

October 21, 2016



Continental Country Club Home Owners Association
2380 North Oakmont Drive
Flagstaff, Arizona 86004

Attn: Vicki Duncan
President

Re: **Supplement to Potential Lake Draining Alternatives
Lake Elaine Restoration – Phase 1
Continental Country Club
Flagstaff, Arizona
Terracon Project No. 65165238**

Dear Ms. Duncan:

Since completion of our Potential Lake Draining Alternatives report dated October 7, 2016, Terracon and the Continental Country Club Home Owners Association (CCC HOA) have discussed a fourth potential alternative. The purpose of this supplemental report is to present the fourth alternative and outline the advantages and disadvantages of this alternative. Additionally, this report provides an engineering opinion regarding the applicability of using soil or soil modified liners considering the underlying karst limestone at Lake Elaine.

Alternative 4: Discharge through regularly scheduled golf course irrigation

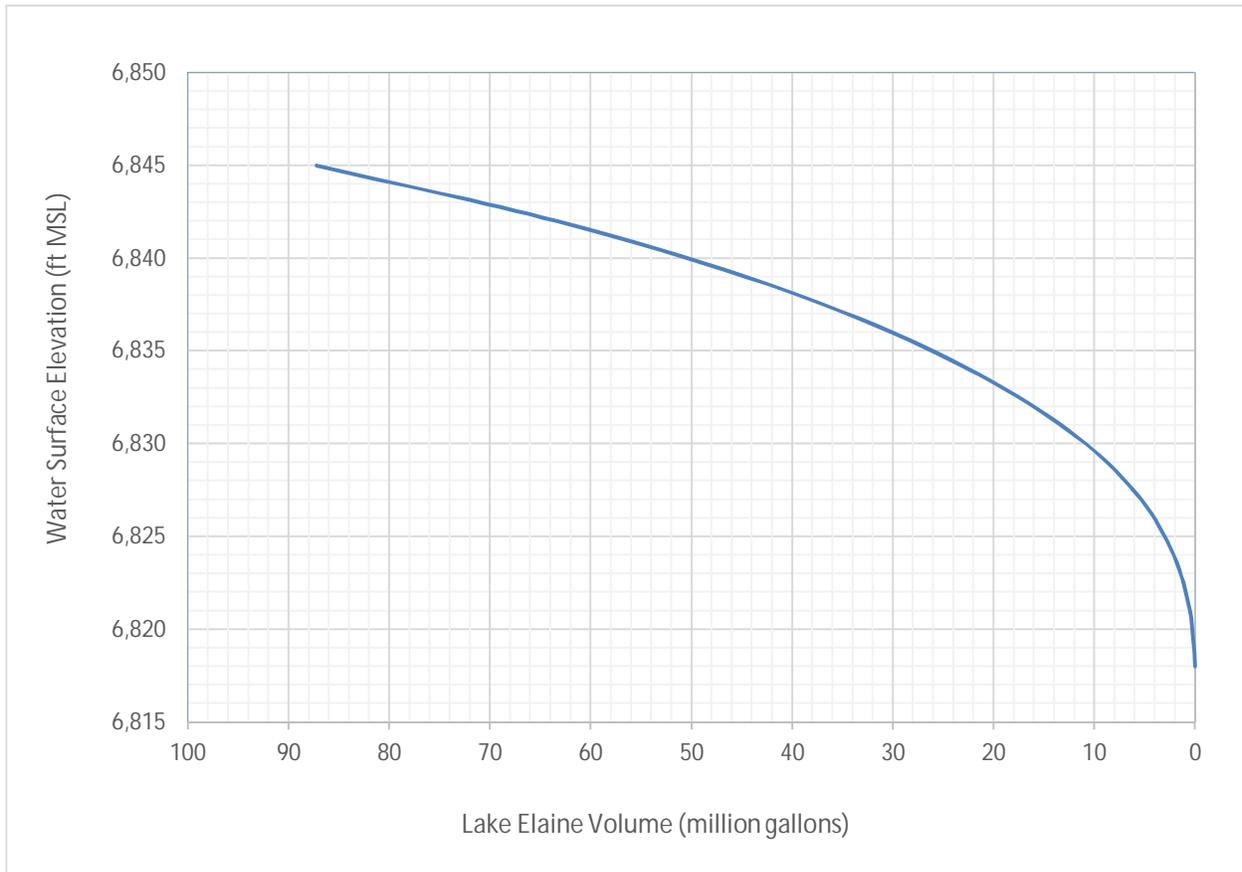
Alternatives 1 through 3, as outlined in our October 7, 2016 report, involved discharging the water from Lake Elaine and ultimately into the Rio de Flag which is not owned or operated by the CCC HOA. Alternative 4, and the one that Terracon considers to be the most advantageous for several reasons, would involve utilizing the existing irrigation system to discharge the water as part of the normal irrigation schedule for the golf courses. By utilizing this alternative, the existing water within Lake Elaine is treated as a capital asset, which it is, and that asset is put to beneficial use and not fully or partially wasted as would be the case under the previously outlined alternatives.

