US Army Corps
of Engineers
Engineer Institute for
Water Resources

# Report on the Current Status of Selected U.S. Waterways in 1985

February 1986

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This is a special report on the current use of U.S. inland waterways including the use, the physical condition and near-term financial commitment to respond to these needs.

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UNCLASSIFIED

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# REPORT ON THE CURRENT STATUS OF SELECTED U.S. WATERWAYS IN 1985

Prepared by

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For

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February 1986 Miscellaneous Report 86-MP-1

# PREFACE

This report was prepared at the request of the Office of the Chief of Engineers. Its objective was to review the current and expected use and condition of the inland waterway system, with a focus on only those waterways with potential lock capacity or integrity problems. The traffic -- historic, existing and forecast -- was reviewed for waterways and locks. One lock capacity indicator -- delays -- was assessed for selected commercially used locks. The current status of the lock rehabilitation and replacement actions was reviewed as was the status of ongoing studies.

ACKNOWLEDGEMENTS

The major portion of this report was authored by Arlene Dietz with contributions by David Grier and Leigh Skaggs. Mr. James R. Hanchey, Director of the Institute provided the overall direction of the report with technical oversight by George Antle and Howard Olson. Frank Sharp and Julie Oweis processed the Lock Performance Monitoring System (PMS) data. Sidney Andrus of the Waterborne Commerce Statistics Center provided the 1984 preliminary traffic data for the selected waterways and U.S. total. Graphics were provided by Robert Swett.

**CURRENT STATUS OF SELECTED U.S. WATERWAYS**

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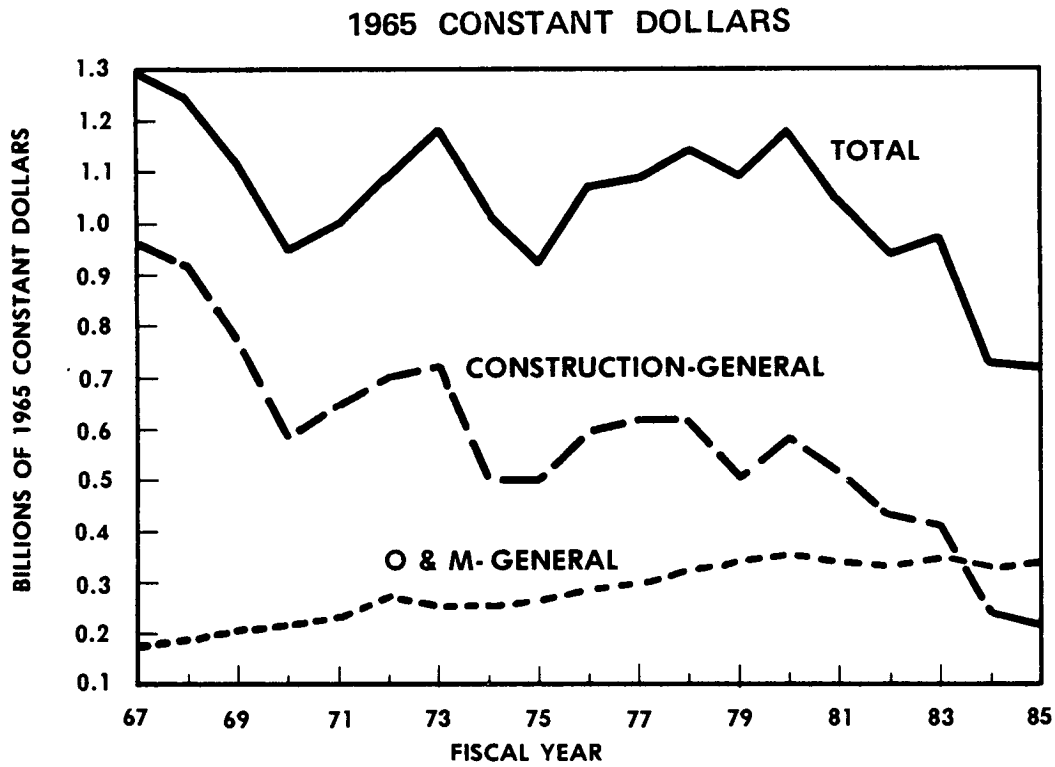
## CURRENT STATUS OF SELECTED WATERWAYS

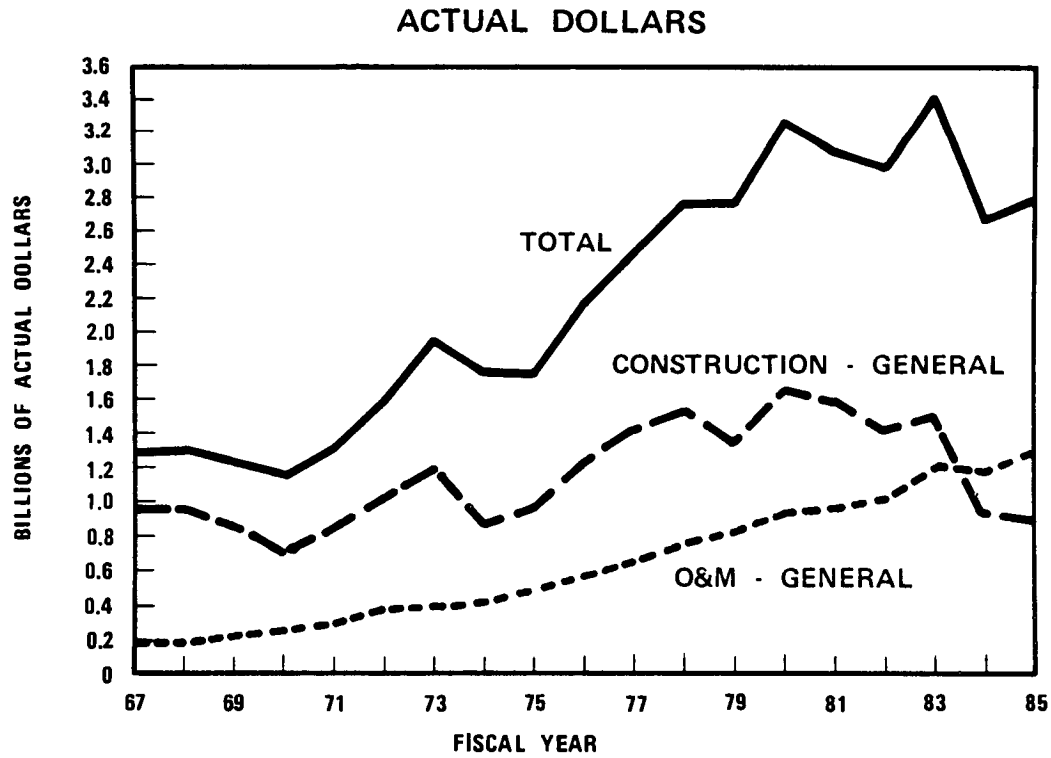
SUMMARY

The status of the U.S. waterways is measured by the intensity of use, the physical condition of structures, and the financial commitment to respond to these needs. The financial commitment, as exhibited in Figure 1, shows in 1965 constant dollars that the total appropriation level fell by nearly half from 1967 to 1985, from $1,293 million to $747 million. Construction general appropriations, the appropriations required for major rehabilitation as well as new project work, have fallen in 1985 to a level that is approximately one-fifth the 1967 level in constant dollars. For construction general the $955 million level in 1985 appears very close to the $966 million appropriated in 1967; however, when converted to constant 1965 dollars, the 1985 expenditure becomes $235 million. This real decline in total and construction general appropriations resulted from the 15-year impasse over authorization legislation, the last significant construction authorization bill was passed in 1970, and no appropriations for new starts for the past five years.

Since 1970 several additions to the inland waterways system have been completed and placed in operation increasing the need for operations and maintenance (O&M) funds. Real maintenance dredging expenses have increased since 1970 as costs for fuel and dredged material management escalated. In addition, maintenance costs will tend to increase as the system ages. As a result, the Corps Operations and Maintenance (O&M) appropriation has steadily

# FIGURE 1: CORPS OF ENGINEERS APPROPRIATIONS
## FY67-FY85 IN ACTUAL AND 1965 CONSTANT DOLLARS




DATA SOURCE. OFFICE, CHIEF OF ENGINEERS
GRAPH BY USACE-WRSC-IWR-N, DEC 1985

risen in constant dollars to a point where it is nearly double the 1967 level. The actual appropriations for O&M in 1967 was $179 million compared to $1.3 billion in 1985. In constant 1965 dollars the $1.3 billion 1985 figure becomes $342 million, a figure nearly double the $179 appropriated in 1967.

