INSTITUTE OF GROUNDSMANSHIP

Assessment of Croquet lawns for Surbiton Croquet Club London

Date August 2014

Contents

Summary of report.

The overall condition of all the lawns was compromised by a serious deep layer of thatch, which has a major impact upon not only the playing quality of the lawns, but also the management of these lawns. There is a need to take decisive action to address the thatch layer issues before any other turf improvements can realistically be achieved.

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Limitations of this report.

Limitations of report and assessments are based upon assessments made during site visit and the results of soil analysis at an independent specialist laboratory.

Any recommendations contained within this report are not a specification of works, nor can they be guaranteed to fully correct any issues or concerns found.

1.0.0 Introduction

1.1.0 Location.

Alexandra Drive
Surbiton
Surrey
KT5 9AA

Lawn numbers shown for clarity of this report.

2.0.0 Assessment methods.

2.1.0 Assessment methods used:

2.1.1 Quadrant.
BS 7370-3: 1991: Appendix A.A6
A standard 75mm mesh quadrant was used to assess sward density and quality.
10 quadrant assessments were undertaken.

2.1.2 Core samples.
BS 7370-3: 1991: Appendix A.A7
Core samples were taken and visually assessed.
4 core samples were taken from each lawn.

1

2.1.3 Laboratory analysis:
BS 7370-3: 1991: Appendix A.A9
(a) pH value of soil
Major nutrient availability analysis.
(b) Soil five sands particle distribution (PSD) analysis.
Soil for analysis was taken from the above core samples, at a depth range of 50 – 150mm.of the core.

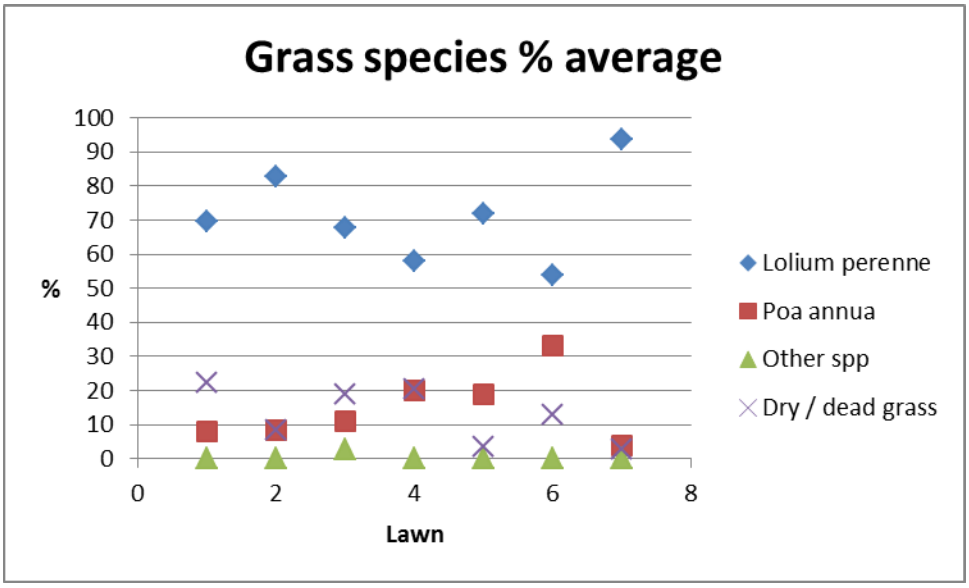
3.0.0 Assessment results.

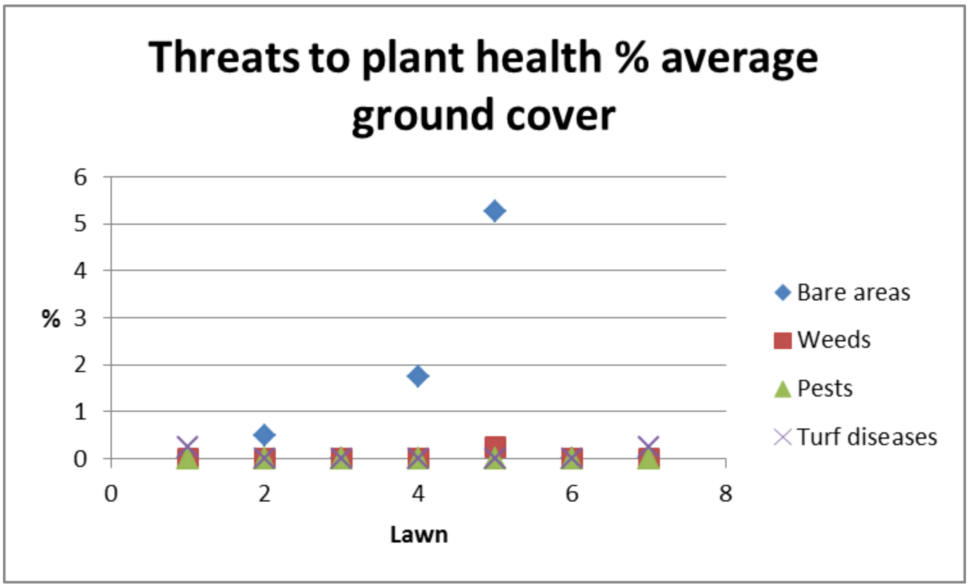
Results of the assessment of the lawns are shown below.

3.1.0 Sward quality.

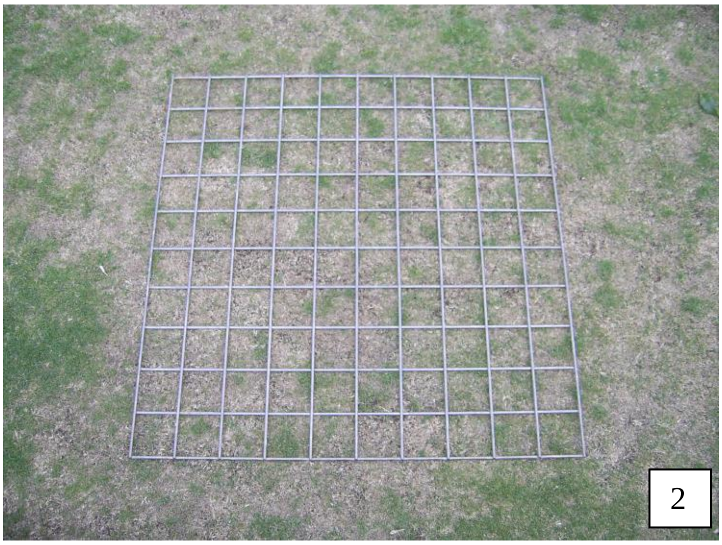
3.1.1 Sward.

