ETHOS URBAN

OTIUM Planning group
SPORT + LEISURE

SYNTHETIC TURF STUDY IN PUBLIC OPEN SPACE

Report

Prepared for the Department of Planning, Industry and Environment

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1.0 Executive Summary

"The Study aims to provide the NSW Department of Planning, Industry and Environment with a better understanding of the potential social, environmental, and economic impacts, benefits, and limitations of using synthetic turf as a replacement for natural grass across NSW and to identify areas for further consideration.

1.1 Overview

Ethos Urban, in collaboration with Otium Planning Group, was commissioned to undertake a preliminary study (the Study) into the use of synthetic alternatives to natural turf in NSW community sports fields.

The Study aims to provide the NSW Department of Planning, Industry and Environment (the Department) with a better understanding of the potential social, environmental, and economic impacts, benefits, and limitations of using synthetic turf as a replacement for natural grass in public open space across NSW, and to identify areas for further investigation and consideration.

The use of synthetic turf as a replacement for natural grass has attracted high levels of interest from a wide range of stakeholder and community groups. Concerns include impacts on the local environment, loss of open space and impacts on the amenity of the local community. Conversely, sports groups and users see the value of synthetic surfaces in meeting growing sporting needs and offering more consistent surfaces to play on.

This Study has been informed by consultation with stakeholders and communities potentially impacted by the issue as well as by a review of relevant published research and technical studies.

This report provides a summary of the key findings of the Study and identifies alternative approaches and practices as well as opportunities for future investigation.

Image source: https://www.pexels.com/

1.2 Key Findings

A summary of the key findings related to the application of synthetic turf as an alternative to natural grass turf is provided below. This summary draws upon the findings uncovered across the Study, which included community feedback, stakeholder workshops, case studies, and a literature review.

Theme	Issues
Best practice natural turf management can improve field capacity	• Best practice natural turf design and maintenance has the potential to improve the capacity of existing natural turf fields to support increased sporting use. • Lack of available information on best practice construction and maintenance of natural turf fields influences and constrains council decision making. • Information about recent innovations and best practice for natural turf are not well known or commonly used. • Advances in technology are enabling more targeted maintenance and management of natural turf to reduce energy consumption and costs and maintain capacity.
Partial/hybrid use of synthetic grass can increase durability	• Hybrid turf combines blades of synthetic grass with natural grass to increase durability of fields while reducing use of synthetic materials. • Synthetic materials can be incorporated in the root zone to reinforce the soil profile. • Synthetic turf can be used selectively in high wear areas of a sports field such as the goal area.
Synthetic turf design is evolving	• Recent technological advances in synthetic design address some of the environmental impacts associated with earlier generations of synthetic turf. • Replacing rubber infill with cork granules is an environmentally friendly option however it is more costly and deteriorates faster.
Innovative management practices can support greater use	• Strategic lighting to encourage evening use of particular areas of fields and shifting line markings are an effective way to distribute usage across a playing field surface. • New technologies and approaches are offering facility owners improved data on the status and usage of sports fields, enabling councils to better target maintenance, manage peak use and quiet periods, scheduling, and planning for use.
Sports field planning and siting	• Siting considerations exist for both natural and synthetic turf. For example, many issues that constrain optimal utilisation of natural turf fields are intensified when they are located in poor drainage or flood prone areas, ex landfill sites, or where they have a dual purpose as stormwater retention basins. • Where synthetic or natural turf fields are located in areas prone to flooding, or subject to overland flows during extreme weather, there can also be issues related to pollution of local waterways or bushland with infill materials or pesticides. Further discussion of potential pollution arising from both natural and turf fields, and the contamination of the surrounding local environment, is discussed below. • Better consideration of siting and planning for the whole open space network can alleviate some pressure on the network, including sharing of facilities (across LGA boundaries and with different land uses such as schools), purpose-built facilities and siting synthetic fields in non-environmentally sensitive areas.
Constrained supply of sports fields	• The existing network of sporting facilities is perceived by some stakeholders as unable to meet growing demand and some clubs turn away potential participants due to a lack of capacity. • Existing fields in densely populated areas, with high levels of sporting participation may not have the capacity to meet very high levels of demand, regardless of the quality of the field. • It can be challenging to acquire new land for sportsfields due to development pressure and lack of available space (particularly in inner city areas). Some councils therefore choose to increase local capacity by converting natural turf sportsfields to synthetic turf.

