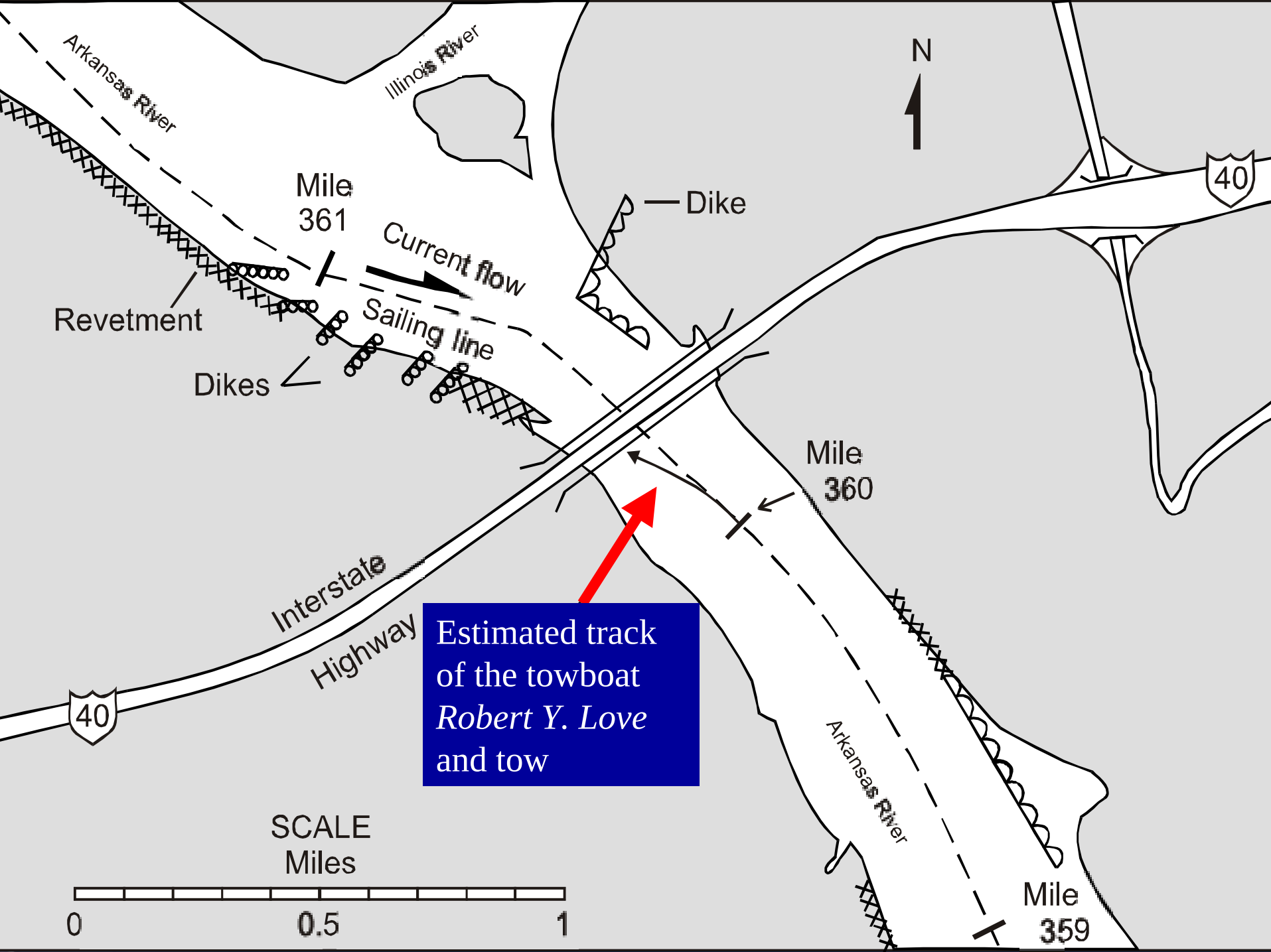
Webbers Falls, Oklahoma

Robert Y. Love Allision

With the I-40 Bridge

May 26, 2002


M T
M
ROBERT Y LOVE


Arkansas River
Illinois River
N
Mile 361
Current flow
Sailing line
Revetment
Dikes
Dike
40
Mile 360
Interstate Highway
40
Estimated track of the towboat *Robert Y. Love* and tow
Arkansas River
Mile 359
SCALE
Miles
0
0.5
1

Parties to the Investigation

- Federal Highway Administration
- U.S. Coast Guard
- U.S. Department of Justice
- State of Oklahoma
- Magnolia Marine Transport Company

Issues

- The captain's incapacitation and countermeasures for such an event
- Bridge protection, including risk assessment
- Mitigation of loss of life, including motorist warning systems

On-Scene Investigative Staff

George Black	Member
Bob Barlett	On-Scene Coordination
Michele Beckjord	Survival Factors
Chris Voeglie	Vehicle Factors
Dennis Collins	Human Performance
Robert Accetta	Highway and Evidence Documentation
Mark Bagnard	Evidence Documentation

On-Scene Investigative Staff (cont)

James Scheffer	Marine IIC and Operations
Theodore White	Marine Survival Factors
Tom Roth-Roffy	Marine Engineering
Jamie Estock	Marine Human Performance
Keith Holloway	Public Affairs
Ken Suydam	Investigator-in-Charge

Report Development Staff

• Dr. Mitch Garber	Medical Officer
• Joe Gregor	GPS
• James Skeen	Meteorology
• Bill Woody	Marine Human Performance
• Leon Katcharian	Marine Report Writer
• Don Tyrrell	Marine Report Writer/Manager

Report Development Staff (Cont)

- Mike Brown — Recommendations
- Ed Pacchetti — Recommendations
- Debbie Taylor — Editor
- Michele McMurtry — Project Manager

