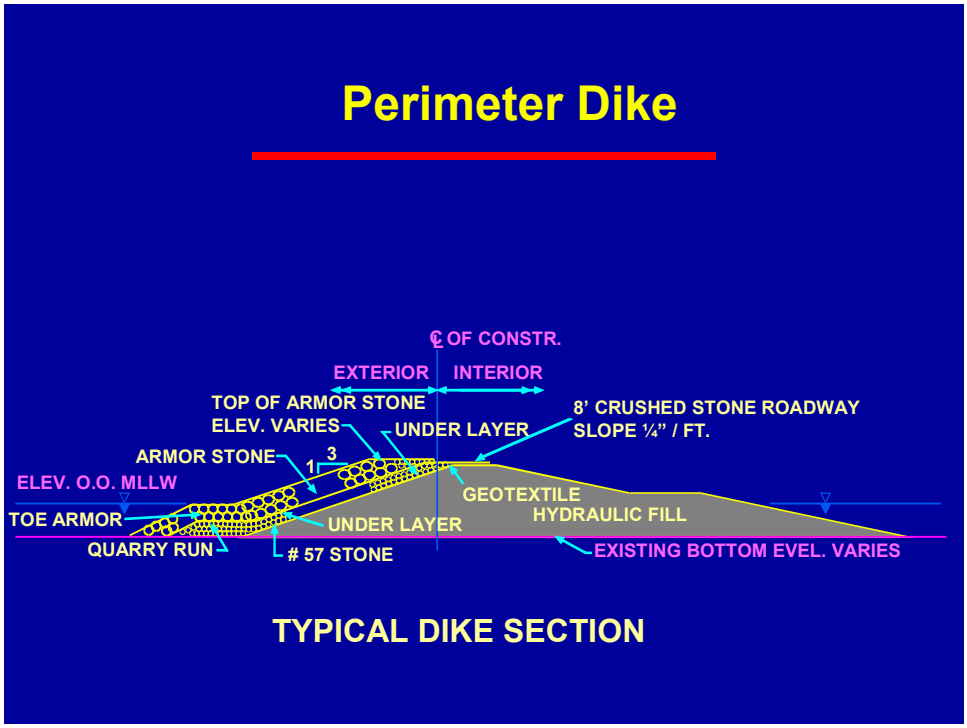
**Containment Dikes**

A dike is a type of berm constructed of soil, sand, rock or a combination of these materials designed to act as a barrier between open water and land. Dikes serve a variety of purposes ranging from erosion protection on coastlines and riverbanks to soil containment in marine construction and wetland restoration projects.

The containment dikes used in the Poplar Island Environmental Restoration Project serve two primary purposes. The first is to contain and manage the dredged material placed during dredging operations. The second is to act as a protective barrier against erosion of the constructed wetland after placement of dredged material has terminated.

The dikes were constructed in several phases concurrent with the filling operations and wetland construction. As seen below, the dike is a complex arrangement of hydraulic fill (sandy material pumped from a dredge), small rocks, large rocks, and geotextile fabric. The large rock is used on the exterior, or open-water side of the dike to resist the erosional forces from waves. The hydraulic fill is used in the interior areas and under the rock where it is not exposed to erosive wave action.




The dike was engineered to maximize use of on-site fill material, which can be placed relatively inexpensively by means of a hydraulic dredge. The fill also serves to contain the dredged material and minimizes the use of rock that must be imported into the site, which is more expensive to place due to transportation costs. Consequently, the rock was placed where it was needed most – on the exterior face of the dike where maximum wave forces occur.

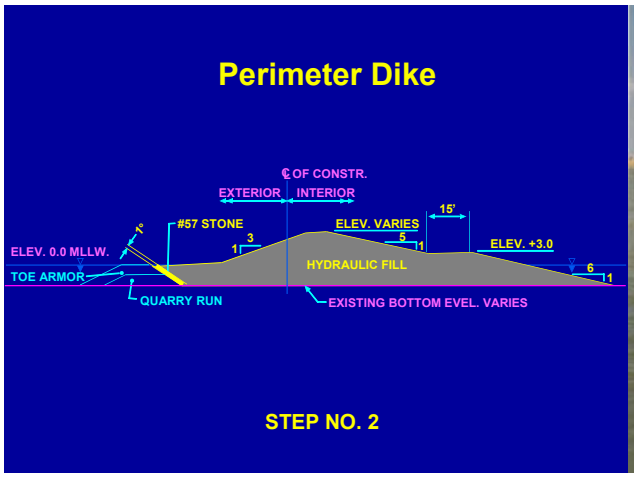
## Construction Sequence

Construction of the containment dike was sequenced to maximize production yet ensure that the dike did not sustain wave damage while being built. The dike was constructed by first putting down geotextile fabric and then building the toe dike of the armor face to provide some protection from waves (see diagram/picture below). This toe dike is vital to the stability of the berm. It provides temporary containment of the hydraulic fill during construction and a permanent foundation of the armor stone layer. The toe dike also acts as a temporary breakwater to resist wave attack during construction of the remaining berm.


