MEMO FOR RECORD
FROM: Andrew Tuthill
SUBJECT: Ice Conditions on the Pemigewasset, Kennebec, Sebasticook, Sandy and Androscoggin Rivers, 8-9 January 2004

Andy Tuthill inspected ice conditions by airplane on the above-mentioned rivers in NH and Maine on 8-9 January 2004. In addition to the aerial survey, Tuthill also met with Andy Straz of E-PRO Engineering and Bob Richter of FPL Energy in Augusta to discuss the Ft. Halifax Dam removal study and check ice conditions from the ground on the Kennebec and Sebasticook Rivers.

Introduction

The winter of 2003-2004 has been unusual in terms of ice. A wet fall led to well above average river flows that, combined with a three-week cold spell in early December, caused high frazil production and rapid ice cover formation. A thaw with rain on December 17-18, caused ice jams and floods at many locations including the Pemigewasset River at Plymouth NH, the Sandy River at Farmington, Maine, and the Androscoggin at the Canton, Rumford Center and Bethel, Maine[1]. Many of these jams froze in place until second major thaw with rain on Dec. 24-25 washed nearly all the ice out of the system, leaving open water at most locations. Greg Stewart of the USGS in Augusta reported that that a six-mile-long by 10-ft -thick jam remains on the Allagash River upstream of Allagash, ME, and a ten-mile-long jam is frozen in place on the St. John River, upstream of Dickey, ME. River flows remained above average through the bitter cold of Jan. 7-11, resulting in heavy frazil production and the rapid formation of ice covers and freezeup ice jams.

Pemigewasset River at Plymouth, NH

A freezeup ice jam had formed in the wide shallow reach downstream of the Plymouth-Holderness Bridge. Breakup ice jams, such as the one on Dec. 17-18, 2003, also form at this location. A frazil ice accumulation also filled the reach upstream of the bridge.

Fig. 1. Pemigewasset River at Plymouth NH.

[1].Daly and Tuthill trip report of Dec 18, 2003, Tuthill, aerial reconnaissance of Dec. 19, 2003.

Kennebec River, Richmond to Skowhegan

Downstream of Augusta, the tidal portion of the Kennebec conveyed large frazil pans, some over 50 ft in diameter. A more or less open channel still extended downstream past Swan Island to Merrymeeting Bay (Fig. 2), Surface ice concentrations were as high as 70% in bends and narrower sections (Fig. 3). Ice transport was aided by strong northwesterly surface winds that were gusting up to 30 knots while surface air temperatures were below 0ºF.

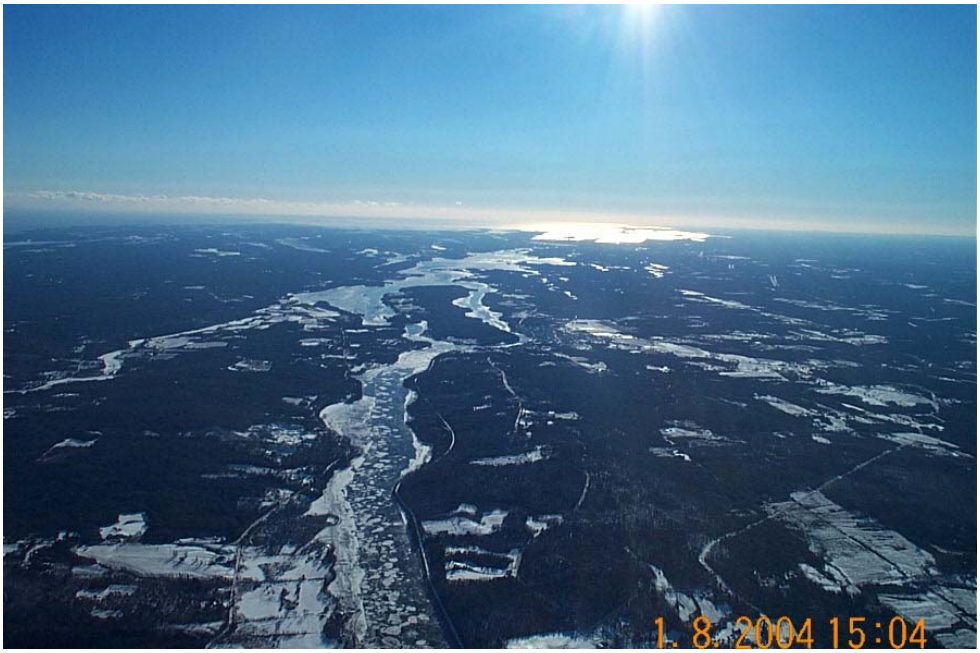

Fig. 2. Frazil pans moving down the Kennebec River towards Swan Island.

