FLOOD PLAIN INFORMATION

TUSCARAWAS RIVER

STARK COUNTY

OHIO

PREPARED FOR
STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
BY
CORPS OF ENGINEERS U.S. ARMY
HUNTINGTON DISTRICT
HUNTINGTON, WEST VIRGINIA
JANUARY 1970

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INTRODUCTION

This report relates the flood situation along that portion of the Tuscarawas River within Stark County, Ohio. It was prepared for the Ohio Department of Natural Resources as an aid to local authorities in the solution of flood problems and in the determination of the best utilization of land which is subject to overflow. The report is based upon information on rainfall, runoff, historical and current flood heights, and upon other technical data bearing upon the occurrence and size of floods on the Tuscarawas River.

The report covers two significant phases of the flood problem. It brings together a record of the largest known floods of the past on the Tuscarawas River and secondly, it considers probable future floods. The future floods are the Intermediate Regional Flood and the Standard Project Flood. Intermediate Regional Floods are defined as floods that have an average frequency of occurrence in the order of once in 100 years and, for a given stream, are determined from an analysis of known floods on that stream as well as on other streams which have similar physical characteristics and are in the same general geographical region. Standard Project Floods represent reasonable upper limits of flooding, are of rare occurrence and, on most streams, would be considerably larger than any floods that are known to have occurred in the past.

The possible future occurrences of Intermediate Regional Floods, Standard Project Floods, or floods of the size of actual past floods, should be considered carefully when selecting specific flood levels to serve as guides in planning for the wise use of the flood plain and in controlling development.

Maps, profiles, and cross sections are included which indicate the magnitude and extent of actual past floods and possible future floods. This information should prove helpful in planning the best use of the flood plains. From the maps, profiles, and cross sections, the depth of probable flooding may be determined for any location. With the depth of flooding known, floor levels for buildings may be planned high enough

to avoid flood damages or, if planned for a lower elevation, with recognition of the potential hazards and of the chances being taken.

This report does not include specific recommendations for the solution of flood problems but rather, is intended to provide the basis for further study and planning by the County or local communities in arriving at solutions to minimize vulnerability to flood damages. This might involve local planning programs to guide developments by controlling the use of the flood plain through zoning and subdivision regulations, or the construction of flood protection works, or a combination of the two approaches to minimize flood losses.

The Huntington District of the Corps of Engineers will, upon request, provide limited technical assistance to Federal, State, and local agencies in the interpretation and use of the information contained herein and will provide other available flood data related thereto.

ANOTHER LARGE FLOOD in July 1969 was the second highest known flood on the Tuscarawas. The July flood was 3.6 feet lower than the March 1913 flood. The 1969 flood was the highest flood to occur since 1913 and was 3.0 feet higher than any other flood since completion of the local protection works at Massillon in 1951.

* * *

OTHER LARGE FLOODS occurred in January 1904, April 1904, March 1933 and January 1959. The third and fourth highest known floods on the Tuscarawas were in January and April 1904 and were four and five feet lower than the 1913 flood, respectively. The 1933 flood was about six feet lower than the March 1913 flood while the flood of January 1959 was nearly 6.5 feet lower than the largest known flood.

* * *

THE INTERMEDIATE REGIONAL FLOOD, which is a flood that would have an average frequency of occurrence in the order of once in 100 years as determined from an analysis of past floods on the river and other streams in the same general area, would be slightly lower than the March 1913 flood along most of the study reach, but would result in flood stages 2.6 feet higher than the July 1969 flood at the Massillon gage.

* * *

STANDARD PROJECT FLOOD determinations indicate that the reasonable upper limit of flooding on the Tuscarawas River in Stark County would be about 5 feet higher than the March 1913 flood and 8.5 feet higher than the July 1969 flood at the gage.

* * *

FLOOD DAMAGES that would result from major floods would be substantial except in the City of Massillon where the flood plain is protected by the local protection works. The Intermediate Regional Flood or a recurrence of a flood of the magnitude of the 1913 flood would cause extensive damages because of their great extent.

* * *

SUMMARY OF FLOOD SITUATION

The Tuscarawas River flows from north to south through the western section of Stark County, Ohio (see Plate 1). In its passage through the county, it flows through the City of Massillon and the Villages of Canal Fulton and Navarre. This report covers the Tuscarawas River from immediately below Navarre, at river mile 80.37, upstream to the Stark-Summit County line, at river mile 100.08.

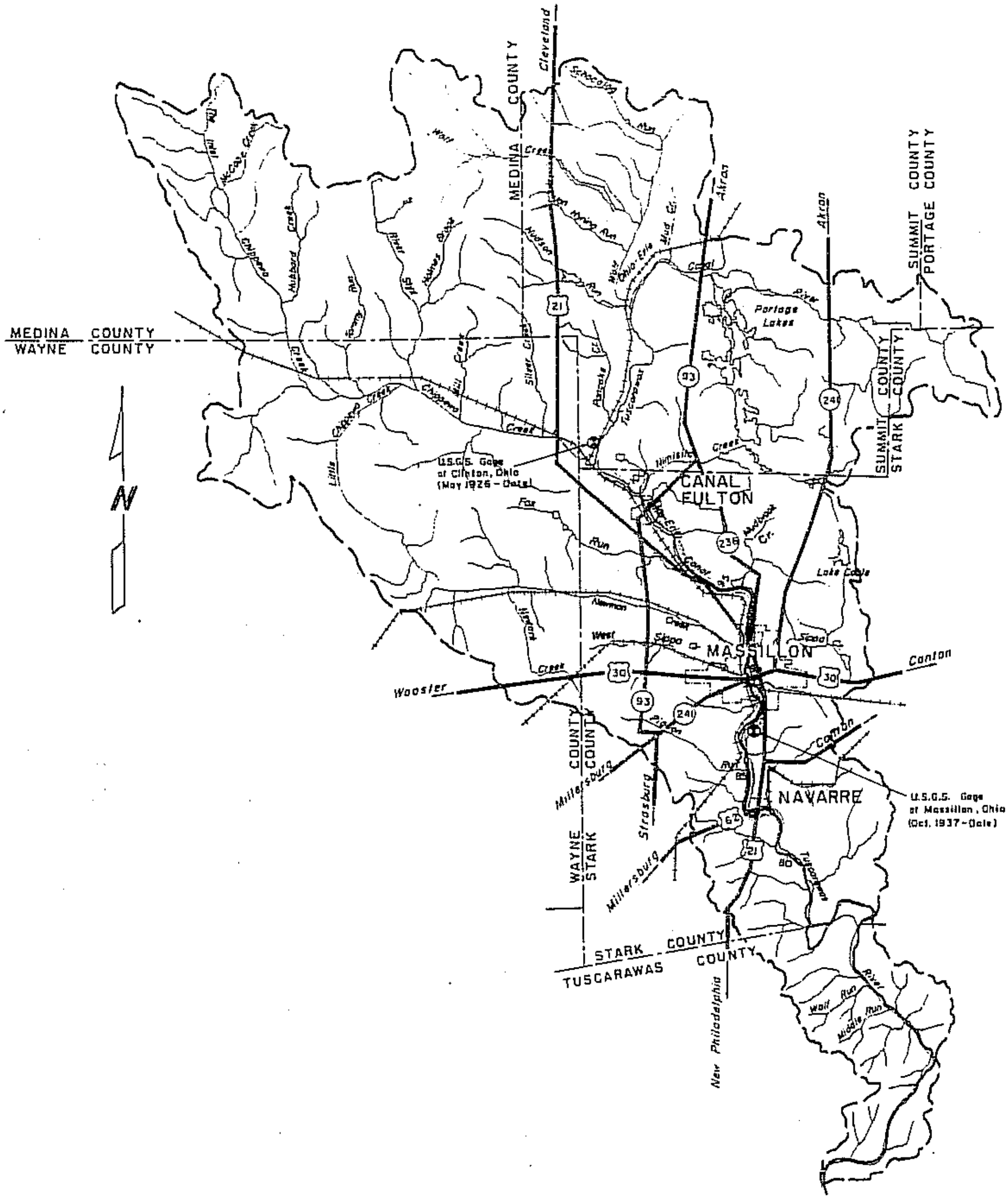
The principal residential, commercial, and industrial developments in the City of Massillon are located either on high ground or within existing local protection works constructed by the Corps of Engineers in 1951. Large areas of agricultural land and smaller developments outside of Massillon lie within areas that have been inundated by floods in the past, and substantially more area is within reach of the potentially greater floods that could occur in the future.

Since April 1938, the U. S. Geological Survey has maintained a stream gaging station on the Tuscarawas River at the City of Massillon sewage treatment plant, river mile 86.00. Records from this gage, newspaper files, and other public documents have been searched for information concerning past floods. From the information on past flood levels and from studies of possible future floods on the Tuscarawas River, the local flood situation, both past and future, has been developed. The following paragraphs summarize the significant findings which are discussed in more detail in subsequent sections of the report.

* * *

THE GREATEST FLOOD known to have occurred on the Tuscarawas River during the past 100 years occurred in March 1913. Newspaper accounts pointed out the disastrous proportions of the flood and leave no doubt that it was far greater than any known to the oldest residents at that time.

* * *



REACH COVERED BY THIS REPORT

CORPS OF ENGINEERS, U.S. ARMY
HUNTINGTON DISTRICT
HUNTINGTON, WEST VIRGINIA

UPPER TUSCARAWAS RIVER WATERSHED

SCALE 4 2 0 2 4 6 8 10 12 14 16 MILES

JANUARY 1970

PLATE 1

MAIN FLOOD SEASON for the Tuscarawas River occurs during the winter and spring months. Seven of the ten highest known floods, including the record flood of 1913, occurred during this period. However, intense local thunderstorms occur in the summer and can cause local flooding. As evidenced by the floods of August 1935 and July 1969, large floods may occur at any time.

* * *

VELOCITIES OF FLOW during major floods range up to 7 feet per second (about 5 miles per hour) in the channel on the Tuscarawas River. On the flood plain there is a considerable variation depending on location, but generally velocities are less than 3 feet per second. During a Standard Project Flood, velocities would be extremely dangerous to life and property. In the channel, they would range up to 7 feet per second and on the flood plain, the corresponding figure would be 3 feet per second. Velocities greater than 3 feet per second combined with depths of 3 feet or greater are considered hazardous.

* * *

DURATION OF FLOOD STAGES is relatively long on the main stem of the Tuscarawas River, especially along the central and lower portion of the study reach. The long duration is caused in part by the large tributary drainage upstream of Stark County, 362 square miles, the relative flat slope of the valley and the fact that the minor tributary streams reach their peak discharge rates and stages before the main stem flood flows from upstream have fully crested. The July 1969 flood was above bankfull stage for some 139 hours while the record 1913 flood is estimated to have remained at flood stage for some 140 hours. However, the rate of rise and fall of flood stage is less pronounced along the reach because of these reasons.

* * *

HAZARDOUS CONDITIONS would occur especially during large floods as a result of prolonged flooding, high velocities and deep flows.

* * *

FLOOD DAMAGE PREVENTION MEASURES. The Corps of Engineers designed and constructed a local protection works in the City of Massillon which protects some 630 acres of residential, commercial and industrial development. This project affords protection against a flood with a peak flow approximately 13 percent greater in magnitude than that of the March 1913 flood, the greatest flood of record at this location.

There are no flood plain regulations for the lands along the Tuscarawas River in Stark County, nor in the City of Massillon and the villages of Canal Fulton and Navarre. However, the subdivision regulations of the County and Massillon require that land subject to flooding be provided with improvements to remove flood hazards from proposed lots.

* * *

FUTURE FLOOD HEIGHTS that would be reached if the Intermediate Regional and Standard Project Floods occurred in the upper Tuscarawas River watershed are shown in Table 1. The table gives the comparison of these flood crests to the actual crests of the March 1913 and July 1969 floods on the Tuscarawas River at the Massillon gaging station.

TABLE 1

RELATIVE FLOOD HEIGHTS

TUSCARAWAS RIVER AT U.S.G.S. GAGING STATION

RIVER MILE 86.0

Flood	Estimated Peak Discharge cfs	Elevation feet	Stage feet	Above 1969 Flood feet
July 1969	10,300	932.42	16.42	0
Intermediate Regional	17,100	935.0	19.0	2.6
March 1913	23,500	936.0	20.0	3.5
Standard Project	36,400	940.9	24.9	8.5

GENERAL CONDITIONS AND PAST FLOODS

This section of the report describes the history of floods on the Tuscarawas River within Stark County, Ohio, from Mile 80.4 to Mile 100.1 as measured in an upstream direction beginning at the river's confluence with the Muskingum River. The drainage area of the Tuscarawas River above the lower limits of this study, Mile 80.4, extends north to the Continental Divide, which separates Ohio River and Lake Erie drainage, and contains approximately 547 square miles.

