A. Effectiveness of underwater groins at various water levels when installed at various water levels.

   a. Page 28: Walther and Barnes both refer to the idea that "at high water, Holmberg does not function well. Benefits to the Holmberg system are realized at medium water levels."
   b. Question 6: high water removes sand from Holmberg systems installed at low water.
   c. Question 6, page 11, Walther: high water dwarfs the (positive?) effects of Holmberg's system.
   d. Question 8, page 14, Walther: (all?) groins operate at better at low water than high water.

If the above statements in "A" are true, how useful would groins installed at low water be at keeping beach in place during high water?

> M. Walther. It's all relative to the extent of high and low water. Generally, under high water conditions, waves commonly erode (move sand from) the upper (previously dry) portion of the beach and deposit sand below the elevated water level; groins do not deter or prevent this "cross-shore transport" and can become ineffective under high water conditions.
>
> D. Barnes. The important point is that with substantial rise in lake levels (above about 581') there will be wide spread shore damage including areas protected by groins systems. As the groins empty with rising lake levels (due to offshore directed sediment transport) the interference with long-shore drift and trapping of sand up drift increases. The groin structures could be installed at higher elevations on the beach at low water levels but would then require substantially more initial fill. With out pre-fill the groins would act as a gigantic sump needing filling and dramatically interfering with long-shore transport, basically big buckets that would need to be filled before reestablishment of the normal long shore drift pattern.

B. Nourishment and ability of underwater groins to trap long-shore transport

   a. Question 2, Walther: nourishment is the most practical and economical technique to provide a beach and protect buildings.
   b. Question 4 (and others): Underwater groins trap long-shore transport. If, as a result of the channel jetties, camp has little or no south-to-north long shore transport within about 500 feet of shore, what sand would underwater groins trap, other than the sand we put in?
   c. Question 14, pages 22-23: Beach nourishment is necessary for a successful groin implementation that holds beach with minimal neighbor effect.

If the above statements in "B" are true, to be effective would the initial cost and ongoing cost of underwater groins to provide beach enhancement include annual or periodic replenishment of the sand between groins?

M. Walther. Yes, to offset the impact of the groins upon adjacent "down drift" properties, periodic nourishment should be part of an "environmentally responsible" use of groins.

D. Barnes. YES, YES, YES, in order to mitigate any potential shore damage attributable to the groin structures.

C. What does Walther mean when he says the beach gain from Holmberg could be up to "10 cubic yards per foot of beach"? Please elaborate on what is meant by "per foot of beach."

M. Walther. Each foot of beach corresponds to the direction and length along the shoreline parallel to the waterline.

a. Based on A above, is this only true for "medium" or "average" water level if the Holmberg system is installed at high water?

M. Walther. The estimate of 10cy/ft is an estimate of the rough average of net volume change (between installation sites and control areas) based upon Dr. Barnes' monitoring of Holmberg systems, which I understand to correspond to low to moderate water level conditions.

b. Based on B above, Is this only true if the Holmberg system is regularly nourished?

M. Walther. It is my understanding that the Holmberg system sites monitored by Dr. Barnes do not include periodic nourishment.

D. Barnes. OK, Mike's comments refer to the measured change in beach profile. Think of a beach profile offshore a specific distance, either 500' or 1000' in Barnes' studies and 1 foot along the shore. Basically what is the volume of sand change from initial installation to final survey in a skinny, rectangular box 1 foot along shore by 500' offshore and was there a net positive volume change or a net negative change. In Barnes' studies the net change within the zone of impact of the structures was about 10 cubic yards for each long, skinny rectangle in the study area. This was without beach nourishment. Conventional coastal engineering wisdom would demand that this additional sediment was extracted from the long-shore drift at the expense of areas down drift (although no measurable erosion was found within the study sites).