The overall quality of grasses in each lawn was difficult to assess accurately as the lawns had experienced some considerable drying which had resulted in drought stressed grass being present, results are shown in the table below. Therefore grass species identification is limited to an estimate rather than an accurate assessment.





Evidence of drought stress varied from limited to sever as shown in the image (2) right.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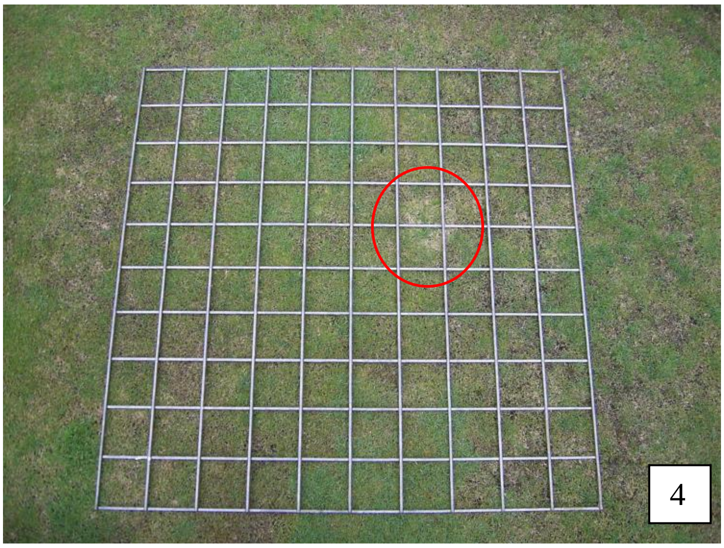
3.1.2 Pests & Diseases.

There was little evidence of any infestation of either turf pests or turf fungal diseases, found on any of the lawns.

Evidence of the following turf fungal diseases found:

- *Lycoperdon spp* (Type 2 Fairy Ring); this is shown as a dark ring of enhanced grass growth. Shown in the library picture (3), right.
- *Microdochium nivale* (Fusarium), a turf fungal disease which affects in particular *Poa annua* grass, which can causing death of the plant and leaving scaring of the playing surface. As highlighted in the image (4) taken on lawn 7.


3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3.1.3 Weeds.

Little evidence of turf weeds found.

3.2.0 Surface levels

No major deterioration in surface levels was observed.

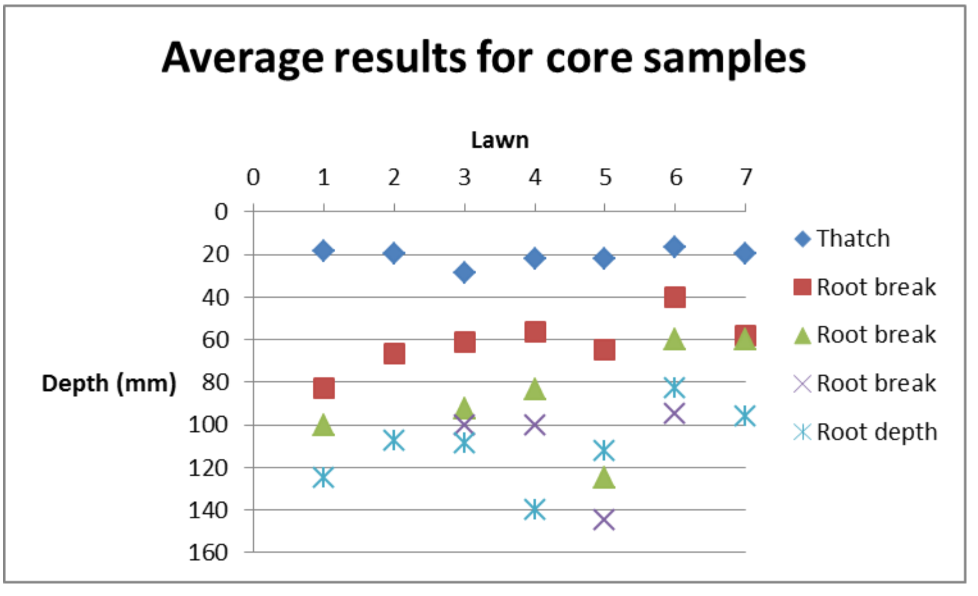
3.3.0 Core samples.

A total of four core samples were taken randomly from each of the playing areas, Additional micro core samples were taken to collect soil for analysis.

The average results are reported below; the results for individual lawns are reported in appendix B.

The core samples were used to assess the following:

1. Thatch layer depth.
2. Maximum depth of root development.
3. Depth of root breaks.



3.3.1 Thatch layer.

Average thatch layer depth across all lawns was 20.92mm.

3.3.2 Root development.

Average root development was 107mm; exact data for each lawn is shown in the charts above.

3.3.3 Root breaks.

A number of root-breaks where found in all core samples taken, with average depths being, 59, 83 and 107mm; with 35% of core samples showing two root-breaks and an additional 17% showing three root-breaks.

3.3.4 Soil profile observations.

Incompatible top-dressing material.

Variations in the type of soil/root-zone used for top-dressing were seen in some samples.

Gleying.