Flow of the river is generally from north to south in the reach covered by this report and passes through the Villages of Canal Fulton, Mile 97, the City of Massillon at Mile 87.5, and Navarre at Mile 82.

Most of the residential properties and business district of the Massillon area are on high ground or located within the local protection works as is a large portion of the industrial community south of town. Upstream and downstream from Massillon, the flood plains are used for agricultural purposes.

The first official records of river stage and discharge on the Tuscarawas River date from April 5, 1938, when the U. S. Geological Survey installed a staff gage at Mile 86.00. Since August 19, 1944, a recording gage has been located at the same site.

In addition to the flood stage and discharge data taken by the U. S. Geological Survey from the stream gage at Massillon, flood heights of major floods which occurred prior to 1938 were obtained from records of the Corps of Engineers. Also, newspaper files and records at the City of Massillon were examined to compile a history of floods on the Tuscarawas River over the past 66 years.

GENERAL SITUATION

Settlement

Stark County, established in 1808, was named after General John Stark of the Revolutionary War. Prior to its organization the area was the land of the Six Nations, inhabited by the Tuscarawas and Delaware Indian Tribes.

The Tuscarawas River was the center of early living, as a passage for the Indian nations and later as a boundary between the Indians and early settlers. John Duncan, the founder of Massillon, in 1828 laid out a village that extended to the east and west of the just then completed Ohio-Erie Canal. Massillon was then a terminal of the canal and rapid growth took place for the next few years with the village being incorporated in 1838.

The early history of the area was centered around agriculture and, as the canal prospered, Massillon became the "Port of Massillon" with wheat being its principal export. The Ohio-Erie Canal extending from Cleveland to Portsmouth paralleled the Tuscarawas River in Stark County. The greatest growth took place in the flood plain where there was ready access to the canal. The coming of the railroads in the 1850's resulted in even further development in the flood plain with railway right of ways being located next to the river. This attracted even greater development into areas of frequent flooding. After the advent of the railroads, industries began to move into the area and helped establish a well balanced growth. From that period on, the growth of industry in Massillon has continued. The need for labor draws people from a surrounding area of about thirty miles in radius. Currently, Massillon has more than fifty diversified manufacturers and processors. A good supply of skilled and semi-skilled labor is available in Massillon and the surrounding area. The entire county had 450 industrial manufacturers including 13 new and 84 expanded firms in 1967. This large number requires a labor force of nearly 60,000 persons, all contributing to the economic growth of the area.

Retail and service establishments provide an industry to Massillon and its nearby area consisting of more than 600 businesses in varying sizes. Over 2,000 persons are employed in these businesses which provide payrolls of $6,000,000 in the community each year. Latest reports show sales in this field total approximately $50,000,000 annually.

The area along the Tuscarawas in western Stark County continues as a good agricultural producer and the county is one of the leading producers of agricultural products in northeastern Ohio.

The 1960 census gives the population of Stark County as 340,345 with Massillon having 31,236, Navarre 1,698 and Canal Fulton 1,555. Estimates for July 1967 indicate that the county has increased in population to 370,450, an increase of nine percent over 1960. Latest projections indicate that the county's population will increase further to 456,500 by the year 1980, reflecting the prospects for continued strong economic growth.

Flood Damage Prevention Measures

A local protection project in Massillon was completed by the Corps of Engineers in October 1951. The project comprised 2.4 miles of channel widening and deepening, 0.8 mile of new channel, relocation of 6 miles of railroad lines, new railroad and highway bridges, 3 miles of earth levees and concrete walls and pump stations. There are gated openings on railroad lines and highways to permit traffic during non-flood periods. The protected area is about 630 acres in extent.

Cost of the protection project amounted to $8,140,000 to the Federal Government and $478,000 to local interests.

In various other locations, levees have been built to protect individual developments such as the City of Massillon and the Village of Navarre sewage treatment plants. Smaller levees have been constructed by individuals to protect other specific areas.

Stark County does not have a county zoning ordinance nor flood plain regulations as such. However, its General Development Plan provides for reserved open space and developed recreation areas along the principal streams outside of incorporated communities. In addition, the Stark County Subdivision Regulations require that "land that is subject to flooding from time to time shall be provided with such improvements as may be required to remove flooding hazards from proposed subdivision lots."

The City of Massillon does not include flood plain districts nor flood plain regulations in its zoning ordinance, but it has the same requirement in its subdivision regulations regarding land subject to flooding as Stark County has.

The Village of Navarre has no flood plain districts nor flood plain regulations in its zoning regulations. Its zoning map shows flood plain areas along the Tuscarawas River zoned for single-family residences, two-family residences and industry.

The Village of Canal Fulton has zoned the flood plain areas along the river for either industrial or park use.

Flood Warning and Forecasting Services

The United States Weather Bureau and the City of Massillon have planned a Flash Flood Warning System to be used in event of heavy rainfall predictions. This plan is designed to alert the city officials of a pending high intensity rainstorm and a subsequent high river stage so adequate measures can be taken to operate the protective works pump stations and flood gates and provide information to other agencies. The flash flood warnings are relayed from the U. S. Weather Bureau at the Akron-Canton Airport to the City of Massillon sewage treatment plant, which serves as a central collection center for such information. This central control point then relays information to other local officials and agencies.

The Stream and Its Valley

The Tuscarawas River rises in Medina and Summit Counties at the divide between Ohio River and Lake Erie drainage basins. Flow is to the south and east to the junction with Little Stillwater Creek near Dennison, thence west for a total of 130 miles where it discharges its 2,596 square miles of tributary drainage into the Muskingum River at Coshocton.

Between the confines of the study area, river miles 80.37 and 100.08, the watershed area decreases from 547 to 362 square miles. It forms an inverted pear shaped area approximately 32 miles in length and up to 30 miles in width. Terrain varies from terraces to gently rolling farmland. A large portion of the land is devoted to agriculture and related uses, with only a scattering of wood-lots.

At the headwaters the river channel is at elevation 1140. The streambed slopes approximately 6.0 feet per mile to elevation 934 at the Stark-Summit County line. Through the 19.7 mile reach of study in Stark County, the channel slope averages only 1.6 feet per mile, with the elevation at the downstream end of the reach being 902.

Plate 1 shows the watershed and stream drainage system of the Upper Tuscarawas River which includes the area through Stark County.

Channel widths vary from approximately 80 feet at the upstream limit to nearly 125 feet at the downstream end of the reach. An exception is the channel through Massillon within the local protection works where the channel has been widened either to 135 feet or to 165 feet throughout the major portion of the project.

Pertinent drainage areas of the Tuscarawas River are given in Table 2.

TABLE 2

DRAINAGE AREAS IN WATERSHED OF TUSCARAWAS RIVER

Location	Miles Above Mouth	Drainage Area sq. mi.
At Mouth	0.0	2,596
Lower Study Limit	80.4	547
Above Pigeon Run	83.6	524
At Massillon USGS Gage	86.0	518
Above Sippo Creek	87.8	491
Above West Sippo Creek	88.2	479
Above Newman Creek	89.0	439
Above Mudbrook Creek	91.9	426
Above Fox Run	94.5	408
Above Nimisila Creek	97.8	365
Upper Study Limit	100.1	362
At Clinton USGS Gage	101.1	174

Developments in the Flood Plain

The index map of the 4 sheets showing the flooded area of the Tuscarawas River valley in Stark County is given on Plate 4. The limits of the Standard Project Flood on Plate 4 are indicated by a dashed line. Plates 5 to 8 show in more detail the flooded area for the March 1913, Intermediate Regional Floods and Standard Project Flood for the reach of river covered by the report. Except for some minor structures at Navarre along the north bank and scattered development in the valley at Massillon, not within the local protective works, the flood plain is devoted almost entirely to agriculture or related purposes. At Canal Fulton there are a few commercial establishments within the limits of the Standard Project Flood.

Behind the Massillon local protection works a vast amount of industrial, commercial and residential property lies in the flood plain.

The 1913 flood inundated much of this important area. A recurrence of a 1913 storm or the occurrence of an Intermediate Regional Flood would not affect the protected area under existing conditions created by the local protective works. However, the occurrence of a Standard Project Flood would cause an overtopping of the protective levee near the center of Massillon as shown on the flood profile on Plate 9. This overtopping would cause the water to back up into the upstream protected area. The depth to which the flooding within the protective works would occur depends upon the duration of the flood crest and the volume of water the pump stations could return to the channel. It is possible that the levee could be raised by sandbagging to prevent this overtopping. Note, however, that Plates 6 and 7 show the area inside the levee inundated by the Standard Project Flood.

On the west side of the river, from Cherry Road north, the top of the levee is slightly above the Standard Project Flood. At Cherry Road, the levee returns to high ground utilizing the Cherry Road bridge approach. The levee opening, providing a railroad underpass for the Pennsylvania and B & O Railroads, is slightly lower than the levee and flood waters back into this vulnerable area containing the Massillon water treatment plant. Expedient measures, such as sandbags, could close this opening in a short period of time. The flooded area of the Standard Project Flood as shown on Plate 6 indicates the area without expedient protection.

Many of the seventeen highway bridges crossing the Tuscarawas River in the study reach, would be closed to traffic during the three flood conditions considered. The five bridges north of U. S. Highway 21 to the Stark County line as well as the five highway bridges south of Oberlin Avenue in Massillon would be closed to traffic during any of the three flood conditions with bridge decks or approach roads flooded.

The Oberlin Avenue bridge and the U. S. Highway 21 bridge in Massillon would be open to traffic during any of the three floods. However, the Lake Avenue bridge would be closed during all three flood conditions.

All remaining bridges deliver traffic above the studied flood crests into the protected area of the city. However, the approaches to bridges within the protected areas could possibly be flooded to some degree by backup of water due to overtopping of the levee during a Standard Project Flood.

The N.Y.C. & S.L. bridge at Mile 82.15 is not passable during any of the three described floods. However, this bridge leads to a siding only.

The B. & O. and W. & L.E. Railroad bridge in Massillon is above all the flooding situations except when backwater occurs during a Standard Project Flood and overtops the levees. All other railroad bridges are safe for passage during the floods.

The Pennsylvania Railroad and B. & O. Railroad tracks, paralleling the river above Massillon on the west bank, are flooded in several locations by one or all of the study floods.

The Massillon sewage treatment plant has a protective levee around its perimeter; however, during a Standard Project Flood this levee would be overtopped by about 1.0 feet. This flooding could be eliminated, provided sufficient warning time is given, by adding sandbags to the levee.

A Standard Project Flood would inundate several commercial buildings in Navarre and Canal Fulton plus homes in the flood plain all along the river.

There has been damage to structures in the past within the study area but construction of the Massillon local protection works will greatly reduce the damages in the event of another major flood. However, considerable losses would still occur under present day conditions in the event of a major flood in the valley. This damage would be even greater if uncontrolled construction in the flood plain is allowed to continue.

Bridges Across the Stream

Seventeen highway and four railroad bridges cross the Tuscarawas River within the 19.7 mile study reach. These bridges and connecting road embankments crossing the valley affect flood stages where the waterway openings are restricted when compared to the natural valley section. However, none of the bridges are serious obstructions to flow as indicated on the high water profiles on Plates 9 and 10.

Pertinent elevations for the bridge structures and their relation to the flood level of the March 1913 and Intermediate Regional Flood are shown in Table 3. A description of the bridges and flood levels is given in the following paragraphs.

The Blough Avenue Bridge, built in 1924, at river mile 81.00 in Navarre, is a reinforced concrete arch. The 263-foot bridge has three spans with a total opening length of 178 feet. Both the 1913 and Intermediate Regional Flood levels are below the bridge floor but the south approach road would be completely flooded. Under Standard Project Flood conditions the bridge deck and approach would also be inundated.

U. S. Highway 21 Bridge in Navarre, at Mile 81.47, is a 162-foot, one-span, truss bridge crossing at right angles to the river. At the 1913 and Intermediate Regional Flood stages the bridge floor begins to be flooded and the north approach roadway is flooded. Low steel trusses of the bridge are also below these flood levels. The Standard Project Flood would completely inundate the deck and both highway approaches to the bridge.

