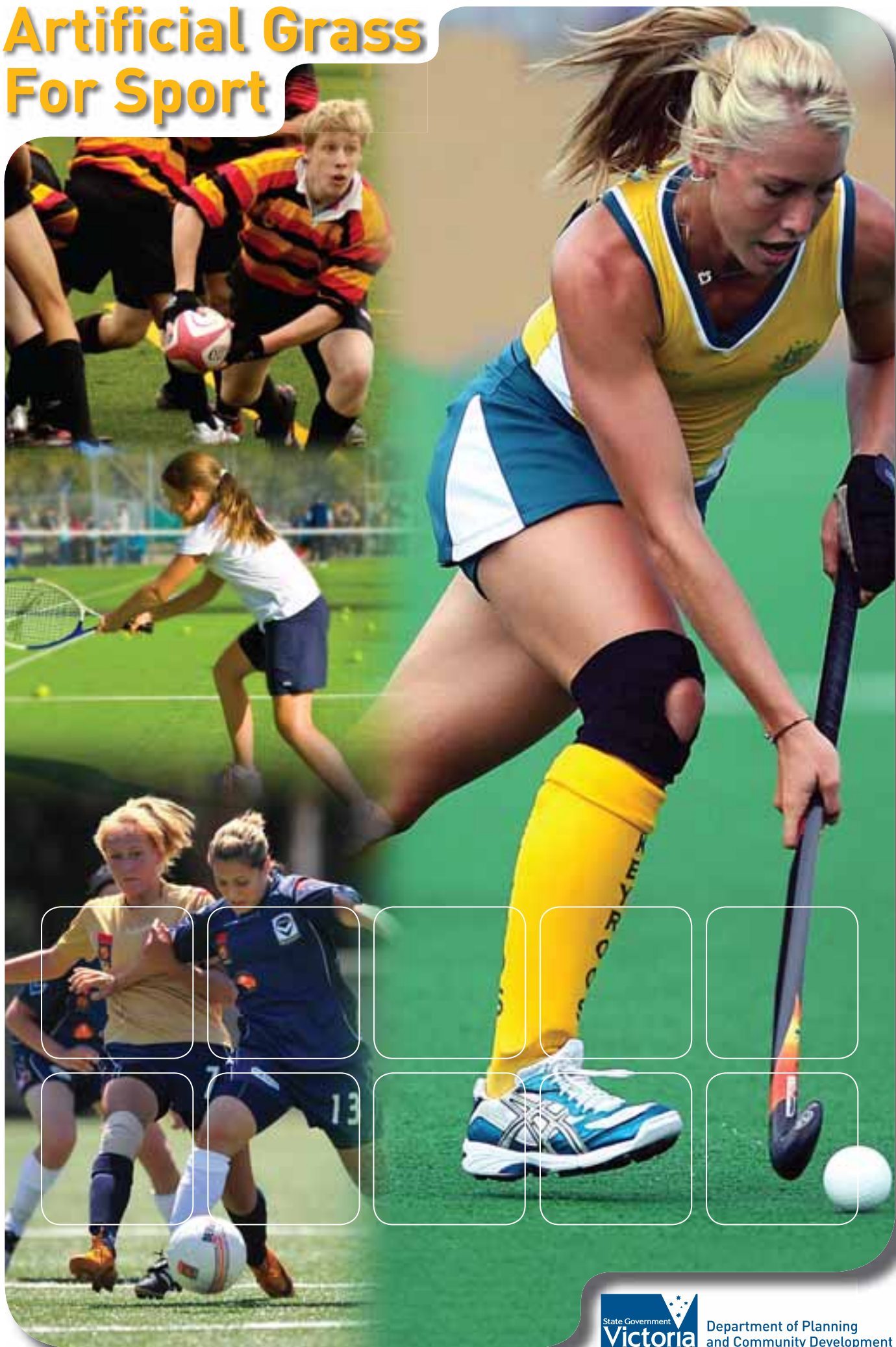


Artificial Grass For Sport



Minister's Foreword

Message from the Minister for Sport and Recreation

It gives me great pleasure to present the Artificial Grass for Sport guide.

Victorian communities are increasingly looking to more sustainable solutions to help keep their sports thriving in the face of weather extremes and increasing participation rates. Artificial grass surfaces are proving to be a viable alternative.

They don't require watering, are easy to maintain, durable and most importantly allow up to three to four times as many hours of use than natural turf surfaces.

That's great news for Victorian clubs, schools and communities looking to accommodate greater numbers in their sports.

Recent experience, however, has shown us that there's been inadequate information and support for local councils and their communities to plan for, select, and install new artificial grass surfaces.

As a result we've consulted with the sports industry to develop what will undoubtedly become an indispensable tool for future artificial grass projects.

This guide will assist you in all aspects of artificial grass installation from selecting the most appropriate site and surface, to preparing the site, choosing the right professionals, planning, and the best way to lay and maintain your surface for years to come.

It brings together current best practice, industry standards, and professional tips gathered and drawn from a range of sporting associations and leading Australian and international artificial turf experts.

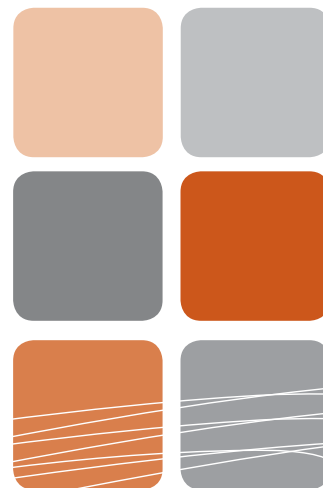
By sharing our artificial grass experience with all Victorians we hope to further enhance the work of local councils, sporting clubs, schools, and communities in their development of quality, durable and accessible artificial grass venues.

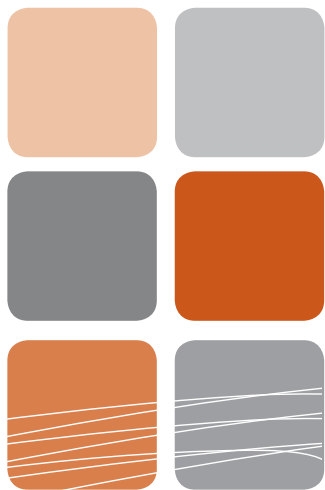
To get the most out of your current or future artificial grass project I strongly encourage you to utilise this fantastic resource - Artificial Grass for Sport.



HUGH DELAHUNTY MP

Minister for Sport and Recreation





Purpose of the Guide

Sport and Recreation Victoria (SRV) has been supporting local government authorities for decades in the funding and development of infrastructure for sport and recreation. Artificial grass surfaces for sport and recreation have been popular during this period given their resilience to weather, their availability for intensive use, and the consistency of their playing characteristics.

The popularity of the artificial grass sub-category of synthetic sports surfaces took off in Australia in the 1980s, principally used for hockey, tennis and lawn bowls. This sporting use continues strongly today, and has expanded in more recent years into provision for sports such as football (soccer) and rugby, and now the expansion into Australian rules football and cricket ovals.

The interest in artificial grass has been further heightened due to the prolonged drought conditions and associated water restrictions, which have made it challenging to maintain good quality, safe playing areas.

It is evident that some local councils, sporting organisations, and schools may not have sufficient information to plan for, select, and install artificial grass surfaces. Further, due to the continual technological development of artificial grass it can be difficult for organisations contemplating artificial grass for the first time to comprehend and deal with the broad range of issues confronting them.

The overall intention of this publication is to provide a sound base of information so that informed decisions can be made at all stages of artificial grass project development.

Structure of the Guide

This publication provides guidance, as well as highlighting 'best practice' for the planning, design, selection, installation, management, maintenance and replacement of artificial grass surfaces for sport. The document is structured accordingly so readers can quickly find the information that is relevant to their enquiry.

Sections 2 – 7 follow in a sequential order, whilst Section 1 is both a traditional introductory collection of subjects (glossary, history, product types, etc), but is also inclusive of several key subject matters brought to the front of the guide for greater emphasis (quality assurance, funding strategies, professional support, research and development, etc).

Overall, whilst the presentation of issues flows in a logical, almost chronological process, it has been kept in mind that many users will want to 'dip in' to the guide for selective reading, and so to support that need some small areas of information and advice have been repeated as deemed appropriate.

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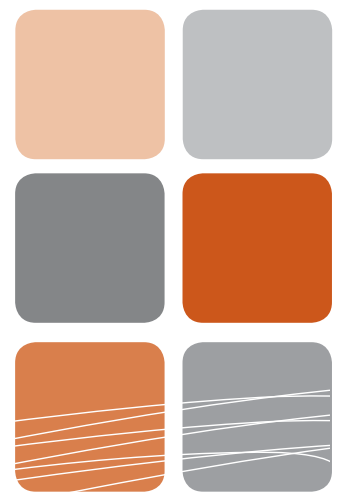
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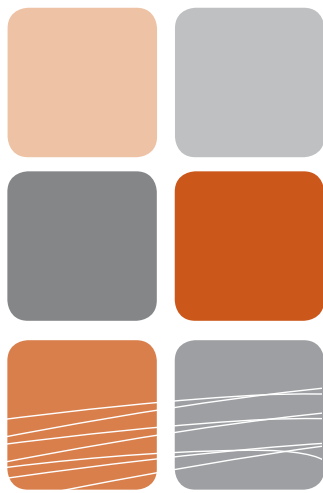
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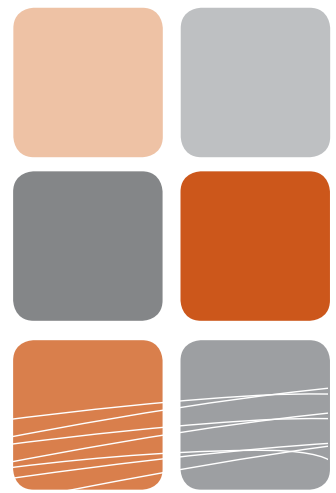
B Cont.	
Base	Fill, either bound or unbound, placed on the sub-grade/sub-base to influence the engineering and playing characteristics of the whole construction. Provides the camber for the pitch and therefore the surface drainage characteristics.
Base materials	Imported job materials that will be used to construct the foundation over the existing sub-grade (native soils or other surfaces) or sub-base. Base materials may be comprised of, but not limited to the use of, crushed, clean gravel, mine rock and fines, compactable aggregates and road base.
Bill of Quantities	Is a construction industry tendering document which should detail the terms and conditions of the construction or repair contract and itemises all work to enable a contractor to price the work for which they are bidding.
Binder	In-situ rubber shock pads are made from a mixture of black Styrene Butadiene Rubber (SBR) granules (2-6mm in size) and a polyurethane binder.
Bound base	Fill (inclusive of a binding agent) is placed on the sub-base to produce one or more cohesive layers, often then sealed with a bituminous layer.
Brooming	Another term for de-fibrillating or brushing-up the blades of grass or to describe the use of a broom to work infill materials into the surface (brooming in the infill – brooming up the turf fibres).
C	
Camber	Another word for slope or gradient. Designed into the field to encourage horizontal drainage.
Carpet (artificial grass)	<p>Manufactured from a polymer yarn, artificial grass carpets are either tufted or needle-punched. Third generation carpets are almost always 'tufted' carpets. With tufted carpets the pile is formed by looping yarn through a backing material and cutting it to the required length (usually between 35mm and 65mm). The underside of the backing material is coated with latex or polyurethane, which helps hold the tufts in place and provides structural stability to the carpet. Holes are pierced through the backing to assist with drainage where vertical drainage is desired.</p> <p>Carpets can vary in terms of the type of yarn used and density (stitching rate). Most carpets use a single form of yarn while some might use a mixture. The yarn is generally made from either polyethylene (PE), which is soft and less abrasive, or from polypropylene (PP), which is stronger and is often used for low-impact sports such as tennis. Generally the denser the carpet, the more durable the product.</p>
Certified pitch/field	An on-site built pitch/field which has been tested by an accredited laboratory and verified as meeting the sport's defined requirements and licensing agreement conditions.
Clay soils	An earthy fine-grained soil that can retain moisture, and when moist can almost be the consistency of putty, i.e. workable in the hand. When dry, clay soils are notably dusty, hard and unworkable. Devoid of any organic materials, clay-rich soils generally drain slowly, if at all. When saturated, clay-rich soil surfaces can easily deform and rut, particularly under heavy weight loads.
Compaction	The act of compressing the surface materials to reduce air content, decrease percolation and increase density and hence surface stability. Also refers to the common observation on sand infilled carpets over time where maintenance/rejuvenation of the sand layer is not carried out effectively – making the surface hard and unforgiving.

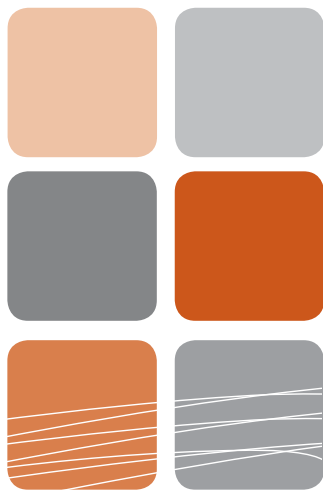




C Cont.	
Conditioning surfaces	The removal of any static electricity charge that remains in the artificial grass. Can happen via the application of fabric softener (see Maintenance Section) or through passage of time.
Contamination	<p>Contamination of the playing surface occurs from mud and other materials brought from outside the playing area, reducing performance.</p> <p>If the synthetic surface is not fenced there will be a higher potential for contamination from players and other park users walking across the surface (mainly from debris in shoe soles). This will necessitate a high level of maintenance and cleaning to prevent the formation of a drainage inhibiting skin within the surface and the establishment of algae and moss.</p>
Crimping	The processing of yarn, by heat or air pressure, to fix a wavy texture into the yarn and increase its apparent bulk.
Crumb rubber	Granules of new or recycled rubber materials used for infill or for top dressing on synthetic grass materials. Granules are specified as either new or recycled rubber, and are sized by the smallest and largest average radius of the granules contained in the packaging. Size of granules used will depend upon the application; golf putting green surfaces require smaller grain size than larger field areas. Typical range is 0.5 – 2.5mm.
Crush recovery (also called 'Fibre Resilience')	Crush recovery describes the ability of the synthetic grass fibres to rebound back upright after being walked on, or after having dead weight from furniture (such as moveable goal posts) or other elements. To encourage good recovery, all synthetic grass surfaces made for lawn and landscaping will benefit from some amount of infill materials that provide horizontal and vertical stability as well as UV protection for blades and backing.
Cut to fill	The act of cutting material from the high side of a slope and placing it in compacted layers at the low side to create a level platform.
D	
Delamination	Separation of the secondary backing or attached cushion from the primary backing of the artificial turf.
Degrade, Degradation	Loss of physical property or performance. The 'weaking out' or weakening of a system or substance, i.e. 'The effectiveness of UV protection, the strength of fibres, backing and the porosity of a surface might degrade during the life of the turf.'
Dimensional stability	Refers to the ability of the finished turf surfaces to retain their original size and shape, and resist lateral movement caused by cyclic temperature changes or movement pressure (participants/ traffic).
Disposal of carpet/pad	If it cannot be re-used (eg. training venues, kindergartens, playgrounds), it would need to be disposed of in a landfill site.
Drainage falls	Where a specific slope is designed into a sports surface so surface water will drain away from the playing area.
Dressed (hybrid) pitches	Pitches using a carpet of woven, tufted or knitted synthetic yarn partly supported or stabilised by the addition of filling material (eg. sand and/or rubber granules – generally filled to around 60% of the pile height and therefore sometimes referred to as a sand-dressed pitch). Usually 16-20mm pile, crimped down to a playing height of 12-13mm. Generally used in relation to hockey surface systems.
Durability	The capacity of the synthetic system to resist degradation by factors such as abrasion, indentation, fatigue, UV, chemicals, fire, staining, delamination and so forth. Durability can vary, depending on the quality of materials used, construction methods, the intensity of use of the pitch, effective maintenance, etc.

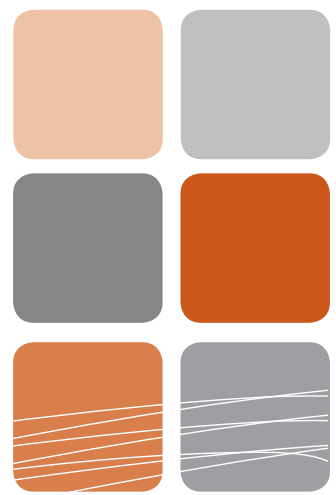
E	
E Layer	Meaning varies internationally but generally refers to an engineered base that has a mixture of resilient particles and granular material that forms a more deformable resilient structural platform for artificial grass surfaces.
Expression of Interest (EOI)	Preliminary process that teases out potential commercial interest in tendering for a project.
F	
Fabric	Materials used under and throughout the construction of a synthetic grass project. Woven and non-woven, commercial grade materials provide additional horizontal and vertical stability to the installation.
Face	Also known as the nap or the pile of the surfaces of turf. It describes the total visible surface of the finished turf materials.
Face weight	Refers to the weight of the yarn that is visible above the carpet backing (refer to Section 1.4 for calculation formula).
Fibre material	Yarn fibres can be manufactured from various natural and synthetic materials. Synthetic grasses and artificial turf are typically made from one or a combination of two or more of the following fibre materials; nylon, polypropylene or polyethylene.
Fibre size/shape	The cross-sectional area and shape of individual ribbons of fibre vary considerably from product-to-product. The unit of measurement for the weight of the fibre is dtex (1 dtex = gram weight per 1 metre of yarn, using a 10,000 metre average). The shape of the fibres can vary from fibrillated flat ribbon yarns to highly-varied shapes of monofilament yarns. The quantity of yarn used to form the pile will have a significant effect on the cost, performance and durability of the carpet. This is measured as face weight. It will also have a significant impact on the stability of the infill medium in a carpet, and the 'crushability' (or fibre resilience) of new 'shaped' fibres.
Fibre width	The width of the fibre is measured across its face and can affect the colour, shine, vertical recovery and durability of the fibres under extreme conditions; especially field applications.
Fibrillated pile/yarn	Yarn ribbon which is cut from a sheet and is then split or slotted to a variable pattern before twisting into a yarn strand. Designed to influence performance. Looks like a honeycomb when held open.
Filament	A single, continuous strand of synthetic fibre.
Filled pitches	Pitches using a carpet of woven, tufted or knitted synthetic yarn fully supported or stabilised by the addition of filling material (eg. sand and/or rubber granules). Generally loose laid, not stuck to the layers below (except at the seams).
Fines	Very small particles of matter (sand, soil, etc). Not used where porosity is important (may clog vertical drainage).
First Generation Turf	Developed in the 1960's and 1970's: Low-profile carpets (8-12mm), high-density fibres.
Foundation	Comprises of the layers beneath the shockpad and carpet – the asphalt, base, sub-base and sub-grade.
G	
Geotechnical report	A report on the ground conditions prepared by an appropriately-qualified geotechnical engineer. This will ideally report such factors that could affect the construction of a pitch, such as subgrade state, drainage capacity, compaction, moisture levels, and the potential for the ground to swell or shrink as moisture levels change.

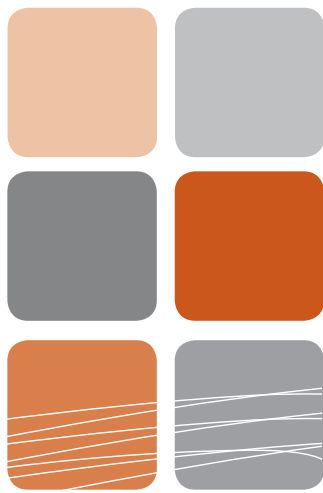




G Cont.	
Geotextile	Material used to support, separate, filter. Used to strengthen compacted ground, provide a filter barrier around drains, etc.
Granulated rubber	Rubber materials that have been processed into small grains of rubber for use in a variety of finished goods including synthetic grass infill materials. See Crumbed Rubber.
H	
Heat radiation	Most synthetic turf surfaces radiate temperature at approximately 1.8 times ambient temperature where as natural turf radiates at 1.3 times ambient temperature.
Hold points	Key stages of a project at which point works should cease, allowing inspection/sign-off of the stage of work just undertaken.
Horizontal stability	Horizontal stability is the ability of the sub-base, base and turf systems to work together to keep the installation from stretching, shrinking or collapsing. Horizontal stability is engineered into the project by the selection of the site, base materials, edging, trim elements, base construction, drainage and final grade. Horizontal stability in a synthetic grass material refers to the stability of the primary and secondary backing materials to keep the synthetic grass surfaces from stretching, shrinking or buckling over time.
I	
Infill	The infill is generally silica sand, rubber granules, or a combination of both, and its function is to support the pile of the carpet, help the pile to remain vertical and contribute to the playing and cushioning qualities of the surface (ball rebound, shock absorption and vertical deformation). Some infill systems use stratified and segregated layers of rubber and sand granules, and others a mixture of sand and rubber. Some new granular rubber infill products may be useful in Australia in reducing radiated heat.
Installation	The installation of a complete synthetic surface system, including the construction of a fully-designed base/drainage system, will take about 16 weeks (two to four weeks for earthworks, six to eight weeks for base works, two weeks for a shock pad and two to three weeks for the carpet and infill). Fencing and floodlight installation can overlap with these phases.
Irrigation	The application of water to an artificial grass carpet is sometimes done for hockey (to aid ball traction and player sliding) and lawn bowls (green playing speed).
K	
Knit-de-Knit (KDK)	After initial production, the yarn is then knitted into socks and heat-set. This process gives the finished yarn a curly appearance. The purpose of Knit-de-Knit yarn is to reduce the impact of fibre direction in the grass surface. Pile nap (lean) is overcome with KDK yarns.
L	
Latex	Latex is a natural product used as a secondary backing material to lock stitches in place and provide additional dimensional stability.
Licensed Manufacturer	An artificial grass manufacturer who has entered a licensing agreement with a sports governing body or other organisation. Can sometimes include a supplier who is partner to a licensing agreement but does not manufacture artificial grass.

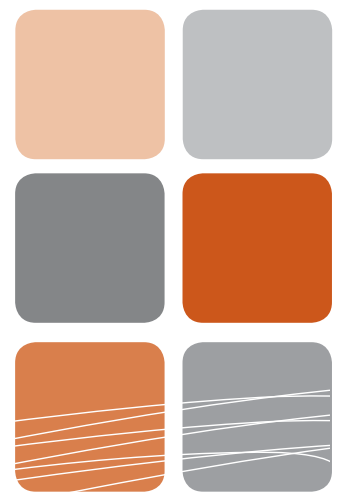
L Cont.	
Licensing agreement	The formal agreement entered into by an artificial grass manufacturer and a sports governing body concerning the conditions under which approval of artificial grass products for that sport specifically may be granted.
Lifecycle costs	The lifecycle cost of a surface consists of three different costs: <ul style="list-style-type: none"> • Initial capital • Maintenance • Replacement
Lifespan	The typical period of time that the item lasts before requiring replacement.
Long-pile pitches	Third to fourth generation surfaces exceeding 35mm pile height.
M	
Macadam	Another name for asphalt. See Asphalt.
Matting	Matting is the usually irreversible adhesion of turf yarn caused by traffic or dirt. Matting can be minimised by exercising the turf with either power brushes or manually raking it back to height.
Monofilament yarn	Individual strips of yarn which are cut from a sheet and twisted or wrapped together to form a yarn strand.
MUGAs	Acronym for 'Multi Use Games Areas'. Generally involves a compromise in some properties to suit several sports.
N	
Needle-punched carpet	Carpet where the fibre in the pile forms both the pile structure and the majority of the backing cloth. The fibres are needled into a flat primary cloth, then secondary needled to pull through/angle the fibre to a felt-like structure of the desired quality/configuration of pile.
Non directional yarn	Yarn can be crimped (twisted) so that it does not end up leaning one way and therefore influencing the direction of a moving ball.
P	
Perforations	Perforations define the holes drilled or heat punched into the backing of some synthetic turf materials. The perforations provide a passage for surface water flow through the impermeable carpet backing into the structure beneath.
Permeability	The ability of a material to allow water to pass through. Determined by percolation (infiltration) tests.
Pile	The full depth of tufts or loops of yarn which form the carpet.
Pile crush	Loss of pile thickness by compression (matting) and bending of tufts caused by high traffic or heavy weight. Grooming turf surfaces will often lift the pile back to original height. All turf will crush to some degree during its lifespan.
Pile density	Determined by multiplying the number of tufts per unit area by the unit weight of each tuft.
Pile length	The length of the extended tufts measured from the primary backing top surface to their tips. Pile tuft should be gently extended but not stretched during this measurement.
Playing characteristics	The ball/surface and player/surface interaction of a surface system.
Playing speed range	Refers to the preferred range of time in which a rolled bowl (lawn bowls) will reach the other end of the green.
Polymer	In synthetics, the basic chemical unit from which fibres are made. It is made of large complex molecules (polymer chains) formed by uniting simple molecules (monomers).

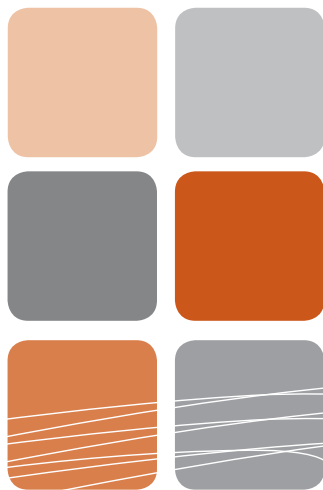




P Cont.	
Polymeric surfacing system	Plastic surfacing system.
Polyethylene	Polyethylene or polythene or polymethylene is the most widely used plastic, with an annual production of approximately 80 million metric tons. Its primary use is in packaging (notably the plastic shopping bag).
Polypropylene	Synthetic, thermoplastic polymer used for moulded items, sheets, films and fibres. The polymer is made by stereo specific polymerization of propylene. Most polypropylene turf fibres are solution dyed and sometimes contain ultraviolet stabilisers for outdoor use. The turf fibre is available as both bulked continuous filament yarns and staple for spun yarn production. Slit-film polypropylene is used on woven turf backing.
Polyurethane	A binder (used in shockpads also) used as a secondary backing on synthetic grass materials. Applied as a viscous coating, the polyurethane is sprayed across the surface to help lock-in fibre stitches and increase the horizontal stability of the synthetic grass materials. The secondary backing process is one of the last in the link of steps to producing finished synthetic grass.
Porous/ Porosity	Porosity is a measure of void space in a material. <u>Note:</u> Not to be confused with permeability which is a measure of the ability of the material (such as rocks) to transmit fluid.
Powerbroom or brush	A tool used during the construction and grooming of synthetic grass installations. A powerbroom or brush was developed for use with concrete and asphalt sweepers and adopted by the synthetic turf industry as a tool to help defibrillate (or broom) synthetic grass surface materials and help to distribute infill materials across the surfaces.
Primary backing	The material into, or onto, which the yarn is attached to form the carpet.
R	
Reactive soil (also called 'high plasticity')	The property of soil that causes it to swell when moisture content increases and shrinks when moisture content reduces. The resulting ground movement may cause damage to a poorly-designed surface.
Resilience	The capability of the turf to bounce back to its original characteristics after being used. How well a turf can handle high traffic or compressive force is determined by several factors; resilience of fibres and yarn materials, denier (dtex) and infill system of the turf system.
Rubber granule infill	Used as a shock-absorption layer within the carpet, to help the carpet fibres to maintain an upright position, and as a contributor to the desired surface playing characteristics (bounce, traction, etc).
S	
Styrene Butadiene Rubber (SBR)	SBR is manufactured from recycled tyres and other rubber products. It has been used as a major component in turf infill systems, resurfacing of sports activity areas, parks, field and track surfaces, horse tracks and a variety of other coatings and formed rubber products such as mats, bumpers and flooring products for restaurants, day-care centres and the hospitality industry.
Seams/ seaming	The line formed where two pieces of turf are joined. The action of setting the turf and seaming using one or more methods; adhesives, sewing or tacks.

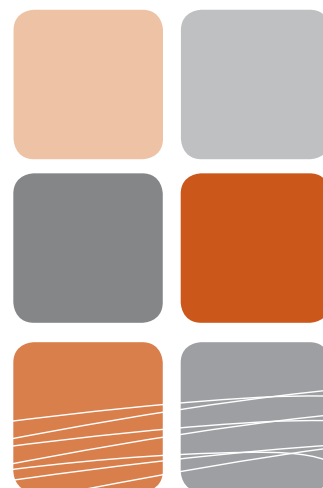
S Cont.	
Second Generation Turf	Introduced in the 1980s. Sparser density of fibres, medium pile height (10-35mm), sand-filled.
Secondary backing	The material used to coat the back of the carpet after the yarn has been attached to the primary backing.
Shedding	New turf appears to shed some fibres after installation. Many of these blades are cut away during normal installation and hidden during job site cleaning. They work their way to the surface during use. Regular blowing and grooming will resolve this problem.
Shrink (See also 'dimensional stability')	Synthetic grass surface materials, like most woven products, can shrink or shift under certain conditions. Where temperature variances can change from extreme cold to extreme heat, synthetic grass surfaces can expand and contract. A minor amount of shrink can also occur on surfaces as they age. Shifting of turf surfaces is more often noticed and can be misidentified as shrink.
Shock pad	<p>If required, a shock-absorbing layer is placed over the base, directly under the carpet. It is used to provide a degree of comfort to players underfoot, but also to reduce peak forces for head impacts, and to create defined playing characteristics for specific sports. The two main installation methods of shock pads are:</p> <ul style="list-style-type: none"> • In-situ: hot mix of rubber shreds/crumbs bound with polyurethane and laid using a small highway type paving machine. • Pre-formed: supplied in rolls and fixed in place by gluing. <p>A shock pad will significantly increase the cost of installing a synthetic surface but may last for several surface replacements (two to three surfaces – 20 years).</p>
Sinking fund	A fund into which an organisation sets aside money over time to pay for the replacement of an asset in the future. Also called a Capital Replacement Fund.
Soft spots	Areas of ground that have lower than typical strength. Typically, these could be areas where tree roots have been removed and insufficient attention has been paid to compaction when the holes were filled. Soft spots may also be caused by moisture collecting in fine grained clay and silt soils.
Spoon drains	Surface drains (generally around or at the end of the sports surface) designed to collect water and direct that water to collection points.
Stability	<p>Horizontal (left to right and reversed) and vertical (up to down and reversed) stability is important to a synthetic grass installation. Turf materials, their backings, the base and sub-base construction of the job all relate to standards of horizontal and vertical stability. A project's sub-base and base construction should maximise horizontal stability to carry weight load. Synthetic grass primary and secondary backing materials aid the turf system's surface materials by: providing additional horizontal stability and providing the required stability needed to suit the project objectives.</p> <p>To achieve vertical stability, synthetic turf systems are helped by the use of infill materials to stand blades upright and provide resilience and cushion underfoot.</p>
Static electricity	Cold and low humidity often create isolated motionless charges of electricity, and some turf products can provide static resistance. See Maintenance Section for treatment advice.





S Cont.	
Slip resistance/traction	Measures of a finished surface related to sufficient grip underfoot to accelerate and decelerate, adequate slip to turn, etc.
Sub-base	A secondary layer of bound or unbound fill placed on the sub-grade to influence the engineering and playing characteristics of the whole construction. Is in addition to the base course, added where the sub-grade conditions are inconsistent.
Sub-grade	The prepared surface of the natural ground onto which the base pavement and carpet system are laid. Provides the ultimate support and sometimes the required surface profile to the base. The strength and stability of the sub-grade are particularly critical for pitches/fields/courts/greens built over filled sites.
Surface system	The composite of the individual layers of materials used in the construction of a sports surface – the base, surface seal, shock pad, artificial grass carpet, and infill (where appropriate).
T	
Tape	Seaming tapes or backing are materials used under the edges of two pieces of synthetic grass which will be used as a part of a seaming system to attach the two pieces of synthetic grass together.
Tender	A process that provides information about a proposed project (via drawings/specifications) and seeks prices from bidders to undertake the project.
Tensile Strength	The resistance of a material to a load applied in tension (as opposed to compression).
Texturised yarn	The term given to yarn which has a crimp (see crimping). This crimp is made by texturing the yarn in a special machine, using heat, rather than knitting the yarn. The finished product has a different appearance and performance when compared with products made from Knit-de-Knit yarns. Texturised yarns help prevent pile 'nap' (where the pile falls in one direction) but do not fully overcome it.
Third Generation (3G) Turf	Introduced in the late 1990s – comprising a longer pile (35-65mm), lower density of fibres infilled with sand/rubber granules or both. Generally loose laid, not stuck to the layers below (except at the seams).
Twist	Twist is the winding of the yarn around itself. More twist improves turf performance (especially in cut pile).
U	
Unfilled pitches	Pitches using a carpet of woven, tufted or knitted synthetic yarn in which the density of the pile is sufficient to maintain yarn vertically without support or stabilisation by other materials. Usually 10-13mm pile height. May be stitched seams, or usually fully adhered to the shock pad beneath, and usually needs to be wet to achieve playability.
W	
Warranty or product guarantee	A written undertaking by the supplier and/or installer that the product will be fit for its intended purpose for a stated time period from the date of supply or installation, and that any imperfections will be addressed during the period of time that the warranty is valid.

W Cont.	
Water-based pitches	An unfilled pitch (generally low-pile height, high-density of fibres) most often used for hockey, that is played on 'wet' to help keep the ball on the carpet surface, provide some controlled foot-slide when players need to stop/turn, and to allow players to fall on the surface without risking friction burns.
Water Harvesting	Collecting and reusing water that drains from the surface system.
Y	
Yarn	A continuous strand of twisted fibres.



Mill Park Secondary College (Refer to case study - Page 126)

1.3 History of Artificial Grass

1st Generation Artificial Grass

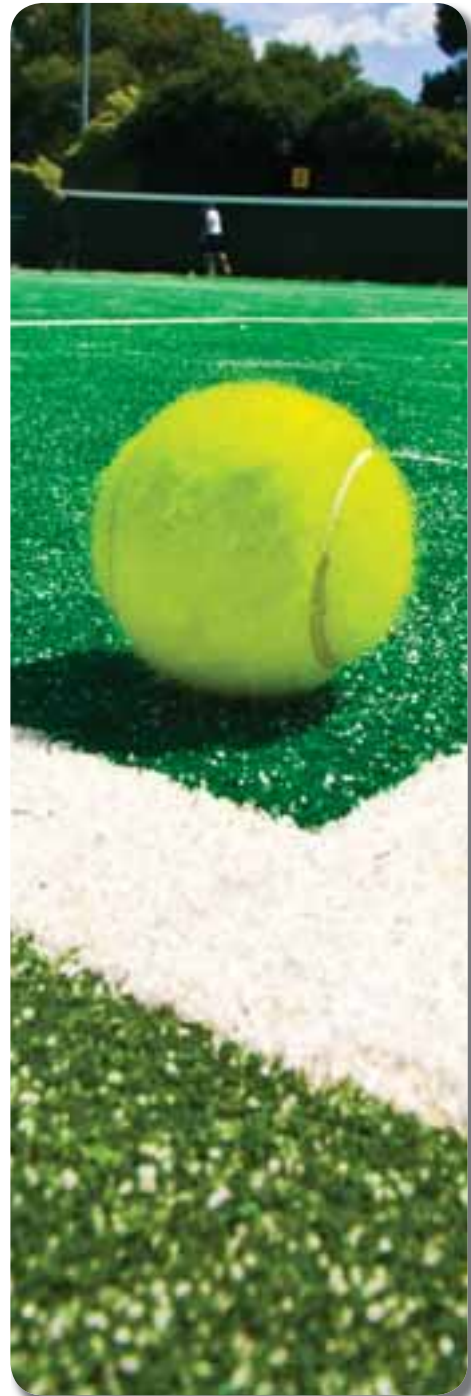
The development of synthetic fibres and their integration into a carpet to try to simulate the conditions of natural grass was first successfully achieved by the Monsanto company in the United States of America at the Moses Brown School, Providence, Rhode Island in 1964.

Two years later, Monsanto's high-density knitted nylon product was installed in the indoor Houston Astrodome following the failure of natural grass to grow under the stadium's translucent roof. Originally called Chemgrass, but nicknamed 'Astroturf' by the media, this early-phase artificial grass was not popular with baseball players or spectators. Many other USA stadiums also tried artificial grass around this time, but as per the Astrodome, they all eventually returned to natural turf.

By the mid-1970s these First Generation artificial grass pitches (low-pile height, high-density of fibres) had improved to the point where an artificial grass pitch was successfully used for the hockey tournament at the 1976 Olympic Games in Montreal.

Made of nylon (polyamide) yarns, first generation pitches were coarse and capable of causing friction burns and wounds unless played on wet - as per the hockey model. They were not UV proof.

As was to be the case with a number of other sports (eg. soccer, lawn bowls) the first artificial grass applications were not a perfect match for baseball (and American football), but the door had been opened to a new world of exciting sporting surface possibilities.



1st Generation Artificial Grass

© Loughborough University; www.sportsurf.lboro.ac.uk

- 10 – 12 mm fibre length, integral shock pad developed 1960s, nylon, unfilled, hard, abrasive
- Used for hockey at the 1976 Montreal Olympics

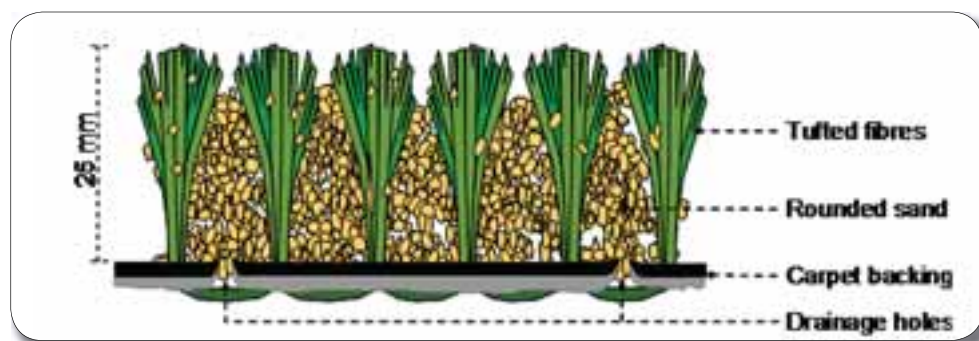
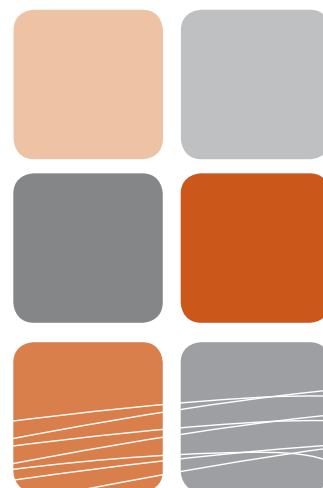
2nd Generation Artificial Grass

London-based soccer club Queens Park Rangers were the first to install a 'Second Generation' artificial pitch (medium pile height – lower density 20 to 35mm of fibres, filled with sand to provide stability and some control of ball bounce) and by the mid-1980s there were four second generation artificial grass pitches in operation in the English soccer leagues.

Now made of polypropylene these versatile and durable pitches were

immediately successful for community level soccer and other activities but at the top level of soccer they soon lost currency as the ball bounced too high for the professionals, and player footing was not reliable enough for that level of the game. Soon these major clubs reverted to natural grass.

This situation continued for another decade, with the low-pile height, high-density carpets (first generation) being ideal for hockey, but a suitable artificial grass system for competition soccer was still some time away.



2nd Generation Artificial Grass

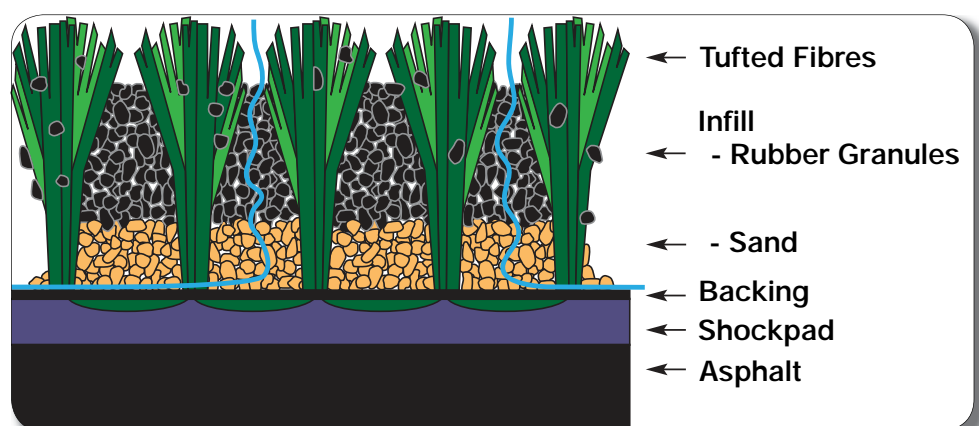
© Cranfield University 2008 www.cranfield.ac.uk

- 20 – 35mm fibre length, monofilament or fibrillated polypropylene, wider spaced tufts, rounded sand infill
- Developed late 1970s, initially no shock pad
- UK professional soccer – banned 1980s for being unplayable

3rd Generation Artificial Grass

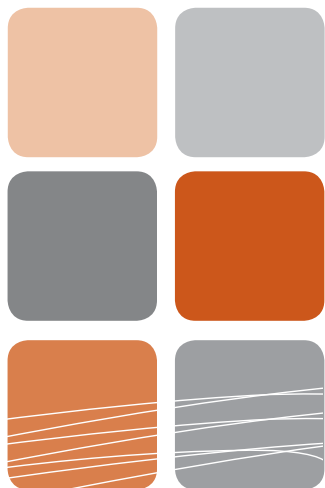
Third Generation carpets (longer pile – 35-65mm, dressed with sand/ rubber granules/both) were introduced in Europe in the late 1990s, and have developed, particularly because of the adoption of the softer polyethylene based fibre and the ability of the surface to take a normal stud, into a very acceptable surface for sports such as soccer and rugby union. The rubber infill, sometimes with a shock pad as well

for added safety (rugby's initial preference), have made third generation artificial grass carpets more acceptable for most sports where a player might occasionally slide, fall to the ground, or land from height. These third generation pitches are now becoming popular for soccer in Australia, and will increasingly be seen in coming years being used for Australian rules football and cricket (outfields), and for multi-sport usage.



3rd Generation Artificial Grass

- Long-pile (40 – 65mm, 65mm = rugby union)
- Monofilament/fibrillated fibres, sand/rubber infill • Developed late 1990s



4th Generation Artificial Grass

Developments so far this century could be gathered under the heading of Fourth Generation artificial grass carpet systems, and these would include:

- For soccer and rugby type use:
 - Variations on the third generation model, utilising a mix of monofilament, textured fibres of variable lengths without infill.
- For hockey type use:
 - Sand-dressed pitches which are a variation on the second generation sand-filled pitches. Sand-dressed pitches have a much-reduced sand content (50-80 per cent of the 12-13mm crimped pile height). The lack of surface-level sand aids faster ball movement and reduces the severity of any abrasions for falling or sliding players.
 - Dry pitches for elite level hockey: a variation on first generation pitches (high-density of low-pile height fibres), but now using polyethylene fibre so that these pitches can be used dry at times when field watering is not possible or desired. This latter development represents the artificial grass industry's initial response to the

International Hockey Federation's push to find an elite playing level carpet system (high-density, low-pile height) that does not require watering. Certain carpets have already been manufactured, installed and tested to 'Global' level (the highest level available), where no water is required.

- For athletics field games:
 - Super long-pile turf (typically 80mm in height, infill to typically 60mm), with sufficient depth to absorb (without damage) thrown objects – such as discus, hammer, shot put and javelin.
- For tennis type use:
 - The development of synthetic clay. This product involves artificial grass infilled with reddish coloured sand (single size granules so as to minimise compaction). Is a waterless alternative to en-tout-cas courts (see photo on page 108).

Examples of these fourth generation soccer, hockey and tennis facilities are now in place in Victoria, while the first prototypes of long-pile pitches for Australian rules football/cricket use are also being installed.

1.4 Benefits and Disbenefits

1.4.1 Benefits

- High-quality and consistent surface (even ball roll/bounce).
- Generally requires no water. An effective response to reduction in availability of potable water due to drought and climate change.
- Relatively low maintenance requirements (in comparison with the labour-intensive natural turf regimes – which also often require professional turf maintenance skills and large machinery).
- More tolerant of adverse weather conditions.
- Can be programmed intensively both in terms of time bandwidth (day and night), as well as subdividing field space and increasing participation.
- Has the potential to generate significant rental income, given intensive programming.
- Potential for multi-use.
- Can reduce the impact that sport has on a player's joints and the body generally due to the placement of shock pads and rubber granular infill.
- Cleaner to play on (ie. no mud).
- Can be used to collect water to aid local irrigation.
- Costs marginally more than natural turf in the long-term, yet allows up to three to four times more hours of use.
- Increases predictability of sports fixtures and events.



Somerville Secondary College

1.4.2 Disbenefits

- High initial capital cost.
- Sometimes requires high fencing to protect the facility.
- Costly to repair if damaged.
- Heat retention and reflection can be an issue in certain circumstances.
- Some facilities are more likely to be single use.
- Requires upgrade or replacement every eight-fifteen years.
- The variability of performance across the range of high value to low value surfaces, and the difficulty for new adopters to differentiate.
- Perception that they are more expensive to establish, maintain and upgrade – refer to Section 1.10 and Appendix 5.
- Perception of increased injury potential (refer to Section 1.8).
- Perception of negative environmental impact (refer to Section 1.16).
- Perception of negative health impacts (refer to Section 1.16).
- The potential for ‘unintended’ differential user charges (artificial V natural surfaces) to evolve. See item 1.11.3.

A UK survey (Cranfield Survey², 2008) looking at annual average maintenance costs (in the UK) suggests expenditure per hour averaging out at: artificial grass - \$7 AUD per hour of use, natural turf - \$70 AUD per hour of use. Refer to Appendix 5 for some Australian based cost-benefit modelling.



1.5 Types of Artificial Grass and Infill

1.5.1 Fibre base materials

Artificial grass carpet is manufactured with yarn from two groups of polymer: polyolefin, which includes polypropylene and polyethylene; and the less common polyamide (nylons). Blends of polymers are also used. They are modified chemically to produce different properties of durability, fibre resilience, frictional resistance and resistance to weathering.

1.5.2 Production methods

Artificial grass carpet is generally produced in one of two ways.

(i) Tufting is the most common type of manufacture where the fibre is tufted into a primary backing cloth, normally made from woven polypropylene or urethane, and the individual tufts are anchored by the application of a latex-based secondary backing material. These backing layers also contribute to the dimensional and structural stability of the carpet.

(ii) Needle-punching is where the fibre in the pile forms both the pile structure and the majority of the backing cloth. The fibres are needled into a flat primary

cloth, then secondary needled to pull through and angle the fibre to a felt-like structure of the desired quality and configuration of pile.

Artificial grass can also be produced through knitting and weaving methods (used for some bowls carpets), but is rarely used because of its greater expense.

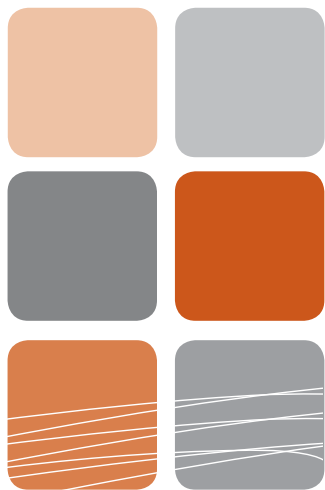
1.5.3 Types of artificial grass

Type according to infill content

(i) Unfilled

Unfilled pitches were the first type of system implemented for sport. They had short pile height, were dense in quantity and had no infill material. They were often made of nylon, which meant the prototypes were often tough and abrasive. Partly due to the abrasiveness, watered unfilled fields were developed and have since been popular for elite levels of hockey. The water is applied through an irrigation system to the surface immediately before play, and it reduces the player-to-surface friction, modifies the speed of the hockey ball and cools the surface in hot weather. It

²Cranfield University, UK Survey, 2008 - See Bibliography



can require a lot of water to maintain the playing characteristics, during a match or training session.

Due to the cost of the high-density unfilled carpet, required irrigation systems, and water, unfilled carpet technology is now focused on producing non-watered unfilled carpet that can replicate the playing characteristics of watered fields. The key change is from abrasive nylon fibre to softer polyethylene yarn. Several such polyethylene-based installations are being trialled in Australia.

(ii) Dressed

Dressed systems are a derivative of the sand-filled system, and intermediate in properties and playing characteristics between the traditional filled and unfilled carpets. They can have either:

- a shorter, denser pile than the standard filled system (with a reduced quantity of sand fill of about 60% of the fibre height) which are considered suitable for hockey, soccer (training), touch rugby, lacrosse and cricket (fielding practice).
- the longer pile (35-65mm) used for soccer, rugby, Australian rules football and cricket, which is dressed with sand, rubber granules or both to within about 15-20mm of the top of the fibre.

(iii) Filled

With filled artificial grass systems, the artificial grass fibres or blades are fully supported or stabilised by the addition of a filling material, such as sand, clay and rubber granules, or a mix of sand and rubber granules. These carpets are marginally less expensive than non-filled systems because the pile density can be reduced due to the sand fill, which is normally taken to within 5-6mm of the fibre tips. The sand and fibres combine to form the characteristics of the playing surface.

Artificial grass surfaces that are filled with sand only are generally suitable for hockey, tennis, lawn bowls, touch rugby, lacrosse, and soccer (training) and multi-function use. See Section 1.6 for more details on sport specific requirements.

Types according to pile height

Short-pile turf

(i) Unfilled

High-density of fibres and used predominantly for cricket pitches (either 8, 10 or 12mm in pile height, or for elite level hockey pitches generally 10-12mm). The unfilled hockey pitches have, until now, had to be kept wet to improve foot traction, ball speed and heat suppression, but suppliers are now responding to the call from the International Hockey Federation to develop a dry unfilled carpet that can perform to elite level standard.

(ii) Dressed

Nominally 10-13mm high with medium-pile density, sand-dressed carpets are a hybrid development midway between sand-filled and elite unfilled pitches. Becoming popular in Australia for hockey, dressed carpets (sand filled to approximately 60% of the pile height) are also suitable for lacrosse, and for training for soccer, Australian rules football, touch rugby and cricket (fielding practice).

Medium-pile turf

(i) Filled

These carpets are in the range of 20-35mm and have traditionally been the hard-wearing sand-filled carpets used for hockey, tennis, lawn bowls and for training level activities for a variety of other sports.

(ii) Dressed

An interesting and recent development is the approval of soccer pitches in Europe that have sand infill and a shock pad instead of rubber granule infill and no shock pad. Because of the lack of rubber granule infill, the pile height can be lower than the typical third generation dressed pitch.

