



June 17, 2010

Peg Comfort
1100 East Torch Lake Drive
Bellaire, Michigan 49615

Dear Peg:

RE: Shoreline Erosion Control and Protection at Torch Lake Yacht Club

Thank you for inviting me to visit the Torch Lake Yacht Club's (TLYC) property to observe the shoreline erosion that is taking place and giving URS the opportunity to provide you with an engineering solution. We recommend a combination of vegetative, riprap and geo products as a solution. These materials can be used to develop a design that will minimize bank erosion and stabilize the shoreline while maintaining a natural aesthetic and preserving the desired view sheds. Our estimate to develop a site specific design is \$5,000. For this fee we will:

1. Meet with TLYC representatives to discuss design elements. Specifically, we will discuss several types of shoreline stabilization. The outcome of this meeting will be to select how each section of the shoreline will look. We will develop designs that incorporate the aesthetic values desired by TLYC while also being able to withstand the erosive forces of waves and shoreline current.
2. Conduct a site visit to measure length of shoreline needing repair, measure bank height, and mark sections for each design detail.
3. Develop a site plan with appropriate details and quantities suitable for construction and bidding.
4. Meet with TLYC representatives to review the site plan.
5. Develop up to three design details for the shoreline. A unique design detail is required for each section of the shoreline that is desired to have a unique look.

Our fee does not include permit submittal, permit fees, bidding support or construction observation; however, we can provide all of these services if desired.

Within this letter I have provided an overview of potential factors contributing to shoreline erosion and conceptual solutions that will work on TLYC property. In addition, several photographs of completed projects are included to help TLYC understand what the proposed solutions may look like. Each of these can be tailored to fit individual site requirements and will provide suitable protection to protect the shoreline from future erosion.

Factors Contributing to Shoreline Erosion

It is important to consider the likely causes of erosion when developing potential solutions. Many factors can contribute to shoreline erosion and the appropriate engineering solution must be selected to reduce or stop loss of shoreline. In the case of

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the TLYC's shoreline erosion the following factors are likely contributing to bank erosion:

- Lateral movement of lake bottom pebbles, leading to undercutting and slumping of banks. This also may be exacerbated by shoreline hardening of neighboring properties.
- Loss of shoreline vegetation. This can make the bank more susceptible to erosive forces from waves and currents within the lake.
- Waves impart force on the bank and lake bottom in relation to the strength of the wind and fetch to the TLYC shoreline.

It is likely that all of the above contribute to the shoreline erosion. Thus, the engineering solutions need to focus on all three of them.

Potential Engineering Solutions

To mitigate shoreline erosion and reduce lateral transport of lake bottom sediments a combination of natural stone and vegetation is proposed for portions of the shoreline where shrubs and trees will be tolerated and direct access to the beach is not needed (Photograph 1). Where access to the beach or maintenance of a view shed is desired a natural stone or engineered block solution is proposed (Photograph 2 and 3, respectively). Photograph 4 shows a solution that includes riprap and coconut coir roll immediately after construction and before planting of vegetation has occurred. It should be noted that the "natural stone and vegetation" approach is similar to what the TLYC attempted last season. Based on observations at the site it is likely that the earlier attempt to control the bank failed due to design and construction limitations. Likely causes of failure are lack of stone, lack of filter fabric, poor soil compaction or lack of good backfill material.

The above solutions can be implemented together as desired by the TLYC. Thus, a natural "north woods" feel can be maintained while keeping the desired views and access to TLYC members. Based on an estimated shoreline length of 200 feet a rough construction estimate is \$15,000 to \$20,000.

Again, thank you for the opportunity to provide you with an estimate for this work. Please feel free to contact me if you have any questions on the proposed conceptual designs or scope of work.

Sincerely,
URS Corporation

Troy R. Naperala, PE
Senior Water Resource Engineer

Jan Hauser, PE
Vice President, Water Resources

Enclosure (1)

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Photograph 1: Example of natural vegetation and stone shoreline protection. Vegetation holds shoreline in place in conjunction with coconut coir log and natural stone rip rap. After two to three years of growth rip rap and coconut coir log are not visible. View sheds are not maintained.



Photograph 2: Example of hard armoring of beach access location. This approach is suitable for areas that receive significant use from foot traffic and/ or launching small water craft. Size of access point can be tailored to specific use and need and incorporated into a more natural shoreline design. Alternatively, the block pavers in the photograph above can be replaced with large flat landscaping rock.



Photograph 3: Example of natural stone and vegetative armoring where views are maintained and tall vegetation is limited.



Photograph 4. Construction phase example of erosion control system that includes coir logs, riprap and vegetation.