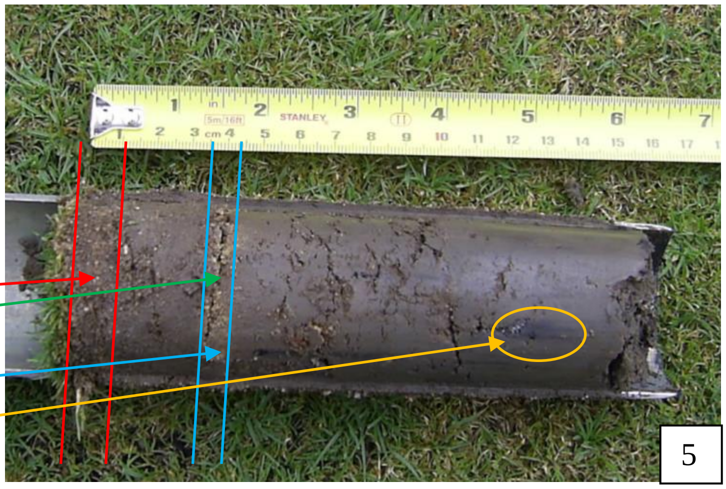
Some 28% of core samples showed evidence of ‘Gleying’ in the lower horizons of the core sample, typically being below 120mm depth.

3.3.5 Sample core.

Image (5), right, shows a sample taken from lawn 6, this is one of 28 core samples taken.

The following points are shown:

1. Thatch layer.
2. Root-break
3. Incompatible top-dressing material
4. Gleying.



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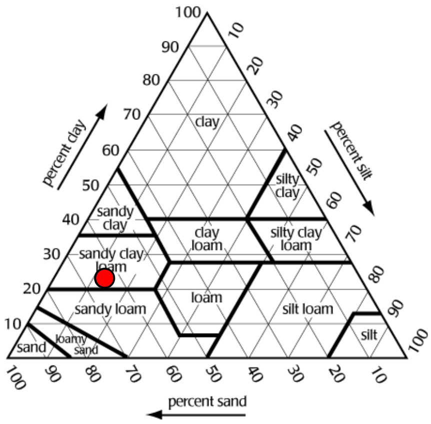
3.4.0 Soil analysis.

3.4.1 Physical structure.

Results of the 5 sands particle distribution are shown in the chart below.

Category		Size mm	Percentage
Sand	Very coarse	1.0 – 2.0	1
	Coarse	0.5 – 1.0	8
	Medium	0.25 – 0.5	34
	Fine	0.15 – 0.25	18
	Very fine	0.05 – 0.15	10
Silt		0.002 – 0.05	16
Clay		<0.002	13

The soil type is classified as a ‘Sandy Loam’, shown on the standard soil triangle right as a red dot.



3.4.2 pH value and Nutrient availability.

The analysis results of the soil samples are shown below.

Category		mg/l
pH	6.9	
Phosphorous		25.2 (2)
Potassium		117 (1
Magnesium		67.9 (2)

3.5.0 Other observations.

3.5.1 Restricted air flow/shade.

The air low across many of the lawns is reduced by hedges or the topography which results in the lawns sitting in a slight hollow/frost pocket; see image (6) right.

Lawn 7 in particular is affected by shade and reduced air flow caused by surrounding buildings and trees; see image (7) right.

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4.0.0 Analysis of results.

4.1.0 Sward.

The main grass found was *Lolium perenne* (Perennial Rye grass). There is also evidence of ingress of *Poa annua* (Annual Meadow Grass) into the lawns, the identification of other species proved difficult owing to the amount of severely drought stressed plant material present in the lawns.

4.1.1 *Lolium perenne*.

Lolium perenne is a relatively quick establishing grass, deep rooting and has a high wear tolerance. However, it is a grass that requires good management to achieve the best results. With the following areas needing to be considered:

1. Nutrient availability – due to the fast rate of growth, this grass requires a balanced supply of plant nutrients, or growth will be weakened, resulting in poor wear tolerance and increased susceptibility to turf fungal diseases, especially *Laetisaria fuciformas* (Red Thread).
2. Correct mowing – as this plant's growing point (Crown) can migrate above the playing surface as a result of infrequent mowing resulting in this being damaged during play, resulting in a weakened or dead plant.
3. Verti-cutting – procumbent (horizontal) growth can result in a thinned sward with poor playing characteristics.

This grass species is also likely to give a slightly higher ball roll resistance than other fine leaved grass species such as *Festuca spp*, however, it should be noted that although these grasses would increase lawn speed, they have a considerably lower wear tolerance than *Lolium perenne*.

4.1.2 *Poa annua.*

Poa annua is generally accepted as the main weed grass of the UK, it is blown in to a site from surrounding areas, where the quality of turf management is not that good. This grass presents a number of areas of concern when managing fine turf sports areas:

1. Not totally winter hardy – resulting in many plants dying out during periods of cold weather, resulting in bare areas, which are ideal for turf weeds or other weed grasses to establish in.
2. Shallow rooting – resulting in the plant becoming drought stressed easily, also having poor wear tolerance.
3. Susceptible to a number of major turf fungal diseases.

4.2.0 Core samples.

4.2.1 Root development.

On these lawns the average root development of 107mm (3.3.2) is less than desirable; ideally root development should around 150mm depth. There are a number of possible causes of the poor root development, as set out below:

There are a number of factors which are likely to be contributing to this reduced root development.

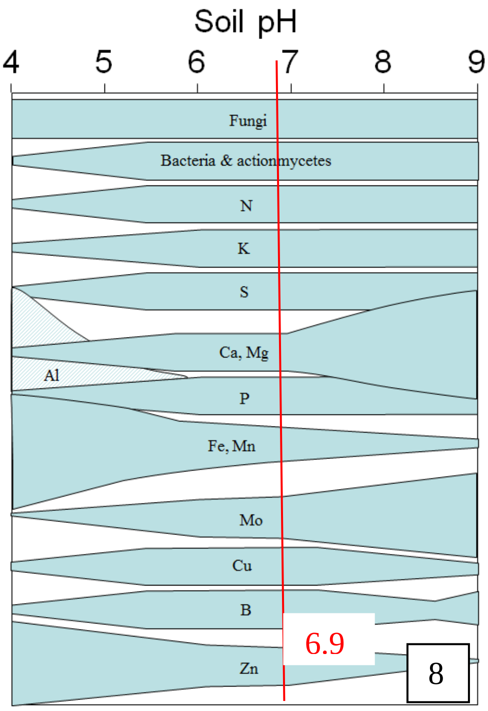
1. Root-breaks in the soil horizon will also restrict root development, see 4.2.2.
2. Thatch layer, see (4.3.3).
3. Soil compaction.
4. Reduced soil drainage. (Gleying) see 4.5.0.
5. Changes in top-dressing material see 4.3.4.

