

MEMORANDUM FOR Jim Ruyak, CO-MH

SUBJECT: Potential Ice Problems due to High Lake Levels,
Mississippi Headwaters Reservoirs

1. This memorandum provides additional information as requested regarding what could be done to alleviate damage to property due to ice action this coming winter season when the lake levels on the headwaters reservoirs are 1 to 2 feet above seasonal averages.

2. With the above average lake levels, it is anticipated that water will be standing in places that are otherwise dry. These areas would be susceptible to damages due to ice expansion during initial freeze-up. Ice has an expansion coefficient five times that of steel, and ice in the 8 to 12 inch range can be aggressively active. Any structures in such areas could expect to be damaged during the late fall to early winter season. It would be prudent to move such structures if at all possible.

3. The most serious threat to property and shoreline comes in the spring when portions of the lake become open water and the ice cover is still mostly intact and quite competent. During the spring ice out period, winds are predominately from the northwest and then can switch to the southwest during the later part of the melt period. A wind generated ice push occurs more often on wide lakes or large lakes with open water fetches greater than 2.5 miles. Ice piling and shoving can occur with wind speeds less than 15 miles-per-hour. Shorelines exposed to such conditions would be at risk to an ice push. The best guide to potential damage areas is to identify those areas which experienced damage in previous years.

4. Based on experience, a literature review, input from technical colleagues on the Corps Ice Engineering Field Review Group, conversations with Dr. J.C. Tatinclaux at Cold Regions Research and Engineering Laboratory, (CRREL) and Professor Al Wortley at the University of Wisconsin. there are a couple ice damage mitigation techniques that may be of value.

5. Permanent docks:

"To protect against ice damages from ice uplift, one might consider keeping the water level high during freezeup, and try to drop the water level in mid to late winter so that when spring runoff (rain or snow melt) occurs the ice is not lifted much above its initial freezeup level and does not pull the marina piles up with it. I would not think that there are large water level fluctuations in the reservoirs due to wind action, especially if the reservoir freezes completely over and there is no open water areas."
.... J.C. Tatinclaux

Professor Wortley suggest the use of a bubbler system using compressed air to keep a small zone of open water around the dock piles, thereby preventing pile uplift due to jacking. Sketches of a bubbler system are provided with this memorandum. Details on bubbler systems should be addressed to CRREL at 603-646-4100. In some areas, permits may be needed to install and operate bubbler systems due to safety concerns. Bubbler systems are very effective in preventing pile jacking.

A few years back, CRREL published a pamphlet entitled "Designing Small Boat Harbors For Ice Conditions". The pamphlet is now out of print. However I am sending you a copy plus 20 reprints for general distribution.