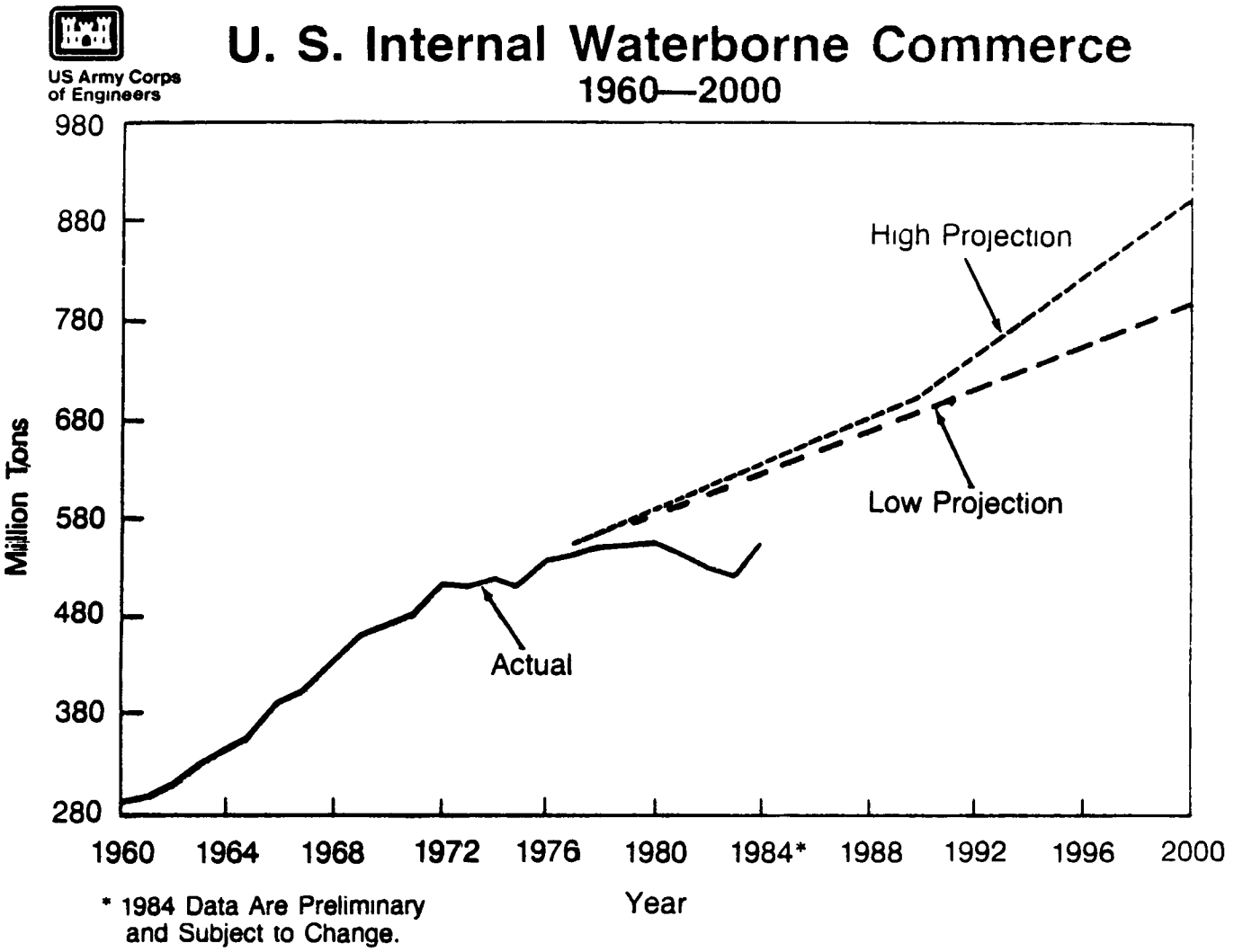
The National Waterways Study (NWS), completed in 1981, showed two fundamental forces acting to define the potential needs for waterway system investment. One is the projected continuing increase in traffic which ultimately implies adding capacity. The other force acting on investment needs comes primarily from the aging of the system, which requires major rehabilitation and replacement work. Several projects reflect both capacity and aging problems. An increasing number of lock rehabilitation projects are now entering the Corps budget, primarily to replace and rehabilitate major structural and mechanical systems in older locks.

Based on pending 1985 authorizing legislation (S.1567 and HR. 6 ), an estimated one billion dollars is included for seven lock replacement projects. Locks included are the second lock at Lock 26 on the Mississippi River, Bonneville on the Columbia River, Gallipolis on the Ohio River, Oliver on the Black-Warrior River, Winfield on the Kanawha River and Locks 7 and 8 on the Monongahela River. The first three of these received authorization and appropriations in the 1985 Supplemental Appropriations signed into law in August 1985. A second wave of replacement needs may include several additional locks now under study: Locks 52 and 53, Inner Harbor, Kentucky, Emsworth, Montgomery and Dashields. All but Inner Harbor (New Orleans) are on the Ohio System or its tributaries. These structures, like those of the first

wave, are old, have dimensions inconsistent with the rest of the navigation system and are heavily used. To resolve the problems associated with the large number of aging structures in the system, the Corps pursues active lock rehabilitation, now estimated at $500 million per decade. Replacement and rehabilitation, hopefully will forestall the fate experienced on the Welland System in October 1985.

Total traffic on the U.S. inland waterways increased steadily until a plateau was reached in the 1978-1980 period. This growth led to increasing delays and congestion at a number of the old and undersized locks noted above. A drop in waterway traffic was evident after 1981, although a recovery occurred in 1984 at which time traffic reached an all time high. During the recession years of 1981-1983 lower growth rates of exports of coal and grain were realized. Current short term expectations are for somewhat lower overall increases in total waterway traffic than were projected a few years ago. Increased fuel taxes may have also inhibited traffic development during this period. Traffic growth projected under the NWS low scenario now seems to be the most appropriate projection for the near term. The effect of a lower growth rate, if it were to continue, would be to ease short-term requirements for investment in capacity-increasing projects. However, the need for timely replacement of old, obsolete structures would persist. Figure 2 shows total internal waterborne commerce for 1960 through 1984 and projected (NWS) traffic to 2000, using 1977 as the base year. Many specific locks and waterways are exceptions to the U.S. total trends and have displayed rapid growth and will be discussed later in this paper.

FIGURE 2


US Army Corps of Engineers
U. S. Internal Waterborne Commerce
1960—2000
980
880
780
680
580
480
380
280
Million Tons
High Projection
Low Projection
Actual
1960
1964
1968
1972
1976
1980
1984*
1988
1992
1996
2000
Year
* 1984 Data Are Preliminary and Subject to Change.

## PHYSICAL CONDITION AND USAGE OF SELECTED WATERWAYS[1]

The existing and potential problems of the U.S. shallow draft locks are explained by two criteria -- the physical condition and the level of use. Similar to all transportation systems and manmade structures, locks and dams wear with time and use.

### Physical Condition

The newest lock chamber at the 96 commercially active lock sites will exceed 50 years of age by the end of the 1980's. Figure 3 displays all U.S. commercially used locks by the decade of their construction. Considering that the age of the second chamber at many sites is equal or greater than the recorded lock age, the high number of aging structures suggests a very large lock infrastructure rehabilitation need.

Beginning in the 1930s, the Corps initiated modernization programs on a number of waterways, including the Black Warrior and the Ohio. Today many old and obsolete first generation structures continue in heavy use, and the oldest of the second generation locks and dams are also in need of rehabilitation and further modernization. Caught in the Federal fiscal crunch, rehabilitation has moved at a moderate pace. During the last five years nearly $200 million were expended on completing ten lock rehabilitation projects. It is estimated that over $300 million will be needed over the next five years for 25 new

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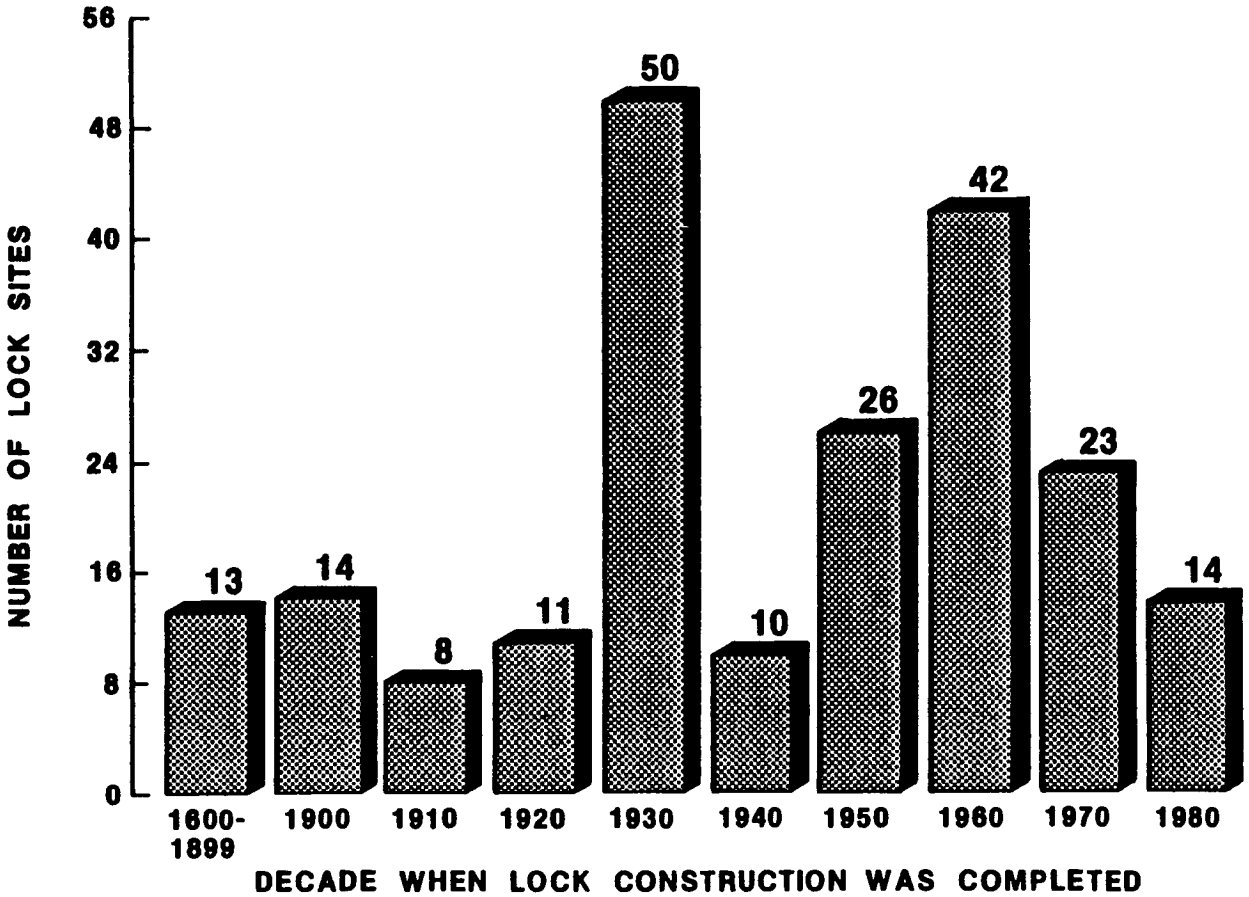
[1] Sources used in this report: USACE PMS lock operating statistics, 1984; rehabilitation and funding data were from OCE and NCR; study schedule data were from OCE, ORD, and the National Waterways Study.

