Summary of Pond Conditions and Causes
The Bay Meadow Cottages – June 2023

The Hydrogeologic Setting of the Ponds

The area surficial geology consists of dune sands (*Quarternary Geology of Michigan. 1998. Michigan Department of Natural Resources*) down to a depth to approximately 35 ft. Available water well logs closest to BMC, on James St and Quincy, indicate glacial deposits of varying thicknesses of clay and sand and gravel below the dune sand unit.

A shallow unconfined aquifer is generally present in this upper dune sand unit, with the water table elevation occurring approximately 10 -15 ft below ground surface. Groundwater is this shallow aquifer is hydraulically connected with area surface waters including Pine Creek and Lake Macatawa. As such, the surface elevation of this aquifer (water table elevation) rises and falls with the normal seasonal variations of the local surface water bodies. One of several pond studies commissioned by Bosgraaf Enterprises, or the Bay Meadows Cottages Association (see the accompanying Oct 2020 letter for list of the studies and conclusions reached) included a one-time measurement of water table elevations on the BMC site. The data indicated that ground water flows from NW to SE where it vents to Pine Creek and the associated wetlands, which in turn discharge to Lake Macatawa.

The ponds were designed and excavated to extend below the average local water table level in the upper dune sand unit. The installation of these ponds is analogous to digging a hole at a Lake Michigan beach deep enough to reach ground water. The water is the hole is at the same level as the lake and because of the porous nature of the sand any water that is added or withdrawn from the hole results in a very temporary change in the level of the water in the hole. The water level quickly recovers to the lake level via the exfiltration or infiltration of groundwater through the porous sand.

Installation Intent and Early History

The ponds were excavated during the first stages of development at Bay Meadows to meet the requirements for storm water detention during significant precipitation events and to serve as an aesthetic enhancement around which to locate the units. They have been designated as Ponds 1 – 6 (fig 1) and were designed to mirror ground water flow, i.e., NW to SE with flow in the ponds moving from Pond 1 sequentially to Pond 6 which outlets to Pine Creek. During 1995, a particularly dry period caused a noticeable decline in pond water levels. In response to residents concerns, the developer installed several wells intending to augment the water level elevation in the ponds. Operation of the wells proved

problematic for several reasons; the well water had heavy concentrations of dissolved iron causing the water in the ponds to turn brown, constant pumping resulted in bacterial fouling of the well screens, the utility expense of running the pumps was impractical and any increase in water level was quickly lost when the pumps were turned off (see preceding beach hole analogy).

The ongoing concerns resulted in six separate evaluations of the ponds and resulting recommendations. The evaluations essentially concurred that to temporarily control the water levels in the ponds, that they be dewatered and the bottoms lined with impermeable material, or that pumping wells be used to augment natural water supply. Please refer to the attached Oct 2020 letter for a more detailed explanation why neither of these "recommendations" are practical to implement or sustain.

Pond Evolution

Since the initial installation and the subsequent completion of the BMC development, the ponds have changed in unique ways depending on where they are situated in the natural flow from upstream to downstream and due to their individual settings in the development. While all of them have likely become somewhat shallower as pre-landscaping erosion caused some in-filling and organic matter continues to settle on the bottoms. Ponds 5 and 6 have undergone the greatest changes. This is due to their downstream locations causing material from the upstream ponds to accumulate in these ponds, and because they have the greatest in-fall of organic material, e.g. seasonal leaf fall from the overhanging trees.

Recent and Current Pond Maintenance Efforts

During the summers of 2020 and 2021 BMC contracted with the "Muck Men" to hydro-excavate the accumulated decayed organic material from Pond 5 and selected areas of Pond 6 in the attempt to restore some of the original depth in these Ponds. Ponds 5 and 6 were selected (as opposed to 1-4) for dredging because they had suffered the most degradation and the contractor was able to pump the discharged slurry (muck and water) onto the BMC property east of Pond 6, the low wooded area known as the Preserve.

