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September 14, 2015

Billy Dunham
Craven Ag Services, Inc.

Subject: Particle Size Analysis and Recommendations
Craven Ag Services, Inc. Compost Site and Associated Products

Shaffer Soil Services, Inc. was contracted to evaluate particle size analysis for 4 samples submitted September 6, 2015. These samples are all from the proposed compost site for Craven Ag Services, Inc. The site was cordoned off into 4 sub-plots, and each plot randomly and representatively sampled with a number of samples to form a composite sample. Under separate letter Craven Ag Services, Inc. will submit the sampling plan and procedure including the sample location map.

The samples were first analyzed by the feel method. The results were as follows:

SAMPLE NUMBER	FEEL TEXTURAL CLASS
1	Fine sandy loam
2	Fine sandy loam
3	Loamy Fine Sand
4	Loamy Fine Sand

For laboratory texture evaluation, the samples were first treated to remove organic matter, then dried and analyzed for particle size analysis with the hydrometer method (ASTM D422). The samples were each analyzed, and a composite of all 4 samples was developed and this shows as sample 5. The table below shows the results of the analysis.

SAMPLE NUMBER	% SAND	%SILT	%CLAY	USDA TEXTURAL CLASS
1	84.8	8.8	6.4	Loamy Fine Sand*
2	85.6	7.6	6.8	Loamy Fine Sand*
3	84.4	8.0	7.6	Loamy Fine Sand*
4	83.2	9.6	7.2	Loamy Fine Sand*
5	84.4	8.6	7.0	Loamy Fine Sand*

*Loamy Fine Sand is defined on the USDA textural calculator. Attachment "C" shows the USDA textural triangle plot for the mean. i.e. sample 5.

Because the sand was noted in the feel method to be fine or very fine, another hydrometer test was run at close intervals through the sand fraction to separate the fine and very fine sands from the medium, coarse, and very coarse sands. These size distinctions are shown in Attachment "A" in an excerpt from the USDA handbook for Soil Classification. Also, the USDA texture calculator classified the texture as loamy fine sand with just the basic data inputs based on the hydrometer readings. The justification to separate the fine and very fine sands are as follows:

1) Although these particle sizes classify under the sand fraction for USDA texture, they are recognized as being more functional in terms of moisture holding capacity, nutrient holding capacity, and compaction/permeability as a silt particle than a sand particle. This is why distinctions are commonly made between sands (medium and coarser) and fine and very fine sands.
2) Fine and very fine sands are capable of making relatively slowly permeable layers in the soil. Farmers are well aware of this feature. Even in soils with a high sand content, a thin, slightly cemented compaction pan can form in shallow layers that become very slowly permeable to downward water movement. Farmers see this as a compaction layer that they will periodically rip or chisel with a tool that cuts into this compacted layer at depths of 10-14 inches. This pan can also limit root penetration, so once it is opened roots begin to move downward. These compacted layers only form, or better said form more firmly, where soils have a higher fraction of fine and very fine sands. The coarser sands will not set up into such firm layers.
3) Fine sands are 4 to 8 times smaller than the coarse sands which allow a far greater amount of particle packing which reduces permeability. Very fine sands are 10 to 20 times smaller than coarse sands.
4) Anecdotal evidence shows that these soil layers of loamy fine sand and loamy very fine sand can be rendered very slowly permeable with repeated equipment grading and pressure.

The hydrometer allows the separation of the fine and very fine sand groupings from the medium and coarser sands. The following table shows the sand separations for the samples. It separates the sand fraction, using the total sand content by % (totaling 100%).

HYDROMETER TEST FOR SAND SEPARATES

SAMPLE NUMBER	Very coarse, coarse, and medium sands (% of total)	Fine and very fine sands (% of total)
1	24	76
2	21	79
3	28	72
4	31	69
5	26	74

A section of the USDA handbook is attached at the end of this report (Attachment "B") to define the distinction between the sand fractions. Since we do not define between fine and very fine sands, we have either a loamy fine sand or a loamy very fine sand. In either case, we have a texture more fine than a straight loamy sand. The data show very good consistence among the samples, which indicates a very uniform area across all 4 subplots.