Human Performance Issues

Dennis Collins

Robert Y. Love Captain

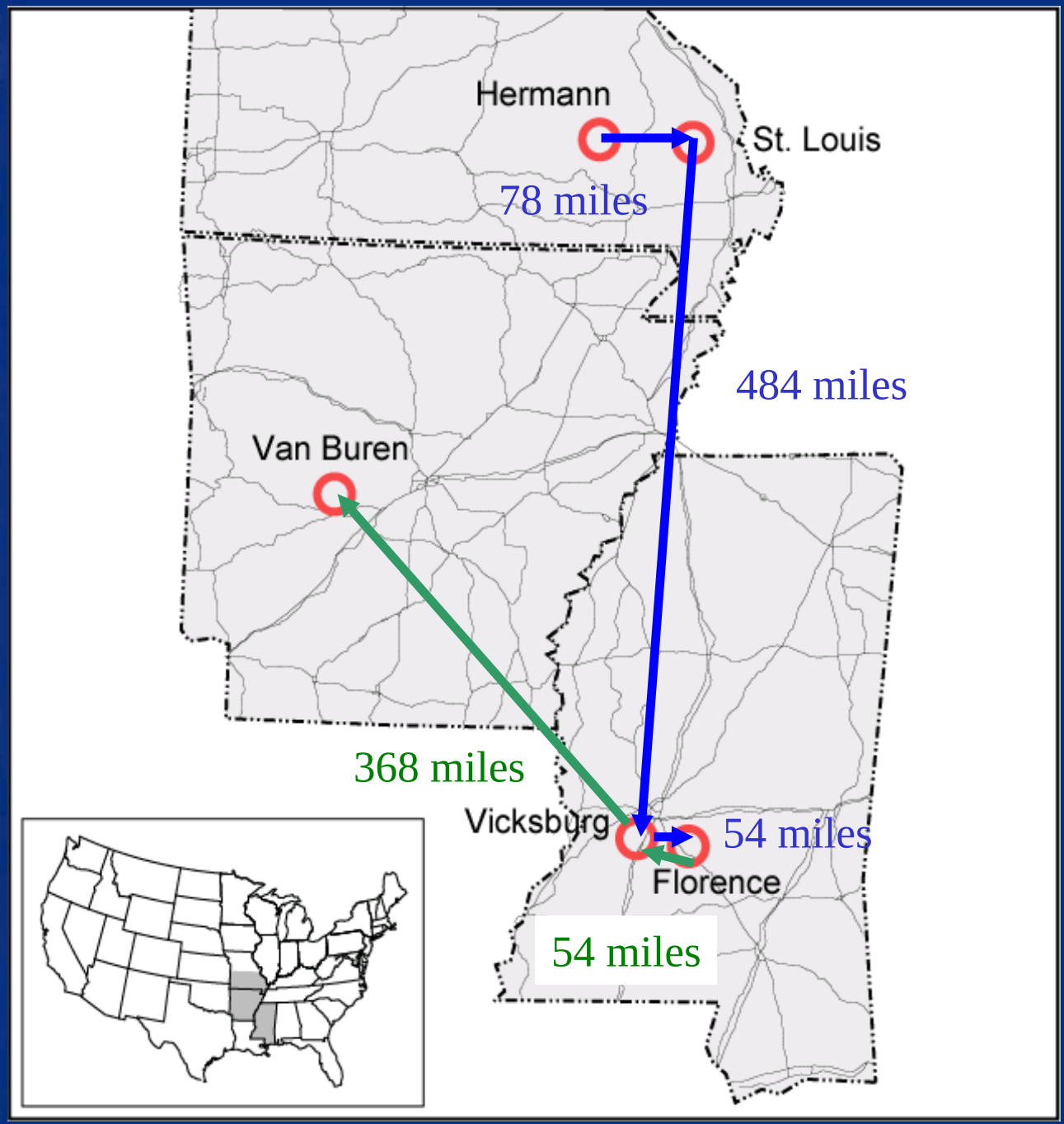
- 60 year-old male
- 40 years on inland towing vessels
  - 29 years licensed as operator
  - With current company 11 years
  - Captain of *Love* since February 2001
- Held a current license
  - Normal vision, hearing

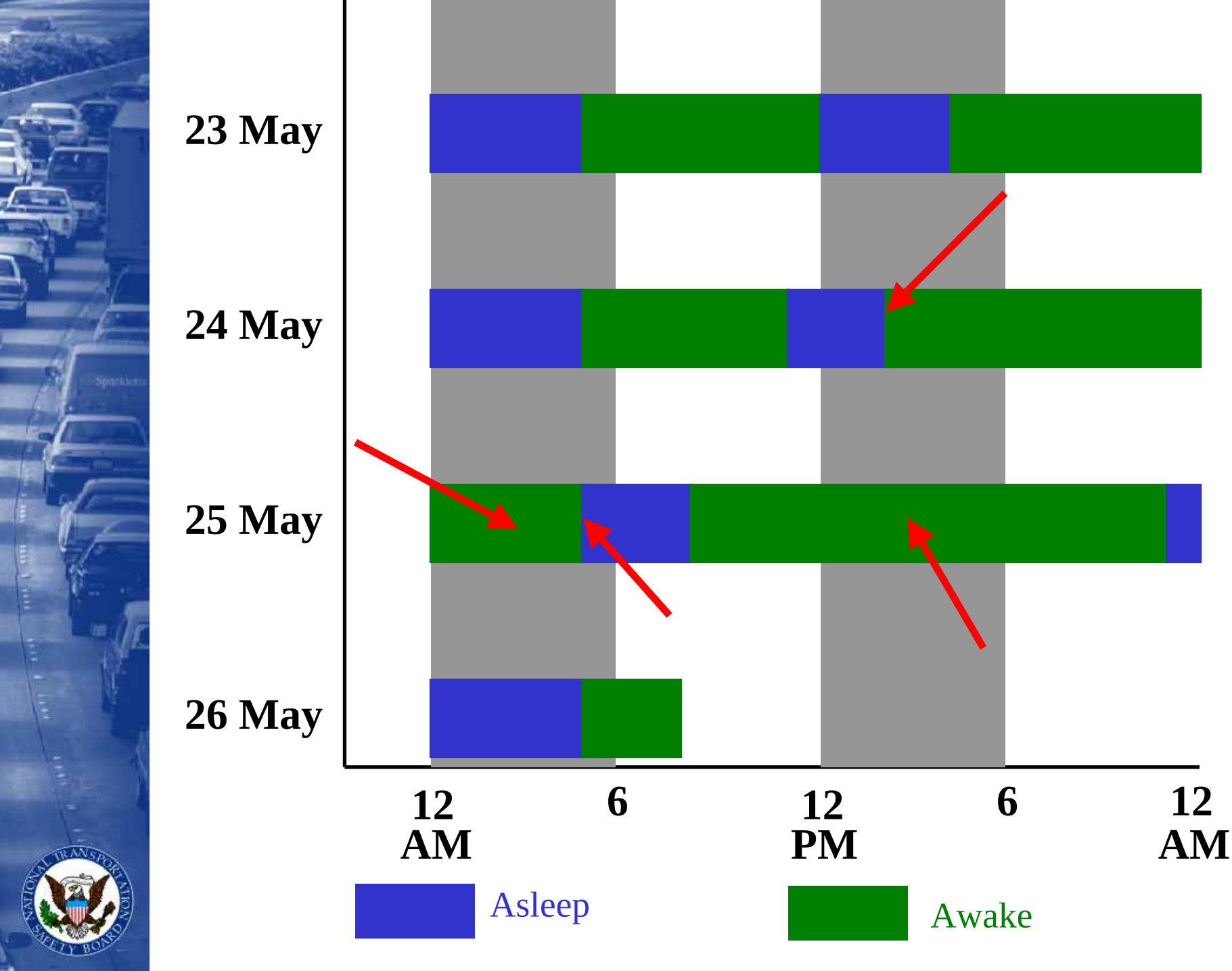
Issues

- Several excluded
  - Workload
  - Training, experience, qualifications
  - Alcohol / illicit / prescription drugs
- Two factors of interest
  - Fatigue
  - Medical condition

Captain's Work Schedule

- Normally 30 days on, 15 days off
- Stood "Captain's watches"
  - 0600 – 1200
  - 1800 – 2400
  - Normal industry schedule
- Schedule changed prior to the accident


Hermann
St. Louis
78 miles
484 miles
Van Buren
368 miles
Vicksburg
54 miles
Florence
54 miles


23 May
24 May
25 May
26 May
12 AM
6
12 PM
6
12 AM
Asleep
Awake

Sleep Deficit

- Captain had a sleep deficit
- Between *Jennie Dehmer* and *Robert Y. Love*
  - 1038 miles
  - 20.5 hours in a car
  - Slept 3.5 hours
- Several disruptions to usual schedule