The BMC board has considered dredging or excavating all of the Ponds but the logistics of access to the Ponds by heavy equipment and the cost of disposing of the excavated materials are prohibitive. Resident volunteers have spent countless hours bottom-raking along the western edges of Pond 6 with a specialized rake to remove a significant amount of the accumulated organic material.

Evergreen Landscaping, the BMC lawn maintenance contractor, uses low phosphorous fertilizers and maintains a natural barrier around the ponds when mowing to minimize artificial nutrients from entering the ponds, which would increase the rate of algae growth.

The BMC board has continued to contract with Pond and Lake Management Corp (PLM) to regularly treat the ponds for algae growth and prevent the ponds from being overtaken by wetland plants like cattails and phragmites. PLM has recently recommended the treatment of phragmites wait until the fall when the herbicide is most effective.

Seasonal and Climate Influences on Pond Conditions

Given the hydrogeolic setting of the ponds, the water levels and circulation are totally dependent on the localized occurrence and quantity of precipitation which determines recharge to the shallow unconfined aquifer in which the Ponds are situated. A wet spring, as we experienced this year until early April, resulted in sufficient recharge that the water levels in the ponds were noticeably higher and the flow-through from Pond 1 to 6 was increased. This early "flushing" cleared the water. However, for the period from April 6 to June 18, western Michigan is in a precipitation deficit of approximately 8" from historic averages. The current condition is not likely to improve this summer unless we get an unusual amount of precipitation during July and August. Typically, the water table will be recharged by the increase fall and winter precipitation.

Climatological trends also can affect pond health, for example milder winters, such as 2022/2023, with fewer ice covered days and snow accumulation allow more light to penetrate the water column and allow algae to continue to remain viable through the winter resulting in the earliest algae bloom in 20 yrs, as reported by PLM staff.

Attachment

October 19, 2020

To: Bay Meadows Cottages Association Co-Owners
Regarding Question: To use well water to maintain pond water levels during dry summers
Response: From Dick Schaap and Scott Siakel

Dry summers and low pond water levels are not a new problem. The history of this problem goes back to the original construction of the ponds and was initially addressed beginning in the mid 1990's. The ponds were constructed based on the surrounding water table. When the water table drops during dry summer months, the pond water levels drop. The ponds are shallow, so the problem is more severe. The water table rises during the wetter months, and pond water levels rise in step with the surrounding water table. Rain water and melting snow provide the water for the ponds and for the water table.

Bay Meadows Inc. and later, the Association hired the following firms and invited a Hope College class to recommend solutions to the problems of low water and increased algae and aquatic weed growth during summer dry spells.

- Fishbeck, Thompson, Carr & Huber – September, 1995 and November, 1995
- Price and Company, Inc. – September, 1995
- Exxel Engineering – October, 1995
- J F New, Inc. – July, 2003
- Class Study Project: Graham F. Peasley, Associate Professor of Chemistry and Environmental Science with students from Hope College – July, 2003
- PLM Lake & Land Management Corp. – July, 2003

The collective findings and response to seasonal low water levels by the firms and Hope College Science class are listed below.

1. Pond water levels represent the local groundwater surface elevation. Due to the permeable dune sands, the groundwater level will fluctuate seasonally, and the pond water levels will fluctuate in tandem with the groundwater levels. Wet periods, normally fall, winter, and spring, would keep the ground water levels stable or slightly above normal. Dry periods, normally summer, would see pond levels go lower as the surrounding water table dropped lower. Ground water levels are greatly affected by the amount of rainfall, especially in areas of sandy soil.
2. Two remedies to control low water levels were suggested in the findings.
   A. Drill wells to pump water into the ponds when water levels drop lower in the summer.
   B. Put a liner into the bottom of the ponds, so that water doesn't seep out into the sandy soil.
3. When it became evident that the ponds were not able to hold a steady level of water, three wells were installed by the Bosgraaf Group of Bay Meadows Inc., the developer of Bay Meadows Cottages. When Bay Meadows Inc. concluded the development of the Cottages, the costs of pump maintenance and electricity to keep the 3 wells functioning, plus the costs of cleaning the ponds due to the brackish iron water being pumped into the ponds could not be fiscally maintained by the Association.
   A. The pumps had to run 24 hours daily during dry spells, and struggled to keep up with water loss.

