Dry and Wet Numbers

Activity idea developed by Dawn Liska-Tollefson, Madison, Wisconsin

OBJECTIVES

Students will be able to:

- interpret data from the *Mississippi River Locks – Location and Elevation figure.*
- calculate change in elevation in positive and negative numbers.
- correlate elevation changes going upstream with dry (positive) integers and elevation changes going downstream with wet (negative) integers.

METHODS

Students use real data about Mississippi River locks and communities to calculate elevation changes using positive and negative integers.

BACKGROUND

In 1930, Congress authorized the construction of locks and dams on the Upper Mississippi River to achieve a 9-foot channel. The Corps of Engineers operates the locks and dams on the Mississippi River for navigation, not flood control. The dams hold back water and form deeper navigation pools. Locks allow river vessels to navigate through a series of "steps" up or down the river from one water level to another. Note that elevations listed on the figure are for the upstream (pool) end of the lock.

Commodities shipped on the Upper Mississippi River include:

- Energy commodities: coal, petroleum
- Agricultural commodities: corn, beans, fertilizers, wheat, cotton by-products
- Other commodities: aggregate (sand/gravel), iron/steel, chemicals

Grade Level: 5 – 12

Subjects: Math

Duration: 50 minutes

Group Size: Any

Setting: Classroom

Key Vocabulary: dry (positive) and wet (negative) numbers, integers, elevation, locks and dams

Materials:

- *Locks Location and Elevation Handout (1/student)*
- *Student worksheet (1/student)*
- *How Navigation Locks Operate Overhead*

MATERIALS

- Mississippi River Locks – Locations and Elevations figure (1/student)
- Student worksheet (1/student)

PROCEDURES

1. Provide background information on the role of locks and dams and barge transportation on the Mississippi River. For a virtual tour of Lock and Dam 15 see: http://www.mvr.usace.army.mil/missriver/VC%20Page/LDTour/Tour.HTM . It could be viewed by the class on-line or sections printed to provide an overview.

2. Show and discuss the figure: *How Navigation Locks Operate.* View a brief animation of how boats lock through a lock and dam at: http://www.mvp.usace.army.mil/navigation/default.asp?pageid=166

3. Have students refer to the figure: *Mississippi River Locks- Locations and Elevations* to answer questions on student worksheet.

4. Correct student worksheets.

5. Discuss results.
   a. Why might some answers differ by five to ten feet? *(The figure's data is plotted on a scale of 50 feet elevations. Students need to interpret to the nearest 5 feet.)*
   b. When traveling upstream does the change in elevation result in a "dry" or "wet" number? *(dry - travel upstream is from a lower elevation to a higher elevation, resulting in a positive change in elevation)*
   c. When traveling downstream does the change in elevation result in a "dry" or "wet" number? *(wet - travel downstream is from a higher elevation to a lower elevation, resulting in a negative change in elevation)*
   d. How did you create a shorter arrow string for number 5? *(The distance between Keokuk and Lock 17 is traveled up and downstream, negating any change in elevation.)*

ASSESSMENT

During:

Monitor how independently the students are able to work.

Post-Activity:

1. Correct the student worksheets.

2. Use classroom discussion to further assess student's understanding.

EXTENSIONS

1. Have students create River elevation word problems for other students to solve.

2. Observe Lock and Dam 15 at Rock Island, IL through the River Cam. It provides an updated image every minute: http://www.mvr.usace.army.mil/MVRCams/RiverCam.asp

3. View aerial photos of Locks and Dams at: http://www2.mvr.usace.army.mil/NIC2/AerialPhotos/default.cfm

Answer Key for Wet and Dry Numbers

1.	630 ft Lock 8	⇨	620 ft Lynxville, WI	⇨	-10 feet	
2.	385 ft Granite City, IL	⇨	425 ft Lock 26	⇨	40 feet	
3.	725 ft St. Paul, MN	⇨	660 ft Lock 5	⇨	-65 feet	
4.	520 ft Lock 19	⇨	550 ft Rock Island, IL	⇨	30 feet	
5a.	480 ft Keokuk, IA	⇨	530 ft Lock 17	⇨	460 ft Lock 22	⇨ - 20 feet
5b.	480 ft	⇨	460 ft	⇨	- 20 feet	

Dry and Wet Numbers

Use the *Mississippi River Locks – Locations and Elevations* figure to answer questions 1-5.
List all elevations to the nearest 5 feet.

