

## **Water Levels of Ponds in the Pemaquid River Watershed:**

### **The Issue, Factors, Assessment, and Pemaquid Watershed Association's Role**

Compiled by Donna Minnis, PWA Executive Director

#### **The Issue of Pond Water Levels**

For pondside property owners in the Pemaquid River watershed, the water level of ponds has been a prominent seasonal issue for decades. The problem takes one of three forms depending on the experiences of the property owner: the pond water level is judged as too low, too high, or is fluctuating too greatly. The problem that is experienced can vary annually as well as within a single summer season.

The primary impacts of concern are (1) how a pond's water level is affecting the use of their dock, (2) how the water level is affecting the usable area of beach on their property, (3) how the water level is affecting the shoreline in terms of erosion, and, (4) often in conjunction with #3, how the water level is affecting loon nests. Other concerns related to high water levels that have been reported to PWA over the years include: impact of runoff from flooded roads on water quality (e.g., Turner Road and McCurdy Pond); flooding of gardens and yards and the impact on domestic animals present; hindered access to structures due to flooding; and potential acceleration of septic system leaching.

Pemaquid Watershed Association's mission is to conserve the natural resources of the Pemaquid Peninsula through land and water stewardship and education. In dutiful allegiance to its mission, water level is a concern to PWA when it threatens the quality of the land, water, or wildlife. In particular, persistent high pond and river water levels that accelerate shoreline erosion are a major concern to PWA because erosion carries sediment and pollutants into the open water. Water levels, whether too high or too low, that cause undesirable impacts on fish and wildlife habitat are also a major concern to PWA.

#### **Factors**

Basically, the water level of a pond depends on the amount and rate of input and the output of water. The primary factors that influence a pond's water level include:

1. Amount and intensity of precipitation
2. The pond's catchment basin (aka "watershed")
3. Amount of wetlands to hold and release water
4. Rate of flow of water out of the pond
5. The elevation of the pond outlet

The challenge in understanding the cause of changes in pondwater level is that these five factors -- as well as others (e.g., evaporation rate, drawdown for residential uses) -- are interrelated as part of a whole system. Quantifying the precise impact of any one factor is complex and would require many assumptions.

## ***Precipitation***

Clearly, how much water falls on the land is an important piece of the puzzle. If all other factors are held constant, there is a direct correlation between the amount and intensity of precipitation and the level of a pond's water. In July 2014, there were 7.13 inches of rainfall; the average for July over the past 5 years was 4.45 inches<sup>1</sup>. Extreme precipitation events add a high volume of water in a short amount of time. This intensity of rainfall tends to cause the outlet of the ponds to back up with water.

## ***The Pond's Watershed***

The land area that catches rainfall and directs it into a pond plays an important part in the water input to the pond. Two key watershed characteristics are how big it is and its composition as it affects runoff.

### **Watershed Size<sup>2</sup>:**

Increased rainfall has a pronounced effect on the water level of ponds with large watersheds by the very nature that a larger watershed means a larger catchment basin shedding water into the pond. The ponds in the Pemaquid River watershed are all connected. Duckpuddle Pond is at the head of the watershed with a direct drainage catchment of 8.5 sq. mi. This flows into Pemaquid Pond, along with water from Paradise "Muddy" Pond's watershed (1.3 sq. mi.) and McCurdy Pond's watershed (1.1 sq. mi.). Adding these three pond watersheds to Pemaquid Pond's direct drainage catchment of 11.5 sq. mi. gives Pemaquid Pond a total watershed of 22.5 sq. mi. This in turn flows into Biscay Pond and is added to its direct drainage catchment of 8.7 sq. miles. This total of 30.8 sq. mi. flows out through the Bristol Mills dam. The total watershed at the outlet of Pemaquid River in Pemaquid Harbor is 47 sq. mi.

### **Extent of Impervious Surface:**

Impervious surfaces that result from development (e.g., pavement and roofs) cause rain to runoff as stormwater instead of soaking



The Pemaquid River system of interlinking ponds, with the 47 sq. mi. Pemaquid River watershed outlined in yellow. Within this larger watershed, each pond has its own watershed.

<sup>1</sup> NOAA Gray, ME

<sup>2</sup> Data on watershed size compiled by Peter Newkirk, Maine DEP, based on GIS data, 8/5/14.

into the ground and vegetation. The stormwater eventually enters nearby water bodies. The percent of a pond's watershed covered by impervious surface area has a direct correlation to the amount and velocity of water entering a pond.

### ***Wetlands***

Wetlands act like sponges and release water slowly either overland through streams or through shallow groundwater flow, thereby retaining higher water levels in the open water (e.g., ponds). Having more wetlands attribute to higher base flows that take a longer to drain out. A watershed that has no wetlands to hold and slowly release water will vary abruptly. When there are a lot of wetlands, water is released slowly and more consistently. Saturated wetlands can hold a store of water over years and can contribute to keeping pondwater levels higher relative to a watershed without wetlands.

