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GEOTECHNICAL
ENVIRONMENTAL
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WATER
CONSTRUCTION
MANAGEMENT

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October 21, 2021

Roger Lindgren
21980 Blueberry Lane
Cornucopia, WI 54827

Re: Coastal Engineering Services

Dear Employee Name,

As a representative of property owners along the beautiful Lake Superior shoreline in the Town of Bell, you likely have noticed a marked increase in the rate of bluff erosion and shoreline damage over recent months. The erosion by wave action and other coastal processes constitutes a serious threat to the valuable natural resources and real properties located along the shoreline. Bluff slope instability, primarily caused by wave action and ice damage at the toe, as well as groundwater seepage, can result in relatively high bluff recession rates. Along unprotected shoreline reaches, bluff recession rates can exceed several feet per year. This is coupled with a significant loss of beach materials.

High lake water levels coupled with low sediment transport rates accelerate the shoreline erosion problems. Based on data provided by the National Oceanic and Atmospheric Administration water gauge at Duluth, MN, we have been in a period of high-water levels (above the historic average) for 7 years. The Lake Superior water levels are currently 15.5 inches lower than the very high stage of January 2019. While still above the historic average water level (by 8 inches), the current levels provide a unique opportunity for project improvements using land-based construction means and methods.

The local engineering firm of GZA GeoEnvironmental (GZA) was founded in 1964 and offers specialized geotechnical, coastal and waterfront engineering with a wealth of experience in shoreline erosion and coastal resiliency solutions along the Great Lakes. Our local offices are located in Brookfield and Milwaukee, WI. We are available to assist you in evaluating your shoreline, the performance of existing protective measures, and also in developing potential solutions to prevent further loss of property.

We appreciate you taking the time to read this letter and the enclosed attachment and thank you for your consideration of GZA. Should you have any questions regarding the information contained herein, please feel free to contact Mr. James F. Drought at (414) 831-2540 or via email, as provided below.

Very truly yours,

GZA GeoEnvironmental, Inc.

Dan Veriotti, P.E.
Principal Coastal Engineer
dan.veriotti@gza.com

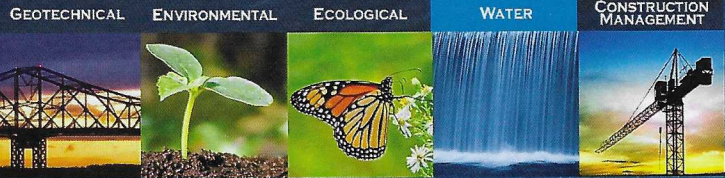
James F. Drought, P.H.
Vice President
james.drought@gza.com

