figure 4 - 2]

31. The tug and barge picked the less conjested path as they approached vessels south of the Starve Island Reef Buoy. [CG38]

32. Virginia Ostrom first saw the "large black vessel" (i.e., tug and barge) at least 8 minutes before the accident or sometime before approximately 1309 hours. At that time, Mr. Crane and Ms. Ostrom could see down the port side of the barge and all of the bow. They could not see the tug. The second time Ms. Ostrom saw it, it had already turned towards her. Mr. Crane did not believe that the large black vessel represented any danger when he first observed it. [CG77; K18; Figure 4 - 1; Figure 4 - 2; II TR, pp. 55, 56, 130, 131, 149, 150, 160, 165]

33. The tug and barge began to make a left turn at or about 0.2 NM (0.23 miles) off the Starve Island Reef buoy at or about 1309 hours. The anchored Mach 1 was approximately 0.85 miles or 1,496 yards away. [CG6A; CG37; CG65A, pp. 12-13; CG77; Figure 4 - 1; Figure 4 - 2; USCP 6, 1994, p. 169; IV TR, pp. 730, 731]

34. At or about 1310 hours, the anchored Mach 1 was approximately 0.78 miles or 1,368 yards away. At about this time, the Mach 1 would not be visible to Captain Coleman from the conning station on the bridge. It would, however, still be visible to both Captain Verret and David Marracino. This was 7 minutes before the accident. [Table 3 - 1; Figure 3 - 3; Figure 3 - 4; CG77; Figure 4 - 1; Figure 4 - 2]

35. As the tug and barge were lining up their course for the stone dock at Kelly's Island [course was approximately 088° T], David Marracino told Captain Coleman about the presence of the Mach 1 and that it "was getting ready to move." Captain Coleman later admitted that he could not see the Mach 1 and assumed everything was okay. He decided to keep the tug and barge on a steady heading [of approximately 088° T] for the stone dock at Kelly's Island. [CG37; CG77; Table 3 - 1; Figure 3 - 3; Figure 3 - 4; Figure 4 - 1; Figure 4 - 2; Paraphrase of verbal statement by Captain Verret to LTJG McDonald on 2 October 1994; IV TR, p. 733]

36. An earwitness on Channel 8, hearing only the "bridge crew" (i.e., either Captain Verret or Captain Coleman), heard one of them ask David Marracino whether the boat [Mach 1] was moving or anchored. [CG29; III TR, p. 366]

37. At or about 1313 hours, the tug and barge were approximately 1/2 mile or 880 yards away from the Mach 1. David Marracino gestured with his arms to the port side of the barge that the Mach 1 should get out of its way. He also pointed which way the barge was going to go. He stated that he believed the persons on the Mach 1 acknowledged the tug and barge's presence because they started to put away their fishing gear. William Crane first saw the tug and barge at a 1/4 mile or more away. [CG15, p. 2; CG18, pp. 3, 5; CG38; CG41, p. 3; CG77; Figure 4 - 1; Figure 4 - 2; II TR, p. 162; III TR, pp. 54-56; IV TR, p. 734]

38. Virginia Ostrom stated that there was no time to wave back once they saw the barge coming at them. William Crane did not remember if he or anyone else on the Mach 1 waved back to the tug and barge. [CG18, p. 3; II TR, p. 162]

39. At or about 1315 hours, the tug and barge were approximately 1/4 mile or 440 yards away from the Mach 1. David Marracino saw a person on the Mach 1 attempt to start the boat and then allegedly wave to him. He later admitted to the ODNR that it was possible, at that distance of several hundred yards, that the person on the Mach 1 was waving at him because he or she could not start the engine. Virginia Ostrom made two attempts to start the Mach 1 in the minutes before the accident. Each time she started the boat and put it in gear, it stalled. In the past, however, she usually let the engine run for "a few seconds" before putting it in gear. Both Virginia Ostrom and William Crane told everyone to put on life jackets (i.e., PFDs). Nobody did. However, Ian Crane and Michael Burghard had worn their life jackets earlier, when the Mach 1 was underway and making way. All of the four wearable life jackets were out in view until after the Mach 1 anchored. After the boat anchored, two of the life jackets were stowed under a seat to make more room. The remaining two life jackets were on the floor of the boat.[CG15; CG18; CG38; CG41; CG42; CG50; CG77; Figure 4 - 1; Figure 4 - 2; II TR, pp. 28, 47, 74, 75, 80, 81, 151, 167, 169, 170; IV TR, p. 736]

40. At or just after 1315 hours, the anchored Mach 1 was approximately 0.21 miles or 364.7 yards away. At about this time, the Mach 1 would not be visible to either Captain Coleman from the conning station on the bridge or to Captain Verret on the roof of the bridge. It would, however, still be visible to David Marracino. This was 2 minutes before the accident. [Table 3 - 1; Figure 3 - 3; Figure 3 - 4; CG77; Figure 4 - 1; Figure 4 - 2; Figure 4 - 3]

41. According to Captain Verret, at 6 knots (6.9 mph), the tug and barge take around 400 yards to stop and at least 1/4 mile (440 yards) to make a 90° turn to avoid an object in the water. David Marracino stated that the tug and barge take around "1/4 to 1/2 mile or so" (440 to 880 yards) to stop. [CG50]

42. At or about 1316 hours, the tug and barge were approximately 1/8 mile or 220 yards away from the Mach 1. According to David Marracino, the Mach 1 still did not move and the person on board waved to him again. [CG38; CG77; Figure 4 - 1; Figure 4 - 2]

43. At or just after 1316 hours, the tug and barge were approximately 500 feet or 167 yards away from the Mach 1. David Marracino allegedly saw a person on the Mach 1 start heaving on an anchor line. It appeared to Mr. Marracino that the Mach 1 began drifting towards the barge after the anchor line was pulled on. [CG21; CG38; CG77; Figure 4 - 1; Figure 4 - 2; IV TR, p. 736]

44. At or about 1317 hours, the tug and barge were approximately 100 to 150 feet or 33 to 50 yards away from the Mach 1. David Marracino told Captain Coleman to make a hard right turn and put the engines full astern because the Mach 1 was still not moving. Captain Coleman then turned the tug and barge to the right. At this time, Captain Verret was on the barge, looking down the port side. Captain Verret told Captain Coleman [over the radio] to shut down the engines, which he did. [CG18; CG21; CG37; CG38; CG77; Figure 4 - 1; Figure 4 - 2; III TR, pp. 366; IV TR, p. 733]

45. According to David Marracino, the person on the Mach 1 was still heaving on the anchor line when the tug and barge were approximately 25 feet away. [CG38]

46. When the tug and barge were approximately 10 feet away from the Mach 1, Ian Crane, wearing a red hat, was seen by David Marracino and another boater, jumping from the starboard quarter without a lifejacket in his hands. According to Mr. Marracino, it "looks like [Michael Burghard] follows Boy #1 [Ian Crane]." William Crane said he came up through the hatch in the cuddy cabin in order to pull the anchor line up, which was

attached to the port bow cleat. However, he never claimed to have pulled on the anchor line. He said he just stood up in the hatch and dropped back down inside because the barge was only approximately 10 feet away. [CG18; CG31; CG32; CG33; CG38; CG42; III TR, p. 27, 76, 77, 436, 437, 458; IV TR, p. 737]

47. There was a pack of approximately 15 boats in the area around the Scott Point Shoal buoy, with the Mach 1 being in the northeast corner of that pack. Before the light rain started, there were approximately 25 boats. Another pack of approximately 10 to 15 boats were to the north and east of the Starve Island Reef buoy. There was also boats scattered throughout the area. [CG22; CG24; II TR, pp. 40, 160, 161; III TR, pp. 301, 302, 337, 341]

48. At 1317 hours, a Mayday was called in on VHF-FM Channel 16 by a boater near the Mach 1. According to the Mayday, the Mach 1 was under the bow of the barge. The square bow rake of the barge struck the port side of the Mach 1; whereby, tilting the starboard side of the Mach 1 up against the barge. The windshield and canopy of the Mach 1 were crushed on top of Virginia Ostrom, who was at the conning station. William Crane was still inside the cuddy cabin. [CG18; CG37; CG41; CG76; II TR, p. 128; Audio TR, pp. 2, 12]

49. The tug and barge were allegedly on a course of 060° when the accident occurred. It has not been clarified whether this course was in true, compass, or magnetic degrees. The variation for the area was 6.2° west. Deviation was unknown due to the age of the compass deviation card. The stone dock at Kelly's Island was on a bearing approximately 088° T from the accident location. [CG6A; CG6C; CG7; CG45; CG46; CG77; Figure 4 - 1; Figure 4 - 2]

50. David Marracino grabbed a lifering and started searching for the two boys as soon as the accident occurred. [CG37; CG38; IV TR, p. 737]

51. Another boat, with a GPS receiver, was approximately three to four boat-lengths or 100 to 150 feet, either south or east of the accident. When the accident occurred, the operator of this boat took a GPS fix at position Latitude N 41° 36.46' and Longitude W 082° 48.29'. The GPS receiver was a Northstar 800 and had an accuracy of 75 meters (246 feet). [CG31; CG77; Figure 4 - 1; Figure 4 - 2; III TR, pp. 395, 401, 402, 417, 418; Audio TR, p. 3]

52. Two witnesses reported that the Mach 1 was pushed by the barge's bow for approximately 200 to 250 yards to the east, before breaking free on the barge's port side. Other witnesses stated the distance was from 100 to 200 yards, to just over a 1/4 mile. At least 30 seconds or more passed between when a caller on the radio said that a small boat [Mach 1] was underneath the bow [of the barge] and when the same caller said it cleared the bow. At 6 knots, the tug and barge would have traveled approximately 100 yards in 30 seconds. The Mach 1 did not sink and was not capsized. [CG23; CG28; CG76; III TR, pp. 28, 152, 298; Audio TR, pp. 2, 56]

53. The tug and barge were still making way after the Mach 1 broke free of the barge. It appeared to William Crane and Virginia Ostrom that the tug and barge were not going to stop after their Mach 1 broke free. After breaking free of the barge, the port side of the Mach 1 slid down the port side of the barge. [CG15; CG18; CG41; CG42; II TR, p. 28]

54. The Mach 1 had its anchor out before and after breaking free of the barge. [CG18; CG23; CG28]

55. William Crane stated during his sworn testimony that the tug and barge did not have any navigation lights on at the time of the accident. The tug's cook, Marcus Kelch, made a sworn affidavit to attorney David Spotts (counsel for Captain Verret, Captain Coleman, and David Marracino) on 30 December 1994, or 3 months after the accident occurred. Mr. Kelch, who was *in the galley at the time of the accident* and since leaving the Detroit River that morning (approximately 4 hours earlier), stated "[a]s far as I know, the tug's running lights including the restricted manueverability [sic] lights were on continiously [sic] until we arrived at the dock at Kelly's Island." However, when Mr. Kelch was interviewed by a Coast Guard Investigating Officer, in the presence of attorney William Schroeder (counsel for Inland Bulk Transfer Company), on 20 October 1994, he made no mention of seeing navigation lights on the tug or barge. This interview was only 19 days after the accident occurred. [II TR, p. 53; CREW1; CREW2, p. 3; CG84] [see also *Lights and Shapes,* Chapter 5 of this report]

56. The Mach 1 did not display a ball dayshape to indicate that it was at anchor. [II TR, pp. 63, 185, 186]

57. Neither the tug nor the Mach 1 sounded a horn or whistle signal at any time. Virginia Ostrom claimed that she did not have any time to give sound signals before the accident. During that time, she was only concerned with starting the engine. The button for the horn on the Mach 1 is located on a control panel [forward of the steering wheel]. The horn can be operated by pushing the button, even without having the ignition key turned on. [CG15; CG18; CG30; CG31; CG33; II TR, pp. 43, 44, 79, 129, 130, 163, 164, 169; III TR, pp. 308, 456, 457]

58. According to a 1325 entry in the deck log book of the tug, it was standing by at the scene of the accident at the following position: Latitude N 41° 36.35' and Longitude W 082° 47.78'. The Forms CG-2692, submitted to the U.S. Coast Guard for the tug and barge, list the same position. [CG45; CG46; CG49]

59. The tug was stopped in the water at or before 1326 hours. [CG76, p. 3; Audio TR, p. 18]

60. The tug and barge got underway from the accident scene, for Kelly's Island, OH at 1730 hours. They arrived at the stone dock on Kelly's Island at 1815 hours. [CG49]

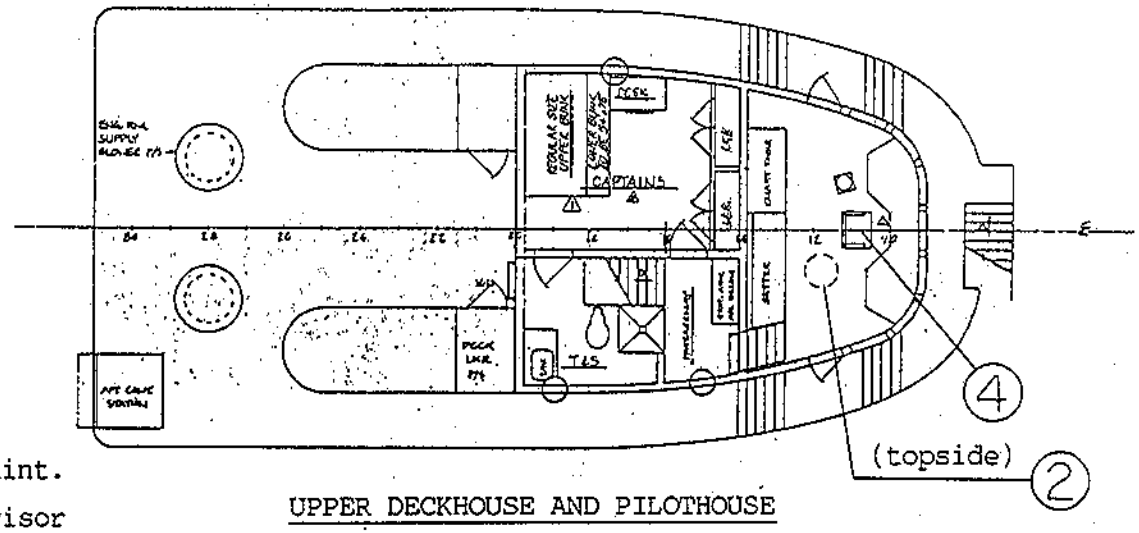
61. It was the opinion of ODNR Watercraft Officer John P. Johnston that "operator inattention" contributed to and was the primary cause of the accident. Officer Johnson's report, however, does not clarify which operator was inattentive, the tug or the Mach 1, or both. [CG19]

62. Figure 4 - 3 depicts the location of the tug and barge crewmembers at the time of the accident. [CG52]

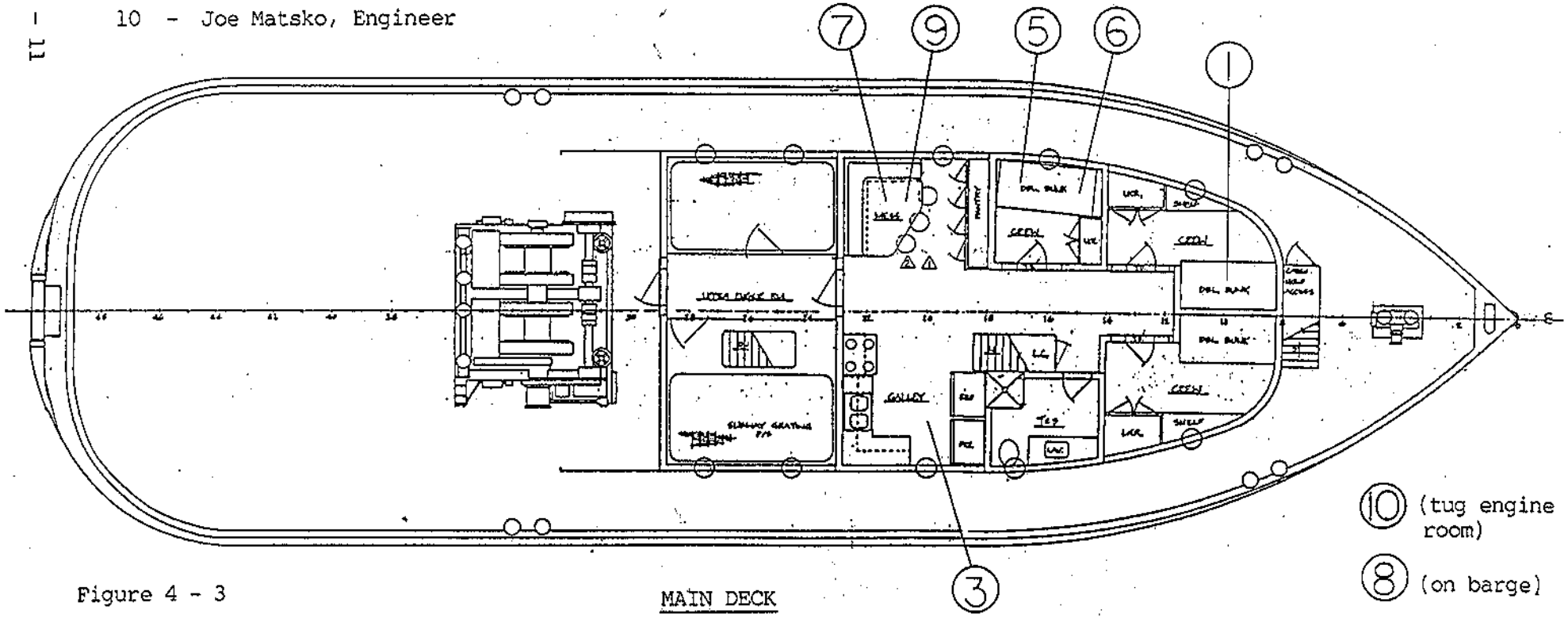
TUG AND BARGE CREW LOCATIONS AT THE TIME OF THE ACCIDENT

LEGEND

1 - Jason Malone, Deckhand
2 - Chad Verret, Master
3 - Marc Kelch, Cook
4 - Robert Coleman, Mate
5 - Joe Mineado, Deckhand
6 - Jason Miller, Deckhand
7 - Jeff Nickles, Deckhand
8 - David Marracino, Barge Maint.
9 - Chris Amity, Barge Supervisor
10 - Joe Matsko, Engineer



UPPER DECKHOUSE AND PILOTHOUSE



MAIN DECK

Figure 4 - 3

Chapter 5 - Miscellaneous Information

Note: This chapter contains the facts occurring after the accident as well as ancillary facts relating to the accident. The ancillary facts were included in this report to assist the reader in understanding how the Investigating Officers arrived at their conclusions.

a. Personnel and Vessel Casualties

1. Virginia Ostrom strained her back muscles in the accident and later sought medical treatment at MacGruder Hospital of Port Clinton, OH. They released her that same day. As of 11 October 1994, she was still being treated with medication for muscle spasms. [CG18, p. 2; CG19, p. 2; CG41, p. 6; CG81, pp. 11, 55-56; II TR, pp. 170-173]

2. William Crane sustained a small cut from some broken glass which was treated with a Band-Aid from the paramedics on the police boat. [II TR, p. 46]

3. There were no other reported injuries on either vessel.

4. At or about 0900 hours, on 8 October 1994, the body of Ian Crane was found in the water at Latitude N 41° 37.09' and Longitude W 082° 48.69'. The recovery location was 0.8 miles and 333° T from the accident site. The time was 6 days and 19.7 hours after the accident. The body was wearing jeans and a brown sweatshirt. [CG40; CG54; CG77, CG81, p. 38]

5. At or about 1011 hours, on 9 October 1994, the body of Michael Burghard was found in the water 0.75 miles south of the Newman's Ferry Dock, Kelly's Island. The recovery location was approximately 4.4 miles and 112.5° T from the accident site. The time was 7 days and 20.9 hours after the accident. [CG81, p. 35]

6. The opinion of Dr. James R. Patrick, Lucas County Coroner, is that the cause of death for Michael Burghard was drowning, in minutes, after a boating accident. There were no traumatic injuries. The body of Michael Burghard was received by the coroner wearing a green and gray hooded "Notre Dame" sweat shirt with the hood up around the head, one white knit glove, black jeans, white Nike tennis shoes, two pairs of athletic socks, and "Harley-Davidson" black sweat shorts. A key was suspended on a chain around the neck. Dr. Patrick's case summary states that the time and date of death were 1039 hours, on 9 October 1994, respectively. Coincidentally, this time and date correlates with Fact 5.a.5, which describes when Michael Burghard's body was found. [CG56]

7. Dr. Kenneth Akins, Ottawa County Coroner, signed the Ohio Department of Health "Certificate of Death" for Michael Alan Burghard on 20 October 1994. Dr. Akins pronounced Michael Burghard dead on 9 October 1994. In his opinion, the immediate cause was from accidental drowning, in minutes. The Certificate of Death listed Michael Burghard's time and date of death as approximately 1400 hours, on 1 October 1994, respectively. [CG55]

8. The opinion of Dr. James R. Patrick, Lucas County Coroner, is that the cause of death for Ian Crane was drowning, in minutes, after a boating accident. There were no traumatic injuries. The body of Ian Crane was received by the coroner wearing a "Browns" hooded sweat shirt, blue jeans, Puma navy blue tennis shoes, and white socks. Dr. Patrick's case summary states that the time and date of death were 0900 hours, on 8 October 1994, respectively. Coincidentally, this time and date correlates with Fact 5.a.4, which describes when Ian Crane's body was found. [CG54]

