TAB 9

Further Improvements to Beach II

Issue:

Sand movement from Beach II remains a significant problem.

B**ackground:**

Last year the board approved improvements to Beach II in hopes that it would minimize the sand incursion from the beach area down the cove. Putting drains under the beach and flattening the slope of the beach were some of the things done to help. However, all the improvements were gauged for a 10-year storm. This past year we had several 100-year storms. When it was clear that sand was still entering the water, a wooden sea wall was erected by maintenance staff. This was effective in some places, but sand moved under the wood during the large storms and during wakes coming from boats.

Once the sand enters the water, the wake from high-speed boating is pushing the sand up the cove. The amount of sand moving up the cove is quite dramatic. The first dock and ramp, which were extended a couple years ago are now beached. The sand is now about three feet deep. At the beach itself the sand is spreading out into the water for about 4 feet.

The wake action is not something that can be controlled, but the movement of sand can be controlled. The association is under no obligation to fully correct a natural water problem, but the sand the association keeps putting on the beach is an unnatural situation and can be improved.

The beach was never supposed to be in this location. It was moved here "temporarily" while the dam road was closed. It ended up staying here permanently.

Before Beach II was improved, the sand was pushed back and rocks were placed near the shoreline. This improved the situation but is certainly not an ideal solution for a beach.

Jim Pagenkopf and Steve Herring visited the beach, talked to Mike, reviewed the site plans and considered two further options: either a sea wall or a jetty.

The sea wall would have to be made of concrete because rock would be too expensive. This option would not be ideal for it would have to sit about 4 feet back from the water, have footings into the ground and, from the water side, would be a few feet high. Getting into and out of the water would be difficult. It would also be very expensive.

A jetty is a rock berm that extends out into the water and blocks the sand while water flows through. The jetty would be placed on the left side of the beach facing out into the water

and would extend outward for 24 feet. The jetty's height would be raised a maximum of 4 feet out of the water. The core of the jetty would consist of square or rectangular Gabian metal baskets filled with small rocks. Additional larger rocks would be placed on top of the baskets to form a rounded jetty. (See diagrams created by Jim Pagenkopf)

The jetty would not interfere with the beach. In fact, there would be a nice slope of sand going into the water making use of the beach much more enjoyable for the community. Nothing would block entering the water, just like at Beach I.

Don Cooke has been asked to provide the association with a ball park estimate for constructing the jetty. His estimate is $30k. Inquiries have made with the US Army Corps of Engineers to see if a permit would be required. That answer is still pending.

Recommendation:

Along with additional storm water management that Don Cooke is working on at Beach II presently, the jetty would create a well-functioning beach that would not require constant replenishment of sand every year and would have a sandy entrance into the water for the community to enjoy.

Motion:

Approve formation of a jetty extending from the shoreline at Beach II. Funding will come from Capital Improvement Fund. Funds will be moved from the beach pavilion to Beach II Enhancement and Erosion.

Pat Majewski

September 27, 2022

Conceptual design of proposed jetty (investigated and written by Jim Pagenkopf)

The most common form of "jetty" or "groin" used in ocean beach environments to control sand movement is a rock or "rubble mound" type structure. Jetties seen along ocean beaches are typically massive structures which need to withstand large storm induced waves.

This jetty will be fairly small (roughly 20-25 feet in length) and composed of a "core" using galvanized steel gabion baskets filled with small stones (to impede sand movement), surrounded by large rocks weighing at least 50-100 lbs to prevent the jetty from moving and from being tampered with (see below). There would be multiple buoys anchored around the Beach 2 area to warn all boats from approaching the beach swimming area, including the jetty. Note that the public dock will extend further out into the lake than would the jetty.

The minimum weight of individual rocks forming the outer layer of the jetty is determined by the size (height) of the "design wave". For Lake Holiday, design wave forces are relatively small by comparison, and are determined by a combination of *wind driven waves* and *boat wakes*.