1. If you were traveling downstream from Lock 8 to Lynxville, WI, what is your change in elevation above sea level in feet? Fill in the arrow string below to calculate your answer.

_____ ⇒ _____ ⇒ _____
Elevation of Lock 8 Elevation of Lynxville, WI change in elevation

2. If you were traveling upstream from Granite City, IL to Lock 26, what is your change in elevation above sea level in feet? Use an arrow string to calculate your answer.

_____ ⇒ _____ ⇒ _____

3. If you were traveling downstream from St. Paul, MN to Lock 5, what is your change in elevation above sea level in feet? Use an arrow string to calculate your answer. Show each step.

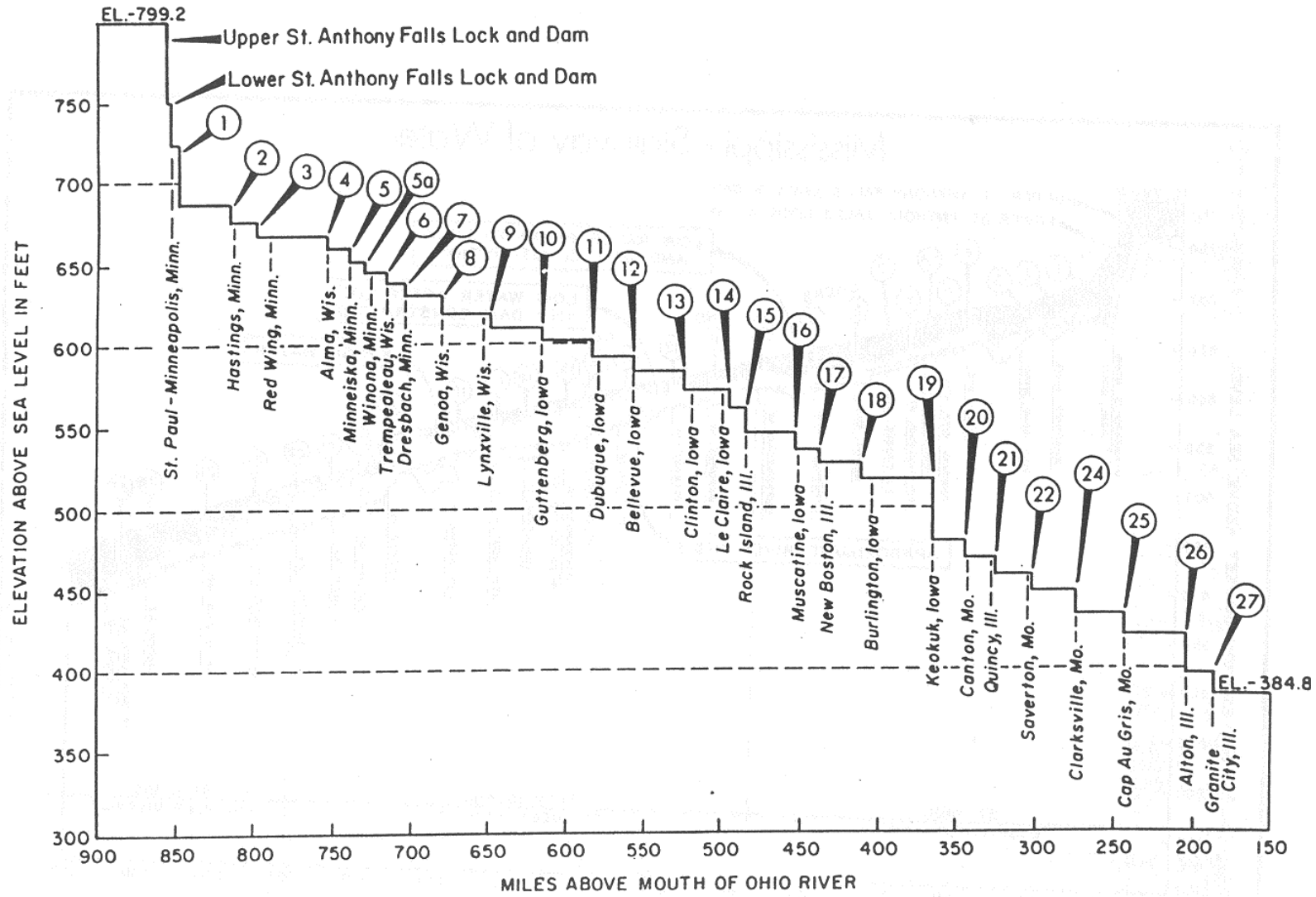
_____ ⇒ _____ ⇒ _____

4. If you were traveling upstream from Lock 19 to Rock Island IL, what is your change in elevation above sea level in feet? Use an arrow string to calculate your answer. Show each step.

5a. If you were traveling upstream from Keokuk, IA to Lock 17 and then down stream to Lock 22, what is your change in elevation above sea level in feet? Use an arrow string to calculate your answer. Show each step.

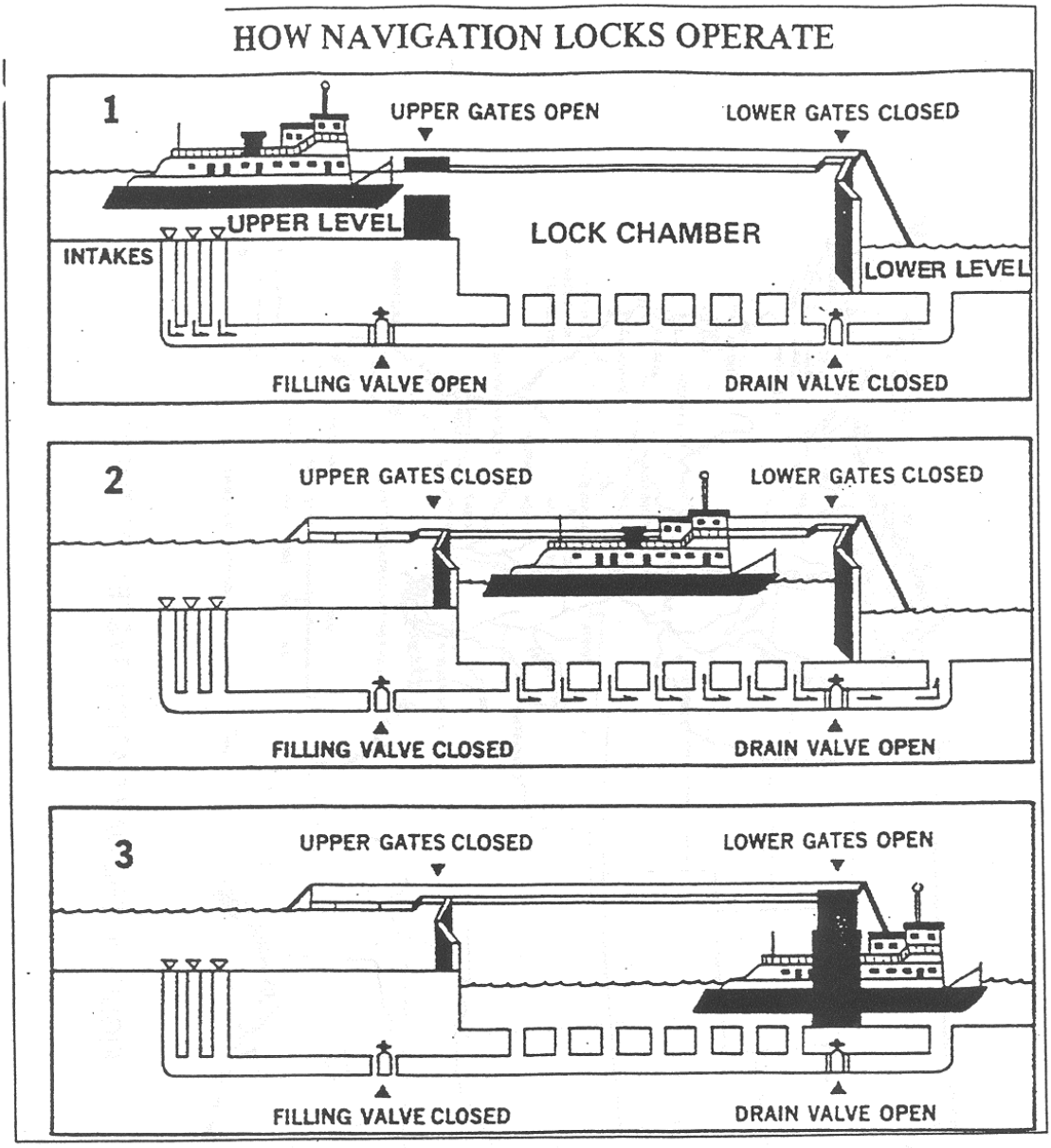
5b. Find the change in elevation using a shorter arrow string. Record the arrow string below.

