Dunfermline Golf Club

Course Report May 2017

Paul Miller PhD

Executive Summary

A visit was made to Dunfermline Golf Club on 19th May 2017 and an inspection made of the surfaces and soil profiles of all 18 greens, along with a visual inspection of tees, fairways and other turf areas. Sward composition of greens is a mix of bentgrass and *Poa annua* which is coming into its summer condition following an improvement in temperatures and the end of a significant dry spell in April. Inspection of soil profiles shows there to be an accumulation of organic matter in the top 25mm (this had been previously identified and work is on going to reduce that) whilst from a depth of 40 – 150mm there is significant compaction. Below 150mm the soil is crumbly and not compacted. Primary recommendations are as follows:

- To continue to work on reducing the organic matter in the upper profile of the greens through an on-going programme of removal through hollow coring and /or use of the Graden and dilution through topdressing.

- To address the compact layer through an on-going programme of appropriate aeration using the verti drain and / or Air2G2.

- To reduce organic matter build up through accurate fertiliser use that does not exceed the recommended rate of 30g/m^2 (300kg/hectare) of product per application and 108kg N/hectare/year.

- To work on improving sward composition by overseeding with bentgrass (*Agrostis tenuis*)

This strategy will improve surfaces and bring both playability and agronomic benefits.

Paul Miller PhD paul@paulmillerphd.com

Introduction

This report is made following a site visit to Dunfermline Golf Club on May 19th 2017 (a dry and bright spring day) during which all greens surfaces and soil profiles were inspected and measurements taken of surface firmness and soil moisture on five of them; tees were also inspected and a general impression gained of the fairways and rough areas by travelling throughout the course. This report focuses on the greens and describes their current surface condition, provides an agronomic assessment, and makes recommendations for future management strategy. Comment is also made of the tees, fairways and roughs with some thoughts offered about the 'wee course' which was discussed briefly.

Background and Agronomic Considerations

Dunfermline Golf Club dates from 1887 and after three previous locations found its home at the Pitfirrane Estate in 1953. The golf course is set in mature, rolling parkland, which brings real interest through a variety of length and style of hole and a feeling of different sections to the course. Greens and tees are largely 'push up' construction, meaning that they were originally shaped from the existing natural soils using, for example, cut and full methods, or by simple preparation of areas that were considered suitable green sites. Subsequent work saw three greens reconstructed some 15 - 20 years ago using a more sandy soil, or 'rootzone'; these are the 1st , 3rd and the rear portion of the 4th.

Natural Soils

The natural soils of any golf course provide the potential of the golf course in terms of their ability to produce quantity of grass growth, as well as naturally selecting particular species of grasses likely to become prevalent, which has a profound effect on surface quality. Put simply, the sandy soils of the links produce different grasses and different surfaces to the inland parklands of which Pitfirrane is an example.

Paul Miller PhD paul@paulmillerphd.com

Scotland is fortunate in having a very well developed ‘soil survey’, which has mapped the agricultural capability and soil types for the whole country. The ‘Land Capability’ scale runs from 1 – 7, where 1 is the most productive agricultural land and 7 is the poorest. Pitfirrane is class 3 land, meaning that it has the potential to do very well for agriculture (look at the fields adjacent to the golf course to appreciate this) but that there are significant limitations due to heavier soil types which restrict water movement and have the knock-on effects of leaving surfaces wet after rain and becoming readily compacted.

All soils are comprised of the solid materials mineral matter and organic matter, with the spaces between occupied by either air or water. If a soil has large particles (sands) then the spaces between are larger, water movement is rapid and, once gravity has removed excess water, the water content is low and air content is correspondingly high. When smaller particles are also present in a soil there is less internal space, water moves more slowly, and there is less air present once gravity has taken away its share of water. Smaller particles belong to the silt and clay fractions.

The particular soils of Pitfirrane belong to a family of ‘agricultural’ soils ranging from clay loams to sandy loams which will grow a lot of grass; these soils have a significant proportion of small particles and therefore, as described, are not naturally free draining, hold a lot of water and nutrients, and become compacted readily.

