

UNCLASSIFIED

AD NUMBER

AD012074

CLASSIFICATION CHANGES

TO: unclassified

FROM: confidential

LIMITATION CHANGES

TO:
Approved for public release; distribution is unlimited.

FROM:
Controlling DoD Organization: Corps of Engineers, Washington District, Washington, DC.

AUTHORITY

WDCE D/A ltr dtd 15 Aug 1979; WDCE D/A ltr dtd 15 Aug 1979

THIS PAGE IS UNCLASSIFIED

UNCLASSIFIED

AD _____

DEFENSE DOCUMENTATION CENTER

FOR

SCIENTIFIC AND TECHNICAL INFORMATION

CAMERON STATION ALEXANDRIA, VIRGINIA

DOWNGRADED AT 3 YEAR INTERVALS:
DECLASSIFIED AFTER 12 YEARS
DCD DIR 5200.10



UNCLASSIFIED

THIS REPORT HAS BEEN DECLASSIFIED
AND CLEARED FOR PUBLIC RELEASE.

DISTRIBUTION A
APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.

SECURITY INFORMATION

MILITARY HYDROLOGY

RESEARCH & DEVELOPMENT BRANCH

SPECIAL STUDY S-52-1

ALLER & LEINE RIVERS

ARTIFICIAL FLOODING

POTENTIALITIES

This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U. S. C., Sections 793 and 794. The transmission or the revelation of its contents in any manner to the unauthorized person is prohibited by law.

SECURITY INFORMATION



Corps of Engineers

Dept. of Army

Washington District

AD No 12074

ASTIA FILE COPY

SECRET
SECURITY INFORMATION

SPECIAL STUDY S-52-1

ALLER & IRINE RIVERS

ARTIFICIAL FLOODING

POTENTIALITIES

This document contains information affecting the national defense within the meaning of the Espionage Laws, Title 18, U. S. C., Sections 793 and 794. The transmission or the revelation of its contents in any manner to the unauthorized person is prohibited by law.

SECRET
SECURITY INFORMATION

PREPARED BY
MILITARY HYDROLOGY R & D BRANCH
ENGINEERING DIVISION
WASHINGTON DISTRICT CORPS OF ENGINEERS
WASHINGTON, D. C.
AUGUST 1952

CONFIDENTIAL
SECURITY INFORMATION

SPECIAL STUDY S-52-1

ALLER AND LETNE RIVERS

ARTIFICIAL FLOODING POTENTIALITIES

TABLE OF CONTENTS

| | <u>Page</u> |
|---|-------------|
| SECTION I. INTRODUCTION | |
| 1-01 Assignment | 1 |
| 1-02 Purpose and Scope | 1 |
| 1-03 Arrangement | 2 |
| 1-04 Definition of Terms | 2 |
| 1-05 References | 2 |
| SECTION II. DRAINAGE BASIN CHARACTERISTICS AND DEVELOPMENTS | |
| 2-01 General | 3 |
| 2-02 Topography | 3 |
| 2-03 Geology | 3 |
| 2-04 Drainage Areas | 3 |
| 2-05 Gradients and Profiles | 4 |
| 2-06 Channel Depths | 4 |
| 2-07 Channel and Flood Plain Widths | 4 |
| 2-08 Navigation | 5 |
| 2-09 Regulation | 5 |
| 2-10 Dams and Reservoirs | 6 |
| 2-11 Levees | 8 |
| 2-12 Canals | 8 |
| 2-13 Bridges | 9 |
| SECTION III. HYDROLOGIC CHARACTERISTICS | |
| 3-01 General | 10 |
| 3-02 Climatology | 10 |
| 3-03 Stream Gaging Stations | 10 |
| 3-04 River Stages | 11 |
| 3-05 River Discharges | 11 |
| 3-06 River Velocities | 12 |
| SECTION IV. ARTIFICIAL FLOOD POTENTIALITIES | |
| 4-01 General | 14 |
| 4-02 Still-water Barriers and Drainage Obstacles | 15 |
| 4-03 Major Flood Waves | 20 |
| 4-04 Stream Flow Variations | 25 |
| 4-05 Artificial Flooding Potentialities of Canals | 33 |
| 4-06 Summary | 34 |

CONFIDENTIAL
SECURITY INFORMATION

TABLE OF CONTENTS (Continued)

Page

SECTION V. EFFECT ON MILITARY OPERATIONS

| | | |
|------|---|----|
| 5-01 | General | 37 |
| 5-02 | Effect of Still-water Barriers and Drainage Obstacles | 37 |
| 5-03 | Effect of Major Flood Waves | 38 |
| 5-04 | Effect of Flow Variations | 38 |
| 5-05 | Effects Related to Other Basins | 39 |

BIBLIOGRAPHY

TABLES

| | |
|-----|--|
| 1. | Equivalent English-Metric Terms |
| 2. | Hydrologic Terms and Abbreviations |
| 3. | Summary of Gage Data, Aller and Oker Rivers |
| 4. | Summary of Gage Data, Leine and Rhume Rivers |
| 5. | Discharge Data, Aller River Basin |
| 6. | Inundation Effect of Still-water Barriers, Aller River |
| 7. | Inundation Effect of Still-water Barriers, Leine River |
| 8. | Effects of Artificial Flood Waves |
| 9. | Effects of Artificial Flow Variations |
| 10. | Estimated Widths of Flooding due to Artificial Floods |

PLATES

| | |
|-----|---|
| 1. | General Map |
| 2. | Physiographic Diagram |
| 3. | Profile, Oder and Rhume Rivers |
| 4. | Profile, Leine River (Rhume R. to Hannover) |
| 5. | Profile, Leine River (Hannover to Aller R.) |
| 6. | Profile, Aller River (Obisfelde to Langlingen) |
| 7. | Profile, Aller River (Langlingen to Weser R.) |
| 8. | Forecast of Possible Inundation |
| 9. | Sketches, Valley Dams |
| 10. | Profile, Mittelland Canal |
| 11. | Cross sections, Mittelland Canal |
| 12. | Flow Duration Curves |
| 13. | Discharge and Velocity Profiles |
| 14. | Rating Curves (Aller River) |
| 15. | Rating Curves (Leine and Rhume Rivers) |
| 16. | Inundation by Still-water Barriers |
| 17. | Oder Reservoir, Stage Hydrograph |
| 18. | Valley Dams, Storage Curves |
| 19. | Oder and Soese Dams Breach Hydrographs |
| 20. | Ecker Dam, Breach Hydrographs |
| 21. | Oder and Soese Dams, Flow Variation Hydrographs |
| 22. | Ecker Dam, Flow Variation Hydrographs |

EXHIBITS

| | |
|---|---|
| A | Description of Bridges and Dams |
| B | Description of Watercourse and Control Structures |

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

SPECIAL STUDY S-52-1

ALLER AND LEINE RIVERS

ARTIFICIAL FLOODING POTENTIALITIES

SECTION I
INTRODUCTION

1-01 ASSIGNMENT.

This special study was assigned to the Military Hydrology Research and Development Branch, Engineering Division, Washington District by letter from Office, Chief of Engineers, ENONE, to the Division Engineer, North Atlantic Division; subject "Military Hydrology R & D Project No. 8-72-12-001: Special Assignments," dated 27 May 1952.

1-02 PURPOSE AND SCOPE.

a. This report presents information regarding the hydraulic effects and nature of artificial flooding potentialities in the Aller and Leine River basin. It consists largely of a compilation and consolidation of information presented in various intelligence documents and technical publications, with certain supplementary analyses and discussions. Additional studies are needed to adequately cover the subject for general military requirements.

b. The report is designed to furnish basic data and results of analyses needed to answer questions concerning:

- (1) Normal and extreme stages and surface velocities at key stations on the Aller and Leine Rivers.
- (2) Stream characteristics including gradients, depths and widths of channel and flood plain of the Aller and Leine Rivers.
- (3) Data concerning locations and zero elevations of gaging stations.
- (4) Data concerning location and dimensions of navigation structures, reservoirs, and bridges.
- (5) The extent of flooding possible by means of erection of temporary dams.

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

(6) The magnitude and duration of flood waves or flow variation created by breaching or regulated discharge from the valley dams and navigation dams and the effect on bridging, crossing, and navigation on the Aller and Leine Rivers.

1-03 ARRANGEMENT.

This report is subdivided as follows:

Section I Introduction
Section II Drainage Basin Characteristics and Developments
Section III Hydrologic Characteristics
Section IV Artificial Flood Potentialities
Section V Effect on Military Operations

Bibliography

Tables

Plates

Exhibit A Description of Bridges and Dams, Aller and Leine Rivers

Exhibit B Description of Watercourse and Control Structures

1-04 DEFINITION OF TERMS.

a. Equivalent English-Metric Terms. Both the English and metric systems are used in this report. Conversion factors are presented for reference in Table 1.

b. Hydrologic Terms and Abbreviations. The following abbreviations are used in this report: m for meters, km for kilometers, l for liters, km² for square kilometers, m³ for cubic meters, m/s for meters per second, and m³/s for cubic meters per second. Abbreviations applicable to stage and discharge are defined in Table 2.

1-05 REFERENCES.

All references cited in this report are listed in the bibliography following Section V of the text.

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

SECTION II
DRAINAGE BASIN CHARACTERISTICS AND DEVELOPMENTS

2-01 GENERAL.

a. The Aller and Leine Rivers lie in the Weser River Basin which is located in the Province of Hannover in the northwest part of Germany. Both streams have their headwaters in the Upper Harz Mountain Region. The Leine River is a 279-km long tributary of the Aller River, and the latter is a 263-km long tributary of the Weser River. A general map is shown on Plate 1, and detailed descriptions are contained in Exhibits A and B and in References 1 to 5, listed in the bibliography.

b. This report is confined to consideration of the main stem of the Aller River, the portion of the Leine River below the confluence of the Rhume River and those reaches of the Rhume, Oder and Soese Rivers below the Oder and Soese Dams.

2-02 TOPOGRAPHY.

The general topography of the Aller and Leine River basins is indicated on the Physiographic Diagram shown as Plate 2. The Leine River emerges from the mountainous Upper Harz region onto the North German Plain near Hannover, while the Aller River flows westerly through the northern foothills of the Mid-German Highlands. Reference is made to the document listed in the Bibliography as Reference 14 for detailed topographic information.

2-03 GEOLOGY.

The river bed of the Aller and Leine Rivers is mostly sand with some gravel. Rock outcrops occur in the lower reaches of the Aller River near Westen and Verden, and in the Leine River near Neustadt. The river valley floors are mostly alluvial clay with extensive sand dunes along the Aller River below Celle. A detailed description of the geologic conditions is contained in References 1, 2, and 14.

2-04 DRAINAGE AREAS.

The drainage area of the Aller River and its tributaries comprises 15,594 km² of the 45,548 km² drainage area of the Weser River system. Drainage areas at key gaging stations of the Aller River system are included in Tables 3 and 4. The areas drained by the Aller River and its major tributaries are as follows:

| <u>River</u> | <u>Drainage Area (km²)</u> |
|----------------------------------|---------------------------------------|
| Oder (tributary of Aller R.) | 1,902 |
| Innarste (tributary of Leine R.) | 1,235 |
| Leine (tributary of Aller R.) | 6,532 |
| Aller | 15,594 |

*Also spelled as Sose

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

2-05 GRADIENTS AND PROFILES.

a. Gradients are indicated on the stream bottom and water surface profiles, Plates 3 to 7, inclusive. Following are average gradients:

| <u>River</u> | <u>Reach</u> | <u>Average gradient per 10,000</u> |
|--------------|--------------------------|------------------------------------|
| Oder | Oder Dam-Rhume R. | 122 |
| Soese | Soese Dam-Rhume R. | 49 |
| Rhume | Oder R.-Leine R. | 15 |
| Leine | Rhume R.-Hannover | 6.7 |
| | Hannover-Aller R. | 2.7 |
| Aller | Weser-Elbe Canal-Oker R. | 3.2 |
| | Oker R.-Leine R. | 2.6 |
| | Leine R.-Weser R. | 2.1 |

b. All elevations referred to in this report are in meters above "Normal Null" the zero of the German land survey datum.

c. River distances are expressed in this report as kilometers above the junction of the Aller and Weser Rivers. However, in Exhibit P and in some official German publications, distances along navigable streams are commonly shown as kilometers below the head of navigation. Both kilometrage systems are indicated on the General Map, Plate 1.

2-06 CHANNEL DEPTHS.

The depth of the streams varies non-uniformly along the course. Reference is made to Appendix A and to the stream profiles, Plates 4 to 7 for detailed depth data. A tabulation of representative average depths follows:

| <u>River</u> | <u>Reach</u> | <u>Depth at Mean Water (Meters)</u> |
|--------------|--------------------------|-------------------------------------|
| Oder | Oder Dam-Rhume R. | 0.5-1 |
| Rhume | Oder R.-Leine R. | 1-2 |
| Leine | Rhume R.-Hannover | 0.5-3 |
| | Hannover-Aller R. | 1.5-2 |
| Aller | Weser-Elbe Canal-Oker R. | 0.5-2 |
| | Oker R.-Leine R. | 1-2.5 (3-4 near dams) |
| | Leine R.-Weser R. | 2-3.5 |

2-07 CHANNEL AND FLOOD PLAIN WIDTHS.

Widths of channel are shown in Exhibit A. The widths of valley subject to flooding can be estimated by reference to the "Forecast of Possible Inundations," Plate 8 and to the General Map, Plate 1. Following is a general indication of the channel and flood

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

plain widths along the streams of the Aller-Leine River system:

| <u>River and Reach</u> | <u>Channel Width (meters)</u> | <u>Flood Plain Width (kilometers)</u> |
|--|-----------------------------------|---|
| <u>Oder River</u> Oder Dam-Rhume R. | 10-25 | 0.5-1.5 |
| <u>Soese River</u> Soese Dam-Rhume R. | less than 10 | 0.5-1.5 |
| <u>Rhume River</u> Oder River-Leine R. | 10-25 | 0.5-3 |
| <u>Leine River</u> Rhume River-Hannover | 10-50 | 0.5-2.5 |
| Hannover-Aller R. | 25-50 | 0.5-2.5 |
| <u>Aller River</u> Weser-Elbe Canal-Oker R. | 5-20 | |
| Oker River-Leine R. | 20-50 | 0.5-2 |
| Leine River-Weser R. | 50-70 | 1-3 |

2-08 NAVIGATION.

a. The Leine River is navigable for 180-ton*craft as far upstream as Hannover. A branch canal, provided with locks, provides for passage of 600-ton*barges between the Leine River port of Hannover and the Mittelland Canal. Navigation locks and dams are provided on the Leine River at Herrenhausen (km 153) and Neustadt (km 110). Locations of structures are shown on the map, Plate 1 and on the profile, Plates 4 and 5. Ice drifts form above Herrenhausen Dam, interrupting navigation.

b. The Aller River is navigable upstream to Cella (km 117). Navigation is suspended for about 35 days a year because of ice or flood. The reach downstream of the Leine River confluence is designed for 350-ton*vessels at low water or 600-ton*craft at mean water stages. Upstream of the Leine River confluence, are four navigation locks: Oldau (km 102), Bannetze (km 90), Marklendorf (km 79), and Hademstorf (km 67). These locks can accommodate barge-trains of three 200-ton or two 300-ton*barges. Locations of structures are shown on the General Map, Plate 1 and on the profiles, Plate 7. Ice conditions occur at Varden on the Aller River for an average of 13 days annually between 11 November and 8 March.

2-09 REGULATION.

a. High-Water Regulation. Flood stages are reduced by impounding flood flows in the reservoirs of the Harz

*metric tons

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

Mountain Region. The Oder Reservoir has 5 mil. m³ of its storage capacity reserved for flood protection, the Soese Reservoir up to 4.5 mil. m³. The newly-constructed Ecker Reservoir and the incomplete Oker Reservoir each will have reserved for flood protection about 5-7 mil. m³ capacity according to the general project plan for the area. Due to insufficient flow records subsequent to/* reservoirs, accurate appraisal cannot be furnished regarding their effect upon stream flow.

b. Low-Water Regulation. Low water stages and flow are regulated by operation of the navigation locks and dams for power generation as well as for navigation. Operation of the outlet control structures of the storage dams in the Harz Mountain Region for power generation and irrigation would influence the stage and flow, especially in the upper reaches. The small mill dams upstream of the navigation limits serve to regulate the flow and stage in those reaches where located. The water level upstream of the Aller River dams located above Celle is raised during the wintertime in order to inundate the adjacent meadows as a means of fertilization. Reference is made to Exhibit B for detailed description of regulation.

2-10 DAMS AND RESERVOIRS.

a. General. Descriptions of important dams are contained in Exhibit B and locations are indicated on the General Map, Plate 1, and on the profiles, Plates 3 to 7, inclusive.

b. Harz Mountain Reservoirs. On the headwaters of the Aller and Leine Rivers in the Harz Mountain Region are located several important large dams, "talsperren," locations of which are shown on Plate 1. In the Leine River basin are the Oder and Soese Dams. The Oder Dam (km 312) is located near Bad Lauterberg on the Oder River, which flows into the Rhume River, tributary to the Leine River near Northeim (km 264). The Soese Dam (km 301) is located north of Osterode on the Soese River, likewise tributary to the Rhume River. In the "Oberharz" area of the Aller River Basin are located the newly-completed Ecker Dam and the proposed Oker Dam, now under construction. The Ecker Dam (km 261), completed in 1943, is located on the Ecker River, a branch of the Oker River tributary to the Aller River near Mueden (km 151). The Oker Dam (km 260) is being built on the Oker River in the vicinity of the Ecker Dam. These dams are all multiple purpose reservoirs providing storage for flood protection, water supply, power generation and flow regulation. Many towns depend upon these reservoirs for their water supply and electrical power; for example, Soese Dam provides water and electricity for Bremen, Hildesheim and fifty other towns. The locations of the Harz reservoirs are shown on the General Map, Plate 1, and the dam cross sections and elevations

CONFIDENTIAL

/* completion of those SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

are shown on Plate 9. Detailed data and description is contained in Exhibit B and in References 8 to 12. The following pertinent data are presented:

| | <u>Oder Dam</u> | <u>Soese Dam</u> | <u>Ecker Dam</u> | <u>Oder Dam</u> |
|---|---------------------|----------------------|----------------------|---------------------|
| Date built | 1928/33 | 1929/31 | 1934/45 | Being built |
| Type | Earth | Earth | Concrete | Concrete |
| Height (m) | 62.3 | 57.3 | 62 | 57 |
| Length (m) | 310 | 500 | 240 | 400 |
| Width at base (m) | 285 | 252.5 | 43 | No data |
| Storage capacity (mil. m ³) | 30.6 | 25.5 | 13 | 45 |
| Drainage area (km ²) | 52 | 46.5 | 19 | 85 |
| Annual power output (mil.kwh) | 8 | 3 | 0.8 | No data |

c. Harz Mountain Ponds. In the northern part of the Harz Mountain Region near Altenau, there are located, in addition to the large valley dams, 69 smaller ponds, called "Oberharsteiche," with a total storage capacity of approximately 10.5 million m³ and a total water surface of about 250 hectares. The largest is the "Oderteich," in operation since 1721, and located on the Oder River about 15 km upstream of the Oder Valley Dam. The "Oderteich," has a storage capacity of 1.67 million m³ and its water surface covers about 22 hectares. Its outflow can be permitted either to enter or to bypass the Oder Dam reservoir. The "Oberharsteiche" are all interconnected by channels and flumes to form an integrated runoff storage system. The Harz ponds and channels provide storage of water for agricultural use, operation of mills, collection of runoff, drainage of mines, and are important recreational assets. Detailed description is contained in References 8 and 10.

d. Maschsee Reservoir. In connection with other phases of an extensive local protection project for the City of Hannover on the Leine River, a marshy area called the "Maschsee," was converted into an artificial lake. The water surface is about 2 m above the Leine River normal stage. The lake contains approximately 1.6 million m³ and is fed by pumping from the river.

e. Navigation Dams. Detailed description of the important navigation dams on the Aller and Leine River is contained in Exhibits A and B and locations are indicated on the General Map, Plate 1 and on the profiles, Plates 5 and 7. Names and locations of navigation dams are listed in paragraph 2-08.

f. Mill Dams. A number of small mill dams, providing power for local electric power plants, mills and factories, are located on the streams of the Aller-Leine system above the head of navigation. Detailed descriptions of the important mill dams are

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

contained in Exhibit B and locations are indicated on the General Map, Plate 1 and on the profiles, Plates 4 to 7, inclusive. The important mill dams are:

| <u>River</u> | <u>Mill Dam</u> | <u>River km</u> |
|---|-------------------------------------|---|
| Aue (tributary of Leine R. at km 120.3) | Blumensau | (2.5 km upstream of Aue-Leine Junction) |
| Leine | "Am Schnellen Graben" (in Hannover) | 159 |
| Aller | Gifhorn | 166 |
| Aller | Diekhorst | 152 |
| Aller | Langlingen (SW of Nordberg) | 140 |
| Aller | Celle | 116 |

2-11 LEVEES.

Levees are of minor importance along the Aller and Leine Rivers, although short local levees exist at various places. In connection with other extensive local flood protection works at Hannover, about 5 km of levees were built along the Leine and Imme Rivers to an elevation 0.5 m above HHW (at junction of Leine and Imme Rivers in Hannover, HHW is 53.2 m/NN). Other short levees with crowns 0.3-0.5 m above HHW, exist along the Leine River near Wilkenburg (km 165) and Bordenau (km 118). Following is a tabulation of the main levee system along the Aller River:

| <u>Place</u> | <u>River km</u> | <u>Remarks</u> |
|----------------------|-----------------|---|
| Wissen | 99.7-97.5 | Winter dike, right bank |
| Ablden | 59.3-56.5 | Left bank |
| | 56.0-55.3 | |
| Bierda | 53.8-53.6 | Right bank |
| | 53.4-52.7 | |
| | 52.4-52.3 | |
| Eilte | 51.0-50.3 | Right bank |
| " | 44.3-22.9 | Summer dike |
| Hulsen | 24.0-21.8 | Winter dike |
| Westen | 22.3-18.7 | Winter dike protecting 99 km ² on right bank |
| Westen | 22.5-16.9 | Winter dike, left bank |
| Downstream of Westen | 16.9- 7.5 | Summer dike, left bank |

2-12 CANALS.

a. Mittelland Canal. The Mittelland Canal System extends from Duisberg on the Rhine River to Magdeburg on the Elbe River. The course is shown on the General Map, Plate 1; the profile appears on

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

Plate 10; and standard cross sections are presented on Plate 11. The Ems-Weser portion crosses over the Leine River near Lohnde (km 136) by means of an aqueduct, while a branch descends through locks to the river near Hannover. The Oker and Aller Rivers, together with smaller streams, pass beneath the Weser-Elbe portion of the canal by means of siphons, equipped with auxiliary relief gates to permit diversion of flood waters into the canal and thence to the Elbe River. Reference is made to document listed as Reference 3 in the Bibliography for detailed description of the canal system.

2-13 BRIDGES.

Locations and clearances (wherever data are available) of major bridges across the Oker, Söese, Rhume, Leine and Aller Rivers are indicated on the profiles, Plates 3 to 7, inclusive. Tabulations of pertinent bridge data are included in Exhibit A and are contained in References 1, 2, 3, and 13 of the Bibliography. Reliable information upon post-war reconstruction subsequent to 1945 is not available.

CONFIDENTIAL
SECURITY INFORMATION

SECTION III
HYDROLOGIC CHARACTERISTICS

3-01 GENERAL.

a. Information regarding river stage, discharge, flow duration, and current velocities pertinent to the Leine and Aller Rivers are presented in generalized graphical form insofar as practicable to facilitate application of the data to specific military problems. References should be utilized for supplementary data.

b. Most available stage and discharge records cover periods prior to completion of the Harz Mountain Valley Dams described in paragraph 2-10b. No data are available regarding the effects of those reservoirs in modification of stages and discharge, but it is considered probable that floods would be reduced and that the minimum stages and flows would be raised.

3-02 CLIMATOLOGY.

Climatological data for the region covered by the report may be found in References 3, 8, and 14. The annual rainfall in Germany decreases from about 700 mm on the North Sea coast to about 600 mm at Hannover and increases about 10 mm for each 100 meters altitude. The average annual rainfall in the Harz Mountains exceeds 1500 mm. Seasonal variation in rainfall is illustrated by the following tabulation showing the monthly percentage of the annual rainfall for a number of stations for the period of 1881 to 1910:

| <u>J</u> | <u>F</u> | <u>M</u> | <u>A</u> | <u>M</u> | <u>J</u> | <u>J</u> | <u>A</u> | <u>S</u> | <u>O</u> | <u>N</u> | <u>D</u> |
|--------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <u>Harz Mountains</u> | | | | | | | | | | | |
| 8.8 | 8.2 | 8.9 | 5.7 | 6.5 | 7.7 | 10.6 | 8.8 | 7.2 | 8.5 | 8.6 | 10.5 |
| <u>Adjacent Lowlands</u> | | | | | | | | | | | |
| 6.5 | 5.9 | 7.7 | 6.2 | 8.8 | 10.1 | 13.7 | 10.4 | 8.3 | 8.4 | 6.8 | 7.2 |

3-03 STREAM GAGING STATIONS

A number of gages have been established on the Aller and Leine Rivers and their tributaries, with records being published for the more important stations in such official annual publications as the German Hydrologic Yearbooks listed as References 6 and 7. Locations of important gages are shown on the General Map, Plate 1, and on the stream profiles, Plates 3 to 7, inclusive.

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

3-04 RIVER STAGES.

a. Records. Data regarding the maximum, mean, and minimum stages of record at key gaging stations on the Aller, Leine, Oker and Rhume Rivers are presented in Tables 3 and 4, together with other pertinent gage information. Additional data are contained in the German Hydrologic Yearbooks, References 6 and 7.

b. Seasonal variation. The range of stages observed for each month is indicated in Tables 3 and 4. It may be observed in those tables that average winter stages (November-April) are consistently higher than corresponding summer stages (May-October), with the maximum MHW, MW, and MNW occurring in January or February and the minimum in July through September. The monthly range between MHW and MNW follows similar trends. It is not considered that operation of the Harz Mountain reservoirs would radically alter these general seasonal trends, although the range between high and low stages would probably be reduced. The maintenance of higher wintertime stages in the Aller River near Gifhorn to inundate and thus fertilize the adjacent pastureland is described in Exhibit B.

3-05 RIVER DISCHARGES.

a. Discharge Records. Mean daily, mean and extreme monthly and yearly discharges are contained in Reference 6. A tabulation of discharge data is presented in Table 5 and discharge profiles are shown on Plate 13. Flow duration curves covering the 1936 to 1938 water years for 3 key stations are shown on Plate 12. Median flows, equalled or exceeded 50 percent of the time, taken from those curves are:

| <u>River</u> | <u>Station</u> | <u>Period of Record</u> | <u>Median Flow m³/s</u> |
|--------------|------------------|-----------------------------|--|
| Aller | Westen | 1936-38 | 70 |
| Oker | Gross-Schneulper | 1936-38 | 8 |
| Leine | Greene | 1937-38 | 21 |

Operation of the Harz reservoirs would be expected to effect reduction of flood flows and increase of minimum discharge.

b. Stage discharge relation. Average stage-discharge rating curves for 3 key stations in the Aller-Leine River basin are presented on Plates 14 and 15. The curves were estimated from discharge measurements and from equivalent stage-discharge data contained in the German Hydrologic Yearbooks, listed as References 6 and 7. For use in this study, the curves were extended considerably beyond the range of observed data and are subject to revision, especially in the higher portions.

3-06 RIVER VELOCITIES.

a. General. The velocity of stream flow varies according to the conformation of the river bed, depths, obstructions, restrictions, local variation in slope, etc. Channel improvements and cutoffs, training walls and levees, operation of dams and other modifications of natural conditions appreciably affect the stream velocity. Inflowing rivers in flood tend to elevate the main river waters at the point of confluence according to the magnitude of the flood, thus tending to reduce the slope above and to increase it below the point of confluence. Accordingly, correlations between river stages and surface velocities at gaging stations cannot be interpreted as applicable to all points along the adjacent river sections, but only serve as general indications.

b. Surface Velocities. Insufficient basic information concerning the stream hydraulic functions (cross-sectional area, wetted perimeter, water surface slope, roughness factor) was available to permit accurate determination of stream velocities. Estimates were based on velocities observed during discharge measurements at gaging stations and recorded in Reference 7. Such velocities probably tend to be higher than velocities in the adjacent stream reaches because discharge measurements are normally made at locations of restricted sections in order to facilitate measurement. The deduced stream velocities were multiplied by 1.18 (i.e. $1/0.85$) to obtain corresponding surface velocities. Surface velocity profiles for MW and MHW are shown on Plate 13. Tabulation of estimated surface velocities corresponding to statistical mean stages for the period 1926-35 follows:

| <u>Station</u> | <u>River km</u> | <u>Surface Velocity (km/hr)</u> | | |
|----------------------|-----------------|---------------------------------|-----------|------------|
| | | <u>MHW</u> | <u>MW</u> | <u>LOW</u> |
| <u>Aller River</u> | | | | |
| Brennackerbrueck | 158 | 2.1 | 1.4 | — |
| Celle | 115 | 6.8 | 3.0 | — |
| Ahlden | 59 | 4.0 | 3.0 | 2.3 |
| Westen | 22 | 5.1 | 3.6 | 2.7 |
| <u>Leine River</u> | | | | |
| Loinetum (Northheim) | 259 | 4.2 | 3.6 | — |
| Herrenhausen | 152 | 4.1 | 3.8 | — |
| Bothmer | 68 | — | 3.1 | 2.5 |
| <u>Rhume River</u> | | | | |
| Elvershausen | 275 | 7.2 | 4.2 | 3.2 |

CONFIDENTIAL
SECURITY INFORMATION

3-06

c. Flood Wave Travel Time. Examination of available flood crest times as recorded in the official German Hydrologic Yearbook, References 6 and 7, for the floods of March 1881, November 1926, January 1932, April 1936, February 1937, and January 1938 revealed considerable variation in the rate of progression of various flood waves; however, the average travel rate of those flood waves (including that of February 1946 obtained from Reference 15) are tabulated below:

| <u>Reach</u> | <u>River km</u> | <u>Average Travel Rate of Peak (km/hr)</u> |
|-----------------------------------|------------------------------|--|
| Brenneckenbrueck-Westen | <u>Aller River</u> 158-22 | 3.1 |
| Ohrum-Gross Schwuelper | <u>Oker River</u> 225-181 | 4.5 |
| Elverhausen(Rhume R.)- Bothmer | <u>Leine River</u> 275-58 | 3.2 |

CONFIDENTIAL
SECURITY INFORMATION

SECTION IV
ARTIFICIAL FLOODING POTENTIALITIES

4-01 GENERAL.

a. The term "artificial flood" as used in this report applies to any major increase in the extent of flooding, over that normally prevailing with existing developments, that is brought about by manipulation of control structures, breaching of dams or levees, or temporary damming operations designed to create flooding conditions. Applications of artificial flooding considered in this report fall into the following four general categories:

(1) Still-water barriers, created by flooding land to form water obstacles, using such means as breaching levees, diverting flow from canals, raising crests of existing dams or constructing temporary dams.

(2) Drainage obstacles or mud-flats, in which the wetness of the soil is increased to form muddy or marshy conditions that would impede military traffic, brought about by disrupting the normal drainage, destroying pumping and drainage facilities used to drain marshy or low land, or by inducing shallow inundation of flood plains or reclaimed land. Mud-flats may also be formed by draining areas normally inundated by reservoirs or ponds.

(3) Stream flow variations, in which changes in discharges, depths, velocities and widths of streams are brought about to hinder stream-crossing operations or navigation such as might be accomplished by opening and closing outlet works of water control structures.

(4) Major flood waves, created by sudden breaching of a dam to release large quantities of impounded water.

b. Many opportunities exist for effective use of each of the four general categories of artificial flooding. The potentialities are reviewed and quantitative evaluation of the effects are presented in this section.

c. Previous studies by German and Allied military staffs indicate the general nature and extent of possible artificial flooding. The document listed in the Bibliography as Reference 4, a translation of which is included in this report as Exhibit B, was prepared for the German General Staff and contains considerable information on the effects of artificial flooding. The area considered by that source as subject to flooding is indicated on the General Map, Plate 1 of this report. Reference is also made to the map overprint prepared by G-2 SHAEP (see Reference 16) presented as Plate 8 of this report, which outlines the areas considered floodable, during high water conditions,

CONFIDENTIAL
SECURITY INFORMATION

by natural or artificial means. These studies have been utilized in preparation of this report. Reference is also made to a report on the Aller System prepared by the British Army of the Rhine in 1946 (Reference 17), which was unavailable at this time. Examination of other similar reports by the same source indicates that some information on the artificial flooding possibilities of the Aller and Leine Rivers is included within the scope of that report.

4-02 STILL-WATER BARRIERS AND DRAINAGE OBSTACLES.

a. General. The studies herein reviewed in this paragraph pertain to artificial flooding produced by creation of still-water barriers and drainage obstacles along the Aller River below the Weser-Elbe Canal crossing, and along the Leine River below the Rhume River confluence. The studies were largely based on a map study, using the 1:25,000 GSGS 4414 map series, supplemented by data from References 1, 2, 4 and 16. Exact determination of elevations, contours, and boundaries from those maps was difficult; however, the results of this study are believed to offer good indications of the relative possibilities of such flooding. First-hand information should be obtained by local reconnaissance regarding ground elevations and the location, elevations and dimensions of levees, roadfills and culverts in the vicinity of specific barriers in order to accurately establish the area subject to artificial flooding.

b. Hydrologic Considerations. The effect of artificial flooding is largely contingent upon the natural hydrologic conditions prevailing at the time of the operation. The volume of water stored and available within the basin, the rate of stream flow and the river stage are important factors. Reference is made to Section III of this report for detailed description, and to the following summation of pertinent hydrologic considerations.

(1) Attention is directed to the wide range between high and low flows shown in Table 5. The following average mean natural discharges were used in this study:

| <u>River</u> | <u>Reach</u> | <u>Average mean Discharge (m³/s)</u> |
|--------------|-------------------|---|
| Aller | Above Oker R. | 10 |
| " | Oker R.-Leine R. | 40 |
| " | Leine R.-Weser R. | 90 |
| Leine | Rhume R.-Aller R. | 30 |

(2) A plentiful supplementary water supply is afforded by the 100 million m³ storage capacity of the existing canals, reservoirs and ponds within the drainage area. Completion of the Oker Dam would add another 45 million m³. During extended dry periods, irrigation and other demands would considerably reduce the volume of stored

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL

SECURITY INFORMATION

4-02

water available for artificial flooding unless drastic conservation of impounded water was enforced.

(3) Considerable variation in river stage has been experienced during the past period of record, as indicated in Tables 3 and 4. Operation of the Harz reservoirs may be expected to moderate the extreme flows in the future.

c. Means of Creating Still-Water Barriers and Drainage Obstacles.

(1) The water obstacle afforded by the existing streams of the Aller-Leine basin could be increased by utilization of one or more of the following means:

(a) Creation of still-water barriers by raising crests of existing dams or by construction of temporary dams, combined with closing of culverts and other openings in levees and road fills.

(b) Inundation of lowlands along the streams by breaching dikes and levees and opening of flood gates in levees.

(c) Inundation of lowlands by closing normal drainage outlets.

(2) In order to obtain a comparative quantitative evaluation of the potential artificial flooding at various locations, analysis was arbitrarily confined to still-water barriers resulting from temporary damming to 1 m and 3 m above mean water (MW), herein designated as "low barriers" and "high barriers," respectively. In this study, it was assumed that the water surface of the pools above the temporary dams would be level, and that mean water conditions would prevail at the time of the operation. During high water conditions, greater flooding could be expected due to the increased slope of water surface upstream from the temporary dams.

d. General Effect of Still-Water Barriers.

The effects of artificial flooding created by temporary damming operations on the Aller and Leine Rivers are summarized in Tables 6 and 7, and the extent of inundation outlined on the strip maps presented on Plate 16. Serial numbers of sites correspond to those of Exhibit A. Reference is made to Exhibits A and B for data on the dimensions of dams and bridges. The flooding produced by the low barriers would be mostly confined within the stream banks, while that produced by the high barriers would flood areas about 0.2 to 2.5 km wide. Formation of continuous overbank flooding would not be practicable, except during periods of high flows. Review of the artificial flooding possibilities in specific reaches of the Aller and Leine Rivers follows.

CONFIDENTIAL

SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

e. Effect of Aller River Still-Water Barriers.

(1) General. The navigation and mill dams along the Aller River are built so that their crest heights may be readily increased without damage to the structure, as described in Exhibit B. For purposes of this analysis, it was assumed that the crest elevation could be increased 1 m, but that higher increases would be impracticable because of the excessive lengths of temporary damming required. Temporary damming by means of blocking of bridge openings at suitable sites was also considered as shown in Table 6 and discussed below.

(2) Source to Gifhorn (km 166). The Aller River flows through a broad marshy valley and is the basis for an extensive system of irrigation canals which could be used to form water obstacles and inundation in localized areas. Blocking of the Aller River syphon beneath the Weser-Elbe canal (See Plates 6, 10 and 16) would cause inundation over a considerable area adjacent to the canal; however, a large volume of water would be required (17.5 million m³ for the low barrier or 57 million m³ for the high barrier as indicated in Table 6). In the vicinity of Gifhorn, shallow artificial flooding of the Aller and Ise Depressions could be accomplished as indicated in Table 6 and further described in Exhibit B.

(3) Gifhorn to Celle (km 115). Temporary damming at Brenneckenbrueck (Site 1) and Diekhorst Sluice (Site 6) could produce a still-water barrier about 0.5 km wide and nearly 15 km long. High barriers at the other 3 sites in this reach indicated on Plate 16 would create isolated shallow inundation of an average width of 250-500 m, and average length of about 1 km as shown in Table 6.

(4) Celle to Leine R. (km 65). The four navigation dams in this reach afford excellent opportunities for formation of low barriers, each producing flooding averaging about 0.3 m deep over areas 2-4 km long and 500-1,000 meters wide (See Plate 16). Creation of high barriers at the 4 suitable bridge sites shown in Table 6 would create additional obstacles each 2-5 km long and 500-1500 m wide, averaging approximately 0.4 m deep over the adjacent lowlands. Considerable construction might be involved in blocking the large bridge openings (each over 100 m in length) to the required height; but the resulting pools would produce a nearly continuous water obstacle.

(5) Leine R. to Weser R. There are no existing dams in this reach; but the bridges at Ahlden (Site 51), Rethem (Site 57), and Verden (Site 63) would be likely locations for erection of temporary dams (See Plate 16). No significant flooding would result from low barriers, but areas 8-11 km long and 1200-2000 m wide would be flooded to an average depth of approximately 1 m by creation of high barriers, as summarized in Table 6. The size of bridge openings are large (110-375 m) and several lengthy stretches of railroad and highway embankments would have to be used as part of the barricade, thus probably involving closure of culverts and other openings.

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

f. Effect of Leine River Still-Water Barriers.

(1) General. The narrow valley and steep gradients in the upper reaches of the Leine River restrict the possibilities for creation of effective still-water barriers (See profiles on Plates 3 to 5). The effects of the low barriers would be mostly confined to increasing the channel depth. High barriers at the sites, indicated on Table 7 and Plate 16 would produce inundation of 300-2500 m average width, practically continuous in the lower reaches below Hannover (km 161).

(2) Rhume R. (km 264) to km 161 (South of Hannover). Artificial flooding produced by still-water barriers is insignificant in this reach, except for the 2 sites (Serial Nos. 196 and 197) shown on Plate 16, in the vicinity of Salzderhelden (km 252), where ponds 1750 m wide for a total length of 11 km could be formed. Table 7 summarizes the effects in this reach of the Leine River.

(3) Km 161 (South of Hannover) to Neustadt (km 110). Several suitable sites for still-water barriers exist in the vicinity of Hannover, where an extensive local flood protection project, including channel rectification, dikes, and creation of an artificial lake (see paragraphs 2-10d and 2-11) has been constructed. Combination of temporary damming and breaching of dikes in that locality would inundate an area about 1 km wide and extending for several kilometers above and below Hannover. A continuous water obstacle, 12 km long, 300-900 m wide and averaging approximately 0.5 m deep would be created by erecting five high temporary dams at sites 112 to 116, inclusive, shown on Plate 16. Blocking of the Neustadt highway bridge opening (site 109) to 3 m above mean water would flood a 1200 m wide area extending for 8.5 km. Reference is made to Table 7 for summary of effects.

(4) Neustadt to Aller R. junction. A practically continuous 26 km long water obstacle, averaging about 300 m wide could be produced by creation of high barriers at the 3 bridge openings designated as 102, 104, and 105 on Table 7 and Plate 16. Flooding by low barriers at those sites would be mostly confined to the stream bed and to the old meanders. A low temporary dam at the Bothmer RR bridge would create a still-water obstacle averaging 460 m wide and 1.2 m deep, extending upstream 5.6 km.

g. Water Requirements for Still-Water Barriers.

(1) The volume of water required to effect the artificial flooding on the Aller and Leine Rivers described in preceding paragraphs and shown on Plate 16 and in Tables 6 and 7, together with the estimated time of filling at the natural mean rates of flow given in paragraph 4-02b(1), are approximately as follows:

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

4-02g

| <u>River Reach</u> | <u>Water Requirement</u> (million m ³) | | <u>Natural Filling Time</u> (Days-hours) | |
|--------------------|---|---------------------|---|---------------------|
| | <u>Low Barrier</u> | <u>High Barrier</u> | <u>Low Barrier</u> | <u>High Barrier</u> |
| <u>Aller R.</u> | | | | |
| Source-Gifhorn | 21.4 | 57.0 | 25- 0 | 66- 0 |
| Gifhorn-Celle | 1.0 | 0.9 | 0- 8 | 0- 6 |
| Celle-Leine R. | 5.0 | 8.7 | 1-11 | 2-13 |
| Leine R.-Weser R. | - | 42.0 | - | 5-10 |
| | <u>27.5</u> | <u>108.6</u> | <u>26-19</u> | <u>74- 5</u> |
| <u>Leine R.</u> | | | | |
| Rhume R.-Hannover | 8.7 | 10.5 | 3- 8 | 4- 1 |
| Hannover-Neustadt | 1.8 | 32.3 | 0-17 | 12-10 |
| Neustadt-Aller R. | <u>9.8</u> | <u>45.0</u> | <u>2-18</u> | <u>17- 7</u> |
| | <u>20.3</u> | <u>87.8</u> | <u>6-19</u> | <u>33-18</u> |

(2) Supplementary sources of water supply for still-water barriers are the reservoirs, ponds and canals located within the basin and described in paragraphs 2-10 and 2-12. A summation of available storage capacities follows:

| <u>Location</u> | <u>Storage Capacity (million m³)</u> |
|-------------------------------|---|
| Oder Dam | 30.6 |
| Soese Dam | 25.5 |
| Ecker Dam | 13.0 |
| Harz Ponds (Harzteiche) | 10.5 |
| Maschsee Reservoir (Hannover) | 1.6 |
| Mittelland Canal | <u>19.0</u> |
| | <u>100.2</u> |

Upon completion of Oker Dam, an additional 45 million m³ capacity would be available. During extended dry periods, the volume of water stored in the reservoirs and available for discharge would be considerably reduced, as indicated by the representative 10-year reservoir hydrograph of Plate 17.

(3) The rates of discharge from the Oder, Soese and Ecker Dam outlets are discussed in detail in paragraph 4-04. The discharge rates and durations are summarized in Table 9. Those flows may be used to supplement natural flows in filling the pools behind temporary dams. The initial combined rate of discharge from the existing Oder and Soese dam outlets at full reservoir pool, is about 85 m³/sec. In 8-10 days, those reservoirs could be emptied, providing about 50 million m³ of released water. Studies described in paragraph 4-04 indicate that it would take about 2 days for the initial increase in flow to travel downstream to the vicinity of the Aller and Leine River confluence, plus 3 additional days for the flow there to reach the sustained maximum rate of approximately 60 m³/s above the base flow. At that rate, the still-water barriers along the Leine River would be

CONFIDENTIAL
SECURITY INFORMATION

filled in about 1/3 the time required by the mean natural stream discharge shown in previous subparagraph 4-02g(1). Modification of the dam outlets to increase their discharge capacity would further reduce the time required. Reference is made to paragraph 4-04 and to Table 9 for further data.

4-03 MAJOR FLOOD WAVES.

a. General.

(1) The studies in this paragraph pertain to the artificial flooding effects that might be produced by breaching of the large Harz Mountain dams.

(2) Quantitative estimates of the potential effects of major flood waves are presented for the Oder, Soese and Ecker Dams. Reference is made to paragraph 2-10b and to Exhibit B for descriptive data on those structures and to Plate 9 for sketches of the dam cross-sections and elevations.

(3) Insufficient data were available to permit detailed study of the effects of a major flood wave from the Oker Dam, which is in process of construction; however, estimates of the relative potentialities are included.

b. Hydrologic Considerations.

(1) High stages on the Aller and Leine Rivers are reduced by impounding runoff in the Harz Mountain reservoirs. Water is released to maintain navigable stages during low flow periods and for irrigation purposes as discussed in paragraphs 2-09 and 3-04. The natural discharges of the Aller and Leine Rivers normally are not disturbed by operation of the dams for power because of re-regulation pools immediately below the main dams. In study of the effect of major artificial flood waves, it was assumed that the base flow in the stream at the start of the wave corresponded to mean water conditions as tabulated in Tables 3 to 5.

(2) The peaks and durations of flood waves are greatly influenced by the initial reservoir pool level and the storage capacity of the reservoirs. In this study, it was assumed that the reservoir was at the maximum level in order to define the maximum probable limits of the flood waves. The maximum reservoir levels shown on Plates 9, 17 and 18 are attained only during the flood season. The hypothetical Oder Dam stage and storage hydrograph for the period 1908 to 1917 (Plate 17) reflects the general trends of reservoir variation prevailing for the Harz dams. The reservoir storage curve for Oder Dam is based on data in Reference 9 and is shown on Plate 18. The curve shown on the plate for Soese Dam was based on data from Exhibit B and developed by the method presented in "A Progress Report on the Disposition of Sediment in Reservoirs" by A. W. Van't Hul (See Reference 18). The Ecker Dam

CONFIDENTIAL
SECURITY INFORMATION

4-03

storage curve was similarly developed from data given in Reference 12. The equations for the storage curves can be expressed as:

| | | |
|-----------|-----------------|------|
| Oder Dam | S equals 3400 H | 2.31 |
| Soese Dam | S equals 3400 H | 2.31 |
| Ecker Dam | S equals 200 H | 2.76 |

Where S equals storage in cubic meters, H equals reservoir depth in meters.

(3) During passage of a major flood wave downstream, an appreciable amount of volume is retained behind embankments and in depressions on the floodplain, and lost through evaporation, seepage, etc. For example, 39.5 percent of the volume of water discharged from the Eder Dam breach of May 1943 was lost in the passage of the flood wave to Intschede, 426.6 km below the dam (See References 19 and 20). Consequently, it was assumed in this study that for each 10 km of travel, about 1 percent of the volume within the flood wave would be lost or retained on the flood plain.

c. Means of Creating Artificial Flood Waves.

(1) Major artificial flood waves can be created on the Aller and Leine Rivers by breaching of the Oder, Soese, and Ecker Dams.

(2) The bombing of the Mohne, Sorpe, and Eder Dams by the R.A.F. in May 1943 (described in Reference 19) provided the basis for estimating the size and shape of breach. For purposes of this study, it was assumed that demolition would cause an opening similar to that produced by the Eder Dam bombing.

(3) The assumed breach approximates a parabolic shape, corresponding closely to the equation:

$$x^2 \text{ equals } 51 y$$

Where x equals horizontal distance from vertical axis
of the opening

y equals vertical distance above lowest point of
breach opening

It was considered that the assumed breach approximates the largest feasible opening likely to be produced in the Oder, Soese and Ecker Dams. Breaching of earth dams with concrete cores like the Oder and Soese Dams would require special preparations and procedures as described in Reference 19.

(4) In order to permit comparative evaluation of artificial flood waves it was further assumed in all cases that the lowest

CONFIDENTIAL
SECURITY INFORMATION

point of the breach was 24 m below the initial water surface (similar to conditions at the Eder Dam breach); therefore, the initial discharge would be 8500 m³/s for breaches at all dams studied. Breach discharge hydrographs are shown on Plates 19 and 20.

(5) In view of the equalizing effect of stream conditions upon various sized flood waves as the wave progresses downstream (See Reference 20), it was considered that more precise computations of probable breach opening would be unwarranted for purposes of this report.

d. Effects of Dam Breaching Operations.

(1) General. The estimated effects of artificial flood waves produced by breaching of the Harz dams, as described above, is summarized in Table 8, and discharge hydrographs at key locations are shown on Plates 19 and 20. The artificial flood waves are designated as follows:

| <u>Artificial Flood No.</u> | <u>Dam Breach</u> |
|-----------------------------|----------------------|
| 1 | Oder |
| 2 | Soese |
| 3 | Ecker |
| 4 | Oder / Soese |
| 5 | Oder / Soese / Ecker |

(2) Artificial Flood No. 1 is the flood wave on the Oder, Rhume, Leine and Aller Rivers caused by breaching of the Oder Dam. The outflow hydrograph at the dam was computed from the storage-discharge relation and routed downstream to produce the discharge hydrographs shown on Plate 19. The peak discharge at the dam of 8500 m³/s would be reduced to 700 m³/s at Elvershausen (37 km below the dam) and to 275 m³/s at Westen, 290 km downstream of the Oder damsite (See Table 8).

(3) Artificial Flood No. 2 hydrographs result from breaching of the Soese Dam and are shown on Plate 19. The peak discharge decreases from 8500 m³/s at the dam to 795 m³/s at Elvershausen and 270 m³/s at Westen as shown on that plate and tabulated in Table 8.

(4) Artificial Flood No. 3 is created on the Ecker, Oker and Aller Rivers by breaching of the Ecker Dam. Discharge hydrographs at key locations appear on Plate 20 and a summation of effects is contained in Table 8. The peak discharge of 8500 m³/s at the dam would be reduced to 260 m³/s at the confluence of the Oker and Aller Rivers (110 km below the dam) and to 210 m³/s at Westen (239 km below the Ecker damsite), representing an increase of about 107 m³/s above the base flow at the latter location.

(5) Artificial Flood No. 4 is produced by synchronized breaching of the Oder and Soese Dams so that the wave crests would arrive simultaneously at the confluence of the Rhume and Soese Rivers

CONFIDENTIAL
SECURITY INFORMATION

(km 276) (See Plate 1). Breaching of the Soese Dam would be lagged 4 hours after the Oder Dam breach to effect that coincidence of peak flows. Plate 19 shows the resulting discharge hydrographs at key locations. As shown on the discharge profile, Plate 13, and in the tabulation, Table 8, the discharge from the combined breachings would be 1475 m³/s at Elvershausen and 420 m³/s at Westen.

(6) Artificial Flood No. 5 results from breaching operations at the Oder, Soese and Ecker dams timed so that the combined Oder and Soese peak flow would arrive at the confluence of the Leine and Aller Rivers to combine with the Ecker dam peak flow at that point, in order to produce the maximum peak stage on the lower Aller River (See Plate 1 for locations). As may be observed from the discharge hydrographs of Plate 19, the initial peak discharge of 8500 m³/s at each dam breach would produce a combined peak discharge of 520 m³/s at Westen. This combined wave results from lagging of breaching operations at the Soese and Ecker Dams approximately 4 and 15 hours, respectively, after the initial Oder Dam breaching. A summary of effects is included in Table 8.