FIGURE 3

# DISTRIBUTION OF U.S. LOCK CONSTRUCTION BY DECADE

**(FOR FEDERAL LOCKS, USED FOR COMMERCIAL PURPOSES)**



starts and for completion of ongoing lock rehabilitation. By 1989 there will be 65 old locks with as yet no planned rehabilitation or replacement. Considering that the rest of the system continues to age as well, there will be a need for continued lock rehabilitation.

Use of Selected Waterways

Between 1960 and 1977, the base year for NWS projections, U.S. total traffic on the inland waterways grew by over 80 percent. Figure 2 shows the growth in actual traffic through 1977, its peak in 1980 at over 534 million tons, and its subsequent decline during the recession years of 1981 through 1983. Preliminary data for 1984 show that traffic levels have turned upward, reaching an all time high. The 1985 grain traffic, however, is down from the 1984 level. Table 1 shows traffic increases by waterway between 1960 and 1984. Table 2 shows an index of growth on each waterway using 1960 as 100. Table 3 is a similar index except 1977 is set at 100. As can be seen in Figure 2, the high NWS projections for the U.S. total were somewhat optimistic due to previous expectations for coal and grain exports. However, lower traffic growth rates than the projected high do not alleviate the critical lock problems anticipated. These locks are still old structures which require congestion relief under the lowest of forecasts. Indeed, the lock problems in the near future will be exacerbated by the combination of traffic congestion and deterioration due to age. The recent collapse of part of a lock wall on the Welland Canal in Canada and the subsequent 23-day closure of the St. Lawrence Seaway to through traffic provides a grim reminder that the present condition of the U.S. system increases the risk of a similar calamity. The need for well funded rehabilitation and replacement programs becomes critical in light of such a disaster.

TABLE 1
INTERNAL TRAFFIC ON SELECTED WATERWAYS, 1960-1984 (1)
(IN MILLIONS OF SHORT TONS)

| | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1960 | 1970 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984(2) |
| US TOTAL | 291.1 | 472.1 | 528.7 | 534.5 | 535.0 | 535.0 | 520.7 | 495.5 | 487.1 | 536.0 |
| Mississippi River System | | | | | | | | | | |
| TOTAL | 188.1 | 297.3 | 351.5 | 355.3 | 370.8 | 356.6 | 362.9 | 347.4 | 352.0 | (3) |
| Miss. R.: Mpls. to Mouth of Passes | 82.5 | 157.0 | 211.5 | 215.5 | 218.0 | 222.9 | 223.3 | 215.4 | 225.0 | 235.0 |
| Miss. R.: Mpls. to Missouri R. | 27.4 | 54.0 | 67.2 | 69.0 | 68.6 | 76.4 | 74.5 | 74.7 | 84.1 | 79.7 |
| Miss. R.: Missouri R. to Ohio R. | 30.0 | 58.3 | 74.5 | 79.3 | 80.4 | 92.9 | 92.2 | 90.5 | 98.7 | 101.7 |
| Illinois River | 22.8 | 34.3 | 40.8 | 37.2 | 35.2 | 41.7 | 39.8 | 39.5 | 41.0 | 36.4 |
| Ohio River | 79.5 | 129.6 | 151.4 | 152.6 | 165.3 | 155.9 | 158.7 | 150.7 | 150.4 | 173.6 |
| Kanawha River | 10.1 | 14.1 | 10.8 | 11.0 | 13.8 | 14.7 | 13.0 | 13.7 | 13.2 | 14.2 |
| Monongahela River | 29.5 | 42.3 | 34.4 | 31.7 | 38.2 | 34.3 | 32.1 | 28.8 | 26.5 | 34.5 |
| Tennessee River | 12.4 | 25.5 | 26.6 | 31.6 | 31.4 | 29.4 | 26.0 | 25.5 | 28.0 | 33.0 |
| Black Warrior-Tombigbee River | 5.8 | 11.1 | 15.3 | 14.6 | 15.3 | 16.7 | 16.0 | 15.2 | 14.7 | 19.6 |
| Columbia River | | | | | | | | | | |
| Vancouver, WA to the Dalles | 3.2 | 3.2 | 6.8 | 7.9 | 8.2 | 9.1 | 9.1 | 7.8 | 8.0 | 10.1 |
| GIWW West: Mississippi River to Sabine River | 36.3 | 65.1 | 63.3 | 61.8 | 55.9 | 54.9 | 52.6 | 50.4 | 51.5 | (3) |

TABLE 2
INTERNAL TRAFFIC ON SELECTED WATERWAYS, 1960-1984(1)
(BASE YEAR INDEX 1960 = 100)

| | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1960 | 1970 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984(2) |
| US TOTAL | 100.0 | 162.2 | 181.6 | 183.6 | 183.8 | 183.8 | 178.9 | 170.2 | 167.3 | 184.1 |
| Mississippi River System | | | | | | | | | | |
| TOTAL | 100.0 | 158.1 | 186.9 | 188.9 | 197.1 | 189.6 | 192.9 | 184.7 | 187.1 | (3) |
| Miss. R.: Mpls. to Mouth of Passes | 100.0 | 190.3 | 256.4 | 261.2 | 264.2 | 270.2 | 270.9 | 261.1 | 272.7 | 284.8 |
| Miss. R.: Mpls. to Missouri River | 100.0 | 197.1 | 245.3 | 251.8 | 250.4 | 278.8 | 271.9 | 272.6 | 306.9 | 290.9 |
| Miss. R.: Missouri R. to Ohio R. | 100.0 | 194.3 | 248.3 | 264.3 | 268.0 | 309.7 | 307.3 | 301.7 | 329.0 | 339.0 |
| Illinois River | 100.0 | 150.4 | 178.9 | 163.6 | 154.4 | 182.9 | 174.6 | 173.2 | 179.8 | 159.6 |
| Ohio River | 100.0 | 163.0 | 190.4 | 191.9 | 207.9 | 196.1 | 199.6 | 189.6 | 189.2 | 218.4 |
| Kanawha River | 100.0 | 139.6 | 106.9 | 108.9 | 136.6 | 145.5 | 128.7 | 135.6 | 130.7 | 140.6 |
| Monongahela River | 100.0 | 143.4 | 116.6 | 107.5 | 129.5 | 116.3 | 108.8 | 97.6 | 89.8 | 116.9 |
| Tennessee River | 100.0 | 205.6 | 214.5 | 254.8 | 253.2 | 237.1 | 209.7 | 205.6 | 225.8 | 266.1 |
| Black Warrior-Tombigbee River | 100.0 | 191.4 | 263.8 | 251.7 | 263.8 | 287.9 | 275.9 | 262.1 | 253.4 | 337.9 |
| Columbia River, | | | | | | | | | | |
| Vancouver, WA to the Dalles | 100.0 | 100.0 | 212.5 | 246.9 | 256.2 | 284.4 | 284.4 | 243.8 | 250.0 | 315.6 |
| GIWW West: Mississippi River to Sabine River | 100.0 | 179.3 | 174.4 | 170.2 | 154.0 | 151.2 | 144.9 | 138.8 | 141.9 | (3) |