When we consider these soil types in a golf course situation we are describing parkland golf, of which Pitfirrane is a fine example. Parkland golf courses are often described as ‘grass factories’ in summer due to the quantity of growth produced, and they can be presented with high aesthetic value of definition and striping because there is the growth and grass species to allow it.

Parkland golf courses, because of the soil types, can become dominated in un-mown areas (roughs and semi roughs) by the fairly coarse ‘pasture grasses’ of Perennial Ryegrass, Yorkshire Fog, Cocksfoot and Timothy.

Paul Miller PhD paul@paulmillerphd.com

However when areas are mown as fairways the grasses become finer, more mowing-tolerant species take over, and strong stands of the finer bentgrasses and even fescues can prevail, although always with a percentage of the coarser grasses in localised areas. On greens and tees – areas where play is concentrated and where maintenance regimes are more intense in order to contribute to turf quality – a further change in sward composition (grasses present) is seen. In these areas of concentrated play the wear is higher, compaction of soil is greater, the plant is under numerous stresses from the (legitimate) demands for playable surfaces, and there is one grass species that can come to dominate a sward in these circumstances – that is 'Annual Meadow Grass' or *Poa annua*. Whilst this grass can produce excellent surfaces it also has certain vulnerabilities and so is considered less desirable than the bent grasses and fescues that can also tolerate the intensity of maintenance pressure on greens. The vulnerabilities of *Poa annua* include a higher demand for water and fertilisers, less wear tolerance, greater susceptibility to disease, poorer colour in the 'shoulder seasons' and the propensity to produce flowering seed heads in late spring.

Playability

Playability of golf greens is often restricted to thinking about green speed as measured using the Stimpmeter, although a recent industry survey showed smoothness and trueness to be of greater priority for the majority of golfers. Creating the ability to manage green speed is best achieved through managing surface smoothness, which in turn is highly dependant on firmness. For example, pitch marks, even when repaired, are not desirable when trying to produce smooth surfaces; pitch marks are less prevalent in firm surfaces. If we follow this through, firmness of the surface is related very closely to moisture content, which in turn is related to organic matter percentages in the upper soil profile. In practice this means that dry and firm surfaces typical of sandy links golf produce firmer, smoother and faster surfaces than moisture-retentive and less firm surfaces typical of many parklands, owing to their native soil types. It also means that it is tempting to focus on and manage the organic matter levels in the upper profile as a means to getting everything

else to fall into place, but this approach runs the risk of neglecting other important agronomic considerations.

What does all this mean for greenkeeping? In its essence it means that the management of greens in particular, and especially on parkland 'push-up' greens, is a constant balancing of the demand for quality putting surfaces with the requirement to keep water moving through the soil and allowing plenty of air to replace it. On the one hand golfers are quite rightly asking for smooth and true putting surfaces, for as long a season as weather and light allows, whilst the greenkeeper also understands that aeration and topdressing are the key to maintaining water movement and thereby dry, well aerated soils, and that these operations are most effective when the grass is actively growing.

Paul Miller PhD paul@paulmillerphd.com

Site Visit Findings

Greens - General

All greens were inspected, and a hole cutter used to reveal the soil profiles to a depth of 25 – 30 cm. Firmness and soil moisture content were measured on five greens.

The grasses of all greens are a mixture of very encouraging stands of *Agrostis* (bentgrass) along with *Poa annua*; these clearly have the potential to produce fine and smooth surfaces although on 19th May were probably 2 or 3 weeks away from full summer condition. Following a droughty April the greens had been fertilised the week before my visit and the recent rain and increasing temperatures meant that growth was beginning in earnest. Indeed, many members commented to us that the greens were performing better than they had been and seemed excited that full summer conditions would soon be arriving. On some greens e.g. the 2nd and 11th there was some remnants of disease scarring from Fusarium Patch, a very common disease of turfgrass to which *Poa annua* is particularly susceptible, but these scars will now 'grow out' and greens will return to full cover and playability.