This product may be similar to the new Australian Football League (AFL) and Cricket Australia-approved artificial grass surface, and might be the first example of a hybrid design that is close to meeting both AFL and Federation Internationale de Football Association (FIFA) specifications.

Long-pile turf

(i) Dressed

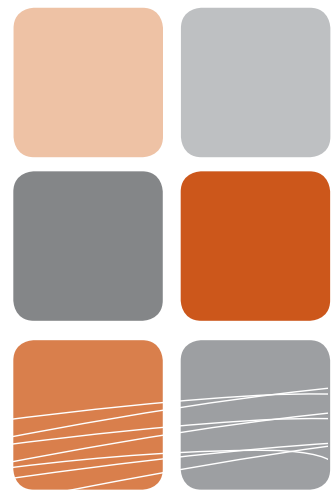
Long-pile turf has long blades of fibre similar in height to some natural turf

playing surfaces. The long fibres (40-65mm in length) provide cushioning and allow for a great amount of infill to be integrated into the pitch adding to the shock absorbency and force reduction characteristics of the ground, and plays more like grass. These fibres can be monofilament (single fibre) or multi-ended filament yarns (brush-like at the tip), and are proving to be popular for soccer, rugby, Australian rules football/cricket and golf.

The pitch infill is comprised of a sand layer at the base with, typically, (recycled) rubber granules above the sand layer. The total infill height is generally between one half and two thirds of the pile height. Some sports (eg. rugby) may also need to have a shockpad under the 'turf'.

The shortest of the long-pile turfs (35 – 40 mm) are targeted at Australian rules football and cricket (outfield) usage, and provide an 'acceptable' surface for some competitive soccer and hockey (lower levels of competition and school usage). A 55 – 65 mm pile height is the recommended soccer turf height, whilst rugby recommends 65 mm, often with a shock pad as well. Refer Appendix 8 for summary table.

The latest development with long-pile turf is the development of even longer fibre carpet (80-85mm, with approximately 60mm of infill material). This is being hailed as the first suitable artificial grass system for athletics field events including hammer, shot put, discuss and javelin.



Top Tip:

In your project specifications, clearly nominate the minimum face weight (the weight of the yarn that is visible above the carpet backing) of the product to be installed. The heavier the face weight the longer the service life.

Top Tip:

Include the following formula (for determining yarn face weight) in your specification. It looks complex, but manufacturers know what it means:
Yard Face Weight (YFW) = FPH X SR X D X EPM

Where:

EPM = No. of rows of stitches per metre (1000/machine gauge)

D = Decitex/1000

SR = Stitch rate/metre

FPH = Pile height above the backing X 2 / 1000

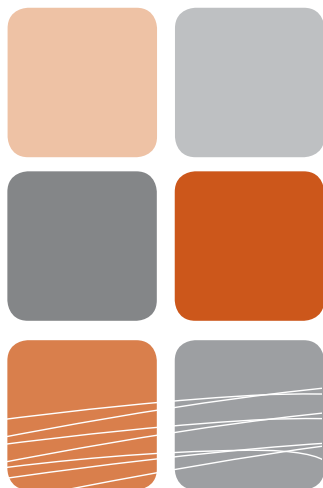
Top Tip:

Product specification sheets will sometimes nominate an acceptable variation of +/- 10% in the face weight of the delivered carpet. Given that -10% represents up to \$15,000 AUD in missing yarn on a hockey field sized area, it is wise to nominate a minimum face weight that has to be delivered and installed.

Top Tip:

Do sample testing (via an appropriate testing laboratory – Appendix 6) to check that the installed product meets specification. Assess the product delivered by taking samples from six different selected locations. Deductions should be made from payments for products that fail to achieve the accepted and agreed minimum product weight (face weight) on a direct pro-rata basis – or reject the product!

In addition to the carpet testing, you may wish to also test conformance to standards for seam strength (having already tested the thickness of the layers in the base the shockpad 'mix' etc).



1.5.4 Carpet Infills

General

The primary purposes of infill materials are to:

- Support the pile of the carpet (to help it remain vertical).
- Provide ballast (weight) to hold the carpet in place (over a sometimes moving base).
- Contribute to:
 - Player/surface interaction (such as underfoot grip) and the cushioning qualities of the surface
 - Ball/surface properties such as, bounce and roll.
- Transfer the loads imposed by players moving about the surface into the underlying base.

The grading, composition and depth of the infill materials are therefore carefully selected by the manufacturer to ensure the combination of the carpet pile and infill materials gives the type and level of performance required from the surface.

The most often used infills are sand (silica sand that is non-abrasive, non-staining, well rounded, dust-free and of uniform grading and density), water (still used on some hockey pitches for elite level competitions), and rubber granules (manufactured or recycled). Recycled granules are often made from recycled tyres, industrial waste rubber and running shoes.



Sand distribution

Rubber Infill

There are three key types of rubber infill:

(i) Recycled rubber

(described above)

- 0.5 – 2.0mm size most common.
- Least expensive, absorbs and radiates heat from sunlight and can raise field temperature to 20°C above air temperature, can give off an odour. Environmental impact still being reviewed. (See 1.16).

(ii) EPDM

(Ethylene Propylene Terpolymer)

- Virgin rubber and fillers
- Produced from sheets of rubber that are specifically manufactured for granulation.

- Good quality, relatively high price.
- Green-colour EPDM rubber is specially manufactured for sport, has better stability under UV radiation, and absorbs and radiates less heat from sunlight than SBR (re-cycled) rubber granules but is more expensive.

(iii) TPE

(Thermoplastic elastomers)

- Manufactured to suit, good quality control, but relatively expensive.

Note: Section 1.16 of this guide (Environmental and Health Issues) includes analysis of information regarding environmental concerns relating to recycled rubber granules.

Organic Infill

A developing alternative to rubber granule infill is the option of organic infill, such materials being of plant origin. Able to be recycled, these infill types are said to keep the median temperature of artificial grass pitches lower than that of pitches with rubber infill. At the time of publication, the first soccer pitch in Melbourne (Kingston Heath Reserve,

Cheltenham) featuring organic infill had just been completed.

Refer to section 1.17 (p54) 'Current Product Developments' for information related to several new developments with infill materials. These include rubber granules that come in colours other than black, and rubber granules that are coated with various compounds.

1.6 Playing Characteristics and Sporting Standards

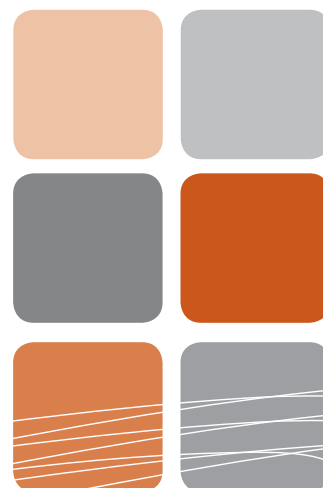
Each sport that utilises artificial grass has its own playing surface requirements, generally tightly defined by the sport's governing body. If an artificial grass sporting area is to be used for more than one sport (which may be necessary to ensure the financial viability of a facility or its full use), then compromises may be necessary to the choice of the most appropriate surface system and the performance.

Short, medium and long-pile, filled, dressed and unfilled systems are each suitable for a variety of sports, but currently no one carpet system is

suitable for all sports. Refer to Table 1, Section 1.7 – Suitability of Artificial Grass Surfaces for Sport.

When planning an artificial grass project, consult with the peak bodies of sports that are intrinsic to your project to ensure that important standards and specifications are met.

This section provides an overview of the requirements of sports in Australia and a range of resources and contacts that can be referenced to determine the artificial grass specifications for various sports.



Multi sport surface - Mill Park Secondary College

1.6.1 General

All materials, workmanship and procedures should comply with the relevant requirements of all current standards, codes of practice and

specifications promulgated by Standards Australia. Those that have relevance to synthetic sporting surfaces in Australia include:

Standard	Year	Topic
AS 3541.1	1988	Synthetic Sports Surfaces – Part 1 General Principles.
AS 2983	1988	Synthetic Sports Surfaces: Test Procedures Only.
AS 4693.8	2004	Surfaces for Sports Areas: Methods of Test Procedure for the preparation of synthetic turf and textile test pieces.

Note: There are no standards for the manufacture, design and installation of synthetic sporting surfaces in Australia for Australian conditions and sports. However, two key British Standards that relate to synthetic turf surfaces are:

Standard	Year	Topic
BS EN 15330-1	2007	Surfaces for Sports Areas – Synthetic Turf Surfaces Primarily Designed for Outdoor Use – Specifications for Synthetic Turf.
BS EN 15330-2	2008	Surfaces for Sports Areas – Needle-Punch Carpets Primarily Designed for Outdoor Use – Specifications for Needle-Punch Carpets.

Other British and European Standards relevant to synthetic grass can be found at: www.infostore.saiglobal.com

Top Tip

It is important that sporting clubs, schools and local government authorities are well-aware of the player insurance coverage for each sport as it relates to games/training conducted on artificial grass.

1.6.2 Soccer

After unsuccessful experimentation with shorter pile carpets in the 1980s, soccer has found its natural turf equivalent in recent years with third generation long-pile carpet (35-65mm), usually filled with a combination of sand and/or rubber granules.

Because of the difficulties that ground

FIFA has conducted a considerable amount of comparative testing to assess artificial grass pitches versus natural grass³ and key findings are:

- There are no significant differences in playing performance on artificial grass pitches versus top-quality natural grass.



Seymour Shaw Park, Sydney

owners have faced in growing and maintaining natural turf surfaces in many parts of the world, soccer authorities introduced artificial grass into the game's laws in 2004 (following the games being played on these surfaces at the FIFA U-17 World Championship in Finland late in 2003).

Locally, the governing body for football (soccer) in Victoria, Football Federation Victoria (FFV) has recognised the value of synthetic surfaces as a complement to natural turf, especially where there is a need for frequent use and where the maintenance of reliable surface standards is required. Nationally there have been W-League (women's national league) and National Youth League matches sanctioned by Football Federation Australia played on synthetic pitches. As yet no A-League matches have been played on synthetic pitches.

FFV has adopted FIFA requirements as the basis for approval of pitches for competition matches.

The aim of FIFA's standards is to replicate as closely as possible the playing characteristics of high-quality natural turf. To meet the FIFA-recommended endorsement level requires successful completion of both laboratory and field tests. There are two FIFA recommended quality levels:

- 1 Star for recreational, community and municipal use; and
- 2 Star for professional use.

FFV's competition rules require at least FIFA 1 Star specification for general competition and FIFA 2 Star for higher order competition (Men's Victorian Premier League).

- Based on play analysis: there is a similar time of ball in play, similar number of touches, similar passing success rate, etc.
- Players are more likely to perform ground tackles on natural turf.
- The number of fouls and yellow cards are higher on artificial surfaces.

The other key requirement relating to the use of synthetic surfaces for soccer is compliance with FIFA's 'Laws of the Game' under which competition matches are held. Law One – 'The Field of Play' sanctions the use of synthetic pitches and has a number of requirements particular to synthetic pitches, including the colour of the surface (which must be green) and the restriction of linemarkings to those required for soccer only (cited in the Interpretations section of the Laws). The linemarking provision applies to natural turf pitches as well. Under certain conditions FFV will allow limited extraneous linemarking on grounds used for junior matches. Temporary linemarking for other sports or variants of soccer can be a solution.

Top Tip:

Local councils, clubs and schools should also be aware that not only does the FFV's Rules of Competition specify the required size of fields for various levels of competition, the required safety run-offs, the necessary provision of ancillary features (including marked technical areas, fences, lighting, team benches) but it also stipulates minimum changeroom and toilet facilities which should be available on-site for matches to be allowed.

³ 'Prozone' studies - http://de.fifa.com/mm/documents/afdeveloping/pitchequip/case_study_technical_analysis_351.pdf

Recently in Europe, artificial carpets that utilise a beneath-the-carpet shock pad instead of, or as well as, rubber granule infill have been approved (at the time of publication the first such soccer installation – shock pad plus rubber granule infill – had been completed in Melbourne). This is a significant innovation from an Australian perspective because this type of soccer pitch is close in structure to the preferred model for Australian rules football, and therefore further highlights the potential for both sports to enjoy a shared sports field. (Refer to section 3.5 for important shock pad information).

Top Tip:

FIFA has recently upgraded their 'Quality Concept' accreditation process to include installed field sample testing and the mandatory acquisition of maintenance equipment and training. Refer www.fifa.com/aboutfifa/developing

Notes:

1. FFV provides a free advisory service related to the design and construction of both natural turf and artificial grass pitches.
2. Refer to the Bibliography (p123) for an extensive list of key resources.



Kingston Heath Reserve, Cheltenham

1.6.3 Rugby

Rugby Union

The International Rugby Board (IRB) has adopted performance standards (involving both laboratory testing and field testing) that define its interest in third generation long-pile carpets.

The key differences between soccer and rugby's specifications of artificial grass are:

(i) Rugby's specification or standard for artificial grass surfaces (refer below) is a developmental or temporary standard. Rugby authorities are clearly monitoring ongoing developments with artificial grass and are still seeking to satisfy themselves regarding suitability for the specific demands of their sport.

(ii) Until recently, the rugby specification ('developmental standard') called for the placement of a shock pad under a third generation carpet (it needs to pass head injury criterion), therefore rugby fields had both a shockpad plus rubber granule infill in the pile. The College Rifles Rugby Club in Auckland has received IRB approval for the world's first artificial grass rugby pitch that has no shockpad. On the performance of the surface system alone (carpet and infill), this field has been able to meet required IRB requirements for vertical deformation and critical fall height. Key resource documents related to rugby's interest in artificial grass fields are:

- UK Rugby Football Union and Football Association 'Artificial Grass Pitches for Rugby and Association Football' (2007).
- International Rugby Board 'Regulation 22 – Standard relating to the Use of Artificial Playing Surfaces' (2008) www.irb.com



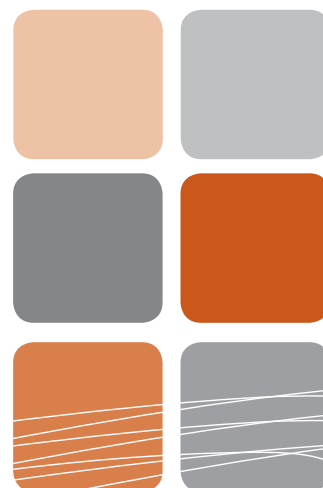
The Scrum

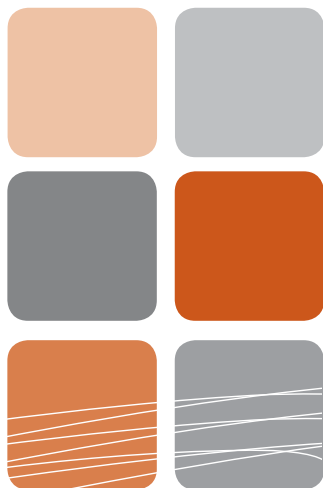
Rugby League

Rugby League is currently reviewing artificial playing surface specifications. The priority is for a non-abrasive product that reduces the risk of player field impact injuries. Refer to the 'Rugby' section in the Bibliography, for draft specifications currently being considered for adoption by Rugby League.

Touch Football

Touch Football is now being successfully played on 3G (rubber granule infill) fields. Touch Football Victoria advise that footwear selection is seen to be very important on artificial grass.





1.6.4 Australian Rules Football

In 2008 the Australian Football League (AFL) and Cricket Australia (CA) released a detailed specification⁴ that allows their sports to be played on artificial grass. By mid-2010 several products meeting that specification had been developed.

These products are typically sand-dressed polyethylene carpets nominally 40mm high, sitting on a 20mm pre-formed shockpad. They are dressed with rounded sand grains to approximately 20mm, leaving approximately 20mm of the fibre blades exposed.

The most significant difference between this carpet system and that now being used for soccer is that the Australian rules football/cricket version requires a shock pad (a key performance criteria for Australian football is the critical fall height for players), while the FIFA-approved surfaces have rubber granule infill rather than, or in addition to, a shock pad (note the reference in Section 1.6.2 to an Australian rules football-similar surface now being used in several soccer installations in Europe).

head injury) issue.

Artificial grass fields have been approved for use for all levels below the key state leagues around Australia (i.e. the Victorian Football League). Even the elite Under 18 TAC Cup can be played on artificial grass fields.

The AFL has confirmed that it is comfortable for fields to include permanent lines for other sporting codes. The AFL acknowledges the benefit to the community of multi-purpose fields.

Another important aspect of the introduction of artificial grass into the Australian rules football and cricket world is the AFL/CA's official licensing arrangement with three suppliers (at the time of publication). At the time of publication these were:

- TEAM Sports;
- Tiger Turf; and
- Sports Technology International.

This arrangement will not prevent other companies from competing for

Top Tip:

Single products that meet the needs of a number of different sports (ie. Australian rules football, cricket and soccer) will evolve in time, but organisations considering the installation of a multi-sport artificial grass pitch now must investigate whether there are limitations (fixturing, insurance, line marking, etc) placed on those multi-use/multi line-marked pitches by particular peak bodies.



Multi-purpose surface at Mill Park Secondary College (not AFL approved)

A key outcome of this difference in the impact-absorbency of the surface will be the capacity of the respective surfaces to cater for other sports. For example, AFL officials believe that the new, approved Australian rules football/cricket surface will meet soccer performance specifications, but that the soccer surface (without shock pad) fails the AFL/CA specification – particularly relating to the critical fall height (risk of

Australian rules football and cricket field installations, but only projects that use AFL/CA-approved synthetic turf products will be eligible for a proposed rebate/grant program from the AFL/CA.

At the time of going to print, the tender process had just begun for the first ever full-sized artificial grass Australian rules football oval, to be constructed at Point Cook in Melbourne (see p129).

⁴ 'Development of Standards for the Use of Artificial Turf for Australian Football and Cricket' (University of Ballarat – 2008).

1.6.5 Cricket

Artificial grass pitches have become the preferred playing surface for middle and lower grade cricket competitions over the past two decades. Replacing old matting and malthoid pitches, these pitches are generally single strips of high-density carpet (9 – 11mm pile height) glued to a concrete base. They have no infill. Pitches that are infilled with rubber granules over the winter period must be thoroughly cleaned out (repeated through cricket season) before summer use.

In comparison with those older types of pitches, the artificial grass version is low maintenance. During the winter season, the pitch is covered with loam or a second sheet of artificial grass (often a longer pile with much less density of fibres) is laid over the actual pitch, and the upper layer is filled with rubber granules to provide a cushioning level to counteract the pitch's concrete base.

In preparation for the new season, the upper layer of artificial grass is removed, and the uncovered pitch is vacuumed clean and sometimes water-blasted to ensure that contaminants are removed from the base of the playing surface.

In recent years a product has been marketed to local government authorities and clubs as both suitable for use as a cricket pitch and as a suitable surface during the winter season – without the need to be covered with loam. This is not a preferred surface from Cricket Victoria's perspective as the longer pile affects ball bounce and playability.⁵



Cricket pitch close up
Mill Park Secondary College

Top Tip:

The cricket pitch needs to be a specialist cricket pitch, not a 'marked-up' area of artificial grass carpet as used in the outfield.

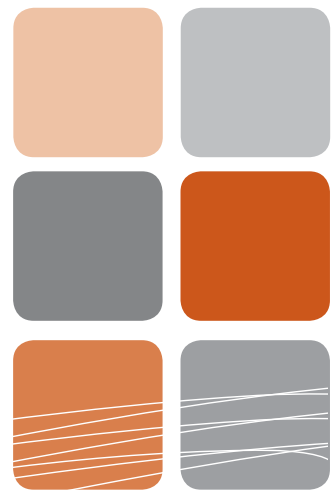
The AFL advises it is happy for artificial grass cricket wickets to be located within or adjacent to its playing fields provided an approved means of covering the pitch in winter is used.

In relation to cricket outfields, as is stated above in the Australian rules football section, (1.6.4) there has been a breakthrough in artificial grass technology, and a prototype surface has been approved as meeting the detailed Australian rules football/cricket outfield specification. Cricket Australia is satisfied that the potential problem of surface temperature during hot weather is one that is manageable (through their existing heat policies), as is the general all-round performance of the product specification for cricket at all levels. Cricket Australia believes the new specification is as close as is practical to the performance of natural grass, with excellent rebound and roll-ability of the ball across the surface area.

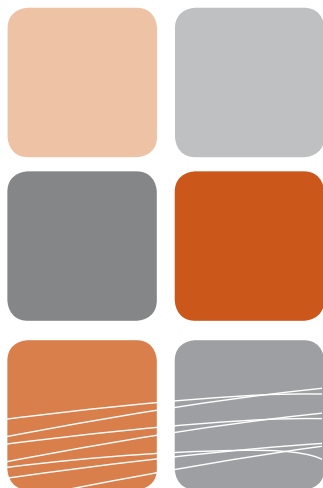
Top Tip:

Ensure that field managers, users, coaches and parents are aware of the potential for heat illness and to recognize the symptoms. Also be specifically aware of the relevant sporting association's heat policies.

Another important aspect of the introduction of artificial grass into Australian rules football/cricket is the AFL/CA licensing arrangement with a limited number of suppliers. While any company with a product that can meet the detailed specification will be able to bid for projects (through local government or other tender processes), in the case of AFL/cricket projects, only projects using products from the preferred suppliers will be eligible to seek financial grants towards project from the AFL/Cricket Australia funding program.



⁵ 'Comparison of the All Seasons and traditional synthetic surface'. (Victoria University 2010)



1.6.6 Hockey

Hockey was an early adopter of artificial grass. First tried for a major event at the 1976 Montreal Olympic Games, artificial grass soon became the preferred surface for all elite hockey events, and by the early 1990's artificial surfaces were becoming commonplace at local club level around the world.

The first artificial grass hockey pitches were similar to AstroTurf at the time – high-density, short-pile height, fairly stiff and abrasive nylon fibres. Hockey quickly moved to watering its elite level pitches to improve player comfort, safety and playability and favoured sand-filled artificial grass for local level hockey.

More recently, 'sand-filled' pitches have given way to 'sand-dressed' pitches (18-20mm fibres crimped down to 10-

13mm) filled with sand to somewhere between 50 to 80% of its pile height. 'Unfilled' pitches (10-12mm high, high-density low-friction carpets without infill material) that can be played on without having to be watered, are also being developed and installed.



Top Tip:

When replacing their worn field surface many hockey clubs are deciding to replace an existing sand-filled field with a sand-dressed model. While players call for this change (sand-dressed pitches immediately present improved playing characteristics due to the absence of sand close to the playing surface), administrators need to be aware of the following:

- Sand-dressed carpets generally cost \$30,000 - \$40,000 more than sand-filled carpets.
- Sand-filled carpets are lasting 10 – 15 years on average in Melbourne, whilst the likely lifespan of sand-dressed pitches is unknown.
- The absence of weight in the carpet ('sand-dressed' = 90 tonnes of sand, sandfilled = 220-300 tonnes) is an issue in areas with reactive clays.

Field Approval Categories

FIH (International Hockey Federation) field approval standards acknowledge:

- 'Global' level: International standard, unfilled, watered
- 'National' level: unfilled, filled or dressed (water not necessary).

Hockey on a third generation (3Gen) long pile turf?

3Gen pitches are rapidly coming on-stream in Victoria for Australian rules

football, cricket, soccer, rugby, etc, but English testing to date suggests that it is unlikely that carpets higher than 40mm would meet FIH standards. Of the 40mm 3Gen surface systems that have met FIH/England Hockey (EH) standards, these have only been sanctioned for lower level club and school usage.

Hockey played on these surfaces will be slower, with sometimes unpredictable levels of consistency. The England Hockey policy is:

EH Category 1	Water based and sand dressed surfaces approved within the FIH Global/National parameters.
EH Category 2	Sand filled surfaces within the FIH National parameter.
EH Category 3	Long pile (3Gen) surfaces that are categorized by FIH as satisfying their 'National' performance parameter. The certification shall be based on on-site testing.

Top Tip:

FIH may follow FIFA's lead in increasing required performance standards under their FIH Assured Quality Pitch Supplier program. Civil works may have to be guaranteed (as well as the surface system), maintenance training provided, etc.

1.6.7 Tennis

The International Tennis Federation (ITF) recognises the use of synthetic grass playing surfaces and has used artificial surfaces since the 1970s. Tennis is one of the few international elite level sports that is played on many different surface types. The standards and properties of each surface are important when

development surfaces', they are widely used and promoted for community and club use. Many clubs and centres report the benefits of artificial surfaces to include increased memberships, revenue and court use, being softer on joints (especially for older players) and decreased maintenance and water

ITF Surface Code	Type	Description
B	Artificial Clay	Synthetic surface with the appearance of clay. 'Appearance' relates only to the form of the uppermost surface material and not other characteristics).
C	Artificial Grass	Synthetic surface with the appearance of natural grass. 'Appearance' relates only to the form of the uppermost surface material and not other characteristics.
E	Carpet	Textile or polymeric surface applied in rolls or sheets.



Sand filled, artificial grass tennis court

evaluating the quality of performance of the court and the level and ability of users.

The ITF provides three classifications for synthetic surfaces under their range of classified court surfaces (the first two of which are artificial grass surfaces⁶).

Tennis Australia's (TA) court surface policy only recognises three surfaces as player development surfaces. Surfaces are based on the existing Grand Slam surfaces (none of which are artificial grass surfaces), being: porous/clay, natural grass and hard court (including cushioned and non-cushioned acrylic variations). Tennis Australia player development requirements state that, 'surface type choice is made on the basis of characteristics including; soft on the body, ability to slide during point play and 'slow' in relation to ball response on the court surface'.

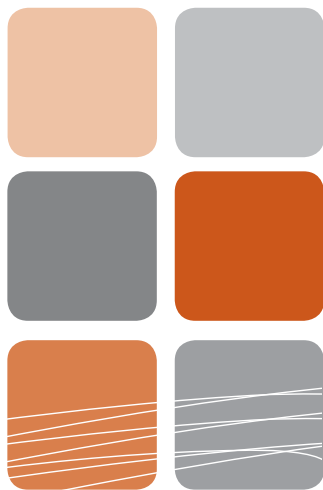
Despite artificial grass surfaces not being Tennis Australia 'supported player

requirements and costs – all of which has significantly contributed to local club viability.

There has been an increasing trend in the use of artificial grass and artificial clay court surfaces in Victoria and across Australia at the community club level. The most common surface choices are Sand-Filled Artificial Grass (SFAG) and synthetic clay. Like surfaces for other sports, there are many products, varieties, colours, pile lengths and infill materials on the Australian market. Careful investigation and research of relevant products, suppliers and installers is recommended for any club, council or land owner wishing to install a synthetic surface.

Alternative hard court and acrylic surfaces (cushioned and non-cushioned) have also seen a resurgence across the Australian market, primarily influenced by the current TA court rebate funding

⁶ ITF Approved Tennis Balls and Classified Court Surfaces, International Tennis Federation, January 2009.
Source: Tennis Australia, Facility Development and Management Framework for Australian Tennis, 2008



scheme, the installation of similar products for the Australian Open and through the conversion of more resource dependent surfaces such as red porous courts (particularly evident in metropolitan Melbourne).

Tennis Victoria's database (as at 2010) identified the following court surface provision breakdown for affiliated clubs across metropolitan Melbourne – red porous (48% of courts), synthetic grass and synthetic clay (30%), hard court (14%) and other or not-specified (8%).

Artificial and acrylic surfaces are generally constructed on concrete, asphalt or crushed rock (not acrylic) bases. The integrity of the surface is highly dependent on the quality of the base construction and detailed soil, ground stability, tree root invasion and drainage investigations should be carried out to inform the most appropriate pavement design and

construction methodology for each court development project.

Tennis Queensland's Technical Manual for the Design, Construction and Maintenance of Tennis Facilities provides a comprehensive guide to the development of tennis courts and associated infrastructure. The document is available at: www.tennis.com.au/qld

Tennis Victoria, in conjunction with Sport and Recreation Victoria, has developed a Tennis Facility Planning Guide promoting best practice in the planning and development of local tennis facilities. The guide is written for clubs and local councils and is available via: www.sport.vic.gov.au

1.6.8 Lawn Bowls

In response to the high costs involved with maintaining natural turf greens, lawn bowls began to look at synthetic greens some 30 years ago. Since that time there has been the evolution of both sand-filled and unfilled synthetic carpets.

Lawn bowls carpets can be either tufted, woven or needle-punched products. The characteristics of these products are:

- a) Sand-filled products
 - **Tufted** products are generally 13-15mm high, and usually made with a Knit-de-Knit fibre yarn which crimps down to 12-13mm, sometimes coming with a cushioned backing. They generally have approximately 8mm of sand infill. In composition and appearance they are similar to artificial grass used for hockey pitches, tennis courts and so on.
- b) Non sand-filled products
 - **Woven** carpets are much lower (generally about 4mm high, but sitting on an underlay to help control both comfort and green speed levels). These carpets are tensioned to achieve a consistent playing surface.
 - **Needle-punched** products are created by a process of converting batts or webs of loose fibres into a coherent nonwoven fabric on a needle loom. The product is generally 6-9mm high, and also has a 3-9mm underlay. The combined carpet and underlay will usually be in the 9-18mm range.

A key to the improvement of performance in Australia for these surfaces has been the significant improvement in base construction over the past decade. All of these surfaces are built over a porous, stable base (typically sand, gravel or scoria) with sub-surface drainage essential given the totally flat playing surface requirement.

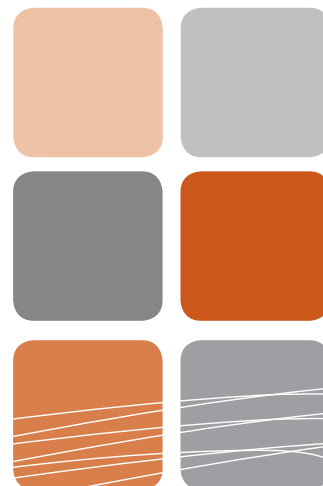
In such a traditional sport, some players are disappointed with the compromises that artificial grass greens can entail (faster green speed, excessive or uneven draw and reduced player comfort due to some surfaces being harder and hotter). But they do provide a guaranteed year-round playing opportunity, regardless of weather and overcome issues relating to grass growth, or natural turf wear and tear, while also benefitting fixtures and fund generation via year-round accessibility to greens.

Maintenance requirements for synthetic grass greens are much reduced in comparison with natural turf greens, mainly revolving around keeping the surface dirt and dust free, which, if unchecked, can lead to the surface becoming hard and fast and the natural drainage through the surface system getting clogged and slowing down.

In Section 6.5 of this guide - Maintenance of Artificial Grass Lawn Bowling Greens - information is provided about the maintenance of tufted, woven and needle-punch surfaces.



Artificial grass bowling green



1.6.9 Baseball

A full synthetic turf baseball field (third generation, long-pile with rubber granule infill) opened in Geelong, Victoria, in 2007. Using artificial grass for the infield, outfield and the running paths between bases, with a small section of en-tout-cas adjacent to each base to allow the base runner to slide in if necessary. There is no natural grass on this field.

Baseball Victoria advise that the major advance that the Geelong facility has over the partly-synthetic carpeted State Baseball Centre at Altona is the use of third generation long-pile artificial grass which now allows players to fully use their metal-cleated baseball shoes – thereby enhancing their stability and safety.



Geelong Baseball Centre

1.6.10 Golf

Synthetic grass is now used at some golf courses for driving range tees and, in some cases, actual tees, greens and fairways. It is also used for similar purposes in private installations and in commercial indoor facilities. The Reef Palm Golf Course at the Zilzie Bay Great

Barrier Reef Resort near Rockhampton, Queensland, combines a system of synthetic greens, tees and fringes with Keppel couch fairways. Internationally there are a number of golf courses with artificial grass fairways.

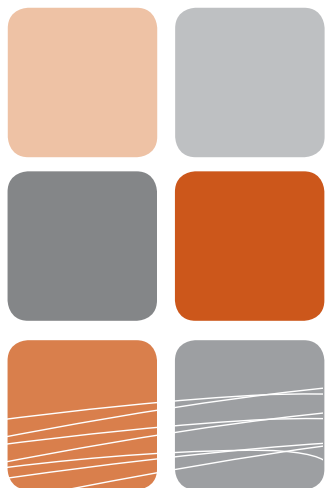
1.6.11 Lacrosse

National level by-laws encourage the use of artificial grass for elite level competition. For such competition Lacrosse Victoria advise that wet, sand-dressed and long-pile surfaces are all preferred ahead of sand-filled surfaces.

Internationally, a high percentage of women's and men's collegiate games in North America are played on artificial grass.



Australian Lacrosse team – Footscray Hockey Centre



1.6.12 School Sports

There is a wide variety of artificial grass installations in Victorian schools, ranging from playground surfacing through to international-standard sporting field provision.

The majority of installations in Victorian schools involve medium-pile sand-filled pitches that are designed for sports such as hockey, tennis, netball, basketball (and other suitable sports) where a harder, ball rebounding surface is required.

Some schools are now adding third generation pitches (long-pile, sand and/or rubber infill) to allow soccer, rugby, and Australian rules football to be played on a surface with more 'give' for falling players. There are many examples of schools installing artificial grass running tracks around new artificial grass play spaces, and these

are proving to be popular for use during physical education and sport classes, and for before and after school fitness programs.

Existing installations in school settings are providing a more serviceable space than previous grass and bitumen activity areas, and there is anecdotal evidence that artificial grass play areas (although hotter than natural grass at times) are cooler and less injury prone than the bitumen areas that they often replace.

Schools, councils and clubs need to be mindful that many multi-use school surfaces are not constructed to sport specifications and therefore cannot be used for formal sporting competition (although they may be used for training).

Check section 3.14 (p. 77) for further information on small games areas.

Top Tip

Before planning for future income from sporting usage of your school's artificial grass area, check with the relevant sports as to their design criteria, i.e. minimum size, line-marking restrictions, other specification requirements.



Monmia Primary School, Keilor Downs

Top Tip

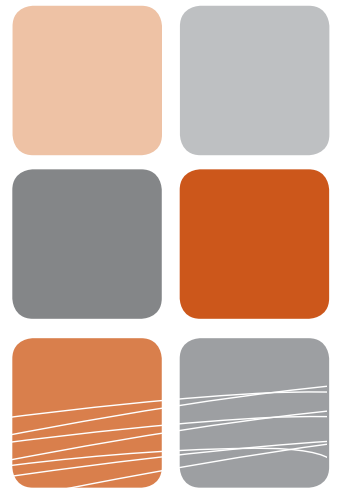
When planning your facility, ensure that you speak to other schools that have had artificial grass installed. Review both new and older installations. When deciding on a supplier, ensure that you check relevant project experience and the quality of the proposed materials.

Top Tip

Lots of lines mean extra potential for seam failure as time goes by. Balance the need for permanently installed lines with a general view that over-doing lines could be problematic down the track.



Wembley Primary School, Yarraville



Ivanhoe Grammar School - Activity specific carpets used

1.7 Multi-Use and Multi Sports Areas

Although artificial grass pitches come in a myriad of forms, no one type of surface is suited to all sports.

As is defined in Section 2 (Planning) there are several early planning considerations that are critical to the success of any sports facility, such as determining which sports are to be provided for, the standards of playing performance needed, the degree of intensity of use and the intended maintained lifespan of the area in question.

If there is a priority sport(s) for an

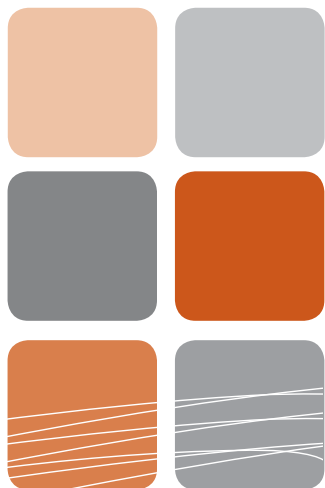
intended facility, then that sport(s) requirements should dictate the carpet system choice. Sand-based pitches have generally been the choice where a variety of sports are to be played (they are sturdy and durable), particularly in a school situation; but third generation pitches with their longer pile and soft infill provide a potentially more suitable field type where ball bounce needs to be restrained and where player surface impact (heavy falling) is more likely. They also allow potentially more community use after school hours.



Kunyung Primary School, Mt. Eliza - Before



Kunyung Primary School, Mt. Eliza - After



The table below outlines the varieties of artificial grass systems available and their suitability to different sports. It illustrates the breadth of playing characteristics catered for by different types of artificial grass.

Type of Surface		Sport/Activity										
		Athletics Training	Basketball	Football		Hockey		Netball	Rugby (Union & League)		Tennis	
				Full Size	Small Sided	Full Size	Training		Full Size	Tag	Full Size	Mini
Type 5: Synthetic Turf	Non Filled (Shockpad Optional)	3	3	3	3	1	1	3	4	2	3	4
	Sand filled	2	3	2	2	2	2	3	4	2	3	4
	Sand filled (with shockpad)	2	3	3	3	3	2	3	4	2	2	2
	Sand dressed (with shockpad)	2	3	3	3	1	2	3	4	2	3	3
	Needle Punch	2	2	2	2	2	2	2	4	2	3	3
	Needle Punch (with shockpad)	2	2	3	3	3	2	2	4	2	2	2
	Longpile (shockpad optional)	3	4	1	1	3	2	4	1	1	4	4
Key:		1 = Recommended Surface		2 = Suitable Surface		3 = May be used with caution but not recommended			4 = Surface not considered suitable			

Table 1: Suitability of Artificial Grass for Sport
Table supplied by the Sports and Play Construction Association (UK)

Notes:

1. The above table makes reference to existing, proven synthetic turf types. New types may challenge the aforementioned classifications of surface suitability.
2. This is a UK table. Check with Australian sporting parent bodies for advice regarding Australian specifications.
3. The 'Football' referred to above is of the soccer variety.
4. Whilst only one long-pile reference is made above, long-pile carpets range from 35-40mm (Australian rules football, cricket, low-level hockey and soccer), to 55-60mm height (preferred soccer surface), to 65mm (often with a shock pad as well) for rugby. New 85mm carpets have been developed for athletics field games (shot put, javelin, etc).

As well as the issue of the surface type and its applicability to different sports, multi-sports use of a synthetic turf pitch also requires skilful planning of ancillary facilities. An example of this might be the floodlighting of a hockey and tennis shared pitch:

- What type of lights are applicable for both sports?
- What height should the towers be?
- Where should the towers be located?
- With on-field or off-field fittings such as goal posts and court nets – how easily are these elements changed over?
- Where can they be moved that is safe and secure?

With some of these issues the answer

is locked-in to the needs of the primary sporting tenant, but in many cases, better, workable compromises can be developed in the early planning/design phases.

The following publications provide in-depth information and will help stimulate thinking about multi-sport and multi-use areas:

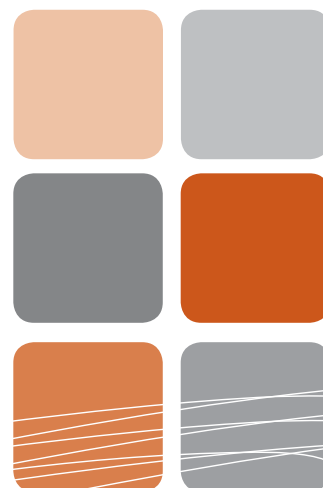
- Football Foundation: Artificial Grass Pitches (2008).
Website: www.thefa.com
- Sports England/Sports and Play Construction Association: 'A Guide to the Design, Specification and Construction of Multi-Use Games Areas (MUGAs) Including Multi-Sport Synthetic Turf Pitches (STPs). Part I.'
Website: www.sportengland.org

A 'Compromise' Carpet System?

The table shown below is taken from the University of Ballarat publication 'Development of Standards for the Use of Artificial Turf for Australian Football and Cricket' (2009). It provides a comparative analysis of the key characteristics required for artificial grass fields to be approved for Australian rules football, soccer and rugby. The table shows the compatibility of

each sport's specified turf, with the areas highlighted in yellow indicating the high degree of similarity in the AFL/Cricket Australia and soccer specifications.

The carpet system being installed at J. J. Holland Reserve in Kensington (yet to be tested onsite at time of publication, no rubber infill) may well meet all of these requirements.

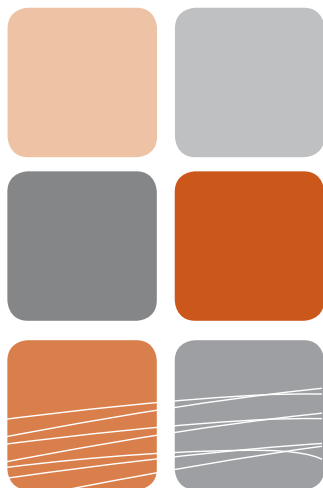


Characteristic	AFL/CA Community Level Standards	FIFA 1 Star Standards	IRB Reg 22 (Applies to Nat/ Int'l Levels)	FIFA 2 Star (Applies to Nat/ Int'l Levels)
Critical Fall Height	1.2m	-	1.0m	-
Hardness	65G – 120G	-	-	-
Vertical Deformation	-	4 – 9mm	4 – 10mm	4mm – 8mm
Energy Restitution	-	55% - 70%	30% - 50%	60% - 70%
Abrasion – change in friction force	50%	30%	-	30%
Friction – coefficient of friction	0.35 – 0.75	0.35 – 0.75	-	0.35 – 0.75
Traction football studs	25Nm – 50Nm	25Nm – 50Nm	30Nm – 50Nm	30Nm – 45Nm
Traction cricket spikes	15Nm – 25Nm	-	-	-
Traction cricket studs	7Nm – 15Nm	-	-	-
Ball Roll Calibrated Ball	4m – 12m	4m – 10m	-	4m – 8m
Ball Roll cricket	4m – 15m	-	-	-
Vert. Ball rebound calibrated ball	0.6m – 1.0m	0.6m – 1.0m	30% - 50%	0.6m – 0.85m
Vert. Ball rebound (cric)	0.1m – 0.4m	-	-	-
Angled Ball rebound calibrated ball	45% - 70%	45% - 70%	50% - 70%	45% - 60%
Angled ball rebound cricket	35% - 60%	-	-	-

Table 2: Comparative listings - Key sporting standards



Kuranjang Reserve, Melton



1.8 Injuries and Artificial Grass

1.8.1 Introduction

Many sections of this guide cover issues of direct relevance to player safety; be that through the planning phase (correct assessment of likely facility use), the design phase (choosing the right artificial grass option), the project delivery phase (getting a quality, approved playing surface), the management and operation of the facility (safe use practices) or the ongoing maintenance phase (maintaining optimum surface performance, including user grip).

The information below relates to injury prevention (reference is made to a range of relevant issues elsewhere in this guide) and to injury research. Readers are encouraged to explore those other sections of the Guide in order to maximise the ability to plan, design and construct a safe, enjoyable and durable artificial grass sporting environment.

1.8.2 Injury prevention

In Section 3.4 of this guide (Artificial Grass Selection) several key selection criteria are recommended, many of which are directly relevant to injury prevention. Key issues/subject areas (with index references provided) include:

- What sports will be played on the proposed sporting area? (Section 2.)
- What are the required sports surface performance criteria for each of those activities? (Section 1.6)
- What type of artificial grass system best matches these requirements? (Section 1.5 and 1.6)
- How can it be maintained at that level for the longest possible period of time? (Section 6.0)

Other parts of the Guide that have direct relevance to injury prevention include:

- Section 2.3.3 (Risk Management Plans), and items in section 3 (Design). Issues such as: Floodlighting (Section 3.9), Shoe Cleaning (Section 3.12), Pitch Layout/Linemarking (Section 3.13), Safe Design (Section 3.22) and Footpaths (Sections 3.18, 3.20).

1.8.3 Injury research

A recent feasibility study⁷ aptly states: *'Many sports and individuals have pre-conceived views on the use of artificial grass sporting surfaces which may not reflect current reality in terms of the technology, the playability or the safety of those surfaces. Although third generation*

surfaces are still relatively new, there is a range of research available that provides us with some key observations to consider.'

Some of those issues are:

(i) Playability

FIFA commissioned 'Pro-Zone Studies'⁸ to analyse soccer match playing patterns over the past decade. Of particular relevance is the review (Technical Study 4) undertaken on the 2007 U-20 World Cup where the playing patterns of 52 matches (29 played on artificial grass, 23 played on natural turf pitches) were analysed. The conclusions documented were:

- Artificial grass does not dramatically affect the pattern of the game.
- There were no differences in the number of possession transactions.
- There was a higher frequency of attempted passes.

(ii) Comparative analysis: Injuries occurring on artificial grass and natural turf pitches.

- FIFA's Medical Assessment and Research Centre (F-MARC) compared injuries that occurred at the FIFA U-17 tournament in Peru (2005) with injuries sustained at the previous FIFA U-17 tournament which was played on natural turf. The research⁹ showed that there was very little difference in the incidence, nature nor cause of injuries observed during games played on artificial grass compared with those on natural turf.
- A study reported in the British Journal of Medicine (2006)¹⁰ showed that there was no evidence of greater injury risk when soccer was played on either artificial grass or natural turf in the Swedish Premier League.



⁷ Artificial Grass Fact File' prepared by the Smart Connection Company for the Boroondara City Council (2009).

⁸ Validation of Pro-zone: A New Video-based Performance Analysis System (2006). International Journal of Performance Analysis in Sport – 6, p108-119

⁹ http://www.fifa.com/mm/document/afdeveloping/pitchequip/turf_roots_1_11166.pdf

¹⁰ 'Risk of Injury' Ekstrand, Timpka, Hagglund – British Journal of Sports Medicine Vol 40 (12)

(iii) Related matters

a) Infill spray:

While still under a watching brief in several countries, completed studies generally show that infill rubber does not pose a serious health risk:

- Allergies: Some people can have an allergic reaction to latex which is sometimes found in car tyres (the recycling source of much infill rubber granules). However, it is a small percentage of the material mix in tyres.
- Most latex is found in rubber gloves and balloons – and the impact that it has on people who are allergic is minor.
- Infill ingestion: Given that there can be a light spray of infill rubber granules when either an Australian rules football, cricket ball or player land on a third generation 'dressed' pitch, observation will need to continue regarding any incidences of infill particles getting into players eyes, inhaled into the respiratory tract or ingested through the mouth.

American research published in May 2009 (study conducted by the New York State Department of Health)¹¹ advises that artificial grass fields using rubber granule infill are neither a significant source of exposure to respirable particulate matter, nor, from an analysis of ambient air sampling, was there any concern raised about cancer/non-cancer health effects for people who use or visit the fields.

Top Tip

Current international and local studies have identified that health risks resulting from contact with rubber crumb are low and/or unlikely.

b) Biological activity:

The feasibility study referred to earlier in this section states that there is less biological activity in an artificial grass system, and that pathogens are not broken down as easily as in a natural turf system. Therefore there are potential health issues where bodily fluids (spittle, blood, sweat, etc), bird droppings and animal faeces/urine are not cleaned

up properly on artificial grass (refer: Maintenance Section for advice).

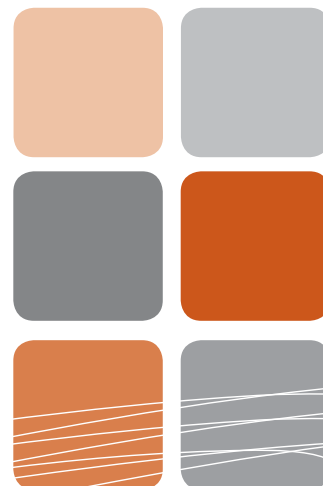
c) Heat stress

Artificial grass surfaces heat up significantly more than natural turf surfaces on hot sunny days. High surface temperatures can lead to heat stress-related conditions, especially for children. Watering surfaces to cool them during such weather is not necessarily the answer for several reasons, such as the likely significant increase in humidity which is not desirable.

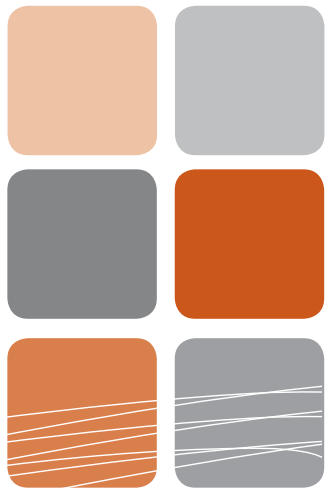
The New York study referred to previously advises that:

'Awareness of the potential for heat illness and how to recognise and prevent heat related illness needs to be raised among users and managers of sporting fields, sports administrators, coaches and parents.'

The introduction and enforcement of appropriate heat policies by sporting bodies/clubs is essential.



¹¹ 'An Assessment of Chemical Leaching, Releases to Air, and Temperature at Crumb-Rubber In-filled Synthetic Turf Fields'. (May 2009) New York State Department of Environmental Conservation and New York State Department of Health.



1.9 Lifespan and Lifecycles

1.9.1 Lifespan

The lifespan of an artificial grass sporting facility is difficult to accurately anticipate as it is determined by a range of factors including:

- The astute selection of an appropriate location and site (stable land, controlled impact from trees, etc).
- Good design (appropriate base design, good drainage, appropriate specification of a good carpet system, etc).
- The quality of raw materials used.
- Usage rate: High-use facilities will generally wear-out before less well-used facilities.
- Good use spatially of the facility, eg. where possible avoiding channelled traffic by moving training sessions around the pitch.
- Good usage practices (insisting on shoe-cleaning, sand re-distribution, monitoring and immediate repair of seam issues).
- Mid-life rejuvenation (removal and cleaning of infill material so as to limit compaction and its negative impact on vertical drainage).

Maximising the lifespan of an artificial grass surface is often essential to a club or facility manager to make their facility financially viable. For example, getting a synthetic hockey pitch to last 10 years instead of eight might allow a club to generate the final \$50,000 required to pay out its loan or complete their amortisation savings target.

Purchasers of artificial grass should investigate warranties offered by suppliers/installers as to whether they relate to the lifespan of the original fibre, the knitted carpet, or the workmanship of the installation. (For more information, refer to Section 1.13.2).



Baseball training

1.9.2 Lifecycle

The lifecycle of a sporting facility usually relates to a longer period of time than just its lifespan because it considers the lifespan of a range of elements at the facility (basework, drainage, pad, carpet, floodlighting, irrigation system, etc).

The period chosen for the lifecycle would usually be set at the lifespan of the longest lasting element in the construction. For example, the lifecycle of a new artificial grass complex might be viewed as 30 years – the period in which the baseworks/drainage should stay stable, but through which period the pad/carpet might be replaced twice, the floodlight fittings twice, etc.

The term lifecycle is often used in reference to longer-term financial planning, and in this regard, lifecycle costing is an important accounting/budgetary process that recognises that the cost of assets is not the same annual figure repeated, but in fact recognises that there are key stages where larger costs are incurred such as major maintenance, major refurbishment or replacement of key elements.

