PULLMAN & COMLEY 100 YEARS

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November 6, 2020

VIA ELECTRONIC FILING

Melanie Bachman, Executive Director/Staff Attorney
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

Re: Docket 492 - Gravel Pit Solar – Application for Certificate of Environmental Compatibility and Public Need to The Connecticut Siting Council Regarding a Solar Project in East Windsor, Connecticut

Dear Ms. Bachman:

I am writing on behalf of my client, Gravel Pit Solar ("GPS") in connection with the November 4, 2020 comment letter filed by the Connecticut Department of Agriculture in the above-referenced Docket. With this letter, I am enclosing soil compaction testing results from the Tobacco Valley Solar Project, located in Simsbury, Connecticut. As you can see from the attached report, significant soil compaction was not encountered at the Tobacco Valley Solar Project.

If there are any questions concerning this submittal, please contact me directly. I certify that a copy of this submittal has been submitted to the parties listed on the service list for this Docket.

Sincerely,

Lee D. Hoffman

Lee D. Hoffman

Enclosure

May 28, 2020

Mr. Aaron Svedlow
Gravel Pit Solar. LLC.
1166 Avenue of the Americas, 9th Fl.
New York, NY 10036

Subject: Soil Strength Due to Solar Array Construction Practices

Dear Mr. Svedlow:

Duraroot performed soil compaction testing on approximately 148 acres of the Tobacco Valley Solar project (TVS), located in Simsbury, Connecticut. Compaction testing was performed by a Duraroot soil scientist on May 8, 2020. The intent of the data is to determine the extent of soil compaction, where present, and to assist Gravel Pit Solar, LLC with improving storm water models for permit processes.

Methods

Duraroot visited the Property on May 8, 2020 and collected soil strength measurements using Field Scout SC 900 Soil Compaction Meter (Spectrum Technologies) cone penetrometer. The soil compaction meter was equipped with a ½ inch cone. Soil strength was measured at 1 inch increments to a depth of 18 inches, or refusal. Soil strength, measured in pounds per square inch (psi), estimates the compaction level of the soil. Soil strength measurements were obtained from 58 locations, 44 locations within the constructed solar farm and 14 locations in undisturbed adjacent areas (Figure 1). Data was analyzed using a two-sample t-test in the R statistical package (R Core Team, 2013). The collected data was grouped by the families associated with the mapped soil map unit and each 1 inch depth increment to determine if soil strength was significantly different between the solar array areas and undisturbed areas at each depth.

In some sampling locations refusal was encountered at depths shallower than 18 inches. In these areas the last depth measured was recorded, and no further data estimates were measured. Refusal was encountered at various depths, both in the arrays and in undisturbed areas. The refusal was either due to coarse gravel or high soil resistance (compaction), but a distinction could not be made based on methodology used.

Results

Two dominant soil type exist on the Tobacco Valley Solar site.

1. Merrimac Series: *Sandy, mixed, mesic Typic Dystrudepts (Inceptisols)*
2. Hinckley Series: *Sandy-skeletal, mixed, mesic Typic Udorthents (Entisols)*

The Merrimac soil map unit encompassed approximately 48% of the site, while the Hinckley soil map unit covers 40%. The soil map units classified as Inceptisol and Entisols Soil Orders each comprised of 50% of the project site (Figure 1). Comparison of the data was based on differences between soil resistance measurements within each Soil Order, discussed below.

Inceptisols

No significant increase in soil strength between undisturbed and within the solar arrays was identified across the Inceptisol Soil Orders at the 95% confidence level (Figure 2). In fact, at the 16 inch depth increment soil strength was greater in the undisturbed area versus the solar arrays. At the 17 and 18 inch depth increment 5 of the 7 undisturbed sampling locations encountered refusal; therefore statistics could not be determined for the 17 and 18 inch depth increment. In other words, soil strength did not increase within the solar arrays on the Inceptisol Soil Orders during the construction of the solar arrays.