Surface Properties

The surface properties of firmness and soil moisture content were measured on 5 greens. Figure 1 is a plot of data from all 5 greens and demonstrates the relationship between soil moisture and firmness, a relationship that has become well established in our industry. Figure 2 shows the data separated out for each green.

Paul Miller PhD paul@paulmillerphd.com

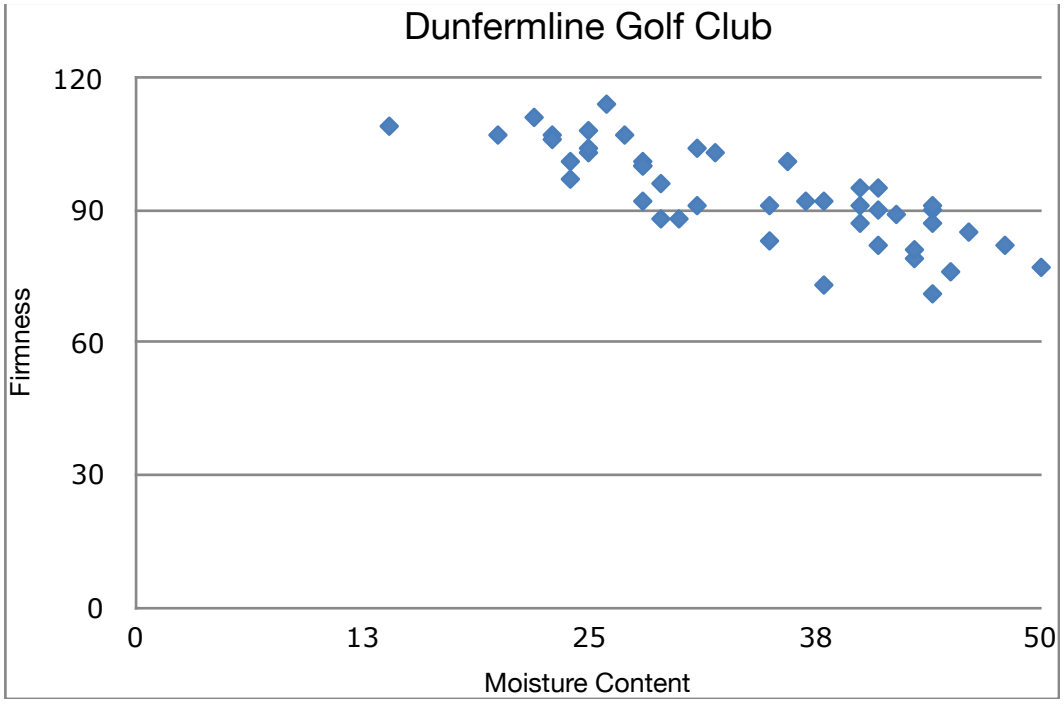

Figure 1. Moisture Content vs. Firmness of five greens – all data. As moisture content increases firmness decreases.