Bringing all these costs into a long-term budgeting horizon allows an organisation to work out the true annual income generation/savings required to meet long-term liabilities.

The lifecycle cost of a surface consists of three different costs:

- Initial capital costs
- Maintenance costs and
- Replacements costs.

Reducing the initial capital cost through choosing a cheaper surface may, due to the poor durability of the surface, result in high maintenance costs and the need to replace the surface sooner. Selecting a high-quality surface may cost more initially, but will likely reduce the overall lifecycle cost of the surface.

Wherever possible, the emphasis should be placed on obtaining the ideal playing characteristics and durability. These aspects will determine the long-term success of the surface.

Examples of the lifecycle costs for different types of sporting fields (natural and artificial) are provided in Section 1.10, and Appendix 5.

1.10 Lifecycle Cost Comparison: Natural Turf versus Artificial Turf

There are a number of studies available that indicate the cost of installing, maintaining and replacing a good quality natural surface over an extended lifecycle (say 30 years) is similar to that of providing a similar-sized artificial surface for the same period of time. This is demonstrated in the indicative lifecycle cost table below (Table 3). This table shows the cost of ownership over 30 years, synchronising two 15-year

natural surface cycles with three 10-year artificial turf cycles.

The figures below are based on high quality sporting fields – an international standard FIFA 2 Star artificial grass pitch and its very high quality natural turf equivalent (hence the 15 year re-build cycle and the high annual maintenance cost). They are based on recent research¹², and have been extrapolated out to a 30-year period.

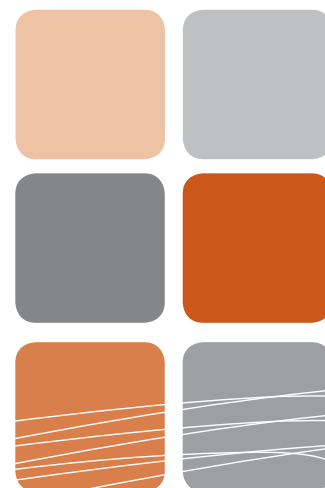


Table 3: Cost of Ownership over 30 years:

	I	II	III
	Natural Turf	3rd Generation Artificial Grass Soccer Pitch	
Item		Maintenance fully at commercial rates	Maintenance utilising club/school volunteers
1. Construction	\$400,000	\$670,000	\$670,000
2. Maintenance			
- 30 years x \$40k pa	\$1,200,000		
- 30 years x \$20k pa		\$600,000	
- 30 years x \$5k pa			\$150,000
3. Replacement			
- Years 15 & 30 @ \$55k	\$110,000		
- Years 10, 20 & 30 @ \$350,000		\$1,050,000	\$1,050,000
TOTAL	\$1,710,000	\$2,320,000	\$1,870,000

Notes:

- The figures shown above reflect today's Australian dollar values. For an understanding of the effects of inflation and compound interest on sinking fund target savings, refer to the 'inflation, compound interest and amortisation' commentary at the end of this section.
- Column II shows the 'worst-case' scenario costs for an artificial grass pitch – that is all maintenance being undertaken at full commercial rates. In a large majority of cases (especially with local government ownership and some school situations) the bulk of this maintenance can/is done by club volunteers – the column III scenario.
- The above model assumes that the natural turf field is of a high standard (i.e. has basic water supply available). Without reasonable water supply, the natural turf pitch will cost almost as much over the lifecycle, but deliver far less community benefit.

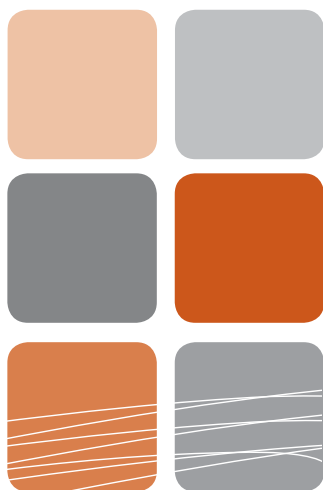
This above cost analysis would only be relevant if the two different types of pitches (natural turf/artificial grass) were delivering a similar number of playing hours. Recent research studies in Australia¹³ estimate that one synthetic turf pitch has the usage capacity of 3-3.5 natural turf fields (average weekly use: natural turf = 15-20 hours, artificial grass fields = 60+ hours). So the calculations in Table 3 therefore could be adjusted to reflect that one artificial grass pitch achieves usage capacity equal to at least three natural turf pitches. In that case, the real comparative analysis reflects:

- Cost of the artificial grass pitch over the 30 year lifecycle
\$2,320,000
- Cost of the three natural turf pitches over the 30 year lifecycle (3 x \$1,710,000 AUD)
\$5,130,000 AUD

¹² 'Artificial Grass Fact File' prepared by the Smart Connection Company.

¹³ 'Development of Standards for the Use of Artificial Turf for Australian Football and Cricket' (University of Ballarat – 2008).

¹³ 'Artificial Grass Fact File' prepared by the Smart Connection Company for the Boroondara City Council (2009).



By providing one artificial grass field instead of three natural turf fields, not only is the artificial grass field provider potentially saving \$2,810,000 over the 30-year period (\$3,260,000 if the maintenance costs of the artificial grass field are delegated to the tenant club), but the installation of the single artificial

grass pitch has the potential to return the equivalent of two natural turf fields to the broader community for alternative use (one of the three fields being converted to artificial grass), and the equivalent of three natural turf sporting fields annual watering requirement is potentially negated.

Table 4: Lifecycle costings related to Tennis Courts / Fittings

Surface	Life Expectancy Range (Yrs)	Planned Life (years)	Typical Replacement Cost (t)	Annual Replacement Cost	Annual Maintenance Cost	Total Annual R&M Cost
'Filled' Art. Grass						
Standard	10 to 12	10	\$14,500	\$1450	\$600	\$2,050
Premium	12 to 18	15	\$18,000	\$1200	\$600	\$1,800
Synthetic Clay	12 to 18	15	\$23,000	\$1,533	\$1000	\$2,533
Ancillary Facilities						
Lights: Side, low, 1 court	30 to 40	30	\$16,000	\$533	\$300	\$833
Lights: Side, low, 2 crts	30 to 40	30	\$12,000	\$400	\$300	\$700
Lights: High, corners, 1 crt	30 to 40	30	\$25,000	\$833	\$300	\$1,133
As above- 2 court	30 to 40	30	\$15,000	\$500	\$300	\$800
Fencing – single court	25 to 35	30	\$8,500	\$283	\$100	\$383
Fencing – 4 court encl.	25 to 35	30	\$4,000	\$133	\$100	\$233
Net Posts	30 to 40	35	\$500	\$14	\$0	\$14
Nets	5 to 7	5	\$250	\$0	\$50	\$50

Table supplied by Tennis Victoria

Table 4 provides a further example of lifecycle costing as it applies to artificial grass tennis courts, including ancillary components. Note that these are 2006 figures.

Notes

1. Cost of removal/tipping of existing surface included where appropriate.
2. Multiple court enclosure costs shown on per court basis.
3. Data from Tennis Victoria Technical Services project management database and research analysis.

1.10.1 Inflation, compound interest and amortisation

For simplicity, lifecycle cost analysis is often undertaken using current day dollar values (i.e. taking 'cost' as at today and dividing it by the number of years remaining until replacement is due). If a capital replacement (sinking) fund is to be established that reflects exactly what needs to be accessed in future years, then inflation and compound interest need to be added to the equation.

As an indicative example, assume the replacement cost in 10 years is \$360,000. Based on 5 per cent inflation, a sum of \$360,000 will equate to \$586,404 in 10 years time. Assuming a compound interest rate of 5 per cent applies, a capital replacement (sinking) fund contribution of \$3,848 per month will be required every month for the 10

year lifecycle of the surface.

Note the difference. On current day dollar values, \$3,000 would be added to the sinking fund each month over 10 years (\$360,000 divided by 120 months). Factoring in inflation and compound interest means that raising a 'year 10' figure of \$586,404 requires \$3,848 per month from the first month of the facility's life.

Top Tip

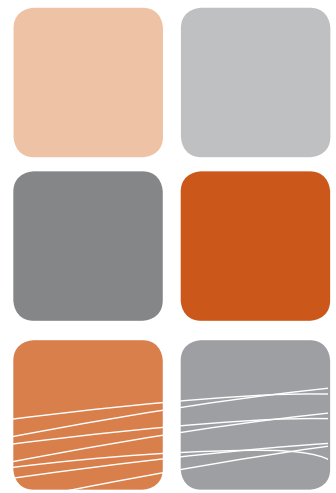
A valuable publication titled **Life Cycle Cost Guidelines** is available from the Western Australian State Department of Sport and Recreation.
www.dsr.wa.gov.au

At Appendix 7 and online at: www.sport.vic.gov.au a 'Pitch Evaluation Model' template is provided. This template will help determine the required annual savings targets over a period of time leading up to the refurbishment or replacement of an artificial grass facility, assist in the preparation of a business case related to sporting facilities, or carry out an analysis of the respective lifecycle costs of a natural turf facility versus an artificial grass facility.

The model operates on discounted cash flow, factoring in inflation and compound interest, to become a more realistic predictor of required annual sinking fund requirements.

When developing these pitch financing models, facility owners/managers need to be aware of both the ongoing routine maintenance costs, and the facility's life expectancy, as well as the expected cost of eventual replacement. The same should be done for components such as the floodlighting and fencing.

On the income side of the calculations, owners/managers need to make realistic and accurate income predictions. Widely optimistic predictions often lead to subsequent significant expenditure cutbacks, often in areas (i.e. surface maintenance) where cutbacks can be counter-productive to the full utilisation of the surfaces.



1.11 Local Government Policy Considerations

A number of policy positions need to be considered when planning for artificial grass surfaces. This section provides an overview of the key considerations.

1.11.1 Open Space & Fencing

Fencing off sporting facilities within public open space is often not the desired outcome in terms of the aesthetic appearance created, nor the conceptual issue of 'alienating public open space'. But many local government authorities (LGAs) acknowledge the significant benefits of artificial grass pitches (refer Section 1.4 of this guide), particularly the capacity of a single artificial grass field to effectively replace three to four natural turf fields. In the latter argument, accessible public open space acreage is actually enhanced. Clubs that previously required two to four natural turf fields on which to conduct their activities might need just one artificial grass field. This has been the experience with hockey facilities in Melbourne over the past 15 years.

Open space that becomes available as a result of the installation of an artificial grass pitch can be returned to passive recreational open space or allocated for other purposes.

The fencing off of an artificial grass facility can be undertaken in different ways. One metre high fencing around the playing area keeps unwanted traffic off the pitch while still allowing casual access. Where full height external security fencing is preferred, then sensitivity is required in finding a site that is more acceptable for such design and use.

Note: The Melbourne hockey

experience achieved significant public open space savings because the sport was flexible in the way that it restructured its fixtures to maximise use of single artificial grass pitches. Other sports may need to be similarly flexible in their programming and fixtures if public open space gains are to be made.

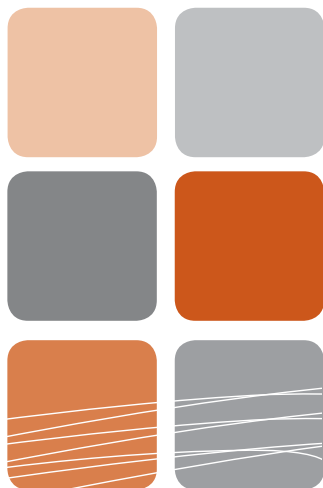
1.11.2 Facility Management and Control

In many situations it is wise to establish an artificial grass field as a multi-sport/multi-user facility, thereby enhancing the capacity of the field to generate additional use and income. To build or re-carpet a synthetic field is a costly exercise so every opportunity should be taken to broaden its appeal to the sporting marketplace.

This broad usage and marketing of an artificial grass field is often best captured where the management and control of the facility is not given over to a single sporting group, but is instead controlled by a multi-club, multi-sport management committee or an independent body (the local council for example), or leased/delegated to a commercial operator.

Funding agencies often prefer management models that work towards sharing and maximising the use of a facility and enhancing and maximising participation.

There are exceptions to this rule where individual clubs with 25-30 teams can fill the fortnightly match/training roster or situations where the facility owner can install a formal agreement with a principal tenant that manages the facility and must achieve significant usage/income targets.



1.11.3 User-Pays and Artificial Grass

There are several excellent facility management/operation examples noted in the Case Studies Section of this guide (Appendix 2).

One of the challenges arising from the trend towards artificial grass is the difficulty for many local councils to develop consistent user fee charges across the range of natural and artificial sporting surfaces.

Historically, community sporting clubs have generally been recognised for their contribution to the community, with councils charging rental which often represents a small percentage of annual costs to maintain facilities.

The advent of artificial grass has generally seen a different cost recovery approach. In many cases, community clubs are now required to contribute significant funds towards up-front capital costs, manage maintenance responsibilities and, through capital replacement plans, contribute significantly towards the future replacement cost of the facility.

This change has largely come about because the move to artificial grass for some sports shifts costs from mainly

recurrent expenditure to large capital expenditure – which is then repeated every 3, 5, 10 years as is applicable. Because costs and replacement timelines are easily known, these costs have translated into often substantial amortisation commitments for user clubs.

This approach is drawn into focus by the analysis presented in Section 1.10 of this guide ('Lifecycle Cost Comparison: Natural Turf versus Artificial Turf') which shows that over a 30 year lifecycle, the cost of building, maintaining and replacing natural turf sporting areas is similar to that of equivalent facilities featuring synthetic surfaces. Councils should consider this analysis in the development of appropriate fee structures that equally share cost recovery and facility subsidy initiatives.

Note: It has been said that some synthetic surface facilities attract higher fees because they are fenced and not constantly available to the general public. If a club seeks exclusivity, then higher fees may be appropriate, but in many cases fences are in place because of the potential of expensive damage being done to valuable community assets.

1.12 Licensing, Certification and Accreditation

Although these terms are individually defined in Section 1.2: Glossary of Terms, it is worth repeating them in order to better understand the difference between like terms. Potential purchasers of artificial grass facilities need to understand this sometimes confusing terminology.

1.12.1 Licensing

A licensing agreement is generally the formal agreement entered into by a turf manufacturer and the sport's governing body regarding the conditions under which approval of turf products may be granted. This is usually based on test results from laboratory or field, or both, by an accredited test house.

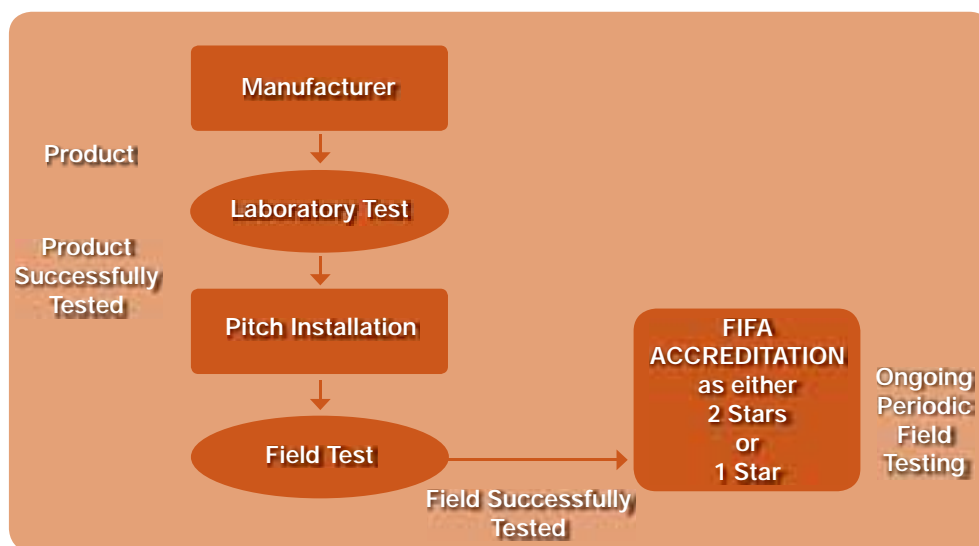
Note: Some sports have different levels of licensing, with the lower level being the full list of suppliers whose products meet the specifications, and an upper level who are designated as preferred suppliers.

1.12.2 Certification

- Industry certification: This refers to the seal of approval that is granted

to a company by the relevant artificial grass manufacturers or installers industry body. In Australia, one such body is the Synthetic Turf Council (www.syntheticurfCouncil.org). The European equivalent is the European Sports Turf Organisation (www.eu-syntheticurf.org).

- Product certification: A product (artificial grass system) that is approved by a sport's parent body via early laboratory testing using an accredited testing house.
- Installed field certification: Some parent sporting bodies make it mandatory that the installed field is tested against required performance measures before it is given the 'green light' for match use. When not mandatory, councils, clubs and schools should still have their facility tested for peace of mind or to obtain evidence that the facility is capable of hosting appropriate competition and elite events.



FIFA's Quality Concept for Artificial Turf Pitches

1.12.3 Accreditation

This generally relates to laboratories that are accredited by a sport's peak body to carry out the laboratory (sample product) or installed field testing.

It is important to know the difference between a manufacturer (company making the yarn or knitting the yarn into the carpet), a supplier (company that manufactures the carpet or lays the carpet), the installer (the company that lays the carpet), and a contractor

(company that constructs the base-work under the shock pad and carpet, or company that lays the carpet, or runs the whole job with sub-contractors called in to do specialised aspects).

It is also important to be able to separate company names from product names, when sometimes they are both (eg. Rebound Ace, En-tout-cas).

1.13 Quality Assurance, Control and Warranties

Both in the interests of the purchaser of an artificial grass sporting facility and the contractor delivering the project, a system of quality control needs to be in place that checks materials and workmanship throughout the contract period.

1.13.1 Quality assurance and control

Essential to a successful project is having clearly defined specifications, an approved 'quality system', and thorough inspections by knowledgeable supervisors.

1.13.1.1 Specify it

At the specification and tender writing stage it is essential that a quality (control) system is either specifically nominated or called for from the bidding contractors. This 'system' or process will involve the nomination by the contractor of a project quality manager who would be responsible for the implementation of the project's quality system. The quality system would also include a system of Inspection and Test Plan (ITPs) that:

- Identifies the project.
- Lists all hold points during construction (including the supply of materials) that will require verification before the works are

covered or installed (see below).

The contractors should show evidence that various stages of the project, eg. levels and surface finishes are being met for at least 10 significant events along the way.

- Identifies the criteria for verification before the works are covered or installed (see below).
- For each hold point, records that the quality has been verified, the date the work is verified, and is signed off by the project quality manager.

ITPs should be prepared for a minimum of 10 significant items, including work by the sub-contractor, and be submitted as part of the tender bid. Preferably they would be nominated by the client in the specification and tender documentation.

Failure to submit the ITPs in accordance with the accepted program and in a form acceptable to the superintendent may give cause for the superintendent to withhold the approval for any portion of the works until approved ITPs are submitted. Prior to practical completion, the project quality manager must certify that all non-compliance or deficiencies have been rectified.



Top Tip

Do your homework (you, or your project manager) at the tender assessment stage to find out:

- Who are the proposed contractors? What is their work reputation?
- Who are the proposed sub-contractors? What is their work reputation?

Top Tip

Knowing who the various players in the industry are, ensure that:

- You establish with the lead contractor just who is responsible for quality systems/procedures through each key phase of the project, and
- You have been provided with a Project Quality System that covers each phase (among the tender bid documents)

1.13.1.2 Data sheets and reference samples

When contractors bid for the project, it is essential that they supply product data sheets and samples that exactly match all materials to be used on that project. These reference samples should be clearly marked/identified.

It is essential that the product being proposed (and the samples provided) have been laboratory certified as being capable of meeting the performance standards set down by the controlling body of any sport that the facility will be used for. These performance standards are often available on the website of the relevant sporting bodies (see Section 1.6).

Top Tip

Make it clear in your specification that samples provided as part of a tender bid must be exactly the same as the materials that would be used in any subsequent installation. Your specification should make it clear that testing will be done to confirm this consistency.

1.13.1.3 Samples of constructed items

Some projects call for very specific samples to be sourced during the projects construction. An example might be a request for a 300mm x 300mm sample of shock pad to be prepared and stored (for subsequent analysis) each separate day of the in-situ shock pad installation phase. Likewise samples of infills (sand, rubber) and adhesives might be called for.

1.13.1.4 Monitoring the construction

The project superintendent and/or the consultant project manager need to monitor both the supply of raw materials to the site, and observe all surfacing and resurfacing phases.

Top Tip

Mark and retain all raw samples as a precaution against problems occurring on site. Should a problem occur, and a dispute arises over cause or liability, detailed analytical and other tests could be conducted on these samples in order to definitively resolve the matter.

By way of example, the construction monitoring, key witness and hold points on a project such as the re-surfacing of wet artificial grass hockey fields could be:

- Pre-commencement (x 1)
- Assess and determine soft spot remediation (if required) (x 1)
- Proof roll of sub-grade (x 2)
- Preparation of spoon drain and drainage structures (x 1)
- Underground drainage (x 1)
- Irrigation mains (x 1)
- Placement of crushed rock pavement (x 2)
- Completion of crushed rock pavement (x 1)
- Completion of bituminous layer (x 1)
- Installation of shock pad (x 2)
- Placement of synthetic surface (x 2)
- Placement/adjustment of sprinkler heads (x 1)
- Pressure testing and commissioning of irrigation system (x 1)
- Final inspection (x 1)

Total: 18 inspections.

Top Tip

A range of items can/should be checked during construction, including:

- conformance to standards for seam strength
- thickness of all layers in the base
- shockpad mix tensile strength
- infill spread rate

1.13.1.5 Testing materials

Shock pad and carpet materials should be checked (against reference samples and specifications) either when delivered to site, or after installation, because there have been cases of more lightweight carpets and pads being installed than was defined in

specifications or contracts.

Sand, rubber granules and glue samples should also be checked.

The following surface material characteristics can be tested (recommended minimum test features are bolded):

Shockpad	Carpet
• Tensile strength and elongation	• Fibre type and dtex
• Density	• Pile length / height
• Thickness	• Pile profile
• Weight per unit area	• Pile density (tufts per square metre)
• Resilience	• Fibre material
• Compressibility	• Total weight per unit area
• Stiffness	• Face weight
	• Tuft withdrawal force
	• Quality of backing materials
	• Pile filling materials
	• Colour of pile

Table 5 - Surface Material Characteristics

Refer to Section 1.5 for important tips on getting the carpet properly tested.

1.13.1.6 Monitoring over time

The specification or contract needs to define the maximum permissible degree of change (related to the key performance criteria), if any, that can occur over a set period. In addition to those performance characteristics,

the same applies to surface levels over the pitch, and the bonding of seams and inlaid lines.

Examples of items that may be defined include:

Sand	Seams	Rubber Granules
• Bulk density • Sieve grading • Particle configuration	• Tensile or peel strength (before and after water immersion)	• Size • Shape • Materials • Grading

Table 6 - Other Key Performance Criteria/Definitions

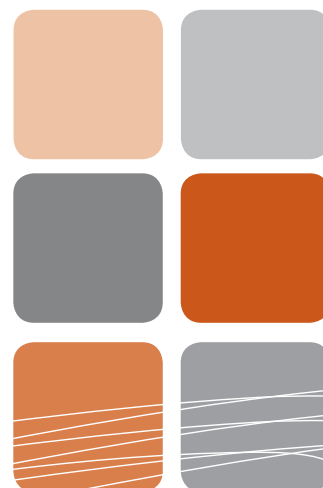
1.13.2 Warranties

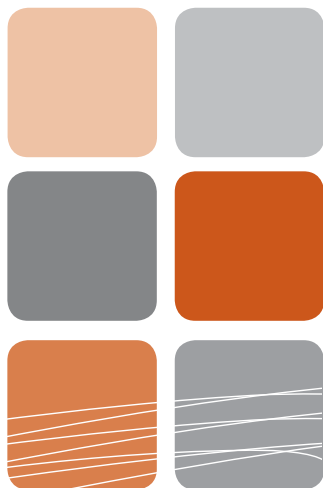
The supplier or installer warranty might appear to be straight forward: (eg. 'warranty five years') but what does that really mean? Warranties can sometimes be difficult to enact when something goes wrong, so it is crucial to question the potential suppliers, constructors or installers upfront regarding who is providing the warranty on the:

- Civil engineering works that lie beneath or beside the surfacing system (the sub-base, pavement, drainage, irrigation system, floodlighting cables, etc)?

- Shock pad, and for what period?
- Original yarn, and for what period?
- Knitted carpet, and for what period?
- Workmanship standards associated with the installation of the pad and carpet and for what period?

Also ascertain how compensation would be negotiated if the carpet comes apart after only a few years. For example, if the total project, including civil works and surfacing system, cost \$1,000,000 and the carpet failed after three years,





the compensation could be calculated using the following formula:

- The carpet was worth \$250,000 out of the \$1,000,000 project (i.e. the base and pad are still fine)
- The carpet was usable for three of the five-year warranty period, therefore the compensation value might relate to three fifths of \$250,000 or \$150,000.

Expect that the contractor will

investigate whether the recommended maintenance regime was followed or if the surface was more heavily used than outlined under the warranty. This may alleviate them of their responsibility.

The best types of warranties are those that are backed by independent insurance companies. Warranty insurers are ranked and rated (refer www.ambest.com). Look for coverage from a company with an 'A' grade ranking or better.

Top Tip

For the sake of knowing who should be supplying you with warranties related to the yarn, knitted carpet, installed product, etc, find out before you sign a contract:

- Who is undertaking the civil engineering works associated with the project (testing/surveys, drainage, irrigation, bulk earth works, floodlighting etc?)
- Who is supplying the yarn?
- Who is knitting the yarn into the carpet?
- Who is laying the shock pad and the carpet?

Top Tip

Warranties generally relate to a maximum numbers of hours of use per annum, a level that can easily be exceeded by highly-popular facilities. Prior to awarding your project's contract, discuss the implications of potentially very high-facility usage rates with your proposed supplier/installer.

Top Tip

Some companies will link their warranties on your surface with their ongoing involvement in the facility's maintenance. During the tender bid review ask about this matter and fully understand the implications for your warranty coverage. Expect to maintain your surface weekly, monthly and yearly, and budget for this.

1.14 Funding Strategies

Local government authorities (LGAs), sometimes with the support of State Government, are the major funder of local-level community sporting facilities in Australia. The requirements for LGA support of projects differ from council to council, but attention to good facility planning and community development principles will help clubs or schools in gaining LGA support. These principles include:

- Thorough pre-planning: Who will use it? When? What for?
- Are there other groups that could also use this facility?

- Could a joint-use partnership between community groups, LGAs, schools or other partners be established which would enable a 'pooling' of funds and resources, and a guarantee of substantial use?
- Could this facility partly or wholly target groups such as – women, children, teenagers, people from lower socio-economic backgrounds, culturally and linguistically diverse backgrounds or people with a disability?

Projects built around these parameters are generally well received by funding agencies because they seek to maximise the potential use of a facility, and seek to attract key government target markets.

Key funding sources/mechanisms are:

Victorian State Government

Department of Planning and Community Development (DPCD) – through Sport and Recreation Victoria, provides a range of funding programs that cover broad leisure planning, specific facility planning/investigation, and the funding of infrastructure development. At the time of writing, funding schemes were in place that covered planning, minor capital works, major capital works, aquatic facility (re)development, sustainable sports grounds and soccer facility development.

See: www.sport.vic.gov.au

Local Government

Speak to your local council's leisure and recreation services unit as early as possible when formulating ideas and seek their advice on how to best advance the project.

Top Tip

Some funding agencies prefer to support new artificial grass facilities rather than the re-surfacing of existing facilities (particularly where the resurface is like for like).

Sporting Associations

Some sports provide funding programs that support facility development i.e. Tennis Australia and the Australian Football League.

Philanthropic trusts and foundations

For instance:

- The Helen McPherson Smith Trust (the Victorian Government's rural and regional community building initiative, located at <http://hmstrust.org.au/>).
- Foundations for Rural and Regional Renewal ('Small Grants for Small Rural Communities Program' located at www.frrr.org.au/)
- The Australian Sports Foundation (ASF) operates the Sport Incentive Program. Eligible organizations can apply to register sport-related projects in either of the following:
 - Category 1 – to collect donations using the ASF's tax deductible status and to receive consideration for discretionary grants from the ASF, OR
 - Category 2 – to receive consideration for a discretionary grant from the ASF.

An organisation can only register under one category at any given time. Projects must meet certain project criteria.

See: www.asf.org.au/how

Club members

Club members can be a source of income through strategies such as donations (including providing links to potential donors or sponsors), debentures, loan guarantees, legacies and in kind work particularly in the case of exciting new facilities.

Debentures

These are essentially unsecured loans usually provided by people keen to support the sport in a personal capacity. They may seek little or no recognition of their contribution and repayment of the debenture is usually with interest.

Because debenture holders are often associated with the club or association, it is tempting to regard this arrangement as an informal one. However, it is recommended that a formal agreement is drawn up (an indenture) so there is no misunderstanding about the terms under which funds have been provided and any arrangements for repayment and/or transfer of the debenture.

In-Kind Contributions

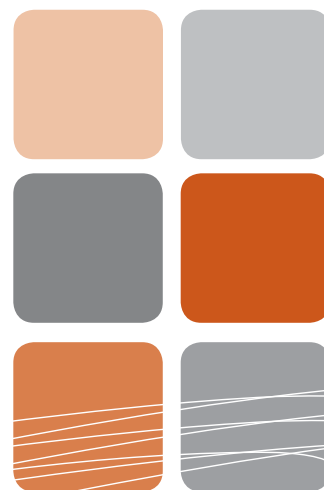
This can be a valuable and creative way of supporting a project. A common form of contribution is the professional or technical skills and efforts of individuals. Such contributions should be carefully noted and acknowledged but also closely monitored to ensure the in kind pledges are realistic and are provided.

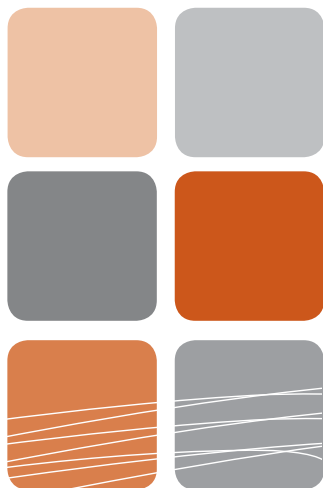
Special activities/events

Special events can be a significant source of fundraising, but remember that many events can be so significant that they require their own project plan, detailed costings and clearly established operational plan.

Sponsorship

Even community level facilities can be attractive to sponsors in terms of buying advertising space at the new facility, or even a naming-rights deal. Keep in mind that raising sponsorship requires careful targeting and good quality presentation material. It is also important to check with the local council regarding any policy or planning implications regarding advertising or signage and naming rights.





Commercial loans

Ultimately it may be necessary to top-up the other forms of funding with commercial loans. Commercial loans or similar banking facilities may also be necessary in order to manage cash flow during the project. Depending on the nature of the economy in which this activity is taking place, the providers of the loan, their terms and interest rates will vary greatly. It is obviously important to be clear about the loan terms and to factor the capital repayment and interest charges into the project cost.

Bank loans may need to be:

- Guaranteed by a local government authority.

- Guaranteed by members (not recommended where risk is involved).

Club funds

The club or playing community may have its own funds which it can devote to the project.

Note:

When raising funds for the eventual replacement or refurbishment of an artificial grass sporting facility, inflation and compound interest need to be factored into calculations so an accurate annual amortisation figure is known. For more information on this matter, refer to Section 1.9 of this guide.

Top Tip

Think about who else could be a stakeholder, and therefore a contributor to your project. The broader the project base, the greater the chance of funding agencies being interested in your project.

1.15 Professional Support

A key success factor in artificial grass installation projects is the involvement of experienced civil engineering expertise (preferably related to artificial grass installation projects), plus experience and knowledge about laying artificial grass and its aftercare.

Where such knowledge and experience is not ensured, project teams should consider enlisting the support of knowledgeable, independent consultants with proven expertise in artificial grass sports surface installation projects. Projects can be compromised by relying too heavily on individual pieces of advice from artificial grass installers, or on the ability of engineers without relevant experience with this particular type of project.

External consulting advice and project management will generally cost between 5% and 10% of the total capital cost, but it can ensure project quality and lifespan that will pay for its own cost many times over. This is particularly the case with large-scale, complex projects.

The consultant's role may include:

- Reviewing current conditions of the site proposed (or helping review potential, alternative sites).
- Undertaking a 'desktop review' of previous, relevant drawings/reports and investigations.
- Supervising new site investigations that might relate to existing services,

a site feature survey, geotechnical investigations, drainage, irrigation, etc.

- Producing schematic design options and pre-design cost estimates.
- Producing or reviewing detailed design and documentation.
- Assisting with any Expression of Interest process.
- Providing tender documentation for inclusion into the client's contract.
- Responding to tender 'requests for information'.
- Assisting with tender evaluation and interviews.
- Carrying out construction phase supervision and checking (assessing build quality and design specification conformity – see 1.13.1.4, and payment approvals).

To carry out these functions successfully the consultant(s) would ideally have extensive knowledge of:

- Current synthetic grass research.
- The performance of different artificial grass surfaces.
- Artificial grass fabrication and construction techniques.
- Artificial grass management and maintenance practices.
- Artificial grass supply and installation costs.

And should be:

- Experienced in the application of relevant standards.
- Experienced in the design and installation of artificial grass sporting surfaces.

- Independent of any one manufacturer/supplier/installer.
- Highly-regarded by people who have used their services.

Obtain a schedule of fees (and references) before engaging a consultant.

1.16 Environmental and Health Issues

In Section 1.11.1 (Open Space and fencing) of this guide a case is put that the installation of artificial grass fields can be an environmental positive because of the number of natural turf sporting areas that are freed up and the reduced level of sporting field maintenance/chemicals or pesticides that will be needed. The matter is described as a 'trade-off' where fencing might be necessary around an artificial grass field, but the benefits of the artificial grass field outweigh the negatives.

A deeper review of associated issues is necessary though given the questions that are raised by some community groups who are unsure about the short and long term impacts of artificial grass installation.

It is clear from the available research, that well planned, designed, installed and maintained artificial grass facilities provide significant community benefits.

Some of the more significant considerations are:

Loss of natural environments

The amount of land that is being taken up by artificial grass sporting field installations is very small in relation to the amount of sporting openspace that is provided. Population growth and restrictions on the use of water in many localities has resulted in a reduction of sporting openspace. Safe, accessible sporting surfaces are essential for younger people to be able to be active and engaged, and artificial grass is now providing a viable alternative to traditional grass surfaces.



Bowling Green - Donvale

Water use reduction

Several things are currently happening in this area:

- A number of water-dependant en-tout-case tennis courts are being replaced with synthetic clay or other similar surfaces that do not require watering.
- Elite level artificial grass hockey pitches that need to be watered to play on are likely to be phased out as soon as a dry carpet can replicate the required playing conditions. Several trial surfaces are now in place in Australia and are being monitored, hoping to overcome this need for large quantities of water.

While watered carpets were cooler to play on than unwatered, thereby responding to the issue of player comfort, there are now artificial grass products (unwatered) being marketed that claim to have much lower levels of heat retention/reflection (refer to item overleaf).

Water harvesting from artificial grass sporting areas

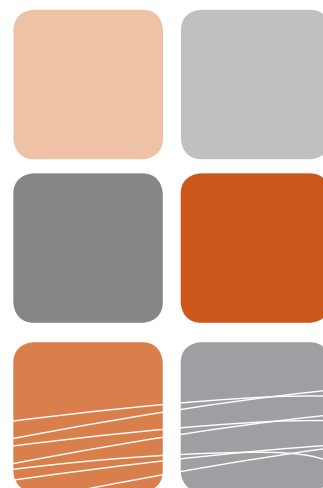
There are a number of reports available (prepared by leisure service consultants and sporting bodies) that have investigated issues around harvesting water run-off from artificial grass sporting surfaces, for re-use on site or locally.

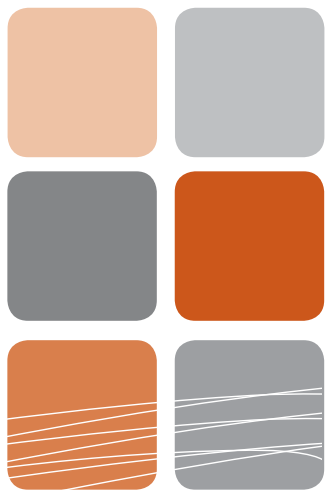
In brief, the water run-off from large artificial grass sporting areas can be of a significant quantity, to the point where storing it in large tanks requires a large capital investment and therefore often becomes economically unviable. Where it can become more financially viable is where there is an adjacent natural holding area – dam, wetland or lake - although these options still require significant additional investment into piping, pumps and filtration equipment.

An alternative way of creating a holding dam underneath the surface is noted in Appendix 2 (Ivanhoe Grammar School).

Heat retention/reflection

Exposed artificial grass surfaces do not absorb heat as well as well maintained





grass surfaces, but do so better than bitumen and many ungrassed areas. This heat retention or reflection has long been known, particularly in the sport of lawn bowls where players are often older, and to whom heat is a more significant issue. The issue has arisen again with the rapid uptake of third generation long-pile carpets with their infill of heat-retaining rubber crumb.

Recent local research for the AFL and Cricket Australia, suggests that: 'in hot conditions an artificial grass sporting area can be up to 40% hotter than a natural turf field, although this increased heat dissipates quickly on a windy day.'¹⁴ This research also highlights that children are far more at risk from heat stress than are adults. The option of having heat policies in place at least for junior participation on artificial grass surfaces to mitigate this risk is a key consideration. Note that some overseas companies are already marketing products that they claim store or reflect less heat – refer to Section 1.17 (Current Product Developments).

Rubber granule Infill

Most rubber granule infill material is produced from recycled tyres. The suggestion that toxic materials can leach out of the infill rubber has been investigated over recent years with no evidence found to date that contaminated 'leaching' is occurring.¹⁵ Conversely, there are reports available that compare the run-off into waterways from natural turf fields (that contain chemical fertilisers and pesticides), which compare poorly with artificial grass field run-off where the run-off will be of better quality.¹⁶

Other research reveals that the release of heavy metals and other substances as fibres wear is well within environmental standards, is considered safe in the air and on the turf surface, and that the levels of take up of these substances through breathing, ingestion and body contact is also small and does not present a health risk.¹⁷

It can be argued that the use of recycled tyres is in itself environmentally friendly because it reduces the quantities of worn tyres that are scrapped and sent to landfill each year (a large artificial grass field can contain approximately 120 tons of crumb rubber or 26,000 recycled tyres).

Lead in yarn

In the early years of artificial grass production there was evidence of lead being used in yarn production, but it is believed to be a rare occurrence currently. It is advisable, as part of the tender process, to insist upon suppliers that all materials must be lead-free.

Less greenhouse gas emissions?

Up until this point in time, there would have been a normal expectation that natural turf fields had less negative impact on global warming than artificial grass fields. In large part this would be because of the role that trees and grass play in the carbon sequestration process, a process that relates to the potential of grass sporting fields to remove carbon dioxide from the atmosphere and store it in the soil as organic carbon.

Recent research from the University of California (UC) at Irvine¹⁸ draws this assumption into question. Their research identifies a marked difference in the performance of ornamental lawns in parks as against that of sporting areas regarding carbon sequestration. Ornamental lawns require very little maintenance and can go 'untouched' for many years (therefore enhancing the carbon retention in the soil). Active sporting areas require constant maintenance, much of it (aeration, etc) which can expose the carbon to the air.

In addition to the carbon retention issue, the UC research makes reference to nitrous oxide emissions which can emanate from natural turf area, caused by the use of fertilisers, particularly inorganic fertilisers.

Disposal of used products

For cost reasons, as well as environmental ones, it is incumbent

¹⁴ 'Development of Standards for the Use of Artificial Turf for Australian Football and Cricket' (University of Ballarat – 2008).

¹⁵ 'An Assessment of Chemical Leaching, Releases To Air, and Temperature At Crumb-Rubber In-filled Synthetic Turf Fields' New York State Department of Environmental Conservation, May 2009

¹⁶ 'Environmental and Health Assessment of the use of Elastomer Granulates (Virgin and from used tyres) as infill in Third Generation Artificial Turf' Ademe/Alapur - Fieldturf - Tarkett Publication.

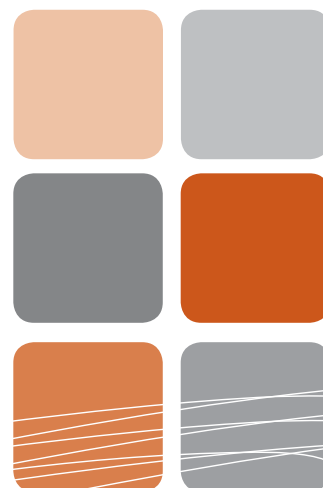
¹⁷ 'Hazardous chemicals in synthetic turf materials and their bio-accessibility in digestive fluids'. Zhang, J, Han I. Zhang L and Crain W. (2008). Journal of Exposure Science and Environmental Epidemiology, Vol 18, No 6.
'Environmental and health assessment of the use of elastomer granulates as infill in third-generation artificial turf', EEDEMS.
'Air quality survey of synthetic turf fields containing crumb rubber infill'. Vetran, K. (2009).

¹⁸ 'Carbon Sequestration and Greenhouse Gas Emissions in Urban Turf' (2010) University of California (Irvine). Published in: Geophysical Research Letters (USA) Vol 37

on clubs or schools to try to re-sell or recycle used synthetic turf wherever possible. It can cost in excess of \$30,000 to have a sports-field's artificial grass carpet lifted and disposed of to land-fill, whereas there are often community members or groups that can utilise used carpet and pads effectively. A key removal issue with sand-filled carpet (particularly if damp) is the weight of the product and the heavy lifting and transporting equipment required to shift it.

In the UK, obsolete artificial grass carpets are sometimes used as fuel in

kilns and furnaces, while used carpet infill is the subject of testing to find better ways in which it can be removed, cleaned and re-used.



1.17 Current Product Developments

For research results related to field playability and injury prevention, go to Section 1.8. The research referred to in this section (1.17) relates to the suitability of playing surfaces for their particular sport.

One of the constants in the artificial grass industry is the continued search for new and better products. In Australia this is highlighted by the development of an artificial grass carpet that can be used for Australian rules football in winter and cricket in summer, but local companies are also at the forefront, testing hybrid unfilled water-free hockey carpets, plus other developments. Interesting areas of research and development for artificial grass sporting areas include:

An artificial grass carpet for Australian rules football/cricket

Climate change and ongoing drought conditions in Australia have forced these sports to seriously look for a compatible synthetic surface. The advent of third generation long-pile carpets has also opened up possibilities for other contact sports to use artificial grass for their sports.

In 2008, the University of Ballarat completed a research and specification development exercise that called for a new artificial grass product tailor-made to match the game characteristics of Australian rules football and cricket. Key issues for these sports include specific play characteristics, critical fall height, abrasion, hardness, rotational traction, ball rebound and roll, player impact forces and also more generic issues such as cost, heat retention or heat reflection, injury rates, water collection and product durability.

At the time of writing, the first approved product is being installed. The carpet is nominally 40mm high, filled with sand to approximately half the height. It sits on a shock pad that is 23mm thick. Variations to this exact system will no doubt follow.

Common systems for Australian rules football and soccer?

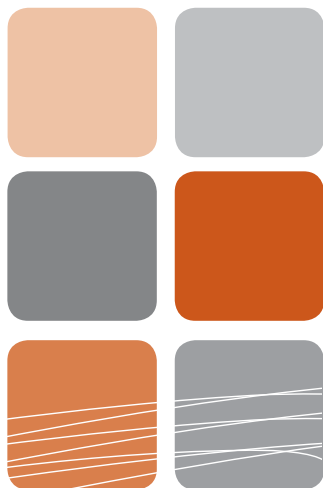
There are many common characteristics about the artificial grass turf systems that have been approved for soccer and Australian rules football, (see table 1, page 38) along with some key differences. The principal difference is in the method of providing shock absorbency, with soccer pitches generally having rubber granule infill within the carpet fibres (with or without a shockpad), while the Australian rules football specification prefers just the shockpad.

At the time of publication though there appears to be developing recognition (1) in Europe of soccer and rugby pitch systems that are similar in construction (shock pad under the carpet) to the approved Australian rules system, (2) and of the use of coloured rubber granule infill for Aussie Rules fields.

Cooler artificial grass carpets?

In the case of summer sports, surface heat reduction is a key design criterion. Over the past decade the incursion of artificial surfaces into lawn bowling has been impacted by the increased playing surface heat reflection. For cricketers, with their extended playing time taking place during the hottest months of the year, this is an issue.

European yarn manufacturers are marketing yarns which they claim



incorporate technology that reduces surface temperatures by up to 35% when compared with regular synthetic turf fields (the first installation of such an artificial grass soccer surface in Australia of this type occurred in Melbourne early in 2010). In the marketing material for one of these products, the claim is made that the product 'dissipates heat into the atmosphere instead of absorbing heat into the yarn, resulting in a lower surface temperature when exposed to sunlight.'

Such advances in technology, if successful, will enable more sports to use artificial grass in warmer climates, hopefully reducing player impacts such as heat stress and rapid dehydration of users.

Rounder sand

Rounder sand particles (same size) are now being used in Australia on artificial clay tennis courts, with the intention of providing greater longevity from the porous infill layer. Traditionally specified sand granules can compact significantly over time adversely affecting vertical drainage.

Teflon coated sand

Some of the rounder sand types referred to above are also coated with a type of teflon to further enhance vertical drainage through the sand infill layer. Several Australian companies are currently experimenting with the development of similar materials.

Different colour rubber granules

Due to the heat-retention properties of black rubber granule infill, and the sometimes darkened nature of the surface, alternate colour rubber granules are now being developed and used. Note though that the longevity/durability of coatings applied to SBR (Styrene Butadiene Rubber - a major component in artificial grass infill systems) is generally unproven at this point in time.

Unwetted carpet for high grade hockey

Due to climate change and the vulnerability of water resources in substantial parts of the world, the International Hockey Federation has called for the development of a playing surface that can be played on dry, which will still produce the playing characteristics required for elite level competition.

Earlier generation watered fields (nylon or polypropylene) cannot be safely played on 'dry' because shoes stick

to the surface and there is an absence of the surface conditions that allow for controlled 'slip', rotation and slide. Also, the ball bounce can be affected, with drier fields likely to lead to higher bounce with potentially more risk.

Prototype carpets (high-density, low-pile, unfilled) are now being played on in several locations around Australia, and the hope is that they will meet the required specifications.

Artificial grass for athletics infields

Several companies are now manufacturing extra long-pile carpets (typically 80mm or so with, say, 60mm of sand or rubber granule infill material) that are being marketed as ideal for athletics field games, i.e. discus, hammer, shot put and javelin throws.

Sophisticated water harvesting/storage systems

Sophisticated water storage systems, are being developed and trialled that allow the capture, and often re-use, of significant water volumes. Seek expert opinion regarding water harvesting and storage systems.

Refer to Appendix 2 of this publication (Ivanhoe Grammar School) for information regarding a unique underfield water storage system.

Horizontal drainage via a void space under the shock pad.

In mid 2010, several fields were built with a void space beneath the shockpad and the base. Each were created by laying an interconnected layer of typically 30mm high open-cell plastic panels all over the field.

The hollow space within the panels (strong enough to take carpet rolls and required machinery) allows water to flow horizontally to collection channels and pits. This is an alternative to vertical drainage and the potential differential settlement that sometimes occurs on fields that have buried drainage pipes.

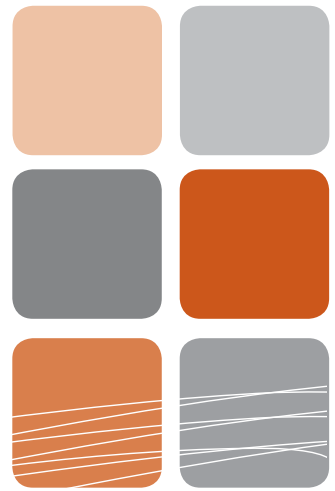
Organic Infill

A developing alternative to rubber granule infill is the option of organic infill, such materials being of plant origin. Able to be re-cycled, these infill types are said to keep the median temperature of artificial grass pitches lower than that of pitches with rubber infill. At the time of publication, the first soccer pitch in Melbourne featuring organic infill had been completed.

2.1: Introduction

The construction of a new sporting facility from initiation through to completion is a long and involved process. Although there is a lot of good documentation available that presents project planning from an engineering or project management point of view, the process outlined here

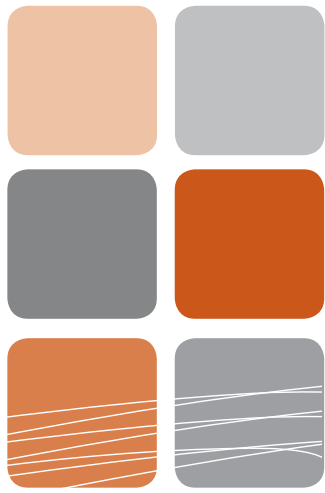
emphasises even greater effort being exerted at the early investigation and forward-planning phases. This is a detailed planning process and is geared towards larger scale projects, but a similar process (although less extensive) is also advocated for smaller projects.