To find the *wind driven* "design" wave height for the Beach 2 jetty requires knowing the local "wind rose" (historical wind statistics), and the "fetch" distances for each wind direction of interest. The wind rose for Front Royal is the closest available statistical wind record for Lake Holiday. The predominant wind directions (and highest wind speeds) for the Front Royal area are from the WNW and NW. Beach 2's location along the south side of the lake and in the entrance of a cove provides shelter from wind driven waves from these directions. The fetch distances and maximum wind velocities are as follows for each wind direction: NW (500 ft, 25 mph); NNW (1500 ft, 19 mph); and NE (1750 ft, 13mph). Using equations from the USDA Engineering Field Handbook "design wave" heights from wind driven waves at Beach 2 are estimated to be as follows: NW (3 inches); NNW (4 inches); and NE (3 inches).

In addition to wind driven waves, boats traveling counterclockwise in the main lake near Beach 2 also create boat wakes that approach Beach 2 directly from the north. Boat wakes tend to dissipate as they travel away from the boat path. A study by C.A. Goudey & Associates on wake characteristics of wake-sport wakes includes analysis of wakes from sport boats that are cruising, wakeboarding, and wakesurfing. For our purposes we want to be conservative and design a jetty that can withstand the largest waves likely to occur at Beach 2. The maximum wave height at 200 ft from a wakesurfing boat traveling in deep water is approximately 16 inches. We will use a more conservative height of 18 inches (1.5 ft) as a safety factor to determine rock weights for the Beach 2 jetty.

Formulas from the Corps of Engineers design manual for jetties can be used to estimate the volume and size of rocks needed to build a 25 foot long jetty at the Beach 2 property line. The "core" of the jetty would be formed using galvanized steel gabion baskets (easily available) that hold small stones/gravel to serve as the jetty anchor and as a barrier to sand movement. These gabion baskets come in the size of 19.7 ft long, 1.7 ft wide, and 1.7 ft high. Two gabion baskets

would be set side by side to form the jetty core. Then a layer of rocks sized from 50-100 lb each would be placed on the sides and on top of the gabion baskets to form the basic jetty outline using a slope of 1.5 to 1 (34 degrees with the horizontal). The outer layer stones would need to have a minimum weight of 100 lbs each to form the stable outer layer that would be able to withstand "design" wave heights of 1.5 feet, which should be adequate for Lake Holiday. The approximate total volumes of rock are as follows:

- Small stone/gravel for 2 gabion baskets – 3.9 cubic yards
- Inner layer jetty rock, assume 50-100 lbs each – 17.8 cubic yards
- Protective Outer rock layer, assume minimum 100 lbs each – 7 cubic yards

These volumes assume an approximate depth of 3 feet at 25 feet from shore. If the depth is greater than 3 feet at this location then the volumes would increase.

Attachment 7 provides the basis for calculating the rock weights, as well as conceptual drawings of the jetty using water depth information collected during November by Princeton Hydro near Beach 2. Also shown in Attachment 7 is the approximate location and shape of the jetty located on the Beach 2 Site Plan. Using this information, preliminary cost estimates will be obtained by local construction firms to build the jetty.

Attachment 7

Lake Holiday Beach 2 Preliminary Jetty Design

Based on "Design and Construction of Jetties" Chapter 26
R.E. Hickson and F.W. Rodolf, Portland District, Corps of Engineers
Department of the Army, Portland, Oregon

Using Iribarren (1949) formula for sizing outer rock layer:

$$W_1 = \frac{K_1' H^3 s}{(\cos\phi - \sin\phi)^3 (s-1)^3}$$

in which: W_1 = weight of individual stone, in tons or 2,000 lbs
$K_1' = 0.000468$ for natural stones
H = design wave height, in feet (1.5 ft for Lake Holiday Beach 2)
s = specific gravity of stone (≈ 2.5)
ϕ = angle of slope with the horizontal (34° ≈ 1.5 to 1)

so: $W_1 = \frac{0.000468 (1.5)^3 2.5}{0.0214 (2.5-1)^3} = \frac{0.0039\,4875}{0.072225} = 0.0546$ tons = 109 lbs