Theme	Issues
Poor quality of existing sporting facilities	• Poorly maintained and constructed natural turf sports fields can struggle to support high levels of use due to poor condition and inadequate drainage, which limits their available hours of use for sport. • Many natural turf fields are perceived to be in poor condition with inadequate drainage, poor construction and maintenance regimes resulting in low field capacity. Well-engineered natural fields maintained in good condition can provide significantly higher levels of utilisation than poor condition ones.
Sporting facility demand, supply and capacity is complex and contextual	• Natural turf fields cater for more diverse uses that includes organised sporting activities and passive recreation activities such as picnicking, walking, jogging, dog walking and more. • The carrying capacity (calculated as hours of organised sports use per week) of synthetic surfaces is higher than natural turf and as such field operators can allocate more users to a synthetic field for organised sport training and competition. • The use of sports field can be concentrated to specific days and certain times of day for training and competition. Implementation of synthetic turf surfaces can offer higher levels of participation during peak periods. • Actual demand for sports use is not always modelled or well understood by authorities when considering converting surfaces to synthetic. The theoretical capacity provided by a synthetic surface may not be required to support actual demand for sports participation. • Synthetic turf can improve the reliability and surface quality for sport use during wet and winter weather compared to natural turf. However, during summer, matches on synthetic turf sports fields may need to be cancelled due to heat more frequently than natural surface fields. • Hybrid surfaces are an emerging response to improving field capacity and combining the advantages and limiting the disadvantages of both pure natural and synthetic.
Amenity and enjoyment for informal users of public open space	• Synthetic fields are generally subject to higher ambient temperatures than natural turf on hot days. • The aesthetic of synthetic turf is very different to and perceived as much less attractive to natural turf. • Synthetic turf does not provide the same benefits of connection to nature compared to natural turf open spaces. • Natural surfaces provide greater levels of noise abatement, glare reduction and UV reflectivity. • Fenced synthetic fields reduce informal use of open spaces while prioritising sporting use.
Impacts from the increased utilisation enabled by the use of synthetic surfaces	• Due to having an increased carrying capacity, synthetic fields can have: - Increased impact on surrounding residents from duration of field lighting at night - Congestion and pressure on parking and increases to local traffic. - Increased impact and duration of noise due to greater intensity of use. - Elevated synthetic fields can impact on perceived privacy for adjacent residents.
Concerns associated with environmental impacts	• **Pollution:** Air and water pollution caused by synthetic turf materials (i.e., rubber crumb) is well documented in academic research. Pollution, particularly of waterways and bushland, was a key concern raised by community representatives. • **Chemical use:** Pesticides and fertilisers are typically used for natural turf fields, while pesticides and fungicides are typically required for synthetic fields. • **Waste:** Environmental and financial challenge of disposing synthetic turf at the end of its 8–10-year life cycle. • **Heat:** Heat impacts to the surrounding environment caused by synthetic turf absorbing heat rather than reflection.

Theme	Issues
Concerns associated with environmental impacts continued	• **Carbon emissions:** Synthetic fields contribute to heightened CO2 emissions due to lack of carbon absorption associated with natural turf. • **Soil sterilisation:** Sterilisation of soil beneath the synthetic turf has an impact on ecosystems. Synthetic surfaces inhibit living systems. • **Water Usage:** Water consumption and irrigation requirements are lower for synthetic turf making it generally more suitable for drought and dry conditions (due to reduced water requirements). • **Variability:** Environmental impacts of synthetic fields vary substantially depending on what type they are. Older synthetic fields (generation 2 and 3) are associated with significantly higher radiant heat and environmental pollution. • **Wildlife:** While natural turf sportsfields have limited biodiversity value, they do provide some habitat for local flora and fauna that synthetic turf does not. • It is noted that design of synthetic surfaces is technologically advancing in response to some of the impacts created by synthetic turf, e.g., microplastic pollution.
Potential human health impacts	• Heat stress and the impact on player and user comfort associated with playing on synthetic fields in hot weather. • Some generations of synthetic turf (typically 1st, 2nd and 3rd) have a greater risk of abrasiveness on skin and higher injury rates. • Research has suggested that biological pathogens, toxic chemicals, and micro-plastic ingestion are all risks to human health that are associated with synthetic materials.
Cost and economic factors are not transparent	• High initial capital cost of synthetic turf can be perceived as a barrier to installation. • Synthetic playing fields have traditionally been perceived as requiring lower maintenance and hence lower operating costs compared to natural turf. However, synthetic surfaces have a prescriptive maintenance regime, and there is indication from recent studies in other jurisdictions, including New Zealand and Western Australia, that in practice synthetic turf can have reoccurring maintenance costs for repairs and cleaning of surfaces that can be comparable to that of natural turf. • Long term maintenance of natural turf surfaces is often underfunded which can result in deteriorating condition facilities and limited capacity. • Renewal costs associated with the disposal and replacement of synthetic fields at the end of their life cycle is not always adequately considered. • Best practice natural turf has ongoing maintenance requirements to maintain high levels of performance for all users, such as mowing, “resting”, and re-surfacing the field.

1.3 Preliminary Recommendations for Consideration

Consultation undertaken in preparation of this Study has demonstrated that there are often conflicting views between local authorities, user groups and the wider community over the suitability and benefits of synthetic turf as an alternative to natural turf.

While it is clear that both types of surfaces can provide positive outcomes in terms of access to public open space and participation in recreation and sporting activities, the absence of consistent guidelines, consultation with communities and transparent consideration of potential alternatives has led to distrust and concern over decisions to implement synthetic sporting fields.

To potentially address this conflict, the Department may reflect on the following opportunities that are identified for further consideration:

- The benefits of providing consistent state-wide guidance to Local Authorities on key considerations or criteria when proposing to provide new synthetic turf surfaces;
- Potential adaptations to state planning policy to require that appropriate and meaningful community consultation informs decisions around the use of synthetic versus natural turf surfaces;
- Further primary, evidence-based research into the human health and natural environmental impacts of synthetic turf use, in particular:
  - The impact of heat on larger fields, and the potential for higher UV reflectivity of synthetic turf
  - The appropriateness of natural vs synthetic in bushfire prone areas
  - The impact of synthetic materials on human health
  - The health and social implications of reduced accessibility for informal and passive enjoyment of public open space associated with synthetic turf usage
- Further consideration of the potential benefits and impacts of the emerging technologies of hybrid and 'fourth generation or 4G' synthetic technology within an Australian context.
- Undertake research to understand barriers to implementing best practice natural turf fields.