Victorian State Netball and Hockey Centre

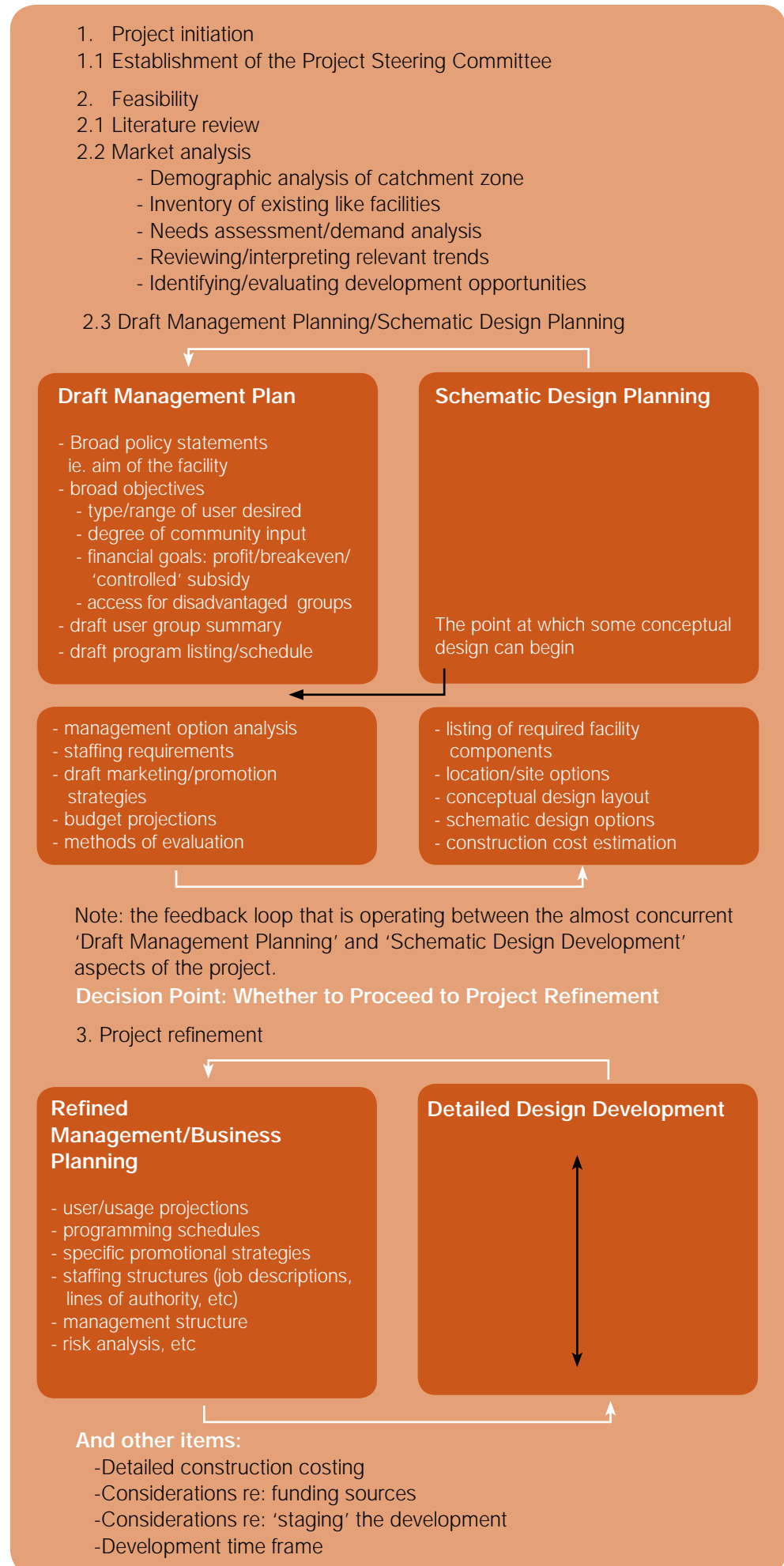


Men's Lacrosse



2.2: Leisure Facility Planning Process

Figure 2: The Leisure Facility Planning Process



2.3 Explanatory Notes

Introduction

The numbering of items for the following 'explanatory notes' corresponds with

the numbering shown in 'Figure 2' (p57) 'The Leisure Facility Planning Process'.

Item 1.1 Establishing the Project Steering Committee

Facility development projects with good design, usage and management outcomes are generally characterised by the guidance of skilled, diverse project steering committees. Good facility planning and design requires expertise over a range of skills and disciplines (refer to table below).

As has been emphasised in Section 1.15 (Professional Support) for large and medium sized projects, it is suggested that there are significant benefits in bringing experienced, proven artificial grass project expertise onto a project steering committee.

Particularly where the club representatives, council officers, school council representatives or staff are relatively inexperienced with this type of project, the group will not want to be left unsupported in its attempts to review the offerings of the artificial grass suppliers/industry, the usage of the civil contractors, and the crucial workmanship of the shock pad and artificial grass carpet layers.

An example of the make-up of the Project Steering Committee is listed below:

Engineering/project management	Team co-ordination, council liaison, co-ordination of the 'brief', control of consultancies, etc
Architectural	Design detailing, cost advice, etc.
Recreational planning	Market analysis, community liaison, etc
Facility management/design, etc.	Draft management planning, design input.
Existing operators/users	Experienced voices re: design, usage, and management.
Parent body support	Some sporting bodies have in-house expertise in facility related project development
State Government Sport and Recreation offices	Have available expertise/resources from many previous similar projects
Funding body representative	Generally a funding requirement

Table 7 - Sample Project Steering Committee

Item 2.1 Literature Review

This involves review of any previous documentation that might aid the planning of the new facility.

Item 2.2 Market Analysis

The components of a market analysis study can vary slightly depending on the project at hand, but some of the basic areas needing to be covered include:

Demographic analysis of the catchment zone.

This information is often readily available from the local council. Issues to consider are particular community characteristics that might affect the location, programming, marketing, management style, etc of the facility being planned.

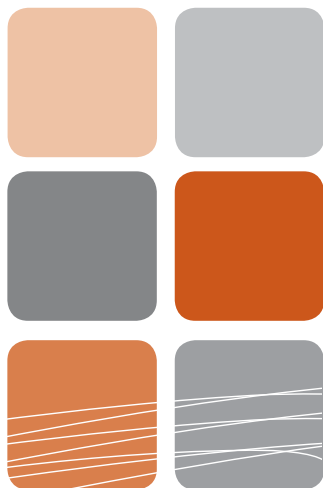
Inventory of existing artificial grass pitches, courts, fields etc.

What is already available locally, and in the region generally?

Needs assessment (i.e. community surveys, demand analysis, etc).

Community involvement in the market analysis is essential both for the information that will be received and also for the interest and ownership of the scheme that this process generates. While professionals involved in the project's development might have strong hunches as to the community's needs, it is important to ensure we understand the range of community opinions. As well as creating a sense of involvement, this consultation might uncover some interesting ideas or an interaction that will improve the project planning.





Reviewing/interpreting relevant trends.

The market analysis needs to include a review of relevant trends in terms of participation patterns, as well as trends in like facility design and development.

Identifying/evaluating development opportunities.

This phase may also incorporate some preliminary location and site analysis. It is, combined with the draft management planning exercise, one of the keys to good feasibility study work.

Item 2.3 Draft Management Planning and Schematic Design Development

As is shown in Figure 2 (page 57) it is vital to develop an interaction between the management planning and schematic design planning areas of a project.

For many projects only a single project steering committee exists, so the requirement is to ensure:

- Expertise in facility management and facility design represented.
- Development of a relationship that allows constant interplay between these disciplines. Only then can a 'design for operational efficiency' be achieved.

If your project has separate working parties for: a) draft management planning and b) schematic design, ensure the active working of a feedback loop (refer to figure 2, page 57) between the two groups.

There are two key elements to keep in mind with this structure:

- The preliminary draft management planning exercise should proceed first that is the development of some broad policy statements, some draft user group analysis and some draft programming schedules.
- Only then should an architect or draftsmen be allowed to begin doing any preliminary drawing. Producing concept drawings earlier in the process tends to lock in people's thinking to a particular design rather than pursuing the development of the absolutely best possible brief that will guide the design process.

At the completion of the draft management planning tasks the following should be known:

- Policy statements to guide the general planning for the facility.

- Who the facility is being designed for.
- What programs will be provided for the users.
- The physical spaces and preferred surface type required to be able to conduct the programs.

For the detailed analysis of potential sites for a facility, and the location of the facility at the site, see Section 3.1 (Site and Location Analysis).

Item 3.0 Refined Management Planning and Detailed Design Development

At this point those planning the project are aware of the type of facility that their client and/or community wants, have a reasonable estimate of its capital cost, preferred locations and the likely budgetary position of the facility for its first few years of operation. They are well placed to determine whether the project should proceed to its next stage of development.

Should the project proceed, a strong feedback loop again needs to operate between those working on the detailed management planning and the detailed design development.



3.1 Site and Location Analysis

3.1.1 Site Selection

The greatest risks and uncertainty arise from site ground conditions, so although selecting the best possible site for a sporting facility can sometimes be a complex task, it is always a vitally important task. Residential amenity, access, land stability, availability of services, etc, are just some of the factors that will affect the suitability of the site, and the cost to develop it.

Selection criteria include:

- Siting within or adjacent to school grounds can significantly enhance the daytime use of the facility.
- Siting within a sporting facility precinct can both reduce costs through the utilisation of existing resources within the reserve (i.e. pavilions, car parks).
- For facilities such as a shared, multi-use artificial grass pitch, choosing a site that is independent of particular clubs can enhance access and allow for alternative and/or more suitable management options.
- Relatively flat land can help reduce construction complexity and cost. On a flat site it is easier to remove topsoil and find solid ground. Natural ground is usually stronger than fill (when the soil is undisturbed) as a base for an artificial grass sporting facility.
- Sheltered locations away from exposed terrain can be advantageous (watch for significant over-shadowing which can lead to algae growth due to constantly moist conditions being maintained).
- Avoid sites closely surrounded by trees due to the potential long-term problems of invasive roots, and of surface moss caused by overhanging branches and leaf litter.
- Proximity to public transport.
- Adequate room for a fully dimensioned facility, including desired run-off allowances.
- Space for future expansion.
- Access for construction and maintenance plant or machinery (and storage of plant and pitch furniture).

- Seek sites where service installation (electricity, drainage, etc) will not be prohibitively expensive.

3.1.2 Locating the Facility on the Preferred Site

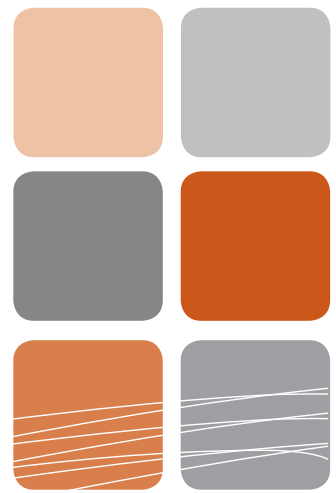
Factors that need to be taken into account include:

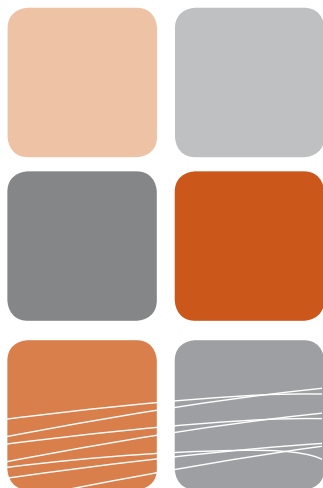
- Ease of access for players, spectators, maintenance and emergency vehicles.
- Proximity to the pavilion and support facilities.
- Location of the facility so that necessary floodlighting will not lead to planning restrictions because of residential amenity issues.
- Orientate the pitch so that ideally it is north-south facing to avoid low sun glare.
- The location must be accessible via a suitable, well-lit pathway(s) running between the site entrance, the changerooms and the car parking area. Well located pathways are essential to avoiding dirt being carried onto the playing surface via players' footwear.

3.1.3 Engineering Investigations of the Site and Location

Design and construction costs are obviously more expensive for sites with difficult ground conditions, so every effort must be made to avoid such sites (if possible) or at least to fully understand the site so that appropriate facility substrate design or ground stabilising works can be undertaken. This investigation phase can require some expense (typically up to 1% of the project cost in some cases), but can greatly reduce the risk of unforeseen problems (such as increased costs).

It is critical in this early stage that sufficient resources be allocated to site and location research so a thorough investigation of levels, geotechnical conditions (the nature of the sub-soil with regard to load-bearing capacity, porosity, summer and winter water table levels and liability to movement), and the locating of underground services (gas, electricity, water, etc) can be determined.





The designer also requires knowledge of the weights and types of plant to be used at the facility during construction or subsequent maintenance (i.e. floodlighting). From all of this accumulated information the designer can determine the required depth and type of base, drainage system, porosity resolution, etc. It also enables far more accurate project costing to be determined.

Top Tip

Utilise a qualified and experienced engineer to both commission the site investigation and also design the facility. If a contractor is to undertake this role, make sure that the 'terms of contract' is clear on required site investigation and analysis.

3.2 Statutory Planning Issues

Statutory planning issues need consideration early in the process. Planning permission may be required for the installation of a artificial grass sporting facility, fencing and floodlighting. It is therefore recommended that the planning department at your local council be approached early to discuss broad siting and orientation issues, but also items such as:

- Fencing: design, height, colour.
- Floodlight poles: design, height, number, location.
- Floodlights: number; luminous intensity; light spread, glare and spillage outside of the playing area.
- Use: intended hours of operation.
- Noise: Expected increase in noise generation.
- Vehicle movement: onto or off the premises.

Potential means of addressing planning issues include:

- Floodlighting poles: can be painted to match surrounds, height can be increased or reduced, tree lines can be planted.
- Floodlight spillage: to lessen the impact of glare and light spill more specific lighting can be selected, as well as having fittings more specifically targeted to a pitch or court through the attachment of baffles to the fittings.
- Noise: evening sporting activities (community level) particularly in winter, attract few spectators. Regardless of this, a sensible time will need to be negotiated for 'lights out'.
- Security of the facility. Supervision should reduce excessive noise and 'out of hours' usage.

3.3 Preferred Form of Construction (Sub-Base, Base)

Utilising all of the information collected in the review of previous drawings and reports pertaining to the site, plus the data from new investigations (topographical survey, geotechnical report, drainage studies, etc), the designer is able to determine their recommended form of construction from sub-base level up to and including any carpet and infill (refer Section 1.1 – Indicative Construction Profiles).

3.3.1 Baseworks Criteria

For outcomes such as longevity and serviceability (drainage performance, etc.) it can be said that base construction is as much a part of the total surface system as the surface material and underlay. Based on good geo-technical advice, the sub-grade and the base-course beneath an artificial grass sports area should be capable of the following:

- Supporting the loads of all vehicles, plant, machines and materials to be

used in the construction (without any excessive deformation being caused).

- Supporting the loads on the playing surface from players and maintenance equipment (without causing any long-term deformation of the surface).
- Providing protection to the surface from the effects of ground water and sub-grade movement.
- Ensuring that the water (rain water or neutral groundwater) drains away freely either into the subsoil or a drainage collection system.
- Providing porosity and/or run-off through heavy rain, ensuring that the playing surface will not hold standing water for any length of time (often a risk versus cost issue).

Top Tip

An essential preparation for basework design and construction is the undertaking of a thorough geotechnical investigation i.e. the testing of the site soils to determine the types of soil and their variability, the soil strength, composition, water content, potential for drainage and its potential for shrinkage/swelling through drying/wetting and other important characteristics. This early site evaluation stage is an essential part of a proper earthwork/foundation design.



Graphic supplied by SAPCA - © SAPCA.org.uk

3.3.2 Construction Techniques

The methods and materials used for sports surface base construction are similar to road construction, with the exception of more detailed drainage design for the porous surface systems. In general, depending on the type and strength of the natural soils at the site (the 'sub-grade'), a sub-base is added to support construction plant and provide frost resistance, and then the upper layer is added which is typically either:

Bound:

- Mineral aggregates bound by spraying with a binder (bitumen emulsion or tar) after laying. Sometimes called semi-bound.
- Mineral aggregates (rubber, occasionally cork and polyurethane foam) bound by polyurethane binders. Usually 35mm to 50mm thick. Adds shock absorption to the construction.
- One or two layers of mineral aggregate pre-mixed with a binder (bitumen, tar). Normally a two-layer system in between 55mm and 85mm thick.

Unbound:

- Mineral aggregates (crushed rock, gravel, sand, lava or a mixture of these with rubber). May have a geotextile membrane above and/or

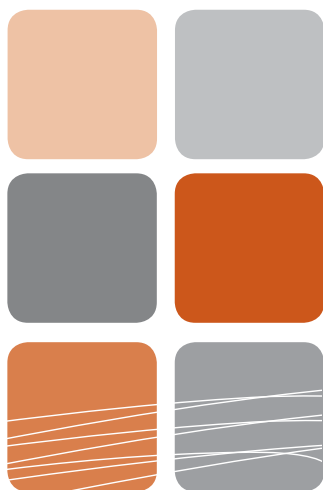
below it. The selection of grade of stone and the degree of compaction will have a significant effect on the eventual playing characteristics of the surface.

Top Tip

A bituminous bound base is often called an engineered base, and an unbound base is often termed a 'dynamic' base. These terms can be confusing as both need to be 'engineered' i.e. designed properly. A bituminous bound base is harder than an unbound base, but will not move in the long-term, whereas an unbound base may need to be rolled and regraded during replacement of worn surface carpet systems.

The construction methodology is generally:

- Excavate down to a firm, load-bearing strata.
- Identify and replace any 'soft spots' with hard, non-degrading filling.
- Install drainage, either beneath the pitch or around it. If installing beneath the pitch, back-filling of trenches must be thorough so as to avoid subsidence and difficult or expensive rectifications.



- Lay and compact the sub-base. Normally a crushed stone, but can be re-cycled material, i.e. a clean crushed brick or crushed concrete. Normally between 150mm and 225mm in depth (Note: Special arrangements may be necessary with softer or more plastic clay sub grades).

In such cases the sub-base may need to be designed to minimise the effects of movement of the sub-grade due to seasonal changes in moisture content in the clay.

Unbound versus bound:

Unbound bases tend to be cheaper than bound surfaces and more yielding. Their disadvantage is their lower standard of dimensional stability (remembering that the greatest risk of pavement failure is movement of the sub-grade due to seasonal variation). Unbound bases demand very good site control and quality assurance to ensure good long-term behaviour.

Top Tip

Bituminous 'prime' spray seals come in many varieties/standards.

Ensure that you know exactly what you are getting, and ensure

(via this being a designated witness/hold point) that you get what you are

paying for – see 1.13.1.4 and 1.13.1.5 for advice re: checking work undertaken.

3.4 Artificial Grass Selection

3.4.1 Role of a Sport Surface

In general, sport surfaces need to deliver three key outcomes:

- To provide safe provision of player movement, player interaction and ball interaction – at an appropriate level of performance to the level of activity or competition required.
- To maintain their performance to an acceptable level with regard to use, climatic effects, and over an appropriate period.

- To be cost effective (including maintenance costs) and manageable.

The tests conducted to check for player-surface interaction measure factors such as hardness, traction and friction, while for ball-surface performance, characteristics such as bounce, roll and spin are measured. These test data must conform to the published sports standards for a specific sport or for multi-use (refer Section 1.6).

3.4.2 Choosing the Surface

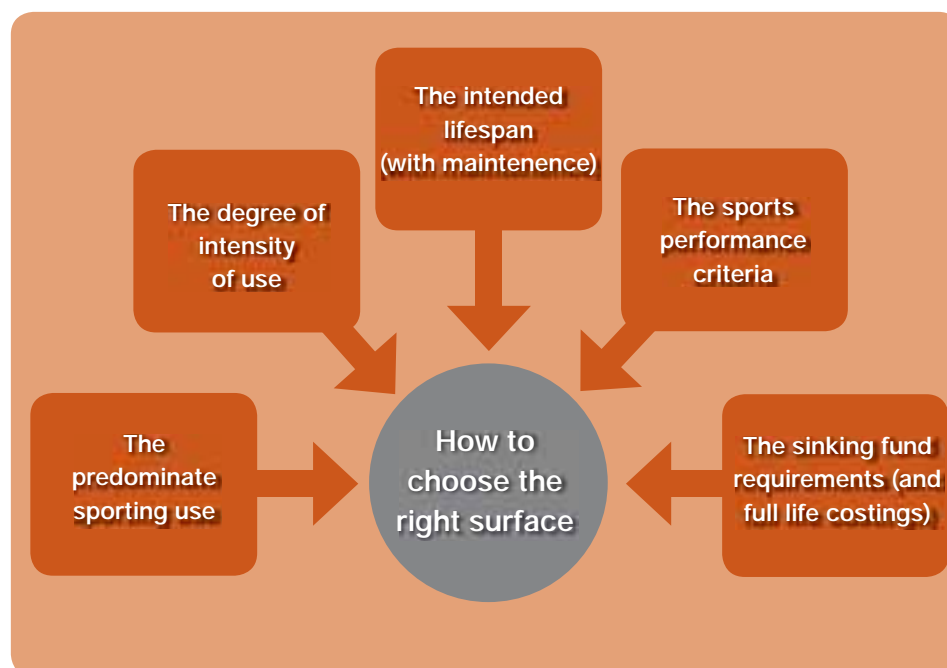


Figure 3: Choosing The Surface
Graphic supplied by SAPCA - © SAPCA.org.uk

Some of the key factors to consider when choosing the best surface are:

- What will be the predominant sporting use(s)?
- What level of performance is anticipated (i.e. international level competition, community level)?
- What is the expected level of intensity of use?
- Assuming appropriate maintenance is carried out, what is the desired lifespan of the surface system?
- From the business plan (in particular the lifecycle costing exercise – see Sections 1.10) what standard of facility can you afford to build, operate, amortise? For example, do you need a likely lifespan or income generating period of 12-15 years from a sand-filled carpet, or can you afford the slightly more player-friendly sand-dressed pitch which may only last eight years?

And once the type of carpet is determined, consider the following in regard to specific products or suppliers:

- Does the product have a license issued by the governing body, relevant for use at the level required for the project (eg. FIFA 1 Star, FIFA 2 Star, FIH Global, AFL/Cricket Australia).
- Has the supplier installed this type of surface in Australian or similar climates before? (Perform reference checks re: the product and the installer).
- Do the specific staff who are undertaking the installation have appropriate experience?

Top Tip

Have the contractor supply the above-mentioned information at the tender stage.

3.4.3 Artificial Grass Types

Section 1.5 of this guide provides a clear description of the types of artificial grass that are produced for sport, and the infill products that can be used. The table at Appendix 8 provides a good visual presentation of the different artificial grass types.

3.4.4 Seam Jointing

Proper initial jointing and the speedy repair of subsequent problem areas are imperative to maximising the lifespan of a facility. Undetected or poorly treated seam failure has been known to end the useful life of an artificial grass surface well before the lifespan of the carpet system should have lapsed.

Jointing occurs where two rolls of carpet (usually between 3.66m and 4.5m wide each) are joined on site, by using a backing tape (approximately 300mm wide) underneath the butted joins of two adjacent carpet strips. Both edges are glued to the backing tape to form a continuous seam, which generally must cross the width of the field. Note: The stitching of seams is still undertaken with some products overseas, but is rarely undertaken in Australia.

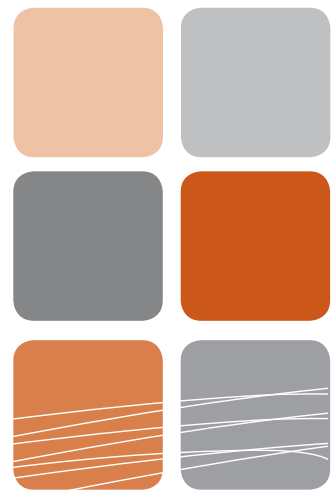


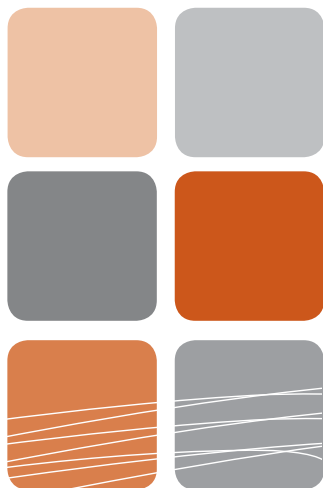
Seam trimming and gluing

Obtaining the maximum possible joint strength is essential, so best practice methods must be observed through this phase of work. Key elements include:

- The selected jointing tape must be high-quality and wide (minimum 300mm for seams, wider for line insertions).
- The tapes must be laid so the seams or inserted lines join centrally along the tape. Joint integrity is compromised if one of the carpet edges is fixed to less than 50% of the backing tape.
- The application of adequate pressure to the bonded seam while the curing of the adhesive takes place.

Be aware of problems that can or will occur applying adhesives in adverse weather conditions, for example wind, rain, humidity and impacted





drying capacity (some high-quality two-pack polyurethane glues require dry conditions for best use – in the atmosphere and on the materials used – to form strong bonds).

Note: Joint seam strength is included in many sport 'standards' for artificial grass surfaces as a test for product acceptability.

Top Tip

Tolerance levels related to the join between two rolls of carpet are important to final appearance and performance of the finished system. Leading companies offer clients detailed documented standards in this area.

Top Tip

Weather can be a key influence on seam quality. Ensure that you ask up-front about all of the adhesives that are going to be used on your project. Some adhesives (specialised, very expensive) can be utilised in wet conditions, while others require absolutely dry conditions. Understand which are being used on your project, and when, and monitor very closely that dry weather glues are not being applied in moist/damp conditions.

Top Tip

Each of the sports has certain areas on their courts/fields where greater activity, and therefore greater wear and tear, occurs. Enquire as to whether the field/court linemarking at that point of the field/court can be produced within the middle of a carpet role so that a seam-free zone can be created in the high-use area. This has been done effectively at the top of the goal-scoring circle in hockey (by some companies).

The issue of what glues are used, and how they are used, are also vital ingredients in joint strength. As an example, the first few sand-dressed hockey pitches installed in Victoria have exhibited minor seam failure in key areas within two years of installation.

In response to this, installers have changed from using latex glues to more expensive, but much more effective two part polyurethane glues.

When considering artificial grass systems, ask questions of potential suppliers related to their exact gluing processes:

- What types of glues do they use?
- Where do they use these glues (some installers use polyurethane glues around the high-use areas, but cheaper glues elsewhere)?
- Understand how each surfacing option being considered works:
 - Is the carpet connected to the shock pad? And if so, how?
 - What is a loose-laid system?
 - At the seams (generally 3.6m apart), what gluing method is used between the pad and the carpet?
 - What is the impact of this gluing method on the ability to remove a carpet at the end of its useful life, and re-use the shock pad?
 - What is their policy regarding installing their product in various weather conditions?

Top Tip

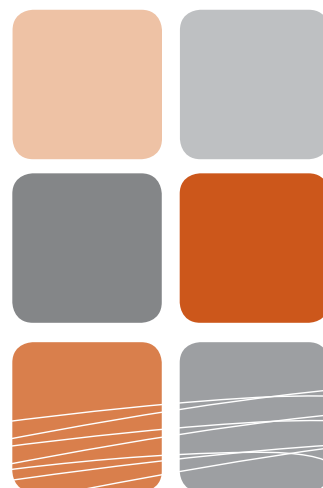
Did you know that rolls of carpet need to be rolled out flat for a minimum period of time before installation? This is done so that flattened or twisted sections (flattened in the rolling/transporting process) can regain proper shape before installation begins.

Top Tip

As well as ensuring that the right glues/backing tapes are being used, it is equally important in determining ultimate seam quality that you select an installer with proven performance technique/methodology. The best guide to this is to check bidding companies previous work (particularly their oldest installations), and also the length of their installation (workmanship) guarantee.

Top Tip

In extreme cases, seam failure can end the life of a carpet system well before the use-by date of the product is reached. Put a lot of planning time into determining which glues, and which seam jointing processes are best for your project's long-term lifespan. Also check the potential installer's record over a long period in terms of seam performance: How many of these surfaces have they installed over how many years? Does the surface manufacturer endorse and support this company's seaming methods and materials?



3.5 Shock pads

An excellent description of shock pad options and quality is provided in the publication 'Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches' prepared by the UK-based 'Sports and Play Construction Association' (SAPCA)¹⁸ which states:

'The introduction of a resilient layer between the base and the synthetic turf is used to provide a degree of comfort to players and to create defined performance characteristics and safety requirements for specific sports. Its correct design may also help systems to meet the required playing characteristics over longer periods of time. There are a number of ways of achieving this resilient layer, with assorted laid in-situ shock pad systems, prefabricated rolls or tiles of prefabricated material. In the case of in-situ systems the components are mixed on site and laid to form a continuous layer of material.'

3.5.1 Pre-formed Construction

Pre-formed rubber pads or rolls

The type and thickness chosen will be dictated by the priority sport, although several different options may be able to provide a surface that complies with the requirements in terms of playing characteristics.

Flat rolls generally have a thickness in the range of 3-15mm.

Carefully consider 'dimpled' (egg box type structure) pads. Experience shows that horizontal carpet movements relative to the shockpad are more likely with this system, causing rucks or tears, unless steps are taken to anchor both the shock pad and carpet.

Rolls are usually 1.25m in width. Lengths vary depending on thickness, but are normally between 25m and 35m but can be supplied in any length up to 65m if needed.

Rolls of shock pad may be laid perpendicular or parallel to the subsequent rolls of artificial grass carpet (perpendicular is more likely to remove any coincidence of joints in the carpet and shockpad occurring). Whichever arrangement is used, it is important that all rolls should be laid straight and true with the minimum of distortion. Head joints (i.e. joints at roll ends, not sides) should be staggered by at least 1.0m across the surface. Prior to head jointing, each roll should be allowed to reach its optimum length before trimming. No joints should have a variance in height greater than 2mm. All joints should be seamed and taped to prevent gaps appearing from movement of the rolls.

Other pre-formed materials

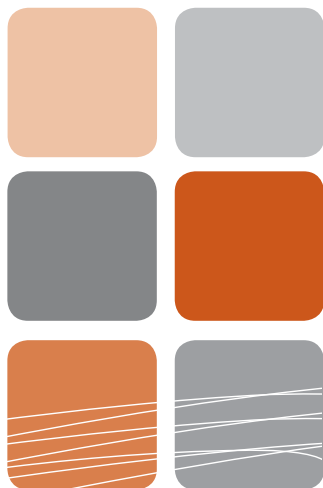
Several other forms of proprietary shock pad are manufactured, marketed and installed by contractors, all with their own individual properties and requirements for laying. These include pads of closed cell foam; nylon filament; needle-punched, expanded polyethylene or vertical fibre systems (some of which are combined with rubber granulate) pads which are an integral part of the carpet system; various designs of prefabricated mat and tile and so on. Careful evaluation of pre-fabricated systems and laying processes is essential when making comparisons between products.

Experience has shown that carpet and shock pad movements are more likely if the shock pad is not fully jointed or is not dimensionally stable.

Top Tip

'Integral' pads are bonded at the factory to the back of the carpet. Although capable of lasting longer than a carpet, integral pads unfortunately are lost when the carpet is worn out and removed.

¹⁸ 'The Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches' The Sports and Play Construction Association (2009)



3.5.2 In-Situ Construction

Shock pads constructed in-situ normally vary in thickness from 10mm to 35mm and consist of a polyurethane binder mixed with rubber crumb or shred. The thicker pads may also contain pea gravel or other small aggregates. The mix design of the rubber particle shape, size and grading, and the binder type and content create the desired properties of the combined system once installed and cured (i.e. binder setting).

The precise specification and laying technique will vary depending on the

installer and the priority sport. As with preformed pads, no joint should vary in height by more than 2mm and the completed mat should comply with the level of tolerance required of the finished installation. Samples should be taken for conformity with the specified density and tensile strength. Tensile strength has been shown to be a useful test for indicating expected durability (inadequate binder in the mix or variation in size range will affect the quality of the durability of the system).



Insitu Pad - Photo© Loughborough University; <http://sportsurf.lboro.ac.uk>

Top Tip

Whichever shock pad system is to be installed, a reference sample should be obtained at tender negotiating stage so that the installed shock pad can be checked for consistency of material.

Carefully monitored procedures and quality control checks should be in place to ensure that any variations in thickness of an in-situ laid pad do not affect the playing performance and compliance with the reference sample.

3.5.3. Other Shock Pad 'Issues'

Long-pile artificial grass fields (used for soccer, rugby, etc) usually use an infill in the carpet (rubber granules with or without sand granules) rather than, or in addition to, a conventional shock pad beneath the carpet. Because of the potential of infill materials compacting over time, disciplined attention to required maintenance regimes is essential in delaying this potential outcome. Note: Information is presented on the Sportsurf website <http://sportsurf.lboro.ac.uk> by ISA sport on long-term hardening of soccer fields (this is the subject of on-going research and development).

'Shared' surfaces such as the successful hockey/tennis model often found in school installations are an example of the need for compromises

in design. Although hockey pitches generally incorporate a 15mm pad under the carpet surface, a tennis court would normally have no shock pad at all. The compromise 5-8mm pad is the usual 'compromise' that best provides a surface that is close to the preferred playing characteristics for each of the sports.

Pre-fabricated shock pads have been known to shrink over time. Some hockey fields have been known to have developed a gap every metre or so (the width of the roll/row of rubber tiles running across the ground) there is a gap in the shockpad of 5mm or more due to pad contraction. Where this has happened, the carpet has sunken slightly and has been filled to playing level with sand – potentially

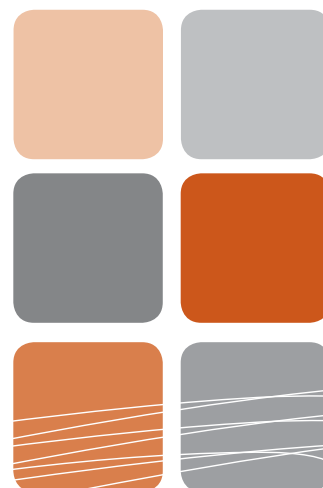
affecting ball roll and player footing. Questions to consider asking artificial grass manufacturers and installers include: "What were these 'shrinking' pads made of? Has the composition of the pads changed since then? How long will the pad size or stability be guaranteed for?"

Implications for future surface replacement: The immediate decision of pad selection or installation also



Evidence of shrunken shock pads

affects choices that will be made when the surface needs to be replaced or refurbished. The option of being able to re-use a prefabricated pad is attractive, but needs to be considered in the light of either of the issues raised above. An in-situ pad should last two carpet lifetimes, but can be damaged, especially at the glued seam locations, by machinery removing the old carpet. Integral shockpads that form part of the carpet manufacture have to be disposed of with the carpet and are most costly long-term for this reason.



Top Tip

With in-situ shock pads, the rough texture of the pad helps grip the underside of the synthetic turf carpet, minimising the risk of carpet creep or movement. Where carpet creep is a potential danger, responses could include ribbon bonding, anchoring or other means of carpet retention.

Top Tip

The advantages of shock pads laid in-situ include the lack of movable joints, and the ability to 'smooth out' or correct small irregularities in the planarity of the stone or bituminous base. Disadvantages include a dependency on workmanship and weather conditions at the time of installation. Large irregularities will mean a variation in shockpad thickness and this affects the test results for player surface behaviour – more than ball behaviour.

Binder content: Shock pads are manufactured (in a factory or on-site) from a mixture of rubber granules and a polyurethane binder (effectively a

glue). The percentage of binder applied has a substantial impact on the tensile strength of the resultant pad. See the chart below.

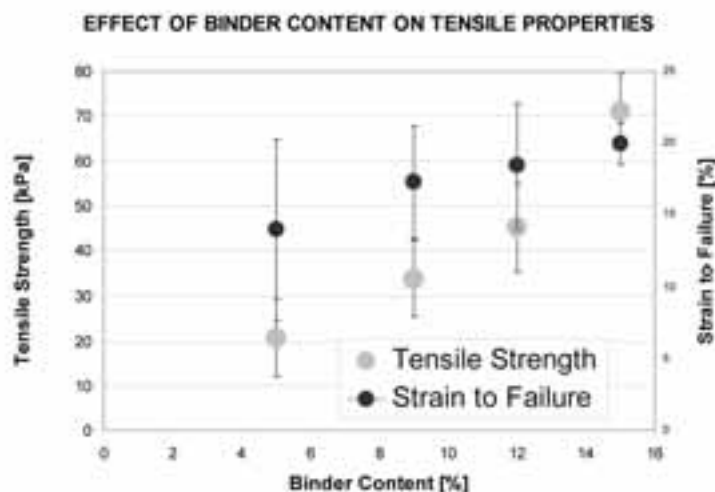
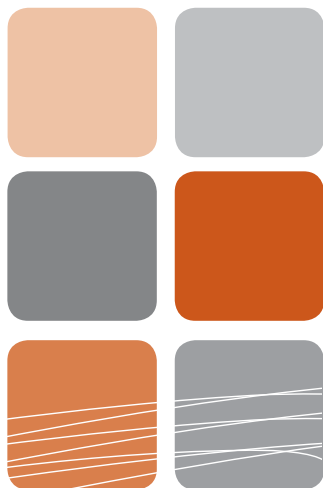


Figure 4: Effect of Binder Content on Tensile Properties
© Loughborough University; <http://sportsurf.lboro.ac.uk>



3.6 Drainage and Flooding Issues

Artificial grass sporting area constructions should always allow for the rapid drainage of water from the surface by either:

- Vertical drainage: A permeable construction that allows water to flow through the surface at a minimum rate of 100mm/hour into a drainage layer, or a piped system or a combination of the two.
- Horizontal drainage: A non-permeable system (on a free-draining site this is often just a simple perimeter drain around the outside of the playing area, with a gradient no greater than 1 in 100 in any direction).

3.6.1 Vertical drainage

The SAPCA Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches describes a permeable (sub-surface) system as follows (see Figure 3):

"A basic design will have lateral drains incorporated beneath the pitch, the spacing of which shall be determined by the composition of the subsoil and the designed infiltration and outfall rates. Spacing usually ranges from 5m to 15m. The ends of lateral drains should be capped to prevent contamination, and connectors should be used when joining lateral drains to collector drains. Collector drains should be located on the outside of the perimeter edging.

Perimeter drains (which may act as collector drains) should be installed at the toe of any embankments to prevent run-off from surrounding areas. Silt/inspection chambers should be constructed where perimeter/collection drains change direction, and the provision of rodding eyes should be included at the head of collector drain runs for ease of access for maintenance.

Drains usually consist of perforated plastic pipes, bedded on, and backfilled with, clean stone which should then be compacted (where drainage trenches run beneath critical grass sporting areas they must be properly back-filled and consolidated to prevent later subsidence, which would prove difficult and expensive to rectify).

No drains should have less than 150mm cover over the top of the pipe, and no drain should be laid to a fall of less than 1:200 unless advised by manufacturer's instructions. In certain sub-soils where silting-up may be a problem, a geotextile membrane may be used to line the trench prior to backfilling. The installation of a full-size synthetic pitch may disturb any existing land drainage and render it ineffective. Where existing land drains are severed they should be connected into the new perimeter drain".

A typical drainage layout for a synthetic turf pitch (not to scale) would be as follows:

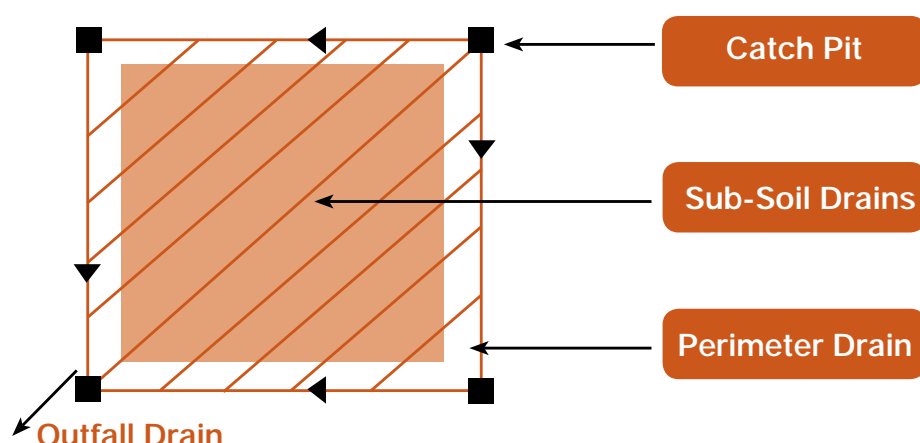


Figure 5: Typical artificial grass area drainage plan (Not to Scale)

3.6.2 Horizontal drainage

Non-permeable systems basically rely on a shaped ('crowned', elevated centre line, etc) pitch and a sealed base, thereby causing surface run-off to perimeter drains once the carpet and pad are saturated to full capacity.

This can also refer to pitches which have a consistent fall (say 1:100) to one or two sides. Even moisture levels can be an issue on large fields where outlying (flatter) areas are slow to drain.

3.6.3 Hybrid system

To overcome potential differential settlement over collection pipes, some projects are now considering an enhanced horizontal drainage system, one where a hollow plastic cell system

sits on top of the sealed base and beneath the porous carpet and pad. The cell system might be 30mm or so high, and strong enough to take heavy carpet rolls and machinery.

3.7 Concrete Kerbs

Top Tip

With relation to hockey field construction, consider the design of the concrete curb/upstand as a potential rebound wall. The curb need only be 100mm high (preferably higher for raised hits) with a 10 per cent incline to provide an effective rebound function for players warming up or learning to hit.



Rebound edging - Doncaster Hockey Club

3.8 Irrigation and Reticulation

Given the specialist nature of irrigation system design, most artificial grass sports area suppliers will seek outside design and installation advice for this element of their project. When required, in most cases this work relates to elite level 'wet' field installations for hockey.

While current experimentation might change this situation, current elite level 'unfilled' artificial grass carpets for hockey must be wetted for several reasons.

- To improve the frictional and traditional characteristics of the surface (reducing the possibility of ankle and knee injuries and minimising the likelihood of friction burns).
- To minimise the problems of static electricity build-up on players.
- To improve the playing characteristics of the pitch, such as ball roll.

There are four standard systems to consider for watering elite-level hockey pitches:

Static systems:

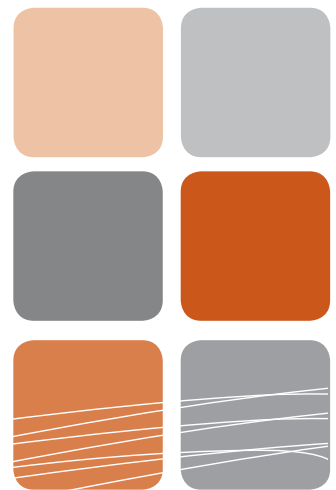
- Pop-up sprinklers – generally located in a row along the pitch edge and down the middle of the pitch.
- Rain guns/cannons – a perimeter only system, often with three cannons down each side, with each cannon able to throw water up to half the width of the pitch.

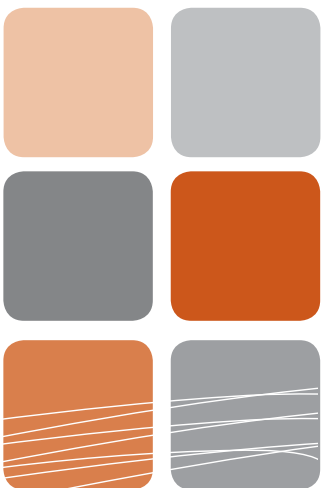
Travelling systems:

- 'Agricultural' spraying: a mini version of the agricultural equivalent, these overhead piping systems travel across a field propelled by water pressure. They are generally very slow and therefore cannot be used to 'top-up' during the half-time break. The weight of the unit is also likely to produce wear marks along the field.



Pop-up sprinklers (State Netball and Hockey Centre, Melbourne)





- Hand held hoses - a labour-intensive method, but the most cost-effective.

The most commonly seen irrigation system on elite hockey pitches comprises of six variable water cannons (adjustable arc and trajectory) fitted with intermittent dynamic jet breakers to influence uniformity.

Top Tip

In addition to the usually specified six cannon system (three down each side), an additional cannon or pop up sprinkler should be considered near each goal area. These would allow goal area only watering for when only that part of the field is being used (i.e. penalty corner practice) or a top up spray to this intensive use area on days of high evaporation. Request that your irrigation system be designed to isolate certain cannons/sprinklers so that smaller areas can be watered when that is all that is needed.

The SAPCA¹⁹ construction manual provides the following specific design considerations:

Rain Guns and Water Cannons

The rain guns will normally be fitted with a 27.5mm taper bore nozzle, which will deliver 66.73m³/hr at 5½ bars with a throw of 58.5m at 24°. They should be configured to operate to provide a result of 3mm application of water in 15 minutes (ideally 10 mins). Rain guns behind the goal area should be designed such that they do not point directly at the surface. The central irrigation risers shall be surface mounted to avoid obstructions pitch side. Pop up rain guns behind the goals shall be located outside of the specified player run-off as dictated by FIH.



Water Cannon - Doncaster Hockey Centre

Pump

The pumps will normally be twin horizon multi-stage centrifugal units, with 22kW 400/3/50 2-pole IP55TEFC (totally enclosed fan cooled) electric motors or equal approved. These are started separately by star/delta starters with a full load running current of not more than 45 amps each or equivalent.

Details of the control valve system should be provided at the time of installation.

Control panel

The control panel will normally be located in the pump house and be designed to accommodate the following features:

- Single button control facility.
- NiCad battery back up.
- Non-volatile memory.
- The facility to retain data for a minimum of 24hrs in the event of a power failure.
- An internal transformer.
- The ability to operate station run times in minutes or seconds.
- The ability to store STX software programmes.
- Pump start facility.
- Warning signal initiation.
- A klaxon should be installed at the control panel location to give an audible warning 30 seconds prior to the operation of the rain guns.

Storage tank

The irrigation tank will ideally be located underground and be a GRP (fibreglass) construction (complying to appropriate standards) with a lockable inspection hatch. The tank capacity will be a nominal 50m³, as far as possible without upsetting the stability of the ground.

Pipe selection

All pipes shall have a minimum of 10-bar rating and shall be of MDPE (Medium Density Polyethylene) construction.

Automatic dosing system

The tank should, ideally, be fitted with an automatic MPD (a concurrent programming language) dosing system. This can be used to deliver a metered dosing of algaecide and moss killer."

Top Tip

Recycling of water requires careful consideration of health issues. It is recommended that specific professional advice be sought if recycling is a consideration.

¹⁹ 'The Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches' The Sports and Play Construction Association (2009)

3.9 Floodlighting

The potential of floodlighting outdoor sporting facilities include:

- Increased facility use.
- More flexible programming: facility managers and users can select from a much broader array of operating hours and programming opportunities.
- Greater income generation: Particularly where synthetic surfaces are involved, extending the operating hours of a facility can allow for significantly increased income generation, without the downside that is sometimes seen with a natural turf field of there being a substantial 'wear and tear' impact on the facility.

Top Tip

Independent consultant engineers with a background in sports lighting and electrical design should be contacted to help in the design of sports lighting facilities. A list of qualified contractors can be found by contacting the Illumination Engineering Society of Australia and New Zealand at www.iesanz.org and requesting the names of members experienced in the design of sports lighting. Source the Australian Standards at: www.standards.org.au

If an organisation is to be saddled with debt from such a development though, the economic viability of the project must be thoroughly investigated 'up front'. A mini-feasibility study (refer figure 2, page 57) should be conducted to ensure that the gap in income over and above operating expenses and amortisation will service loan repayments.

That being the case, attention should then be focused on the design process, with particular attention being paid to functional elements:

- Specificity: Think through the future levels of likely usage for the facility in question. Floodlighting systems can be expensive and it's pointless installing (and having to maintain) very high-level lighting if it is not necessary. As a minimum know exactly what the base requirements are as stipulated by your sports parent body; and the relevant

Australian Standards.

- Flexibility: Create a system where sections (i.e. a half field) can be lit, and to varying levels (i.e. training standard, match play standard)
- Access: Are the individual lighting towers and the fields or courts themselves located to allow easy access for maintenance, emergency and other vehicles?
- Residential amenity: Sports lighting can be a sensitive subject in terms of residential amenity, and requires careful consideration and expert advice. The design of the lighting system must meet planning authority guidelines. Your specific lighting plan needs to account for desired levels of illumination, uniformity, glare and design.

Top Tip

When planning your floodlighting system, ensure that it is in line with applicable Australian Standards.

Top Tip

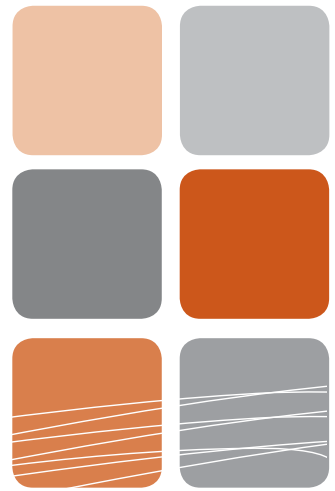
When planning approvals require a lighting system to shut down at a certain time, programmable controllers are a useful automatic system. These can be programmed so that some lights can stay lit for an extra five minutes or so to allow safe egress from the playing area.

Top Tip

A flashing beacon on each pole or one pole can be programmed to give a five minute warning prior to the 'automatic-off' function occurring.

Top Tip

Floodlight towers are often a good location for the provision of a waterproof power socket which can be used to hook-up cleaning equipment, public address systems, etc.



Top Tip

The maintenance plan is important and must include routine work on all the associated electronic services, the cleaning of fittings and the correct adjustment to maintain the aiming angles of the lamps. These tasks can be the basis of an annual maintenance contract with your floodlighting contractor.

Top Tip

An 'hours-run' counter can be included in a lighting system control/monitoring equipment as a handy guide to a systems maintenance plan implementation.

3.10 Fencing

Philosophical issues related to the fencing of community sporting spaces have been discussed in Section 1.11.1. Artificial grass sporting facilities are more likely to sustain potentially expensive damage if left unsecured, so most local government authorities or schools will opt to install fencing of some sort around their artificial grass sporting facility.

Other reasons why fencing is considered include:

- To retain balls within the playing area.
- To allow spectators to view the game safely.
- To keep animals out of, or off the pitch.
- To protect the pitch from unauthorised use or vehicle access.

If fencing is to be used, the choice of fencing style and dimensions are usually dictated by the priority sport, site constraints and budget.

Some ideas to consider when designing your fencing:

- Try to always include a double gate (wider than a set of hockey goals) so maintenance and emergency vehicles will have access.
- Consider the installation of a removable lintel above your double gates so that large goals or equipment can be easily moved in or out of the field.
- All gates should open outwards for player safety.
- Provide boot or shoe cleaning equipment at all access gates. Contaminants must be removed from shoes before players enter the playing area.
- Gates should be located so as to help avoid bottleneck areas,

particularly at points where team changeovers would occur.

- Gate thresholds should be level or slightly ramped (not stepped).
- Fencing should incorporate recesses for goal storage when not in use (see section 3.15). Fence-fixed foldaway goals are an alternative where space is an issue.
- If the activity space is to be used for Futsal or similar (where the end of court walls are 'in play'), the goals should be recessed behind the line of the end wall.



Recessed goals – Taylors Lakes

Top Tip

Consider designing and utilising the concrete kerb/upstand at the base of the fence (see photo overleaf) as a potential rebound wall for hockey hitting practice.



Rebound area-base of fence.
Footscray Hockey Centre



Rebound wall incorporated in fence
(Gold Coast)

Top Tip

Ensure that the fence railing at the bottom of any fence is less than the ball height above the concrete kerb/upstand so balls cannot fit under the fence.

- All steel supports, fencing and fittings should be heavy duty galvanised or coated steel. Clips and fixings should have no sharp edges, nor face inwards.
- Where site security is not an issue, or there is already a high security fence surrounding a site, often a 1.2m high fence is enough around the actual playing field.
- Be conscious of the exact field or court dimensions and the required safety run-off spaces.
- Steelwork should be galvanised to minimise premature corrosion, and can be plastic coated (black or green) to improve appearance.
- Consider upgrading fencing beside and behind goals so as to protect the fencing from the repeated impact of balls.

Top Tip

The size of the diamond and the thickness of the wire strand have significant impact on the performance of the fence in terms of distortion from ball and player contact.

