PART 2C

GEOTECHNICAL CONSTRUCTION CONSIDERATIONS FOR STORMWATER MANAGEMENT SYSTEMS

ALTHOUGH EVERYTHING LOOKS GOOD ON PAPER

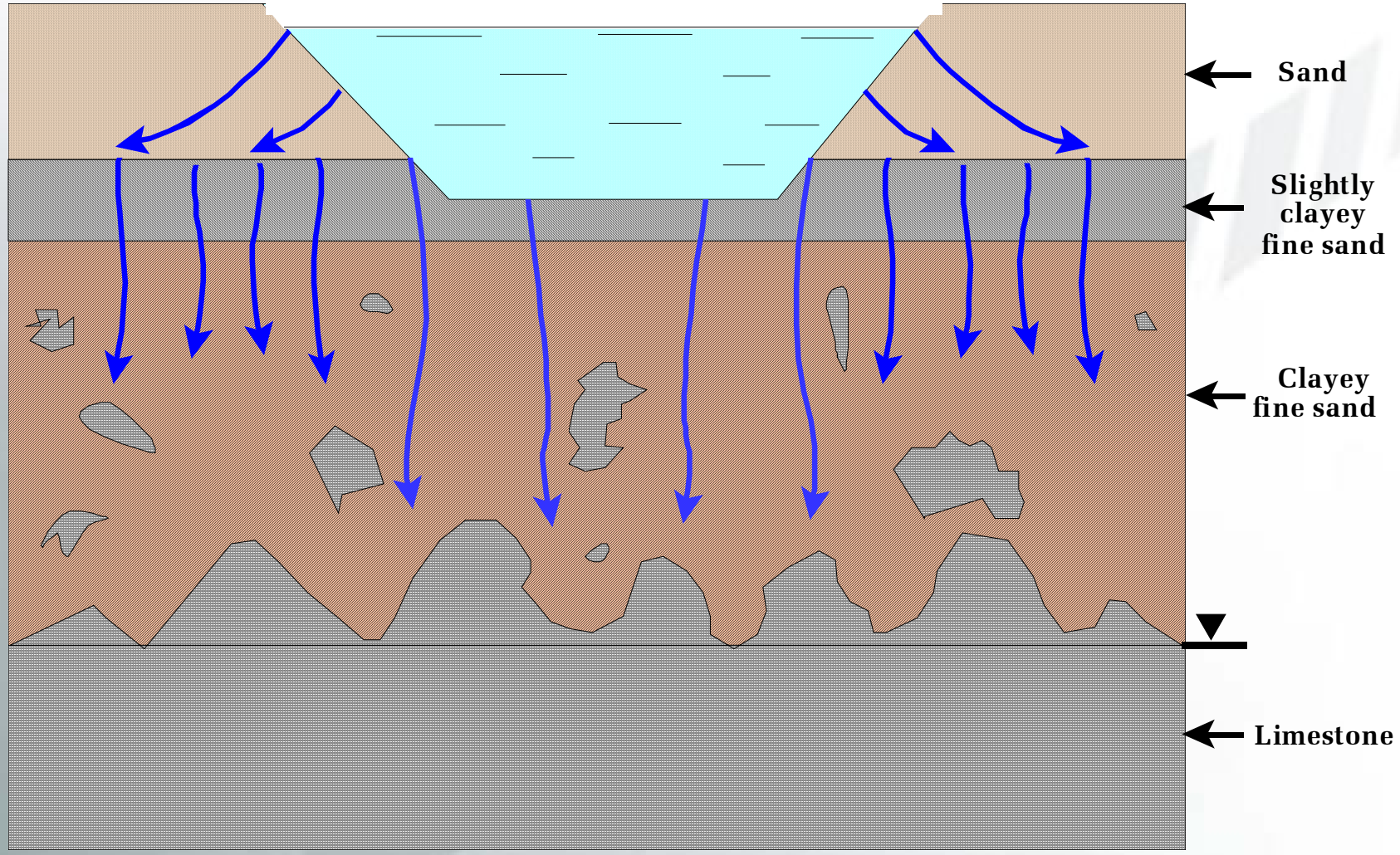
(i.e., thorough geotech & appropriate analysis)

YOU MAY STILL SOMETIMES RUN INTO PROBLEMS IN THE *FIELD*...

