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SWAFFHAM SEN

Swaffham Sen Feasibility.Docx

A*grostis* Sports Surface Consulting

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A*grostis* Sports Surface Consulting aims to assist clients in matters concerning sports surfaces. All recommendations are offered free of bias. A*grostis* has no commercial connections or obligations to any manufacturer, supplier or contractor.

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26 September 2023 TAL

SWAFFHAM SEN

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1 INTRODUCTION

1.1 General

A new Special Educational Needs (SEN) school is to be constructed in Swaffham, Norfolk. That school is to have natural turf sport and play areas within its boundary. A site investigation was required to determine the existing conditions in relation to this and to indicate the likely procedures that will be required in the formation of those sport and play areas.

A site investigation was undertaken on 23 August 2023.

1.2 Contacts

The report was commissioned by [redacted] Assistant Project Manager:

NPS Property Consultants
5 Anson Road
Norwich
NR6 6ED

Email: [redacted]
Mob: [redacted]
Tel: [redacted]
Web: www.nps.co.uk

1.3 Site location

The centre of the site with which we are concerned is at the location:

Nat. Grid: TF812090
OS X (Eastings) 581284, OS Y (Northings) 309084
Lat: N52:38:57 (52.649188)
Long: E0:40:42 (0.678352)
Nearest Postcode: PE37 7BN

Maps showing this location are provided in Figure 1-1.

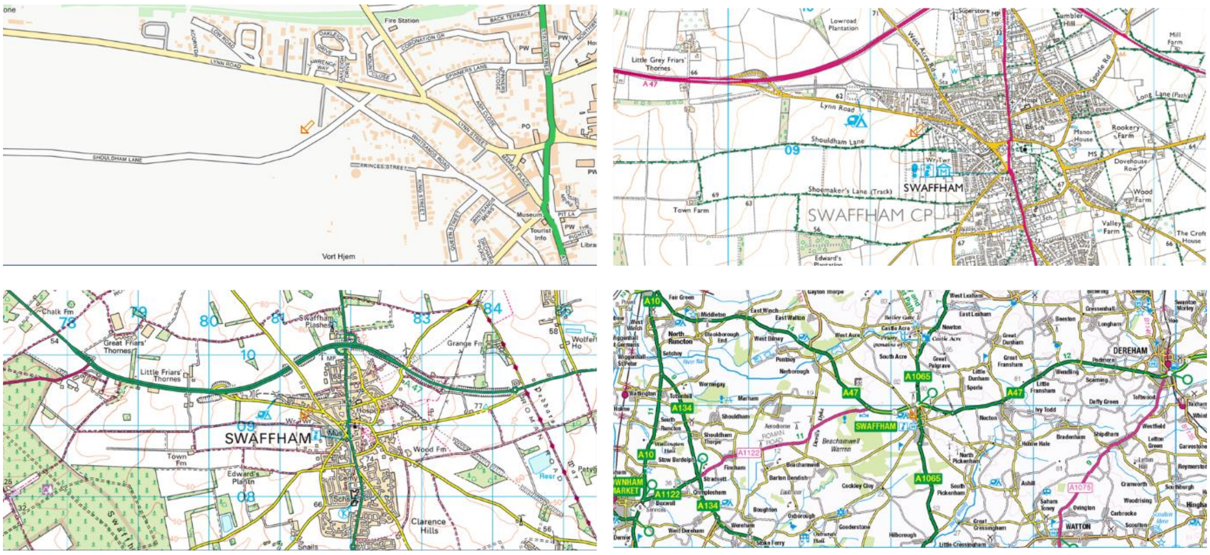

Figure 1-1 Location of the Site

A Google view of the site, with the area under consideration shown in outline, is provided in Figure 1-2.

Figure 1-2 Contemporary Google Earth image of the site with grassed areas shown in outline

The grassed area shown occupies approximately 5 464 m^2 (0.5464 ha, 1.35 acres, 0.005464 km^2).