Top Tip

Consider the construction of a rebound wall within/instead of some fencing. These types of walls offer practice opportunities to individual players.

Top Tip

The edges of many pitches can be affected by wind blowing in dirt and rubbish with the relevant run off and field edge becoming 'muddy' or contaminated.

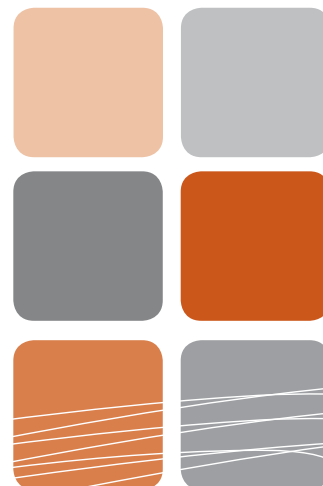
Determine the wind patterns at your facility and consider a plinth or barrier at the base of the fence to prevent this occurring.

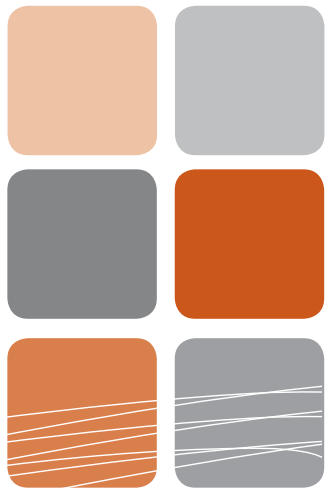
A useful resource relating to fencing is the SAPCA (Sports and Play Construction Association) Code of Practice 'The Construction and Maintenance of Fencing Systems for Sports Facilities'.

Website: www.sapca.org.uk



Off field cage for retractable netting (East Keilor)





3.11 Divider Netting and Screening



Cross – field retractable netting

It is a good idea to consider divider netting within a large activity space so as to improve flexibility and usage.

Considerable thought should go into the likely or possible programming that could occur at the planned facility. The answers that emerge from that process will determine what spaces will be necessary, either permanently or via partitioning.

The typical arrangement is divider netting suspended from tensioned steel cables hung across the pitch (removable when not in use). In this way a full sporting field can be divided in two, into thirds, or into quarters. The latter is often seen when schools are using a full pitch for four rows of tennis courts.

Top Tip

If designing a full artificial grass soccer pitch so that it can be divided into thirds or quarters for small sided games or Futsal (ie. by the use of divider netting - no solid side walls in place), play should be within lined areas, not right up to the divider netting. Consider installing cross-field blue lines either side of the netting as safe 'boundaries' for the cross-field courts, but understand the implications of additional linemarking through undertaking thorough consultation with all relevant sporting peak bodies.



Futsal courts

Cricket practice areas are now often designed as a large flexible space utilising moveable divider netting between pitches. When the netting

is retracted (and presuming that the artificial grass surface is relatively uniform), the resultant open area can be used for a variety of sporting activities.



Multi-use practise space - Eltham

Top Tip

Some of the new 'open-plan' cricket practice net configurations (see photo below) feature netting storage cabinets within the activity space. These cabinets can be damaged by fast-moving cricket balls or may be an obstruction when the overall space is being used for small games. Consider padding or relocating the cabinets outside the fence-line (see photo p74).



Multi-use practice space - Eltham

Top Tip

If screening of a space is being considered (either for site screening, as a windbreak, as advertising), the fence design – especially pole and footing strength – need to be sufficiently scaled to cope with the wind forces that will be transferred from the screening into fence infrastructure.

3.12 Shoe Cleaning Areas

Algal contamination of artificial grass or its infill medium is a problem where contaminants are either blowing onto a sports surface, or where players are transferring it to the playing surface through their footwear.

Contaminants blowing onto an artificial grass surface are difficult to control and should be prevented from becoming a problem in the first instance. Dusty car parks should be sealed and windbreaks installed where possible.

A more difficult situation to control is participants bringing dirt, parts of leaves and stones on their shoes on the journey from the car park to the playing area. Thought needs to be applied to the design of field or court entry points so they also become shoe-cleaning channels. Good design should ensure that players have to go through a shoe wash area (a narrow walking space in which the player may find shoe-cleaning brushes, a tray of water-saturated artificial turf, etc).



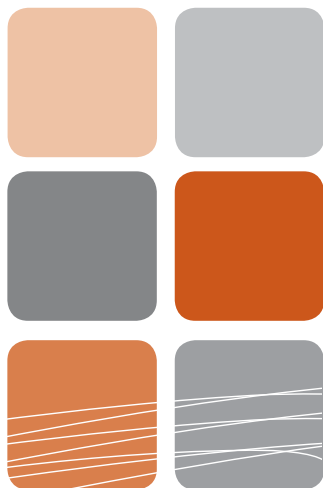
Algae on carpet



Shoe Cleaners



Shoe cleaning bay - Footscray Hockey Centre



3.13 Pitch Lay-out and Linemarking.

Considerable thought needs to go into likely future uses of your sporting space, so that the facility can be designed to capture the flexibility required.

Activity spaces and their usage can be radically enhanced at the planning stage. Think about special events, school use, cross-field activities, and associated access, lighting, fencing and goal storage requirements.

Top Tip

To enhance and safeguard player footing ensure that:

- The run-off area should provide a similar gradient to the playing area (for the specified distance from the field).
- The pitch or court run-off areas are surfaced with the same type of carpet as the playing area.

It is important to get your dimensions right. Appropriate field space, appropriately sized and safe run-off

zones are mandatory. Think through the trade-off between multi-lined flexibility and line clarity, particularly where tennis is involved – because tennis players need to make repeated, split-second decisions re: ball location and court lines.

Lines placed on the field can be either cut in (inlaid) or painted on. Inlaid lines are permanent and therefore significantly reduce field preparation time, but the use of painted lines for temporary requirements can also be effective.

Most sportspeople are able to cope with multi-lined sports halls and sporting fields, and this process is aided by sticking to the recommended colour hierarchy – the most frequently played sport should use white lines, the second most frequently played in yellow, followed by blue and red. It is important to check with the relevant sport peak body in relation to their requirements.



Painted yellow temporary lines

3.14 Practice, Warm-up and Multi-Games Areas

Many schools are developing smaller artificial grass activity areas similar to what exists in some sporting club facilities. These smaller spaces (500 - 3000m²) can be fantastic attributes where usable activity space is limited, or where there is a desire to remove activity from high-wear areas on the

main sporting field or court, or as a replacement of an underutilised existing activity area.

The 'School Sports' section (1.6.12, p35) highlights potential considerations in developing these smaller projects.



Wembley Primary School, Yarraville



Footscray Hockey Centre

The planning and development of a smaller artificial grass activity area should follow the same planning process and set of general considerations outlined in this guide for large or full court facilities.

The key broad considerations are:

- Assess the likely or potential users of the space.
- Determine the priority order in which those activities or sports will be involved. This may help determine the shape of the required activity space, and the priority of line marking and line colour allocation.

Top Tip

Find the balance between inserting lines for high-use activities (including lines that will help casual users of the space) with minimising the number/length of potentially problematic extra seams being added to the facility. Large, lightly marked spaces can provide greater flexibility through the use of witches hats, cones, etc.

- Develop a draft management plan for the space that includes anticipated use, programs, lines and fittings required for those programs, conceptual design/review of potential site/location, management options and other operational considerations (access, security, access to toilets/changing rooms, etc).
- Review the list of likely activities and determine whether a shock pad is appropriate. Where the space is to be used principally for activities such as soccer, hockey, athletics, netball, etc (remember that we

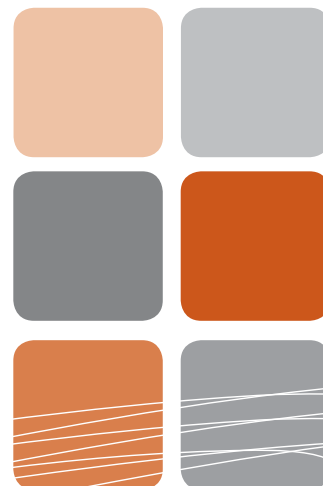
are talking about a multi-use area here, not a specialised sporting field), then a shock pad may be a valuable addition. If the principle activities are to be tennis, mini tennis or basketball, then the need for a higher ball bounce might mitigate against the nomination of a shock pad.

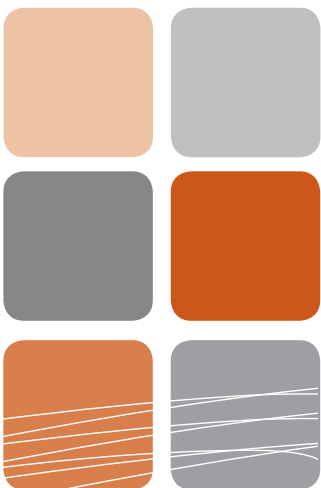


Multi Use/Cricket Net Space

Other specific issues for consideration include:

- Site/location choice: (Refer to Section 3.1).
- Basework: (Refer to Section 3.3).
- In many school installations the emphasis may be on maximising the size of the activity space, possibly at the expense of constructing a solid, long-term base. This likely to have implications for the lifespan and quality of the facility.





Top Tip

Remember that the 'platform' on which the artificial grass surface/ pad sits is ideally solid/stable enough to last the lifetime of many surface carpets. Constructed properly the first time, it can avoid repeated expensive base/sub-grade repairs every time that the surface system is replaced.

- Artificial grass selection: (Refer to Section 3.4). Given the stability of sand-filled surfaces, this type of artificial grass surface is used in most cases where durability and long lifespan are important.
- Line marking: (Refer to Section 3.13).
- Fittings and goal storage (Refer to Section 3.15). Remember that the flexible use of spaces is enhanced by having both an open and unencumbered (ie. removable posts, nets, coaching aids etc) activity area, but is further enhanced by having good adjacent storage space for these items.
- Recessed goals: These are a good idea on courts where small sided soccer is the main activity. They relate to fenced areas where the fences themselves incorporate rebound walls, and there are no external boundary lines. (Refer to photograph on page 73).
- Rebound walls: These facilities are a terrific asset for individual practice (in particular for tennis, volleyball, soccer and hockey goal shooting, casual games such as handball, and so on). This is achieved via the painting of cricket stumps, targets and tennis nets on the wall (Refer to photograph Page 74).
- Fencing or divider nets: (Refer to Sections 3.10 and 3.11).
- Artificial grass protection: Consider the importance of paved access to the practice area and the provision of shoe cleaning equipment (Sections 3.12, 3.18).
- Drainage: (Refer to Section 3.6)
- Concrete kerbs: Particularly effective for hockey hitting practice (Section 3.7)
- Floodlights: (Refer to Section 3.9).
- Access points: (Refer to Section 3.18).
- Signage: particularly if the space involved is small or enclosed, consider installing signage that establishes some basic protocols for the use of the space. Enhancing the safety of the users is a key consideration particularly in confined spaces.

3.15 Goal and Net Storage

At the design stage, thought needs to be given to the storage of goal posts and nets. Recessed areas in fencing are often a satisfactory option, particularly in maintaining safe, clear perimeter run-offs around the field. In such cases ensure

that the storage bay is level with the sporting field, and that the bay is wide enough for adults to fit either side of the goals being moved. Another satisfactory option is the installation of fold-away goals.



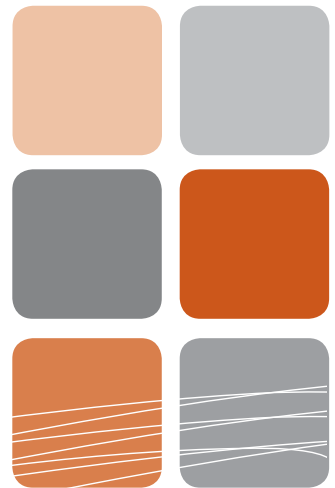
Tennis net storage – Koonung Secondary College



Off field goal storage – Kew Hockey Centre

Top Tip

Consider installing a high-tension wire and netting across the front of the goal/tennis net storage area. This will prevent balls going into that space and becoming difficult to retrieve.



3.16 Player and Umpire Shelters

Player and umpire shelters are invariably built too small. Remember that there is generally an overlap where teams arrive for the following timeslot and need to store their bags, and equipment, while the earlier timeslot teams are still competing. Space therefore needs to be allowed for four teams to all have adequate space for their bags and equipment, and possibly that of the umpires as well.

Too often the shelters cater for the coach and a few interchange players (i.e. those involved on the sideline during a game) rather than the four full squads that need storage before, during and after their game. Nearby taps or water fountains for players to access are also key considerations.



Shelters – Kew Hockey Centre

3.17 Spectator Areas and Furniture

Shelters like the one shown above also provide excellent weather protection for spectators at events where relatively small spectator numbers are the norm. These areas require some provision of seating, rubbish bins and ideally a water fountain or two.



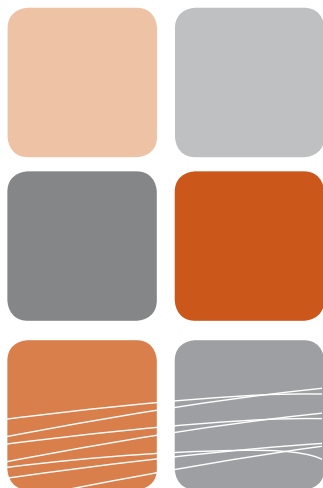
3.18 Access Points (including Ambulance Access)

Consider what is the largest item that might need to be moved on or off your sporting facility (i.e. sets of goals) and plan your access routes and gate sizes accordingly. You may need to request gate-opening sizes (including lintel heights) different to standard provision. Also think about the size and weight of maintenance and repair vehicles that will need access at some stage, including sizeable trucks and equipment that are required intermittently for floodlight maintenance, pitch grooming and repairs.

It is particularly important that clear passage is always maintained for emergency services vehicles such as ambulances.



Access gates – Footscray Hockey Centre



3.19 Trees

While trees can provide both a welcomed screening from the sun and the wind, their proximity to constructed sports facilities can be problematic. Root invasion underneath artificial grass sporting surfaces can lead to surface cracking and upheaval. Artificial grass sporting areas should ideally be located one to two times the tree's mature height away from strong rooted trees, and in other cases where trees are adjacent to the synthetic surface the installation of a root barrier is strongly recommended.

Overhanging branches can be a source of contamination with dripping leaf sap, insect secretions and bird droppings, as well as the dropping of leaves and nuts. If not quickly removed, these elements can be crushed or broken down and will penetrate into the carpet surface and will potentially contaminate infill or lead to algal-type growth. Overhanging branches should be pruned back regularly.

3.20 Relationship to Changerooms and Car Parking

Issues relevant to this topic are mentioned in Section 3.1.1 (Site Selection). A close relationship of the carpark and changeroom to the playing surface is preferable, ideally with wide pathways between all three elements. Players and spectators need to be kept on clean hard surfaces so as not to bring contaminants onto the synthetic grass surfaces.

Note the reference in Section 3.23 to the importance of using Universal Design Principles so that people of all abilities are appropriately provided for.

Top Tip

It is important that the clubroom and surrounding structures are not located such that they overshadow the synthetic surface for long periods – which can lead to algal problems.

3.21 Environmentally Sustainable Design

Economic, environmental and social sustainability is now the logical planning framework around which our communities are designed and maintained. Reducing negative impacts on the environment, repairing damage done, and finding more 'sustainable' processes for the future underpin our communities being prosperous and liveable in the future.

The Victorian State Government Department of Sustainability and Environment developed a publication, 'Environmentally Sustainable Design

and Construction' www.resourcesmart.vic.gov.au/documents to help integrate environmental sustainability into the planning, design and construction processes for all new capital works.

Providing a detailed methodology to ensure the integration of ESDC principles, these guidelines will help achieve the Government's vision of a future in which all Victorians are living sustainably within their natural and built environments.

3.22 Safety

During the design phase there are many elements to be considered that relate to the safety of facility users. Safety must first be investigated during the Planning (Draft Management Plan – Figure 2, page 57) phase via the development of a preliminary Risk Management Plan for the proposed facility. At this early stage the document would outline a broad policy position, and make reference to a number of key issues to be explored during the design phase. These issues are:

A safe location

- Ensure that the chosen location is safe in terms of visual sight lines. Players and spectators should be generally visible to site managers/supervisors and to passers-by.
- Ensure good lighting for the playing area, but also for access pathways, the car park and change room areas.
- The playing area has some shelter from inclement weather (screen planting, fence screening, etc),

but more so the ancillary facilities (verandas for weather shelter, etc).

- The facility is easily accessible for ambulances and emergency vehicles.

A safe pitch or court (refer to the regular safety check-list noted in Section 6 - 'Maintenance')

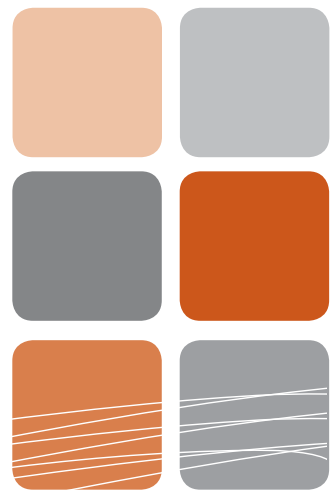
- The initially constructed pitch or court must meet the specified performance criteria mandated by the sports governing body. These performance standards must then be continued by rigorous application of ongoing maintenance and cleaning responsibilities.
- The pitch or courts are designed with the appropriately sized 'run-offs', with these run-off areas built with the current contour to match that of the playing field. The facility is checked daily to ensure it is clear of rubbish and obstructions.
- The run-off areas are carpeted with the same product as was used on the field or court proper.
- Spread the wear and tear across the field, thereby reducing worn areas.
- Select appropriate maintenance equipment, maintain it properly and only let trained and approved personnel utilise it.
- Check that fittings such as goal posts and nets are sturdy, well secured, and appropriately located (particularly when they are not being officially utilised).

- Check for and respond to gaps or bumps in seams (see Section 6).
- Check for and respond to algal growth on the field or the presence of debris such as dirt and leaves, that usually precipitates the development of algal growth.
- Check the age and condition of the floodlight towers.
- Check that fixtures that need safety padding have it installed.
- With wet fields, occasionally sanitize the field (via irrigation and use of enzyme-based cleansers) to counter any potential bacterial, microbial or staph infections that could be present due to bodily fluids, bird droppings, etc.

A safe player

In addition to all of the above:

- Ensure that first-aid equipment is always available (first aid kit, ice, stretcher, etc).
- Ensure that essential emergency phone numbers are clearly on display.
- Ensure that a heat policy is known and observed.
- Ensure via your specification that your contractor produces an acceptable health and safety plan.
- Ensure guidance is provided and that footwear and boot cleaning facilities are being used.
- Ensure that litter bins are provided.



3.23 Disability Standards for Access to Premises / Universal Design

All sport and recreation building projects are to comply with the Disability Standards for Access to Premises. Please visit the following website for copies of the Standards and incorporate them into your building planning: www.aph.gov.au

Universal design is a philosophy that encourages building development beyond what is required by the Disability Standards for Access to Premises. The intent of universal design is to create environments to be usable by all people. To know more about Universal Design, go to: www.design.ncsu.edu

Top Tip

Good access is essential for a variety of people be they the elderly, people with injuries or just parents with prams. As a mandatory part of your planning and design process follow the nominated design principles referred to in the access and inclusion publications available on Sport and Recreation Victoria's website at: www.sport.vic.gov.au

3.24 Designing to Minimise Maintenance

The following text is taken from the English Hockey Board's October 2009 paper 'Pitch Maintenance' (www.englishhockey.co.uk)

"Many facets of good maintenance practice can be incorporated into the design and construction phase of the project. Steps can be taken to keep the pitch and adjacent areas free of litter, gravel, grit, mud, dirt, oil, and toxic materials including:

- Landscaping with non-leaf-shedding trees and bushes.
- Installation of concrete or asphalt paths.
- Specification of static and rolling load limits.
- Control of access to minimize the possibility of vehicles entering the pitch area.

- Availability of artificial grass practice or warm-up areas.
- Provision of markings and extra goals for cross-pitch practice.
- Routing of player traffic to minimise tracking of impurities.
- Installation of brushes, sluices and mats for cleaning boots – and a requirement that boots are cleaned before entering the pitch area.
- Setting up food and beverage facilities well away from the pitch.
- Strategic placement of rubbish bins with provision for regular emptying.
- Erection of prominent signs designating required positive actions and prohibitions for everyone.

Construction must be closely monitored to ensure that specifications are adhered to, that inspection is thorough, and that any corrections have been satisfactorily completed".



Caroline Springs College (Springside Campus)



Port Adelaide F.C. Indoor Training Venue

4.1 Project Stages

The key stages in project delivery are listed below. Many of these elements have been covered in previous sections:

Project brief development

- Business case, preliminary designs and cost estimates, statutory planning issues, funding issues, engagement of project management support, and determination of procurement route.

Design development

- The development of detailed scheme proposals and supporting documentation.

Construction procurement

- Preparation of contracts, selection of possible tenderers, putting the scheme to tender (or single party negotiations), resolving tender queries, reporting on tenders submitted, confirming funding, letting the main construction contracts.

Monitoring construction

- Monitoring the quality of work undertaken, contract administration (including arranging payments,

evaluating variations and extension of time claims).

Completing the project

Ensure:

- That the facility meets specifications.
- That you have obtained required certificates and endorsements.
- That contracts managing defect rectifications are finalised.
- That appropriate maintenance arrangements are in place.

Top Tip

You may wish to consider conducting an Expression of Interest (EOI) process, sometimes called a Registration of Interest process, prior to the design development/construction procurement phases. The EOI seeks preliminary nomination by interested parties, and enables the project manager(s) to develop a 'shortlist' of best qualified companies which would then be invited to tender.

4.2 Procurement Routes

There are a range of project procurement methods. Common models operating in Australia include:

- Design and Documentation, Tender, Construction (traditional)
- Design and Construct (D and C)
- Construction Management (CM)
- Engineering, Procurement, Construction Management (EPCM)
- Alliancing/Private Public Partnerships (PPP)

The two most commonly used options for artificial grass sporting installation projects are:

Design and Documentation

- Where a comprehensive specification is prepared, including detailed working drawings, a bill of quantities and supporting contract conditions. The project is then tendered for construction.

Design and Construct

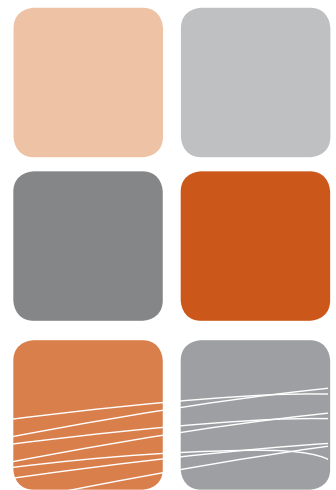
- Where performance outcomes are specified (not design details).

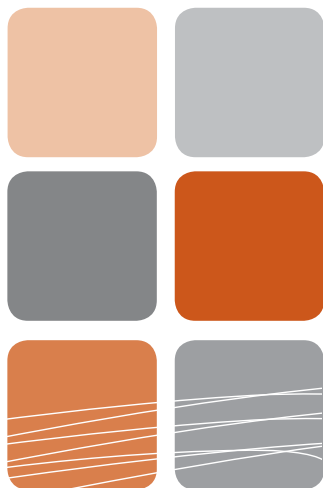
The project is then tendered for design and construction. After acceptance of the successful tender the detailed design and specification are prepared by the contractor and subsequently signed off by the client prior to commencement of construction.

Top Tip

More detailed information on procurement routes can be obtained from the Sport England document: 'A Guide To The Design, Specification and Construction of Multi-Use Games Areas Including Multi-Sport Synthetic Turf Pitches – Part 2: General Procurement and Contracts Guidance, 2004.'

Website: www.sportengland.org





4.3 Choosing the Most Suitable Project Procurement Method

Choosing the project procurement method most suitable to your project requires an assessment of the following key issues:

- Project complexity and cost
- Design responsibility
- Level of cost certainty required
- Risk items (i.e. ground conditions and how to manage them, the risks of having to make changes on site)
- Safety hazards
- Whether sufficient information

can be supplied to potential contractors early enough to enable the contractor to reasonably assess risks

- How much flexibility and financial control is required.

Top Tip

The bottom line is that a procurement method needs to be determined that will deliver maximum value for money over the whole life of the facility.

4.4 Design and Documentation versus Design and Construct

Design Documentation (Detailed Specification)

In relative terms artificial grass sporting facility projects are small, although scale is relative to the financial capacity of the project owner. For local government authorities, and more so local sporting clubs or school councils, artificial grass projects are complex and high-cost, and therefore may warrant comprehensive specifications and detailed drawing development in order to reduce risk and provide certainty with respect to quality and cost.

Documentation will typically include:

- Geotechnical investigation report.
- Detailed drawings for set out, levels and all construction elements.
- Specification.
- Bill of quantities.
- Supporting contract.

This degree of project owner research and preparation is appropriate where there is a need to resolve complex site or interface issues.

Top Tip

The level of specific detail that is defined prior to this type of project being tendered leads to one of its greatest strengths – the capacity for specific line-item bidding over exact quantities/methods and therefore allowing an ‘apples with apples’ comparison of bids.

Design and Construct (Performance Outcome)

The potential strength of the design and construct project delivery method is that it allows bidding contractors to think creatively about options for delivering the required facility or service without being locked into just one specific design or construction resolution.

Although these types of projects are ultimately about a contractor producing a facility that meets a performance specification, the bidding companies (prior to the tender) should still receive:

- Existing Feature Survey.
- Comprehensive utility services survey and associated information.
- Geotechnical Investigation Report.
- Concept and preliminary layout.
- The performance specification (including quality control and warranty requirements).
- Information relating to access to the site and any specific requirements needed eg. storage of materials, tipping of soil, etc.
- Supporting contract.

When putting together this information package for the bidding companies, the project owner, employer or client should also tightly define design and construction standards as well as provide a clear indication of any construction arrangement preferences.

4.5 Project Cost Estimation

Accurate cost estimates are a key element in making sound decisions at each stage of the project. In the case of the design and documentation procurement method, cost estimates should be developed at the following stages:

1. Concept Development and Project Briefing.
2. Preliminary Design.
3. Pre-tender Documentation.

Cost estimates and project budgets are typically established early in the project's life when there is limited information and detail. If a budget or estimate has to be set at this stage, it should be done on the basis of a developed concept drawing, all available site information, independent industry rates, investigation and design (civil works and synthetic) and generous contingencies.

As the level of information and detail increases with progress of the design process, the cost estimate can be refined and the contingency amounts reduced. In the case of a design and construct contract a similar process can be adopted, however the tenderers/bidding companies take on the responsibility for developing and costing the detailed design elements. Cost estimates can be developed with the assistance of an independent consultant, i.e. quantity surveyor or engineer experienced in this work.

Top Tip

Obtain independent costing advice. Be wary of cost estimates provided by just one individual surfacing contractor (particularly in the absence of a reasonable specification).

4.6 Selecting Your Lead Contractor

Artificial grass sporting facility installations generally require two key areas of work:

- The civil engineering and construction tasks of clearing and preparing the sub-grade, the design and preparation of the base, and associated works for drainage, irrigation, fencing, etc.
- The artificial grass installation, involving the possible placement of a shock pad, the laying of artificial grass carpet, the installation of lines into the carpet, and often the application of infill products (such as sand, rubber granules, etc).

Typically companies which regularly undertake this type of work are structured as one of the following:

- Civil contractor with surfacing supplier as subcontractor.
- Surfacing supplier with civil contractor as subcontractor.
- Contractors who have both civil and surfacing expertise 'in house'.
- Alternatively some projects have been delivered with separate contracts:
 - Civil contractor for civil works.
 - Surfacing supplier for surfacing works.

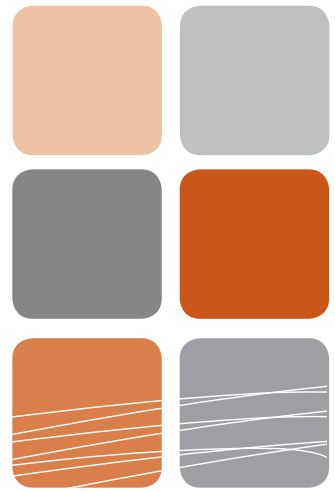
The trend in recent times is for the work to be lead by the synthetic surfacing company with a civil contractor as subcontractor. The project owner/their delegate can have some influence here in terms of specifying expectations and requirements for contractors/tenderers in terms of:

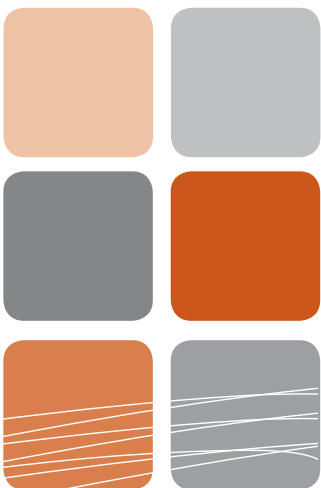
- Expected lead contractor.
- Experience with similar high tolerance work.
- Subcontractor experience.
- Project management capability.
- Project resourcing.
- Program of works.
- Witness and hold points.

Setting expectations and requirements with respect to the lead contractor will be based on the level of complexity of the project and the balance of work types, i.e. civil works versus synthetic surfacing works.

Top Tip

Regardless of the lead contractor arrangement chosen, it is essential that the project owner retains a suitably qualified engineer (expertise across both earth preparation and artificial grass installation) to supervise all works and protect the client's interests.





Top Tip

Regardless of the lead contractor arrangement chosen, it is essential that the selected company is able to accept sign-off on both the design/construction of the baseworks (whether they did that work themselves or not) and the supply and installation of the surface system. The door cannot be left open, if base or surfacing issues arise later, to complaints that the baseworks undertaken were inadequate.

Top Tip

Many companies are producing sports surface systems that are endorsed/licensed by peak bodies such as FIFA, FIH and ITF. Given that some companies on-sell their surfacing systems to other providers or preferred contractors, it is important for the client to seek written assurance that the company actually holding the licence warrants the work of their contractor/sub-contractor in full.

4.7 Selecting a Tender List and Inviting Tenders

There are a number of simple criteria by which decisions can be made as to who goes on your tender shortlist:

- The 'product' being promoted by a particular contractor/supplier must have performed satisfactorily in independent laboratory testing for durability and other required characteristics (copies of relevant independent reports should be requested).
- The contractor/supplier should be able to demonstrate that they have previously constructed similar facilities, or have acquired or has a direct trading relationship with another company that has the experience (request that the contractor provide a list of similar projects completed – not just under construction).
- There is no evidence of the performance of the company, or offered product, being the subject of any outstanding dispute, or that they have previous customers that remain dissatisfied with the facility that they have had constructed.

A useful process to help in collating preliminary information from prospective contractors is to run an Expression of Interest process in which the need to attract interested, suitable contractors is advertised (along with the availability of a brief specification or project outline), and from the response a short-list of best-fit respondents is invited to tender.

As has been said many times in this guide, through all of these phases it is highly recommended that your club or school has independent expert consulting advice available to assist in the decision making.

Top Tip

Personally inspect as many of the bidding companies' previously-constructed facilities as is possible, particularly the oldest of the installations. Question the owners about the performance of the surface, usage levels, the performance of the seams, line creep, wear rates in high-use areas, maintenance needs – and their opinion of the performance of the contractor and subcontractors generally.

4.8 Tender Documentation

Documentation required with a tender release is partly dependant on the procurement route being followed (refer to Sections 4.2, 4.3 and 4.7 of this guide), but in broad principle tender documents should make reference to:

- The role and responsibilities of the client/project owner.
- The role and responsibilities of the client/project owner's consultants.
- General conditions of contract.
- Provide background information such as surveys, geo-technical data, planning permits (including any 'conditions' applicable), floodlighting specifications, construction drawings (if applicable), bill of quantities, etc).
- Guarantees/warranties.
- Performance – standards and specifications.

- Off-site and on-site testing procedures.
- Associated works (fencing, gates, etc).
- Equipment issues.
- Requirement for 'as built' drawings (post-construction).
- Maintenance requirements.
- The process/methodology by which tenders will be assessed.

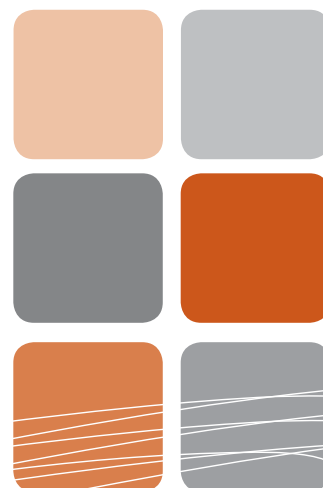
It is extremely important that the tender documents also make strong reference to:

- The need for a quality control

process that defines key stages (hold points) where inspections of key phases of work are to be undertaken and approved.

- The provision, with the tender bids, of data sheets and specifications and actual samples of the materials that are being offered in the tender – carpet and shock pad, sand and/or rubber granule infill, glues, and a sample demonstrating the exact seaming technique to be used.

Some examples of specifications and briefs are noted in Appendix 3.



4.9 Evaluation of Tenders

It is at this stage of the project that decisions made earlier in the process (i.e. procurement route – full design and documentation versus design and construct) can make evaluating tenders difficult.

While providing opportunities for alternative ideas and approaches, the Design and Construct project delivery method can make it difficult to compare tender bids ie. 'apples with apples'. Lack of clarity in this area not only makes the initial assessment process more difficult, but can also set up the possibility of additional changes or variations as the project proceeds.

With the full documentation, drawings, and bill of quantities approach, all of the bids can be analysed on a detailed line-by-line basis which gives clear indication of the true and fair cost for the particular item, and also highlights where a bidding contractor might not fully understand the issue or process in question. It should also help avoid circumstances where the client or their consultant is unaware of key issues or implications that may impact on their project's performance. These issues can be clarified as part of tender negotiations.

For either procurement method (but particularly Design and Construct) it is recommended that you interview the two or three lowest conforming tenderers, going through their proposals in detail. This allows the full exploration of the technical aspects of bids, moving beyond a simple focus on price. At these interviews, contractors should be able to demonstrate:

- A detailed knowledge of the scope of work (Civil and Synthetic).

- What the specific materials or products will be.
- Precisely how they will be installed.
- Critical stages in the process.
- Not just how they do things, but why.
- A detailed program of works.
- A knowledge of the site and its ground conditions, existing and finished levels and services.
- A knowledge of who the subcontractors are and their experiences.

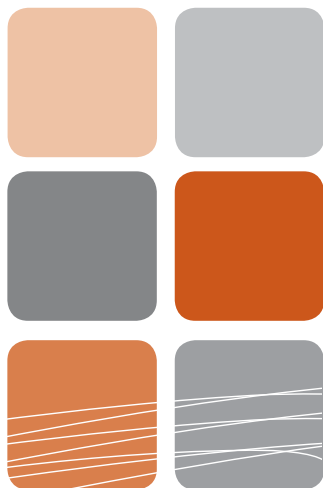
To complete the tender review, check each bid for:

- Compliance with specifications.
- The total value of the package.
- The company's experience.
- The company's reputation.

Visit sites of relevant, finished products and evaluate them for quality and performance. For example, see how the surface/seams are wearing over time.

Top Tip

Obtain samples of the tendered surfaces. Establish whether the samples provided exactly match the written product description/specification offered, and whether they are exactly the same as the product that would be laid. These comparisons (via simple testing) should be made once the product arrives on-site for installation. Testing laboratories are listed in Appendix 6 of this guide.



4.10 Agree to Final Details With Preferred Contractor

Prior to confirming acceptance of the tender from the preferred contractor, a meeting should be held involving all project partners and the preferred contractor. Matters that should be discussed and agreed to include:

- Costs and provisional sums
- Specification and test samples
- Contract monitoring procedures
- Timescale and critical path analysis
- Site working procedure
- Subcontractors and supervision
- Maintenance schedule
- List of equipment
- Guarantee/warranty
- Specific questions related to the surfacing products, their manufacture and their installation.

Top Tip

Prior to signing off on the acceptance of a tender bid, go through the guarantee document in detail with the proposed contractor. Understand specifically what is being offered, particularly extended warranty offers as these often come with restrictions.

Top Tip

Appendix 4 is a sample questionnaire used recently to help clarify tender submission issues with a proposed 'lead contractor'. You may wish to undertake a similar process for your project.

4.11 Awarding the Job

Once your decision has been made, send the contractor a letter of intent and ask for confirmation of their precise starting date on site. Promptly initiate the preparation of formal written agreements, as few contractors will agree to start work on-site before the formal contract has been received.

The Sport England document 'A Guide to the Design, Specification and Construction of Multi-Use Games Areas' (Website: www.sportengland.org) provides the following advice regarding projects where it is intended that work will commence based on a letter of intent:

'If, due to time constraints, a construction contract is to be let initially on the basis of a 'letter of intent' - a letter in which the employer instructs a contractor to proceed before contract documents are executed – particular care should be taken not to issue such a letter without agreement between the project owner and contractor of all contractual terms and conditions. To proceed on any other basis potentially prejudices the negotiating strength of the project owner and can have unexpectedly adverse consequences for him/her.'

Depending on the form of contract chosen and its content, bonds may need to be obtained and financial audits undertaken.

4.12 Establishing a Contract

There are generally a range of contract options available. For works of this scale it is usual for work to be tendered on a 'fixed lump sum' basis which can include provisional sums, amounts and quantities if some elements of scope are not able to be qualified adequately. Other alternatives include a 'schedule of rates' or 'construction management' where the client effectively pays for the contractor on a rates basis or labour and materials with agreed overheads and profit components. There are a number of 'standard' forms of contract that can be used and adopted for the chosen contract type. For example, *Australian Standards AS 4000 General Conditions*

of Contract and AS 4300 General Conditions of contract for Design and Construct are good starting points.

In determining which contract type is most appropriate to your project, the following factors should be considered:

- Project complexity and cost.
- Design responsibility.
- Level of cost certainty required.
- Risk items such as ground conditions, and their management.
- The impact of weather.
- The risk of onsite changes.
- Safety hazards
- How much flexibility and financial control the project owner or client wants.

- Preparedness to deal with late variations or changes and the potential impact of same on proposed completion dates.
- The degree to which you want to leave design and construction risks

with the contractor (could lead to construction problems and almost certainly higher tender prices).

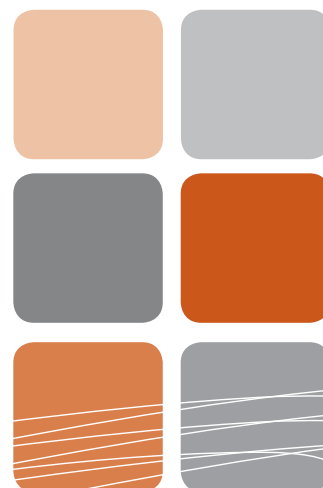
- Eliminate all the unknowns about a project prior to the tender and pricing phase.

Top Tip

Minimise this transferred risk by providing potential tenderers with sufficient ground investigation information.

Top Tip

For the scale of works associated with most artificial grass projects you would generally go with a Fixed Lump Sum contract, whether for a fully-documented or design and construct project.



4.13 Timing and Period of the Contract/Project

Because the final stages of an artificial grass field installation (laying the shock pad and carpet) can be critically dependant on weather conditions, it is sensible to plan a project's timelines so that the construction phase is taking place during the drier or warmer months of the year.

An indicative timeline (working back from when the field might become available for upgrade at the end of a winter playing season – say mid September) for a full field project might be similar to the following:

1 May	Advertise for Expressions of Interest (2 weeks). Finalise the specification during this period.
15 May	Close EOI (3 weeks to review, followed by the selective release of tender).
8 June	Release tender documents (allow 4 weeks).
8 July	Close tenders (allow 4 weeks to decide/have approved).
8 August	Award contract (lead-in time 5 weeks from awarding).
15 September	Field available, construction commences.
22 December	Field completed (14 weeks).

4.14 Terms and Warranties Offered

Refer to Section 1.13 of this guide for information on Warranties.

4.15 Manufacturer/Supplier Licensing

Refer to Section 1.12 of this guide for information on Licensing.

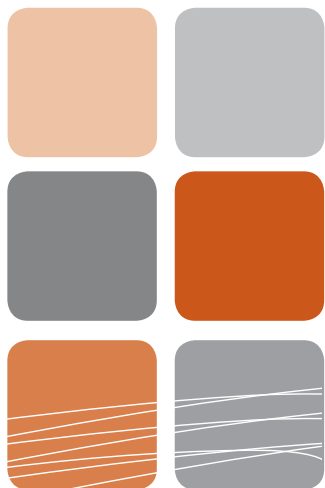
4.16 Product Compliance

In terms of interpreting product compliance along certification lines, Section 1.12 of this guide lists two references:

- Product certification: 'A product (synthetic turf system) that is approved by a sports parent body via early laboratory testing'.
- Installed field certification: 'The testing and approval of the synthetic grass field or court after it is installed'. For some sports this is mandatory, and for some others it is only mandatory if you want to be

able to bid for or host elite events. In many cases it is best to wait for several months worth of 'playing-in' time (i.e. time for sand and rubber infill to settle) to lapse before you conduct the post-installation testing.

Product compliance can also refer to compliance in terms of performance and checking processes during construction. This important quality check is discussed in Section 4.17 Monitor and Supervise Construction and the Contract.



4.17 Monitor and Supervise Construction & Contract

During the development of the project specification and contract, there needs to be appropriate reference made to quality systems, particularly the importance of key hold-points involving constant checking of workmanship and materials. The SAPCA Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches²⁰ suggests the following test items and timetable:

4.17.1 Workmanship

The quality of the workmanship should be checked at various key stages during the construction process (against the specification for the works). These stages may include:

- At completion of the sub-grade, to check size, levels, gradients and strength - to compare to the geotechnical report, which will validate the design of the sub-base (thickness, etc).
- At completion of the construction of the drainage system, to ensure that all connections have been made and that the correct falls have been made in pipe work (and that they are clean – many have been used as rubbish pits or have had waste concrete dumped in them!).
- At completion of the base to check that level and thickness requirements have been met and that the materials supplied are

as per tender, eg. crushed rock, concrete, etc.

- At completion of the shock pad to check thickness.
- At completion of the carpet surface to ensure consistency of infill depth across the pitch. Also to ratify lines, dimensions, and so on.

4.17.2 Materials

Shock pad and carpet materials delivered to site should be checked (samples sent for analysis) against the reference sample for:

Shock pad:

- Tensile strength.
- Density.
- Thickness.
- Weight per unit area.

Carpet:

- Fibre type and dtex.
- Pile length. This should match the nominal value to ± 1 mm when tested using the appropriate method.
- Pile density in terms of tufts per square cm.
- Face pile weight per unit area.
- Total weight per unit area.
- Tuft withdrawal force.
- Quality of backing materials.
- Pile filling materials (size, shape, grading).

4.18 Quality Control

Refer to Section 1.13 for extensive coverage of quality control issues.

4.19 Check Final Completion with Consultants and the Contractor

Before the facility is classified as 'Practically Complete', it is recommended that the client or their consultant project manager undertake or commission all necessary tests to ensure the compliance of the facility with your specification/standards. This step is normally linked to the retention of a certain percentage of the contract price.

Checks may include:

- The colour of the pile
- The pile length
- The infill spread rate
- Any deviations in levels (beneath a 3 metre straight edge and according to standard deviation nominated by sports code tolerances)
- Uniformity and acceptability of seams and joins

- A thorough visual examination and preparation of a photographic record of any distinctive features
- The formal tests, such as:
 - Ball rebound resilience
 - Ball rolling resistance and deviation
 - Berlin athlete impact response (deformation)
 - Peak acceleration (g) from 1.0m
 - Limoux surface friction
 - Porosity.

This would also be the time at which the materials (carpet, shock pad, sand, rubber granules, adhesives, etc) are checked to see that they match those first proffered at the time when companies were making their tender bids.

²⁰ 'The Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches' The Sports and Play Construction Association (2009)

Top Tip

While unfilled artificial grass carpets can be tested immediately at the completion of works, with filled/dressed carpets this is often best done a month or two later after the infill materials have settled properly into the carpet, and the redistribution of infill has been completed. With projects calling for filled/dressed carpets, you should consider advising bidding suppliers (in the tender specification) that final payment will be held until the delayed testing is completed.

4.20 Remedial Works and Re-Inspection

Hopefully the monitoring and inspection process during construction has been sufficiently effective, and the final check and testing has revealed no problems. In this case the formal handover (the trigger for the final payments, less retention monies to be retained) can occur.

Should any defects be revealed, establish a rectification program and timetable with the contractor, and

do not accept project handover until satisfied with the resolution. Depending on the extent of the remedial works required, it is possible that further survey and testing work might be necessary. This is where a site supervisor and clients advisor are vital, with a very clear form of contract spelling out the Quality Assurance, Quality Control and payment procedures, and the procedure for defects rectification and payment.

4.21 Field Testing

If there were no defects identified following practical completion (and the carrying-out of appropriate tests at that stage), then by now the facility will be fully operational. If remedial works were identified though, it may be necessary to re-test the surface.

The appropriate testing issues and protocols are listed in Section 4.19 of this guide (Check Final Completion with Consultants and the Contractor).

Top Tip

The formal testing of an artificial grass surface can be an expensive process, but the cost is minor compared with the overall investment in the project.

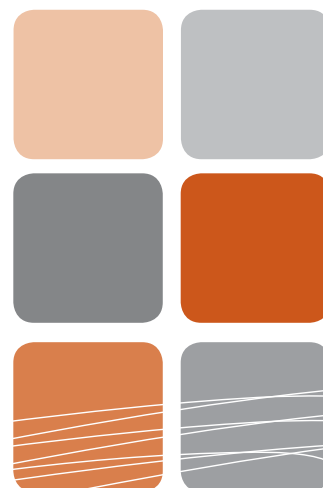
The stages at which field compliance testing can or should occur are:

- When the carpet arrives on site. Send several samples (min. size 350mm X 350mm) for analysis and comparison with the samples and specifications provided originally with the tenderers bid and product specification.
- Check the thickness and composition of all layers in the base.
- Test the composition and depth of the shock pad before the shock pad laying phase is completed.
- Check the performance to standards or seam strength.

- Check the infill spread rate.
- Performance testing on site immediately or soon after practical completion.
- Performance testing prior to the end of the defects liability period (usually 12 months). Note: This may only be appropriate for high-end facilities, not community level.
- Performance testing prior to the end of the warranty period - five to seven years (also probably only relevant to high-end facilities. Adds cost to the project, but more importantly will place a stronger spotlight on usage levels, maintenance regimes, etc.
- Annual or biannual certification – where required by the sport's parent body. If so required, this needs to be made absolutely clear in the brief and contract details.
- At any time if you think that your surface is failing to meet required playability and performance.



Brisbane Hockey Centre



4.22 Handover and Defects Liability Period

When the client or their representative consultants is satisfied that the facility is satisfactorily finished (practical completion), the formal handover can occur.

At this point the contractor is entitled to receive the balance of their payment,

less the usual retention amount that is held until the end of the defects liability period – usually 12 months from the date of the handover. Some owners may wish to again formally test the facility prior to the end of the defects liability period.

4.23 The Warranty or Guarantee Period

Guarantees on artificial grass pitches are often advertised as being for five to seven years, but what do they actually cover? What facility users and financiers need is a guarantee that the playing performance of their pitch (to standards generally set by their sport's parent body) is guaranteed for a set period of time. In many cases, the warranty provided may just relate to issues such as ultra-violet degradation or general wear.

Follow the trail back and you will often find that the warranties offered by

suppliers or installers are likely to be underpinned by warranties provided by the yarn extruders. Note that these warranties are often linked to things such as:

- hours of play (the general ceiling is 1,500-1,600 hours per annum)
- number and age (size) of participants.

Check Section 1.13 of this guide for important information related to establishing, understanding and implementing warranties.

Top Tip

Make sure that you are clear on the specifics of the warranty. Does it cover minimum playability throughout the warranty period? If so, how is that measured? How does the warranty relate to the yarn, the carpet, the seams? Who is issuing the warranty?

Top Tip

Most warranties will be linked to maintenance, both specialised and in-house, particularly any performance warranty.

Top Tip

Before the warranty period elapses, consider another batch of formal testing if you think that your facility is failing to meet the minimum playability standards specified.

Top Tip

Warranties are generally paid on a pro-rata basis, not full replacement. For example, if your carpet fails, the compensation formula might revolve around the percentage of the warranty period that has elapsed and what percentage of the cost of the installation relates to the carpet.



5.1 Facility Objectives

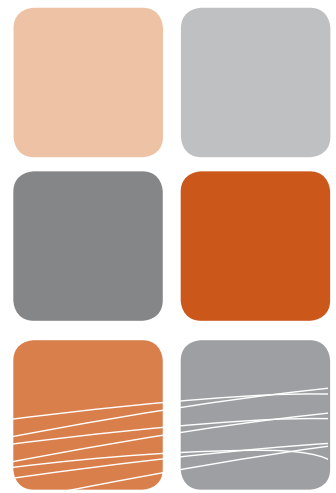
It is important in the early planning of your project to establish some broad policy positions and objectives for your planned facility. For example:

- Who is it for – elite or community level, or both?
- What should be charged – enough to cover operating expenses, or ground replacement costs as well or a percentage of same?
- Will public access be allowed?

The answers to these philosophical and policy questions provide guidance to subsequent, detailed management planning and design development matters.

Ideally management and design objectives are adopted that broaden potential access to a proposed facility, and therefore try to maximise the participation and usage possibilities of the facility. To capture these outcomes requires the thoughtful consideration of:

- The broadest possible usage.
- Low or discounted rental rates to encourage use by particular markets.
- Marketing practices that seek diverse usage.
- Design objectives that encourage thoughtful location of the facility and easy access.



5.2 Specific Policies

Section 2.2 (The Leisure Facility Planning Process) recommends a two-stage process for resolving management issues. The first is the early completion of an indicative management plan, to provide guidance to the subsequent early management and design planning, and the second phase is the development of the final, detailed management plan that will be implemented when the facility is operational.

Based on the established objectives referred to above, broad policy positions can then be established for things such as:

- Programming.
- Pricing.
- Opening hours.
- Marketing and promotions.
- Employment of staff (full time, part time and casual).
- Use of advertising.
- Public access.
- Safety (player, spectators, staff).

These types of objectives and policies are sometimes listed under headings such as:

Social

- Single purpose versus multi-purpose.
- Single user versus multi-user.
- Differential pricing.
- Equal opportunity.

Economic

- Cover operating costs only?
- Cover operating costs plus the cost of capital?
- Cover operating costs, the cost of capital, plus depreciation?

Quality

- Standards of use anticipated.
- Maintained pitch standards.
- Quality of management and service.

Environmental

- Water consumption and re-use.
- Maintenance impacts.
- Impact on open-space values, aesthetic appearance, etc.

Managerial

- Management mode and governance structure.
- Alignment with council policies and strategies.
- Business case sustainability.
- Facility priorities.