THESE ARE SOME OF THE FIELD PROBLEMS

- Remolding & reduction in permeability of naturally leaky clayey soils due to grading and traction of construction equipment
- Siltation of pond bottom mainly during construction (due to lack of erosion & sediment control)
- Rapid clogging of sand filtration systems due to “algae”, especially near wetlands
- Settlement of exfiltration trenches on loose sands after initial loading with runoff volume of water
- Over-excavations for under-drained or dry-bottom ponds not carried out per design intent
- Sinkholes form due to concentration of runoff
- Shallow rock in certain parts of the state
- Construction dewatering

Dry Retention In Leaky Aquifer With Deep Water Table Excavation Extends into Clayey Sand

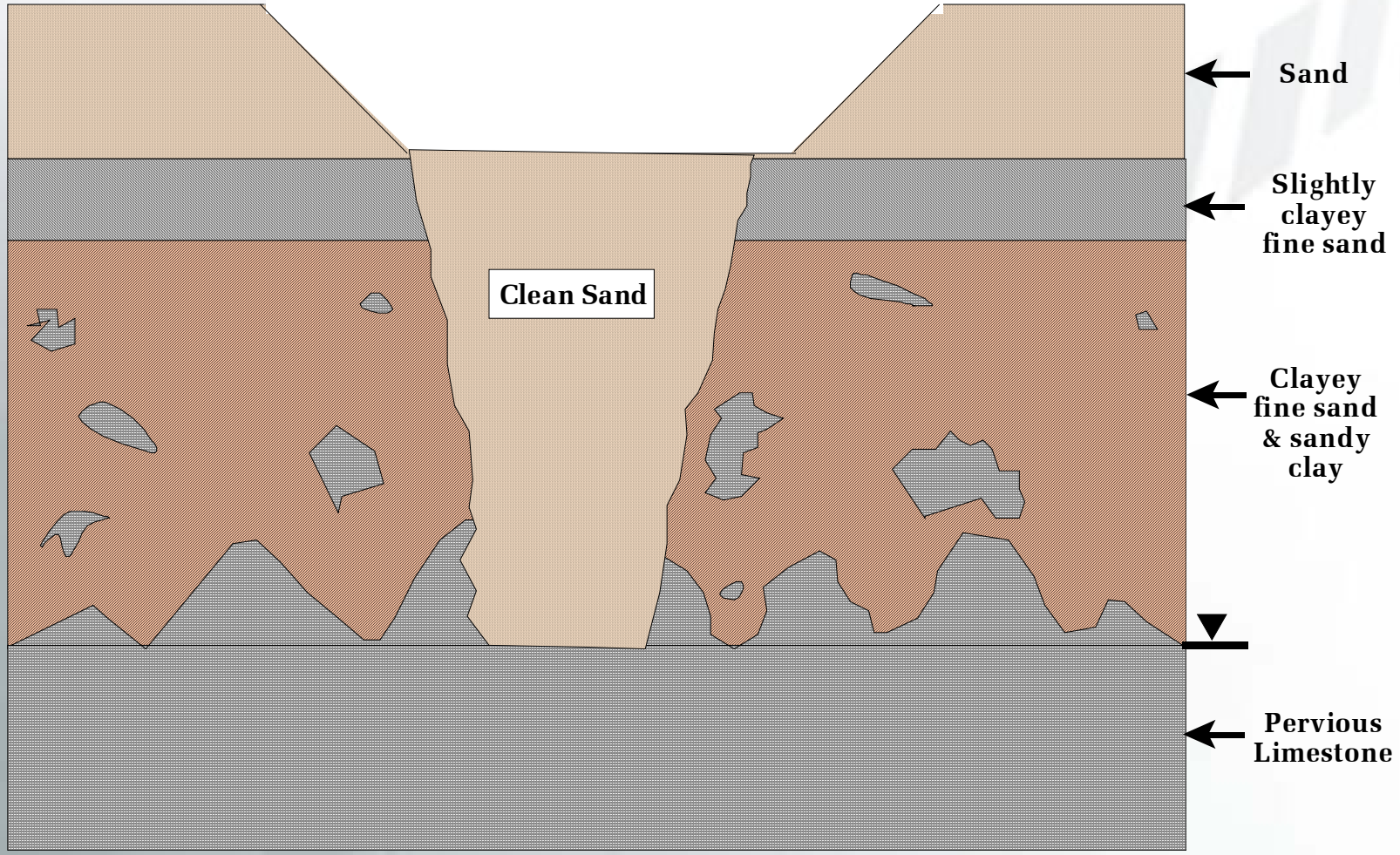


MAINTAINING LEAKINESS OF POND BOTTOM EXCAVATED IN CLAYEY SAND

Where exposed by the pond excavation, the clayey sand unit should be overexcavated by 1 ft, the overexcavated surface heavily scarified, and then backfilled with clean sand excavated from the upper soil profile. Prior to backfilling with sand, the surface should be inspected by the engineer to ensure heavy equipment track & wheel loads have not sealed the naturally occuring fractures and channels. As an added safety measure, at least two (2) double ring infiltrometer tests should be performed to ensure the vertical infiltration rate has not been reduced below an acceptable level.

- RETROFIT OPTION -

OVEREXCAVATE & BACKFILL WITH PERMEABLE SAND ENSURE BOTTOM OF EXCAVATION HAS SUFFICIENT VERTICAL DISPOSAL CAPACITY MOST ASSURED METHOD TO VERIFY THIS IS BY LOAD TESTING



POND BOTTOM SILTATION

- This problem is usually at its worst during construction before the streets are paved and the bare ground is sodded. High sediment load enters the pond reducing percolation through bottom & sides.
- SJRWMD recommends that the pond bottom remain 1 ft higher than the design grade until construction is complete. As a last step, the pond bottom should be excavated to its finish grade and then sodded. This ensures the sediment is removed prior to the pond being put in service.

CLOGGING OF SAND FILTERS

- Some agencies still allow the use of sand filters for treatment of the water quality volume.
- From experience, waters in or around wetlands tend to contain high concentrations of micro-organisms which rapidly clog the filter fabric. This is a similar effect to the formation of a biomat in septic drainfields.
- Solution: do not rely on the long-term performance of filters in these areas. Use alternate BMPs such as wet detention, etc.