1.4 Proposed layout

The layout proposed for the school site and encompassing the natural turf surface with which we are concerned is shown in Figure 1-3.

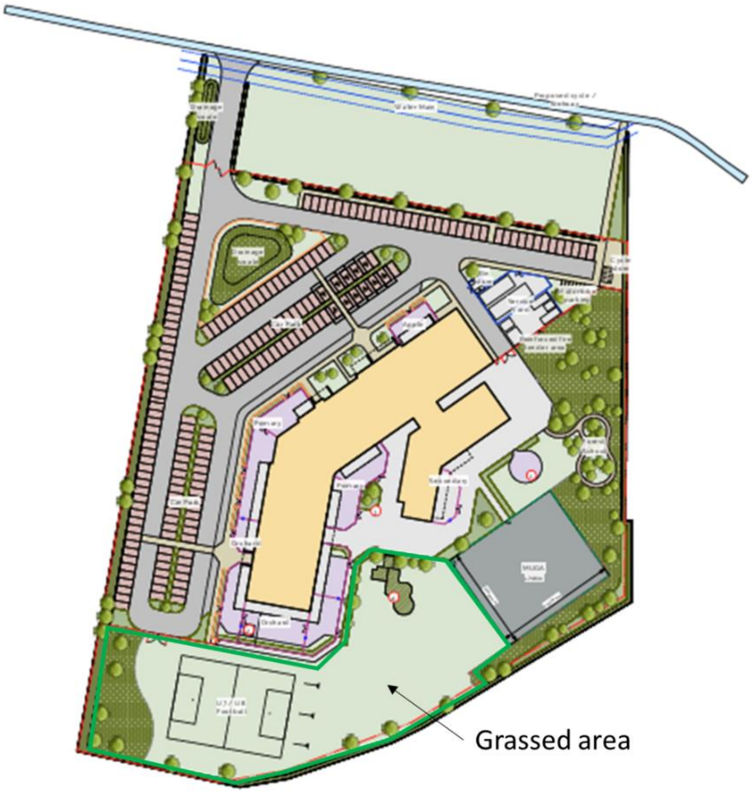

Figure 1-3 Grassed area in proposed layout[1]

1.5 History of the site

The area with which we are concerned has almost certainly maintained as arable agricultural fields for centuries. The outline of the grassed area of the site is shown in the historic map from the late 19th century alongside the current image of the site in Figure 1-4.

[1] Landscape Layout Plan. 2247-WWA-LS-ZZ-D-L-0103 13 January 2023

Figure 1-4 Outline of the grassed area of the site on OS 6-inch map 1888 – 1913 (left) and on contemporary image

1.6 Topography and slope

A topographic survey of the site was not available. It could be discerned, however, that the land falls to the north-west of the area with which we are concerned with a slight fall to the west. The highest point of the development area is in its south-west corner, corresponding with the location for the small side football pitch (Figure 1-3).

2 SITE GEOLOGY, SOIL TYPE AND HYDROLOGY

2.1 Geology

The British Geological Survey classifies the solid (bedrock) geology of the site as:

Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation and Culver Chalk Formation - Chalk. Sedimentary bedrock formed between 93.9 and 72.1 million years ago during the Cretaceous period..

The drift (superficial) deposits are recorded as:

Lowestoft Formation - Diamicton. Sedimentary superficial deposit formed between 480 and 423 thousand years ago during the Quaternary period.

The Lowestoft Formation forms an extensive sheet of chalky till, together with outwash sands and gravels, silts and clays. The till is characterised by its chalk and flint content. The carbonate content of the till matrix is about 30%, and tills within the underlying Happisburgh Formation have less than 20%.