(7) Comparison of Effects of Dam Breaching Operations. Table 8 presents a summary of the effects estimated to be obtained by breaching of the Harz dams. The average width of area flooded at time of passage of the peak, considering levees along the stream as breached or overtopped, is tabulated in Table 10. The relation of the peak effects of Artificial Flood No. 4 to natural conditions of stage is shown on Plates 4, 5 and 7. Discharge and surface velocity relations are graphically presented on Plate 13. Since the artificial flood flows are considerably higher than the observed discharge, stage, and velocity measurements, the estimated values for artificial floods were extrapolated and are subject to revision. Extracts of the effects shown in Tables 8 and 10 at selected key locations are presented below for comparison:

| <u>River</u> | <u>Location</u> | <u>River km</u> | <u>Artificial Flood No.</u> | | | | |
|---|-----------------|-----------------|-----------------------------|-----|-----|-----|-----|
| | | | 1 | 2 | 3 | 4 | 5 |
| (a) Height of Wave above Mean Water Profile (m) | | | | | | | |
| Rhume | Elvershausen | 275 | 3.7 | 3.8 | - | 4.2 | - |
| Leine | Herrenhausen | 152 | 4.6 | 4.5 | - | 6.0 | - |
| " | Bethmer | 68 | 3.2 | 3.2 | - | 4.8 | - |
| Aller | Celle | 115 | - | - | 3.1 | - | - |
| " | Ahlden | 59 | 2.4 | 2.4 | 1.8 | 3.9 | 4.9 |
| " | Westen | 22 | 1.6 | 1.6 | 1.1 | 2.5 | 3.1 |
| (b) Surface Velocities at peak of wave (km/hr) | | | | | | | |
| Rhume | Elvershausen | 275 | 9 | 9 | - | 9 | - |
| Leine | Herrenhausen | 152 | 5 | 5 | - | 5 | - |
| Aller | Celle | 115 | - | - | 9 | - | - |
| " | Westen | 22 | 5 | 5 | 5 | 6 | 6 |

CONFIDENTIAL
SECURITY INFORMATION

4-03d(7)

Artificial Flood No.

| <u>River</u> | <u>Location</u> | <u>River km</u> | 1 | 2 | 3 | 4 | 5 |
|--------------|-----------------|-----------------|---|---|---|---|---|
|--------------|-----------------|-----------------|---|---|---|---|---|

(c) Time of Arrival of Start of Wave (hours after initial breaching)

| | | | | | | | |
|-------|--------------|-----|----|----|----|----|----|
| Rhume | Elvershausen | 275 | 11 | 9 | - | 12 | - |
| Leine | Herrenhausen | 152 | 40 | 33 | - | 37 | - |
| Aller | Celle | 115 | - | - | 33 | - | - |
| " | Westen | 22 | 74 | 74 | 61 | 74 | 74 |

(d) Time of Arrival of Peak of Wave (hours after initial breaching)

| | | | | | | | |
|-------|--------------|-----|----|----|----|----|----|
| Rhume | Elvershausen | 275 | 18 | 14 | - | 18 | - |
| Leine | Herrenhausen | 152 | 54 | 49 | - | 53 | - |
| Aller | Celle | 115 | - | - | 46 | - | - |
| " | Westen | 22 | 95 | 87 | 80 | 93 | 93 |

(e) Duration of Wave above Mean Water (hours)

| | | | | | | | |
|-------|--------------|-----|----|----|----|----|----|
| Rhume | Elvarshausen | 275 | 21 | 19 | - | 24 | - |
| Leine | Herrenhausen | 152 | 38 | 38 | - | 41 | - |
| Aller | Celle | 115 | - | - | 30 | - | - |
| " | Westen | 22 | 56 | 52 | 45 | 60 | 60 |

(f) Duration of Wave above Mean High Water (hours)

| | | | | | | | |
|-------|--------------|-----|----|----|---|----|----|
| Rhume | Elvarshausen | 275 | 14 | 13 | - | 16 | - |
| Leine | Herrenhausen | 152 | 20 | 18 | - | 25 | - |
| Aller | Celle | 115 | - | - | 9 | - | - |
| " | Westen | 22 | 0 | 0 | 0 | 19 | 24 |

(g) Width of Flooded Area at Peak of Wave (km)

| | | | | | | | |
|-------|--------------|-----|-----|-----|-----|-----|-----|
| Rhume | Elvershausen | 275 | 0.8 | 0.8 | - | 0.9 | - |
| Leine | Bordenau | 121 | 1.4 | 1.4 | - | 1.6 | - |
| Aller | Celle | 115 | - | - | 0.7 | - | - |
| " | Westen | 22 | 2.0 | 2.0 | 2.0 | 3.0 | 3.0 |

(8) Effect of Oker Dam Breach. Completion of the Oker Dam, now under construction on the headwaters of the Oker River near the Ecker Dam, would provide an additional source of artificial flood waves. Sufficient data were not available to permit analysis of the effects of breaching of that dam upon artificial flooding; however, estimates based upon comparison with the effects of the Oder, Soese and Ecker Dams indicate that breaching of the Oker Dam would raise the stages on the Aller River at Westen approximately an additional 1 to 2 m when combined with the flood waves resulting from breaching of the existing valley dams.

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

(9) Effect of Breaching of Navigation Dams. Breaching of the navigation and mill dams on the Aller and Leine Rivers would create artificial flood waves of short duration and small amplitude. The low heights and small storage capacities of those dams are factors limiting the resulting waves. Because of lack of essential data, detailed study was not made; however, it is indicated by German sources (Exhibit B) that demolition of the navigation dams would produce flood waves 1 to 3 m high, depending upon the difference in the upstream and downstream water surface at the particular dam. Locations of navigation structures are shown on the General Map, Plate 1 and on the profiles, Plates 3-7, and descriptive data are contained in paragraphs 2-08 and 2-10, and in Exhibits A & B.

4-04. STREAM FLOW VARIATIONS.

a. General.

(1) The studies in this paragraph pertain to the artificial flooding effects that might be produced by release of water from the outlets of the Oder, Soese, and Ecker valley dams.

(2) Included are quantitative estimates of the potential effects of detrimental flow variation produced by operation of the existing outlets and by modification of the outlet structures to increase the discharge capacity.

(3) Reference is made to paragraph 2-10b and Exhibit B for general descriptions of the structures, to Plate 1 for locations, to Plate 9 for sketches of the dams, and to documents listed as References 8 to 12, inclusive, in the Bibliography of this report for detailed descriptions and drawings of the dams and their outlet structures.

(4) Flow variations may be repeated to produce cyclic effects, dependent upon the replenishment of the depleted storage in the reservoirs.

b. Hydrologic Considerations.

(1) Reference is made to paragraph 4-03b for discussion of the influence of natural stream discharge and initial reservoir pool level on artificial flooding.

(2) The average time required for complete filling of the Oder and Soese reservoirs is stated in Exhibit B to be 6 months and 9 months, respectively.

c. Means of Creating Detrimental Flow Variations. Detrimental flow variations may be produced downstream from the Oder, Soese and Ecker Dams by one of the following three methods:

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

(1) Type A, operation of the existing controlled outlets for sustained or cyclic discharge.

(2) Type B, modification of the outlets to increase discharge capacity, accomplished by temporary by-passing, alteration or dismantling of restrictions, machinery or other outlet appurtenances without causing permanent or serious disruption of normal reservoir functions.

(3) Type C, major modification of the outlet structures to increase discharge capacity accomplished by permanent removal of restrictions or such modification as to seriously hinder the normal functions of the reservoir.

d. Oder Dam Outlet Discharges.

(1) Type A. The existing main outlets of Oder Dam can discharge $42.7 \text{ m}^3/\text{s}$ when the reservoir is full and $37.5 \text{ m}^3/\text{s}$ when one-half full, as stated in Exhibit B. Simultaneous opening of outlets and turbines would increase the discharge capacity, at full pool, to $50 \text{ m}^3/\text{s}$ for 8 to 10 days (See page 1 of Leine River tabulation in Exhibit B).

(2) Type B. Based on information in References 9 and 10, it was estimated that removal or by-passing of the turbines and the relief outlet would increase the discharge capacity to about $165 \text{ m}^3/\text{s}$ at full pool. Discharges above $100 \text{ m}^3/\text{s}$ could be sustained for about 2 days.

(3) Type C. Under full pool conditions, it was estimated that sudden release of water over the spillway by demolition or rapid operation of the 13 spillway gates, combined with discharge through the Type B modified outlets, would result in an initial peak flow of approximately $445 \text{ m}^3/\text{s}$. However, the rate of flow would reduce rapidly to about $160 \text{ m}^3/\text{s}$ in 8 hours, as the reservoir level dropped to the spillway crest elevation.

e. Soese Dam Outlet Discharges.

(1) Type A. The discharge capacity of the existing outlets is stated in Exhibit B to be $36 \text{ m}^3/\text{s}$ under maximum pool conditions, and $31 \text{ m}^3/\text{s}$ when the reservoir is one-half full.

(2) Type B. Based on information in References 9 and 10, it is estimated that removal or by-passing of the existing turbines and water supply discharge pipe would increase the initial rate of discharge to about $55 \text{ m}^3/\text{s}$, which would drop to about $25 \text{ m}^3/\text{s}$ in 5 days as the reservoir level was lowered to the elevation of the main intakes.

CONFIDENTIAL
SECURITY INFORMATION

4-04

(3) Type C. Discharge capacity of the Soese Dam outlets could be greatly increased by removal of the 6 m long concrete plug located approximately midway in the 3 m diameter outlet tunnel beneath the axis of the dam. Downstream from this restriction, water for water supply and power is carried through a 1.25 m diameter pipe built inside the 120 m long portion of the large tunnel. This pipe line, together with the turbine and pump machinery, would have to be removed in order to effect maximum increase of discharge capacity. Available data contained in References 9, 10, and 11 is not adequate to permit firm evaluation of the possibilities of such modification. Making these outlet modifications would permit increase of initial discharge under full pool conditions to about 280 m³/s, but the flow would diminish to about 150 m³/s in 30 hours when the reservoir level drops to the elevation of the intakes.

f. Ecker Dam Outlet Discharges.

(1) Type A. Information is lacking regarding the normal discharge capacity of the Ecker Dam outlets and turbines.

(2) Type B. Based upon information in Reference 12, it was estimated that by opening or by-passing the discharge pipe lines at the downstream exit of the dam, the discharge capacity would be increased to an estimated 30 m³/s under initial full pool conditions and would be sustained above 20 m³/s for about 5 days.

(3) Type C. Dismantling of the outlet pipes and removal of the regulating discharge valve installations would permit a discharge rate estimated to be 165 m³/s under initial full pool conditions and dropping to about 90 m³/s within 24 hours. Subsequent to this time, the pool level would have receded below the elevation of the main intakes and the discharge would recede from about 25 m³/s to zero discharge in about 2 days.

g. Oker Dam Outlet Discharges.

No information is available concerning the probable discharge capacity of the incompleted Oker Dam.

h. Effects of Detrimental Flow Variations.

(1) General. The effects of the detrimental flow variations produced by release of discharge from the outlets of the Odor, Soese, and Ecker Dams is summarized in Tables 9 and 10. Reference is made to Plates 21 and 22 which present discharge hydrographs at key locations. For identification purposes, the resulting flow variations are designated herein as follows:

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

4-04h(1)

| <u>Artificial Flood No.</u> | <u>Location of Initial Discharge</u> |
|---|--------------------------------------|
| <u>Type A - Existing outlets</u> | |
| 6 | Oder Dam |
| 7 | Soese Dam |
| <u>Type B - Minor modification of outlets</u> | |
| 8 | Oder Dam |
| 9 | Soese Dam |
| 10 | Ecker Dam |
| <u>Type C - Major modification of outlets</u> | |
| 11 | Oder Dam |
| 12 | Soese Dam |
| 13 | Ecker Dam |
| 14 | Oder / Soese Dams |
| 15 | Oder / Soese / Ecker Dams |

(2) Effects of Discharge from existing outlets (Type A).

(a) General. Release of discharge through the existing outlets (designated as Type A discharges in paragraph 4-04c) could produce moderate flow variation of 8-10 days duration if outlets are allowed to remain open. Pertinent data relative to the effects are contained in Tables 9 and 10.

(b) Artificial Flood No. 6 is designated as the flow variation on the Oder, Rhume, Leine and Aller Rivers below Oder Dam resulting from sustained discharge under initial full pool conditions from the existing outlets of that reservoir. As described in paragraph 4-04d(1) and on page 1 of the Leine River table included in Exhibit B, approximately 50 m³/s can be released for a period of 8-10 days by opening the bottom sluices and operating the turbines. The resulting discharge at Westen (km 22) would be 139 m³/s, an increase of 36 m³/s over the MW base flow at that location as summarized in Table 9.

(c) Artificial Flood No. 7 corresponds to the flow variation below Soese Dam resulting from sustained discharge from the existing outlets of that dam. As discussed in paragraph 4-04e(1) and in the table included in Exhibit B, approximately 36 m³/s can be released under maximum pool conditions. The duration of discharge would be 8-10 days. As shown in Table 9, the resulting discharge at Westen would be 128 m³/s, an increase of 25 m³/s above the base flow at MW at that location.

(d) Comparison of Effects of Discharge from Existing Outlets (Type A). Only slight reduction in the amplitude, accompanied by slight increase in the duration of the flow variation, would be evidenced during its progress downstream as may be observed in Table 9. The resulting inundation along the stream would be negligible as indicated in Table 10. A summary of effects at selected locations, extracted from Table 9, is shown for comparison.

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

4-04h(2)(d)

| <u>Location</u> | <u>River km</u> | <u>Artificial Flood No.</u> | |
|---|-----------------|-----------------------------|----------|
| | | <u>6</u> | <u>7</u> |
| <u>Height of crest above mean water profile (m)</u> | | | |
| Elvershausen | 275 | 0.6 | 0.5 |
| Herrnhausen | 152 | 1.1 | 0.9 |
| Westen | 22 | 0.4 | 0.3 |
| <u>Surface velocities (km/hr)</u> | | | |
| Elvershausen | 275 | 6 | 6 |
| Herrnhausen | 152 | 3 | 3 |
| Westen | 22 | 3 | 3 |
| <u>Time of start of rise after initial discharge (hrs.)</u> | | | |
| Elvershausen | 275 | 12 | 10 |
| Herrnhausen | 152 | 41 | 38 |
| Westen | 22 | 69 | 66 |
| <u>Time of peak after initial discharge (hrs.)</u> | | | |
| Elvershausen | 275 | 40 | 45 |
| Herrnhausen | 152 | 84 | 90 |
| Westen | 22 | 129 | 135 |
| <u>Duration of stages above MF (hrs.)</u> | | | |
| Elvershausen | 275 | 210 | 210 |
| Herrnhausen | 152 | 270 | 270 |
| Westen | 22 | 340 | 340 |

(3) Effects of Minor Modifications of Outlets (Type B).

(a) General. Release of discharge through the outlets, with minor (Type B) modifications described in paragraphs 4-04c to 4-04f, would produce flow variations with peaks ranging from about 0.3 to 2.5 meters above mean water. Pertinent data are summarized in Tables 9 and 10.

(b) Artificial Flood No. 8 is the flow variation on the Oder, Rhume, Leine and Aller Rivers resulting from sustained discharge under initial pool conditions from the outlets of Oder Dam, modified as described in paragraph 4-04d(2). The peak discharge of 165 m³/s at Oder Dam would result in an increase of 120 m³/s over the base flow at Westen (See Table 9).

(c) Artificial Flood No. 9 is the flow variation downstream from Soese Dam created by sustained discharge under initial full pool conditions from the modified outlets of that dam, as described in paragraph 4-04e(2). The peak discharge at the dam of 55 m³/s would not be appreciably reduced during its progress downstream. An increase of 40 m³/s over the base flow at Westen would result as shown in Table 9.

*/full

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

4-04h(3)

(d) Artificial Flood No. 10 is the flow variation below Ecker Dam resulting from sustained discharge under initial pool conditions from the Ecker Dam outlets, modified as described in paragraph 4-04f(2). As may be observed in Table 9, the peak discharge of 30 m³/s at the dam would result in an increase of 20 m³/s over the base flow at Westen.

(e) Comparison of effects of minor modifications of Outlets (Type B). The effects of flow variation resulting from sustained discharge from the outlets (with minor Type B modifications) are summarized in Tables 9 and 10. The flooding would be confined generally within the stream banks, except for Artificial Flood No. 8, which would cause overbank flooding ranging in width from 0.2 to 1.7 km at various locations as shown in Table 10. Extracts of effects from Table 9 are shown below for comparison:

| <u>Location</u> | <u>River km</u> | <u>Artificial Flood No.</u> | | |
|---|-----------------|-----------------------------|----------|-----------|
| | | <u>8</u> | <u>9</u> | <u>10</u> |
| <u>Height of crest above mean water profile (m)</u> | | | | |
| Elvershausen | 275 | 2.2 | 0.8 | - |
| Herrenhausen | 152 | 2.7 | 1.3 | - |
| Celle | 115 | - | - | 0.6 |
| Westen | 22 | 1.3 | 0.5 | 0.3 |
| <u>Surface Velocity (km/hr.)</u> | | | | |
| Elvershausen | 275 | 8 | 6 | - |
| Herrenhausen | 152 | 4 | 4 | - |
| Celle | 115 | - | - | 3 |
| Westen | 22 | 5 | 4 | 4 |
| <u>Time of start of rise after initial discharge (hrs.)</u> | | | | |
| Elvershausen | 275 | 8 | 6 | - |
| Herronhausen | 152 | 25 | 23 | - |
| Celle | 115 | - | - | 26 |
| Westen | 22 | 55 | 46 | 55 |
| <u>Time of peak after initial discharge (hrs.)</u> | | | | |
| Elvershausen | 275 | 30 | 48 | - |
| Herronhausen | 152 | 69 | 95 | - |
| Celle | 115 | - | - | 71 |
| Westen | 22 | 121 | 138 | 106 |
| <u>Duration of stage above MW (hrs.)</u> | | | | |
| Elvershausen | 275 | 76 | 190 | - |
| Herronhausen | 152 | 100 | 250 | - |
| Celle | 115 | - | - | 145 |
| Westen | 22 | 112 | 330 | 160 |

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

4-04h

(4) Effects of Major Modifications of Outlets (Type C).

(a) General. The effects of flow variations resulting from sustained discharge from the outlets of Oder, Soese and Ecker Dams, as a result of Type C major modifications described in paragraphs 4-04c-f are summarized in Tables 9 and 10. Plates 21 and 22 show discharge hydrographs at key locations. Attention is directed to the influence of the comparatively large base flows upon the resulting discharge hydrographs.

(b) Artificial Flood No. 11 is the flow variation resulting from sustained discharge from the Oder Dam outlets modified as described in paragraph 4-04d(3). The sharp peak release of $445 \text{ m}^3/\text{s}$ would be reduced to $218 \text{ m}^3/\text{s}$ at Westen, an increase of about $115 \text{ m}^3/\text{s}$ over the base flow at that location. Plate 21 shows the discharge hydrographs.

(c) Artificial Flood No. 12 is the flow variation resulting from operation of the modified Soese Dam outlets as described in paragraph 4-04e(3). The peak discharge at the dam of $282 \text{ m}^3/\text{s}$ would result in an increase of $160 \text{ m}^3/\text{s}$ over the base flow at Westen, effecting a peak flow of $263 \text{ m}^3/\text{s}$ at that location as shown on Plate 21.

(d) Artificial Flood No. 13 is the result of discharge from the Ecker Dam outlets with Type C modifications as described in paragraph 4-04f(3). The peak flow at Westen of $193 \text{ m}^3/\text{s}$ represents an increase of approximately $90 \text{ m}^3/\text{s}$ above the base flow at that location, and is the result of the initial $165 \text{ m}^3/\text{s}$ peak discharge from the dam outlets. Hydrographs at other key locations are shown on Plate 22.

(e) Artificial Flood No. 14 results from the combined discharge of the Type C modified outlets of Oder and Soese Dams, timing initial operation of the outlets so that the peak flows would arrive simultaneously at Elvershausen to produce maximum peak flows in the stream below that point. This combination could be effected by delaying the initial operation at the Oder Dam 5 hours later than initial discharge at the Soese Dam. The peak discharge of $445 \text{ m}^3/\text{s}$ from the Oder outlets so combined with the peak discharge of $282 \text{ m}^3/\text{s}$ from Soese Dam would produce a peak flow of $418 \text{ m}^3/\text{s}$ at the point of junction of flow and would result in a peak of $318 \text{ m}^3/\text{s}$ at Westen, an increase of $215 \text{ m}^3/\text{s}$ over the base flow at that location. See Plate 21 for discharge hydrographs at key locations, Plates 4, 5 and 7 for water surface profile, Plate 13 for discharge profile, and Tables 9 and 10 for summary of effects.

(f) Artificial Flood No. 15 is the flow variation in the Aller River below the confluence of the Leine River resulting from the combined discharge of the type C modified outlets of the Oder, Soese and Ecker Dams. In order to produce maximum peak flow, the initial operation of the outlets at Oder and Ecker Dams were lagged

CONFIDENTIAL
SECURITY INFORMATION

5 and 27 hours, respectively, after the initial operation at Soese Dam. The resulting peak discharge at Westen would be approximately 365 m³/s, an increase of 262 m³/s over the base flow at that location as shown in Table 9. Discharge hydrographs at Ahlden and Westen are shown on Plate 21.

(g) Comparison of Effects of Major Modifications of Outlets (Type C). The effects of flow variations induced by Type C major modifications of the outlet structures are summarized in Tables 9 and 10, extracts from which are shown below for purposes of comparison:

| <u>Location</u> | <u>River km</u> | <u>Artificial Flood No.</u> | | | | |
|---|-----------------|-----------------------------|-----------|-----------|-----------|-----------|
| | | <u>11</u> | <u>12</u> | <u>13</u> | <u>14</u> | <u>15</u> |
| <u>Height of crest above mean water profile (m)</u> | | | | | | |
| Elvershausen | 275 | 2.3 | 2.6 | - | 3.2 | - |
| Herrnhäusen | 152 | 2.7 | 3.4 | - | 4.3 | - |
| Celle | 115 | - | - | 1.9 | - | - |
| Westen | 22 | 1.2 | 1.5 | 1.0 | 1.9 | 2.2 |
| <u>Surface Velocity (km/hr.)</u> | | | | | | |
| Elvershausen | 275 | 8 | 8 | - | 9 | - |
| Herrnhäusen | 152 | 4 | 4 | - | 4 | - |
| Celle | 115 | - | - | 4 | - | - |
| Westen | 22 | 5 | 5 | 4 | 5 | 6 |
| <u>Time of start of rise after initial discharge (hrs.)</u> | | | | | | |
| Elvershausen | 275 | 4 | 4 | - | 4 | - |
| Herrnhäusen | 152 | 27 | 26 | - | 25 | - |
| Celle | 115 | - | - | 20 | - | - |
| Westen | 22 | 57 | 61 | 48 | 59 | 64 |
| <u>Time of peak after initial discharge (hrs.)</u> | | | | | | |
| Elvershausen | 275 | 16 | 21 | - | 20 | - |
| Herrnhäusen | 152 | 69 | 59 | - | 60 | - |
| Celle | 115 | - | - | 50 | - | - |
| Westen | 22 | 115 | 103 | 76 | 104 | 104 |
| <u>Duration of stages above MHW (hrs.)</u> | | | | | | |
| Elvershausen | 275 | 52 | 32 | - | 58 | - |
| Herrnhäusen | 152 | 18 | 30 | - | 51 | - |
| Celle | 115 | - | - | 0 | - | - |
| Westen | 22 | 0 | 0 | 0 | 0 | 32 |
| <u>Duration of stages above MW (hrs.)</u> | | | | | | |
| Elvershausen | 275 | 76 | 52 | - | 84 | - |
| Herrnhäusen | 152 | 97 | 73 | - | 105 | - |
| Celle | 115 | - | - | 60 | - | - |
| Westen | 22 | 105 | 80 | 78 | 118 | 130 |
| <u>Width of Flooding at Peak of Rise (km)</u> | | | | | | |
| Elvershausen | 275 | 0.8 | 0.8 | - | 0.8 | - |
| Borndau (Leine R.) | 121 | 0.3 | 0.3 | - | 0.6 | - |
| Celle | 115 | - | - | 0.3 | - | - |
| Westen | 22 | 0.7 | 0.5 | 0.5 | 1.4 | 2.0 |

CONFIDENTIAL
SECURITY INFORMATION

4-04h

(5) Effects of Discharge from Oker Dam and Harzteiche.

(a) Detrimental flow variations might be produced by discharges from the Oker Dam, now under construction. No data are presently available to permit evaluation of the magnitude and duration of such discharges; however, it can be estimated that the resulting peak flows would be of similar magnitude to those from the other existing Harz Dams and that the duration of flow would be somewhat longer due to the larger storage capacity (45 million m³) proposed for that new reservoir.

(b) The scattered location and small individual capacity of the 69 "Harzteiche," the Harz Mountain Ponds described in paragraph 2-10c, together with the long, small channels leading to the main streams, minimize the potential effect of discharges from those ponds to produce detrimental stream variations in the main streams of the basin.

(6) Effects of Discharge from the navigation dams.

Opening of the outlets of the navigation and mill dams on the Aller and Leine Rivers would result in an undetermined amount of flow variation. The small storage capacity and the low head between the upper and lower pool elevations limit the magnitude and duration of discharge.

Reference is made to Exhibit B for discussion and tabulation of the potential effects.

4-05 ARTIFICIAL FLOODING POTENTIALITIES OF CANALS.

a. Reference is made to paragraph 2-12 and to the document listed as Reference 3 in the Bibliography for detailed description of the canals.

b. Demolition of the Mittelland Canal (Ems-Weser and Weser-Elbe Canals) at the Leine River Aqueduct and at the Oker River and Aller River siphons would empty the water stored in the canals, (approximately 19 million m³) into those streams, provided that the canal safety gates were raised (See Plate 10). The rates of flow would be too slow to create effective artificial flooding; however, the volume of released water could be utilized to supplement other sources of supply for still-water barriers described in paragraph 4-02. A total of approximately 13 million m³ could be discharged at those three locations in 48 hours. The estimated rates of discharge are indicated in the following tabulation:

| <u>Hours After Breaching</u> | <u>Rate of Discharge (m³/s)</u> | | |
|------------------------------|--|----------------|-----------------|
| | <u>Leine R.</u> | <u>Oker R.</u> | <u>Aller R.</u> |
| 1 | 85 | 100 | 95 |
| 3 | 55 | 65 | 65 |
| 6 | 40 | 50 | 50 |
| 12 | 30 | 30 | 30 |
| 24 | 15 | 15 | 15 |
| 48 | 5 | 5 | 5 |

CONFIDENTIAL
SECURITY INFORMATION
- 33 -

CONFIDENTIAL
SECURITY INFORMATION

4-06 SUMMARY.

The artificial flooding potentialities of the Aller and Leine River basin described in preceding paragraphs 4-01 to 4-05 are herein summarized.

a. Temporary damming operations at suitable existing damsites and bridge openings would create flooding extending 1 to 11 km upstream from those locations with average widths of overbank flooding ranging from 0.1 to 2.5 km and depths of 0.03 to 2 m. The extent and locations of flooded areas are shown on Plate 16 and results summarized in Tables 6 and 7. Associated breaching of levees would be necessary in most cases. Except during high water periods, overbank inundation would not present a continuous water obstacle. Temporary dams with heights less than approximately 3 m above mean water would not effect appreciable overbank flooding. Reference is made to paragraph 4-02 for detailed discussion.

b. Breaching of the Oder, Soese, and Ecker Dams (plus the Oker Dam when completed) would create major artificial flood waves with amplitudes of approximately 4-6 m in the upper reaches and 2-5 m in the lower reaches of the Aller and Leine Rivers downstream of those structures as discussed in paragraph 4-03. Locations appear on Plate 1 and sketches of the dams on Plate 9. The start of the waves produced by breaching of the Oder or Soese Dam would arrive at Westen (km 22 above the mouth of the Aller River) in about 75 hours and the peak in about 95 hours. Waves caused by breaching of the Ecker Dam would take approximately 15 hours less time to travel to Westen. Surface velocities at the peak of the wave would range from approximately 9 km/hr in the upper reaches to about 5 km/hr in the lower reaches of the Aller and Leine Rivers. The average rate of rise of stage would be about 0.6 m/hr near the dams and 0.2 m/hr in the lower reaches of those rivers. Stages would remain above normal for 15 to 20 hours immediately below the breached dams and for 45-60 hours farther downstream. Effects are summarized in Tables 8 and 10, discharge hydrographs are shown on Plates 19 and 20; and stage, discharge, and velocity profiles are shown for a representative flood wave on Plates 4, 5, 7 and 13. The effects can be intensified by synchronized breaching of the dams to produce either increased height, longer duration or repetition of flood waves.

c. Detrimental flow variations ranging in amplitude from 0.3 to 3 m might be produced along the Aller and Leine Rivers by manipulation of the controlled outlets of the Oder, Soese, and Ecker Dams (and of the Oker Dam upon its completion). Locations of the dams are shown on Plate 1. As discussed in paragraph 4-04, modification of the outlets to increase their discharge capacity would be necessary in order to produce the higher flow variations summarized in Tables 9 and 10. River stages could be maintained higher than normal for 40 to 200 hours immediately downstream from the dam and for 80 to 350 hours in the lower reaches of the Aller and Leine Rivers, by means of sustained discharge

CONFIDENTIAL
SECURITY INFORMATION

4-06

from the dam outlets. Average surface velocities of as high as 8 km/hr could be produced in the upper reaches during the passage of the peak of the rises. In the lower reaches, the average surface velocity would not exceed 4 km/hr. The relation of the peak discharges and surface velocities of a representative flow variation to natural conditions can be observed on Plate 13. The relative peak stages are plotted on the profiles of Plates 4, 5 and 7. The resulting overbank flooding, tabulated in Table 10, would be mostly confined to the areas included within the loops of the old river meanders and would be of short duration. In most cases, levees would also have to be breached in order to cause significant inundation along the streams.

d. The approximately 100 million m³ maximum storage capacity of the existing reservoirs, ponds and canals could be utilized as a source of supply for the still-water barriers shown on Plate 16. A combined rate of discharge as high as approximately 100 m³/s could be sustained for about 10 days under initial/pool conditions. It would take about 2 days for the initial flow to travel downstream to the lower reaches and about 3 additional days before the flow would rise to near the sustained maximum rate. Reference is made to paragraph 4-02g for detailed discussion.

e. Completion of the Oker Dam would add 45 million m³ of storage capacity, and would permit increase of flood wave heights of 1 to 2 m by synchronized breaching in combination with the other dams. Breaching or discharge operations at the 69 smaller ponds (Harzteiche) would exert insignificant effects upon stage and velocity in the main streams of the basin (See paragraph 4-04h(5)).

f. The elevation of a reservoir pool at the time of breaching or regulated discharge operations would have direct influence upon the rate of discharge. For example, the discharge rate of 8500 m³/s resulting from breaching of the Oder Dam at full reservoir (elevation 381.10 m/ANN) would be reduced to 4200 m³/s at elevation 377.3 m/ANN, the lower limit of flood control storage (shown on Plate 17); and the effect downstream would be reduced accordingly.

g. Breaching or sudden release of discharge from the navigation locks and dams on the Aller and Leine Rivers would cause rises in downstream stages of 1-3 meters and corresponding reduction in upstream water surface. Locations of dams are shown on Plates 1 to 7 and descriptions are contained in Exhibit B. Synchronized demolition or operation would make possible either cyclic variation, increased duration or increased height of resulting stream stages. The duration of waves or flow variations would not exceed about 12 hours, due to the low height and small storage capacity of the navigation dams. Inundation of lowlands, unprotected by levees, would result but extent and duration of flooding would be slight. See Exhibit B for detailed discussion.

*/full

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

4-06

h. The amount of flooding to be expected as a result of breaching or regulated discharge from the large Harz Mountain Dams largely depends upon the base flow, i.e., the flow of water existing in the streams prior to passage of the flood wave. See Tables 3 to 5 for tabulation of natural statistical stages and discharges, and Plate 12 for expected frequency of occurrence of natural flows. The studies presented in this report were based upon an assumed base flow corresponding to mean water conditions. The stage to be expected at a key station during an artificial flood for any other condition of base flow may be determined by reference to Plates 14 and 15 and Tables 8 and 9. Add the difference in base flows between that indicated in Table 8 or 9 and the flow for the given initial stage (See Plates 14 or 15) to the peak discharge shown in those tables. Having thus determined the new peak discharge, determine the corresponding stage from the rating curve on Plate 14 or 15 for the station under consideration.

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

SECTION V
EFFECT ON MILITARY OPERATIONS

5-01 GENERAL.

The purpose of this section is to assist military planning personnel in estimating the relative value and effect of artificial floods on associated military factors such as bridging, ferrying, and trafficability. The effects of artificial floods on military operations may vary greatly, depending on hydrologic conditions, type of equipment involved, and the tactical and logistical situation. The effects presented in this section are opinions based largely upon discussions of the military effects of artificial flooding on the Aller and Leine Rivers given in Exhibit B, a military geography document published by the German General Staff. See paragraph 4-06 for summarized discussion of hydraulic effects of artificial flooding.

5-02 EFFECT OF STILL-WATER BARRIERS AND DRAINAGE OBSTACLES.

a. Reference is made to paragraph 4-02 for discussion of the hydraulic features associated with formation and augmentation of water obstacles by means of temporary damming operations or by disruption of normal drainage.

b. Bridging and ferrying operations within the backwater reaches upstream from the temporary dams would be hindered by reason of the resulting greater width and depth of crossing, indicated in Tables 8 and 9 and on Plate 16. Approach trafficability would be decreased by the shallow overbank flooding, and the increased stream depths would hinder fording of the upper reaches of the river. Since the resulting increased water obstacle would not be continuous along the streams (as illustrated on Plate 16), still-water barriers must be combined with other natural obstacles and with tactical operations in order to channelize military action.

c. Continuous military support of the temporary dam installations would be necessary to prevent their destruction by enemy air or ground action. Destruction of a temporary dam would release a flood wave of short duration that would hinder crossing operations below the structure and which might cause progressive failure of other downstream structures.

d. Maneuverability and trafficability in the area up to 2 km from the Aller and Leine riverbank would be hindered by blocking of the numerous drain ditches and culverts which drain the low-lying pasture land adjacent to the rivers.

CONFIDENTIAL
SECURITY INFORMATION

5-03 EFFECT OF MAJOR FLOOD WAVES.

a. Reference is made to paragraph 4-03 for discussion of the hydraulic features associated with creation of major flood waves by means of breaching of the storage dams and navigation dams located on the Aller and Leine Rivers and their tributaries.

b. Breaching of the Oder, Soese, or Ecker Dams would create artificial flood waves that would destroy or endanger bridges and dams along the streams for an undetermined distance below the breached dam. Insufficient data are available regarding the structural features of existing bridges and dams to permit estimate of the degree of destruction.

c. Breaching of one or more of the large Harz dams or destruction of the navigation dams would produce temporary flood conditions which could interfere with stream crossing operations and endanger equipment and floating bridges along the Aller and Leine Rivers. See Tables 8 and 10 for summary of resulting flood conditions. Except in the immediate vicinity of the breached dam, the time required for travel of the flood wave (as shown in Table 8) would probably be sufficiently long to permit safeguarding measures to be undertaken.

d. Destruction of the large Harz dams would seriously disrupt the municipal water supply and electrical power supply of Bremen, Hildesheim and other important industrial and urban areas.

e. Destruction of the navigation dams on the Aller and Leine Rivers would disrupt waterborne traffic to Hannover and other industrial centers, and would disrupt power supply for a number of mills and factories, as described in Exhibit B.

5-04 EFFECT OF FLOW VARIATIONS.

a. Reference is made to paragraph 4-04 for discussion of the possible detrimental flow variations that could be created on the Aller and Leine Rivers by means of regulated discharge from the Harz dams and the navigation dams. The resulting flow conditions are summarized in Tables 9 and 10.

b. Combined or cyclic release of water from the outlets of the Oder, Soese, or Ecker Dams, especially if the outlets are modified to increase the discharge capacity, would produce appreciable flow variations along the Aller and Leine Rivers that would endanger existing structures and floating bridging for considerable distances downstream. The large storage capacities of the reservoirs permit extended durations or multiple repetitions of flow variations. The several days travel time required for a release from the dams to be fully effective on the Leine River below Hannover or below Celle on the Aller River (as shown in Table 9) would permit protective measures to be undertaken.

CONFIDENTIAL
SECURITY INFORMATION

c. Deliberate demolition of the Harz dams and the navigation locks and dams would prevent their use by the enemy in producing detrimental flow variation during a later critical period.

5-05 EFFECTS RELATED TO OTHER BASINS.

Artificial flooding along the Aller or Leine Rivers could be coordinated with similar operations on other river basins to create simultaneous or progressive water obstacles affecting military action. Reference is made to reports on studies of artificial flooding possibilities on the Rhine, Danube, Weser, and Ems Rivers listed as References 20 to 24, inclusive, in the Bibliography of this report.

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

BIBLIOGRAPHY (Continued)

- | <u>Reference
Number</u> | <u>Document</u> |
|-----------------------------|--|
| 10. | "Talsperren im Harz" (Valley Dams in Harz), F. Kennerknecht, Wasserkraft und Wasserwirtschaft v. 25, n. 22, 23 and 24, (Nov.-Dec. 1930) |
| 11. | "Neuere Talsperrenbauten in Deutschland und im Ausland" (New Valley Dam Construction in Germany and in Foreign Countries). H. Link. Zeitschrift des Vereines deutscher Ingenieure, v. 80 n. 34, 22 August 1936. |
| 12. | "Fernwasserversorgung aus der Eckertalsperre" (Overland Water supply from the Ecker Valley Dam) Zeitschrift des Vereines deutscher Ingenieure, v. 90 n. 2 (Feb. 1948). |
| 13. | "Zusammenstellung der Uebergänge im Stromgebiet der Weser und Ems" (Compilation of the crossings in the areas of the Weser and Ems Rivers), <u>Mili-</u> <u>tary Geography ("Mil-Geo") Training Manual</u> , H. Dv. g. 33, General Staff of German Army, Section 9, Hamburg 1939. |
| 14. | "Germany, Vol. 1, Physical Geography," B. R. 529, Geographic Handbook Series, Naval Intelligence Division, British Admiralty, January 1944. |
| 15. | "Report on Weser System," Vol. V & VI (Maps and Plans), Hq. Chief of Engineers, British Army of the Rhine, First Edition, June 1946. |
| 16. | "Forecast of Possible Inundations," overprint of Hannover Sheet L-53, GSGS 4346 map series, 1:250,000. Engineer Section G-2 Division, SHAEF |
| 17. | "Report on Weser System" Vol. II (Tributaries-The R. Aller System), Hq. Chief of Engineers, British Army of the Rhine, First Edition, 1945-46. |
| 18. | "A Progress Report on the Disposition of Sediment in Reservoirs," by A. W. Van't Hul, U. S. Dept. of Interior, Bureau of Reclamation, January 1950. |

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

BIBLIOGRAPHY

- | <u>Reference
Number</u> | <u>Document</u> |
|-----------------------------|--|
| 1. | "Report on River Aller," First Edition, Parts I & II. G.S.I. (R.E.), Main Hq, 21 Army Group, March 1945. |
| 2. | "Report on River Leine," First Edition, Parts I & II. G.S.I. (R.E.), Main Hq, 21 Army Group, March 1945. |
| 3. | "Strategic Engineering Study, S.E.S. 128, Navigable Waterways of Germany, Vol. I (General Introduction) and Vols. 4 and 5 (Ems-Weser Region and Canals)." Engineer Research Office, North Atlantic Division, Corps of Engineers, August 1944. |
| 4. | "Stromgebiet der Weser und Ems, Einwirkung auf der Wasserfuehrung" (River Basins of the Weser and Ems, Influence of Flow), Military Geography ("Mil-Geo") Training Manual H. Dv. 6. 33a. General Staff of German Army, Section 9, Berlin, December 1937. |
| 5. | "Weser und Ems, Ihre Stromgebiete und ihre Wichtigsten Nebenfluesse, Band IV, Die Aller und die Ems" (Weser and Ems, Drainage Basins and Main Tributaries, Vol. IV, The Aller and the Ems). H. Keller, Berlin 1901. |
| 6. | "Jahrbuch fuer die Gewaesserkunde des Deutschen Reichs," (Yearbook of Hydrology of Germany). Berlin 1937-38. |
| 7. | "Jahrbuch fuer die Gewaesserkunde Norddeutschlands," (Yearbook of Hydrology of North Germany (Prussia). Berlin 1926-36. |
| 8. | "Teiche und Talsperren-400 Jahre Harz-Wasserwirtschaft" (Ponds and Reservoirs-400 Years of Water Economics in Harz). H. Schwarte & H. Haase, Ed. Piepersche Buchdruckerei Clausthal-Zellerfeld, 1950. |
| 9. | "Die neuen Talsperrendaemme im Harz" (The New Valley Dams in Harz) Collario, Pauck and Schoendorf. Bautechnik, v. 14 n. 47, 48 and 49 (30 Oct., 13 Nov., and 8 Dec. 1936) v. 15 n. 9, 12, 15 and 32 (26 Feb., 19 Mar., 2 Apr., and 23 July 1937.) |

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

BIBLIOGRAPHY (Continued)

- | <u>Reference
Number</u> | <u>Document</u> |
|-----------------------------|---|
| 19. | "Zerstörung und Schutz von Talsperren, und Dämmen (Destruction and Protection of Dams and Levees)" O. Kirschner. Schweizerische Bauzeitung, 14 May 1949 pp 277-81 and 300-03 (a translation has been prepared and distributed by Military Hydrology R. & D Branch, Washington District, Corps of Engineers, Washington, D. C.). |
| 20. | "Weser River System: Hydraulic Effects of Demolition of Eder Dam," Vols. I & II, Special Study S-51-4. Military Hydrology R & D Branch, Engineering Division, Washington District, Corps of Engineers, Washington, D. C., March 1952. |
| 21. | "Rhine River Hydrology Study" Design Section, Construction Division, O.C.E., Hq. Com. Zone, Nov. 1944. (Issued by Information Section, Intelligence Division, O.C.E., Hq. ETOUSA). |
| 22. | "Military Hydrology Report on the Rhine River," Hydrology and Hydraulics Branch, Engineering Division, Office of the Chief of Engineers, Washington, D. C., 20 July, 1951). |
| 23. | "Danube River Lock and Dam System at Passau, Germany; Hydraulic Effects of Regulation, Operation or Possible Demolition," Special Study S-51-5. Military Hydrology R & D Branch, Engineering Division, Washington District, Corps of Engineers, Washington, D. C., March 1952. |
| 24. | "Ems River, Artificial Flooding Potentialities," Special Study S-52-2. Military Hydrology R & D Branch, Engineering Division, Washington District, Corps of Engineers, Washington, D. C., August 1952. |

CONFIDENTIAL
SECURITY INFORMATION

TABLES

1. **Equivalent English-Metric Terms**
2. **Hydrologic Terms and Abbreviations**
3. **Summary of Gage Data, Aller and Oker Rivers**
4. **Summary of Gage Data, Leine and Rhume Rivers**
5. **Discharge Data, Aller River Basin**
6. **Inundation Effect of Stillwater Barriers, Aller River**
7. **Inundation Effect of Stillwater Barriers, Leine River**
8. **Effects of Artificial Flood Waves**
9. **Effects of Artificial Flow Variations**
10. **Estimated Widths of Flooding due to Artificial Floods**

CONFIDENTIAL
SECURITY INFORMATION

TABLE I
EQUIVALENT ENGLISH-METRIC TERMS

To reduce A to B, multiply A by F. To reduce B to A, multiply B by G.

| Unit A | Factor F | Factor G | Unit B |
|-----------------------|----------|------------|---------------------------|
| Miles | 1,60935 | .62137 | Kilometers |
| Meters | 3,2808 | .30480 | Feet |
| " | 39,370 | .025400 | Inches |
| Square Miles | 2,590 | .3861 | Square kilometers |
| " " | 259,000 | .0038610 | Hectares |
| Hectares | 2,47104 | .40469 | Acres |
| Acres | 404,69 | .00024710 | Square Meters |
| Cubic Meters | 35,3145 | .028317 | Cubic Feet |
| Cubic Feet | 28,317 | .035314 | Liters |
| Acre-feet | 43560. | .000022957 | Cubic Feet |
| " | 1233,5 | .00081071 | Cubic Meters |
| Cubic Feet per second | 1,9835 | .50417 | Acre-feet per 24 hours |
| " Meters per " | 35,3145 | .028317 | Cubic-feet per second |
| Miles per hour | 1,60935 | .62137 | Kilometers per hour |
| " " " | 1,4667 | .68182 | Feet per second |
| Meters per second | 3,2808 | .30480 | " " " |
| " " " | 2,2369 | .44704 | Miles per hour |
| Feet per second | 1,097 | .99113 | Kilometers per hour |
| Tons (metric) | 1,102 | .9072 | Tons (short) |
| " (long) | 1,016 | .9842 | " (metric) |
| " (metric) | 2205. | .0004536 | Pounds (avoirdupois) |
| " (metric) | 1000. | .001 | Kilograms |

TABIE 2
HYDROLOGIC TERMS AND ABBREVIATIONS
(In conformance with German practice)

| Non-Tidal Stage | High-Tide Stage | Low-Tide Stage | Rate of Discharge (m ³ /sec) | Discharge per Unit Area (l/see-km ²) | Definition |
|-----------------|-----------------|----------------|---|--|--|
| HHW | HHHTW | HHLTW | HHQ | HHq | Highest value ever known or observed |
| HW | HTW | HLTW | HQ | Hq | Highest value observed during a stated period of time |
| HW | MHTW | MHLTW | MHQ | MHq | The mean high value during a stated period, derived by averaging the highest values of each unit time element (1.0. MHW 1926/35 is average of the 10 yearly peak stages) |
| MW | MTW | MLTW | MQ | mq | The mean (arithmetical average) of all observations during a stated time period |
| MW | MHTW | MHLTW | MNQ | MNq | The mean low value during a stated period, derived by averaging the lowest values of each unit time element (MNW 1926/35 is the average of the 10 yearly lowest stages) |
| NW | NTW | NLTW | NQ | nq | Lowest value observed during a stated period of time |
| NW | MNTW | MNLTW | MNQ | MNq | Lowest value ever known or observed |

TABLE 3
SUMMARY OF GAGE DATA - ALLER AND OKER RIVERS

| Gage | OSGS Map Series <u>4416</u> <u>4414</u> | "Nord de Guerre" Grid | Km. above Mouth of Aller | Drainage Area Sq. Km. | Gage Zero m/MN | Item* | Date or Period of Record | River Stage in Centimeters above Gage Zero | | | | | | | | | | | | | | | | | |
|--|---|--------------------------------|--------------------------------------|-----------------------------|----------------------|-------|-----------------------------------|--|------|------|------|------|------|-----|------|------|------|-------|------|------|-----|--|--|-----|-----|
| | | | | | | | | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Year | | | | | |
| Brenneckenbruck (Aller R.) (7 km. upstream of Oker R. junction) | <u>M5</u> 3528 | X8535 | 158 | 1645 | 47.57 | HHW | Mar 1881 | | | | | | | | | | | | | | 269 | | | | |
| | | | | | | HW | 1926-35 | | | | | | | | | | | | | | | | | 250 | |
| | | | | | | MHW | " | 145 | 163 | 188 | 171 | 173 | 162 | 117 | 110 | 117 | 94 | 94 | 111 | | | | | | 222 |
| | | | | | | MW | " | 104 | 108 | 141 | 126 | 114 | 110 | 71 | 73 | 69 | 59 | 66 | 75 | | | | | | 93 |
| | | | | | | MNW | " | 73 | 73 | 96 | 81 | 69 | 65 | 43 | 49 | 28 | 34 | 46 | 50 | | | | | | 25 |
| | | | | | | NW | " | | | | | | | | | | | | | | | | | | 8 |
| Celle (Aller R.) (1 km. upstream of Fuhse R. junction) | <u>M4</u> 3326 | X5950 | 115 | 4494 | 31.82 | HHW | Feb 1946 | | | | | | | | | | | | | | 528 | | | | |
| | | | | | | HW | 1926-35 | | | | | | | | | | | | | | | | | 495 | |
| | | | | | | MHW | " | 264 | 270 | 322 | 286 | 277 | 273 | 222 | 202 | 199 | 182 | 179 | 206 | | | | | | 382 |
| | | | | | | MW | " | 196 | 199 | 245 | 228 | 210 | 213 | 167 | 153 | 153 | 145 | 143 | 157 | | | | | | 184 |
| | | | | | | MNW | " | 154 | 156 | 186 | 180 | 161 | 162 | 132 | 120 | 108 | 109 | 116 | 127 | | | | | | 101 |
| | | | | | | NW | " | | | | | | | | | | | | | | | | | | 80 |
| Ahlden (Aller R.) (6 km. downstream of Leine R. junction) | <u>M4</u> 3223 | X2464 | 59 | 14122 | 18.96 | HHW | Mar 1881 | | | | | | | | | | | | | | 468 | | | | |
| | | | | | | HW | 1926-35 | | | | | | | | | | | | | | | | | 434 | |
| | | | | | | MHW | " | 282 | 312 | 348 | 331 | 315 | 325 | 262 | 231 | 226 | 207 | 187 | 236 | | | | | | 384 |
| | | | | | | MW | " | 217 | 231 | 279 | 273 | 250 | 256 | 199 | 173 | 169 | 155 | 145 | 165 | | | | | | 209 |
| | | | | | | MNW | " | 169 | 166 | 212 | 211 | 198 | 191 | 157 | 133 | 114 | 116 | 119 | 122 | | | | | | 100 |
| | | | | | | NW | " | | | | | | | | | | | | | | | | | | 58 |
| Westen (Aller R.) | <u>M3</u> 3121 | X0573 | 22 | 15221 | 10.59 | HHW | Mar 1881 | | | | | | | | | | | | | | 553 | | | | |
| | | | | | | HW | 1926-35 | | | | | | | | | | | | | | | | | 522 | |
| | | | | | | MHW | " | 338 | 368 | 407 | 381 | 372 | 367 | 310 | 280 | 277 | 252 | 240 | 282 | | | | | | 454 |
| | | | | | | MW | " | 271 | 285 | 336 | 322 | 301 | 303 | 252 | 228 | 225 | 210 | 202 | 220 | | | | | | 263 |
| | | | | | | MNW | " | 224 | 226 | 267 | 267 | 253 | 243 | 216 | 194 | 179 | 179 | 179 | 183 | | | | | | 163 |
| | | | | | | NW | " | | | | | | | | | | | | | | | | | | 112 |
| Gross-Schnelper (Oker R.) | <u>M5</u> 3628 | X8321 | 181 | 1763 | 57.77 | HHW | Nov 1926 | | | | | | | | | | | | | | 341 | | | | |
| | | | | | | HW | 1926-35 | | | | | | | | | | | | | | | | | 341 | |
| | | | | | | MHW | " | 188 | 192 | 222 | 192 | 182 | 199 | 154 | 133 | 137 | 130 | 117 | 163 | | | | | | 279 |
| | | | | | | MW | " | 108 | 103 | 138 | 126 | 115 | 133 | 90 | 75 | 83 | 78 | 54 | 78 | | | | | | 99 |
| | | | | | | MNW | " | 61 | 54 | 74 | 72 | 69 | 78 | 51 | 39 | 33 | 36 | 36 | 37 | | | | | | 24 |
| | | | | | | NW | " | | | | | | | | | | | | | | | | | | 6 |
| Gross-Schnelper (Oker R.) | <u>M5</u> 3628 | X8321 | 181 | 1763 | 57.77 | NNW | July 1934 | | | | | | | | | | | | | 6 | | | | | |
| | | | | | | NNW | July 1934 | | | | | | | | | | | | | | | | | 6 | |

*See Table 2 for definition of symbols

TABLE 4
SUMMARY OF GAGE DATA - LEINE AND RHUME RIVERS

| Gage | GSOS Map Series | "Nord de Guerre" Grid | Km. above Mouth of Aller | Drainage Area Sq. Km. | Gage Zero m/NN | Date or Period of Record | River Stage in Centimeters above Gage Zero | | | | | | | | | | | | Year | | | | |
|--|-----------------------------------|--------------------------------|--------------------------------------|-----------------------------|----------------------|-----------------------------------|--|------|------|------|------|------|------|-----|------|------|------|-------|------|------|------------------|--|-----|
| | | | | | | | Item* | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | | Oct. | | | |
| Northeim (Leineturn) (Leine R.) (4 km. upstream of Rhume R. junction) | <u>Q4</u> 4416 4414 4226 | C5447 | 269 | 984 | 113.69 | HHW | Feb 1909 | | | | | | | | | | | | | | 286 | | |
| | HW | | | | | 1926-35 | | | | | | | | | | | | | | | | | 265 |
| | MHW | | | | | " | 92 | 77 | 124 | 86 | 64 | 78 | 47 | 28 | 58 | 28 | 18 | 43 | 184 | | | | |
| | MW | | | | | " | 27 | 28 | 50 | 45 | 33 | 38 | 21 | 13 | 16 | 12 | 9 | 13 | 25 | | | | |
| | MNW | | | | | " | 10 | 10 | 22 | 23 | 18 | 15 | 11 | 5 | 2 | 2 | 3 | 3 | -2 | | | | |
| | NW | | | | | " | | | | | | | | | | | | | -20 | | | | |
| | | | | | | NNW | Jul 1883 | | | | | | | | | | | | | -30 | | | |
| Greene (Leine R.) | <u>P4</u> 4125 | C5264 | 241 | 2898 | 94.92 | HHW | Feb 1946 | | | | | | | | | | | | | | 721 | | |
| | HW | | | | | 1926-35 | | | | | | | | | | | | | | | | | 679 |
| | EHW | | | | | 1926-35 | 401 | 387 | 452 | 398 | 374 | 370 | 305 | 275 | 321 | 300 | 242 | 353 | 563 | | | | |
| | MW | | | | | " | 295 | 299 | 325 | 306 | 304 | 288 | 259 | 241 | 252 | 246 | 231 | 254 | 275 | | | | |
| | MNW | | | | | " | 258 | 246 | 268 | 257 | 265 | 248 | 238 | 223 | 224 | 226 | 215 | 226 | 212 | | | | |
| | NW | | | | | " | | | | | | | | | | | | | 180 | | | | |
| | | | | | | NNW | Sep 1911 | | | | | | | | | | | | | 172 | | | |
| Herrenhausen (Leine R.) | <u>N4</u> 3624 | X3322 | 152 | 5355 | 44.15 | HHW | Feb 1946 | | | | | | | | | | | | | | 670 | | |
| | HW | | | | | 1931-35 | | | | | | | | | | | | | | | | | 536 |
| | MHW | | | | | " | 264 | 206 | 340 | 325 | 275 | 311 | 217 | 212 | 209 | 147 | 178 | 236 | 422 | | | | |
| | MW | | | | | " | 159 | 130 | 205 | 205 | 169 | 191 | 140 | 114 | 114 | 94 | 95 | 104 | 143 | | | | |
| | MNW | | | | | " | 66 | 83 | 88 | 109 | 92 | 86 | 65 | 73 | 52 | 56 | 59 | 53 | 37 | | | | |
| | NW | | | | | " | | | | | | | | | | | | | | | | | |
| | | | | | | NNW | Jun 1929 | | | | | | | | | | | | | 15 | | | |
| Basse (Leine R.) | <u>N4</u> 3423 | X2041 | 98 | 6155 | 28.51 | HHW | May 1881 ¹ | | | | | | | | | | | | | | 670 ¹ | | |
| | HW | | | | | 1926-35 | | | | | | | | | | | | | | | | | 634 |
| | MHW | | | | | " | 305 | 314 | 291 | 324 | 307 | 328 | 241 | 207 | 239 | 217 | 183 | 244 | 470 | | | | |
| | MW | | | | | " | 205 | 207 | 272 | 250 | 226 | 241 | 182 | 157 | 169 | 155 | 142 | 159 | 197 | | | | |
| | MNW | | | | | " | 153 | 142 | 181 | 184 | 172 | 168 | 152 | 131 | 122 | 123 | 122 | 116 | 104 | | | | |
| | NW | | | | | " | | | | | | | | | | | | | 72 | | | | |
| | | | | | | NNW | Oct 1934 | | | | | | | | | | | | | 72 | | | |
| Elverhausen (Rhume R.) (13 km. upstream of Leine R. junction) & 1 km downstream of Soese R. junction) | <u>Q4</u> 4226 | C6247 | 275 | 1115 | 125.51 | HHW | Jan 1932 | | | | | | | | | | | | | | 348 | | |
| | HW | | | | | 1926-35 | | | | | | | | | | | | | | | | | 348 |
| | MHW | | | | | " | 130 | 124 | 169 | 142 | 106 | 119 | 93 | 89 | 104 | 106 | 84 | 135 | 246 | | | | |
| | MW | | | | | " | 83 | 79 | 91 | 86 | 81 | 86 | 72 | 65 | 70 | 69 | 64 | 75 | 77 | | | | |
| | MNW | | | | | " | 66 | 61 | 66 | 66 | 67 | 70 | 62 | 56 | 55 | 55 | 55 | 58 | 51 | | | | |
| | NW | | | | | " | | | | | | | | | | | | | 45 | | | | |
| | | | | | | NNW | Oct 1921 | | | | | | | | | | | | | 35 | | | |

*See Table 2 for definition of symbols

¹Feb 1946 Flood stage probably higher, but records not available

TABLE 5
DISCHARGE DATA - ALLER RIVER BASIN
1926-1932

| Gage | Km above mouth of Aller | Drainage Area km ² | Discharge in cubic meters per second | | | | | | | | | |
|----------------------------|-------------------------|-------------------------------|--------------------------------------|----------|------------|----------|------------|----------|------------|----------|--|--|
| | | | HQ HQ | HQ HQ | MHQ MHQ | MQ MQ | MNQ MNQ | NQ NQ | MNQ MNQ | NQ NQ | | |
| Aller River BUNNENBUCK | 158 | 1,645 | 80* | 54* | 34(1) | 8(1) | 2(1) | | | | | |
| | | | 42.5 | 32.8 | 20.7 | 4.86 | 1.22 | | | | | |
| | | | Mar. 1861 | | | | | | | | | |
| | | | | | | | | | | | | |
| CELLE | 115 | 4,494 | | | | 28* | 6* | | | | | |
| | | | | | | 6.2 | 1.3 | | | | | |
| AHLSEN | 59 | 14,122 | | | 215* | 87* | 33* | 17* | | | | |
| | | | | | 15.2 | 6.15 | 2.34 | 1.2 | | | | |
| WESTEN | 22 | 15,221 | 1600(2) | 430* | 318(1) | 92(1) | 42(1) | 23* | 21(2) | | | |
| | | | 105(Est) | 28.2 | 20.9 | 6.04 | 2.76 | 1.5 | 1.38(Est) | | | |
| | | | Mar. 1881 | | | | | | | | | |
| Leine River GRSENE | 241 | 2,898 | 500* | 455* | 220* | 28* | 14* | 7* | 6.40 | | | |
| | | | 172 | 157 | 76 | 9.7 | 4.8 | 2.3 | 2.21 | | | |
| | | | Feb. 1946 | | | | | | | | | |
| HERRENIAUSEN | 152 | 5,355 | | | 125* | 32* | | | | | | |
| | | | | | 23.3 | 6.0 | | | | | | |
| Rhume River ELVERHAUSEN | 275 | 1,115 | 230* | 230* | 96* | 13* | 4* | | | | | |
| | | | 206 | 206 | 86 | 12 | 3.6 | | | | | |
| | | | Jan. 1932 | | | | | | | | | |

(1) Flow at MH, MW, MNW from Jahrbuch fuer die Gewaesserkunde des Deutschen Reichs, 1938.