Note; shallow rooting is often a combination of factors rather than as a result of a single causal factor.

4.2.1a Soil pH value affect upon grass species.

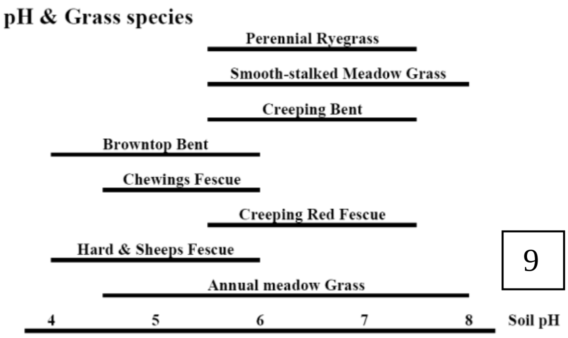
The reported soil pH value is only slightly above the ideal of 6.5, therefore this is not likely to have any major impact upon the growth of the grass.

As shown in the chart (8) right, a pH value of 6.9 is within the area of balanced availability of plant nutrients. Any increase in the pH value is likely to begin to cause reduced ability of desirable grass species to extract, plant nutrients from the soil, which is likely to reduce the plants ability to grow healthily.



The effect of soil pH value on individual grass species is shown in the diagram, (9) right. *Lolium perenne* is tolerant of pH values from around 5.5 – 7.5, while *Poa annua* is tolerant of pH values from 4.5 – 8.

4.2.2 Root-breaks.



These are horizontal fractures in a soil profile which cause roots to be physically broken, when the two sections of the soil profile move independently of each other. Soil movement can be caused by a number of different factors, including:

1. Temperature difference between soil horizon layers.
2. Movement of maintenance machinery over the surface.

Also the roots tend to grow along the break lines as this is less compacted, resulting in shallow overall root development.

Possible causes of root breaks include:

1. Ineffective keying together of different soil layers.

2. The soil being worked, driven over by heavy machinery or used when the soil was too wet for the work or use.

The effect of root-breaks on the grass plant, include:

1. Shallow rooted plants.
2. Increased risk of drought stress on the plant, as the plant has a reduced volume of soil from which to extract water.
3. Generally reduces the overall health of the grass plant, thus increasing the risk of turf fungal disease infections, as well as the ingress of turf weed grasses and turf weeds.
4. Restricts the downward movement of water through the soil profile.

4.2.3 Organic matter/Thatch layer.

All lawns showed evidence of a thatch layer, with the average depth being some 20mm. This is considerably greater than would be advised as an acceptable depth.

Thatch is partially decomposed plant material, which presents a number of concerns for the quality of the playing surface.

Potential problems caused by thatch layers on fine turf playing surfaces, include:

1. Reduced playing speed, as the thatch creates a soft surface, which the balls tend to sink into slightly rather than running on the surface, creating a slower surface.
2. Provides an ideal environment for the establishment of *Poa annua* grass (see 4.1.1 above).
3. Thatch holds moisture and plant nutrients near the surface. As a result thatch has a high CEC value (see 4.4.1), this encouraging shallow rooting of the grass plant into the thatch layer rather than down into the soil.
4. Provides an ideal environment for the establishment of many turf fungal diseases.
5. Thatch is **NOT** caused by poor collection of grass clippings, but has developed from the sheath plant material from weed grasses such as *Poa annua* and dead plant material. Plant material from grasses such as *Festuca spp* tends to break-down slower than material from other grass species. If clippings were returned to the playing surface un-collected the amount of thatch would only increase by about 20%, (Adams *et al* 1994).
6. Thatch is an indication that there is a low soil microbial community, which is unable to break-down the volume of organic matter in the upper soil horizon, resulting in the development of a thatch layer. This low microbial level would tend to indicate that if the management of the lawns was to include the use of organic fertilizers then there is a possibility that these products would not work as well as hoped, unless the levels of soil microbial activity are increased.

4.2.4 Top-dressing

Top-dressing material has been changed in the past, can be seen in the colour change in the soil profile (3.3.5). This has resulted in a root-break and hydraulic break developing. The former will encourage shallow rooting, while the later will reduce the downward movement of water, requiring large amounts of water to overcome the barrier by mass (weight).

A hydraulic break can lead to the following soil problems:

1. Poor soil oxygen levels which will contribute to shallow rooting of the grass plant.
2. A wetter thus cooler soil, which will reduce the length of the overall growing season.
3. Reduced soil microbial community levels, which will result in a greater than average rate of thatch layer development.

4.2.5 Root-breaks.

The root-breaks found are concern, as these are weak fracture lines within the soil profile. When the different layers move in relation to one another the roots that cross this layer are physically torn apart, resulting in a shallow rooted plant which has reduced drought stress tolerance.

Movement of the different layers can be caused by normal maintenance machinery operations, or soil layers warming at different rates during periods of hot weather.

4.3.0 Soil structure.

4.3.1 Textural analysis.

The soil is shown as a 'Sandy Loam'

The percentage of sand is reported as being 71% of the profile, although this is an average taken across all seven lawns, there is a possibility that the sand top-dressing applied to some lawns has affected these results.

Sand has a low CEC (Cation Exchange Capacity), meaning that the sands ability to retain plant nutrients in the soil is poor, resulting in nutrients being easily leached from the soil. This can result in poor unbalanced availability of plant nutrients which weakens overall plant health.