The above recommendations have been further explored within **section 5.0** of this report.

1.4 Alternative Approaches

A number of alternative approaches to mitigating the impacts of using synthetic turf were identified during the study. These are:

- **Improvements to Natural Turf Design:** Natural turf fields can be designed and managed to withstand more use, drain more effectively, reduce reliance on water for irrigation, and be available during or immediately after bad weather.
- **Improved Data Collection and Analysis for Facility Owners:** New technologies and approaches are offering facility owners improved data on the status and usage of sports fields, enabling councils to better target maintenance, manage peak use and quiet periods, scheduling, and planning for use.
- **Managing use:** Local government, state agency stakeholders and sporting associations have identified innovative approaches to managing usage and reducing pressure on high-wear areas of a natural turf field, including around the goal mouths.
- **Hybrid Turf Options:** Some hybrid turf options that may offer alternative solutions to enhancing sports field capacity and durability this includes profile reinforcement to increase the durability of the root zone, integrating synthetic turf blades into natural grass, and selectively using dynthetic turf in high wear areas.
- **Advancements in Synthetic Design:** Alternative construction materials and methods, hybrid sports surfaces, and the use of organic infill layers have the potential to mitigate against some of the challenges traditionally faced by adopters of synthetic surfaces.
- **Utilisation of Spaces and Siting Considerations:** Siting considerations exist for both synthetic and natural turf fields. Greater consideration of the whole open space network when selecting suitable sites for field upgrades is required to improve the quality and availability of public open spaces in NSW.

2.0 Introduction

2.1 Project Background

From opportunities to participate in active recreation, a space to socialise with friends and family, or connect with nature, access to public open space provides a diverse range of opportunities and benefits to communities.

The NSW Government is seeking to increase access to public open space to help support the health and wellbeing of individuals, social cohesion in communities, and thriving local economies[1]. However, there are areas across NSW, particularly in inner urban areas, where demand for public open space is not being met by the current supply.

The factors that have contributed to a widening gap between supply and demand for public open space in some areas include growing use of public open space for sport and recreation, rising land prices, projected population growth, declining land availability, climate pressures, and a diversification of community needs. The growing demand for flexible and available public open space has been observed during the COVID-19 pandemic when community of open space increased significantly.

To help address the growing demand for multi-functional and flexible public open spaces, councils, state agencies, and sporting bodies are exploring different options to increase the capacity of the public open space network. These different options include upgrading the surface type, either by converting to synthetic turf or replacing with a higher grade of natural turf, improving the management of existing turf and modifying games times and traditional days of play.

Synthetic turf has become an attractive option to respond to this growing demand for sports fields due to its ability to support greater levels of use, particularly for sports, than most natural turf surfaces, as well as:

- The perceived reduction in ongoing maintenance requirements
- The reduction in irrigation requirements
- The ability to support more intensive use
- High durability, reliability, and consistency in all weather conditions.

As a result, there has recently been a higher rate of adoption of synthetic surface types, with more than 35 synthetic fields installed in NSW over the last five years alone[2].

However, there has been a growing number of concerns raised by local communities and stakeholders about the impacts of synthetic field including, but not limited to:

- Lack of community consultation on proposed conversion of natural turf to synthetic turf
- Loss of existing public open spaces that are flexible and readily available to the community
- Suitability of location and proximity to residential dwellings, natural waterways, and bushland
- Increased air and water pollution due to rubber and microplastic particles within synthetic turf materials
- Increased surface temperatures during warm weather and the adverse effects on thermal comfort
- Restriction of access for informal and passive recreation activities due to exclusivity of use (either perceived or real) and advance booking of facilities

1 *NSW Government 2021, Premier's Priorities: Greener Public Spaces, NSW Government, accessed 17 May 2021 < https://www.nsw.gov.au/premiers-priorities/greener-public-spaces>*

2 *Football NSW, Synthetic fields continues to grow across NSW, https://footballnsw.com.au/2021/03/24/synthetic-fields-continues-to-grow-across-nsw/.*

- Health concerns about chemicals used in synthetic grass and toxicity of crumb rubber
- Detrimental impact of synthetic fields to local wildlife and ecosystem
- Detrimental impact to local amenity (i.e., light and noise pollution at night, additional local traffic) due to extended hours of use and intensity of use.

Ethos Urban, in collaboration with Otium Planning Group, was commissioned to undertake a study (the Study) into the use of synthetic alternatives to natural turf in public open spaces. The Study has been requested by the Department to develop a greater understanding of the social, environmental, and economic impacts, benefits, and limitations of using synthetic turf as a replacement for natural grass in public open spaces across NSW.

2.2 Purpose of this Report

The purpose of the Report is to provide a summary of the findings from the Study, including community feedback, stakeholder workshops, case studies and literature review, and to highlight further areas for consideration and research.

The Report provides a summary of the key findings of the Study and identifies opportunities for future investigation and seeks to:

- Provide an overview of the social, economic, and environmental impacts, benefits, and limitations of using synthetic turf as a replacement for natural grass fields in public open spaces across NSW
- Identify alternative turf technological solutions and management techniques which allow for increased use of sports fields
- Evaluate the management approaches (for natural, synthetic, and alternative turf) identified in relation to the social, economic, and environmental impacts
- Identify issues that influence the decision-making process for local sports facilities.