(2) Mean and extreme discharge (Q) tabulation in 1938 Jahrbuch.

* Flow at mean and extreme stages of tables 3 & 4, obtained by application of discharge rating curves from Plates 13 & 14.

CONFIDENTIAL
SECURITY INFORMATION

TABLE 6
ALLER RIVER
INUNDATION EFFECT OF STILLWATER BARRIERS

| Serial No. | Km above mouth of Aller | Map GSGS Series <u>4416</u> <u>4414</u> | "Nord de Guerre" Grid | Location and Description * | Low Stillwater Barrier (1m/MW) | | | | | High Stillwater Barrier (3m/MW) | | | | | | |
|------------|-------------------------|---|-----------------------|---|---|-----------|---------------|------------------|---------------------------|---------------------------------------|----------------|-----------|---------------|----------------------------------|---------------------------|---------------------------------------|
| | | | | | Pond Elev m/NN | Length km | Aver. Width m | Aver. Depth m | Pond Area km ² | Vol. 10 ⁶ x m ³ | Pond Elev m/NN | Length km | Aver. Width m | Aver. Depth m | Pond Area km ² | Vol. 10 ⁶ x m ³ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| | 200.1-191 | | | No significant flooding | | | | | | | | | | | | |
| | 191.4 | <u>N5</u> 3531 | 131327 | <u>Crossing under Weser Elbe Canal</u> Siphon crossing and High-water inlet to Canal | 57.5 | | | 0.5 | 35 | 17.5 | 58.75 | | | 1.0 | 57 | 57 |
| | 189.1 | <u>N5</u> 3531 | 114312 | <u>Vorsfelde Rd. Br.</u> 3 spans Total opening 25 m Stream width 10 m | 57.0 | 8 | 800 | 0.3 | 6.4 | 1.9 | 58.75 | | | Site unsuitable for high barrier | | |
| | 189-183 | | | No significant flooding | | | | | | | | | | | | |
| | 182.7 | <u>N5</u> 3530 | 043322 | <u>N.W. Fallersleben Rd. Br.</u> 3 spans Total opening 20.5 m Stream width 7 m | | | | | | | | | | | | |
| | 166.1 ¹ | <u>N5</u> 3529 | 9136 ¹ | <u>Gifhorn Sluice</u> | 52.38 | | | 0.5 ² | 4 ² | 2 | | | | Site unsuitable for high barrier | | |
| 1 | 161.8 | <u>N5</u> 3528 | 855349 | <u>Brenneckeabrueck Rd. Br.</u> 3 spans Total opening 31 m Stream width 20 m | | | | | | | | | | | | |
| | | | | | "Mil-Geo" mentions a provisional dam placed at this point to form a pool back to Gifhorn. Approximate width of 500 m ¹ | | | | | | | | | | | |

¹ Estimated location; contradictory data given in Exhibit B.

² See Exhibit B

* See Exhibit A for details

CONFIDENTIAL
SECURITY INFORMATION

TABLE 6
ALLER RIVER
(Continued)

| Serial No. | Km above mouth of Aller | Map Series 4416 4414 | "Nord de Guerre" Grid | Location and Description* | Low Stillwater Barrier (1m/MW) | | | | | | High Stillwater Barrier (3m/MW) | | | | | | |
|------------|-------------------------|----------------------------|-----------------------|---|---|-------------------------|---------------|---------------|---------------------------|---------------------------------------|----------------------------------|-----------|---------------|---------------|---------------------------|---------------------------------------|--|
| | | | | | Pond Elev m/NN | Length km | Aver. Width m | Aver. Depth m | Pond Area km ² | Vol. 10 ⁶ x m ³ | Pond Elev m/NN | Length km | Aver. Width m | Aver. Depth m | Pond Area km ² | Vol. 10 ⁶ x m ³ | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | |
| 6 | 151.7 | N5 3428 | 788398 | <u>Diekhorst Sluice</u> | 49.75 | 12.8 | 300 | 0.3 | 3.8 | 1.1 | Site unsuitable for high barrier | | | | | | |
| | 151-147 | No significant flooding | | | | | | | | | | | | | | | |
| 9 | 147.5 | N4 3427 | 760411 | <u>N of Flettmar RR Br.</u> 2 spans Total opening 68 m Stream width 20 m | By damming to 46.5 (3m/MW) and breaching levee on left bank, water would be diverted overland to Fuhse R. depression. However, no stillwater barrier would be formed. | | | | | | | | | | | | |
| 10 | 143.7 | N4 3427 | 737434 | <u>Langlingen Rd. Br.</u> 7 spans Total opening 47 m Stream width 29 m | 43.5 | No significant flooding | | | | | 45 | 1 | 250 | 0.2 | 0.25 | 0.05 | Breaching of left bank levee also necessary |
| 11 | 139.6 | N4 3427 | 712442 | <u>Nordberg Weir</u> | Increase of dam height would involve excessively long dam due to flat low-lying land in vicinity of site. | | | | | | | | | | | | |
| 12 | 138.1 | N4 3427 | 703454 | <u>E. of Offensen Rd. Br.</u> 2 spans Total opening 60.4 m Stream width 25 m | No significant flooding | | | | | | 43.75 | 1.3 | 500 | 1 | 0.6 | 0.6 | |
| 13 | 133.7 | N4 3427 | 680465 | <u>N.W. of Offensen Weir</u> | Site unsuitable (See Serial No. 11) | | | | | | | | | | | | |
| 14 | 131.4 | N4 3427 | 666460 | <u>Weinhausen Rd. Br.</u> 4 spans Total opening 71 m Stream width 30 m | 39.75 | No significant flooding | | | | | 41.80 | 1 | 400 | 0.5 | 0.4 | 0.2 | Possible additional flooding may extend farther on right bank reaching upstream to the Offensen weir |
| | 131-102 | No significant flooding | | | | | | | | | | | | | | | |

* See Exhibit A for details

CONFIDENTIAL
SECURITY INFORMATION

TABLE 6
ALLER RIVER
(Continued)

| Serial No. | Km above mouth of Aller | Map GSGS Series 4416 4414 | "Nord de Guerre" Grid | Location and Description* | Low Stillwater Barrier (1m/MW) | | | | | High Stillwater Barrier (3m/MW) | | | | | | |
|------------|-------------------------|---------------------------------|-----------------------|--|--------------------------------|-----------|---------------|---------------|---------------------------|---------------------------------------|--|-----------|---------------|---------------|---------------------------|---------------------------------------|
| | | | | | Pond Elev m/NN | Length km | Aver. Width m | Aver. Depth m | Pond Area km ² | Vol. 10 ⁶ x m ³ | Pond Elev m/NN | Length km | Aver. Width m | Aver. Depth m | Pond Area km ² | Vol. 10 ⁶ x m ³ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 30-31 | 102.3 | <u>M4</u> 3425 | 491536 489538 | <u>Oldau Lock and Dam</u> Height of movable crest 1 m | 33.75 | 3 | 700 | 0.5 | 2 | 1.0 | Limit of mechanical rise is 1 m; location at lock and dam on separate channels would create difficulties for higher barriers | | | | | |
| 32 | 98.4 | <u>M4</u> 3325 | 471555 | <u>Winsen Rd. Br.</u> 5 spans Total opening 108.1 m Stream width 32 m | 30.75 | | | | | | 32.50 | 2 | 500 | 0.3 | 1 | 0.3 |
| 34-35 | 90.4 | <u>M4</u> 3324 | 418560 415560 | <u>Bannetze Dam and Lock</u> Height of movable crest 1 m | 30.60 | 4 | 500 | 0.3 | 2 | 0.6 | Not considered Limit of mechanical rise is 1 m Lock and dam on separate channels | | | | | |
| 38 | 84.8 | <u>M4</u> 3324 | 381547 | <u>Jeversen Rd. Br.</u> Multi-span Total opening 75 m Stream width 40 m | 29.1 | 4 | 1000 | 0.5 | 4 | 2.0 | 31.1 | 5 | 1500 | 0.5 | 7 | 3.5 |
| 40-41 | 78.8 | <u>M4</u> 3324 | 333557 334558 | <u>Marklendorf Dam and Lock</u> Height of movable crest 1 m | 27.7 | 4 | 800 | 0.2 | 3 | 0.6 | Limit of mechanical rise is 1 m; dam and lock on separate channels | | | | | |
| 42 | 71.9 | <u>M4</u> 3323 | 300576 | <u>Essef Highway Br.</u> 3 spans Total opening 124 m Stream width 45 m | 25.1 | | | | | | 27.1 | 3 | 1000 | 0.2 | 3.5 | 0.7 |
| 43 | 70.1 | <u>M4</u> 3323 | 288582 | <u>Essef RR Br.</u> 3 spans Total opening 116 m Stream width 45 m | 25.2 | 2 | 500 | 0.2 | 1 | 0.2 | 27.2 | 5 | 1200 | 0.7 | 6 | 4.2 |
| | | | | | | | | | | | Pool must hold along 2 km of rail line on left bank | | | | | |

* See Exhibit A for details

Table 6
3 of 4 pages

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

TABLE 6
ALLER RIVER
(Continued)

| Serial No. | Km above mouth of Aller | Map GSGS Series <u>4416</u> <u>4414</u> | "Nord de Guerre" Grid | Location and Description* | Low Stillwater Barrier (1m/MW) | | | | | | High Stillwater Barrier (3m/MW) | | | | | | |
|------------------|-------------------------|---|-----------------------|---|--------------------------------|-------------------------|---------------|---------------|--------------------------|---------------------------------------|---|-----------|---------------|---------------|--------------------------|---------------------------------------|-------------------------------|
| | | | | | Pond Elev m/NN | Length km | Aver. Width m | Aver. Depth m | Pond Area m ² | Vol. 10 ⁶ x m ³ | Pond Elev m/NN | Length km | Aver. Width m | Aver. Depth m | Pond Area m ² | Vol. 10 ⁶ x m ³ | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | |
| 45-46 | 67.1 | <u>N4</u> 3223 | 270590 268590 | <u>Hademstorf Lock and Dam</u> Height of movable crest 1 m | 25.0 | 3 | 1000 | 0.2 | 3 | 0.6 | Limit of mechanical rise 1 m Dam and lock on separate channels | | | | | | |
| 51 | 58.6 | <u>N4</u> 3223 | 240644 | <u>Ahlden Rd. Br.</u> 5 spans Total opening 119.4 m Stream width 56 m | 22.2 | No significant flooding | | | | | 24.2 | 11 | 1500 | 1.0 | 17 | 17 | Flooding back to Essel RR Br. |
| 57 | 35.2 | <u>N4</u> 3222 | 115669 | <u>Rethem Rd. Br.</u> 7 spans Total opening 110 m Stream width 55-69 m | 17.5 | No significant flooding | | | | | 19.5 | 8.5 | 2000 | 1.0 | 17 | 17 | |
| 63 | 6.4 | <u>M3</u> 3021 | 013801 | <u>Verden RR Br.</u> 21 spans Total opening 375 m Stream width 57 m | 11.5 | No significant flooding | | | | | 13.5 | 8 | 1200 | 0.8 | 10 | 8 | |

* See Exhibit A for details

CONFIDENTIAL
SECURITY INFORMATION

TABLE 7
LEINE RIVER
INUNDATION EFFECT OF STILLWATER BARRIERS

| Serial No. | Km above mouth of Aller | GSQS map series 4416 4414 | "Nord de Guerre" Grid | Location and Description* | Low stillwater barrier (km/MW) | | | | | High stillwater barrier (3m/MW) | | | | | 18 | | |
|------------|-------------------------|---------------------------------|-----------------------|---|--------------------------------|-----------|-------------------------|---------------|---------------------------|---------------------------------------|--------------------|-----------|---------------|---------------|------|---------------------------|---|
| | | | | | Pond level m/MW | Length km | Aver. width m | Aver. depth m | Pond area km ² | Vol. 10 ⁶ x m ³ | Pond level m/MW | Length km | Aver. width m | Aver. depth m | | Pond area km ² | Vol. 10 ⁶ x m ³ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | |
| 197 | 254.0 | P4-Q4 4225 | 503577 | <u>Salsderhelden Rd. Br.</u> 7 spans Total opening 49 m Stream width 45 m | 106.6 | 5 | 1750 | 1 | 8.7 | 8.7 | 108.7 | | | | | | No suitable site above Salsderhelden |
| 196 | 251.8 | P4 4125 | 503589 | <u>Salsderhelden RR Br.</u> 10 spans Total opening 130 m Stream width 25 m | 105.5 | | No significant flooding | | | | 107.5 | 6 | 1750 | 1 | 10.5 | 10.5 | |
| | 252-161 | | | No significant flooding potentialities | | | | | | | | | | | | | |
| 149 | 161.0 | M4 3624 | 369183 | <u>Hannover RR Br.</u> 2 spans Total opening 52.5 m Stream width 36 m | | | No significant flooding | | | | 53.75 | 2.5 | 2500 | 1 | 6.3 | 6.3 | Must hold along 2 km of RR embankment. May be necessary to block bridge over Inne at 359192 |
| 119 | 147.9 | M4 3624 | 315239 | <u>Herrenhausen RR Br.</u> 3 spans Total opening 109.6 m Stream width 25.9 m | 47.5 | 4.9 | 560 | 0.6 | 2.8 | 1.7 | 50 | 5.7 | 860 | 2 | 4.3 | 8.3 | |
| | 148-137 | | | No significant flooding | | | | | | | | | | | | | |
| 116 | 136.8 | M4 3523 | 264245 | <u>Seelze Rd. Br.</u> 1 span Total opening 41.2 m Stream width 27.5 m | 43.2 | | No flooding | | | | 45.0 | 1.3 | 640 | 0.5 | 0.8 | 0.4 | |
| 115 | 136.2 | M4 3523 | 259246 | <u>Lohnde Aqueduct</u> 3 spans Total opening 76 m Stream width 23 m | 42.9 | | No flooding | | | | 45.0 | 3.0 | 320 | 0.5 | 0.9 | 0.5 | Carries Weser Elbe Canal over Leine R. |

Table 7
1 of 3 pages

* See Exhibit A for details

CONFIDENTIAL
SECURITY INFORMATION

TABLE 7
LEINE RIVER
(Continued)

| Serial No. | Km above mouth of Aller | OSGS map series 4416 4414 | "Nord de Guerre" Grid | Location and Description* | Low stillwater barrier (1m/MW) | | | | | | High stillwater barrier (3m/MW) | | | | | | | |
|---------------------------------|-------------------------|---------------------------------|-----------------------|--|--------------------------------|-----------|---------------|---------------|---------------------------|---------------------------------------|----------------------------------|-----------|---------------|---------------|---------------------------|---------------------------------------|---|--|
| | | | | | Pond level m/NN | Length km | Aver. width m | Aver. depth m | Pond area km ² | Vol. 10 ⁶ x m ³ | Pond level m/NN | Length km | Aver. width m | Aver. depth m | Pond area km ² | Vol. 10 ⁶ x m ³ | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | |
| 114 | 134.4 | <u>N4</u> 3523 | 259246 | <u>Lehade Rd. Br.</u> 1 span Total opening 22.8 m Stream width 26 m. | 42.5 | 0.8 | 400 | 0.4 | 0.3 | 0.1 | Site unsuitable for high barrier | | | | | | | |
| 113 | 129.3 | <u>N4</u> 3523 | 219260 | <u>Bielefeld-Hannover Autobahn Br.</u> 8 span Total opening 250 m Stream width 25 m | No significant flooding | | | | | | 45.0 | 6.7 | 920 | 1.4 | 6.2 | 8.7 | | |
| 112 | 127.3 | <u>N4</u> 3523 | 201270 | <u>Ricklingen Rd. Br.</u> 1 span Total opening 42.7 m Stream width 30 m | No significant flooding | | | | | | 42.5 | 2.0 | 290 | 1.0 | 0.5 | 0.5 | May require artificial barrier on right bank | |
| 127-110 No significant flooding | | | | | | | | | | | | | | | | | | |
| 109 | 109.7 | <u>N4</u> 3422 | 176356 | <u>Neustadt Rd. Br.</u> 3 spans Total opening 57 m Stream width 30 m | No significant flooding | | | | | | 37.5 | 8.5 | 1200 | 0.75 | 10.2 | 7.6 | May require blocking bridge over left channel (Serial 110)* | |
| 110-99 No significant flooding | | | | | | | | | | | | | | | | | | |
| 105 | 98.1 | <u>N4</u> 3423 | 201415 | <u>Basse Rd. Br.</u> 8 spans Total opening 46 m Stream width 37 m | No significant flooding | | | | | | 35.0 | 7.1 | 320 | 1.5 | 2.3 | 3.5 | | |

* See Exhibit A for details

Table 7
2 of 3 pages

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

TABLE 7
LEINE RIVER
(Continued)

| Serial No. | Km above mouth of Aller | GSGS map series <u>4416</u> <u>4414</u> | "Nord de Guerre" Grid | Location and Description* | Low stillwater barrier (1m/MW) | | | | | | High stillwater barrier (3m/MW) | | | | | | |
|------------|-------------------------|---|-----------------------|---|--------------------------------|-----------|---------------|---------------|---------------------------|-------------------------------------|---------------------------------|-----------|---------------|---------------|---------------------------|-------------------------------------|----------------------------------|
| | | | | | Pond level m/KN | Length km | Aver. width m | Aver. depth m | Pond area km ² | Vol. 10 ⁶ m ³ | Pond level m/KN | Length km | Aver. width m | Aver. depth m | Pond area km ² | Vol. 10 ⁶ m ³ | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 104 | 88.6 | <u>M4</u> <u>3423</u> | 252451 | <u>Helstorf Rd. Br.</u> 1 span Total opening 51 m Stream width 40 m | 30 | 9.5 | 230 | 0.3 | 2.2 | 0.66 | 31.25 | 9.5 | 340 | 0.9 | 3.2 | 2.9 | |
| | 88-80 | No significant flooding | | | | | | | | | | | | | | | |
| 102 | 79.2 | <u>M4</u> <u>3323</u> | 250511 | <u>Niederstockern Rd. Br.</u> 6 spans Total opening 56 m Stream width 40 m | 27.5 | 0.4 | 100 | .03 | .04 | 0.02 | 30.0 | 9.4 | 2030 | 2 | 19.3 | 38.6 | |
| | 79-66 | No significant flooding | | | | | | | | | | | | | | | |
| 100 | 66.2 | <u>M4</u> <u>3323</u> | 258583 | <u>Bothmer RR Br.</u> 5 spans Total opening 110 m Stream width 50 m | 25.0 | 5.6 | 460 | 1.2 | 2.6 | 3.1 | 27.5 | | | | | | Site unsuitable for high barrier |

*See Exhibit A for details

CONFIDENTIAL

TABLE 8
SECURITY INFORMATION SUMMARY OF EFFECTS OF ARTIFICIAL FLOOD WAVES

| RIVER | LOCATION | RIVER Km | ARTIFICIAL FLOOD NO. * | RIVER DISCHARGE | | RIVER STAGE | | | TIME of ARRIVAL | | DURATION of WAVE | | SURFACE VELOCITY of PEAK Km/hr |
|--------------|------------------------|----------|------------------------|-------------------|-------------------|--------------|-------|-------|-----------------|--------------|------------------|----------|--------------------------------|
| | | | | PEAK of WAVE | BASE FLOW | PEAK of WAVE | MHW | MW | START of WAVE | PEAK of WAVE | above MHW | above MW | |
| | | | | m ³ /s | m ³ /s | m+NN | m+NN | m+NN | hrs. * | hrs * | hrs | hrs | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| AT DAY: | (ODER) | (312) | 1 | 8500 | - | - | - | - | 0 | 0 | - | 15 | - |
| | (SOESE) or (SÖSE) | (301) | 2 | 8500 | - | - | - | - | 0 | 0 | - | 17 | - |
| | (ECKER) | (261) | 3 | 8500 | - | - | - | - | 0 | 0 | - | 19 | - |
| | (ODER+SÖSE) | | 4 | - | - | - | - | - | - | - | - | - | - |
| | (ODER+SÖSE+ECKER) | | 5 | - | - | - | - | - | - | - | - | - | - |
| ELVERHAUSEN | Zero Gage = 125.51m+NN | 275 | 1 | 700 | 13 | 130.0 | 128.0 | 126.3 | 11 | 18 | 14 | 21 | 9 |
| | | | 2 | 795 | ↓ | 130.1 | ↓ | ↓ | 9 | 14 | 13 | 19 | 9 |
| | | | 3 | - | ↓ | - | ↓ | ↓ | - | - | - | - | - |
| | | | 4 | 1475 | ↓ | 130.5 | ↓ | ↓ | 12 | 18 | 16 | 24 | 9 |
| | | | 5 | - | ↓ | - | ↓ | ↓ | - | - | - | - | - |
| GREENE | Zero Gage = 91.92m+NN | 241 | 1 | 547 | 27 | 102.3 | 100.5 | 97.6 | - | - | - | - | - |
| | | | 2 | 577 | ↓ | 102.4 | ↓ | ↓ | - | - | - | - | - |
| | | | 3 | - | ↓ | - | ↓ | ↓ | - | - | - | - | - |
| | | | 4 | 950 | ↓ | 103.7 | ↓ | ↓ | - | - | - | - | - |
| | | | 5 | - | ↓ | - | ↓ | ↓ | - | - | - | - | - |
| HERRENHAUSEN | Zero Gage = 44.15m+NN | 182 | 1 | 360 | 32 | 50.2 | 48.3 | 45.6 | 40 | 54 | 20 | 38 | 5 |
| | | | 2 | 350 | ↓ | 50.1 | ↓ | ↓ | 33 | 49 | 18 | 38 | 5 |
| | | | 3 | - | ↓ | - | ↓ | ↓ | - | - | - | - | - |
| | | | 4 | 650 | ↓ | 51.6 | ↓ | ↓ | 37 | 53 | 25 | 41 | 5 |
| | | | 5 | - | ↓ | - | ↓ | ↓ | - | - | - | - | - |
| BOTHMER | Zero Gage = 22.77m+NN | 68 | 1 | 275 | 50 | 26.5 | 25.0 | 23.3 | 60 | 81 | 22 | 50 | 4 |
| | | | 2 | 270 | ↓ | 26.5 | ↓ | ↓ | 55 | 77 | 21 | 44 | 4 |
| | | | 3 | - | ↓ | - | ↓ | ↓ | - | - | - | - | - |
| | | | 4 | 447 | ↓ | 28.1 | ↓ | ↓ | 59 | 81 | 30 | 52 | 5 |
| | | | 5 | - | ↓ | - | ↓ | ↓ | - | - | - | - | - |

* NOTE: TIME AFTER INITIAL BREACHING OPERATION

FLOOD NO. 4 - INITIAL BREACH AT ODER DAM; SOESE BREACHING 4 HOURS LATER

FLOOD NO. 5 - SAME AS ABOVE; ECKER BREACHING 15 HOURS AFTER ODER

CONFIDENTIAL
 SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

TABLE 9
SUMMARY OF EFFECTS OF FLOW VARIATION

| River | Location | River Km. | Type of Flow | Artificial Flood No | RIVER DISCHARGE | | RIVER STAGE | | | TIME OF ARRIVAL | | DURATION OF RISE | | SURFACE VELOCITY AT PEAK | |
|-------|-------------------|------------------------|--------------|---------------------|-------------------|-------------------|--------------|-------|-------|-----------------|--------------|------------------|----------|--------------------------|---|
| | | | | | Peak of Rise | Base Flow (at MW) | Peak of Rise | MHW | MW | Start of Rise | Peak of Rise | above MHW | above MW | Km/hr | |
| | | | | | m ³ /s | m ³ /s | m+NN | m+NN | m+NN | hrs* | hrs* | hrs* | hrs* | | |
| | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| Oder | AT DAM (Oder) | 312 | A | 6 | 50 | | | | | | 0 | 0 | | 200 | |
| | (Soese) or (Söse) | 301 | | 7 | 36 | | | | | | 0 | 0 | | 200 | |
| | (Oder) | | B | 8 | 165 | | | | | | 0 | 0 | | 70 | |
| | (Söse) | | | 9 | 55 | | | | | | 0 | 0 | | 180 | |
| | (Ecker) | 261 | | 10 | 30 | | | | | | 0 | 0 | | 142 | |
| | (Oder) | | C | 11 | 445 | | | | | | 0 | 0 | | 60 | |
| | (Söse) | | | 12 | 282 | | | | | | 0 | 0 | | 40 | |
| | (Ecker) | | | 13 | 165 | | | | | | 0 | 0 | | 77 | |
| | Oder+Söse | | | 14 | - | - | - | - | - | - | - | - | - | - | - |
| | (Oder+Söse+Ecker) | | | 15 | - | - | - | - | - | - | - | - | - | - | - |
| | Leine | ELVERHAUSEN | 275 | A | 6 | 49 | 13 | 126.9 | 128.0 | 126.3 | 12 | 40 | 0 | 210 | 6 |
| | | Gage Zero = 125.5/m+NN | | | 7 | 38 | | 126.8 | | | 10 | 45 | 0 | 210 | 6 |
| | | | | B | 8 | 145 | | 128.5 | | | 8 | 30 | 42 | 76 | 8 |
| | | | | | 9 | 53 | | 127.1 | | | 6 | 48 | 0 | 190 | 6 |
| | | | | | 10 | - | | - | | | - | - | - | - | - |
| | | | C | 11 | 165 | | 128.6 | | | 4 | 16 | 52 | 76 | 8 | |
| | | | | 12 | 220 | | 128.9 | | | 4 | 21 | 32 | 51 | 8 | |
| | | | | 13 | - | | - | | | - | - | - | - | - | |
| | | | | 14 | 418 | | 129.5 | | | 4 | 20 | 58 | 84 | 9 | |
| | | | | 15 | - | | - | | | - | - | - | - | - | |
| Leine | | GREENE | 241 | A | 6 | 63 | 27 | 98.6 | 100.5 | 97.6 | - | - | - | - | - |
| | | Gage Zero = 94.92/m+NN | | | 7 | 52 | | 98.4 | | | - | - | - | - | - |
| | | | | B | 8 | 162 | | 100.0 | | | - | - | - | - | - |
| | | | | | 9 | 68 | | 98.7 | | | - | - | - | - | - |
| | | | | | 10 | - | | - | | | - | - | - | - | - |
| | | | C | 11 | 162 | | 100.0 | | | - | - | - | - | - | |
| | | | | 12 | 234 | | 100.6 | | | - | - | - | - | - | |
| | | | | 13 | - | | - | | | - | - | - | - | - | |
| | | | | 14 | 397 | | 101.6 | | | - | - | - | - | - | |
| | | | | 15 | - | | - | | | - | - | - | - | - | |

* NOTE: TIME AFTER INITIAL DISCHARGE AT DAM

FLOOD NO 14 INITIAL DISCHARGE AT SOESE DAM, ODER DISCHARGE BEGUN 5 HOURS LATER.

FLOOD NO 15 SAME AS ABOVE, ECKER DISCHARGE BEGUN 27 HOURS AFTER SOESE.

CONFIDENTIAL
SECURITY INFORMATION

CONFIDENTIAL
SECURITY INFORMATION

TABLE 9
SUMMARY OF EFFECTS OF FLOW VARIATION

| River | Location | River Km. | Type of Flow | Artificial Flood No | RIVER DISCHARGE | | RIVER STAGE | | | TIME OF ARRIVAL | | DURATION OF RISE | | SURFACE VELOCITY AT PEAK Km/hr | | | | | | |
|-------|-------------------------------------|-----------|--------------|---------------------|----------------------------------|-------------------|--------------|------|------|-----------------|--------------|------------------|----------|-----------------------------------|-----|-----|-----|---|----|-----|
| | | | | | Peak of Rise | Base Flow (or MW) | Peak of Rise | MHW | MW | Start of Rise | Peak of Rise | above MHW | above MW | | | | | | | |
| | | | | | m ³ /s | m ³ /s | m+NN | m+NN | m+NN | hrs* | hrs* | hrs* | hrs* | | | | | | | |
| | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | | | | |
| Leine | HERRENHAUSEN Gage Zero 44.15m+NN | 152 | A | 6 | 68 | 32 | 46.7 | 48.3 | 45.6 | 41 | 84 | 0 | 270 | 3 | | | | | | |
| | | | | | 57 | | 46.5 | | | 38 | | 90 | | | 0 | 270 | | | | |
| | | | | | 148 | | 48.3 | | | 25 | | 69 | | | 24 | 100 | 4 | | | |
| | | | | | 73 | | 46.9 | | | 23 | | 95 | | | 0 | 250 | 4 | | | |
| | | | | | - | | - | | | - | | - | | | - | - | - | - | | |
| | | | | | 141 | | 48.3 | | | 27 | | 69 | | | 18 | 97 | 4 | | | |
| | | | C | 12 | 205 | 49.0 | 26 | 59 | 30 | 73 | 4 | | | | | | | | | |
| | | | | 13 | - | - | - | - | - | - | - | | | | | | | | | |
| | | | | 14 | 313 | 49.9 | 25 | 60 | 51 | 105 | 4 | | | | | | | | | |
| | | | | 15 | - | ↓ | ↓ | ↓ | - | - | - | | | | | | | | | |
| | | | | Laine | BOTHMER Gage Zero = 22.77m+NN | 68 | A | 6 | 86 | 50 | 24.1 | 25.0 | 23.3 | 59 | 113 | 0 | 310 | 3 | | |
| | | | | | | | | | 75 | | 23.9 | | | 56 | | 119 | | | 0 | 310 |
| | | | | | | | | | 148 | | 25.0 | | | 50 | | 105 | | | 24 | 106 |
| | | | | | | | B | 9 | 90 | 24.2 | 39 | 123 | 0 | 300 | 3 | | | | | |
| | | | | | | | | 10 | - | - | - | - | - | - | - | | | | | |
| C | 11 | 145 | 25.0 | | | | | 52 | 99 | 0 | 102 | 4 | | | | | | | | |
| | 12 | 185 | 25.5 | | | | | 53 | 87 | 24 | 74 | 4 | | | | | | | | |
| | 13 | - | - | | | | | - | - | - | - | - | | | | | | | | |
| 14 | 279 | 26.5 | 47 | | | | | 89 | 52 | 109 | 4 | | | | | | | | | |
| 15 | - | ↓ | ↓ | ↓ | - | - | - | | | | | | | | | | | | | |

* NOTE: TIME AFTER INITIAL DISCHARGE AT DAM

FLOOD NO 14 INITIAL DISCHARGE AT SOESE DAM, ODER DISCHARGE BEGUN 5 HOURS LATER.
FLOOD NO 15 SAME AS ABOVE, ECKER DISCHARGE BEGUN 27 HOURS AFTER SOESE.

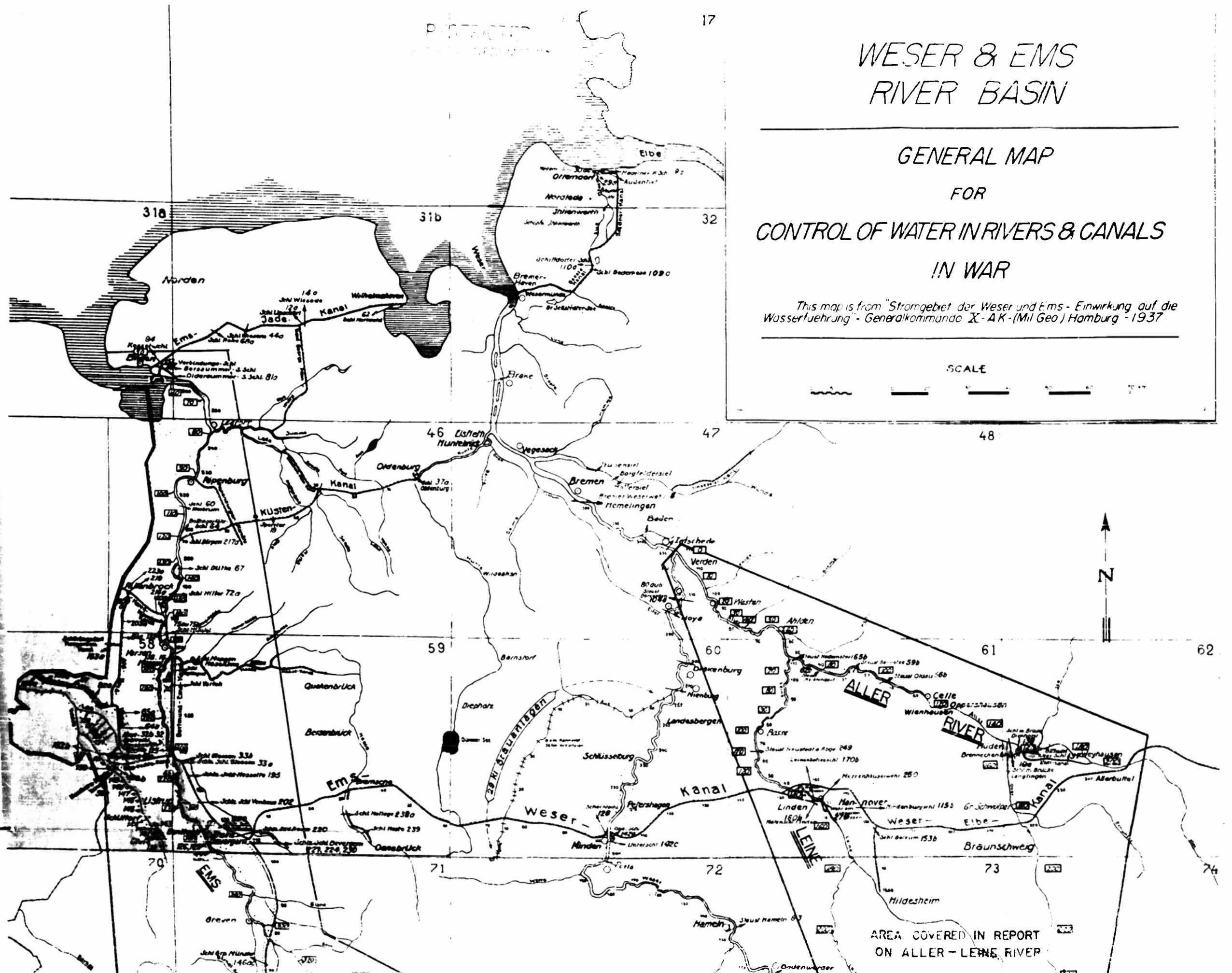
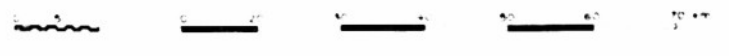
CONFIDENTIAL
SECURITY INFORMATION

WESER & EMS RIVER BASIN

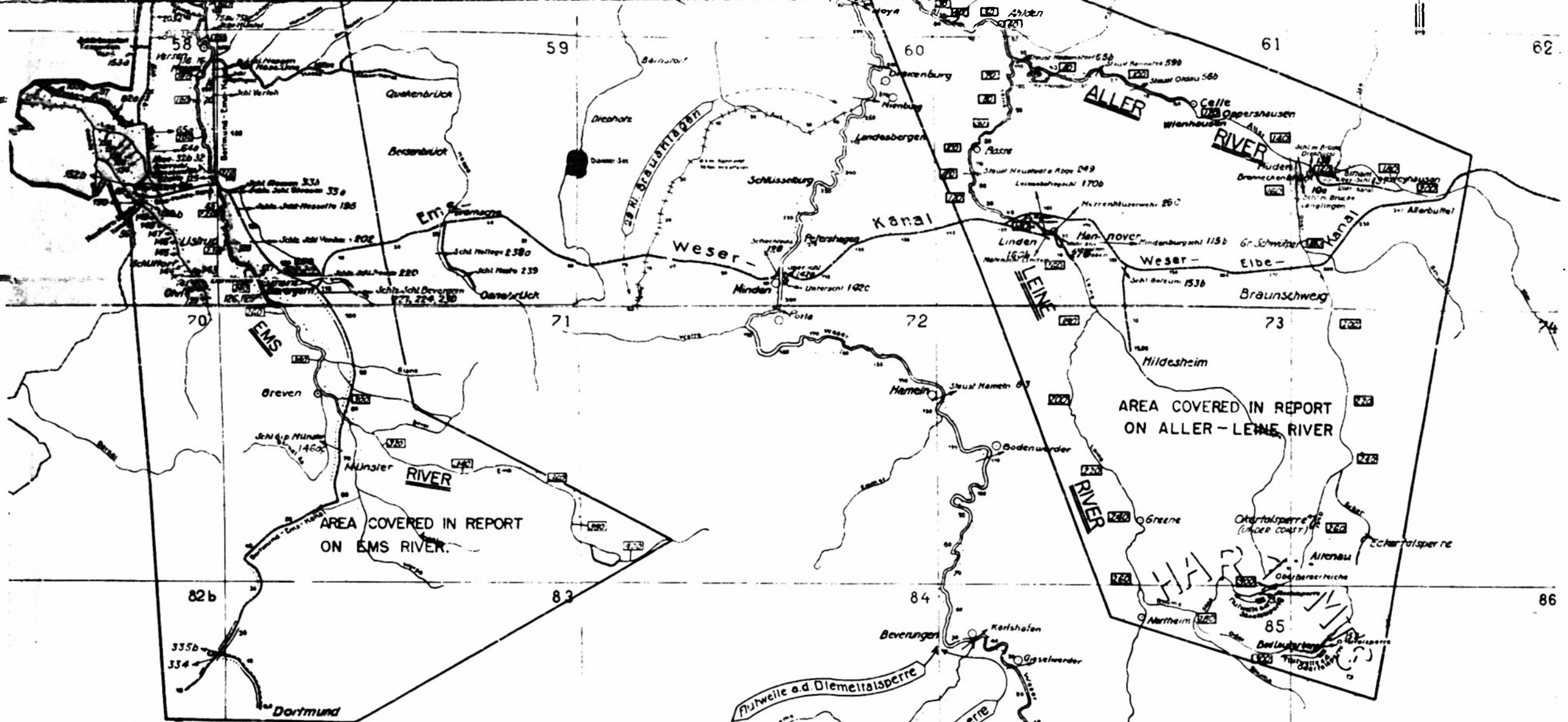
GENERAL MAP FOR CONTROL OF WATER IN RIVERS & CANALS IN WAR

This map is from "Stromgebiet der Weser und Ems - Einwirkung auf die Wasserführung - Generalkommando X-AK-(Mil Geo.) Hamburg - 1937"

SCALE



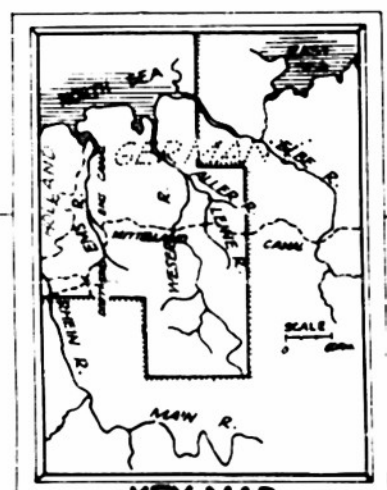
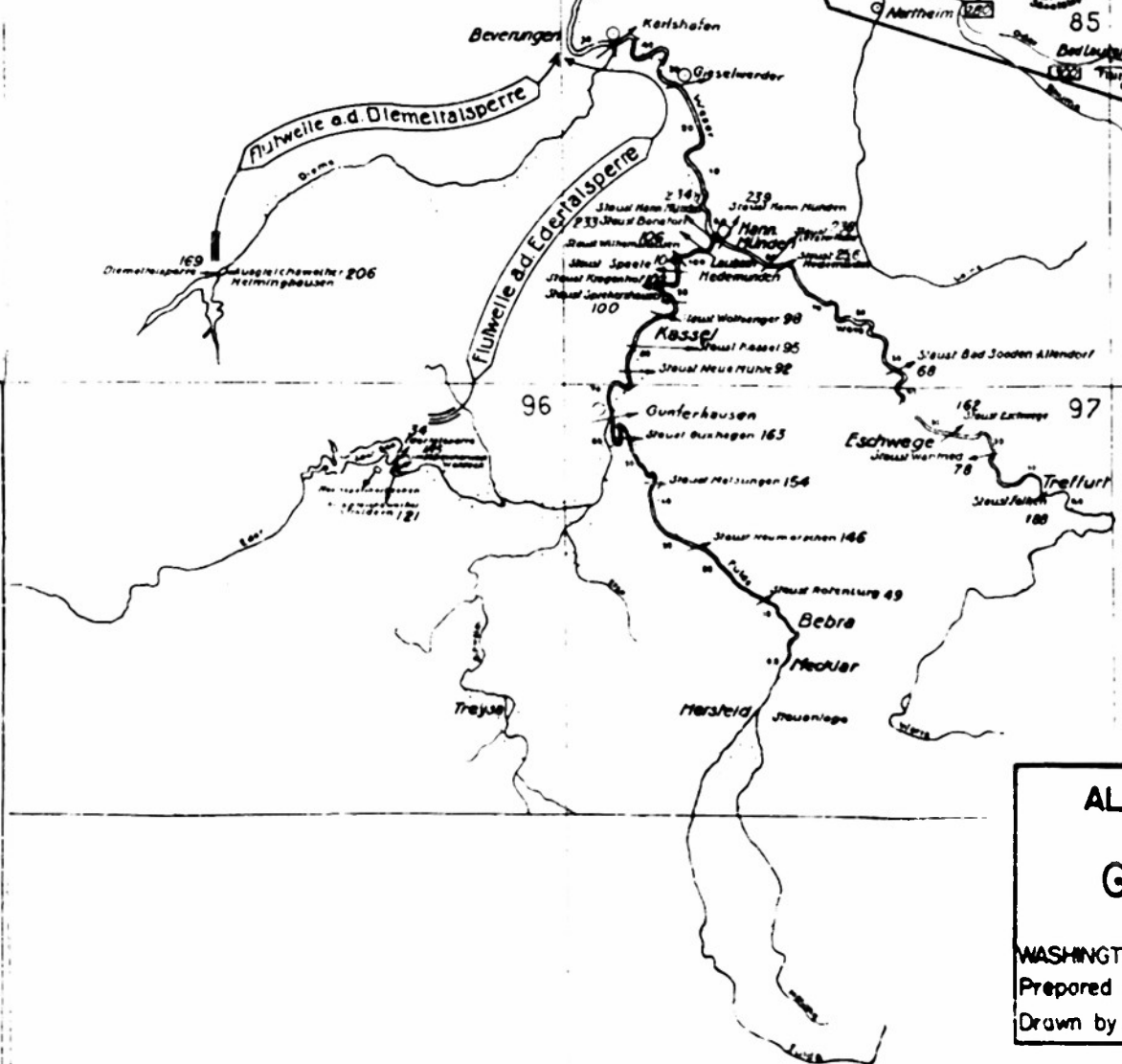
AREA COVERED IN REPORT
ON ALLER-LEINE RIVER



| Symbol | Meaning |
|--------|---------------------------------------|
| | Retained water and inundation areas |
| | Navigable rivers |
| | Non-navigable rivers |
| | Canals |
| | Completed sheet pilings |
| | Planned sheet pilings |
| | River kilometers (used in Appendix B) |
| | Location of lock or dam |
| | Number of unit map sheet |
| | Object number |
| | Major Gaging Station |
| | River kilometers (used in report) |

LEGEND

- Retained water and inundation areas
- Navigable rivers
- Non-navigable rivers
- Canals
- Completed sheet pilings
- Planned sheet pilings
- River kilometers (used in Appendix B)
- Location of lock or dam
- Number of unit map sheet
- Object number
- Major Gaging Station
- River kilometers (used in report)

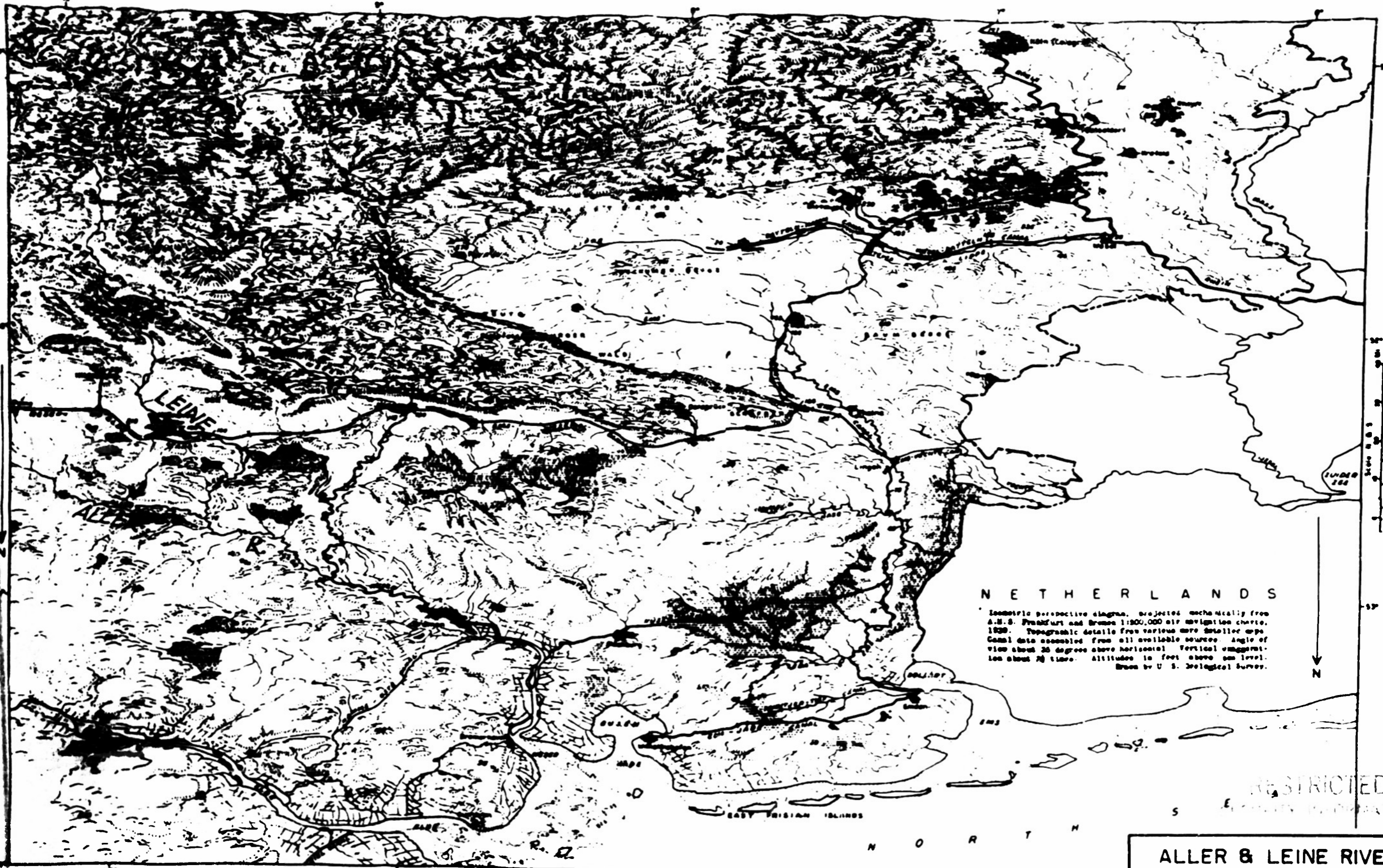


KEY MAP

RESTRICTED
SECURITY INFORMATION

ALLER & LEINE RIVERS GENERAL MAP

WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by J.J.H. Date Aug 1952
Drawn by



NETHERLANDS

Isometric perspective diagram, projected mechanically from A.S.S. Frankfurt and Bremen 1:500,000 air navigation charts, 1939. Topographic details from various more detailed maps. Canal data assembled from all available sources. Angle of view about 25 degrees above horizontal. Vertical exaggeration about 2 1/2 times. Altitudes in feet above sea level. Drawn by U. S. Geological Survey.

RESTRICTED
 EXCLUDED INFORMATION

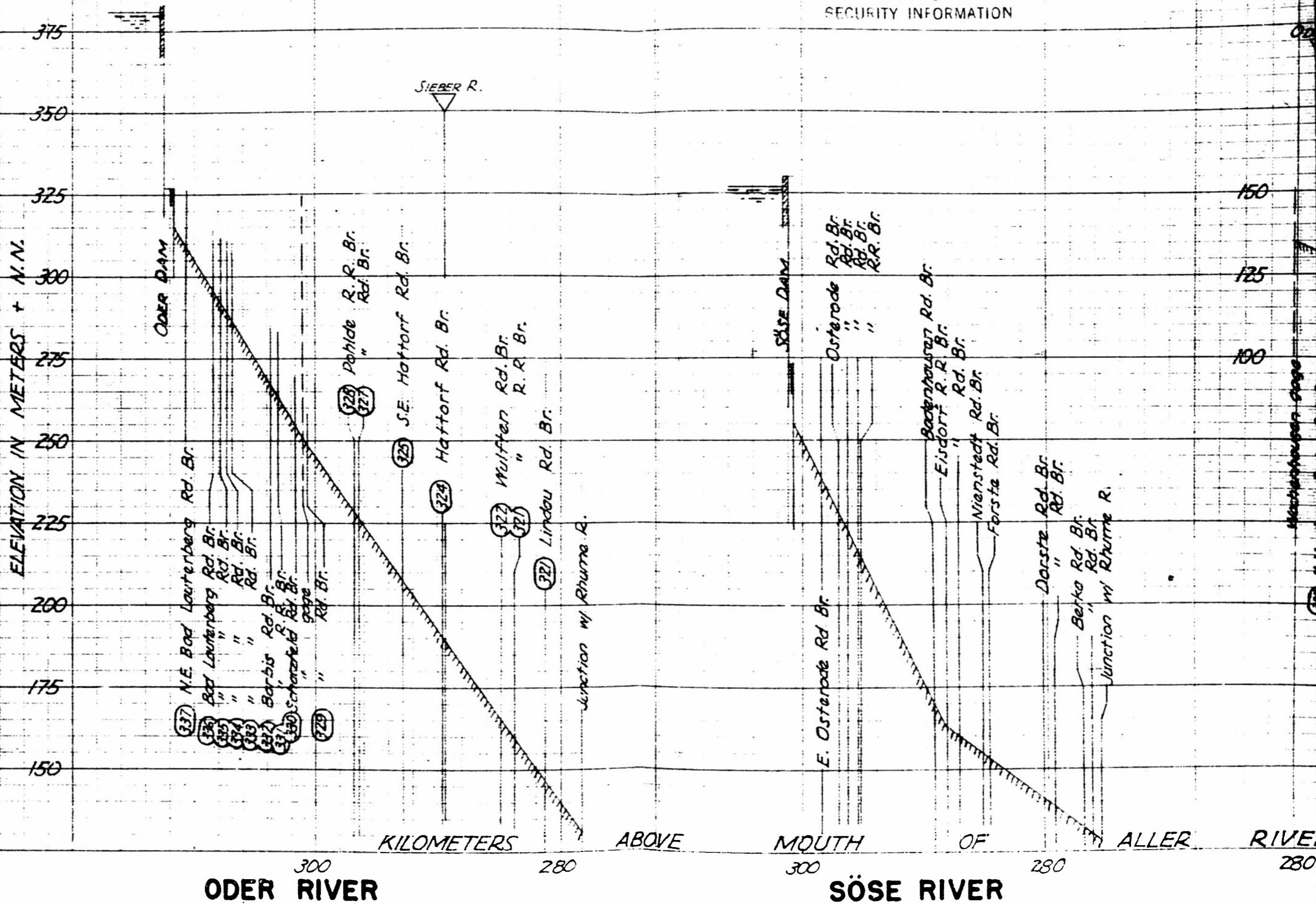
- | | | | | | |
|--|---|---------------------|------------------------------|--|----------------------------|
| Canal light (indicates shallow canal, for vessels of less than 170 tons) | Canal lock (arrow points toward higher level) | Embankment on canal | Cut on canal | Drainage ditches (not shown in detail) | Marsh, meadow, or peat bog |
| Approach or bridge on canal | Weir or dam in stream | Reservoir | Pumping plant or water works | Tidal flat | |

**ALLER & LEINE RIVERS
 PHYSIOGRAPHIC
 DIAGRAM**

WASHINGTON DISTRICT CORPS OF ENGINEERS
 Prepared by J.J.H. Date Aug. 1952
 Drawn by _____

REPRODUCED FROM "NAVIGABLE WATERWAYS OF GERMANY"
 S.E.S. 128, O.C.E., U.S.A., AUGUST, 1944.

