YOUR
ISTRC SYSTEM™
REPORT

NORFOLK
COUNTRY CLUB

May 9, 2014
Green 3
Lab ID: 14040041

Presented To:

Mr. Jon Zolkowski, GCS

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May 9, 2014

Mr. Jon Zolkowski, GCS
NORFOLK COUNTRY CLUB
166 East St.
Westwood, MA 02090

re: Lab ID: 14040041; ISTRC SYSTEM™ BenchMarking of undisturbed core sample taken from Green #3 [center]. **ISTRC Rep:** Mr. Scott Mackintosh

Dear Jon;

We have completed the ISTRC SYSTEM™ BenchMarking of the undisturbed core sample taken from Green 3.

The laboratory data can be found in its entirety at the end of this report. There are two sets of data. The first set of data consists of the physical evaluation, the evaluation of the root systems, and the measurement of the organic matter by layer. The second set of data contains the textural & particle size analysis. The textural analysis measures the percentage of gravel, sand, silt and clay comprising the soil. The particle size distribution analyzes the size distribution of the sand.

On the following pages we will discuss the current test results. Included with the discussion is a selected time lapse photo of the root zone, our Target Table with the green's physical properties and an inch-by-inch analysis of the Textural & Sand Particle Size Distribution. Table 1 compares the current test results to our recommended target range for native soil, push-up greens. The time lapse photos were taken to monitor the drying process of your greens and to provide visual confirmation of the tested physical properties.

The Norfolk Country Club was originally built in 1896. The greens are characterized as native soil push-ups that have been gradually modified through years of topdressing & aerification. The turf is a Bent/*Poa* blend. Green #3 was submitted for testing. The green was previously tested in 2012 and its past test results have been included within the report as a basis for comparison. The primary objective for testing is to document any changes in the green's physical properties and/or particle distribution to not only help assess the aging of the root zone, but also evaluate the impact of the past & current cultural practices.