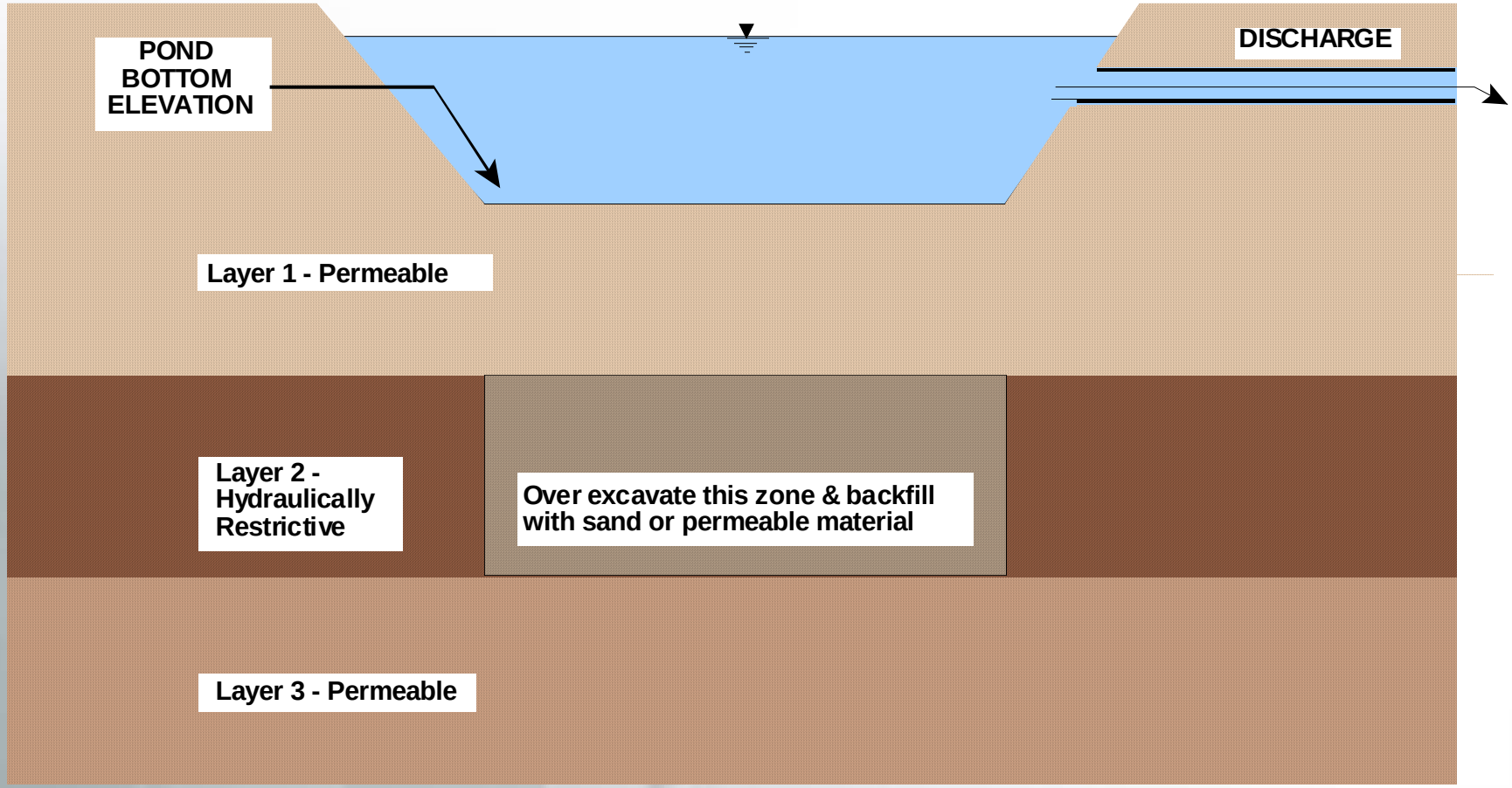
SETTLEMENT OF LOOSE SAND SUBGRADE UNDER EXFILTRATION TRENCHES

Loose sands may settle (consolidate) due to the hydraulic stresses resulting from the rapid concentration of stormwater runoff in exfiltration trenches. Very loose soil conditions can occur in nature or can be created by the placement of sand backfill without compaction. Settlement of this type usually occurs after the trench receives its first significant quantity of rainfall runoff. While this type of settlement may not be a cause for concern where the exfiltration trench is located within a landscape area, it can lead to distress when the trench underlies a structure such as a pavement.

HOW TO AVOID SETTLEMENT OF LOOSE SAND SUBGRADE UNDER EXFILTRATION TRENCHES

To avoid settlement, it is recommended that, prior to final grading of the cover, the trench be flooded continuously for a minimum period of 8 to 10 hours. Water for flooding may be obtained from a nearby fire-hydrant, well, lake, or potable water connection. This flooding should simulate worst case rainfall runoff conditions and mitigate future generalized or localized subsidence. Settlement of the chambers and the gravel backfill in the trench should be monitored during the flooding and for about a week thereafter, before final grading is performed.