6. Harbors and Shoreline:

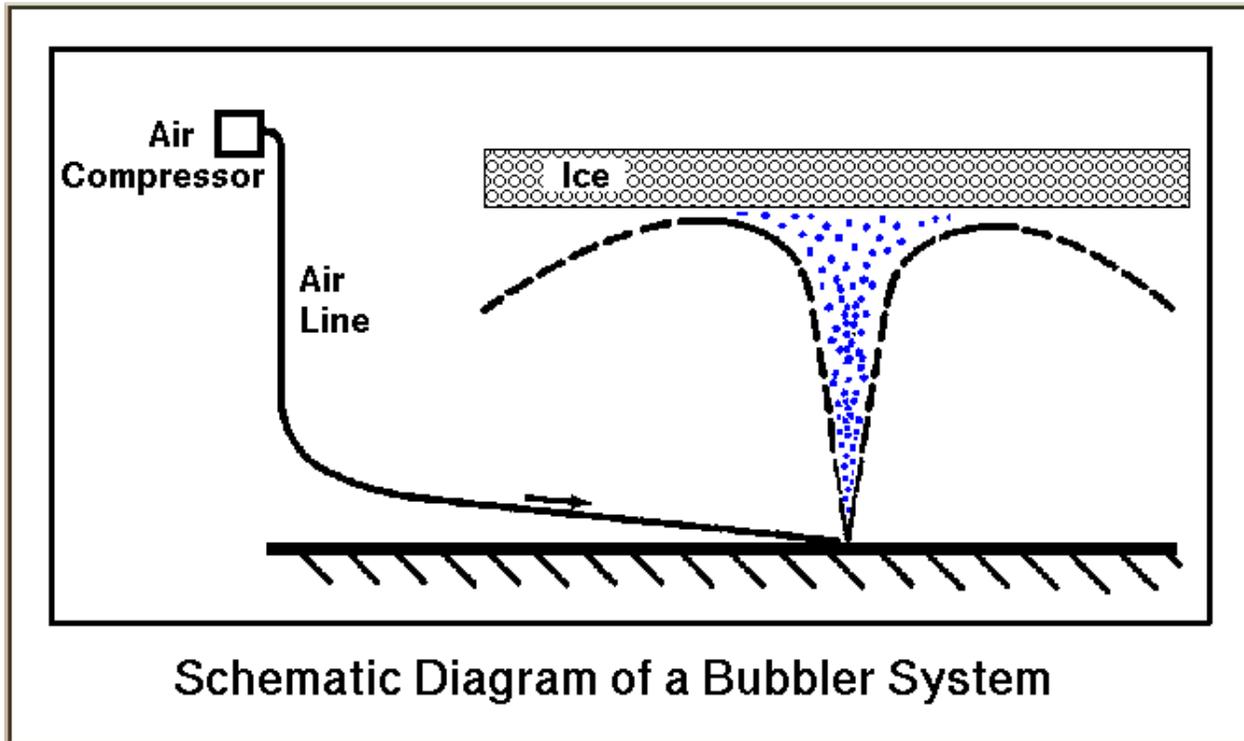
"To protect against damage to marinas and bank protection due to possible ice thermal expansion in case of a rapid increase in temperature (and also help against rising water level and ice uplift), it is advisable to cut a trench in the ice sheet offshore from the area to be protected using a ditch witch or similar trencher. The cut should extend only 75 to 80% of the ice thickness to avoid refreezing. trenching should be done two to three weeks before the expected onset of warmer weather also to avoid refreezing. This cut will provide a line of weakness in the ice where it will break more easily and minimize damage to the structure closer to shore. If a trencher is not available, then a line of holes may be substituted, drilled with a 4 or 6" auger. A thin layer of dark material, sand, coal dust, or ashes, can also be spread to increase solar energy absorption and melting/weakening of the ice. Again, this should be done late enough in winter when the likelihood of a snow fall is low, but early enough for the sun to do its part."
J.C. Tatinclaux

7. It is also recommended that areas of concern be monitored during the winter and early spring season. Photographs and/or video imagery taken in these areas before, during, and after freeze-up could provide valuable documentation.

8. A summary sheet suitable for public distribution is provided as an attachment. If there is any additional support you or anyone else requires on this subject, please feel free to call me at 651-290-5640 or via email to:

Encl: Bubbler Schematic
Summary Sheet

RICHARD POMERLEAU, P.E.
Senior Hydraulic Engineer



Mississippi Headwaters Lake Ice Damage Mitigation

- Keep the water level high during freeze-up, then drop the water level in mid to late winter to generate offshore fractures.
- Identify areas where damage has historically occurred and consider mitigation measures in these areas first.
- Install a bubbler system at permanent docks. Be sure to check on any permitting requirements.

- In late winter, about 2 to 3 weeks before the onset of warm weather, use a trencher to cut a trench in the ice offshore. Choose a distance where dropoffs are located, or a reasonable distance for that location. The trench should be 75-80% of the ice thickness. If a trencher is unavailable, a line of holes drilled with a 4 to 6-inch auger may be used.
 - Document potential damage areas before, during, and after the ice season.
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