Other Information

- Sleep deficit may not have caused incapacitation
  - Slept at least 5 hours
  - Loss of consciousness “all at once”
  - His position after the allision
  - Visual problems, disorientation
- Loss of consciousness atypical of fatigue

Medical Issues

Mitch Garber

Captain's Statements

- No recollection for last 1/3 mile (4 minutes)
- No recollection of allision
- Found himself wedged in crouched position between console and chair
- Initially could not visually focus or get oriented

Syncope (Faint)

- Loss of consciousness due to interruption of blood flow to brain
- Typically, consciousness is restored rapidly after individual falls
- Space did not allow complete fall

Syncope (Faint)

- Possible causes
  - Certain heart conditions
  - Dehydration
  - Rising too quickly
  - Certain types of migraines
- Not associated with fatigue

Preaccident Conditions

- No significant diagnoses
- Recent dizzy spells at home (attributed to overexertion from yard work)
- 4 days prior, dizzy spell with nausea while on another vessel
- No other symptoms

Postaccident Testing

- Comprehensive evaluation at local regional medical center
- Results normal except blocked coronary artery with no effect on heart function
- Later electrophysiological study (EPS) generated serious abnormal rhythms
- Implanted defibrillator – no shocks, no symptoms

Postaccident Testing

- Cardiac catheterization, EPS done, despite negative noninvasive evaluation
- With normal nuclear medicine stress test, invasive testing not essential
- Without loss of consciousness, invasive testing would not have been pursued
- Preaccident evaluation would not have been abnormal

Toxicology

- Diphenhydramine (Benadryl®) at low levels in captain's blood and urine
- Consistent with reported ingestion of two tablets of Benadryl® the night before the accident
- Diphenhydramine is impairing and sedating, but substantial effects unlikely at low levels detected

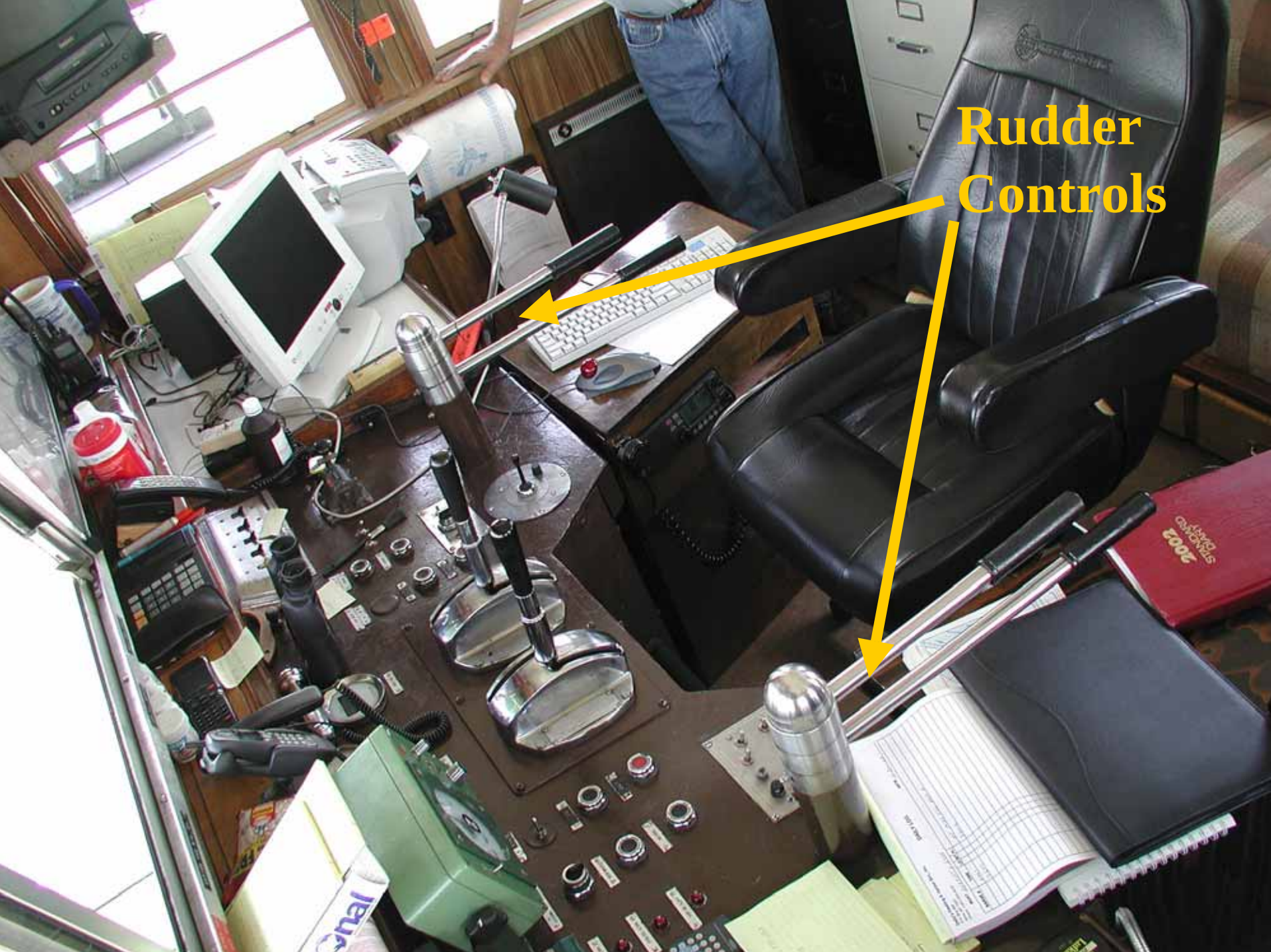
Alerter Systems and Safe Transit Procedures

James Scheffer


M T
M
ROBERT Y LOVE

Wheelhouse Alerter Systems

- Two systems under evaluation by three inland towing companies
  - Monitoring of rudder movement
  - Monitoring of physical motion


Rudder
Controls


Wheelhouse audible alarm
M/T
ROBERT Y LOVE
Crew quarter alarms

Wheelhouse Motion Detection

Wheelhouse Alerter Systems

- Promising safety improvement
- Three companies independently evaluating these systems

Safe Transit Procedures

- Identify bridges subject to allisions
- Develop best practices for transiting bridges
- Route familiarization
- Sharing of near-miss information
- Removal and alteration of bridges
- Crew Endurance Management Systems