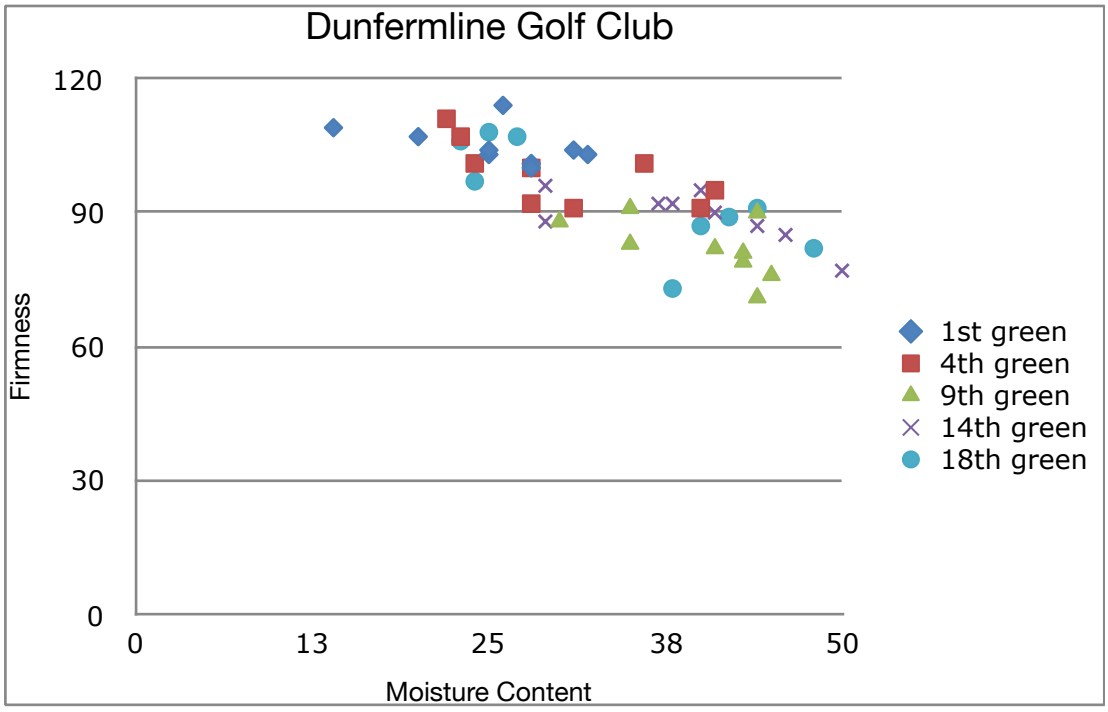

Figure 2. Moisture Content vs. Firmness of five greens – data separated by green. 1st green and rear portion of 4th are drier and firmer than other greens.

A firmness target for a parkland course is typically 80 - 100 gravities, reflecting moisture content ranging from 20 – 45%, however there are advantages in terms of sward composition and playing performance if moisture can be

managed to 30% or below. The drier greens at Pitfirrane (1st and 4th, as measured on 19th May) are 25 – 30 % moisture and firmness of 100 – 105 gravities, whilst the wetter ones are 35 – 40 % moisture with firmness at 80 – 90. It is understood that the drier greens described (1st and 4th) have to be played a little differently due to that increased firmness, and have a slightly leaner grass cover that comes as a consequence of them being drier and naturally lower in nutrition due to the higher sand content. If the push-up greens could be managed to a similarly dry state through a reduction in organic matter it is my view that there would be significant agronomic and playability advantages which I list after describing the soil profiles.

Soil profiles

Turf maintenance practices of mowing, verti-cutting and topdressing are used to present playable surfaces, but the capacity to do this year after year and in a sustainable way is determined to a very large extent by the soil of which the green is constructed and its capacity to provide the plant with nutrients, air and water. Looking at and understanding soil profiles enables an assessment to be made of this.

The profiles of all greens (with the exception of the 1st, 3rd and 4th) were very similar and consistent. The profile of the 9th is shown in Figure 3, and is a typical example. The profile of the rear portion of the 4th is shown in Figure 4.

Paul Miller PhD paul@paulmillerphd.com

Figure 3. Soil profile from 9th green (typical of the push-up greens).

Figure 4. Soil profile from 4th green (typical of the ‘rootzone’ greens)

Paul Miller PhD paul@paulmillerphd.com

For both the ‘push-up’ and rootzone greens the surface 25mm has a high concentration of organic matter. Organic matter in this layer can really hold on to water leading to soft playing surfaces as well as favouring *Poa annua*. Organic matter in a soil is the result of several things. Firstly, grass lives and dies and so naturally deposits organic matter on to the surface. The rate of this deposition depends upon how much growth is being produced, which is a consequence of grass species, weather, soil type and fertiliser and water use. Set against this accumulation of organic matter is its removal, which can be from various means. It can be physically removed e.g. hollow coring or the Graden, and it can be broken down through the actions of soil microorganisms, requiring a pH-balanced, moist and well aerated soil. Top dressing is an additional maintenance practice that introduces more sand and therefore air to the soil, and also dilutes organic matter *in situ* and can therefore be seen as having some impact on its management. Management of organic matter therefore rests on how much of it is being produced set against encouraging the soil to do its natural thing, and physical removal. The advantages to be gained by continuing to reduce the organic matter content are as follows:

- The greens will be firmer and drier which will allow well-struck shots to hold the greens giving the better golfer a competitive advantage.
- The greens will be smoother and truer meaning better putting.
- Greens speed can be controlled to desired levels without stressing the grass plant.
- Sward composition will be improved.
- Disease incidence will be reduced.
- Fertiliser demand will be reduced.
- The greens will reach summer condition earlier in the season and retain it later into the season.

