D. McLaughlin, 10/22/19

I've read the two-page EGLE document titled "Crooked and Eagle Lakes Dewatering Update" (referred to here as "EGLE document") and spent some time reviewing the weekly monitoring reports posted on the Texas Township website ("GEI reports"). My goal was to assess the scientific basis presented in these documents for EGLE's decision to substantially limit the pumping rate out of Crooked Lake based on their determination of adverse impact to downstream wetlands caused by the Crooked Lake pumping project.

In my view, the scientific basis presented by EGLE is weak. The EGLE document does not reflect a careful analysis of the data in the GEI reports, and misses several important details that are relevant to this decision. For example, it seems to over-emphasizes stress in individual plants observed in the wetlands, including some plants that are actually invasive/aggressive species whose presence poses risks to wetland ecosystems. Because these are not species that occur naturally in the wetlands being monitored, they cannot be considered good indicators of wetland condition with the level of analysis presented here. The EGLE document also doesn't accurately reflect the fact that measured water level changes in the tamarack swamp (Sites 1-4) were zero to minimal, not nearly as much as the 8 inches referenced in the EGLE document as occurring at "some sites". This calls into question the attribution of symptoms of stress to Crooked Lake pumping, especially in the tamarack swamp. Third, the document doesn't reflect an understanding of the importance of hydrologic variation to the long term biodiversity and health of these dynamic ecosystems, especially in emergent wetlands where the largest increases in water levels were reported. Below, I offer some additional explanation for these comments.

Comment 1. The use of invasive, aggressive plant species as indicators of wetland health and biodiversity is not appropriate.

The GEI report from July 24, 2019 states:

> "The species most visibly stressed in Sites 1-4 was glossy buckthorn (Frangula alnus) with most individuals losing leaves or exhibiting discoloration of the foliage."

Glossy buckthorn is an undesirable invasive species. Information provided by the state of Michigan (Michigan Invasive Species at https://www.michigan.gov/invasives/0,5664,7-324-68002_71240_73850-379568--,00.html) on glossy buckthorn states:

> "This invasive shrub is a threat to native plants in prairie fens and other ecologically important wetland communities. It is a host for alfalfa mosaic virus and crown fungus, and may be a possible host for the soybean aphid."

Information provided by the Michigan Natural Features Inventory (MNFI) on "rich tamarack swamp" wetlands (https://mnfi.anr.msu.edu/communities/description/10660/Rich-Tamarack-Swamp) , where Sites 1-4 are located, states:

> "Glossy buckthorn is probably the greatest threat to rich tamarack swamps as it is capable of completely dominating the shrub and ground layers."

Because buckthorn is not native to the tamarack swamp community, and even represents a significant threat to the long term viability of this ecosystem, the value of using observations of this plant as an indicator of hydrologic stress and risk to the ecosystem is questionable.

In addition, adverse impacts to red maple also are reported by GEI. Red maple is a very common, aggressive plant (Michigan Department of Natural Resources at https://www.michigan.gov/dnr/0,4570,7-350-79135_79218_79615_85482---,00.html) that can pose risks to wetland habitats. MDNR information also indicates that this species is a preferred host for the invasive pest Asian longhorn beetle that is being watched by MDNR.

Information provided by the MNFI states:

> "Invasion by red maple can cause rich tamarack swamp to shift toward hardwood domination, resulting in a significant decrease in shrub-layer cover and loss of shade-intolerant species such as tamarack."

The MNFI description of the rich tamarack swamp section on biodiversity management considerations indicates that prolonged flooding can be an important risk factor to this wetland community; however, water is also important to this ecosystem as a means of limiting the replacement of tamarack by less desirable species.

Signs of stress are reported for species other than buckthorn and red maple. However, no information is provided on the spatial extent of observed stress in relation to observed water level changes. In addition, none of the GEI reports appear to identify any concerns to individual tamarack trees at these sites. Furthermore, as described in the next comment, water level changes recorded in the tamarack swamp from May through October were minimal, and even decreasing and zero at two of the study sites. Consequently, there is no basis for linking the apparent stress in individual plants to Crooked Lake pumping in the tamarack swamp wetland.

<u>Comment 2. Water elevation change at Sites 1-4 (Rich Tamarack Swamp) is minimal, much less than the 8 inches identified in the EGLE document</u>

Information presented in Table 8 of the most recent GEI report (included below for reference) indicates that there are only small changes in water levels at Sites 1-4, with Site 1 showing a decrease of 0.5", Site 2 unchanged, Site 3 showing an increase of 0.5" and Site 4 an increase of 1.9" from May 13 through July 22, a time period over which some plants exhibit stress as reported by GEI. With respect to adverse impacts associated with pumping, it's hard to see how this combination of water elevation data, where there is a decrease at one station and no increase at another, provides evidence that Crooked Lake pumping is causing adverse impacts on any plant species in these ecosystems. These elevation changes are very small compared to the broad statement in the EGLE document that "some sites have increased approximately eight inches" (in fact, Table 8 shows that an increase of eight inches was only observed at Site 7 near the middle of the emergent wetland, not in the tamarack swamp or at any other site).