5.3 Management Options

Having established objectives for the proposed facility, and some specific draft policy statements, your project planning committee now has some guiding philosophy to help it determine which management options best suit the achievement of those objectives.

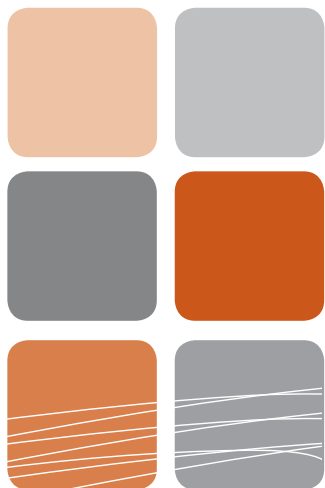
In the following section, key considerations are listed for each of the five main management options as noted. They are:

5.3.1 Direct Management By the Facility Owner

(usually the local government authority).

Key Considerations:

- Can allow the direct application of council's broader policies regarding community development, social equity, etc (refer Appendix 2: Case Studies).
- Can provide total governance control.



- Can allow centralised booking arrangements (utilising existing staff and services).
- Can mean tighter control of keys/ access.
- Allows all income to be retained by council.
- Allows consistent pricing strategy across all council-run facilities.
- Can lead to the development of stronger partnerships with schools, encouraging improved sporting 'pathways'.
- Staffing costs will rest with council.
- Can result in lack of ownership within the community.
- Staffing costs for evenings and weekends.
- Council's level of experience in operating such a facility.

5.3.2 Resident Club Control

Under this model the resident club, or the primary resident club, would control the facility via lease or similar.

Key Considerations

- Can lead to maintenance and management costs being transferred to the club and their volunteers.
- Can encourage investment by the resident club into the facility.
- Potential to provide a club income source to enable the establishment of a pitch surface replacement sinking fund.
- Gives the managing club the opportunity to fully utilise its promotion, programming and income generation skills.
- Has potential for the facility to be 'captured' by the management entity which may have no interest in generating broader community use.
- Requires a well-written lease/ service agreement that clearly defines the broader community benefits that have to be achieved by the lessees as well as standard operating information. Targets should be set regarding:
 - Breadth of sports and clubs to be utilising the facility.
 - Demographic or gender targets.
 - Amortisation fund targets.
- Ensuring prescribed maintenance Standards.

5.3.3 Representative Advisory Body Under Council Management

An example of this management option is the representative soccer group that Whittlesea City Council (Victoria) initially established to coordinate the use of the synthetic turf soccer pitch at the Harvest Home Rd complex in Epping. The fact that there were no tenant clubs based at this facility made it far easier for this management option to be adopted.

Key Considerations

- Potential to provide ownership among local sport stakeholders to determine and manage access (requires clear guidance from Council regarding basic access guidelines and management principles).
- How will usage demands be monitored and policy adjustments be made?
- The need for the advisory body to have the skills to manage access appropriately.

5.3.4 Committees of Management

Can apply where a variety of users of the artificial grass facility are formed into a management committee, or it can be the utilisation of an existing management committee that has delegated control over a facility to which artificial grass facilities are being added.

Key Considerations

- Possibly provides greater community ownership.
- Can lead to a synergy of Council pricing across its facilities.
- Income can be controlled and maintained.
- Will required maintenance standards be maintained?
- Would the committee have the appropriate expertise regarding artificial grass and its management.

5.3.5 Third Party (Commercial)

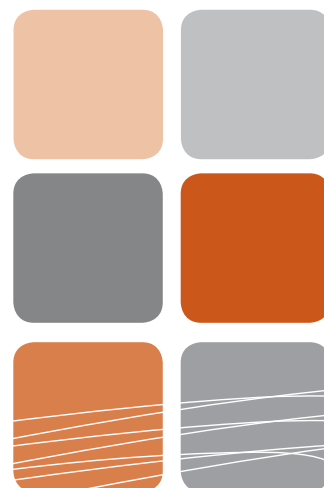
There are a number of examples emerging where local government authorities are establishing management arrangements with interested third parties. Current examples include the City of Moonee Valley placing its new artificial grass pitch (adjacent to

the East Keilor Leisure Centre) under management contract serviced by the Victorian YMCA, and the Football Federation of Victoria (FFV) managing a three-field complex at the Eastern Recreation Precinct in the City of Knox. 'Third Party' arrangements can lead to substantial capital contributions in return for extended management contracts.

Key Considerations

- Can generate a capital contribution from the third party.
- Can bring in leisure facility promotion and management expertise.
- Allows the creation of a sinking fund for field surface replacement.

- Provides a neutral party not directly linked to any club or sport.
- Maintenance requirements may not be adequately addressed.
- The extent of direct Council control.
- Cost.
- Could be driven by market forces unless the specification and contract clearly define specific market segments to be attracted.



5.4 Programming and Pricing Structures

The early establishment of both project and facility draft objectives and policy statements give clear guidance to subsequent decision making for matters such as programming and pricing. Items to be considered include:

5.4.1 Programming

- Is the facility to cater for a variety of sports and clubs, a single sports club, or a single sport with a number of sharing clubs?
- What are the attitudes and protocols of the parent bodies of the key sports that will be playing at the venue? Will they allow alternate fixturing that will fully utilise the extended availability of artificial grass?
- Are there any likely statutory planning issues that might limit the availability of the venue?
- What off peak business might be found for the facility, i.e. the daytime schools market, Friday night junior sport, Monday night veterans?

Top Tip

In the earliest planning phases, establish indicative weekly schedules (i.e. one for a typical week in winter, one in summer). This will give you a feel for the level of demand, establish the gaps to be filled, and will identify matters such as the type of carpet required, storage requirements, etc.

Top Tip

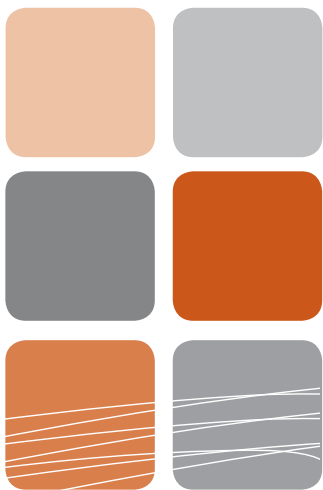
There are examples in place of larger artificial grass fields being sub-divided into smaller activity areas so that the field can provide two, three, four activity spaces at the same time. Examples include small-side soccer training areas and multi-court tennis installations. There are certain key design elements required to make this work – see Sections 1.6.11, 1.7, 3.11, 3.13, 3.15, and 3.18.

Pricing

Pricing is directly related to the earlier establishment of a proposed facility's objectives and general policies. Is the facility there to enhance community development, (targeting groups that traditionally have low participation rates), or is it a commercial or semi-commercial user pays facility?

Depending on the facility owner's stance on these questions, the following issues will find their own cost settings:

- Cost recovery: Will the facility just need to cover a percentage of its operating costs (i.e. as per most leased/rented natural turf sporting facilities), or will the hourly hire rate need to incorporate a substantial contribution towards a 'sinking fund' for the facility?
- Targeted discounts: Off-peak users will generally pay a lower fee anyway, but will fees for groups such



as school classes be set at levels to maximise access and participation.

- Co-tenant contributions: Is it possible to find a co-tenant(s) i.e. a school, an ex-students association, supportive commercial business or similar, with the capacity to pay an up-front lump-sum contribution in lieu of, say, the first five years rent? Such a deal can be extremely beneficial in helping reduce initial borrowings, or may help provide the cash for an improved initial level of facility.
- The change-over period when first moving from natural turf to synthetic turf involves a significant cost shift. Suddenly members may be responsible for their usual membership fees, plus the cost of artificial grass access. Clubs need to determine whether to leave annual fees at the same general level, and charge a special access fee each time their members train or play on the expensive artificial grass, or add together the traditional annual

membership with an aggregated lump sum to cover the member's artificial grass field usage as well.

- Consider differentiated pricing for different times of the day, i.e. when floodlighting is provided, or when a field might need to be watered pre-match.

Top Tip

People understand the principle of paying a fair market rate for access to facilities/programs such as a squash court, a tennis lesson or an aerobics class. Despite the fact that it imposes an additional administrative burden, in the initial stages you may wish to consider a per-access payment charge (in addition to their usual annual membership fee) than an all-inclusive aggregated membership/field access fee. The per-access playing fee is a gentler introduction to the world of full user-pays.

5.5 Staff and Supervision

There is a significant difference in the workload associated with running a simple 'pick up the key at the local milk bar' arrangement, as opposed to the fully supervised level of management. How you weigh up your management decision might depend on the level of debt-servicing or amortisation associated with the facility, and your club's capacity for volunteerism and the club's ambitions.

Issues to be considered:

- Opening and closing times: How will it be done? Who will do it? If in an isolated location, or if it will be dark when closing up, will volunteers be safe closing-up on their own?
- Access to changerooms and toilets: Is this a requirement of council, the parent sporting body, or just good practice? How will it be done?
- Kiosk opening hours: Opportunity to generate additional income, or demanding drain on volunteer's time? Choosing your level of service here depends on many issues including ability to pay staff and find volunteers, and sometimes the rules and expectations of users or parent sporting bodies.

- Daytime supervision: Can you just provide local schools with their own sets of keys?
- Weekly maintenance: Who will clean and groom the field or courts each week? Who will inspect them for seam stability? Who will inspect and maintain the pavilion, court or field, fixtures, etc.
- Cleaning: Dependant on your facility's scale of operation, how or who will undertake daily or weekly cleaning duties?
- Volunteers: Overall rates of volunteering in Victoria remain high, but the way in which people volunteer is changing (younger people in particular). Organisations need to study these trends and develop strategies around them.



Rugby scrum practice area (Auckland)

5.6 Marketing

Your organisation should think about its position in relation to:

- **Promotion:** How will you promote the usage of your facility (field, courts, pavilion)? Are you subject to any local council regulations related to advertising and signage?
- **Media:** How will you service your relationship with local media?
- **Sponsorships:** Refer comments under 'Promotion' re: local government regulations related to advertising.
- **Special programs:** Are there opportunities to use your facilities through smart programming such as lawn bowling 'barefoot bowls' and promotional activities for businesses?

5.7 Accounting and Financial Procedures

The advent of artificial grass for sport has substantially shifted playing field costs from mainly recurrent costs to large capital expenditure every 7-12 years. The timing of these substantial costs can be planned for, as part of a lifecycle of annual or incremental maintenance and capital replacement.

Some facility managers are passing responsibility for this liability onto the user groups, so it is prudent that these

groups establish separate accounts that clearly demonstrate the necessary annual response to that liability.

If done in this manner, members can appreciate the linkage between the user fees that they are paying (refer Section 5.4) and either the savings fund that is accumulating funds towards the next re-surfacing, or the debt that is being paid on the current surface.

5.8 Operating Procedures

Squeezing an extra year or two of playable life out of an artificial grass playing area can lead to substantial additional income generation. Some of the strategies to consider are:

Take the pressure away from high-wear zones

Particularly on full-sized fields, areas can be designed and constructed (separate colour lines, good storage and floodlighting provision) that allow for specialised training activities to take place away from the main goal areas, etc.

Having access to mobile goal posts also allows an easy relocation of training drills to other areas of the field.

Footwear issues

The correct footwear must be clearly stipulated and monitored, and all participants entering onto the artificial grass should do so via a single entry point or other such mechanism that encourages them to clean the soles of their shoes of dirt, stones, or other contaminants.

Access from car park and changerooms

Even prior to participants having to clean their shoes, it is important to consider how they will get from their car to the changerooms, the changerooms to the pitch, or their car direct to the pitch. Can the natural inclination to take a direct

course from 'A' to 'B' be aligned with the provision of sealed, clean pathways?

Opening and closing

Established procedures are necessary at opening and closing times so as to ensure:

- Appropriate risk management protocols (inspection of the pitch, court dug-outs, changerooms, etc) are performed.
- The facilities are ready for use (floodlights turned on, first-aid kit in place, etc).
- The security of the facility is checked.
- Lights, heaters, other electrical appliances are turned off where required.
- The safety of volunteers and staff leaving the facility at night is assured.

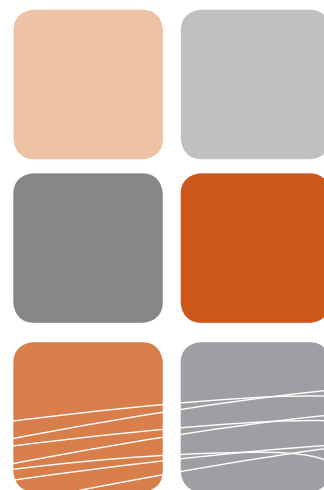
Maintenance inspections

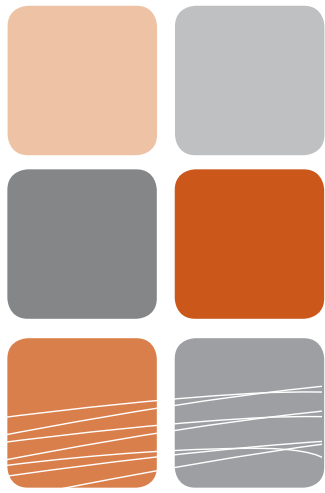
Procedures should be in place for weekly inspections such as sand and rubber infill being correctly distributed – especially in areas of high wear and tear.

Other monitoring

Maintaining a usage logbook:

- Is important in terms of indicating when major maintenance is required, as well as providing important usage data that might be relevant to a warranty or guarantee issue.





Seek player feedback:

- Maybe a suggestion box or some other more formal feedback process that allows the facility managers to be constantly aware of the cleanliness of the facility, its playability (player and field traction, ball and field interaction), and so on.

Repairs:

- Procedures need to be in place regarding response to seam failure, spillage on the artificial grass (eg. blood, first-aid medications, and burn marks).



Easts Hockey Centre - Brisbane

6.1 Maintenance Overview

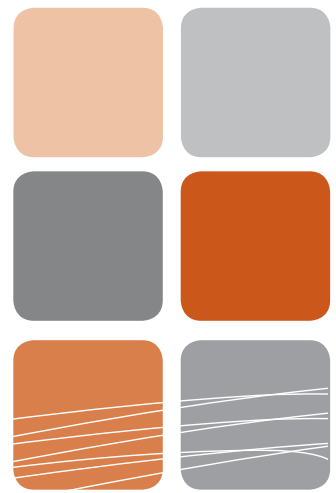
Maintenance processes will differ between surface types but the basic principles and objectives are the same:

- Inspect the surfaces regularly for safety, and signs of wear.
- Remove detritus from the surface.
- Apply treatments to reduce or impede the growth of plant life.
- Clean and power wash the surface to remove plant life, dirt and other contamination.
- Re-distribute infill material in the surface (i.e. rubber granules, sand, artificial clay).
- Repair broken elements of the surface.
- Ensure that equipment such as goals and netting is safe and in good working order.

There are different types of maintenance that can be carried out on the surface, ranging from routine cleaning and brushing to more advanced treatments requiring specialist equipment and chemicals. Simple routine maintenance can be conducted by the ground staff but more advanced procedures are often undertaken by specialist companies with advanced equipment which can prolong the life of an ageing facility.

In this section are specialist maintenance considerations for:

- 6.1)** Artificial grass pitches.
- 6.2)** Artificial grass (sand-filled) tennis courts.
- 6.3)** Artificial grass cricket pitches.
- 6.4)** Artificial grass lawn bowling greens.



6.2 Maintenance of Artificial Grass Pitches

6.2.1 Introduction

Synthetic turf pitches are generally hard-wearing, however to ensure that the surface continues to meet the specific performance requirements throughout the pitch's life, maintenance is essential. The primary aim of this maintenance is to keep the artificial grass surface and surrounds as clean and free of litter, spoil and the build-up of airborne contaminants as possible. The other important aspect of maintenance is the grooming and regulation of the infill material and the inspection and attention to any failure and opening up of the seam or joints.

Such maintenance is critical if the surface is to achieve its optimum performance, and life. The installer's guarantee or warranty will usually be conditional on the recommended maintenance requirements being carried out with reasonable diligence and recorded properly for auditing.

6.2.2 What Maintenance and Why?

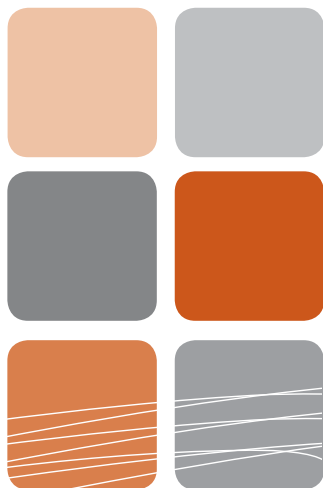
Maintenance procedures are designed to ensure that:

- The playing surface is kept scrupulously clean and the infill topped up to the required level.
- The playing surface remains level and of consistent texture so that it gives a true and predictable game.
- The effective drainage of surface water is maintained throughout the life of the pitch.

- The facility looks attractive and well-kept at all times.
- The specific performance requirements continue to be met.
- The playing surface does not become slippery due to the growth of algae and moss, or harder through compaction of the infill.
- The optimum service life is achieved from the installed surface.

These objectives are achieved by:

- Regular inspections.
- Sweeping leaves and other detritus from the surface.
- Grooming the surface through brushing and/or drag matting. Grooming lifts the fibres at the surface, redistributes evenly any sand or rubber that has been disturbed, and counteracts compaction of the sand and any tendency to form an impervious surface skin that might impair drainage (filled surfaces only).
- Applying prophylactic treatments of moss-killer and/or algaecide.
- Power washing to remove algal growth. Extraction is also required to ensure that the residue does not flow back into the carpet (unfilled surfaces only).
- Any joint or seam failure is repaired and reinstated promptly before loss of any synthetic surface pile or risk to users.

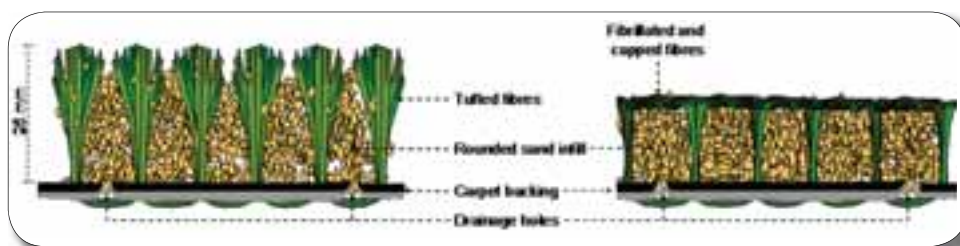


Note: the recommendations of the carpet installer or supplier should always be followed otherwise the manufacturer's warranty may be affected and potentially voided. Seek particular advice if you are contemplating the 'power washing' option, because the force of water application is potentially damaging to the seams and carpet. Appropriate training in maintenance of the system should be provided by the contractor prior to completion and handover.

SAPCA²¹ research into 'best practice' suggests the top three reasons for maintaining good maintenance practices are:

- To ensure even distribution of sufficient (not excess) infill.
- To minimise infill contamination.
- To ensure that the fibres stay upright.

If the surface is not maintained properly, fibres can eventually split and then fold over and 'cap' the surface (see illustration below). Should this happen, the surface will become hard and fast, traction will be diminished, and drainage reduced. The 'exposed' artificial grass fibres across the surface will also be vulnerable to faster ultra-violet degradation.



Fibrillation and Infill Confinement © Cranfield University 2008 www.cranfield.ac.uk

6.2.3 Maintenance Issues

Depending on the type of surface (unfilled, dressed or filled) the maintenance requirements will differ. Consequently, it is essential to follow the instructions provided by the carpet manufacturer and installer to ensure the correct methodology is applied. In this section a list of maintenance procedures are described which are commonly used for all types of artificial grass surfaces.

Initial maintenance (filled surfaces)

For infilled surfaces, immediately after installation of the carpet there may be a period where the infill is somewhat mobile and has not reached the full degree of compaction within the carpet pile to give its optimum performance.

Initially the surface may have a slight excess of infill material on its surface, but full penetration of the infill into the fibres of the carpet and its subsequent compaction into a uniform playing surface occurs naturally, through good initial grooming helped by rainfall and by play on the surface. This process may take up to two to three months. It may be necessary to top up specific areas of high wear such as penalty spots and short-corner areas, at regular intervals dependent on use.

During construction every effort is made to ensure even distribution of infill over the whole pitch. Experience shows,

however, that increasing the frequency of brushing in the early weeks of use is beneficial in creating the final playing surface.

If areas are found which are short of infill, it should be possible to brush the infill into them from adjacent areas of ample or surplus material, provided this is done within the first few weeks. If the under-filled areas are extensive (or do not respond to this treatment) the installer should be called in immediately to add more infill.

Conditioning surfaces

Any artificial grass surface can produce static charge. When materials are exposed to outdoor elements, over time, the grass tends to lose the ability to create or hold static in any way. To eliminate any potential for static charge or to alleviate a problem, simply condition the area with a 5 to 10% solution of fabric softener and water sprayed generously across the surface. An unscented liquid (biodegradable where possible) is recommended. Leave the materials on overnight and then rinse. You may need to repeat the application in a few weeks. Generally, after the first winter, the grass blades are grounded and can't hold a static charge due to the accumulation of materials on the blade surfaces.

²¹ SAPCA: Sport and Play Constructors Association (U.K.)

Keeping the surface clean

Leaves, tree flowers, pine needles and other detritus should not be allowed to remain on the surface for any length of time. If this does happen, they rapidly rot down forming a drainage-inhibiting skin within the surface and providing a growing-medium for algae and moss.

A wide soft broom, a rubber-tined rake or mechanical blower is suitable for removing vegetable matter and other rubbish. Better still, a mechanical leaf-sweeper or vacuum cleaner will greatly speed up the operation. The equipment should be well maintained and carefully operated to avoid contamination of, or physical damage to, the surface. Both sweepers and vacuum cleaners may tend to remove too much infill during the first few months of the life of the surface, but thereafter this should cease to be a problem. Some disturbance of the surface including the sand and/or rubber can be a positive benefit (see 'grooming' below).

The provision of litter bins, an information board outlining do's and don'ts and footwear cleaning mats or wash area will help to keep the surface clear of spoil brought on by players and users of the facility. It is strongly recommended that the pitch should be treated as a 'no smoking' area, since a dropped cigarette can melt the fibres down to the surface leaving an unsightly mark. Chewing gum should also be banned.

Grooming

Grooming the surface is a crucial operation aimed at keeping the mat and texture of the artificial grass as even and uniform as possible to prevent the deterioration of play characteristics, appearance and drainage properties. Apart from freshening up the look of the surface, the purpose of regular and fairly vigorous brushing is to prevent the formation of a compacted and impervious skin on the top of the sand or rubber bed that will inhibit drainage and encourage moss and algae. Because the bed of infill is an effective filter, it unavoidably retains any particulate matter conveyed or blown on to the pitch or carried down by rainfall. By constantly disturbing and moving the upper layers of sand or rubber, brushing and vacuuming can prevent or delay the onset of maintenance issues by several years.

Drag brushing with a wide brush with bristles of medium stiffness is valuable

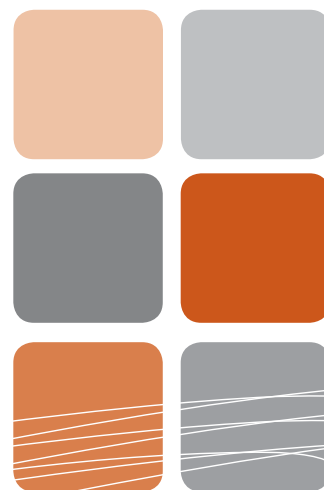
in this regard. The installer should be able to recommend or supply the correct type. There are many types on the market, with prices ranging from \$400 to \$1000. On a full-size installation it would be normal to pull the brush along with a suitable small tractor with low pressure balloon-type tyres, these typically cost in the range of \$10,000 to \$20,000. On much smaller installations the brush can be dragged manually. Brushing should ideally be done in both directions each time: up and down the length of the pitch and then at right angles across it, but if this is too time-consuming, the direction of brushing can be varied from occasion to occasion.

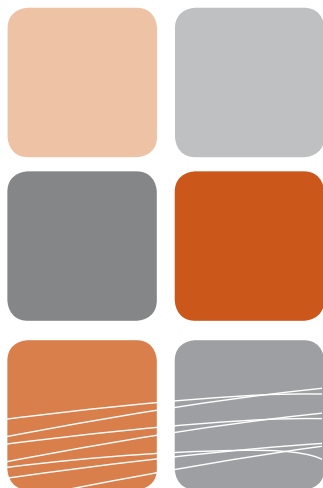
Top Tip

Following brushing (with sand-filled, and possibly sand-dressed pitches as well) it is likely that more of the infill will be visible on the surface, so consideration should be given to the timing of brushing if particular users or sports prefer less infill to be visible.

Grooming and brushing must be done to avoid any damage to the mat and pile of the artificial grass. It is essential that no damage has occurred on the meshing of the mat to avoid snagging of the surface. For fibrillated carpets, to avoid the risk of damage and to slow down the fibrillation (the splitting of the carpet fibres) of the pile, a carpet 'sock' around a steel drag mat can be used. The sock consists of a section of artificial grass material formed into a sleeve to fit the drag mat. This is used when a light re-distribution of the fill is required, without over-agitating the material and bringing it to the surface. If drag matting, with or without a sock, is regularly carried out, it is important that a frequent, deeper penetration of the upper infill layers also takes place with a drag brush or, ideally, a powered sweeper to minimise the risk of a skin or pan forming on the infill layer.

The recommended frequency of grooming must depend on the amount of use the pitch receives and whether its location is open and clean. General housekeeping and checking of infill levels in high-use areas such as penalty spots should be done once a week, but it may be advisable to brush more often if the pitch is heavily used, shaded or subject to pollution.





It cannot be overemphasised that to neglect the grooming of this kind of pitch may have serious long-term consequences even if, in the shorter term, the pitch does not appear to suffer. Grooming and cleaning need not be either time-consuming or onerous, and its benefits are profound. To omit the process may result in a pitch ceasing to drain at half-life or sooner. An ungroomed pitch will look scruffy and be susceptible to moss infestation.

The installer's advice should always be sought when considering the use of any but the lightest machines.

Power brushing

Many (but not all) manufacturers of third generation rubber-filled surfaces now recommend the use of powered brushing machines to ensure that the rubber particles remain mobile and the carpet fibres upright.

Many of the machines on the market use a contra-rotating brush, which as the machine moves forward brushes the fibres and particles forward. The equipment required can cost in the range of \$20,000 to \$40,000 AUD and may be a worthwhile investment for facilities which are heavily used or are required to be in their best condition at all times. If this is beyond the capability of owners of small facilities then there are specialist contractors offering this service. The process may be required up to four times per year but will depend upon usage and environment.

Top Tip

If using a brushing/brushing-vacuuming machine on your carpet, be careful to select the machine after receiving clear advice from your carpet supplier. Incorrectly chosen/used brushes can do more harm than good to carpet fibres, seams, etc.

Deep cleaning

Both sand filled, dressed and rubber-filled surfaces may in time require a degree of deep cleaning. The timing required for these actions will depend largely on the environment and use. Detritus, pollution and the breakdown of the carpet fibre all add to surface contamination. In time these will settle into the carpet pile and lead to hardening of the surface and a reduction in surface permeability. Usually an

owner of a facility will only be aware of the need to carry out deep cleaning when the surface begins to hold water after heavy rain. The amount and type of deep cleaning required will depend upon the type of surface contamination and how far down into the carpet pile it has reached. It may be worthwhile employing a specialist to assess this and recommend the most appropriate corrective action.

If, in spite of the regular maintenance described above, or as a result of a lack of it, the surface becomes over-compacted, clogged-up and impervious, this condition may warrant correction using specialist machinery (the advice of the supplier should be sought in this regard) to remove a proportion of the infill (containing almost all the filtered dirt) from the upper part of the carpet. This is then replaced with new or cleaned infill.

The best of these processes will improve the play characteristics, ball roll and surface/foot interaction and will prolong the useful life of the pitch by a number of years. It is essential that any scarification or very deep penetration of the surface is only carried out by experienced operatives.

Top Tip

Power washing of filled surfaces should be avoided because the action of the water on the fill can mix the contaminants through the depth of the pile and increase clogging of the through drainage.

Top Tip

Deep cleaning is best undertaken with the surface completely dry. This needs to be factored into the facility's usage and programming.

There are two basic methods which will remove contamination from within the carpet fibres. The first uses a large contra-rotating brush to tease out around 5mm of the infill material and help to brush-up the carpet fibre. The contaminated sand or rubber is vacuumed out and in some cases filtered and returned to the surface, in others it is simply returned to the surface, and if required can be removed and replaced. Typical machines necessary to undertake this type of cleaning cost around \$20,000 AUD. However there are a number of specialist companies

offering this service. This process is unlikely to be required within the first five years of the pitch's life unless flooding or other serious contamination event has occurred. However consideration should be given to carrying out this every two or three years after the end of the first five years. It has been noted however that if contaminated infill is not removed from the pitch it can prove to be a continuing problem gradually settling out further down into the carpet fibre.

The second method of deep cleaning uses proprietary machines which use either compressed air or water to force the contaminated infill from the carpet fibres, which is then removed from the surface, filtered and returned (or new infill is installed). Generally these machines remove up to 15mm of contaminated fill material. The cost of these treatments is expensive for a full-size pitch. They should be considered if severe contamination has occurred and the pitch surface permeability has reduced to a degree where the pitch is not being used after heavy rain due to surface water or the contamination, usually in the form of a slippery sludgy material, is causing the pitch to be dangerous for players.

Moss and algae prevention and removal

In certain situations and in some seasons, algae or moss can become established on the surface. Since prevention is more effective than cure, it is important to treat the affected areas of the pitch with a good proprietary moss killer and algaecide at least once a year. Some manufacturers will recommend twice a year because they are known to have minimal residual properties.

Moss is not usually found on the parts of the surface that are trafficked by play, and although it may not be essential to treat these areas it is still a wise precaution to do so. However, particular attention should be paid to perimeter and other areas that are not trafficked, especially if they are shaded by walls or buildings or are overhung by trees. Proprietary product should not be oil-based. The manufacturer's instructions should be closely followed. Some installers can supply specially formulated moss-killers.

Where moss becomes established it should be treated immediately, the application being repeated after the dead spores are removed until

eradication is complete. In the case of very severe infestation, the installer should be consulted. High air-pressure cleaning equipment is available but its use is a skilled process.

It should be emphasised that moss is only a serious problem if it is allowed to become established. An annual prophylactic application of moss-killer is an easy way of preventing this. Regular grooming and regular use of the pitch render moss an even less likely problem.

Removal of weeds

No matter how much care is taken, weeds may occasionally appear on the surface, usually as a result of wind-blown seeds. Small numbers of weeds can be removed by hand without damaging the surface. If the weeds are removed by hand, it is important to ensure that the full root of the weed is extracted, not broken off. Some weeds are more prolific if they are simply cut off at surface level. If the weeds are deep-rooted it is advisable to kill them with an appropriate weed-killer.

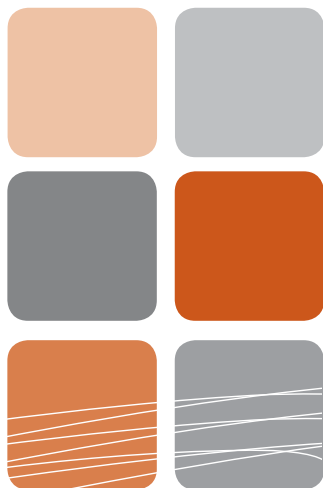
Localised areas of weed seedling infestation can be treated with domestic weed killers without causing damage to the surface of the pitch. Always check with the carpet supplier or installer to ensure the chemicals applied to the surface are acceptable and will not void the warranty. Oil-based weed-killers should not be used.

Play lines

An artificial grass pitch will normally be supplied with permanently inlaid play lines. The number of sports to be included and whether the lines are to be inlaid or painted on to the surface will be decided prior to construction. However, if additional lines are required for special events or changes in the sports being played, these can be painted onto the surface using line paint. Some of these are more effective than others and consultation with installers, suppliers and other users of artificial grass pitches is recommended. Chalk lines can be applied but these tend to leave a lasting powder spread in the area of the line. Marking compounds for natural grass should not be used because these will leave a build-up forming a crust and potential trip hazard.

Permanent lines require no special attention, other than, if cut-in, occasionally checking they are secure. This regular check should also be carried out on the seams in the carpet.





Any breakdown of the seams at lines or in the main carpet should receive immediate attention to avoid ongoing deterioration. This should be reported to the installer if within the warranty period. If the warranty has expired, a number of specialist companies will offer seam repair services. In the past seam failure has determined the service life of the facility.

Stain removal

Most stains can be removed easily with a solution of warm (not boiling) water and a household detergent such as dishwashing liquid. The removal of chewing gum can be simplified by making the gum brittle with a proprietary aerosol freezing material (then chip it away). Heavy oil marks may be removed with a cloth and white spirit used in moderation.

Dog urine will not stain the surface, but dog and rabbit droppings will need to be picked up manually because they will not break down. Dogs may also cause surface unevenness by digging and disrupting the level of the infill (although it is not anticipated that this will cause extensive or permanent damage).

Seek the advice of the manufacturer before attempting to remove heavy soiling and stubborn stains.

Top Tip

Care should be taken to ensure that all equipment that may be used on/near the surface system is free of oil and fuel leaks. All refuelling and servicing of the machinery should be remote from the installed surface.

Footwear

Suitable footwear should always be used. Most shoe manufacturers produce boots that are specifically designed for the sport played on a artificial grass pitch. Some artificial grass systems, eg. long-pile systems, are designed to take a normal soccer or rugby stud. Consideration should be given to excluding the use of bladed studs, as it has been suggested that these types of studs can increase wear on the surface. Consequently, if any doubt

exists the surface manufacturer should be consulted.

6.2.4 Daily, Weekly, Monthly, Annually

The following are minimum recommendations. Cleaning, brushing and pitch inspection can always be done more frequently, to the benefit of the surface. Common sense and careful observation should prevail. If any serious doubt exists about the effectiveness of the maintenance regime or the condition of the pitch, contact the installer immediately.

Daily – at end of the day's play:

- Check fixtures and fittings.
- Make sure gates are shut.
- Check and top-up fill levels at high-traffic areas such as penalty spots, and short corners.

Weekly:

- Clear leaves and rubbish from the area.
- Deal with any new weeds, moss or algae.
- Brush the surface of the pitch.

Monthly:

- Check infill levels (filled only).
- Outside the fence, check and clear mowing strips and check cleanliness of access paths.
- Check seams and inlaid lines, and report failures to installer.
- Check the irrigation system (if required).

Periodically (at least every six months):

- Check thoroughly for moss, algal growth, food stains, or other debris, and remedy as appropriate.
- Treat pitch with moss killer, algaecide, etc.
- Power brushing to help keep the infill mobile and the carpet fibres erect (filled only).

Annually:

- Treat pitch with moss-killer or algaecide.
- Call in installer if any aspect is causing significant concern.

Deep cleaning should only be carried out if surface contamination is suspected and then only by specialist contractors.

Top Tip

Maintenance procedures for sand-dressed and rubber-granule infilled fields are still evolving. If you are constructing a facility utilising either of these infill mediums, ask your manufacturer/supplier for a product-specific maintenance regime.

Top Tip

A crucial tip for maintaining the pitch is to do a little often, rather than neglecting maintenance procedures for months and then facing large expenses to restore the pitch to its optimum performance capabilities.

6.3 Maintenance of Artificial Grass Tennis Courts

6.3.1 Introduction

An artificial grass tennis court is basically a tufted synthetic carpet laid on a base usually constructed of concrete or asphalt (preferably porous in nature). The carpet is then usually filled with sand to occupy the space between the carpet fibres to within about 2mm of the top of the pile. The purpose of the sand is to hold the carpet in place, to provide a firm playing surface and to facilitate the drainage of surface water.

Play-lines are either tufted into the carpet (and are therefore integral with it), or are subsequently cut in using similar carpet materials of the appropriate white or yellow colour. The resulting tennis surface is permeable, hard-wearing and requires only a modest amount of maintenance. This maintenance is, nevertheless, of vital importance if the surface is to remain visually appealing, consistent in play, permeable and long-lasting. Indeed, the installer's guarantee will usually be conditional on the recommended maintenance requirements being carried out with reasonable diligence.

6.3.2 What Maintenance and Why?

Maintenance procedures are designed to ensure that:

- The playing surface is kept scrupulously clean.
- The surface is level and of consistent texture to give a true and predictable bounce.
- The free drainage of surface water is maintained throughout the life of the court.
- The tennis court will look attractive and well-kept at all times.

These objectives are achieved by:

- Sweeping leaves and other debris from the surface.
- Brooming the surface to freshen the fibres, counteracting any slight sand drift or compaction and counteracting any tendency to form an impervious skin on the sand surface that might impair drainage.
- Applying prophylactic treatments of moss-killer and/or algicide.

6.3.3 Maintenance Issues

Keeping the surface clean

Leaves, tree flowers, pine needles and other debris should not be allowed to remain on the surface for any length of time. If this does happen, they rapidly rot down forming a drainage-inhibiting skin within the surface, and provide a growing medium for algae and moss.

A wide soft broom or a rubber-tined rake is ideal for removing vegetable matter and other rubbish. A mechanical leaf-sweeper or garden vacuum cleaner will greatly speed-up the operation. The equipment should be well-maintained and carefully operated to avoid contamination of, or physical damage to, the surface. Both sweepers and vacuum cleaners may tend to remove too much sand during the first few months of the life of the surface, but thereafter this should cease to be a problem. Some disturbance of the surface of the sand may be a positive benefit (see Brooming below).

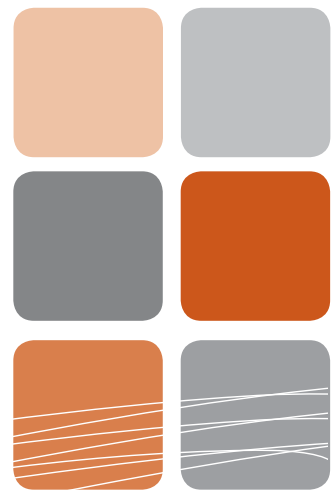
Brooming

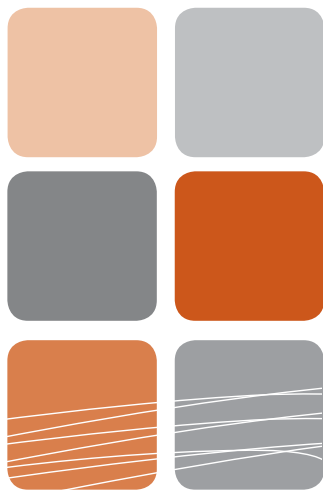
Brooming the surface is a crucial operation if premature loss of appearance and drainage is to be prevented. Apart from freshening the look of the surface, the purpose of regular and fairly vigorous brooming is to prevent the formation of a compacted and impervious skin on the top of the sand-layer which will inhibit drainage and encourage moss and algae.

A one metre wide broom with bristles of medium stiffness is best. The installer should be able to recommend or supply the correct type. It can be dragged over the surface or, better still, pushed. Brooming should ideally be done in both directions - the length of the court and then at right angles across. If this is too time-consuming, the direction of brooming can be varied from time to time.

The recommended frequency of brooming must depend on the amount of use the court receives and whether its location is open and clean. Once a month is a recommended norm, but it may be advisable to broom more often if the court is heavily used, shaded or subject to pollution.

There is a selection of mechanical brooming machines available, which will speed up and lighten the operation and these are recommended at clubs and





other venues where there are several sand-filled artificial grass courts. The machines vary in the vigour with which they broom the surface, some are rather fierce and are only recommended for use by experienced operatives and where heavy remedial brushing is needed.

Combined brush and vacuum machines must be used with even greater care because sand brushed and sucked from the surface may be very difficult to replace, especially when the court is well worn. The installer's advice should always be sought when considering the use of any but the lightest machines.

It cannot be overemphasised that to neglect the brooming of this kind of court may have serious long-term consequences even if, in the shorter-term, the court does not appear to suffer. Brooming need not be either time-consuming or onerous, and its benefits are profound. To omit the process may result in a court ceasing to drain at half-life or sooner. An un-broomed court will look scruffy and be susceptible to moss infestation.

If, in spite of the regular brushing described above, or as a result of a lack of it, the sand-filled surface becomes over-compacted and impervious, this condition can often be corrected by appropriate treatment usually involving the use of specialist machinery. Machines vary from simple scarifiers to more elaborate proprietary machines that remove a proportion of the sand from the carpet, which is then replaced with new sand. The best of these processes will prolong the useful life of the carpet by a number of years.

Moss and algae

In certain situations and in some seasons, algae or moss can become established on the court surface. Since prevention is much more effective than cure, it is important to treat the court with a good proprietary moss-killer and algaecide at least once a year.

Moss is not usually found on the part of the surface that is trafficked by play, and although it may not be essential to treat these areas it is still a wise precaution to do so. Particular attention should, however, be paid to those perimeter and other areas that are not trafficked, especially if they are shaded by walls or buildings or are overhung by trees. Particular attention should be paid to courts located in dark and wet areas that have significant tree cover. These

surroundings do not promote open air and free drying of courts and moss and algae can propagate easily in moist environments.

Proprietary product should not be oil-based. The manufacturer's instructions should be closely followed. Some installers can supply specially formulated moss-killers. Where moss becomes established it should be treated immediately, the application being repeated until the moss can be brushed and cleared away. In the case of very severe infestation, the installer should be consulted. High-pressure cleaning equipment is now available but its use is a skilled process. It should be emphasised that moss is only a serious problem if it is allowed to become established. An annual prophylactic application of moss-killer is an easy way of preventing this. Regular brooming and use of the court renders moss an even less likely problem.

The first month or two

Immediately after construction there is an initial working-in period during which the final playing surface is created. Initially the court surface will be left rather sandy, but full penetration of the sand infill into the polypropylene fibres and its subsequent compaction into a uniform playing surface occurs naturally, especially as a result of rainfall and initial play. This process usually takes two to three months.

During construction every effort is made to ensure even distribution of sand over the whole court. Experience, however, shows that increasing the frequency of brushing in the early weeks of use is beneficial in creating the final playing surface.

If areas are found which are short of sand it should be possible to brush the sand into them from adjacent areas of ample or surplus sand, provided this is done within the first few weeks. If the under-sanded areas are extensive or do not respond to this treatment, the installer should be called in immediately.

Play lines

An artificial grass court will normally be supplied with permanently in-laid playing lines. Permanent lines require no special attention.

Stain removal

Most stains can be removed easily with a solution of hot (not boiling) water and a household detergent, such as washing

up liquid. The removal of chewing gum can be simplified by using ice cubes or freezing spray to harden the gum. Heavy oil marks can be removed with a cloth and methylated spirits.

Dog urine will not stain the surface, but dog droppings will need to be picked up manually because they will not break down. Dogs may also cause surface unevenness by digging and disrupting the level of the infill (although it is not anticipated that this will cause extensive or permanent damage).

Weeds

No matter how much care is taken, weeds may occasionally appear on the surface, usually as a result of wind-blown seeds. Small numbers of weeds can be removed by hand without damaging the surface. Localised areas of weed seedling infestation can be treated with domestic weedkillers without causing damage to the surface of your court. Oil-based weedkillers should not be used.

Rejuvenation

Rejuvenation involves the removal, cleaning and replacement of the sand to assist de-compaction of the sand and to improve drainage. Generally it should be undertaken at about the half-life of the carpet. This would generally be done in the range of four to seven years after installation of a new sand-filled artificial grass surface²¹.

Footwear and general court care

Suitable footwear should always be used, i.e. good quality tennis shoes. If the court is used occasionally for other sports (eg. hockey), rubber moulded boot studs will be satisfactory. Metal studs must not be used. It is strongly recommended that the court should be treated as a 'no smoking' area because a dropped cigarette can melt the fibres down to the surface leaving an unsightly mark. Chewing gum should also be discouraged.

6.3.4 Daily, Weekly, Monthly, Annually

Daily – at end of the day's play:

- Make sure the net is slackened and rolled up in the middle – if practical.
- Make sure the gate is shut.

Weekly:

- Clear leaves and rubbish from the court.
- Deal with any new weeds, moss or algae.

Monthly:

- Broom court to redistribute sand. Check sand levels.

Periodically

(at least every six months):

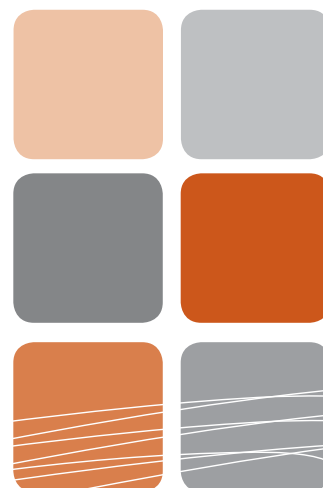
- Check for moss and algal growth, food stains, shoe marks etc. and remedy as appropriate.
- Apply grease to the net winding gear.

Annually:

- Treat court with moss-killer or algaecide.
- Call in the installer if any aspect is causing significant concern.

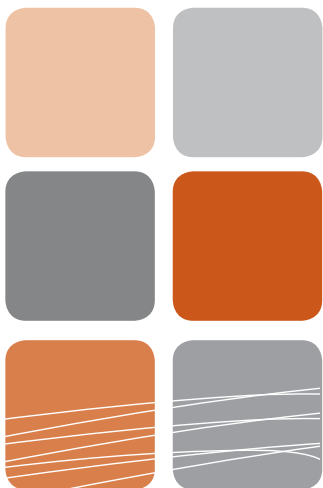
Note: These are minimum recommendations. Cleaning, brooming and court inspection can always be done more frequently. Commonsense and careful observation should prevail. If any serious doubt exists about the effectiveness of the maintenance regime or the condition of the court, call in the installer immediately.

All artificial grass suppliers and installers should supply purchasers with an owner's manual that includes a recommended maintenance regime. Following this regime will be important in meeting your warranty obligations. Always seek the manufacturer's advice prior to undertaking major cleaning and/or rejuvenation works.



Artificial Clay Infill

²¹ Tennis Australia Information Sheet – Sand Filled Artificial Grass Surface, 2003



6.4 Maintenance of Artificial Grass Cricket Pitches

6.4.1 Introduction

Artificial grass cricket pitches are normally constructed by installing a short pile, high-density artificial grass carpet over a concrete base, sometimes with the addition of a cushioning layer (bowlers' shock pad) under the carpet from the popping crease back to the start of the concrete slab.

The carpet is normally within the range of 9-11 mm fibre height.

6.4.2 What Maintenance and Why?

In order to get the most out of an artificial cricket pitch there is a certain amount of initial and routine maintenance that needs to be carried out. Adhering to this maintenance will help to extend the useful life of the facility while ensuring the best possible performance of the surface. If maintenance is not carried out then the life and performance of the pitch will deteriorate.

Maintenance procedures are designed to ensure that:

- The surface is kept scrupulously clean.
- The surface is safe for all standards of user.
- Moss and algae are not allowed to grow on the surface.
- The pitch achieves its intended lifespan.

These objectives are achieved by:

- Sweeping leaves and other detritus from the surface.
- Applying prophylactic treatments of moss killer and algaecide.
- Washing if required.
- Removing weed and grass growth from the periphery.
- Cutting the perimeter grass.
- Repairing the surface.

6.4.3 Maintenance Issues

Keeping the surface clean

Leaves, pine needles, grass clippings and other debris should not be allowed to remain on the pitch for any length of time. If this does happen they will rapidly rot down and encourage the growth of moss and algae, resulting in a slippery and dangerous surface, which will also affect performance. Therefore the pitch should be swept regularly by hand brushing with a stiff broom. Stains or discolouration can be washed from

the surface with a hose or high-pressure washer if required.

Stain removal

Most stains can be removed easily with a solution of hot (not boiling) water and a household detergent, such as washing up liquid. The removal of chewing gum can be simplified by using ice cubes to harden the gum. Heavy oil marks can be removed with a cloth and methylated spirits.

Dog urine will not stain the surface, but dog droppings will need to be picked up manually because they will not break down.

Moss and algae

In certain situations moss and algae can become established on the surface carpet. Since prevention is better than cure it is important to treat the surface with a good proprietary non oil-based, moss-killer and algaecide once per year. If moss is already established, then the resulting dead moss should be brushed from the surface with a stiff broom.

Crease markings

The crease lines should be re-marked regularly with the paint which has been recommended by the supplier of the pitch or surface.

Pitch perimeter

Grass growing at the perimeter of the pitch needs to be properly maintained. Ideally it should be cut with a cylinder mower, with the intention of keeping clippings and dust away from the pitch surface.

Footwear

Cricket boots with metal studs or spikes should not be worn on an artificial grass pitch because the spikes could rip the carpet. The footing of any player wearing spiked shoes would also be compromised because the spikes might grip the surface too firmly and not allow free movement across the surface. To minimise the wear and tear, wear multi rubber-studded boots.

Stump areas

Some artificial cricket pitches will have an area of clay or soil around the stumps so proper stumps can be used instead of portable ones. The clay or soil should be worked around with your heel to re-firm it, adding a little water if necessary to soften it.

Surface repair

Depending on the amount of use per

year, after a number of years, the carpet may show signs of fraying in high-wear areas such as the bowler's delivery area and where the batsman takes block. Any such areas should be given immediate attention by applying a suitable adhesive to bind together any loose fibres (consult the supplier or installer of your pitch). If this work is not carried out then it will be necessary to patch the surface with a new strip of artificial grass. The supplier or installer of the pitch should be able to provide instruction on how this is best carried out.

Note: It is important that no repairs to the surface are carried out in areas where a ball is likely to pitch, as it could cause a dangerous bounce.

6.4.4 Daily, Weekly, Monthly, Annually

The following schedule may vary dependent on the specific instructions

provided by the carpet system installer.

Daily – before each match:

- Brush to remove debris.
- Re-mark if needed.

Weekly – throughout the season:

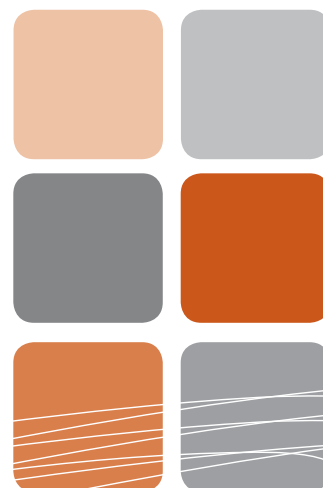
- Brush to remove debris.
- Mow the perimeter to the pitch.