Fig. 3. Concentrated frazil pans moving past Sidney.

At Augusta, at 3:00PM, a freezeup ice jam was actively shoving its way down the western half of the channel with its upstream end located near the railroad bridge (Fig. 4). By the following morning (Jan. 9th), the jam had frozen in place and the head had moved upstream as far as the former Edwards Dam site. Several thousand feet upstream of here, a second ice cover had formed behind the piers of the new highway bridge under construction. This accumulation had cut off the frazil ice supply to the Augusta jam below (Fig. 5). Fig. 6 shows the Augusta jam downstream of the Father Curran Bridge on the evening of Jan. 8th, with ice rubble shoving its way down the eastern side of the channel. Ice pieces were 2-4 inches-thick, and the accumulation thickness appeared to be about 2 ft.

Fig. 4. Augusta ice jam actively forming on the afternoon of Jan. 8, 2004

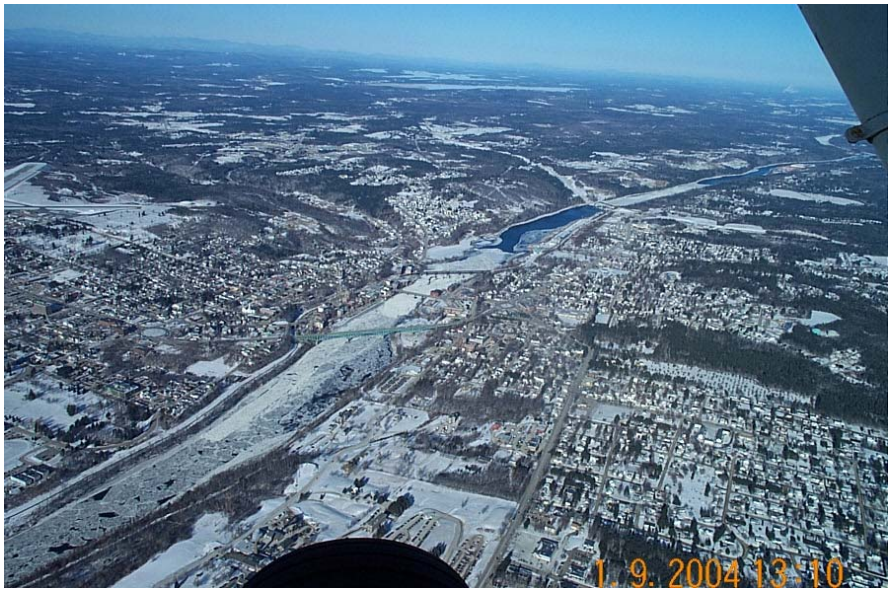

Fig. 5. Augusta jam frozen in place the following day. Note the second ice accumulation upstream of the new highway bridge.