Mississippi River Locks - Locations and Elevations



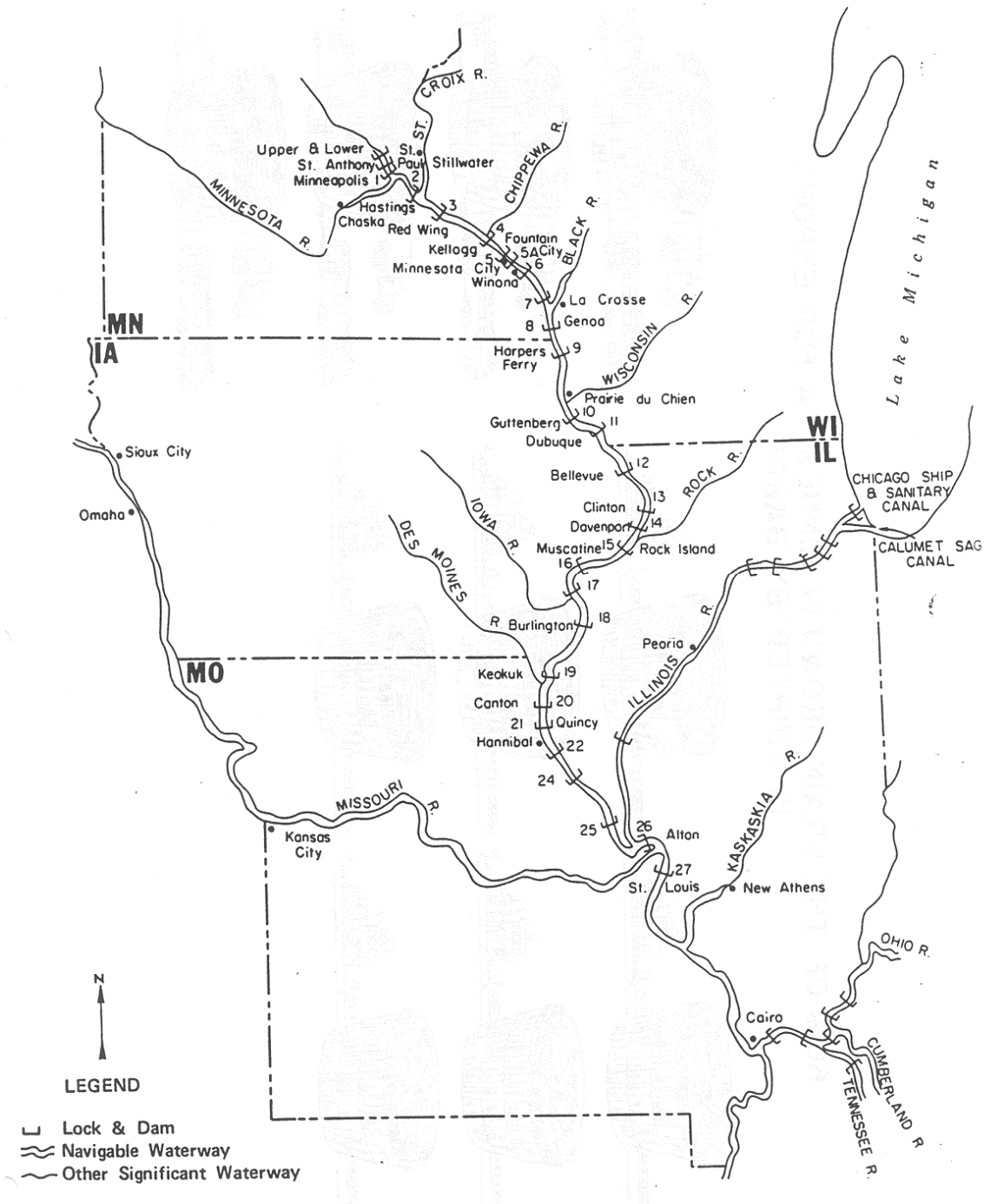
Note that elevations listed on the figure are for the upstream (pool) end of the lock.