The following facts should, however, be noted:

1. The sample used was an amalgamation of soil taken from all seven lawns rather than a single lawn. Therefore this is a general overview, rather than an accurate assessment of each lawn.
2. The samples were taken from the upper soil horizon and do not indicate the lower soil horizon, which is a clay type soil.

4.3.2 Nutrient availability.

The results are based upon a combined soil sample taken from all seven lawns rather than from each lawn separately.

a) Phosphorous (P) value 25.2 mg/l

The ideal availability of this nutrient would be 16 – 25mg/l.

This nutrient is only very slightly above the recommended availability for this nutrient. The maximum recommended limit before this nutrient becomes toxic to *Lolium* *perenne* grass is 28mg/l. At this level instead of encouraging root development there will begin to be a reduction in the root development of the plant.

b) Potassium (K) value 117 mg/l.

The ideal availability of this nutrient would be 121 – 240mg/l

This nutrient is slightly below the midpoint of recommended availability levels. K is required by the grass plant to help the plant manage its internal temperature and to respond to extremes of temperature. The low availability of this nutrient, would help to explain the excessive amount of the sward that was showing signs of drought stress.

c) Magnesium (Mg) value 67.9 mg/l.

The ideal availability of this nutrient would be 51 – 100mg/l.

This nutrient is within that recommended for the establishment of *Lolium perenne*.

4.4.0 Other factors.

4.4.1 Reduced soil drainage.

The presence of evidence of 'Gleying' in the lower soil profile would indicate that these lawns lie wet for a part of the year. This is likely to cause the following problems:

1. Water logging which would result in:
    a. The start of anaerobic conditions, which are toxic to health plant growth, which restricts root development.
    b. Reduced soil Oxygen availability which restricts plant root development.
    c. Reduced soil microbial community volume, which results in a reduced ability to break-down waste plant material, leading to the development of a thatch layer.
2. Wet soils tend to be colder, which restricts plant root activity, typically reducing the effective growing season by up to four weeks a year.

4.4.2 Reduced air flow.

Reduced air flow across areas of fine turf, results in conditions which favour the establishment and spread of turf fungal diseases; especially through the dew layer which will tend to form on the lawns in the cooler mornings.

5.0.0 Recommendations.

The following recommendations are **NOT** specifications of works.

5.1.0 Sward quality.

5.1.1 Grass.

To increase the ability of lawns to perform in a uniform quality, the percentage of *Lolium perenne* needs to be maintained at a level ideally greater 90% of the sward. to achieve this a number of operations will need to be undertaken to achieve this goal, no single operation will be sufficient.

A combination of the following should be considered:

1. Over-sowing.
2. Thatch management, reduction.
3. Nutrient management.
4. Improving surface drainage.

Over-sowing

It should be noted that modern cultivars of dwarf *Lolium perenne* used for sports surfaces, tend to have a shorter life than older traditional cultivars, having an active growing life of around two to three years. After this period the plant loses vigour and therefore needs to be replaced with new younger plants routinely, hence the need for annual over-sowing operation.

The seed mixture should be one suitable for croquet lawns, with at least three different cultivars to reduce the risk of a cultivar failure, which could result in poor establishment.

This operation would normally be undertaken in the autumn as part of the autumn renovation programme, it is essential to note that the timing of this operation is controlled by soil temperature. If sowing takes place into soil which has a daily average temperature below 5ºC then the seed will rot rather than germinate. Therefore to achieve a good rate of germination, the soil temperature should ideally be nearer 9²C. Minimum night temperatures greatly influence soil temperature.

5.1.2 Fertilizer applications.

The availability of Phosphorous and Magnesium are within acceptable levels and the current fertilizer programme in relation to these nutrients should not be altered. However, there is a need to increase the amount of Potassium (K) applied, this should be done by slightly increasing the amount of K in each fertilizer application made. This means the third number in those found on the fertilizer bag needs to be higher than the value found on previous applications.

As the sample used was an amalgamation of samples from all seven lawns it would be advisable to re-test for the major nutrients on each lawn individually in mid-winter, when a true base reading will be obtained. This would enable individual fertilizer programmes for each lawn to be devised, which would help enhance plant growth.

5.1.3 pH.

Monitoring of all materials applied to the playing surface should be undertaken to ensure that no products are likely to further increase the current soil pH value. Ideally over the next few years the pH value will be slowly lowered to just around a pH value of 6.5.

5.1.4 Thatch management.

Thatch development is a natural part of a croquet lawn, however, if not managed this will eventually result in long-term deterioration of the lawns

An effective management programme, through removal of the existing thatch layer should be undertaken annually, this is then support the prevention work during the remainder of the year.

The options for controlling the thatch layer include:

1. Scarification.
2. Liner aeration.
3. Aeration.
4. Koro.

Scarification.

Physical removal of the thatch layer through effective scarification, this would involve using machinery capable of cutting down to about 1mm deeper than the thatch layer. With a number of passes being made in at least three different directions, for efficiency each pass should be at approximately 10 - 15º to the previous pass. With all arisings (waste) being collected up after each pass, to leave clean slots, which then form an effective tilth in which to establish grass seed.

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Liner aeration (Graden)

This is similar to scarification in process; however, it is undertaken by machinery which is capable of cutting deeper into the sward easier than a scarification unit. Otherwise the process is effectively the same as scarification. Images 10 and 11; show the machine and cutting blades respectable.


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Aeration.

In combination with either scarification or liner aeration the lawns can be ‘Hollow tined’ to physically remove the thatch material. If large 5/16’’ (8mm) cores are removed at about 2’’ (50mm) spacing, then this will remove around 5% of thatch layer.

Cores should be collected and removed for composting.

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Aeration should be ideally undertaken using a ‘Cam-action’ type machine, as opposed to a drum action type machine. Cam-action type machines, (12), force the tine into the ground through a punch type action rather than reling upon the weight of drum action type machines, (13). With the later type there is a risk that a ‘Ciultivation’ pan can develop in the soil, especially in the lower clay soil areas. This would result in the development of root-breaks and reduced downward gravitaional flow of soil water.