Crew Endurance Management Systems

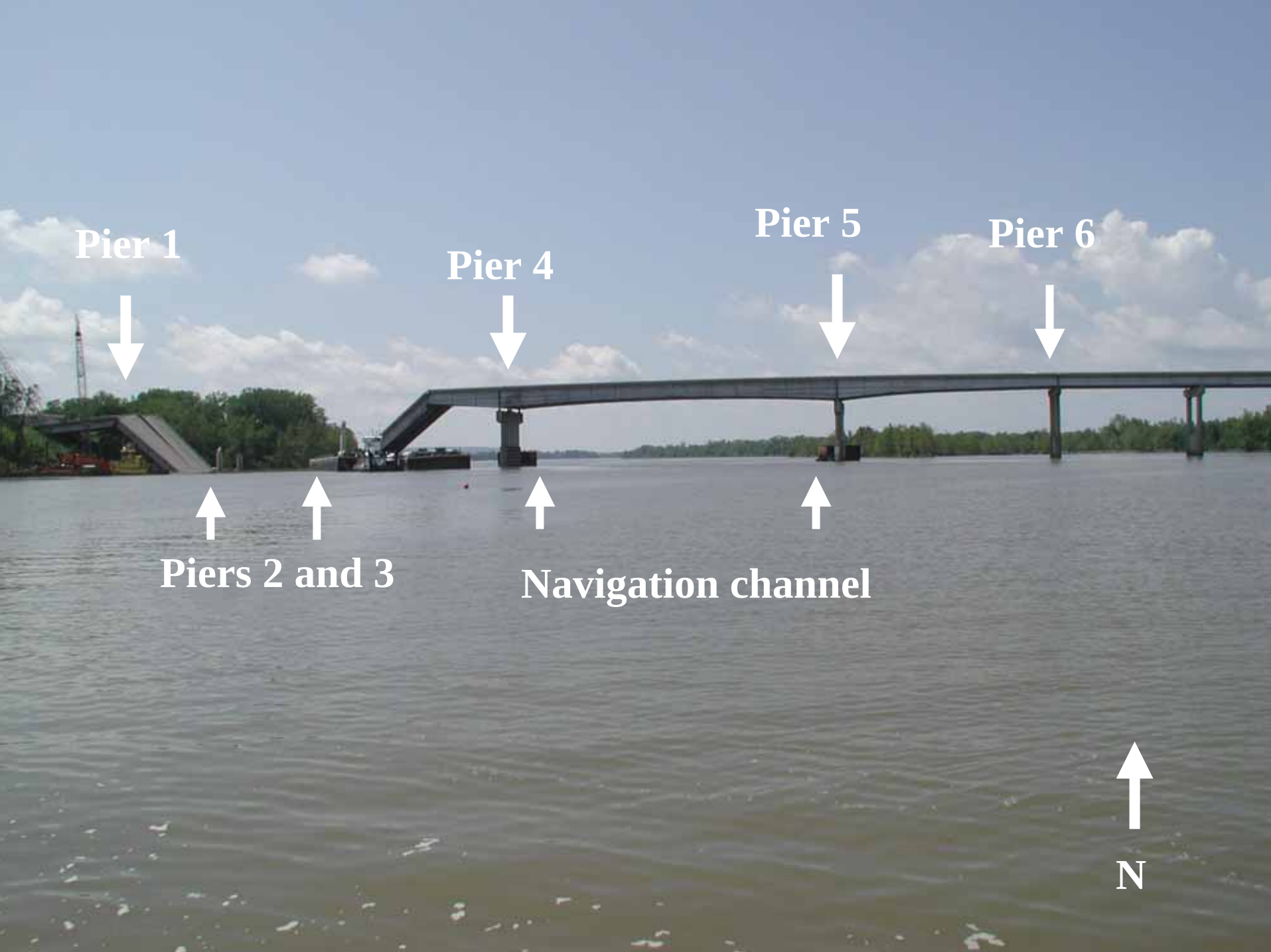
- Develop a system to manage risk factors
  - Ensure sufficient hours of uninterrupted sleep
- Demonstration project
  - Eight companies
  - 40 towing vessels
  - 150 CEMS coaches