9. Dr. Kenneth Akins, Ottawa County Coroner, signed the Ohio Department of Health "Certificate of Death" for Ian Crane on 20 October 1994. Dr. Akins pronounced Ian Crane dead on 8 October 1994. In his opinion, the immediate cause was from accidental drowning, in minutes. The Certificate of Death listed Ian Crane's time and date of death as approximately 1400 hours, on 1 October 1994, respectively. [CG53]

10. "It is common belief that someone dressed in heavy clothing or waders will sink immediately if they fall overboard. This is not true. Air trapped in clothing provides considerable flotation, and bending the knees will trap air in waders, providing additional flotation. To stay afloat, remain calm, do not thrash about or try to remove clothing or footwear. This leads to exhaustion and increases the loss of air that keeps you afloat. Keep your knees bent, float on your back and paddle slowly to safety." [CG61; IBT26]

11. "Sudden immersion in cold water can induce rapid, uncontrolled breathing, cardiac arrest, and other life-threatening situations which can result in drowning. Wearing a PFD will help reduce this condition. If you must enter the water, button up your clothing, wear a PFD, cover your head if possible and enter the water slowly. Hypothermia is the loss of body heat and immersion in water speeds the loss of heat. About 50% of body heat loss is from the head." [CG61; IBT26]

12. If the water temperature is between 50° and 60° F, a person in the water will normally experience exhaustion or unconsciousness from 1 to 2 hours. The expected time of survival is from 1 to 6 hours. If the water temperature is between 60° and 70° F, a person in the water will normally experience exhaustion or unconsciousness from 2 to 7 hours. The expected time of survival is from 2 to 40 hours. [ITB13B; IBT26]

13. The total estimated cost of repairs to the Mach 1 was $11,766.00. The repair estimate was done by Advanced Marine of Marion, OH. [CG75]

14. There were no reported damages to the tug and barge.

b. Search and Rescue

1. Just minutes after the accident, a witness saw a floating olive-colored object sink as he approached it in his boat with a boat hook. Also seen was a floating red hat. [II TR, p. 29; III TR, p. 305]

2. At 1453 hours, the Huron Fire Division's Underwater Recovery Team was called to assist the Ottawa County Sheriff's Department Underwater Recovery Team in searching for the two missing teenagers. They dove at both 2 miles south and south by southeast of Starve Island, on the American Eagle Shoal. The dive search was discontinued after 1846 hours because of impending darkness and deteriorating weather conditions. The following is a partial list of the rescue divers that participated in the dive operations that day [CG43B-D]:

(a) Kevin M. Gadd, Firefighter/Paramedic, City of Huron, OH
(b) John A. Zimmerman, Fire Chief, City of Huron, OH
(c) Steven W. Southard, Rescue Diver, Huron Fire Division
(d) Bob Tabennestler

3. The following agencies or persons were among the participants in the Search and Rescue efforts on 1 October 1994: Put-in-Bay Police, Port Clinton Police, ODNR Watercraft Division, U.S. Coast Guard Auxiliary, U.S. Coast Guard Station Marblehead, U.S. Coast Guard Air Station Detroit (helicopter), U.S. Coast Guard Group Detroit (SAR Mission Coordinator), Catawba Island Fire Department divers, Marblehead Fire Department divers, Lakeside Fire Department divers, Ottawa County Dive Rescue, Huron Fire Department divers, and approximately 15 private boaters. The organized search efforts lasted for approximately 22 hours after the collision. [CG20; CG81; IV TR, pp. 742-744]

4. Six divers searched the bottom of the tug and barge after the accident and did not find any evidence of the two missing boys. [CG21]

c. Navigation Rules

1. "The Inland Rules [33 U.S.C. 2001 *et seq.* and 33 CFR Subchapter E] replaced the old Inland Rules, Western Rivers Rules, Great Lakes Rules, their respective pilot rules and interpretive rules, and parts of the Motorboat Act of 1940. Many of the old navigation rules were originally enacted in the last century. Occasionally, provisions were added to cope with the increasing complexities of water transportation. Eventually, the navigation rules for United States inland waterways became such a confusing patchwork of requirements that in the 1960's [sic] several attempts were made to revise and simplify them. These attempts were not successful." [Navigation Rules, 1990, CH-4, p. vii]

2. "The effective date for the Inland Navigation Rules was December 24, 1981, except for the Great Lakes where the effective date was March 1, 1983." [Navigation Rules, 1990, CH-4, p. vii]

3. The Inland Navigation Rules apply to all vessels upon the Great Lakes. [33 U.S.C. 2001(a); Navigation Rules, 1990, CH-4, p. 3]

4. The public may purchase *Navigation Rules: International - Inland* (COMDTINST M16672.2B, CH-4) from the U.S. Government Printing Office (GPO) at GPO Bookstores located in many cities, from GPO sales agents located in principal ports or by telephone at (202) 783-3238. The book is also available for order by mail from:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

5. Annex III of the Inland Navigation Rules describes technical details for sound signal appliances (i.e., whistles). [33 CFR 86.01 through 86.15; Navigation Rules, 1990, CH-4, pp. 151-159]

6. Annex V of the Inland Navigation Rules states that "[a]fter January 1, 1983, the operator of each self-propelled vessel 12 meters [39.4 feet] or more in length shall carry on board and maintain for ready reference a copy of the Inland Navigation Rules." [33 CFR 88.05; Navigation Rules, 1990, CH-4, p. 165]

7. "The word 'underway' means that a vessel is not at anchor, or made fast to the shore, or aground[.]" [Rule 3(h); 33 U.S.C. 2003(h); Navigation Rules, 1990, CH-4, p. 9]

8. "Vessels shall be deemed to be in sight of one another only when one can be observed visually from the other[.]" [Rule 3(j); 33 U.S.C. 2003(j); Navigation Rules, 1990, CH-4, p. 9]

9. "Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision." [Rule 5; 33 U.S.C. 2005; Navigation Rules, 1990, CH-4, p. 13]

10. "Lookout is a function to be performed by a member of a navigational watch." [46 CFR 15.850]

11. "The term [lookout], as used by the Rules, denotes not a person but rather the systematic collection of information." [Llana & Wisneskey, 1986, p. 23]

12. "A proper lookout is, by Federal Court definition, a person specially charged with the duty of observing lights, sounds, echoes, or any obstruction to navigation with that thoroughness which the prevailing circumstances permit." [Turpin, MacEwen, 1965, p. 13-26]

13. "A lookout must have a *reasonable amount of experience* as a seaman; no minimum length of service has been set by the courts as the required qualification for duty as a lookout." [Turpin, MacEwen, 1965, p. 13-26]

14. "*The proper station* for a lookout has been defined as 'as far forward and as low down as conditions allow.'" [Turpin, MacEwen, 1965, p. 13-26]

15. "The degree of vigilance required of the lookout is not specified in the law, but the courts hold that he [sic] must be 'actually and vigilantly employed in the performance of the duty.' The actual degree of vigilance employed in a particular case is likely to be judged by the standard of its effectiveness in preventing collision." [Turpin, MacEwen, 1965, p. 13-26]

16. "*Number of lookouts*. According to decisions of the courts, more than one lookout is required under certain conditions, although one with that exclusive duty will ordinarily be sufficient. Good seamanship practice complies with the foregoing obligation in large vessels in stationing as many as four lookout men in thick weather, two of whom usually would be placed aloft." [Turpin, MacEwen, 1965, p. 13-26]

17. "On vessels where there is an unobstructed all-round view provided at the steering station, as on certain pleasure craft [emphasis by Investigator], fishing boats, and towing vessels, or where there is no impairment of night vision or other impediment to keeping a proper lookout, the watch officer or helmsman may safely serve as the lookout. However, it is expected that this practice will only be followed after the situation has been carefully assessed on each occasion, and it has been clearly established that it is prudent to do so. Full account shall be taken of all relevant factors, including but not limited to the state of the weather, conditions of visibility, traffic density, and proximity of navigational hazards. It is not the intent of these rules to require additional personnel forward, if none is required to enhance safety." [CDOA 2421 (RADER), p. 6; CDOA 2420 (LENTZ), pp. 6, 7; Senate Report No. 96-979, 2d Session 7-8 (1980)]

18. "[A] blind spot created by the makeup of the tow mandates posting a lookout aboard the barge." [CDOA 2414 (HOLLOWELL), p. 10; *Taylor v. Tiburon,* 1975 A.M.C. 1229 (E.D. La. 1974)]

19. "If there is not enough information to assess the situation, you should tap all your resources to gather more. If you are still unable to acquire all the information you need, then you should take steps immediately to reduce your requirement for information (for example, by slowing or stopping). Otherwise, you are violating Rule 5." [Llana & Wisneskey, 1986, p. 28]

20. "The term 'vessel engaged in fishing' means any vessel fishing with nets, lines, trawls, or other fishing apparatus which restricts maneuverability, but does not include a vessel fishing with trolling lines or other fishing apparatus which do not restrict maneuverability[.]" [Rule 3(d); 33 U.S.C. 2003(d); Navigation Rules, 1990, CH-4, p. 7; IBT12]

21. "When vessels in sight of one another are approaching each other and from any cause either vessel fails to understand the intentions or actions of the other, or is in doubt whether sufficient action is being taken by the other to avoid collision, the vessel in doubt shall immediately indicate such doubt by giving at least five short and rapid blasts on the whistle." [Rule 34(d); 33 U.S.C. 2034(d); IBT12]

22. The danger signal on the tug was used "quite often," during the times Aric Barrett was onboard, in order to warn other vessels that were not getting out of the way. [IV TR, p. 636]

23. "The presence of more than two vessels may preclude full compliance with the Rules; action required with respect to one vessel may conflict with the action required with respect to one or more of the others. Again, special circumstances exist." [Llana & Wisneskey, 1986, p. 10]

24. "Cases of 'special circumstances' may be divided into five general categories: (1) *'in extremis'* situations; (2) situations where physical conditions make it impossible to follow the rules which would apply in the absence of such conditions; (3) cases in which the ordinary Rules cannot be applied strictly because of the presence of other vessels; (4) cases where the situation is not specifically covered by the Rules; and (5) cases where one of two vessels proposes a departure from the Rules and the other consents." [Nealy & Sharpe, 1986, p. 585]

25. "In an extremis situation, the operators on one or both vessels have failed to take the first line of preventive actions prescribed by the Rules. The second line of defense comes into play; the parties in extremis are required to do *whatever* is necessary to avoid a collision or at least to minimize the damage." [Llana & Wisneskey, 1986, p. 10]

26. "If necessary to avoid collision or allow more time to assess the situation, a vessel shall slacken her speed or take all way off by stopping or reversing her means of propulsion." [Rule 8(e); 33 U.S.C. 2008(e); IBT12]

d. Lights and Shapes

1. "[Day] shapes shall be black [in color]." [33 CFR 84.11(a); IBT12]

2. "A ball [day shape] shall have a diameter of not less than 0.6 meter [2 feet]." [33 CFR 84.11(a)(1); IBT12]

3. "A cone [day shape] shall have a base diameter of not less than 0.6 meter and a height equal to its diameter." [33 CFR 84.11(a)(2); IBT12]

4. "A diamond [day] shape shall consist of two cones having a common base." [33 CFR 84.11(a)(3); IBT12]

5. "The vertical distance between [day] shapes shall be at least 1.5 meter [4.9 feet]." [33 CFR 84.11(b); IBT12]

6. "In a vessel of less than 20 meters [65.6 feet] in length [day] shapes of lessor dimensions but commensurate with the size of the vessel may be used and the distance apart may be correspondingly reduced." Multiplying vessel length in feet by a factor of 0.36 will yield the minimum day shape diameter in inches. [33 CFR 84.11(c); IBT12; Maloney, 1994, p. 144; Factor determined by LTJG McDonald]

7. A ball day shape of 7.6 inches (19.3 cm) in diameter would be commensurate in size to a vessel 21 feet (6.4 meters) in length. [Maloney, 1994, p. 144; IV TR, p. 841]

8. "The Rules concerning shapes shall be complied with by day." [Rule 20(d); 33 USC 2020(d); IBT12]

9. "A vessel of less than 7 meters [22.97 feet] in length, when at anchor, not in or near a narrow channel, fairway, anchorage, or where other vessels normally navigate, shall not be required to exhibit the lights or shape prescribed in paragraphs (a) and (b) of [Rule 30]." [Rule 30(e); 33 U.S.C. 2030(e); IBT12; CG61, p. 27]

10. "A vessel at anchor shall exhibit where it can best be seen in the fore part, one ball." Although required by law, it is not common practice for recreational vessels to display day shapes. [Rule 30(a); 33 U.S.C. 2030(a); IBT12; Observation by Investigator]

11. "A vessel engaged in a towing operation which severely restricts the towing vessel and her tow in their ability to deviate from their course shall, in addition to the lights or shapes prescribed in subparagraphs (b)(i) and (ii) of this Rule, exhibit the lights or shape prescribed in Rule 24." [Rule 27(c); 33 U.S.C. 2027(c); CG61; IBT12]

12. "The term 'vessel restricted in her ability to maneuver' means a vessel which from the nature of her work is restricted in her ability to maneuver as required by these [Inland] Rules and is therefore unable to keep out of the way of another vessel; vessels restricted in their ability to maneuver include, but are not limited to: * * * a vessel engaged in a towing operation such as severely restricts the towing vessel and her tow in their ability to deviate from their course." [Rule 3(g)(vi); 33 U.S.C. 2003(g)(vi); Navigation Rules, 1990, CH-4, pp. 7, 8; IBT12]

13. "A vessel restricted in her ability to maneuver * * * shall exhibit: (i) three all-round lights in a vertical line where they can best be seen. The highest and lowest of these lights shall be red and the middle light shall be white; (ii) three shapes in a vertical line where they can best be seen. The highest and lowest of these shapes shall be balls and the middle one a diamond; (iii) when making way through the water, masthead lights, sidelights and a sternlight, in addition to the lights prescribed in subparagraph (b)(i)[.]" [Rule 27(b); 33 U.S.C. 2027(b); Navigation Rules, 1990, CH-4, p. 89; IBT12]

14. "A power-driven vessel underway shall keep out of the way of * * * a vessel restricted in her ability to maneuver[.]" [Rule 18(a)(ii); 33 U.S.C. 2018(a)(ii); Navigation Rules, 1990, CH-4, p. 35; IBT12]

15. "The status [of a vessel restricted in her ability to maneuver] does not apply to vessels that cannot maneuver because they are in a narrow channel or in shallow water or because of strong currents or bad weather." [Llana & Wisneskey, 1986, p. 15]

16. "Vessels engaged in line towing [i.e., towing astern] operations are almost by definition restricted in their ability to manoeuvre [sic]." [CG68, p. 41]

17. "A towing vessel with tow is under some circumstances less able to maneuver than a power-driven vessel alone. However, the master of a vessel engaged in a routine towing operation is not normally justified in claiming restricted-in-ability-to-maneuver status. This is emphasized in the definition by the words '*severely* restricts.'" [Llana & Wisneskey, 1986, p. 15]

18. U.S. Coast Guard Investigating Officer, David Sandahl, took photographs of the tug and empty barge on the morning of 5 October 1994, when they were alongside the stone dock in Marblehead, Ohio. No day shapes were displayed. The National Ensign was flying at the gaff. In addition to deck lighting being lit, the following underway navigation lights were visibly lit on the tug and barge: two masthead lights and both sidelights on the tug; and a special flashing light (amber) on the bow centerline of the barge. Due to the aspects of the photographs, neither the tug's towing lights nor the barge's sidelights were visible. [CG9A; CG9B; CG9D]

19. During the hearing on 11 October 1994, Kellstone submitted to the Coast Guard an aerial photograph of the tug and empty barge underway. In this photograph, no "restricted in her ability to maneuver" dayshapes or lights were displayed or burning, respectively. [K1; II TR 59]

20. Aric M. Barrett was interviewed on 20 October 1994 about the normal, day-to-day operations of the tug and barge. He later testified about the tug's dayshapes in a formal hearing, on 17 November 1994. He has been employed as a deckhand or engineer on the tug for three years and as a "Mate" on the tug since obtaining his 100 gross ton Inland Master license in September 1994. Barrett was not onboard the tug on the day of the accident. He stated that the tug had at least a ball and diamond shape stored under the settee in the pilothouse. It might even have had a second ball shape, but he could not remember. Barrett stated that dayshapes are not normally used and that he never used them during the times when he was the Mate. The tug also does not exhibit restricted in her ability to maneuver lights. [CG84; IV TR, pp. 622, 623, 636, 637]

21. William Crane stated that the tug and barge was not exhibiting navigation lights at the time of the accident. [II TR, p. 53]

e. Visual Distress Signals

1. In order to clarify the regulations in 33 CFR 175, the U.S. Coast Guard published a boating safety information pamphlet titled "Visual Distress Signals for Recreational Boaters." Copies of this pamphlet are available to the public. Another U.S. Coast Guard published pamphlet that includes information on visual distress signals is "Federal Requirements and Safety Tips for Recreational Boats" [CG61; CG63; IBT26]

2. The regulation to carry visual distress signals became effective on January 1, 1981. This regulation requires all boats when used on coastal waters, which includes the Great Lakes, the territorial seas and those waters directly connected to the Great Lakes and the territorial seas, up to a point where the waters are less than two miles wide, and boats owned in the United States when operating on the high seas to be equipped with visual distress signals. The only exceptions are daytime (sunrise to sunset) for:

(a) Recreational boats less than 16 feet in length;
(b) Boats participating in organized events such as races, regattas or marine parades;
(c) Open sailboats not equipped with propulsion machinery and less than 26 feet in length; or
(d) Manually propelled boats.

These boats only need to carry night signals when used on these waters at night. [CG63]

3. The purpose of a visual distress signal is to attract attention and secure assistance should the need arise. [CG63]

f. Radio Usage

1. The tug had two VHF-FM radios mounted on the inside ceiling of the bridge. One was a Cybernet CTX 2050 and the other was a Standard Horizon Eclipse. [CG65A, p. 5]

2. The crew of the tug used handheld VHF-FM radios to communicate vessel operations among themselves on Channel 8. The VHF-FM handheld radios used were 5 watts with a 3 to 4 mile range. [Paraphrase of verbal statement by Captain Verret to LTJG McDonald on 2 October 1994]

3. The tug was monitoring VHF-FM Channels 13 and 16 at the time of the accident. [Paraphrase of verbal statement by Captain Verret to LTJG McDonald on 2 October 1994]

4. VHF-FM Channel 8 is designated for commercial usage from ship-to-ship only. The transmit and receive frequency is 156.400 MHz. [USCP 6, 1994, p. 26]

5. VHF-FM Channel 16 is designated for distress, safety and calling. The transmit and receive frequency is 156.800 MHz. [USCP 6, 1994, p. 26]

6. The Mach 1 originally had a VHF-FM radio on. However, Virginia Ostrom turned it off because the static and traffic got so bad that it had a constant screechy sound. She also got "tired of listening to a lot of the stuff." [II TR, pp. 79, 129, 164, 178]

g. Channels, Fairways & Passages Defined

1. "Although the conduct required of vessels navigating in a 'narrow channel' is specified in great detail, neither the definition section of the Inland Navigational Rules Act of 1980 [33 U.S.C. §2003 (Rule 3)], the legislative history of the Act [Senate Report No. 96-979 of 22 Sep 80], nor any of the predecessor navigation rules, define what types of waterways fall within the term 'narrow channel.'" [Thomas, 1983, pp. 543, 544]

2. "In considering the width of a waterway, the courts have been careful to look, not merely at the overall width, but also at the width which was actually usable for navigation." [Thomas, 1983, p. 544]

3. "It is generally recognized that in determining whether or not a waterway is a 'narrow channel' one must look not only at its physical dimensions but also at the character of the navigational use to which the waterway is put. It has been held that narrow channels are bodies of water where navigation is normally up and down the channel in opposite directions, and that therefore harbor waters with piers on each side, where the necessities of commerce require navigation in every direction (up and down, across, etc.) can not be considered narrow channels." [Thomas, 1983, pp. 545]

4. The following is a definition of a *narrow channel* from a nautical publication:

> "... by court definition, is a body of water navigated up and down in opposite directions, and does not include harbor waters with piers on both sides, where navigation may be, and frequently is, in any direction." [Turpin & MacEwen, 1965, p. 13-21]

5. A *"Shipping safety fairway or fairway"* is defined as "a lane or corridor in which no artificial island or fixed structure, whether temporary or permanent, will be permitted. Temporary underwater obstacles may be permitted under certain conditions described for specific areas in [33 CFR] Subpart B. Aids to navigation approved by the U.S. Coast Guard may be established in a fairway." [33 CFR 166.105(a)]

6. The following are definitions of *fairway* from nautical publications:

> "... interpreted by the courts to include any navigable water on which vessels of commerce habitually move, and therefore embraces the water exterior to a buoyed channel where vessels of light draft frequently navigate, and not merely the channel itself." [Turpin, MacEwen, 1965, p. 13-21]
>
> "The main thoroughfare of shipping in a harbor or channel. Although generally clear of obstructions, it may include a MIDDLE GROUND suitably indicated by navigation marks." [Bowditch II, 1981, p. 803]
>
> "[G]enerally in open water and the water on either side is not much shallower than within the fairway. Fairways are used to route vessels away from natural hazards, oil platforms, mines, or smaller vessels." [Llana, Wisneskey, 1986, p. 48]

7. The following are definitions of a *pass* or *passage* from nautical publications:

> "A navigable channel, especially one through reefs or islands. Also called PASS." [Bowditch II, 1981, p. 876]
>
> "A navigable channel leading to a harbor or river. Sometimes called PASSAGE." [Bowditch II, 1981, p. 876]
>
> "A narrow opening through a barrier reef, atoll, or sand bar." [Bowditch II, 1981, p. 876]

8. "A mariner in a rapidly developing meeting situation on the Mississippi, attempting to use the [court] decisions as a guide in determining whether or not the narrow channel rule should govern his conduct, would need to know, (1) at the prevailing river stage, the width, depth and shape of the navigable portion of the river (including any obstructions such as sandbars, barge fleets, channel dredges, etc.) and the velocity and direction of the current and any counter currents, (2) the navigational use to which that particular portion of the river is generally put, including the normal traffic flow (upstream and downstream, or crossing), whether it is a harbor area, and what, if any, local navigation customs apply; and (3) the approximate dimensions (length, width, and draft) of the approaching vessel, relative to those of the mariner's vessel and the physical dimensions of the river." [Thomas, 1983, p. 551]

9. In a previous marine casualty involving Inland Rule 9, the National Transportation Safety Board made the following comments [NTSB-MAR-82-5, p. 17]:

> "The new inland navigation rules * * * fail to define what constitutes a narrow channel. The Safety Board believes that some interpretive guidance should be formulated for the new rules so that towboat operators may know when to apply this rule. It will do towboat operators little good to learn months after an accident that a court has ruled that a particular portion of a waterway, under a particular set of circumstances, was or was not a 'narrow channel' under the rules, and that the narrow channel rule should or should not have been applied by the persons involved in the accident. Therefore, the Safety Board believes that the Coast Guard should publish interpretive rulings that would help the towboat operator make the determination for himself and thereby assist him in applying the Rules of the Road."