Koro

This is a prcess where the upper layer of the soil horizon containing the thatch layerr is physically removed, by machinery. Image 14 shows the process being undertaken on a winter sports pitch.

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Once the thatch layer has been removed the area is then lightly (shallow) scarified to create a tilth for re-seeding the area, re-establish a new lawn.

5.1.5 Top-dressing.

There is evidence that the type of top-dressing material used in the past has been changed, this has resulted in the problems reported in 4.3.4.

The options these layers are:

1. Aeration; the aim of this operation would be to create columns of soil which physically link the different soil layers together, thus reducing the risk of one layer moving in relation to another.
    i. Hollow tines; removal of a portion of the soil profile which is then replaced with top-dressing material. However, if this operation is undertaken more than once every third year there is evidence that this results in a softer playing surface, due to the fact that the top-

dressing which is worked back into the tine holes is at a lower density than the soil that was removed.

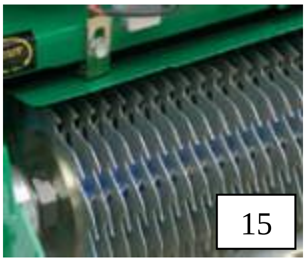
ii. Solid tines; large diameter tines, should be used in between hollow tine use, to achieve a similar result.
iii. Drill; this is where a block of drill bits is used to physically remove columns of soil from the profile, these holes are then back filled with top-dressing material.

2. Koro; if this process is used to remove the thatch layer, then the machinery could be set to work at greater depth and remove the upper soil horizons above the visible top-dressing change layer, to include removal of this layer. Surface levels would need to then be reinstated by importing new soil. Where this is done at depths greater than 50mm deep the lawns should be retired form use for at least six months to allow natural consolidation of the new soil before use.

5.2.0 Preparation of the playing surface.

5.2.1 Verti-cutting

The use of a verti-cutter unit to reduce the amount of procumbent growth should be part of the routine maintenance operations of the courts. These have the appearance of a scarifier, but with thinner blades. These are not designed to cut into the playing surface, but to cut vertically between the grass plants, clearing the surface by 2mm, to prevent damage to the meristematic area of the plant, see 15 right.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5.2.2 Rolling.

Rolling should be limited to that resulting from normal mowing operations, as this will correct the majority of playing surface issues that can be corrected by rolling. Over use of a heavy roller will only encourage the establishment of *Poa annua* grass, resulting in increased thatch layer development; which over the long-term will have a major detrimental impact upon the quality of the playing surface.

5.2.3 Threat management.

The management of threats to plant health such as weeds and turf fungal diseases should be an on-going part of the management programme. Where possible cultural and environmental management practices should be adopted rather than reliance upon chemical solutions, if chemicals are to be used then steps to ensure the greatest effectiveness of the product used should be taken.

A number of companies provide free down-loadable apps for smart phones which can assist in the correct identification of weed, pests and turf fungal diseases.

If a chemical control programme is selected then it is essential to ensure that this work is undertaken by a suitably qualified operator, as required by current legislation applicable to the application of Plant Protection Products (Pesticides).

5.2.4 Irrigation.

The aim of future irrigation management should be to allow a small ‘Soil Moisture Deficit’ to develop over the growing season. This means that amount of water lost from the soil, through the combination of evaporation and transpiration (sweating by the plant), is not fully replaced by irrigation, allowing a deficit of between 10 – 20% less water replaced, than the amount required to return the soil to ‘Field Capacity’ (the state of the soil after natural drainage has finished approximately 36 hours after rainfall). If the soil is maintained at field capacity then this will result in a softer playing surface, which is prone to wear and thatch development.

5.2.5 Aeration.

Although aeration is part of the renovation programme, it is also an essential part of the routine maintenance programme. Whenever possible; different machines should be used to give effective soil de-compaction at varied depths to reduce the possibility of a soil pan developing.

6.0.0 Conclusion.

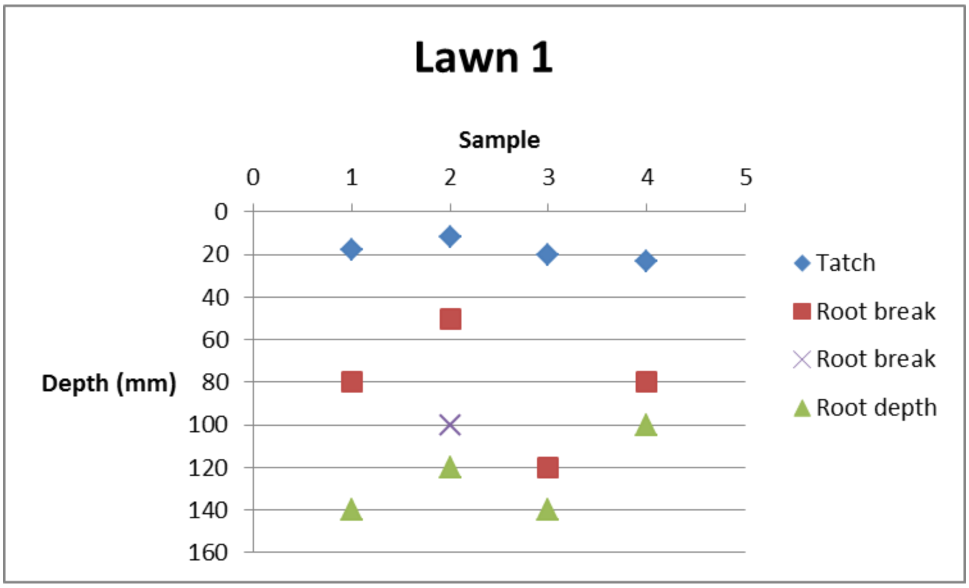
To improve the over quality of these croquet lawns there is a need to take what might appear to be dramatic action. However, in the long-term an investment in such action should provide firm true playing lawns that are sustainable into the long-term for the club. The development of a deep thatch layer is the first major issue that should be addressed, as this impacts upon the success of any other operation undertaken on the lawns. From grass type establishment, nutrient management, to irrigation management programme.

