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Assessment of the Effectiveness of the Israel River Ice Control Structure, Lancaster, NH

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**Cold Regions Research
and Engineering Laboratory**



Cover: Ice cover retained upstream of the ICS during the 24 March 2003 ice event.

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ABSTRACT

The Israel River in Lancaster, NH, has experienced numerous significant ice jams. In 1981 the New England Division of the U.S. Army Corps of Engineers completed an ice control structure (ICS) located about 0.5 miles upstream from the center of town. The 9-ft-high concrete-capped gabion weir was designed to retain both frazil ice during freezeup and broken ice after ice cover breakup. In recent years, the ICS has fallen into disrepair. The structure's current condition, combined with operation and maintenance safety issues and concerns about fish passage, have prompted the town to pursue the option of its removal. New England District Corps of Engineers, through the Corps' Wetlands Regulatory Assistance Program (WRAP), requested CRREL's assistance in determining whether the ICS has been effective in reducing the impacts of ice jams since its construction 24 years ago. Study results show that while the frequency of ice jam events in Lancaster has not decreased, the severity of ice jam flooding has, even though winter conditions at the time of the events have not lessened. The results of this preliminary analysis indicate that the Israel River ICS does provide some flood damage reduction benefit to the Town of Lancaster.

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CONVERSION FACTORS, NON-SI TO SI UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To obtain
degrees Fahrenheit	5/9	degrees Celsius or kelvins ¹
feet	0.3048	meters
miles (U.S. statute)	1.609347	kilometers
square miles	2,589,998	square meters

¹ To obtain Celsius (°C) temperature readings from Fahrenheit (°F) readings, use the following formula: $^{\circ}\text{C} = (5/9)(^{\circ}\text{F} - 32)$.

PREFACE

This report was prepared by Carrie M. Vuyovich, Research Hydraulic Engineer, Remote Sensing, GIS, and Water Resources Branch, and Dr. Kathleen D. White, Research Hydraulic Engineer, Environmental Sciences Branch, U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), Engineer Research and Development Center (ERDC), Hanover, New Hampshire. This work was prepared for the New England District, Army Corps of Engineers and funded under the U.S. Army Corps of Engineers Civil Wetlands Regulatory Assistance Program, managed by Robert L. Lazor, with additional support from the Flood and Coastal Storm Damage Reduction Research Program Work Unit *Ice-Affected Structures*. Technical reviews were provided by Andrew M. Tuthill, Research Hydraulic Engineer, Remote Sensing, GIS, and Water Resources Branch, and by Leonard J. Zabilansky, Civil Engineer, Engineering Resources Branch, CRREL.

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The Commander and Executive Director of the Engineer Research and Development Center is COL James R. Rowan. The Director is Dr. James R. Houston.

Assessment of the Effectiveness of the Israel River Ice Control Structure, Lancaster, NH

CARRIE M. VUYOVICH AND KATHLEEN D. WHITE

1 INTRODUCTION

The town of Lancaster, NH, has a long history of ice jams and ice jam flooding. In 1981 the Corps of Engineers built an ice control structure (ICS) in an attempt to alleviate the problem. Since that time no severe ice jam flooding has occurred. However, no studies have been done to determine to what extent, if any, the ICS is responsible for that success. Structural deterioration of the ICS and a desire to restore fish passage upstream from the ICS have resulted in a recommendation by the town to have the dam removed. The purpose of this study is to determine, within the budget constraints and based on existing data, whether the ICS has had any impact in reducing ice-affected floods in Lancaster. This study will not attempt to determine to what extent the ICS has reduced water surface elevations due to ice. For that, a more detailed hydraulic analysis is necessary.

2 ICE FORMATION

Ice formation in the Israel River is heavily influenced by the river's geomorphology and its location near the White Mountains of New Hampshire. The Israel River is approximately 21 miles long and has a drainage area of about 136 square miles at the confluence with the Connecticut River (White and Moore 2002). Elevations in the watershed range from about 5,715 ft at Mt. Jefferson to about 835 ft downstream of Lancaster. The river is generally shallow and relatively steep with a rough bed, until it reaches the mildly sloping reach that forms because of backwater from the confluence with the Connecticut River. The average channel slope for the basin is 0.03, though the average slope in the reach through Lancaster is about 0.0083 (Provan and Lorber, Inc. 2003). Where the Israel River flows into the Connecticut River, the average slope is about 0.0001. The backwater from the Connecticut extends approximately 7,900 ft up the Israel River to the location of the abandoned railroad abutments approximately 2,800 ft downstream from the Main Street Bridge in Lancaster. Figure 1 shows the profile of the Israel River.

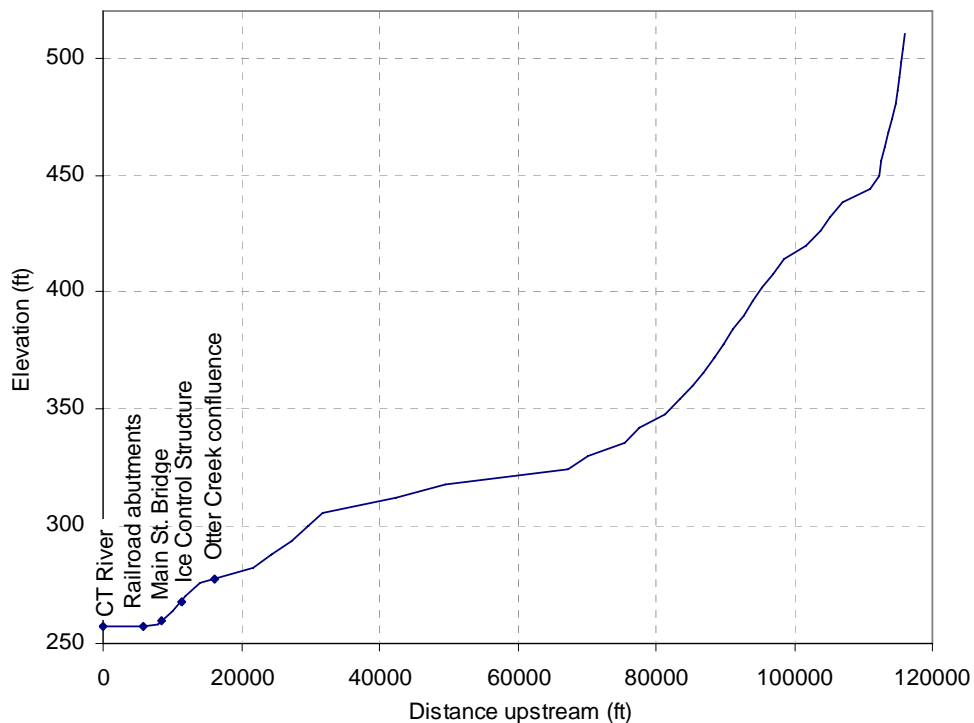


Figure 1. Israel River profile.