It is important to note that while the Report draws on information from existing academic and industry research, it does not represent primary research or seek to duplicate existing technical information on synthetic and natural turf construction that is readily available.

Furthermore, whilst acknowledging that sporting clubs and associations are the predominant users of formal sporting fields, it is important to note that the Study was not limited to that of organised sport. Sports fields form part of a broader public open space network that is used by a wide section of the community for outdoor recreation. This includes exercising, walking, relaxing, gathering for picnics, dog walking, play, community events, formal and informal sport.

While the findings may be relevant, the role of synthetic fields in supporting elite level sport or its use outside of public non-community sports fields (i.e., Department of Education or Transport for NSW) was not included within the scope of the Study and has therefore not been referenced within the Report.

2.3 Context

2.3.1 Value of Public Open Spaces in NSW

Public open space is considered critical environmental and social infrastructure that is integral to the character and public life of NSW communities. Access to high quality public open spaces will become even more critical as communities continue to densify in response to NSW's sustained population growth.

Quality public open spaces make for liveable, sustainable, and healthy neighbourhoods. Public open spaces include parks, gardens, play spaces, public beaches, riverbanks, waterfronts, publicly accessible bushland and outdoor playing fields and courts. They provide us with places to exercise, play, rest, participate in social activities, and contribute to healthy, happy, and resilient communities. The social, environmental, and economic benefits of access to green open space are well established, and include:

- **Encouraging physical activity:** Public open space helps people to maintain healthy lifestyles by providing spaces that encourage physical activity, children's play, participation in sport and active transport. Public open space users are more likely to meet recommended levels of physical activity, and park amenities and improvements can increase park use and rates of physical activity[3]. Inactivity is less common among residents of greener neighbourhoods[4].
- **Social connection:** Public open spaces are the living rooms of cities, places where people of all ages, cultures, abilities, and socio-economic backgrounds come together. Sharing these spaces, including through participation in sport, promotes social interaction, connection, and cohesion. Socially cohesive communities provide support and practical help to each other, and a sense of belonging and community.
- **Enabling participation in sport:** Public open spaces also play an important role in supporting participation in sport. In NSW, many people participate in sport to improve their health and wellbeing, connect with others, including positive role-models, and build their physical and mental resilience[5]. The 2020 Ausplay survey[6] identified that 61.1% of NSW residents participate in sport-related activities.
- **Connection to nature:** Access to the natural environment is good for physical and mental health, but is increasingly difficult to maintain in high density, urbanised environments. Natural landscapes and semi-natural systems such as parks, rivers, bushland, and private gardens, are essential 'green infrastructure' that support quality of life in an urban environment[7].
- **Mental health and restoration:** Even brief contact with nature can improve emotional wellbeing and reduce psychological stress.
- **Place identity:** Public open spaces, including sports fields, can strengthen attachment to place and a sense of community, which is strongly associated with improving mental health. Feelings of disconnection, and the experience of loss of place can have significant psychological impacts.
- **Reduced urban heat:** Natural green spaces and canopy cover reduce urban heat by contributing to shade and evapotranspiration (the process by which the suns energy is used to transfer water from plants into the atmosphere)[8]. They also provide cooling relief on hot days, enabling people to relax and interact with the public realm[9].

3 *NSW Health 2020, Healthy Built Environments Checklist, p.36 <https://www.health.nsw.gov.au/urbanhealth/Publications/healthy-built-enviro-check.pdf>.*
4 *NSW Health 2020, Healthy Built Environments Checklist, p.56 <https://www.health.nsw.gov.au/urbanhealth/Publications/healthy-built-enviro-check.pdf>.*
5 *May, C 2021, "Physical activity," Clearinghouse for Sport < https://www.clearinghouseforsport.gov.au/kb/physical-activity>*
6 *Clearinghouse for Sport 2021 Ausplay results, NSW data tables – January 2020 to December 2020, released 30 April 2021 < https://www.clearinghouseforsport.gov.au/__data/assets/excel_doc/0005/1004576/AusPlay-NSW-data-tables-30-April-2021_Final.xlsx>.*
7 *NSW Health 2020, Healthy Built Environments Checklist, p.56 <https://www.health.nsw.gov.au/urbanhealth/Publications/healthy-built-enviro-check.pdf>.*
8 *Scott, C 2015, A brief guide to the benefits of urban green spaces, p.6 < https://leaf.leeds.ac.uk/wp-content/uploads/sites/86/2015/10/LEAF_benefits_of_urban_green_space_2015_upd.pdf>.*
9 *WSROC 2018, Turn down the heat: Strategy and action plan, p.28, 55 < https://wsroc.com.au/media-a-resources/reports/send/3-reports/286-turn-down-the-heat-strategy-and-action-plan-2018>.*

"With the increase of population, this is becoming much harder for many sports who are struggling to find sufficient grounds.

The best way to counter this is to convert selected turf fields into synthetic as this enables grounds to be utilised more and increase the number of people using it."

- Online submission.