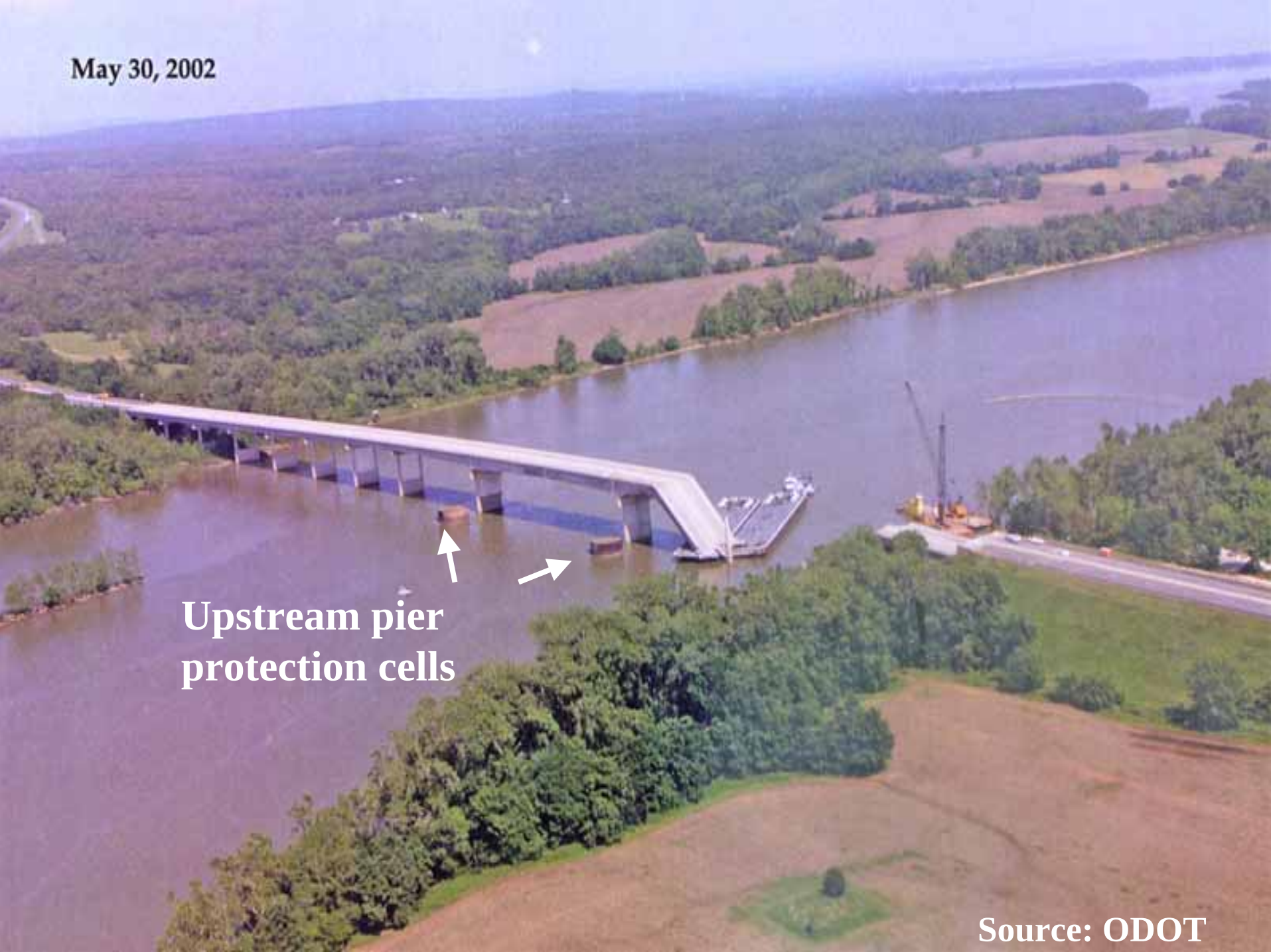
Crew Endurance Management Systems

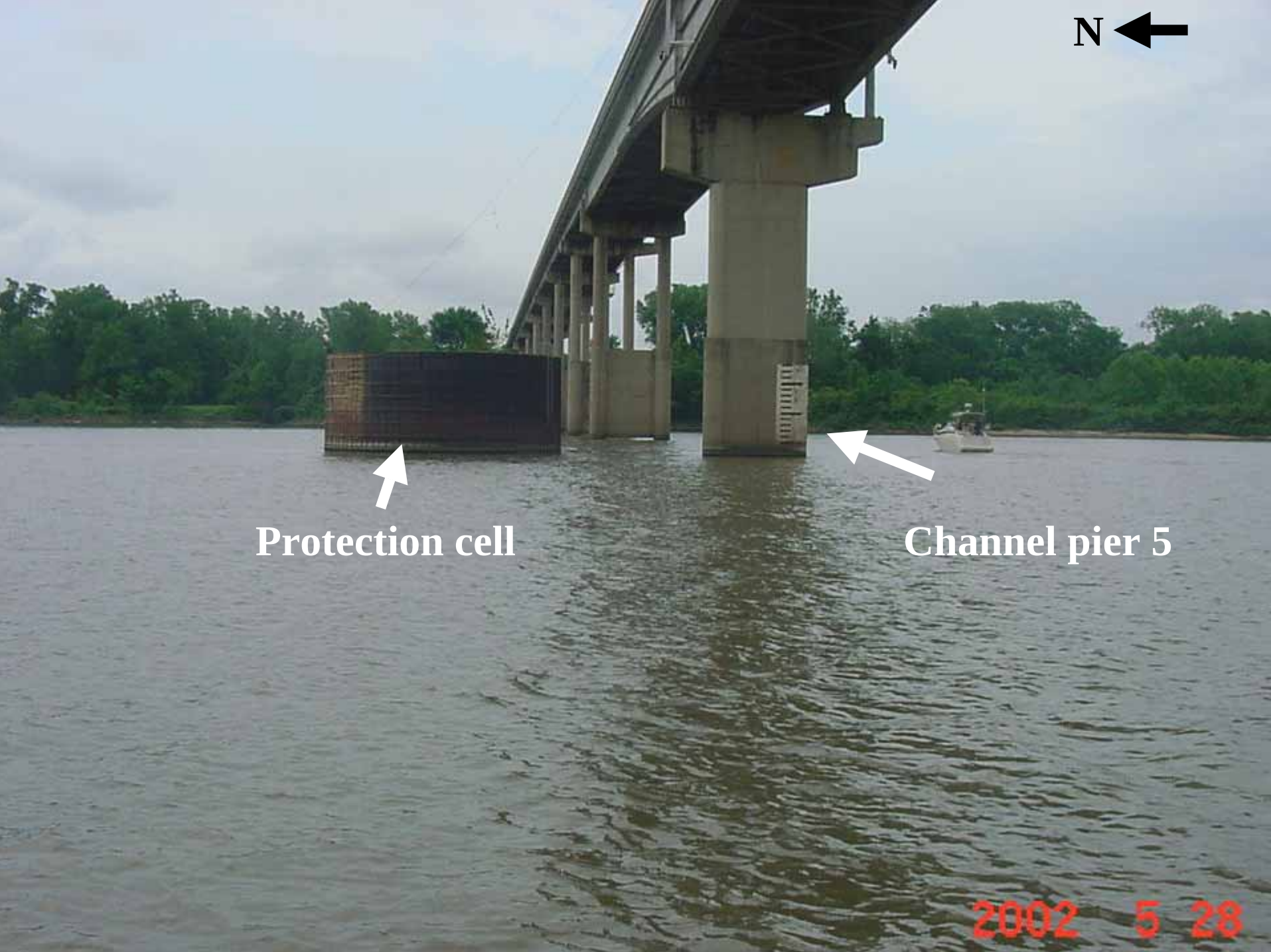
- The Coast Guard and Maritime Transportation Act of 2004
  - The Secretary shall conduct and report to Congress on the results of a demonstration project involving the implementation of Crew Endurance Management Systems on towing vessels

Bridge Protection

Michele McMurtry


Pier 1
Pier 4
Pier 5
Pier 6
Piers 2 and 3
Navigation channel
N


May 30, 2002
Upstream pier protection cells
Source: ODOT


N
Protection cell
Channel pier 5
2002 5 28

Pier Protection

- 1960s - Pier protection not required
- 1970 - Vessel traffic near bridge
- 1977 and 1980 - Damage on channel piers
- 1982 - Application to install protection cells
- No standards

Accidents Outside of Navigation Channel

- Pier protection *inside* navigation channel
- Bridge struck *outside* navigation channel

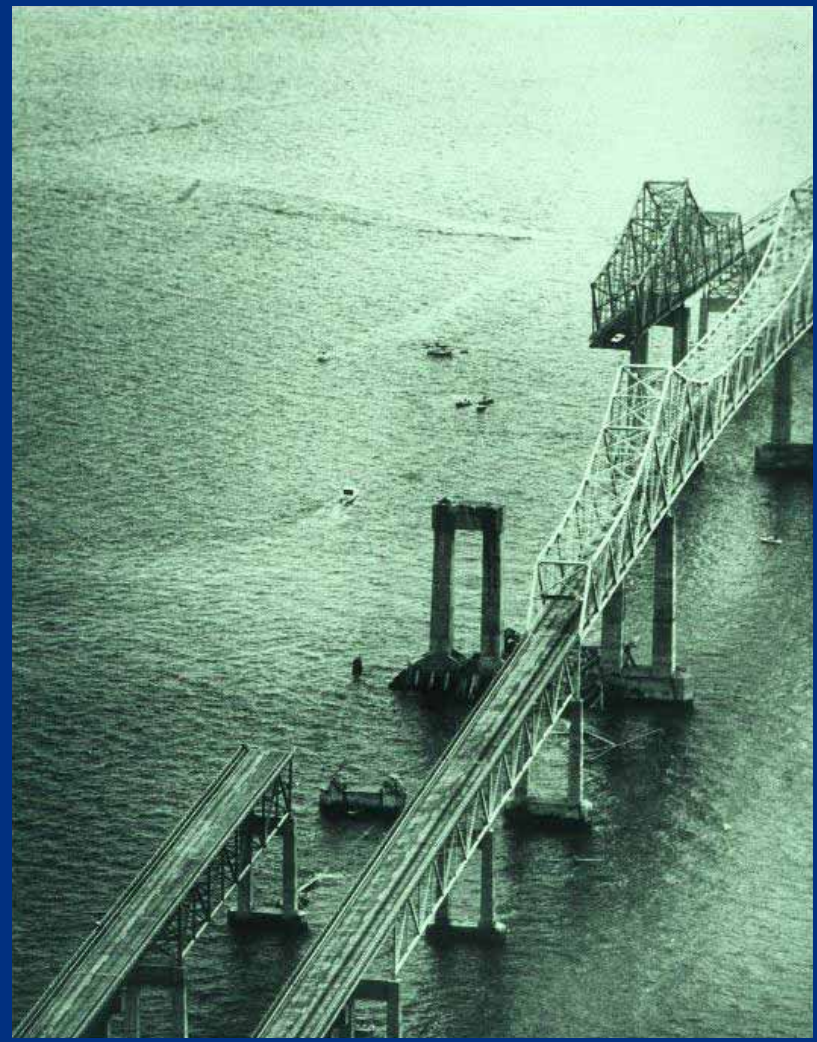
Benjamin Harrison Bridge

James River, Hopewell, Virginia (1977)