TABLE 3
INTERNAL TRAFFIC ON SELECTED WATERWAYS, 1960-1984(1)
(BASE YEAR INDEX 1977 = 100)

| | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1960 | 1970 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984(2) |
| US TOTAL | 55.1 | 89.3 | 100.0 | 101.1 | 101.2 | 101.2 | 98.5 | 93.7 | 92.1 | 101.4 |
| Mississippi River System | | | | | | | | | | |
| TOTAL | 53.5 | 84.6 | 100.0 | 101.1 | 105.5 | 101.5 | 103.2 | 98.8 | 100.1 | (3) |
| Miss. R.: Mpls. to Mouth of Passes | 39.0 | 74.2 | 100.0 | 101.9 | 103.1 | 105.4 | 105.6 | 101.8 | 106.4 | 111.1 |
| Miss. R.: Mpls. to Missouri River | 40.8 | 80.4 | 100.0 | 102.7 | 102.1 | 113.7 | 110.9 | 111.2 | 125.1 | 118.6 |
| Miss. R.: Missouri R. to Ohio R. | 40.3 | 78.3 | 100.0 | 106.4 | 107.9 | 124.7 | 123.8 | 121.5 | 132.5 | 136.5 |
| Illinois River | 55.9 | 84.1 | 100.0 | 91.4 | 86.3 | 102.2 | 97.5 | 96.8 | 100.5 | 89.2 |
| Ohio River | 52.5 | 85.6 | 100.0 | 100.8 | 109.2 | 103.0 | 104.8 | 99.5 | 99.3 | 114.7 |
| Kanawha River | 93.5 | 130.6 | 100.0 | 101.9 | 127.8 | 136.1 | 120.4 | 126.9 | 122.2 | 131.5 |
| Monongahela River | 85.8 | 123.0 | 100.0 | 92.2 | 111.0 | 99.7 | 93.3 | 83.7 | 77.0 | 100.3 |
| Tennessee River | 46.6 | 95.9 | 100.0 | 118.8 | 118.0 | 110.5 | 97.7 | 95.9 | 105.3 | 124.1 |
| Black Warrior-Tombigbee River | 37.9 | 72.5 | 100.0 | 95.4 | 100.0 | 109.2 | 104.6 | 99.3 | 96.1 | 128.1 |
| Columbia River | | | | | | | | | | |
| Vancouver, WA to the Dalles | 47.1 | 47.1 | 100.0 | 116.2 | 120.6 | 133.8 | 133.8 | 114.7 | 117.6 | 148.5 |
| GIWW West: Mississippi River to Sabine River | 57.3 | 102.8 | 100.0 | 97.6 | 88.3 | 86.7 | 83.1 | 79.6 | 81.4 | (3) |

(1) Source: U.S. Army Corps of Engineers, Waterborne Commerce of the United States, Annual, Parts 2, 4, and 5. The data shown are internal freight traffic and exclude rafted logs. Minor amounts of coastwise freight traffic might be included in waterways other than the U.S. total and the Mississippi River, Minneapolis to the Mouth of Passes.

(2) Preliminary, subject to change.

(3) Data not available.

Although total traffic on the U.S. inland waterways has not shown significant growth since 1977, traffic on individual waterway segments and at specific locks has increased substantially. In many cases these are also the very segments with the most serious problems in terms of lock age, obsolescence or traffic congestion. Currently proposed authorizing legislation includes seven critical locks -- a second lock at 26 on the Upper Mississippi; Gallipolis on the Ohio; Monongahela Locks 7 and 8; Winfield Lock on the Kanawha; Oliver Lock on the Black Warrior; and Bonneville Lock on the Columbia. The estimated 1984 costs for these seven locks is slightly over one billion dollars. Costs range from $68 million for Lock 8 to $245 million for a second chamber at Lock 26. Traffic on the Upper Mississippi River from Minneapolis to the mouth of the Missouri River increased 18.6 percent from 1977 to 1984 and a higher growth rate of 36.5 percent was reported for that period for the next reach on the Mississippi River extending downstream to the Ohio River. Lock 26 is located near the junction of those two reaches. In 1984 Lock 26 had 71 million tons of traffic while the capacity range of the existing locks are 70-75 million tons and the new single chamber lock under construction at 26 will be 94-101 million tons. Delays at the two existing old chambers at Lock 26 averaged nearly 9 hours per tow in 1984 as noted in Table 4. In 1984, traffic on the Ohio was up nearly 15 percent from 1977 levels and delays at Gallipolis averaged 3.4 hours per tow. On the Kanawha, commerce increased about 32 percent from 1977 to 1984 and average delays at Winfield exceeded 4 hours in 1984. Similarly, the Black Warrior-Tombigbee system increased about 28 percent and delays at Oliver Lock averaged over an hour per tow. Bonneville lock also experienced excessive make-break time of about 2 hours per tow associated with rearranging a tow for a small lock, plus

Table 4
Status of Selected U.S. Commercially Used Locks - 1985

| Waterway & Lock | Age (1985) | 1984 Traffic[4] | 2000 Projection Low-High[3] | Capacity Range | Delay per Tow (Hr.)'84 | FY85 Supplemental | S1567 or HR6 | Study Name | Study Date to complete | Major Rehabilitation[1] (completion or start date - millions of current dollars) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Miss | | | | | | | | | | |
| * 27 | 27 | 77 | 107-120 | 142-158 | .9 | No | No | | | |
| * 26 | 47 | 71 | 95-107 | 70-75 | 8.9 | Yes | Yes | First lock chamber is under construction. | Thru FY 86 | $406.5 |
| * 25 | 46 | 36.2 | 44-50 | 59-60 | 3.3 | No | No | | | |
| * 24 | 45 | 36.0 | 44-49 | 59-60 | 3.0 | No | No | | | |
| * 22 | 47 | 34.6 | 43-47 | 50 | 2.9 | No | No | | | FY87-90 (15.6) |
| * 21 | 47 | 34.0 | 42-46 | 60-61 | 1.3 | No | No | | | FY87-90 (14.2) |
| * 20 | 49 | 33 | 40-44 | 59-60 | 1.2 | No | No | | | FY86-89 (14.4) |
| * 19 | 28 | 32.3 | 39-43 | 67 | 1.6 | No | No | | | FY77-80 (5.1) |
| * 18 | 48 | 30.1 | 36-40 | 55-58 | 1.8 | No | No | | | FY88-92 (14.0) |
| * 17 | 46 | 29.4 | 35-38 | 55-58 | 1.6 | No | No | | | FY88-92 (13.7) |
| * 16 | 48 | 28.2 | 33-37 | 53-56 | 1.6 | No | No | | | FY91-95 (10.0) |
| * 15 | 51 | 25.7 | 30-33 | 54-57 | 1.3 | No | No | | | FY91-95 (10.0) |
| * 14 | 63 | 25.2 | 29-32 | 54-57 | 1.7 | No | No | | | 78-82(7.8)/FY92-96(10.0)New |
| * 13 | 47 | 21.6 | 26-28 | 48-51 | .9 | No | No | | | FY90-94 (18.6) |
| * 12 | 47 | 21.6 | 26-28 | 48-51 | 1.0 | No | No | | | FY89-94 (10.0) |
| * 11 | 48 | 19.6 | 23-26 | 48-50 | 1.0 | No | No | | | FY92-96 (10.0) |
| * 10 | 49 | 19.1 | 23-26 | 48-50 | .8 | No | No | | | |
| * 9 | 47 | 17.8 | 22-24 | 48-50 | .6 | No | No | | | FY87[2] |
| * 8 | 48 | 16.8 | 21-23 | 49-50 | .8 | No | No | | | FY87[2] |
| * 7 | 48 | 16.1 | 20-23 | 49-50 | .7 | No | No | | | FY87[2] |
| * 6 | 49 | 16.1 | 20-23 | 49-50 | .8 | No | No | | | FY87[2] |
| * 5a | 49 | 14.9 | 19-22 | 49-50 | .6 | No | No | | | FY87[2] |
| * 5 | 50 | 14.9 | 19-22 | 48-49 | .7 | No | No | | | |
| * 4 | 50 | 14.8 | 19-22 | 48-49 | .7 | No | No | | | |
| * 3 | 47 | 14.2 | 19-21 | 48 | .7 | No | No | | | FY87[2] |
| * 2 | 37 | 15.1 | 22-25 | 36 | .9 | No | No | | | |
| * 1 | 55 | | 6-7 | 19-22 | | No | No | | | FY82 (44.1) |
| Total | | | | | | | | | | $57.0 million completed to date, $156 million to complete ($406.5 for L26 not included) |
| Illinois | Major Rehabilitation closed portions of system for part of FY84 contributing to reduced traffic. | | | | | | | | | |
| *LaGrange | 46 | 31.3 | 49-53 | 46-49 | .8 | No | No | | | FY86-90 (20.9) |
| *Peoria | 46 | 28.3 | 47-52 | 44-52 | 1.5 | No | No | | | FY86-90 (17.3) |
| *Starved Rk | 52 | 20.8 | 35-39 | 42-43 | 1.3 | No | No | | | FY78-85 (13.3) |
| *Marseilles | 51 | 19.2 | 33-37 | 33-38 | 2.0 | No | No | | | FY85-88 (14.0) |
| *Dresden Is. | 52 | 14.5 | 31-34 | 33-38 | .8 | No | No | | | FY78-83 (16.7) |
| *Brandon Rd. | 52 | 14.5 | 29-31 | 33-38 | 3.1 | No | No | | | FY83-88 (25.6) |
| *Lockport | 52 | 14.1 | 30-33 | 33-38 | 1.8 | No | No | | | FY83-86 (20.5) |
| O'Brian | | 5.8 | 13-14 | | .1 | No | No | | | |
| Total | | | | | | | | | | $30 million completed to date $98.3 million to complete |

1 DAEN-CWO-M Major Rehabilitation on Inland Waterways, 30 Sept. 1985 and Rock Island, District Oct. 1985.
2 Total rehab. costs at Locks 3, 5A, 6, 7, 8 and 9 are $15.9 million
3 Source of projections: WRSC-IWR, "National Waterways Study," Working papers, Sept. 1981.
4 1984 traffic from PMS data, WRSC-IWR.
* Denotes lock identified for further study or action by National Waterways Study, (NWS), 1983.