Such an over-excavation must be monitored by geotechnical engineer



Notes:
①Typical in Brevard and Indian River County where the hardpan layer can be removed to access the lower zone of sand and shell
②Must be inspected by geotechnical engineer
③Weighted horizontal hydraulic conductivity

SINKHOLES

- Exfiltration trenches not a good idea in parts of the state where there is a thin overburden and high potential for sinkhole development, unless thoroughly checked out by a geotechnical engineer. Concentration of stormwater can lead to sinkhole development which cannot be seen at the surface.
- FDOT tried this on I-75 (in Marion County) and numerous sinkhole developed leading to a maintenance nightmare. Many of you remember when the southbound of I-75 was shut down. FDOT abandoned the trenches & went with swales.

DESIGN OPTION WHERE POTENTIAL FOR SINKHOLE DEVELOPMENT IS HIGH

- If rock is shallow and sinkhole development could be a problem, design for spanning a 5 to 10 ft opening. Use 3 ft of sand cover over a structural filter fabric with about 1350 lb/ft of load carrying capacity.

AVOID CLAIMS
CAUTION CONTRACTOR ON POTENTIAL FOR ROCK EXCAVATION

Contractors also have to be aware when digging these ponds that there is sometimes a large amount of rock within the soil matrix and also rock pinnacles. Some of this rock may require rock breakers or ripping.

STEP #1 & #2 - FDOT RECOMMENDATIONS

- Step #1: If the sinkhole consists only of a surface depression (re: no open fissure or exposed cavern), proceed to step #3.
- Step #2: If the sinkhole has an open fissure or exposed cavern, fill the sinkhole to within 3 feet of plan grade with either: a) concrete rubble or gravel, or b) flowable fill. If concrete rubble or gravel is used it should consist of hard, durable stone, broken concrete and/or broken concrete block. Material acceptance may be based on visual inspection. The most important material characteristics are that the concrete/stone pieces be durable (i.e. not soft and dissolvable), somewhat angular, and predominately coarser than a 1-1/2 inch sieve.

STEP #3 - FDOT RECOMMENDATIONS

Place two layers of geosynthetic reinforcement, and one layer of geotextile fabric-if required, as follows:

Material:

The reinforcement to be used should have a minimum tensile strength of 1,35O lb/ft (ASTM D-4595) at a strain of 10% or less. If the reinforcement has an Apparent Opening Size (AOS) less than 70, place a layer of type D-3 (R&TD Standard Index 199) geotextile fabric with AOS ≥ 70 over the reinforcement layers.

Excavation:

Excavate to a depth of approximately 3 feet below the pond bottom, and to a plan area which allows for a reinforcement/fabric installation that extends/provides coverage to at least 10 feet beyond the surface opening of the sinkhole, but does not interfere with existing travel lanes.

STEP #3 - FDOT RECOMMENDATIONS

Placement:

Place the geosynthetic reinforcement layers 3 feet below the pond bottom, within the above described excavation. If the reinforcement has an AOS less than 70, place a layer of above described geotextile fabric over the reinforcement layers. Anchor the two reinforcement layers (and the fabric, if installed) at least 10 feet beyond the limits of the fissure/cavern opening. In the 10 foot anchor zone area, the two reinforcement layers should be separated by at least 6 inches of soil. In the non-anchor zone area, the upper reinforcement layer may be laid directly on the underlying layer. Stagger the two reinforcement layers so the joints do not coincide. Fill the upper 3 feet of the excavation/sinkhole to grade using select backfill, and compact to a firm and unyielding surface.

CONSTRUCTION DEWATERING ISSUES

- May need a permit
- Watch out for artesian conditions with uncontrollable vertical upwelling of ground water
- Deep permeable sands may yield very high dewatering quantities. Need to come up with a plan to manage the ground water discharge.
- Dehydration impacts to adjacent wetlands can be a controlling factor.