Testimony on boat wakes on Newberg pool. June 24, 2021.

Dr. Pedro Lomonaco, Director O.H. Hinsdale Wave Research Laboratory, Oregon State University

The purpose of my testimony is to briefly describe the physical processes of boat wake generation, propagation to the shore, as well as the sediment transport due to these wakes. These processes are observed everywhere in the world, including Newberg pool. We can describe the processes qualitatively in detail, but to do it quantitatively, measurements and a morphodynamic study is required.

On boat wakes

As boats sail, they produce a disturbance on the surface in form of waves. These waves, called wakes, are defined by their height and frequency. The amount of energy carried by a boat wake is proportional to its height and inversely proportional to the frequency. The energy transfer from the boat to the water depends on the boat speed, shape of the boat, displacement (i.e. weight) and water depth. The design of vessels and boats is normally intended to reduce energy losses, minimizing wakes where the power of the engine is used to move the boat but in wake surf sport activity, the design is opposite, where the power of the engine (and the submerged displacement) is intended to produce a large wake with certain shape and characteristics that enables surfing.

Once the wake is generated, it propagates away from the source, in our case towards the shore. The wake suffers a series of transformations, including a wave height increase due to shoaling, wave height decreases due to dispersion and friction, wave direction changes due to refraction, and breaking ashore among others. All waves breaking are able to stir up the sediment and move it offshore, reconfiguring the shoreline profile, as well as alongshore due to wave angle to shore. Again, the intensity of the transport is proportional to the wave height and wave angle, and inversely proportional to the wave frequency.

Sediment transport

Wave-induced and river-induced currents are responsible for the sediment transport. Stronger currents are able to transport larger sediment sizes as well as larger quantities. Anything along the shoreline that modifies the existing currents (rocks, debris, vegetation, etc.) will also alter sediment transport.

Sediment transport can be studied in two directions: along the river and across the shoreline. Along-river transport is primarily determined by the river flow, while across-shoreline transport is dominated by waves. In a relatively narrow river like the Willamette, wakes are significantly larger than wind-generated waves.

Erosion

Sediment transport does not mean erosion or accretion. These occur when the sediment balance is not zero, in other words, when the amount of sediment that enters a given zone is not the same as the amount of sediment that exits. Along the river sediment transport can be larger than cross-shore transport, but naturally the river has attained a sediment balance that is not introducing significant erosion or deposition in average. However, episodic extreme events can cause localized erosion or accretion at some locations, but in the long-term will return gradually to the initial configuration.

Artificial boat wakes, or any other man-made episodic events, imposes an imbalance in the sediment transport (i.e. erosion) where nature does not have the means to recover the initial configuration. Moreover, individual wakes reaching the shoreline may not cause significant damage, but intensive repetition of the same event will end up producing irrecoverable loss of material, erosion and damage. This is particularly true if these events happen during the season where natural dynamics are small.