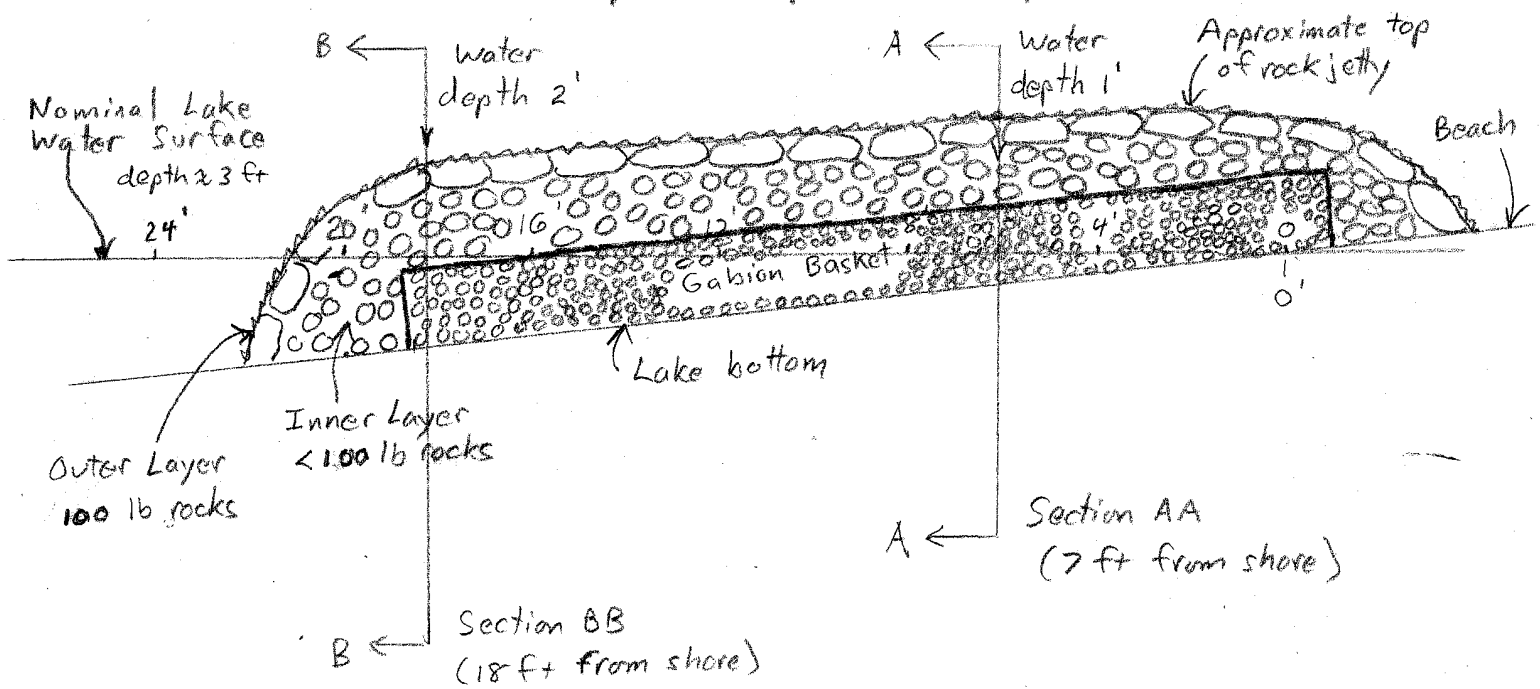
for Beach 2 jetty design assume weight of outer layer rocks
≈ 100 lb minimum (this weight should also prevent tampering)

Core of jetty can be formed using gabion steel (galvanized) baskets filled with small stones/gravel. The core serves as a barrier to sand movement and inner foundation/support for outer rock layers.