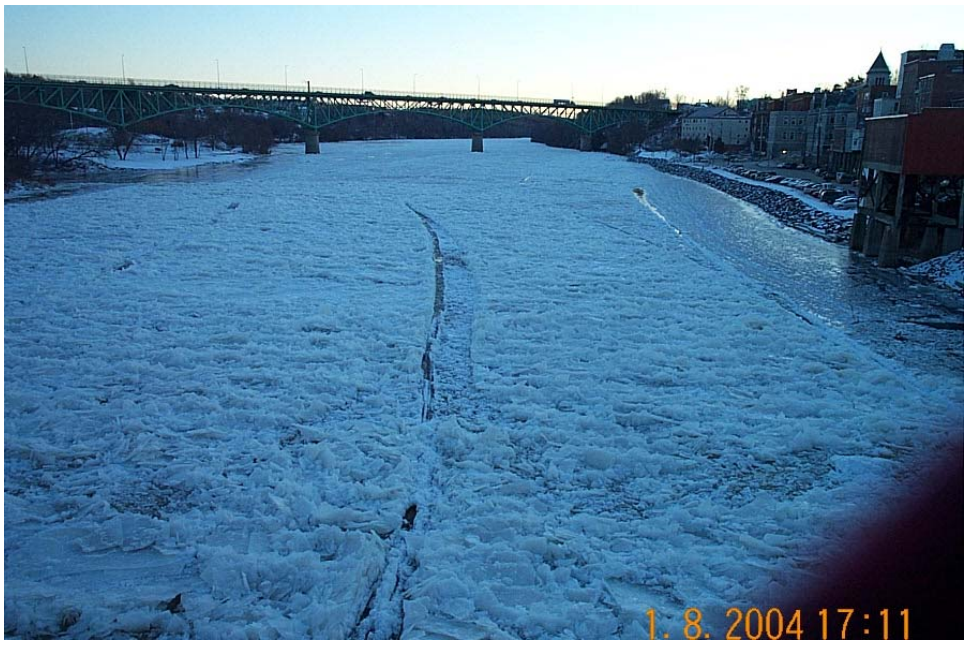

Fig. 6 Augusta jam viewed from the Father Curran Bridge looking downstream. At this time, the ice rubble in the left-hand half of the channel was shoving its way downstream.

About 5 miles upstream of Augusta, on the afternoon of Jan. 8th, the ice was slowing at channel constriction near Seven-Mile Island. Just below this point is a fast section where the river bends sharply to the right and passes a row of rock-filled timber cribs. By the next day, the ice had jammed here creating a 2-mile long frazil ice cover that extended upstream past Sydney (Figs. 7&8).

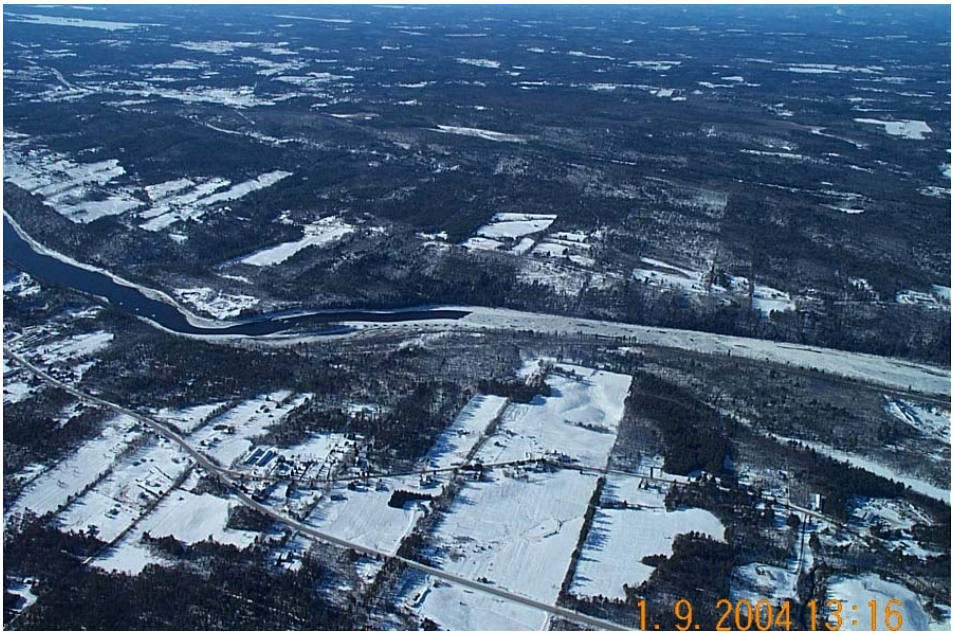

Fig. 7. Freezeup ice accumulation at Seven Mile Island.