- **Climate change resilience:** Public open space can improve resilience to extreme weather events, such as bushfires, floods and heatwaves, by improving air quality and reducing temperatures and flood risk in urban areas, while sequestering carbon dioxide from the atmosphere[10].
- **Supporting ecosystems:** Public open space can contribute to biodiversity conservation by providing habitats for flora and fauna[11], enhancing micro-climates, as well as other ecosystem benefits such as stormwater management, temperature regulation (e.g., via shade, reduction in wind capacity) and urban heat island mitigation and biodiversity[12].
- **Economic benefits:** Well maintained and high amenity public open space may raise the prices of adjacent properties and stimulate economic activities in nearby businesses[13]. *"The creation, maintenance and management of green space also generates employment opportunities and may have indirect benefits to local economies by encouraging further investment and property development in the area."*

2.3.2 Growing Demand for Public Open Space

Through a combination of busy lives and increasingly denser urban areas, access to public open spaces that enable multi-functional recreation (i.e., walking, cycling, dog-walking or formal or informal sport), becomes very valuable to local communities. An ever-increasing demand for public open space in NSW is driven by:

- **Population growth:** The population of NSW is forecast to reach 8.9 million by 2030-31, an increase of 9% on 2021 levels[14]. Population growth is placing pressure on existing public open spaces which need to accommodate increased levels of demand and more diverse community aspirations. In inner city areas, population growth is occurring within areas already lacking adequate levels of public open space. Ongoing growth will require improvement to the quantity, diversity, quality, and capacity of public open space to meet the needs of the NSW population.
- **Increasing urban density:** Access to high quality public open space is becoming increasingly important as towns and cities in NSW become denser, and dwellings becomes smaller – and increasingly without access to private open space, such as backyards. Increasing urban densities is resulting in more people needing to use public open space to maintain their physical and mental health and wellbeing.
- **Increasing diversity of participants in sport and outdoor recreation:** The profile of participants in organised sport is also changing. AFL, soccer, and rugby, once considered male-dominated sports, are seeing an increase in the number of female participants, with more participation from people over the age of 35. Furthermore, the increasing cultural diversity of NSW communities has also driven a change in community preferences and demand for public open space.

10 *GANSW 2017, Greener Places – draft for discussion, p.16 < https://www.governmentarchitect.nsw.gov.au/resources/ga/media/files/ga/discussion-papers/greener-places-discussion-draft-2017-11.pdf>.*
11 *GANSW 2017, Greener Places – draft for discussion, p.16 < https://www.governmentarchitect.nsw.gov.au/resources/ga/media/files/ga/discussion-papers/greener-places-discussion-draft-2017-11.pdf>.*
12 *Ives et al 2014, Planning for green open space in urbanising landscapes, final report prepared for Australian Government Department of Recreation, Natural Environment Research Program, Environmental Decisions Hub, RMIT, p.7 < https://www.environment.gov.au/system/files/pages/25570c73-a276-4efb-82f4-16f802320e62/files/planning-green-open-space-report.pdf>.*
13 *Ives et al 2014, Planning for green open space in urbanising landscapes, final report prepared for Australian Government Department of Recreation, Natural Environment Research Program, Environmental Decisions Hub, RMIT, p.82 < https://www.environment.gov.au/system/files/pages/25570c73-a276-4efb-82f4-16f802320e62/files/planning-green-open-space-report.pdf>.*
14 *DPIE 2021, projections adjusted for the impact of the COVID-19 pandemic.*

2.3.3 Sports fields and ovals

Open space, including sports fields and ovals, are in high demand in many areas across NSW. In some areas, such as Greater Sydney, there are limited opportunities to provide new public open spaces in response to population growth.

Where land for additional public open space is difficult for councils to acquire, alternative solutions and practices are increasingly required to increase the capacity of existing public open space to meet community needs. This can include improved maintenance or selection of natural turf type, better design of sports fields, more durable and higher quality materials, better lighting, and the introduction of synthetic or hybrid playing surfaces, especially where there is demand for 'elite level' competitions or codes with a preference for synthetic playing fields (such as Hockey, Tennis, and to an extent Football).

The following section provides an overview of the different surface materials for public open space, including:

- Natural turf
- Synthetic turf
- Hybrid technologies.

Each of these surface materials has a complex and diverse range of designs and configurations appropriate for different uses. The performance and user experience of each surface type is also strongly influenced by the maintenance regime and funding levels allocated to upkeep.

The literature review undertaken for this report identified that most existing analysis on the subject tends to evaluate different surface materials from the perspective of sports users. As we heard from community and stakeholder engagement, public open spaces also support important community and informal uses, in additional to formal sporting participation.

Acknowledging the complexity of different surface materials for public open space, this section provides a brief definition of the main types of surface materials. Further discussion of the history, construction and design of different surface types is included in **Appendix D**.

Natural turf

The construction of natural turf varies considerably and has significantly evolved over time to enhance the capacity and durability of natural turf-based playing surfaces. Since the 1920s, research has investigated ways to improve the performance of natural turf playing fields, which has resulted, "almost universally" in the use of coarse-grained, quick-draining materials, such as sand being used to construct natural turf sportsfields[15].

The construction options for natural turf range from a basic soil-based grass field to a high-quality engineered sand-based field with profile reinforcement. The design of a high quality (engineered) natural turf playing surface sand profile typically consists of a natural turf surface layer, rootzone sand layer and gravel drainage layer.

SportEng, an engineering firm specialising in "fields of play," states that natural turf fields are becoming increasingly complex and designed to:

- Drain more effectively while maintaining sufficient moisture content
- Reduce reliance on water for irrigation
- Tolerate more use
- Be available during or immediately after bad weather[16].