10. The NTSB made the following recommendation to the U.S. Coast Guard in 1982 regarding Inland Rule 9: "Publish interpretive rulings so that river towboat operators will know when to apply the narrow channel rule of the Inland Navigation Rules Act, 1980. (Class II, Priority Action) (M-82-32)" [NTSB-MAR-82-5, p. 18]

11. "The easiest way to provide guidance would be to publish and distribute a summary of the factors the courts have used in determining whether or not particular waterways are 'narrow channels,' and to continue to leave the decisions up to mariners on a case by case basis. This would in no way reduce the problems associated with obtaining and evaluating information on all the factors applicable to narrow channel determinations, nor would it eliminate the inconsistencies caused by the fact that even when all the factors are considered, experts may disagree on the applicability of the narrow channel rule." [Thomas, 1983, pp. 554, 555]

12. The NTSB received a response from the U.S. Coast Guard on 6 October 1982, for NTSB Recommendation No. M-82-32. The response was: "To define a 'narrow channel' so as to apply to all situations would be virtually impossible. It is possible, however, that the factors to be considered in determining when to apply the Rule can be bounded and broad guidance can be issued to mariners." [CG69]

13. On 1 August 1988, the NTSB sent a letter to the Commandant to resolve several "open" safety recommendations previously issued to the Coast Guard. NTSB Recommendation No. M-82-32 on Rule 9 was one of them. The NTSB made the following comments in its letter:

"The Safety Board finds it difficult to understand why the Coast Guard does not concur with this recommendation, and particularly why the Rules of the Road Advisory Council, which was primarily responsible for drafting the Inland Navigation Rules Act of 1980, cannot formulate general guidelines for defining when a narrow channel exists and when to apply the Narrow Channels Rule (Rule 9). With respect to the November 28, 1984, change to Rule 14, this change did not resolve the problem that vessel operators have in complying with the requirements of Rule 9. First, the change to paragraph (a) of Rule 14 simply corrected what was an impractical requirement: that two power-driven vessels meeting on reciprocal or nearly reciprocal courses could not pass on the starboard side of the other. With regard to the second change to Rule 14 giving certain privileges to a downbound vessel with a following current, the Board agrees that this change improves inland navigation safety in situations where vessels are meeting head-on on certain designated waterways other than 'narrow channels' i.e., Great Lakes, Western Rivers, or waters specified by the Secretary. However, the amended Rule 14 does not address the remainder of the requirements of Rule 9, namely paragraphs (b), (c), (d), and (g) (the requirements of paragraphs (e) and (f) not being applicable solely to vessels operating in narrow channels or faiways) [sic]."

"The Safety Board fails to see the wisdom of requiring a vessel to observe specific navigation rules when operating in a narrow channel if the Coast Guard or the Rules of the Road Advisory Council cannot formulate general guidelines for defining when a narrow channel exists and when to apply the Narrow Channels Rule. Safety Recommendation M-82-32 has been classified as 'Closed--Unacceptable Action.'" [CG69]

14. "Another possible solution would be to designate certain portions of confined waterways as 'narrow channels', and to indicate clearly the location of these areas on charts and in other navigational guides. * * * The determination of which portions of a waterway to designate as 'narrow channels' would be fairly complex and would require input from all of the competing interests that use the waterway. * * * Having the narrow channel rule apply to an entire waterway would promote consistency by eliminating the problems associated with change-over points, and would provide simplicity by eliminating the complex designation determinations and revisions required by partial applications of the rule." [Thomas, 1983, pp. 555, 556]

h. Performance of the Towing Vessel Crew

1. "The reason that piloting and chartwork are still an integral part of electronic navigation is that, without a graphic representation of your pilot waters, you cannot know what lies along the course. Without a chart and without plotting your electronically determined position on a chart, you cannot know whether or not you are headed for danger." [Maloney, 1994, p. 427]

2. "A DR [dead reckoning] track should be kept whenever position fixes are not possible, and especially when aids to navigation and landmarks are not available, or when visibility is poor. You should also keep a DR track whenever there is any possibility of an emergency, and it might suddenly be crucial to report your position to the Coast Guard or another source of assistance. In other words, keeping a DR track is part of safe boating and is almost always important." [Maloney, 1994, p. 438]

3. "[I]n coastal piloting, a DR position every hour is common practice." [Maloney, 1985, p. 239]

4. "Cruising just offshore or in larger inland water, a skipper will usually maintain a DR plot of his track with periodic fixes, perhaps every 15 or 20 minutes, perhaps at hourly intervals." [Maloney, 1994, p. 445]

5. "It is your duty as skipper to make a careful judgment as to the precision and frequency with which your vessel's position should be fixed, and then to see that these fixes are carefully made and recorded. This is true whether you are doing the piloting or someone else is - you can delegate the function, but not the responsibility." [Maloney, 1994, p. 445]

6. There were no position fixes or DR positions on the charts in use on oboard the tug. There was, however, a partial DR track from southwest of Green Island toward the Scott Point Shoal buoy. [CG5; CG6A; CG6B; CG6C]

7. In the past, Captain Chad Verret had given standing orders to his "Mate (i.e., operator)," Aric Barrett to wake him up if he had any problems. Captain Verret also gave Barrett orders to keep the tug and barge a certain distance off aids to navigation. [IV TR, p. 644]

8. "Each person in the required complement of licensed deck individuals, including the master, on inspected vessels of 300 gross tons or over which are radar equipped, shall hold a valid endorsement as radar observer." The tug in this case was radar-equipped, but under 300 gross tons. [46 CFR 15.815(a)]

9. The U.S. Coast Guard published an interim rule establishing radar training requirements for licensed Masters, Mates, and Operators of radar-equipped uninspected towing vessels 8 meters (approximately 26 feet) or more in length. Persons employed on or after 1 June 1995 shall hold a valid radar observer endorsement; those holding a valid license dated before 1 June 1995 shall hold a valid certificate from a Radar-Operation course. [NVIC 9-94; 59 FR 53754 (26 Oct 94); 60 FR 8308 (14 Feb 95)]

10. "Radar can be used in several ways to obtain position. * * * The accuracy of radar or radar-assisted position fixes follows in descending order: [a)] Radar ranges and visual bearings of prominent isolated objects; [b)] Radar ranges of several radar-conspicuous objects plotted as position circles; [c)] Radar range and radar bearing of a single charted feature; [and d)] Radar bearings of two or more charted features." [Maloney, 1985, p. 229]

11. The radar on the tug has been used to take ranges (i.e., distances off of land masses) for navigation. [IV TR, p. 634]

12. "Proper use shall be made of radar equipment if fitted and operational, including long-range scanning to obtain early warning of risk of collision and radar plotting or equivalent systematic observation of detected objects." [Rule 7(b); 33 U.S.C. 2007(b); Navigation Rules, 1990, CH-4, p. 17]

13. "[Inland Navigation] Rule 2(a) also requires conformity with the precautions required by the ordinary practice of seamen. There is some opinion (with which this author agrees) [parenthetical phrase from Flyntz] that good seamanship requires plotting. There is also some opinion which indicates that the practice of making a complete radar plot (i.e., relative plot and vector analysis) bears directly on the safety of the ship." [Flyntz, 1983, p. 573]

14. "The worst case [for plotting] is represented by the Ship's Head Up Relative Motion (unstabilized) display. This presentation is the most affected by the ship's motion. The most insidious of the ship's motions is yaw, the oscillation of the ship's heading right and left of its base course. This motion is ever-present and mostly random. Under these circumstances, any information taken directly from the screen will yield relative bearings which will not give an accurate assessment of the risk of collision. This is precisely the reason why compass bearings are specified in [Inland Navigation] Rule 7. * * * An additional problem with this display is that of the target's rapidly shifting position when the observer's own vessel changes course. The presentation during a course change can be disorienting and makes continuous tracking of the contact difficult, if not impossible. During the course change there is no way to determine what effect the navigator's own ship's maneuver is having on the contact's relative motion." [Flyntz, 1983, pp. 569, 570]

15. A disadvantage of radar as a navigational aid is that "[b]uoys, small boats, etc., may not be detected, especially if a high sea is running, or if they are near shore or other objects." [Maloney, 1985, p. 229]

16. The Navigation Safety Regulations in 33 CFR 164 only apply "to each self-propelled vessel of 1600 or more gross tons * * * when it is operating in the navigable waters of the United States except the St. Lawrence Seaway." [33 CFR 164.01]

17. On each self-propelled vessel of 1600 or more gross tons, "[t]he owner, master, or person in charge of each vessel underway shall ensure that * * * [t]he wheelhouse is constantly manned by persons who * * * [f]ix the vessel's position[.]" [33 CFR 164.11(a)]

18. On each self-propelled vessel of 1600 or more gross tons, "[t]he owner, master, or person in charge of each vessel underway shall ensure that * * * [t]he position of the vessel at each fix is plotted on a chart of the area and the person directing the movement of the vessel is informed of the vessel's position; * * * electronic and other navigational equipment, external fixed aids to navigation, geographic reference points, and hydrographic contours are used when fixing the vessel's position; * * * [b]uoys alone are not used to fix the vessel's position; * * * [t]he danger of each closing visual or each closing radar contact is evaluated and the person directing the movement of the vessel knows the evaluation; * * * [m]agnetic variation and deviation * * * are known and correctly applied by the person directing the movement of the vessel[.]" [33 CFR 164.11(c) thru (f); 33 CFR 164.11(i)]

19. On each self-propelled vessel of 1600 or more gross tons, "[t]he owner, master, or person in charge of each vessel underway shall ensure that * * * [t]he person directing the movement of the vessel sets the vessel's speed with consideration for: * * * [t]he density of marine traffic[.]" [33 CFR 164.11(p)(5)]

i. Towing Operations

1. The U.S. Coast Guard took possession of the tug's deck logbook on 2 October 1994. The logbook entries began on 28 August 1994, at Cleveland, Ohio and ended on 1 October 1994, at Kelly's Island, Ohio. During this 35-day period, the barge made 32 trips: 9 trips to Cleveland, Ohio; 8 trips to Marblehead, Ohio; 8 trips to Kelly's Island, Ohio; 6 trips to Fairport Harbor, Ohio; and 1 trip to Detroit, Michigan. Captain Verret made a verbal statement to ODNR Officer Johnston that he only traveled the route to and from Detroit "a few times." [CG49; IV TR, p. 731]

2. Aric Barrett stated, that of his three years being employed on the tug, he had made only two or three trips between Detroit and Kelly's Island; however, during those times he was an engineer. [IV TR, pp. 623-625]

3. Captain Verret indicated that the barge's bowthruster was not used during the accident because it is not effective for barge speeds greater than 2 knots through the water. [Paraphrase of verbal statement by Captain Verret to LTJG McDonald on 2 October 1994]

4. Bow lookouts on the barge have sometimes operated the bow thruster. There is a portable control switch up on the bow of the barge so that a person can physically control the direction of the bow thruster. [IV TR, pp. 651, 654, 676, 677]

5. The barge has been towed astern before. This was done anytime the wind and seas did not allow the tug to safely push the barge in the notch. [CG65A, p. 13]

6. A towing vessel pushing in the notch of a barge has more control than when towing a barge astern. [Blank, 1989, p. 80; Reid, 1975, p. 83]

7. According to Blank [1989, p. 80], when a tug is in the notch of a barge, the "pivot point that had been near the barge's bow had moved back to approximately just forward of the middle of the barge. The deeper the tug was fitted into the barge, the greater the control and ease of steering."

8. "[W]ith a large, deep-loaded barge, with too much way on it, the 'twin-screw effect' (assuming the tug is twin-screw) is largely diminished. The screws in relation to the size of the barge are set quite close together and simply lack the leverage to 'twist' it as they would a smaller barge." [Reid, 1975, p. 83]

9. "Realistically, the tug-barge notched together is a ship and must be handled as such with certain exceptions, the first being speed." [Blank, 1989, p. 304]

10. "As the [big] barge will displace from 20 to 25 times the tug's displacement this difference of draft and displacement slows down the results of rudder action: The water coming from under the barge contains air and is disturbed and in motion." [Blank, 1989, p. 304]

11. "If the large barge being pushed is empty, the speed over the ground in still water will normally be within 1 knot of the tug's own speed when running free." [Blank, 1989, p. 305]

12. "Moderate to slow speed should be used in restricted waters or if approaching a situation where it may be necessary to back down." [Blank, 1989, p. 305]

13. "Most barge towing takes place at speeds between 5 and 10 knots [5.8 and 11.5 mph], and speed will vary according to barge size and form, tug power and propeller design, area of operation, and the wind and weather conditions en route." [CG68, p. 40]

14. "A pushed barge should be as manoeuvrable [sic] as any self-propelled ship. This is likely to be so in the case of fully integrated or articulated tug/barge combinations, where rudder size will be determined as a function of the entity." [CG68, p. 41]

15. "In the case of 'general' pushing configurations however, it is quite likely that the tug has rudders which were designed only for its own manoeuvring [sic] capability. Typical rudder area on a tug is about 2-1/2 to 3 percent of the projected underwater lateral area. When the tug is placed behind a loaded barge, it is obvious that the amount of steering control surface is disproportionately small." [CG68, p. 42]

16. "Tugs with enhanced steering systems, such as azimuthing propulsion (none operating in the Great Lakes to our knowledge) [author's note], steering nozzles, or even twin screws can bring thrust directly to bear in exerting steering force, hence are much better able to control a pushed barge than are conventional screw tugs." [CG68, p. 44]

17. As a result of the 22 September 1993 Amtrak Sunset Limited accident, the Secretary of Transportation directed the Coast Guard to review specific areas of responsibility regarding marine safety on the inland waterways. The following 6 areas were reviewed in an internal report titled "Review of Marine Safety Issues Regarding Uninspected Towing Vessels," on 1 December 1993 [CG67]:

(a) the history of incidents involving operators of uninspected towing vessels;
(b) the adequacy and effectiveness of the licensing requirements for operators of uninspected towing vessels;
(c) the adequacy of the requirements for the reporting of marine casualties and hazardous conditions involving vessels and the adequacy of the penalties for failure to report such incidents;
(d) the adequacy of fendering and lighting systems for bridges over navigable waterways;
(e) the adequacy of the navigation equipment requirements for uninspected towing vessels; and
(f) the adequacy of the aids to navigation system for marking bridges and for marking the approaches to bridges over navigable waterways.

18. The following 7 *conclusions* were from a 1 December 1993 internal Coast Guard report titled "Review of Marine Safety Issues Regarding Uninspected Towing Vessels" [CG67, pp. 16-18]:

(a) "The majority of personnel and vessel casualties involving uninspected towing vessels are directly attributable to human error."
(b) "A towing vessel exists to propel or control one or more other vessels. Therefore, the towing vessel should be considered as part of a system rather than a stand-alone unit. The 'towing-vessel system' can include a tug or towboat and tow that may be over 25,000 GT and propelled by as much as 18,000 HP."
(c) "Horsepower is a more reasonable indicator of a towing vessel's capabilities than gross tonnage. The number of barges that a towing vessel can handle is dependent on horsepower. Enhanced skills are required to safely operate the larger vessels and their tows."
(d) "The standards of training required for an OUTV license are inadequate for an unlimited license, particularly in regards to the use and interpretation of radar."
(e) "The experience required for a license as master or mate of a vessel of 500/1,600 GT is insufficient qualification to serve as an OUTV on high horsepower towing vessels."
(f) "In order to ensure that the mariner has the tools necessary to operate the vessel in a safe manner, regulations prescribing specific navigation equipment

are needed. Use of depth finders and compasses seems to be driven by area of operation and should not be universally required on all towing vessels."

(g) "The present Waterways Analysis and Management System (WAMS) is adequate for identifying a waterway's ATON requirements. The aids to navigation authorized in the Aids to Navigation Manual - Technical (COMDTINST M16500.3A) provide an adequate selection for use by Coast Guard waterway ATON system designers."

19. The following 6 *recommendations* were from a 1 December 1993 internal Coast Guard report titled "Review of Marine Safety Issues Regarding Uninspected Towing Vessels" [CG67, pp. 18-20]:

(a) "Regulations should be developed requiring a radar equipped towing vessel more than 26 feet in length to be operated by an OUTV qualified as a radar observer."

(b) "Regulations should be developed to specify the equivalency of licensed masters and mates of 500/1,600 GT vessels to service as an OUTV. Licensed masters of vessels of 200 GT or less should be limited to service as a second class OUTV."

(c) "The Coast Guard should initiate rulemaking under authority of the Ports and Waterways Safety Act (33 USC 1231) to require that all uninspected towing vessels carry * * * a marine radar system for surface navigation[.]"

(d) "The Coast Guard should initiate rulemaking under authority of the Ports and Waterways Safety Act (33 USC 1231) to require that all uninspected towing vessels carry * * * marine charts for the area to be transited. Charts published by the National Ocean Service (NOS) should be carried in areas they cover, and charts published by the U.S. Army Corps of Engineers in areas where there are no NOS charts[.]"

(e) "The Coast Guard should initiate rulemaking under authority of the Ports and Waterways Safety Act (33 USC 1231) to require that all uninspected towing vessels carry * * * current or corrected publications: Coast Pilot (where coverage exists), Light List and local notice to mariners for area to be transited. The Coast Pilot is published by NOS to supplement navigational information shown on the nautical charts. The Coast Guard publishes the Light List which contains a list of lights, sound signals, buoys, daybeacons, radar responder beacons (RACONS) and radiobeacons. The Light List provides more complete information concerning aids to navigation than can be conveniently shown on charts. However, it is not intended to be used in place of charts, but as a source of additional information. Amendments to the Coast Pilot and changes made to aids to navigation are published in the Local Notice to Mariners. * * * In addition, the rulemaking should seek to identify areas of operation where a compass and depth finder are necessary tools for safe navigation. This will result in carriage requirements while navigating in specified areas."

(f) "The Coast Guard should emphasize the responsibility of towing vessel owners to employ qualified, experienced personnel as operators in charge (or masters) of their vessels."

j. Vessel Manning

1. "A towing vessel that is at least 26 feet in length measured from end to end over the deck (excluding sheer), shall be operated by an individual licensed by the Secretary to operate that type of vessel in the particular geographic area, under prescribed regulations." [46 U.S.C. 8904(a)]

2. "Every uninspected towing vessel which is at least 26 feet in length measured from end to end over the deck (excluding sheer) must be under the direction and control of an individual licensed by the Coast Guard." [46 CFR 15.610]

3. A *Master* is defined as "the officer having command of a vessel." [46 CFR 10.103]

4. "The master is regarded as the individual primarily charged with the care and safety of the vessel and crew. * * * In order to ensure the proper management and safety of his vessel and crew, the master must keep himself well informed of any defects in the vessel which could pose a significant hazard to life or property." [CDOA 2321 (HARRIS), p. 5; CDOA 2307 (GABOURY), p. 6]

5. An *Operator* is defined as "an individual licensed to operate certain uninspected vessels." [46 CFR 10.103]

6. No law or regulation required a Master to be in command of the tug and barge in this case. [46 U.S.C. 8904; 46 CFR 15.805]

7. "A person employed in the service of a vessel is considered to be acting under the authority of a license, certificate or document when the holding of such license, certificate or document is * * * [r]equired by an employer as a condition for employment." [46 CFR 5.57(a)(2)]

8. "It is common practice in the maritime industry to refer to operators of uninspected towing vessels as 'captains.' Neither the term 'captain' nor 'master' is mentioned in the law. The responsibilities of an operator and master are quite different. Fulfilling the manning requirements of a vessel is the responsibility of the master. However, the manning requirements spelled out in 46 U.S.C. 405(b)(2) [repealed by P.L. 98-89, present provisions are in 46 U.S.C. 8104 and 8904] are not the responsibility of an operator of uninspected towing vessels. The legislative history of 405(b)(2) and a careful reading of the statute itself establish that the operator's license is a control not a management license. That being the case, to obtain jurisdiction, even under the condition of employment test, conduct which could place the license in jeopardy must relate to control of the vessel. It is questionable whether ensuring vessel manning is included." [CDOA 2292 (COLE), p. 4]

9. "In the past, there have been cases in which jurisdiction was maintained in the instance of a licensed master hired as master of an uninspected towboat when the holding of that license was required as a condition of employment." [CDOA 2153 (MCKINNEY), p. 8]

10. "The Master of a ship may not rely on others to take the blame for damage resulting from their negligence especially when the danger would have been avoided if the Master had taken proper steps to prevent the errors of others from jeopardizing the safety of the ship." [CDOA 2395 (LAMBERT), p. 6; CDOA 360 (CARLSEN)]

11. "An 'operator' license is not a management license. Rather, it is a control license. * * * An 'operator' is subject to charges for professional activities peculiar to his licensed status solely for the period during which he is directing and controlling the vessel." [CDOA 2373 (OLDOW), p. 5; NTSB Order No. EM-121]

12. "We recognize that a requirement that a vessel have a licensed operator aboard does not mean that the individual who holds such a license must physically be at the wheel whenever the vessel is underway. Rather, it means that there always must be someone aboard who is responsible at all times for the vessel's navigation, by virtue of his or her licensed status, without regard to who is actually steering the vessel at any given point in time. * * * As a result, when the navigation of a vessel has been shared by two or more individuals who are licensed to act as operator, each of them, during his or her turn at the helm, is properly considered to have been acting under the authority of his license **unless it is affirmatively shown that his navigational judgment within the relevant time frame was subordinate to that of another license holder aboard the vessel [emphasis by Investigator].**" [NTSB Order No. EM-121, pp. 3, 4]

13. Inland Bulk Transfer Company stipulated that Captain Verret was the Master of the tug and barge while he was on board. His duties and responsibilities on board were clearly management-oriented and included the following list [CG65A, pp. 11, 12]:

(a) Assist in the selecting, interviewing, and hiring of crew personnel;
(b) In charge of supervising, training, and disciplining crew personnel;
(c) In charge of the vessel and its equipment, including the operation and maintenance of it;
(d) Make recommendations and oversee improvements and repairs;
(e) Assist in the scheduling of vessel operations and personnel; and
(f) Provide information and participate in the evaluation of potential contracts, docking facilities and equipment and other aspects as needed.