Referring to the profiles, and again on both types of green, this upper layer gradually transitions to a layer below of more sandy, lighter coloured material representing many years of top dressing on top of the native soil construction

Paul Miller PhD paul@paulmillerphd.com

– this extends from around 40mm to 100 – 150mm into the profile. My assessment of this is that this layer has become compacted, which can be felt on insertion of the soil sampling tool as well as by physically handling the material, and as such will impede water movement and prevent good air levels in the soil. The causes of this compaction can only be speculated upon, but it could be the legacy of many years of aerating to the same depth, and of accumulated foot and machinery traffic over many years. In the vast majority of cases this layer 'breaks' from the material beneath at some 150 mm, showing an abrupt change in composition. In the 'push-up' greens the darker material below is the un-ameliorated natural soil from which the greens were originally constructed. When squeezed this becomes sticky and it can be seen that it would be very difficult to manage should it become compacted, however it is not and the structure here is quite crumbly and would allow water movement. In the rootzone greens this lower layer is sandy, and so will allow good drainage once water reaches this layer.

There is evidence throughout the profile of aeration work. For example evidence of work with the Graden is seen in the upper profile with various sand channels and sandy build-up being seen. Further down, and very impressively, there are even roots penetrating through to the full depth of the hole cutter having grown down through verti-drain holes to the deeper profile. This can be seen in figure 5.

Paul Miller PhD paul@paulmillerphd.com

Figure 5. Roots emerging from verti-drain holes.

Greens – Specific

The 2nd

The 2nd green is showing greater disease damage, largely through the centre, than the other greens. The disease scars are filling in, with bentgrass trying hard to colonise the damaged areas, which is encouraging, and further overseeding with bentgrass along with topdressing will ensure the green is more fit for play within a short while. There is nothing obvious in the profile to explain why this green has suffered more than the others, and although it was shaded in the early morning during my visit it is open to the south and so should be in receipt of plenty of sunlight. Other factors that might be relevant include it being low lying and the proximity to the main road that might have an impact on drainage, and the fact that there are a lot of trees near it, however these aren't obvious or even particularly different to other areas of the course. Both Kenny and Allan referred to a flooding event a few years

ago from the old mine workings and the orange 'iron ore' liquid that flooded the area including the 2nd green, and they told me that the green hadn't been the same since then. If the green persists in being weaker than the others in terms of disease then it might be considered worth exploring a nutritional analysis of the soil to try and pinpoint if there is anything different here that could provide an explanation for this phenomenon.

The 7th

I noticed one small thing on the 7th which is, on the right hand side of the green, there were a couple of small patches that look like they are threatening to become hydrophobic i.e. to develop dry patch. Hydrophobic soils can result from a variety of causes, but high levels of organic matter are often implicated, and this, coupled with the April drought, might well have led to this situation. These need to be watched and if required some localised hand aeration and hand watering might be appropriate. I understand that wetting agents are in use throughout, and these will also help to prevent this problem developing.

The 11th

Kenny and Allan referred to the 11th as the most difficult green on the course to manage. It is wetter than other greens, probably due to surface and underground water draining from the area of the 5th green above to the area left of and at a lower level to the 11th green. The green certainly showed increased seeding of the *Poa annua*, indicating that it is under stress, so this green will always need to be managed carefully to avoid further stress leading potentially to a loss of quality.