RESTRICTED
SECURITY INFORMATION









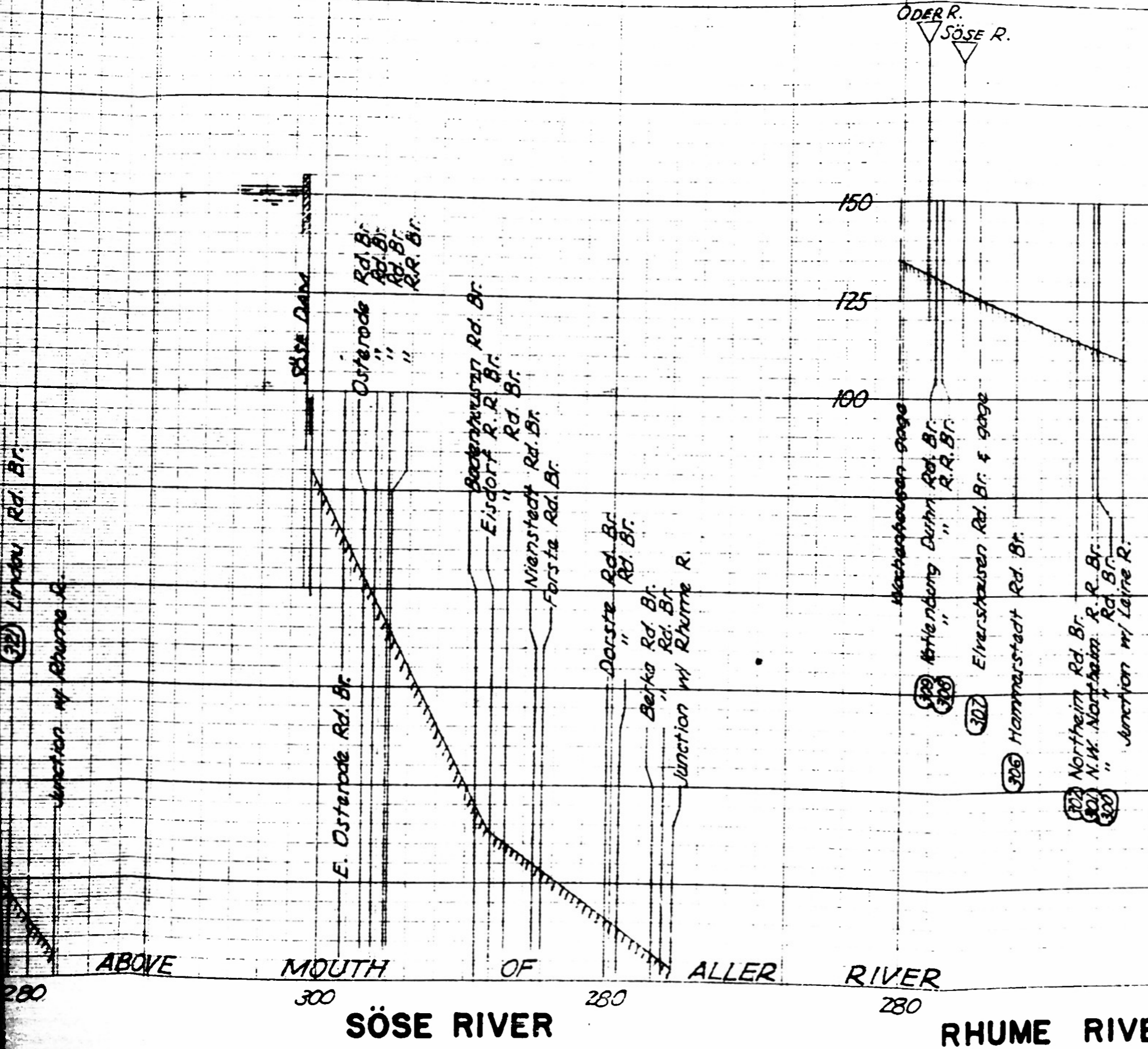
ODER RIVER

SÖSE RIVER

RESTRICTED
SECURITY INFORMATION

LEGEND

-  River junction
-  Bridge showing clearance
-  Gage
-  Dam or lock
-  Serial No
-  Average channel bottom



RESTRICTED
SECURITY INFORMATION

ALLER & LEINE RIVERS
 PROFILES
 ODER SÖSE & RHUME
 RIVERS

WASHINGTON DISTRICT CORPS OF ENGINEERS
 Prepared by NH Date Aug. 52
 Drawn by J.H.

CONFIDENTIAL

SECURITY INFORMATION

LEGEND

- River junction
- Bridge showing clearance
- Gage
- Dam or lock
- Serial No
- Average channel bottom
- Mean water
- Mean High water
- Natural flood
- Artificial flood No 4
- " " No 14

ELEVATION IN METERS + N.A.M.

115
110
105
100
95
90
85
80
75
70
65

260 240 220 200

KILOMETERS ABOVE MOUTH OF ALLER RIVER

FEB. 1946 HHTV
MHW
MNY
RHUME R.

194 Höckelheim Rd. Br. & 0094 (LEINSTRUMEN)

190 191 Hohenstedt Rd. Br.

197 196 Salzdetthalen Rd. Br.
Salzdetthalen R.R. Br.

194 193 194 Ottheim Rd. Br.
Kreensen Rd. Br.
" " R.R. Br.

191 Greane Rd. Br. & gage

190 Erzhause Rd. Br.

189 187 Gr. Freden Rd. Br.
" " R.R. Br.

186 Wispenstein Rd. Br.

182 183 Alfeld Rd. Br.

181 Wettensen farm Br.

179 180 Brügger Rd. Br.

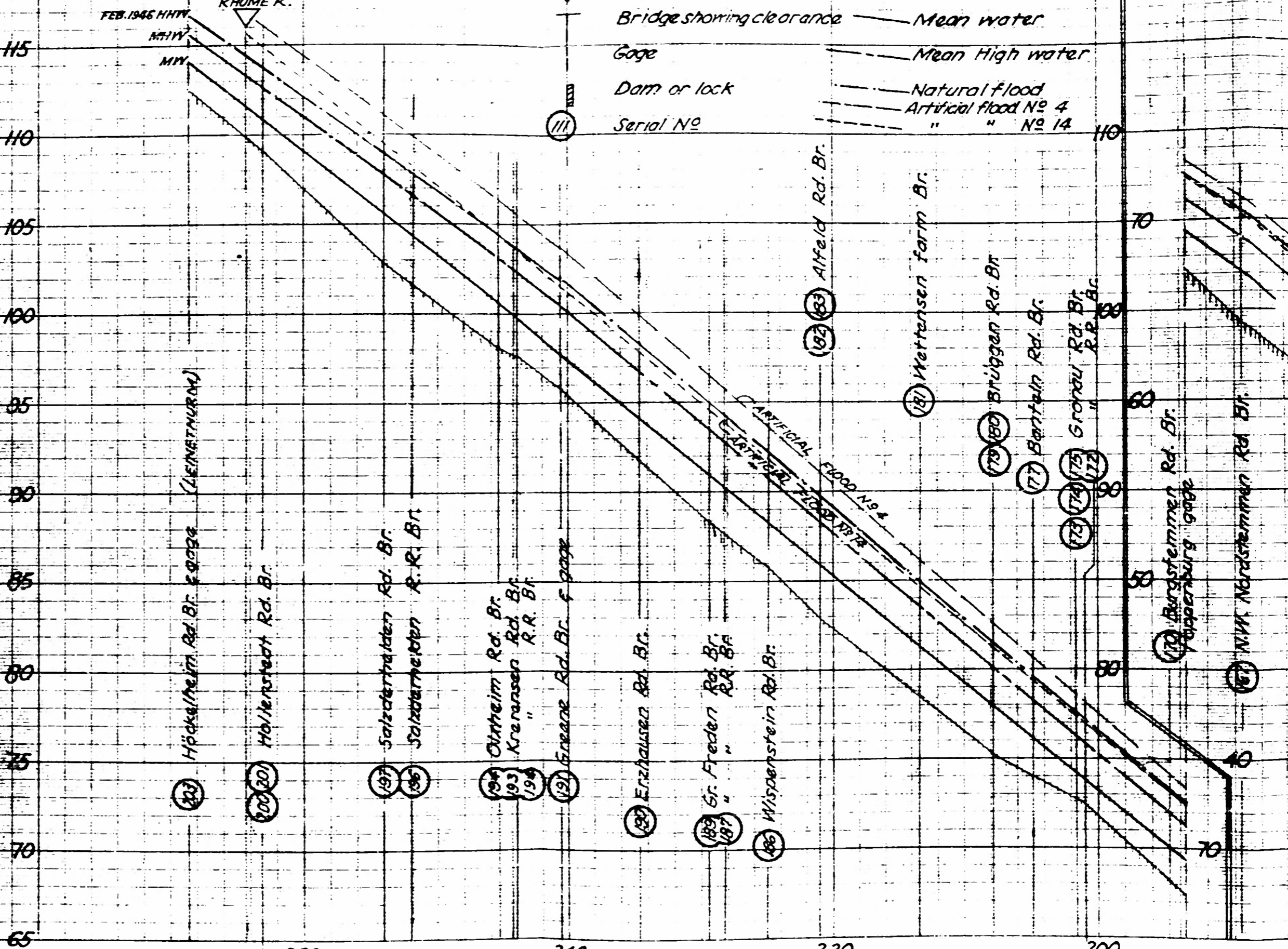
177 Banteln Rd. Br.

173 174 175 Gronau Rd. Br.
" " R.R. Br.

170 Burgstemmen Rd. Br.
" " Appenberg gage

167 N.V.M. Nordstemmen Rd. Br.






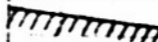


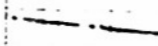
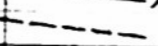

160 Schuttburen Rd. Br.

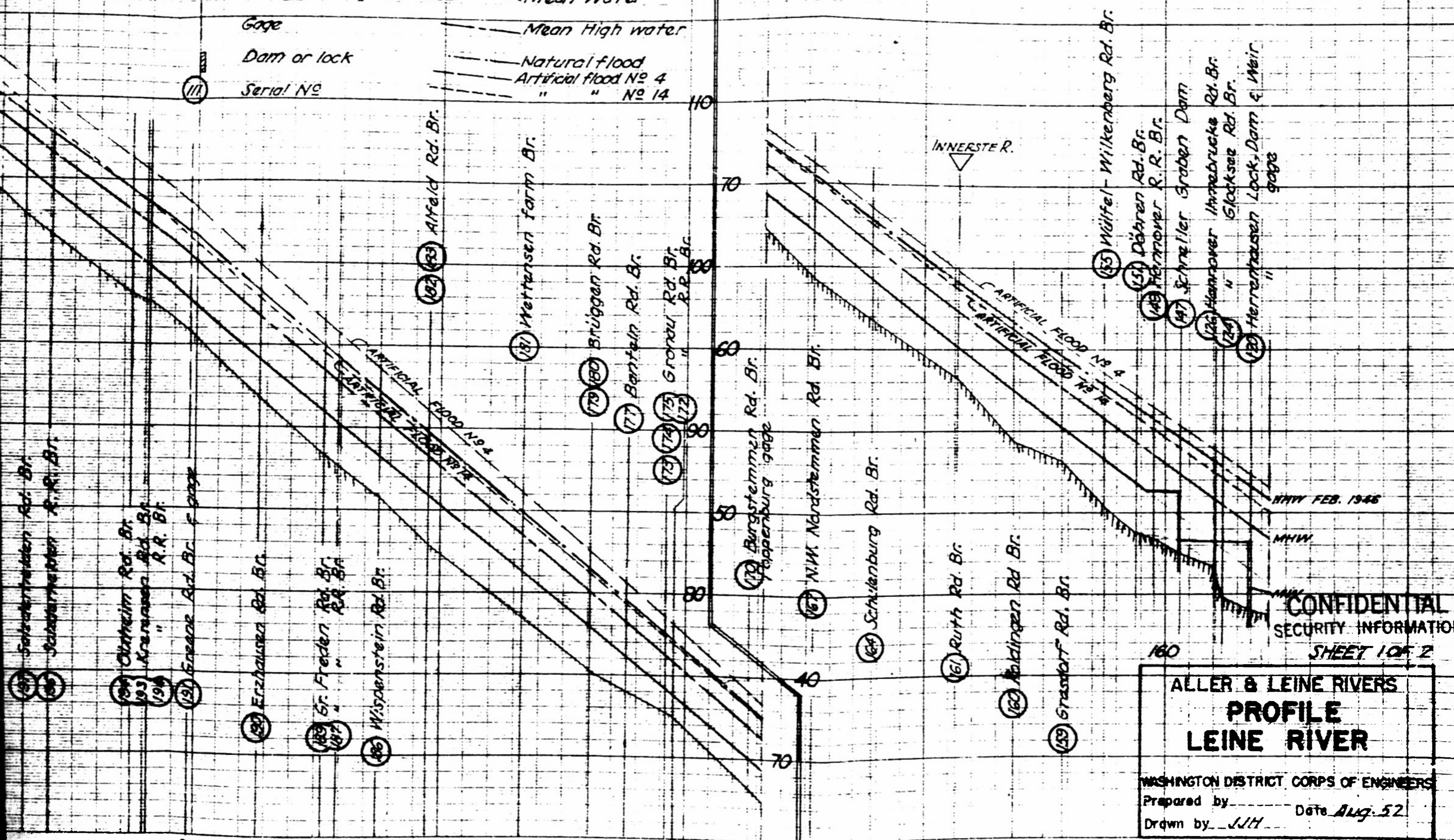


CONFIDENTIAL

SECURITY INFORMATION

LEGEND

-  River junction
-  Bridge showing clearance
-  Gage
-  Dam or lock
-  Serial No
-  Average channel bottom
-  Mean water
-  Mean High water
-  Natural flood
-  Artificial flood No 4
-  " " No 14



HWY FEB. 1946

MHW

CONFIDENTIAL
SECURITY INFORMATION

SHEET 1 OF 2

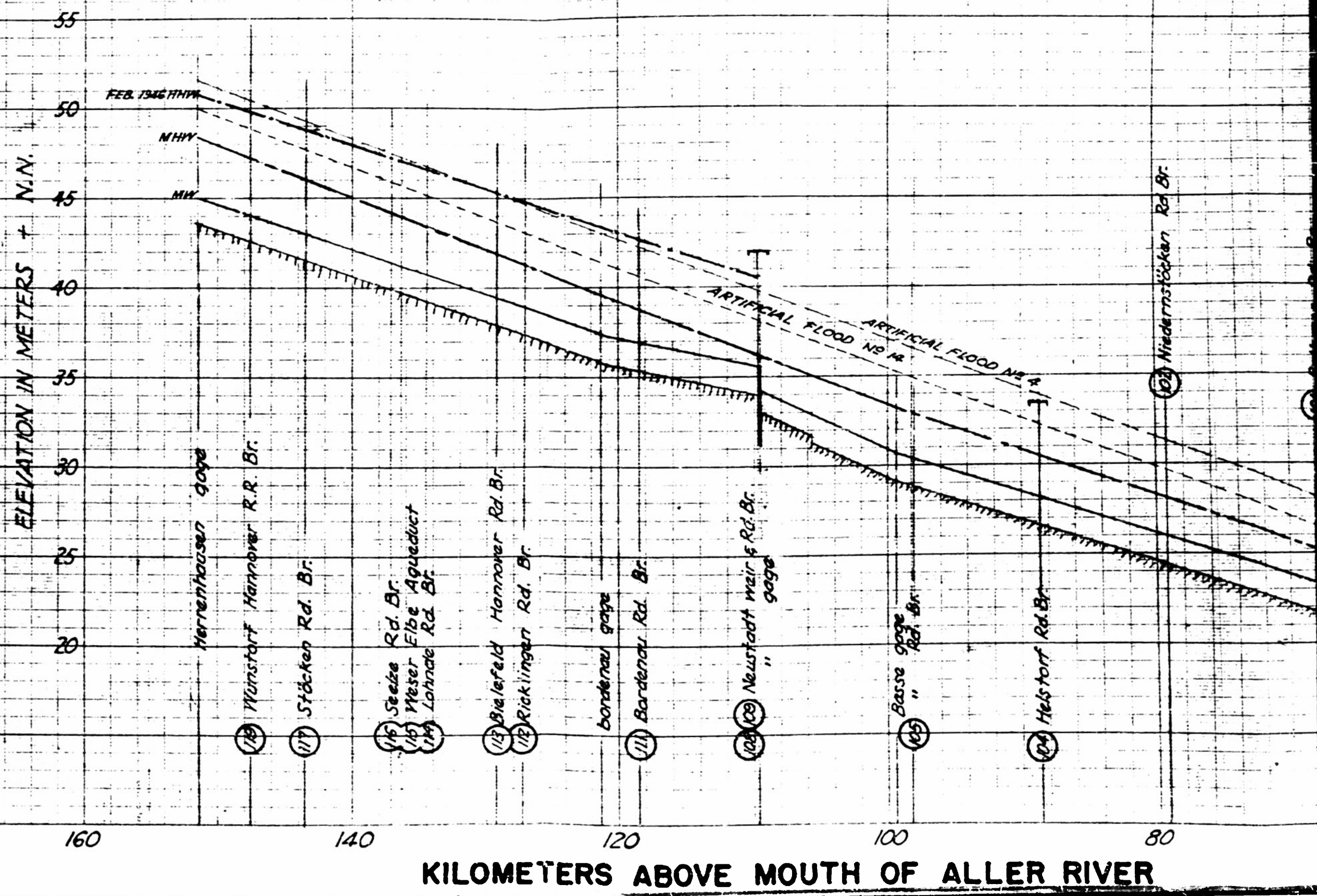
ALLER & LEINE RIVERS
PROFILE
LEINE RIVER

WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by _____ Date AUG. 52
Drawn by JH

240 220 200 180
KILOMETERS ABOVE MOUTH OF ALLER RIVER

PLATE 4






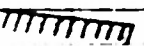
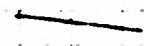
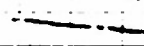
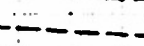

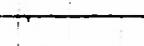
CONFIDENTIAL
SECURITY INFORMATION

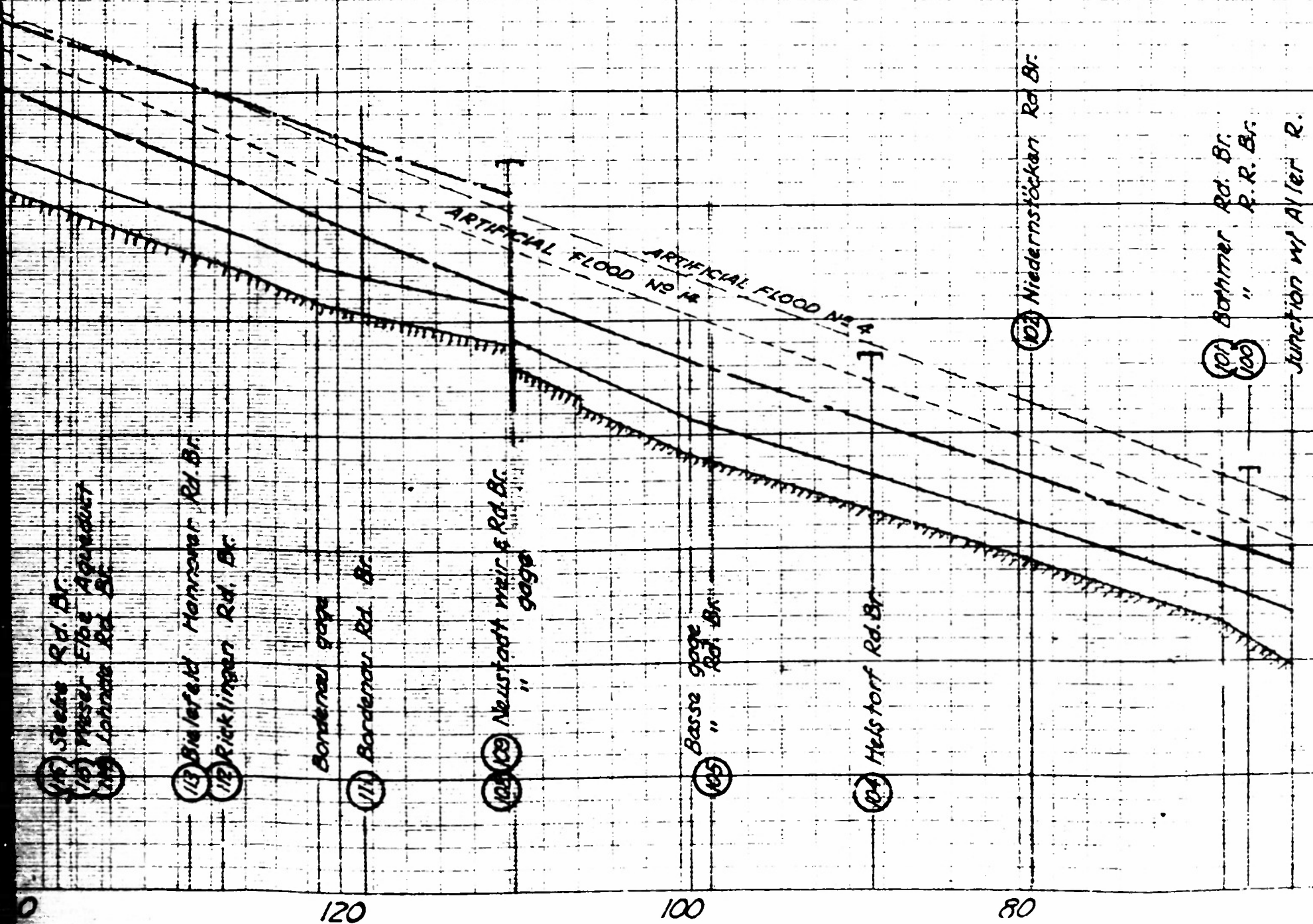


KILOMETERS ABOVE MOUTH OF ALLER RIVER

CONFIDENTIAL
SECURITY INFORMATION

LEGEND

-  River junction
-  Bridge showing clearance
-  Gage
-  Dam or lock
-  Serial No
-  Average channel bottom
-  Mean water
-  Mean High water
-  Natural Floods
-  Artificial Flood No 4
-  " " No 14



CONFIDENTIAL
SECURITY INFORMATION

SHEET 2 OF 2

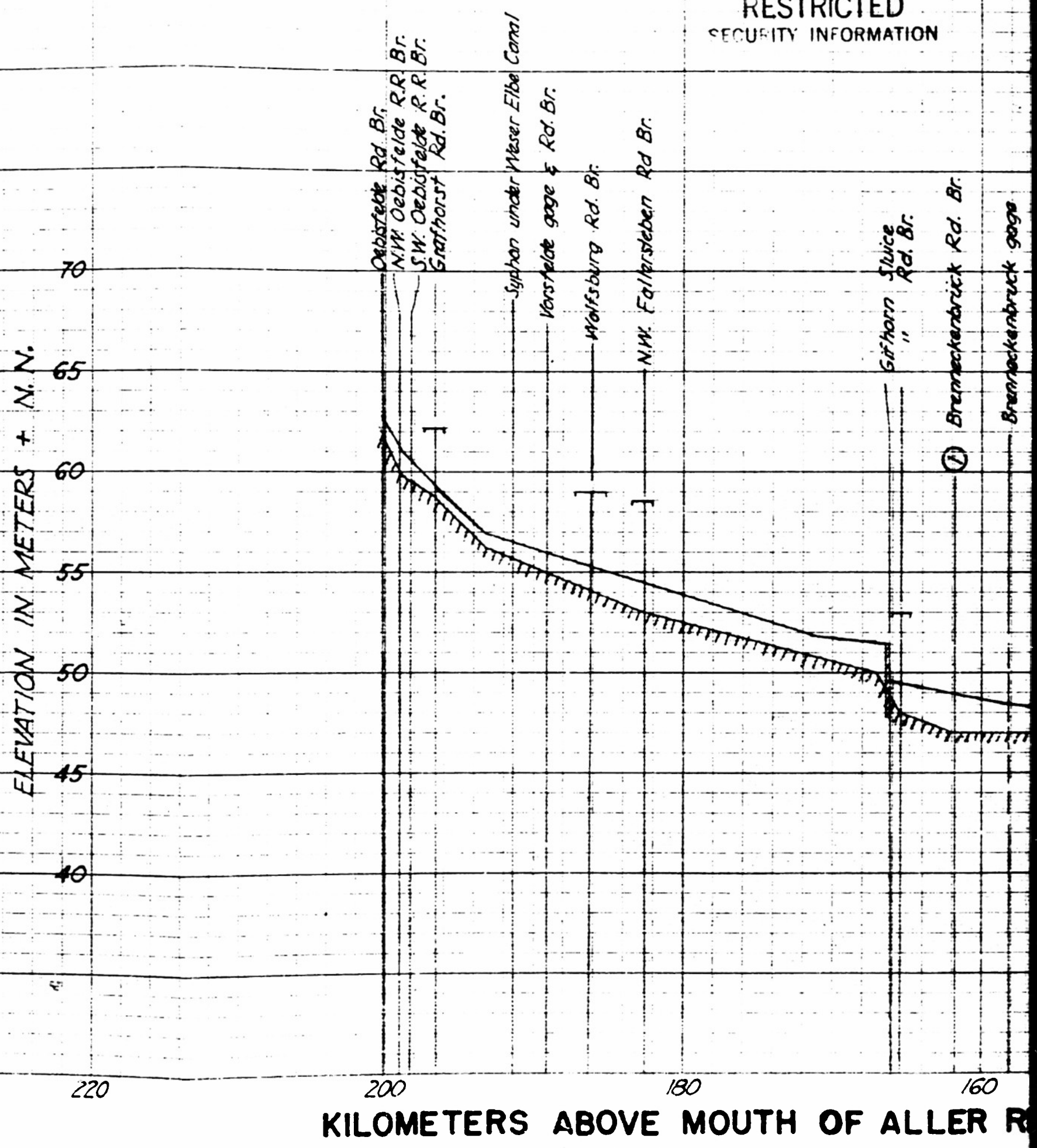
ALLER & LEINE RIVERS
PROFILE
LEINE RIVER

WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by _____ Date Aug. 52
Drawn by J.H.

PLATE 5

KILOMETERS ABOVE MOUTH OF ALLER RIVER







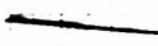
RESTRICTED
SECURITY INFORMATION

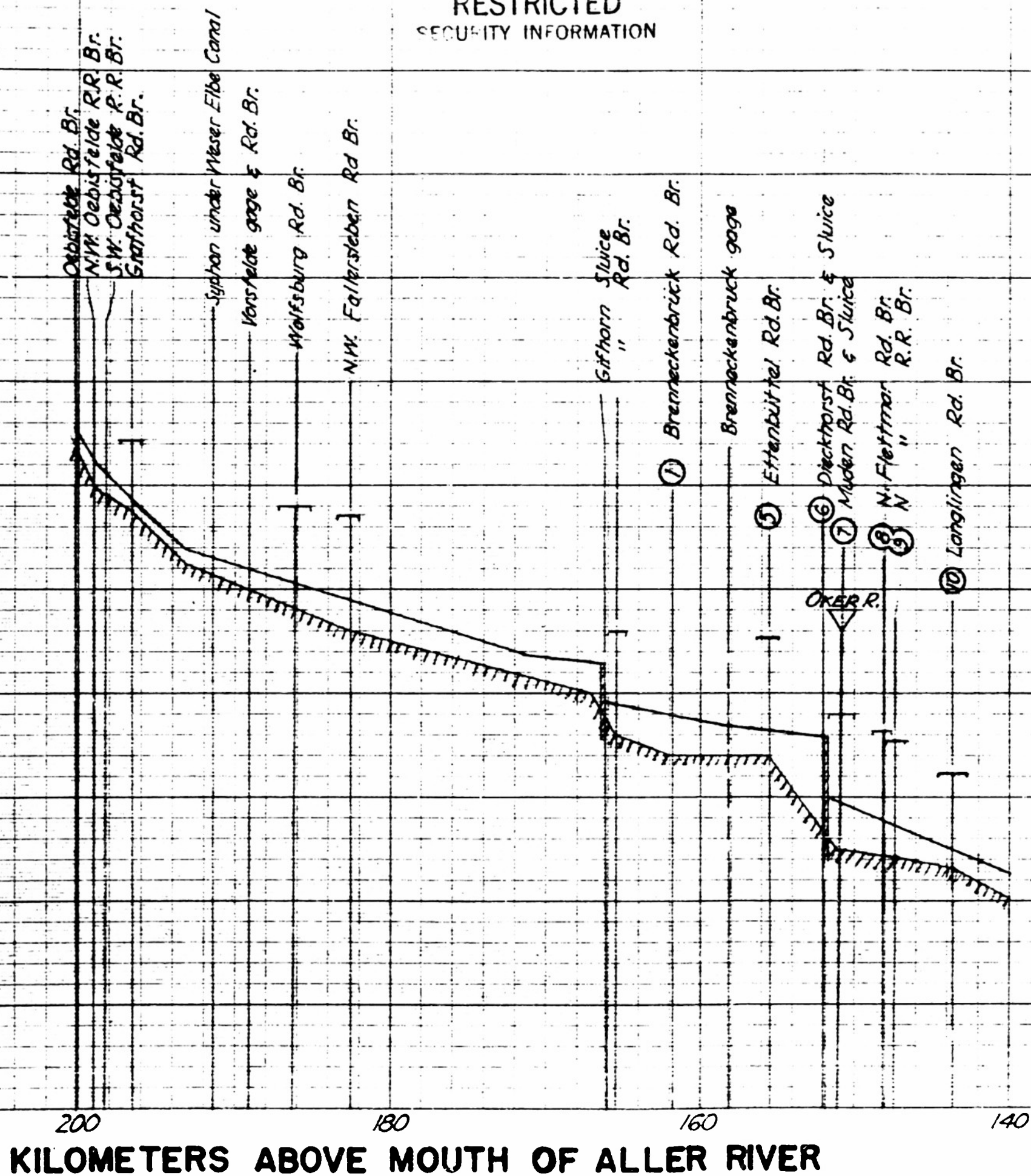


D

RESTRICTED
SECURITY INFORMATION

LEGEND

-  River junction
-  Bridge showing clearance
-  Gage
-  Dam or lock
-  Serial No
-  Average channel bottom
-  Mean water



RESTRICTED
SECURITY INFORMATION

SHEET 1 OF 2

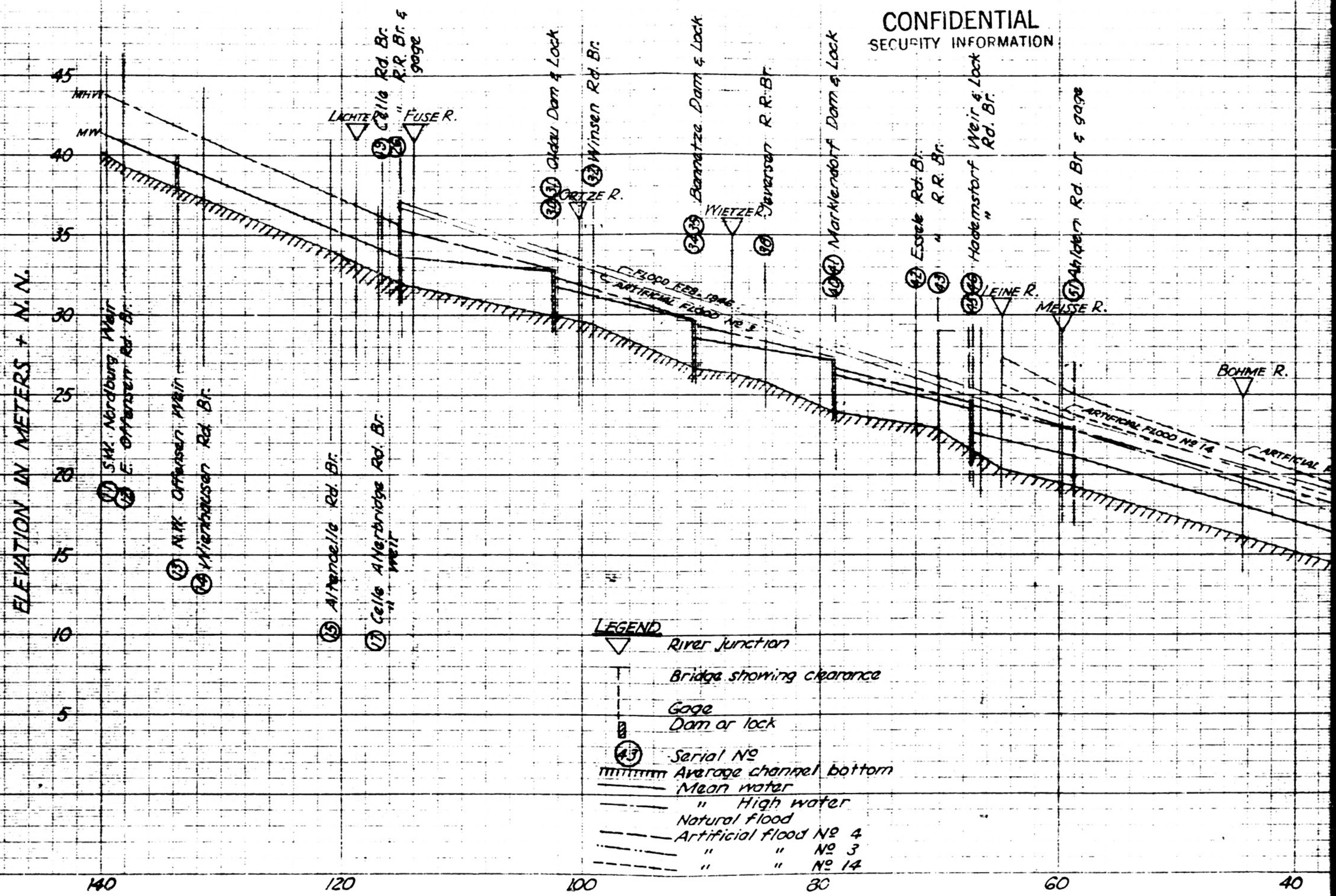
ALLER & LEINE RIVERS
PROFILE
ALLER RIVER

WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by VB Date Aug 1952
Drawn by LB

PLATE 6

KILOMETERS ABOVE MOUTH OF ALLER RIVER

CONFIDENTIAL
SECURITY INFORMATION



ELEVATION IN METERS + N.N.

- LEGEND**
- River junction
 - Bridge showing clearance
 - Gage
 - Dam or lock
 - Serial No
 - Average channel bottom
 - Mean water
 - High water
 - Natural flood
 - Artificial flood No 4
 - " " No 3
 - " " No 14

140

120

100

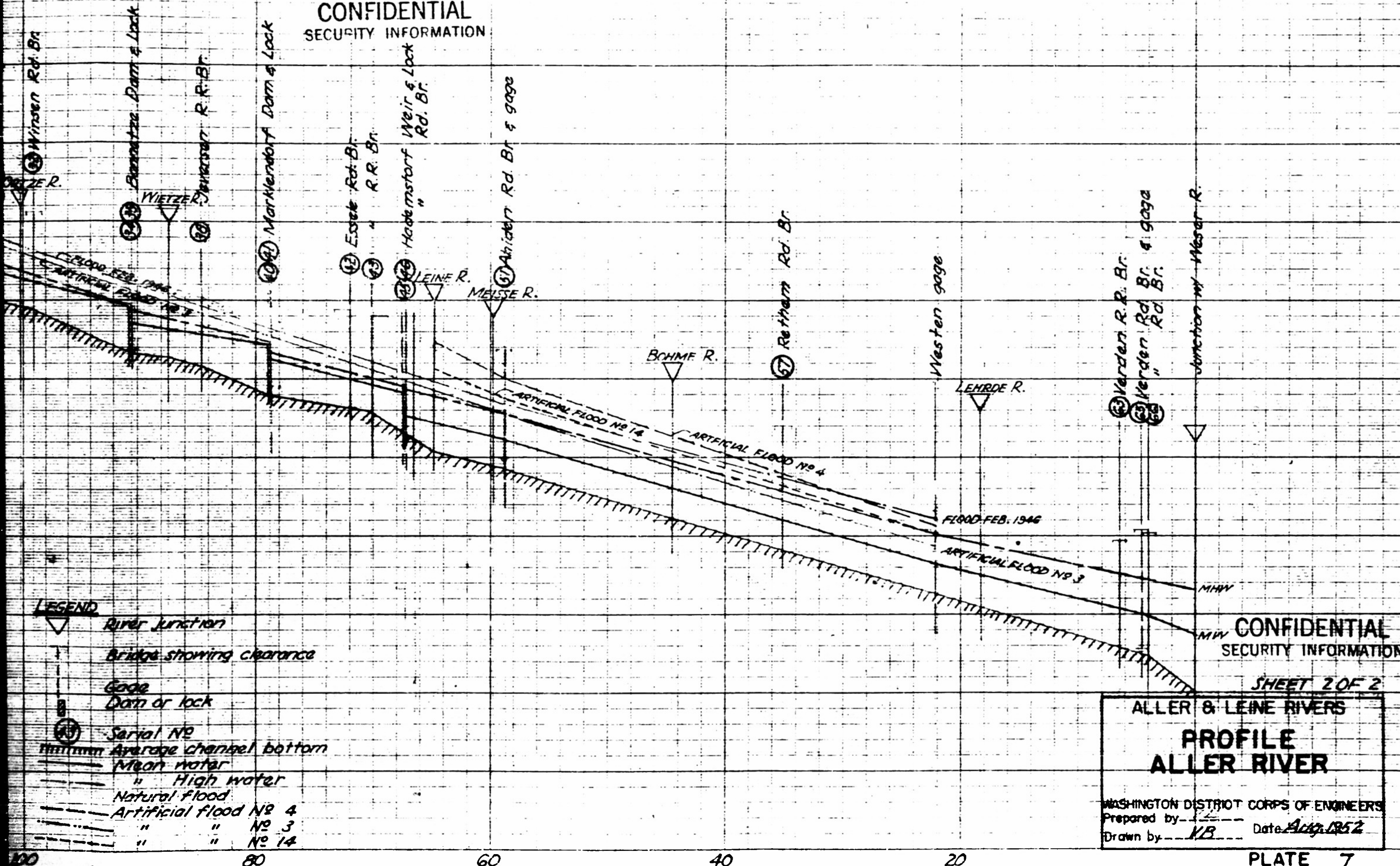
80

60

40

KILOMETERS ABOVE MOUTH OF ALLER RIVER

CONFIDENTIAL
SECURITY INFORMATION



- LEGEND**
- River junction
 - Bridge showing clearance
 - Dam or lock
 - Serial No
 - Minimum Average channel bottom
 - Mean water
 - " High water
 - Natural flood
 - Artificial flood No 4
 - " " No 3
 - " " No 14

CONFIDENTIAL
SECURITY INFORMATION

SHEET 2 OF 2

ALLER & LEINE RIVERS

PROFILE

ALLER RIVER

WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by Date Aug. 1952
Drawn by VB

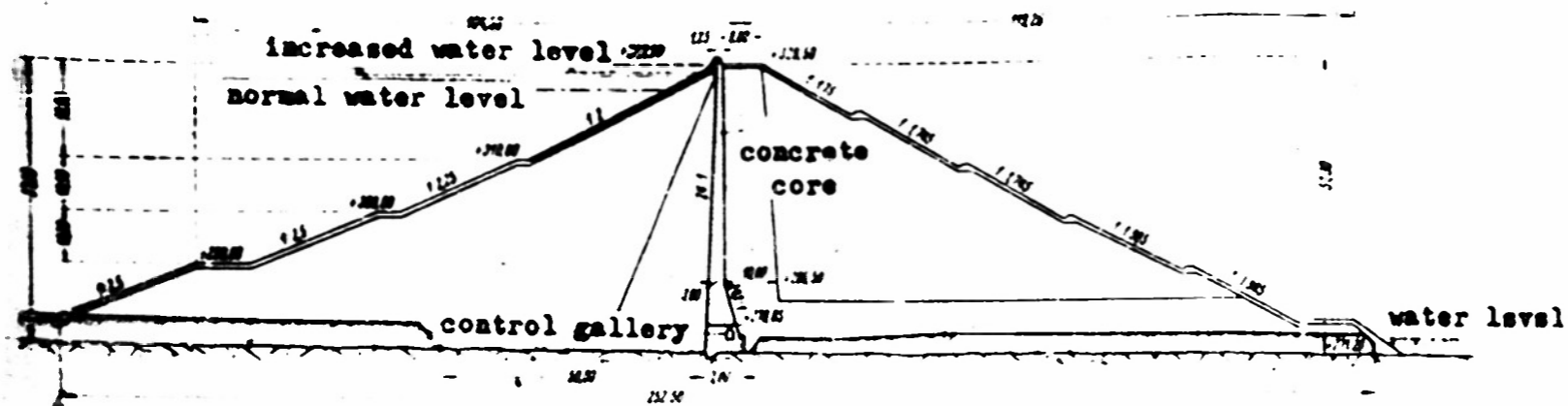


Fig. I: Soese Dam - Cross section of main dam

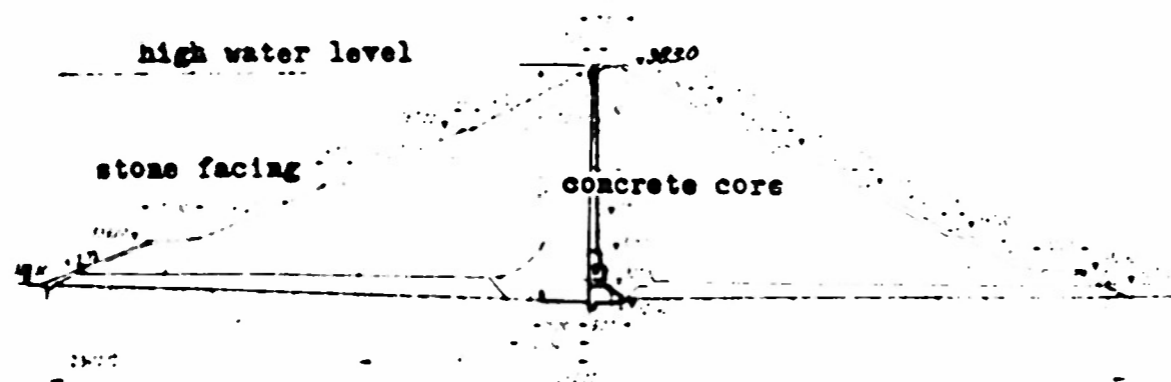


Fig III Oder dam - Hartz: Cross section of main dam

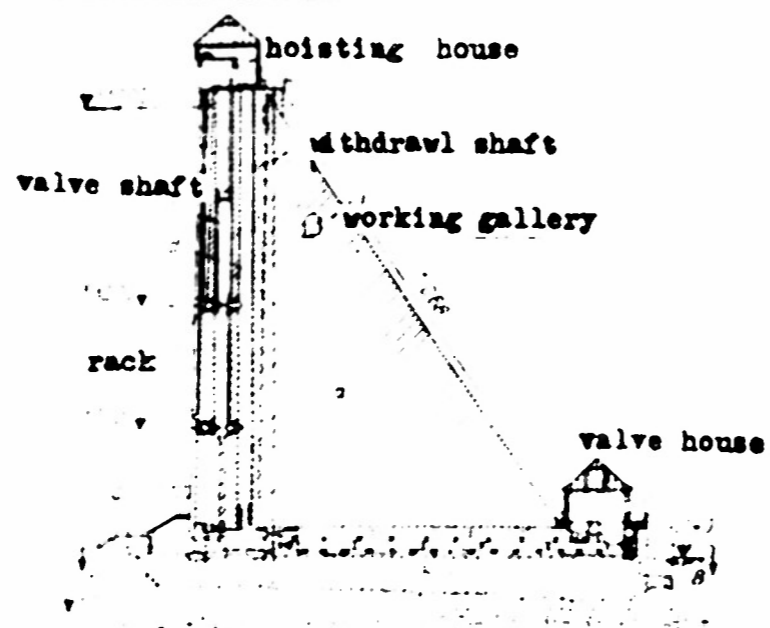


Fig. V Ecker Dam: Cross section



Fig. II Soese Dam - Section thru

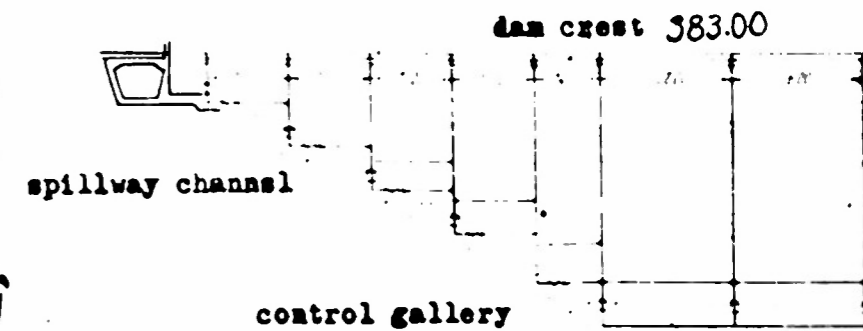


Fig. IV Oder Dam - Hartz: Cross section

Ref:
 Fig I "Bautechnik", Dec. 1936, p 756
 Fig II "Bautechnik", Dec. 1936, p 752
 Fig III "V D I", Aug. 1936, p 1064
 Fig IV "Bautechnik", Dec. 1936 p 753
 Fig V "V D I", Feb. 1948 ; p 38

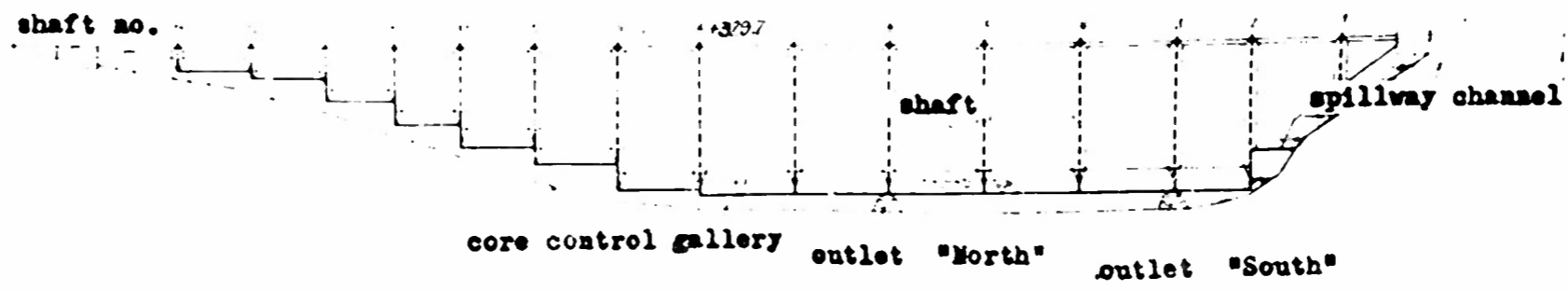
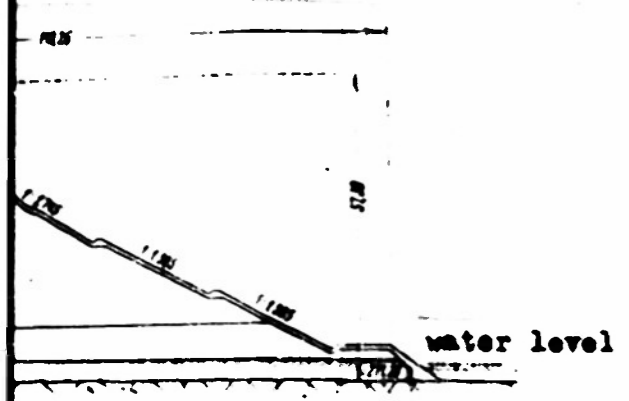


Fig. II Soese Dam - Section thru concrete core from downstream

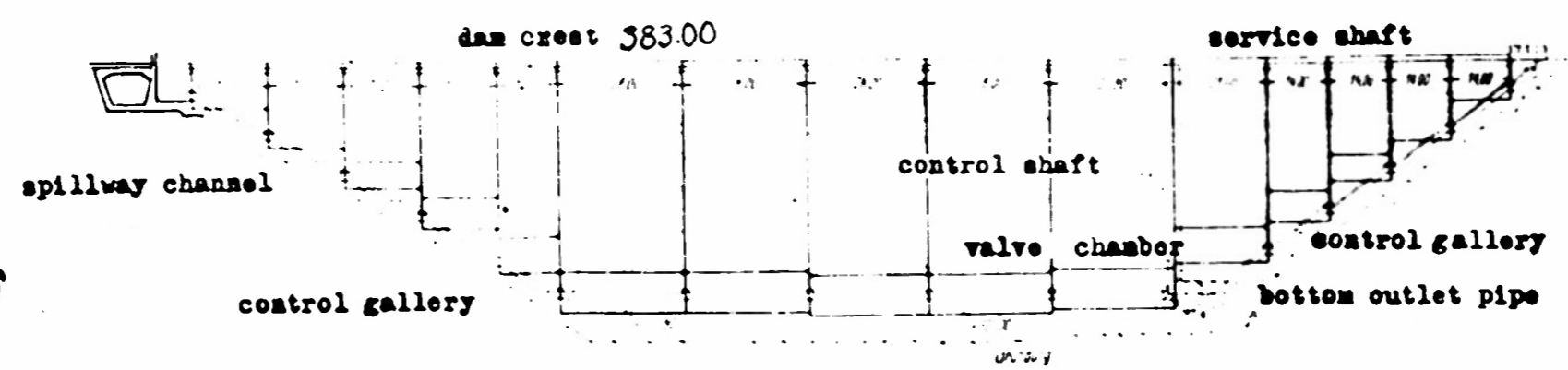
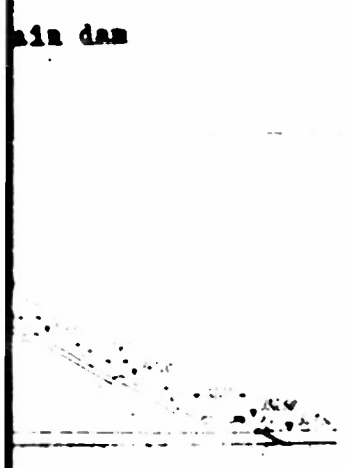
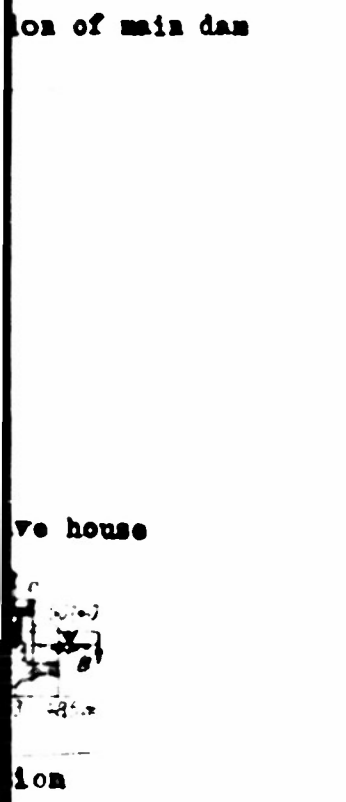
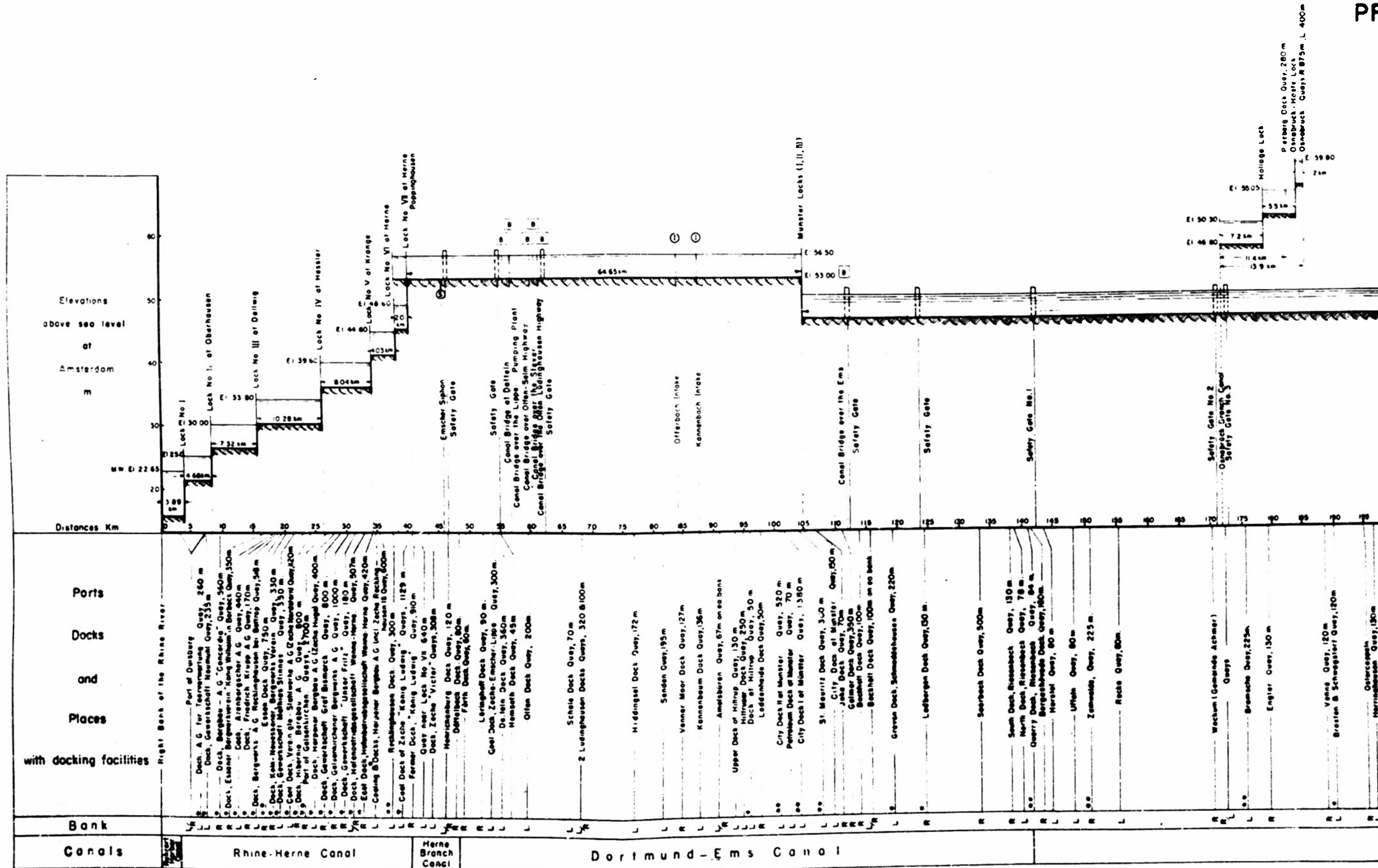


Fig. IV Oder Dam - Hartz: Cross section thru concrete core from downstream.