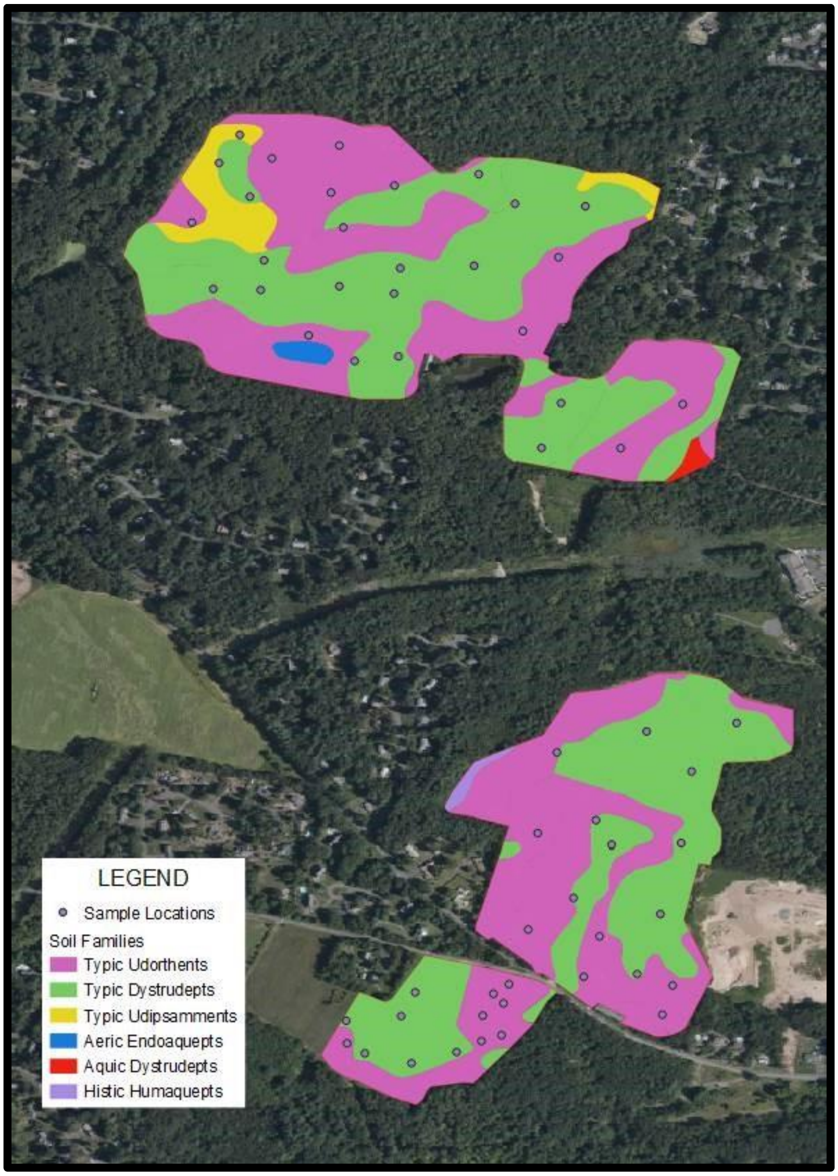

Figure 1. The soil map units within the study area.

