FLOODS IN
STARKWEATHER CREEK BASIN
MADISON, WISCONSIN

Open-file report

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FLOODS IN STARKWEATHER CREEK BASIN, MADISON, WISCONSIN

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Introduction

The city of Madison is establishing standards for flood-plain zoning and land-use planning. The evaluation of flood potential is a necessary factor to be considered before such standards are established and put into effect.

Purpose and scope.--The purposes of this report are to determine the magnitude and water surface elevations of the regional (100-year) flood for both existing and future conditions, to determine their limits of flooding, and to analyze maximum hydraulic capacities of the channel system of Starkweather Creek.

The regional flood is defined by the Wisconsin Department of Natural Resources (1968, p. 94) as a flood that occurs on an average of once in 100 years and "which is representative of large floods known to have occurred generally in Wisconsin and reasonably characteristic of what can be expected to occur on a particular stream".

The reaches evaluated are (1) Starkweather Creek and West Branch Starkweather Creek, for a distance of 6.0 river miles from the mouth at Lake Monona upstream to the U.S. Highway 51 crossing north of Truax Field; and (2) East Branch Starkweather Creek (2.8 river miles), from its confluence with the West Branch near Milwaukee Street upstream to a point near the Interstate Highway 90-94 crossing.

Description of area.--The Starkweather Creek basin is about 24 square miles in size. It is located near the center of Dane County, Wisconsin, and about 50 percent of the basin is within the city limits of Madison. It can be characterized as generally flat with low hills around the perimeter of the basin. The drainage pattern consists of two branches, the West Branch and East Branch of Starkweather Creek, which meet one-half mile above the mouth at Lake Monona. Maximum relief is 210 feet.

Cooperation and acknowledgment.--This report was prepared under a cooperative agreement between the U.S. Geological Survey and the city of Madison. The agreement was coordinated by the Wisconsin Department of Natural Resources.

Information, useful for this report, was furnished by the Engineering Department and the Planning Department of the city of Madison. Their helpfulness is appreciated.

Additional information.--Information about data used in this report can be obtained from the U.S. Geological Survey, Water Resources Division, 1815 University Ave., Madison, Wis.

Basin Characteristics

The lower half of the Starkweather Creek basin is now considered urban. Thus flood characteristics have changed from the original undeveloped condition. Because urbanization probably has reduced lag-time from rainfall to runoff, flood magnitudes probably have increased.

A significant hydrologic characteristic of Starkweather Creek basin is the relatively large overbank storage capacity. Hundreds of acres in the vicinity of Truax Field, including the area east of U.S. Highway 51, which is outside the limits of the present study, are subject to inundation during major floods.

The areas of Truax Field adjoining runways and taxiways are well drained by storm sewers leading to outfalls at many points along the channel of the West Branch. Thus, although inundated at the time of the flood peak in the channel, they will drain quickly once the peak has passed.

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Regional (100-year) Flood for Existing Land-Use Conditions

<u>Flood magnitude</u>.--The magnitude of the regional flood for existing land-use conditions has been determined as follows:

Location	Drainage Area, in square miles	Discharge, in cubic feet per second
West Branch Starkweather Creek at U.S. Hwy. 51	6.0	590
West Branch Starkweather Creek at mouth of East Branch	12.2	950
East Branch Starkweather Creek at Lien Road	4.4	160
East Branch Starkweather Creek at confluence with West Branch	9.0	600
Starkweather Creek at mouth	24.1	1,600

These discharge figures were determined by using equations derived by D. H. Conger (1971) and adjusted for presently urbanized conditions on the basis of concepts proposed by Anderson (1970). A large part of the drainage area of the East Branch upstream from Interstate Highway 90-94 does not significantly contribute to flood peaks downstream from the highway, because it drains into a large gravel pit in a depression below the invert level of the highway culvert.

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Flood profile.--The regional-flood profile (sheets 2 and 3) was defined from flood-plain cross sections and supplemental data, including roughness coefficients, bridge and culvert geometry, and road profiles obtained from field surveys. Field data were augmented by information from topographic maps and photographs. The profile was determined by standard step-backwater methods, unobstructed culvert flow, and embankment-overflow computations. The water-surface elevation for the regional flood at the downstream end of the study reach at Lake Monona (sheet 2) was obtained from flood-frequency relations based on 55 years of lake-level records.