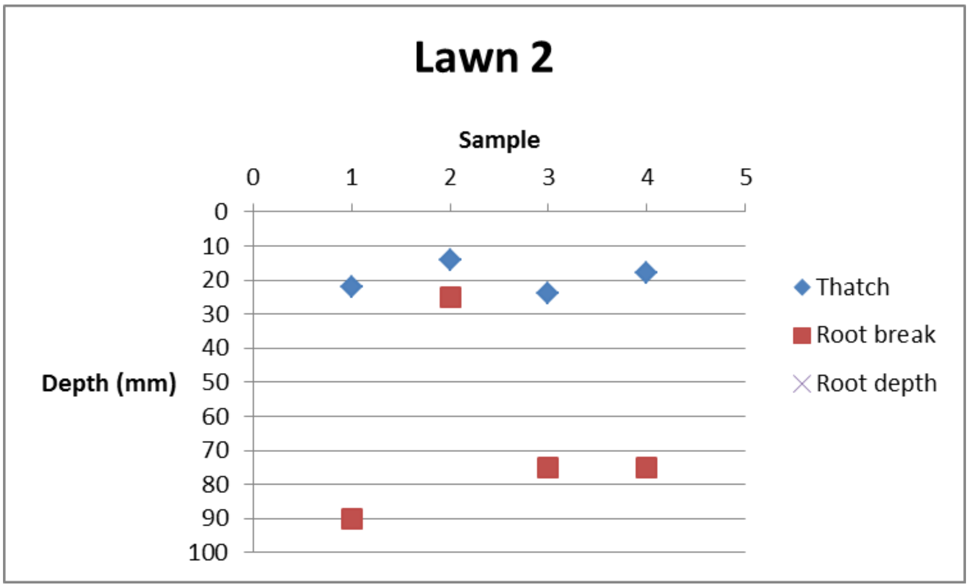
References:

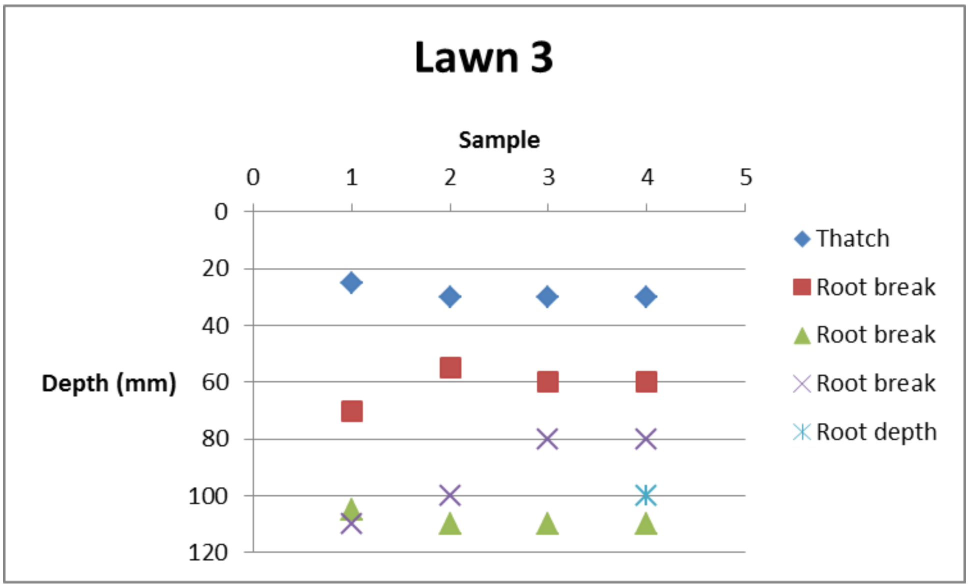
Adams, W.A. and Gibbs, R.F. 1994 *Natural turf for sport and amenity: science and practice.* CAB International Cambridge