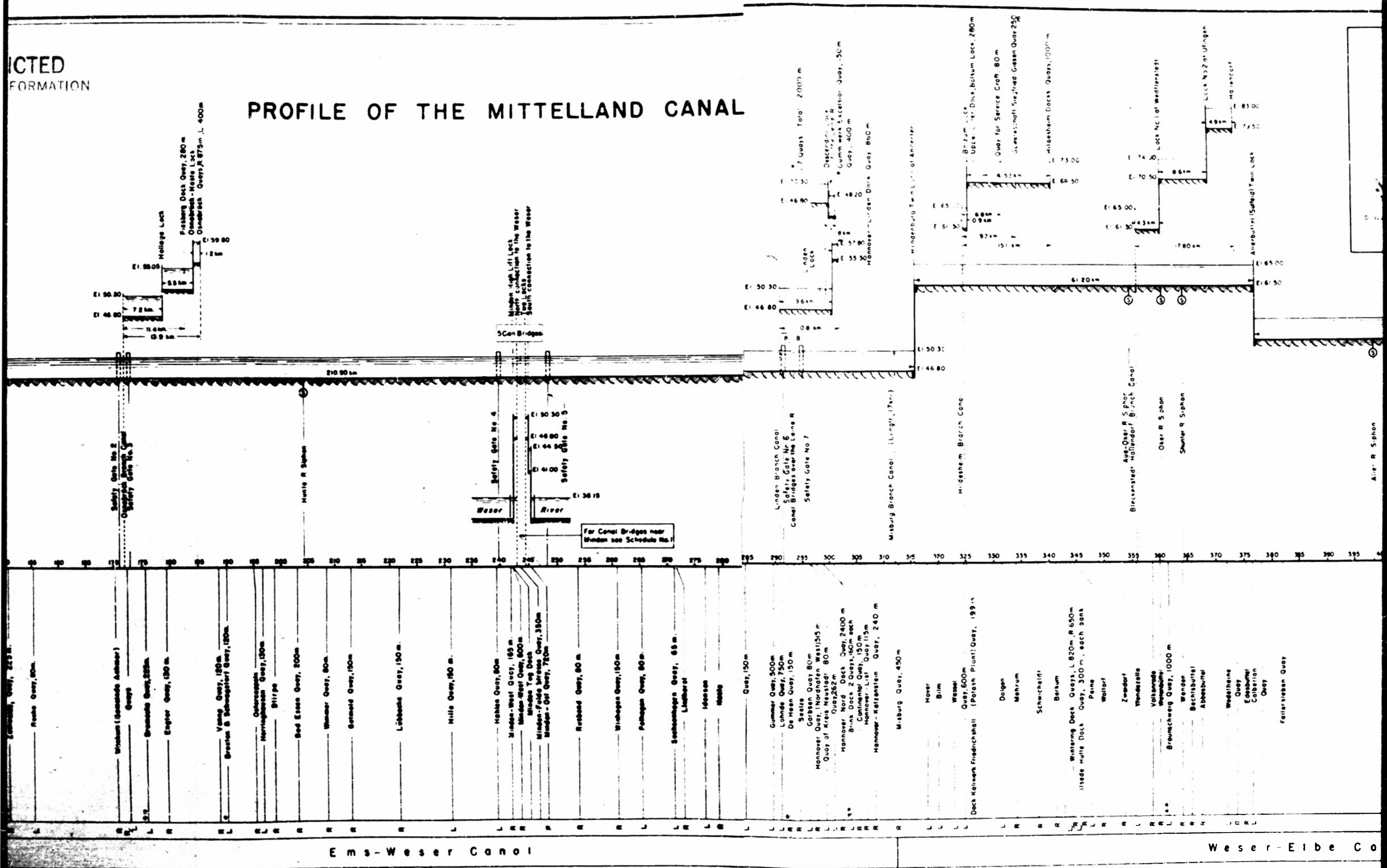
Ref:
 Fig I "Bautechnik", Dec. 1936, p 756
 Fig II "Bautechnik", Dec. 1936, p 752
 Fig III "V D I", Aug. 1936, p 1064
 Fig IV "Bautechnik", Dec. 1936 p 753
 Fig V "V D I", Feb. 1948 ; p 38

ALLER & LEINE RIVERS
 SKETCHES
 VALLEY DAMS
 WASHINGTON DISTRICT CORPS OF ENGINEERS
 Prepared by L.B. Date Aug-1952
 Drawn by _____



ICTED
FORMATION

PROFILE OF THE MITTELLAND CANAL

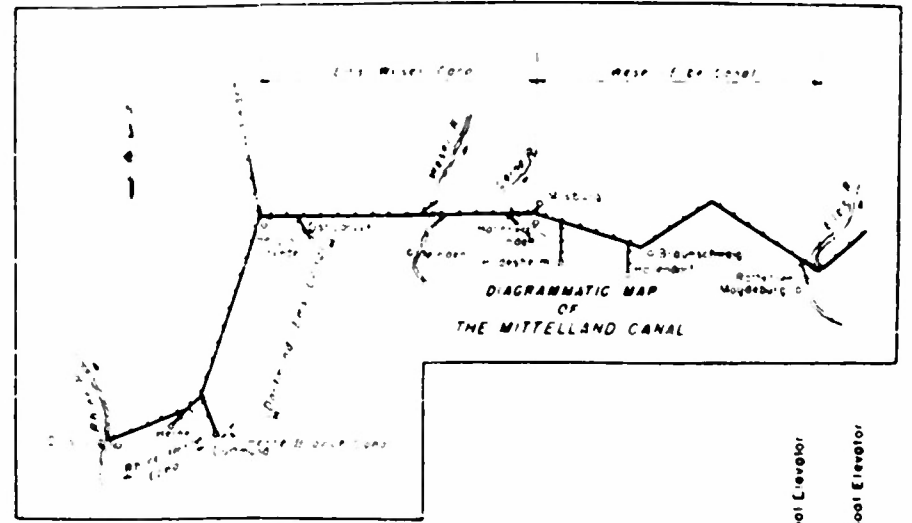
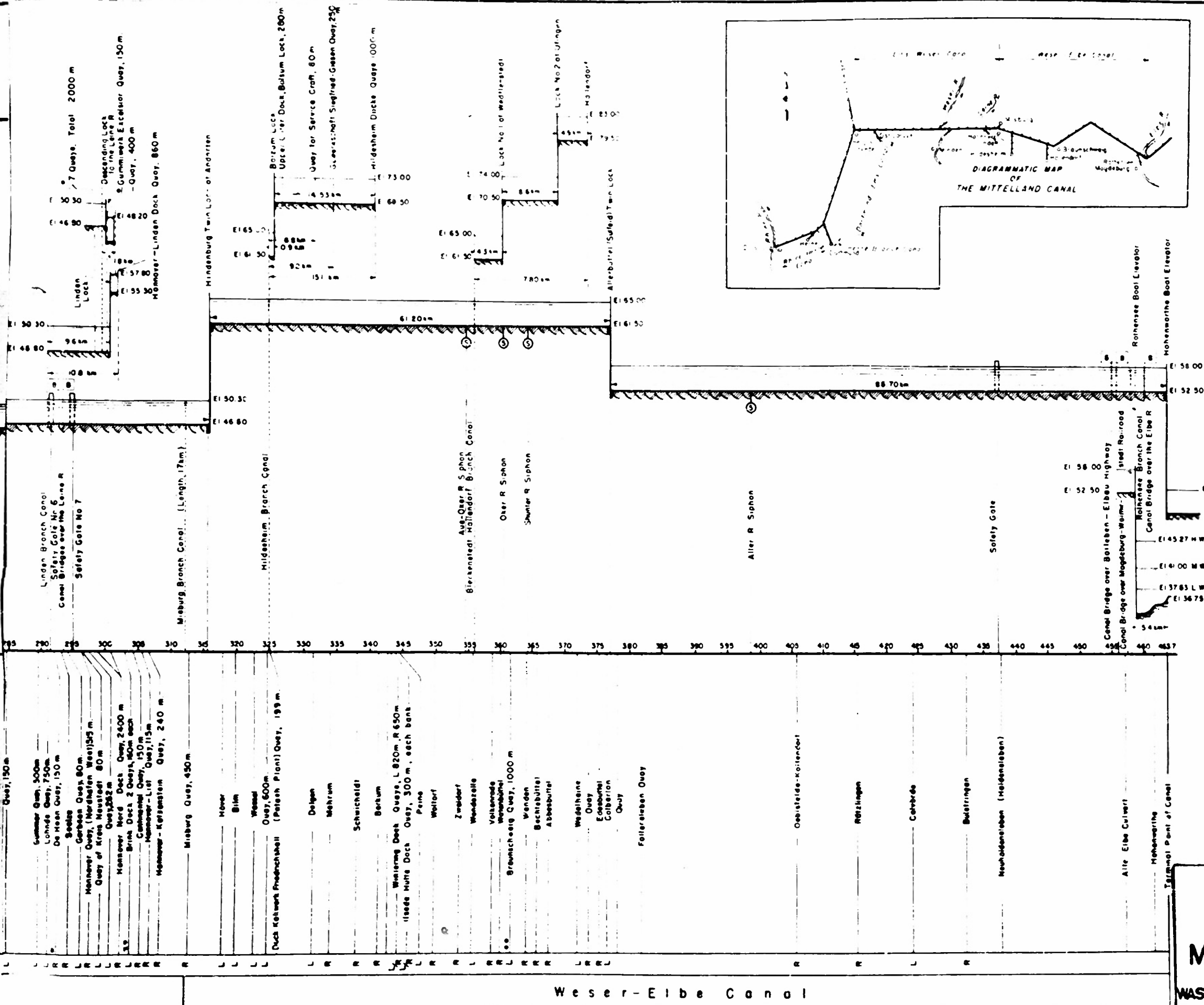


Ems-Weser Canal

Weser-Elbe Co

FIG 15-4

CANAL



Reproduced from
 "NAVIGABLE WATER-
 WAYS OF GERMANY"
 S.E.S. 128, O.C.E.
 U.S.A., August,
 1944.

SCHEDULE NO. 1
 Canal Bridges near Minden

| km Point | Canal Bridges |
|----------|---|
| 2437 | Canal Bridge over Werffstrasse |
| 2438 | Canal Bridge over the Wesel |
| 2443 | Canal Bridge over Friedrich Wilhelm Strasse |
| 2463 | Canal Bridge over Dankersen-Hessenkamp Road |
| 2471 | Canal Bridge over Dankersen Common Road |

RESTRICTED
 SECURITY INFORMATION

ALLER & LEINE RIVERS
 PROFILE
 MITTELLAND CANAL
 WASHINGTON DISTRICT CORPS OF ENGINEERS
 Prepared by J.J.H. Date Aug 1952
 Drawn by _____

RESTRICTED
SECURITY INFORMATION

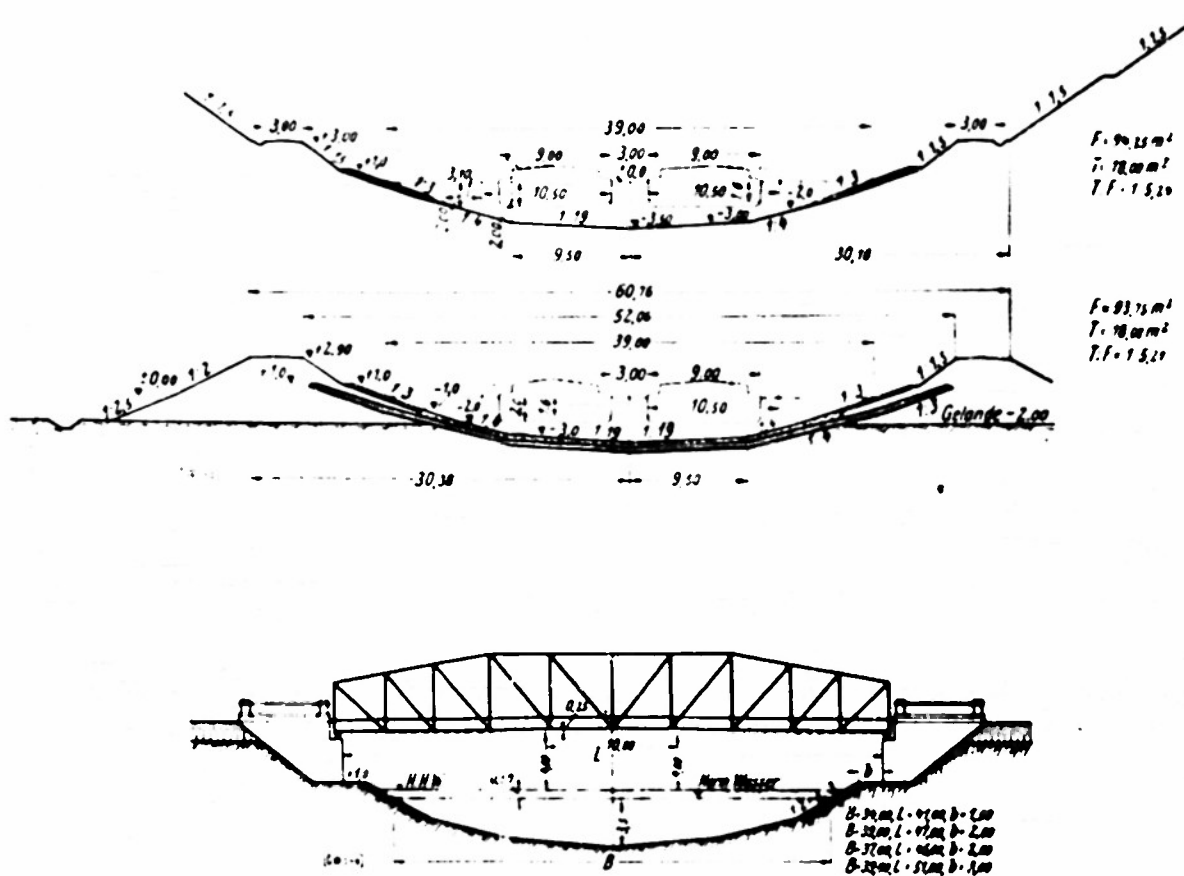


Fig. 15-7
Standard Cross Sections of the Mittelland Canal in Cuts,
on Embankments, and Under Bridges

- F - Wet cross section of canal prism
- T - Wet cross section of boat
- B - Canal width at the surface, at regulation water level
- b - Berm
- L - Horizontal clearance between abutments

RESTRICTED
SECURITY INFORMATION

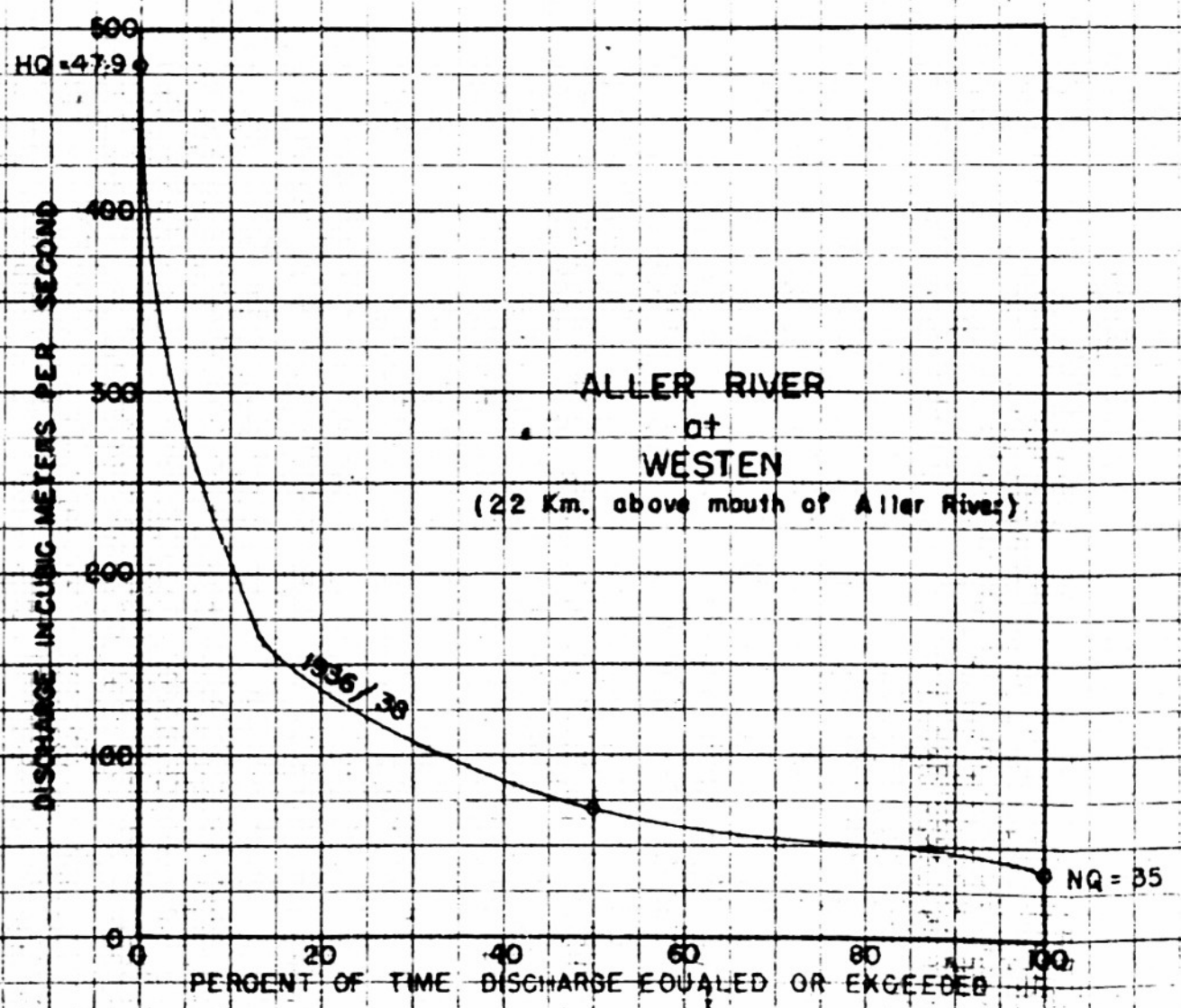
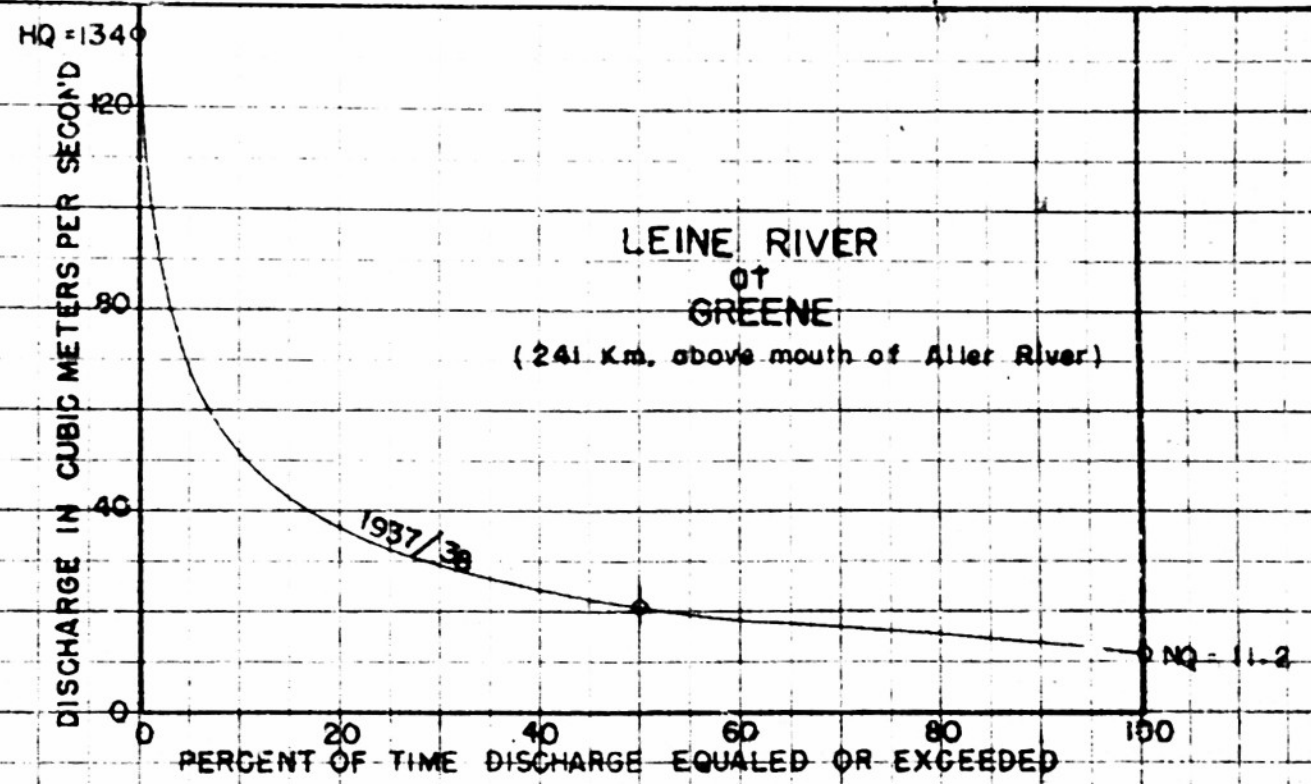
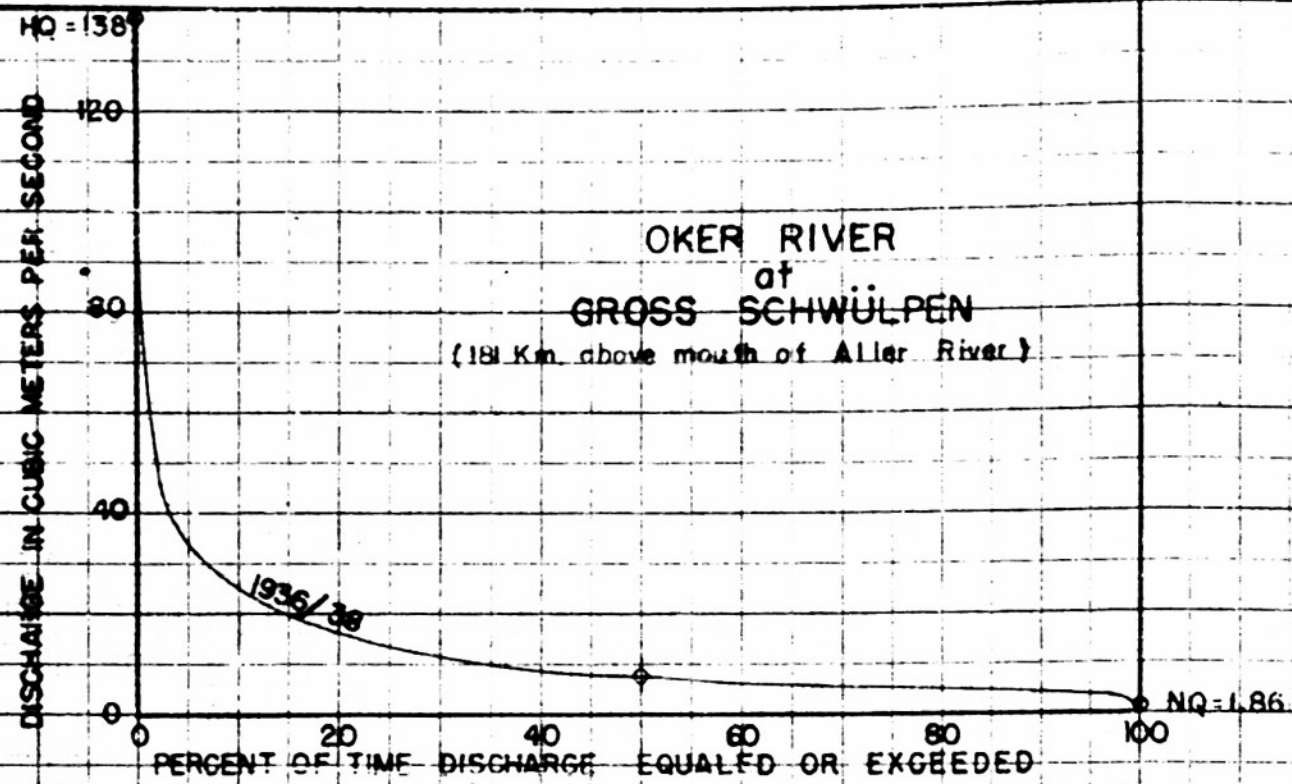
On newly constructed German canals the ratio T:F is kept
within the limits of 1:4 or 1:5.

REPRODUCED FROM "NAVIGABLE WATERWAYS OF GERMANY"
S.E.S. 128, O.C.E., U.S.A., AUGUST, 1944.

ALLER & LEINE RIVERS
CROSS SECTIONS
MITTELLAND CANAL

WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by J.J.H. Date Aug 1952
Drawn by _____

PLATE II

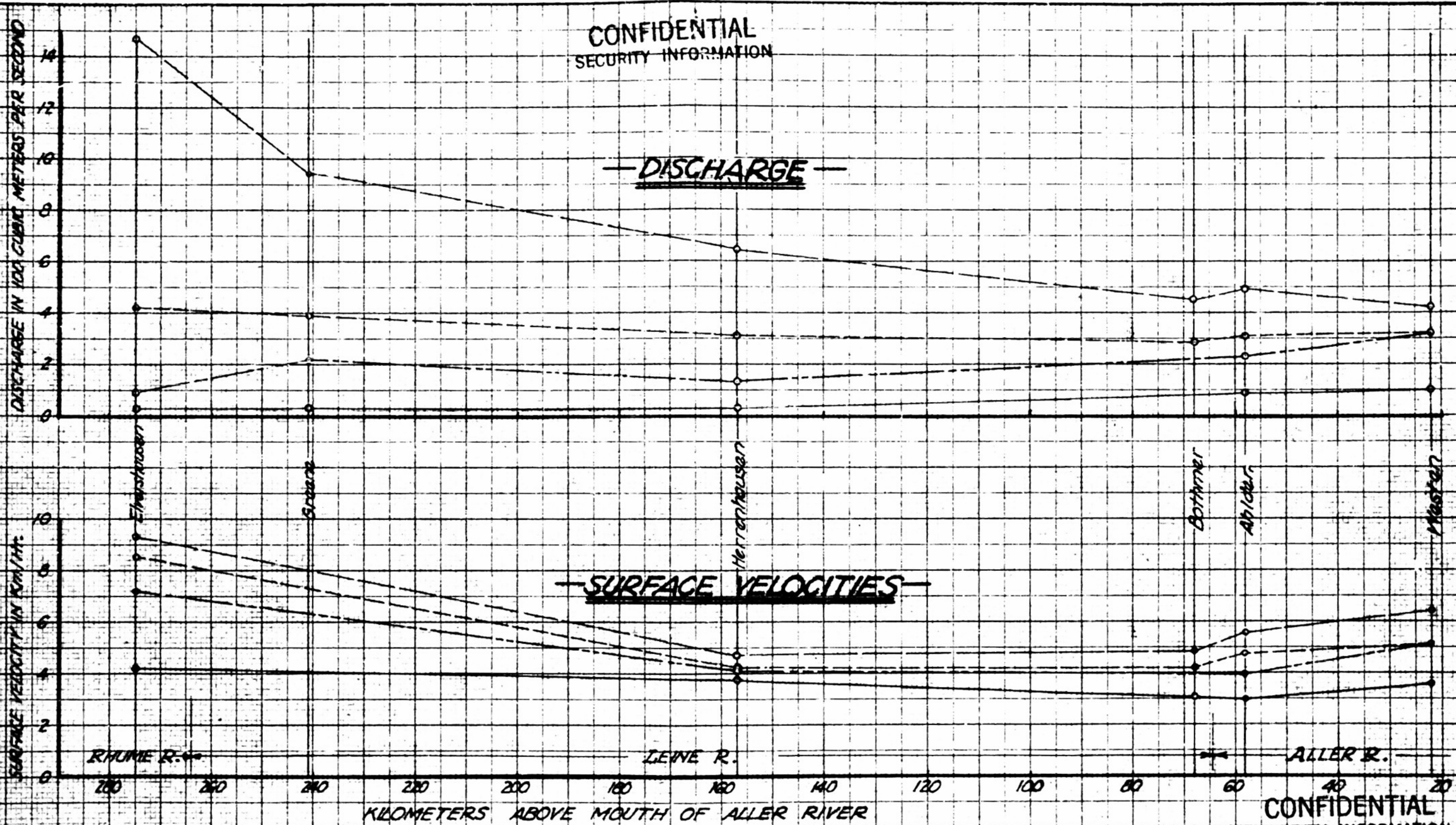


SOURCE: Jahrbuch für die Gewässerkunde
des Deutschen Reichs, Abflussjahr 1938

**ALLER & LEINE RIVERS
FLOW DURATION
CURVES**

WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by *F.B.B.* Date *Aug 4, 1952*
Drawn by *J.W.H.*

CONFIDENTIAL
SECURITY INFORMATION



LEGEND

- Combined Söse & Oder breaches - Artificial Flood No 4
- Combined Söse & Oder flow variation - Artificial Flood No 14
- MHVY
- MW
- o Computed value

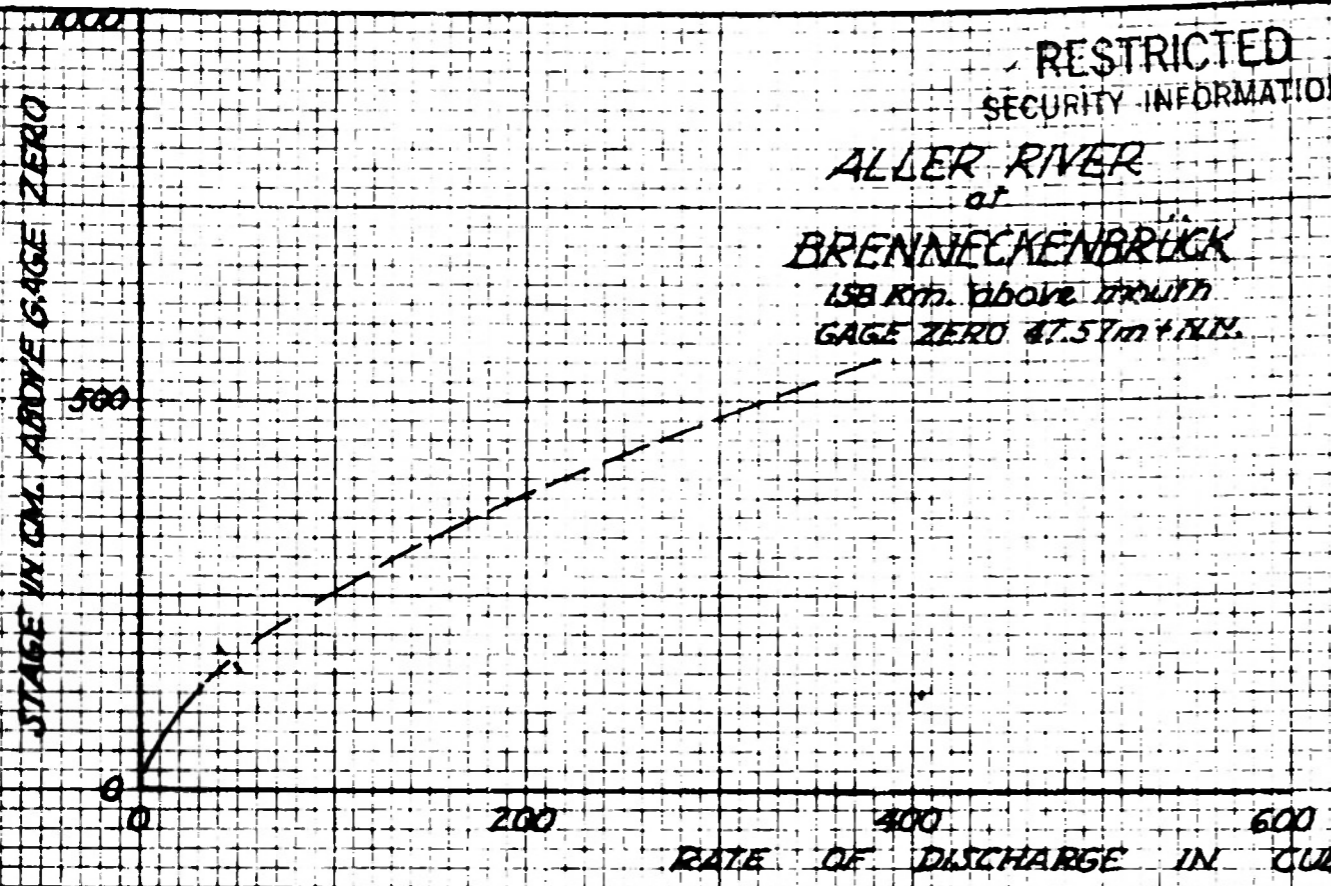
CONFIDENTIAL
SECURITY INFORMATION

ALLER & LEINE RIVERS
DISCHARGE & VELOCITY PROFILES

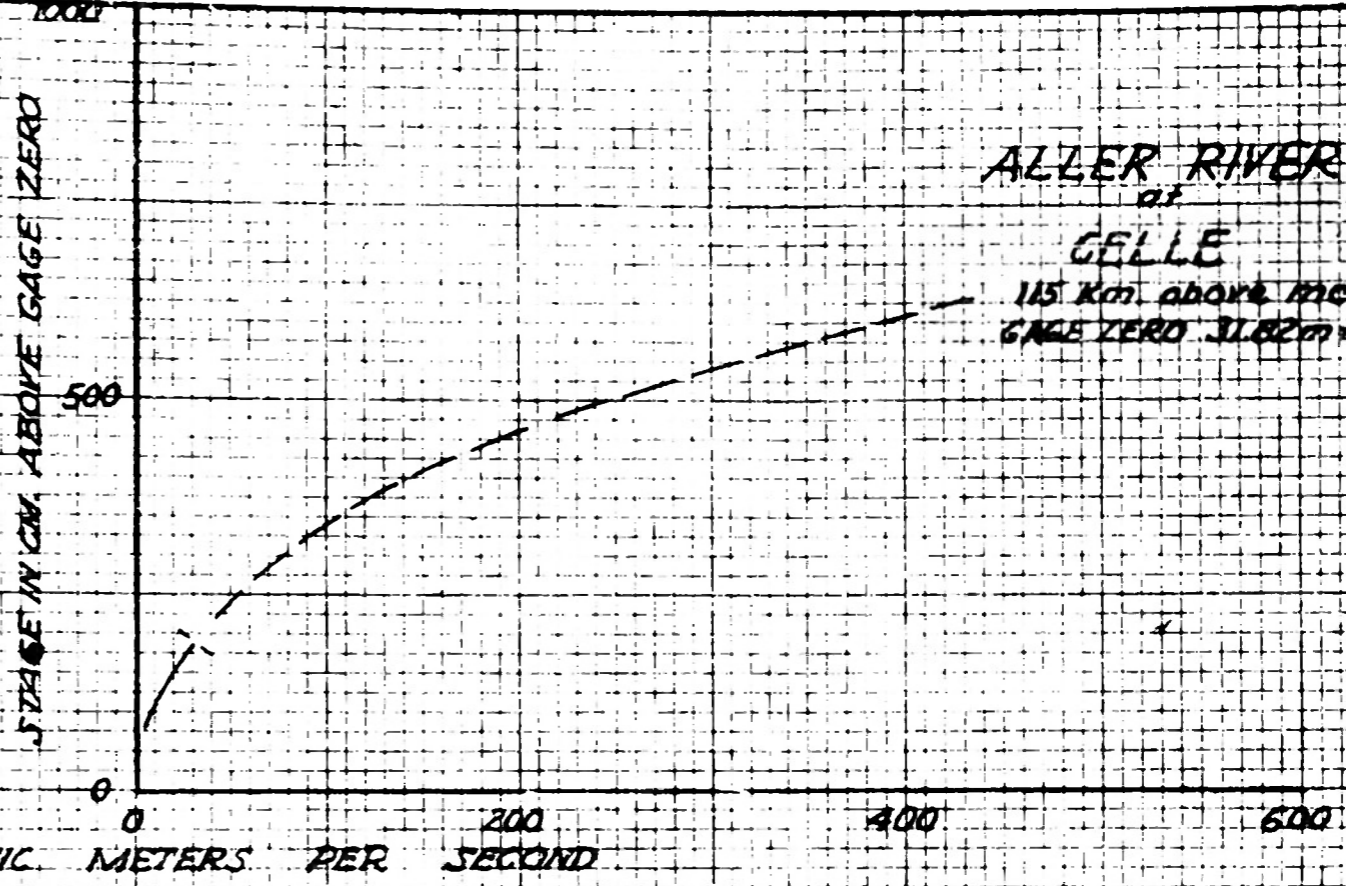
WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by VB Date Aug 52
Drawn by VB

RESTRICTED
SECURITY INFORMATION

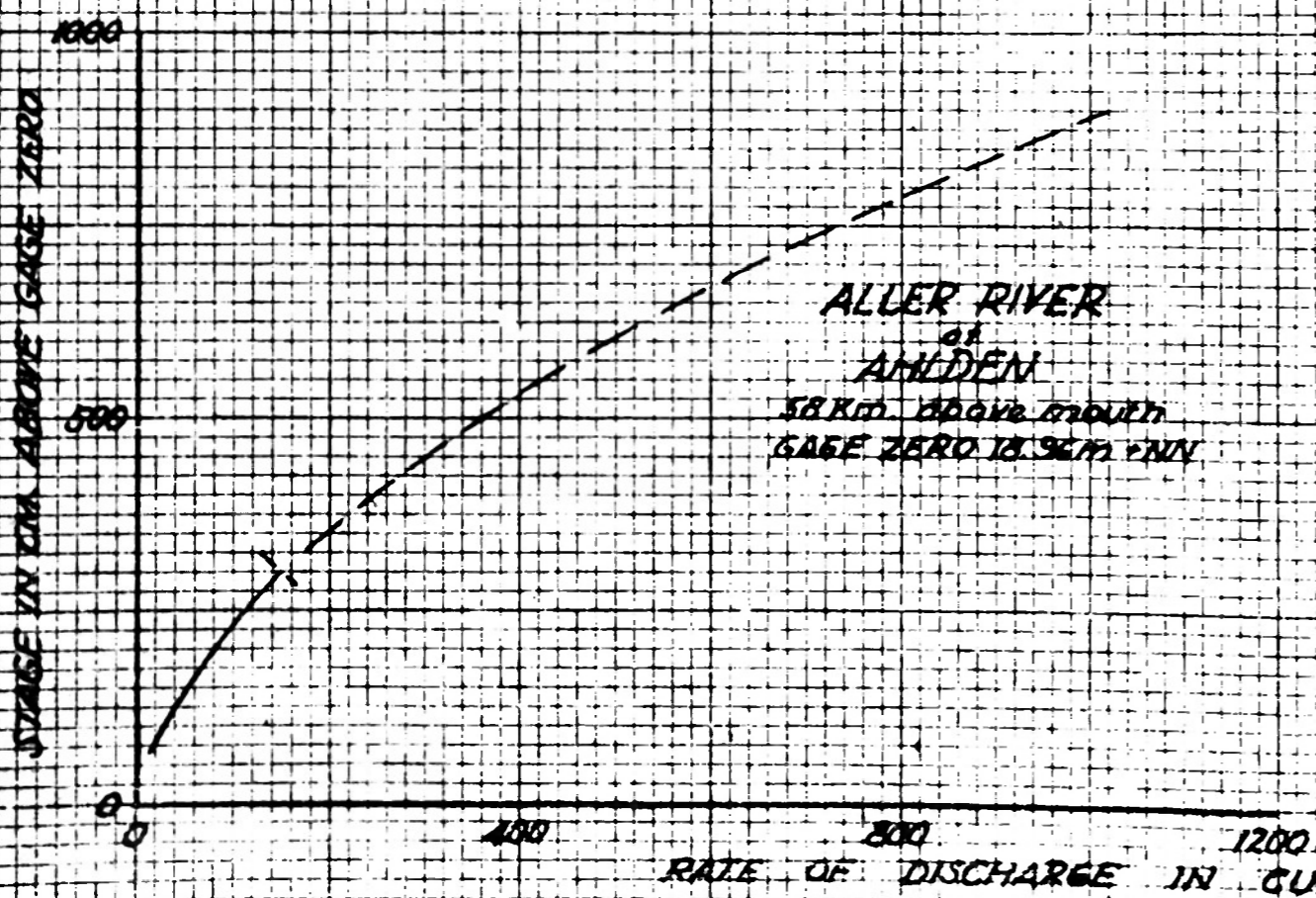
ALLER RIVER
at
BRENNECKENBRÜCK
158 Km. above mouth
GAGE ZERO 47.57m FNN.



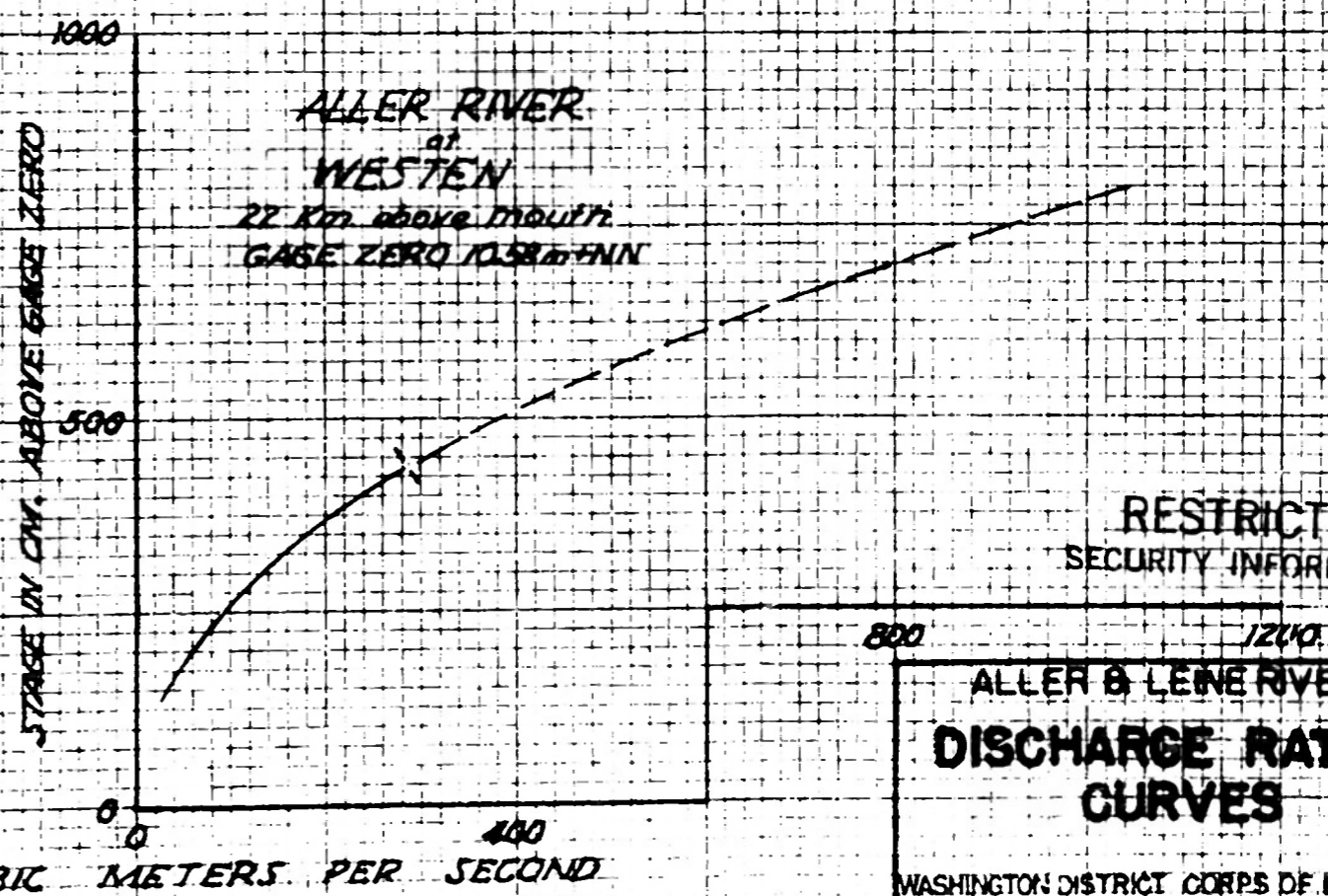
ALLER RIVER
at
CELLE
115 Km. above mouth
GAGE ZERO 31.82m FNN.



ALLER RIVER
at
AHLDEN
58 Km. above mouth
GAGE ZERO 18.96m FNN.



ALLER RIVER
at
WESTEN
27 Km. above mouth
GAGE ZERO 10.58m FNN.