Table 4
Status of Selected U.S. Commercially Used Locks - 1985 (Continued)

| Waterway & Lock | Age (1985) | 1984 Traffic[4] | 2000 Projection[3] Low-High | Capacity Range | Delay per Tow (Hr.)'84 | FY85 Supplemental | S1567 or HR6 | Study Name | Study Date to complete | Major Rehabilitation[1] (completion or start date - millions of current dollars) |
|---|---|---|---|---|---|---|---|---|---|---|
| Ohio | | | | | | | | | | |
| *Emsworth | 64 | 20.3 | 27-40 | 35-48 | .6 | No | No | Up Oh-Oh Maintream | 87 | FY85 (30.4) |
| *Dashields | 56 | 21.2 | 28-41 | 39-54 | .6 | No | No | Up Oh-Oh Maintream | 87 | FY86 (22.8) |
| *Montgomery | 49 | 22.2 | 25-37 | 37-39 | .9 | No | No | | - | - |
| NewCumberland | 26 | 26.4 | 29-41 | 104-125 | | No | No | | - | - |
| Pike Island | 17 | 32.5 | 36-49 | 100-115 | | No | No | | - | - |
| Hannibal | 13 | 35.0 | 42-46 | 110-132 | | No | No | | - | - |
| Willow Isl. | 13 | 36.0 | 43-46 | 107-130 | | No | No | | - | - |
| Belleville | 17 | 38.6 | 44-48 | 104-126 | | No | No | | - | - |
| Racine | 14 | 39.9 | 45-49 | 107-138 | | No | No | | - | - |
| *Gallipolis | 48 | 37 | 62-71 | 58-64 | 3.4 | Yes | Yes | Chiefs Report 1982 | | - |
| Greenup | 26 | 39.2 | 70-85 | 100-129 | | No | No | | - | - |
| Meldahl | 23 | 41.0 | 60-73 | 97-133 | | No | No | | - | - |
| Markland | 22 | 39.8 | 69-83 | 89-133 | .6 | No | No | | - | - |
| *McAlpine | 24 | 44 | 89-105 | 82-116 | .6 | No | No | Lower Oh-Oh Main. | 88 | - |
| Cannelton | 13 | 46.5 | 90-106 | 107-157 | .6 | No | No | Lower Oh-Oh Main. | 88 | - |
| *Newburgh | 10 | 50.9 | 85-106 | 104-128 | .3 | No | No | Lower Oh-Oh Main. | 88 | - |
| *Uniontown | 10 | 58.2 | 100-129 | 114-127 | .5 | No | No | Lower Oh-Oh Main. | 88 | - |
| Smithland | 5 | 64.2 | 112-144 | 177-214 | .1 | No | No | Lower Oh-Oh Main. | 88 | - |
| *52 | 57 | 74 | 102-128 | 3 | 1.4 | No | No | "Olmstead" O&M Study | 85, 86(BERH) | Underway (6.0) |
| *53 | 56[2] | NA | 85-107 | 3 | | No | No | "Olmstead" O&M Study | 85, 86(BERH) | FY84 (9.9) |
| Total | | | | | | | | | | 40.3 million completed and 56.8 to complete |
| Monongahela River | | | | | | | | | | |
| *2 | 34 | 17.5 | 24-36 | | | No | No | Lower Mon-Youghiogheny Study - 89 Sept. | | FY83(16.3) |
| *3 | 78 | 19.0 | 25-36 | | | No | No | Lower Mon-Youghiogheny Study - 89 Sept. | | - |
| *4 | 53 | 16.6 | 19-30 | | | No | No | Lower Mon-Youghiogheny Study - 89 Sept. | | - |
| Maxwell | 21 | 15.8 | 19-30 | | | No | No | Lower Mon-Youghiogheny Study - 89 Sept. | | - |
| *7 | 60 | 11.3 | 8-18 | 13-21 | | No | Yes | Report of Chief Sept. 84 | | |
| *8 | 60 | 10.0 | 6-17 | 18-25 | | No | Yes | Report of Chief Sept. 84 | | |
| Morgantown | 35 | .9 | 1-1.3 | | | No | No | | | |
| Hildebrand | 26 | .3 | .9 | | | No | No | | | |
| Opekiska | 21 | .1 | .2 | | | No | No | | | |
| Kanawha River | | | | | | | | | | |
| *Winfield | 48 | 15.3 | 11-12 | 22-26 | 4.3 | No | Yes | Kanawha R. Nav. Study | 86 (Mar) | |
| *Marmet | 51 | 7.9 | 8 | 21-22 | 1.0 | No | No | Kanawha R. Nav. Study | 88 (Sep) | |
| London | 51 | 2.8 | 3 | 20-23 | | No | No | Kanawha R. Nav. Study | 90 (Sep) | unfunded |

1 DAEN-CWO-M, 30 Sep 85, Major Rehabilitation on Inland Waterways
2 Temporary 1200 structures added at 52 & 53 in 1969 and 1980, respectively, (combined temporary plus permanent capacity is 114 - 120 MT single 600 lock < 50 MT
3 Source of projections: WRSC-IWR, "National Waterways Study," Working papers, Sept. 1981.
4 1984 traffic from PMS data, WRSC-IWR.
* Denotes lock identified for further study or action by National Waterways Study, 1983

Table 4
Status of Selected U.S. Commercially Used Locks - 1985 (Continued)

| Waterway & Lock | Age (1985) | 1984 Traffic[4] | 2000 Projection Low-High[3] | Capacity Range | Delay per Tow (Hr.)'84 | FY85 Supplemental | S1567 or HR6 | Study Name | Study Date to complete | Major Rehabilitation[1] (completion or start date - millions of current dollars) |
|---|---|---|---|---|---|---|---|---|---|---|
| Tennessee R | | | | | | | | | | |
| *Kentucky L. | 43 | 27 | 34-39 | 36-47 | 3.0 | - | - | Tenn. River Nav. of Cumberland-Tenn. Study | Sep 89 | - |
| Chickamauga | 46 | 2.0 | 2.0 | 7-10 | 1.8 | - | - | Tenn. River Nav. of Cumberland-Tenn. Study | Sep 89 | - |
| Watts Bar | 44 | 1.3 | .5 | 7-10 | 0.4 | - | - | Tenn. River Nav. of Cumberland-Tenn. Study | Sep 89 | - |
| Ft. Loudon | 42 | 0.6 | .3 | 7-10 | 0.2 | - | - | Tenn. River Nav. of Cumberland-Tenn. Study | Sep 89 | - |
| GIWW - West | | | | | | | | | | |
| *Harvey | 51 | 4.5 | 9-10 | 12 | 0.6 | - | - | GIWW, TX & LA | FY89 | - |
| *Algiers | 49 | 24.4 | 26-30 | 35 | 3.2 | - | - | GIWW, TX & LA | FY89 | - |
| Leland Bowman (Vermilion) | 1 | 39.3 | 48-54 | 72-74 | 4.5 | (new lock) | - | New Lock Complete | FY84 | - |
| *Calcasieu | 35 | 40.5 | 48-55 | 97-98 | 1.6 | - | - | GIWW, TX & LA | FY89 | - |
| GIWW-East | | | | | | | | | | |
| *Inner Hbr. | 62 | 22.2 | 30-32 | 31-35 | 7.9 | - | - | Study Ongoing | no date | - |
| GIWW: Morgan City-Port Allen Route | | | | | | | | | | |
| Port Allen | 24 | 22.3 | 17-19 | 27-35 | 1.4 | - | - | No Study | - | - |
| Bayou Sorrel | 34 | - | - | - | 1.1 | - | - | No Study | - | - |
| Mobile R & Tribs | | | | | | | | | | |
| *Coffeeville | 25 | 16.2 | 37-46 | 45-54 | 0.3 | | | Black-Warrior-Tomb Study | No date | - |
| *Demopolis | 31 | 16.0 | 36-46 | 45-54 | 0.2 | | | Black-Warrior-Tomb Study | No date | - |
| *Warrior | 28 | 16.6 | 25-32 | 31-39 | 0.4 | | | Black-Warrior-Tomb Study | No date | - |
| *Oliver | 46 | 15.9 | 22-28 | 22-24 | 1.2 | Yes | Yes | Chiefs Report | Sep 84 | - |
| *Holt | 19 | 15.6 | 22-27 | 31-36 | 0.3 | - | - | Black-Warrior Tomb | No date | - |
| *Bankhead | 10 | 11.7 | 16-21 | 32-39 | 0.2 | - | - | Black-Warrior Tomb Study | No date | FY83 (48.8) |
| Columbia-Snake | | | | | | | | | | |
| *Bonneville | 47 | 9.3 | 10-15 | 12 | 1.3 | Yes | Yes | Chiefs Reports | 80&81 | - |
| John Day | 17 | 8.0 | 8 | 30 | .1 | | | | | FY83 (6.3) |
| Great Lakes | | | | | | | | | | |
| *Poe | | | 101-123 | | | - | - | Great Lakes | 85 | - |

1. DAEN-CWO-M, 30 Sep 85, Major Rehabilitation on Inland Waterways
2. Source of projections: WRSC-IWR, "National Waterways Study", Working papers, Sept. 1981.
3. 1984 traffic from PMS data WRSC-IWR.
* Denotes lock identified for further study or action by National Waterways Study, 1983

average delays of over an hour per tow in 1984 as traffic on that stretch of the Columbia increased almost 50 percent from 1977 levels. In addition to displaying significant congestion, all of the locks discussed above are or will be over 50 years old by the end of this decade.

## STATUS OF MAJOR WATERWAYS IN 1984

This section reviews lock conditions (ages, traffic, and delays) on selected waterways in 1984 and compares these to the base conditions used for NWS analysis in year 1977. The following section identifies the higher growth segments and critical locks which are projected to have congestion and/or reliability problems by the year 2000. Information for each lock's age in 1984 and projected traffic, capacity range and 1984 average delays per tow are shown in Table 4 for selected locks. Also discussed are the ongoing rehabilitation actions, proposed construction of new locks, and the status of ongoing studies. The current status of U.S. locks is summarized in the following paragraphs by waterway systems.