15 *SportEng 2021, "What is natural turf?" SportEng, blog post dated 25 March 2021 <https://blog.sporteng.com.au/what-is-natural-turf>.*
16 *SportEng 2021, "What is natural turf?" SportEng, blog post dated 25 March 2021 <https://blog.sporteng.com.au/what-is-natural-turf>*

Natural turf, like other surfaces, has significant maintenance requirements to maintain high levels of performance for all users, such as mowing, "resting" and re-surfacing the field. '

However, councils, community groups and sporting association stakeholders consulted to inform this Study noted that many fields across NSW are not allocated adequate budgets to enable them to perform at high levels of performance, particularly after heavy winter use or wet weather. As a result, facility owners consider replacing natural turf fields with synthetic turf, when instead performance issues may be addressed upon examination of maintenance requirements, turf type, design, or location.

Synthetic turf

Synthetic turf is being adopted by some community sports facility owners for a range of reasons as outlined in **section 2.2.3**, particularly to enable increased use for formalised sport.

The major components of contemporary synthetic turf construction include a pavement base, shock pad to reduce the risk of injury, turf carpet made of artificial grass blades (composed of polyethylene or polypropylene) stitched through a woven mat and infill, which helps keep the blades upright, improves grip and drainage. Common types of infill include crumbed rubber, sand, and cork.

There are a diverse range of synthetic surfaces and construction methods used in public open spaces across NSW. Synthetic turf has been through four generations and continues to evolve with new solutions and applications emerging as the industry matures. Fourth generation (4G) synthetic turf designs are currently emerging and being considered by councils. This generation is characterised by diversified construction materials and methods, including the removal of infill layers (see **section 4.3.3**).

Councils and sporting association stakeholders consulted as part of the Study indicated that the most common type of synthetic turf in NSW is third generation, which is characterised by shock pads and rubber, cork, or sand infill. This type of surface is acceptable for sports including football, AFL, and rugby.

Hybrid turf

There are a range of emerging hybrid turf systems, including:

- **Hybrid turf profile:** This system combines blades of synthetic grass with natural turf to provide a consistent playing surface, improved surface durability and stability[17]. The hybrid system is still relatively new to Australia with only a few installations of this type, including the Melbourne City Football Club training facility and Harrie Denning Football Centre in Kareela, NSW. The hybrid system has become a popular option for international sporting codes such as the English Premier League and National Football League. This system is more durable than natural turf, due to the presence of synthetic grass fibres that provide traction even if natural grass is worn. However, hybrid turf can impede typical maintenance practices required for natural turf (i.e., deep aeration/ decompaction), and further research is required to understand maximum carrying capacity of hybrid playing fields.
- **Profile reinforcement:** In addition to hybrid systems, it is possible to incorporate synthetic elements within the soil or rootzone layer to improve the durability and stability of natural turf and reduce divoting (i.e., holes made in grass by sports activities, e.g., rugby scrums), examples include[18]:
    - Fibre system, whereby various types of synthetic fibre are mixed into the soil or sand into which natural grass is grown, improving root stability.
    - Mesh-based system, where either a mesh or shredded mesh is mixed into the root zone area to stabilise the natural grass fibres.

17 *SportEng 2018, SportEng Field of Play Surface Profiles.*
18 *Smart Connection Consultancy 2019, The Smart Guide to Synthetic Sports Surfaces: Volume 2: Football Turf – Synthetic and Hybrid Technology,*

- **Combining natural and synthetic turf:** Stakeholders consulted during this Study noted that some councils are exploring options to combine some high use areas of natural turf fields (e.g., cricket wicket at the centre of an oval and around goal mouths) with synthetic turf, or a blend of both natural and synthetic, to improve durability without needing to convert the entire field.

This approach is also used in elite facilities, for example the playing surface at Bankwest Stadium in Parramatta consists of a high-quality natural turf pitch, but synthetic grass is used around the pitch to maximise the extent of vehicular traffic without damaging the natural turf surface. Council representatives who participated in the consultation process noted that Liverpool City Council has recently installed hybrid turf alongside natural fields and is monitoring the outcome.

2.3.4 Sporting Demand for Synthetic Fields

The growing demand for synthetic surfaces as an alternative to natural turf fields is predominantly due to two key drivers: increasing demand for access to sporting fields and a decreasing supply of available land and cost to acquire lands to develop new fields.

Other factors driving the demand for synthetic fields within the sporting community include:

- **Increasing participation in sport and outdoor recreation activities:** Population growth is increasing participation in sport and other outdoor recreation activities, even as participation in some forms of sport is declining (e.g., hockey and rugby union). For example, the 2019 (pre-Covid-19) AusPlay data indicates that there are more than 516,000 football participants across NSW. Football NSW in the same year cited an 11% growth in winter participants across the previous five years[19]. The NSW Office of Sport also noted that there has been an increase in non-organised or time-flexible pursuits, such as fitness classes or running, alongside continuing high levels of participation in organised sport. The combination of these formal and informal uses continues to drive a strong demand for active public open space, with most metropolitan councils reporting an increased pressure on community fields during consultation.
- **Shortfall of public open space:** Population growth, especially within cities, and the increasing residential densities resulting from infill development in established areas, have resulted in significant pressure on existing public open space networks for both formal sporting use and general recreation. However, finding and acquiring land suitable for sporting use (i.e., large flat areas) is an increasingly difficult challenge. In some areas of higher density growth, councils can struggle just to achieve sufficient parkland for recreation.
- **Greater resiliency in all-weather conditions:** Responding to changing climate conditions is another driver to the provision of synthetic sport field surfaces. The loss of playable hours on natural turf playing fields due to wet weather is often cited as a key reason for pursuing synthetic playing fields, ensuring consistent sport participation during the winter season when demand is typically at its highest (especially for football, rugby and AFL). Conversely, in drought-prone areas, the use of synthetics means that a lack of water will not impact on the playing surface quality. It should also be note that hot weather can impact user safety and comfort on synthetic fields.
- **Higher return on investment:** Synthetic surfaces are also perceived to have a greater ability to attract a higher return on investment than natural turf playing fields through user chargers. The ability to charge increased hire costs, the number of hours a field can be hired, and the ability to plan and fund refurbishment are attractive to facility owners or operators. However, this is seen by the community as privatisation of public open space.