RESTRICTED
SECURITY INFORMATION

ALLER & LEINE RIVERS
DISCHARGE RATING
CURVES

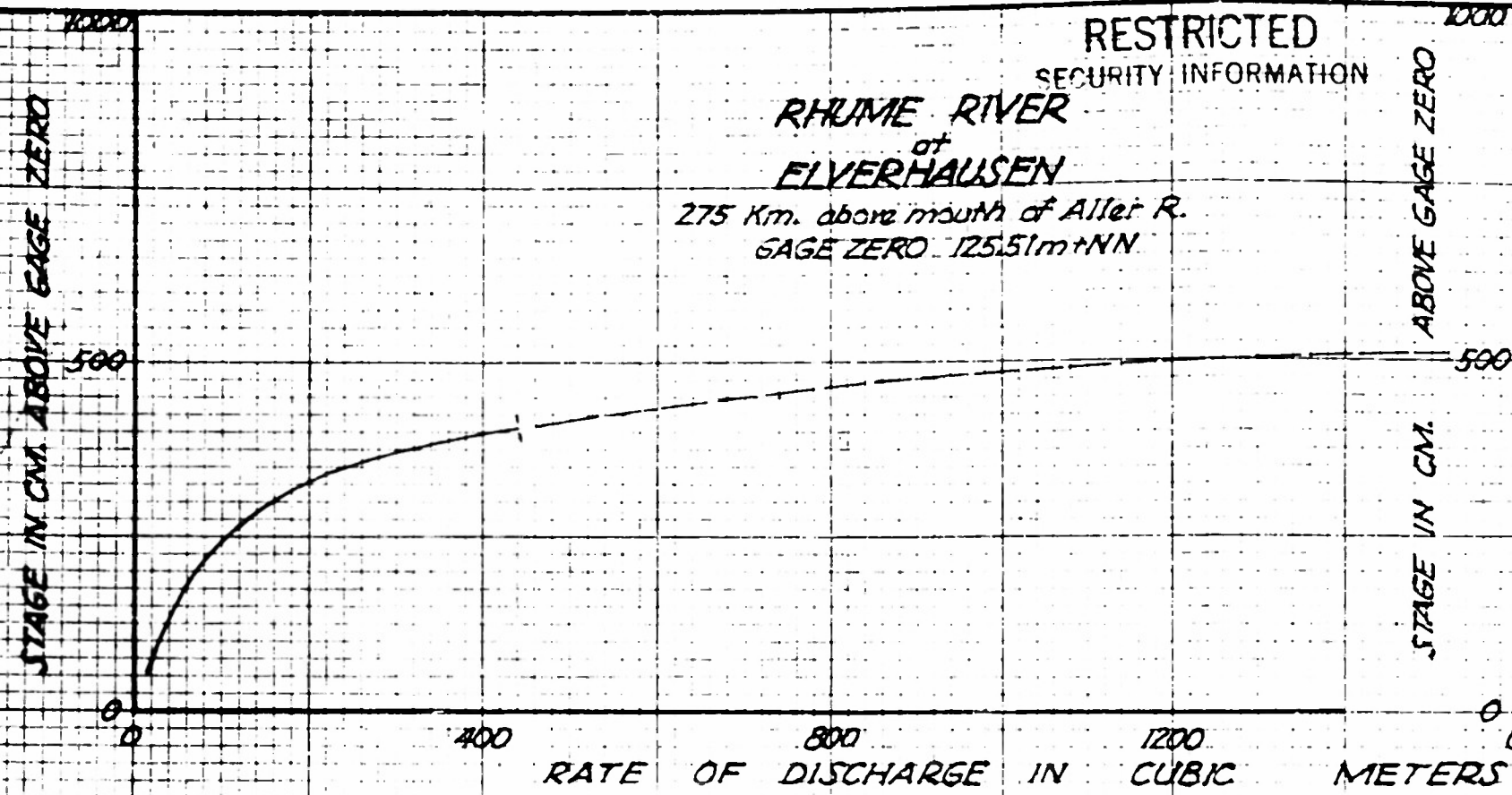
WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by _____ Date Aug 52
Drawn by NH

LEGEND: ——— Based on observed data
----- Estimated Extension

RESTRICTED
SECURITY INFORMATION

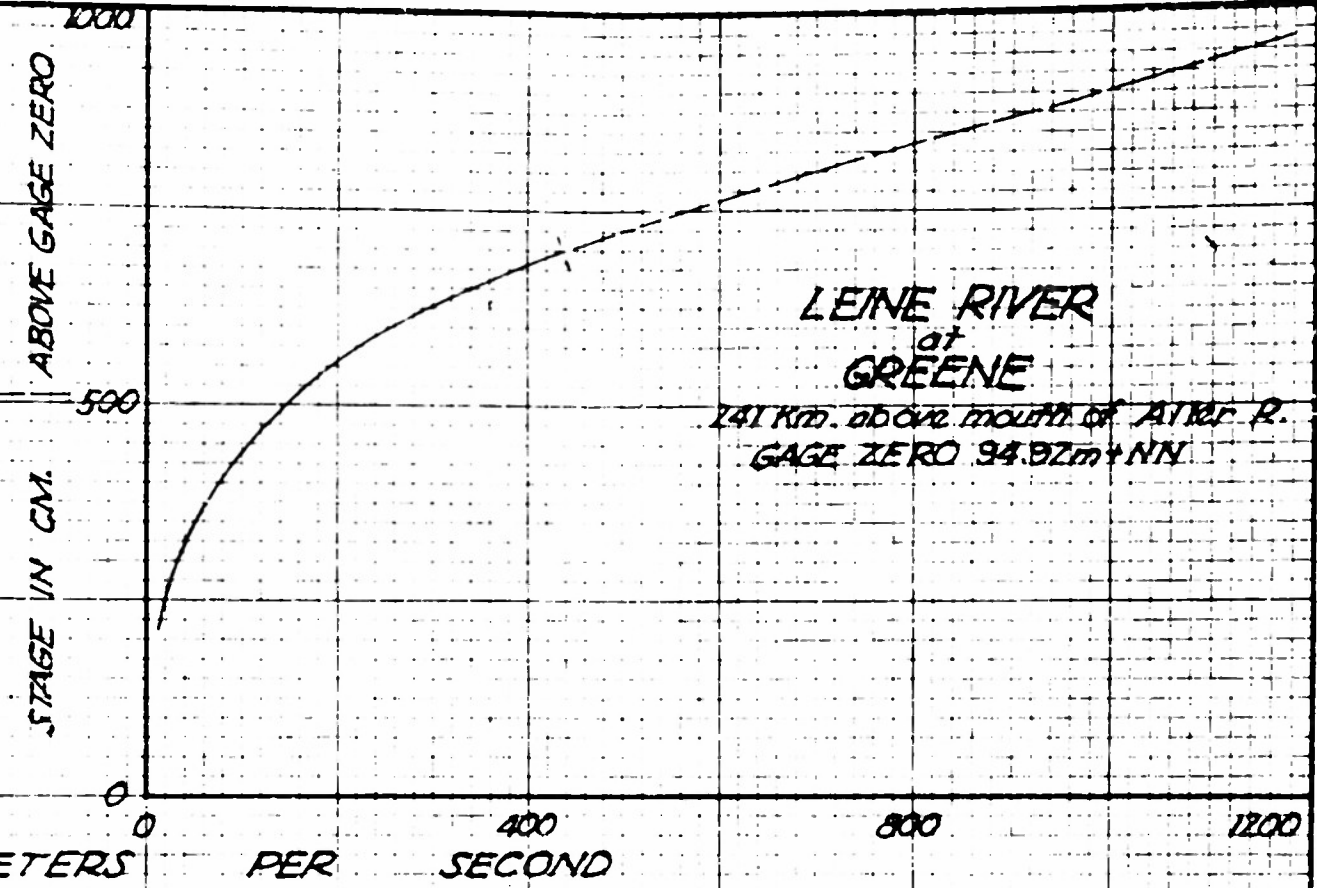
**RHUME RIVER
of
ELVERHAUSEN**

275 Km. above mouth of Aller R.
GAGE ZERO 125.51m+NN



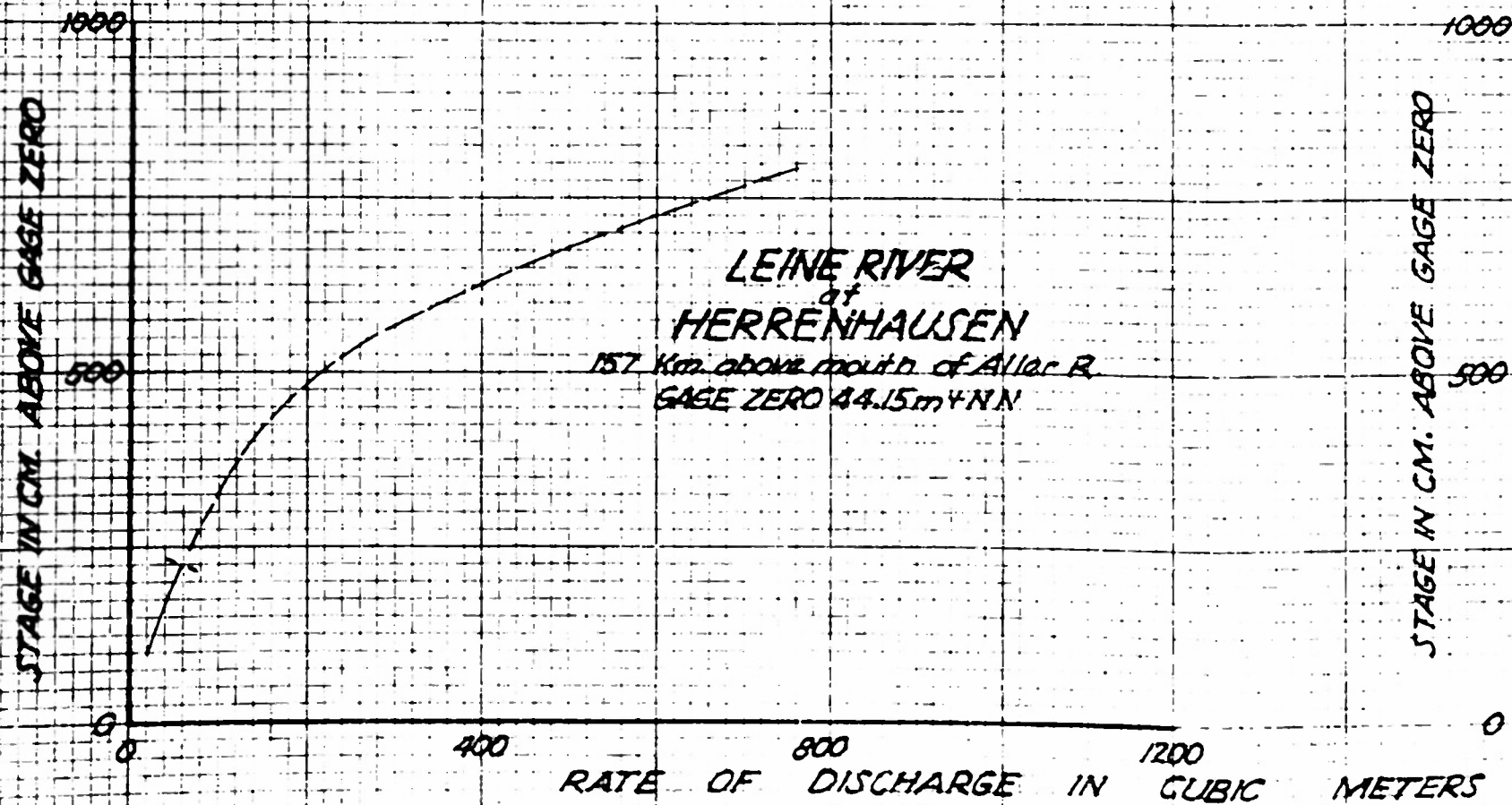
**LEINE RIVER
of
GREENE**

241 Km. above mouth of Aller R.
GAGE ZERO 94.92m+NN



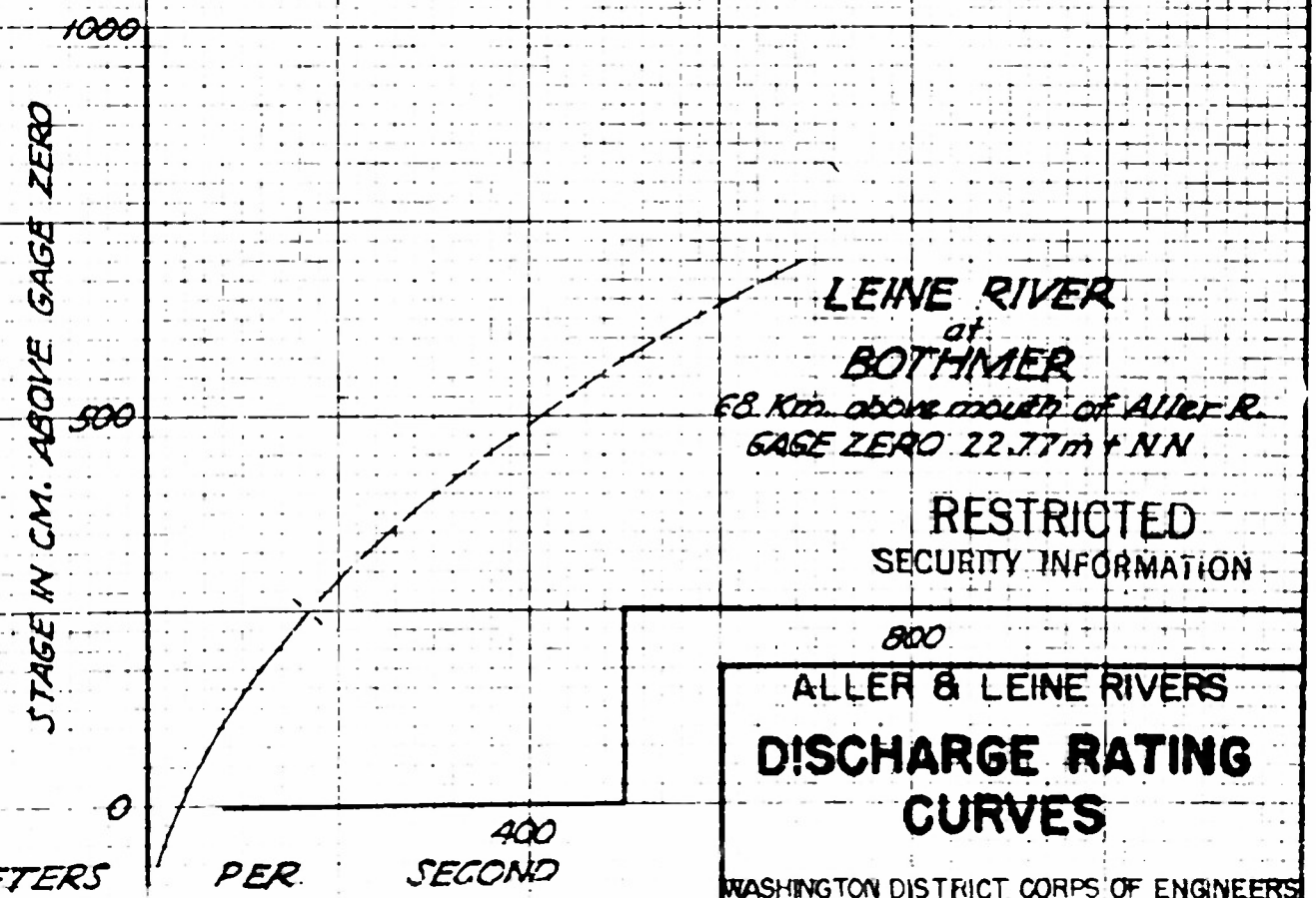
**LEINE RIVER
of
HERRENHAUSEN**

157 Km. above mouth of Aller R.
GAGE ZERO 44.15m+NN



**LEINE RIVER
of
BOTHMER**

68 Km. above mouth of Aller R.
GAGE ZERO 22.77m+NN



RESTRICTED
SECURITY INFORMATION

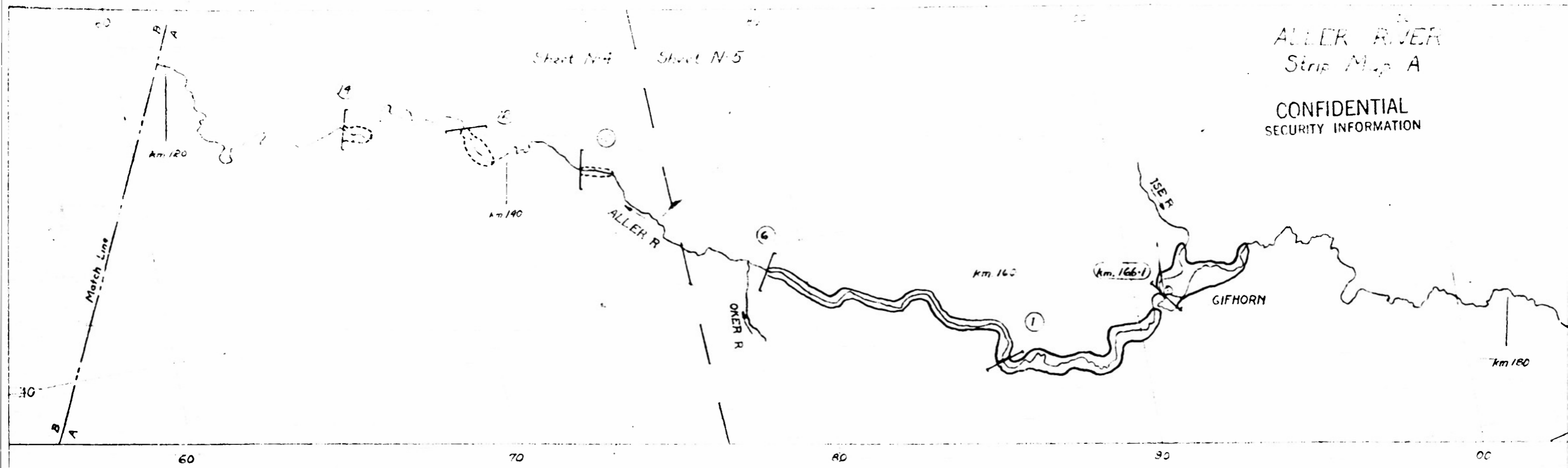
**ALLER & LEINE RIVERS
DISCHARGE RATING
CURVES**

WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by _____ Date Aug 52
Drawn by LLH

LEGEND: ———— Based on observed data
- - - - - Estimated extension

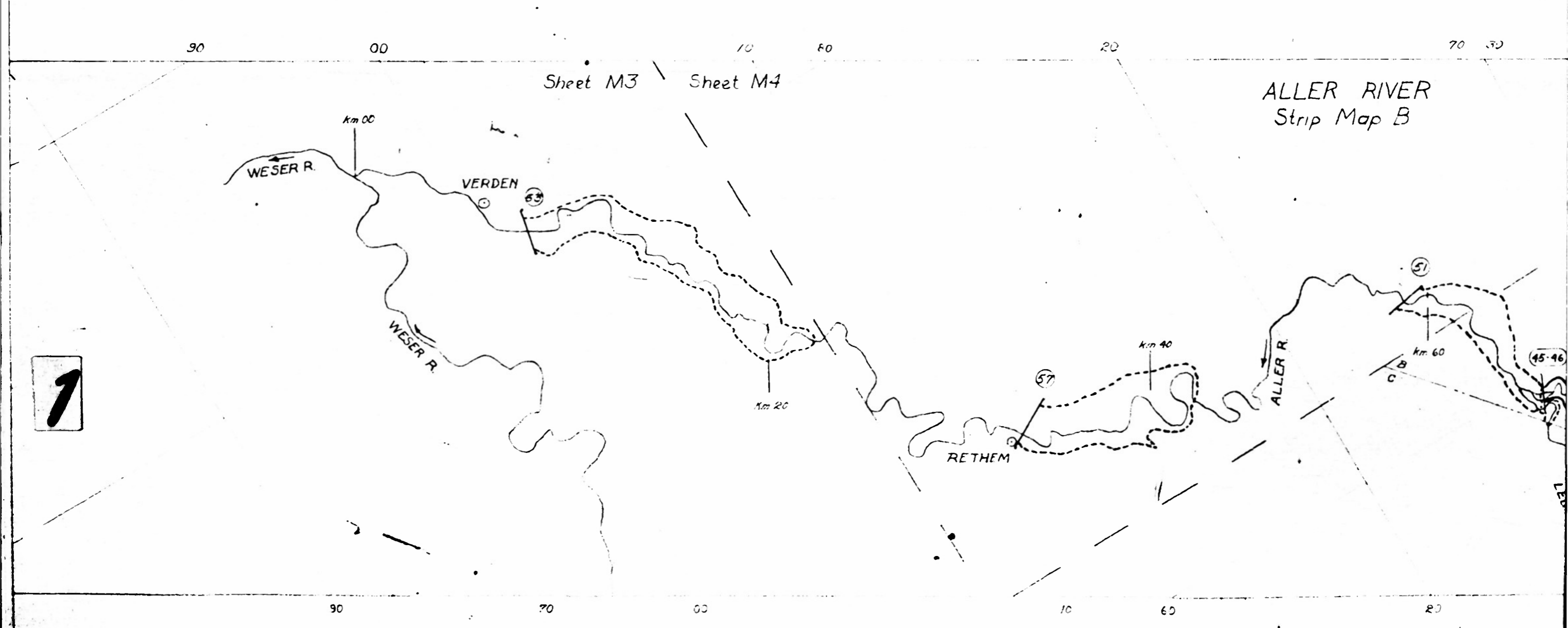
ALLER RIVER
Strip Map A

CONFIDENTIAL
SECURITY INFORMATION



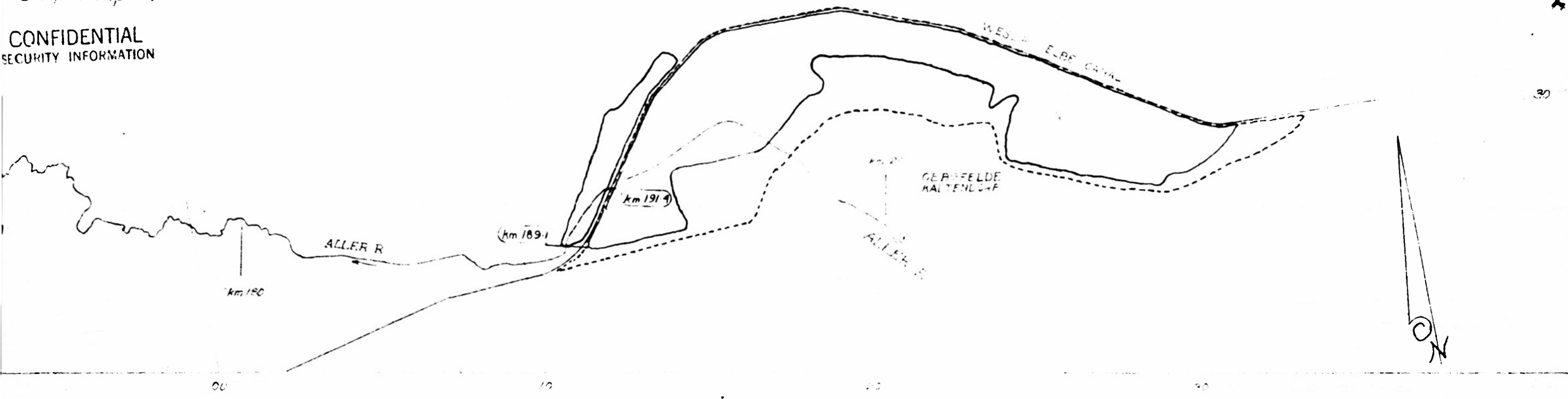
Sheet M3 Sheet M4

ALLER RIVER
Strip Map B



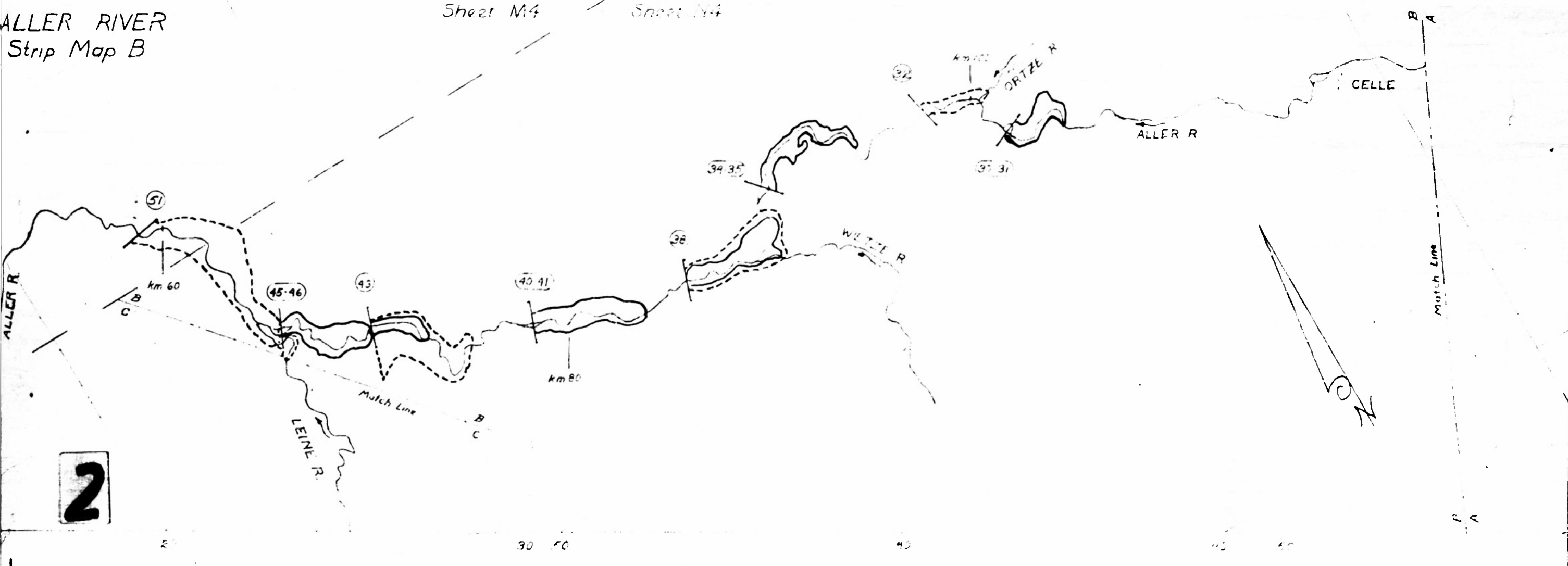
30
ALLER RIVER
Strip Map A

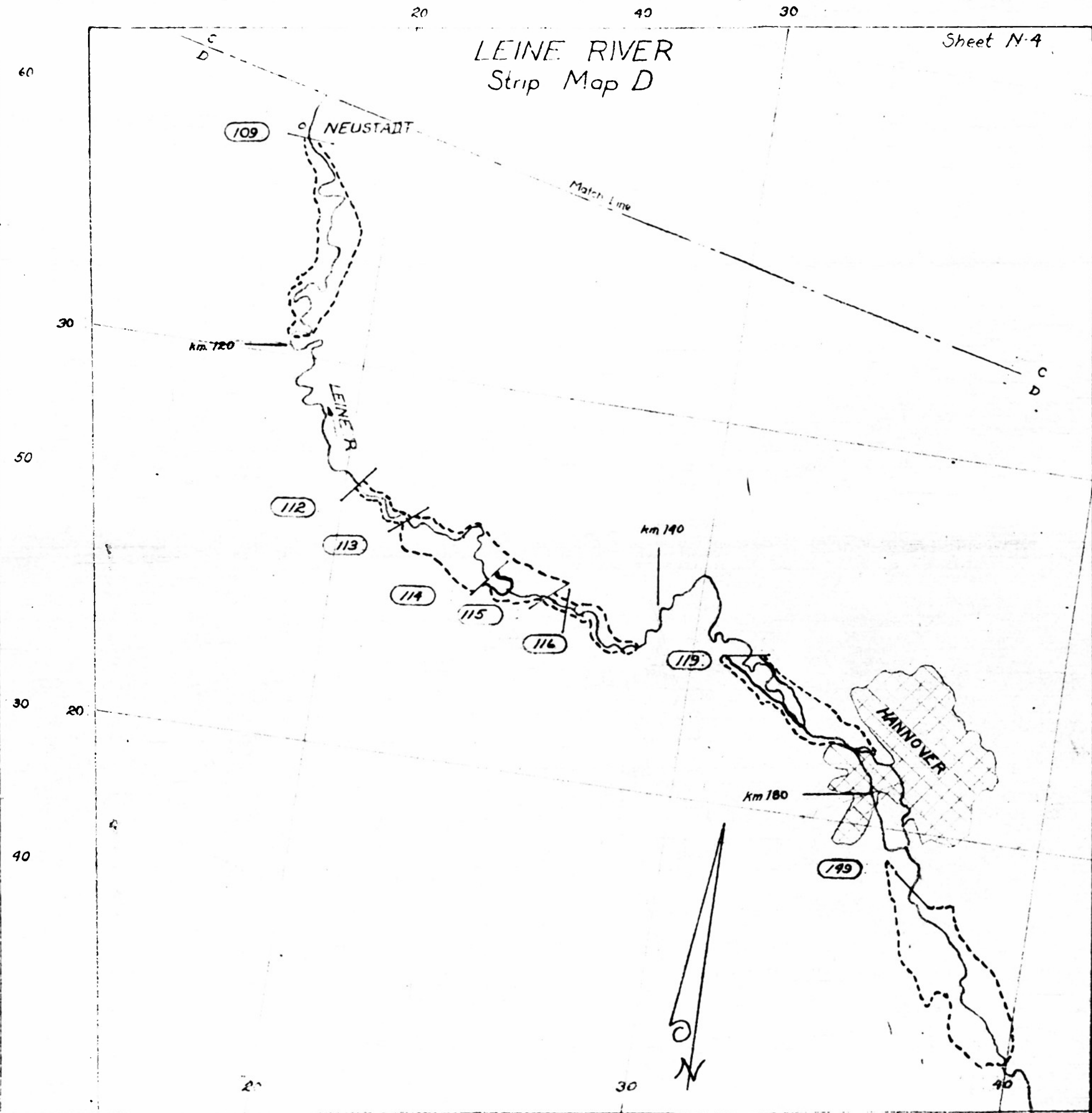
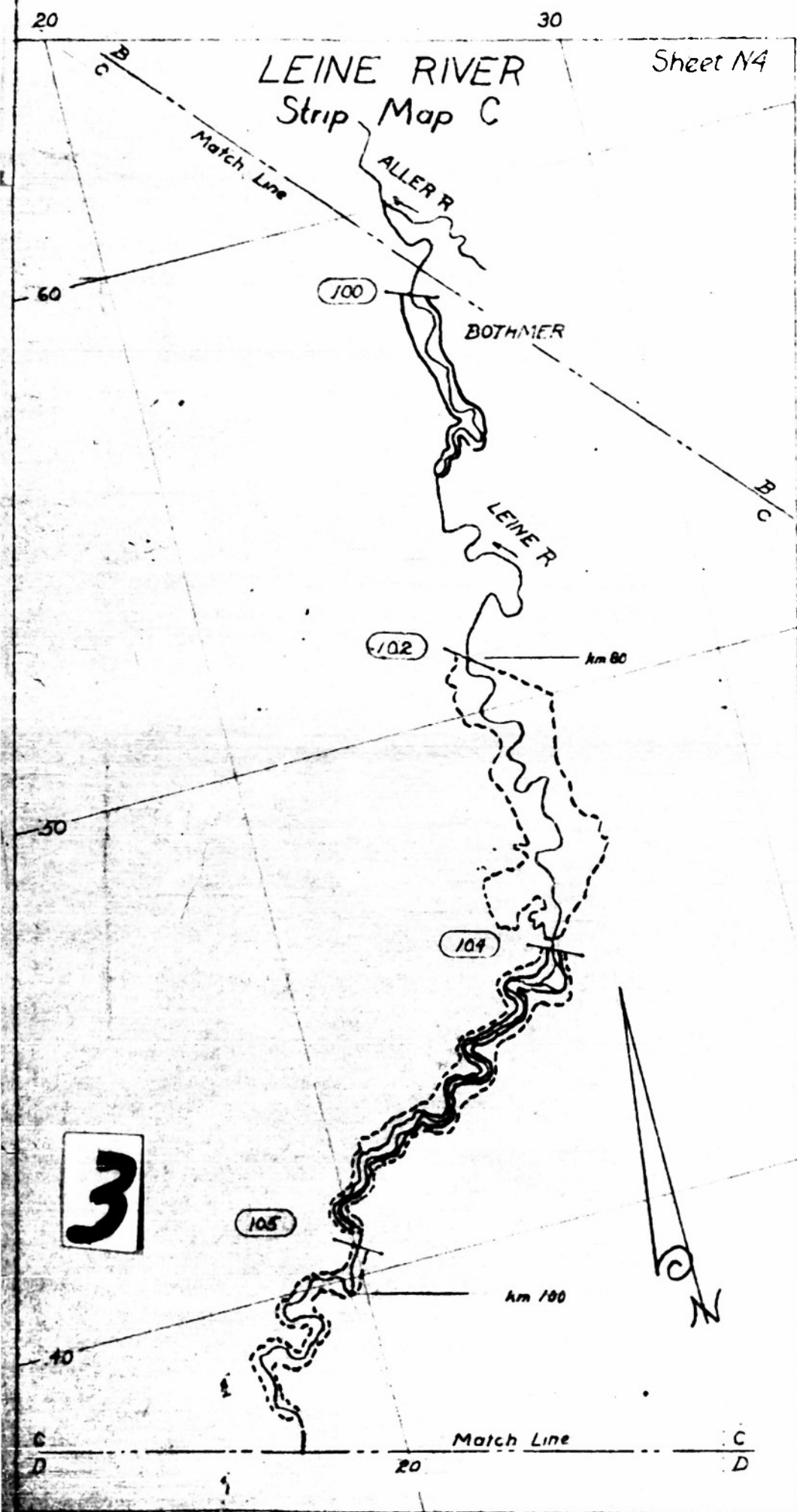
CONFIDENTIAL
SECURITY INFORMATION

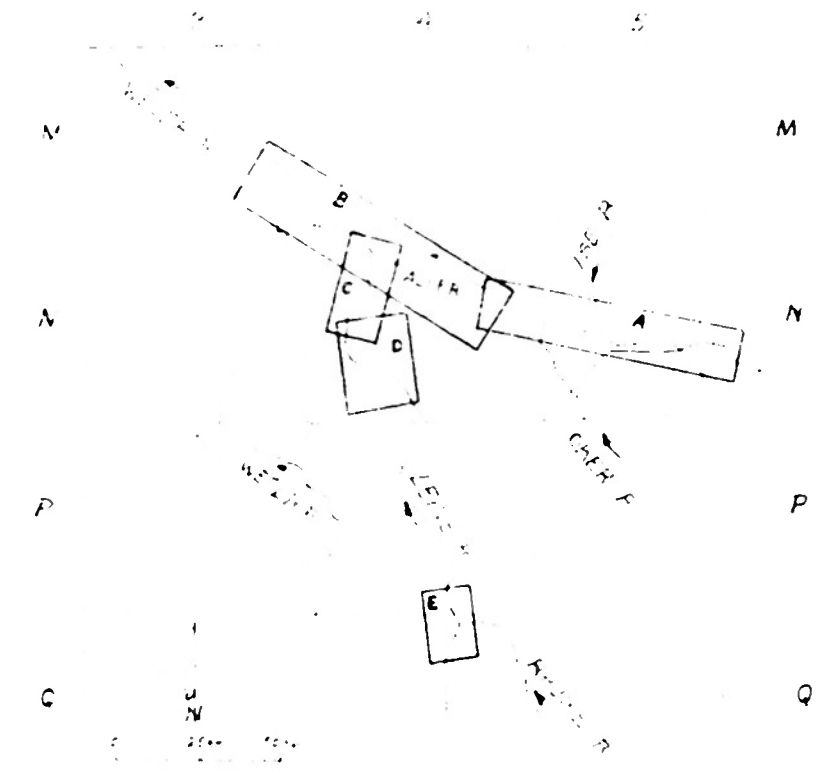
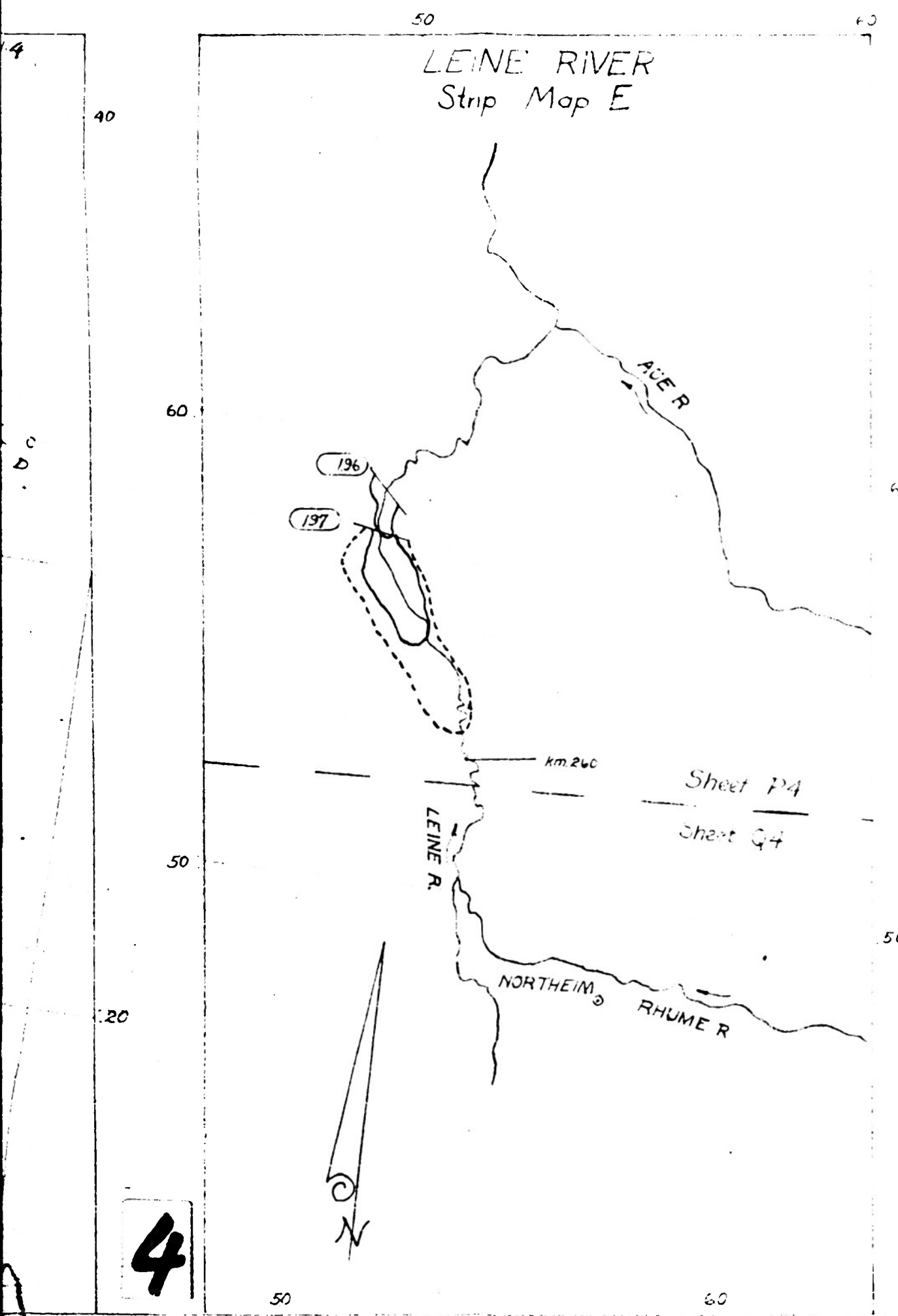


70 30
ALLER RIVER
Strip Map B

Sheet M4 / Sheet N4

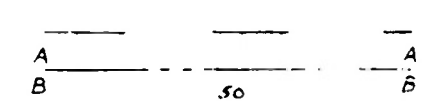






KEY MAP

LEGEND



Sheet Line GSGS 4416 Map Series (1:100 000)
Match Line for Strip Maps

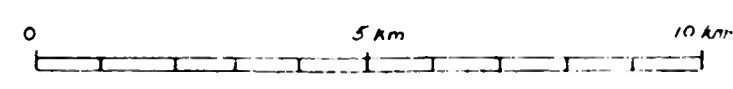
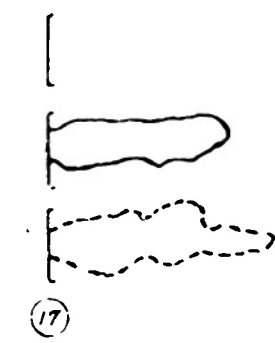
"Nord de Guerre" Grid Lines

Temporary Dam Location

Low Barrier Inundation (1m + MW)

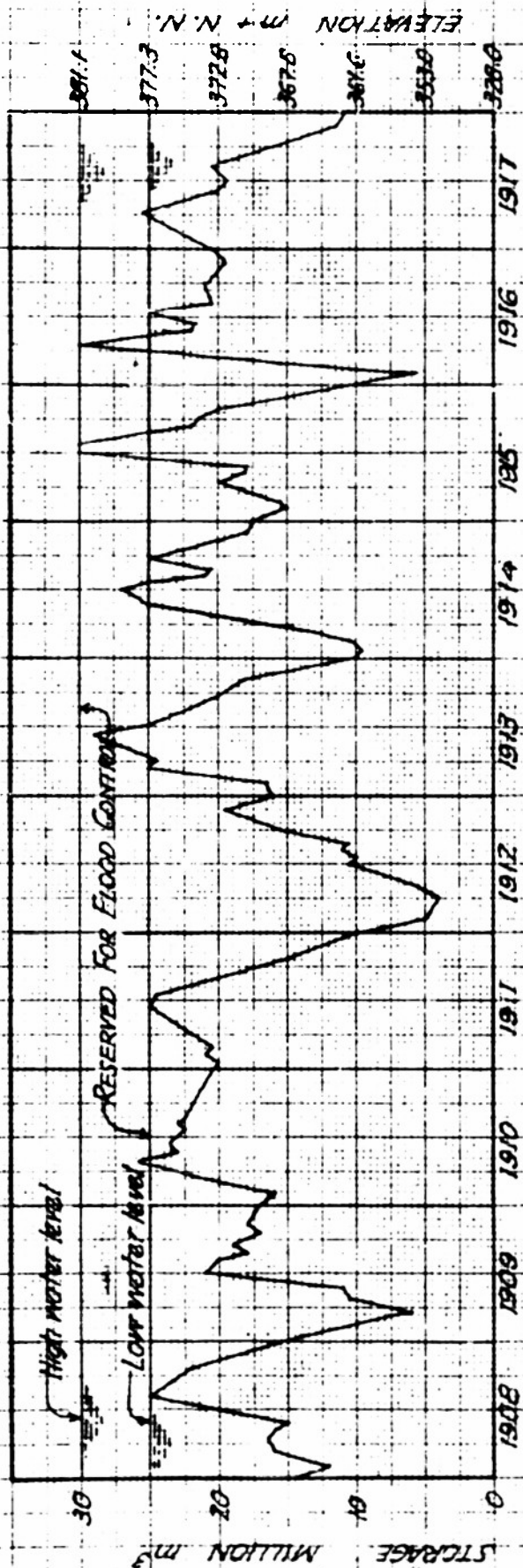
High Barrier Inundation (3m + MW)

Site Serial (Table 6&7)



CONFIDENTIAL
SECURITY INFORMATION

ALLER & LEINE RIVERS
**INUNDATION BY
STILLWATER BARRIERS**
WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by _____ Date _____
Drawn by _____



OPERATION PLAN - ODER DAM

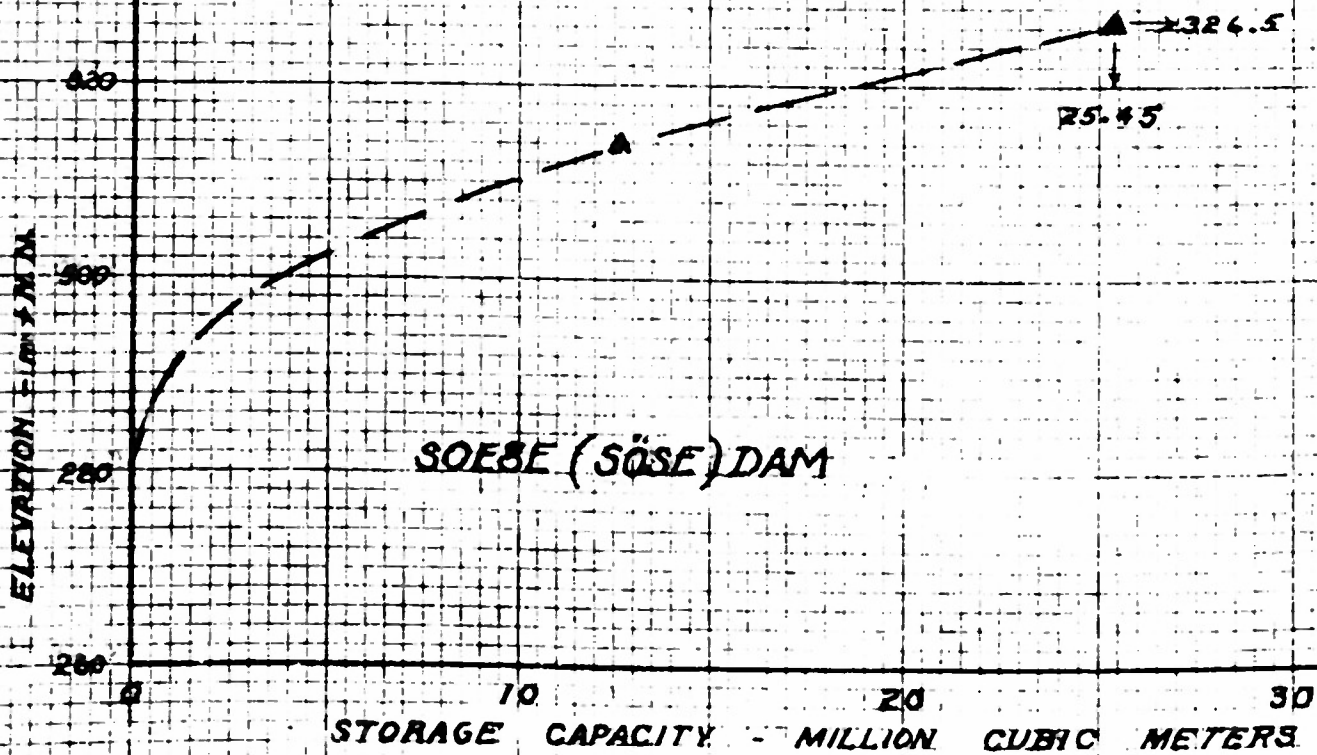
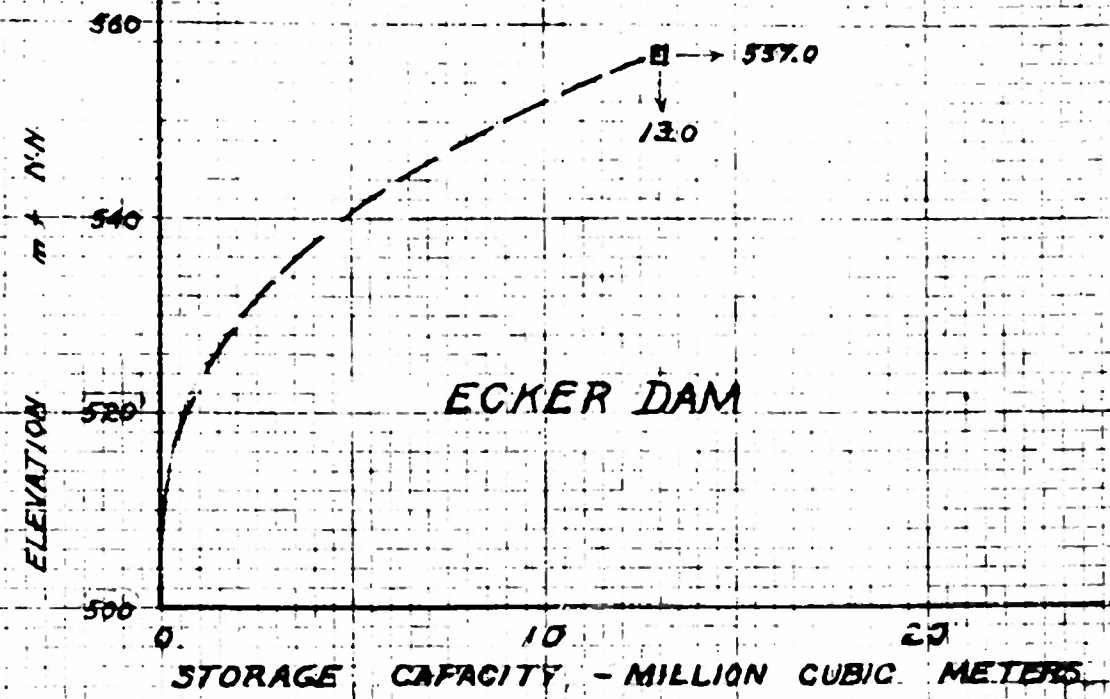
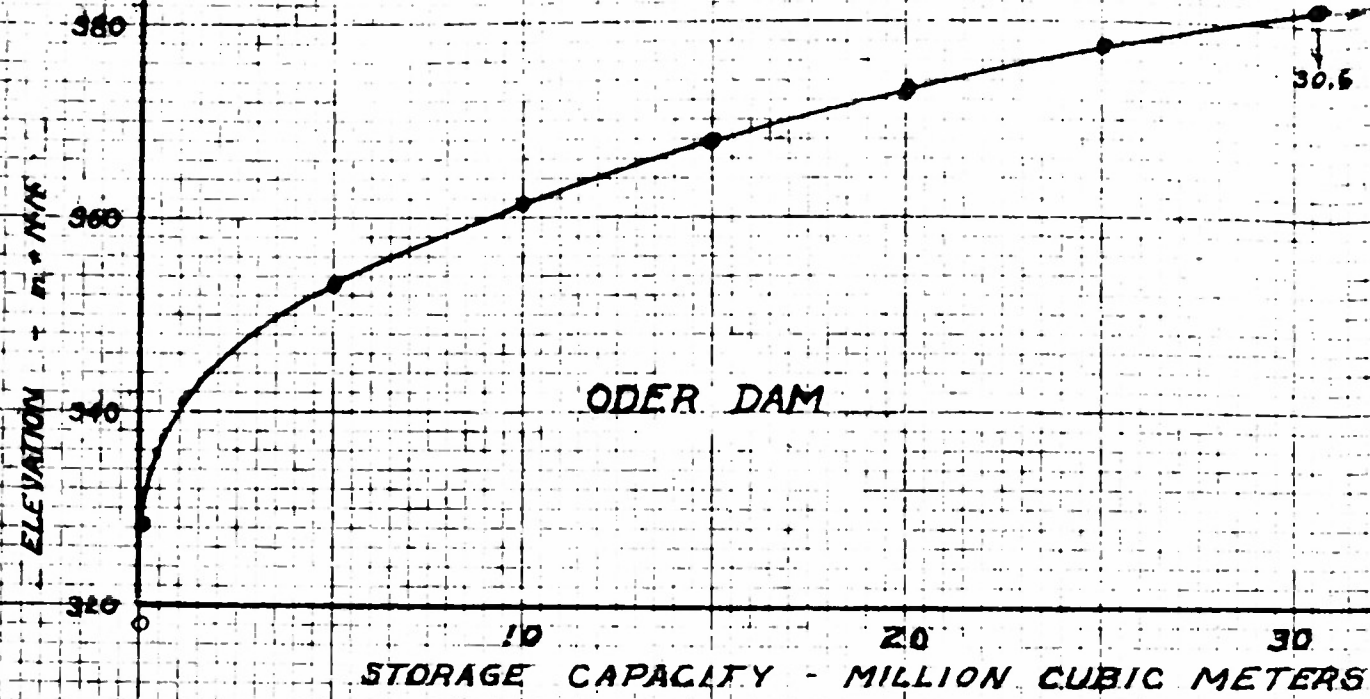
ALLER & LEINE RIVERS
**ODER RESERVOIR
 STAGE HYDROGRAPH**

WASHINGTON DISTRICT CORPS OF ENGINEERS
 Prepared by F.B.S.
 Drawn by J.P.F. Date Aug. 52

NOTE: Estimated Oder Reservoir stage & storage for 1908 - 1917. Conditions and with proposed operation plan if Oder Dam had been in full operation during that period.

SOURCE: "Die neuen Talsperrentwürfe im Harz" by Prof. Collario, DIE BAUTECHNIK, Jahrgang 15, Heft 15, 2 April 1937.