Paul Miller PhD paul@paulmillerphd.com

Recommendations

There are two important recommendations concerning the soil profile:

1. To continue to work on the organic matter layer in the upper profile.

This has been being addressed through use of the Graden over the last 2 – 3 years and has to be seen as a 'work in progress' and part of the maintenance programme for the foreseeable future; this acts to remove organic matter. Regular light scarification will also assist in this removal. (As explained above, an organic matter reduction programme doesn't mean it has gone forever as the plant continues to grow and deposit dead material. In that sense the job is never complete). In addition to the physical removal of the organic matter we can review the fertiliser inputs (Appendix 1) to see if there is any potential to grow a little less grass and so attack the organic matter from both ends i.e. we produce less organic matter to begin with. Improved aeration will also allow the soil microorganisms to work harder on organic matter decomposition through the provision of oxygen into the soil profile. And finally, light and regular top dressing is a great complement to these other operations as it makes the soil sandier which means it drains more freely and contains more air. I understand that at present the annual topdressing application is 40 tonnes; this isn't a high rate of application in current thinking, with a range of 80 – 100 tonnes not being unusual, and some clubs applying up to 160 tonnes. The top of this range seems excessive and can bring its own difficulties, but I would recommend an increase in topdressing up to 60 tonnes with light applications being made on a monthly basis through the growing season, and certainly after light scarification or aeration work.

Paul Miller PhD paul@paulmillerphd.com

2. To address the compacted layer lying between 40 and 150 mm.

Reducing the compaction here will facilitate water movement into the lower profile. A verti-drain is in use at Dunfermline Golf Club and it would be good to see this used more, although with narrow tines and set with minimal 'heave' so as to minimise surface disruption. The club has also had a demonstration of the 'Air2G2' machine which would appear to offer several advantages over the verti-drain, but shouldn't be considered as the 'magic bullet', as no such thing has ever been found in turf management! The Air2G2 website claims the specific relief of compaction at 150mm (6 inches) which is exactly what is needed here, so perhaps a further demonstration and assessment of the results could be arranged. Also, Kenny Duncan as Head Greenkeeper, and the Club, need to be comfortable that the machine does as is claimed and leaves minimal surface disruption.

These recommendations are intended to improve the soil profile, improve water movement and contribute to drier and firmer surfaces. This will encourage bentgrasses to compete more effectively with the *Poa annua*, conferring several advantages, and will encourage the production of smoother and truer putting surfaces allowing the appropriate management of green speed without stressing the grass plant.

The focus of my visit on this occasion was on the underlying agronomic conditions, however we also discussed current maintenance practices. With the exception of the recommendations already made, and in terms of 'in-season' course maintenance I am of the view that Kenny Duncan and his team have this in hand. I have no reason to recommend changes to aspects of maintenance including height and frequency of cut, verti-cutting and rolling in producing surfaces for summer golf, although further detailed discussion of this might provide the basis for a future visit.

Tees

Tees were visually inspected and the soil sampler used on a number of them. In many instances the teeing grounds have been prepared by small 'cut and fill' into the existing contours of the ground, and they sit well in that

environment, a good example being the 14th. The profiles are largely of native soil ameliorated with sand from years of divot repair work and top dressing. On most of the tees there was good grass cover although we are at the start of the season and these will be expected to take considerable wear over the coming months. It is understood that the enlargement of tees was discussed relatively recently as a consideration within the course re-design proposals; larger teeing grounds are always appreciated by greenkeepers so long as they are easy to access and are built flat and are easy to maintain. Tee enlargement might best be described as an on-going consideration. With regard to overseeding the use of Perennial Ryegrass was discussed; this is a very hardwearing species of good colour and texture, and modern varieties have made it a popular choice on golf tees on all types of golf course. It is my view that this species would be a very good 'fit' for overseeding tees Pitfirrane.

One tee that seemed to be suffering more than others is the 8th. This is severely shaded by trees and whilst trees and their management are outside my area of knowledge the constant shading of this tee cannot be a good thing. I'd respectfully suggest some radical tree work around this tee if it is to be given a change of presenting a satisfactory surface.