Monthly:

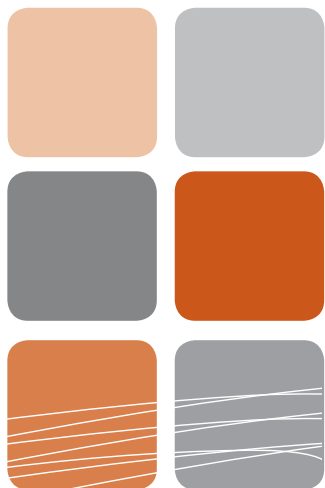
- Deal with any moss, algae or weeds.
- Repair any areas of frayed carpet.

Annually:

- Carry out pre-season uncovering and cleaning.
- Apply moss and algae treatment if needed.
- Patch any damaged areas if required.



Cricket practice facilities, Kuranjang Reserve, Melton



6.5 Maintenance of Artificial Grass Lawn Bowling Greens

6.5.1 Introduction

This section on the maintenance of lawn bowls synthetic surfaces has been written based on information from various websites, and with specific advice provided by industry sources. From this review it is clear that there are differences of opinion/emphasis about certain maintenance processes. It is therefore emphasised that the information provided below is of a general nature only. Specific maintenance plans for specific greens should be developed through ongoing liaison with the manufacturer or installer of each green.

Maintenance requirements for lawn bowls synthetic surfaces are much reduced in comparison with natural turf greens, mainly revolving around keeping the surface dirt and dust free, which, if not done, can lead to the surface becoming hard and fast and the natural drainage through the surface system getting clogged and slowing down.

As described in Section 1.5.2 of this guide, there are three different types of lawn bowls synthetic surfaces, tufted (partially sand-filled), and two non-filled products: woven and needle-punched. Given that, Section 6.5.3 (Maintenance Issues) that follows will be structured as per:

- a) Generic Issues.
- b) Specific advice related to tufted carpets.
- c) Specific advice related to woven and needle-punch carpets.

6.5.2 What Maintenance and Why?

The playing characteristics required of a bowls surface relate to issues such as flatness, rolling speed, sand levels (where appropriate), vertical drainage capacity, etc. All of these elements are dependant on good maintenance practices.

While the impact time and the labour costs associated with the maintenance of natural turf greens have become too prohibitive for many bowls clubs, it is incorrect for them to anticipate that lawn bowls synthetic surfaces are going to be maintenance free.

Maintaining high-quality playability and maximising the lifespan of such facilities requires a full understanding of and ongoing commitment to necessary,

continual maintenance practices.

6.5.3 Maintenance Issues

a) Generic issues

The general principles of maintenance of bowling greens are the same as for all synthetic surfaces. However the game of bowls requires an extremely level and smooth playing surface and maintenance should only be undertaken by trained and knowledgeable staff. The advice and instructions of bowls synthetic surface suppliers should be sought before undertaking maintenance on a bowling green. Having said that, the following generic information contributes towards a checklist of issues and ideas to pay attention to:

Prevention

Remember that maintaining a synthetic grass surface begins long before the laying of the surface. It begins at the time of planning, design and construction.

It is imperative that a geotechnical soil test be conducted as a pre-requisite for installing a synthetic surface.

- Design your installation to be free of total shade spots.
- Always plan for the heaviest possible rainfall and be aware of any situation that could result in water running onto your green.
- Ensure retaining walls have their own drainage and do not let water seep onto the surface.
- The bank area where your bowlers step onto the green **MUST** be very well grassed or suitable matting or paving should be provided. This will prevent dirt or mud being carried onto your green via players' shoes.
- Remove loose matter regularly.
- Avoid unnecessary traffic on the surface.
- Ban food and smoking near the surface.
- Correct footwear must always be used (flat soled).

Settling-in period

After your new green has been constructed, be a little patient in the interests of achieving a beautiful, flat playing surface. Your members will have experienced the long settling period with natural greens – your artificial grass green will require a much shorter settling period, but will still require a little time to stabilise.

Changing rink numbers

Changing rink numbers is similar to that recommended for a grass green, ie. do it on a regular basis to facilitate even wear over the whole of the green.

Line marking

Do not force any markers through the surface into the base (eg. golf tees) the initial 2m marks can be put in place by using a small round piece of sponge dipped in water-based paint. Mark a 2m and a 5m dot, and draw a chalk line impregnated with titanium (or similar marking chalk), between the two dots in line with the number at the opposite end of the green. Alternatively a craft marker filled with water-based paint can be purchased at major hardware and office supply stores.

Rink markers

Four sets of rink markers should be sufficient. Once in place the lines can be re-marked before the lines have completely faded to avoid the need to re-measure the rinks. T-bars can be added using a wooden bar with a light cotton rope attached and when rubbed in the titanium will mark a crossbar at the 2m spot.

'Dumping' bowls

Please note that continual 'dumping' of bowls at the ends of the green may result in minor cracking of any bonded surface over time. This will then make the bonded surface more susceptible to movement during or after heavy flooding. 'Dumpers' should be coached to avoid any serious imperfections of the base layer. A bowling aid may need to be used. A 2mm imperfection will make a huge difference to the running of today's narrow bias bowls.

Influence of climate

The local climate will have a bearing on the playing characteristics of the green. This varies from club-to-club depending on wind exposure, mean temperatures and rainfall. How you groom and water will depend on the prevailing weather conditions, the settling down progress and the immediate play requirements. Good green-keeping judgment is still needed, even with synthetic grass.

Stain removal

(Refer also Section 6.6 – 'Chemicals on Artificial Grass').

- General instructions:

The first rule here is to act promptly because fresh spills are always easier to remove than dried or hardened

ones. Remove any solids with a plastic spatula. Blot up excess liquids with paper towels or a dry absorbent. Dry absorbents can then be swept or vacuumed.

- Procedure:

Polyethylene surfaces have good resistance to staining. However, the surface is only one part of a sophisticated system of components designed for overall green performance. Some cleaners safe to use on polyethylene could be harmful to other parts of the system. This means cleaning fluids should be grouped into two sets – those which can be used liberally on the surface and those which should only be applied by rubbing with a cloth soaked in the cleaner to minimise possible effect on the pad.

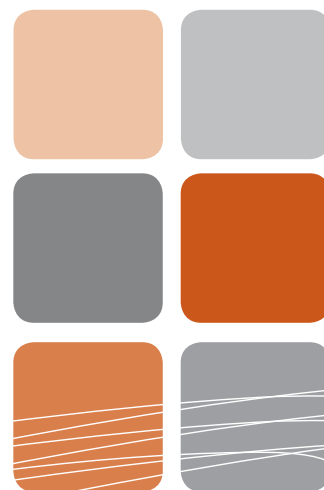
The following cleaners (first group) can be applied without any special precautions:

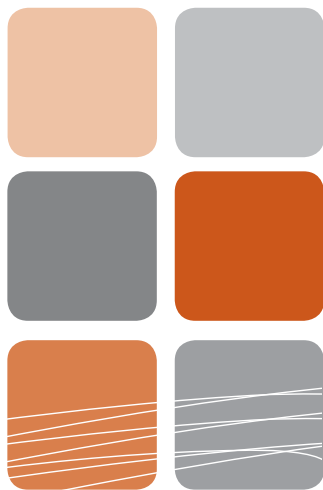
- A warm mild solution of granular household detergent in water OR a neutral low-foaming detergent recommended for delicate fabrics. Use with approximately 5 litres of water.
- Stains removed with detergent solution include: Coffee, tea, grape juice, tomato juice, cocoa, watercolour, beer, cola, milk, ice cream, tomato sauce, food colouring, mustard, margarine, butter.
- A 3% solution of ammonia should be used for more severe problems. Thoroughly flush the surface with lots of cold water afterwards.
- Clean, dry absorbents such as paper towels or 'kitty litter' for stains which can be blotted up.

The second group of cleaners includes chemicals such as pH-neutral dry cleaning fluids. These cleaners must be applied sparingly using a damp cloth or rag, with care taken to avoid penetration beneath the turf (carpet). Before using any such chemicals, clarification should be sought from a member of your installer's technical team.

Stains removed with the second group of cleaners include: asphalt, ball point ink, shoe polish, cooking oil, suntan oil, lipstick, floor wax, crayon, scuff marks, motor oil/grease and chewing gum*.

(*Chewing gum is a common hazard and can be removed by using dry cleaning fluid, ice cubes or by freezing.





Aerosol packs or refrigerant can be sourced from carpet cleaning suppliers for this purpose, or dry ice could be used).

When using such products care should be taken to ensure that the user instructions are strictly complied with. To neutralise animal waste, use a mixture of white distilled vinegar with equal amounts of water. Flush thoroughly with water after the application. If in doubt, please consult your installer for clarification. The handling and use of cleaning chemicals in general should be undertaken in strict adherence to the manufacturer's instructions.

Vandal damage

Contact your insurers and the installer immediately.

Keep a diary

As with all types of bowling greens, a diary should be kept recording all actions carried out during the life of the green. Any unusual weather events should also be recorded.

Actions which may void a warranty:

- The use of any chemicals not approved by the installer.
- Failure to clean the surface as per instructions given in the maintenance manual.
- Allowing the drainage outlet to become blocked causing lengthy saturation of the base profile (if organic contamination is allowed to persist it will create a build-up of fine dirt. This will result in reduced drainage and contribute to hardening of the surface and/or moss and algae growth. If this condition is not dealt with on a regular basis the surface will deteriorate over time and put your warranty at risk). Contamination build-up will need to be professionally removed.
- Engaging a company other than the installer, or a contractor recommended by same, to undertake repairs or maintenance of the synthetic surface or base profile.
- The use of spiked footwear or inappropriate footwear on the surface.
- Using the surface for purposes other than bowls unless granted written permission from the installer.

b) Tufted carpets

Settling-in period

Encourage maximum use during the settling-in period because usage of the carpet will help to stabilise the sand infill. After the settling-in period the bowling green surface should provide an acceptable surface speed and performance with watering (where recommended) and grooming. The installers usually conduct the first grooming, and then, from that period forward the resident club should follow their recommendations. The bowling green surface is designed to work without any heavy maintenance after the settling-in period, and it should provide the required speed and performance with minimal watering, rolling and grooming.

Rolling

Rolling of synthetic bowling green surfaces should not usually be done by the club without express approval of the installer and then only under the installer's strict instructions.

Maintaining the sand level

The initial sand levels will be a little high because the green is slightly over-filled to allow the sand to settle with watering, rain and playing. Your sand level will probably drop about 2 or 3mm below the fibre tips and that is approximately where it should be maintained. The installer should return to inspect the surface to determine if the sand needs removal or topping up, and to provide any further advice.

Be aware that lowering the sand levels excessively will slow the green speed and make it difficult to maintain an even speed. Once the right sand level has been achieved, aim for a target speed of 13-15 seconds by balancing watering and grooming.

Post installation green speed adjustment

After a few months of play the ends of the green will show signs of trafficking and the green speed may increase over time. Brushing with a static brush every month will lift the fibres and reduce the green speed.

Grooming

Grooming (brushing) is to open and clean the pile; again follow the installer's recommendations.

Where available a converted reel mower can be used, utilising a fitted brush

instead of the cutting blade. The brush would nominally be set at a 2-3mm penetration level. Undertake monthly.

After grooming, the sand near the surface could be a little loose and the green will play slower. At this stage, a watering cycle will help to settle and consolidate the surface sand and the speed will generally increase.

Watering (sand infill)

A feature of synthetic greens is a possible reduction in green speed during hot weather when the sand infill dries out and becomes a little loose. Watering (where recommended) prior to play will minimise this effect, but drying out during the course of the day could result in a slower green speed at the end of the day. The timing and degree of watering can only be determined by local experience, something which may take time to acquire. Watering the green during the day may be an option and certainly assists in keeping the green cool. On some of the older greens the speed increases when they dry out. Excess watering should be avoided. If the green is not kept clean of plant matter, excess watering will promote algal growth.

Sub-grade watering

Do not allow the sub grade to dry out during periods of drought. Failure to monitor the moisture content may result in shrinkage of the sub grade causing differential movement. Installers cannot necessarily be held responsible for any reactive movement caused by inclement weather. During periods of extended dry weather periodic irrigation may be beneficial. Moss and algae can quickly become a problem if regular grooming and antibacterial spraying of the surface is not carried out. The surface can be completed in sections if time is not available to complete the task in one day.

Removing plant matter

Tree debris is the most common mess maker. Leaves, pine needles, fruit and seeds can block your drainage system or lead to algal growth.

There are three methods of removal:

- Leaf rake - hard work but is an effective cleaning method.
- Leaf collecting devices, such as the outdoor vacuum cleaners. You may have to use a leaf rake in the corners and along the edges.
- Mechanical blowers will blow all leaves to one side of the green

making it necessary to sweep along one side with a leaf rake. If the blower is used too close to the surface it may have a tendency to blow sand out.

Algae and moss removal

(refer Section 6.6)

If you remove vegetation you will dramatically minimise the chance of algae forming. However, given the right environment, algae will grow on bare bitumen. If little black spots appear, immediately treat the whole green. Otherwise, each quarter, use an antibacterial spray to prevent any fungal growth. Treat the surface with algaecides, herbicides if required.

New surfaces (tufted surfaces only) should require only occasional brooming when signs of fibre compaction become noticeable on the ends of the green. A very stiff static brush bolted to a stable framework should be towed behind a ride-on mower for approximately two to four hours every three months or as required. If moss or algae becomes a problem, or if volunteers are not available to apply the quarterly application of algaecide, refer the issue to your installation company. A special cleaning service can be provided.

There are a range of commercial products you can use for algae and moss removal, but check with the carpet manufacturer before selecting your products.

Seam failure

Problems with seams should be reported to your installer immediately. Any concerns over the quality of a seam, or change to seam appearance should be highlighted to your installer. Repair work covered by warranty should be carried out free of charge. Other works are likely to be billed to the client.

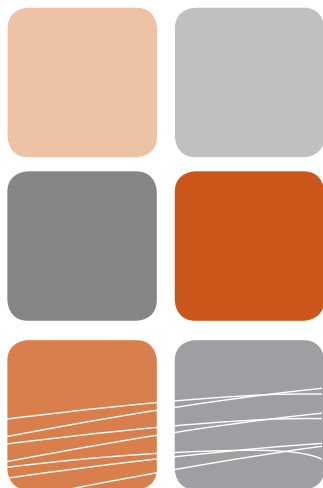
c) Woven and needle-punch carpets

Post installation green speed adjustment

After a winter installation the green speed of the surface can drop back slightly during the first weeks of warmer summer months. Needle-punch carpets are even more variable, with the green speed of a needle-punch quite easily affected by weather conditions and the level of sunlight.

If the green speed on a woven green





drops below 14 seconds when timed with a stopwatch contact the installer and report the change. If the surface continues to experience a reduced green speed after approximately four weeks, again contact the installer and have the surface re-tensioned to approximately 15 seconds. It should be noted that a surface that is over tensioned during hot weather will experience much quicker green speed during the winter months.

Rolling

Roll only if really necessary, in the direction of the seams but only on the advice of the installer.

Vacuuming

New surfaces will require vacuuming from the date of installation. Under no circumstances should vacuum cleaners with circular or rotating brushes be used on the green surface, because this might damage your surface in the long-term.

Algaecides and herbicides

Treat the surface with algaecides regularly (three to four times a year). Herbicides as required. Many installation companies offer chemical spraying as a specialised service option.

Shampooing of the surface

Many installation companies offer a complete shampoo and cleaning service which should be considered on an annual basis if the club is unable to shampoo the surface itself.

Line marking

Do not use any wax or oil-based products to mark the green. Four sets of rink markers should be sufficient. Once in place the lines can be remarked before the lines have completely faded to avoid the need to re-measure the rinks. T-bars can be added using a wooden bar with a light cotton rope attached and when rubbed in the titanium will mark a crossbar at the 2m spot.

Watering

Do not allow the sub-base to dry out during periods of drought. Failure to monitor the moisture content may result in shrinkage of the sub-base causing differential movement. Installers will deny responsibility for any reactive movement caused by inclement weather. During periods of extended dry weather periodic irrigation may be beneficial.

Retensioning

During the first 12 months the new surface may require re-tensioning (the

line markings will move in the direction of the side ditches). To avoid unwanted lines you may wish to use a short-term marking product.

After the first 12 months, the surface should seldom need re-tensioning. However, if for any reason the green speed noticeably reduces contact the installation company for advice.

Repairs to stitching

Should any gaps appear in the stitched seams during the first 12 months the installation company should attend to the stitching under warranty. They should also supply a suitable repair kit to allow the club to repair the stitching in-house if required.

Repairs after the warranty period will generally attract a service fee.

6.5.4 Weekly, Quarterly and Annually

Weekly

Use a garden blower on the surface to blow clear debris, leaves and stones etc. The blower can move the debris into the ditch, and from there it can be removed with a vacuum option.

Do not use the blower on suction mode because contact with the surface in this mode can result in disturbance of the base materials.

Regular vacuuming is essential to avoid the green becoming contaminated and non-porous over time. The vacuum is to clean the fibres of the artificial grass carpet and should be likened to cleaning the carpet in your home; it is to remove the dust and particles that get trapped in the fibre and small loose surface contaminants.

- Vacuum surface using a machine approved by the installer.
- Never use the suction pipe to directly contact the surface – always ensure that the supplied elongated head is affixed to your vacuum.
- The vacuum can also be used when the green is wet or damp; this is recommended on an occasional basis, particularly after heavy rain when the surface is quite wet.
- The vacuum is not a general cleaner of twigs, flowers and leaves etc; it is to help in the porosity and cleanliness of the carpet.
- It is important that the vacuum is always in motion and not stationary while in operation.

- Installers do not recommend the use of machines with a brush or mechanical means to clean the green because it will pill the surface over time.

Moss and algae can quickly become a problem if regular vacuuming of the surface is not carried out. The surface can be completed in sections if time is not available to complete the task in one day.

Quarterly

If the installer agrees that it is necessary, roll the surface slowly in the same direction as the seams using a lightweight sidewinder greens roller. This rolling will even out any variations in tension that may develop over time with heavy rain or large variations of temperature. Care should be taken to ensure the roller is clean and in good mechanical condition. Rolling is not always necessary after the bedding-in period, bowls performance will be the indicator.

Use an antibacterial spray to prevent any fungal growth. Spray with a penetrant type wetting agent to help maintain infiltration rates.

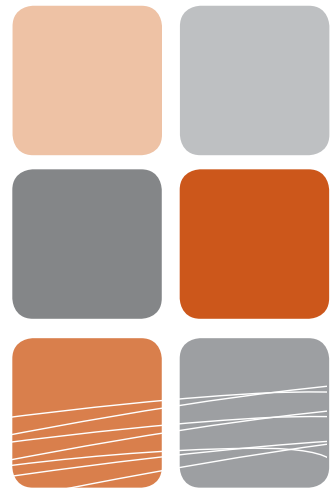
Annually

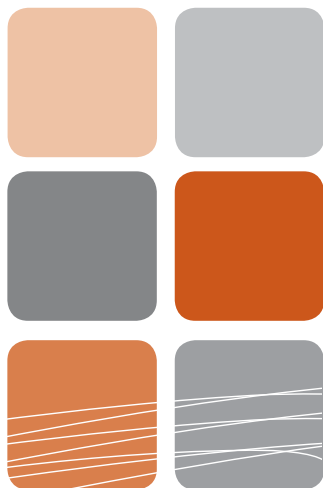
Using a hose, pre-soak playing surface, apply a proprietary low-foam antibacterial cleaning solution. Apply using a hand pump pressure sprayer (gardener type), or any suitable greens spraying equipment. Cover the entire playing surface and allow soaking in for one-two hours.

The hand-held nozzle of a wet/dry machine can be used to remove excess water and dirt residue. The above process should take a minimum of eight hours to complete for a full-size green, 37m x 37m.

If moss or algae becomes a problem, refer to your installation company representative. A special cleaning service might be necessary.

To achieve consistently high levels of performance from your woven surface you require a machine that can handle all the debris that lands on the surface daily. Fine dust builds up in the fibre very quickly and only regular vacuuming and preventative sprays of an approved product will prevent contamination build-up and fungal growth.





6.6 Chemicals on Artificial Grass

There is no easy answer as to which chemicals may be used on artificial grass to treat weeds and moss, or act as a cleaning agent. This is because of the vast number of differing varieties of product available.

Generally speaking any product that is acidic in nature (i.e. pH less than three) containing halogens (chlorine, bromine, etc), sulphur or nitrogen is likely to react in an undesired way. Likewise, if a product is oxidizing (such as bleach or peroxide), then this can liberate free ions of the above elements that can then form acidic species in the presence of water.

In brief:

- All products that are classed as 'non-acidic' and 'non-oxidizing' are likely to be suitable.
- Anything that contains 'halogens', 'acids' or 'sulphur' are likely to be unsuitable.
- Pesticides and weed-killers should be pH-neutral.
- Most detergents should be suitable.

If doubt exists as to the suitability of any chemical substance, the manufacturer of the carpet should always be consulted before application to the surface.

Top Tip

Use solvents sparingly and avoid penetration below the fibres.

Top Tip

Animal waste can be a problem. One recommended solution is to neutralise the waste with an equal mixture of water and white distilled vinegar.



Doncaster Hockey Centre

Re-Surfacing and Replacement

Note: With minor alterations, this section has been taken from the UK-based trade association, The Sports and Play Construction Association's

(SAPCA) publication, The SAPCA Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches (2009). Visit: www.sapca.org.uk

7.1 General considerations

When consideration is being given to resurfacing an existing pitch that has an artificial grass carpet of some type, it should be recognised that the requirements of the client, the sports' governing bodies, Australian Standards and the local authority may have changed considerably in the years since the pitch was originally constructed.

In addition, the technology of artificial

grass systems is constantly changing and may have advanced significantly since the first installation. In the absence of a copy of the original design and specification, it is essential that a comprehensive investigation be carried out to establish the basis of the original design and its relevance to the design being proposed for the resurfaced facility.

7.2 Design considerations

Playing characteristics

Different sports require different playing characteristics and their respective governing bodies stipulate precise requirements. It may be that the sport to be given priority on the resurfaced pitch is different from that played on the original pitch, or that the requirements of the sport's governing body may have changed since the original pitch was constructed. In any case, the design items detailed in Section 3 of this guide should, where possible, be followed.

Where it is not possible or practical to comply with these requirements, this fact must be pointed out by the contractor to the client prior to commencement of re-construction works.

Dealing with the existing surface

The most common reason for resurfacing an existing facility is that the playing surface is no longer suitable for the standard of play required from the pitch. It follows that this surface must be removed and disposed of prior to any reconstruction work taking place. This removal process must be undertaken in a manner that will not damage the existing structure below the playing surface. These layers may include a shock pad, unbound layers, and geotextile membranes and asphalt bases. Subsoil drains may also exist at a depth which could make them vulnerable to damage by heavy vehicular traffic.

The existing surface, and perhaps the shock pad, must be disposed of off-site and careful thought should be given to environmental considerations when disposing of this material. In the case of hard porous materials (such as redgra,

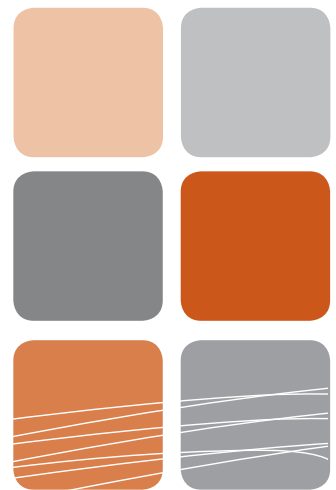
olisett, blaes and similar) disposal will not normally present a problem in landfill sites. However, the disposal and handling of artificial grass carpets, silica sand fill, rubber fill and rubber shock pads may present problems in certain areas and will carry a price premium on disposal. In some instances, recycling companies will collect the unwanted materials at a lower cost than land fill disposal. Additionally, depending on its condition the artificial grass carpet could be sold to another user.

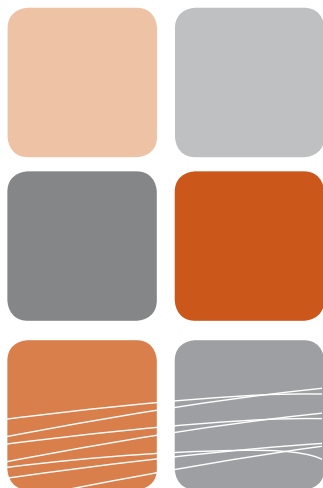
Top Tip

An alternative to removing the sand-filled carpet and pad is to leave them in place, add a layer of crushed stone to take out low spots, and place the new carpet and pad over the top. This option saves on demolition, cartage and disposal fees. Hockey clubs at Toorak (Melbourne) and Orange (NSW) have utilised this process in recent years, and it is a technique used in tennis court upgrades also. Think about the potential altered levels of playing surface, spoon drains and kerbs, and, for tennis projects, check on the likely affect on ball bounce.

Dealing with the existing shock pad and base

Until the entire surface layer has been removed from an existing pitch, it is difficult to be confident of the condition of the layers below. Cores or cross-sectional samples can be taken but this can only provide an indication at a few locations of the condition of the





substructure layers. Lifting the corners is an often used quick technique but in these areas little wear will have occurred.

On removal of the surface the remaining layers of the existing construction should be checked as to their suitability for incorporation into the new construction.

Top Tip

It is important to avoid damage during removal, or to spill old fill into the substructure (and therefore clogging a porous system).

Shock pad

If the existing pitch was constructed using a shock pad (refer Section 3.5) as a resilient layer to provide player comfort and to comply with the playing requirements for various sports, this existing pad must be checked to ensure that it will perform satisfactorily in the new design. This may require performance testing of the combined pad and new surface system by an approved test house before reconstruction begins.

The condition of the existing resilient layer is likely to vary over the area of the pitch and care must be taken to ensure that any inspection or survey is comprehensive.

Experience has shown that prefabricated shock pads that are not either stuck down to the base or seamed together have a tendency to move under the carpet. If the existing pad is found to be otherwise satisfactory, the contractor should ensure that it is either stuck down to the base or seamed using an acceptable tape before re-use.

During a resurfacing process it might be necessary to do regulating works to either an asphalt or stone type base. Where pre-fabricated shock pads have been used it has been found to be very difficult to roll up and re-use the rolls of shock pad and it may be necessary to dispose of them and to install a new shock pad.

If specific areas of shock pad are found to be unsuitable, it is permissible to reinstate these areas with a pad of equal thickness, resilience and density or as near as can be achieved.

If doubt remains about the suitability of an existing pad, it should not be incorporated in the new surface system but should be removed from site and a new shock pad installed.

Unbound layers

Where the existing pitch has been constructed using an unbound base of loose rock or sand (see Section 3.3) and it is the intention to retain this design in the new facility, the top layer of the unbound construction may need to be re-levelled using new material and then re-compacted to specification. The amount of re-levelling or compacting will depend on the mobility of the existing unbound material; the amount of disturbance, if any, caused by the removal of the surface layers, along with the degree of protection the upper geotextile layers have given the structure during its life. This course of action will also apply where lava or rubber mixes have been used in the existing facility and it is the intention to continue with this form of resilient layer.

If the design of the new pitch is to incorporate a bound base, (i.e. using one or two layers of bituminous asphalt with a shock pad as a resilient layer), the material which constituted the unbound layers, which may be frost susceptible and impede drainage, should be removed down to the dry stone sub-base.

Bound base

If the existing pitch has been constructed with a bound base of one or more layers of bituminous asphalt on a dry stone sub-base layer (see Section 3.3), the client should be given the option of adding a further layer of macadam if thought to be advantageous.

The porosity of the exposed asphalt base should be checked by an appropriate method, eg. flooding the pitch to check for impervious areas which may then be drilled to improve the flow of surface water through the system. All drill holes should be filled with pea gravel and compacted prior to installation of subsequent layers.

Note: Insitu laid shockpads do help regulate the top of the macadam layer, but may result in varying thickness shockpad (not ideal if it varies too much).

The final surface level tolerance will be difficult to achieve unless the top surface of the macadam base is also laid to this tolerance. Careful checks on the surface of any previously laid macadam should be carried out to ensure compliance.

Sub-base

Checks, by excavating trial holes, should be made to ensure adequate thickness of sub-base material and that the material has not become contaminated in any way, eg. from the migration of fines from an overlying unbound base.

Drainage

The existing drainage system should be checked for compliance with required standards. It may be necessary to 'prove' the existing drains by rodding or carrying out a standard drain test. The presence of silt collection chambers should be checked along with the presence of rodding eyes. Resurfacing the pitch may be seen as an opportunity to install such facilities where they do not exist in adequate numbers.

Any soakaways should be checked for efficiency of operation and opportunity taken to connect to surface water outlets, if now available, as alternatives to soakaways.

Perimeter edging

The existing edging which retains the pitch construction should be checked

for line and level as well as structural integrity of the materials, including the backing. Any areas that do not comply with the requirements should be rectified prior to installation of the new surface. This may mean total replacement of the perimeter edging, particularly where the finished level is going to vary substantially from the original profile.

New surface

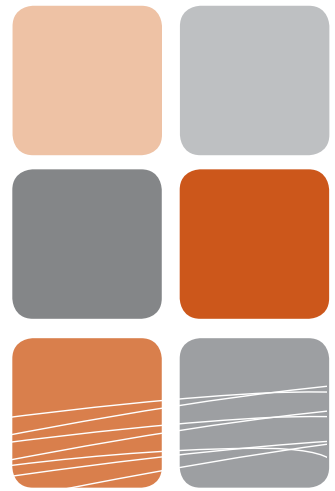
The design and specification of a new surface should comply with the requirements of the relevant sport's parent bodies and with issues raised in Section 1.3 of this guide.

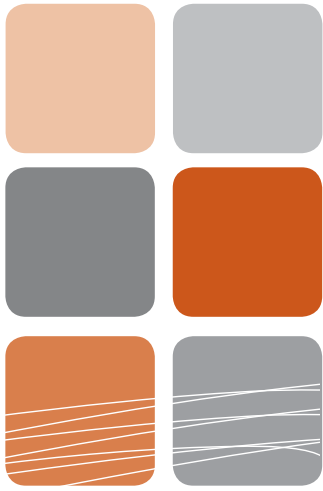
Fittings

All existing fitted equipment, including inset sockets should be checked and replaced where required as part of the contract for the new pitch facility.

Surround fencing

As part of the upgrading program, the surrounding fencing should be inspected and repaired or replaced, as required (refer Section 3.10 of this guide).





College Rifles RUFC, Auckland, New Zealand



College Rifles RUFC, Auckland, New Zealand

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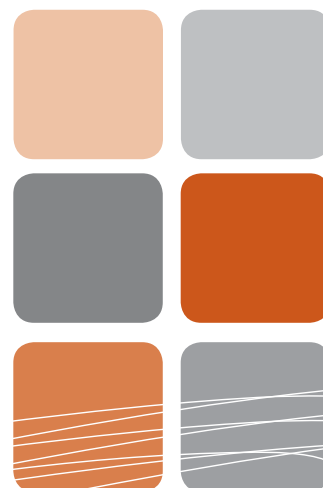
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Appendix 2: Case Studies

The case studies listed below represent best practice examples located in Victoria.

The Darebin International Sports Centre (DISC) Soccer Facilities

DISC was developed in 2004 and includes state-level facilities for the Football Federation of Victoria (FFV), Cycling Victoria and the Royal Victorian Bowls Association.

FFV's facilities at this Fairfield site include three FIFA two-star third generation pitches two natural grass pitches, and office accommodation. The artificial grass pitches have been an outstanding success with the Melbourne soccer community, and local schools. The pitches are programmed extensively (9am to 10pm, seven days), and add up to more than 60 hours of use per pitch per week without ongoing promotion.

Each pitch is groomed once a month and a major service is undertaken twice a year. Maintenance costs are in the order of \$8,000 AUD per year.

Lessons learned from the operation of these facilities include:

- The lack of vandalism to date is put down to the high usage rate and the fact that the facility is supervised (this is despite only low-level fencing around the facility).
- Full-field training is not normally essential, so the FFV is currently reviewing training use with the view of offering half pitch rental opportunities. This will both save users rental fees, and generate the operator more income.



Darebin International Sports Centre

The Footscray Hockey Centre

The Footscray Hockey Club (FHC) moved to its location at the McIvor Reserve in Yarraville in 1994. Since that time it has established a world-class facility that features two artificial grass pitches (an international standard 'wet' pitch and a recently resurfaced sand-dressed pitch), a large basketball court sized specialist training/warm-up

area (featuring an experimental elite playing level 'dry' carpet), and a large clubhouse.

The secret to FHC's ability to develop these facilities has been its preparedness to develop shared, multi-sport facilities. For example, the club's first pitch at the Yarraville site was a sand-filled field which was also marked for netball. The club's initiative to cater for other sports playing at its venue generated income, but more importantly made the project more appealing to government funding sources - which support the establishment of shared, high participation number facilities.

The club repeated this initiative when establishing its second artificial grass pitch in 2000, an international standard 'wet pitch'. Prior to submitting its plan to government agencies, the club established tenancy agreements (some of which included multi-year up-front rental payments that could be used to reduce capital works borrowings) with the sports of lacrosse and American football (gridiron), as well as with a co-tenant hockey club. The field was made larger to accommodate lacrosse and features the major lacrosse line markings permanently installed.

In addition to these usage and design initiatives, the club developed a unique 'Service Agreement' (an adjunct to its lease) which described in detail the club's commitment to service non-hockey markets. Targets were established, (and have been met every year since), around making significant 'peak-time' hours available for non-hockey activities.

Learnings from this facility:

- Think about who else could use your facility. Utilising available spare time to maximise use and participation enhances the community value of your project, and its chances of receiving financial support.
- Think about adding a Service Agreement to your standard lease, or some other means by which you can provide surety to possible external funding agencies, that broader community benefits will be achieved. Flesh-out the 'promised' community benefits with a plan of how the benefits/targets will be achieved.

St Monica's College, Epping

Showing foresight in 2003, college leaders invested in two artificial grass pitches, one a specialist third generation soccer pitch, and the other a combined hockey/tennis model. These facilities (especially the soccer pitch) are used extensively – 60/70 hours per week – for soccer, hockey, tennis, Australian rules football, cricket, rugby, American football and general play.

Lessons learned from the operation of these facilities include:

- Their use is almost limitless.
- Regular maintenance is important. Strict attention by college staff means that only \$2,000 AUD needs to be spent annually on specialist maintenance purposes.
- The base preparation is the key phase. There has been some expansion and settlement under the soccer field, leading to minor depressions in some places, but it is manageable.
- The growth of weeds into the artificial grass matting along the surface edging has been a minor issue, as has that of general litter.
- Some spray painting incidences have been overcome by painting over the vandalised area with green paint (it is suggested that you speak to your artificial grass supplier for specific advice about graffiti removal).
- The college's soccer coach notes that there have been no major differences observed in the performance of balls or player injury on the artificial grass field compared with natural turf.

Harvest Home Road Soccer Complex, Epping

In 2007/08 the City of Whittlesea developed a third generation artificial grass pitch at its soccer complex at Epping. Council developed a very innovative management plan which established that the facility's usage was substantially determined by the Whittlesea Soccer Group (WSG), a group that involves representation from all seven of the municipality's soccer clubs. These clubs include both senior and junior organisations. The facility's aim is to help with the overall growth and development of soccer across the municipality, and therefore no one club was allocated the facility, instead it is shared between all of

the clubs, local schools and the Football Federation of Victoria.

The WSG met fortnightly, following which Council was advised of issues raised and of the recommended training schedule for the following few weeks for both the Harvest Home Road pitch, and the two new pitches at the Mill Park Secondary College.

Mill Park Secondary College

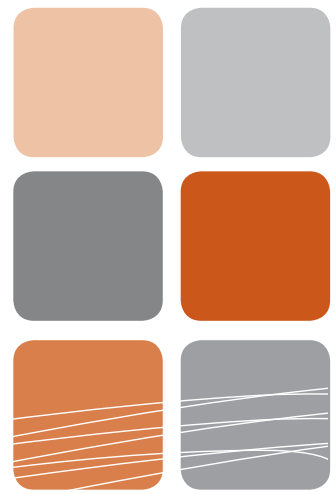
The Mill Park Secondary College (MPSC) artificial grass sporting complex is a joint development between the City of Whittlesea, Mill Park Secondary College, Sport and Recreation Victoria and the Department of Education and Early Childhood Development.

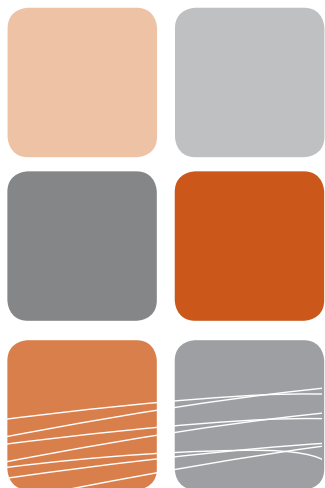
Constructed in 2008/09 at a cost of approximately \$1.7 million AUD, the all artificial grass complex features two adjacent senior-size third generation soccer fields, a cricket pitch located in between those fields, a warm-up/specialist practice area, and, encompassing the soccer fields, an Australian rules football field. The complex is floodlit to training level and also includes toilets, storage and basic shelter. The soccer fields are rated as FIFA 1 Star, and the entire complex covers 20,000 m². It is said to be the largest synthetic surface in the southern hemisphere, and it is estimated by Council to be saving six million litres of water a year (they require no watering at all).

Just like Whittlesea Council's Harvest Home Road artificial grass soccer field, the MPSC complex is unaligned with any specific sporting clubs. Instead its emphasis is on training, junior matches, senior practice matches and if necessary (and approved) senior matches.

Use of the facility is split between the MPSC (8am to 4.30pm each weekday) and broader community use which is determined by Council via consultation with relevant parties. Priority use is directed towards clubs that might be affected by ground closures or ground maintenance, followed by clubs that have overflow issues. Casual bookings are also taken when times are available, but not at the expense of community access.

All clubs are allocated one set of keys to the facility, and all users are required to exercise due care while at the complex, and to complete a maintenance checklist prior to its use. Maintenance issues have to be reported to Council as soon as possible.





This partnership development is under an initial 30-year joint-use agreement, with a 15-year extension available.

Learnings from these City of Whittlesea projects (HHRSC and MPSC):

- The management principles, operational practices and shared usage principles that underpin these facilities are 'leading edge' in terms of municipal leisure practice.
- These arrangements allow for better ground maintenance and management.
- The location adjacent to a school enables maximum daytime use.



Mill Park Secondary College

City of Moreland Artificial Grass Soccer Facilities

At the time of publication Moreland Council is implementing the second half of its artificial grass soccer facility strategy which will result in a 'no resident club' shared third generation artificial grass field being available in each of the northern (Fawkner) and southern (Brunswick) parts of the municipality. The already existing northern field is being used extensively by several local soccer clubs and four Australian rules football clubs for pre-season training, and is being heavily used by the students from Fawkner Secondary College where the pitch is located. The facility is managed by the adjacent Council-controlled Fawkner Leisure Centre.

The planned second pitch at Brunswick will be within a Council reserve, but will also be managed by a nearby Council leisure centre.

Learnings from Moreland's approach:

- Council's approach of developing its artificial grass fields at locations that do not involve existing, strong tenant clubs has provided it with the ability to maximise the use of the fields.
- Moreland is a linear north-south municipality. Strategically locating these fields, they can each service

sporting demand in their respective northern or southern precinct represents insightful strategic planning by Council.

- Using local leisure centres to supervise and manage these facilities provides an independent, experienced facility manager to maximise the use of the facility. This can be an efficient and cost-effective option.

Victoria Park Tennis Club, Kew

In conjunction with the neighbouring Kew Tennis Club, Victoria Park Tennis Club (VPTC) undertook a redevelopment program in early 2008 that included fence replacement, court lighting upgrades, and the replacement of en-tout-cas courts with sand-filled artificial grass courts.

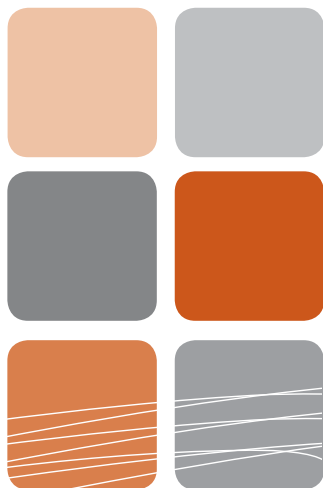
The court change-over has been an outstanding success for the club.

Key outcomes include:

- Court maintenance time has all but disappeared.
- More than \$4,000 AUD in water cost has been saved in the last 18 months since the conversion.
- Working bees to repair lines, etc, have been eliminated.
- The winter coaching program has been expanded.
- Play continues virtually immediately after rain.
- The standard of play has improved across the board because the new surface gives players a greater degree of confidence.
- Usage of the courts has more than doubled in the 18 months following the re-build.
- And most significantly, membership, which has hovered about the 80 person mark for many years has jumped to more than 200 with another 100 children being associated with the club coach's programs.

Key learnings include:

- The club expects that its 10-year loan will be paid out in less than five years.
- Employ a recognised contractor, not necessarily the least expensive.
- Thoroughly understand the clients needs before commissioning the project. Avoid changes during construction.



AFL/Cricket Facility Planned For Point Cook

The City of Wyndham is one of the fastest growing communities in Australia, which has placed significant pressure on its active sporting spaces. One of Council's strategies to meet demand and overcome its lack of sporting grounds and address drought and water restrictions, has been to get a number of artificial grass fields in key locations across the municipality.

Liaising with the Australian Football League (AFL), Cricket Australia (CA), and Sport and Recreation Victoria, Council has planned a large sporting precinct in Point Cook Road, Point Cook which

will contain a variety of sporting facilities, including Australia's first full-sized AFL/CA approved Australian rules football/cricket synthetic turf field.

The football oval will feature a Teamsports "Enviroturf" surface, which has met the specific AFL/CA performance specification and will differ from the planned nearby Truganina third generation artificial grass soccer pitch with rubber infill, in that it will have a shock pad base. The pile height of the carpet will be in the order of 40mm, with rounded sand infill up to approximately 20mm, leaving about 20mm of exposed fibre.



Point Cook Road Reserve, Point Cook

Shire of Melton Facilities

Another rapid-growth community in Melbourne's outer western suburbs, Melton Shire now possesses several innovative and flexible artificial grass facilities. Both Kuranjang Recreation Reserve at Melton (photo page 38) and Brookside Central Reserve at

Caroline Springs (photo page 6) feature small extensions which allow Australian rules football and cricket usage as well as their predominant use for soccer. There is also a running track around the soccer field at Brookside. See also Caroline Springs College photo (Page 83).



Ivanhoe Grammar School

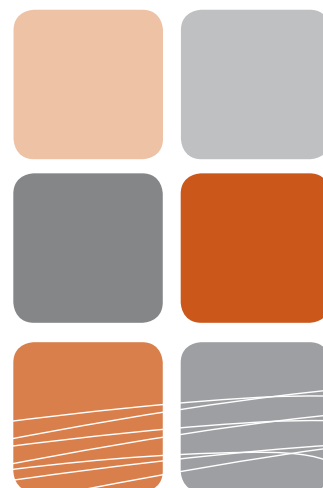
In 2010 Ivanhoe Grammar School installed an 8,500m² artificial grass surface on its North Ground oval, a substantial space that includes marked areas for soccer, hockey, softball, netball, basketball, volleyball, hand tennis, long jump and an 80m eight lane running track.

An innovative component of the project is the installation of a giant underground dam beneath the playing surface that can store up to 1.1 million litres of rain water. This dam was constructed in a unique manner in that a 3,300m³ hole was created under the field (typically 3m deep), and the edges were lined with layers of waterproof bentonite clay/geo-fabrics to create a water-tight membrane for water storage. The hole was then

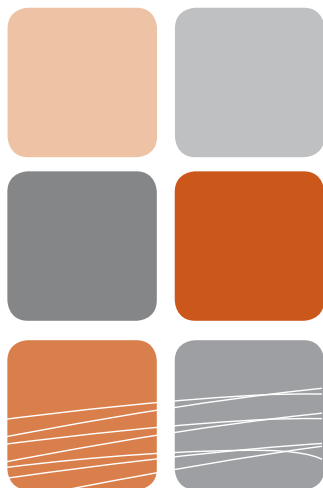
filled with rocks of various sizes which acts as a support for the artificial grass as well as a natural filter for the rain water so as to avoid sediment build up. The dam will collect stormwater from across the senior school section of the campus.

The rock-fill idea overcomes the problem sometimes associated with the traditional method of achieving underground water storage (the burying of a series of interconnected hollow cellular plastic cubes), being the settlement of backfill around the plastic tanks with the resultant settlement/low spots on the playing surface above the tanks.

It is anticipated that the underground dam will lead to water savings per year of between 2 and 2.5 million litres.



Ivanhoe Grammar School



Appendix 3: Sample Specification (Primary School Installation)

For many projects that fail to reach their full potential, an inadequate brief/specification is often the source of their problems. A number of documents provide guidance on how to develop good briefs and specifications, with the following examples all relating to artificial grass sporting surfaces:

- 'Towards A Level Playing Field: A Guide to the Production of Playing Pitch Strategies' (2003). Sport England.
See Appendix 'D'
– 'Consultants Brief'
www.sportengland.org
- 'Guideline Template: Design Brief for Artificial Grass Pitches (Version 2) January 2010
Football Association. See Part 3: Outline Design Brief
www.thefa.com/GetIntoFootball
- 'Specification for Construction of Synthetic Playing Surfaces in Primary Schools' (2009). Sport and Recreation Victoria (attached overleaf).

The specification that follows is an actual specification developed and used by SRV during 2009 for the State Government project involving the installation of artificial grass activity spaces in 13 nominated primary schools. As a guide to the type of issues that need to be covered in a good brief, the specification is reproduced here in full.

Please note:

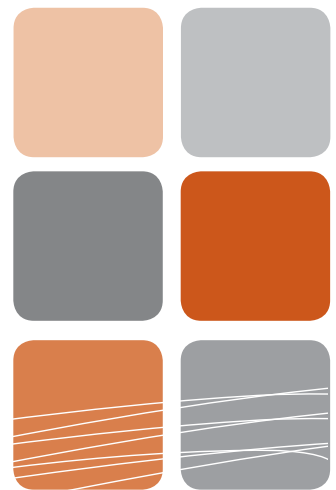
The activity spaces to be provided in schools funded through this project are basically for informal, semi-structured play/sport, not organised higher-level sport. Therefore the level of specification is reduced accordingly (for this project the pitches are built over an unbound base and have no shockpad). Should you wish to use your artificial grass pitch for a reasonable level of community sport, then a higher level of specification may be required.



Specification for Construction of Synthetic Playing Surfaces in Primary Schools

TENDER SPECIFICATION

CONSTRUCTION OF SYNTHETIC PLAYING SURFACES IN PRIMARY SCHOOLS



1 GENERAL SCOPE OF WORKS

The following document details the scope of work and specification for the supply and installation of synthetic playing surfaces in primary schools in metropolitan and regional Victoria. The specification relates to artificial grass area to be used at a recreational level only, not for competitive, higher-level sport.

Scope of Work

- 1.1 Strip the site, cut and fill to level, grade and compact base foundation, to cross fall 1:100, in the direction specified in the drawing, and to levels indicated on each site plan.
- 1.2 Remove and dispose of any existing tree root/stumps obstructing the site.
- 1.3 Remove and relocate existing bins, unless otherwise stated in the drawing.
- 1.4 Supply and install drainage pipes and connect to an existing collection system unless otherwise stated in the drawing.
- 1.5 Supply and install base (compacted crush rock), to provide a stable platform for the turf.
- 1.6 Supply and install rock dust.
- 1.7 Provide 250mm x 50mm treated pine timber edge strip and a root barrier.
- 1.8 Supply and install artificial turf according to manufacturer's installation guidelines.
- 1.9 Supply and install linemarking as per detail supplied in the relevant project drawings.
- 1.10 Supply and install infill system (sand and sand/rubber crumb) designed to suit the performance characteristics required for the specified activity, according to specified manufacturer's recommendation.
- 1.11 Leave the site clean and fit for purpose as a school play field with no dangerous, protruding or remaining objects and material.
- 1.12 Maintain the surface for a period of up to two years from the date of practical completion.

2 GENERAL REQUIREMENTS

2.1 Materials – Workmanship - Procedures

All materials, workmanship and procedures shall comply with the relevant requirements of all current Standards, Codes of Practice and Specifications promulgated by Standards Australia, including but not limited to:

AS 3541.1 (1988) Synthetic Sporting Surfaces – Part 1 General Principles

AS 2983 (1988) Synthetic Sporting Surfaces – Test Procedures only

AS/NZS 2455.1 Textile Floor coverings – Installation Practice – General

AS/NZS 2455.2 Textile Floor Coverings – Installation Practice – carpet tiles

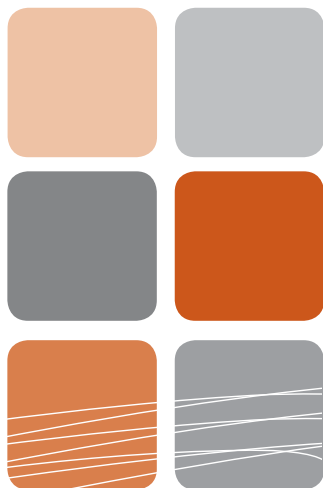
All work shall conform to the relevant product manufacturer's installation guidelines and be quality control compliant to AS/NZS ISO 9001:2000 requirements.

Where required, all materials, workmanship and procedures shall comply with other appropriate international standards, including but not limited to:

DIN18035.6 (1986) German industry norm for outdoor sports surfaces

BS 7044.4 (1991) British industry norm for multi-sports use of artificial surfaces

ISO/DIS 9239 International norm for fire hazard rating by critical radiant flux



Where not covered under any standard, the materials and workmanship shall be suited to a play field for children and general community use.

2.2 Measurements

All measurements are to be verified on-site before starting any work or ordering materials.

2.3 Site and construction constraints

The following construction constraints will be imposed on this contract:

- Prior to construction, the School Principal shall nominate the areas he/she wishes to maintain access to during the period of the contract.
- The areas to which the contractor's activities shall be confined will be specified by the school and the Project Manager prior to the construction date.

Possession of site will be as agreed at time of contract or no later than one (1) month from time of contract.

The contractor may be required to carry out some site work during school holiday periods.

2.4 Site Meetings

A senior representative of the Contractor shall attend regular on-site meetings with representatives from the Principal, Project Manager and Project Director.

The Project Manager will chair the meetings and provide minutes to all parties within one week of the meeting.

2.5 Manufacturer's installation, operation and maintenance literature

Before the date of practical completion, the contractor shall provide two (2) copies of a manual containing manufacturer's installation, operation and maintenance literature, for the specified playing surfaces systems supplied under this contract.

The information is to be compiled in a clear and orderly manner, fully indexed and bound into a durable hard covered manual. The manual is to be submitted to the Project Manager.

