



## PONDS 3.2 TECHNICAL MEMO

Date: January 29, 2008 (revised)  
Re: **Analyzing PONDS With Sand Chimneys**

In some areas (such as in the Florida Panhandle) when a hydraulically restrictive soil layer occurs near the pond bottom, it is common to excavate the restrictive soils beneath the pond bottom and backfill with a more permeable material in order to access the underlying permeable soil layer and improve pond recovery performance, as illustrated in Exhibit 1 below. This configuration is sometimes referred to as a "sand chimney".

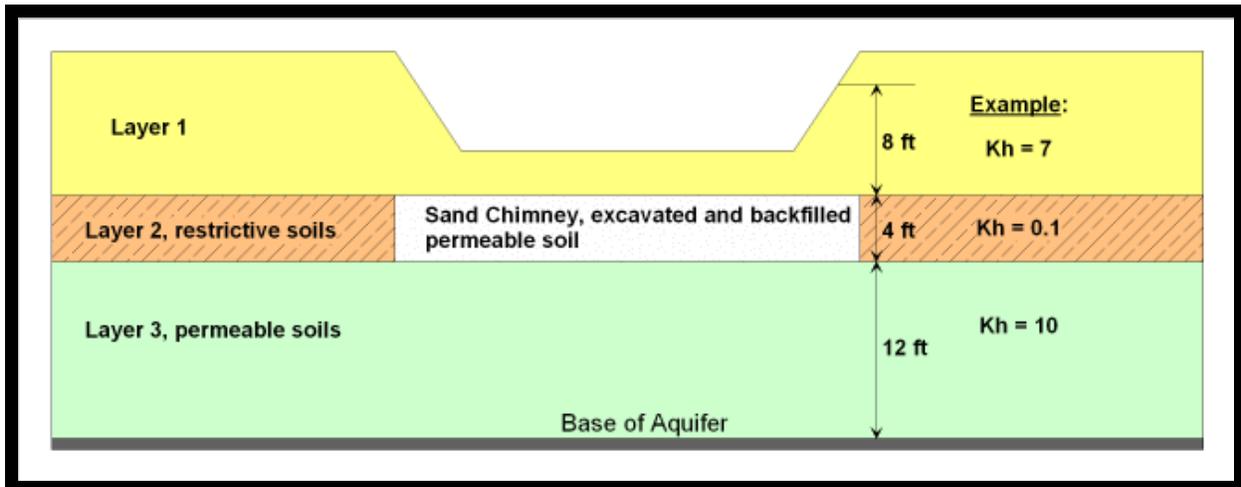


Exhibit 1. Sand Chimney Illustration

In order to model this situation in PONDS, it is necessary to adjust the aquifer parameters to account for the variability of the soil layers, as described below.

### Horizontal Saturated Hydraulic Conductivity

A vertically weighted average of the horizontal saturated conductivity (Kh) should be used. For example, given the following data, the weighted average horizontal conductivity is calculated as follows:

Layer 1:      Kh = 7 ft/day  
                 Thickness of layer = 8 ft,  
                 measured from bottom of layer to pond control elevation or peak stage

Layer 2:      Kh = 0.1 ft/day  
                 Thickness of layer = 4 ft

Layer 3:      Kh = 10 ft/day  
                 Thickness of layer = 12 ft

$$\begin{aligned} K_{h_{avg}} &= (8 \text{ ft} \times 7 \text{ ft/day} + 4 \text{ ft} \times 0.1 \text{ ft/day} + 12 \text{ ft} \times 10 \text{ ft/day}) / (8 \text{ ft} + 4 \text{ ft} + 12 \text{ ft}) \\ &= 7.35 \text{ ft/day} \end{aligned}$$

### Unsaturated Infiltration

The unsaturated vertical infiltration rate is the rate at which water will percolate from the pond in an unsaturated condition. When modeling a sand chimney, the most restrictive infiltration rate should be used from among the soils beneath the pond bottom, i.e., the most restrictive infiltration rate from among the top layer (Layer 1), the permeable fill (chimney) or the bottom layer (Layer 3).

If the excavated area is less than the pond bottom area, then one of the following adjustments should be applied:

- ① The Maximum Area for Unsaturated Infiltration should be set equal to the excavated area, or
- ② The weighted average of the vertical infiltration rates in Layer 2 should be taken for the soils beneath the pond to determine the average effective infiltration rate in Layer 2. Then, the most restrictive infiltration rate from among each of the layers should be used.

### Groundwater Elevation

Often, the groundwater table will not be encountered in the bottom layer, i.e., Layer 3 is dry. In this case, the groundwater elevation should be set nominally above the bottom of Layer 3, such 1 ft above the bottom of Layer 3.

### Construction Considerations

The permeability of the backfill soil should be higher than the permeability of the underlying soil layer (Layer 3).

The over-excavation and backfilling should be monitored and certified by a registered geotechnical engineer.