Shore Erosion Factsheet

Produced by Ted Manning for the Patterson Lake Association September, 2008

What causes shores to erode? The main causes of shore erosion are wave action and runoff. Wave action is caused by winds and by passing boats. Runoff comes from rainfall events, or from other sources such as sewage spills or overwatering.

How does erosion happen? All materials are affected by gravity, and will naturally tend to move down slope until everything is level (*law of entropy*). "Solid" material, like the Canadian Shield rock, will move much more slowly than less dense material, taking millennia to erode(even so, it does erode due to wind and water, freeze and thaw cycles). Other materials will flow more rapidly, seeking their *angle of repose.*. This is the slope where they will tend not to move unless disturbed. Materials like sand or mud will flow much more readily than rock or more consolidated materials seeking to achieve a near flat profile.

How does water erode shores? The energy in lake water is mostly in the wave zone. That means that the greatest erosion at the shore will take place where the waves actively hit the shore. When water is high, most of the erosion energy is therefore higher up the slope. When the water is low, the energy is directed at the lower area. Where shores are shallow or vegetated (such as wetlands) the energy is dissipated across a larger area and the ability to erode is reduced.

What about walls or constructed shorelines? Where cement, rock or other walls or berms are constructed on the shoreline, these are intended to absorb the wave energy, reflecting it back at the water body and eliminating its impact on the shore materials behind. Ideally, they cover the entire wave zone, from the top of the waves in highest water to the bottom of the wave zone in lowest water. Where they do not cover the entire wave zone, they are subject to enhanced erosion, sometimes deflecting the wave energy to concentrate it on other parts of the shore or even where it will undermine the structure.

What about high water? During high water events, the zone of impact and therefore the zone of erosion is raised, and may subject shore areas not normally subject to erosion to wave action. This may mean that, for example, structures built close to the shore, shoreline trees and bushes, or walkways can be eroded. On Patterson Lake, the picturesque trees which hang over parts of the shore do so primarily because the soil around their roots was removed during storm events in the high water season.

What about low water? When water is low, the impact of erosion occurs lower down the shore. Low water events can focus the wave action at the bottom of walls or retaining structures undermining them. According to the Great Lakes Water Level study, by far the greatest amount of damage to docks, retaining walls and stone berms occurs during low water, mainly because the wave energy is directed at the foot of the structures, and often below them, taking out the footings. Low water also has the greatest impact on sand beaches, eroding the bottom of beach areas and causing the sand to flow more rapidly downhill.

How does sand behave on a beach? Natural beaches are the epitome of an erosion laboratory. Geomorphologists refer to the beach as a *river of sand* which is constantly in motion. Sand is constantly being swept away – usually in the direction of flow of the water or wind – but on natural beaches it is constantly replenished from erosion upstream (cliffs, other beaches). Where sand beaches are not natural, they must constantly be replenished by loads of new sand. Sand migrates with each wave which hits, being moved up the beach by the incoming wave (in the

direction of the wave) and back down by the retreating water. More is moved down than moved up by each wave (except in very violent storms).

Boats Boat wakes impact the shore just like waves created by wind. While they may be less frequent, large wakes can send waves which are larger than most storm driven waves towards a shore, Again, the impact zone of the wave will be where it hits the shore. Most of the energy in a two foot wave will be in the area one foot above the water level to one foot below the water level. When this is high, it can overflow walls and other structures; when water is low, it can undermine the bottom of such structures. Both cause damage. Because the power of wake waves diminishes rapidly with distance from where they are created, keeping large wakes away from shore can substantially reduce the impact on the shore.

Does planting help? Planting a shoreline with deep rooted vegetation can help slow downslope *soil creep.* But planting is most effective when a slope is near its natural *angle of repose*. The objective is to dissipate the wave energy as it hits – and this may take a large area of water vegetation a shallow slope and/or a very dense shoreline planting. Planting also helps reduce erosion from rain events, slowing the rapid flow of water off the land and allowing it to seep into the soil.

Shore naturalization Shore naturalization means trying to return a shoreline which has been altered in the past back towards its natural state. This may mean removing walls, berms, areas where the near shore has been terraced etc. The objective is to stop fighting nature and instead allow nature to stabilize the shore. This will often mean restoration of something resembling the original slope, and extensive use of natural vegetation to help in the stabilization. It also usually means using materials which are the same or close to what was there – rock, local soil and native plants. If successful, naturalized shores seldom need maintenance and retain their slope and configuration themselves.

Patterson Lake Shorelines Most of Patterson Lake's shores are natural. Some are rocky, (like much of the northwest shore) and do not exhibit much erosion or change. The wetlands as well are reasonably stable, although their extent can change in very wet or very dry periods. Areas of steep shoreline where the rock is not on the surface are undergoing erosion and downslope creep of soils (this is very evident in the southwest shore and in parts of the northeast shore– one of the most visible indicators of downslope soil creep is tilted trees.) Less than ten percent of the shoreline of the lake is altered significantly from its natural state. Even so, all but the most low and flat of properties will have some natural downslope erosion occurring, particularly during extreme rain events.