RESTRICTED
SECURITY INFORMATION



Note: Estimated storage curves based on points from cited sources
○ From Ref. 9
△ From Exhibit B
□ From Ref. 12

RESTRICTED
SECURITY INFORMATION

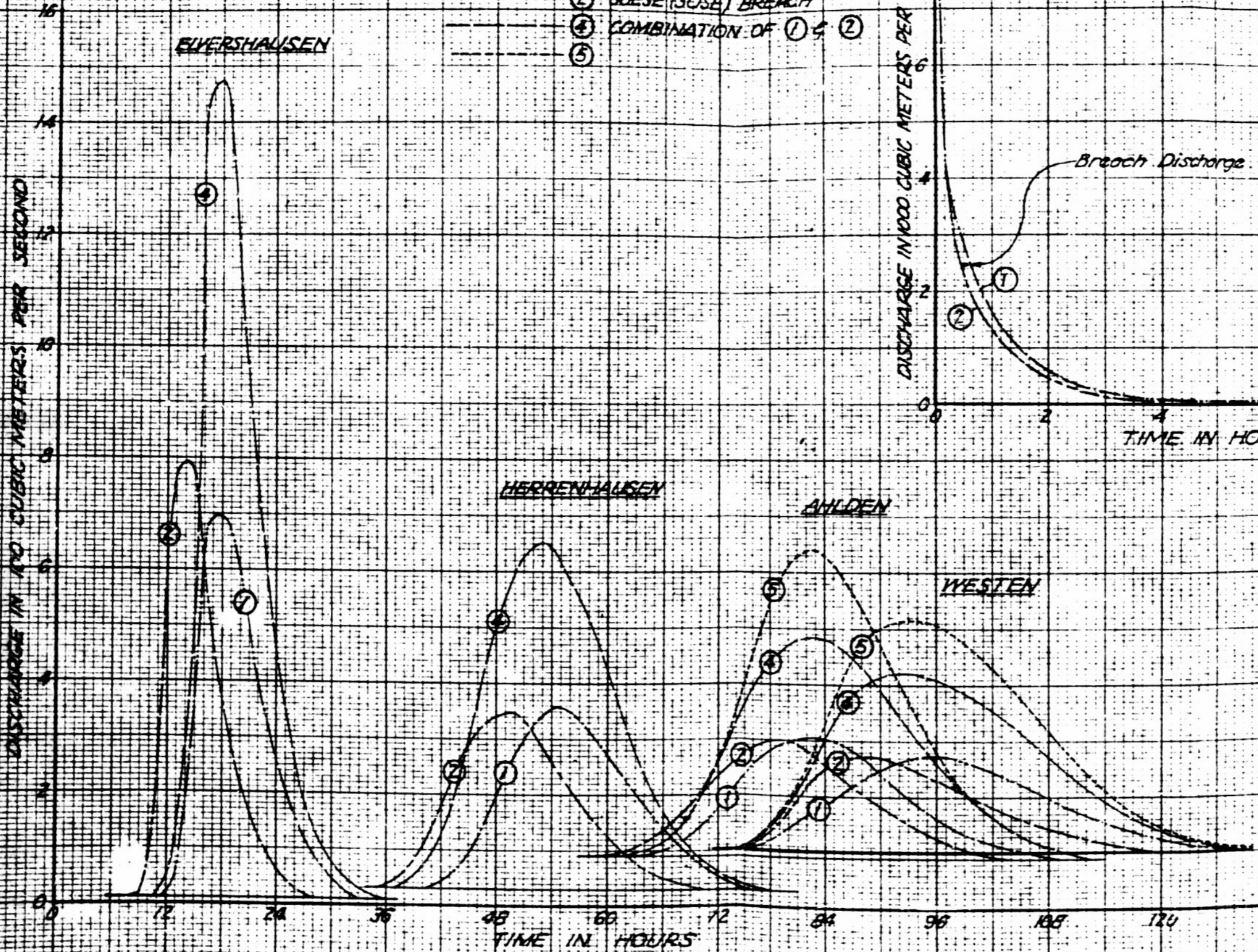
ALLER & LEINE RIVERS
VALLEY DAMS
STORAGE CURVES

WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by FPA Date Aug. '52
Drawn by FBB

CONFIDENTIAL

SECURITY INFORMATION

- LEGEND
- ① ODER BREACH
 - ② SOESE (SOSE) BREACH
 - ③ COMBINATION OF ① & ②
 - ④
 - ⑤



CONFIDENTIAL
SECURITY INFORMATION

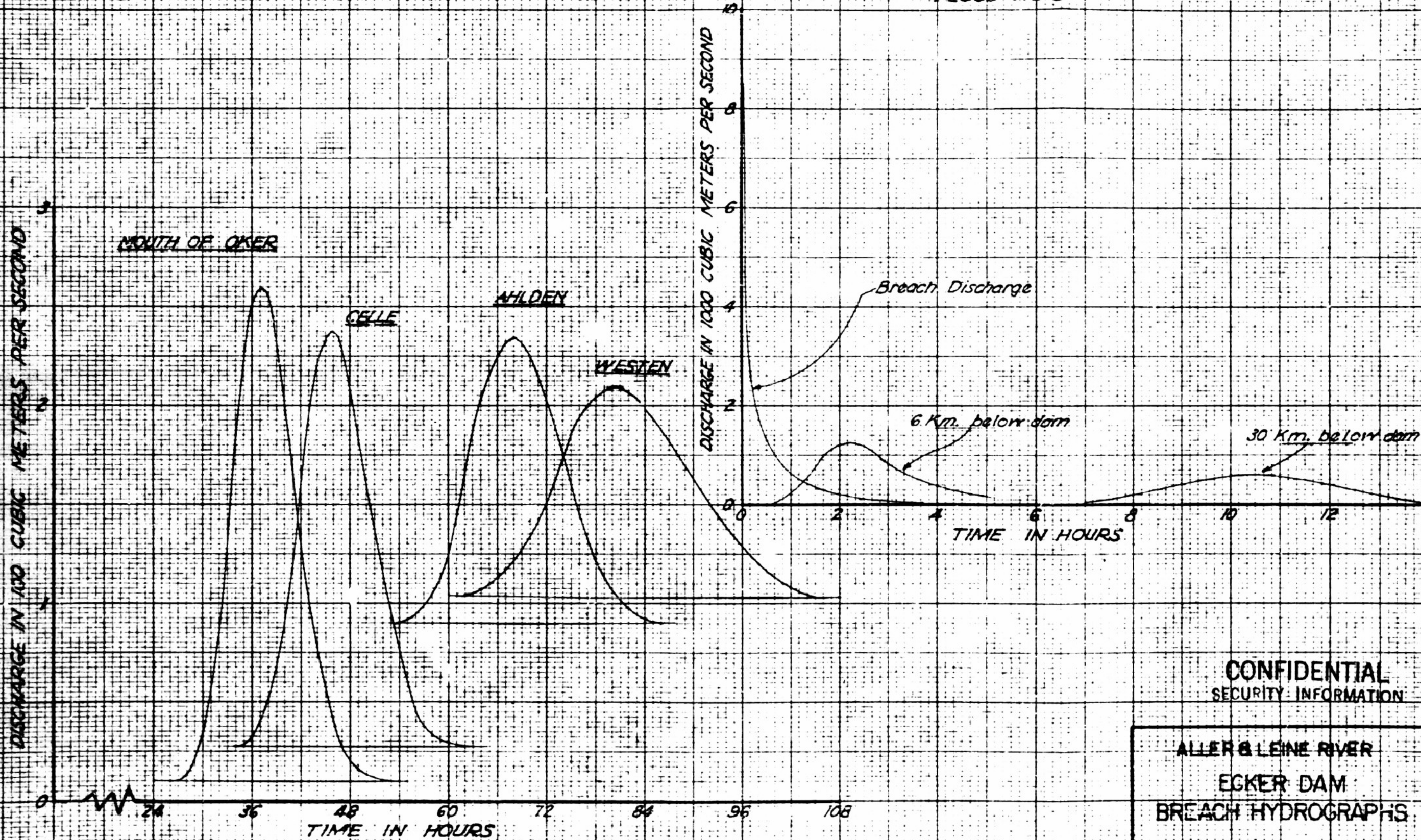
ALLER & LEINE RIVER
OKER & SOESE DAMS
BREACH HYDROGRAPHS

WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by JQB Date Aug. 1952
Drawn by

CONFIDENTIAL
SECURITY INFORMATION

LEGEND

FLOOD N 3 3



CONFIDENTIAL
SECURITY INFORMATION

ALLER & LEINE RIVER
EGKER DAM
BREACH HYDROGRAPHS

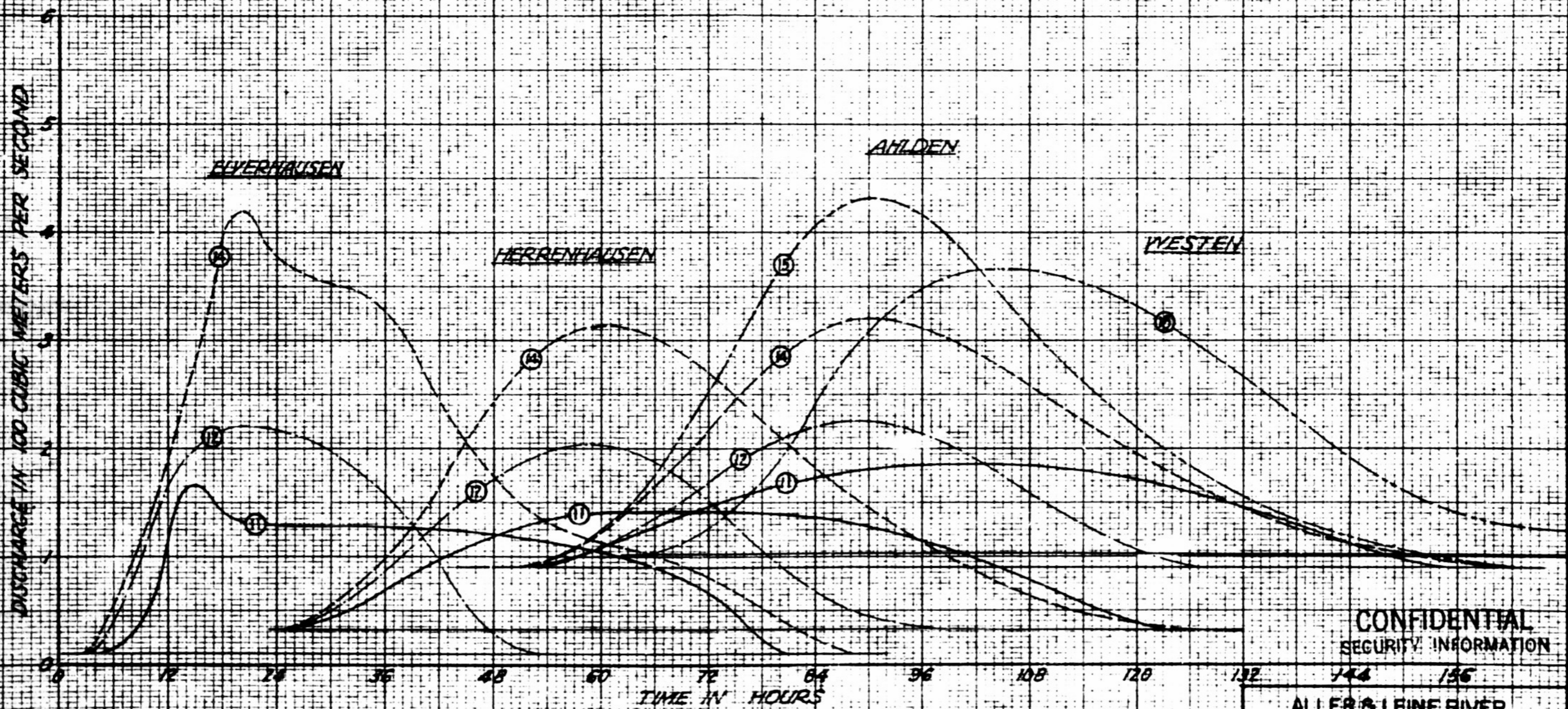
WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by J.D.B. Date: Aug. 1952
Drawn by _____

PLATE 30

CONFIDENTIAL
SECURITY INFORMATION

LEGEND

- ⑪ ODER DISCHARGE
- ⑫ SOESE DISCHARGE (SÖSE)
- ⑭ COMBINATION OF ⑪ & ⑫
- ⑮ COMBINATION OF ⑮ & ⑭



CONFIDENTIAL
SECURITY INFORMATION

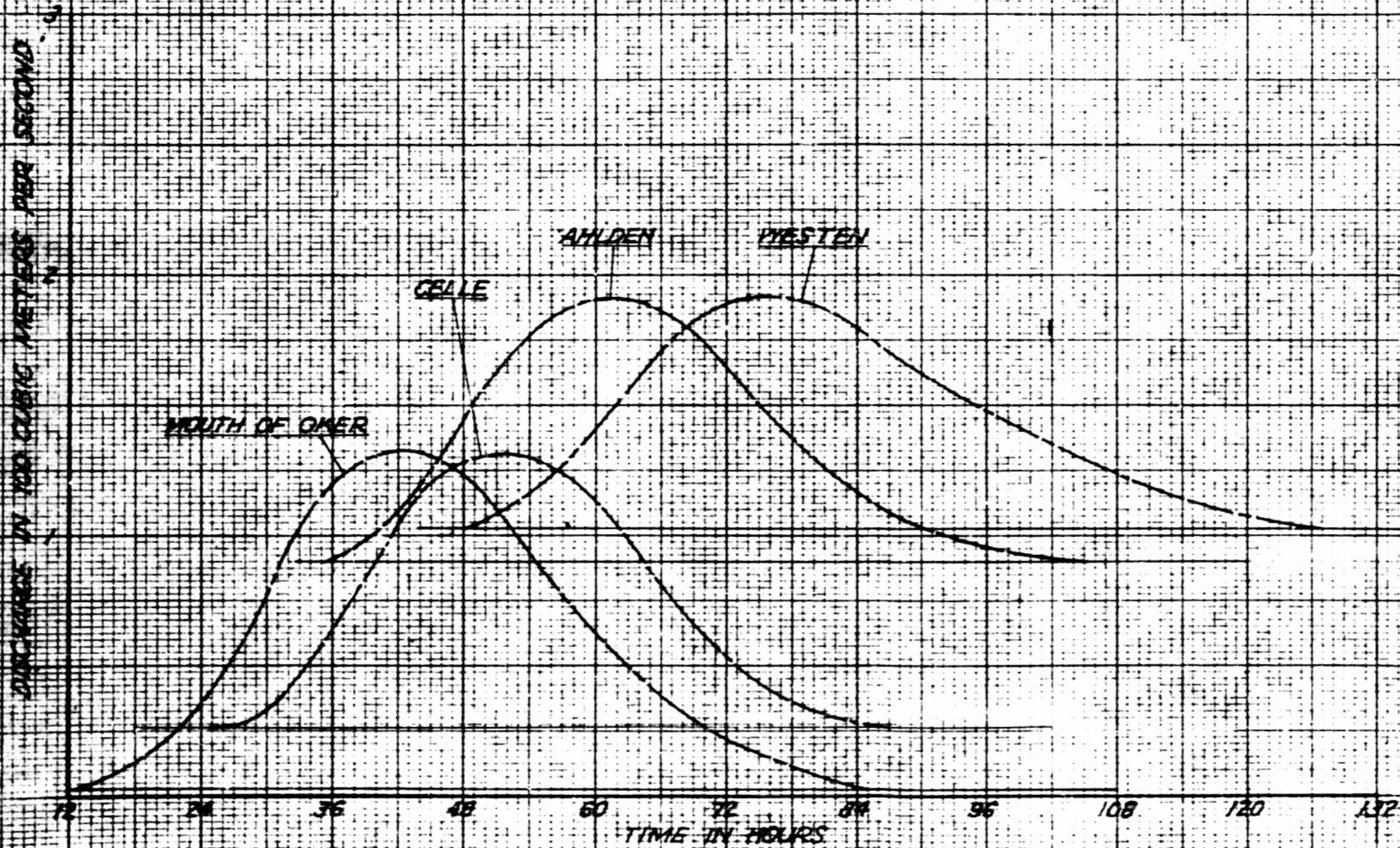
NOTE:
⑪ ⑮ ASSUME COMBINATION OF PEAKS
AT POINT OF CONFLUENCE BY
LAGGING BEGINNING OF COMPONENT
DISCHARGE. TIME BASED ON SOESE
ZERO TIME.

ALLER & LEINE RIVER
ODER & SOESE DAMS
MAJOR FLOW VARIATION
HYDROGRAPHS
WASHINGTON DISTRICT CORPS OF ENGINEERS
Prepared by W.D.B. Date Aug. 1952
Drawn by _____

CONFIDENTIAL
SECURITY INFORMATION

LEGEND

Artificial flood No 13.



CONFIDENTIAL
SECURITY INFORMATION

ALLER & LEINE RIVERS
ECKER DAM
MAJOR FLOW VARIATION
HYDROGRAPHS

WASHINGTON DISTRICT CORPS OF ENGINEERS

Prepared by JDB Date AUG 1952
Drawn by J.E.

PLATE 22

RESTRICTED
SECURITY INFORMATION

EXHIBIT A

DESCRIPTION OF BRIDGES AND DAMS*

| | <u>Page</u> |
|-------------|-------------|
| Notes | 1 |
| Aller River | 2 |
| Leine River | 10 |
| Rhume River | 25 |
| Oder River | 27 |

*Abstracted and Reproduced from "Report on River Aller, First Edition," Part II; and "Report on River Leine, First Edition," Part II. G.S.I. (R.E.) Main Hq. 21 Army Group, March 1945.

RESTRICTED
SECURITY INFORMATION

Description of Bridges, Locks, Dams, etc.

NOTES.

1. Accuracy. The majority of constructional details and measurements have been taken from documentary sources and unless otherwise stated have been checked and supplemented from air photos. Measurements of river widths refer to normal water levels.
2. Crossings not shown on GSGS 4416 A note "Not marked on map" has been included in the remarks column wherever a road or railway bridge exists which does NOT appear on the current edition of the sheet concerned in the GSGS 4416 series. It has not been thought necessary to do so in the case of farm bridges, footbridges and other constructions.

3. Abbreviations.

| | | |
|----|-----|--|
| I. | ii. | Low water. |
| M. | v. | Mean low water |
| H. | v. | Mean high water |
| H. | v. | High water |
| H. | N. | Highest navigable water |
| D. | | metre |
| N. | N. | Normal Null (German land survey datum) |

4. Load classification of bridges. The load classification of bridges, as given in this schedule is almost entirely taken from official German ratings by conversion according to the following table:-

| <u>GERMAN CLASS.</u> | <u>MEANING.</u> | <u>BRITISH EQUIVALENT.</u> |
|----------------------|--|----------------------------|
| (a) Road Bridges. | | |
| I | 2 - axled vehicles up to class 40 or over. | |
| II | 2 1/2 (metric) tons singly and slowly. | class 24 |
| III | " " up to 16 tons. | " 12 |
| IV | " " up to 7 tons. | " 12 |
| | " " " " less than 7 tons Under class 12. | |

(b) Railway bridges

| | | |
|----|----------------|----------------------|
| N. | max. axle load | 25 tons. |
| E. | " " | 25 " |
| G. | " " | 20 " |
| H. | " " | 18 " |
| J. | " " | 16 " |
| K. | " " | " less than 16 tons. |

Where the German sources give only a civil rating in tons, usually in the case of weak bridges, this has been recorded in the schedule as e.g. "5 tons". This civil figure is the heaviest safe load in metric tons for 2 axled vehicles without intervals and gives a guide to the strength of the bridge until the military classification can be ascertained. It will be noted that "Class 40" in this schedule includes bridges of greater capacity.

ALL MEASUREMENTS IN FEET.

Description of bridges, dams, etc.

R. ALLEN

| Serial | Type | Location & Name | Map ref 1/750,000 | Constructional details | Overall length | Road | Width | Overall | Load | River | Depth | Depth | Remarks |
|--------|-------------|-------------------------------|-------------------|---|---------------------------------|------|---|---------|-------------------|-------|-------|-------|--|
| | | | | | | | | | | | | | |
| 1 | Road bridge | South of MANSFIELD, R. 20 108 | Sheet M6 655369 | Two span reinforced concrete beam & slab bridge spans 45 ft each. This bridge replaces one at original site immediately downstream. New section of RC has been built across the valley to eliminate bends on original course. | 100 | 20 | | 32 | | 65 | 14 | 6.5 | |
| 2 | Road bridge | SE of MANSFIELD | 655356 | Single span reinforced concrete road bridge | 60 | 10 | | 14 | | 45 | | | NOT marked on map. |
| 3 | Foot bridge | East of STRINGSMITH | 655371 | Foot bridge, probably timber. Unmarked approaches. | 60 | 8 | | 10 | | 45 | | | |
| 4 | Foot bridge | East of STRINGSMITH | 655375 | Foot bridge, probably timber. Poorly detailed approach track on right bank, none on left bank. | 45 | 7 | | 9 | | 33 | | | |
| 5 | Road bridge | STRINGSMITH | 616376 | Single span reinforced concrete arch bridge with cast all top deck type on reinforced concrete abutments. 10 ft span 131 ft. Footed across valley. Reinforced concrete slab road span of 46 ft clear span, roadway 15 ft with 2 sidewalks each of 14 ft is 50 yds from main bridge on right bank. | 164 | 20 | One of 1. | 25 | Ext. 140 | 47 | 24 | 4 | |
| 6 | Road bridge | DIXONIST | 768293 | Two span stone arch bridge with sluices and two flood bridges. T - girder abutments, masonry abutments. Main two 2 spans, each flood br. each 30 ft. | Main br 30. Flood br 92 each | 12 | Main br 20 Two of 12 flood brs One of 3 | 15 | 2.5 | 20 | 7 | 6.5 | Partial rd bridge. Sluice immediately upstream of this bridge. |
| 7 | Road bridge | MCCON | 768298 | Eight span wooden br. with three wooden middle piers flanked on each side by two masonry piers and masonry abutments. 2 clear spans each 18.7 ft. 4 " " " 19 ft. 2 " " " 20.6 ft. | 174 | 12 | One of 2. | 20 | 7.9 | 82 | 3 | 6 | |
| 8 | Road bridge | North of FLETCHER | Sheet M4 761407 | Eight span timber bridge on timber trestle piers. Footbridge 200 yds downstream. | 167 | 10 | | 12 | Total load 3 tons | 98 | 3 | 8 | |

* ICE checked from air cover.

ALL MEASUREMENTS IN FEET.

DESCRIPTION OF BRIDGES, DAMS, ETC.

REPORT ON R. ALLER

| SERIAL | TYPE | LOCATION & NAME | MAP REF 1/100,000 | CONSTRUCTIONAL DETAILS | OVERALL LENGTH | ROAD | WIDTH SIDEWALKS | OVERALL | LOAD CLASS | PIER WIDTH | PIER SPACING | REMARKS | |
|--------|-----------------------|------------------|-------------------|---|----------------|------|--|---------|-------------------|------------|--------------|----------|-------------|
| 9 | Railway bridge | North of PLASTER | 760411 | 2 span single truss bridge. Main river span 140ft through type steel truss with curved top chord. Left bank floodspan of 69 ft parallel truss. | 223 | | | 11 | Max. 210 tons | 35 | 27 10 3 | 5 | |
| 10 | Road bridge | LANDLINDEN | 737434 | Seven span timber bridge with six river piers 7 clear spans of 24 ft. | 154 | 11 | | 14 | Total load 6 tons | 25 | 24 | 1 | |
| 11 | RAILWAY BRIDGE & WEIR | SW of MICHIGAN | 712442 | Multi-span timber frame bridge over weir. Stream joists longitudinally upstream & restricts left bank approach. | 65 | 8 | | 10 | | 75 | | | |
| 12 | Road bridge | East of OFFENSEN | 703454 | Two span steel through truss. bridge on masonry piers and abutments. Spans each 80 ft. | 197 | 19 | Two of 14 | 11 | 40 | 2 | 3 5 10 4 | 5 5 10 4 | |
| 13 | Weir & RAILWAY BRIDGE | SW of OFFENSEN | 680465 | Masonry weir with 7 timber road bridge over top. | 93 | 8 | | 11 | | 71 | | | |
| 14 | Road bridge | MICHIGAN | 666460 | 4 span deck type reinforced concrete bridge with extended approach. River span 65 ft, 2 left bank, 1 right bank flood span each 33 ft. Original 9 span timber bridge at 666461 (shown on map) has been removed. | 232 | 22 | | 32 | | 65 | | | NOT LOCATED |
| 15 | Road bridge | ALTONVILLE | 624464 | Eight span timber bridge on timber abutments & piers. 8 clear spans each 27.8 ft. | 230 | 11 | One of 2 | 5 | 19 | 114 | 3 5 10 4 | 5 5 10 4 | |
| 16 | RAILWAY BRIDGE | CELLE | 594504 | Narrow 7 wooden footbridge. | 218 | | | 5 | | 200 | | | |
| 17 | Road bridge | CELLE R.S.S. | 599505 | 3 span steel bowstring girder bridge on masonry piers and abutments. 2 clear spans each 41 ft. 1 " " span of 78 ft. | 177 | 20 | Cycle track 14, 2 foot-walks cantilevered beyond bowstring trusses each 10 | 60 | 24 | 164 | 5 10 64 | about 10 | |
| 18 | Dam & Hill | CELLE | 539505 | Dam over right channel with 2 mill buildings, projecting 100 ft from right bank. | | | | | | 230 | | | |

RESTRICTED
SECURITY INFORMATION

ALL MEASUREMENTS IN FEET.

DESCRIPTION OF BRIDGES, DAMS, ETC.

REPORT ON R. ALLEN

| Serial | Type | Location & Name | Map ref 1/100,000 | Constructional details | Overall length | Road | Width | Depth | Span | Remarks | |
|--------|---|------------------------------------|-------------------|--|----------------|----------------|---|-------|---------|----------------------------------|--------------------------------------|
| 19 | Road BR. over left channel. | CELLE SCHUTZEND- MAESBIELEN* | 507504 | Four span, steel girder with concrete filling between girders, concrete piers & abutments. Spans each 46.7 ft. | 103 | 18 | 98 | 3 | 5 to 64 | RT a through road | |
| 20 | MILL, dam & foot-bridge (over left channel) | CELLE | 506503 | Left channel in 2 streams round small island. Left stream passes under mill building, right stream over weir, with footbridge immediately above downstream junction of the 2 streams. | | | Right stream 80 at weir 25 at footbridge Left stream 10 - 15 | | | | |
| 21 | Foot-bridge (over left channel) | CELLE | 505503 | 7 Multispan light steel girder footbridge Serial 20 immediately upstream. | 150 | | 160 | | 6 | | |
| 22 | Foot-bridge (over left channel) | CELLE | 505503 | Light foot bridge, probably steel girder. | 45 | | 40 | | 4 | | |
| 23 | Railway bridge (over left channel) | CELLE | 503503 | 2 span single track electrically operated lift bridge. Line leads to harbour area only. One river lift span 1 right bank flood span of 46 ft. CELLE harbour on right bank immediately downstream. | 120 | Single track | 50 | 4 | 6 | | |
| 24 | Railway bridge (over right channel) | CELLE | 500905 | Single track steel girder railway bridge leading harbour to main line 53ft through truss river span. 2 plate girder flood spans each 26 ft masonry piers and abutments. | 110 | Single track | 40 | 34 | 54 | Max axle load less than 16 tons. | |
| 25 | Foot-bridge | CELLE | 570699 | Seven span lattice steel girder on steelwork piers and masonry abutments. 6 clear spans each 41 ft 1 span of 83 ft. Immediately upstream of serial 26. | 330 | 74 | 65 | | 5 | Vertical clearance at MW 15 ft. | |
| 26 | Railway bridge | CELLE | 570699 | 3 single track railway bridges side by side. Each 7 spans. Plate girder & rail. concrete piers on masonry piers and abutments. One central span flanked by 3 flood spans each side. Spans 1 X 25 ft, 4 X 42 ft, 2 X 40 ft. | 341 | 3 single track | 85 | 6 | 6 | 6 | Vertical clearance at MW 14 & 17 1/2 |

RESTRICTED

SECURITY INFORMATION

ALL RELEASES IN FIRM.

| Serial | Type | Location & Name | Map ref 1/100,000 | Constructional details | Overall length | Mileage | | Load class | River width | Depth LM | Depth FM | Remarks |
|--------|--|-----------------|-------------------|---|----------------|---------|-----------|-------------------|---------------------|--|----------|---|
| | | | | | | Road | Sidewalks | | | | | |
| 27 | Foot-bridge | West of CIBLE | 563503 | Small Mississippi timber footbridge. | 75 | | | | 65 | | | |
| 28 | Ferry | BOYS | 551515 | 1 small boat for 12 passengers | | | | | 75 | 3 | 64 | No boat visible on air photos 13 Sep 44. Uninstalled approach. |
| 29 | Vehicle ferry | OLDAU | 491535 | Reported vehicle ferry. Underwater cable type length 43 ft; breadth 13 ft; draught 2 ft (loaded). Capacity 60 passengers or 13 horses or 1 lorry. Also another small boat ferry for 10 passengers. | | | | | 147 | | | |
| 30 | Lock & foot-bridge (over left channel) | OLDAU | 409538 | Masonry lock with footbridge over lock gates. Lock: length 540 ft; width 48 ft. | 55 | | | | 48 | | 12 | |
| 31 | Footbridge dam & powerhouse (over right channel) | OLDAU | 491536 | Dam with power house on left bank and foot-bridge. Dam has 4 double sluices & a 49 ft lift gate for use in flood. | 236 | | | | Above 195 below 170 | | | |
| 32 | Road bridge | WIRSON | 471557 | Single steel girder through truss with curved top chord river span and 1 right bank & 3 left bank reinforced concrete flood spans. Masonry piers & abutments. Main span 140 ft. Flood spans each 47 ft. | 354 | | 19 | 40 | 105 | | 64 | Vertical clearance at NW 13 ft HWM = 33-23ft + HWM See photographs. |
| 33 | Vehicle ferry | West of WIRSON | 445564 | Reported underwater cable ferry. Length 19ft breadth 9.8ft; draught 0.6ft (loaded). Capacity 20 passengers (or 3 horses). No approach roads, but trucks lead to site. Small boat visible. | | | | Total load 3 tons | 115 | Max 7 Min 4 dependent on operation of dam. | | Dependent on operation of dam. |
| 34 | Lock & foot-bridge (over right channel) | BUNNETZ | 415560 | Masonry lock. Length 540 ft width 48 ft with footwalk over lock gates. | 60 | | | | 48 | | | Max. 10 Min. at HWM 3 |

Description of bridges, dams, etc.

REPORT ON R. ALLER.

* NOT checked from air cover

RESTRICTED

REPORT ON R. ALLER. ALL INFORMATION IS UNCLASSIFIED

| Serial | Type | Location & Name | Map ref 1/100,000 | Constructional details | Overall length | Span | Width | Lock class | Span width | Depth LF | Depth MR | Remarks |
|--------|---|---------------------|-------------------|--|----------------|------|-------|------------|------------|----------|----------|--|
| 35. | Dam & footbridge (over left channel) | BANKS | 418560 | Dam with footbridge. Dam has 5 double sluices and a needle weir. | 148 | | | | 125 | | | |
| 36. | Vehicle ferry | WHITE | 40594 | Underwater cable type length 46 ft breadth 16 ft. draught 1.3 ft (loaded). Capacity 20 passengers or 25 horses or 1 lorry. Also a further small boat capable of carrying 6 passengers. | | | | | 105 | 6 | 7 | |
| 37. | Vehicle ferry | NE of JEVENSEN | 385945 | Underwater cable type. Length 40 ft; breadth 13 ft. Capacity 60 passengers or 18 horses or 1 lorry. Also a further small boat, capacity 4 passengers. | | | | | 147 | 6 | 7 | Dependent on operation of dam (serial 41.) |
| 38. | Light fly br. 7 rd. with rd br. under construction. | North of JEVENSEN | 391547 | (a) Multi-span steel girder light fly and 7 rd bridge on masonry abutments. (b) Immediately downstream of (a) main road br. under construction, multi-span 7 rd. concrete beam. Approaches embanked but not finished. Light fly leads to quarry on right bank downstream, crossing main rd under constr. 100 yds from br on right bank. | 250 | 10 | | | 140 | | 10 | Dependent on operation of dam (serial 41.) |
| 39. | Vehicle ferry | North of HARKENDORF | 330558 | Underwater cable ferry length 43 ft breadth 13 ft draught 2 ft (loaded). Capacity 60 passengers or 21 horses, or 1 lorry. Also a further small boat for 6 passengers. The top of the dikes is 5 ft above mean water level. | 250 | | | | 140 | | | |
| 40. | Footwalk over lock (over right channel) | North of HARKENDORF | 334558 | Masonry lock with footwalk over each pair of gates. Lock length 540 ft width 48 ft | | | | | 235 | | 9 | |
| 41. | Dam & powerhouse (over left channel) | North of HARKENDORF | 335557 | Masonry dam with power station on left bank foot bridge over all. Dam has 7 sluices and a 49 ft wide lift gate. | 142 | | | | 230 | | | |

NOTE: Work has not been started on proposed adobe dam across valley of R. ALLER.

ALL MEASUREMENTS IN FEET.

Description of bridges, dams, etc.

REPORT OF S. ALLER.

| Serial | Type | Location & Name | Map ref 1/100,000. | Constructional details. | Overall length. | Road sidewalks. | Width Overall. | Load class. | River width. | Depth LM | Depth HM | Remarks. |
|--------|--|-----------------|--------------------|---|-----------------|-----------------|----------------|------------------------|--------------|----------|-------------|--|
| 42 | Road bridge | North of BIRM. | 30076 | Single span steel girder through truss with curved top chord on masonry abutments. Clear span 140 ft. Five flood spans, reinforced concrete slab, one left bank, four right bank each of 47 ft. | 407 | 17 | One of 3 | 40 | 140 | | 9 | Vertical clearance at HM 13 ft. See photographs. |
| 43 | Key bridge | North of BIRM. | 28522 | 3 span steel girder through truss with curved top chord single truss bridge on masonry piers and abutments. 3 clear spans each 119 ft. Truss embedded across old meander on right bank. | 300 | Single track. | One of 24 | Max axle load 25 tons | 131 to 147 | 4 | 6 | Vertical clearance at HM 13 ft. |
| 44 | Vehicle ferry (over left channel) | WESTON | 28528 | Underwater cable type. Square-ended steel boat length 42 ft, width 13 ft, draught 2 ft (loaded) Capacity - 50 passengers or 20 horses or 1 lorry. Crust of spans 6 ft above normal water level. | | | | Total load 7 1/2 tons. | 121 | | 10 | |
| 45 | Lock & foot-bridge (over left channel) | WESTON | 28590 | Masonry lock. length 540 ft, width 48 ft. Foot walk over lock gates. | | | | | 48 | | | |
| 46 | Dam & foot bridge (over right channel) | WESTON | 27090 | At LENE confluence immediately downstream. Concrete weir with light steel girder footbridge 174 ft. Has 2 double slides and a needle weir. Dammed ferry site 100 yds downstream. | | | 3 | | 150 | | Max 9 Min 4 | Vertical clearance on operation of dam. |
| 47 | Road bridge (over right channel) | WALSLEY | 27095 | 6 span timber trestle and steel girder road bridge. | 155 | 12 | | | 100 | | | NOT TO BE OPERATED. |
| 48 | Vehicle ferry (over right channel) | WESTON | 26000 | Underwater cable type. Square ended steel boat. Length 40 ft; width 14 ft. draught 2 ft (loaded) Capacity 70 passengers or 16 horses or 1 lorry. Also another small boat capacity 8 passengers. Approaches probably unimproved. | | | | | 137 | 1.6 | 5.0 | |
| 49 | Ferry | WESTON | 26607 | Underwater cable ferry 43 ft long by 13 ft wide, draught 8 ft. Capacity 50 passengers or 16 horses or 1 lorry. Also 1 rowboat for 7 persons. Approach ramps both banks. | | | | | 92 | 3 | 6.4 | |

ALL MEASUREMENTS IN FEET.

Description of bridges, dams, etc.

REPORT ON R. M.I.B.

| Serial | Type | Location & Name | Map ref 1/100,000 S.S. No. | Constructional details | Overall length | Head | Overall Sidewalks | Load capacity | Span width | Depth LM | Depth TM | Remarks |
|--------|-------------------|------------------------|----------------------------|--|----------------|------|-------------------|-------------------|------------|----------|----------|---|
| 50 | Vehicle ferry | INDRUMEN | 29635 | Underwater cable type. Square ended wooden boat. Length 42 ft, breadth 13 ft, draught 2 ft (loaded). Capacity - 60 passengers or 20 horses or 1 lorry. Also another boat capacity 10 passengers. | | | | Total load 5 tons | 170 | 5 | 12 | |
| 51 | Road bridge | AMLOH | 28064 | Single span, steel girder, curved top chord over river. Two rail, com. flood spans each side, clear spans 1 x 140 ft, 2 x 47 ft, 2 x 47.2 ft. Beams trapezoidal. 3 span rail, com. deck type bridge over interfilled original run at 23064. Overall length 220 ft. | 390 | 20 | Two of 14 | 40 | 123 | 8 | 12 | Vertical clearance at 12M 13 ft. |
| 52 | Vehicle ferry | ELITE | 18865 | Underwater cable type. Square ended steel boat. Length 50 ft; breadth 17 ft; draught 2.6 ft (loaded). Capacity - 100 passengers or 30 horses or 1 lorry. Also another smaller boat capacity 15 passengers. Metal ramp and approach roads on both banks. | | | | 167 | | 5 | 84 | |
| 53 | Vehicle ferry | West of ELITE | 17858 | Marked underwater cable type. Square ended wooden boat. Length 41 ft, breadth 13 ft, draught 2 ft (loaded). Capacity - 50 passengers or 16 horses or 1 lorry. Also another smaller boat capacity 7 passengers. | | | | 170 | | 54 | 9 | No boat visible on air photo of 13 Sep 44. |
| 54 | Vehicle ferry | SE of ELITE | 17842 | Underwater cable type. Square ended steel boat. Length 39 ft, breadth 10.8 ft, draught 1.3 ft. Capacity 100 passengers or 13 horses or 1 lorry. Uninstalled right bank approach. | | | | 180 to 225 | | 44 | 8 | |
| 55 | 7 passenger ferry | ELITE | 16751 | Small boat for 5 passengers. | | | | 180 to 225 | | 44 | 8 | No boat visible on air photo 13 Sep 44. |
| 56 | 7 passenger ferry | ELITE | 16650 | Small boat for 5 passengers. | | | | 180 to 225 | | 44 | 8 | No boat visible on air photo 13 Sep 44. |
| 57 | Small bridge | WEST of ELITE S.S. 23. | 18569 | Four span-steel girder, curved top chord, over river with three rail, com. flood spans. Length of spans side by side 140 ft. Length of flood spans 2 x 31.5 ft (left bank) 1 x 50 ft (right bank). | 361 | 20 | Two of 3 | 40 | 180 to 225 | 44 | 8 | Vertical clearance at 12M 13 ft. See photographs. |

ALL MEASUREMENT IN FEET.

Description of bridges, dams, etc.

S. NAME

Type

Location & Name

Map Ref
1/100,000
& sheet N 4

Constructional details.

Overall
length

Road
SIOMALLS

Overall

Load
class

River
width

Depth
LM

Depth
RM

REMARKS

| Serial | Type | Location & Name | Map Ref 1/100,000 & sheet N 4 | Constructional details. | Overall length | Road SIOMALLS | Overall | Load class | River width | Depth LM | Depth RM | REMARKS |
|--------|--------------|----------------------|-------------------------------------|--|-------------------|-------------------------|---------|-----------------------|----------------|-------------|-------------|-------------------------------------|
| 900 | Railway Br | CULZEN | 250803 | Five span single track railway bridge on masonry abutments. Two main river spans, steel through truss with curved top chord, clear spans 102 ft. Three right bank flood spans, probably masonry arch, each of 31 ft. | 360 | Single track | 15 | Max axle load 18 tons | 164 | 3 | 54 | |
| 901 | Road Br | NORWA S.A. 214 | 250771 | Eight span steel girder and timber bridge on timber piers and concrete abutments. One electric steel bascule span of 35 ft, 7 fixed spans 27 ft each. | 235 | 20 | 24 | 40 | 118 to 142 | 3 | 54 | |
| 902 | Road Br | MIDWATER STOCKTON | 210711 | Five span steel and timber bridge on timber piers. Central double leaf steel bascule span of 35 ft. Two other river spans and two flood spans each of 24 ft. Bascule also approaching tree litred. | 182 | 22 (14 on Bascule span) | 25 | Total load 6 tons | 130 | 24 | 54 | |
| 903 | Mobile Ferry | BRASS | 215-03 | Underwater cable ferry 46 ft long by 14 ft wide. Capacity 40 persons. Small tumbot also visible on air photos of 13 Sep 45. | | | | Total load 44 | 130 | 24 | 54 | Bridge shown on map does not exist. |
| 904 | Road Br | MILBURY | 200601 | 150 ft single span steel through truss bridge with curved top chord on masonry abutments. Bascule above highest navigable water 114 ft | 162 | 16 | 21 | 20 ton limit | 130 | 26 | 54 | |
| 905 | Road Br | MILBURY | 201415 | Eight span timber bridge on timber piers. Main river span of 25 ft with bascule section two spans of 20 ft, five spans of 16 ft. | 132 | 114 | | 12 | 118 to 140 | 24 | 54 | NOT marked on map. |
| 906 | Ferry | FEENE | 160309 | Reported passenger ferry for night persons | | | | | 130 | 14 | 44 | No boat visible 13 Sep 45 |

Serial 9175. River flows in two channels right (main stream) 90 ft average width, left stream 30-40 ft average width. The two channels are joined by a lock downstream (the left channel containing separately through mill Serial 87 for 200 ft). There is a weir at the upstream end of the right stream.

* NOT checked against air cover.

ALL MEASUREMENTS IN FEET

REPORT ON R. LEINE Description of bridges, dams, etc.

| Serial | Type | Location & Name | Map Ref 1/100,000 Sheet #/4 | Description of bridges, dams, etc. | Overall Length | Highways | | Load Class | River Width | Depth LH | Depth RH | Remarks |
|--------|--------------------------------|------------------------------------|-----------------------------------|--|----------------|-----------|-----------|-----------------------|-------------|----------|----------|----------------------------|
| | | | | | | Road | Sidewalks | | | | | |
| 108 | Lock (over left channel) | NEUSTADT | 175359 | Mill bridge and probably fern bridge over left stream downstream of lock. | | | | | 35 | | | |
| 109 | Lock (over left channel) | NEUSTADT | 175357 | Masonry lock, effective dimensions 130 ft x 12 ft immediately downstream of Serial 109. | 116 | Two of 5 | 35 | 40 | 100 to 110 | 5 | 8 | In series with Serial 110. |
| 110 | Road Br (over left channel) | NEUSTADT R.S.6 | 175356 | Three span masonry arch bridge with reinforced concrete structure. Masonry piers and abutments. Spans 47 ft each. 130 yds tree lined embankment on left bank leads to Serial 110. Clearance at MW 21 ft. | 86 | Two of 5 | 35 | 40 | 50 | 2 | 5 | In series with Serial 109. |
| 111 | Road Br | BONDENAU | 182310 | Two span masonry arch bridge with concrete strengthening. Masonry piers and abutments. Spans 35 ft on ab. 130 yds tree-lined embankment on right bank leads to Serial 109. Clearance at MW 14 ft. | 310 | Two of 14 | 22 | 24 arti- masked | 100 to 115 | 2 | 5 | |
| 112 | Road Br | RICKLINGEN | 20126 | Four span concrete arch deck type road bridge. Spans from right to left - 2 of 54 ft, 1 of 82 ft and 1 of 54 ft. Headroom above highest navigable water is 114 ft over a breadth of 26 ft. | 150 | Two of 14 | 22 | 24 arti- masked | 100 to 115 | 2 | 5 | |
| 113 | Road Br | RICKLINGEN | 219260 | 140 ft single span steel through truss with curved top chord. Tree-lined and embanked approaches. | 800 | One of 64 | 74 | 40 | 40 | | | |
| 114 | Road Br | BIELEFELD - HAWORTH Aurobach | 243047 | Eight span reinforced concrete deck arch embankment bridge. Concrete piers and abutments to abutments across valley. Spans 3 x 108 ft, 1 x 106 ft, 1 x 104 ft, 1 x 101 ft, 1 x 99 ft, 1 x 96 ft. | 120 | One of 5 | 22 | 85 | 85 | 2 | 4 | |

ALL MEASUREMENT IN FEET.

| Serial | Type | Location & Name | Map Ref 1/10000 Sheet No. | Description of bridge, dam, etc. - Constructional details. | Overall Length | Width | | Load Class | Rivet Width | Depth IM | Depth HM | REMARKS. | |
|--------|---|-----------------|---------------------------|---|----------------|---------|--------------------------------------|----------------------------|-------------|----------|----------|----------|---------------------------|
| | | | | | | Road | Sidewalks | | | | | | |
| 115 | A girder | LOWEY | 282246 | Three span steel plate girder aqueduct carrying BNS & MSRA - R.R. Canal. Central span 90 ft. side spans 70 ft each. Headroom above highest navigable water is 10 ft over a width of 26 ft. | 250 | | Two tow-paths of 9 ft | Canal 81 | 75 | 2 | 4 1/2 | | |
| 116 | Road B r. | BEELER | 282245 | 130 ft single span steel through truss with curved top chord on masonry abutments. Headroom above highest navigable level 11 1/2 ft. | 135 | 13 | One of 6 | 23 | 90 | 2 | 4 1/2 | | |
| 117 | Road Br. | STOCKER | 302257 | Two span bridge 7 reinforced concrete. Spans 45 ft each | 160 | 10 | | 22 | 65 | | | | |
| 118 | Pipeline Bridge | MANOVER | 315239 | Single span steel arch pipeline bridge. Serial 119 immediately upstream. | 125 | | | 6 | 60 | | | | |
| 119 | Railway Bridge | MANOVER | 315239 | Three span 4 track deck type parallel steel truss bridge on masonry piers and abutments. Spans of 110 ft each. Similar bridge over dried out arm of river at 310239 with spans of 78 ft each. Head room of main bridge above highest navigable water is 12 ft. | 360 | 4 track | 6 1/2 ft footwalk on up-stream side. | 61 | 85 | 4 1/2 | 5 | | |
| 120 | Lock dam and Road Br (over right channel) | MANOVER | 315220 | From 315225 to 315230 B. LEINE is in two channels, the right channel being approach to lock. Average width of right channel is 45 ft and left channel is 90 ft. Right channel is split by small island, with lock in left branch and dam in right branch. Lock is 140 ft x 17 ft. Right branch is 35 ft wide at upstream end and 45 ft at downstream end. At upstream end of right branch there is a 7 dammed run with footbridge at downstream end there is another dam with several sluices. Road bridge passes across downstream side of lock and lower dam. | 150 | 9 | 11 | 130 immediately downstream | | | | | In series with Serial 121 |

RESTRICTED

SECURITY INFORMATION

ALL MEASUREMENTS IN FEET.

Description of bridges, dams, etc.

R. LEINE

REPORT ON

| Serial | Type | Location & Name | Map Ref 1/100,000 Sheet N 4 | Constructional details. | Overall length | Width | | Load Class | River Width | Span | Depth | Remarks |
|--------|---------------------------------------|--------------------------|-----------------------------------|---|---------------------------|--------------|------------|------------|----------------------------------|------------|--------------|----------------------------|
| | | | | | | Road | Side-sluik | | | | | |
| 121 | Dam & Foot-bridge (over left channel) | HANNOVER | 33322 | Left channel is split into two branches by small island 65 ft maximum width, and is dammed in both branches. Bridge passes over dam and sluice gates on both branches. Left channel is separated from LEINE Branch Canal for 800 yds, from 35225 to 35221, by split of land 80 - 100 ft wide. River and canal are confluent 200 yds upstream of dam. Bridge over right branch steel girder deck type 7 or 8 span; over left branch steel girder 3 span. | 180 (right) 100 (left) | 30 | 12 | | 175 right 90 left | | | In series with Serial 120. |
| 122 | Foot Br. (over left channel) | HANNOVER | 35218 | Multi span frame bridge probably steel and timber leading to small island only, over left channel. | 140 | | 6 | | 130 | | | Not marked on map. |
| 123 | Road Br. | HANNOVER | 35219 | 7 five span steel girder road bridges | 290 | 11 | 16 | | 225 | | | Not marked on map. |
| 124 | Road Br. (over R. LEINE) | HANNOVER "HILFENBUCH" | 35215 | 116 ft single span steel through truss bridge Cantilevered side-sluik. | 128 | 28 | 6 | 40 | 125 (150 at other side of flood) | 5 1/2 6 | 11 1/2 13 | |
| 125 | Railway Br. (over R. LEINE) | HANNOVER | 35214 | Three span steel girder rly bridge (leads to summit only) Main River span 123 ft, two side spans each 14 ft. | 220 | Single track | 15 | | 225 | | | |
| 126 | Road Br. (over R. LEINE) | HANNOVER "HILFENBUCH" | 35205 | Two span steel plate girder with masonry-faced concrete pier. Spans 70 ft each. | 140 | 45 | 75 | 40 | 130 | 5 1/2 6 | 11 1/2 13 | |

From 35194 to 35219 R. LEINE is in two channels. The right channel (known also as the HANNOVER LEINE) is of 65 ft average width, the left channel is from 100 - 200 ft wide. The left channel is confluent with the R. LEINE at 35219 and is called the LEINE till it confluent with the LEINE proper at 35215.
The R. LEINE is less than 30 ft average width above the point where it is confluent with R. LEINE at 35193.

RESTRICTED
SECURITY INFORMATION

ALL MEASUREMENTS IN FEET.

Description of bridges, dams, etc.

REPORT ON R. LEINE

| Serial | Type | Location & Name | Map Ref 1/100,000 Sheet N 4 | Constructional details | Overall length | Width | | Load class | River width | Depth LM | Depth BM | Remarks |
|--------|-----------------------------------|-------------------------|-----------------------------|--|----------------|-------|------------------------|------------|-------------|----------|----------|--|
| | | | | | | Road | Stomwalk | | | | | |
| 127 | Road Dr. (over R. LEINE) | NARROW | 355203 | Three span steel plate girder bridge at 70° skew on concrete granite-faced piers and abutments. Roadway is reinforced concrete with allinlar brick surfacing laid in sand. Main span of 150 ft, side spans of 70 ft each. Bridge allegedly damaged Oct 44 but repaired Mar 45 | 300 | 39 | Two cycle tracks of 64 | | 115 | | | BM 44.40 + BM 44.40 + BM 52.68 + BM Not marked on map. |
| 128 | Road Dr. (over R. LEINE) | NARROW | 355201 | 7 free span steel plate girder bridge on concrete stone-faced piers and abutments. Roadway is reinforced concrete with allinlar brick surfacing laid in sand. Main span of 144 ft, side spans of 70 ft each. Right bank span appears a stomwalk damaged by bombing on photos of 9 Mar 45, roadway unaffected | 285 | 294 | Two cycle tracks of 54 | | 95 | | | BM 44.80 + BM 52.17 + BM Not marked on map. |
| 129 | Light Railway Dr. (over R. LEINE) | NARROW | 355215 | 7 7 no span steel light tly bridge. Detail obscured by trees. Rly leads to LEINE RYON only. | 190 | | Single track | | 65 | | | |
| 130 | Road Dr. (over R. LEINE) | NARROW WILKINSON BRIDGE | 355220 | Single span steel girder bridge. | 55 | 15 | | | 65 | | | |
| 131 | Road Dr. (over R. LEINE) | NARROW WOODBERRY BRIDGE | 355217 | 80 ft single span masonry arch stone bridge | 100 | 35 | | | 60 | | | |
| 132 | Road Dr. (over R. LEINE) | NARROW | 355215 | 7 Single span masonry arch bridge. Detail obscured by bushes. | 70 | 7 10 | | | 7 50 | | | |
| 133 | Road Dr. (over R. LEINE) | NARROW | 355216 | Single span masonry arch bridge. | 75 | 22 | | | 65 | | | |
| 134 | Road Dr. (over R. LEINE) | NARROW WOODBERRY BRIDGE | 355216 | 60 ft single span masonry arch bridge | 109 | 40 | | | 55 | 64 | 10 | Not marked on map. |

ALL MEASUREMENT IN FEET.

Description of bridges, dams, etc.

| Serial | Type | Location Name | Map Ref 1/100,000 Sheet N 4 | Constructional details. | Overall length | Width | | | Load Class | River Width | Depth LM | Depth HW | REMARKS. | |
|--------|--|---------------|-----------------------------|--|----------------|-------|----------|---------|------------|-------------|----------|----------|----------------------------|----------------------------|
| | | | | | | Road | Shoulder | Overall | | | | | | |
| 135 | Road Dr. (over L. LEINE) | RAMOVER | 36215 | Three span masonry arch bridge. It has been damaged by bombing and temporarily shored up. Spans of 25 ft each. | 85 | 11 | | 21 | | 70 | | | | |
| 136 | Road Dr. (over L. LEINE right channel) | RAMOVER | 36213 | Single span deck type box girder bridge. | 65 | 10 | | 19 | | 65 | | | In series with serial 137. | |
| 137 | Road Dr. (over L. LEINE left channel) | RAMOVER | 36213 | Single span steel girder bridge. | 37 | 9 | | 13 | | 32 | | | In series with serial 136. | |
| 138 | Road Dr. (over L. LEINE right channel) | RAMOVER | 36212 | Single span masonry arch bridge. | 33 | 22 | | 30 | | 33 | | | In series with serial 139. | |
| 139 | Road Dr. (over L. LEINE left channel) | RAMOVER | 36212 | Single span masonry arch bridge. | 45 | 10 | | 32 | | 40 | | | In series with serial 138. | |
| 140 | Road Dr. (over L. LEINE right channel) | RAMOVER | 36121 | Single span bridge probably masonry arch. | 45 | 17 | | 24 | | 41 | | | | |
| 141 | Road Dr. (over L. LEINE left channel) | RAMOVER | 36211 | 34 ft single span steel plate girder bridge. Hill bridge (now demolished by bombing) span channel immediately downstream. River makes dog-leg turn under bridge on which two rocks meet. | 100 | 120 | | 100 | | 34 | 64 | 10 | | In series with serial 142. |
| 142 | Road Dr. (over L. LEINE right channel) | RAMOVER | 36120 | 49 ft single span steel plate girder bridge. Bridge built out over downstream side. River makes dog-leg turn under bridge on which two rocks meet. | 54 | 130 | | 165 | | 49 | 64 | 10 | | In series with serial 141. |

RESTRICTED
SECURITY INFORMATION

ALL MEASUREMENT IN FEET.

Description of bridges, dams, etc.

REPORT ON

R. LEINE

| Serial | Type | Location & Name | Map ref 1/100,000 Sheet MJA | Constructional details. | Overall length | Width | | | River width | Depth LH | Depth HW | REMARKS. |
|--------|--------------------------------|-----------------|-----------------------------|--|----------------|--------------------------|--------------|---------|-------------|----------|----------|-----------------------|
| | | | | | | Reeds | Sidewalks | Overall | | | | |
| 143 | Road D.F. (over R. LEINE) | HANNOVER | X62208 | Single span steel girder bridge. Approaches possibly uninstalled. | 132 | 9 | | 15 | 50 | | | |
| 144 | Road D.F. (over R. LEINE) | HANNOVER | X62204 | Single span deck type steel girder bridge. Approaches possibly uninstalled. | 135 | 17 | | 22 | 55 | | | |
| 145 | Road D.F. (over R. LEINE) | HANNOVER | X62203 | Single span slab bridge reinforced concrete or steel plate girder. | 170 | 20 | | 59 | 82 | | | |
| 146 | Foot D.F. (over R. LEINE) | HANNOVER | X65195 | Single span through steel truss footbridge. | 130 | 0 | | 12 | 6.5 | | | |
| 147 | Dam foot bridge power station. | HANNOVER | X64195 | Three sector dam with steel footbridge over. Short channel leads to power house on left bank. Sectors 32 ft each. Gate is on the SCHWELLE GRAUZE which forms the left branch of R. LEINE and opens it to the R. LEINE. | 112 | 4 | | 6 | 100 | | 13 | |
| 148 | Road D.F. | HANNOVER | X66153 | 114 ft single span steel through truss bridge with curved top chord, formerly through route but rd now closed by MASCHKE lake on right bank. | 126 | 11 | | 14 | 100 | 10 | 13 | |
| 149 | Railway D.F. | HANNOVER | X9103 | Two parallel double track trolley bridges, steel through truss and steel plate girder, center on masonry pier and concrete abutments. Main river span of 115 ft. Left bank flood span of 48 ft. | 172 | Two of double track each | One of 24 ft | 26 each | 110 | 64 | | Max axle load 20 tons |
| 150 | Light foot br. | WATER OF ROSEN | 377175 | Light footbridge, probably steel girder single span | 170 | 6 | | 8 | 85 | | | |

RESTRICTED
SECURITY INFORMATION

RESTRICTED

ALL MEASUREMENTS IN FEET.

| Serial | Type | Location & Name | Description of bridges, dams, etc. | Map Ref 1/100,000 Sheet N 4 | Constructional details | Overall length | Width | | | Load Class | River Width | Depth IM | Depth DM | Remarks |
|--------|----------------------------------|-----------------------|--|-----------------------------------|--|----------------|-------------------------------|-----------|---------|------------------------------|-------------|----------|------------------------------|---------|
| | | | | | | | Roads | Sidewalks | Overall | | | | | |
| 151 | Road Br. | DOHREN | Four span steel girder deck type. Steel piers, concrete abutments. Spans 41 feet each. | 301173 | | 164 | 20 with two 4 ft cycle tracks | Two of 64 | 41 | 25 | | | | |
| 152 | Road Br. (over right channel) | DOHREN | Two span road bridge over right channel, built in centre on small island. Spans 50 ft each. Probably masonry arch construction. | 301170 | Immediately upstream river flows in two channels round island covered by factory Bldgs with mill on right channel between Serials 151 and 152. | 170 | 10 | | 28 | Two Channels of 30 ft on ab. | | | | |
| 153 | Railway Br. (over right channel) | DOHREN | Single track steel girder bridge. | 301170 | | 70 | Single track | 15 | 15 | 60 | | | | |
| 154 | Railway Br. (over left channel) | DOHREN | 125 ft single span single track skew through steel girder rly bridge. | 379169 | | 150 | Single track | 15 | 15 | 30 | | | Track leads to factory only. | |
| 155 | Road Br. | MUTTEL WILKENBURG Br. | Six span steel girder on reinforced concrete piers. Spans, two of 30 ft, two of 24 ft, two of 18 ft. | 303161 | | 145 | 23 | | 27 | 15 | 6 | 70 | | |
| 156 | 7 light railway Br. | LAATZEN | 7 two span light rly bridge. Track may have been removed. | 390154 | | 170 | Single track | 10 | 10 | 30 | | | | |
| 157 | Road Br. | LAATZEN | Road bridge probably two span steel girder | 395149 | | 130 | 8 | | 11 | 85 | | | | |
| 158 | Road Br. | GRASPOFF | 130 ft. single span masonry arch bridge, 20 ft side spans at each end. Masonry piers and abutments. Unbanked approaches. Possibly intended as replacement for Serial 159. Cover unsuitable for interpretation of approach roads. | 406129 | | 140 | 15 | Two of 2 | 20 | 115 | 34 | 7 | Not marked on map. | |

SECURITY INFORMATION

RESTRICTED
SECURITY INFORMATION

ALL MEASUREMENTS IN FEET.