Fairways

Fairways at Pitfirrane appear to be in good condition and were being cut and presented to give the classic parkland stripe. In terms of grasses the foundations of the fairways are of fine grasses, with areas where e.g. Yorkshire Fog has become established. This is entirely to be expected given the loamy soils of Pitfirrane and of course a natural variability always exists within an area of this size which includes higher ground such as the 8th approach as well as lower areas such as the 18th fairway. Recovery from divotting and wear on fairways should be fairly rapid in the summer months, given the loamy soils, although well trodden areas and maintenance routes could be vulnerable to compaction and loss of grass cover at times. I

Paul Miller PhD paul@paulmillerphd.com

understand that aeration of approaches is carried out when possible, assisting these areas to be drier and firmer and therefore more satisfactory for play.

Paul Miller PhD paul@paulmillerphd.com

Semi roughs and roughs

No specific attention was given to these areas although I know from golfing at Pitfirrane that they will now be growing very strongly during the summer months, which is typical of golf courses of this type. I was made aware of some tree thinning and rough management adjacent to the 12th fairway and it will be interesting to see how that performs as rough this season. An unintended benefit that might occur here is an increased biodiversity and the creation of different habitats. Nature conservation on golf courses has become quite an issue and this would appear to be a small yet worthwhile contribution in that direction.

The Wee Course

A brief inspection was made of the Wee Course. This would appear to be a unique asset of Dunfermline Golf Club and I understand that its development is under discussion. Again, this is not strictly within my area of knowledge, but I wonder what the business potential for this course is, and where it might fit within any development strategy of the Club. At the time of my visit it was dry and firm following the dry April, and the greens, although not in fully presentable condition, have enviable sward composition with high proportions of fescue and bentgrass. It would be very easy to lose all that is good about this area, and personally I wouldn't be making decisions about it without a thorough review of the options and implications of the various potential courses of action.

Summary

Dunfermline Golf Club has a fine example of a mature parkland golf course built with traditional ‘push up’ greens. These are stable and produce good surfaces for the playing season, but are not without their challenges in terms of constantly encouraging water movement thus creating dry and firm conditions. A couple of areas within the greens need ongoing attention, those of the organic matter in the top 25mm, and the compact layer at some 40 – 150mm. Addressing these as part of an on-going management strategy and through appropriate maintenance practices will encourage the greens to perform better for longer each season, bringing advantages to the greenkeepers, members and Management Team of the Club.

Paul R Miller
26th May 2017

Appendix 1

Fertiliser Programme

Fertiliser programmes consist of a number of elements designed to apply a recommended or needed quantity of each of the major elements to the turf. The nutrient of primary concern is always Nitrogen (N) and in the vast majority of fertiliser programmes concentrate on N. The quantity of N required in different growing situations depends on the grass species, the climate and weather, the soil type and the desired turf quality. The effects of N are to speed up growth, increase colour, increase density and allow recovery from wear, and so is used when the demands on turf are greatest i.e. in the spring and summer months. However it is not a case of 'more is better' as N can contribute to excess organic matter production, can make the grasses more susceptible to disease, and can change the sward composition in favour of *Poa annua*.

Since my visit I have spoken with Blair Young from Aitkens, the fertiliser supplier, which was very useful. In reviewing the fertiliser programme from Dunfermline Golf Club I see it is designed to deliver 108 kg N /hectare/year, which is absolutely in the right ball park for a golf course of this type. It is commonly assumed that the total area of greens on a golf course is 1 hectare (approx.) i.e. 19 x 500m^2, and so fertilisers are supplied on that basis – this is the case with Aitken's recommendation. However I understand that a more accurate greens' area was ascertained during the course re-model exercise carried out by Howard Swan, and the total area is nearer to 8000m^2. What this means that 1 hectare's worth of N has been going on to 0.8 hectares so it is in effect being applied at 25% over the recommendation. This is through no fault of any individual but simply a long-standing acceptance of greens area rather than an accurate assessment of it. This over-supply of N will be contributing to the accumulation of organic matter in the surface layer and I recommend that, given the new and more accurate information about area, the application of N is reduced such that the recommended rate is applied.

Paul Miller PhD paul@paulmillerphd.com