14. Both Captain Verret and August Palladino, the Vice President of Inland Bulk Transfer Company, have listed Captain Verret as the "Master" of the tug and barge on the *Reports of Marine Accident, Injury or Death* (Form CG-2692) dated 2 October 1994 and 28 October 1994. August Palladino listed Robert Coleman as the "Operator on Watch" on the Form CG-2692 dated 28 October 1994. [CG45; CG46]

15. Merchant Mariners' Documents (MMDs) are required on vessels of at least 100 gross tons operating on the Great Lakes. According to current law, MMDs are not required on Great Lakes barges. [46 U.S.C. 8701(a); 46 CFR 12.02-7(c)(1)]

k. Anchoring

1. According to Virginia Ostrom, it takes her approximately one minute to retrieve the anchor on the Mach 1. [II TR, p. 161]

2. The Mach 1 had a 15-pound navy stockless anchor. "The [navy] stockless anchor consists of a heavy head in which the crown, arms, and flukes are forged in one piece. This unit is pivoted on the shank so that it can swing from 30° to 40° to either side of the shank. The flukes are large and long, and projecting shoulders or tripping palms are cast at the base of the flukes to make them bite. As the force of the drag exerts itself, the shoulders catch on the bottom and force the anchor to take hold by pushing the flukes downward into the bottom. With too short a scope, or even under a steady pull with a long scope, a stockless anchor may still disengage its flukes as a result of gradually turning over and rolling them out. It also has a tendency to clog or ball on a muddy bottom, causing it to break loose from the bottom. The arms may then pivot to an angle that makes it impossible for the flukes to bite, and the anchor can offer no resistance to dragging except by its weight." [CG9M; II TR, p. 159; Knight, 1984, p. 113]

3. "Some inexperienced boaters [not necessarily the Mach 1 boaters in this case], seeing navy anchors on large ships, conclude that this type is best for all vessels, including small boats. This is simply not so. Ships use them because such stockless anchors can be hauled up into hawsepipes. Their ratio of holding-power-to-weight is so great that, if weight is held within reason for a small boat, holding power is far below safe limits." [Maloney, 1994, p. 257]

4. "[B]ecause of the acknowledged difficulties of appraising dynamical forces, vessel responses, and anchor holding power in different media, most writers on the subject have confined themselves to the assumption of static forces, multiplied by large safety factors, and leading to weights and strengths of anchor tackle larger than necessary to withstand the actual forces involved." [Van Dorn, 1974, p. 398]

5. "Down through the years there have been repeated attempts to reduce anchor weights to a simple formula or table based on boat length or tonnage. Recommendations have varied widely, gradually becoming lighter as more modern designs replaced old-fashioned kedge anchors. With the development of patented designs, however, came the problem of minor variations between manufacturers of anchors of the same general type. The result is that any table of anchor size vs. boat size can only be a broad recommendation, to be modified for individual craft and local situations." [Maloney, 1994, p. 260]

6. There exists a table of recommended sizes for working and storm anchors. "Recommended by various anchor manufacturers, [the] suggested anchor sizes are higher than the average fair weather needs. The sizes assume that in a blow you will have fair holding ground, a scope of seven to one and moderate shelter from heavy seas." The anchor types* in Table 5 - 1 are recommended for a 15 to 25-foot (4.6 to 7.6 meter) boat [Maloney, 1994, p. 261]:

TABLE 5 - 1

Rode length ft (m)	*Rode size in (mm)*	*Chain size in (mm)*	*Danforth standard model*	*Fortress model no.*	*Plow lbs (kg)*	*Bruce lbs (kg)*	*Delta lbs (kg)*
150 (45.7)	3/8 (10)	1/4 (6)	13-S	FX-7	15 (6)	11 (5)	14 (5.7)

**The navy stockless anchor was not represented in the cited reference.*

7. "To anchor, bring the bow into the wind or current and put the engine in neutral. When the vessel comes to a stop, lower, do not throw, the anchor over the bow. The anchor line should be 5 to 7 times the depth of water. Anchoring a small boat by the stern has caused many to capsize and sink. The transom is usually squared off and has less freeboard than the bow. In a current, the stern can be pulled under by the force of the water. The boat is also vulnerable to swamping by wave action. The weight of a motor, fuel tank, or other gear in the stern increases the risk. Do not anchor by the stern!!" [CG61]

8. "Never anchor a small boat by the stern - freeboard is less, and swamping is much more likely to happen." [Maloney, 1994, p. 264]

9. "Tradition notwithstanding, there are really only two satisfactory ways of solving the swinging problem. Both are variations of a single method, which I shall call *elastic anchoring* * * * The preferred way is to anchor by the stern. Sheer heresy? I think not. Any vessel that swings to a bow anchor will usually ride stably by the stern -- the resultant of yawing forces now acts behind the CLR [center of lateral resistance], and the vessel is self-stabilizing. Stern anchoring admittedly raises problems of wind and wave forces from a direction never considered by the designer, and which rule out its application to boats having square vertical transoms, large open cockpits, or fragile cabin superstructures. But most sailboats, and many power craft have relatively soft waterlines aft, and some stern overhang. Given enough flexibility in the anchor system, they will rise to stern seas, and remain drier and more comfortable than if yawing and swinging to a bow anchor. * * * Riding to a stern anchor is much akin to towing[.]" [Van Dorn, 1974, pp. 400, 402]

10. "The rodes for boats may be small chain (for large yachts) but are usually Nylon. This synthetic fiber provides a very desirable elasticity; moreover, when fitted with a length of chain next to the anchor, the problem of wear and abrasion on the bottom is eliminated." [Knight, 1984, p. 126]

11. "For maximum efficiency, all anchors require a low angle of pull - preferably less than 8 degrees from the horizontal. With short scope, holding power is reduced because the angle of pull is too high, tending to break the anchor out. As the pull is brought down more nearly parallel with the bottom, flukes dig in deeper with heavier strains on the line. Surging, as a boat pitches in a sea, throws a great load on the anchor, particularly on short scope. With long scope, the angle of pull is not only more horizontal at the anchor, but the elasticity of a long nylon line cushions the shock loads materially." [Maloney, 1994, p. 262; Van Dorn, 1974, p. 400]

12. Elbert S. Maloney had the following comments regarding proper scope ratios for anchoring: "Under favorable conditions using nylon line, 5:1 might be considered a minimum [scope]; under average conditions, 7 or 8:1 is regarded as satisfactory. Tests show that proper scope ratios range between 5:1 and 10:1, the latter for heavy weather. Even in a very hard blow, in an exposed anchorage, you will probably never need a scope of more than 15:1 with an anchor of suitable holding power. Effective scope for given conditions varies with the type of anchor." Hayler et al. agrees with Maloney's minimum scope ratio: "Good practice requires allowing 5 to 7 fathoms [30 to 42 feet] of chain for each fathom [6 feet] of depth." [Maloney, 1994, p. 262; Hayler, Keever, & Seiler, 1980, p. 8-17]

13. "The character of the bottom is of prime importance [to anchoring]. While the type and design of anchor fluke have a direct bearing on its ability to penetrate, it may be stated broadly that mixtures of mud and clay, or sandy mud, make excellent holding bottom for most anchors. Firm sand is good if your anchor will bite deeply into it. Loose sand is undesirable. Soft mud should be avoided if possible. Rocks prevent an anchor from getting a bite except when a fluke is lodged in a crevice." [Maloney, 1994, p. 263]

1. Great Lakes Barges

1. Navigation and Vessel Inspection Circular (NVC) No. 2-81 was published on 25 February 1981 and became effective on that date. Change number one (CH-1) to this NVC was published on 06 January 1982 and became effective on that date. [CG64]

2. An *Integrated Tug Barge (ITB)* is defined by the U.S. Coast Guard as the following:

> "[A]ny tug barge combination in which a specially designed propulsion unit (tug) is mated to a cargo unit (barge) of a compatible special design or where a propulsion unit (tug) is mated to a cargo unit (barge) with a specially designed connection system such that the combined unit has operating characteristics and seakeeping capabilities which exceed, under all anticipated weather conditions, those of a tug and barge where the tug is secured in the barge notch or on fenders by means such as wire rope, chains, lines or other tackle now commonly used in offshore towing."

This definition applies to vessel construction standards, inspection, certification and manning and may not be applicable with reference to other regulations and statutes. In order to accommodate the wide spectrum of designs, ITBs are classed as either Push-Mode or Dual-Mode. [CG64]

3. NVC 2-81 CH-1 has a non-exhaustive list of four examples where a tug barge combination will be considered by the U.S. Coast Guard as an ITB. The following is one of those examples: "is restrained in the notch of a barge to the extent that the speed and weather operating capabilities of the combined unit approach those of a single vessel." [CG64]

4. A *Push-Mode ITB* is defined by the U.S. Coast Guard as the following [CG64]:

> "[H]as the characteristics of a ship of comparable size in that it has a similar seakeeping capability and it remains in the pushing mode throughout a voyage under all anticipated weather conditions. A Pushing Mode ITB tug may be connected to the barge with either a rigid or an articulated connection system."

5. A *Dual-Mode ITB* is defined by the U.S. Coast Guard as the following [CG64]:

> "[I]s similar to a tug and barge where the tug is secured in the barge notch or on fenders by means such as wire rope, chains, lines or other tackle now commonly used in offshore towing in that it is in all respects equipped to tow by hawser. It does differ, however, in that it employs a method of connection which may permit greater speed, improved maneuverability and seakeeping, and which may be easier and safer to operate."

6. There are five mandatory characteristics of a Dual-Mode ITB [CG64]:

(a) The tug has a hull shape which permits safe hawser towing;
(b) The tug meets the weather, dynamic and towline pull stability criteria;
(c) The tug and barge are equipped and rigged with the necessary gear for hawser towing. This should include a towing engine or bitts, hawser and bridle;
(d) The tug has the capability to separate safely in a timely fashion at a predesignated sea state and shift to towing on the hawser. The capability to disconnect must be demonstrated;
(e) The barge is subject to inspection under applicable statutes. If the barge is not subject to inspection, the combined tug and barge will be considered a conventional tug barge combination.

7. Push-Mode units will be reviewed as self-propelled vessels. Certification and inspection procedures will be the same tonnage as the aggregate tonnage of the Push-Mode ITB. [CG64]

8. Dual-Mode units will be reviewed as separate vessels. The tug will be inspected only if it requires inspection under applicable statutes. Similarly, the barge will be inspected only if it requires inspection under applicable statutes. [CG64]

9. The Dual-Mode seagoing ITB manning scale is controlled by the gross tonnage and inspection status of the tug. For Dual-Mode Great Lakes ITBs, the tug is not subject to inspection regardless of gross tonnage. [CG64]

10. NVC 2-81 CH-1 gives representative examples of Dual-Mode seagoing ITB manning scales for tugs of various gross tonnages. These manning scales were broken down into the following four categories:

(a) 1000 Gross Tons and Above (inspected);
(b) 300 and Over, But Less Than 1000 Gross Tons (inspected);
(c) 200 and Over, But Less Than 300 Gross Tons (uninspected); and
(d) Less Than 200 Gross Tons (uninspected).

11. The only manning scale for a Dual-Mode seagoing ITB less than 200 gross tons is two licensed Operators of Uninspected Towing Vessels. This manning scale applies to Dual-Mode Great Lakes ITBs, but without tonnage limitations. [CG64]

12. Section 5208 of Public Law 102-587 amended 46 U.S.C. 2101 by adding paragraph (13a) and 46 U.S.C. 3301 by adding paragraph (13). 46 U.S.C. 3301(13) now lists Great Lakes barges as a category of vessel subject to inspection. 46 U.S.C. 2101(13a) defines a Great Lakes barge as "a non-self-propelled vessel of at least 3,500 gross tons operating on the Great Lakes." These amendments took effect on 4 November 1992 for Great Lakes barges placed in operation after 4 November 1992. These amendments took effect on 4 November 1993 for Great Lakes barges in operation on or before 04 November 1992. Section 5208(d)(2) of the law states "[t]he Secretary of Transportation may impose reasonable interim requirements to assure safe operation of the barges affected...." To address this matter, on 4 January 1993, Ninth Coast Guard District (m) wrote a letter to Commandant (G-MVI-2) of the U.S. Coast Guard. The letter was titled, "Inspection of Great Lakes Barges in Connection With Revisions to Inspection Laws." Commandant (G-MVI-2) answered the Ninth District's letter on 13 April 1993, by issuing the interim requirements in MVI Policy Letter Number 06-93. These interim requirements went into effect 45 days after issuance of the policy letter, for that operating season only. On 14 July 1993, Coast Guard Marine Safety Office Toledo, Ohio issued a copy of the policy letter to Jim Richmond of Kellstone, Inc. [CG58; IBT27; CG66; CG72]

13. A Ninth Coast Guard District letter to Commandant (G-MVI-2) on 03 January 1993, made several regulation proposals for the new law requiring inspection of Great Lakes barges. The following excerpts of proposals or comments were of particular interest to this investigation [CG66; IBT27]:

> "If the barges are self-unloading and have machinery and power generating equipment we would propose that the manning for that operation be on the certificate and include licensed deck officers and engineers to handle the cargo and ballast operations, QMED's [sic] and deckhands (AB's [sic] and ordinary seaman) to assist in the offloading operations."

"If the barge remains unmanned during the transit the towing vessel shall have sufficient berthing and messing facilities to accommodate the manning required (3 watch system) and an MSD of sufficient capacity for the crew size and could be considered for dual mode status if other criteria are met."

"If the vessel combination is considered a dual mode ITB then an OUTV license holder could be in charge of the navigation of the entire tow, even though the barge may have personnel with superior licenses required by the barges [sic] COI. * * * The vessel [dual mode ITB] reacts like a ship, with the tug in the notch and a bow thruster on the barge * * *."

"Currently the regulations allow the towing vessels to escape common sense with limited or no forward visability when in the notch. This would be corrected if the a [sic] finding of ITB were made and the combined Gross Tons exceeded the 1600 cutoff point of the Navigation Safety Regulations. If it looks like a duck and quacks like a duck, can or should we really call it something else?"

14. On 18 March 1991, Coast Guard Marine Safety Office Milwaukee, WI wrote a letter to the Ninth Coast Guard District (m), titled "Tug/Barge Combinations Operating on the Great Lakes." The letter discussed three tug/barge combinations that were former lake ships converted to barges by removal of various structures and/or machinery. The barges were usually configured to be moved from one location to another by a tug in the pushing mode. All three companies were issued Captain of the Port Orders outlining operating requirements after discussions with each company by the Captain of the Port. The following excerpts of comments were of particular interest to this investigation [CG71]:

"Of initial concern was the degree of visibility from the pilot house of one of the tugs when in the pushing mode. The preamble to the visibility regulations issued in September 1990 (33 CFR 164.15) indicates that the regulations apply only to ships, a fact confirmed by the project officer. It was felt, however, that these tug/barge combinations were of a size and configuration that approximated a ship. I therefore felt that for safe navigation, especially in restricted waters, they too required visibility equal to 33 CFR 164.15."

"The aforementioned lack of applicable regulations results solely from the definition of seagoing (for either vessel or barge) referring only to voyages beyond the Boundary line and not including voyages on the Great Lakes. On the coast, a miscellaneous cargo vessel of more than 300 GT would require an inspection. This limiting factor would be 100 GT for barges. All the barges and several of the tugs used in the aforementioned combinationns [sic] clearly exceed these tonnage barriers and would therefore be regulated if operating out of coastal ports."

The size of the JOSEPH H. THOMPSON now approximates that of a 'Triple A' class ore carrier while the manning and scope of licensed personnel required are vastly different."

"[W]e would then have an OUTV piloting what approximates a ship with a detachable engine room."

"I am currently of the opinion that a 'combination' that approximates the size of a ship (THOMPSON) or that is hastily assembled (HARRIMAN) begins to introduce an unacceptable level of safety degradation."

"My recommendation, therefore, is that consideration be given to a legislative or regulatory change that would bring this type of vessel operating on the Great Lakes under clear guidelines. One plausible solution to this situation would be to change the definition of seagoing to include Great Lakes voyages."

15. The 14 July 1993 letter 16711 from Coast Guard Marine Safety Office Toledo, Ohio to Jim Richmond of Kellstone, Inc stated that the "[i]nspection of the Great Lakes Barge KELLSTONE I has been completed this date. The KELLSTONE I appears to be in compliance with all interim requirements as outlined in MVI policy letter 6-93 [sic]." [CG58; IBT27]

16. Currently, Commandant (G-MVI-2) of the U.S. Coast Guard is requiring the application of existing standards for seagoing barges from 46 CFR Subchapter I (Cargo and Miscellaneous Vessels) and associated subtitles related to pollution prevention and navigation safety, to Great Lakes barges. [CG58; IBT27]

17. The interim requirements for manning is applicable to the following Great Lakes barge operations: a) tug/barge combinations operating in the Push-Mode, as defined in Navigation and Vessel Inspection Circular (NVC) No. 2-81; b) when equipment on the barge unreasonably restricts the visibility of the tug operator; OR c) when the configuration of the tug/barge combination is such that "the person in charge of navigation maintains control from a fixed steering station on the barge." The following are those manning requirements: a) the tug/barge configuration shall be manned as a single vessel utilizing a three watch system; b) the master and mates must hold inspected vessel licenses with tonnage limitations appropriate to the combined tonnages of the tug and barge; and c) the manning scale below should be used as a guide [CG58; IBT27]:

1-Master/1st Class Pilot	1-Chief Engineer
3-Mates/1st Class Pilot	*-Assistant Engineer
6-Able Seaman	*-Oilers

* Dependent on automation level of equipment.

18. According to MVI Policy Letter 06-93, "[f]or tug/barge combination operating in the Dual-Mode, as defined in Navigation and Vessel Inspection Circular (NVIC) No. 2-81, with navigation control of the tow exclusively on the tug, the manning level shall be commensurate with that required for the tug (46 USC Part F) [sic, should be 46 CFR Part F]." [CG58; IBT27]

19. The FRANK PALLADINO JR and KELLSTONE I are of the "2nd Generation Push-Tow Type With Very Deep Notch and Dedicated Tug." A 2nd Generation tug/barge system is defined as one "designed for offshore work with notch and hardware to permit the tug to push over half the time while offshore." [CG68, pp. 27-28]

m. Drugs and Alcohol

1. Prior to this accident, Inland Bulk Transfer Company, Inc. used Firelands Corporate Health Services of Sandusky, Ohio and Solan Urgent Care of Sonal, Ohio for administering drug tests to its employees. [CG58; CG65A, p. 11]

2. Inland Bulk Transfer Company had a drug and alcohol policy since 11 March 1993. The company stipulated the following as its policy [CG58, pp. 3-5; CG65A, pp. 11, 12]:

> "The company has a zero tolerance anti-substance abuse policy which is strictly enforced. This policy includes pre-employment, periodic, random, post accident and reasonable cause substance testing of all crew employees. All crew employees are subject to this policy without exception. All employees are informed of this policy and required to comply. Records are kept of the tests administered as a part of the personnel file of each employee. * * * [A] person who tests positive would be immediately relieved of duty, and ultimately his or her employment would be terminated."