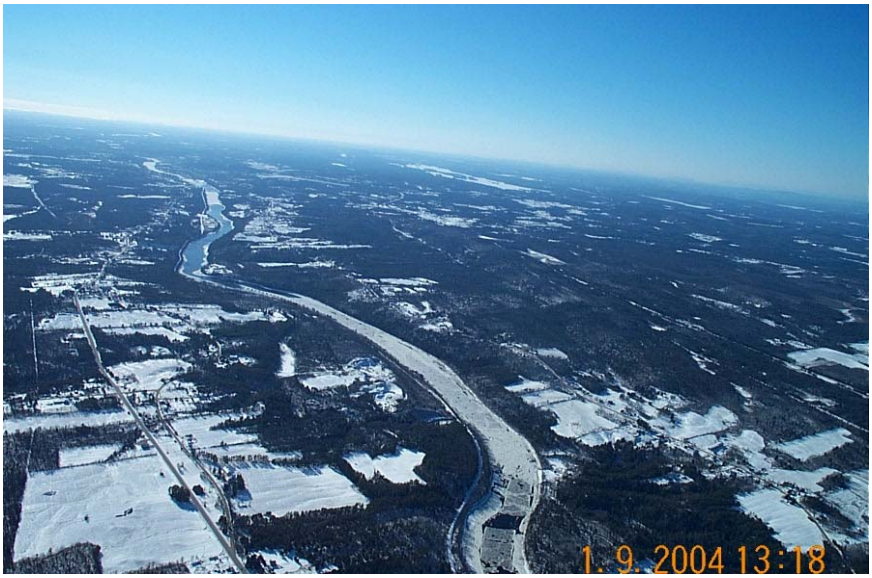

Fig. 8. View of the he Seven Mile Island ice cover looking downstream.

From Waterville to the head of the Seven Mile Island ice cover, the Kennebec was open and carrying frazil that increased in concentration in the downstream direction. Above the second dam at Waterville, black sheet ice covered the Kennebec for several miles, cutting off the downstrean frazil ice supply. From Fairfield up to the third dam at Shawmut, the Kennebec was again open.

Sebasticook River, Winslow to Clinton

Black sheet ice also covered the Sebasticook for about 1 mile, from Fort. Halifax Dam up to the confluence of Outlet Stream (Fig. 9). This thermally-grown ice, which had formed since the thaw of Dec.24-25 was measured at 4-inches. The bordering snow covered sheet ice, which had survived both the meltouts of 17-18 and 24-25 Dec., was about 8-inches-thick.

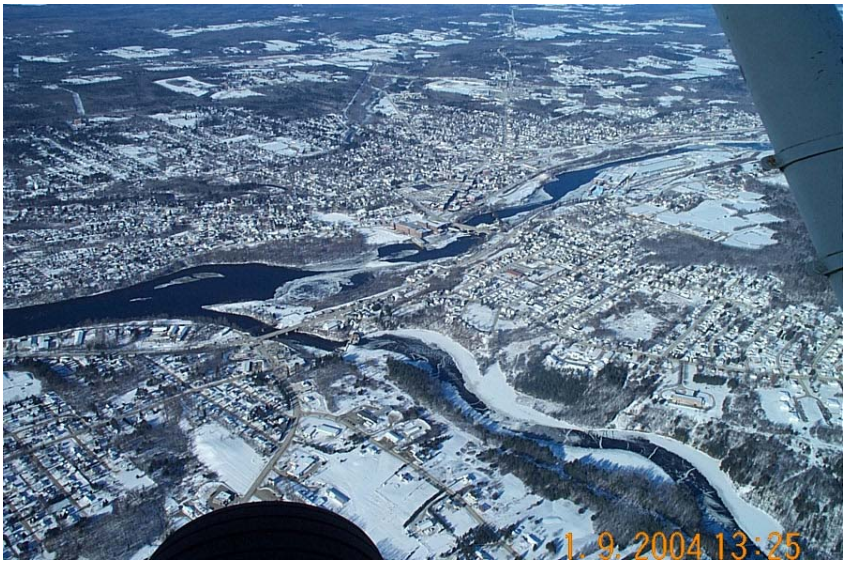

Fig. 9. Kennebec and Sebasticook Rivers at Waterville and Winslow.

The snow-covered sheet ice extended to within about 1.5 miles of Benton Dam (Fig.10). The first half-mile below the dam was fast flowing and open. Slightly shoved frazil floes made up the upper-most several thousand feet of the ice cover. The frazil then graded into thermally-grown

black sheet ice similar to the ice cover near the Ft. Halifax Dam. Fig. 11 shows the frazil ice cover from Garland Road, the near the mouth of Pattie Pond Brook. The ice was too thin to measure thickness at this time.

Fig. 10. Upper end of Fort Halifax Dam Pool at Benton, showing the frazil ice cover grading into thermally-grown sheet ice.