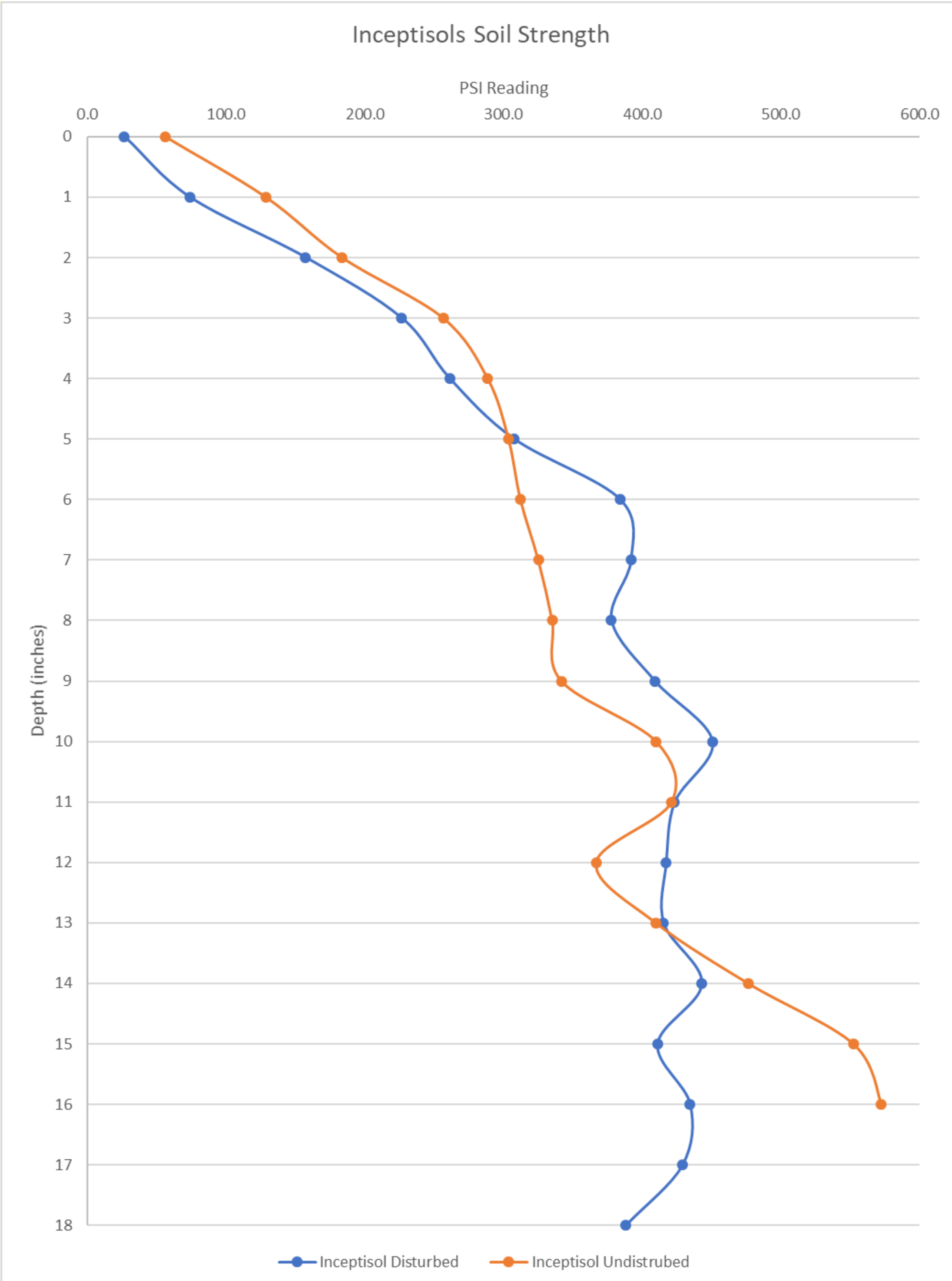

Figure 2 Soil resistance with depth on the Inceptisol, no significant differences.

Entisols

Surface soil strength (0-5 inches) was not significantly different between the undisturbed and solar arrays within the Entisol Soil Order (Figure 3). However, soil strength was significantly greater in the solar arrays than the undisturbed areas at most depths below 5 inches. The only nonsignificant difference observed below 5 inches was at the 13-inch depth, however, there was still a numeric difference of 120 PSI and had a p value of 0.07. Based on the data it appears that during the construction of the solar arrays that the Entisol Soil Order was compacted at depths greater than 5 inches.