3. Captain Verret was not given a pre-employment drug test because he was employed before the company was in operation and before any drug and alcohol testing program was in place. However, subsequent to program implementation, he was subject to random testing. Chad Verret was given a random drug test on 12 July 1993 by Firelands Corporate Health Services. The test result was negative. [CG58; CG65A, p. 11]

4. David Miles Marracino was given a pre-employment drug test on 18 April 1994 by Firelands Corporate Health Services. The test result was negative. According to the company, Robert Coleman was given a pre-employment drug test. However, no date was mentioned to the Coast Guard for this report. [CG58; CG65A, pp. 11, 12]

5. Prior to 2 October 1994, there was never a positive drug test of any Inland Bulk Transfer Company employee. [CG65A, p. 12]

6. At or about 1600 hours on 1 October 1994, ODNR Watercraft Officer Jeffrey Nehls boarded the tug and barge. He noticed four bags of garbage on the deck. None of the bags had alcoholic beverage containers visible in them. [CG21]

7. On 1 October 1994, the two survivors on board the Mach 1 and all of the crewmembers on board the tug and barge appeared normal to ODNR Watercraft Officer John P. Johnston. They did not have any impaired ability, physical disability, alcohol usage, or drug usage. [CG18; IV TR, pp. 739, 740-742]

8. On 2 October 1994, Serious Marine Incident drug testing was conducted at the Providence Preferred Business Health Network, Providence Hospital, Sandusky, OH. The urine sample collector was Christine Koehler. The laboratory that conducted the urine sample analysis was Roche Biomedical Laboratories, Inc. (a subsidiary of Hoffman-La Roche, Inc.). The Medical Review Officer (MRO) was Thomas Nesgoda, MD, also of Providence Preferred Business Health Network. The following three crewmembers provided urine samples for testing after being registered with the sample collector: Captain Chad J. Verret, Robert E. Coleman, and David M. Marracino. They registered for their tests at 1142, 1145, and 1148 hours, respectively. The registration for drug tests were over 22 hours after the time of the accident. [CG45; CG46; CG79; CG80]

9. On 14 November 1994, the Chairperson and Recorder received from the attorney for the MRO, notorized copies of the urine drug testing procedures used by the urine sample collector and the MRO. On 15 November 1994, the Chairperson and Recorder received from the attorney for the marine employer, a copy of the drug test results for the three crewmembers. The MRO indicated on his 18 October 1994 report to the marine employer, that **David Marracino failed the drug test for *cannabinoid* (i.e., marijuana).** The other two individuals, however, had negative test results. On 21 November 1994, the Chairperson referred the positive drug test for David Marracino to

Coast Guard Marine Safety Office Toledo, Ohio for a separate suspension & revocation investigation under 46 U.S.C. Chapter 77 and 46 CFR 5. [CG79]

10. The bodies of Ian Crane and Michael Burghard were given an autopsy and examined by a coroner on 10 October 1994 (9 days after the accident). No drugs were detected. However, Ian Crane's body had an alcohol (ethanol) level of 40 mg/dl or 0.04% weight by volume, and Michael Burghard's body had an alcohol (ethanol) level of 50 mg/dl or 0.05% weight by volume. [CG54; CG56]

11. On 14 March 1995, LTJG McDonald (i.e., the Recorder) had a telephone conversation with Robert B. Forney, PhD. Dr. Forney has a PhD in Toxicology and is Director of the Medical College of Ohio. The Department of Pathology of this college prepared the forensic toxicology report on the two boys. Dr. Forney stated that he was familiar with the 1 October 1994 accident involving the deaths of the two teenage boys. The Recorder explained to Dr. Forney that the boys had 0.04 to 0.05% weight by volume of alcohol in their bodies at the time of the autopsy, 9 days after their drowning. One body was in the water for 7 days and the other for 8 days. The Recorder also explained that no alcoholic beverage containers were found aboard the boat and that 6 or more hours elapsed between the time they left their homes and the time of the accident. During this entire time, the two boys were in the constant presence of two adults. Ohio DNR officers and other police officers observed these two adults immediately after the accident and did not suspect any alcohol consumption. Dr. Forney stated that two or three kinds of ethanol-producing bacteria exist in the body at all times. This process is called "neoformation of ethanol." Because of the immune system of living persons, the bacteria do not exist in sufficient quantities to produce the amount of ethanol found in the two boys during the autopsy. However, in a post-mortem body the bacteria could reach population levels sufficient to produce measurable levels of ethanol. He could not determine, within a reasonable degree of scientific certainty, that some or all of the ethanol was attributable to either neoformation or ingestion, or both. Dr. Forney stated that, given the circumstances as described by the Recorder, it is more likely that the ethanol was attributable to bacterial neoformation than by ingestion.

12. "Alcohol and other drugs reduce judgment and the ability to react. Furthermore, sun, wind, vibration and noise are very fatiguing, increasing the debilitating effects of alcohol and drugs." [CG63; IBT26]

13. "Analysis results which indicate the presence of alcohol, dangerous drugs, or drug metabolites shall not be construed by themselves as constituting a finding that use of drugs or alcohol was the probable cause of a serious marine incident." [46 CFR 4.06-50(c)]

14. Inland Bulk Transfer Company was a *marine employer* at the time of the accident. [46 CFR 16.105]

15. "The marine employer shall ensure that urine specimen collection and shipping kits meeting the requirements of [46 CFR 16.330] are readily available for use following serious marine incidents. The specimen collection and shipping kits need not be maintained aboard each vessel if they can otherwise be readily obtained within 24 hours from the time of the occurrence of the serious marine incident." [46 CFR 4.06-20(b)]

16. The State of Ohio only allows their courts to admit evidence of drug and alcohol test results conducted within 2 hours of an alleged criminal violation relating to the operation of a vessel. All violations of boating laws and rules in Ohio waters are criminal violations. [Ohio Revised Code 1547.11(B); IV TR, p. 741; Verbal statement by ODNR Officer Johnston to LTJG McDonald]

17. The National Transportation Safety Board (NTSB) conducted a marine casualty investigation into a 21 December 1992 collision in the Houston Ship Channel. In its Marine Accident Report for this casualty, it made the following statement in support of its Safety Recommendation M-93-24 [NTSB/MAR-93/02, p. 25]:

> "The Safety Board believes that delays of up to 18 hours in sample collection were excessive. Current Federal regulations (46 CFR 4.06-10) require that an individual provide appropriate specimens only 'as soon as practicable.' The Safety Board, however, has investigated several other marine accidents in which delays in collecting specimens for drug and alcohol testing were excessive. The Board has recommended 4 hours as the maximum time allowed for obtaining specimens. A recent Board report[23] recounts the history of those accidents and the Board's prior recommendations regarding the importance of timeliness in collecting postaccident [sic]samples for drug and alcohol testing."

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[23] Marine Accident Report- - *Grounding of the United Kingdom Passenger Vessel RMS QUEEN ELIZABETH 2 near Cuttyhunk Island Vineyard Sound, Massachusetts, August 7, 1992* (NTSB/MAR-93-01).

18. Black's Law Dictionary defines *practicable* as "* * * that which may be done, practiced, or accomplished; that which is performable, feasible, possible * * *" and *as soon as practicable* to be "* * * feasible in the circumstances." [Black, 1990, p. 1172]

n. Immunity of Witnesses

1. In the formal hearing on 17 November 1994, Captain Chad Verret, Robert Coleman, and David Marracino invoked their Fifth Amendment rights to not answer questions asked of them. Each of them stated that his reasoning for refusing to testify was that his testimony may be used in further proceedings. [IV TR, pp. 602-618]

2. In the formal hearing on 17 November 1994, LTJG McDonald asked Captain Chad Verret, Robert Coleman, and David Marracino questions about the locations and actions of other crewmembers. Some of these questions were not only about critical, unresolved information needed in the investigation, but were obviously non-self-incriminating. All three individuals still refused to testify. [IV TR, pp. 604, 610, 611, 615, 616]

3. In the formal hearing on 17 November 1994, CAPT Mastenbrook advised Captain Chad Verret, Robert Coleman, and David Marracino that they may be subject to administrative action under 46 CFR 5.61(a)(10) for refusing to testify in the investigation and for interfering with government officials in the performance of their official duties. After being advised of the possible consequences of not testifying, all three individuals still refused to testify. [IV TR, pp. 606, 611, 612, 616, 617]

4. "**Use immunity.** Term generally refers to order of court which compels witness to give testimony of self-incriminating nature but provides that such testimony may not be used as evidence in subsequent prosecution of such witness. People v. Koba, 55 Ill.App.3d 298, 13 Ill.Dec. 306, 371 N.E.2d 1. Such immunity protects a witness only against actual use of his compelled testimony and evidence derived directly or indirectly therefrom, while 'transactional immunity' protects the person against all later prosecutions relating to matters about which he testifies. People v. Sutter, 134 C.A.3d 806, 184 Cal.Rptr. 829, 833. * * *." [Black, 1990, p. 1543]

5. In October of 1994, CAPT Mastenbrook consulted both the Legal Officer and the Chief of the Marine Safety Division from the Ninth Coast Guard District about the granting of testimonial use immunity to Captain Chad Verret, Robert Coleman, and David Marracino. A decision was made that it was not in the public interest to grant use immunity to the three individuals. [IV TR, pp. 618-621]

6. "The immunity statute, in plain terms, authorizes the agency conducting the proceeding to make the public interest assessment, subject to the veto power of the Attorney General. Obviously, this authority is not intended to be used indiscriminately but in the sound exercise of the agency's discretion. It is not enough to argue, as does appellant, that the Coast Guard 'had nothing to lose' by granting immunity to the master. The statute is designed solely to serve the government's need for information rather than the interest of persons prosecuted by the government." [NTSB Order No. EM-86, p. 4]

7. "The Fifth Amendment protects witnesses from answering questions only if it appears that their testimony could subject them to *criminal* prosecution. **The master and mate on watch at the time of a collision resulting in a loss of life could, for example, properly refuse to answer questions which might subject them to prosecution for negligent homicide arising from the operation of a vessel** [emphasis by Investigator]. The witnesses could not, however, refuse to answer questions out of fear that their answers may subject them to a civil penalty, or to sanctions which are not penal in nature, such as license suspension or revocation." [Allen, 1991, p. 257]

8. "To benefit from the privilege against self-incrimination, the witness must invoke it the first time the incriminating question is asked, or the privilege is waived. Where a witness invokes the Fifth Amendment privilege, the government can compel the answer by granting the witness testimonial immunity." [Allen, 1991, p. 257]

9. "Whenever a witness refuses, on the basis of his privilege against self-incrimination, to testify or provide other information in a proceeding before or ancillary to * * * an agency of the United States, * * * and the person presiding over the proceeding communicates to the witness an order issued under this part [18 USCS §§ 6001 et seq.], the witness may not refuse to comply with the order on the basis of his privilege against self-incrimination; but no testimony or other information compelled under the order (or any information directly or indirectly derived from such testimony or other information) may be used against the witness in any criminal case, except a prosecution for perjury, giving false statement, or otherwise failing to comply with the order." [18 U.S.C. 6002(2)]

10. "In the case of any individual who has been or who may be called to testify or provide other information at any proceeding before an agency of the United States, the agency may, with the approval of the Attorney General, issue, in accordance with subsection (b) of this section, an order requiring the individual to give testimony or provide other information which he refuses to give or provide on the basis of his privilege against self-incrimination, such order to become effective as provided in section 6002 of this part." [18 U.S.C. 6004(a)]

11. "An agency of the United States may issue an order under subsection (a) of this section only if in its judgment -- (1) the testimony or other information from such individual may be necessary to the public interest; and (2) such individual has refused or is likely to refuse to testify or provide other information on the basis of his privilege against self-incrimination." [18 U.S.C. 6004(b)]

o. Safety, Education & Training

1. Virginia Ostrom has over 500 hours of experience operating boats but no formal instruction in boating safety. William Crane had not taken any formal boating classes, but had some boating experience. [CG19; II TR, p. 60]

2. The two deceased boys knew how to swim. [CG19; II TR, p. 48]

3. According to Captain Chad Verret, David Marracino had 10 years of experience with tugs and steamships in the Great Lakes and New York harbor. [Paraphrase of verbal statement by Captain Verret to LTJG McDonald on 2 October 1994]

4. Inland Bulk Transfer, Inc. made the following statements in regard to professional training for the crew [CG65A, pp. 10, 11]:

> "* * * Captain Verret, in charge of crew personnel, supervises and oversees on-vessel training in which the more experienced men assist less experienced men in improving their knowledge and skills. The company regards this as professional training, since it is done by and under the supervision of professional mariners. Captain Coleman and Mr. Marracino were both employed in the spring of 1994, and were experienced and able employees at their jobs. No additional professional training from outside the company was needed for them to capably perform their jobs, and none was given."
>
> "All crew employees are under continuous supervision and are instructed in ways which assist in improving their skills and techniques. Vessel management, which is in charge of crew personnel, keeps abreast of developments and information in the maritime industry and provides the crew with such information as is appropriate."

5. "Each licensed, registered, or certificated individual must become familiar with the relevant characteristics of the vessel on which engaged prior to assuming his or her duties. As appropriate, these include but are not limited to: general arrangement of the vessel; maneuvering characteristics; proper operation of the installed navigation equipment; firefighting and lifesaving equipment; stability and loading characteristics; emergency duties; and main propulsion and auxiliary machinery, including steering gear systems and controls." [46 CFR 15.405]

6. The U.S. Coast Guard Auxiliary reported that 356, 810 persons were enrolled in public safe boating courses in calender year 1993. This figure represents an *increase* of 9,532 persons since calender year 1992. There has been a decreasing trend in fatalities per 100,000 boats since the early 1970s, with 1992 and 1993 *decreasing* from 4.0 to 3.9, respectively. In 1993, 79% of boating fatalities involved Operators without some form of boating instruction. [COMDTPUB P16754.6, June 1993, pp. 6, 7, 25; COMDTPUB P16754.7, September 1994, pp. 7, 16, 41]

7. The Code of Federal Regulations (CFR) specifies the license examination topics for each USCG license. A partial list of these topics for Captain Chad Verret and Robert Coleman is in Table 5 - 2.

TABLE 5 - 2. Partial list of U.S. Coast Guard Deck License Examination Topics required for both Chad J. Verret and Robert E. Coleman. [46 CFR 10.910-1, 10.910-2]

U.S. Coast Guard Deck License Examination Topics	Chad J. Verret (Codes 3, 6, 7)	Robert E. Coleman (Codes 11, 17, 24)
Distance Off (Piloting)	X	X
Bearing Problems (Piloting)	X	X
Fix or Running Fix (Piloting)	X	X
Chart Navigation (Piloting)	X	X
Dead Reckoning (Piloting)	X	X
Electronic Navigation	X	X
Instruments and Accessories	X	X
Aids to Navigation	X	X
Charts, Navigation Publications, and Notices to Mariners	X	X
Inland Navigational Rules	X	X
Basic Principles, Watchkeeping	X	X
Radar Observer Certificate*	X	X
Gyro Compass Error/Correction	X	X
Magnetic Compass Error/Correction	X	X
Deviation Table Construction	N/A	N/A
Terrestrial Observation	X	X
Maneuvering in Shallow Water	X	X
General: Turn Circle, Pivot Point, Advance and Transfer	X	X
Towing Operations (Ship Maneuvering and Handling)	X	X
Collision (Emergency Procedures)	X	X
Rescuing Survivors from Ship/ Aircraft in Distress	X	X
Man Overboard Procedures	X	X
Rules and Regs for Uninspected Vessels	X	X
Personnel Management	X	N/A
Shipboard Organization	X	N/A
Required Crew Training	X	N/A
Safety	X	X
Radiotelephone Communications	X	X
Search and Rescue Procedures	X	N/A

*Valid radar observer endorsement not required for uninspected vessels under 46 CFR 15.815.

8. Chad J. Verret received a valid "Radar Observer- Unlimited" endorsement in September 1986; however, it expired in September 1991. [LTJG McDonald's observation of Captain Verret's USCG license file]

9. "In order to obtain a master or mate license with a tonnage limit above 200 gross tons, or a license for 200 gross tons or less with an ocean route, whether an original, raise in grade, or increase in the scope of license authority to a higher tonnage category, the applicant must sucessfully complete the following training and examination requirements: * * * Approved radar observer course[.]" [46 CFR 10.401(g)(2)]

10. A provision exists in the Federal regulations to allow only First Class Pilots to upgrade their licenses **based on the combined gross tonnage of a towing vessel and the vessel(s) towed.** There are no similar provisions for any other license type. The tug and barge, in this case, have a combined gross tonnage exceeding 1,600 gross tons. Robert E. Coleman could, therefore, upgrade his limited First Class Pilot license (300 gross tons) for service on vessels of *any gross tons*. With a First Class Pilot license of any gross tons, Coleman could then obtain after only one year of service, either a license for Master of Great Lakes and Inland Steam or Motor Vessels of Any Gross Tons, or Master of Inland Steam or Motor Vessels of Any Gross Tons. [46 CFR 10.433(c); 46 CFR 10.435(a); 46 CFR 10.711(a) and (d)]

11. The U.S. Coast Guard has a toll-free Boating Safety Hotline: 800-368-5647. The hotline is open Monday through Friday, 8:00 AM to 4:00 PM, eastern time, except on Federal holidays. Callers can use this hotline for boating safety recall information, to comment on U.S. Coast Guard boarding procedures, to report possible safety defects in boats, for answers to boating safety questions, or for boating safety literature. The hotline number can be found in many U.S. Coast Guard published pamphlets and Boating Safety Circulars. [CG60; CG61; CG62; CG63; IBT26]

12. The U.S. Coast Guard Auxiliary, the U.S. Power Squadron, and most State boating agencies teach free courses in boating safety (with possible fees for course materials) for the general public. There exists a toll-free phone number for information about the dates and nationwide locations of these free safe boating classes: 800-336-2628. In Virginia, call 800-245-2628. The Ninth Coast Guard District published pamphlet titled "The Western Lake Erie Boater," contains the national phone number. [CG61; CG62; IBT26]

p. Casualty Reporting

1. Copies of Forms CG-2692 and CG-2692B were sent by facsimile, from Inland Bulk Transfer to the U.S. Coast Guard on or about 2 October 1994. Both of these forms were signed by Captain Chad J. Verret, as Master. Block 44, "Description of Casualty," was left blank. [CG45]

2. A different set of Forms CG-2692 and CG-2692B were sent by first class mail, from Inland Bulk Transfer to U.S. Coast Guard Marine Safety Office Toledo, OH on 2 November 1994. This was over a month after the casualty. Both of these forms were signed by August M. Palladino, as Vice President. Block 44, "Description of Casualty," had the following entry [CG46]:

> "While in route [sic] from Detroit, Mi [sic] and while transiting between Red and Green Bouys [sic] that marks Starve Island Reef and Scott Shoal Point [sic] respectly [sic]. The vessel while maneuvering through many small crafts in said passage was involved in a collision with a Mach I, OH 0164 YU."

