

Comparison of Runoff from a Ski Resort and Adjacent Undeveloped Watershed in Northern Vermont

JON C. DENNER¹, JAMES B. SHANLEY¹, AND BEVERLEY WEMPLE²

ABSTRACT

The US Geological Survey, in cooperation with the State of Vermont, Agency of Natural Resources, Department of Forest Parks and Recreation, conducted an investigation of runoff characteristics of watersheds with contrasting land use. The study area includes West Branch Little River (11.84 km²) and Ranch Brook (9.84 km²), two adjacent catchments on the east slope of Mt Mansfield in the Green Mountains of northern Vermont. West Branch drains an entire ski resort, whereas Ranch Brook is nearly pristine forest. Ranch Brook therefore acts as a baseline reference area that will become increasingly important as planned ski-resort expansion and related development occur in the West Branch catchment. Stream gages were established at both sites in September 2000.

For the 2001 water year (October 2000 through September 2001), water yield was 790 mm for Ranch Brook and 1170 mm for West Branch. Some flow augmentation might be expected at West Branch from increased soil imperviousness, reduced evapotranspiration, slightly higher elevation, and enhanced snow capture in forest openings. However, this runoff differential is excessive, and is more likely a result of local orographic precipitation enhancement and/or snow redistribution than a result of the effects of development. Evidence to support this notion is demonstrated by storm hydrographs. The hydrograph shape and response time are nearly identical for both the natural and the developed watersheds. Also, the proportional flow differential between the two sites was persistent from month to month, except for the redistribution due to snowmaking.

The winter 2000–2001 had abundant natural snowfall, thus water withdrawals for snowmaking from West Branch were less than average. Nonetheless, snowmaking withdrawals had a marked influence on the seasonal distribution of flow. After snowmaking commenced in late fall, withdrawals increased the frequency and duration of low-flow periods at West Branch. At the same time, snowmaking augmented the existing snowpack, thereby storing water until the spring melt period. The snowmelt runoff from West Branch persisted for almost a month longer than the spring runoff observed at Ranch Brook.

¹ U.S. Geological Survey, Montpelier, Vermont 05601

² Department of Geography, University of Vermont, Burlington, Vermont 05405