PREFACE

Lake Summerset Association’s Lake Planning Committee (LPC) maintains a membership of knowledgeable, experienced and competent individuals familiar with all facets of our lake and its related amenities. All committee members are lakefront lot resident owners who have had first-hand experience with many different shoreline types. In addition, many LPC members are (or were prior to retirement) Licensed Professional and/or Structural Engineers, with advanced education and an excellent understanding of the forces acting on shoreline slopes and walls. It is hoped that the combined experience, technical knowledge, environmental awareness, and cost consciousness of this group have contributed to make this a valuable guide for our community.

The primary purpose of this report is to document the educated observations and findings of the LPC regarding the performance of the wide variety of shoreline types that exist at Lake Summerset. This report is intended to be used as a guide by lakefront lot owners, the Environmental Control Committee, and Lake Summerset Association Management and Board of Directors when considering repairs or modifications to Lake Summerset shorelines.

Lake Summerset Lake Planning Committee
Marty Beierwaltes, Secretary
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INTRODUCTION

Boise Cascade created Lake Summerset a little more than 40 years ago by damming the south branch of Otter Creek. Because our lake is man made, truly natural shorelines do not exist and lakefront lot owners have used a wide variety of slope protection methods and/or retaining wall types to protect their shorelines.

It should be noted that environmental conditions on the shoreline can vary tremendously depending on; the location on the lake, the steepness of the slope into the lake above and below the water lines, the distance between grade and normal water level, water depth, etc. Environmental conditions at locations with steep side slopes adjacent to deep water are much more severe than locations with shallow side slopes and shallow water. Forces due to wave action are more severe near the fast boating area than those in the no wake areas. North shore locations are generally subject to more severe damage from ice flows than those on the south shore.
SHORELINE TYPES

Some type of slope protection and/or retaining wall is required to maintain the shoreline on nearly all of the lakefront lots at Lake Summerset. The only exceptions to this are the lots in close proximity to Beaches 1 and 2, where drifting beach sand has covered much of the original slope protection.

Numerous slope protection methods and retaining wall types and combinations of these options have been used on individual lots. All of these options will degrade over time and eventually require maintenance, repair, and/or replacement. Photos showing the benefits and drawbacks of each of these shoreline types follow.

• UNPROTECTED SLOPE:
  SAND BEACH

• SLOPE PROTECTION:
  DEEP ROOTED VEGETATION
  RIP-RAP STABILIZED SLOPES
  RIVER ROCK STABILIZED SLOPES

• RETAINING WALLS:
  TIMBER
  CONCRETE
  CONCRETE BLOCK
  STEEL SHEET PILING
  VINYL SHEET PILING
Personal Sand Beaches

**Benefits of Design**
Provides easy lake access for water sports and children, but a curb is required to minimize the washing of sand into the lake.

**Drawbacks**
Erosion from waves and storm water runoff will wash away sand and add to the lake sediment problem.
Sand w/ Shallow Rooted Lawn

Benefits of Design
Allows for easy access to lake for recreation and has a clean, natural look.

Drawbacks
Addition of sand onto the shorelines is NOT allowed by members. Shoreline will constantly erode due to waves.
Benefits of Design

Shoreline vegetation improves water quality by trapping surface runoff, sediment, contaminants and excess nutrients before they enter the water. Native plants anchor the soil, protect the shoreline from erosion and are adapted to their environment and do not depend on chemical application or frequent watering to survive. A natural near-shore zone supports spawning and nursery areas for fish as well as bugs and insects for food. Natural vegetation at the shoreline can deter nuisance geese.
Natural w/ Deep Rooted Vegetation

Drawbacks

On steeply sloping shorelines and in areas of concentrated storm water runoff (ditches, swales, etc.) even deep rooted plants cannot provide complete resistance against soil erosion. Does not provide a “clean, finished” look.
Limestone Rip-Rap

**Benefits of design**

Properly sized riprap can provide excellent resistance against erosion due to wave action and storm water runoff. Larger size riprap is required in areas subject to large waves or high velocity storm runoff flows. It also reduces or eliminates rip currents and scouring of the lake bed.
Limestone Rip-Rap

Drawbacks

Riprap can still be moved by ice as the lake freezes and thaws. Poor quality rock may degrade due to freeze thaw cycles. Periodically, existing rock needs to be repositioned and/or new rock needs to be added to rip-rapped slopes. Since the rock needs to extend above the wave crest at high water and below the wave trough at low water, walking on the lake bottom is difficult.
**Large River Rock**

**Benefits of Design**

Properly sized river rock can provide excellent resistance against erosion due to wave action and storm water runoff. Larger size rock is required in areas subject to large waves or high velocity storm runoff flows.