Summary- the data support the classification of loamy fine sand which does technically represent a texture finer than loamy sand. The lab data support the high amount of fine and very fine sand within the sand fraction, which renders these soils much less permeable than a loamy sand. As these layers are on the soil surface to 12 inches, the loamy fine sand will also allow a significantly reduced infiltration rate into the soil profile, effectively acting as a soil barrier of sorts to reduce the amount and speed of water infiltration. Packing of these textures promotes reduced infiltration and permeability, and likewise these layers should not be disturbed with a plow or chisel or any equipment that would eliminate the compacted loamy fine sand layers.

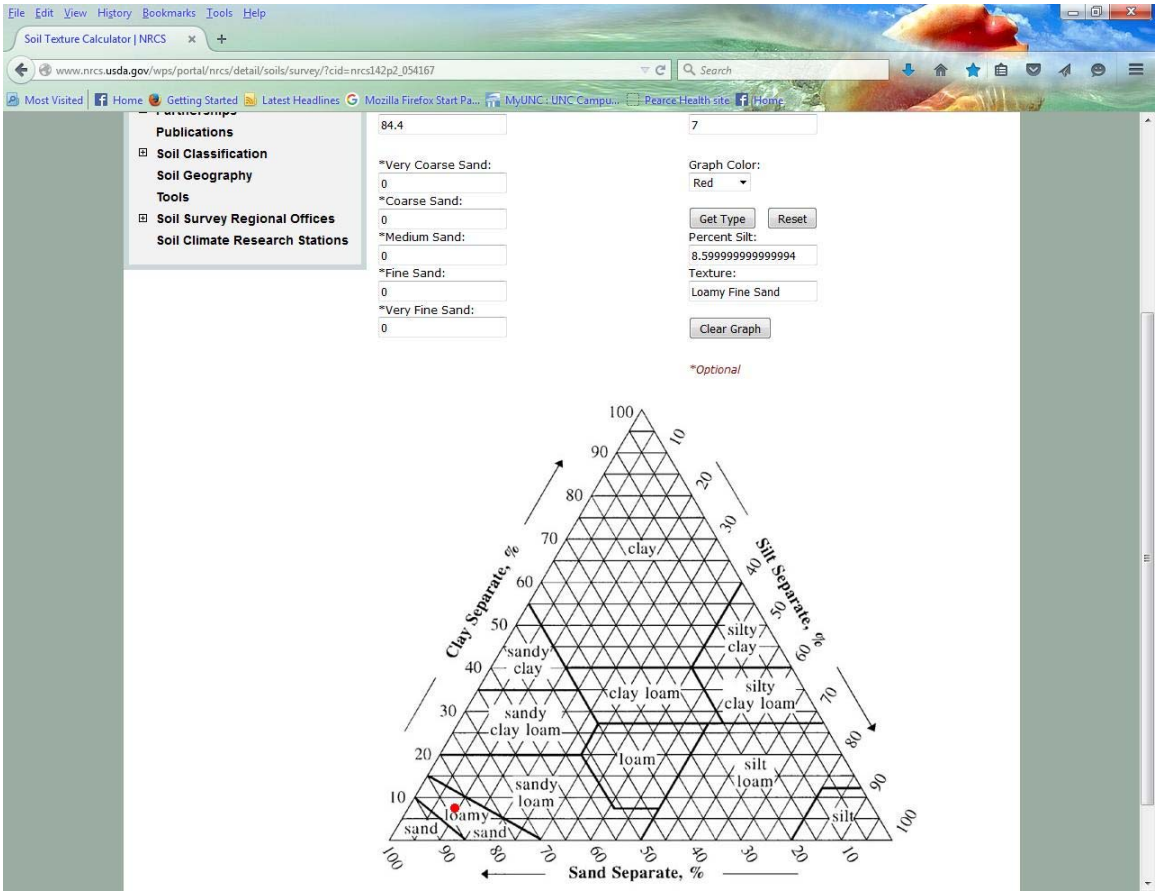
If you have any questions concerning this report or require further assistance, please do not hesitate to contact me. Thank you for the opportunity to perform this service for you. Let me know if you need the raw samples back. Otherwise I will maintain them for a period of time.

Sincerely,

Karl A. Shaffer
NC Licensed Soil Scientist
Certificate No. 1009

Raw Data Table for hydrometer analysis

Sample #	T_1 reading	T_1 Temp (° F)	T_2 reading	T_2 Temp (° F)	Solution Blank Reading
1	11.6	77	7.0	78	6
2	11.2	77	7.2	78	6
3	11.4	79	7.6	78	6
4	12.0	79	7.8	78	6
5	11.6	79	7.4	78	6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84.4
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*Very Coarse Sand:
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