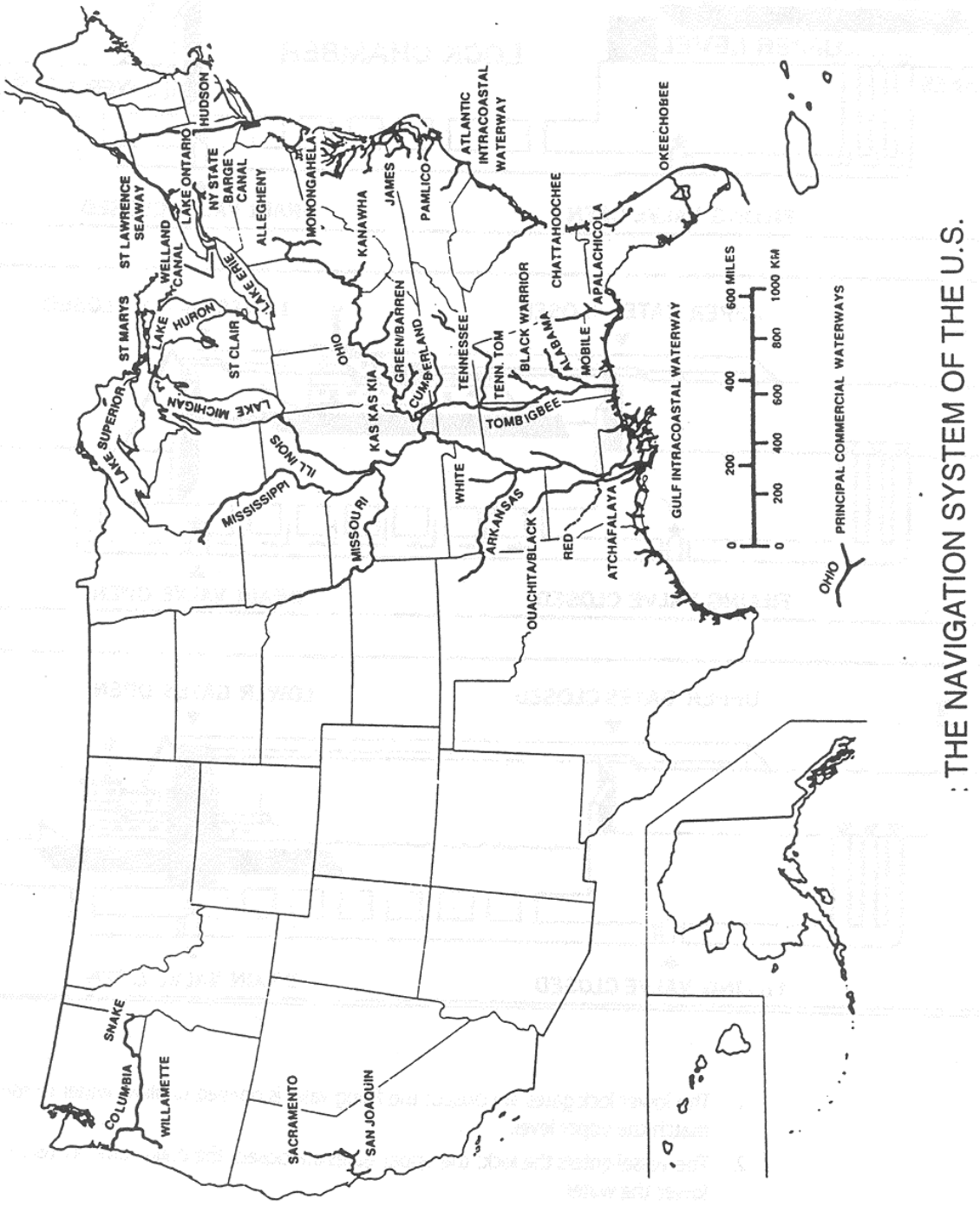
Ports and Waterways Section
Program Management Divis