3. Block 22 of the Forms CG-2692 submitted to the U.S. Coast Guard for the tug and barge list the following conditions at the time of the accident [CG45; CG46]:

(a)	Sea or River Conditions:	(left blank)
(b)	Weather:	Rain
(c)	Time:	Daylight
(d)	Visibility (meteorological):	Fair
(e)	Distance (miles of visibility):	(left blank)
(f)	Air Temperature (°F):	(left blank)
(g)	Wind Speed & Direction:	(left blank)
(h)	Current Speed & Direction:	(left blank)

PART II - CONCLUSIONS

a. Apparent Causes

1. The primary cause of the collision was the excessively obscured waterline distance forward of the barge's bow from the conning position of the tug (i.e., navigation bridge visibility). The tug and barge were in an unseaworthy condition because of this lack of adequate navigation bridge visibility. International Standard ISO 8468: 1990(E), IMO Resolution A.708(17), and the respective Federal regulations did not apply to the tug and barge combination in this case, even though it exceeded the visibility requirements and standards by a factor of *four*. However, in the absence of an explicit safety regulation, a vessel owner still has a general duty to regard the intent of any international standards and inapplicable safety regulations as being domestic maritime industry safety standards (i.e., good marine practice). [3.a.1; 3.a.2; 3.a.3; 3.a.4; **3.a.5**; **3.a.6**; **3.a.7**; **3.a.8**; 3.a.10; 3.a.11; 3.a.12; Figure 3 - 1; Figure 3 - 2; Table 3 - 1; Figure 3 - 3; Figure 3 - 4]

2. The secondary cause of the collision was the failure of the tug and barge to proceed at a safe speed through the South Passage. The following factors were not given appropriate consideration by the Master and/or Operator in determining a safe speed: the presence of dense recreational vessel traffic on a weekend; the maneuverability of the tug and barge with reference to stopping distance and turning ability in the prevailing conditions; the limited bridge visibility on the tug; and the proximity of numerous shoals and reefs. The tug and barge maintained a cruising speed of 6 knots since its departure from the Detroit River that morning. It only slowed down from its cruising speed when it was within 100 to 150 feet of the Mach 1. At that time, and albeit too late, the Operator of the tug and barge commenced a right turn and slowed down by stopping the engines. [3.a.1; 3.a.2; 3.a.3; 3.a.4; 3.a.5; 3.a.6; 3.a.7; 3.a.8; 3.a.10; 3.a.11; 3.a.12; 3.c.3; 3.c.5; 3.c.8; 3.c.9; 3.c.10; 3.c.11; Figure 3 - 5; Figure 3 - 6; Figure 3 - 7; 3.c.12; 3.c.14; 3.c.15; 3.c.16; 3.c.17; 3.c.18; **3.c.26**; **3.c.27**; 4.13; 4.14; 4.15; 4.21; 4.22; 4.24; 4.28; 4.29; 4.35; **4.41**; **4.44**; 4.47; 4.52; 4.53; 4.59; 5.i.7; 5.i.8; 5.i.10; 5.i.11; 5.i.12; **5.i.13**; 5.i.14; 5.i.15; 5.i.16; 5.i.17]

3. The primary cause of the deaths of Ian Crane and Michael Burghard was by drowning within minutes of entering the water. [**4.46**; 5.a.4; 5.a.5; 5.a.6; **5.a.7**; 5.a.8; **5.a.9**; 5.a.11]

4. The secondary cause of the deaths of Ian Crane and Michael Burghard was their failure to wear personal flotation devices before entering the water. The impending collision (i.e., within seconds) by the barge influenced Ian Crane to jump into the water. Evidence suggests that Michael Burghard also jumped into the water. Both of them knew how to swim. [4.39; 5.a.10; 5.a.11; 5.a.12; **5.o.2**]

5. The cause of Virginia Ostrom's back injury was the collision of the Mach 1 by the barge and the subsequent dragging of the Mach 1 on the water's surface by the barge. [4.48; 4.52; 4.53; 5.a.1]

b. Contributing Causes

1. A contributing cause of the collision was the failure of the Mach 1 and of the tug and barge to sound at least five short blasts on their whistles (i.e., the doubt or danger signal). Both Operators either failed to understand the intentions or actions of the other, or were in doubt whether sufficient action was being taken by the other to avoid collision. The Mach 1 had its radio turned off; therefore, radio communications were not an option. [4.10; 4.57]

2. A contributing cause of the collision was the inability of Virginia Ostrom to start the engine on the Mach 1 in time to maneuver. [4.39; 4.42]

3. A contributing cause of the collision was the presence of more than two vessels in sight of one another; whereby, possibly creating a special circumstance as described by Inland Rule 2. Because Inland Rules 11 through 18 only apply to two vessels in sight of one another, the presence of the additional recreational vessels may have precluded "full compliance with the Rules; any action required with respect to one vessel may conflict with the action required with respect to one or more of the others" (Llana & Wisneskey, 1986, p. 10). In this case, the tug and barge could have made a departure from the Rules in order to avoid a collision with the Mach 1 or at least to minimize the damage. [5.c.8; 5.c.23; **5.c.24**; 5.c.25]

4. A contributing cause of the collision was the tug and barge Operator's strict observance of the customary usage of the Starve Island Reef Buoy 2 and Scott Point Shoal Buoy 1 as a channel for navigation. As stated in both the U.S. Coast Pilot and the Light List, these two buoys were aids to navigation that marked a reef and shoal, respectively. A mile-wide channel only existed directly between the two buoys and had no defined length. As stated by the Chief of the Ninth Coast Guard District Aids to Navigation Branch in Coast Guard Exhibit 78: "* * * masters and pilots may deviate from the prescribed buoy and beacon signals in the interest of safe and prudent navigation." In this case, however, the Operator took the customary route between the two buoys; rather than taking the alternate, less congested, unmarked deepwater passage to the north. [3.c.11; Figure 3 - 6; Figure 3 - 7; 3.c.12; 3.c.14; 3.c.15; 3.c.16; **3.c.17**; 3.c.18; 3.c.22; **3.c.25**; 3.c.26; 3.c.27; 3.c.29; 3.d.1; 3.d.2; 3.d.3; **3.d.5**; 3.d.6; 3.d.7; 3.d.8; 3.d.9; 4.28; 4.29; 4.31; **4.35**; 4.47]

5. A contributing cause of the collision was the failure of the tug to drop its anchor after realizing a collision was imminent and unavoidable. By dropping the anchor, the tug and barge could have minimized the impact with the Mach 1 or even shortened the distance that the Mach 1 was dragged along the surface of the water. [1.a; Figure 1 - 2; 4.52; 4.53]

6. A contributing cause of the collision was inadequate voyage planning by the tug and barge. An alternate route to Kelly's Island from Detroit could have been taken by the tug and barge, considering the presence of shallow water and the high density of recreational vessel traffic in the South Passage customarily expected on a weekend. A possible route could have been around North Bass Island. [3.b.10; 3.c.3; 3.c.5; 3.c.8; 3.c.9; 3.c.10; 3.c.11; Figure 3 - 5; Figure 3 - 6; Figure 3 - 7; 3.c.12; 3.c.14; 3.c.15; 3.c.16; 3.c.17; 3.c.18; **3.c.26**; **3.c.27**; 4.6; 4.21; 4.28; 4.29; 4.31; 4.47]

7. A contributing cause of the collision was the failure of the tug and barge Operator to use the operational radar for ranges in order to determine other options for safe navigation outside of the route between the two buoys. The one, operational radar was turned on, but was not being used for position-fixing. Aric Barrett testified that the radar had been used by him in the past for ranges. [1.d.1; 1.d.2; 1.d.3; Figure 3 - 6; Figure 3 - 7; 3.c.14; 3.c.15; 3.c.16; 3.c.18; 3.c.24; 3.d.7; **4.29**; 4.35; **5.h.1**; 5.h.2; 5.h.3; 5.h.4; **5.h.5**; **5.h.6**; **5.h.10**; **5.h.11**; 5.h.12; 5.h.17; **5.h.18**; 5.h.19]

8. It could not be determined whether a lack of radar training for the Operator contributed to the cause of the collision, because of the Operator's refusal to testify. The Federal regulations in existence at the time of the collision did not require Operators of uninspected vessels to hold a valid endorsement as a radar observer. The endorsements were only required for deck officers on radar-equipped inspected vessels of 300 gross tons or over. Inland Rule 7 does not make such a clarification between inspected or uninspected radar-equipped vessels. It also does not address radar competency or training. It just says that the radar equipment *shall* be properly used if fitted and operational to obtain early warning of risk of collision. It is most fortunate that the Coast Guard published an interim rule in the 26 Oct 94 and 14 Feb 95 Federal Registers, establishing radar training requirements for operators of radar-equipped uninspected vessels. [2.a; 5.h.8; **5.h.9**; 5.h.12; **5.h.13**; 5.h.14; 5.h.18; 5.h.19; 5.n.1; 5.n.2; 5.n.3; 5.n.5]

9. A contributing cause of the collision was the lack of navigation safety equipment and manning on board a tug/barge combination that would be required for an ITB or ship of the same size. Currently, the navigation safety regulations of 33 CFR 164 only apply to self-propelled vessels of 1,600 or more gross tons (i.e., ships). The tug in this case was only 88 gross tons with a length over all of 100 feet (30.48 m). However, the tug and barge combined were 6,368 gross tons with a length over all of 456 feet (138.99 m). The barge also had self-unloading equipment and a bow thruster. The only required manning for the combination was an Operator for the tug. The tug's magnetic compass had no bearing azimuth circle or azimuth ring; however, it could be used to take visual bearings. Several fixed navigation aids were available in the vicinity. The last time the magnetic compass of the tug was adjusted and a compass deviation card was made was in Louisiana in 1985, or nine years prior to the accident. Both the adjustment and card were done by the previous owner for the tug alone. Therefore, it would have been imprudent for the Operator in this case to rely on any magnetic compass bearings taken. In absence of the Operator's testimony, it was probably this reason that the magnetic compass was not used for position-fixing. Since the FRANK PALLADINO JR rarely operates by itself and usually operates in the notch of the KELLSTONE I, it would seem reasonable and prudent to make two compass deviation cards: one for the tug alone and one for the tug in the notch of the barge. The lack of a gyro-stabilized radar display may have also contributed to the collision. Even though the Operator did not plot targets in this case, if he did, he would be incapable of maintaining an accurate, systematic plot of those targets anyway. This fact alone, would preclude the use of the tug's radar in effectively assessing any risk of collision. It also makes a strong case for requiring gyrocompasses on *all* radar-equipped vessels, whether inspected or uninspected. [1.a; 1.b; 1.d.1; 1.e.1; **1.e.2**; **1.e.3**; 1.e.4; 1.e.5; **1.e.6**; **3.a.7**; 3.c.23; 5.h.6; **5.h.12**; 5.h.13; **5.h.14**; **5.h.17**; **5.h.18**; **5.h.19**]

10. It could not be determined that David Marracino's use of drugs contributed to the cause of the collision, despite the fact that he failed a drug test for cannabinoid (i.e., marijuana) 22 hours after the collision. Furthermore, 46 CFR 4.06-50(c) explicitly prohibits construing a finding based solely on a positive urine specimen that use of drugs was a probable cause of a casualty. [5.m.7; **5.m.8**; 5.m.9; 5.m.17; 5.m.18; 5.m.19; 5.m.20; 5.m.21]

11. It was not an apparent cause, nor a contributing cause of the collision that the Mach 1 failed to exhibit a ball dayshape while at anchor. Given the density and frequency of recreational vessels that customarily fish while at anchor in the South Passage, a reasonable and prudent mariner would expect a single recreational vessel among a pack of anchored vessels to also be anchored. Even if the Mach 1 was underway (which includes dragging anchor and not making way), its aspect was such that the tug and barge were approaching it from the port side, in a crossing situation, and was therefore required by Inland Rule 15(a) to keep out of the way of the Mach 1. Inland Rule 16 further requires that the vessel directed to keep out of the way of another vessel shall, so far as possible, take early and substantial action to keep well clear. The tug and barge, in this case, waited until they were 100 to 150 feet away from the Mach 1 before commencing any action to avoid collision. Testimony of witnesses revealed that hardly any recreational vessels exhibit ball shapes when at anchor. [3.b.6; 3.b.11; 4.9; 4.21; 4.29; 4.31; 4.35; 4.36; 4.43; 4.44; 4.47; 4.54; 4.56; 5.c.7; 5.d.1; 5.d.2; 5.d.6; 5.d.7; 5.d.8; 5.d.9; 5.d.10]

12. Evidence suggests that hypothermia was not a contributing cause of the deaths of the two boys. The water temperature at the surface was 68° F (20.0° C). At this temperature, the expected time of survival for a person is from 2 to 40 hours. Exhaustion or unconsciousness will normally be experienced from 2 to 7 hours. According to their death certificates, death occurred within minutes due to accidental drowning. [**3.b.9**; 5.a.6; 5.a.7; 5.a.8; 5.a.9; 5.a.11; **5.a.12**]

13. There is no evidence to suggest that alcohol caused or contributed to the cause of the casualty. [5.m.6; **5.m.7**; 5.m.10; 5.m.11; 5.m.16]

14. There is no evidence that inspected material or equipment caused or contributed to the cause of the casualty.

15. There is no evidence that any Coast Guard personnel or representative or employee of any other government agency or any other person caused or contributed to the cause of the casualty.

c. Evidence of Culpability

1. There is evidence of a violation of 46 U.S.C. 2302(a) on the part of Captains Chad J. Verret and Robert E. Coleman: operating a vessel in a negligent manner that endangered the life, limb, or property of a person. The following is a non-exhaustive list of this evidence: (a) the tug and barge proceeded at an unsafe speed of 6 knots through the South Passage; (b) the tug and barge did not reduce speed until about the time of the collision; (c) an obvious condition of poor navigation bridge visibility that existed when the tug was in the notch of the barge; (d) the South Passage was heavily congested with small recreational vessels on a Saturday afternoon; (e) failure to sound a danger/doubt whistle signal to warn the Mach 1; and (f) failure to follow good marine practice regarding magnetic compass deviation cards. Supporting a case of possible negligence against Captain Verret, is the fact that he held the tug plans in his home on Kelly's Island: plans with a "theoretical" raised conning station that were never implemented. The operation of the tug and barge with poor navigation bridge visibility could also be used as evidence of a violation of Inland Rule 5 [33 U.S.C. 2005]: failure to maintain a proper look-out. As explained by Llana & Wisneskey (1986, p. 23), "[t]he term, as used by the Rules, denotes not a person but rather the systematic collection of information." This description is consistent with the Inland Rule 5 phrase "by all available means." Simply putting a licensed person on the roof of the tug pilothouse and an unlicensed person on the bow of the barge does not alone consitute a proper look-out. A person as a look-out is an *extra* set of eyes and ears for the vessel, not the *only* set of eyes and ears. The Operator, in this

case, could not see objects on the surface of the water for 1,135.08 meters (3,724 feet) or eight tug/barge lengths and chose to rely totally on the reports from his two look-outs to navigate safely.

2. There is evidence of a violation of 46 CFR 5.61(a)(10) on the part of Captains Chad J. Verret and Robert E. Coleman: refusing to testify at a formal investigation while under subpoena; whereby, interfering with government officials in the performance of their official duties. David Marracino also refused to testify, but later voluntarily surrendered his MMD in preference to appearing at a suspension and revocation hearing for charges of drug use. [**5.n.1**; **5.n.2**; 5.n.3; 5.n.4; **5.n.5**; 5.n.6; 5.n.7; 5.n.8; 5.n.9; 5.n.10; 5.n.11]

3. There is evidence of a violation of Inland Rule 30(a)(i) [33 U.S.C. 2030(a)(i)] on the part of Virginia Ostrom: failure to exhibit a ball shape while at anchor where other vessels normally navigate. [4.9; 4.54; 4.56]

4. There is evidence of a violation of Inland Rule 34(d) [33 U.S.C. 2034(d)] on the part of Virginia Ostrom: failure to sound five or more short and rapid blasts on a whistle when in doubt. Ms. Ostrom either failed to understand the intentions or actions of the tug and barge, or was in doubt whether sufficient action was being taken by the tug and barge to avoid collision. [4.57]

5. There is evidence of a violation of 46 CFR 67.323 on the part of Inland Bulk Transfer, Inc: engaging a documented vessel in trade without changing the Managing Owner's name and address as required by 46 CFR 67.113 and 67.321. Inland Bulk Transfer, Inc. is the *de facto* owner of the FRANK PALLADINO JR even though the documented Managing Owner is Inland Refuse Transfer Company. [1.a]

d. Analysis of Facts

1. There was some discrepancy on what the wind speed and direction was at the time of the collision. Credible evidence suggests that the wind direction was from the northeast and the wind speed was 8 or 9 knots (9.2 or 10.4 mph). [3.b.6; 3.b.7]

2. There was sufficient water available for the tug and barge to safely navigate through the deepwater passage (i.e., Starve Island Deep) to the north of Starve Island Reef Lighted Buoy 2. [1.a; 1.b; 3.b.10; 3.c.5; 3.c.8; 3.c.9; 3.c.10; 3.c.11; Figure 3 - 6; Figure 3 - 7; 3.c.12; 3.c.14; 3.c.15; 3.c.16; 3.c.17; 3.c.18; 3.c.29; 4.6; 4.47]

3. The towing operation of the tug and barge combination did not severely restrict its ability to deviate from its course. Also, more credible evidence suggests that the tug and barge were not exhibiting restricted in the ability to maneuver lights or shapes at the time of the collision, than to the contrary. Therefore, the tug and barge combination was simply a "power-driven vessel" under Inland Rules 3(b) and 18(a), and was not restricted in its ability to maneuver. [3.d.4; Figure 1 - 4; 3.d.6; 3.d.7; 5.d.11; 5.d.12; 5.d.13; 5.d.14; 5.d.15; 5.d.16; 5.d.17; 5.d.18; 5.d.19; 5.d.20; 5.d.21; 5.i.6; 5.i.7; 5.i.8; 5.i.10; 5.i.11; 5.i.12; 5.i.15]

4. More evidence suggests that the Mach 1 *should have been* dragging anchor, than suggests it was not dragging anchor. Marracino alleged that he saw someone pull on the anchor line just prior to the collision, causing the Mach 1 to drag its anchor and drift into the path of the oncoming tug and barge. Crane stated that he never touched the anchor line and that his vessel was not dragging its anchor. The navy stockless anchor used by the Mach 1 was within the recommended weight range (i.e., 15 pounds), but was not one of the recommended types for a vessel of its size and did not have suitable holding power

according to treatises on anchoring. The Mach 1 also did not have a sufficient amount of rode for the depth of water. The actual scope ratio for the 61 to 62-foot rode (portion below water surface) and a water depth between 24 and 26 feet was between 2:1 and 3:1. A 62-foot rode with a standard scope ratio of 7:1 would be satisfactory for a water depth of 9 feet. Using a *minimum* scope ratio of 5:1, the water depth of 24 to 26 feet requires a 120 to 130-foot rode. Using a *standard* scope ratio of 7:1, the water depth of 24 to 26 feet requires a 168 to 182-foot rode. [4.9; 4.43; 4.45; 4.46; 4.54; 5.c.7; 5.k.1; 5.k.2; 5.k.3; 5.k.4; 5.k.5; 5.k.6; 5.k.7; 5.k.8; 5.k.9; 5.k.10; 5.k.11; 5.k.12; 5.k.13]

5. The South Passage is not currently a narrow channel, fairway, or anchorage. It is, though, an area where other vessels normally navigate. Therefore, Inland Rule 30(e) required the Mach 1, a vessel less than 7 meters in length, to exhibit a ball shape in the fore part while at anchor in the South Passage. The Mach 1, however, did not exhibit a ball shape. [1.c; Figure 1 - 3; 3.c.5; 3.c.8; 3.c.9; 3.c.10; 3.c.11; Figure 3 - 5; Figure 3 - 7; 3.c.12; 3.c.14; 3.c.15; 3.c.17; 3.c.18; 3.c.19; 3.c.20; 3.c.21; 3.c.26; 3.c.27; 3.c.29; **3.d.5**; 4.9; 4.54; 4.56; 5.c.1; 5.c.2; 5.c.3; 5.c.7; 5.d.1; 5.d.2; 5.d.6; 5.d.7; 5.d.8; 5.d.9; 5.d.10; 5.g.1; 5.g.2; 5.g.3; 5.g.4; 5.g.5; 5.g.6; 5.g.7; 5.g.8; 5.g.9; 5.g.10; 5.g.11; 5.g.12; 5.g.13; 5.g.14]

6. None of the Inland Rules prohibited the Mach 1 from anchoring where it did in the South Passage.

7. None of the Inland Rules required the Mach 1 to not impede the passage or safe passage of the tug and barge.

8. No person was designated a lookout per se on board the Mach 1. Virginia Ostrom first observed the tug and barge when it was heading south of them toward the other anchored vessels. This was before it turned left at the Starve Island Reef buoy and was at least 8 minutes before the collision. The Mach 1 had an all-round view at its steering station, limited only by the canopy stanchions, and was anchored in open water along with a pack of other anchored recreational vessels. William Crane did not believe at that time that the tug and barge represented any danger to his vessel. The second time Ms. Ostrom saw the tug and barge, it had already turned towards her. [1.a; 1.b; 1.c; Figure 1 - 3; 3.b.1; 3.b.2; 3.b.3; 3.b.4; 3.b.5; 3.b.6; 3.b.7; 3.b.8; 3.b.10; 3.c.5; 3.c.8; 3.c.9; 3.c.10; 3.c.11; Figure 3 - 5; Figure 3 - 6; Figure 3 - 7; 3.c.12; 3.c.14; 3.c.15; 3.c.16; 3.c.17; 3.c.18; 3.c.19; 3.c.20; 3.c.21; 3.c.26; 3.c.27; 3.c.29; 3.d.5; 4.6; 4.9; 4.17; 4.32; 4.33; 4.37; 4.39; 4.47; 4.54; 4.56; 5.c.1; 5.c.2; 5.c.3; 5.c.7; 5.c.9; 5.c.10; 5.c.11; 5.c.12; 5.c.13; 5.c.14; 5.c.15; 5.c.16; **5.c.17**; 5.c.19; 5.d.1; 5.d.2; 5.d.6; 5.d.7; 5.d.8; 5.d.9; 5.d.10; 5.g.1; 5.g.2; 5.g.3; 5.g.4; 5.g.5; 5.g.6; 5.g.7; 5.g.8; 5.g.9; 5.g.10; 5.g.11; 5.g.12; 5.g.13; 5.g.14]

9. Virginia Ostrom was the Operator of the Mach 1 at the time of the collision as evidenced by her assuming the control of the vessel. [4.10; 4.39; 4.48]

10. Captain Chad J. Verret was the Master for the tug and barge, despite the fact that a Master was not required by law or regulation. The fact that Captain Verret was the Master was stipulated by the company and was further supported by the following facts: (a) he holds a license authorizing service in the capacity as a Master; (b) both Form CG-2692s submitted to the Coast Guard listed him as the "Master;" and (c) his company-assigned responsibilities were clearly management-oriented, exceeding that expected of just an Operator. Evidence also suggests that the navigational judgement of both "Mates," Captain Coleman and Aric Barrett, were subordinate to Captain Verret's. [2.a; 4.7; **4.44**; **5.h.6**; 5.j.1; 5.j.2; 5.j.3; 5.j.4; 5.j.5; 5.j.6; 5.j.7; 5.j.8; 5.j.9; 5.j.10; 5.j.11; **5.j.12**; 5.j.13; 5.j.14]

11. Captain Robert E. Coleman was the Operator of the tug and barge at the time of the collision. [2.a; 4.7; 4.18; 4.44; 4.62; 5.j.1; 5.j.2; 5.j.5; 5.j.7; 5.j.8; 5.j.11; 5.j.12; 5.j.14]

12. It cannot be determined whether the 22 hours, in this case, was an unreasonable delay by the marine employer in obtaining urine specimens of required individuals. Inland Bulk Transfer, Inc. obtained Serious Marine Incident urine specimens of Verret, Coleman, and Marracino 22 hours after the collision. The terms "as soon as practicable," "readily available for use," "readily obtained within 24 hours," and "due diligence" are used throughout the drug and alcohol testing regulations to describe marine employer responsibilities, but are not explicitly defined. The term "as soon as practicable" is used in 33 CFR 95.035(b), 46 CFR 4.06-10, 46 CFR 4.06-20(c), and 46 CFR 16.250(c). The terms "readily available for use" and "readily obtained within 24 hours" are used in 46 CFR 4.06-20(b) in reference to specimen collection and shipping kits. The term "due diligence," is used in 33 CFR 95.050(a). The National Transportation Safety Board believes that 18 hours is excessive, recommending 4 hours as the maximum time allowed for specimens. The State of Ohio is even more restrictive in that it uses 2 hours as the maximum time allowed for samples. [5.m.7; **5.m.8**; 5.m.9; 5.m.17; 5.m.18; 5.m.19; 5.m.20; 5.m.21]