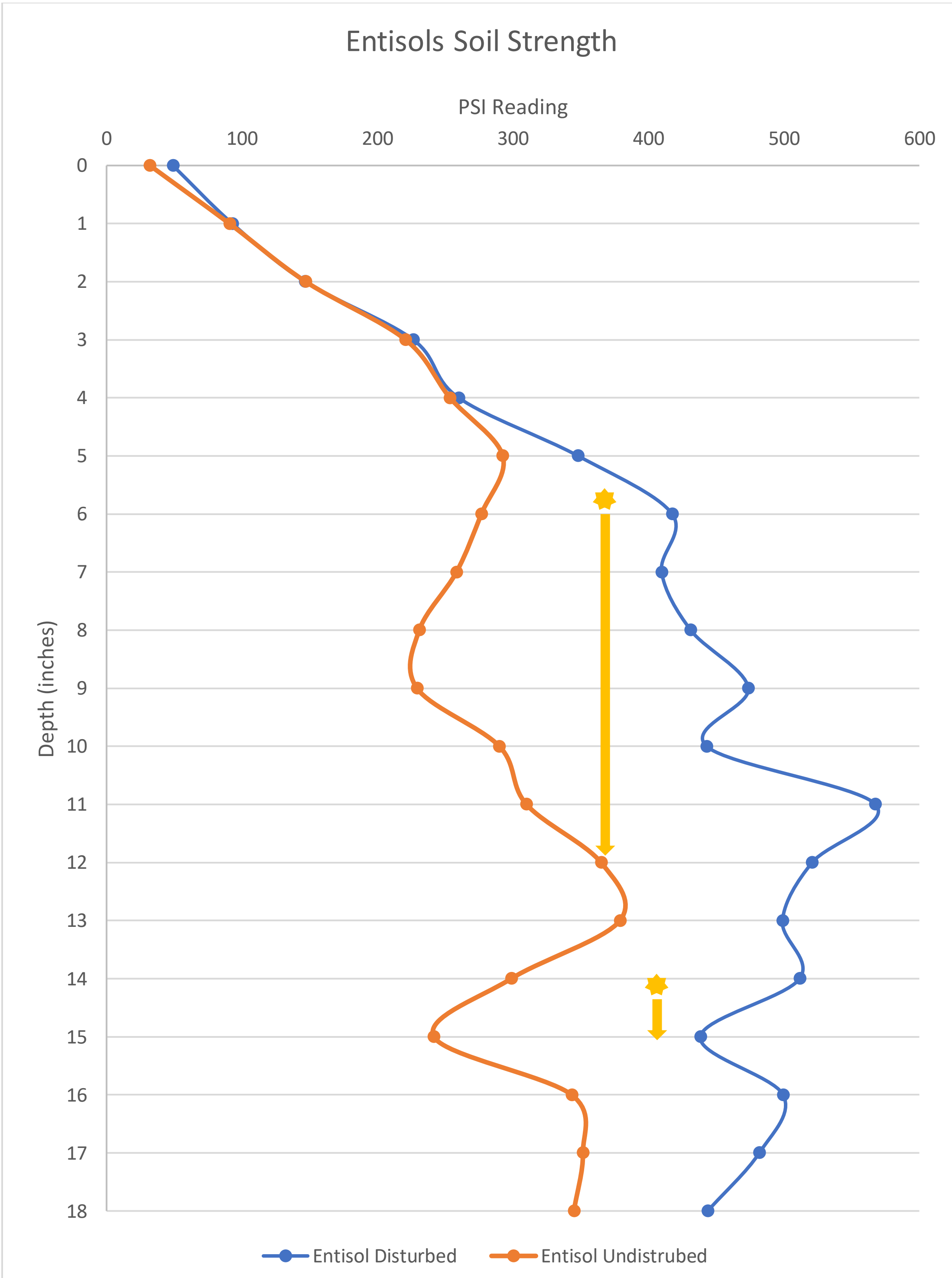

Figure 3. Soil resistance with depth on the Entisol, star and arrow indicate significant differences at the 95% confidence level.

Discussion

Soil resistance (strength) measurements, obtained with a penetrometer, are a practical method used to infer levels of soil compaction. Soil strength has been shown to be a good predictor of root system performance and because of this, it is often used as a surrogate for soil bulk density measurements (Thompson et al. 1987). Soil strength measurements can predict crop root development in disturbed soils such as those on the property (Thompson et al. 1987; Vance et al. 1998). Plant roots extend through existing soil pores or by displacing soil particles; when compaction is introduced, the amount of available air filled pore space decreases and subsequently, soil strength increases. When soil strength exceeds a root's ability to expand into smaller sized pores, root growth is redirected and growth rate or root elongation decreases (Kozlowski et al. 1999). Therefore, for this report, a significant increase in soil strength will be assumed to be a significant increase in soil bulk density, and no significant difference in soil strength will be assumed to be equivalent to no significant difference in bulk density.

Compaction

The process of solar field development typically involves removing native vegetation and disturbing soil structure through grading and excavating. Soil compaction can result from the construction equipment traversing the work area over an extended time period. Gregory et al (2006) documented significant soil compaction from heavy equipment wheel traffic on construction sites. The increased compaction reduced the soil infiltration rate 70% to as much as 99% compared to non-compacted soils. Soil compaction, if left untreated, can ultimately lead to a reduction in overall soil porosity, resulting in increased surface runoff and subsequent erosion (Haynes et al 2013, Woltemade, 2010). Preventing soil compaction to the extent possible and implementing decompaction measures is an important component to maintaining soil infiltration rates and the hydrologic group classification. Based on the data collected, approximately 50% of the site was compacted during the construction of the solar array. Increased soil resistance, interpreted as bulk density, will likely impair water movement through the soil and ultimately increase surface run-off as the soil approach field capacity. Soil strength was not significantly increased on the remaining portion of the site and it is expected that infiltration and percolation will not be decreased due to soil compaction.