REPORT ON R. LEVINE Description of bridges, dams, etc.

| Serial | Type | Location & Name | Map ref 1/100,000 Sheet H 4 | Construction details | Overall length | Width | | | Load spans | River width | Depth LF | Depth MF | REMARKS |
|--------|---------------------------|-----------------|-----------------------------|---|----------------|--------|-----------|---------|-------------------|-------------|----------|----------|----------------------|
| | | | | | | Road | Sidewalk | Overall | | | | | |
| 159 | Road Br | GRANDON | 407135 | Five span bridge, possibly timber and steel girder spans 30 ft each. | 150 | 10 | | 14 | | 120 | | | |
| 160 | Road Br | WOLFINEN | 412107 | Three span brick arch bridge. Main span @ ft, side spans 50 ft each. Bridge also carries tramway. | 215 | 16 | Two of 34 | 25 | 40 | 130 | 74 | 104 | |
| 161 | Road Br | ROVNE | Sheet P 4 420074 | R. IMEGOFF right bank tributary confluence at 420077. Width at confluence 55 ft. 3 span reinforced concrete beam and slab bridge. Piers 5 ft thick. Piers and abutments masonry with granite facing. Spans 65 ft each. | 205 | 20 | 5 and 64 | 24 | 40 | 90 | 3 | 6 | |
| 162 | Part Br | SCHLEIBER | 425063 | Six span timber cantilever bridge. Spans - 5 of 22 ft, 1 of 21 ft. Round timber of 35 in. diameter. | 135 | 11 | | 13 | Total load 4 tons | 89 | 3 | 6 1/2 | |
| 163 | Part Br | JERINEN | 416043 | Seven span timber and steel girder bridge. Spans - 15 1/2; 16; 20; 2 x 21; 23; 24 ft. | 148 | 10 1/2 | | | Total load 4 tons | 102 | 3 | 6 | |
| 164 | Road Br | SCHLEIBER | 405022 | Three span sandstone arch bridge. Main span 48 ft side spans 38 ft each. | 140 | 18 1/2 | | | 40 | 110 | 34 | 64 | Leads to Serial 167. |
| 165 | Road Br | SCHLEIBER | 405021 | On right channel. Dam on left channel at 402016 | | | | | | | | | |
| 166 | Mill and 7 light mill Br. | SCHLEIBER | 403019 | Six span reinforced concrete arch bridge. Two main river spans each of 48 ft with side spans of 36 ft and 24 ft on each side. Site is overtopped by steep wooded hill rising to 175 m + 88 on which stands SCHLEIBER MILLWORKS. | 255 | 12 1/2 | Two of 34 | 23 | 40 | 95 | 7 | 9 | |
| 168 | Part Br | WOLFINEN | 389975 | 7 timber frame bridge probably several spans | 75 | 8 | | 10 | | 65 | | | |

* Not checked against air cover.

RESTRICTED

SECURITY INFORMATION

ALL MEASUREMENTS IN FEET.

REPORT ON A. LEASE Description of bridge, dam, etc.

| Serial | Type | Location & Name | Map Ref 1/100,000 Sheet P 4 | Constructional details | Overall length | Width | | Load Class | River Width | Depth LW | Depth HW | Remarks |
|--------|-----------------------------------|------------------|-----------------------------------|---|----------------|--------------|----------|-----------------------|----------------|----------|----------|----------------------------|
| | | | | | | Road | Sidewalk | | | | | |
| 169 | Road B. | MUN/UMCH | 37072 | 77 ft. single span steel through truss bridge with truss on common piers and abutments. Five spans two of 62 ft each, three of 77 ft each. | 375 | Two of 2 | 30 | Max axle load 20 & 25 | 50 | 3 | 40 | |
| 170 | Road B. | reference A.S.L. | 39194 | 100 ft. single span steel through truss bridge on masonry piers and abutments. Truss riveted. 100 yds from site on left bank in the center of a flooded concrete flood wall with spans, one of 41 ft, two of 32 ft, 12 ft overall length. Class 40. Max. 30 ft wide with sidewalk of 5 ft and 6 ft. | 115 | Two of 4 | | 40 | 30 | 4 | 64 | |
| 171 | 7 Passenger Ferry | SEZE | 30728 | Bridge shown on map does not exist. Position of road not ferry site. | | | | | 65 | | | |
| 172 | Railway B. | GRONAU | 37072 | Two span steel lattice girder single track bridge on masonry piers and abutments. River span of 152 ft. Flood span of 73 ft each. | | Single track | | Max axle load 16 tons | 100 | 24 | 74 | |
| 173 | Road B. (over left channel) | GRONAU | 37585 | From 37585 to 37586 river is in two channels. The main one is called the "Griffin" and has a weir at its upstream end. | | 15 | | 24 | | | | connected with Serial 174. |
| 174 | Road B. (over right channel) | GRONAU | 37585 | 84 ft. single span steel through truss with girder top chord. | 100 | 3 and 5 | | 24 | 57 50 82 | 3 | 8 | In series with Serial 173. |
| 175 | 7 Bill (over right channel) | GRONAU | 40081 | 82 ft. single span steel through truss with curved top chord. 114 ft clearance above HL. | | 3 and 5 | | 24 | | | | |

* Not checked against air cover.

RESTRICTED

SECURITY INFORMATION

RESTRICTED
SECURITY INFORMATION

ALL MEASUREMENTS IN FEET.

| SERIAL | TYPE | LOCATION & NAME | MAP REF 1/100,000 SHEET P 4 | CONSTRUCTIONAL DETAILS | OVERALL LENGTH | WIDTH | | | LOAD CLASS | RIVER WIDTH | DEPTH BY | DEPTH FM | REMARKS | |
|--------|--|-----------------|-----------------------------------|--|-------------------|-------|----------|---------|---------------|--|-------------|-------------|---|--|
| | | | | | | ROAD | SIDEWALK | OVERALL | | | | | | |
| 176 | Farm Br | MARTIN | 390876 | Three span 7 steel girder and timber farm bridge Spans 30 ft each. Left bank approach track embanked across water- filled old meander at 390877 | 105 | 6 | | 9 | | 80 | | | | |
| 177 | Lead Br (over left channel) | MARTIN | 390872 | River in two channels from 390873 to 390865. Weir runs small island at upstream end of right channel with footbridge to island. Both channels are 50 - 60 ft average width. | 65 | 14 | | 18 | | 45 under 14 and will be up- stream | | | Mt through route. Depth shown on map from right channel at 390871 about 10 ft expose. | |
| 178 | Farm Br - KORN OF BLUFF | | 390860 | 7 Three span timber bridge. Water filled meander on right bank. | 65 | 6 | | 9 | | 52 | | | | |
| 179 | Road Br (over left channel) | | 390865 | River in two channels from 390867 to 390863, both 55 ft average width. Weir at upstream end of left channel. | 105 | 18 | | 20 | 24 | 55 | 6 | 7 | In series with Serial 150. | |
| 180 | Road Br. BRIDGE (over right channel) | | 390866 | Three span steel girder bridge on timber piers with concrete base. Masonry abutments. Spans of 30, 29 and 25 feet. Height of bridge above river bed is 20 feet. The flood spans on left bank as follows: (a) At 390865 28 ft single span steel through truss with curved top chord. (b) At 390866 Three span masonry arch bridge - spans of 26 ft and two of 13 ft each. | 62 | 15 | Two of 4 | 25 | 24 | | | | | |
| | | | | 35 Part single span reinforced concrete beam and slab bridge on concrete abutments. | 48 | 21 | Two of 4 | 28 | 40 | 35 | | | In series with Serial 179 | |

RESTRICTED
SECURITY INFORMATION

RESTRICTED
SECURITY INFORMATION

ALL MEASUREMENTS IN FEET.

DESCRIPTION OF BRIDGES, DAMS, ETC.

R. LEINE

REP. CRT. CH.

| Serial | Type | Location & Name | Map Ref. (1/100,000) Sheet P. I. | Constructional details. | Overall length | Width | | Load Class | River Width | Depth IM | Depth BM | Remarks |
|--------|--------------------------------|-----------------|----------------------------------|--|----------------|-------------------|---------|---------------------------------|-------------|----------|----------|--|
| | | | | | | Road | Overall | | | | | |
| 181 | Furn Br. | KOYERIN | 42281 | Five span timber trestle bridge with steel girder roadbeams and timber decking 3 inches thick. Spans - 1 of 23 ft, 2 of 26 ft and two of 11 1/2 ft. Vertical clearance 12 ft. | 103 | 10 | 11 1/2 | Low class 12 | 70 | 4 | 8 | |
| 182 | Road Br. (over stream channel) | ALFELD | 42733 | River in two channels from 421753 to 424782. Left channel 50 - 60 ft, right channel 25 - 30 ft average width. 95 ft wide weir at upstream end of left channel. Probable single span masonry arch, (site obscured by channel) 12 ft high. On right bank 750 yds concrete structure. | 40 | 13 | 21 | | 25 | | | 100 ft through 12 ft. 100 ft carried on 12 ft. |
| 183 | Road Br | ALFELD | 42402 | Three span steel plate girder bridge with reinforced concrete decking or floor 6 ft thick. Main river span 130 ft, side spans 56 ft each. 100 yds from site on left bank is 20 ft reinforced concrete beam flood span, 100 ft overall length. Class 40. Width of roadway 23 ft and sidewalks of 8 and 1 1/2 ft. Overall 31 ft 6 in. 23 ft. | 265 | 23 | 40 | 40 | 30 | 7 | 10 | |
| 184 | Footbridge | ALFELD | 42178 | Timber footbridge probably 2 or 3 spans | 60 | 8 | 5 | | 50 | | | |
| 185 | Furn Br. | SOUL of ALFELD | 42771 | Multi span steel girder and timber beam bridge | 105 | | 11 | | 60 | | | |
| 186 | Road Br | NIERHARTLIN | 45753 | Two span steel girder bridge with 4 inch thick timber decking. Masonry abutments. Spans of 35 ft each. Minimum height above water is 10 feet. | 75 | 12 1/2 | 14 | Timber class 15 tons | 50 | 6 | 8 1/2 | |
| 187 | Railway Br. | OL. FREDEN | 42074 | Two parallel five span steel plate girder single track bridge on concrete piers and abutments. Three spans of 69 feet each, two spans of 57 feet each. | 330 | Two single trucks | 18 | Timber and steel class 15 tons. | 60 | 14 | 4 1/2 | |
| 188 | Road Br | OL. FREDEN | 42973 | Single span parallel truss steel girder bridge. Slight bank approaches appear in poor condition. Level crossing at 421735. | 75 | 10 | 14 | | 60 | | | Not finished on map. |

RESTRICTED
SECURITY INFORMATION

RESTRICTED

SECURITY INFORMATION

ALL MEASUREMENTS IN FEET.

REPORT ON R. LEHNE Description of bridge, size etc.

| Serial | Type | Location & Name | Map Ref 1/100,000 Sheet P 4 | Construction details. | Overall length | Width | | | Load class | River width | Depth LH | Depth RH | Remarks |
|--------|-------------|------------------|-----------------------------------|---|----------------|-------|---------------|---------|------------|-------------|----------|----------|---------|
| | | | | | | Roads | Sidewalk | Overall | | | | | |
| 109 | Road Dr. | GR. PRISON | 485723 | 17 1/2 ft. single span steel through truss with curved top chord on masonry abutments. Right bank approaches embanked and tree lined. Vertical clearance 15 feet. | 220 | 16 | Two of 4 | 27 | 40 | 100 | 6 | 9 | |
| 190 | Road Dr. | BUNHAUEN | 518577 | River in two channels from 485723 to 487720. Factory on island between the channels with sluice gates and footbridge over it at downstream end and two footbridges and two roadbridges upstream. None of them is a through route. All are on left channel which is 50 feet average width. There are no crossings over right channel which is 50 - 65 feet average width. At its upstream end are two wires 30 feet and 65 feet wide on each side of small island. | 124 | 12 | Two of 16 lbs | - | 24 | 82 | 64 | 8 | |
| 191 | Road Dr. | GRUBER R.L.S. 64 | 522546 | River in two channels from 522550 to 523644. 145 ft wide weir across upstream end of right channel. Right channel 50 ft, left channel 25 ft average width. 79 feet single span reinforced concrete arch bridge over right channel. Reinforced masonry approaches. Mill abutts. across left channel. 250 yds approach spans, as follows - (a) over left channel at 522546 single span reinforced concrete arch. (b) Right bank at 524046 four span reinforced concrete beam and slab on masonry piers. Spans 12 ft each. (c) Right bank at 525047 eight span reinforced concrete beam and slab on masonry piers. Spans 13 ft each. (d) Right bank at 526047 five span reinforced concrete beam and slab on masonry piers. Spans 20 ft each. | 110 | 24 | Two of 5 | 39 | 40 | 75 | 3 | 64 | |
| 192 | Railway Dr. | REIDENH | 59659 | Four span double track masonry arch bridge. Two central spans of 41 ft each. Total length of 15 ft each. | 150 | 20 | Two of 5 | 32 | 40 | 60 | 5 | 7 | |

* Not checked against air cover.

RESTRICTED
SECURITY INFORMATION

ALL MEASUREMENTS IN FEET.

| Serial | Type | Location & Name | Map Ref 1/100,000 Sheet P 4 | Constructional details | Overall Length | Width | | Load Class | River Width | Depth LM | Depth AM | REMARKS |
|--------|-------------|------------------------|-----------------------------------|---|-------------------|--------------|-----------|--------------------------|--|-------------|-------------|--------------------|
| | | | | | | Roads | Sidewalk | | | | | |
| 193 | Road Br. | BELEWEN | 53658 | 100 Feet single span reinforced concrete through arch bridge | 120 | 17 | Two of 18 | 24 | 65 | 54 | 8 | |
| 194 | Road Br. | CLUBEN | 50569 | Six span timber bridge on timber trestle piers and masonry abutments. Spans - two of 21 ft, 20 ft, 19 ft, 14 ft, 9 ft. | 104 | 16 | | 20 | 79 | 5 | 0 | Not marked on map. |
| 195 | Foot Br. | NUTTIBROU | 52761 | Three span timber footbridge. Pier immediately downstream with small island approached by 25 ft footbridge over narrow side area | 82 | 4 | | 6 | 70 | 5 | 8 | |
| 196 | Railway Br. | SALZBURGEREN | 50569 | R. ILYE (left bank tributary) confluence at 510597 width of confluence 30 ft. Four span steel girder single track bridge on masonry piers and abutments. Spans 49 ft each. Six span flood bridge 250 yds from site on left bank. Spans of 39 ft each. | 225 | Single track | 16 | | Max axle load less than 16 tons. | 2 | 4 | |
| 197 | Road Br. | SALZBURGEREN R.S. 3 | 50577 | River in two channels from 503504 to 503579. Right channel 40 - 50 ft, left channel 25 - 30 ft average width. Left channel is crossed by two trestle bridges at 503581 and 503582. There are no crossings over right channel. Three span masonry arch bridge with centre section over upstream end of island 40 ft wide by 275 ft long. Spans of 48 ft, 20 ft and 17 ft. Flood bridge on right bank at 505777, 4 spans of 88 ft each. | 160 | 23 | 4 & 6 | 36 | Upstream 143 Downstream left channel 40 right channel 65 | 6 | 9 | |
| 198 | Foot Br. | WOLLEN | 51459 | Six span timber trestle footbridge. Spans 20 ft each | 134 | 4 | | | 65 - 85 | 4 | 64 | |
| 199 | Foot Br. | DEUSEN | 52528 | Four span steel girder and concrete bridge on timber piers. Spans 10 ft, 13 ft, 23 ft and 32 ft. | 60 | 44 | | 20 - load 2 ton | 50 | 3 | 44 | |

* also checked against air cover.

ALL MEASUREMENTS IN FEET.

Description of bridges, dams, etc.

R. LEINE

| Serial | Type | Location & Name | Map Ref 1/100,000 Sheet Q-4 | Constructional details | Overall Length | Width | | | Load Class | River Width | Depth LM | Depth RM | REMARKS. |
|--------|------------------------------------|-----------------|-----------------------------------|--|-------------------------|--------------|--------------|---------|---------------|----------------|-------------|-------------|----------------------------|
| | | | | | | Roads | Sidewalk | Overall | | | | | |
| 200 | Road Dr (over left channel) | WILLIAMS | S20513 | From S20520 to S20501 river is in two main channels each 40 - 50 ft average width with minor branches 15 - 20 ft wide. R. RINGS (right bank tributary) is confluent at S20503. Width at confluence 65 ft. Hair immediately downstream of confluence. | 53 | 16 | Two of 3 1/2 | 25 | 12 | 50 | 14 | 6 | In series with Serial 201. |
| 201 | Road Dr (over right channel) | WILLIAMS | S20512 | Five span concrete arch bridge. Spans 51 ft each. Three lined embankment approaches. Flood span over side stream at S21512. Steel superstructure on concrete abutments. Single span of 55 ft. | 225 Flood Span 59 | 16 | Two of 3 | 26 | 12 | 50 | 1 | 24 | In series with Serial 200. |
| 202 | Road Dr (over left channel) | WILLIAMS | S20500 | Multi span timber trestle bridge. 7 Footbridge upstream at S20504 (no air over available). | 60 | 9 | | 12 | | 50 | | | Not a thru arch route. |
| 203 | Road Dr | WILLIAMS | S20476 | 55 Feet single span steel girder through type bridge on masonry abutments. Footbridge immediately downstream. | 60 | 14 | Two of 4 | 24 | 40 | 42 | 24 | 5 | |
| 204 | Railway Dr. | WILLIAMS | S20459 | Four span double track masonry arch bridge. Spans 49 ft each. | 270 | Double track | Two of 14 | 27 | | 42 | 24 | 5 | |
| 205 | Road Dr | WILLIAMS | S20440 | River in two channels from S20451 to S20446. Both channels 35 - 40 ft average width. Hair at upstream end of right channel. | 45 | 11 | | 15 | 12 | 43 | 24 | 4 1/2 | |
| 206 | Road Dr | WILLIAMS | S20445 | Two span timber bridge over right channel. Spans of 20 and 22 ft. Also 2: ft single span over left channel with mill bays on left bank. | 50 | 25 | | 32 | 40 | 37 | 24 | 4 1/2 | |
| 207 | Road Dr | WILLIAMS | S20434 | Single span iron bridge on concrete abutments Timber footbridge, probably 2 or 3 spans | 65 | | | 6 | | 40 | | | |

RESTRICTED
SECURITY INFORMATION

ALL MEASUREMENT IN FEET

R. LEINE

R. LEINE

| Serial | Type | Location & name | Map Ref 1/100,000 Sheet Q 4 | Description of bridges, dams, etc. | Overall Length | Width | | Load | River | Depth | Remarks |
|--------|---------------------------------|------------------|-----------------------------------|---|-------------------|----------------------------------|-----------|------------------------|-------|-------|---|
| | | | | | | Road | Sidewalks | | | | |
| X00 | Road Br | NORTHEM | 501405 | R. RIVER. Confluent with R. LEINE at 53+50.3. Width at confluence 65 ft. | 90 | 114 | | 12 | 69 | 4 | |
| X01 | Railway Br | NORTHEM | 553406 | Five span oak bridge. Spans of 10 ft each. Six span masonry arch double track bridge. Spans 30 ft each. | 275 | Double track | | Max axle load: 25 tons | 30 | 2 | 4 |
| X02 | Road Br (over right channel) | NORTHEM R.S.3 | 503406 | River in two channels through NORTHEM from 562+05 to 577+04. Left channel 30 ft, right channel 65 ft average width. Five span masonry arch bridge. Spans 41 ft each. Ford immediately downstream. | 245 | 20 | Two of 3 | 40 | 145 | 1 | In series with Serial X03. |
| X03 | Road Br (over left channel) | NORTHEM R.S.3 | 565401 | Single span stone masonry arch road bridge. Pillars immediately downstream. Footbridge across left channel downstream at 563+05 | 90 | 20 | | | 50 | | In series with Serial X02. |
| X04 | Road Br (over left channel) | NORTHEM | 566401 | Single span 7 masonry arch bridge. Footbridge across left channel upstream at 570+03 | 50 | 15 | | | 45 | | In series with Serial X02 as alternative to Serial X02. |
| X05 | Farm Br & foot Br | NORTHEM | 503404 | Farmlands and footbridge parallel and probably on common plans. Three spans each of 25 ft approx. | 75 | 5 (farm br) 4 (foot br) | | | 60 | | |
| X06 | Road Br | UNIDENTIFIED | 605470 | Three span timber truss bridge. One span of 36 ft and two spans of 21 ft each. | 37 | 64 | | Total load 5 tons | 60 | 2 | Not marked on map. |

RESTRICTED
SECURITY INFORMATION

REPORT ON R. LEINE. ALL MEASUREMENTS IN FEET R. RUMPEL.

| Serial | Type | Location & Name. | Map Ref 1/100,000 Sheet Q 4 | Description of bridges, dams, etc. | Overall length | M. Lth. | | Load class | River width | Depth LM | Depth hd | REMARKS. |
|--------|-----------------------------|--------------------------|-----------------------------|---|----------------|--------------|---------------|------------------------|-------------|----------|----------|---|
| | | | | | | Road | Sidewalks | | | | | |
| 307 | Road Dr | ELVENSHALLEN | 6 28476 | 95 Ft single span steel through truss bridge. Minor bridges over mill stream on right bank and weir 250 yds upstream. | 110 | 13 | One of 2 1/2 | 40 | 50 | 3 1/2 | 4 1/2 | Bridge marked on map at 62477 does not exist. |
| 308 | Railway Dr | KATLENDURO-DURN | 64035 | Two three span parallel single track steel plate girder bridges on masonry piers. Spans 30 ft each | 160 | Two | single tracks | Max axle load 20 tons. | 30 | 2 1/2 | 3 1/2 | |
| 309 | Road Dr | KATLENDURO-DURN R.S. 261 | 63052 | Six span timber trestle bridge with piers on masonry foundations. Spans of 20 ft each. | 100 | 15 | One of 2 1/2 | 40 | 30 | 2 | 3 1/2 | |
| 310 | Road Dr. | KATLENDURO-DURN R.S. 247 | 63747 | R. OVER right tributary confluent at 637440. Mill at confluence 35 ft. | | 14 | | 40 | 30 | 3 1/2 | 5 1/2 | |
| 311 | Road Dr | WACHENHAUSEN | 63535 | Two span timber bridge. Spans 21 ft each. | 44 | 11 | | Total load 4 tons | 35 | 3 | 5 | |
| 312 | Road Dr | LINAU | 65320 | 36 Ft single span steel girder bridge. 23 Ft steel girder span over right channel (mill stream) 200 yds NORTH. | 43 | 17 | Two of 3 | 40 | 33 | 3 1/2 | 5 1/2 | |
| 313 | Road Dr | BILLSHAUSEN | 67000 | Two span steel girder bridge. Spans 16 ft each | 34 | 15 | Two of 3 | 40 | 33 | 4 | 5 1/2 | |
| 314 | Railway Dr. | GIEOLDHAUSEN | 70934 | Two span steel plate girder on masonry pier and abutments. Spans 50 ft each. | | Single track | | Max axle load 25 tons | 33 | 3 | 4 | |
| 315 | Road Dr (over left channel) | GIEOLDHAUSEN R.S. 247 | 71979 | 26 Ft single span steel girder | 33 | 16 | Two of 3 | 40 | 26 | 1 | | |

* Not checked against air cover.

RESTRICTED
SECURITY INFORMATION

ALL MEASUREMENTS IN FEET

Description of bridges, etc., etc.

R. LEINE

REF ORT ON

R. ODER

| Serial | Type | Location & Name | Map Ref 1/100,000 Sheet Q 4 | Description of bridges, etc., etc. | Overall length | Widths | | Load class | River width | Depth LH | Depth | Remarks |
|--------|-------------|-----------------|-----------------------------|---|----------------|--------------|-----------|-----------------------------|------------------|----------|-------|---------|
| | | | | | | Road | Sidewalks | | | | | |
| + 320 | Road Dr | LINDAU | 65G429 | R. ODER Confluent with R. RUMIG at 657448. Width at confluence 35 ft. Ten span steel girder bridge on 4 timber and five masonry piers. Spans 23 ft. each. | 245 | 13 | | Total load 5 tons | 22 | 14 | 3 | |
| + 321 | Railway Dr. | MULPTEN | 66B425 | Three span steel plate girder bridge on masonry piers and abutments. Spans 22 ft. each. | 240 | Single track | | Max axle load 25 tons. | 65 | 1 | 24 | |
| + 322 | Road Dr | MULPTEN | 66B420 | Twelve span timber bridge. Spans 20 ft each | 45 | 10 | 1 and 4 | Total load 5 tons | 79 | 1 | 24 | |
| 323 | Foot Dr | WEST of HATTORF | 71K410 | Timber footbridge | | | | | 35 | | | |
| 324 | Road Dr | HATTORF | 72K413 | Four span timber bridge. Two spans of 29 ft each two of 34 ft each. Footbridge and weir 250 yds and 300 yds upstream. | 140 | 11 1/2 | Two of 14 | Estimated total load 5 tons | 30 (90 in flood) | 1 | 24 | |
| + 325 | Road Dr | SE of HATTORF | 75G396 | 102 ft single span iron bridge. Footbridge 400 yds downstream. | | 15 | Two of 24 | 40 estimated | 65 | 1 | 24 | |
| + 326 | Road Dr | POHLDE | 791K1 | Road bridge. Retail concealed by saw. | 70 | 14 | | | 35 | | | |
| + 327 | Road Dr. | POHLDE | 791K1 | Five span timber truss bridge on concrete foundations with iron truss superstructure. Spans 17 ft each. Trestled embankment right approach. | 90 | 16 | 3 1/2 | 12 estimated | 30 (90 in flood) | 14 | 34 | |
| 328 | Railway Dr. | POHLDE | 794K4 | Two span steel through truss single track bridge on masonry pier. Spans 79 ft each. | 170 | Single track | | Max axle load 20 tons. | 30 | 1 | 24 | |

+ Not checked against air cover.

RESTRICTED
SECURITY INFORMATION

R. OBER.

ALL REQUIREMENTS IN FEEL

Description of bridges, dams, etc

R. LINE

REPORT ON

| Sheet | Type | Location & Name | Map Ref 1/100,000 Sheet Q 4 | Construction details | Clearance height | Span | | Load Class | River Width | Depth LM | Depth LM | Remarks |
|-------|------------|-------------------------|-----------------------------------|--|---------------------|-------------------|------------------|---------------|-------------------|-------------|-------------|-------------------|
| | | | | | | Road | Spanning Over | | | | | |
| 329 | Road BR | SCHWARZFELD | 083375 | Single span masonry arch road bridge. Level crossing immediately on right bank. Footbridge 400 yds downstream. | 45 | 14 | 10 | | 7.25 | | | Not marked on map |
| 330 | Road BR | SCHWARZFELD | 083395 | Single span steel girder bridge. Left bank approach probably poorly detailed. | 75 | 8 | 12 | | 60 | | | Not marked on map |
| 331 | Railway BR | BABIS | 083395 | Two span twin steel plate girder single track bridges on common concrete and masonry piers and abutments. Spans 51 ft each. Weir immediately downstream. Pier on small island. | 115 | Two single tracks | Two of 3 | 35 | 40 | 1 | 2 | Not marked on map |
| 332 | Road BR | BABIS R.S.243 | 083395 | 72 Ft single span reinforced concrete skew bridge | 85 | 19 | 64 & 5 | 35 | 60 | 1 | 2 | Not marked on map |
| 333 | Road BR | BAD LAUTERBERG | 083392 | 7 Single span reinforced concrete bridge. Possibly sluice gates underneath | 100 | 10 | | 17 | 85 | | | Not marked on map |
| 334 | Road BR | BAD LAUTERBERG | 083395 | Masonry arch bridge 7 single span | 95 | 15 | | 22 | Obscured by trees | | | Not marked on map |
| 335 | Road BR | BAD LAUTERBERG | 083391 | 22 Ft single span masonry arch bridge. | 87 | 16 | 4 and 34 | 27 | 39 | 2 | 4 | Not marked on map |
| 336 | Road BR | BAD LAUTERBERG | 084402 | 7 Steel girder and timber bridge | 100 | 8 | | 10 | 80 | | | Not marked on map |
| 337 | Road BR | NE of BAD LAUTERBERG | 912415 | | | | | | | | | |

At 9142 R. OBER reaches lower end of ... This reservoir, completed in 1934 has a superficial area of 346 acres, with a maximum head of 172 ft and a maximum capacity of 30 million m³. A roadway runs along the top of the dam, 70 across the lower end of a compensating reservoir at the foot of the main dam. A power station on the right bank has a capacity of 6 MW.

* Not checked against air cover.

RESTRICTED
SECURITY INFORMATION

EXHIBIT B

DESCRIPTION OF WATERCOURSE AND CONTROL STRUCTURES*

| | <u>Page</u> |
|-----------------|-------------|
| The Aller River | 1 |
| The Leine River | 7 |

*Abstracted and Translated from "Stromgebiet der Weser und Ems, Einwirkung auf der Wasserführung" (River Basins of the Weser and Ems, Influence of Flow). Military Geography ("Mil-Geo") Training Manual H. Dv. g. 33a, General Staff of German Army, Section 9, Berlin 1937.

RESTRICTED
SECURITY INFORMATION

RESTRICTED
SECURITY INFORMATION

THE ALLER RIVER

1. Description of the Watercourse.

a. Above Celle with its Tributaries

(Ocker, Fuhse, Ise, etc.)

| Discharge at | Mean Low Water m 3/s | Middle Water m 3/s | High Navigable Water m 3/s |
|---------------------------|-------------------------------|--------------------------|-------------------------------------|
| Langlingen | 6.1 | 15 | 60 |
| Bannetze | 15 | 32 | 100 |
| Hadenstorf (uncontrolled) | 36 | 108 | 250 |
| Verden | 43 | 110 | 300 |

The velocity at MNW is up to 0.95 m/s
 MW " " " 1.1 "
 HschW " " 1.35 "

The Aller is not navigable above Celle. Aside from high water and two pools of 150 and 170 hectares at Grifhorn and Mueden, and without the erection of new installations, the military obstacle is hardly of importance.

Ice seldom forms.

The river bed is mostly sandy.

Fording is possible in straight reaches.

Between Bockelskamp and Celle the river spreads out; therefore, it is shallow: the remainder is irregular; concave banks are mostly steep (up to 4 m high), convex banks are mostly flat.

Between Wolfsburg and Gifhorn in the Aller Depression, the bottom is unstable and is passable for horses and motor vehicles only in the valley floor; below Gifhorn, it is mostly sandy and also passable.

| Larger side canals | Length m | Width m | Depth m |
|--|-------------|------------|------------|
| 1. Aller Diversion Canal, between Weyhausen and Brcnneckenbrueck | 19 | 20 | 1-3 |
| 2. Wichhaeusen Mill Canal, below Langlingen up to Wichhaeusen | 9.4 | 15 | 1.2-1.5 |

RESTRICTED
SECURITY INFORMATION

b. From Celle to the Mouth at the Weser.

From Celle (River km 0.0), it is navigable. Above the Leine mouth it is canalized, below it is built for 350-ton vessels, at \bar{M} up to 600 ton.

Between Verden (River km 113.0) and the mouth, a strong increase in stream velocity may appear, when the low stage of the Weser meets the high flow of the Aller, which is often the case.

In the reverse condition (high Weser stage with small flow in the Aller), a backwash of the Weser is observed up to Verden.

Large overdepths (up to 5m) exist on the convex banks.

The width up to Celle is 5-60m, from Celle to the mouth 22-70 m.

Above Celle it is fordable nowhere.

The subgrade consists of fine sand and is therefore unstable.

The banks are sandy all the way through the foreland (Heide); steep and rocky slopes are seldom if ever found.

Valley flats are uneven across the course.

II. Peacetime Regulation and Utilization of the Flow.

a. Above Celle with the Tributaries.

(Oker, Fuhse, Isc, etc.)

The following are control structures on the Aller:

1. Above Celle

| | Unit map no. | Object no. | Description | River km. |
|----|--------------------|---------------|---|--------------|
| a. | 62 | 137 | Lock with a walk, above Gifhorn for power production for operating a mill | 28.6 |
| b. | 62 | 138 | Lock with a bridge, at Dieckhorst above mouth of Isc (Purpose same as 1a) | 0.6 |

RESTRICTED
SECURITY INFORMATION

RESTRICTED
SECURITY INFORMATION

| | Unit map no. | Object no. | | River km. |
|----|--------------------|---------------|--|--------------|
| c. | 62 | 10b | Lock with a bridge, at Langlingen, for power production for Weinhausen flour and saw mills and irrigation | 48.4 |
| d. | | | Lock at Opperhausen, serves for irrigation of Osterbruch meadows, east of Altoncelle | |
| e. | | | Domain-Fiscal Dam in Celle, for power production for the Domain-Fiscal Mill and for the city and for the paper factory at Drewsen, also it feeds the Magnus City and Castle ditch for hygienic purposes. | |

All the control structures are hand operated and are without significance for the flow in the navigable reach.

2. Below Celle

The following are the most important control structures:

| | Unit map no. | Object no. | Description | River km. |
|----|--------------------|---------------|---------------|--------------|
| a. | 61 | 56b | Dam, Oldau | 14.8 |
| b. | 61 | 59b | " Bannetze | 26.8 |
| c. | 61 | 62b | " Marklendorf | 38.2 |
| d. | 61 | 65b | " Hadenstorf | 49.7 |

Besides that stored by these control structures, there is no other water stored in the Aller watershed.

The dams serve to improve the navigation of the Aller up to Celle harbor; also the Oldau and Marklendorf Dams generate electric power.

III. Warfare Changes in the Flow.

a. Above Celle with the Tributaries.

(Okcr, Fuhsc, Isc, etc.)

RESTRICTED
SECURITY INFORMATION

RESTRICTED
SECURITY INFORMATION

With the help of temporary installations, the maximum winter water stage of the locks at Gifhorn and Diekhorst can be increased about 20 cm. forming flooded areas totaling from 320 to 400 hectares. If a temporary dam were erected below Bronckenbrueck (about River km. 32 near the bridge at Map No. 62, Object No. 8), together with the dams at Gifhorn and Diekhorst, the artificial inundation of a 20 km-reach of the Aller Valley to a width of about 400 m would result, but only when the flow is sufficient, which at low stages is doubtful.

By suddenly releasing this storage a damaging wave of short duration would be generated below Mueden (River km about 49.5), which could be repeated every 2-3 days at Middle Water.

When at High Water the Aller water level lies above the surrounding land, lying so that a penetration of the left Aller dikes between Flettmar and the Celle-Gifhorn railroad dam will produce an artificial flooding of the area between Flettmar up to Kleine Eicklingen bringing about the partial discharge of High Water to the Fuhse Lowlands. This would, however, besides endangering the villages of Flettmar, Hohnsbostel, Fornscheke, Paulmannscheke, and Sandlingen, cause great cultural damage, particularly to farmland. If the dams are wrecked or made inoperative from enemy action, the operation of flour mills and irrigation would be stopped. With longer duration, the damages of drouth should be considered, especially in the higher areas.

The tributaries of the Aller above Celle, such as Oker, Fuhse, etc., are not navigable. With the smaller dams, it is not possible to inundate large areas.

The Oberharzer Ponds (Toiche), west of Altenau, would produce a floodwave of a few hours duration if the dams were cut; however, this would have little effect, except to put the war factory "tanne" out of order.

b. From Celle up to the Junction with the Weser.

The normal damming can be raised by closing the weirs and making the turbines inoperative so the lowland areas along both banks will be inundated. The opening of the High Water intakes, and if necessary, by cutting the low-bank dikes above the Bannetze and Marklendorf Dams will increase the flooded area.

Both the Bannetze and Hadenstorf Dams can be raised about 40 cm, the Marklendorf Dam about 20 cm, above the peacetime level, without any special superstructure. Furthermore, all four dams can be raised about 20 cm higher by means of a superstructure. The tops of the dams are not prepared and must be specially constructed. A break in the dam producing a higher stage is not to be feared, because the foundation is strong enough.

RESTRICTED
SECURITY INFORMATION

A further inundation of the lowland, independent from the damming of the river, can be produced by damming the numerous drain ditches on both sides (obstructing the intakes to the existing conduits).

It is not possible to create an effective flood wave.

The emptying of the pools of the four dams below Celle, would cause the halting of navigation and power generation, therewith hindering the transportation of oil necessary to the war effort.

RESTRICTED
SECURITY INFORMATION

Aller River Basin (Sequence Downstream)

DESCRIPTION OF CONTROL STRUCTURES

| Location River km | Sheet No. Obj. No. | Control Structure (Name & Purpose) | Pool Data | | | Lock & Dam Data | | | Operation Effects | | Remarks |
|--|-----------------------|--|---|--|--|--|--|---|---|--------------|---------|
| | | | a. Backwater Extent | b. Pool Width | c. Pool Depth | d. Headwater Elev. | e. Tailwater Elev. | a. Lock | b. Dam | c. Bridgeway | |
| 1 | 2 | 3 | 4 | | | 5 | | | 6 | | 7 |
| E of Gifhorn 28.6 km (according to the "Wasser- buch") | 62 137 | Aller Lock Power Irrigation of Aller lowlands | a. 3 km b. 1200 m (In winter, east of Gifhorn on Aller and Ise Rivers 300 m (In winter, south of Neuhaus on Aller River. c. <u>Maximum depth</u> : East of Gifhorn: (In winter) 2.25 m (channel), 0.60 m (flood plain). South of Neuhaus: (In winter) 1.90 m (channel), 0.30 m (flood plain) d. 51.30 m/NN (Summer) 52.18 m/NN (Winter) e. 49.60 m/NN | d. Headwater Elev. e. Tailwater Elev. | a. Lock b. Dam c. Bridgeway | b. Pile clusters. 6 movable wooden gates. Length 14.0 m. c. Roadway 2.5 m. | a. <u>Upstream</u> : Simultaneous operation of this lock Sandmuehlen Lock and the Cardenaps Mill and Lock would produce the winter stage of 52.18 m/NN and flood 170 hectares of the Aller and Ise lowlands 0.6 m deep. <u>Downstream</u> : At Brennecken- brueck (at mouth of Aller Canal) the river bed would be dry in a short time. b. <u>Upstream</u> : Would return to natural flow. <u>Downstream</u> Rapid opening would flood the Aller River Valley from Minden to Diek- horst. After the wave re- cedes, the stage would be lowered to base flow. c. Damage to agriculture from long periods of closure (except during winter- 15 Oct.-1 March, also by repeated overflowing of the land. | a. Full Closure b. Full Opening c. Associated Results | 60. By flooding. other than during the winter, the mills at Gifhorn would be shut down until the flow recedes to normal winter stages. | | |
| In Gifhorn 0.6 km above the mouth of the Ise River | 62 138 | Cardenaps Mill and Lock (Cardenapsmuehlen- schleuse) Power Irrigation | a. 2.5 km b.-c. Widths and depths, same as above d. 51.45 m/NN (summer) 52.18 m/NN (winter) e. 49.60 m/NN | | b. Masonry side walls. the rest, wood. 8 gates. Length 5 m. | a.-c. Same as above. | | | | | |

* General map reference

RESTRICTED
SECURITY INFORMATION

Aller River
p 2 of 3 pp

Aller River Basin (Sequence Downstream)

DESCRIPTION OF CONTROL STRUCTURES

| Location River km | Sheet No. Obj. No. | Control Structure (Name & Purpose) | Pool Data | | | Lock & Dam Data | | | Operation Effects | | Remarks |
|---|-----------------------|---|---|--------------------------------|---|---|---|---------|---|--------------|---------|
| | | | a. Backwater Extent | b. Pool Width | c. Pool Depth | d. Headwater Elev. | e. Tailwater Elev. | a. Lock | b. Dam | c. Bridgeway | |
| 1 | 2 | 3 | 4 | | | 5 | | | 6 | | 7 |
| At Langlingen 40.4 km (according to the "Wasser- buch") | <u>62</u> 10a | Aller Lock (Aller- schleuse) Power for Diek- horst Mill Irrigation of Aller lowlands | a. 3 km b. 300-500 m (Diekhorst to Ettenbuettel) c. 2.25 m d. 47.90 m/NN e. 45.00 m/NN | d. 47.90 m/NN e. 45.00 m/NN | a. Lock b. Dam c. Bridgeway | b. Dam and wing-walls of masonry, 2 wooden gates with iron lifting devices. Length 3.0 m. c. Roadway 3 m. Walkway 0.85 m/0.7 m | a. <u>Upstream</u> : At winter stage (47.90 m/NN) of the Aller and Muehlen Locks, would flood 150 hectares of Aller lowland. <u>Downstream</u> : For a short time the groundwater level would be lowered until the appearance of seepage from the Oker River, the mouth of which is about 700 m above the mill. b. <u>Upstream</u> : Same as for Aller Lock at Gifhorn. <u>Downstream</u> : Rapid empty- ing through Aller and Muehlen Locks would flood the Aller Valley from Diekhorst to Mienhof and below Langlingen to Wienhausen. c. Agricultural damage same as Aller Lock at Gifhorn. Flooding below Langlingen to Wienhausen could be prevented by timely opening of Aller Locks below Lang- lingen and at Copershausen. | | | | |
| East of Oldau 14.8 km | <u>61</u> 56b | Oldau Dam (Staustufe) Power Navigation | a. 14.5 km b. 17 m (km 1.0) 31 m (km 7.0) 49 m (km 14.2) c. 1.5 m (max. at km 1.0) 2 m (max. at km 7.0) 3.8 m (max. at km 14.2) d. 32.80 m/NN e. 30.01 m/NN (MNV) | | a. Concrete with vitrified facing. Iron siter gate. Chamber, length 165 m, width 14.9 m. Gate 10 m. b. Concrete with vitrified facing. Iron weir struc- ture. Vertical lift gate with 4 double wickets. Length 30 m. c. Walkway 1 m over both. Powerhouse 2 turbines Total peak capacity 400 kw Total daily capacity 2400 kw | a. <u>Upstream</u> : Increase in the stage. <u>Downstream</u> : Temporary lowering of stage. b. <u>Upstream</u> : Reduction in the water level. c. Inundation of river low- lands. Vessels in Celle Harbor and Oldau shelter harbor would be grounded. | | | <u>Destruction</u> : Block- ing of the operating machinery for the weir gates and lock gates, or by blast- ing the large gate- lifts and a pair of lock gates. | | |

* General map reference

RESTRICTED
SECURITY INFORMATION

Aller River
p 3 of 3 pp

| Aller River Basin (Sequence Downst m) | | DESCRIPTION OF CONTROL STRUCTURES | | | | | Remarks |
|---------------------------------------|-----------------------|---|--|--------------------|---|----------------------------|--|
| Location River km | Sheet No. Obj. No. | Control Structure (Name & Purpose) | Pool Data | | Lock & Dam Data | Operation Effects | |
| | | | a. Backwater Extent | d. Headwater Elev. | a. Lock | a. Full Closure | |
| 1 | 2 | 3 | b. Pool Width | e. Tailwater Elev. | b. Dam | b. Full Opening | |
| | | | c. Pool Depth | | c. Bridgeway | c. Associated Results | |
| | | | 4 | | 5 | 6 | 7 |
| E of Bannetze 26.8 km | <u>61</u> 59b | Bannetze Dam (Staustufe) Navigation | a. 12 km b. 22 m (km 16) 41 m (km 23) 49 m (km 26) c. 1.5 m (max. at km 16) 2.9 m (max. at km 23) 3 m (max. at km 26) d. 29.57 m/MN e. 27.53 m/MN (MNW) | | a. Concrete with vitrified facing. Iron miter gate. Same as at "Oldau Lock," river km 14.8. b. Same as at "Oldau Dam." Length 37.5 m. c. Walkway 1 m on both | a.-c. Same as "Oldau Dam." | <u>Destruction: Same as "Oldau Dam."</u> |
| NW of Marklendorf 38.2 km | <u>61</u> 62b | Marklendorf Dam (Staustufe) Power Navigation | a. 11.4 km b. 33 m (km 28.0) 49 m (km 33.5) 61 m (km 37.6) c. 1.5 m (max. at km 28.0) 2.4 m (max. at km 33.5) 3.6 m (max. at km 37.6) d. 27.2 m/MN e. 24.40 m/MN (MNW) | | a. Concrete lock. Iron miter gate. Chamber, length 165 m, width 14.9 m, gate 10 m b. Concrete dam with vitrified facing. Iron weir struc- ture. 1 lift gate and 7 double wickets. | a.-c. Same as "Oldau Dam." | <u>Destruction: Same as "Oldau Dam."</u> |
| W of Hadenstorf 49.7 km | <u>61</u> 65b | Hadenstorf Dam (Staustufe) Navigation | a. 11.5 km b. 33 m (km 40) 40 m (km 45) 49 m (km 49) c. 1.5 m (max. at km 40) 2 m (max. at km 45) 2.8 m (max. at km 49) d. 24.0 m/MN e. 21.56 m/MN at MNW | | a. Lock same as "Marklendorf Lock" b. Concrete dam with vitrified facing. 2 double-lift wickets. Frame weir with 6 frames with 300 drop- boards. | a.-c. Same as "Oldau Dam." | <u>Destruction: Same as "Oldau Dam."</u> |

• General map reference

RESTRICTED
SECURITY INFORMATION

RESTRICTED
SECURITY INFORMATION

THE LEINE RIVER

I. Description of the Watercourse.

Below Hannover, the Leine has 19 water-control structures which are utilized for the operation of flour mills and other industrial installations.

The Leine River below Hannover.

The current velocity varies from about 0.5 m/s at Low Water to 1.5 m/s or more at High Water.

Ice Drifts: Small ice drifts generally form above Herrenhausen Dam (River-km. 22.8) halting navigation.

Backwash does not exist.

Navigation is possible only at Middle Water and above (up to 150 tons at high stages) to High navigable water, except the reach of the Ihme River Branch above Herrenhausen Dam to the Hannover gas plant. This reach is accessible from the Mittelland Canal through the Leine Descending Lock (Mittelland Canal, Linden Branch Canal, Canal-km. 0.6) and is navigable for 600-ton vessels. The lower canal of the lowest Aller Lock empties into the Leine River 1.5 km. above the mouth.

The river bed is sandy with bed-load movement.

The width at water level from the mouth of the Ihme River (river-km. 16.7) to the mouth of the Leine at the Aller (river-km. 112.1) averages 25-35 m.; the bottom depth averaging from 1.4-1.9 m. at Middle Water, except at Herrenhausen Dam, where the depth is 2.5 m. at Middle Water.

The Leine River can be forded at low water stages in almost all straight reaches, except in pools formed by dams.

River cross sections are very irregular. In the concave banks of curves, they are very deep (up to 5 m).

The river banks have numerous breaks, particularly in the upper reaches where they are proportionally high.

Swampy banks, steep and rocky banks, dikes, and built-up reaches do not exist.

Old river channels, drain ditches, and side canals, likewise, do not exist.

RESTRICTED
SECURITY INFORMATION

On the Innerste River below the Harz, 18 water-control structures are located for industrial purposes, without military significance.

The Soese Dam (Unit map 85, Object 255) north of Osterode in Harz, serves for power production and drinking water for Brome, Hildesheim and 50 other communities, and for flood control.

An opening of the sluice outlets will produce a flood wave (up to 2 m/s) which would not even entirely eliminate the fording possibilities.

By destruction and not servicing the sluice gates, high-water protection can not be maintained, so that High Water, which, like flow from the filled or destroyed dam, can destroy roads and bridges in the lower reach.

The Oder Dam (Unit map 86, Object 152) north of Bad Lauterberg, Harz, serves for power production and flood control.

An opening of the sluice outlets will produce a flood wave (1-2 m/s) which would eliminate fording possibilities and a single emptying, produced by the breaching of the dam, would cause the destruction of the village of Bad Lauterberg and the roads and bridges until the crest of the wave (length unknown) is over. Flood-control protection at Soese Dam is the same.

II. Peacetime Regulation and Utilization of the Flow.

The important dams are:

| <u>Unit Map</u> <u>Number</u> | <u>Object</u> <u>Number</u> | <u>Dam</u> | <u>River</u> <u>km.</u> |
|----------------------------------|--------------------------------|--|----------------------------|
| (1) 61 | 250 | Herrnhacusen Sluice Dam | 22.8 |
| (2) 61 | 249 | Fixed dam near Neustadt for flour mills and electric power. Without regulation | 65.4 |
| (3) 61 | 270 | Dam on the "Schnellen Graben" in Hannover | 20.3 |
| (4) 61 | 271 | Dam on the Aue at Blumhau for the electric power works Neustadt, Rberge | |

Interlocking of dams 1 and 4 is not possible.

RESTRICTED
SECURITY INFORMATION

III. Warfare Changes in the Flow.

Except from the river itself, damming can not produce a serious obstacle, because the over-damming and swamping of extended reaches is not possible.

A flood wave of long duration and intensity can not be produced.

A certain river-discharge increase can be attained only below Northem which is below the mouth of the Rhume, from the Soese and Oder Dams. The effect of such additional water is not permanent enough to change the above conditions.

By the destruction of Herrenhaeusen Dam, the water connection of the City of Hannover and other, large industrial plants would be eliminated so that special examination should be made of the federal, state, and local war industries affected.

RESTRICTED
SECURITY INFORMATION

RESTRICTED
SECURITY INFORMATION

Leine River
p 1 of 2 pp

| Leine River Basin (Sequence Downstream) | | DESCRIPTION OF CONTROL STRUCTURES | | | | | Remarks |
|---|------------------------|--|--|--------------------|---|--|---|
| Location River km | Sheet No.* Obj. No. | Control Structure (Name & Purpose) | Pool Data | | Lock & Dam Data | Operation Effects | |
| 1 | 2 | 3 | a. Backwater Extent | d. Headwater Elev. | a. Lock | a. Full Closure | 7 |
| | | | b. Pool Width | e. Tailwater Elev. | b. Dam | b. Full Opening | |
| | | | c. Pool Depth | | c. Bridgeway | c. Associated Results | |
| N of Bad Lauterberg | <u>86</u> 252 | Oder Dam (Odertal- sperre) Flood control Power Flow regulation | <u>1/2 full:</u> (15.31 mil. m ³) a. 3.3 km c. 37.7 m (at dam) d. 364.65 m/HN <u>Full:</u> (30.62 mil. m ³) a. 4.5 km c. 51.15 m (at dam) d. 381.10 m/HN (Downstream equalizing reservoir, 900,000 m ³) | | b. Earth dam of river- gravel. Crest 383.00 m/HN. Foot 329.95 m/HN. c. Roadway 4.5 m, made to carry heavy traf- fic. Walkway, 1.95 plus 1.45 m. | <u>Discharge:</u> At 1/2 full 37.5 m ³ /s, completely full-42.7 m ³ /s. By opening the bottom out- lets and starting the tur- bines, the discharge at full pool can be raised to 50 m ³ /s for 8-10 days. (Endangering bridges) Simultaneous opening of bottom outlets and tur- bines-discharge 200 m ³ /s for 2 hrs. This flow would destroy Bad Lauter- berg and roads and bridges. | <u>Power:</u> 1 turbine, 6,000 kw. Total daily output, 36,000 kw in 6 hrs. Power generation is greatly reduced when the pool is below 1/2 full. <u>Refilling time:</u> 6 months |
| N of Oster- rode, in Hart | <u>85</u> 255 | Seese Dam (Seese- talsperre) flood control Drinking water Power Flow regulation | <u>1/2 full:</u> (12.72 mil. m ³) a. 2.7 km c. 34.85 m (at dam) d. 313.95 m/HN <u>Full:</u> (25.45 mil. m ³) a. 3 km c. 47.4 m d. 326.50 m/HN | | b. Earth dam of river- gravel. Crest 328.50 m/HN. Foot 279.10 m/HN. c. Roadway 6.4 m Walkway 1.7 m | <u>Discharge:</u> At 1/2 full 31 m ³ /s, completely full- 36 m ³ /s. <u>Refilling time:</u> 9 months | <u>Power:</u> Power generation is greatly reduced when pool is below 1/2 full. <u>Drinking water:</u> Water supply is inadequate when pool is below 1/3 full. |
| In the City of Hannover 20.3 km | <u>61</u> 270 | "Am Schnellen Graben" Weir | | | | | |
| S section of Hannover- Herrnhansen 22.6 km | <u>61</u> 256 | Herrnhansen Dam (Herrnhansener Wehr) Navigation Power | a. 2.5 km b. 36 m c. 2.5 m d. 48.20 m/HN e. 45.20 m/HN | | a. Solid masonry lock. Chamber, length 37 m, width 6.3 m. Gate 5.1 m. Roadway 2.5 m. b. North part-wood. South part-concrete. Length 55 plus 30 m. 2 undershot water- wheels. Roadway 3 m. | a. <u>Upstream:</u> Only at HW would the flow be affected. <u>Downstream:</u> No signifi- cant effect. b. <u>Upstream:</u> Leine river- bed would become dry. <u>Downstream:</u> Wave 2-3 m high created. Bottom land flooded and banks damaged. c. Flood damage in Hannover. Navigation shut down. | Destruction of dam would stop navigation between Hannover and the Mittelland Canal Cross- over of the Leine and Ihme Rivers. |

* General map reference

SECURITY INFORMATION

Leine River
p 2 of 2 pp

| Leine River Basin (Sequence Downstream) | | DESCRIPTION OF CONTROL STRUCTURES | | | | | Remarks |
|---|------------------------|---|---|--------------------|---|-----------------------|---|
| Location River km | Sheet No.* Obj. No. | Control Structure (Name & Purpose) | Pool Data | | Lock & Dam Data | Operation Effects | |
| | | | a. Backwater Extent | d. Headwater Elev. | a. Lock | a. Full Closure | |
| | | | b. Pool Width | e. Tailwater Elev. | b. Dam | b. Full Opening | |
| | | | c. Pool Depth | | c. Bridgeway | c. Associated Results | |
| 1 | 2 | 3 | 4 | | 5 | 6 | 7 |
| In the village of Blumensau on the Aue R. (a tributary of the Leine R.) | <u>61</u> 271 | Dam on the Aue Power (for Neustadt a Rbge electric works) | | | | | |
| In the city area of Neustadt a Rbge. 65.4 km (dam) 66.0 km (lock) | <u>61</u> 249 | Neustadt Dam Flour mill operation Navigation | a. 7.5 km b. 60 m (km 65.3) 30 m (km 60.0) c. 3.2 m (km 65.3) 0.5 m (km 60.0) d. 35.66 m/BB e. 34.12 m/BB | | a. Stone lock. Chamber length 44.7 m, width and gate 5.25 m. b. Overflow weir, Faschine and stone. Length 60 m | | Destruction of dam would stop flour mill operation. |

SECURITY INFORMATION

* General map reference