A low-water profile is shown on sheets 2 and 3 to indicate the magnitude of flood rise at any point.

The channel thalweg shown is the line joining points of lowest elevation of successive cross sections.

Limits of flooding.--The flood profiles were used to delineate flood boundaries on the inundation map (sheet 1). The location of the boundaries of the regional flood were based principally on surveyed cross sections and on interpolation between 10-foot contour lines on U.S. Geological Survey topographic maps and 2-foot contour lines on maps provided by the city of Madison.

Depth of flooding.--The depth of flooding at any point may be determined by subtracting the land-surface elevation from the water-surface elevation. An approximate depth may be estimated by subtracting the interpolated land-surface elevation (topographic map) from the elevation of the water surface (inundated-area map). In a few places the contour lines shown may no longer be applicable due to land-surface changes. More accurate depths of flooding can be obtained if ground elevations are determined by leveling from a bench mark or other point of known elevation.

The maximum difference between the regional flood elevation and the normal low-water elevation along both branches of Starkweather Creek, for existing conditions, is less than 10 feet. On the West Branch (sheet 4) it is 9.9 feet in an undeveloped area just upstream from State Highway 30. On the East Branch (sheet 5) the maximum height during the regional flood above normal low water would be 5.8 feet.

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Regional (100-year) Flood for Future Urban Conditions

Estimates of land use.--The city of Madison Planning Department has provided a land-use map (written communication, 1970) for the entire basin, which shows areas proposed to be zoned for residential, industrial, commercial, or open space use. At present agricultural use prevails in much of the upper reaches of the basin.

Flood magnitude.--Adjustments to the regional flood, as previously determined for existing land-use conditions, have been made to reflect future urban conditions. The inherent characteristics of urbanization such as paving and roof tops, and storm-sewering or channelization, generally increase the flood peak magnitude, though not necessarily the flood volume, and reduce the response time to storms.

The peak discharge estimates were principally based on the concepts of Anderson (1970). Estimates of impervious area from the city of Madison land-use map, range from 8 percent on the West Branch upstream from U.S. Highway 51 to 20 percent on the East Branch upstream from Lien Road. The estimated decrease in lag time at the same sites was approximately 80 percent.

Regional (100-year) flood magnitudes for future urban conditions are shown in the following table:

Location	Discharge in cubic feet per second
West Branch Starkweather Creek at U.S. Hwy. 51	860
West Branch Starkweather Creek at mouth of East Branch	950
East Branch Starkweather Creek at Lien Road	290
East Branch Starkweather Creek at confluence with West Branch	600
Starkweather Creek at mouth	1,600

Flood profile.--The water-surface profile of the regional flood, adjusted to reflect future urban development, is also shown on sheets 2 and 3. No adjustment to the regional flood was made in the lower reaches of the creek for future urbanization because the lower reaches are already completely urbanized and because the present open-space flood-storage areas in the middle reaches would generally remain after urbanization. Much channelization has already taken place.

The regional flood elevation as adjusted for future urbanization is a maximum of 0.5 foot above the standard regional flood elevation on the West Branch and 1.1 feet on the East Branch.

Limits of flooding.--The boundaries of the regional flood for future urban conditions are also shown on sheet 1.

Maximum Hydraulic Capacities

The maximum hydraulic capacity of the channel system within the area of study presented on a frequency basis is the 10-year flood. This is for existing land-use conditions. An exception is the East Branch upstream from Lien Road, where the channel is relatively steep and will accommodate the 100-year flood.

This is shown graphically on sheets 4 and 5, where profiles of the left and right banks (facing downstream) are superimposed on profiles of the 100-year, 50-year, 25-year, and short reaches of the 10-year floods. The shorter-period profiles were determined by the same techniques used for preparing the regional (100-year) flood profile.

Due principally to channelization, bank heights are man-made rather than natural and are extremely variable. Overflow will occur where the flood profile is higher than the bank profile. Thus, the regional flood could be contained within the channel in some areas, whereas even the 10-year flood could cause minor overflows elsewhere.

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References Cited

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