Green #3

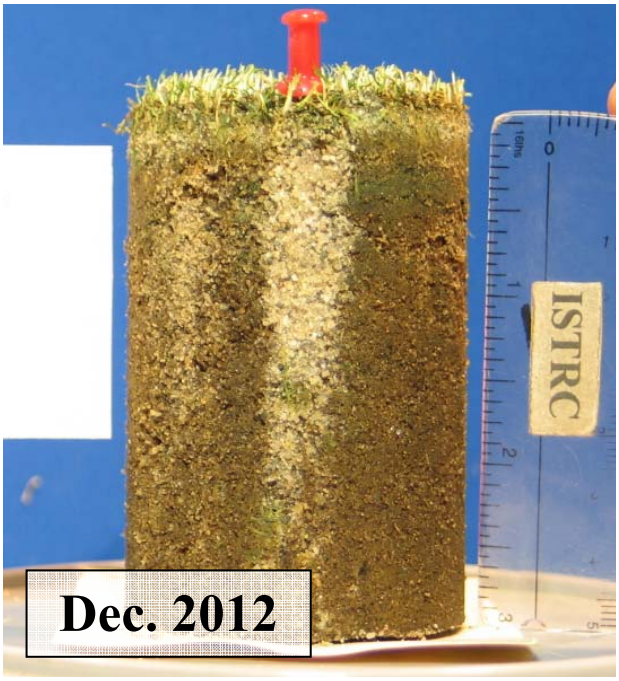

Table 1. **'+' improvement, '=' no change, '-' regressed**

Green #3 1st tier (0-4")	Native Soil Greens (1st tier Sample)	Comparison Index* +,=,-	April 2014	Dec. 2012
Infiltration Rate [In/hr]	At least 2	++	7.31 [excellent improvement since 2012, but without corresponding improvements in the air pores and/or water pores often times it lacks sustainability and is the reflection of an open aerification hole – one visible change in the root zone, which would certainly aid in improving permeability, is less compaction/layering]	1.96
Air Porosity [Non-Capillary]	At least 12%	=	16.56% [remains low for a sand green – recapturing lost air pores or maybe more accurately put converting water pores back into air pores will require further dilution of OM & buried thatch]	17.31%
Water Porosity [Capillary]	Less than 30%	=	31.83% [high]	32.96%
Bulk Density [g/cc]	1.35 to 1.45	++	1.24 [often times in older greens a drop in bulk density is induced by higher percentages of organic matter and/or thatch; however in your case we would attribute Green #3's drop in bulk density to the root zone being less compacted]	1.32
Water Holding	Less than 25%	=	25.59% [at our upper target range – mirrors the percentages & distribution of organic matter]	24.98%
Organic Content: 0-1"	1.5% to 3.0%	+	3.32% [has improved, but remains high]	4.21%
Organic Content: 1-2"	1.0% to 2.0%	+	2.40% [has improved, but remains high]	3.43%
Organic Content: 2-3"	0.5% to 2.0%	+	2.43% [has improved, but remains high]	3.01%
Organic Content: 3-4"	0.5% to 2.0%	=	4.84% [high – is the transition between the amended upper root zone and the native soil]	4.68%
Root Mass	at least ½ in.	-	3/8 in.	5/8 in.
Feeder Roots	at least 3.5 in. –med. density	=	Less than 3 in.	<3 in.

Particle Distribution

	Textural Analysis				Sand Particle Size Distribution						
	Sand	Silt	Clay	Gravel	Very Coarse	Coarse	Medium	Medium	Med/Fine	Fine	Very Fine
USDA (mm)	.05 to 2.00	.002 to .05	<.002	2.00	1.00	0.50	0.25	0.18	0.15	0.10	0.05
U.S. Sieve (mesh)	270 to 18	(Pan)	(Pan)	10	18	35	60	80	100	140	270
SAMPLE NAME					% Retained on Sieve						
.25 - 1.0 in.	96.92	0.44	2.64	0.00	3.03	25.43	46.33	11.78	4.65	3.75	1.95
1.0 - 2.0 in.	97.07	0.02	2.63	0.28	5.65	28.90	47.78	9.83	2.45	1.73	0.73
2.0 - 3.0 in.	94.90	0.04	4.76	0.30	5.48	22.78	50.43	9.53	2.65	2.18	1.85
3.0 - 4.0 in.	92.92	0.05	5.05	1.98	13.73	21.55	31.78	8.70	3.88	5.33	7.95

Green #3
1st tier

	89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	At least 60		20 Max.		5 Max.	
pecifications		10 Max. w/ Fine & V.F.		10 Max.						10 Max. w/Silt & Clay	
es	89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	15 to 25	40+	10 to 15	20 - #80	5 Max.	
		10 Max. w/ Fine & V.F.		10 Max.		65 to 85 Optimum				10 Max. w/Silt & Clay	

Above is the inch-by-inch analysis of the Textural & Sand Particle Size Distribution for Green #3's 1st tiers. A complete inch-by-inch analysis for the green is also attached to the end of the report. The lower box contains the USGA specifications & ISTRC Guidelines - the upper set is the USGA specifications and the lower set is the expanded guidelines from ISTRC. The inch-by-inch breakdowns of the Textural & Sand Particle Size Distribution for Green #3's upper 4 inches are comparable to our previous testing of the green. Over the years the upper 3 inches of Green #3 has been amended using what appears to be a quality USGA topdressing sand while the increases in Gravel & Very Coarse Sand as well as Fine Sand, Very Fine Sand, Silt & Clay at 4 inches likely highlights the transition to the native soil.

Summary

A general discussion on Maintenance Practices is contained in Section V of **The ISTRC Guidebook**. We encourage you to reference the Guidebook for a wide range of topics relating to the root zone, environmental factors, and maintenance.