Source: Virginia DOT

Sunshine Skyway Bridge

Tampa, Florida (1980)



Source: St. Petersburg Times

Judge William Seeber Bridge

New Orleans, Louisiana (1993)

Bayou Canot RR Bridge

Mobile, Alabama (1993)

Queen Isabella Causeway

South Padre Island, Texas (2001)

Accidents Outside of Navigation Channel

- Previous accidents demonstrate
- Most bridges can be struck *outside* navigation channel
- Increases complexity of bridge protection

Protecting All Bridge Piers

- Pier protection cells
  - I-40 bridge would cost $6.8 million
- 2,844 highway bridges requiring permits
  - Multiple piers vulnerable to vessel impact

AASHTO Vessel Collision Guide Specifications

- Bridge's risk to collision and collapse
- Load and resistance factor design (LRFD)
- In 2007, LRFD will be the Federal-aid bridge standard
- Florida is using for *new* bridge design

AASHTO Vessel Collision Guide Specifications (cont)

- Louisiana using to evaluate *existing* bridges
- Oklahoma evaluating 12 *existing* river crossings
- Not mandatory to evaluate vulnerability of *existing* bridges

Sufficiency Rating System

- Method of measuring one bridge's needs against another
- Relative risk of a bridge to extreme events
  - Vessel or vehicle collisions
  - Flooding, including scour and debris loading
  - Seismic events
  - Terrorist attacks
  - Not part of the sufficiency rating formula

Sufficiency Rating System (cont)

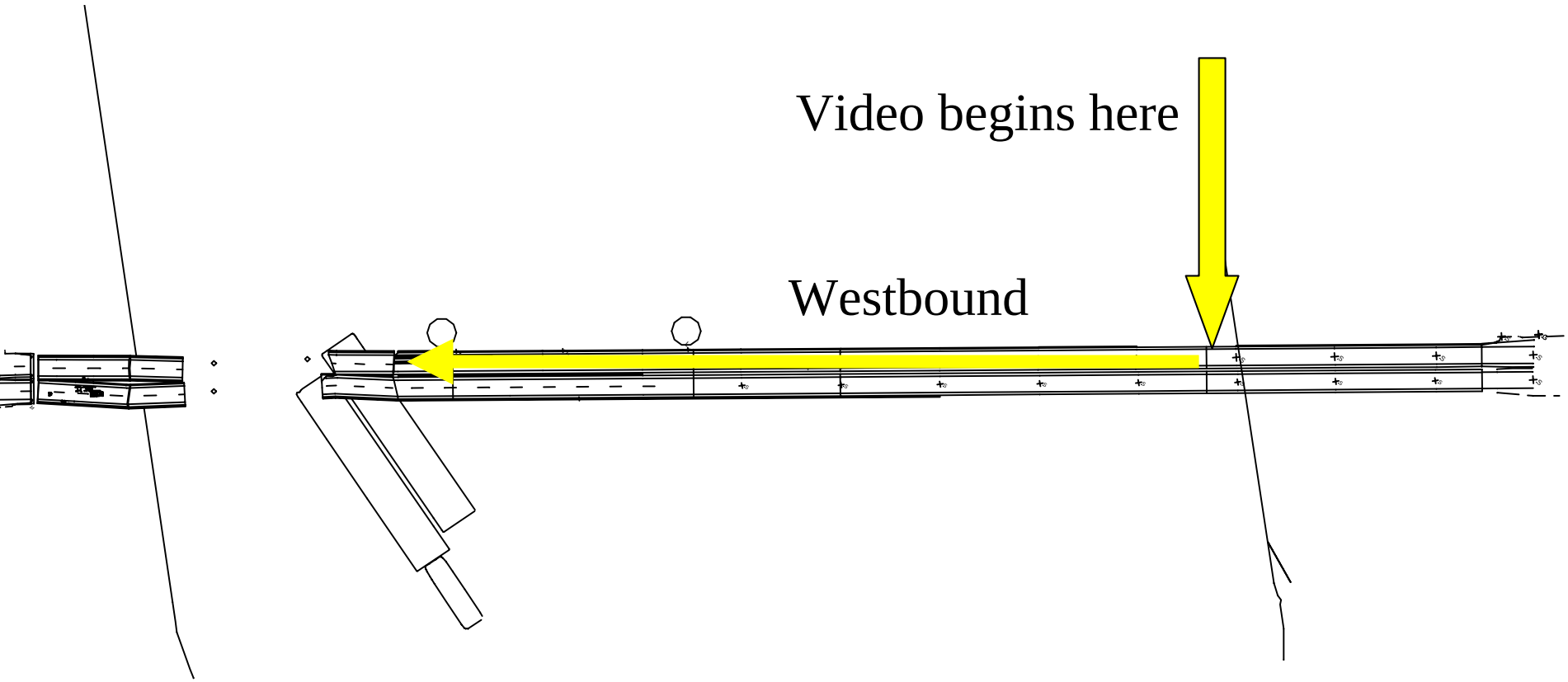
- Tools are available
- Risks to extreme events *can* be included in a bridge's sufficiency rating
- Balance needs while not ignoring conditions that can lead to catastrophic events