### Upper Mississippi River:

1) Age: Twenty-three of 27 locks will be over 50 years old by the end of this decade. Nineteen of the 27 are scheduled for, or have received, major rehabilitation estimated to cost about $200 million. It is estimated that for the rest of the decade one-quarter of the nation's major lock rehabilitations and two-thirds of the funds programmed will be for the Upper Mississippi locks.

2) Use: Traffic on this waterway segment increased by 18.6 percent from 1977 to 1984 above the mouth of the Missouri, and by 36.5 percent between the mouth of the Missouri and the mouth of the Ohio. Grain has been and remains the dominant commodity on the Upper Mississippi River. The first replacement lock for Locks 26 is 110 x 1200 feet. It is under construction and will be completed in 1988. Funds were included in the 1985 Supplemental Appropriation to initiate another 110 x 600 foot lock at Lock and Dam 26 in FY 1986. These locks will be the same sizes as those at Lock 27, which is immediately below Lock 26. These are the southernmost locks on the Upper Mississippi River System.

3) Average delays per tow in 1984: Delays at locks 1-13 ranged from 0.6 to 1.0 hours; delays at locks 14 to 21 ranged from 1.2 to 1.8 hours; delays at locks 22-25 ranged from 2.9 to 3.3 hours; delays at Locks 26 were 8.9 hours.

4) Status: No study funded. All forecasts for 2000 (from low to high) produce congestion at Locks 22, 24, 25, and 26. Traffic in 1984 exceeded the NWS low forecast for year 1990 at all locks, an indicator of real need when coupled with the fact that 23 of the systems locks will be over 50 years old in 1990.

Illinois Waterway:

1) Age: Seven of the eight locks will exceed 50 years of age by the end of this decade. All of the older locks have received, are receiving or are scheduled for major rehabilitation at a cost estimated at about $130 million. See Figure 4 for photos of lock conditions.

2) Use: Annual traffic on the Illinois has fluctuated between 35 and 42 million tons with no real increase over 1977. Grain traffic growth in recent years compensated for significant losses associated with traffic serving the smokestack industries of Chicago -- iron and steel, aggregates and coal. Ongoing rehabilitation projects have also adversely affected traffic growth at several locks in the past few years.

3) Average delays per tow in 1984: In spite of traffic losses, delays persisted, ranging from a low of 0.8 hours at LaGrange and Dresden to a high of 3.1 hours at Brandon Road. Delays were 2.0 hours at Marseilles; 1.8 hours at Lockport; 1.5 hours at Peoria; and 1.3 hours at Starved Rock. Additional make-up and break-up time, similar to Bonneville, is required of tows moving through Brandon Road Pool. Also unique to Brandon Road Pool are closed bridge hours which restrict passage. In all, several additional hours are consumed in both bridge delays and for the time necessary for the required change of equipment and tow size. Thus the delay time cited for both Brandon Road and Lockport locks understates the congestion actually incurred.

4) Status: No study funded. O'Brien Lock, a modern structure built in the 1960's, is the only lock not forecast to become congested by the year 2000.

Ohio River:

1) Age: Six of 20 locks will exceed 50 years of age by the end of this decade. One, Gallipolis, was funded for replacement in the 1985 Supplemental Appropriations Bill. Gallipolis is a 110 x 600 foot lock in the middle of a river system containing 110 x 1200 foot locks. The other 5 (Emsworth, Montgomery, Dashields, Lock 52 and Lock 53) have recently received, are receiving, or will shortly receive major rehabilitation totalling nearly $100 million. See Figure 4 for photos of lock conditions.

2) Use: Traffic increased by nearly 15 percent on the Ohio River between 1977 and 1984. Total river traffic has rebounded 16 percent since the recession year of 1983, and traffic at Gallipolis Lock increased 21 percent.

3) Average delays per tow in 1984: Gallipolis realized the highest delays of 3.4 hours per tow. Lock 52 delays were 1.4 hours per tow. Delays from .6 to .9 hours per tow were experienced at Emsworth, Dashields, Montgomery, Markland, McAlpine and Cannelton.

4) Status: Ongoing studies include Olmstead O&M (to replace Locks 52 & 53) - 1985; Upper Ohio (Emsworth, Dashields, Montgomery) - 1987 completion; Lower Ohio (McAlpine, Cannelton, Newburgh and Uniontown)

- 1988 completion. Projections for these locks in the year 2000 indicate they will be either congested or at capacity under one or more scenarios.

Monongahela River:

1) Age: Four of the nine lock sites have very old chambers: Lock 3's most modern chamber is currently 78 years old; Locks 7's and 8's are 60 years old, and Lock 4's is 53 years old. Major rehabilitation was recently performed on Lock 3 for $16.3 million. Locks 7 and 8 are included for replacement in proposed authorization legislation. These two locks have dimensions of 56 x 360 feet. This compares to larger locks both upstream (84 x 600 feet) and downstream (84 x 720 feet). See Figure 4 for photos of lock conditions.

2) Use: Monongahela River traffic declined to 26.5 million tons in 1983 after peaking at 38.2 million tons in 1979. It rebounded in 1984 to 34.5 million tons, nearly equal to the level in 1977 and a 31 percent increase over 1983. Traffic at Locks 7 and 8 increased 1.5 and 2 million tons, respectively, from 1983 to 1984.

3) Status: Studies of locks 2, 3, 4 and Maxwell in the Lower Monongahela Study are scheduled for completion in September 1989. Locks identified for further study by NWS are covered by the ongoing study or in authorizing legislation (Locks 7 & 8). Projections show Locks 7 and 8 as being near or at capacity by 2000. However, the

advanced age and the existing deterioration at these locks, together with the absence of auxiliary locks for emergency use at both locations, is an immediate concern.

Kanawha River:

1) Age: All three locks are or will exceed 50 years of age by the end of this decade.

2) Use: Traffic on the Kanawha has increased nearly 32 percent since 1977 and nearly 8 percent just since 1983 (to 14.2 million tons). Commerce at individual locks increased to 2 million tons from 1983 to 1984.

3) Average delays per tow in 1984: Delays for Winfield were about 4 hours while traffic at Marmet and London was delayed about one hour.

4) Status: The Kanawha River Navigation Study is scheduled to produce a report on Winfield by March 1986, Marmet by September 1988, and London by 1990. The London Lock study is currently unfunded. Traffic at Winfield Lock in 1984 (15.3 million tons) already exceeded the NWS high projection for 2000 by over 3 million tons.

Tennessee River:

1) Age: The 14 lock chambers at the ten Tennessee River (and Clinch River) dams have five sites (eight chambers) at which the primary locks are currently over 40 years of age and three sites at which the

auxiliary chambers average 52 years of age. The locks Chickamauga, Watts Bar and Ft. Loudon at the upstream end are not only old but also have 60 x 360 foot lock chambers. This compares to the 110 x 600 foot chambers downstream.

2) Use: Traffic on the Tennessee River increased 24 percent between 1977 and 1984. Significant growth is forecast for 1990 and 2000 on the Lower Tennessee with the opening of the Tennessee-Tombigbee Waterway. Kentucky Lock, already over 40 years old, is projected to be nearing capacity by the turn of the century. Traffic at Kentucky Lock experienced an 11 percent increase from 1983 to 1984.

3) Average delays per tow in 1984: Tows at Kentucky Lock located at the downstream end were delayed an average of 3 hours while they waited 1.8 hours at Chickmauga. Delays at other locks were under 1/2 hour.

4) Status: The Tennessee River Navigation Study covering all locks is underway and is scheduled for completion in September 1989.

Gulf Intracoastal Waterway (GIWW) West:

1) Age: Harvey Lock is 51 years old and Algiers Lock will be 50 years old in 1986. Calcasieu will be 50 years old in 2000.

2) Use: Traffic on the GIWW-West between New Orleans and the Sabine River declined by nearly 20 percent between 1977 and 1983 due to the large reduction in the movement of petroleum and chemicals.

3) Average delays per tow in 1984: Tows through Algiers Lock faced an average of 3.2 hours of delay, while tows at Calcasieu had 1.6 hours and those at Harvey waited less than one hour.

4) Status: The GIWW, Texas and Louisiana study is scheduled for completion in 1989. A Gulf Coast-West Study has been recommended to address lock problems identified in NWS as well as other emerging navigation problems. Harvey and Algiers locks could both experience congestion by 2000 under high traffic projections.

Gulf Intracoastal Waterway (GIWW) East:

1) Age: Inner Harbor Lock, with dimensions of 75 x 640 feet, is currently 62 years old.

2) Use: Traffic on the GIWW-East between Mobile and New Orleans decreased from 24.8 million tons in 1977 to 16.5 million tons in 1983 (latest year available). The 1984 lock traffic at the Inner Harbor was 22.2 million tons, down from 25 million tons in 1977. This lock, like others on the GIWW, has been influenced by the reduction in petroleum traffic.

3) Delays: Inner Harbor Lock delays averaged 7.9 hours in 1984.

4) Status: On-going study of Inner Harbor Lock; no completion date. The lock is projected to be near or at capacity by the year 2000.

GIWW: Morgan City - Port Allen Route:

1) Age: No locks are identified with problems due to age.