Under this alternative, water from Lake Elaine would be pumped back into Humphrey Lake utilizing the existing supply line, and water from Humphrey Lake would be used to supply the golf course irrigation needs as the demand would dictate. As necessary for Alternative 1 that was previously outlined, system modifications would be required to reverse the flow between Lake Elaine and Humphrey Lake. Modifications to the system would include disconnecting the pipe at the existing pump house located at the south end of Humphrey Lake and connecting a temporary above ground line that discharges into Humphrey Lake. At Lake Elaine, modifications would include connecting a temporary pump and intake line at the existing supply line discharge point.



We understand that irrigation for the golf courses is shutoff between November and February. Accordingly, draining of Lake Elaine would not begin until spring of 2017 under this alternative. During the actual draining operations, the selected contractor would have to work with golf course management to supply the necessary water and to move the expected temporary pumping system to various locations within Lake Elaine to complete the draining operations.

To assess the potential cost saving benefits to the CCC HOA for Alternative 4, an assessment of the current lake volume has been completed. Terracon requested and obtained lake bottom elevation data from Natural Channel Design, Inc. (NCD) that was published in their March 2016 study previously provided to us. Based on our discussions with NCD, we understand that this data is not intended to be sufficient enough to develop grading plans, but provides an approximate contour of the existing lake bottom. Utilizing this data, Terracon prepared the following chart that depicts the approximate lake volume versus the surface elevation of the lake.



We understand that Lake Elaine is currently at an elevation of approximately 6,840 feet, corresponding to a water volume of approximately 50,000,000 gallons. Based on our recent discussions with the maintenance staff for the golf courses, we understand the water demand for irrigation is approximately 400,000 gallons per day between the two golf courses during the fall months. We would anticipate a similar irrigation demand during the early spring months and

increasing demand as the summer months approach. To estimate the amount of time that would be required to drain Lake Elaine during the spring and early summer months of 2017, we have estimated an average daily demand between both golf courses of approximately 600,000 gallons per day. Based on this average rate and considering a current lake volume of 50,000,000 gallons, we estimate approximately 80 to 90 days would be required to drain Lake Elaine under this alternative.

Advantages of Alternative 4

In our opinion, Alternative 4 is the preferred and recommend alternative for draining the lake, provided that it is acceptable for delaying the start of the lake draining operations until the spring of 2017. We realize there may be other advantages and disadvantages to this alternative from a CCC HOA perspective; however, the advantages that we have identified are as follows:

- n As compared to Alternatives 1 through 3, this alternative would consider the water in the lake to be a capital asset and would put the water to beneficial use to irrigate the golf courses as opposed to essentially wasting the water into the Rio de Flag at no benefit to the CCC HOA. Considering the 2015 rate of \$1.66 per 1,000 gallons, this capital asset is valued at approximately \$83,000.
- n Humphrey Lake supplies the water for irrigation of both golf courses. Humphrey Lake is supplied by treated water that is purchased and delivered from the City of Flagstaff Waste Water Treatment Plant. Utilizing Lake Elaine to supply Humphrey Lake would allow the CCC HOA to cease purchasing water from the City of Flagstaff for the period of time necessary to drain Lake Elaine through the irrigation system. We understand that the cost of purchasing treated water from the City of Flagstaff is increases roughly 5% each year. Considering a 10% increase from 2015 pricing, the 50,000,000 gallons not purchased from the City of Flagstaff (at a rate of \$1.83 per 1,000 gallons) in 2017 will result in a savings of \$91,500 to the CCC HOA when compared to Alternatives 1 through 3.
- n To complete Alternatives 1 through 3, assessment of the topography and flow capacity along the drainage pathways would be necessary. Alternative 4 eliminates the need to complete these engineering assessments, and the CCC HOA will realize cost savings in the form of due diligence engineering fees.
- n Alternatives 1 through 3 have the potential to negatively impact the golf course with concentrated flows, and create ponding areas that could potentially impact residential areas along the discharge paths. Alternative 4 eliminates this potential by using the water to irrigate the golf courses according to the established irrigation schedule.
- n As we understand, water conservation is a topic of increasing interest in the City of Flagstaff, and we understand the City and residents are generally more aware of water conservation (and wasteful actions) than might be expected. Alternative 4 allows the CCC HOA to utilize the water for a “green” purpose, other than discharging the water into the Rio de Flag. While