Motorist Warning Systems

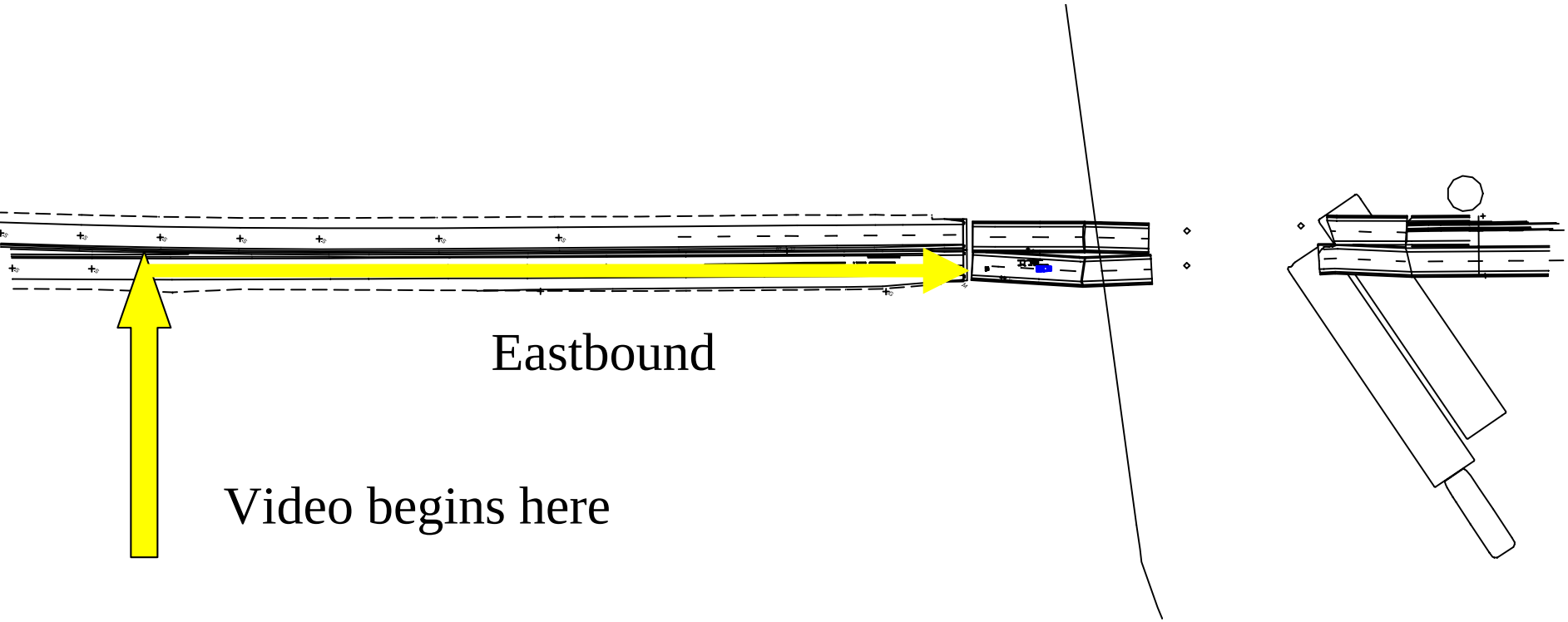
Robert Accetta

Available Sight Distance

- Passenger cars and truck tractor semi-trailers
- East and westbound directions
- Total stopping distances exceeded available sight distances



Click here to view test video



Click here to view test video

Motorist Warning Systems Installed After Bridge Accidents

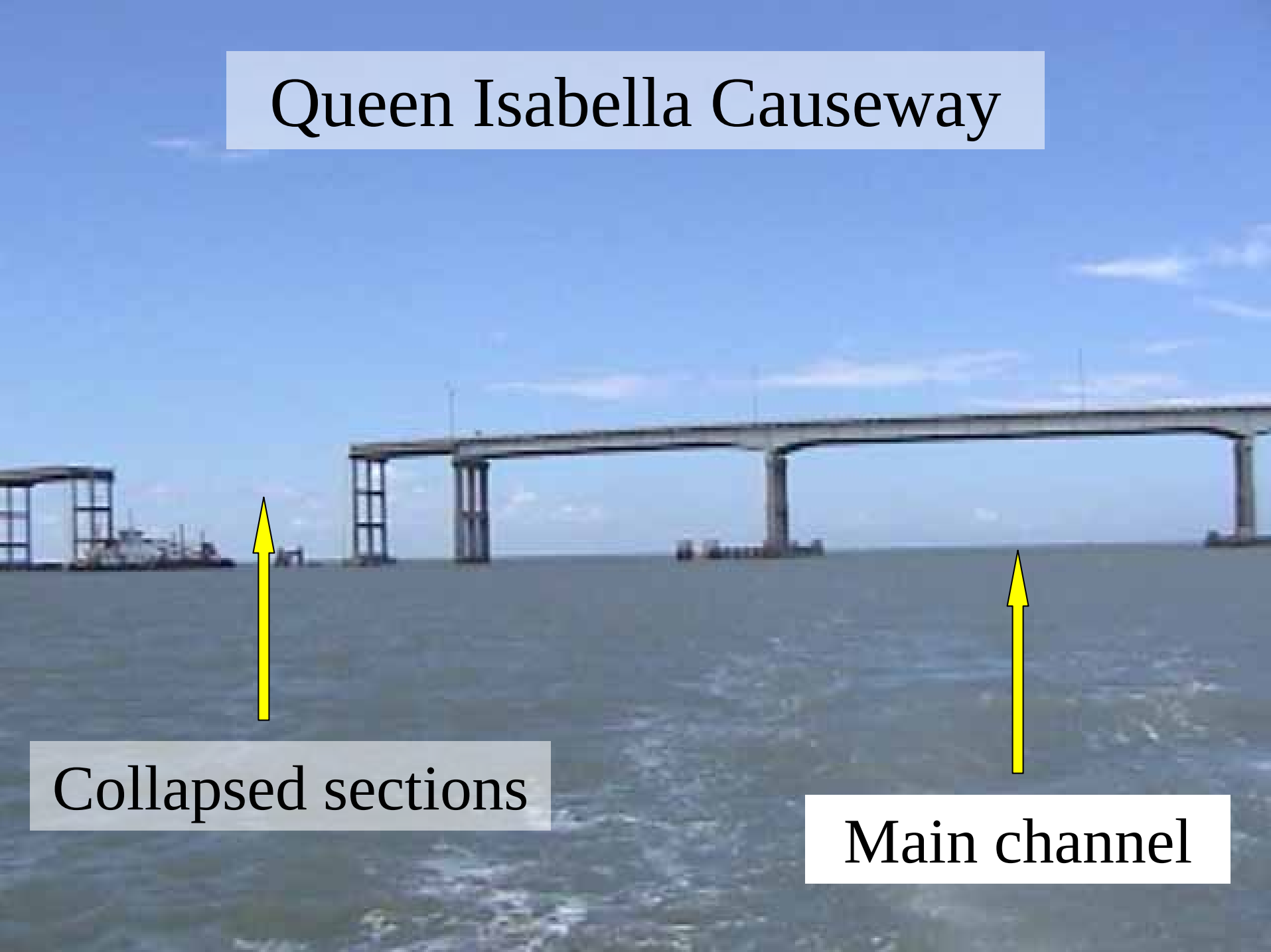
- Lake Pontchartrain Causeway in Louisiana
- Sunshine Skyway Bridge in Florida
- Queen Isabella Causeway in Texas

Lake Pontchartrain Warning System

- Marine radar system scans lake for vessels
- Hazard lighting system uses yellow flashing lights
- Police monitor marine frequencies and post messages on variable message signs
- Coast Guard is notified for enforcement action