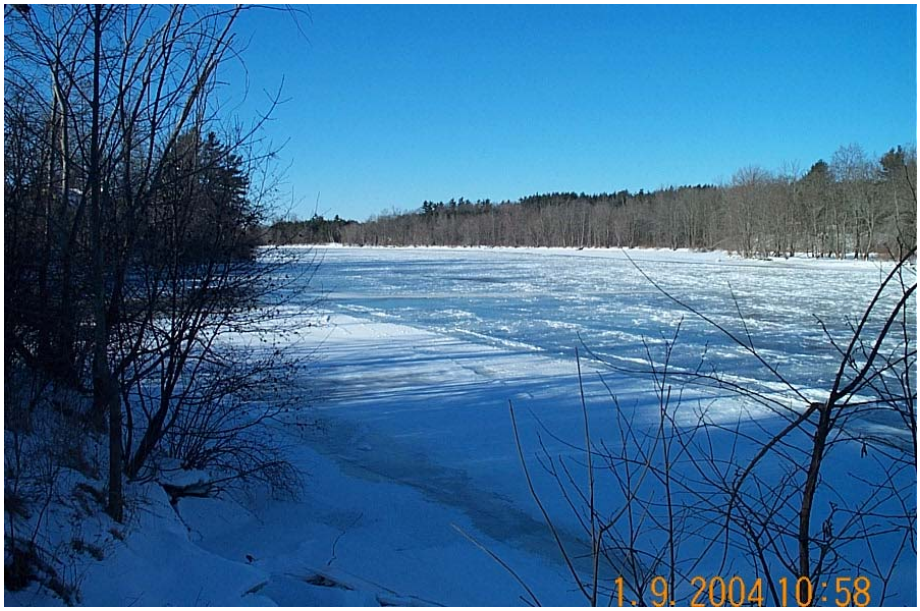

Fig. 11. Frazil ice cover at upstream end of Fort Dam Halifax Pool at Benton.

Sandy River at Farmington

The frozen-in ice jams that were observed on Dec. 19 on the Sandy River, upstream and downstream of Farmington[2] had melted out, most likely during the 24-25 Dec. thaw. This is good since these jams might have obstructed breakup ice runs later on, increasing the chance of ice jam flooding.

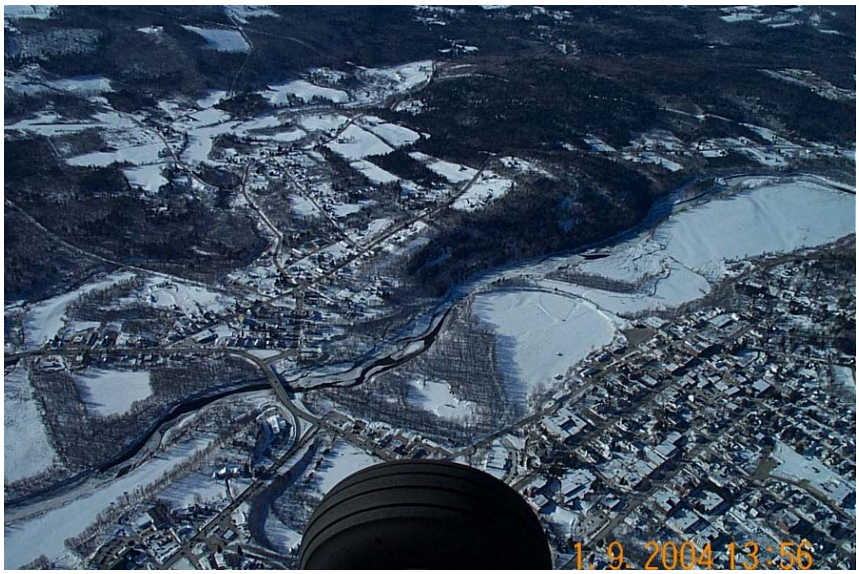

Fig. 12. Sandy River at Farmington.

Androscoggin Rive,r Canton, ME to Gorham, NH

The Androscoggin River From Jay, ME to Gorham, NH was over half ice-covered, mostly in frazil ice accumulations of varying roughness and thickness. A frazil accumulation had formed in the bend below Canton along Stevens Island, the site of the Dec.18th breakup ice jam (Fig. 13).