1. The lower lock gates are closed: the filling valve is opened to allow water to rise to match the upper level.
2. The vessel enters the lock; the upper gates are closed; the drain valve opens to lower the water.
3. The process is reversed for the upstream movement.

UPPER MISSISSIPPI RIVER SYSTEM

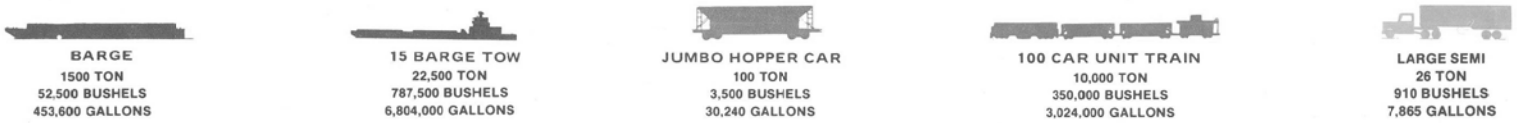




: THE NAVIGATION SYSTEM OF THE U.S.

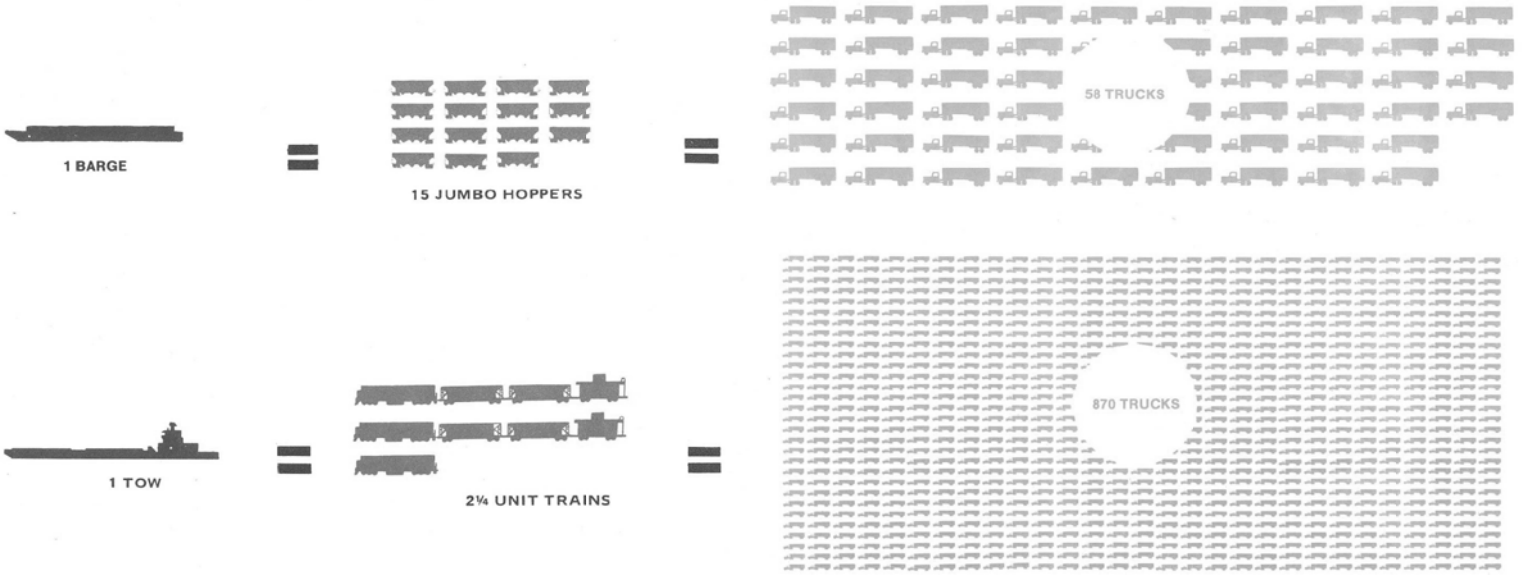
COMPARE

CARGO CAPACITY

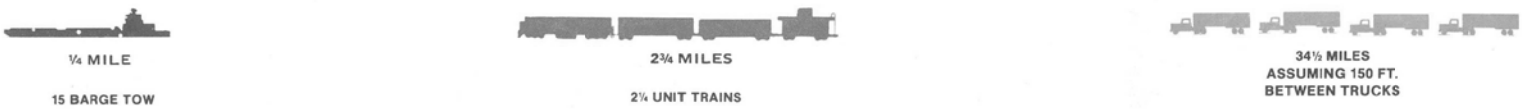


BARGE	15 BARGE TOW	JUMBO HOPPER CAR	100 CAR UNIT TRAIN	LARGE SEMI
1500 TON	22,500 TON	100 TON	10,000 TON	26 TON
52,500 BUSHELS	787,500 BUSHELS	3,500 BUSHELS	350,000 BUSHELS	910 BUSHELS
453,600 GALLONS	6,804,000 GALLONS	30,240 GALLONS	3,024,000 GALLONS	7,865 GALLONS