Green #3 has reported 1st tier (0-4 in.) physical properties that would be characterized as above average for native soil push-ups. Its 1st tier (0-4 in.) infiltration rate at 7.31 inches per hour, up from 1.96 inches per hour in 2012, mirrors the air porosity at a very respectable 16.56 percent. The water holding & water porosity properties are not unusual or unexpected for soil greens, but are at or slight above our recommended target ranges. Often times the perception with soil greens it is the fines (soil) limiting the agronomic health of the root zone; however our testing & research has shown more often than not the upper root zone of an older soil green has been amended with topdressing sand and the key variables in the 1st tier physical properties is the percentage & distribution of organic matter and the degrees of layering & compaction. Your greens are no different. The particle distribution in Green #3's upper root zone has been amended to resemble a USGA green. When compared to 2012, the organic percentages in the upper 3 inches are lower; however from a cumulative standpoint the amount in the upper 4 inches remains high. It impact on the root zone is reflected in the moderate to high water holding properties; however it is important to note there are numerous aerification holes of various ages, depths, sizes and degrees of openness that are aiding in keeping Green #3 open & breathing.

Aerification has played, and will continue to play, a significant role in the long-term health & sustainability of the greens. Much of the physical health of the root zone can be attributed to your cultural program; however it is important to note the high percentages of organic matter continues to describe greens that are prone to sealing off. Our long-term goal for your greens would be to continue to dilute the percentage of organic matter in the upper root zone while also increasing the transition depth to the native soil. Given the current conditions, age of the greens and turf-type our general recommendation for your greens would be a program that targets **at least** 15 to 20 percent annual surface area displacement (calculation based on tine OD). For your reference we have attached a copy of our Aerification Displacement Chart at the end of the report. Non-disruptive venting using equipment such as the HydroJect, Planet Air, needle/pencil tines, bayonet tines, star/cross tines, slicer, or deep spiker will continue to be extremely beneficial to the health of the turf and promoting gas exchange, particularly when done on a regular basis. Improving the ability for the root zone to breathe will not only encourage a deeper, more sustainable root system, but also enhance microbial activity to aid in the natural decomposition of the organic matter & thatch.

We would recommend that you continue to monitor your greens with regular testing. The information derived from regular testing will allow you to monitor the aging process of the greens, evaluate the effectiveness of the current cultural practices, modify the program based on hard data, make adjustments to the program to meet the individual needs of specific greens, and detect problems before they affect the health of the greens.

If you have any questions or need any additional information we encourage you to give us a call. We are always available to answer questions and discuss ideas with you. Our service is not confined to analyzing undisturbed cores. We do not charge for telephone calls and we encourage our client superintendents to use us as a resource.

Sincerely,

I.S.T.R.C.

by: 

Matt Pulis, M.S.
Agronomist

I.S.T.R.C.

"International Sports Turf Research Center, Inc."

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Account No. 6175487
Date 5-May-14
Facility Norfolk G.C.
ISTRC Rep. Mr. Scott Mackintosh

Physical Evaluation

ISTRC SYSTEM™ Core Analysis

LAB ID NO.	SAMPLE NAME	Infiltration Rate in/hr	40 cm Water Holding %	Bulk Density g/cc	Solids %	Porosity: Total Porosity %	Porosity: Capillary [Water Pores] %	Porosity: Non-Capillary [Air Pores] %
14040041-G03	Green #3, Center	7.31	25.59	1.24	51.61	48.39	31.83	16.56
	Organic [ISTRC Walkley/Black] .25 to 1 in.	**3.32%**				**Root Mass:**	**3/8"**	
	Organic [ISTRC Walkley/Black] 1 to 2 in.	**2.40%**				**Feeders:**	**Less than 3"**	
	Organic [ISTRC Walkley/Black] 2 to 3 in.	**2.43%**						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	**4.84%**						
	Organic [ISTRC Walkley/Black] .25 to 1 in.					**Root Mass:**		
	Organic [ISTRC Walkley/Black] 1 to 2 in.					**Feeders:**		
	Organic [ISTRC Walkley/Black] 2 to 3 in.							
	Organic [ISTRC Walkley/Black] 3 to 4 in.							
	Organic [ISTRC Walkley/Black] .25 to 1 in.					**Root Mass:**		
	Organic [ISTRC Walkley/Black] 1 to 2 in.					**Feeders:**		
	Organic [ISTRC Walkley/Black] 2 to 3 in.							
	Organic [ISTRC Walkley/Black] 3 to 4 in.							
	Organic [ISTRC Walkley/Black] .25 to 1 in.					**Root Mass:**		
	Organic [ISTRC Walkley/Black] 1 to 2 in.					**Feeders:**		
	Organic [ISTRC Walkley/Black] 2 to 3 in.							
	Organic [ISTRC Walkley/Black] 3 to 4 in.							
	USGA Sample Range [Root Zone Mix]	at least 6	10 to 20	1.4 to 1.7	45 to 65	35 to 55	15 to 25	15 to 30