2.2 Soil Survey of England and Wales

The Soil Survey of England and Wales classifies the soil type of the location as being of the 'Newmarket 1 Association'. These are formed over chalk or chalky drift and are described as '*Shallow well drained calcareous sandy and coarse loamy soils over chalk or chalk rubble. Some similar deeper sandy soils, often in an intricate striped pattern. Risk of wind erosion.'*

A typical profile is shown in Figure 2-1.

Figure 2-1 Soil Survey of England and Wales profile description of Newmarket 1 Association (Cranfield University 2016. The Soils Guide. Available: www.landis.org.uk. Cranfield University, UK. Last accessed 26/09/23)

The Soil Survey goes on to state of the Newmarket 1 soils…

Detailed Description

This association of shallow, calcareous coarse loamy and sandy soils covers 249 km², mainly in Norfolk where it occurs on the gentle slopes of the broad shallow valleys that dissect the Breckland . In the western part the largest parcels run from the level plateau surface, at about 35 m O.D. across gently undulating slopes to the valley margins which, close to the Fens, lie at about 5 m O.D.

The main soils are the Newmarket series … brown rendzinas. [These are] brown coarse loamy, topsoils which directly overlie a white rubble of chalk stones with flints and some sand.

The patterned ground, so characteristic of the association, consists of alternate deep and shallow soils every few metres. On slopes the soils are aligned downslope to form a pattern of stripes 6 to 10 m wide. On level ground the deep soils form a polygonal network 5 to 7 m across around a core of shallower soils. On the level or very gently sloping ground in the western Breckland, Elveden or Newmarket soils about 30 cm deep alternate with Methwold or Swaffham Prior soils 40 to 80 cm deep…
…

Cropping and Land Use

…. Weak surface structure and soil wetness restrict the opportunities for cultivation particularly in spring so spring crops are rarely sown. The soils are slightly droughty for cereals and moderately droughty for grass. While grass yields are moderate the risk of poaching restricts early spring and late autumn grazing. Most component soils are naturally acid, …. Phosphorus levels are low, but potassium is readily available and sufficient for the needs of most crops.
…

2.3 Soil water regime and runoff characteristics

The Soil Survey of England and Wales states of the Newmarket 1 soils water regime…

All the soils are permeable and overlie the chalk or chalky drift so the soils are well-drained (Wetness Class I). They readily absorb winter rain with little run-off. Crops obtain some moisture from the chalk but the coarse textured soils are moderately or very droughty for most arable crops, oilseed rape being least affected. All the soils are very droughty for grass.

Sustainable drainage system (SuDS) design is based upon the local greenfield runoff rate. Natural turf sports pitches are, of course, green fields usually established on the existing soil so the stipulations concerning the management of runoff need not technically be applied. In many situations, however, it is necessary to incorporate pipe drainage into natural turf sports pitches. The extent to which this affects the runoff characteristics of the surface it is not possible to determine with any accuracy or by means of any established procedure. In effect, the incorporation of pipe drains alters the greenfield runoff rate as opposed to creating a new ‘urbanised’ feature with particular runoff qualities.

Greenfield runoff following rainfall events is divided into the more immediate 'direct' runoff and the more drawn out 'base' flow which relates to the deeper groundwater flows that come about. Our approach, where applicable, is to consider these base flow rates as indicative of the runoff enhancement that the installation of pipe drainage will bring about.

The computer modelling facility developed by Wallingford HydroSolutions and known as ReFH 2.3 is the recommended method for estimating greenfield runoff rates and volumes. The software is designed to be used in conjunction with the FEH (Flood Estimation Handbook) Web Service which gives local data referring to specific locations within the UK. This is based on rainfall modelling and on soil type. The FEH Web Service is available here:

https://fehweb.ceh.ac.uk/GB/map

This approach, utilising ReFH2.3, has been adopted to establish greenfield runoff rates for the present project.

The area used in the calculations is one hectare (0.01 km^2).

The FEH point data for the site are shown in Table 2-1.