B. It was discovered that the wells carried increased amounts of brackish iron water which turned the pond water brown and provided iron that increased algae and aquatic weed growth. This finding was later supported by the PLM and Hope College studies.
C. Pumps had to be replaced at considerable cost, because the iron corroded the pumps. This practice of using well water to maintain pond levels had to be discontinued.

4. Why wasn't a liner system put into the ponds? Basically, the huge cost to do it was not reasonable.
   A. Each pond would have to be drained in turn.
   B. The drained pond would have to receive a 1 foot layer of base sand. The liner would then be laid on top of the base sand. Two feet of sand would be laid on top of the liner to hold it in place. A 3 foot wire mesh would have to be buried around the entire edge of the pond liner to protect it from muskrat damage. Muskrat gnawing damage would allow pond water to begin seeping out into the surrounding sandy soil along the edge of the pond.
   C. After one pond was finished then the same process would be done with the next pond. For this system to work best, the recommendation was to do ponds 1, 2, 3, & 4.
5. A third solution was not used until this fall and when finished will have helped ponds 5 & 6. This solution is dredging which will restore the water channel depths. Ponds 5 & 6 offer some distinct differences from the other four ponds.
   A. Falling leaves and branches from deciduous trees along with other rotting vegetation have significantly filled these two ponds over the past 25+ years. Ponds 1-4 do not have the same amount of sediment buildup over the same time period, due in part to fewer leafy trees growing near pond banks.
   B. The Association owns enough vacant land next to ponds 5 & 6 where the dredged sediment can be dispersed. This is not the case for ponds 1-4. The cost to truck the dredged sediment away from ponds 1-4 is prohibitive.
6. Other findings and observations from the pond studies are as follows.
   A. Turf lawns do not extend to the pond edges. This is a good thing. Fertilizer runoff is filtered by the vegetation that provides a buffer between lawns and ponds. Lawn fertilizers increase algae and weed growth in ponds. Evergreen Landscaping is a member of the Lake Macatawa Watershed Restoration Project. Bay Meadows is part of the Lake Mac Watershed. Evergreen Landscaping does not fertilize closer than than 20' from each pond, and uses 0 phosphorus fertilizer around the ponds.
   B. Water circulation improves the health of the ponds. The Association purchased and installed aerators to improve water circulation during the summer.
   C. Chemical control of algae, aquatic weeds, and invasive species was recommended. The Association contracted PLM Lake & Land Management to treat the ponds during the weed growth months of the year. It is only during times of sustained drought when the water circulation and chemical treatment of the water is unable to completely inhibit algae and weed growth.

In summary, the best ways to enjoy healthy ponds are with the use of aerators for water circulation and the use of chemicals to inhibit algae and aquatic weed growth. The Association can control and afford the use of these means to support our ponds. Adequate snowfall and rainfall amounts with shorter summer dry spells are in the hands of Mother Nature.

Recognition and thanks is extended to the volunteers who put the aerators into the ponds each spring and remove, clean and store them early each fall, and to the many volunteers who weed around the ponds spring, summer, and fall. Your Association co-owners say thanks for the pond work you do.