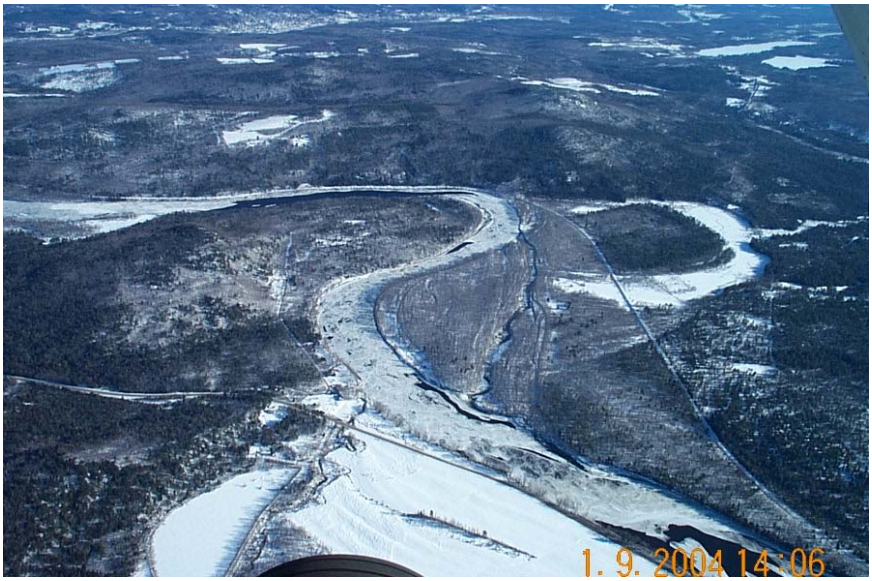

Fig. 13. Freezeup ice accumulation on Androscoggin River downstream of Canton, ME.

[2] Tuthill, aerial reconnaissance of Dec. 19, 2003.

The sheet ice cover on the pool upstream of the mills at Rumford had survived both of the December thaws, and remnants of the breakup ice jam at the head of pool at Rumford Center could still be seen.

The Dec. 17-18 jams that had frozen in place at Bethel (Fig. 14) appeared to have melted out during the 24-24 Dec. thaw. Since then, a frazil ice accumulation had formed upstream of town near the airport (Fig. 15).

Fig. 14. Breakup ice jams on the Androscoggin at Bethel, frozen in place.

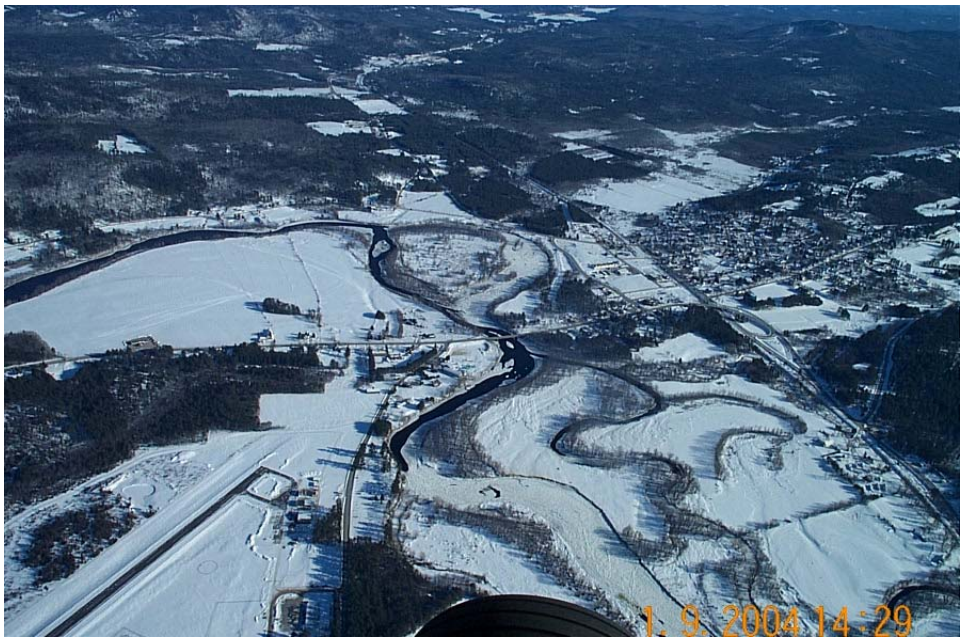

Fig. 15. Frazil ice accumulation upstream of Bethel on Jan. 9, 2004.

