

floods has increased rapidly in the last half century. Losses due to flood "Hazel" in October, 1954, in the Toronto region alone ran to over \$20 million.

Floods in Ontario are caused by one or more of the following situations: rapid melting of a heavy snow pack, with or without accompanying rainfall; severe local thunderstorms; hurricane type storms; an abrupt change in the river section alignment or slope; ice jams and, man-made encroachments on the river. In May, 1960, rapid snowmelt accompanied by rains swelled most of the rivers in north-eastern Ontario to flood stage. Among the municipalities which suffered significant damage were Timmins and Mountjoy. Three notable floods caused by severe local thunderstorms are those at Barrie on June 5 1890, Dundas, August 28-30, 1956, Collingwood, July 5 and 6, 1958. The most devastating flood due to a hurricane type storm in Ontario was "Hazel" October 1954, when 86 lives were lost. In August 1883 another storm of this type caused widespread flood damage from Lake Huron eastward to beyond the Toronto area. Rain-fall amounts in excess of 6 inches in 24 hours were recorded and several lives were lost. Many municipalities situated on the Great Lakes near the mouths of the rivers suffer flooding to some degree from ice jams. Severe flooding from this cause occurs frequently at Belleville, Port Hope, Dundas, Chatham and Fort William. Backwater from bridges, culverts and mill dams which have inadequate flow openings causes flooding in many other localities.

Analyses of flood problems require careful examination of all pertinent available data and field surveys followed with detailed computations. To provide needed data on flood levels and extent of damages incurred, accounts of floods dating back over 200 years are catalogued by the History Section of the Branch. From this catalogue it may be noted that for the year 1947 alone, which is one of the worst on record for Ontario, over 80 serious floods occurred on 54 of the Province's rivers. The Photography Section photographs flood situations and obtains copies of photos of earlier floods from local residents and newspapers, all of which are useful to arrive at a logical solution to the problem.

Since the inception of the Branch, its technical personnel have been dispatched to the scene of most major floods in the Province to observe, photograph, measure and report on conditions, peak stages and flows and prepare estimates of damages. In some instances aircraft have been engaged to obtain oblique and vertical photographs of the distressed area at or near the peak flood stage. Topographic maps of the watershed are examined for possible dam and reservoir sites and tributary areas are determined. Aerial photographs are examined stereoscopically and the extent of channel improvements, dikes or diversions, needed is estimated.

Additional control data are determined by detailed field surveys. The survey parties are usually composed of university students supervised and supplemented by technical personnel from the Branch. After completion of the field surveys much detailed analysis is required for the preparation of a comprehensive control plan and report.

For the design of flood control works, the volumes and rate of run-off causing particular flood situations are essential information. All run-off and stream flow originates from precipitation and all the physical characteristics of the drainage basin influence the amount of water which reaches the river channels. Gauging of stream flow in Ontario was started systematically in 1912 by the Ontario Hydro Electric Power Commission, but was later taken over by the Federal Government. These agencies were chiefly interested in hydro electric power development and gauges were only established on those rivers which showed significant power potential. Most of the rivers with which the Conservation Authorities are now concerned were not gauged. Where flow