In addition, the EGLE document states that

> "While stable wetland systems are adapted to seasonal and some annual fluctuations in hydrology, extreme short-term changes, taking place here over just four months, appears to be reaching the stress tolerance capacity of many individual species, and thus adversely impacting the entire wetland community."

The EGLE document does not distinguish between observed elevation changes in the tamarack swamp and the emergent wetland (Sites 5-7), leaving the impression that "extreme short-term changes" are

occurring throughout the site, including the tamarack swamp. The water elevation data clearly show that this is not the case.

Furthermore, with no assessment of the size of the wetland areas that may be experiencing significantly higher water levels or adverse impacts, there is no way to determine the significance of observations on individual plants to the ecosystems as a whole. This idea appears to be underscored in the August 13 GEI report, which states:

> "Elevated water levels may be causing stress to trees and shrubs within the wetlands surrounding Sites 5, 6, and 7, but it remains unclear to what extent."

No further explanation of this statement is provided.

Comment 3. The long term health and biodiversity of emergent wetlands depends on periods of high water

The EGLE document expresses concern that the increased water levels observed in the shrub/emergent wetland (Sites 5-7) pose long term adverse impacts to this ecosystem. In my view, EGLE's focus on water stress to individual plants, including invasive species, rather than the emergent wetland as an ecosystem is not well founded scientifically. EGLE appears to be placing limits on the pumping rate without acknowledging the dynamic nature of water levels and associated impacts in these wetland ecosystems that occur naturally. In fact, emergent wetland ecosystems and their functions, including biodiversity, depend on water level fluctuations including high water years. It is true that a change in the hydrologic conditions of a wetland occurring over a long period (on the order of years) can eliminate a wetland ecosystem. However, periodic high water ensures that there are open water areas interspersed with emergent vegetation, creating large amounts of edge habitat where water and vegetation meet. These zones are highly productive and tend to support an increased diversity of plant and animal species within emergent wetlands.

In light of this fact, increased water levels on the order of inches in the emergent wetland should not be viewed as putting the ecosystem at substantial long term risk. Open water areas in this wetland may increase during the pumping of water from Crooked Lake, but the duration of pumping is limited and the degree of risk to this wetland ecosystem overall seems small or nonexistent.

Summary

In summary, EGLE appears to be placing excessive concern on adverse impacts to individual plants, and apparently even on invasive, aggressive plants that themselves pose risks to the wetland ecosystems of concern, without regard to the wetland ecosystem as a whole. Water level change at the tamarack swamp sites has been minimal. Larger water level changes have been observed at the emergent wetland. However, EGLE is not acknowledging that the long term health and biodiversity in these ecosystems depends on cycles of high and low water. Therefore, in my view there is little evidence that the pumping of Crooked Lake water at project design rates poses significant long term risks to either the tamarack or emergent wetland ecosystems.

Screen shot of Table 8 from the October 15, 2019 GEI report:

Table 8. Staff Gage Water Levels

Date	Monitoring Site Water Elevations (NAVD88)							Notes
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	
5/13/2019	875.22	875.82	877.76	878.50	885.02	885.24	885.14	None
5/21/2019	875.22	875.82	877.76	878.51	885.00	885.22	885.13	None
5/28/2019	875.22	875.82	877.78	878.52	885.15	885.35	885.54	None
6/4/2019	875.22	875.82	877.78	878.58	885.30	885.58	885.54	None
6/11/2019	875.22	875.82	877.78	878.63	885.34	885.58	885.54	None
6/18/2019	875.22	875.82	877.78	878.66	885.40	885.58	885.56	None
6/25/2019	875.22	875.82	877.78	878.60	885.20	885.30	885.23	None
7/2/2019	875.22	875.82	877.80	878.62	885.39	885.78	885.88	None
7/9/2019	875.22	875.82	877.80	878.60	885.40	885.70	885.80	None
7/16/2019	875.22	875.82	877.76	878.60	885.40	885.70	885.74	None
7/22/2019	875.18	875.82	877.76	878.64	885.42	885.52	885.54	None
7/29/2019	875.18	875.82	877.76	878.64	885.40	885.70	885.78	None
8/5/2019	875.18	875.82	877.76	878.64	885.34	885.46	885.44	None
8/13/2019	875.18	875.82	877.76	878.64	885.37	885.62	885.69	None
8/20/2019	875.18	875.82	877.76	878.64	885.37	885.55	885.62	None
8/26/2019	875.18	875.82	877.76	878.66	885.38	885.76	885.80	None
9/4/2019	875.18	875.82	877.76	878.68	885.38	885.56	885.62	None
9/10/2019	875.18	875.82	877.76	878.66	885.16	885.33	885.07	None
9/17/2019	875.18	875.82	877.76	878.66	885.35	885.48	885.49	None
9/24/2019	875.18	875.86	877.80	878.65	885.36	885.49	885.54	None
10/1/2019	875.18	875.86	877.83	878.64	885.18	885.32	885.08	None
10/7/2019	875.18	875.86	877.83	878.70	885.34	885.40	885.39	None
10/15/2019	875.18	875.86	877.83	878.66	885.34	885.40	885.43	None