From about 4 miles upstream of Bethel to Gorham, NH, the Androscoggin was mostly open and carrying high concentrations of frazil, as seen in Fig. 16. The Wild and Peabody rivers were choked with anchor ice. and contributing little or no frazil to the Androscoggin.

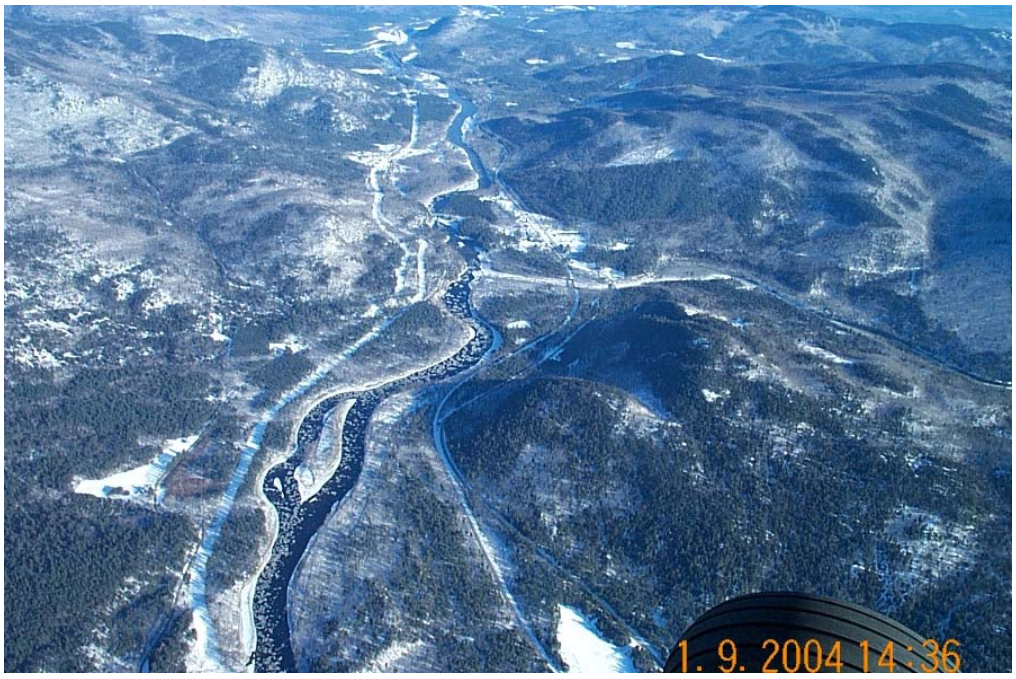

Fig. 16. Androscoggin River at Gilead, ME, looking downstream.

Conclusions

The large areas of open water combined with the bitter cold of Jan 7-9, provided a good opportunity to observe the formation of frazil ice covers and jams on northern New England rivers.

An example is the freezeup jam observed on the Pemigewasset River, downstream of the Plymouth-Holderness Bridge. This ice accumulation likely obstructs the passage of the breakup ice run in this reach.

At least this winter, the frazil ice supply to the Augusta freezeup ice jam on the Kennebec River is limited by the formation of two upstream frazil ice covers, the first at the new highway bridge and the second at Seven Mile Island. It will be interesting to see if breakup ice run also stalls at these two locations.

The freezeup ice cover behind the Fort Halifax Dam is extremely stable, having, for the most part, survived both December thaws and the associated high flows on the Sebasticook. At present, only half a mile of open water exists below the Benton Dam

A 2-mile-long sheet ice cover behind the second Waterville dam on the Kennebec, and the ice cover on the Sebasticook above the Ft. Halifax Dam retain all frazil ice produced upstream of these locations.

The 17-18 Dec. breakup ice jams on the Sandy River at Farmington and the Androscoggin River at Canton and Bethel melted out during the 24-25 December thaw. This reduces the threat of breakup ice jam flooding at these locations later in the winter and early spring.

Respectfully Submitted,

Andrew M. Tuthill, P. E.
Ice Engineering Group
Remote Sensing/ GIS Branch
US Army Engineer Research and Development Center
Cold Regions Research and Engineering Laboratory
72 Lyme Rd.
Hanover, NH 03755

603-646-4225 phone 4477 fax