13. The Mach 1 was not a "vessel engaged in fishing," as defined in Inland Navigation Rule 3(d), because its fishing apparatus did not restrict its maneuverability. The Mach 1 was simply a "power-driven vessel" under Inland Rules 3(b) and 18(a). [4.9; 4.37; 5.c.20; 5.d.12]

14. The refusal to testify by Captain Chad J. Verret, Captain Robert E. Coleman, and David M. Marracino interfered with the collection of critical, unresolved human factors needed in this investigation. The Coast Guard decided that it was not in the public's interest that testimonial use immunity be granted to these three individuals. [**5.n.1**; **5.n.2**; 5.n.3; 5.n.4; **5.n.5**; 5.n.6; 5.n.7; 5.n.8; 5.n.9; 5.n.10; 5.n.11]

15. U.S. Coast Guard policy guidances and regulations pertaining to deep notch tug and barge combinations, ITBs, and Great Lakes barges do not fully address safety, manning, and equipment issues. MVI Policy Letter 06-93 required increased manning for Great Lakes barge operations "when equipment on the barge unreasonably restricts the visibility of the tug operator." A literal interpretation of the wording of the interim requirements for manning, because of the use of the word "or" between the requirements, suggested that any one of them would require the following: a) the tug/barge configuration shall be manned as a single vessel utilizing a three watch system; b) the master and mates must hold inspected vessel licenses with tonnage limitations appropriate to the combined tonnages of the tug and barge. These interim requirements went into effect 45 days after issuance of the policy letter, but *for that operating season only*. A letter on 3 January 1993 from the Ninth Coast Guard District (m) to Commandant (G-MVI-2), made several important regulation proposals or comments pointing out the same concerns as the Investigating Officers (*see also* item 13 of Chapter 5 under *Great Lakes Barges*). [3.a.1; 3.a.5; 3.a.6; 3.a.7; **3.a.8**; Table 3 - 1; Figure 3 - 3; Figure 3 - 4; 4.2; **4.24**; 5.i.9; 5.i.14; **5.i.18**; 5.1.1; 5.1.2; 5.1.3; 5.1.4; 5.1.5; 5.1.6; 5.1.7; 5.1.8; 5.1.9; 5.1.10; 5.1.11; **5.1.12**; **5.1.13**; **5.1.14**; 5.1.15; 5.1.16; **5.1.17**; 5.1.18; 5.1.19]

16. Between calender years 1992 and 1993, there was a 3% *decrease* in fatalities per 100,000 boats. During the same time period, there was a 3% *increase* in the number of persons enrolled in U.S. Coast Guard Auxiliary public safe boating courses. In 1993, 79% of boating fatalities involved Operators without some form of boating instruction. [5.o.1; 5.o.6; 5.o.11; 5.o.12]

17. The performance of the various response personnel involved in the search effort were as complete and as thorough as possible and are deserving of public recognition. The following agencies or persons were among the participants in the Search and Rescue efforts on 1 October 1994: Put-in-Bay Police, Port Clinton Police, ODNR Watercraft Division, U.S. Coast Guard Auxiliary, U.S. Coast Guard Station Marblehead, U.S. Coast Guard Air Station Detroit, U.S. Coast Guard Group Detroit (SAR Mission Coordinator), Catawba Island Fire Department divers, Marblehead Fire Department divers, Lakeside Fire Department divers, Ottawa County Dive Rescue, Huron Fire Department divers, and approximately 15 private boaters. [5.a.4; 5.a.5; 5.b.1; 5.b.2; 5.b.3; 5.b.4]

PART III - RECOMMENDATIONS

1. Inland Bulk Transfer Company and Kellstone, Inc. should take immediate and appropriate action to improve the navigation bridge visibility problem when the tug FRANK PALLADINO JR is in the notch of the empty, ballasted barge KELLSTONE I.

2. U.S. Coast Guard Marine Safety Offices should include visibility surveys as a part of vessel inspections and Port State Control boardings.

3. U.S. Coast Guard policies and regulations pertaining to deep notch tug and barge combinations, ITBs, and Great Lakes barges should be reviewed and updated to ensure a consistent high standard of safety for large, specialized tug and barge combinations.

4. The U.S. Coast Guard should further investigate if either the lack of a mast on smaller, power-driven recreational vessels (particularly those under 7 meters) or ignorance of the regulations is the reason for the common practice of not exhibiting ball shapes while at anchor. The goal should be to establish enforceable provisions that can be easily complied with by recreational vessels, even mastless ones.

5. The U.S. Coast Guard should sponsor a technical study by an appropriate third party (e.g., American Boat and Yacht Council, National Marine Manufacturers Association, or United Laboratories) of the various anchor types on the recreational vessel market. The ultimate goal of the study should be to publish a user-friendly guide that evaluates each anchor type under specific conditions. Such a guide would aid the average recreational boater in making an informed choice when purchasing an anchor.

6. The U.S. Coast Guard should review and reconsider NTSB's recommendation that post accident urine sample collection be conducted within 4 hours after a casualty.

7. The U.S. Coast Guard should revisit the issue of whether portions of waterways should be formally designated as "narrow channels."

8. The U.S. Coast Guard should publish in the Marine Safety Manual, COMDTINST M16000 (series), more extensive policy guidance on the handling of "use immunity" situations occurring during marine casualty investigations.

9. The U.S. Coast Guard should consider amending 46 CFR 5.57 using the intent of the statements found on pages 3 and 4 of NTSB Order No. EM-121. Amending this regulation would then apply the "acting under the authority" accountability to off-duty Licensed Operators who exercise control over an on-duty Licensed Operator.

10. The cognizant Officer in Charge, Marine Inspection should further investigate the following violations:

(a) 46 U.S.C. 2302(a) on the part of Captains Chad J. Verret and Robert E. Coleman: operating a vessel in a negligent manner that endangered the life, limb, or property of a person.
(b) 46 CFR 5.61(a)(10) on the part of Captains Chad J. Verret and Robert E. Coleman: refusing to testify at a formal investigation while under subpoena; whereby, interfering with government officials in the performance of their official duties.
(c) 33 U.S.C. 2030(a)(i) on the part of Virginia Ostrom: failure to exhibit a ball shape while at anchor where other vessels normally navigate.

(d) 33 U.S.C. 2034(d) on the part of Virginia Ostrom: failure to sound five or more short and rapid blasts on a whistle when in doubt.
(e) 46 CFR 67.323 on the part of Inland Bulk Transfer, Inc: engaging a documented vessel in trade without changing the Managing Owner's name and address as required by 46 CFR 67.113 and 67.321.

11. The U.S. Coast Guard should work with the National Boating Safety Advisory Council to encourage States to require the following item(s) prior to operating a recreational vessel in State waters: (a) a State-administered motorboat license, and/or (b) proof of *one-time* attendance at a prescribed boating safety training course.

12. The U.S. Coast Guard should give this report broad distribution following its approval.

13. This accident investigation should be closed.

M. W. MASTENBROOK
Captain
U.S. Coast Guard
Chairperson

B. C. MCDONALD
Lieutenant Junior Grade
U.S. Coast Guard Reserve
Member and Recorder

PART IV - APPENDICES

Appendix A - U.S. Coast Guard Station Marblehead, Ohio

Station Marblehead has been a part of the Marblehead community since 1875. The station, originally part of the U.S. Lifesaving Service, was merged with the U.S. Revenue Cutter service in 1915 to become the U.S. Coast Guard.

The primary mission of Station Marblehead is Search and Rescue (SAR) for the island area of western Lake Erie. The station's western border is just east of the Davis Besse Power Plant, to just west of Vermilion, Ohio. This includes all of the Erie Islands and Sandusky Bay.

Station Marblehead is operational 24 hours a day, 7 days a week, 365 days a year. There is a watchstander on duty in the Operations Room at all times for emergencies. There is always one boat crew ready at all times. The number of boats at Ready Standby varies with the season. From Memorial Day, to the Friday after Labor Day, two boats and crews are maintained for immediate response on weekends. Weekends are from 0800 hours on Friday, to 2200 hours on Sundays and holidays. During the remainder of the week, at least one boat is maintained at Ready Standby. Of course emergencies are handled when and as necessary. United States Coast Guard Auxiliary (USCGAUX) vessels and crews are utilized on weekends and holidays during most of the summer. Once ice sets in, the station shifts to winter operations.

- Equipment available for the watchstanders: Three VHF-FM marine radiotelephones
- For SAR responses, the following platforms are available:

  One, 44 ft. Motor Life Boat (MLB). A heavy weather boat with dewatering and self-righting capabilities. It is equipped for most any emergency it might encounter. Maximum speed is 12 knots and maximum range is 215 statute miles.

  One, 41 ft. Utility Boat (UTB). A fast response utility boat. It is equipped for most any emergency it might encounter. Maximum speed is 26 knots and maximum range is 300 statute miles.

  One, 6 Meter Rigid Hull Inflatable Boat (RHIB). A fast response boat that can provide immediate help until one of the larger boats can arrive on scene. Maximum speed is 45 knots and a maximum range is 95 miles.

  One, 14 Ft. Ice Skiff for ice rescue.

Station Marblehead is presently manned by 29 Regular Coast Guard personnel. The main functions of the personnel assigned to the station are as either a boat coxswain, boat engineer, or boat crew member. Each undergoes a strenuous training program before being assigned to one of these positions. The first function learned by all of the station personnel, however, is to be a qualified "watchstander." Many of the station crew are also Emergency Medical Technicians, trained to provide immediate first aid on-scene.

The USCGAUX not only helps with SAR during the summer months, but also does other boating safety functions for the boating public:

- conducts Courtesy Marine Examinations (CMEs) of recreational boats
- checks for proper and required safety equipment

- teach boating safety and seamanship classes
- up-date charts
- public appearances in the communities to pass on boating safety information

The station crew and vessels are here to assist all boaters. From 1988 through 1994 the station responded to 3,450 calls for help, saved 360 lives, assisted another 9,215 people on the water and assisted in saving $53,397,000 in property and equipment. The station has been ranked as the busiest station in the United States over several of the past years. So far this year, there have not been too many lives lost and this is reflected in the actions of the station's crew. They stand ALWAYS READY (i.e., Semper Paratus).

On June 20, 1874, Congress gave authorization for the establishment of new Lifesaving Stations on the Great Lakes. Marblehead received one of those stations.

Station Marblehead has had a rich history of lifesaving duties since it was first established. The islands and reefs have claimed many boats and lives over the years. The Lifesaving Station crews at Marblehead were credited for saving many lives. Crew duties were demanding physically and required much boat-handling skills.

The first station at this site was built in the late 1800s. In 1921, a new station was constructed and designed for 14 men. This building remained in use until January 6, 1982 when the existing station was finished.

The existing facility, with an accompanying new pier and travel lift, was completed at a cost of $1.6 million. The station can billet 50 personnel and provides space for an electronic shop, machinery shop, and a boatswain mates shop. The station can also house two, 41 ft. UTBs, which allows the crew to complete the bulk of exterior hull maintenance during the winter months. [CG59]

Appendix B - Adequacy of the Navigation Equipment for Uninspected Towing Vessels

46 USC 4102 prescribes safety equipment required on uninspected towing vessels. Each uninspected towing vessel propelled by machinery is required to (1) carry and maintain fire extinguishers capable of promptly and effectively extinguishing burning liquid fuel; (2) carry at least one readily available life preserver or other lifesaving device for each individual on board; (3) equip carburetors of each engine of the vessel using gasoline as fuel with an efficient flame arrestor, backfire trap, or other similar device; (4) have the means to ventilate the bilges of the engine and fuel tank compartments so as to remove any explosive or flammable gases if a volatile liquid is used as fuel; and (5) if operating on the high seas or beyond three nautical miles from the coastline of the Great Lakes, be equipped with a specified number and type of alerting and locating equipment, including emergency position indicating radio beacons.

Under 46 USC 4106, failure to comply with the above provisions subjects the owner, charterer, managing operator, agent, master, and individual in charge to a civil penalty of not more than $5,000. The vessel is also liable in rem for the penalty.

Under the Vessel Bridge-to-Bridge Radiotelephone Act, 33 USC 1201-1208, every towing vessel of 26 feet or over in length is required to have a radiotelephone capable of operation from its navigational bridge, and capable of transmitting and receiving on the frequency or frequencies within the 156-162 mega-hertz band using the classes of emissions designated by the Federal Communications Commission, after consultation with other cognizant agencies, for the exchange of navigational information. The civil penalty for non-compliance is $500. 33 CFR Part 26 implements the provisions of the Vessel Bridge-to-Bridge Radiotelephone Act.

Under the International and Inland Navigation Rules (Rules), a vessel of 12 meters or more in length is required to carry a copy of the Rules for ready reference, a whistle, a bell, and if 100 meters or more in length, also a gong. The Rules further prescribe how this equipment is to be used to prevent collisions.

In light of recent incidents, it appears that the above requirements may not provide an operator of an uninspected towing vessel with all of the necessary tools with which to make prudent decisions regarding the operation of the vessel. This view may be shared by industry as it is not uncommon for uninspected towing vessels to carry other navigation equipment, even though not legally required to do so.

Recently, representatives from five towing industry companies were interviewed to determine what equipment they carried on their vessels to ensure safe navigation. The areas of operation for these companies included the Western Rivers, the Gulf Intracoastal Waterway from Brownsville, Texas to Panama City, Florida, the Chesapeake Bay, the Pacific Ocean and coastwise (Puget Sound, San Francisco, California), and coastal from Canada to Mexico and Central America.

All five companies equip their vessels with radar, and those vessels used in ocean and coastwise trade require a second radar. Charts and publications (light lists were specifically mentioned) of the area being transited are also required equipment for these five companies. The value of compasses was questioned. One company uses them on open sounds and bays, while another uses them on the Gulf only. The general view of these representatives was that compasses are of little value when navigating rivers. Depth finders were considered unnecessary for vessels navigating on the Gulf Intracoastal Waterway as it is a

dredged channel with an established project depth that is known to mariners. Depth finders were considered to be useful in river and coastwise navigation.

The companies engaged in towing on ocean and coastwise routes also carry most of the following additional equipment: Loran-C, automatic pilots (iron mikes), satellite navigation equipment (SATNAV), gyrocompasses, automatic radar plotting aids (ARPA). New technology equipment is added as it is developed (such as global positioning system receivers (GPS)). [CG67]

Appendix C - License Requirements for Operator of Uninspected Towing Vessel (OUTV)

Through World War II, most tugs and towing vessels were propelled by steam. Federal law required that the person in the wheelhouse of a steam-powered towing vessel be licensed as a Master or Pilot. The licensing requirements stemmed from the federal inspection and manning requirements for steam-powered vessels.

The post-war industrial boom caused significant growth in the towing industry, particularly on the Western Rivers. As companies built replacements for aging steam-powered vessels, diesel propulsion was selected. Diesel propulsion not only offered economy of operation for the powerplant, but also eliminated the requirement for federal inspection. When this occurred, federal requirements for the number of crewmembers and their qualifications were also eliminated. Along with the demand for personnel to crew new vessels, the old hands were gradually being attrited. New vessels were often operated by unlicensed personnel with minimal qualifications. With few exceptions, companies did not require their wheelhouse personnel to hold a license issued by the Coast Guard.

Other technological advances also occurred. The horsepower (HP) in the new towboats gradually increased and by the 1960s two vessels were fitted with diesel engines of 10,000 HP. New high-lift locks with larger lock chambers were constructed to replace the original low-lift locks. The size of the barges increased. The standard barge of the 1940s, measuring 175' X 26', was replaced by the jumbo barge measuring 195' X 35'. These are now being supplanted by the super-jumbo barge measuring 250 ' X 52'. The trend through the years has been to encourage the most economical movement of cargoes through increased tow size.

Similar changes took place in the coastal ports and on offshore waters. As on the rivers, steam tugs were phased out and replaced with diesel propulsion; the size of the barges increased; and the integrated tug-barge concept developed. The same amount of cargo as carried in a self-propelled vessel could be moved by a tug and tow crewed with fewer mariners with reduced qualifications.

The operator of an ocean-going towing vessel of 200 GT or more was required to be licensed under the Officer's Competency Certificates Convention, 1936 . In ocean service, the diesel propelled towing vessel was required to be inspected if it exceeded 300 GT . Inevitably, many ocean-going towing vessels were built to either 199 or 299 GT to avoid these requirements.

Larger tows, larger barges, larger lock chambers, and greater towing vessel horsepower demanded superior skills of the pilothouse personnel. With the gradual loss of experienced personnel in the pilothouse, the number of casualties gradually increased through the 1960s and early 1970s. These casualties caused a growing awareness of a need to license the operator of an uninspected towing vessel. The result was the enactment of Public Law 92-339 (46 USC 8904, formerly 46 USC 405 (b)(2)) in 1972 to require that the person in charge of operating an uninspected towing vessel be licensed. Through licensing, the operator would be required to acquire experience and demonstrate acceptable knowledge before assuming the responsibility for operating the vessel.

The term "operator" was selected for the new license. The Coast Guard considered it a direct contravention of the congressional intent to extend the conventional master/mate/pilot concepts to the new license. Throughout the congressional hearings held before enactment of the law, the towing industry maintained that their unlicensed towboat operators were excellent seamen. However, with their limited education, they would have extreme

difficulty in passing an examination. Therefore, the resulting regulations recognized the limited educational background of many towboat operators by reducing the scope of knowledge required for licensing. Applicants for OUTV licenses were only tested on the knowledge necessary to navigate and safely direct the operation of the vessel.

Although formal training was not required, the traditional apprenticeship training of the master/mate licenses carried into the OUTV regulations. **In addition, an OUTV license was limited to a broad geographic route: oceans, inland, Great Lakes, or Western Rivers. The routes corresponded to the different navigation rules (Rules of the Road) then existing.*** While the regulations provided for special cases, in general no limitations other than route were placed on an OUTV license. The regulations also provided for a second- class OUTV license that was obtainable with reduced experience to serve as an entry-level license. **While a second-class OUTV may operate a towing vessel, an OUTV must also be on board as part of the crew.**

When the original regulations were developed, several commenters recommend that a gross tonnage or other suitable limitation be included on the license. **This was not done because the 200 GT limitation for oceans and coastwise routes limited the validity of those OUTV licenses. Also, at that time, the Coast Guard believed that gross tonnage was not an accurate indication of the overall capability of a towboat to move a tow.** After considering all the comments, the Coast Guard decided to use route limitations only.

Although the operator of a towing vessel requires many professional skills, some of those skills relate to the type of towing being conducted. Towing on the Western Rivers is almost exclusively push-towing. On the inland waters and the Great Lakes, vessels tow by pushing ahead or alongside, as well as by towing astern on a hawser. In ocean and coastwise service, towing astern on a hawser is the most common, though other forms may be used. However, the examination for an OUTV license only tests the applicant's knowledge of a few topic areas. It contains fewer questions than the test for a license as master of an inspected vessel of 200 GT. **However, a master of a vessel of less than 200 GT may not serve as an OUTV, only a second class OUTV.** A licensed master, mate, or pilot for vessels over 200 GT may serve as an OUTV within the limitations of the license. **The requirements for a license as master, mate, or pilot of vessels over 200 GT do not include experience on towing vessels.** However, all of the other requirements are similar to or exceed those for OUTV. At the time the original OUTV licensing regulations were issued, the Coast Guard took the position in Navigation and Vessel Inspection Circular 3-74, "Management must assume some responsibility in this area if they hire such personnel." "Such personnel" refers to holders of licenses other than OUTV.

As the horsepower of the towing vessel increased, the number of barges being propelled also increased. It is not uncommon to have tows on the Western Rivers consisting of 20, 30 or more barges. **The total tonnage of the tow exceeds that of an inspected, self-propelled vessel carrying the same amount of cargo.** In addition, economical barge transportation has created a demand for the movement of many hazardous chemicals and petroleum products by water.

*This text and the subsequent text emphasized in bold, were done so by the Investigator because of their relevance to this case.

The highest powered U.S. flag towing vessel in oceans service has 18,200 HP. On the Western Rivers, the highest horsepower towing vessel has 10,500 HP. **There is little correlation between gross tonnage and horsepower.** In the 300 to 399 gross ton range, the horsepower ranges from 760 to 7,260 HP and forty percent of these vessels have 1,800 HP or less. In the 600 to 699 gross ton range, the vessels have from 1,400 to 6,700 HP.

The international maritime community recognized the necessity of establishing standards for watchkeeping personnel and in 1978 adopted the International Convention on Standards for Training, Certification and Watchkeeping for Seafarers, 1978 (STCW). The STCW includes standards of knowledge for watchkeeping officers on sea-going or near coastal vessels of less than 200 GT. Standards may be relaxed if a Party believes them unreasonable for a small vessel. Parties must consider then the effect of the relaxation on the safety of all ships operating in the same waters. The United States became party to the convention on 1 October 1991.

Current regulations require three years service before an applicant can qualify for an OUTV license. There are two alternatives for acquiring this service and both include six-months training or duty in the wheelhouse. In 1987, requirements for formal training in fire-fighting, CPR, and first aid were added. Three alternatives are available to an applicant for a second-class OUTV license and may require up to three-months training in the wheelhouse.