U. S. Route 62 crosses the Tuscarawas in Navarre at river mile 81.94. It is a continuous steel beam three-span bridge having a concrete deck and superstructure with a total opening of 208 feet. Both the 1913 and Intermediate Regional Flood levels would submerge portions of the bridge floor and east approach road while the Standard Project Flood would completely submerge the bridge superstructure and portions of both approach roads.

TABLE 3

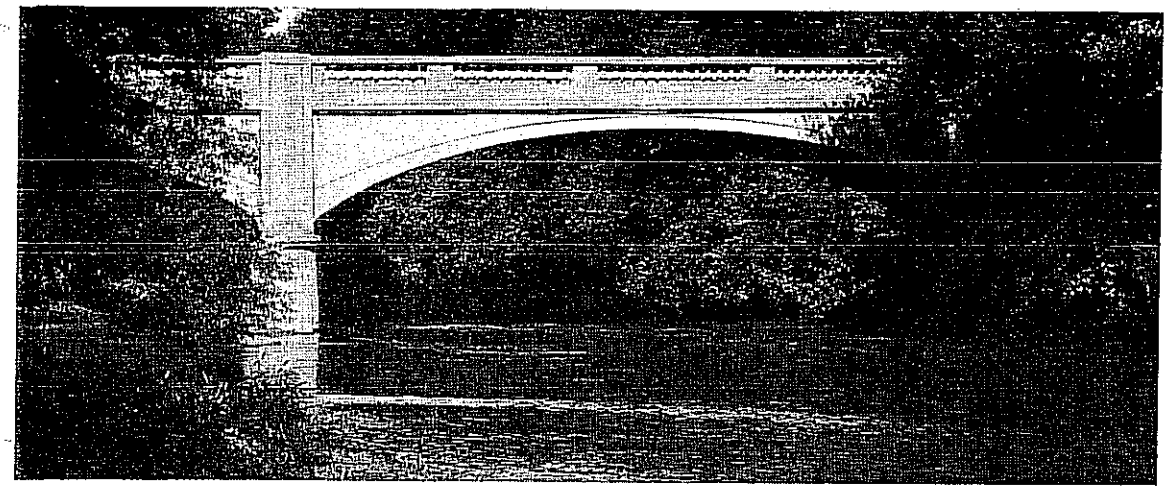
BRIDGES ACROSS TUSCARAWAS RIVER

Mile Above Mouth	Identification	Stream Bed Elev. feet	Bridge(1) Floor Elev. feet	Intermediate Regional Flood Crest Elev. feet	March 1913 Flood Crest Elev. feet	Underclearance(2) Elev. feet	Above 1913 Flood feet	Below 1913 Flood feet
81.00	Blough Avenue	904.2	922.5	922.7	922.6	920.2		2.4
81.47	U. S. Highway 21	904.5	923.6	924.1	924.0	920.8		3.2
81.94	U. S. Highway 62	904.2	923.3	925.4	925.0	919.4		5.6
82.15	N.Y.C. & St. L.R.R.	905.0	926.5(3)	926.6	926.1	924.3		1.8
82.19	N.Y.C. & St. L.R.R.	904.3	942.3(3)	927.0	926.5	933.9	7.4	
82.37	Wooster Street	903.0	930.8	927.3	927.0	928.4	1.4	
84.38	Warmington Street	910.5	935.3	931.6	932.5	933.0	0.5	
86.85	Oberlin Avenue	918.0	960.2	935.7	937.4	955.8	18.4	
87.38	Walnut Road	917.7	943.9	936.0	938.4	941.2	2.8	
87.68	B. & O. & W. & L.E.RR	918.4	947.0(3)	936.1	944.0	941.6		2.4
87.74	Penna. R.R.	917.5	946.0(3)	936.1	944.1	941.0		3.1
87.84	Tremont Avenue SW	920.8	949.4	936.2	944.2	945.0	0.8	
87.96	U. S. Highway 30	917.8	948.5	936.3	944.3	942.7		1.6
88.28	Cherry Road NW	918.4	945.2	936.6	944.5	941.0		3.5
89.17	Lake Avenue NW	919.6	935.7	939.0	945.6	931.4		14.2
89.43	U. S. Highway 21	919.5	961.0	939.7	945.8	953.3	7.5	
91.24	Forty Corners Street	923.0	939.4	943.3	947.2	937.4		9.8
91.86	Highmill Avenue	922.4	942.9	944.5	947.9	940.1		7.8
94.70	Butterbridge Road	925.7	944.4	947.6	951.3	942.3		9.0
97.14	Cherry Street	932.2	949.4	951.6	953.0	946.1		6.9
97.20	West Market Street	931.4	948.8	951.9	953.2	947.0		6.2

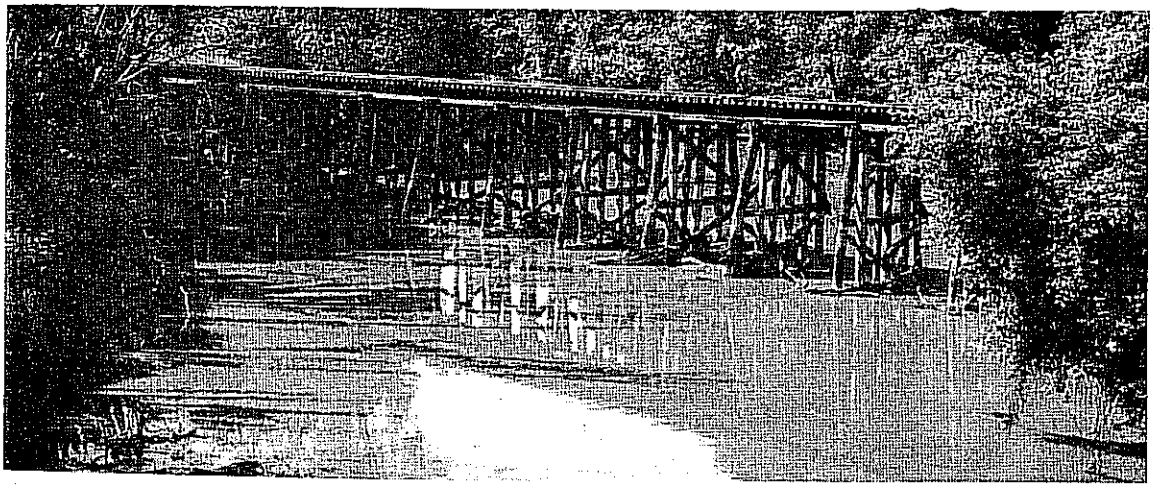
(1) Bridge floor elevations represent lowest elevation of bridge deck.

(2) Underclearance elevations represent the lowest girders or other supporting members.

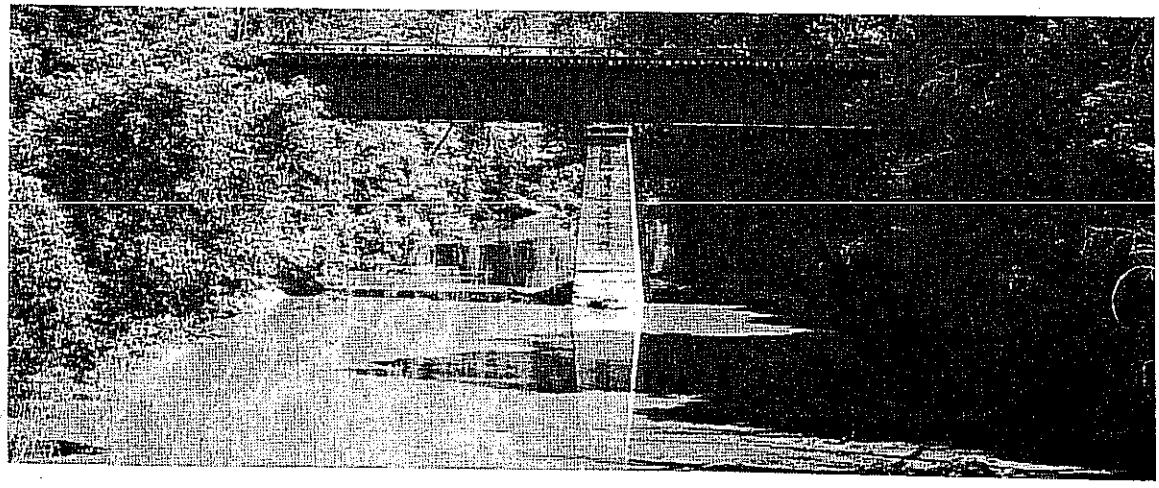
(3) Top of rail.



Downstream side of the Blough Avenue bridge in Navarre at Mile 81.00.



Upstream side of the N.Y.C. & St. L. railroad bridge at Mile 82.15 in Navarre.



Downstream side of the N.Y.C. & St. L. bridge at Mile 82.19 in Navarre. Note the heavy summer foliage which reduces the flood carrying capacity of the river.

Figure 1---TUSCARAWAS RIVER BRIDGES

The New York Central and St. Louis Railroad Bridge at Mile 82.15 crosses the Tuscarawas River at an acute angle. This wooden trestle structure has 14 spans with thirteen pile bents constructed parallel with the flow of the river. The 1913 and Intermediate Regional Flood stages would inundate the east approach to the bridge while the Standard Project Flood would completely submerge the bridge and both approaches. There is a significant head loss through the bridge due to the numerous pile bents. Another N.Y.C. & S.L. Railroad bridge at Mile 82.19 crosses the river normal to its course with a three-span steel girder bridge. The top of railroad approach, deck and low steel are well above the 1913, Intermediate Regional and Standard Project Floods.

The Wooster Street Bridge in the northwest part of Navarre is a two-span, steel truss bridge having two spans totaling 210 feet. This structure is located at Mile 82.37. All portions of the bridge are safely above the 1913 and Intermediate Regional Flood levels; however, the west approach would be flooded by more than 3 feet of water by the Intermediate Regional Flood. The Standard Project Flood stage would flood a large portion of the deck.

The Warmington Street Bridge at Mile 84.38 is a high steel truss bridge with a steel grating floor. This bridge, constructed in 1913, is located above the March 1913 and Intermediate Regional Flood crests but the west approach roadway is below these flood levels. Under Standard Project Flood conditions the floor would be submerged as would an additional length of approach road.

The Oberlin Avenue Bridge at Mile 86.85 is presently under construction as a part of the relocation of U. S. 21. This structure will replace the existing bridge located immediately downstream from the new bridge site. The old bridge is being razed. The design elevation provided by this nine-span steel beam and girder bridge is well above the 1913, Intermediate Regional and Standard Project Flood levels.

Walnut Road Bridge is a three-span continuous steel beam bridge at River Mile 87.38 within the City of Massillon. The bridge is higher

than all three of the flood levels considered but the approach providing access within the local protection works would be subject to flooding by overtopping of the protective levee during the Standard Project Flood.

A single track two-span truss and single plate girder bridge for the B. & O. & W. & L.E. Railroad crosses the river at an oblique angle at Mile 87.68. All three flood levels are below the rail elevations of the bridge. The marked drop in the 1913 flood level below the bridge, as shown on Plate 9, results from channel conditions existing at that time and would not occur under present circumstances. The bridge approach within the local protection works would be flooded by overtopping of the levees during a Standard Project Flood.

A Pennsylvania Railroad Bridge at Mile 87.74 parallels the preceding railroad bridge. It is a three-span steel truss bridge with double tracks. The top of the rails are above the crests of the 1913, Intermediate Regional and Standard Project Floods. Standard Project Flood flows would encroach into the low steel of this structure.

The Tremont Avenue Bridge at Mile 87.84 is an eleven-span steel beam bridge that crosses the Tuscarawas River and the railroad embankment along the west bank. For this reason the elevation of the deck is considerably higher than each of the three flood levels. The approach to this bridge would be flooded to some degree by water overtopping the levee during a Standard Project Flood.

U. S. Highway 30 or Lincolnway Bridge is located at Mile 87.96. It is a 686-foot bridge with nine spans of structural steel beams. This bridge, providing a large waterway opening, passes over the local protection works and establishes an artery into and out of the protected low area. All three flood stages are contained within the floodway by the protective levee; however, downstream overtopping during the Standard Project Flood would flood the bridge approach.