Key modelling descriptor	Value	Unit
SAAR (61-90)	692	mm
PROPWET	0.31	mm
BFIHOST 19	0.911	

Table 2-1 FEH point descriptors for the site

These data were then used with the ReFH 2.3 software to determine the peak greenfield runoff *rates* for storm events over a range of return periods. These are shown in Table 2-2. For the 30-year and 100-year storm event, an allowance of 40 % for climate change has also been included.

	Peak runoff rates (l/s)		
Return period	Direct	Base	Total
1 year	0.37	0.08	0.41
2 year	0.37	0.08	0.49
5 year	0.45	0.10	0.76
10 year	0.70	0.16	0.96
30 year	0.88	0.20	1.32
30 year 1.4 CC	1.21	0.27	2.04
100 year	1.85	0.42	1.79
100 year 1.4 CC	1.63	0.37	2.80

Table 2-2 Peak greenfield runoff rates (per hectare)

Greenfield runoff is divided into two components in this form of analysis. These are termed 'Direct' and 'Base' and their peak values are shown in Table 2-2. Direct runoff is that which discharges from the specified area over the surface of the natural ground or through the soil. This normally takes place within a few hours of a rainfall event, the time to peak flow varying according to soil type. Base flow is that which permeates deeper in the soil profile and discharges more slowly over a longer period, usually days. These responses may be seen in the flow patterns associated with particular rainfall events.

The greenfield flow pattern for a design storm event taking place with a 1-year return period and over 24 hours is shown in Figure 2-2.

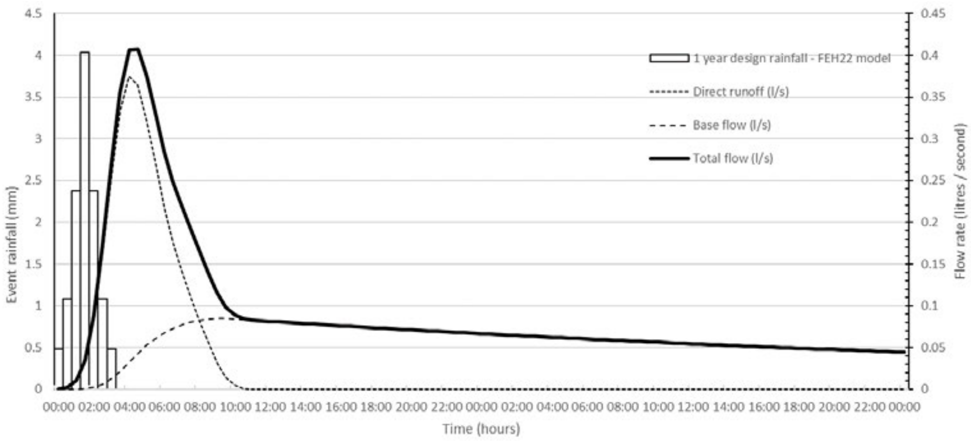

Figure 2-2 Greenfield runoff pattern over 24 hours during the 1-year design rainfall event for the location

Note in particular the differing rates as indicated by the right-hand axis. The equivalent flow patterns may readily be obtained for all of the return periods listed in Table 2-2.

2.4 Hydrology of Soil Types (HOST) classification

The soil type is of HOST categorisation 1 (Boorman et al. 1995).[2]

The BFIHOST (Base Flow Index HOST) item in Table 2-1, 0.911, reinforces the HOST description of the soils and indicates that the great majority of rainwater arriving at the surface, is able to pass directly through the topsoil and into the subsoil where it contributes very quickly to ground water.