EQUIVALENT UNITS



EQUIVALENT LENGTHS

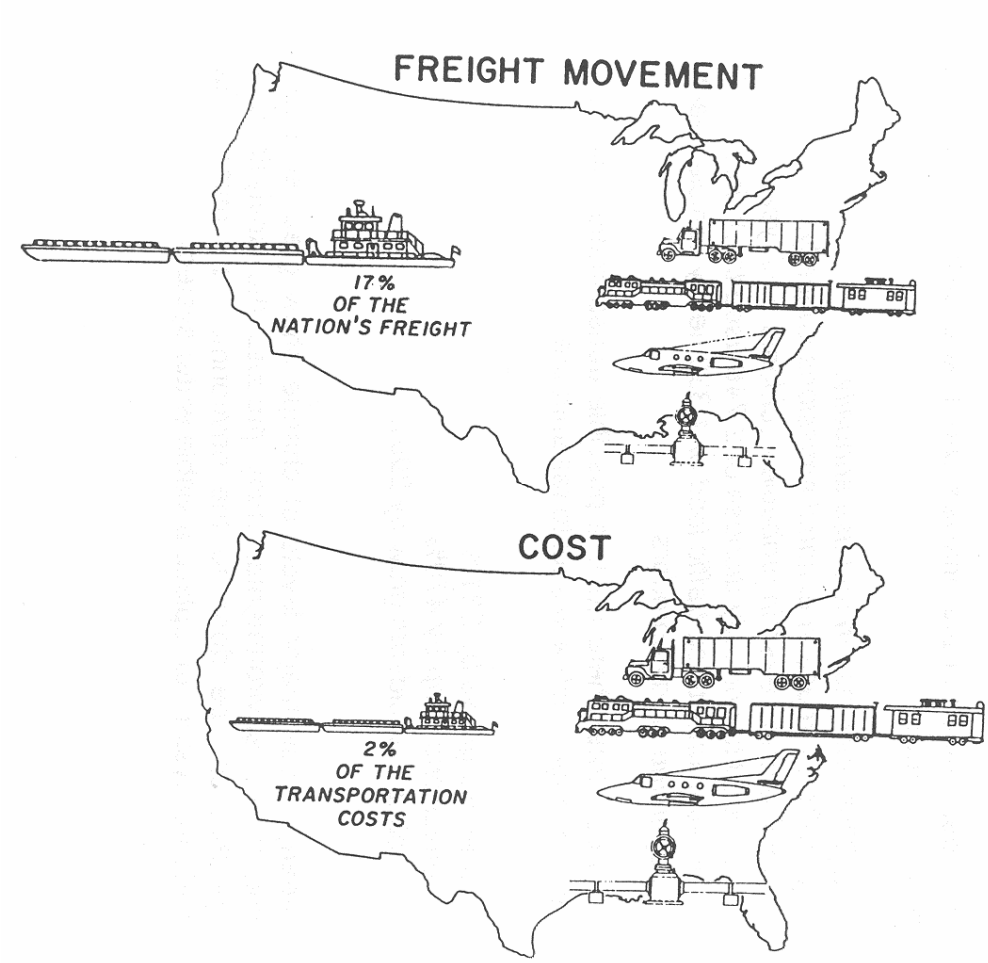


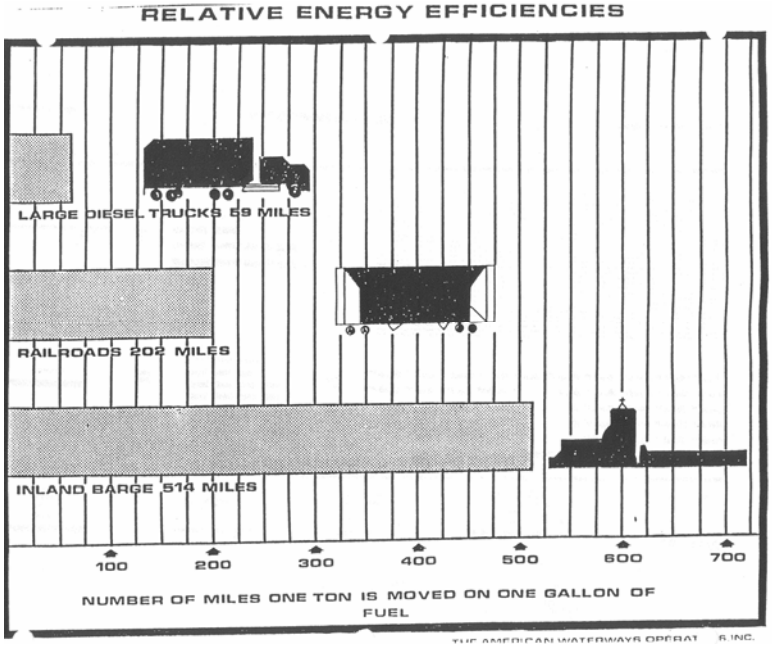
¼ MILE	2¾ MILES	34½ MILES
15 BARGE TOW	2¼ UNIT TRAINS	ASSUMING 150 FT. BETWEEN TRUCKS

RAIL AND WATER
800 Lincoln Way
Ames, Iowa 50010
515-239-1367

Gra. 432
0410 1/7/92

Iowa Department of Transportation
Prepared by:
Planning and Research Division


FREIGHT MOVEMENT
17%
OF THE
NATION'S FREIGHT
COST
2%
OF THE
TRANSPORTATION
COSTS


RELATIVE ENERGY EFFICIENCIES
LARGE DIESEL TRUCKS 59 MILES
RAILROADS 202 MILES
INLAND BARGE 514 MILES
100
200
300
400
500
600
700
NUMBER OF MILES ONE TON IS MOVED ON ONE GALLON OF FUEL

Example of 1995 Commodities Shipped on the Upper Mississippi River (Millions of Tons)

Energy Commodities
- **Coal – 22.3**
- **Petroleum – 14.3**

Agricultural Commodities
- **Corn – 31.5**
- **Beans – 11.7**
- **Fertilizers – 4.5**
- **Wheat – 4.3**
- **Other farm commodities (ex. *cotton by-products*) – 1.6**

Other Commodities
- **Aggregate – 8.6**
- **Iron/Steel – 10.1**
- **Chemicals – 5.0**
- **Misc. – 6.5**

1997 Facts: Wisconsin and Minnesota Comparison

Wisconsin

- **Shipped & received nearly 3.9 million tons**
- **Tonnage valued at $314 million**
- **Generates 430 direct jobs, $2.5 million payroll tax. In direct employ 3,214, $15 million payroll tax.**
- **Water transportation is essential for transportation of coal, minerals, paper products, and farm products.**

Minnesota

- **Shipped & received nearly 14.4 million tons**
- **Tonnage valued at +$1.5 billion**
- **Commodities include: grain, coal, & petroleum**
- **The water transportation sector of the grain industry directly employs only a few hundred workers, yet produces $ 4 million of state and federal taxes.**