The Cherry Road Bridge at Mile 88.28 is a four-span, continuous steel beam bridge over the Tuscarawas River. This structure was built

in 1951-52 and is above the 1913 Flood, Intermediate Regional and Standard Project Flood levels. Some obstruction to flow at the east end of the bridge would occur due to low steel; however, this effect would be negligible and traffic could be maintained from the west into and out of the protected eastern areas. The three floods studied are safely contained within the floodway by the protective levees, but again backwater during a Standard Project Flood might cause some difficulty.

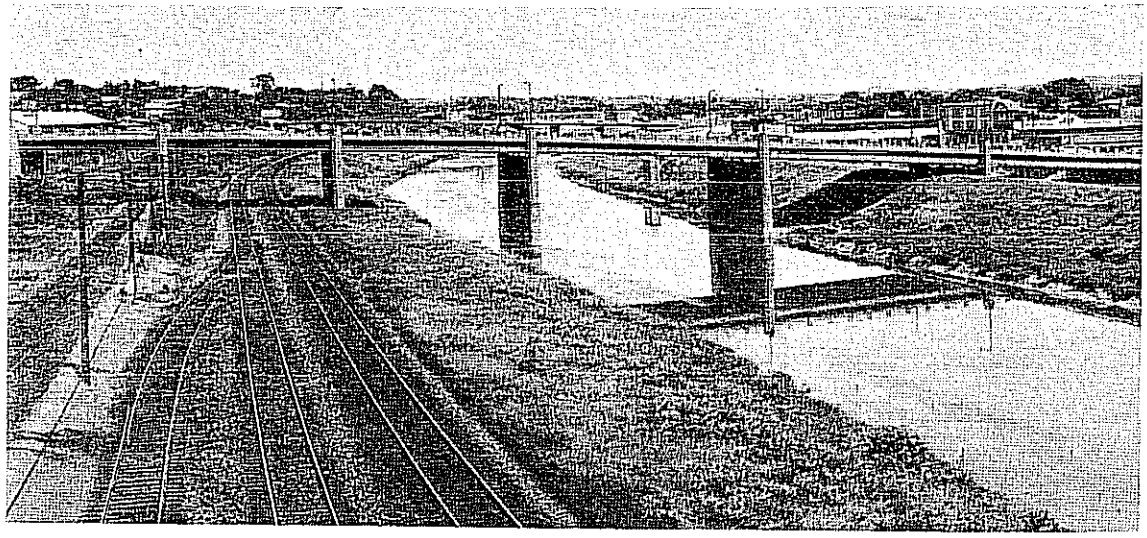
The Lake Avenue Bridge at Mile 89.17 is a low steel truss bridge with a 26-foot steel beam approach span. The principal span of 116 feet would have been completely inundated by the 1913, Intermediate Regional and Standard Project Floods, with approaches flooded as far east as U. S. Highway 21.

U. S. Highway 21, crossing the Tuscarawas River at Mile 89.43, leaves the City of Massillon in a northwesterly direction. It crosses the river over a twin, four-span, continuous steel girder bridge at a 50 degree skew. The substructure is parallel to the stream, offering little obstruction to flow and the bridge deck and approach highway are elevated above all three flood levels.

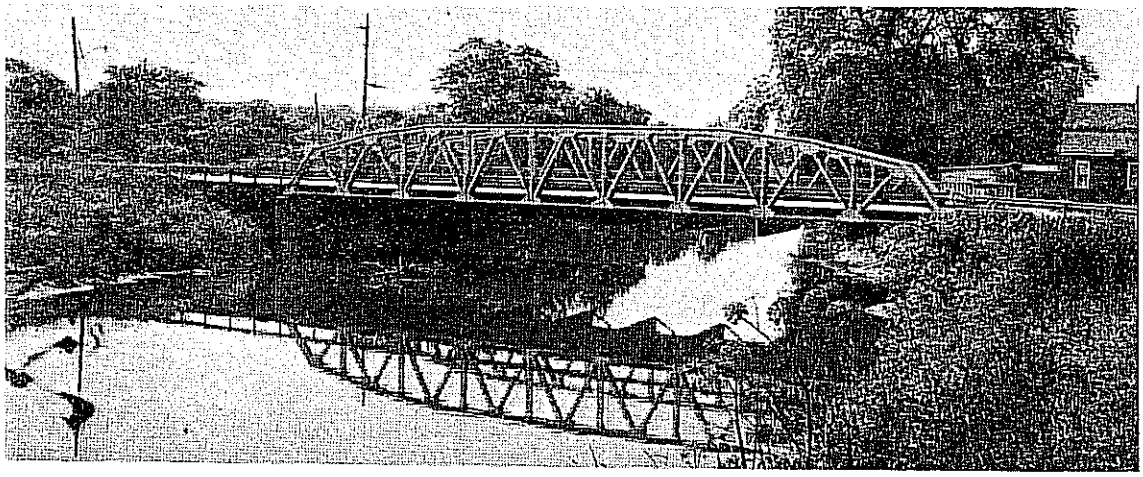
Forty Corners Street crosses the Tuscarawas River at Mile 91.24 with a 127 foot, steel truss bridge. The 1913, Intermediate Regional and Standard Project Flood levels would submerge the deck and approaches.

The Highmill Avenue Bridge, a two-span, steel truss bridge at Mile 91.86, was built in 1913. Each 102-foot span rests on a masonry pier which is parallel to the stream. The floor of the structure was covered by the 1913 flood as were portions of the trusses. The Standard Project Flood, the 1913 flood, and the Intermediate Regional Flood would cause the bridge to be closed due to the deck and approach road being flooded.

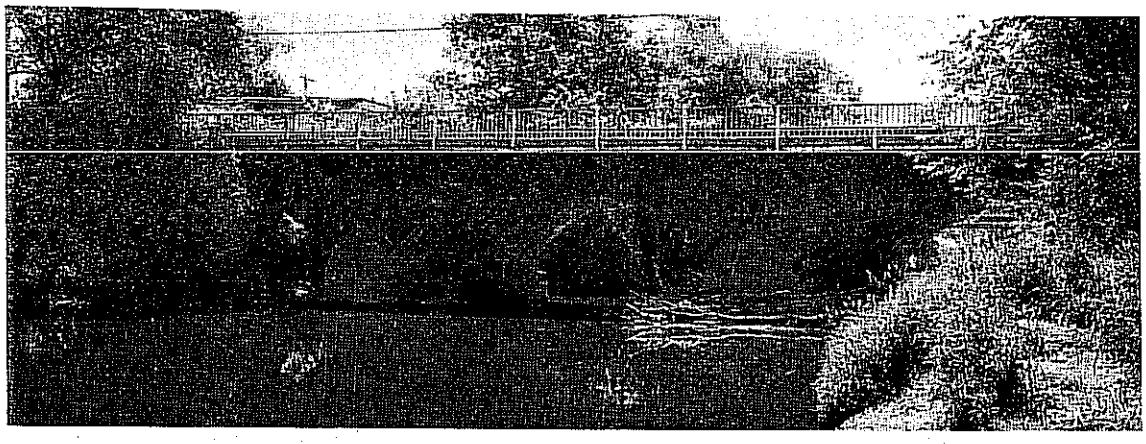
Butterbridge Road crosses the river at Mile 94.70 on a 132-foot span, high steel, truss bridge. The bridge floor is generally level with the flood plain and at the lowest point would be about 6.8 feet below the 1913 flood level. The Intermediate Regional and Standard Project Flood stages are also above the bridge deck and approach elevations.



Downstream side of the Lincolnway bridge at Mile 87.96. The levee of the local protection works is shown in the right side of the view.



The upstream side of the Lake Avenue bridge at Mile 89.17.



The upstream side of the Market Street bridge at Mile 97.20 in Canal Fulton.

Figure 2---TUSCARAWAS RIVER BRIDGES

The Cherry Street Bridge in the Village of Canal Fulton is located at Mile 97.14. This bridge, constructed in 1914, is a two-span, low truss, steel bridge, 212 feet in length. A flood, such as occurred in 1913, would cover the bridge floor by 3.6 feet. The Intermediate Regional Flood would cover the floor about two feet and the Standard Project Flood would be about 4 feet higher than the 1913 level.

The West Market Street Bridge is the northernmost bridge in Stark County that crosses the Tuscarawas River. It is located at Mile 97.20 in the Village of Canal Fulton. It is of stone and brick arch construction with three spans totaling 137 feet. Built in 1900, the bridge has elevated approach roads with only a small waterway opening below the bridge floor. This constriction causes a head loss in the flows of smaller storms, thereby forcing the upstream level to rise until overtopping of the entire bridge roadway grade occurs at about Elevation 950. The 1913 flood crested at 953.2 in this location almost covering the entire parapet railing and bridge approaches. The Standard Project Flood would completely flood the parapet while the Intermediate Regional Flood level would approximate the 1913 stage.

Obstructions to Flood Flow

The effects of obstruction due to bridges and their approach embankments have been described in the previous paragraphs. With the exception of these bridges, no significant structural obstructions to flows exist in the Tuscarawas River reach included in this study. A control weir constructed as a part of the Massillon Local Protection works at Mile 88.90 has a drop of approximately 3 feet at low water, but offers no obstruction to normal or flood flows.

Along most of its length outside the City of Massillon, the Tuscarawas River is lined with trees, having some areas of very dense growth, while others are only moderately so. The extent of these wooded areas vary from a few feet to several hundred feet back from the river bank. The overbank area is rarely pastured and as a result brush and other

growth is denser during the summer months, thereby increasing the resistance to flow in the period of thunderstorm type floods.

It is possible for floating material to catch on bridge piers and low steel and further block the waterway openings or clog the overbanks in wooded areas. In the winter months, ice jams could occur in the same manner.

FLOOD SITUATION

Flood Records

The first river gage in the area was a chain gage located on the Highmill Avenue bridge over the Tuscarawas River at Crystal Spring, Ohio, and was operated for eight years between 1921 and 1929.

In May 1926 a stream gaging station was located on the highway bridge over the Tuscarawas River at Clinton, Ohio, about one mile north of the study area. A chain gage was used from May 1926 to July 1930 and a recording gage has been in use from the latter date to the present.

Records of river stages and discharge measurements on the Tuscarawas River have been maintained also at the Massillon sewage treatment plant since April 1938, when the U. S. Geological Survey began observations on a staff gage. In August 1944, a recording gage was installed at the same site, and continuous records are available from that date to the present.

To supplement the record obtained at the Massillon gaging station, newspaper files were searched along with municipal records and Corps of Engineers records. From these records flood data over the past 66 years have been compiled.

Flood Stages and Discharges

Table 4 lists crest stages and discharge rates for floods exceeding a generally bankfull stage of 8 feet at the stream gaging station at the City of Massillon sewage treatment plant. Table 5 lists the highest ten floods in order of magnitude. For floods since April 1938, the flood crest stages are those observed at the gage. The stages for the floods prior to 1938 were established from nearby high water marks.

TABLE 4

TUSCARAWAS RIVER AT MASSILLON, OHIO

FLOOD CREST ELEVATIONS ABOVE BANKFULL STAGE OF 8 FEET

1904 - 1969

Drainage area at gage is 518 square miles. Zero of gage is at elevation 916.00 (Sea level datum of 1912). Gage is at River Mile 86.00.