[2] Hydrology of soil types: a hydrologically-based classification of the soils of the United Kingdom. Report No. 126. Institute of Hydrology. Boorman, D.B., Hollis, J.M. & Lilly, A. (1995)

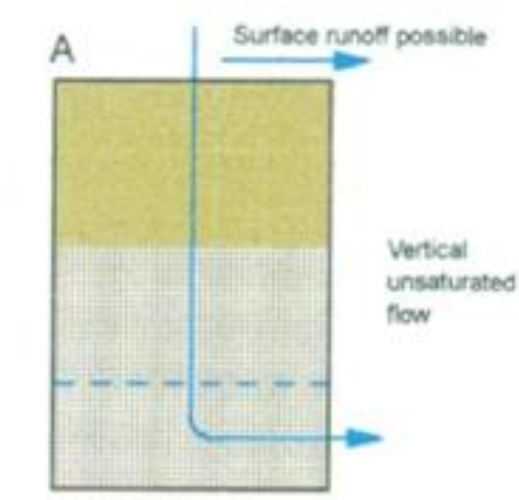

Figure 2-3 Illustration of flow pattern through category 1 HOST soils

3 CONDITION APPRAISAL

3.1 Access, boundaries and surroundings

Figure 3-1 Views from west (left) and east across the site with approximate outline of the grassed area

To the north of the development site is Lynn Road, and to the east is an area providing caravan or semi-permanent accommodation. To the south is a public footpath with an area of woodland and scrub beyond. To the west, the arable field of which the site is composed extends over some considerable distance. The sport and play area is to the south of this development area.

Unmaintained hedgerow and small trees run along the southern and northern boundaries. Along the edge of the arable land, an area of set-aside extends around 5 metres into the development area.

Figure 3-2 Southern boundary of the development site and of the grassed area

Figure 3-3 Westward view across the southern extent of the development area (left) and the south eastern corner offering limited opportunities for access

The proposed layout (Figure 1-3) indicates a new bell-mouth entrance directly off Lynn Road to the north. Prior to the construction of this, no alternative vehicular access is readily available.

3.2 Ground cover

Figure 3-4 Typical appearance of ground cover at the time of the investigation

At the time of the investigation the grain crop had been harvested and the remaining vegetation cut down to around 100 mm height.

3.3 Services

Overhead power lines run from approximately 30 metres west of the north-eastern corner of the development site to the south east corner. However, these do not pass over the area of the natural turf preparation.

Figure 3-5 Overhead power lines at the north east side of the development site

3.4 Undulation and evenness

Within the overall slope, barely any undulation was noted although the surface was far form even at smaller scales with variation in levels of the order of 75 mm over 1 metre of surface.

3.5 Natural drainage

No evidence of piped drainage was seen within the body of the area with which we are concerned. No evidence of surface or ground water having been at any time present were noted throughout the area with which we are concerned.

3.6 Soil profile

The soil profile is shown in Figure 3-6. Topsoil was a very sandy organic loam, easily worked by hand, and containing flints. Flints were often quite large and examples up to 150 mm across were widespread in the surface.

Flints continued to be encountered throughout the profile which was easily excavated down to approximately 900 mm.

The topsoil extended to around 300 mm beyond which depth it merged into a similarly-textured, though less organic subsoil. No groundwater was noted in the excavation.

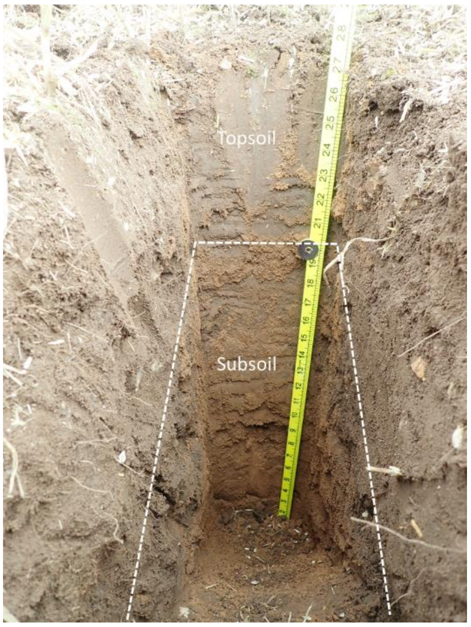

Figure 3-6 Images of soil profile

3.7 Soil texture

The sand, silt and clay content and the organic matter content of the topsoil and subsoil are shown in Table 3-1.