2) Use: Traffic increased from 18.5 million tons in 1977 to 19.3 million tons in 1983. Tonnage at the Port Allen lock in 1984 was 22.3 million, already above high projections for this lock in 2000.

3) Delays: Delays in 1984 averaged 1.4 hours per tow at the Port Allen Lock.

4) Status: Port Allen Lock had not been identified by NWS as an emerging problem for this waterway. However, current delays and traffic levels are indicative of growing congestion worthy of monitoring and initiating studies.

Mobile River and Tributaries:

1) Age: Only Oliver Lock will exceed a 50-year life within this decade, and with 95 x 460 foot dimensions, it is sandwiched between the system's larger 110 x 600 foot locks. A major $48.8 million rehabilitation was completed for Bankhead Lock in 1983. Oliver was included in the FY 85 Supplemental Appropriations and in the proposed Omnibus legislation. See Figure 4 for photos of lock conditions.

2) Use: Traffic on the Black Warrior-Tombigbee system increased by over 28 percent from 15.2 million tons in 1977 to 19.6 million tons in 1984. Tonnage at Oliver Lock increased 32 percent between 1983 and 1984.

3) Delays: Only Oliver experienced significant delays in 1984 -- an average of 1.2 hours per tow.

4) Status: The Black Warrior-Tombigbee Study is underway. Every lock is projected to be congested by the year 2000 under one or more forecasts, and Oliver is projected to be near or at capacity.

Columbia/Snake Waterway:

1) Age: Only one lock on the Columbia/Snake Waterway is not a modern structure. That lock--Bonneville--is 47 years old and, with dimensions of 76 x 500 feet, is smaller than all other Columbia/Snake locks, which are 86 x 675 feet. Major rehabilitation was completed in 1983 on 17-year old John Day Lock for $6.2 million. The 1985 Supplemental Appropriations included funds to begin construction on Bonneville's replacement lock. The lock authorization is also included in proposed Omnibus legislation.

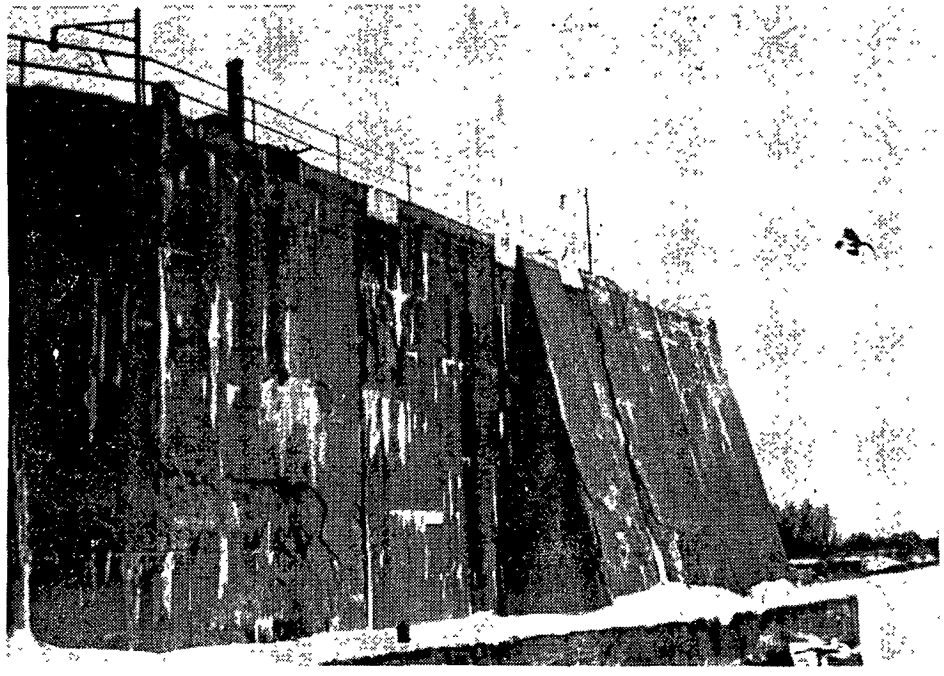
2) Use: 1984 traffic on the Columbia between Vancouver and the Dalles was up 50 percent from 1977 levels. Tonnage handled at Bonneville Lock increased 16 percent between 1983 and 1984, growing from 8 to 9.3 million tons.

3) Delays: Bonneville's delays averaged 1.3 hours per tow in 1984 as measured by PMS plus an additional delay time of 2 hours per tow which was not recorded by PMS. This added time loss is due to the requirement to reconfigure tows outside of the lock in order to transit the small lock.

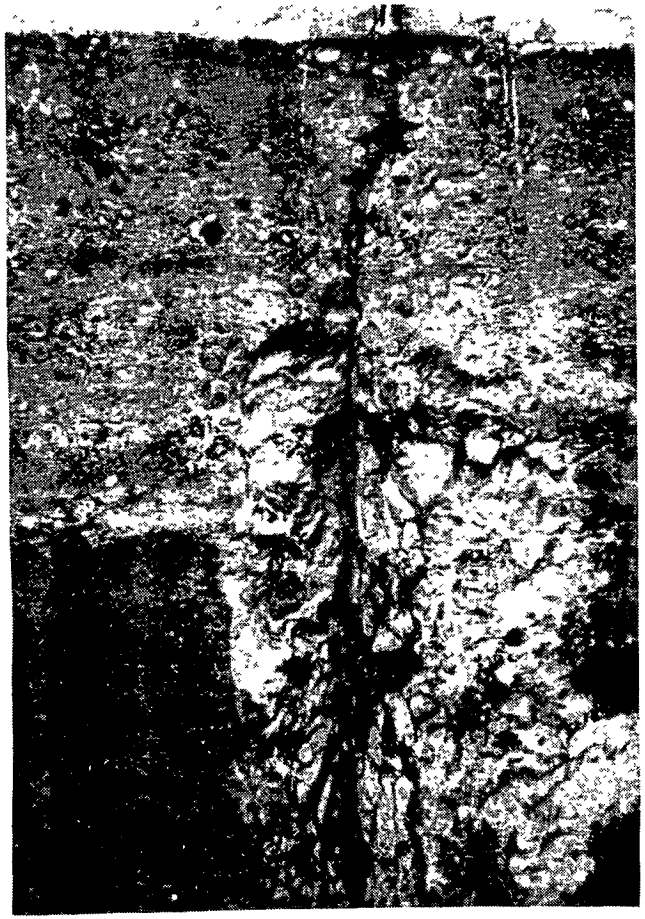
4) Status: No new lock studies are underway.

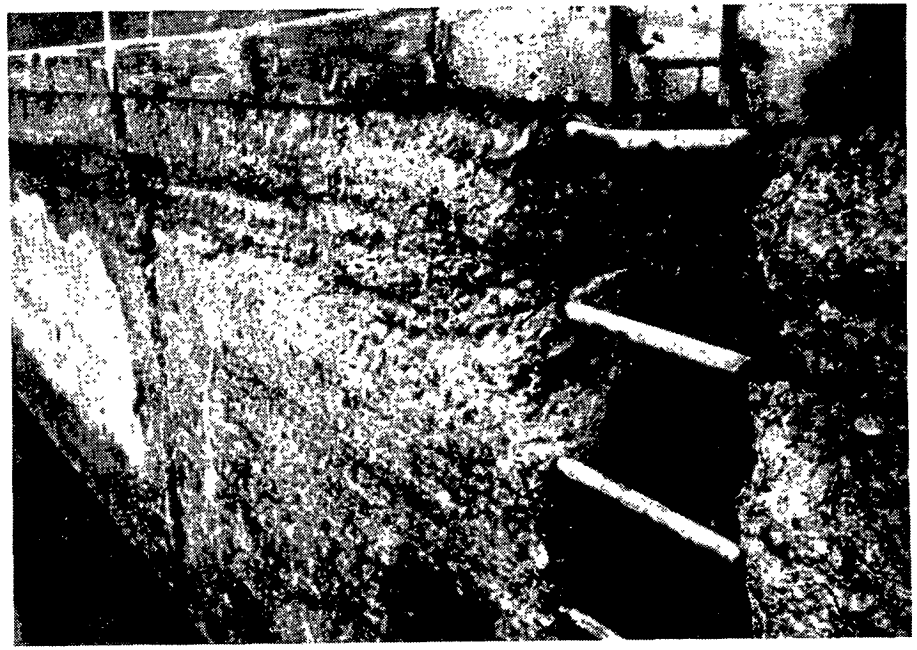
FIGURE 4

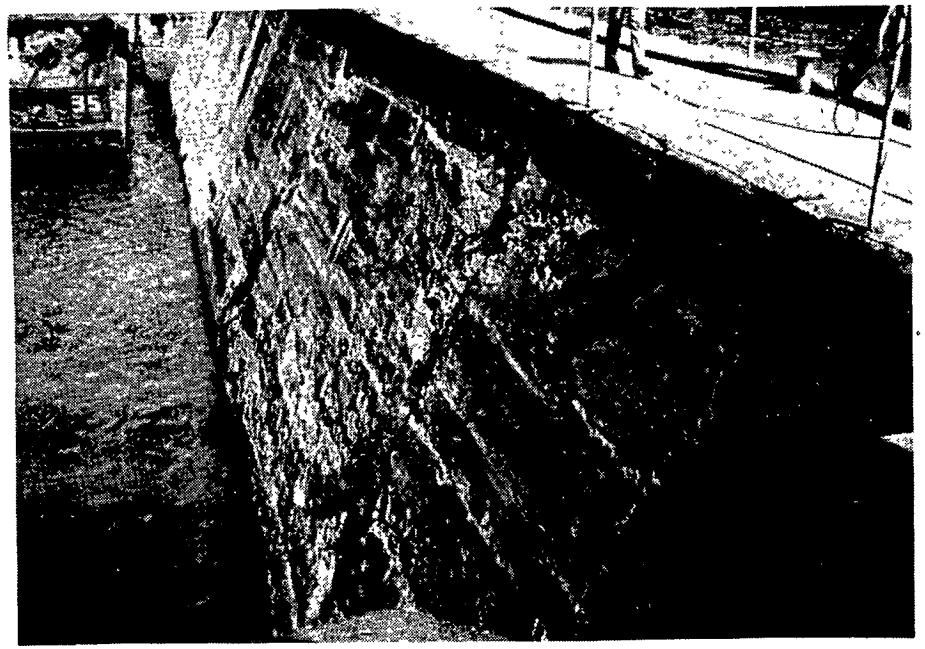
PHOTO DISPLAY OF PHYSICAL LOCK CONDITIONS
FOR
LOCKPORT, EMSWORTH, MONTGOMERY,
LOCK 3 AND OLIVER LOCKS