Date of Crest	Gage Heights		Discharge
	Stage feet	Elevation feet	cfs
January 1904	15.7 (1)	931.7 (1)	(2)
April 1904	14.6 (1)	930.6 (1)	(2)
March 1913	20 (1)	936 (1)	23,500
February 1929	12.6 (1)	928.6 (1)	(2)
March 1933	14.1 (1)	930.1 (1)	(2)
August 1935	13.3 (1)	929.3 (1)	(2)
April 10, 1938	8.54	924.54	3,900
August 4, 1938	9.70	925.7	4,260
March 14, 1939	10.02	926.02	5,350
March 5, 1940	11.39	927.39	6,940
April 21, 1940	9.05	925.05	4,540
December 31, 1942	9.00	925.00	4,540
June 1, 1943	9.82	925.82	5,300
April 13, 1944	8.40	924.40	4,030
March 21, 1945	8.74	924.74	4,280
May 19, 1945	8.53	924.53	4,120
May 28, 1947	8.05	924.05	3,550
June 3, 1947	10.16	926.16	5,200
June 8, 1947	9.85	925.85	4,900
February 15, 1950	8.92	924.92	4,220

Table 4 (Continued)

Date of Crest	Gage Heights		Discharge
	Stage feet	Elevation feet	cfs
January 20, 1952	8.21	924.21	3,700
January 28, 1952	10.52	926.52	5,420
February 26, 1956	8.70	924.70	4,080
March 9, 1956	8.07	924.07	3,620
April 6, 1957	8.65	924.65	4,000
June 30, 1957	8.10	924.10	3,630
August 1, 1958	10.74	926.74	5,580
January 22, 1959	13.46	929.46	7,220
February 12, 1959	10.40	926.40	5,060
July 31, 1961	8.48	924.48	3,520
March 6, 1963	9.47	925.47	4,200
March 10, 1964	10.74	926.74	5,140
February 2, 1968	9.61	925.61	4,300
May 30, 1968	8.28	924.28	3,390
July 5, 1969	16.42	932.42	10,300

(1) Estimated by United States Geological Survey from high water marks in immediate vicinity of gage

(2) Not determined

TABLE 5

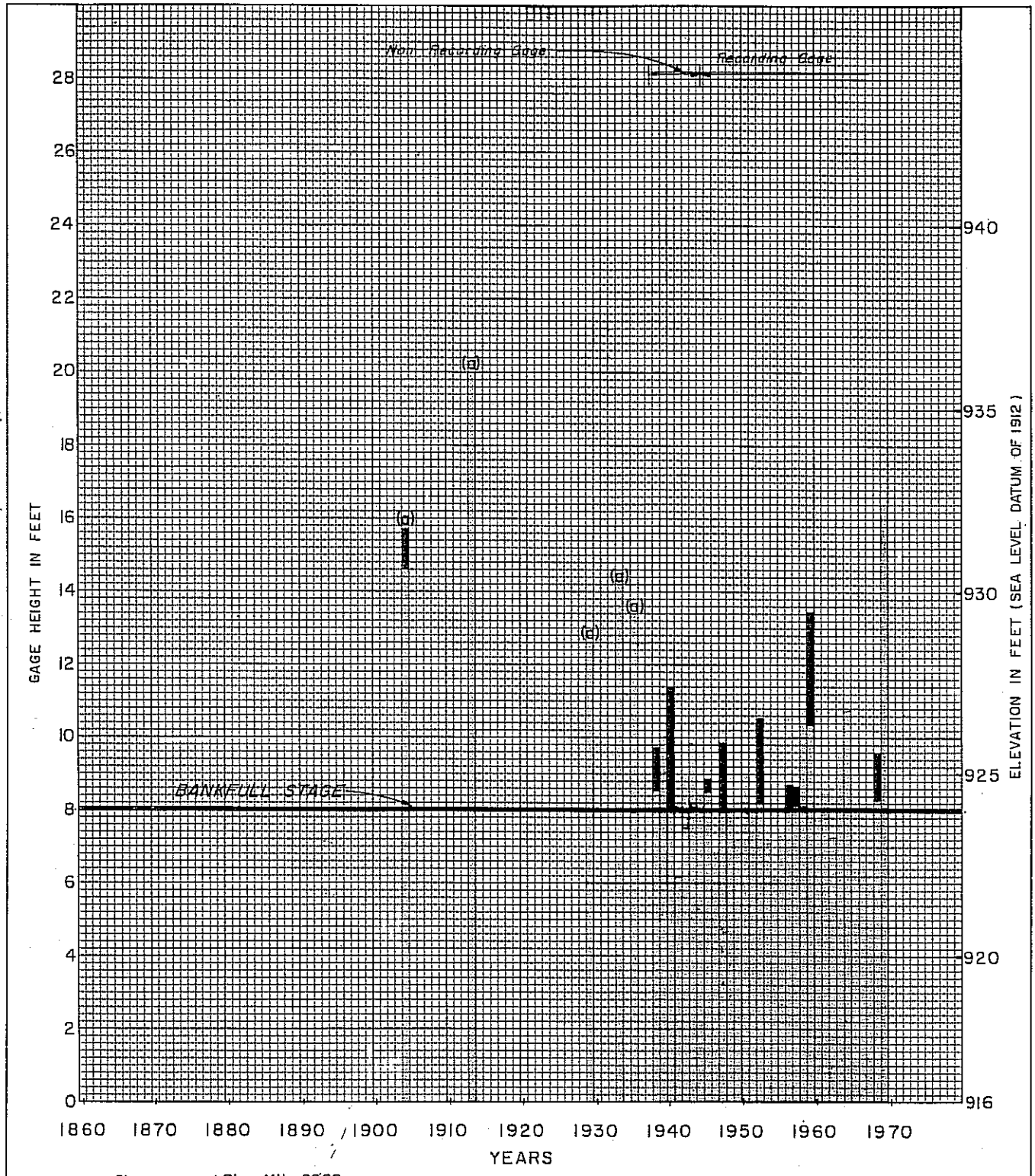
HIGHEST TEN KNOWN FLOODS IN ORDER OF MAGNITUDE

TUSCARAWAS RIVER AT MASSILLON, OHIO

Order No.	Date of Crest	Gage Height		Estimated Peak Discharge
		Stage feet	Elevation feet	cfs
1	March 1913	20	(1) 936	23,500
2	July 1969	16.42	932.42	10,300
3	January 1904	15.7	(1) 931.7	(2)
4	April 1904	14.6	(1) 930.6	(2)
5	March 1933	14.1	(1) 930.1	(2)
6	January 22, 1959	13.46	929.46	7,220
7	August 1935	13.3	(1) 929.3	(2)
8	February 1929	12.6	(1) 928.6	(2)
9	March 5, 1940	11.39	927.39	6,940
10	August 1, 1958	10.74	926.74	5,580

(1) Estimated

(2) Not determined



Stream gage at River Mile 86.00.

Variation in shading on the bar graph indicates more than one flood during the year. For example, in 1959 there were 2 floods; gage heights were 10.40 and 13.46 feet. Where stream level did not exceed bankfull stage of 8.0 feet during the year, the highest rise for that year is indicated. Absence of bar indicates records not available.

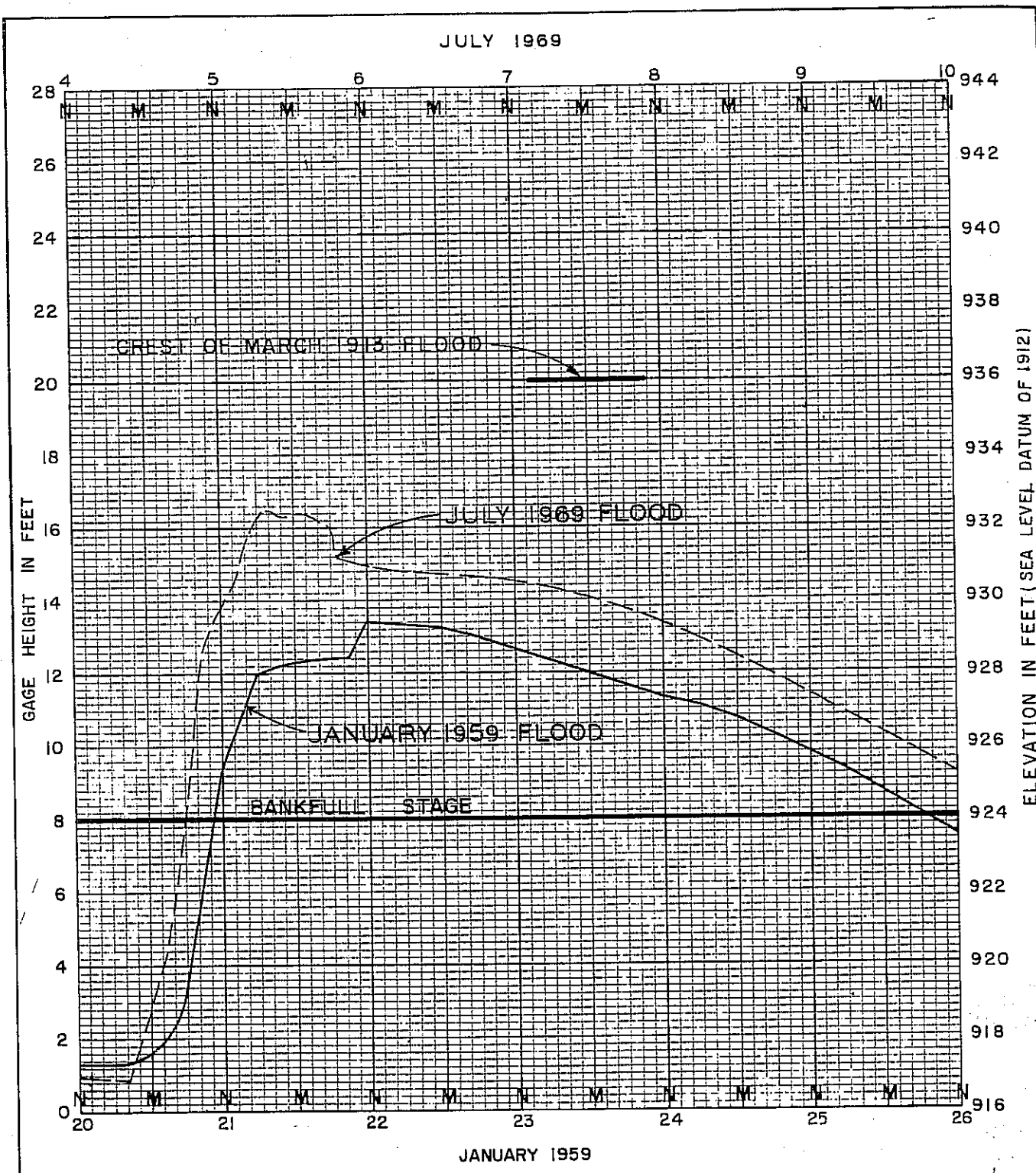
Zero of gage Elevation 916.00

(a) Stage estimated from flood mark.

CORPS OF ENGINEERS, U.S. ARMY
HUNTINGTON DISTRICT
HUNTINGTON, WEST VIRGINIA

FLOODS ABOVE BANKFULL STAGE
TUSCARAWAS RIVER
NEAR
MASSILLON, OHIO

JANUARY 1970



Stream Gage at
River Mile 86.00
Zero Gage 916.00

CORPS OF ENGINEERS, U.S. ARMY
HUNTINGTON DISTRICT
HUNTINGTON, WEST VIRGINIA

STAGE HYDROGRAPHS
TUSCARAWAS RIVER
MASSILLON, OHIO
JANUARY 1970

PLATE 3

Flood Occurrences

Plate 2 shows all known crest stages at the Massillon gage above a generally bankfull stage of eight feet, and the year of occurrence for each crest since 1938. In years when the river did not reach a stage of eight feet, the maximum rise for that year is shown. In most years there have been more than one crest above bankfull stage. Prior to 1938, only those crest stages which could be ascertained for major floods are shown. No reliable high water marks or other records could be uncovered for lesser floods during this period before the U.S.G.S. gage was installed. The lack of records, however, does not indicate that floods above bankfull stage did not occur.

Duration and Rate of Rise

Plate 3 shows the stage hydrographs on the Tuscarawas River, at the Massillon gaging station for the floods of January 1959 and July 1969. There are 518 square miles of tributary drainage area upstream of the gage. Because of the relative flat channel slope and distance, it takes a considerable time for the river to crest. Recession of the flood crest is also relatively slow as shown by the hydrographs on Plate 3.

During the July 1969 flood the river rose to its crest stage in 23 hours. This amounts to an average rate of 0.7 foot per hour with a maximum rate of 1.0 foot per hour. It remained above bankfull stage for 139 hours. During the January 1959 flood the river rose to its crest stage in 30 hours at an average rate of 0.2 foot per hour with a maximum rate of 1.0 foot per hour, and remained above bankfull stage for 116 hours.

Velocities

It is estimated that velocity in the channel of the Tuscarawas River in the vicinity of Massillon during the July 1969 flood approached 4 feet per second. Overbank velocities ranged up to 2 feet per second.

Flooded Areas, Flood Profiles, and Cross Sections

Plates 5 to 8 show approximate areas along the Tuscarawas River from Navarre upstream to the Stark County line that were inundated by the flood of March 1913. The flood limit is based on the stage that occurred in 1913 and does not necessarily represent the limit of flooding that would occur under present conditions particularly within the local protection works at Massillon. The plates also show the limits of both the Intermediate Regional and the Standard Project Floods under existing conditions. Actual overflow areas on the ground may vary some from the limits shown on the map because the contour interval and scale of the maps do not permit precise plotting of the flooded area boundaries.