TBC

Table 3-1 Sand, silt, clay, organic matter content of the topsoil and subsoil

These data confirm the very sandy texture of both the topsoil and the subsoil.

3.8 Hydraulic conductivity (*in situ*) and soil structure

Hydraulic conductivity was measured using intact cores (50 mm diameter, 50 mm depth), taken from varying depths through the soil profile of excavations within each of the two fields. Total porosity and air-filled porosity (equivalent to field capacity) after the application of 300 mm tension for 24 hours was also determined for each of the core samples.

The results, with conductivity measures adjusted to 10 ºC, are shown in Table 3-2.

Depth (mm)	Hyd Cond (mm/hr)	AFP 300 (%)	Total P (%)
50	45	12.21	41.87
150	30	6.48	36.49
200	8	4.03	35.56
250	11	1.75	33.77
320	18.5	1.57	44.28
450	9	1.85	30.04
600	40	1.80	36.09
750	36	1.78	32.53

Table 3-2 Hydraulic conductivity from intact cores at varying depths

Average hydraulic conductivity in the topsoil was 24 mm/hr and in the subsoil 26 mm/hr. As anticipated, these data corresponded reasonably well with the air-filled porosity data.

4 INTERPRETATION AND COMMENT

4.1 Topsoil

The texture of the topsoil is such that handling of this should be very straightforward and may probably be undertaken for much of the year due to its capacity to retain very little moisture. The subsoil may also be described in this way.

Despite these favourable textural characteristics, all soil handling and storage should follow the guidelines set down in the Code of Practice for the Sustainable Use of Soils on Construction Sites[3].

The flint content of the topsoil is likely to require some specific management, either through picking or burying, or both, during the surface preparation works. This issue is by no means insurmountable, however.

4.2 Ground formation

It is possible that the relatively small extent of the sport and play area with which we are concerned may not require levelling within the subsoil to achieve a satisfactory overall level for the purposes required. It may be possible to achieve the desired levels by adjusting these within the, relatively deep, topsoil itself. A topographic survey, ideally at 5 metre centres, will be required to confirm this, however.

4.3 Subsoil and pipe drainage

The hydraulic characteristics of both the topsoil and subsoil indicate that no pipe drainage will be necessary.

4.4 Surface drainage

Similarly, the topsoil will not require any supplementary features, for example a sand carpet, designed to enhance surface water infiltration in the immediate aftermath of rainfall events.

[3] DEFRA publication. 2009

4.5 Seed selection

The texture of the topsoil is such that any carefully-prepared surface made ready for the incorporation of seed will be extremely vulnerable to wind-blow disrupting this. Accordingly, it would be appropriate to establish a nursery crop of cereal, for example winter barley, sowing into this when it has reached the 2 or 3 leaf stage of growth. The cereal will be unable to survive the first cut of the developing ground cover and so will of course be entirely absent from the finished surface.

With the progress of climate change and the general need to reduce maintenance inputs as much as possible, a seed mix dominated by grass species that are tolerant of wear, drought and heat stresses would be appropriate. A reduced requirement for nutrient input (fertiliser) would also be advantageous. Accordingly, a seed mixture containing significant amounts of fescues along with the more wear-tolerant smooth stalked meadow grass (SSMG) would be preferable, as opposed to the ryegrass-dominated mixtures that are more conventionally used.

SSMG has many advantages over ryegrass but requires much warmer soil temperatures in order for the seed successfully to germinate and establish. Sowing with SSMG mixes should therefore be completed before the end of September at the latest if failures in establishment are to be avoided. If the works are undertaken in the summer months, sowing at this time should fall comfortably into a continuous schedule of works that will not require irrigation to sustain grass growth and establishment.