it could be argued that flow to Rio de Flag actually recharges downstream aquifers, we consider the golf course irrigation to be a potential benefit from the public's perspective.

- n By not discharging the treated waste water into the Rio de Flag, the CCC HOA will not be required to go through the potential permitting process necessary to discharge into the Rio de Flag. The permitting process would likely involve the City of Flagstaff, the Arizona Department of Water Resources (ADWR), and the Army Corps of Engineers. Based on our experience, the permitting process through the Army Corps of Engineers (if required) could take up to 12 months or longer to complete.
- n Not undertaking the lake draining process during the winter avoids issues with having to run the system constantly during sub-freezing temperatures and avoids the potential of ice build-up that could occur on streets and over portions of the golf course with the other alternatives, and reduces the potential of any associated damage that could result from ice build-up.
- n While discharging water through the existing irrigation system may be a slower process than Alternatives 1 through 3, the slower rate of discharge is considered to be better controlled and would allow the opportunity to address issues as they occur without potentially negatively impacting adjacent properties.
- n This alternative would allow for better planning to deal with the fish harvesting issue that will be a necessary part of the lake draining process. We would intend to explore options that would allow for the beneficial use of harvesting fish from the lake during the interim period before beginning the process.
- n Draining Lake Elaine in the spring of 2017 allows for Terracon to complete our Phase 1 engineering evaluation of the lake outside of the winter season. While the engineering and construction work could be completed during the winter months, it is our opinion that both scopes would be completed more thoroughly, for less overall costs, and in a safer manner when not battling the winter weather elements.

Disadvantages of Alternative 4

The potential disadvantages we see to this alternative include:

- n A delay in the actual start time in draining the lake; and,
- n A potential increase in the length of time necessary to drain the lake when compared to the other alternatives.

Applicability of soil and soil-modified liners

Based on the geologic conditions of the lake bed as determined by previous geotechnical explorations at Lake Elaine, the underlying geologic formation is karst limestone. As has been well documented in previous engineering reports, initial construction of Lake Elaine was

completed using compacted clay soils derived from the site to form the liner. As evidenced by the performance of the lake liner shortly after the initial filling, this soil liner did not perform. Previous explorations indicate the limestone bedrock underlying the lake is highly fractured and contains solution cavities. Considering that soil and soil-modified liners do not have sufficient tensile strength to span the fractures and solution cavities that are known to exist below the lake and which could occur in the future, these systems are considered risk prone and would potentially require substantial future maintenance. As we have also previously discussed, there is the potential that there is already an insufficient quantity of clay soils in the lake bottom that could be used to support soil liners and for the cushion/cover that is necessary for geo-synthetic type liners. For these reasons, soil and soil-modified liners are not considered as a viable liner solutions for Lake Elaine, and have in fact been ruled out in at least two of the previous engineering studies.

General Comments

The intent of this document is to expand on the alternatives that we presented to you in our initial report concerning this project. This document presents the results of our due diligence efforts to date and may not necessarily reflect all requirements that may be necessary to undertake draining the lake. We expect that a more comprehensive list of requirements will be developed as final due diligence efforts are completed during the course of our work on this project. Assuming that the CCC HOA selects this particular alternative outlined in this supplemental report, our next due diligence efforts will be to complete a study at the location of the pump house to determine the technical requirements of reversing the flows between Lake Elaine and Humphrey Lake, and to meet with golf course personnel regarding a project schedule to undertake Alternate 4. Additionally, our due diligence efforts will then be directed toward the fish harvesting issue.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.



Jesse R. Huston, P.E.
Senior Project Manager



Donald R. Clark, P.E.
Senior Principal

Copies to: Addressee (1 via email)