Plates 9 and 10 show the high water profiles for the flood of July 1969, March 1913, the Intermediate Regional Flood and the Standard Project Flood discussed previously in the report. Again, the 1913 flood profile is based on channel conditions that existed at that time and does not reflect the channel and bridge improvements made since the date of the flood. The sharp drop in the actual profile of the 1913 flood at Mile 87.5 in Massillon reflects channel conditions existing at that time. Such conditions no longer exist and profiles of more recent floods and possible future floods do not break sharply in that reach. For this reason, comparisons of flood heights at Massillon referred to herein relate to flood heights at the USGS gaging station. The low bridge steel shown on these plates represents the elevation at the center of the span and is not necessarily the lowest steel elevation. Similarly, the bridge deck on these plates represents the elevation of the center of the bridge and may not be the lowest bridge deck elevation. Table 3 lists these lowest values.

Plates 11, 12, 13 and 14 show cross sections of the valley and bridges which are typical of the total of 35 sections surveyed in the field. The location of all sections are shown on Plates 5 through 8.

FLOOD DESCRIPTIONS

Following are descriptions of known large floods that have occurred on the Tuscarawas River in Stark County. These are based on published Corps of Engineers and United States Geological Survey accounts.

July 5, 1969, The Highest Recent Flood

The July 5 flood was the result of heavy rains accompanying a line of severe thunderstorms that moved with little warning into northern Ohio on the evening of July 4. The initial line of thunderstorms, with intense rainfall, lightning, and wind gusts up to 100 miles per hour, moved east-southeast at a forward speed of about 50 miles per hour. The storm centered along a line beginning just east of Toledo and extended through Ashland and Wooster to Dennison, Tuscarawas County, Ohio. Following the first storms, an area of great atmospheric instability remained almost stationary over this area for almost eight hours. This instability produced heavy rains until about noon on July 5. By the time the rains subsided rainfall had varied from about four to nearly eleven inches over the upper Muskingum River Basin drainage area with an average rainfall of 6.6 inches for the 18-hour period.

The rainfall at Massillon on the Tuscarawas River was 6 inches. At Chippewa Lake on Chippewa Creek the rainfall was 5.28 inches and 9.44 inches at Marshallville in the same basin. As is typical of summer storms, the major portion of the rainfall was in one portion of the basin. Chippewa, Newman, and Sippo Creeks crested at high levels while creeks in the eastern portion of the basin crested at lower heights.

The crest stage of the Tuscarawas River at the Massillon gage was 16.42 and occurred at 7:30 PM on July 5. This crest corresponded to a peak discharge of 10,300 cubic feet per second.

The following newspaper excerpts were published concerning the flood:

The Evening Independent

Massillon, Ohio

July 5, 1969

REPORT 6 INCHES OF RAIN HERE

"It's been one storm after another."

"That's the way a spokesman for the U. S. Weather Bureau station at Akron-Canton airport today described the atmospheric situation over Massillon and western Stark County. There were a couple of storms Friday afternoon, but the real string started at about 9 p.m. The almost-continuous downpour deposited six inches of rain on Massillon, according to records at the local sewage treatment plant.

THE A-C Weather Bureau recorded 3.13 inches, including that of Friday afternoon. By comparison, the greatest 24-hour fall ever recorded by the station was 5.96 inches on July 7, 1943.

All five pumping stations along the Tuscarawas river were activated at 9 p.m. Friday. They were still in operation late this morning as the river had risen from less than one foot to 13 feet.

Normal procedure is to start the pumps when the river reaches the six to seven foot level, according to officials at the treatment plant.

Maximum gusts of wind Friday night at the airport were 59 miles an hour. Some stronger gusts were reported in the area.

The rain is supposed to stop tonight, but may return Monday. Tonight's low will be around 60 under partly cloudy skies, making it cooler than last night.

Sunday's high will be in the upper 70's under partly sunny skies, but with lower humidity.

STORM CAPSULES

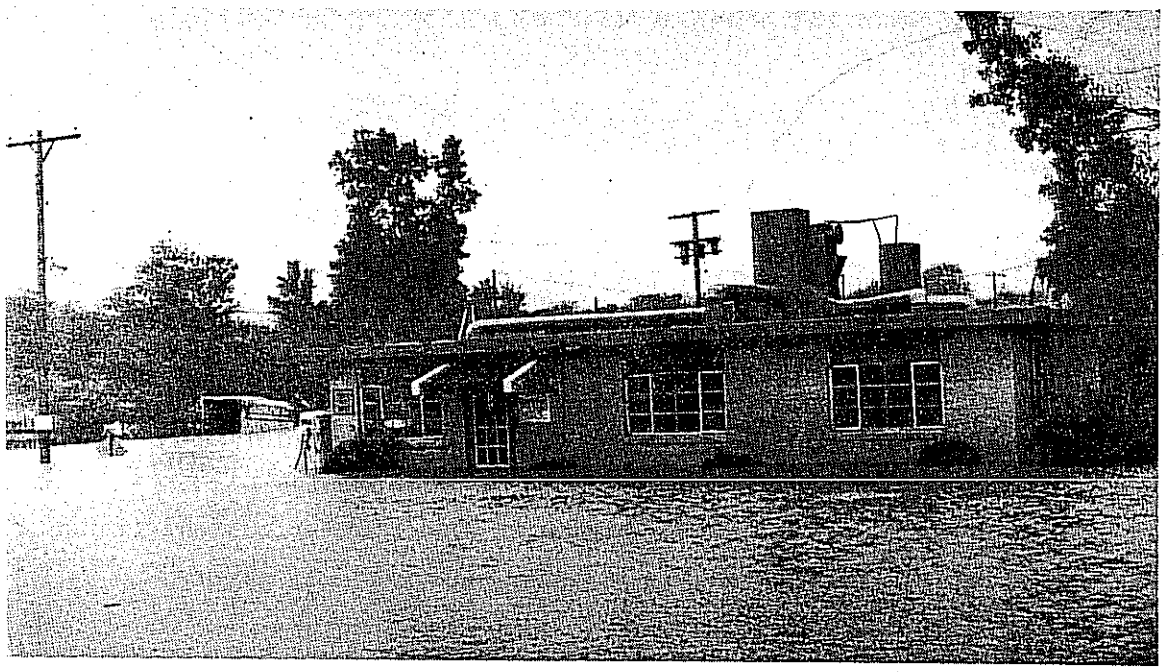
By Mary Immler

The city sewage treatment plant was flooded and water was reportedly running over the top of the tanks. This situation developed because too many residents have downspouts connected to sanitary lines and the 13-foot-high Tuscarawas river began backing up into the plant, according to a plant worker....

"Our problem is not so much the Tuscarawas river, but the creeks that feed the river, especially Newman creek which is almost the size of the Tuscarawas after the rain," commented (Raymond) Marshand. (Safety Service Director)....

High waters of the Tuscarawas river flooded the landfill at Warmington St. SW, south of Massillon this morning. Debris was reported being washed down the river.

Sippo creek rose to flood proportions and covered parts of the park road in both North and South Sippo parks. The water raging through the creek from the overflowing city reservoir wiped out several foot bridges in the park.



Huth Ready Mix and Supply at 501 5th Street NW

Figure 3 - - - FLOOD SCENES IN MASSILLON - JULY 1969

March 23-27, 1913, The Highest Known Flood

The flood of March 1913, which began on Easter Sunday, March 23, and continued through the 27th, was caused by a winter frontal type storm producing excessive precipitation over a long period of time. It was preceded by a storm of moderate intensity which passed down the St. Lawrence Valley on March 22 with sufficient precipitation over the Ohio Basin to moisten the soil and cause it to become quickly saturated by heavier rains that followed. The storm period was preceded by a warming trend so that frozen ground and snow melt were not a problem.

The storms developed in the Far West on the 22nd, moved slowly eastward and gathered energy. The rain area advanced ahead of the main storm. Another storm developed in the southwest and developed into an elongated trough of low pressure which rapidly extended eastward closely following the initial main storm. These two main storms passed in succession, with the peculiar condition that one disturbance followed the other so closely that the rain areas of the two blended, concentrating over the same portion of the country and creating the most disastrous flood in the history of the Ohio Valley.

Rainfall over the Tuscarawas River Valley above the gage at Massillon ranged from 8 to 10 inches. The flood stage crest, developed from nearby high water marks, indicated a stage of 20 feet at the Massillon gage. This stage was 3.6 feet above the July 1969 flood, the largest flood recorded at the stream gage.

No newspaper could be published in Massillon until March 29 because of the severity of the flood damage to power facilities and transportation. The following excerpts appeared on March 29, 1913:

This area is north of Lincolnway and east of the Tuscarawas River.

Cherry Road NW looking west.

FIGURE 4 - FLOOD SCENES IN MASSILLON - MARCH 1913

The Evening Independent

Massillon, Ohio

March 29, 1913

THE STORY OF THE CITY'S GREAT DISASTER

Massillon today is recovering from the worst flood in its history. Hundreds of families are homeless, thousands of men are out of work, stores closed, rail traffic suspended, the water supply is cut off and the east side of the city is separated from the west side by a broad expanse of water. While there has been no known loss of life, the damage to property will run into the hundreds of thousands.

Only the roofs of the houses in Pategonia (Cherry Road NE area) were visible at 9 o'clock Tuesday morning. One by one the telegraph and telephone wires went down and before night fell the city was completely cut off from the outside world except for a wire out of the Western Union and the Postal Telegraph Company.

The Evening Independent

Massillon, Ohio

March 31, 1913

GOVERNOR OFFERS MASSILLON AID

The State of Ohio has offered assistance to flood stricken Massillon. Governor Cox, through State Senator J. J. Wise today sent his sympathy to the citizens and said that the state was ready to supply food, clothing and shelter. Funds are being donated to the State and this money is going for the purpose of necessities for residents of the flood stricken areas of the State. Senator Wise was given assurance that this City would be taken care of.

Charles Avenue SE looking west from Third Street SE.

Cherry Road bridge over the Tuscarawas River. This bridge was rebuilt, channel relocated and widened and levees built as a part of the local protection works. Note the buildup of debris on the upstream side of the bridge.

FIGURE 5 - FLOOD SCENES IN MASSILLON - MARCH 1913

FUTURE FLOODS

This section of the report discusses the Standard Project Flood and the Intermediate Regional Flood on the Tuscarawas River in Stark County, and some of the hazards of great floods. The Standard Project Flood represents reasonable upper limits of expected flooding. The Intermediate Regional Flood represents a flood that may reasonably be expected to occur more frequently, although the flood stages will not be as high as the infrequent Standard Project Flood.

Large floods have been experienced in the past on streams in the general geographical and physiographical region of Stark County. Heavy storms similar to those causing these floods have occurred in the past and will occur again in the future on the Tuscarawas River watershed. When this occurs, floods would result on these streams comparable in size with those experienced on neighboring streams. It is therefore desirable, in connection with any determination of future floods which may occur on the Tuscarawas River, to consider storms and floods that have occurred in the region on watersheds whose topography, watershed cover, and physical characteristics are similar to those of this river.

MAGNITUDE OF GREAT FLOODS

Determination of Intermediate Regional Floods

The Intermediate Regional Flood is defined as a flood having an average frequency of occurrence in the order of once in 100 years, at a designated location, although the flood may occur in any year. Some flood probability estimates are based on statistical analyses of streamflow records available for the watershed under study, but limitations in such records usually require analyses of rainfall and runoff characteristics in the "general region" of the area being considered. The Intermediate Regional Flood represents a major flood, although it is much less severe than the Standard Project Flood.

TABLE 6

MAXIMUM KNOWN FLOOD DISCHARGES ON

STREAMS IN THE REGION OF STARK COUNTY, OHIO

Stream	Location	Drainage Area Sq. Mi.	Date	Peak Discharges Amount cfs	Peak Discharges Per Sq. Mi. cfs
Tuscarawas River	At Newscomerstown	2,443	March 1913	83,000 (a)	34
Tuscarawas River	Near Dover	1,405	March 1913	62,000 (a)	44
Sandy Creek	At Sandyville	481	January 25, 1937	14,200	30
Killbuck Creek	At Killbuck	462	July 5, 1969	58,600	126
Stillwater Creek	At Uhrichsville	367	August 8-9, 1935	7,650	21
Sugar Creek	At Strasburg	311	July 5, 1969	46,000	148
Sugar Creek	Below Beach City Dam	300	March 13, 1939	7,500 (b)	25
Sandy Creek	At Waynesburg	253	January 22, 1959	15,000	59
Nimishillen Creek	At North Industry	175	January 21, 1959	8,600	49
Tuscarawas River	At Clinton	174	August 8, 1935	2,700	16
Chippewa Creek	At Easton	146	July 5, 1969	11,000	75
Indian Fork	Below Atwood Dam	70	April 7, 1945	1,610 (b)	23
Middle Branch-Nimishillen Creek	At Canton	43.1	January 22, 1959	2,470	57
Little Chippewa Creek	Near Smithville	13.9	January 21-22, 1959	1,800	129
Home Creek	Near New Philadelphia	1.64	July 7, 1969	650	400

(a) Computed by Corps of Engineers

(b) Affected by Storage

In order to determine the Intermediate Regional Flood for various points within the study area, statistical studies were made using the 27-year record of streamflow data at the Massillon U.S.G.S. gage and the 38-year record at Clinton. Table 6 lists the maximum known floods that have occurred on watersheds in the general region.