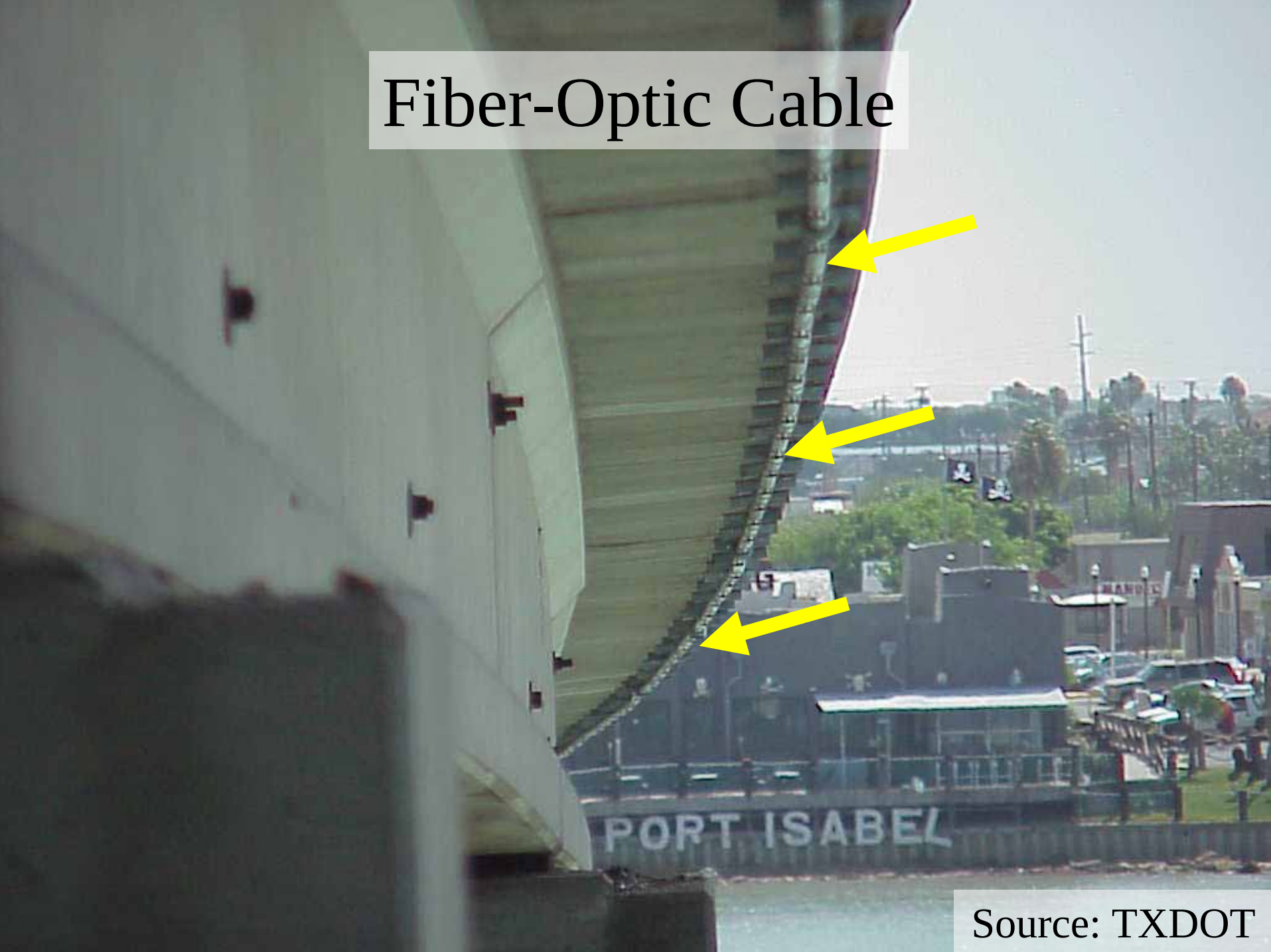
Sunshine Skyway Bridge Warning System

- Digital message signs
  - high winds
- Bridge span continuity warning system
  - less than totally dependable

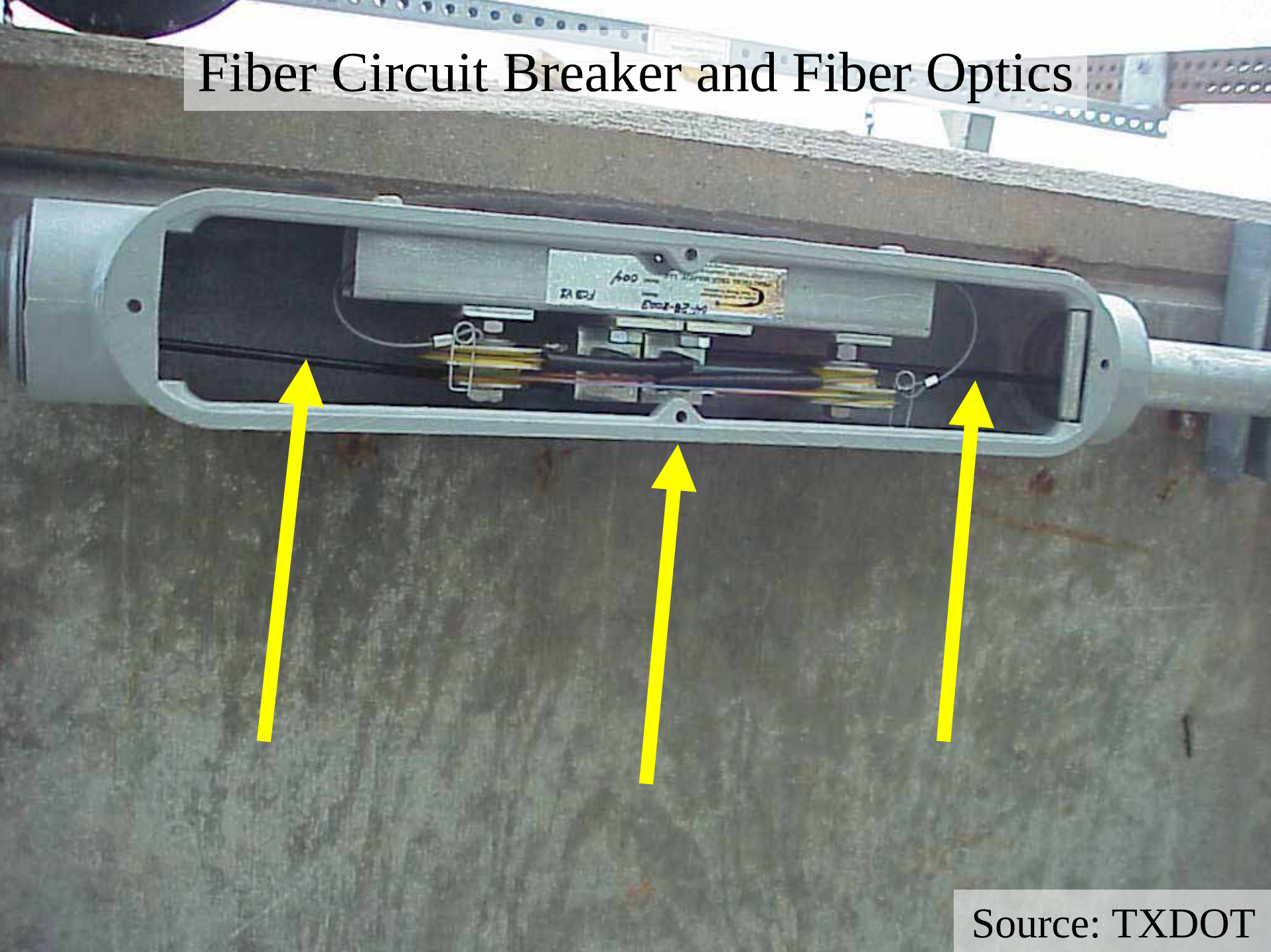

Queen Isabella Causeway
Collapsed sections
Main channel

Queen Isabella Causeway Motorist Warning System

- Fiber-optic cable
- “STOP WHEN FLASHING, DANGER” warning signs
- Gates at both ends of causeway
- Red flashing signals in both directions


Fiber-Optic Cable
PORT ISABEL
Source: TXDOT

Fiber Circuit Breaker and Fiber Optics



Source: TXDOT

Queen Isabella Causeway

Source: TXDOT

Red Warning Signals

Source: TXDOT

Red Warning Signals

Source: TXDOT

Red Warning Signals

Source: TXDOT

Queen Isabella Causeway Motorist Warning System

- If the fiber-optic cable is severed
  - Signals before break flash red
  - Signals beyond break do not flash
  - Automatically calls police and Coast Guard

Motorist Warning Systems

- FHWA working to improve reliability of long-term instrumentation
- March 2004 Structural Health Monitoring initiative
- Neither AASHTO nor the FHWA provide guidance on the use of these systems