Attachment: Coastal Engineering Services



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WATER



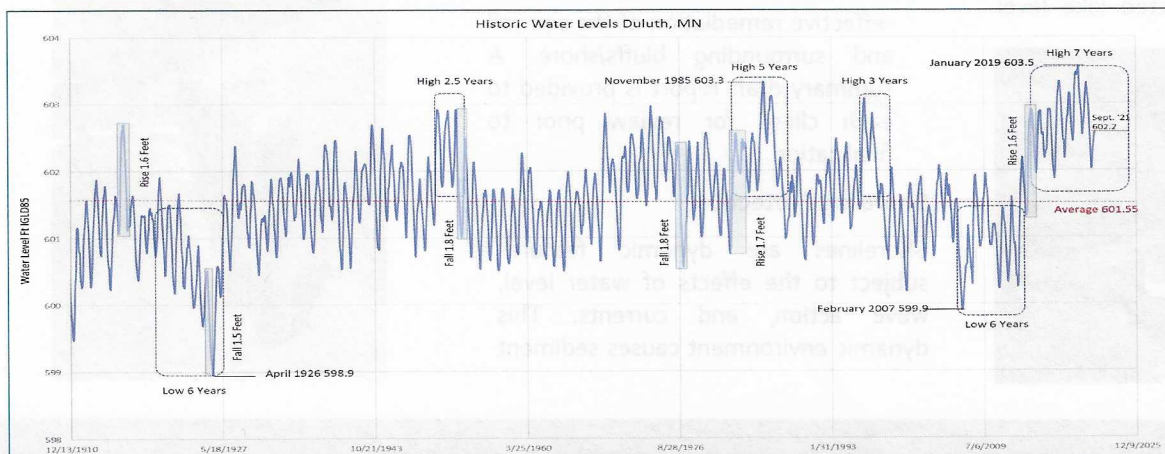
COASTAL ENGINEERING SERVICES



GZA provides complete coastal services ranging from site evaluations, to engineering, to natural resource management, to permitting. Each coastal site is different, with a unique set of needs and issues. GZA's staff includes coastal engineers, coastal geomorphologists, geotechnical engineers, ecologists, and geographic information management specialists. GZA's priority is designing innovative solutions that address the specific needs of each project in an environmentally conscious and economical way, while planning for future threats such as intense storm events and the continued variation of lake water levels. Throughout the analysis and design phases, GZA utilizes a combination of field measurement data, advanced statistical analyses, and state-of-the-art numerical computer models to determine environmental impacts under both extreme events and also normal conditions. Our team values research and is dedicated to assisting our clients with innovative and cutting-edge numerical modeling, analysis, and design tools.

SERVICES SPOTLIGHT

- ✓ Bathymetric and Topographic Surveys
- ✓ Geotechnical Engineering:
 - Subsurface Exploration
 - Slope Stability Analysis
 - Seepage Analysis
- ✓ Coastal Processes:
 - Shoreline Recession Analysis
 - Long-Shore and Cross-Shore Sediment Transport Analyses
 - Water Levels
 - Waves
- ✓ Shoreline Protection Design:
 - Structures
 - Natural and Nature-Based (Living Shorelines)
 - Beach Nourishment
- ✓ Regional Sediment Management
- ✓ Beach Management Plans
- ✓ Dune and Beach Restoration
- ✓ Coastal Modeling
- ✓ Dredging and Sediment Management
- ✓ Marsh and Wetland Restoration
- ✓ Permitting
- ✓ Flood Risk Analysis and Lake Level Rise
- ✓ Geospatial Information Management



This chart illustrates the long-term monthly water level variation, as recorded by the NOAA water gauge at Duluth.



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COASTAL ENGINEERING SERVICES

WATER



Surveys

GZA provides technical field services to evaluate shoreline erosion, bluff conditions, surface/subsurface water management, analysis of bluff stability, erosion control structures, assessment of shoreline erosion rates, exploratory drilling/sampling, and instrumentation installation and monitoring. GZA also performs hydrographic, topographic, ecological, and beach surveys.

Coastal Evaluation

Coastlines are comprised of different combinations of loose sediments such as sand, gravel, silt, and clay. Understanding coastal processes is a key step to designing shoreline protection, beach nourishment, beach management plans, and inlet management.

GZA conducts coastline evaluations utilizing the following tasks:

- ◆ *Desktop Reviews* - GZA will perform a desktop review of the coastal site setting by reviewing current and projected lake level



data, soil information, and other internal information regarding the site.

- ◆ *Desktop Analysis* - GZA will complete a preliminary assessment of publicly available data at the site. The review will identify potential environmental factors for the increased shoreline recession and bluff failure. Gathered data will be processed and presented.
- ◆ *Subsurface Exploration* - GZA will test the soil beneath the surface to determine the material composition of beaches. Soil samples will be classified by our field engineer and select soil samples will be submitted for additional laboratory testing. A data package will be provided at the end of our work that will contain the geospatial information collected throughout our exploration.
- ◆ *Geotechnical Instrumentation* - GZA may incorporate the use of geotechnical instruments to further evaluate geostructural conditions at the site.
- ◆ *Geotechnical Laboratory Testing* - Laboratory results will provide an array of soil parameters that aid in the determination of possible remedial designs.
- ◆ *Preliminary Recommendations and Reports* - GZA will perform a preliminary engineering analysis to determine recommendations for cost-effective remediation of the seawall and surrounding bluffs/shore. A summary draft report is provided to each client for review prior to finalization.

Shoreline Protection

Shorelines are dynamic features subject to the effects of water level, wave action, and currents. This dynamic environment causes sediment

to erode from certain stretches of the shoreline and accrete at locations of mild currents and low wave action.

Eroding shorelines cause problems, such as coastal flooding and wave exposure on homes and structures in the vicinity of the shoreline. GZA provides design services for eliminating the problems caused by shoreline erosion. GZA's shoreline protection projects include:

- ◆ Natural and nature-based solutions (living shorelines, beach, dune);
- ◆ Hard structures (revetments, buried revetments, seawalls); and
- ◆ Hybrid designs (a combination of the two).

GZA analyzes the physical site conditions and environmental forces to determine the most feasible and sustainable shoreline protection alternatives for the needs of the site and the client.