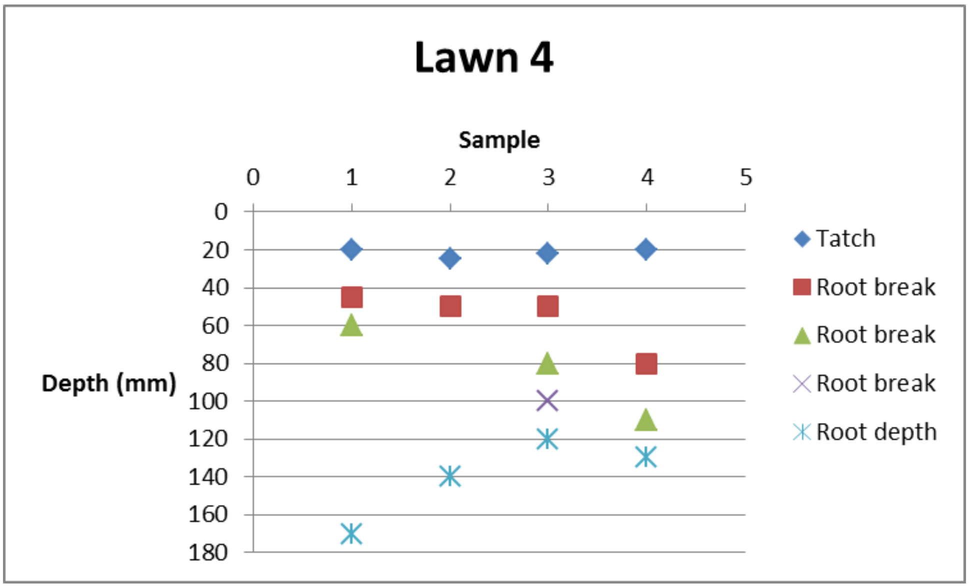
Appendix B

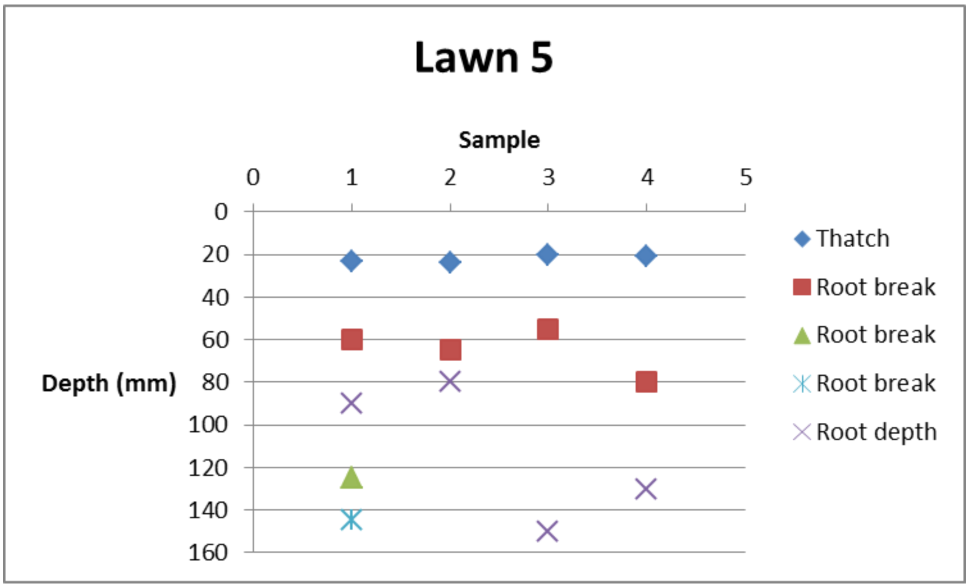
The detailed results of core samples for each lawn are reported below.

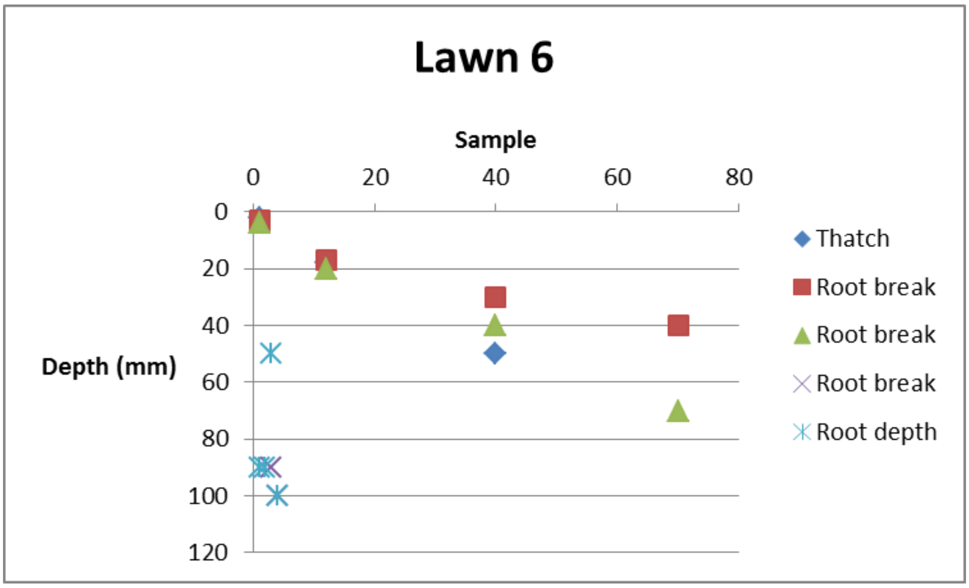


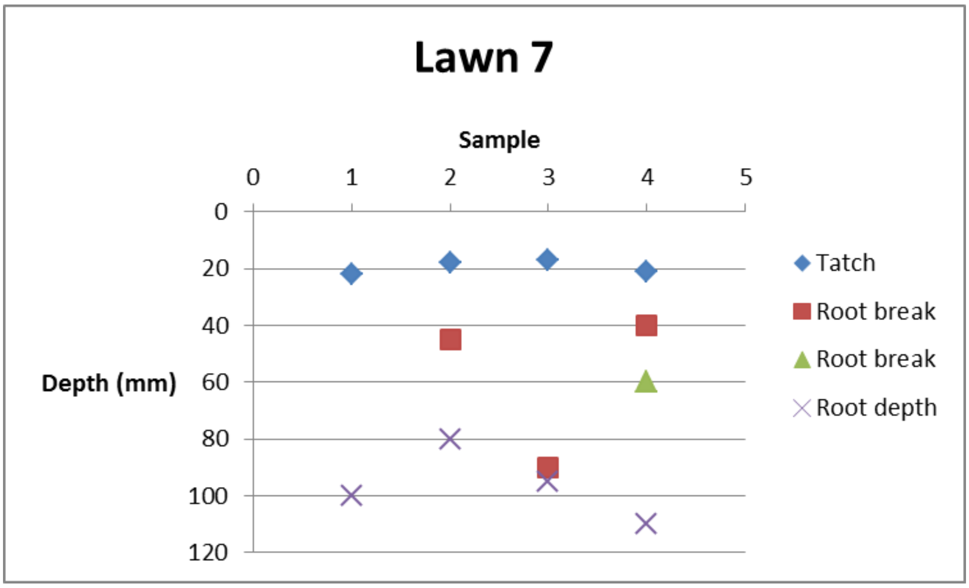



Lawn 3
Sample
0 1 2 3 4 5
0 20 40 60 80 100 120
Depth (mm)
Thatch
Root break
Root break
Root break
Root depth


Lawn 4
Sample
0 1 2 3 4 5
0 20 40 60 80 100 120 140 160 180
Depth (mm)
Tatch
Root break
Root break
Root break
Root depth


Lawn 5
Sample
0 1 2 3 4 5
0 20 40 60 80 100 120 140 160
Depth (mm)
Thatch
Root break
Root break
Root break
Root depth


Lawn 6
Sample
0
20
40
60
80
0
20
40
60
80
100
120
Depth (mm)
Thatch
Root break
Root break
Root break
Root depth


Lawn 7
Sample
0
1
2
3
4
5
0
20
40
60
80
100
120
Depth (mm)
Tatch
Root break
Root break
Root depth