4.6 Timescales

The works described should be timed so that the grass seed may be sown at the optimum time of year which is between late July and mid-September. Thereafter, the grass will need to establish and, if the appropriate sowing time has been achieved, it should be possible to commence light use of the surface by the following spring. Favourable weather, that is wet and warm, during September and October could bring the start date forward to December.

Although spring sowing can be successful, that success is less reliably achieved than sowing during the period described above. Fortunately, this coincides with the best time of year for carrying out earth-moving operations which is when everything is dry at the height of summer. Work on the grassed areas starting around May or June should therefore be more or less completed by the end of September.

An idealised schedule of works is provided in Table 4-1.

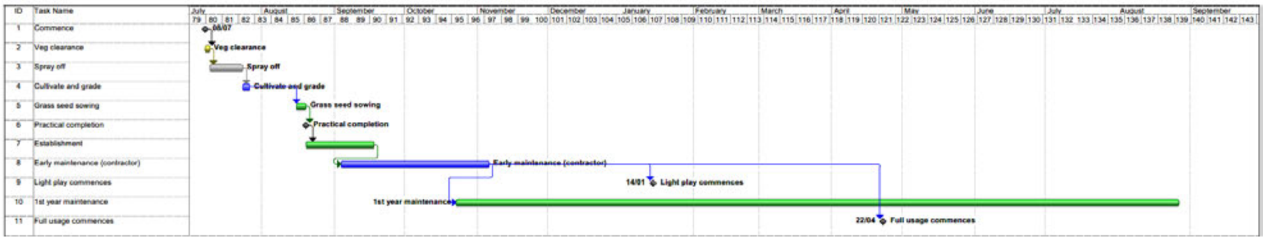

Table 4-1 Idealised schedule of works

4.7 Playability

Conforming to the intended standard of surface will require the treated area of the site to be maintained to an appropriate standard. Contracts for the construction works involved in projects such as this typically cover the period from the sowing of the grass to that time when play may commence on the new surfaces. The subsequent maintenance programme must be taken up by the Client at this point. Agrostis would normally provide a maintenance schedule, tailored to the particular circumstances of the site as it is created, and this should be followed more or less indefinitely after handover.

5 PROCEDURES

5.1 Design and procurement

Having undertaken the site investigation, Agrostis are well-placed to prepare the detailed design documentation for the reinstatement of the natural turf surface at the appropriate stage.

Our preference would be to work according to the RIBA work stages which we have adapted for sports pitch projects. This report represents RIBA stages 1 and 2. The subsequent design is a two-stage process, RIBA 3 and 4, whereby the details of the procedures to be undertaken are reviewed and revised according to the needs and expectations of the client.

When everyone is satisfied that the work described in the documentation the job may be put out to tender. We would strongly recommend that this is done among contractors who have known capabilities and reputation in this form of work. The work itself constitutes RIBA stage 5 and that work should, ideally, be supervised, with progress reports provided to the client throughout the construction and establishment period.

5.2 Summary of procedures

The procedures involved in the reinstatement will be as follows:

1. Cut down and remove any vegetation that has established (provisional)
2. Spray off any remaining vegetation with total herbicide (provisional)
3. Strip and set aside topsoil (provisional)
4. Grade the subsoil surface to the design formation in a balanced cut and fill operation (provisional)
5. Replace topsoil to achieve a uniform depth across the site. Topsoil to be handled when dry and in dry conditions. (provisional)
6. Prepare stone free tilth
7. Sow nursery crop
8. Sow grass seed
9. Maintain developing sward during establishment period

5.3 Cost estimate

A guideline for the cost of the development as described is provided in Table 5-1. The quantities are based on the data described here.

The prices are derived from rates offered by various contractors for the same operations and materials in projects undertaken in the last year and in the south of England. The specification put out to tender, and following negotiations, would of course provide the definitive figures for all aspects of the work as it is determined it should go ahead.