For some sporting codes (i.e., football, AFL, hockey, and rugby union) there has been substantial research and investment in the development of standards around synthetic surfaces to assist in deploying this solution. For many facility owners, the investment in a synthetic surface meets the sporting needs of the local clubs, is favoured by them, and provides a known outcome in terms of capacity and reliability.

19 *https://footballnsw.com.au/2019/11/07/football-remains-number-one-in-nsw/.*

Image source: https://www.twenty20.com/

"To date, the decision has been presented as a very binary one – either we keep the natural turf and have to deal with reduced playing time with ever increasing demand from sports team or install synthetic turf."

- Online submission.

2.3.5 Community Sentiment

The installation of synthetic turf fields, particularly the replacement of natural turf fields with synthetic turf, is attracting high levels of interest from communities in NSW.

There is strong support among participants of specific sporting codes (i.e., football, AFL, hockey) for the installation of synthetic fields due to the increase in capacity of playing fields. This increased capacity is seen to help address the growing demand for playing space and participation rates with some of these sports.

Conversely, it was noted in the stakeholder workshops that for some sporting codes (i.e., cricket and rugby league) the introduction synthetic fields have not been welcomed by their local clubs and associations due to the playing surface not being conducive their style of game (i.e., tackling, and impact to fielding side). However, in the example of rugby league, it was noted during the consultation process that there was an openness for synthetic from the less contact forms of their game, including Touch Football and OzTag.

Feedback from other stakeholders, including community groups, environmental groups, academics, and other sporting codes spoke about their concern about the potential social, environmental, and economic impacts of synthetic turf. Within local government areas (LGA) across Greater Sydney have formed action groups in response to the conversion of natural turf fields into synthetic turf fields within their community

Throughout the consultation process, it was clear that there is strong support for increased participation in recreation and improved access to high quality public spaces – including from community members, council representatives, sporting groups and industry experts.

The differences of opinions were associated with the potential solutions to addressing the competing needs and growing demand for green open spaces, noting the challenges of sharing field space with sporting codes and informal uses in any given facility.

There was however consensus amongst different community groups (i.e., resident action groups and sporting clubs) on the need to identify alternative solutions to ensure the best outcome for the community, from a social, economic, and environmental perspective.

This included a strong recognition of the need for consultation, possibly achieved through modification to the ISEPP (see **section 1.3**).

"This is not about balancing competing open space needs – it's about making available space usable for all potential users."

- Online community workshop participant, 25 May 2021

3.0 Methodology

3.1 Developing the Study

The following section outlines the methodology developed by the Department and Ethos Urban in conducting this Study.

3.2 Literature Review

A literature review was undertaken to identify key existing academic and industry research from an Australian and international context. This literature review was guided by two primary inquiries:

- What are the established social, economic, and environmental impacts associated with the process of replacing natural turf with synthetic surfaces?
- What is the status and best practice of synthetic turf installation and use in NSW?

The review followed a two-step process:

1. Ethos Urban conducted key word searches to identify potentially relevant material published in English. The search included any study that referred to the social, environmental, and economic impacts of synthetic turf, with priority given to Australian studies. Ethos Urban also obtained additional relevant studies from the reference lists of identified articles, industry documentation, as well as from participants in the stakeholder and community workshops.
2. Ethos Urban screened all identified references to compile key findings and perspectives, and to identify potential gaps in research and areas for deeper inquiry.

This literature review identified that:

- Most existing analysis on the subject tends to evaluate different surface materials from the perspective of sports users, rather than informal community users.
- There are few Australian-specific studies on key issues, including heat, UV, injury, chemical leeching, and comprehensive economic and carbon life cycle analyses[20].
- There are currently no NSW-specific guidelines for decision makers considering the implementation of synthetic turf. However, there are discussion papers and guidelines from other jurisdictions, such as Victoria and Western Australia.
- The social impact of synthetic turf is under-researched, compared to the more extensive environmental and economic analysis conducted overseas. Therefore, this report has drawn from the findings of community and stakeholder consultation to explore social impacts of this issue within the NSW context.

The key findings and perspectives from this literature review have been incorporated throughout this report.