The computed peak discharge of the Intermediate Regional Flood at the Massillon U.S.G.S. gage is 17,100 cubic feet per second. This is less than the 1913 flood which is estimated at 23,500 c.f.s. but over one and one-half times the peak rate of discharge of the July 1969 storm. At different locations along the stream, the discharge will vary according to the drainage area. This variation is shown in Table 7.

TABLE 7

INTERMEDIATE REGIONAL FLOOD

PEAK DISCHARGE RATES

Location	River Mile	Drainage Area sq. mi.	Discharge cfs
Lower Study Limit	80.37	547	17,700
U.S.G.S. Gage	86.00	518	17,100
U.S. Highway 21	89.43	437	15,500
Stark County Line	100.08	362	13,900

Determination of Standard Project Floods

Only in rare instances has a specific stream experienced the largest flood that is likely to occur. Severe as the maximum known flood may have been on any given stream, it is a commonly accepted fact that, in practically all cases, sooner or later a larger flood can and probably will occur. The Corps of Engineers, in cooperation with the Weather Bureau, has made broad and comprehensive studies and investigations based on vast records of experienced storms and floods and has evolved generalized procedures for estimating the flood potential of streams.

These procedures have been used in determining the Standard Project Floods. It is defined as the largest flood that can be expected from the most severe combination of meterological and hydrological conditions that are considered reasonably characteristic of the geographical region involved.

Standard Project Flood estimates have been made for the lower limit of the study area, the Massillon U.S.G.S. Gage, the U. S. Highway 21 bridge, and at the Stark County line. The storm rainfall used for the lower limit of the study area at Navarre amounts to 4.96 inches in three hours, 7.51 inches in six hours, 10.07 inches in 24 hours and a total of 12.75 inches in 96 hours. Rainfall amounts for the upstream points are proportionally less. Peak discharges for the Standard Project Flood at the different locations are shown in Table 8.

The Standard Project Flood would have a peak discharge of 36,400 c.f.s. at the gage near Massillon. This discharge rate is over 1.5 times the peak rate experienced in the flood of 1913. Such a storm would be the culmination of various events leading to such an extreme flood flow.

TABLE 8

STANDARD PROJECT FLOOD

PEAK DISCHARGE RATES

Location	River Mile	Drainage Area sq. mi.	Discharge cfs
Lower Study Limit	80.37	547	37,900
U.S.G.S. Gage	86.00	518	36,400
U. S. Highway 21	89.43	437	32,100
Stark County Line	100.08	362	27,900

Frequency

It is not practical to assign a frequency to the Standard Project Flood. The occurrence of such a flood would be a rare event; however, it could occur in any year.

Possible Larger Floods

Floods larger than the Standard Project Flood are possible; however, the combination of factors that would be necessary to produce such floods would seldom occur. The consideration of floods of this magnitude is of greater importance in some problems than in others but should not be overlooked in the study of any problem.

HAZARDS OF GREAT FLOODS

The amount and extent of damage caused by any flood depends in general upon how much area is flooded, the height of flooding, the velocity of flow, the rate of rise, the duration of flooding and the extent and type of development within the flooded area.

Areas Flooded and Heights of Flooding

The areas along the Tuscarawas River flooded by the 1913 flood, Intermediate Regional Flood and Standard Project Flood are shown on Plates 5 through 8. Depths of flow can be estimated from the crest profiles shown on Plates 9 and 10.

The high water profiles for the river were computed by using stream characteristics for selected reaches as determined from observed flood profiles, topographic maps, and valley cross sections which were surveyed in November and December 1967. The elevation shown on Plates 9 and 10 and the overflow areas shown on Plates 5 through 8 have been determined with an accuracy consistent with the purposes of this study and the accuracy of the basic data.

Profiles of the Standard Project Flood and the Intermediate Regional Flood depend in part upon the degree of destruction or clogging of various bridges during the floods. Because it is impossible to forecast these events, it was assumed that all bridge structures would stand and that no clogging of openings would occur to impede flow.

The Standard Project Flood profile for the Tuscarawas River is from zero to seven feet higher than the March 1913 flood. Maximum difference occurs at the downstream limit of the study. The two floods have coincident profiles from the B. & O. & W. & L.E. Railroad bridge, at Mile 87.68, through the City of Massillon to approximately Highway 21 Bridge, at Mile 89.43. The pronounced rise in the 1913 high water profile between Walnut Road Bridge and the railroad bridge was the result of a restricted channel in this reach. The much larger flood flows of the Standard Project Flood can be carried in the improved channel that exists today without increasing the depth of flooding. This is an excellent example of how a stream's carrying capacity can be improved by channel straightening, bank improvements and the increasing of waterway openings at bridges.

The Intermediate Regional Flood profile is lower than the actual March 1913 flood profile for the entire length of reach. It varies from a fraction of a foot to seven feet below the 1913 high water. The Standard Project Flood nearly parallels the Intermediate Regional Flood along the entire study reach, varying from five to seven feet above the Intermediate Regional Flood stage.

The Intermediate Regional Flood ranges from about one to seven feet lower than the actual 1913 flood through the City of Massillon, illustrating again that recurrence of another March 1913 flood would be much less disastrous today due to the construction of the Local Protection Works.

Figures 6 through 9 on pages 41 and 42 show the heights that were reached by the March 1913 Flood and heights that would be reached by the Intermediate Regional Flood on existing structures within the flood plain of the Tuscarawas River in Stark County.

Velocities, Rates of Rise, and Duration

Water velocities during floods depend largely upon the size and shape of the cross section, the condition of the stream, and the bed slope, all of which vary on different streams and at different locations on the same stream.

Table 9 lists the maximum velocities that would occur in the Tuscarawas River channel and overbank areas during the Intermediate Regional Flood.

TABLE 9

INTERMEDIATE REGIONAL FLOOD

MAXIMUM VELOCITIES

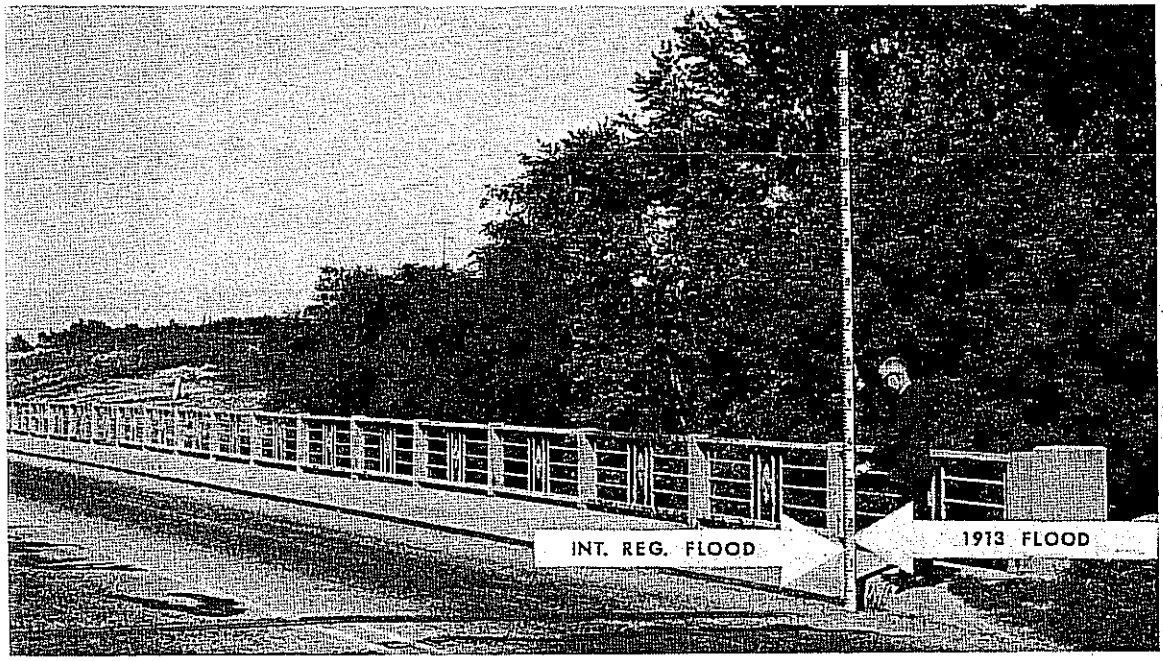
Location	Maximum Velocities	
	Channel ft. per sec.	Overbank ft. per sec.
Tuscarawas River Mile 80.37	4	2
Tuscarawas River Mile 86.00	5	-
Tuscarawas River Mile 90.43	3	1
Tuscarawas River Mile 98.75	1	1

TABLE 10

STANDARD PROJECT FLOOD

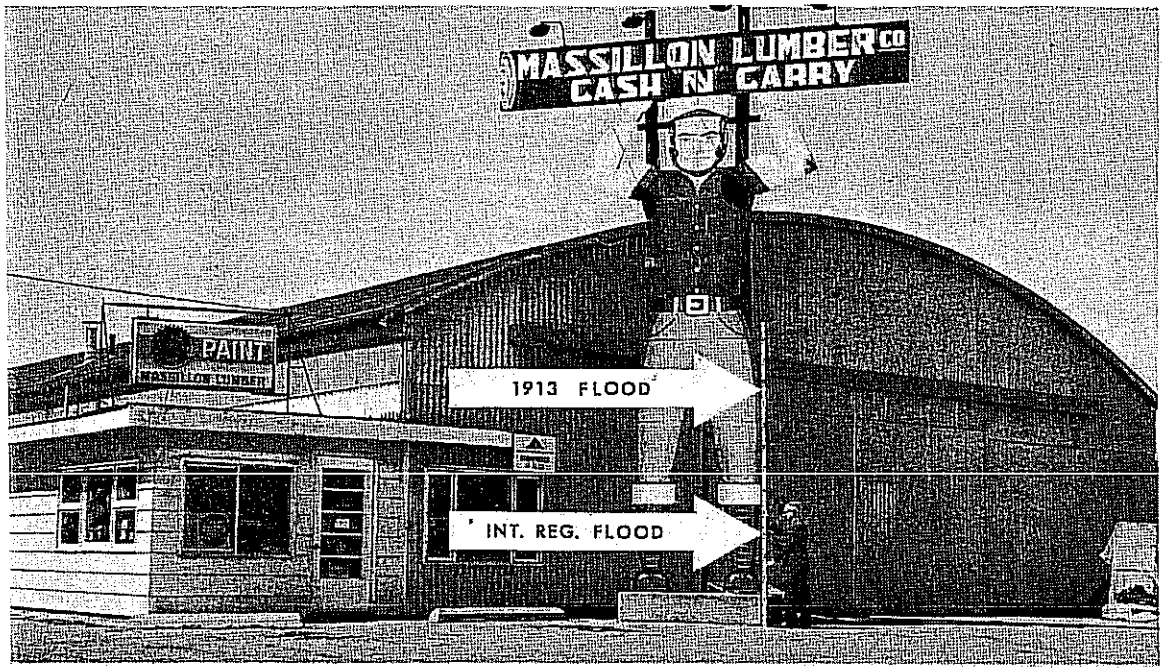
MAXIMUM VELOCITIES

Location	Maximum Velocities	
	Channel ft. per sec.	Overbank ft. per sec.
Tuscarawas River Mile 80.37	5	3
Tuscarawas River Mile 86.00	7	1
Tuscarawas River Mile 90.43	4	1
Tuscarawas River Mile 98.75	1	1