## Hydraulic Fill Placement

Hydraulic fill was then placed and formed to create the main portion of the dike. The fill was pumped with a hydraulic dredge from underwater sand sources called “borrow areas” located at the site. The borrow areas for the Poplar Island Environmental Restoration Project were chosen based on several factors: quality of sand; proximity of the borrow site to the dike; and environmental concerns related to sand mining. Each of these factors influenced the cost, schedule and final design of the project. The material used for the dike construction was predominantly sand as opposed to the finer silts and clays that are placed within the perimeter of the dikes. In general, coarser material like sand and gravel make better construction fill.

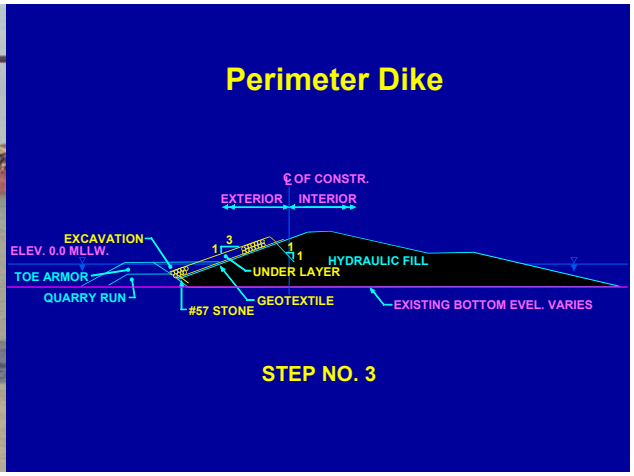
The hydraulic fill is pumped from the borrow area via dredge and formed into the shape of the dike with standard earthmoving equipment, or pumped into a stockpile and then taken by dump truck to the final dike alignment. The dike is constructed linearly, using the top of the newly formed dike as an access road to build subsequent sections.





**Under layer Stone Placement**

After the hydraulic fill is formed and graded to the required shape, geotextile fabric is placed on the slope and the first layer of "under layer" stone is placed on the seaward side of the dike. This "under layer" consists of relatively smaller stones designed to contain the sand (hydraulic fill) and serve as a foundation for the larger outer layer of armor stone. The geotextile fabric prevents the under layer stone from sinking into the hydraulic fill. The geotextile also retains the sand in the dike.


**Armor Layer Placement**

Next, the armor stone layer is applied to the top of the under layer. The armor stone consists of larger stones than those used to construct the under layer and are applied in a thicker layer roughly 2 times the average rock diameter. The armor stone serves as the main protection of the exposed dike against waves and currents. The size of the armor stones is chosen based on the highest waves expected to strike the dike. Because some areas along the perimeter of the dike are exposed to higher energy waves, the armor stone size varies along the perimeter of the dike. Shown in the photo below are the largest armor stones used on the dike, which have an average diameter of 5 feet.


As can be seen from the photo below, each layer of the dike: hydraulic fill, under layer stone and armor stone, are placed in sequence, following each other by only a few hundred feet. Applying the stone layers soon after hydraulic fill is placed, limits the time that the hydraulic fill is exposed to erosional waves.


**Rock Dike Frequently Asked Questions**

Why not use rock to construct the entire dike?

> *Rock must be imported from off-site quarries and is therefore much more expensive than hydraulic fill. In addition, the hydraulic-fill dikes are more efficient at retaining the dredged material.*

Why use two layers of stone with different size?

> *Larger stones are more costly and take longer to place. Since armor stone is only needed in the area directly exposed to waves, its use is limited to the outer layer.*
> *Smaller under layer stone is required to distribute the weight of the armor stone on the*

*dike. Smaller stone is less expensive and easier to place but is too small to withstand the wave forces. Without this under layer, the armor stone would damage the geotextile fabric and sink into the sand layer, reducing the effectiveness of the dike.*

Where do the large stones come from?

*The stone is brought in by barge after being shipped from off-site quarries.*