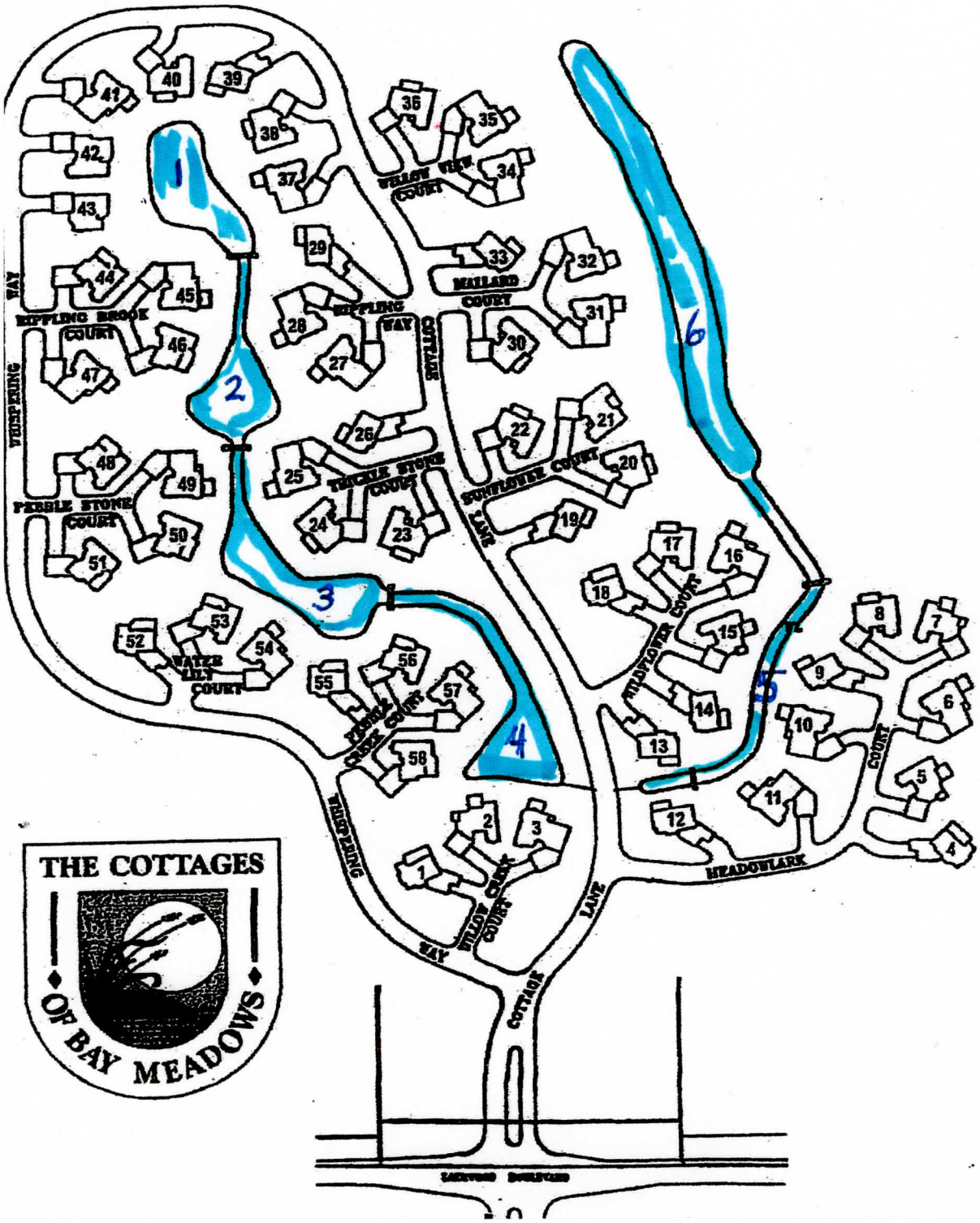
THE COTTAGES
OF BAY MEADOWS
1
2
3
4
5
6
RIPPLING BROOK COURT
RIPPLING WAY
MALLARD COURT
PEBBLE STONE COURT
TRICKLE STONE COURT
SUNFLOWER COURT
WATER LILY COURT
PEBBLE CREEK COURT
WILDFLOWER COURT
MEADOWLARK
WILLOW COURT
COTTAGE
LANE
WAY

Figure 1