2.6 Care of Pavements and Existing Grassed and Landscaped areas

Construction methods and traffic shall be limited to prevent damage to existing pavements, grassed and landscaped areas and constructions. The contractor shall be liable for the repair and making good of all damage caused by the construction works and traffic.

The pavements are to be promptly cleaned of any materials resulting from the carting of materials and other operations to the approval of the Project Manager.

2.7 Setting out

Arrange and bear all cost associated with the proper setting out of relevant athletic tracks and sport pitches/fields/ovals etc, to ensure compliance with their specific requirements.

The general positioning and siting of the relevant athletic running track(s) and relevant sport pitches/courts/fields/ovals shall match the existing configuration shown on the contract drawings provided as attachments to this tender specification – refer attachment B. Please note that the drawings provided are only preliminary tender plans and may be subject to alteration before construction drawings are issued.

2.8 Safety, Protection, Nuisance etc

Assume responsibility for safety at all times including:

- Provide and maintain suitable measures to ensure the safety of the public, contractor personnel and property.
- Minimise dust rising from the works by adequate watering or other suitable approved method.
- Control dust noise, vibration etc to avoid nuisance to nearby properties, school lessons and facilities.

2.9 Services

Co-ordinate the location of all below ground services.

Arrange for disconnecting, cutting, sealing off any redundant services affected by the works.

Prevent damage or interference to existing services above and below ground.

Immediately rectify any damage or interference of these services.

2.10 Contingent work

Before commencing work, verify the location of existing services by going on-site to confirm their locations. Should any unforeseen conditions, constructions and services be encountered, the Project Manager shall be informed and his instructions obtained before proceeding.

Any damage to services caused by the Contractor is to be repaired at their own expense.

Prepare shop-drawings (required to provide stitching/pattern details for approval by Project Manager prior to manufacture).

2.11 Care of site works

Accept responsibility for the proper retention of sub-grade, formation, materials of construction and site-work constructions making good to the approval of the Project Manager.

Plan the works so that works in progress are not subjected to excessive loading likely to cause damage to sub grades or construction work in progress.

2.12 Quality

2.12.1 Project Quality System

The contractor shall provide at time of tender, inspection and test criteria that shall be carried out as well as the reporting method to be adopted during installation.

The contractor shall nominate a Project Quality Manager (in some projects this may be an external consultant) who shall be responsible for the implementation of a quality system for this project.

The minimum requirement for the quality system is a system of Inspection and Test Plans (ITP's) that:

1. Identifies the project.
2. Lists all hold points during construction, (including supply of materials), that will require verification before the works are covered up or installed.
3. Identifies the criteria for verification of quality at these hold points.
4. For each hold point, records that the quality has been verified, the date the work was verified, and is signed off by the project Quality Manager. Prepare ITP's for a minimum of 10 significant items, including works by the subcontractors, and submit to the Project Manager for approval within one (1) week of acceptance of the Tender. Failure to submit the ITP's in accordance with the above program, and in a form acceptable to the Project Manager, may give cause to the Project Manager to withhold the certificate for any portion of the works until approved ITP's are submitted.
5. Prior to practical completion, the Project Quality Manager must certify that all materials and workmanship comply with the contract documents and with the specified product manufacturer's installation guidelines, and that all non-compliance or deficiencies have been rectified.

ITP's shall be identified/notified with the Project Manager prior to signing of contract.

3. DETAILED REQUIREMENTS

3.1 Demolition

3.1.1 General

Removal of all redundant surfaces, fencing and concrete works, etc, as nominated in the documents and drawings.

The site is to be stripped, levelled and prepared for the application of new synthetic playing surfaces. Ensure no "soft spots" in base work by localised compaction, removal, and/or replacement.

Care shall be exercised to protect all adjoining existing construction.

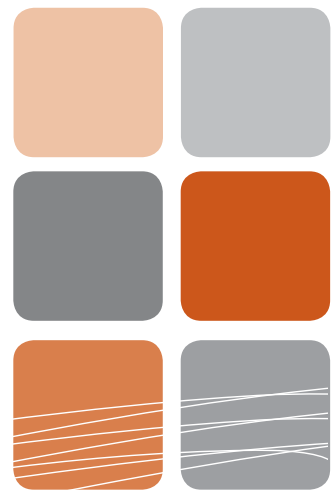
3.1.2 Materials resulting from demolition

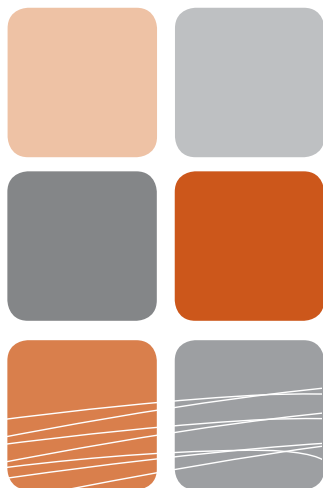
All materials resulting from demolition work shall become the property of the contractor.

Remove such materials from the site regularly and progressively.

Should it become necessary to store or stockpile any such material on the site, it shall only be undertaken in approved locations.

Do not re-use such material in new work, unless authorised by the Project Manager.





3.1.3 Demolition to be contained within the site

Carry out demolition in a manner to prevent the encroachment of any demolished materials onto adjoining property.

3.1.4 Clean up site

On completion of the demolition work, remove all debris, clean up site and leave in a tidy condition.

3.2 Excavation

3.2.1 Excavation

Consists of the excavation and disposal of all surplus materials, as specified and in conformity with the design intent shown on the drawings and to achieve end compliance with the specified playing surface profile, slope and smoothness requirements.

In acceptance of this document, the contractor understands and accepts the conditions of the site. No additional payment will be made for rock or other problem or unexpected material encountered.

3.2.2 Definitions

Formation – is defined as the finished surface, after completion of earthworks.

Subgrade – is defined as the trimmed or prepared proportion of the formation on which the pavement is to be constructed.

3.2.3 Construction Review by the Project Manager

Give three (3) working days notice to the Project Manager so that he may, as he deems necessary review the excavations in which construction work has been completed prior to any backfill.

3.2.4 Site clearing

Strip topsoil/root mat layer (100mm nominal) from the area of the works.

Remove roots, vegetation, existing footings, drains, pits and solid obstructions, within the area of the works.

3.2.5 Excavation requirements

Keep faces of the excavations free from loose earth and fill.

Dress off bottom of trench excavations to provide solid bearing for pipes and their sockets. Unless otherwise specified or shown on the drawings, excavate pipe trenches 150mm wider than the outside diameter of the pipe or service.

Finish subgrade surface to reasonably smooth surface, free from ruts and loose excavated material with a minimum cross fall of 1:100, graded to the appropriate drainage discharge points.

Take care when excavating near existing footings not to disturb the soil below such footings. Make good any damage.

3.2.6 De-watering

Keep water from excavations by pumping or other suitable means. Provide adequate means for disposal of such water without causing nuisance to adjoining properties or the public including the prevention of contamination to local watercourses.

i. Proof Rolling

On completion of compaction give the Project Manager a minimum of one (1) working days notice before commencing proof rolling.

Proof roll the cleared area with a vibrating flat drum roller of at least 200kN centrifugal force.

ii. Preparation of Subgrade

Trim the subgrade so that on completion of compaction, the lines and levels comply with the following tolerances:

- The finished level is not to be more than 10mm above or 20mm below the specified levels, and no point in the general surface deviates more than 10mm from a 3m straight edge laid parallel to the grade.
- The finished width is not less than the specified width or more than 150mm greater than the specified width.

iii. Surplus Materials

Remove from the site, all surplus material.

3.3 Filling and Backfilling

3.3.1 Fill within Pavement Perimeter

Fill shall be used as make up fill from top of topsoil strip to underside of pavement.

Fill shall be excavated material, free of any organic matter, bricks, pottery etc.

3.3.2 Placement and Compaction

Placing of fill shall be in 150mm maximum loose layers, compacted using minimum of 10 passes of a vibrating flat drum roller of at least 200kN centrifugal force. Add water as required to assist the compaction process.

3.3.3 Crushed Rock Backfill

Crushed rock backfilling shall be Class 3 Fine Crushed Rock, compacted to 98% of modified maximum dry density (MMDD).

3.4 Pitch Base works

3.4.1 General

The slope and flatness of the existing pitch bases are to be restored and re-levelled to achieve specified playing surface tolerances. Make good the base pavement to match existing, including bituminous spray seals. Technical data detailing the proposed material shall be submitted with the Tender.

3.4.2 Crushed Rock

Crushed rock in the base layer shall be Class 2 Fine Crushed Rock compacted to 98% of modified maximum Dry Density (MMDD).

3.4.3 Finished Tolerances

Surface of the sprayed rock base shall be finished to level within a tolerance of $\pm 5\text{mm}$ of the required levels, and no point shall lie more than 6mm below a 3m straight edge laid on the finished surfaces, in any direction. The regraded areas of the base shall be finished to comply with the tolerance requirements of the nominated sport and required playing surface.

3.5 Synthetic Grass Surface

3.5.1 Technical Requirements

The contractor shall employ specialist and experienced installers to install the synthetic surfaces in accordance with the manufacturer's recommendations and to the satisfaction of the Project Manager.

Contractors shall submit full details of the synthetic surface system with the tender to enable the Tender Evaluation Team to fully appraise the offer and provide additional information where requested by the Tender Evaluation Team.

The surface systems offered shall meet the performance requirements and be compliant to AS/NZS ISO 9001:2000.

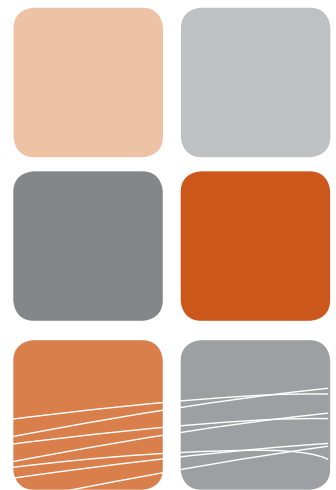
It is highly desirable that the product system offered is product compliant to Australian Standards and preferably Australian manufactured and complies with other appropriate international standards – refer section 2.1.

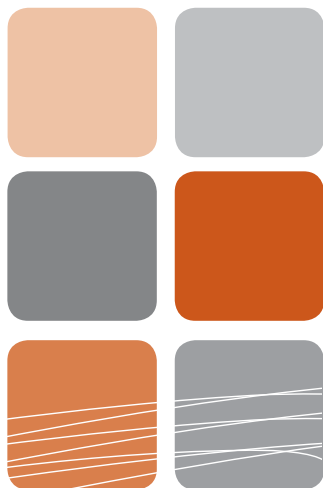
3.5.2 Synthetic Surface

The multipurpose playing grounds are to be surfaced with new premium grade synthetic turf manufactured to a high quality standard and suitable for primary school level competition play.

	Athletic Track, Cricket Pitch and Courts	Play Fields and Ovals
Colour	Surface and border colour, as specified in the drawings (to be approved).	Surface and border colour, as specified in the drawings (to be approved)
Pile material	U.V stabilised Polypropylene	U.V resistant Polyethylene
Pile height	19 -23mm pile height Nominal	35 - 50mm pile height Nominal
Pile weight	900 - 1200g/sqm Nominal	1250 - 1400g/sqm Nominal
Total product/ yarn weight	1500 - 1700g/sqm Nominal	2500g/sqm Nominal
Infill type	100% Sand - graded quartz sand, round, washed and dried. Sand size/range between 0.2mm – 1.0mm	Sand and rubber-crumbs (Sand) Siliceous 80% round, washed and dried. (Rubber) Recycled
Infill height	15 – 19mm nominal	(Sand) Minimum 15 - 25mm (Rubber) Minimum 8 - 13mm
Stitch rates	Minimum 285 per metre	Minimum 200 per metre

Note: The athletics track requirements are not to be confused with International Amateur Athletics Federation track specifications.





3.5.3 Lines

The track, field, pitch, court dimensions and locations shall be in accordance with the current requirement of primary school level competition play.

All line marking shall be white, unless specified in the drawings. Line marking shall be stitched 'tufted' material (painted lines are not acceptable).

As per the relevant drawings, the synthetic surface shall be line marked in accordance with the specified sport noted in the drawings.

The laying of the synthetic grass shall be planned so that the maximum number of lines is tufted in during manufacture of the product. The number of lines to be cut in shall be minimised. Join lines shall be arranged to be away from high use zones.

Line Tolerances:

1	Straightness	Within \pm 10mm over any 10m length
2	Location (Line markings)	Within \pm 20mm

3.5.4 Plan of Synthetic Grass Installation

Before commencing, the manufacturer of the synthetic grass shall submit to the Project Manager for approval a plan of the proposed synthetic grass installation showing directions and lengths of cut lengths, and extent of lines to be tufted or cut in.

3.5.5 Sand Infill

Sand infill shall be an approved washed and graded quartz sand, with sand size/ range between 0.2mm -1.0mm, with a sub angular to rounded particle shape and of consistent colour. Infill operations shall only be undertaken with the sand and surface being dry. Sand infill is to be applied on the following playing surfaces: athletic tracks, basketball and netball courts, cricket pitch, handball courts - refer to drawings.

3.5.6 Sand and rubber-crumb Infill

Fine washed and graded sand and granulated rubber at a ratio of 2:1 (sand: granulated rubber – measured by volume). Infill operations shall only be undertaken with the sand and rubber-crumb and surface being dry. Sand and rubber-crumb infill is to be applied on the following playing surfaces: soccer field, football oval – refer to drawings.

3.5.7 Installation

Commencement of the base work and synthetic grass installation shall only begin after total acceptance of the underlying base. Acceptance of the underlying base shall not be considered as grounds for invalidating any of the conditions of warranty on the surface system.

Lay grass in long lengths. No lateral join lines in the main field of play will be permitted.

Fixing method shall be by all weather adhesives, with sufficient adhesive to ensure that the surface is permanently fixed in position. Joins shall be butt joined with continuous adhesive on both sides of the join.

An appropriate adhesive shall be determined through the advice or recommendation of the specified manufacturer/supplier and approved by the Project Manager prior to installation.

Installation method shall also follow the specified manufacturer/supplier's installation guidelines.

3.5.8 Warranty

The supplier/manufacturer of the synthetic grass, shall provide a warranty in favour of the Principal, warranting that the product installed will not fade or fail due to ultraviolet degradation (minimum seven years) and that any faults due to poor workmanship in manufacture and installation will be rectified, (minimum of five years).

3.5.9 Maintenance

The contractor is responsible for the routine maintenance of the synthetic surface for a minimum of two (2) years after the date of practical completion.

During the maintenance period, the contractor is responsible to provide maintenance instruction and training of ground staff of the school, in order for the school to continue maintenance of the product

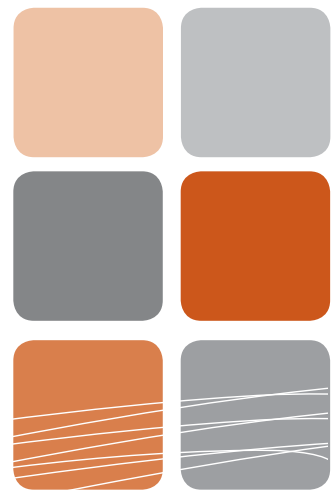
The contractor is to provide two (2) copies of maintenance manuals giving full details of the maintenance procedures required to keep the synthetic surface in sound and good condition.

3.5.10 Information to be submitted with the Tender

Submit all technical information necessary for the Tender Evaluation Panel to appraise the offer.

The information shall include:

- Complete lists of the sub-contractors and suppliers proposed to be used which must include the manufacturer, supplier and installer– refer Schedules 9 & 10 Part D Tenderers Response.
- Technical details of the synthetic surface system - refer Schedule 17 Part D Tenderers Response.
- Details of similar installations completed by the synthetic grass supplier and installer - refer Schedule 9 Part D Tenderers Response.
- Technical details of the adhesives proposed to be used - refer Part D Tenderers Response Schedule 17.
- Details of the sand infill - refer Schedule 17 Part D Tenderers Response.
- Details of the sand and rubber-crumb infill - refer Schedule 17 Part D Tenderers Response.
- Drafts of the warranties offered - refer Schedule 18 Part D Tenderers Response.



4 SITE SAFETY

4.1 Suitable Contractor / Tradespersons

The head Contractor must ensure that all contractors or sub-contractors on site have the appropriate registration/licence for their work.

Where the legislation provides that a certificate of compliance/safety/etc may or should be provided, the head Contractor will ensure that all such certificates are provided and that a copy is made available to the Project Manager.

4.2 Site Safety Requirements & Contractor's Performance Review

The Contractor is required to maintain a daily site safety checklist using construction industry organisation OH&S checklist pro-formas (for example, the MBAV Form 18 is suitable). These checklists are to be appended to the Contractor's regular site meeting status report.

The Department of Education & Early Childhood Development requires the main contractor to IMMEDIATELY notify by telephone and then in writing DEECD Facilities Branch, the Project Manager and Project Director if a significant OH&S incident occurs on their construction site. By "significant" this means:

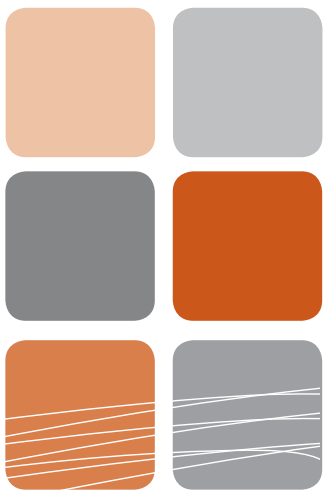
- WorkSafe notifiable injury to person(s) and/or damage to school property (including services) as a result of a workplace incident.
- Any event related to the construction works which requires the evacuation of any school.
- Any accident involving a major item of construction equipment (eg.; crane, hoist, vehicle).
- Collapse of any building element, excavation or temporary scaffolding or shoring.
- Injury to any student, staff member or visitor to the school due to construction works; or,
- having the site closed down for OH&S reasons by WorkSafe, Federal Government inspectors or trade union representatives.

The Site Safety Requirements & Contractor's Performance Review checklist is to be completed by the Contractor and submitted to the Project Manager each month with their monthly progress claim. Refer to Site Safety Requirements & Contractor's Performance Review checklist.

4.3 Safety

The Contractor shall carry out the whole of the works in a thoroughly safe manner and in particular shall:

- Ensure that on site safety is maintained in accordance with the Occupational Health and Safety Act, the Victorian Building Industry Safety Code and all other relevant legislation.
- Ensure that Sub-Contractors conform to the requirements of the relevant Acts of Statutes of Parliament, Regulations and By-laws or orders relating to the safety of persons on or about the site.
- Ensure that all workers on site are insured for Workcare in accordance with relevant legislation, and have current registration with the relevant Construction Industry Long Service Leave Authority.



- Ensure that all tools and tackle, gear, stagings, scaffolding, ladders, machines, winding arrangements and other equipment used by the Contractor in connection with the works are of adequate strength and safe for use.
- Immediately discontinue any practice or remove any equipment, which becomes or is likely to become unsafe.
- Ensure the removal from the works promptly of any of his employees or representatives or those of any Sub contractors who conduct tends to create danger to themselves or others or to the work.

Provide all hoardings, etc as required by local regulations and maintain all such hoardings, barriers, etc in a neat, tidy appearance.

4.4 Working with Children Check (WWCC)

The Agency may require that all workers attending the site in relation to the works, possess a working With Children Check ("WWCC") as defined under the Working with Children ACT (Vic) 2005 ("The Act").

The Contractor acknowledges and accepts responsibility in all respects regarding compliance with the Act and procuring WWCC's for all its employees and sub-contractors' employees entering the Site and shall take all responsible steps to ensure compliance with this clause, if requested by the Agency.

The contractor shall have no entitlement to claim additional costs, expense of damage whatsoever arising out of compliance with this clause and shall protect and hold harmless the Agency in the event of a breach of this clause or the act by the Contractor, its employees or subcontractors.

During the period of the contract, contractor movements shall be confined within the nominated areas, which will be clearly specified by the school and by the Project Manager prior to construction date. School buildings, classrooms and school toilets are restricted areas and under no circumstances are to be accessed by contractor personnel.

5 FINAL COMPLETION

5.1 Final cleaning/clean project site

At the hand-over stage, all discharge drains shall be clean of all spoil and debris resulting from construction works. The final cleaning is to be done to a normal 'clean' condition.

Sweep paved areas to a broom clean condition. Remove debris and other foreign deposits.

Be responsible for maintaining clean roads and access.

Remove and clean away mud, building/construction debris from footpaths, gutters, drains etc, when such occurs.

5.2 Maintenance

As mentioned in section 3.5.9 Maintenance, the contractor is responsible for the routine maintenance of the synthetic surface for a minimum of two (2) years after the date of practical completion.

The contractor is required to provide within the two year maintenance period, three (3) sessions of chemical weed and moss control, and brush and revitalise during each 12 month period.

During the maintenance period, the contractor is responsible to provide maintenance instruction and training of ground staff of the school, in order for the school to continue maintenance of the product.

The contractor is to provide two (2) copies of maintenance manuals giving full details of the maintenance procedures required to keep the synthetic surface in sound and good condition.

5.3 Product and installation Warranty

Approval process of product:

To test the durability of the product and the reliability of the performance characteristic of the synthetic turf, independent testing and inspections may be requested by the Project Manager. This testing and inspection may need to be undertaken in the laboratory, as well as when installed, to identify that the product matches what was tested and to guarantee that the supplied product performs to its specified application as a "safe" play field for children.

Factors that need to be considered:

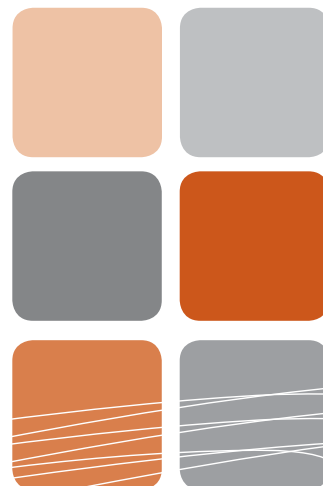
- Fibre strength.
- Pile weight.
- Abrasion resistance and joint strength.

(these characteristics will also need to be further examined once exposed to UV, water and extreme temperatures).

Product is to be warranted for 10 years (nominal).

Installer should warrant installation work for period of equal warranty of the synthetic turf, including seam and stitching.

Note: The original of this specification did not call for any insitu testing to check on the performance of the facility at handover. Although a slightly expensive exercise, it is recommended that you have your activity area tested before taking formal delivery of the artificial grass surface, and you should also consider having it tested again at the end of the first maintenance period (if your arrangement is similar to that described in item 5.2 above).



Brighton Primary School - Before



Brighton Primary School - After

Attachment A (Page 1)

Site safety requirements & contractor's performance review checklist

Project or Job No _____ Date of Report _____

School _____

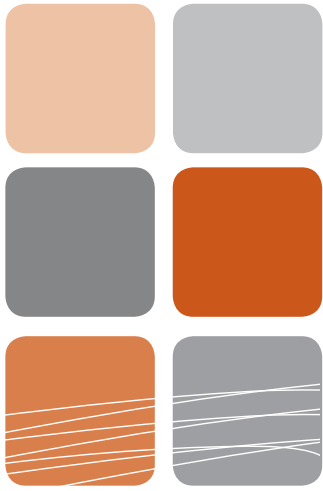
Project Description _____

Target Completion Date of Project _____

Contractor _____

No.	Item	Contractor's Advice	Superintendent's Verification
1	Has a safety plan been developed from hazard identification and risk assessment data, and is revised as necessary?		
2	Does supervision ensure that the contractor's work methods on site conform to the site safety plan requirements?		
3	Are all relevant specifications, drawings and work plans available on site?		
4	Has the contractor obtained all relevant permits, licenses and approvals, and are hard copies available on site?		
5	Does the contractor have up-to-date copies of all correspondence, instructions and directives relevant to health and safety on the site?		
6	Does the contractor conduct regular site safety inspections, and are records of inspections available?		
7	Does the contractor maintain material safety data sheets for all substances used on site?		
8	Are copies of relevant legislation, standards and codes of practice available on site?		
9	Has the contractor nominated a person on site with overall responsibility for health and safety matters?		
10	Have work site boundaries been defined and are access restrictions enforced to prevent unauthorised entry?		
11	Does the contractor maintain a site visitors' book which is kept up-to-date?		
12	Are safe means of access and egress to the site maintained?		
13	Has the contractor implemented a site safety induction program, and are records maintained?		

No.	Item	Contractor's Advice	Superintendent's Verification
14	Are safety/warning signs in place and maintained in good order?		
15	Are isolation/tagging systems used for unsafe or defective equipment?		
16	Have site emergency response plans been developed and are they regularly practiced?		
17	Is an accident/incident report book maintained and is WorkSafe notified of incidents as required by legislation?		
18	Are all accident/incident investigations up-to-date and completed satisfactorily?		
19	Are first aid facilities and trained personnel available on site?		
20	Has a site safety committee been formed, and does it meet regularly?		
21	Are minutes of the safety committee meetings maintained and published?		
22	Have health and safety issues been resolved in a timely manner?		
23	Are any outstanding prohibition or improvement notices from WorkSafe inspections being addressed?		
24	Does the contractor monitor the safety performance of all sub-contractors on site, and are records available?		
25	Are hazard identifications and risk assessments available for the equipment used on site?		
26	Are inspection, maintenance and service records available for the equipment used on site?		
27	Is fire protection equipment available on site, and is it maintained in good working order?		
28	Is personnel protective equipment available, and is it maintained in good working order?		
29	Are flammable materials and other hazardous substances stored safely on site?		
30	Are facilities, amenities and the standard of general housekeeping on site satisfactory?		
31	Are the public, staff and students protected by appropriate barricades, signage, lighting, access paths (free of debris), dust and noise control, and traffic procedures?		
32	Does the contractor respond to school-altered OH&S matters in a timely manner?		



Attachment B

Preliminary Tender Drawings

Drawings attached as appropriate.

Appendix 4

Sample Questionnaire for Use When Interviewing Proposed Contractor

Prior to formally engaging the preferred contractor, it is prudent to interview the contractor and clarify as many issues about the project as possible.

The questionnaire shown here ('Notes' added by editor) is reproduced with the permission of the Footscray Hockey Club Inc, and consulting engineer Douglas Golder. Their project included the re-development/re-surfacing of a

full-sized pitch, plus the construction of a new, artificial grass surfaced junior training area.

Note that **questionnaires need to be designed to be project specific**. The following document is reproduced purely as an example of a check-list/agenda for clarifying matters prior to committing to a contract.

Footscray Hockey Centre Upgrade		
Item	Aspect of project	Response
1	General	
1.1	Have you allowed for all items in the tender documents in your tender submission?	
1.2	Are there any aspects or items of the project that are unclear to you and needs clarification?	
2	Eastern Pitch Re-Development	
2.1	Have you allowed for the removal all of the old synthetic grass and shock pad from the pitch?	
	<p>Notes:</p> <ul style="list-style-type: none"> - For lifting and removal, the contractor should be asked about methods to be utilised, and contingency for any damage to the subsurface (remembering that the shockpad should last more than one carpet lifetime). The shockpad can easily be damaged by heavy machinery lifting the carpet – especially if the infill is wet and extra heavy. Damage can also be done to the asphalt or base layers by tracking laden fork lifts/dumper trucks across the surface. <p>Your site agent should take photos for supporting reinstatement damage, etc.</p>	
2.2	Have you allowed in your tender for the disposal of this redundant surface and pad?	
	<p>Notes:</p> <ul style="list-style-type: none"> - how will this be done? - what equipment will be used? - how will the integrity of the existing shockpad be ensured? - what methods will be used to ensure the integrity of the subsurface/asphalt layer? 	
2.3	What is your dump site?	
2.4	Have you allowed for the full reconstruction and regrading of base to comply with the nominated International Hockey Federation (FIH) requirements?	
2.5	Will the resultant surface profile satisfy current FIH requirement?	
2.6	How do you propose to regulate the base?	
2.7	Have you allowed for the reinstatement of the bituminous spray to the base pavement?	
2.8	Have you allowed for installation of the root barrier to three sides of the pitch?	

2.9	Have you allowed for installation of the root barrier to three sides of the pitch?	
2.10	Have you allowed for the backfill of the root barrier trench with stabilised sand and disposal of excavated spoil?	
2.11	Have you allowed for the regrading of the perimeter concrete invert?	
2.12	In this regrading works have you allowed for any associated adjustment of fencing and the maintenance of any drainage paths from adjoining areas?	
2.13	Have you allowed for the modification of the fencing for the installation of the backdrop netting post behind the four practice circles?	
2.14	Have you allowed for the installation of the four panels of back drop netting?	
2.15	Who is your supplier of the netting?	
2.16	Have you allowed for the complete cleaning and flushing of the underground drainage system from the NW corner of the eastern pitch to the outlet in Fogarty Road, including disposal of all spoil?	
3	Junior Practice Area	
3.1	Have you allowed for the full extended length as nominated in the tender addendum?	
3.2	Have you allowed for the full excavation of the topsoil from the complete area of junior the practice area including disposal of surplus material from site?	
3.3	Have you allowed for the removal of the redundant concrete paving at the western end of the practice area?	
3.4	Have you allowed for the grading of the base of the junior practice area to an even and uniform profile matching the adjacent paving levels?	
3.5	Have you allowed for the relocation of water meter and the installation of protection for the extended pipe work?	
3.6	Have you allowed for the modification of the wet pitch goal storage area and foot wash enclosure affected by the nominated works?	
3.7	Have you allowed for the installation of the formed, angled concrete kerb up-stand to three sides of the junior practice area?	
3.8	Have you allowed for all fencing to fully enclose the junior practice area, as nominated?	
3.9	Have you allowed for the modification of the existing gates?	
3.10	Have you allowed for the construction of the base to the full extent of area of the junior practice area?	
4	Synthetic Surfaces	
4.1	Does the nominated surface system have FIH accreditation?	
4.2	Is this accreditation for the same surface/shock pad combination?	
4.3	What is your source of yarn?	
4.4	What is the warranty on the yarn product?	
4.5	Where is the synthetic surface manufactured?	
4.6	Is there any lead content in the yarn?	
4.7	What is the warranty on the shock pad?	
4.8	What is the warranty on the synthetic surface?	
4.9	Which parties provides the warranty?	
4.10	Do you acknowledge the yarn face weight calculation in the tender documents and understand that this is the minimum to be provided under the contract and deductions will be made from payments for products that fail to achieve the agreed minimum?	

4.11	Who provides the warranty?	
4.12	If the synthetic surface fails, say after three years, what would be the club's contribution to its replacement?	
4.13	If the project cost was, say \$400,000 and the surface component was \$200,000, how would this relate to the club's contribution?	
4.14	Have you allowed for the insertion of all line marking to FIH requirements including practice circles?	
4.15	How do you propose to insert the curved line marking?	
4.16	What is the type and source of the glue proposed to be used?	
4.17	What is the composition of the nominated shock pad?	
4	Synthetic Surfaces (Cont.)	
4.18	What is the percentage of binder?	
4.19	What is the product and source of binder?	
5	Subcontractors	
5.1	Who do you propose to employ for the following works?	
5.1.1	Civil, base works?	
5.1.2	Fencing?	
5.1.3	Concrete works?	
5.1.4	Shock pad installation?	
5.1.5	Surface installation?	
5.1.6	Sand supply?	

Record of response:

Signed: _____ on behalf of tenderer.

Appendix 5 Construction Costs and Whole-of-Life Costings

The following analysis sheets provide an indication of facility construction costs – as at early 2009, as well as providing whole-of-life costings (construction, maintenance, replacement) for soccer and hockey pitches, lawn bowling greens and tennis courts.

This is taken from information prepared by Smart Connection for the City of Boroondara (2009).

The information is provided as a starting point for the debate about the long-term value of artificial grass surfaces versus natural turf surface.

Note:

- **These figures are not meant to be current. This analysis is provided purely to demonstrate how to undertake a whole-of-life cost comparison.**
- All of these figures include GST, but they relate to 2009 dollar values. They do not include allowance for inflation, compound interest, etc. Refer to Section 1.10, and Appendix 7, for commentary on the importance of developing these business planning models using discounted cash flows – that is allowing for the real value of dollars over time.
- Remember that in many club scenarios, where quality volunteer work can be relied upon, the maintenance figures can be significantly discounted.
- Revenue figures can be added to these models to develop preliminary business plans.
- All costings are in Australian dollars.



Multi-sport pitch in Wellington, New Zealand



Ivanhoe Grammar School

Soccer

Whole of life costing

Dimensions: 105m x 68m + 3m run offs = 111m x 74m = 0.82 ha

Construction - Natural Turf

Item	Turf
Earthworks	\$40,000
Drainage (5m spacing)	\$40,000
Irrigation	\$50,000
Concrete works, spoon drain	\$8,000
Topsoil supply, placement and shaping	\$140,000
Amendments	\$5,000
Grassing	\$11,000
Grow in (12 weeks)	\$11,000
Total Cost	\$305,000

Annual Maintenance – Natural Turf

Item	Turf
Mowing (x 70 cuts)	\$14,000
Fertilising (x 8)	\$8,000
Pest control (weeds, insects: x 3)	\$3,000
Aeration (verti drain x 2, slicing x 4)	\$5,000
Irrigation (3 ML/year)	\$3,000
Overseeding	\$2,000
Topdressing	\$7,000
Surface repair, sod goals (500m2)	\$5,000
Repair - irrigation system	\$2,000
Miscellaneous	\$2,000
Total Cost	\$51,000

Replacement – Natural Turf

Item	Turf
Earthworks, levelling, minor drainage	\$27,000
Amendments	\$6,000
Grassing	\$11,000
Grow in	\$11,000
Total Cost	\$55,000
Lifespan (years)	15 years
Replacement cost per year	\$3,667

Natural turf has an indefinite lifespan if properly maintained, generally resurfaced between 10 and 20 years

Total cost of ownership: 10 years

Cost of Ownership	Turf	Synthetic
Construction	\$305,000	\$570,996
Maintenance	\$510,000	\$210,000
Surface Replacement	\$36,667	\$348,000
Total Cost of Ownership	\$851,667	\$1,128,996

Construction - Synthetic Turf

Item	Synthetic
Earthworks	\$76,994
Base construction works	\$138,844
Synthetic grass (including infill)	\$355,158
Total Cost	\$570,996

* Average cost of key suppliers for FIFA 1 Star pitch
Lights, fencing, goals & accessories not included.

Annual Maintenance - Synthetic Turf

Item	Synthetic
Weekly cleaning	\$10,000
Monthly grooming	\$8,000
Annual surface treatment	\$2,000
Miscellaneous	\$1,000
Total Cost	\$21,000

Replacement - Synthetic Turf

Item	Synthetic
Uplift existing surface	\$11,000
Disposal of existing surface	\$11,000
Minor base repairs	\$16,000
Synthetic grass	\$200,000
Infill	\$110,000
Total Cost	\$348,000
Lifespan (years)	10 years
Replacement cost per year	\$34,800

Synthetics need to be replaced every 8 - 12 years

Total cost of ownership: 25 years

Cost of Ownership	Turf	Synthetic
Construction	\$305,000	\$570,996
Maintenance	\$1,275,000	\$525,000
Surface Replacement	\$91,667	\$870,000
Total Cost of Ownership	\$1,671,667	\$1,965,996

Inflation has not been factored into any of these calculations. All costs were calculated in 2009 and are GST inclusive.

Lawn Bowls

Whole of Life Costing

Dimensions: 40m x 40m = 1.6 ha

Construction - Natural Turf

Item	Turf
Earthworks	\$40,000
Drainage	\$5,000
Aggregate	\$15,000
Irrigation	\$10,000
Ditches	\$10,000
Topsoil supply, placement and shaping	\$20,000
Amendments	\$5,000
Consolidation / levelling (x2)	\$5,000
Grassing	\$2,000
Grow in (12 weeks)	\$12,000
Total Cost	\$124,000

Annual Maintenance – Natural Turf

Item	Turf
Mowing (x 110 cuts)	\$6,000
Fertilising / Pesticides	\$12,000
Aeration (verti drain x 2)	\$1,500
Irrigation (0.6 ML/year)	\$600
Renovation	\$2,000
Miscellaneous	\$1,500
Total Cost	\$23,600

Replacement – Natural Turf

Item	Turf
Surface removal, amendments, levelling & grassing	\$15,000
Total Cost	\$15,000
Lifespan (years)	9 years
Replacement cost per year	\$1,667

Natural turf has an indefinite lifespan if properly maintained, generally resurfaced between 8 and 10 years

Total cost of ownership: 10 years

Item	Turf	Sand Filled	Non sand filled
Construction	\$124,000	\$214,000	\$186,000
Maintenance	\$236,000	\$98,000	\$141,000
Surface Replacement	\$16,667	\$117,600	\$90,400
Total Cost of Ownership	\$376,667	\$429,600	\$417,400

Construction - Synthetic Turf

Item	Sand filled	Non sand filled
Geo tech survey, site management	\$5,000	\$5,000
Earthworks	\$7,000	\$7,000
Drainage	\$11,000	\$11,000
Plinth work	\$5,500	\$5,500
Ditch construction	\$33,000	\$33,000
Base construction	\$43,000	\$43,000
Synthetic grass	\$100,000	\$72,000
Ditch coverings	\$4,500	\$4,500
Site clean	\$1,000	\$1,000
Freight	\$4,000	\$4,000
Total Cost	\$214,000	\$186,000

Annual Maintenance - Synthetic Turf

Item	Sand filled	Non sand filled
Weekly cleaning	\$6,000	\$8,500
Quarterly grooming	\$1,200	-
Mould treatments	\$1,600	\$1,600
Annual shampoo	-	\$3,000
Miscellaneous	\$1,000	\$1,000
Total Cost	\$9,800	\$14,100

Replacement - Synthetic Turf

Item	Sand filled	Non sand filled
Uplift existing surface	\$2,000	\$2,000
Disposal of surface	\$800	\$1,600
Plinth adjustment	\$1,300	\$1,300
Re-level base	\$8,500	\$8,500
Install new carpet	\$100,000	\$72,000
Site clean	\$1,000	\$1,000
Freight	\$4,000	\$4,000
Total Cost	\$117,600	\$90,400
Lifespan (years)	10 years	10 years
Replacement cost per year	\$11,760	\$9,040

Replacement is between 8 and 12 years depending on maintenance and usage.

Total cost of ownership: 25 years

Item	Turf	Sand Filled	Non sand filled
Construction	\$124,000	\$214,000	\$186,000
Maintenance	\$590,000	\$245,000	\$352,500
Surface Replacement	\$41,667	\$294,000	\$226,000
Total Cost of Ownership	\$755,667	\$753,000	\$764,500

Inflation has not been factored into any of these calculations. All costs were calculated in 2009 and are GST inclusive.

Hockey

Whole of Life Costing

Dimensions: 91m x 55m + 5m run offs = 101m x 65m = 0.66 ha

Notes 1: The figures shown below are based on high quality sporting surfaces (sand dressed artificial grass and its natural turf equivalent).

Notes 2: On the Artificial Grass side of the page, Column 1 shows the 'worst case' scenario for maintenance - all undertaken at commercial cost. Column 2 figures reflect most of the maintenance being undertaken by club volunteers.

Notes 3: These figures represent 2010 costings, but are for 'indicative' purposes only. Therefore detailed cost breakdowns have not been sought.

Construction - Natural Turf

Item	Cost
Earthworks	-
Drainage	-
Irrigation	-
Concrete works, spoon drain	-
Topsoil supply, placement and shaping	-
Amendments	-
Grassing	-
Grow in (12 weeks)	-
Total Cost	\$400,000

Lights, fencing, goals and accessories not included

Annual Maintenance – Natural Turf

Item	Cost
Mowing	-
Fertilising	-
Pest control	-
Aeration	-
Irrigation	-
Overseeding	-
Top Dressing	-
Surface repair, re-sod goals	-
Repair irrigation system	-
Miscellaneous	-
Total Cost	\$40,000

Replacement – Natural Turf

Item	Cost
Earthworks, levelling, minor drainage	-
Amendments	-
Grassing	-
Growing in	-
Total Cost	\$55,000

Natural Turf

Total Cost of Ownership: 30 Years

Item	Cost
Construction	\$400,000
Maintenance - \$40,000 x 30 Years	\$1,200,000
Surface Replacement - \$55,000 at yrs 15 & 30	\$110,000
Total Cost	\$1,710,000

Construction - Artificial Grass

Item	Column 1 Cost	Column 2 Cost
Earthworks	-	-
Base construction	-	-
Synthetic grass/infill & shockpad	-	-
Total Cost	\$670,000	\$670,000

Lights, fencing, goals and accessories not included

Annual Maintenance – Artificial Grass

Item	Commercial Maintenance	Club Maintenance
Weekly cleaning	-	-
Monthly grooming	-	-
Annual surface treatment	-	-
Miscellaneous	-	-
Total Cost	\$20,000	\$5,000

Replacement – Artificial Grass

Item	Column 1 Cost	Column 2 Cost
Uplift and dispose of surface	-	-
Base and shockpad repair	-	-
Sythetic surface system	-	-
Total Cost	\$350,000	\$350,000

Artificial Grass

Total Cost of Ownership: 30 Years

Item	Column 1 Cost	Column 2 Cost
Construction	\$670,000	\$670,000
Maintenance \$20,000 x 30 Years	\$600,000	-
Maintenance \$5,000 x 30 Years	-	\$150,000
Surface Replacement	1,050,000	1,050,000
Total Cost	\$2,320,000	\$1,870,000

Inflation has not been factored into any of these calculations. All costs were calculated in 2010 and are GST inclusive. Hockey Tables updated by Sport and Recreation Victoria.

Tennis

Whole of Life Costing

Dimensions: 34.8m x 17.1m
(including 5.5m back runs & 3.05m from side fence) = 0.6 ha

Construction – Hard court

Item	Hard court
Minor earthworks/Base construction	\$45,000
Non-cushioned surface (acrylic)	\$10,000
Total Cost	\$55,000

Construction – Artificial Grass

Item	Artificial Grass
Minor earthworks/Base construction	\$45,000
Surface (sand filled)	\$17,000
Total Cost	\$62,000

Annual Maintenance – Hard court

Item	Hard court
Weekly cleaning (20 minutes/week)	\$1,000
Total Cost	\$1,000

Annual Maintenance – Artificial Grass

Item	Artificial Grass
Moss/Algae control, regular brushing	\$1,750
Total Cost	\$1,750

Replacement - Hard Court

Item	Hard Court
Remove old surface	\$3,500
Non cushioned surface (acrylic)	\$4,500
Total Cost	\$8,000
Lifespan (years)	8 years
Replacement cost per year	\$1,000

Replacement - Artificial Grass

Item	Artificial Grass
Remove old surface	\$3,500
Replacement carpet	\$16,500
Total Cost	\$20,000
Lifespan (years)	12 years
Replacement cost per year	\$1,667

Total cost of ownership: 10 years

Cost of Ownership	Hard court	Artificial Grass
Construction	\$55,000	\$62,000
Maintenance	\$10,000	\$17,500
Surface Replacement	\$10,000	\$16,670
Total Cost of Ownership	\$75,000	\$96,170

Total cost of ownership: 25 years

Cost of Ownership	Hard court	Artificial Grass
Construction	\$55,000	\$62,000
Maintenance	\$25,000	\$43,750
Surface Replacement	\$25,000	\$41,675
Total Cost of Ownership	\$105,000	\$147,425

Inflation has not been factored into any of these calculations. All costs were calculated in 2010 and are GST inclusive.



Appendix 6: Accredited Testing Laboratories

Accredited Laboratories:

Quality and Durability Testing

Qualspec
Contact Details: Level 1, 200 Kingsgrove Road
Kingsgrove, NSW 2208
P: (02) 9150 5531
E: david@qualspec.com.au
W: www.qualspec.com.au

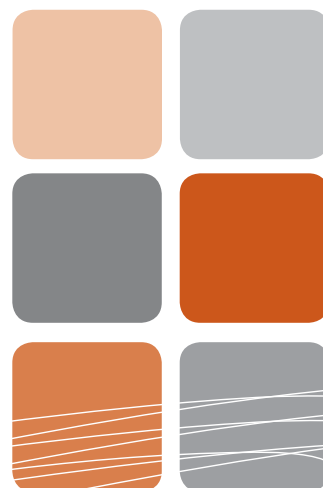
Surface Characteristic and Performance Testing

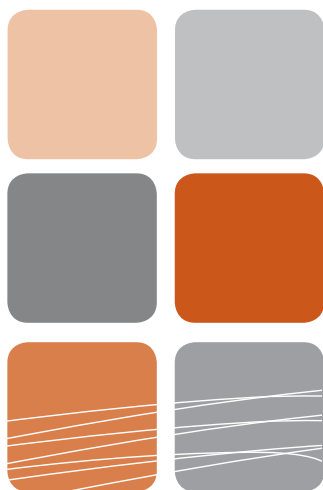
Acoustoscan
Contact Details: 2 - 4 Bedford Street, Surry Hills, NSW 2010
P: (02) 9699 4092
E: admin@acoustoscan.com.au
W: www.acoustoscan.com.au

University of Ballarat
Contact Details: School of Human Movement and Sports Sciences
PO Box 663 Ballarat, Vic 3353
P: (03) 5327 9062
E: hmms.enquiries@ballarat.edu.au
W: www.ballarat.edu.au/ard/hmss

AFL/Cricket Association Note:

A lab must be able to conduct tests for durability, weathering, ball to surface and player to surface characteristics against the AFL/CA's performance characteristics and standards using internationally-recognised testing methods and apparatus and must have accreditation to the highest National or International level.





Appendix 7: Surface Evaluation Model

Introduction

The electronic version of this guide is available at www.sport.vic.gov.au and it includes an interactive template that allows the user to undertake two sports field planning exercises:

1. To analyse the comparative costs between a natural turf field and an artificial grass field over a given lifecycle, and
2. To calculate potential sinking-fund requirements for your pitch/court/green over a given period of time.

A printed copy of this template is shown on the next page.

The model provided is based upon 'discounted' cash flow – in other words it factors in both costs and revenue so that it allows for the real value of the dollar over time. It acknowledges that the value of a dollar over time is not the same as it is today, and that sinking funds set up today need to contain the right amount of dollars in five/10/15 years depending on your project.

In other words, rather than just taking a field's replacement cost in 10 years time and dividing it by 10 to get your annual banking requirement, the discounted cash flow method requires you to allow for factors such as compound interest, and inflation (if you choose to include it) in the model, to give you a more accurate end figure/annual saving rate.

Here's an example: let's say that it costs \$360,000 to resurface an artificial grass soccer pitch. Based on a 3% inflation rate, the current day cost of \$360,000 equates with just over \$590,000 in 10 years time. To achieve this figure, and assuming a compound interest rate of 5%, a monthly contribution of \$3,800 (\$45,600 per annum) is required every month from the first month of the pitch's life.

Of course such business plans need to incorporate allowances along the way (say, \$50,000 in year five) for a major rejuvenation of the pitch, (an extra \$735 per month), an allowance for floodlight system refurbishment, and so on.

The Model

The model is designed to enable simple evaluations to be undertaken by people preparing business cases for artificial grass and natural turf pitches, and it

allows them to plan for the replacement of their pitches as well - from the time of project inception. It requires a minimal number of inputs in the designated green areas.

This is provided as a guide only and should not be expressly relied upon by project proponents.

Some of the assumptions/options built in to the model are:

- Artificial grass fields have three times the use capacity of turf fields.
- The real discount rate is 2%, which is the risk-free rate of return after inflation, including an allowance for the community benefits associated with such expenditures.
- An inflation rate of 3%.

Note the discount rate and inflation rates can be adjusted if necessary.

The rates used reflect the upper limit of the Reserve Bank of Australia's annual inflation target and a real discount rate of 4% which is currently required by the Victorian Department of Treasury and Finance for these types of evaluations.

Contributors / Acknowledgements

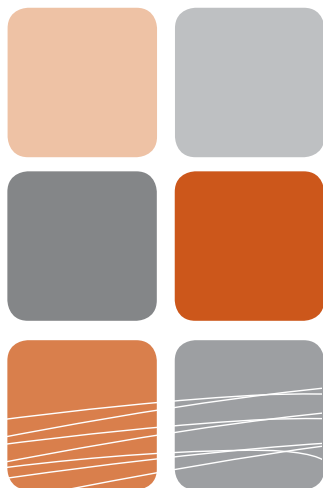
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Women's Golf Victoria Inc	Lacrosse Victoria
Victorian Rugby League	Victorian Rugby Union
Tennis Victoria	Touch Victoria
Baseball Victoria	





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p38: Kuranjang Reserve
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p129: Brookside and Kuranjang Reserves

Greenfields Sports Turf Systems

p21: Somerville Secondary College
p108: Artificial Clay Infill

Hockey Victoria

p56: State Hockey Centre, Royal Park
p70: Pop-Up Sprinklers
p93: Hockey player

Grassports Australia

p83: Caroline Springs College
p140: Brighton Primary School (x2)

City of Maribyrnong

p78: Footscray Hockey Centre

City of Whittlesea

p18: Mill Park Secondary College
p127: Mill Park Secondary College

City of Melbourne

p128: J J Holland Reserve, Kensington

Sports Turf International (STI)

p22: Soccer field

Tiger Turf

p27: Seymour Shaw Park
p28: Rugby players
p32: Tennis players
p34: Lawn bowlers
p35: Monmia Primary School
p36: Wembley Primary School (+p77)
p36: Kunyung Primary School(x2)
p75: Futsal/Small sided games courts
p125: Darebin Int. Sports Centre
p156: 'Balloon' photo

City of Wyndham

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Lacrosse Victoria

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p56 State Netball & Hockey Centre

Team Sports Surfaces

p92: Brisbane Hockey Centre

Limonta Sport (Greenplay Australia)

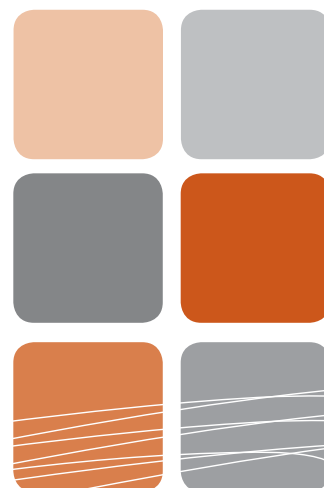
p52: Port Adelaide Football Club

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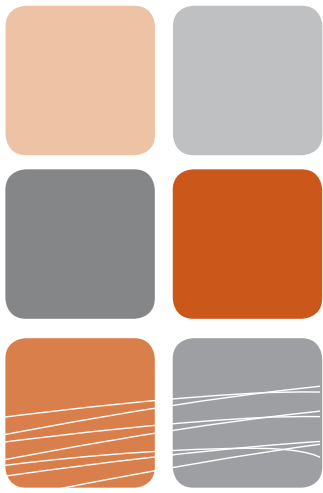
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Keep your notes together

Please find opposite a handy pouch in which you can store collected notes/material re: artificial grass.