Example gabion – see Festnight Gabion Wall Basket
19.7 ft × 1.7 ft × 1.7 ft = Volume 1.95 cu yd (each)

Assume use 2 gabion wall baskets (see pg 2) total volume 3.9 cu yd

Beach 2 Jetty Conceptual Design

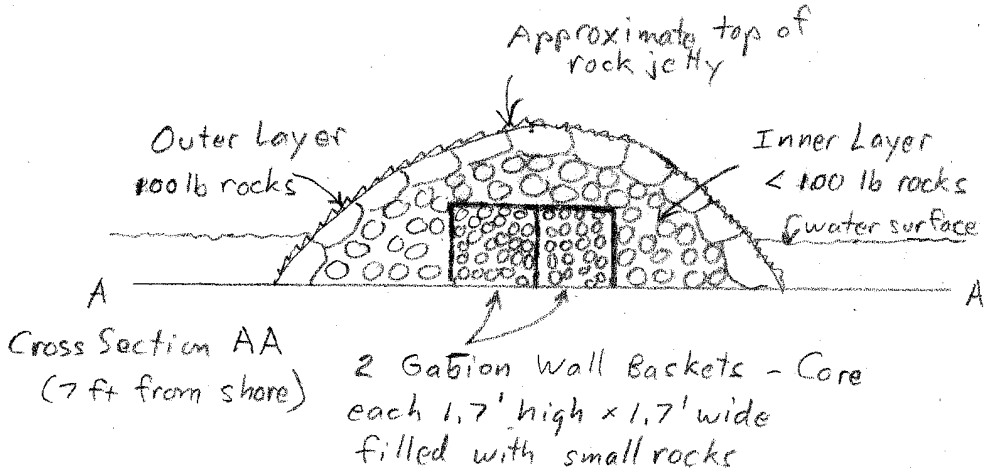


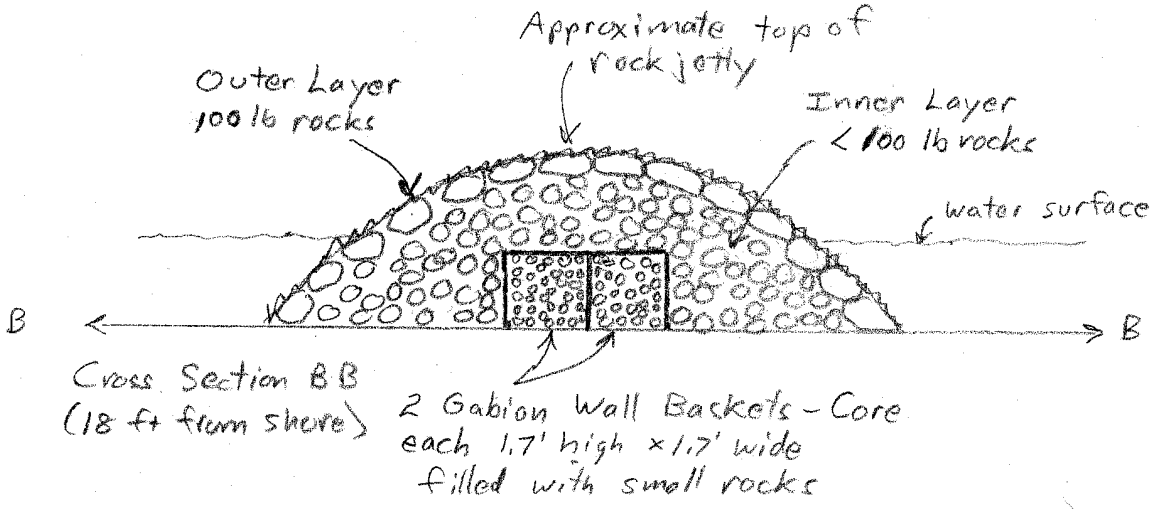
Volumes:

2 Gabion Baskets
small stone → 3.9 cu yd

Inner Layer Stone
assume 50-100 lb each
approx → 17.8 cu yd

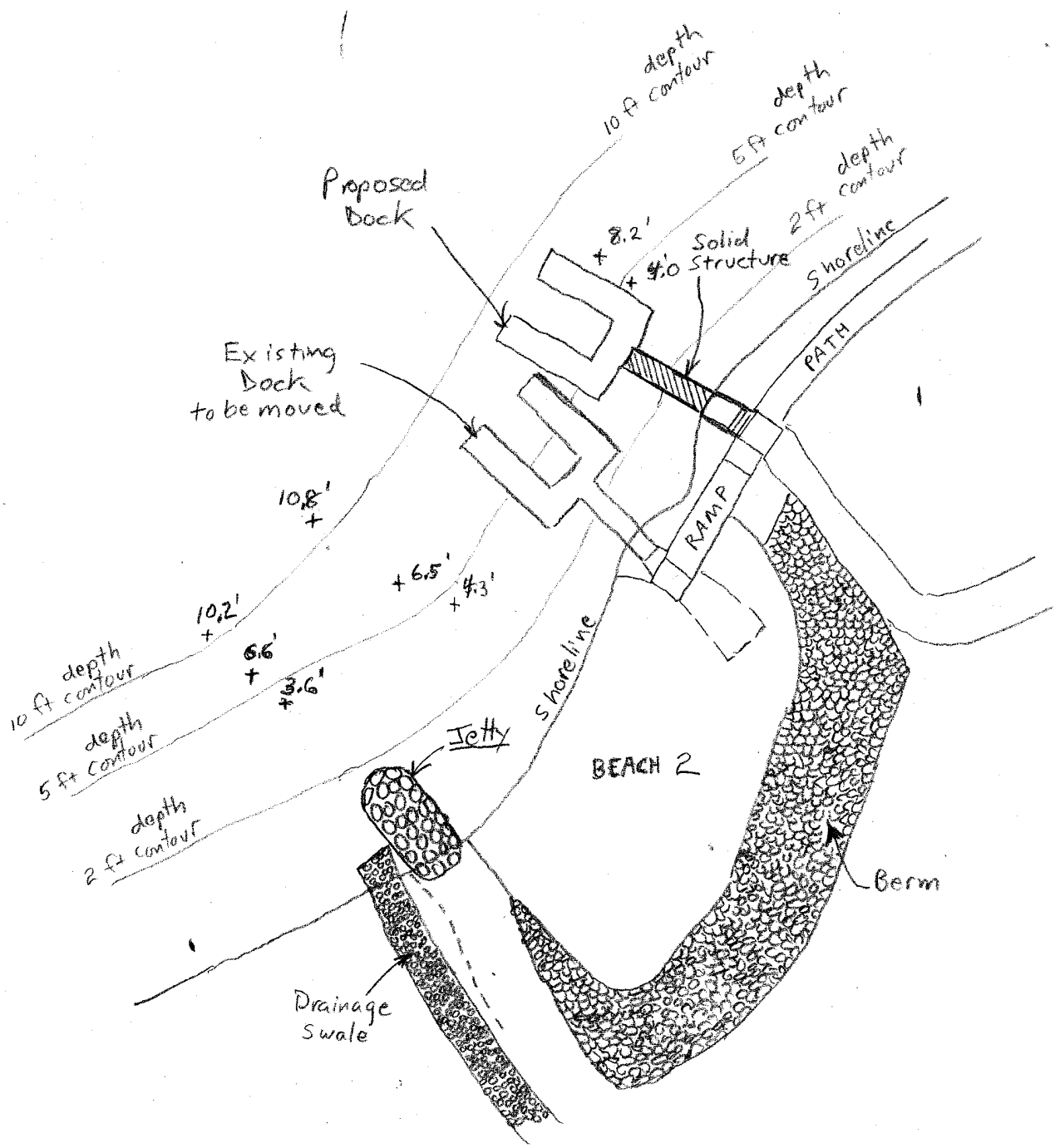
Outer Layer Stone
assume minimum 100 lb each
approx → 7 cu yd





Scale:
1 ft = 1/4 inch

Pg 3



Location of Proposed Jetty at Beach 2

25' 0 25' 50'

Scale