# Lockport
# Lock Deterioration
# Illinois River



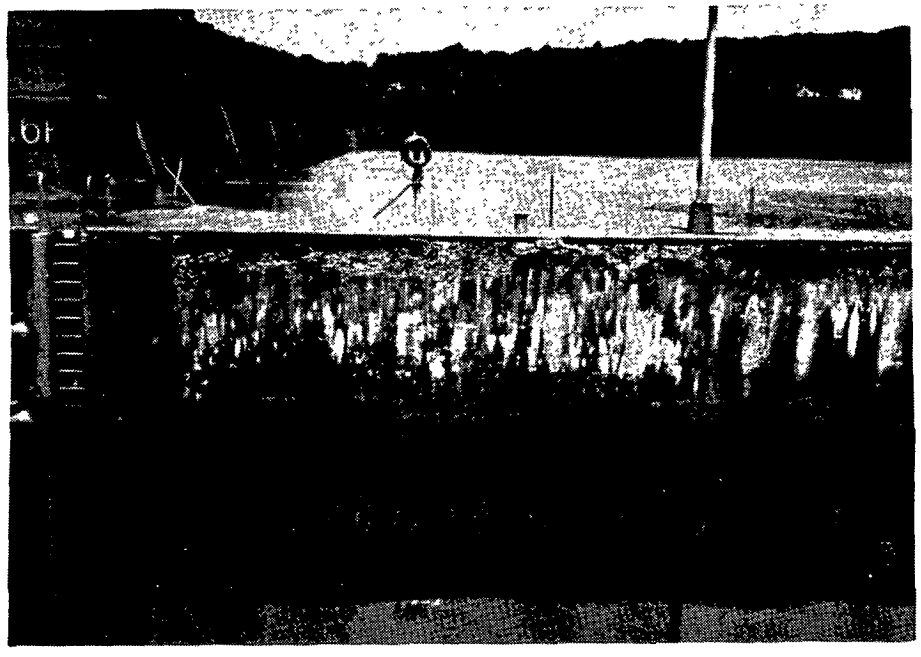


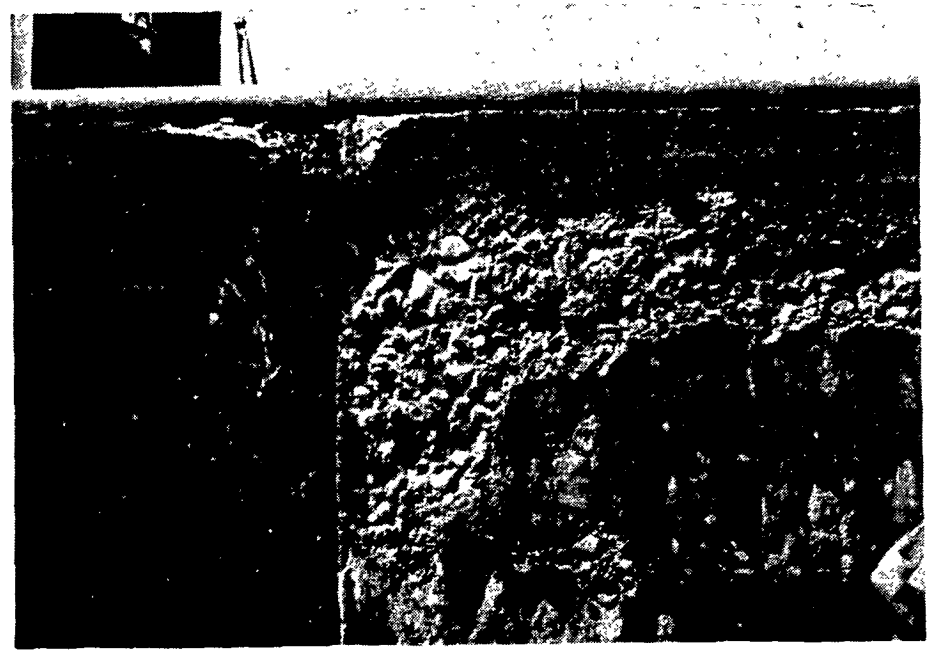


Emsworth

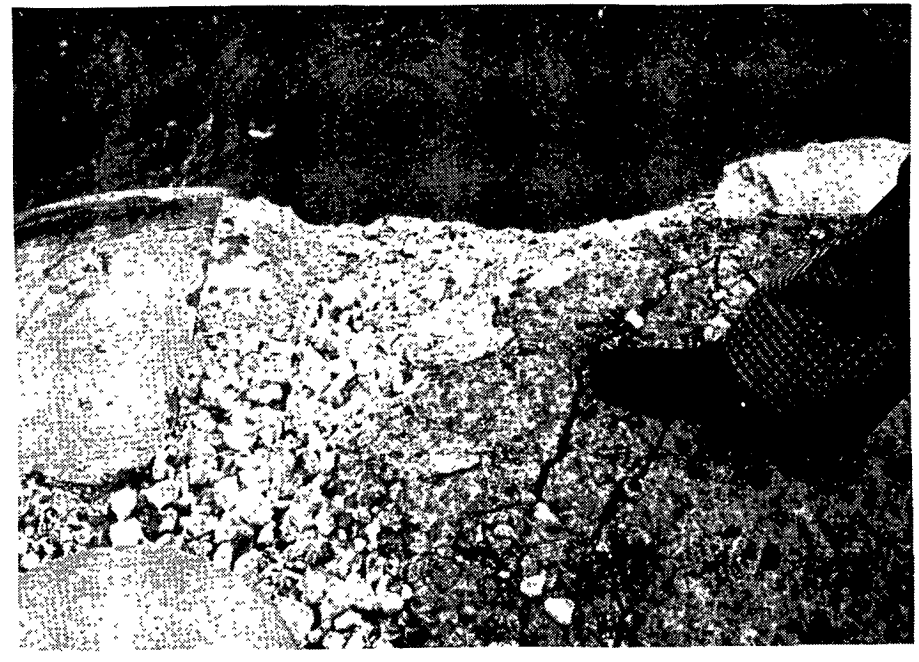
Lock Deterioration

Ohio River

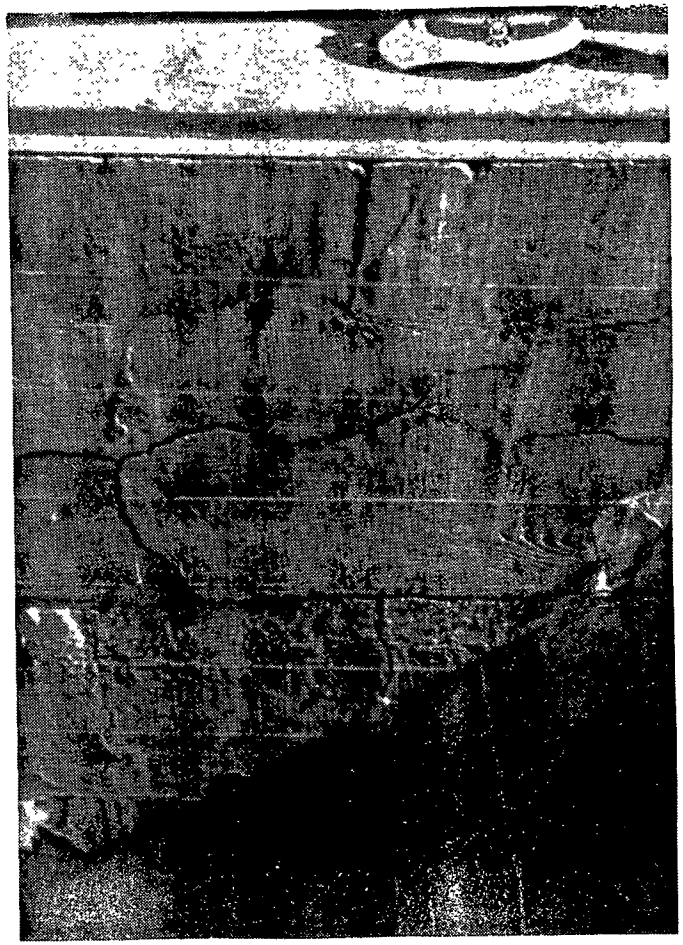




# Montgomery Lock Deterioration Ohio River



# Lock #3
# Lock Deterioration
# Monongahela River



# Oliver
# Lock Deterioration
# Black Warrior River