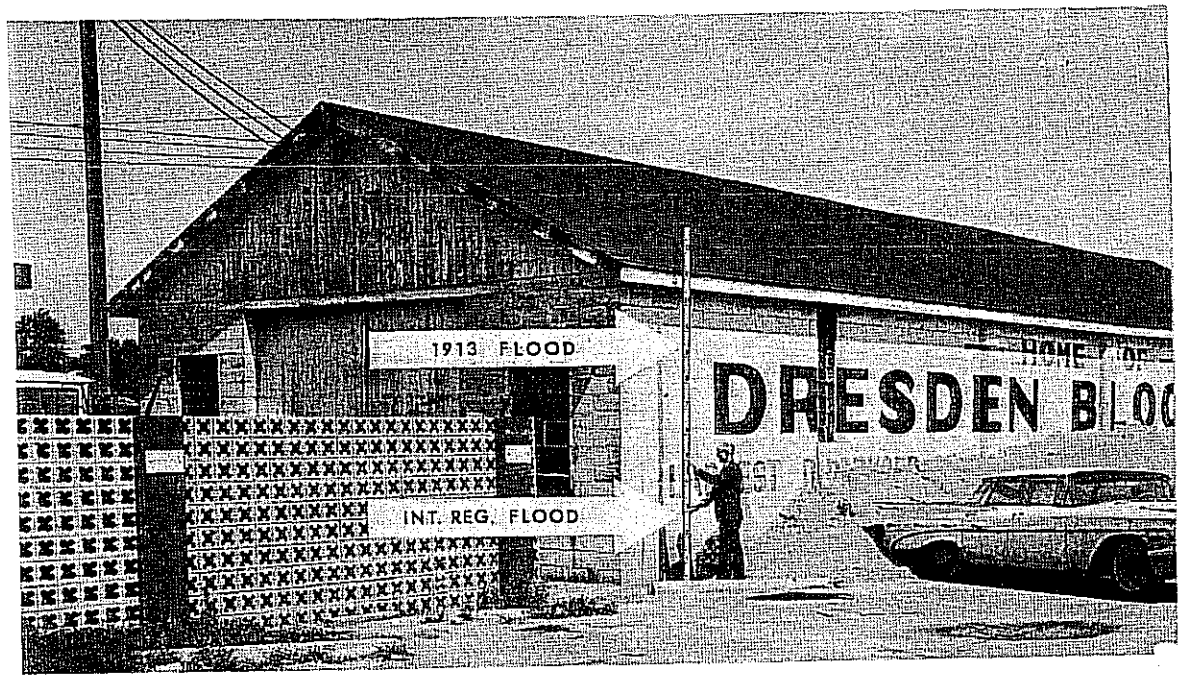
The arrow shows the height of the Intermediate Regional Flood over the east end of State Route 62 highway bridge over the Tuscarawas River at Navarre. The flood of March 1913, as indicated, would reach approximately the same elevation at this point.

FIGURE 6 - FLOOD HEIGHTS AT NAVARRE



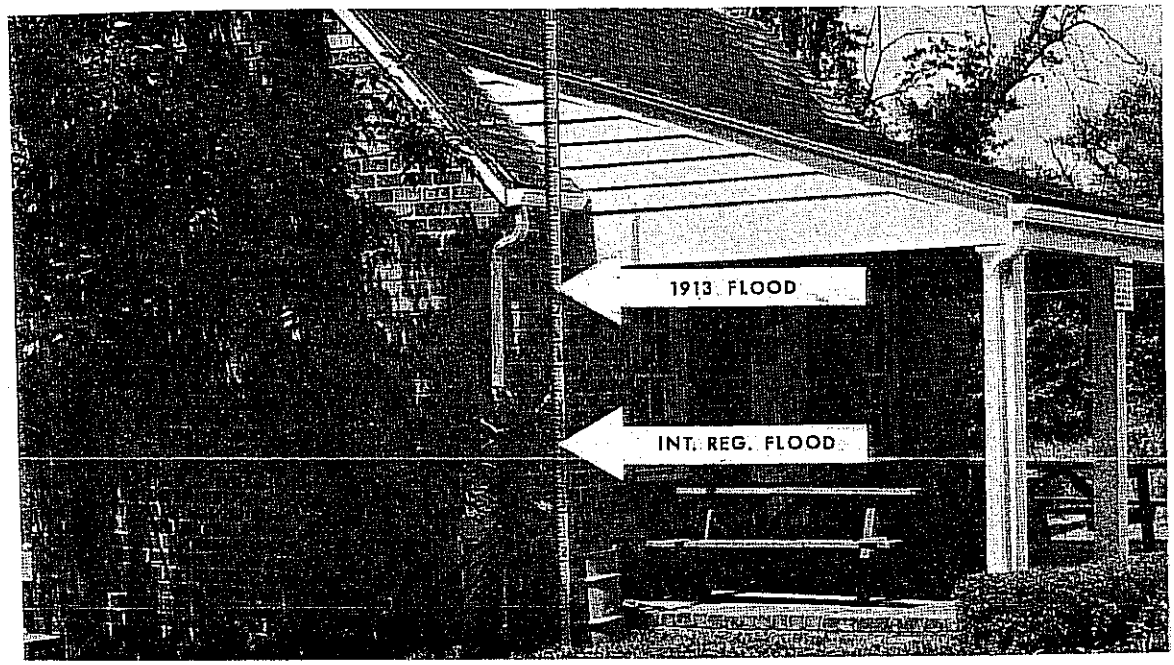
The level reached by the flood of March 1913 and the level that would be reached by the Intermediate Regional Flood is shown in relation to Massillon Lumber Co. at Mile 89.43. This area is unprotected by levees.

FIGURE 7 - FLOOD HEIGHTS AT MASSILLON



This structure is located outside the Massillon local protection works and shows the levels of the Intermediate Regional Flood and the flood of March 1913.

FIGURE 8 - FLOOD HEIGHTS AT MASSILLON



This office, owned by Stark County, is located at Canal Lock 4, Mile 95.95. The upper arrow indicates the March 1913 flood level and the lower arrow indicates the level that would be reached by the Intermediate Regional Flood.

FIGURE 9 - FLOOD HEIGHTS ALONG THE TUSCARAWAS RIVER

GLOSSARY OF TERMS

Flood. An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river or stream or an ocean, lake or other body of standing water.

Normally a "flood" is considered as any temporary rise in stream flow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased stream flow, and other problems.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Peak. The maximum instantaneous discharge of a flood at a given location. It usually occurs at or near the time of the flood crest.

Flood Plain. The relatively flat area or low lands adjoining the channel of a river, stream or watercourse or ocean, lake, or other body of standing water, which has been or may be covered by flood water.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Head Loss. The effect of obstructions, such as narrow bridge openings or buildings that limit the area through which water must flow, raising the surface of the water upstream from the obstruction.

Intermediate Regional Flood. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the "general region of the watershed".

Left Bank. The bank on the left side of a river, stream, or water course, looking downstream.

Low Steel (or Underclearance). See "underclearance".

Right Bank. The bank on the right side of a river, stream or water course, looking downstream.

Standard Project Flood. The flood that may be expected from the most severe combination of meterological and hydrological conditions that is considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Peak discharges for these floods are generally about 40 percent to 60 percent of the Probable Maximum Floods for the same basins. Such floods, as used by the Corps of Engineers, are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

Underclearance. The lowest point of a bridge or other structure crossing a river, stream, or water course that limits the opening through which water flows. This is referred to as "low steel" in some regions.

AUTHORITY, ACKNOWLEDGEMENTS, AND INTERPRETATION OF DATA

This report has been prepared in accordance with the authority granted by Section 206 of the Flood Control Act of 1960 (PL 86-645), as amended.

* * *

Assistance and cooperation of the U. S. Weather Bureau, U. S. Geological Survey, the City of Massillon, the Stark County Engineers' Office, the Massillon "Evening Independent" and private citizens in supplying useful data are appreciated.

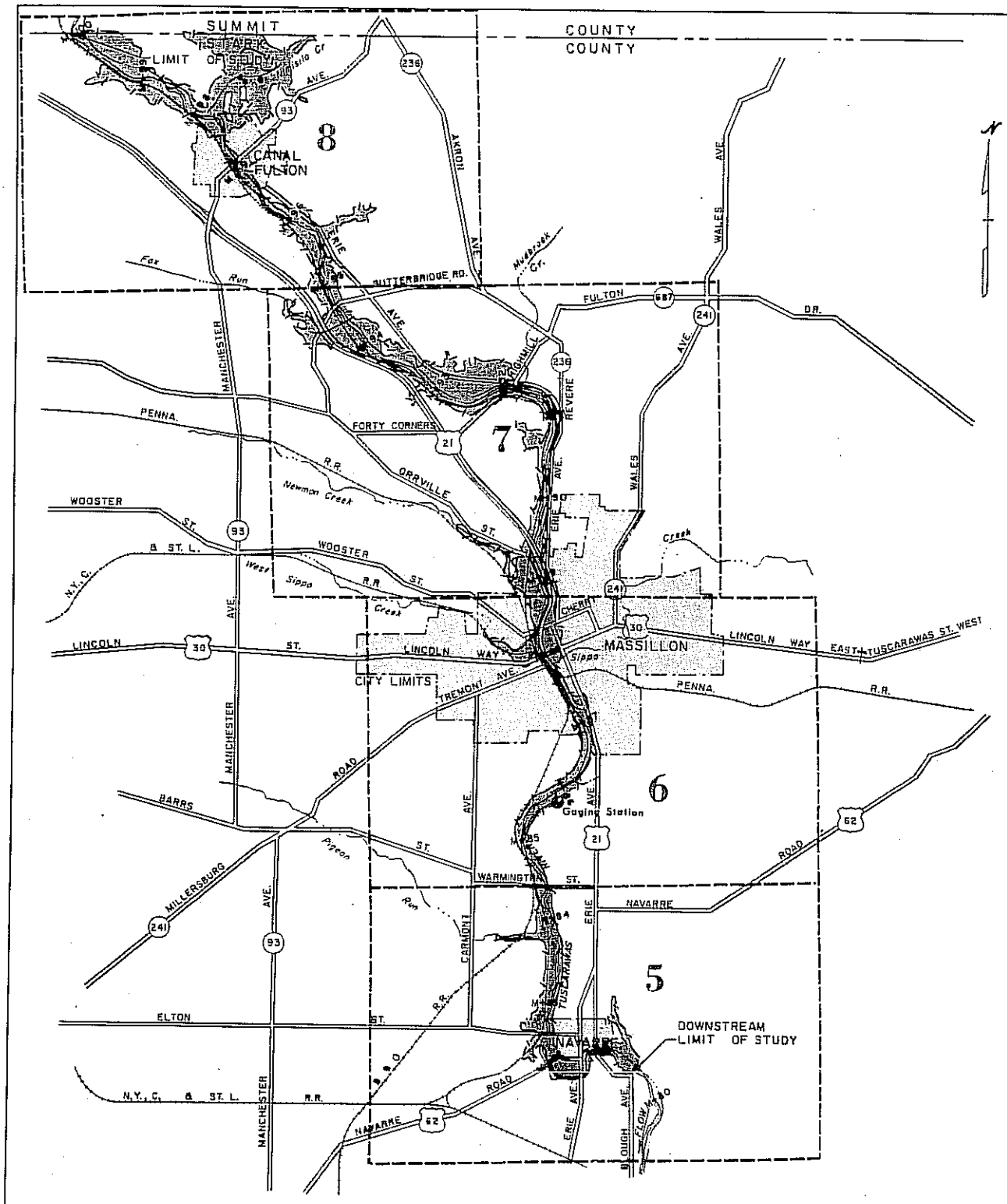
* * *

This report presents the local flood situation for the area of Stark County adjoining the Tuscarawas River. The Huntington District, Corps of Engineers, will, upon request, provide interpretation and limited technical assistance in application of data presented herein.

* * *

This report was originally prepared for the U. S. Army, Corps of Engineers, Huntington District, by Burgess & Niple, Limited, Consulting Engineers, Columbus, Ohio.

The report has been revised by the Huntington District office to incorporate the extensive floods that occurred in northern Ohio in July 1969.



LEGEND

Standard Project Flood

6 Plate Number Of Detail Sheets

M+88 Miles Above Mouth Of River

CORPS OF ENGINEERS, U.S. ARMY
HUNTINGTON DISTRICT
HUNTINGTON, WEST VIRGINIA

INDEX MAP-FLOODED AREAS

TUSCARAWAS RIVER

STARK COUNTY, OHIO

SCALE 0 10000 20000 FEET

JANUARY 1970

PLATE 4