Reviewed by: MAP

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		Textural Analysis				Sand Particle Size Distribution						
		Sand	Silt	Clay	Gravel	Very Coarse	Coarse	Medium	Medium	Med/Fine	Fine	Very Fine
	USDA (mm)	.05 to 2.00	.002 to .05	<.002	2.00	1.00	0.50	0.25	0.18	0.15	0.10	0.05
	U.S. Sieve (mesh)	270 to 18	(Pan)	(Pan)	10	18	35	60	80	100	140	270
LAB ID NO.	**SAMPLE NAME**					% Retained on Sieve						
14040041-G03	.25 - 1.0 in.	96.92	0.44	2.64	0.00	3.03	25.43	46.33	11.78	4.65	3.75	1.95
Green #3	1.0 - 2.0 in.	97.07	0.02	2.63	0.28	5.65	28.90	47.78	9.83	2.45	1.73	0.73
Center	2.0 - 3.0 in.	94.90	0.04	4.76	0.30	5.48	22.78	50.43	9.53	2.65	2.18	1.85
	3.0 - 4.0 in.	92.92	0.05	5.05	1.98	13.73	21.55	31.78	8.70	3.88	5.33	7.95
USGA		89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	At least 60		20 Max.		5 Max.	
Recommended Specifications			10 Max. w/ Fine & V.F.		10 Max.						10 Max. w/Silt & Clay	
ISTRC Guidelines		**89 to 100**	**5 Max.**	**3 Max.**	**3 Max.**	**10 Max.**	**15 to 25**	**40+**	**10 to 15**	**20 - #80**	**5 Max.**	
			10 Max. w/ Fine & V.F.		**10 Max.**		**65 to 85 Optimum**				**10 Max. w/Silt & Clay**	

Reviewed by: MAP

ISTRC

International Sports Turf Research Center

Aerification Displacement Chart

Tine Size	1.25” x 1.25” Centers	1.5” x 1.5” Centers	2.0” x 2.0” Centers	2.5” x 2.5” Centers	5” x 5” Centers
¼” Hollow Tines	3.14%	2.18%	1.23%	0.79%	
3/8” Hollow Tines	7.07%	4.91%	2.76%	1.77%	
½” Hollow Tines	12.57%	8.73%	4.91%	3.14%	
5/8” Hollow Tines		13.64%	7.67%	4.91%	
5/8” Hollow Vertidrain					1.23%
¾” Hollow Tines				7.07%	1.77%
¾” Hollow Vertidrain					1.77%
1” Hollow Tines					3.14%
1” Hollow Vertidrain					3.14%
7/8” Drill & Fill (7” Ctrs)					1.23%
Graden Verticutter (15 Blades @ 1” Spacings)	1mm Blade 3.93%	2mm Blade 7.87%	3mm Blade 11.81%		

Note: 1/4" Quadtines remove as much material as Regular 1/2" Hollow Tines
3/8” minimum for ease of topdressing fill if replacement of material is required
For double aerification make two passes at approx. 37° (slightly less than 45°) to minimize overlap

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For Additional Information Please Call:

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