**Drawbacks**

Riprap properly sized to resist wave action and storm water flows can still be moved by ice as the lake freezes and thaws. Poor quality rock may degrade due to freeze thaw cycles. Periodically existing rock needs to be repositioned and/or new rock needs to be added to rip-rapped slopes.
Wood Timbers w/ Deck

Benefits of Design

Properly designed and constructed timber retaining walls provide excellent resistance against erosion due to wave action and storm water runoff. Because timber walls resist lateral earth pressures in addition to providing erosion protection, they need to be founded below grade and be tied back into the embankment to be stable.
Drawbacks
Service life tied to wood species and type of preservatives used.
Wood preservative must be environmentally compatible.
Requires “dead-men” anchoring to resist wall tipping
Ice jacking can displace the wall at water line
Concrete Wall

**Benefits of Design**

Properly designed and constructed concrete retaining walls provide excellent resistance against erosion due to wave action and storm water runoff. Because concrete walls resist lateral earth pressures in addition to providing erosion protection, they need to be founded below grade and be designed to use gravity or a tie back system to resist overturning. Large rocks are not required in front of the wall which makes wading on the lake bed easier.

**Drawbacks**

Concrete walls that are not founded below the frost line may heave and not return to their original position when the ground thaws. Concrete walls are vulnerable to damage (spalling) from freeze thaw cycles.
Large Concrete Blocks

**Benefits of Design**

Concrete block walls provide excellent resistance against erosion due to wave action and storm water runoff. Because concrete walls resist lateral earth pressures in addition to providing erosion protection, they need to be founded below grade and be designed to use gravity or a tie back system to resist overturning.
Large Concrete Blocks

**Drawbacks**

Concrete walls that are not founded below the frost line may heave and not return to their original position when the ground thaws. Concrete walls are vulnerable to damage (spalling) from freeze thaw cycles.
Benefits of Design
Concrete block walls provide excellent resistance against erosion due to wave action and storm water runoff. Because concrete walls resist lateral earth pressures, in addition to providing erosion protection, they need to be founded below grade and be designed to use gravity or a tie back system to resist overturning.
Small Concrete Blocks

**Drawbacks**
Lateral forces due to lake freezing can push the blocks, beneath the water line, towards the shore, causing the wall to lean towards the lake, and eventually fail.
Interlocked Steel Sheet Wall

**Benefits of Design**

Steel sheet pile walls provide excellent resistance against erosion due to wave action and storm water runoff. Because steel sheet pile walls resist lateral earth pressures in addition to providing erosion protection, they need to be adequately toed into the ground. Sheet pile walls may also need to be tied back into the embankment depending on the flexibility of the sheet piling sections being used and the height of the wall.
Sheet piling will heave if bedrock is too close to the surface and prevents installing the sheets to a sufficient distance below grade. Sheet piling may also heave without sufficient embedment depth. Added dead load to overcome freezing forces may help.
Interlocked Vinyl Sheet Wall

Benefits of Design
Vinyl sheet pile walls provide excellent resistance against erosion due to wave action and storm water runoff. Because vinyl sheet pile walls resist lateral earth pressures in addition to providing erosion protection, they need to be adequately toed into the ground and tied back into the embankment. Large rocks are not required in front of the wall which makes wading on the lake bed easier.

Drawbacks
Sheet piling will heave if bedrock is too close to the surface and prevents installing the sheets a sufficient distance below grade. Sheet piling may also heave without sufficient embedment depth or dead load to overcome adfreezing forces.
FORCES ACTING ON SHORELINE SLOPES AND WALLS

- **Storm Water Flow** – Large volumes of water flowing down steep slopes or in concentrated areas create high water velocities that will erode soil particles that have insufficient size and weight to resist the energy of the water.

- **Wave Action** – Waves create lateral forces that push against vertical surfaces and erosive forces slopes. Waves are created by wind and boats. The higher the wind speed and the longer the stretch of open water (fetch distance) parallel to the direction of the wind, the larger the wave force. The size of boat induced waves (wakes) is a function of boat size, hull shape, and speed. The largest wakes are created by boats that are moving at a speed that does not allow them to plane off. In most areas of the lake, wind induced waves can be much larger than those caused by boat wakes. However, the frequency of boat induced waves is much greater.

- **Lateral Earth Pressure** – Backfill behind retaining walls exerts lateral forces that will cause improperly designed walls to slide or overturn. The magnitude of these forces varies with the type of backfill material and the height of the wall. Very permeable, clean, coarse-grained, granular backfill minimizes lateral earth pressure.

- **Ice** – Lateral forces are caused by volume expansion as water turns into ice. As the lake freezes, ice forces at lake level push retaining walls toward the shore. Ice forces are also created behind retaining walls with low permeability backfills that push the wall toward the lake at grade level.

- **Adfreezing** – A strong bond can develop between retaining walls and adjacent frost susceptible soil or ice. As freezing occurs, this bond and the volume change can lift the wall upwards unless there is sufficient dead load and skin friction beneath the frost line to resist the uplift force.

- **Freeze-Thaw Cycles** – When water gets into porous rigid materials (like concrete and rock) and freezes, cracking and spalling occurs to relieve the stresses caused by the expanding ice. The more freeze-thaw cycles these materials are subjected to, the greater the damage.

**SUMMARY**

Most shoreline slope protection methods and retaining wall types have worked well in, at least, a few locations on the lake with minimal maintenance and/or repair. However, based on overall performance during the 40+ years of Lake Summerset’s existence, it appears that properly sized rip-rap stabilized slopes and well constructed steel sheet pile retaining walls have been the most successful options, regardless of location on the lake.

Further information:  http://www.lsfishclub.org/shoreline_health.html