In Maine, 6.7% of the land area is wetland. Throughout the Midcoast Maine area, the percent of wetland is higher because of the bedrock and surficial geology (i.e., lots of nooks and crannies for water to be held in). Thus, relatively speaking, the 47 square miles of land that drains into the Pemaquid River has a high proportion of wetlands. Approximately 22% of the Pemaquid River watershed is wetland, and 12% is open water.

### ***Rate of Flow Out of the Pond***

How fast water flows out of a pond depends in part on physical limiting factors, notably any constraints at the outlet. In the case of the Pemaquid River system, the two main flow limiting factors are narrow water corridors and the Bristol Mills dam.

#### **Narrow Water Corridors:**

Two sites of potential low constraint in the Pemaquid River system are the connecting water corridors between Pemaquid Pond and Biscay Pond and between Biscay Pond and the Pemaquid River's riverine portion south of Biscay Pond. If water flow is blocked at these segments due to vegetative encroachment, sediment build-up, or beaver dams, then flow rate can be hindered. Overall, high pond water levels are not likely a sediment issue at the two narrow water corridors because sediment would not flow to the outlets of the pond but rather settle closer to its shoreline origin. Nevertheless, it is important to keep an eye on the water corridors for emergence of obstructions.

#### **Bristol Mills Dam<sup>i</sup>:**

The dam at the swimming hole in Bristol Mills affects water levels upriver. Three removable flashboards function to regulate the flow of water over the dam. Bristol Selectmen govern the regulation of the dam. The Town of Bristol's primary interests when it comes to the dam are to provide water flow for alewives to swim upriver in the spring, to provide an adequate and safe swimming hole in summer, and to provide a water supply for the fire department.<sup>3</sup>

### ***Elevation of Pond Outlet***

The elevation of water at the Bristol Mills dam, in Biscay Pond, and in Pemaquid Pond is the same during high flow (78.3 ft +/- 6 in)<sup>4</sup>. When flow through is base flow (not subject to high runoff after a storm), the lip of the spillway at the dam will control the elevation of the water up

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<sup>3</sup> Kristine Poland, Bristol Town Administrator, 8/6/14.

<sup>4</sup> Based on LIDAR data evaluated by Peter Newkirk, Maine DEP.

through the ponds. Raising the outlet elevation at the dam will keep the upriver ponds at a set depth such that, even if it has not rained in ages, the water will be held at that elevation; if one additional flashboard that is 6 inches is added, it will raise the base elevation of all the ponds by a comparable elevation, presuming all other factors are held relatively constant. Removing 6 inches of flashboard will set the base flow elevation of the water in both Biscay and Pemaquid Ponds down that 6 inches, again presuming that all other factors are held relatively constant.

## **Situation Assessment**

In the fall of 2013, at the request of PWA, an expert on river systems<sup>ii</sup> at the Maine Department of Environmental Protection evaluated the Pemaquid River system in terms of water flow as it relates to pond water levels. He found no historical reports on the river's flow, but he did review the watershed hydrology, topography, and land use using Geographic Information Systems. He also referenced information from the weather stations in Waldoboro and New Harbor. His conclusion was that if the dam spillway elevation has not changed in recent years, then the high water levels being experienced were probably due to higher than usual rainfall. He also cited the relatively high percentage of wetlands in the Pemaquid River watershed as a contributing factor.

## **Addressing the Problems**

### Private Property Uses:

Landowners experiencing a problem with using their dock or beach due to pondwater levels may consider contacting the Bristol Selectmen to encourage them to regulate the water flow over the dam to help alleviate the problem. The main contact for the dam is Bristol Selectman Chad Hanna, who can be reached at (207) 315-5116. Given the confluence of factors involved (as described in this document), there is no guarantee that this action will provide relief to the landowner.

### Shoreline Erosion:

PWA is working to document and mitigate shoreline erosion and to educate relevant parties about the issue of pondwater levels. PWA is compiling a list of observed changes in pondwater levels as anecdotally reported by pondside residents. PWA also has begun a mapping effort to document shoreline erosion that is being attributed to high water levels.

Landowners who are concerned about shoreline erosion on their property may receive free technical advice from PWA via the LakeSmart Program. A trained volunteer can evaluate the shoreland area of concern and recommend practices that landowners can take to reduce or prevent erosion and stabilize the bank. Contact PWA at (207) 563-2196 to learn more about the LakeSmart Program.

PWA has compiled this summary document on the issue to share with concerned citizens, and PWA also has shared and will continue to share information about the issue with the Bristol Selectmen.

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<sup>i</sup> The dam at the swimming hole in Bristol Mills is the youngest and only remaining dam on the Pemaquid River Watershed. Built in 1917, it was constructed to provide water for the hydroelectric plant. Eventually the power company gave the dam to the Town of Bristol. In 1994, extensive work was performed to restore the dam and remove the original penstock.

<sup>ii</sup> Peter Newkirk, Senior Environmental Engineer, Maine Department of Environmental Protection, Bureau of Land and Water Quality, Division of Environmental Assessment. (207) 592-1804