At the time of the accident, an OUTV was not required to have a radar observer endorsement or other formal training in the use of radar, even though most tugs/towboats have radar.** The requirements for radar observer endorsements arose from a series of radar-assisted collisions in the 1950s. While the regulations authorize a radar observer endorsement for inland waters, the existing course standards stress collision avoidance. **Plotting to determine the closest point of approach, the course and speed of a contact, and methods to maneuver to avoid collision have limited application on inland waters. Many inland waterways have marked or defined channels or are so limited in geographic extent that these skills are virtually useless. Further, on-scope plotting is not feasible with many radars in use today.** The Maritime Administration is responsible for developing the curricula for the radar courses, and the Coast Guard is responsible for approving the schools that teach the course.

When the regulations in 46 CFR Part 10 were revised in 1987, minor changes were made to the requirements for an OUTV license. The broad geographic routes were carried forward with slight changes reflecting the 1981 unification of the Rules of the Road. While not specifically stated in the regulations, the traditional hierarchy of routes of the master/mate's licenses was extended to the Great Lakes and the Western Rivers as a matter of policy. For example, with this policy, an OUTV licensed for oceans or inland waters could navigate on the Western Rivers with no further examination. **The OUTV licensing regulations do not currently contain clear guidance on the areas of operation authorized for each route.** [CG67]

**The U.S. Coast Guard published an interim rule establishing radar training requirements for licensed Masters, Mates, and Operators of radar-equipped uninspected towing vessels 8 meters (approximately 26 feet) or more in length. Persons employed on or after 1 June 1995 shall hold a valid radar observer endorsement; those holding a valid license dated before 1 June 1995 shall hold a valid certificate from a Radar-Operation course. [NVIC 9-94; 59 FR 53754 (26 Oct 94); 60 FR 8308 (14 Feb 95)]

LIST OF EXHIBITS

a. U.S. COAST GUARD

EXHIBIT NO.

CG1	Towing vessel "General Arrangement Plan," FRANK PALLADINO JR (blueprint)
CG2	Towing vessel "Outboard Profile Plan," FRANK PALLADINO JR, name missing (blueprint)
CG3	Modified towing vessel "Outboard Profile Plan," FRANK PALLADINO JR (above, but with elevated structure shown on tracing paper and taped to original blueprint)
CG4	Towing vessel "Hold Plan," FRANK PALLADINO JR (blueprint)
CG5	"West End of Lake Erie" Chart No. 14830, 23rd Edition
CG6A	Sheet 28 from Recreational Chart (booklet) No. 14842, 8th Edition (taken from FRANK PALLADINO JR on 02 October 1994)
CG6B	Sheet 30 from Recreational Chart (booklet) No. 14842, 8th Edition (taken from FRANK PALLADINO JR on 02 October 1994)
CG6C	Sheet 31 from Recreational Chart (booklet) No. 14842, 8th Edition (taken from FRANK PALLADINO JR on 02 October 1994)
CG7	Compass Deviation Card, "[ex-] LADY IDA," [now the FRANK PALLADINO JR], dated 12-10-85
CG8	Copy of FRANK PALLADINO JR logbook cover page and page no. 35 for 01 Oct 94
CG9A	Photo: View of starboard side of towing vessel FRANK PALLADINO JR and starboard quarter of empty barge KELLSTONE I (Note: There is another vessel in background with twin yellow-striped stacks and a deck boom) DATE: Morning of 05 October 1994 LOCATION: stone dock at Marblehead, OH PHOTOGRAPHER: LTJG David Sandahl, USCGR WITNESSES: Chad Verret, John Climaco
CG9B	Photo: View of starboard side of bridge on towing vessel FRANK PALLADINO JR and starboard beam of empty barge KELLSTONE I (Note: There is another vessel in background with twin yellow-striped stacks and a deck boom) DATE: Morning of 05 October 1994 LOCATION: stone dock at Marblehead, OH PHOTOGRAPHER: LTJG David Sandahl, USCGR WITNESSES: Chad Verret, John Climaco

CG9C Photo: View from conning station inside of bridge on towing vessel FRANK PALLADINO JR overlooking empty barge KELLSTONE I in the notch
DATE: Morning of 05 October 1994
LOCATION: stone dock at Marblehead, OH
PHOTOGRAPHER: LTJG David Sandahl, USCGR
WITNESSES: Chad Verret, John Climaco

CG9D Photo: Eye level view, on bow centerline of empty barge KELLSTONE I looking aft toward bridge of towing vessel FRANK PALLADINO JR
DATE: Morning of 05 October 1994
LOCATION: stone dock at Marblehead, OH
PHOTOGRAPHER: LTJG David Sandahl, USCGR
WITNESSES: Chad Verret, John Climaco

CG9E Photo: Eye level view, on centerline, atop of bridge on towing vessel FRANK PALLADINO JR looking forward over empty barge KELLSTONE I
DATE: Morning of 05 October 1994
LOCATION: stone dock at Marblehead, OH
PHOTOGRAPHER: LTJG David Sandahl, USCGR
WITNESSES: Chad Verret, John Climaco

CG9F Photo: Eye level view, on centerline, from outside passageway in front of bridge on towing vessel FRANK PALLADINO JR, looking forward at notch of empty barge KELLSTONE I
DATE: Morning of 05 October 1994
LOCATION: stone dock at Marblehead, OH
PHOTOGRAPHER: LTJG David Sandahl, USCGR
WITNESSES: Chad Verret, John Climaco

CG9G Photo: View of starboard side of towing vessel FRANK PALLADINO JR and empty barge KELLSTONE I (Note: There is another vessel in background with twin yellow-striped stacks and a deck boom)
DATE: Morning of 05 October 1994
LOCATION: stone dock at Marblehead, OH
PHOTOGRAPHER: LTJG David Sandahl, USCGR
WITNESSES: Chad Verret, John Climaco

CG9H Photo: View from dock of bow of damaged pleasure craft Mach 1 (OH 0164 YU)
DATE: Afternoon of 03 October 1994
LOCATION: USCG Station Marblehead, OH
PHOTOGRAPHER: LTJG David Sandahl, USCGR
WITNESSES: None

CG9I Photo: View from dock of port side of damaged pleasure craft Mach 1 (OH 0164 YU)
DATE: Afternoon of 03 October 1994
LOCATION: USCG Station Marblehead, OH
PHOTOGRAPHER: LTJG David Sandahl, USCGR
WITNESSES: None

CG9J Photo: View from centerline midships, looking forward at bow of damaged pleasure craft Mach 1 (OH 0164 YU)
DATE: Afternoon of 03 October 1994
LOCATION: USCG Station Marblehead, OH
PHOTOGRAPHER: LTJG David Sandahl, USCGR
WITNESSES: None

CG9K Photo: View from dock of inside of damaged pleasure craft Mach 1 (OH 0164 YU)
DATE: Afternoon of 03 October 1994
LOCATION: USCG Station Marblehead, OH
PHOTOGRAPHER: LTJG David Sandahl, USCGR
WITNESSES: None

CG9L Photo: View of control station of damaged pleasure craft Mach 1 (OH 0164 YU)
DATE: Afternoon of 03 October 1994
LOCATION: USCG Station Marblehead, OH
PHOTOGRAPHER: LTJG David Sandahl, USCGR
WITNESSES: None

CG9M Photo: View of anchor and chain/rope of damaged pleasure craft Mach 1 (OH 0164 YU) on dock
DATE: Afternoon of 03 October 1994
LOCATION: USCG Station Marblehead, OH
PHOTOGRAPHER: LTJG David Sandahl, USCGR
WITNESSES: None

CG9N Photo: View of starboard side of towing vessel FRANK PALLADINO JR and loaded barge KELLSTONE I
DATE: 1833 hours on 02 October 1994
LOCATION: Kellstone Dock, Kelly's Island, OH
PHOTOGRAPHER: LTJG Bernard C. McDonald, USCGR
WITNESS: LTJG David Sandahl, USCGR

CG9O Photo: View of starboard side of bridge of towing vessel FRANK PALLADINO JR and starboard quarter of loaded barge KELLSTONE I
DATE: Afternoon on 03 October 1994
LOCATION: Cleveland, OH
PHOTOGRAPHER: LTJG David Sandahl, USCGR
WITNESS: None

CG9P Photo: View of inside of bridge of towing vessel FRANK PALLADINO JR overlooking starboard quarter of loaded barge KELLSTONE I
DATE: Afternoon on 02 October 1994
LOCATION: Kellstone Dock, Kelly's Island, OH
PHOTOGRAPHER: LTJG Bernard C. McDonald, USCGR
WITNESS: LTJG David Sandahl, USCGR

CG9Q Photo: Eye level view, on centerline, atop of bridge on towing vessel FRANK PALLADINO JR looking forward over loaded barge KELLSTONE I
DATE: 1854 hours on 02 October 1994
LOCATION: Kellstone Dock, Kelly's Island, OH
PHOTOGRAPHER: LTJG Bernard C. McDonald, USCGR
WITNESS: LTJG David Sandahl, USCGR

CG9R Photo: View from dock of port side bow of loaded barge KELLSTONE I
DATE: 1846 hours on 02 October 1994
LOCATION: Kellstone Dock, Kelly's Island, OH
PHOTOGRAPHER: LTJG Bernard C. McDonald, USCGR
WITNESS: LTJG David Sandahl, USCGR

CG9S Photo: Eye level view, on bow centerline of loaded barge KELLSTONE I looking aft toward bridge of towing vessel FRANK PALLADINO JR
DATE: 1844 on 02 October 1994
LOCATION: Kellstone Dock, Kelly's Island, OH
PHOTOGRAPHER: LTJG Bernard C. McDonald, USCGR
WITNESSES: LTJG David Sandahl, USCGR

CG10 "Barge Arrangement Plan," KELLSTONE I (blueprint)

CG11 USCG documentation file; towing vessel FRANK PALLADINO JR

CG12 USCG documentation file; barge KELLSTONE I

CG13 "U.S. Coast Pilot 6, Great Lakes:" cover page, pages 129 thru 131, and pages 163 thru 164

CG14 "USCG Light List, Vol VII, Great Lakes:" cover page and pages 55 thru 58

CG15 Synopsis of USCG interviews: Mr. William R. Crane, Jr. and Ms. Virginia Ostrom

CG16 Measurement Report on FRANK PALLADINO JR/KELLSTONE I by LTJG David P. Sandahl, USCGR on 05 October 1994

CG17 FRANK PALLADINO JR/KELLSTONE I make–up profiles (drawing by CWO J. Jackson, USCG)

CG18 Ohio DNR "Watercraft Accident Investigation" report #94–D6–117W

CG19 Ohio DNR "Boating Accident Report" #94–D6–117W

CG20 Sandusky Police Department "Complaint Report" #13272

CG21 Ohio DNR Witness Statement: Officer Jeff Nehls

CG22 Drawing on Chart 14842, Sheet 28 by Mr. William Crane

CG23 Ohio DNR Witness Statement: Mr. Andrew T. Ungar

CG24	Drawing on Chart 14842, Sheet 28 by Mr. Andrew T. Ungar
CG25	Drawing of FRANK PALLADINO JR/KELLSTONE I & Mach 1 (OH 0164 YU) by Mr. Andrew T. Ungar
CG26	Drawing on Chart 14842, Sheet 28 by Mr. Robert S. Amos
CG27	Drawing of FRANK PALLADINO JR/KELLSTONE I by Mr. Robert S. Amos
CG28	Ohio DNR Witness Statement: Mr. Robert S. Amos
CG29	Ohio DNR Witness Statement: CAPT James O. Caynor
CG30	Ohio DNR Witness Statement: Mr. Wayne S. Amlin
CG31	Ohio DNR Witness Statement: Mrs. Holly A. Amlin
CG32	Ohio DNR Witness Statement: Mr. Ezra Jordan
CG33	Ohio DNR Witness Statement: Mr. Donald E. Thomas
CG34	Drawing on Chart No. 14842, Sheet 28 by Captain Neil Schrock
CG35	Ohio DNR "Vessel Safety Inspection" for OH 0164 YU on 01 Oct 94
CG36	Ohio "Watercraft Registration" for Ms. Virginia S. Ostrom (OH 0164 YU)
CG37	Ohio DNR Witness Statement: Captain Robert E. Coleman
CG38	Ohio DNR Witness Statement: Mr. David M. Marracino
CG39	Ohio DNR Inter-Office Communication
CG40	Ohio DNR Witness Statement: Mr. Edington
CG41	Ohio DNR Witness Statement: Ms. Virginia Ostrom
CG42	Ohio DNR Witness Statement: Mr. William R. Crane, Jr.
CG43	Huron Fire Department Dive Team (Four Statements)
CG44	IP letter to LT David Sandahl
CG45	Faxed copy of "Report of Marine Accident, Injury or Death" (Form CG-2692) for M/V FRANK PALLADINO JR, dated 02 Oct 94
CG46	Original "Report of Marine Accident, Injury or Death" (Form CG-2692) for M/V FRANK PALLADINO JR, dated 28 Oct 94
CG47	National Weather Service SRRS Product Retrieval for 0000Z 29 Sep 94 to 2359Z 01 Oct 94

CG48 Canadian Coast Guard Vessel Traffic Center Sarnia cover ltr & enclosed Transit Cards for FRANK PALLADINO JR, dated 30 Sep 94 & 01 Oct 94

CG49 Copy of FRANK PALLADINO JR deck logbook from 28 Aug 94 to 01 Oct 94

CG50 Statement from ODNR Officer Joseph V. Yingling for 01 Oct 94 boarding of FRANK PALLADINO JR

CG51 Notes on crew for 01 Oct 94 boarding of FRANK PALLADINO JR by ODNR Officer Joseph V. Yingling

CG52 Sketch on 01 Oct 94 boarding of FRANK PALLADINO JR and KELLSTONE I by ODNR Officer Jeff Nehls

CG53 Certificate of Death for Ian Crane

CG54 Lucas County Coroner's Office case summary on the death of Ian Crane

CG55 Certificate of Death for Michael Alan Burghard

CG56 Lucas County Coroner's Office case summary on the death of Michael Alan Burghard

CG57 Faxed copy of brochure for Mach I MV 2100 CC Explorer boat

CG58 W. Schroeder ltr to CAPT Mastenbrook CG MSO Detroit w/ enclosures:
- Firelands Corporate Health Svcs summary of crew drug tests
- Captain Verret's portable phone acct by CELLNET
- Inland Bulk Transfer Co. Drug & Alcohol Policy
- CG MSO Toledo ltr 16711 to J. D. Richmond, Kellstone Inc. of 14 July 93
- Commandant (G–MVI–2) Policy Letter 06–93 of 13 Apr 93

CG59 History of Coast Guard Station Marblehead

CG60 Pamphlet "Boating Safety Hotline"

CG61 Booklet "Federal Requirements"

CG62 Pamphlet "The Western Lake Erie Boater"

CG63 Pamphlet "Visual Distress Signals"

CG64 "Navigation and Vessel Inspection Circular No. 2–81 (NVC 2–81)" and "NVC 2–81 Ch–1" [sic]

CG65A & B "Stipulation of Facts" by Inland Bulk Transfer, Inc. and Kellstone, Inc.

CG66 Ninth Coast Guard District ltr 16700 to Commandant (G–MVI–2) of 4 Jan 93

CG67 "Review of Marine Safety Issues Related to Uninspected Towing Vessels" by Commandant (G–MMI)

CG68	"Guidelines for Tug/Tow Combinations on the Great Lakes" by Robert G. Allan, PE
CG69	NTSB documents regarding Rule 9
CG70	CG MIO Sturgeon Bay, WI ltr 16710 of 19 Mar 91
CG71	CG MSO Milwaukee, WI ltr 16700 of 18 Mar 91
CG72	Public Law 102-587, November 4, 1992: Amendments to Marine Protection, Research, & Sanctuaries Act of 1972
CG73	USACOE Lake Stages for Cleveland & Toledo for 01 Oct 94
CG74	"Reconstruction of Lake Erie Physical Conditions for September 28th to October 2nd, 1994"
CG75	Advanced Marine "Marine Service Order"
CG76	Canadian Coast Guard ltr for radio transcripts, dated 10 Nov 94
CG77	Drawing on sheet 28 of Recreational Chart 14842 by LTJG B. McDonald
CG78	Ninth CG District (oan) ltr 16500 to CG MSO Detroit of 16 Nov 94
CG79	Drug test results for Verret, Coleman, & Marracino (PROTECTED FROM DISCLOSURE BY PRIVACY ACT OF 1974)
CG80	Conversation Record for times of urine drug tests at Providence Hospital of Sandusky, OH
CG81	CCGDNINE SAR Case Report #008, MUCN005
CG82	"Guide to Fishing Reefs in Western Lake Erie" by the Ohio Sea Grant College Program
CG83	Designation Letter from RADM R. Peschel to CAPT M. Mastenbrook as Investigating Officer for One-Man Formal Investigation
CG84	Synopses of crewmember interviews on 20 Oct 94
CG85	Coast Guard Aids to Navigation Team Sandusky, OH message 16500 "Buoy Position Check/Marine Accident" to Coast Guard Group Detroit, MI of DTG 031725Z OCT 94

b. KELLSTONE, INC.

EXHIBIT NO.

K1	Aerial photo of FRANK PALLADINO JR/KELLSTONE I underway (bow view)
K2	Photo of "Hot Spot" chart used on Mach 1 (OH 0164 YU)
K3	Photo of Mach 1 (OH 0164 YU) photo (bow view)
K4	Chart 14830 (copy of vessel chart with shoals marked)
K5	Exhibit A (shallow areas)
K6	Exhibit B (safe channel or fairway)
K7	Photo of Starve Island Reef Lighted Buoy 2 (red)
K8	Photo of Scott Point Shoal Lighted Buoy 1 (green)
K9	Affidavit: Ernest E. James
K10	Affidavit: Robert M. Swanson
K11	Affidavit: Charles E. Schneider
K12	Affidavit: Arthur L. Wolf
K13	Affidavit: John E. Schneider
K14	Affidavit: Dennis E. Wieber
K15	Affidavit: John P. Lamb
K16	Affidavit: Gary A. Kowalski
K17	VHS Video #1 "Road Signs of the Waterways"
K18	VHS Video #2 "Excerpts of Ohio DNR Education"
K19	VHS Video #3 "How Can We All Help..."
K20	VHS Video #4 "Rules of the Road"
K21	Proposed Findings of Fact of Kellstone Inc.
K22	Proposed Conclusions of Law Submitted on Behalf of Kellstone, Inc. and Inland Bulk Transfer Company

c. INLAND BULK TRANSFER, INC.

EXHIBIT NO.

IBT1	Recreational Chart 14842, 9th Edition (entire booklet)
IBT2	Unmarked Sheet 31 of Chart 14842, 9th Edition
IBT3	Synopsis of Crane/Ostrom Interview by CWO2 E. Miner, USCG
IBT4	Photo of Mach 1 (OH 0164 YU) (top view)
IBT5	Photo of Mach 1 (OH 0164 YU) (front view)
IBT6	Photo of Mach 1 (OH 0164 YU) (port side view)
IBT7	Photo of Mach 1 (OH 0164 YU) (top view of stern)
IBT8	Photo of Mach 1 (OH 0164 YU) (top view of port rear seat)
IBT9	Photo of Mach 1 (OH 0164 YU) (looking into cabin)
IBT10	Photo of Mach 1 (OH 0164 YU) anchor and chain/rope
IBT11	Copy of handwritten notes beginning with "1519 – Anchored..."
IBT12	USCG "Navigation Rules" Book (COMDTINST M16672.2B), corrected thru change number 4 (CH–4) of 9 July 1993
IBT13A	Letter by Paul Gregory, Chief, Ohio Division of Watercraft
IBT13B	Ohio DNR "Ohio Boating Basics"
IBT14	"Make Way" pamphlet
IBT15	USCG Auxiliary pamphlet
IBT16	"Ohio Boat Operator's Guide 1994"
IBT17	"Life Lines" pamphlet
IBT18	Photo of KELLSTONE I bow
IBT19	Photo of KELLSTONE I bow
IBT20A	Copy of Chart No. 14830 (wall chart, top half)
IBT20B	Copy of Chart No. 14830 (wall chart, bottom half)
IBT21	(deleted because duplicate of Exhibit No. CG26)
IBT22	Copy of US Army Corps of Engineers Chart No. 36, dated 1952

IBT23 Entire Ohio DNR Case File

A. Ohio DNR Officer Yingling Statement
B. Ohio DNR Continuation Sheet for PALLADINO Report (Johnston)
C. Time of Events (W. Crane, V. Ostrom, I. Crane, M. Burkhart)
D. Ottawa County Subpoena
E. USCG Subpoena 05 October 1994 (issued by LTJG McDonald)
F. Preliminary Incident Report (Phone-in)
G. Ohio DNR ltr 21 October 1994 (by Roselor to Petersen)
H. Ohio DNR ltr 06 October 1994 (by Roselor to Petersen)
I. Statutes
J. Witnesses
K. Ohio DNR Watercraft Accident Investigation Report (hand written)
L. Excerpts from "Chapman Piloting" (3 pages)
M. US Army Corps of Engineering Chart, dated 1955
N. Cardboard replica of ball dayshape (7" diameter) (by Johnston)

IBT24 Article from "Sandusky Register" 13 November 1994

IBT25 Article from "Toledo Blade" 13 November 1994

IBT26 USCG Ninth District Boating Envelope (with pamphlets)

IBT27 USCG MSO Toledo ltr 14 July 1993 (to Jim Richmond)

d. CREW

EXHIBIT NO.

CREW1 **Affidavit from Marcus A. Kelch dated 30 December 94**

CREW2 **Proposed Findings of Fact and Conclusions of Law by Attorney David M. Spotts**

CREW3 **Proposed Recommendations by Attorney David M. Spotts**

PART VI - REFERENCES

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