Decompaction

Soil compaction is a relatively common problem in agricultural systems, because of this, numerous methods to decompact soil have been developed and studied. These methods can be useful when remediating soil after construction impacts. The two primary methods of decompaction are mechanical and biological. A variety of agricultural implements exist to mechanically break through compacted soil layers and introduce pore space to the soil profile. Mechanical decompaction of soil improves has shown to improve crop growth, decrease soil penetration resistance (soil strength), and increase soil infiltration rates (Álvarez et al. 2009). Soil infiltration rates were significantly increased and sustained for several years after implementing tillage on compacted soils in a study by Mohammadshirazi et al. (2017).

Similar to mechanical (tillage) decompaction, biological methods have also shown to be successful in remediating soil compaction. Biological decompaction utilizes the root mass of certain crops, to physically break through compacted soil layers. Cover crops have been observed to increase infiltration significantly when compared to areas without cover crops in no till systems (BlancoCanqui et al. 2011). A study by Chen and Weil (2010) demonstrated that forage radish and brassica, species with tuberous roots, had twice the root mass of fibrous rooted rye cover crops. Cover crops break through compacted soil layers, creating channels for the roots of subsequent crops to growth through. Williams and Weil (2004) observed significantly improved soybean yields following a crop of forage radish and rye on a compacted soil.

Conclusions

No statistically significant differences in soil resistance were observed between disturbed soils of the Inceptisol Soil Order within array and soils unimpacted by solar construction. Significant differences were observed within the Entisol Soil Orders at depths greater than 6 inches. Although soil compaction, measured as resistance, was identified throughout portions of the site, the observed compaction can be alleviated or prevented during construction by implementing decompaction. The data indicates that the Inceptisol Soil Orders, especially those classified as Typic Dystrudepts , will not be subject to compaction during solar array construction. Data indicates that Entisol soils may be more prone to soil compaction during solar array construction. However, based on research data on soil management processes, including mechanical deep ripping and/or bio decompaction, methods exist to limit compaction and maintain original soil infiltration and percolation rates both during and after construction on the Entisol soils.

The Inceptisol (Enfield soil map unit) soil, *Typic Dystrudepts,* is also the dominant soil type of the proposed Gravel Pit Solar site. Based on the data from the Tobacco Valley Solar soil strength evaluation, construction on the soils mapped on the Gravel Pit Solar site will likely not result in soil compaction. Soil compaction and subsequent change in hydrologic group is not anticipated at the proposed Gravel Pit site, based on soil physical properties and the proposed reclamation strategy.

Recommendations

The data collected from the Tobacco Valley Solar site indicates that soil strength, and likely compaction, is dependent on soil forming factors. Inceptisol soil, particularly *Typic Dystrudepts*, showed no increase in soil strength compared to undisturbed areas. However, the Entisol soils indicated that soil strength increased due to construction activity. There is no data that indicates that an increase in soil strength occurs due to solar construction on Typic Dystrudepts and no scientifically valid reason to decrease the soil hydraulic grouping on these soil families. On the Entisol soils an increase in soil strength was identified and it is possible that infiltration and percolation could be reduced. It is believed that the soil infiltration and percolation can be maintained if proper management is implemented prior to and after construction, even in compaction prone soils.

In order to maintain soil infiltration and percolation and associated hydraulic group ratings, decompaction by mechanical and/or biological methods should be considered as part of the solar site construction and reclamation process. Mechanical decompaction, using agricultural tillage equipment, is recommended to be implementing during the final phases of earthmoving and grading. By implementing deep tillage to a depth of 18 inches, hardpan soil layers below the surface will be fragmented and shattered. Breaking through compacted layers allows for surface water to infiltrate through the soil profile; this reduces overall runoff and subsequent erosion potential. Tillage in combination with the biological decompaction provided by certain vegetative cover crops, will help to maintain infiltration and promote the establishment of deep root systems of perennial grasses. Cover crops, such as brassicas, break up hardpans and create channels and voids in the soil for other plant roots to inhabit. Selecting and establishing proper vegetative cover before and during solar construction, minimize compaction, maintain soil porosity and water movement through the soil. Additionally, the decomposition of annual cover crop plants adds to the organic matter content of the soil, providing long term fertility and further resistance to compaction.

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