Session 6
Septic Tank Drainfield Site Suitability and Evaluation Workshop
6-Coarse Fragments x Reaction DEQ Septic.doc

This power point provides in-depth information about soil coarse fragments and soil reaction, i.e., acidity or basicity.

Frame 1: The last two soil physical properties that need to be considered are

Soil reaction
Coarse fragments

Frame 2: A little review about these physical properties before we investigate them in detail.

Soil reaction refers to the acidity or alkalinity (or basicity) of soil. Reference to soil reaction is a little confusing in that a soil which is acid is said to have an 'acid reaction' while a soil which is alkaline is said to have an 'alkaline reaction'.

With regard to septic tank drain fields, **coarse fragments** are materials greater than ¼" in diameter. This would include very coarse sand, pebbles, gravel, cobble, stones, boulders, rocks. Probably the single most important consideration with regard to coarse fragments is that these materials neither retain or hold water nor retard the rapid flow of water through the soil profile.

Frame 3: Soil reaction is a reflection of the pH of the soil solution, which can be assessed either qualitatively or quantitatively. pH is a measure of acidity, which is a reflection of the hydrogen ion concentration. A literal assessment of **soil reaction** can be accomplished by observing how soil responds when wetted with a weak hydrochloric acid solution (10%). **Soil reaction** can also be assessed qualitatively or quantitatively with one of a variety of commercially available test kits or by submitting a sample to a soil testing laboratory. The commercially available test kits involve wetting a soil sample with a reagent and matching the resulting color to a color comparison of known references for which the acidity has been determined.

Frame 4: pH, the hydrogen ion concentration or activity, is reported on a scale from 0 to 14, with 0 being very acidic and 14 being very alkaline. An alkaline soil, one which will react to weak hydrochloric acid, will have a pH greater than 7.0. **The USDA lists soils with a pH 7.4–7.8 as mildly alkaline; soils with pH 7.9–8.4 as moderately alkaline; soils with a pH 8.5–9.0 as strongly alkaline; and soils with pH more than 9.0 as very strongly alkaline.**

Soil reaction and pH of the soil solution are a function of:

1) the geologic parent material,
2) climate/weather – particularly rainfall,
3) the predominant vegetation, and

4) the drainage, leaching, or historic wetting conditions of the soil.

The acidity or alkalinity will influence the life of the septic system, and the functioning of the biofiltration process; it also reveals the circumstances of the soil proper.

Frame 5: In the literal sense, the measure of 'soil reaction' is whether the soil reacts or effervesces, when the soil comes in contact with weak hydrochloric acid. Under such circumstances, the effervescence is caused by a reaction between hydrochloric acid and calcium carbonate, i.e., limestone. This reaction:

no effervescence – corresponds to pH , 7.0
weak effervescence - pH 7.4–7.8 as mildly alkaline
moderate effervescence - pH 7.9–8.4 as moderately alkaline
strong effervescence - pH 8.5–9.0 as strongly alkaline
violent effervescence - pH more than 9.0 as very strongly alkaline

The presence of calcium carbonate, i.e., limestone, indicates that the parent material is sedimentary, that rainfall-induced leaching has occurred to a depth approximated by the depth of limestone accumulation, that 'cementing agents' are likely present in the soil.

About this depth of accumulation of calcium carbonate – limestone. Calcium minerals in the soil are dissolved by rainwater and leached into the soil profile. These dissolved calcium minerals eventually accumulate at the depth of long-term geologic leaching, where they form limestone and precipitate (solidify). Thus, the depth of calcium carbonate accumulation is a good index of the natural depth of annual rainfall leaching. The presence of calcium carbonate generally signifies that the amount of annual rainfall is less than the amount of water lost to evaporation annually.

However, it is possible for the presence of calcium carbonate to be a reflection of upward movement of groundwater. A calcium-rich ground water being evaporated near the soil surface will result in an alkaline reaction. This is a rare occurrence, but it can happen.

Frame 6: The opposite circumstance is the occurrence of acidic soil reaction, i.e., acidic soils. These are soils with pH < 7.0. Acidic soils reflect one of several circumstances, either alone or in combination:

Soils derived from granite or predominantly quartz
Soils with an abundance of acid-forming minerals (primarily ferrous)
Excessively leached soils – all the base cations have been leached out and replaced with hydrogen
Soils with accumulations of excessive amounts of organic matter and likely poor aeration status.

Obviously, none of these conditions is conducive to properly functioning drain fields – either because of excessive drainage, lack of drainage, or a hostile environment for a functioning drain field.

Frame 7: Coarse fragments are defined as any material greater than ¼" in diameter – from the perspective of soil material, although coarse fragments (rocks and stones) in the 1-3" diameter category are generally used as the gravel envelope material surrounding drain tiles.

Coarse fragments, when used as the envelope material, are specifically intended to facilitate good internal drainage away from the tile line. The objective is to allow water to flow freely from the tile line to the surrounding soil and biomat, which work to biologically degrade and physically filter the suspended sediment and organic material from the discharge water from the tank.

Once water has drained away from the line, the objective is to provide a storage mechanism and retention time for biodegradation of organics, destruction of bacteria and viruses, and transformation of nitrogen in the waste water. Coarse fragments in the soil – sand, pebbles, gravel, stones – do not provide either this storage opportunity or retention time for effective wastewater treatment.

The presence of 10% coarse fragments means a 5% reduction in pore space – and a 20% increase in rapidly-conducting pore channels. The presence of 20% coarse fragments means a 10% reduction in water-storing pore space and a 40% increase in rapidly-conducting pore channels.

Frame 8: Here are a few examples of unacceptable substrate conditions – Situations A and C would likely provide acceptable overburden material, i.e., fill over the top of the drain field. However, neither would be acceptable as soil below the drain field – because of: 1) excessively high percolation rate, 2) lack of sufficient fine material to allow for either retention or biological treatment/filtration. Site B is unacceptable because of the presence of a seasonally shallow water table.

Frame 9: Summarizing: the purpose of gravel, when used, is to support the pipe, provide a relatively stable and non-slumping envelope around the pipes or below the infiltrator chambers, and form an envelope around the pipe, to protect it from roots and varmints and facilitate water flow away from the buried line.

The effluent flows though the gravel and enters the soil both below and to the side of the trench, where suspended sediment (any remaining fine solids) is filtered out and organics, bacteria, and viruses are removed through biological degradation. The lack of a significant role of gravel with respect to treatment is evident by the growing use of technologies such as infiltrator chambers and other designs which do not require gravel.

Frame 10: Questions?

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