20 *See, however: Football NSW n.d., Increasing capacity with synthetics: The impact of investing in synthetic pitches on the operation of a club, provided to NSW DPIE during stakeholder workshops; GHD for Horticulture Innovation Australia Limited 2020, Living turf fire benefits study – Literature review, April 2020 < https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/tu17008-literature-review-living-turf-fire-benefits-study.pdf>; Lamble, P & Battam, M n.d., "Creating sustainable open spaces – using compost to deliver liveability, sustainability and economic outcomes," technical paper prepared for OzWater; Smart Connection Consultancy 2017, The Smart Guide to Synthetic sports Fields Rubber Infill; Smart Connection Consultancy 2019, The Smart Guide to Synthetic Sports Surfaces: Volume 3: Environmental and sustainability considerations, accessed 17 May 2021 < https://www.smartconnection.net.au/wp-content/uploads/2019/11/Vol-3-Envirnmental-and-Sustainability-Considerations-v1.01.pdf>; WA Department of Local Government, Sport and Cultural Industries nd., Natural Grass vs Synthetic Turf Study Report, < https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>.*

3.3 Consultation Process

The Department recognised that consultation with key stakeholders including the local community was essential to ensuring this Study was considerate of the diverse perspectives of those involved in the use and decision-making process in the application of synthetic surfaces.

Throughout May 2021, the Department and Ethos Urban held a series of in-person and online workshops, including three stakeholder workshops and two community workshops on the following dates:

- **Stakeholder Workshop 1:** Tuesday 4 May (in-person).
- **Stakeholder Workshop 2:** Wednesday 5 May (in-person).
- **Stakeholder Workshop 3:** Thursday 6 May (online).
- **Community Workshop 1:** Tuesday 25 May (online).
- **Community Workshop 2:** Thursday 27 May (in-person).

A mixture of both in-person and online sessions were held to ensure representatives from across NSW could also participate in the consultation process. Each workshop ran for approximately two hours with approximately 12–15 participants in attendance at each workshop.

Image source: https://www.twenty20.com/

3.3.1 Workshop Format

The purpose of both the stakeholder and community workshops was to obtain feedback from participants on the social, environmental, and economic impacts and benefits of synthetic turf.

To help ensure participants had the opportunity to share their views and experiences, larger workshops (over 15 participants) were divided into two groups with time at the end of the workshop allocated for a report back to the wider group.

Approximately 90 minutes of the two-hour workshops were allocated to a roundtable discussion where participants were able to share their feedback on a series of questions that had been developed in response to the key requirements of the project brief. Workshop materials (i.e., meeting agenda and sample presentation have been included under **Appendix E**).

It was recognised that to ensure the diverse range of perspectives could be considered, workshop questions needed to be similar for both the stakeholder and community workshops; however, some targeted questions were included in recognition of the representatives in attendance.

Workshop Questions

- How are your local fields used? Is there a mixture of formalised and informal recreation and cultural uses? What are the positive / negative aspects?
- What impact has the increased adoption of synthetic turf fields had within your community?
  - Environmental
  - Social
  - Economic.
- What factors inform Council's decision-making process on upgrading and/or selecting a surface type?*
- How can we better balance competing open space needs for different community groups?^
- What practices are currently in place to manage fields within your local area? Could these be improved and if so, how?
- Are there any alternative turf technological solutions and/or management techniques available that enable an increase in usage? If so, where are these, what have been the benefits / outcomes?

**Stakeholder workshop only*
^Community workshop only

To help understand the effectiveness of the workshop facilitation as well as capture any additional feedback from participants, a post-workshop survey was emailed to each stakeholder participant. Due to time constraints, a post-workshop survey was not issued to those who attended the community workshops; however, the participants were encouraged to provide follow up feedback via the online comment box or by directly emailing the Department's Open Spaces team.

As survey participation varied across each of the three stakeholder workshops, the results collected are not considered to be statistically significant. However, further feedback on the workshop questions has been incorporated into this report.

3.3.2 Stakeholder Consultation

Recognising the need to hear from a balanced and diverse range of perspectives on synthetic, natural and hybrid surfaces for public open spaces across NSW, the Department identified a broad representation of stakeholder groups to participate in the three stakeholder workshops.

The Department cross pollinated the selection across various sectors and subject matter experts to ensure this Study was considerate of those involved in the decision-making process in the application of synthetic surfaces.

Stakeholder groups invited to participate included:

Table 1 – Stakeholder Groups Invited

Type	Stakeholder groups
Local Councils	• Selected Metropolitan councils, including infill and greenfield councils • Selected Regional councils
State agencies	• Sports • Environment • Health • Public Spaces • Infrastructure and Place
Peak sporting associations	• AFL • Hockey • Cricket • Rugby League • Football
Academics & Research	• Environment • Health
Industry Peak Bodies	• Planning • Environmental Protection • Landscape and Design
Turf specialists and consultants	• Natural • Synthetic

A full list of the organisations who participated in the stakeholder workshops has been included in **Appendix F**.

3.3.3 Community Consultation

Understanding that the Study would attract high levels of interest from different groups within the community, it was important that community groups had the opportunity to share their experiences and perspectives. Due to the limited timeframes, participants in the stakeholder workshops, including councils and peak associations, were asked to help identify community groups and representatives for the community workshops. This was in addition to the Department's own knowledge of key community groups.

Interested community members were also invited to submit an Expression of Interest to the Department's Open Space Team, which was advertised on the Department's website. All applications received were invited to participate in either the online or in-person workshop. Participants in the community workshop ranged from:

- Residents from areas undergoing the installation or planning of a new synthetic turf field (i.e., Banksia, Lane Cove, Ku-ring-gai, Northern Beaches)
- Community groups (i.e., resident action groups, environmental protection groups)
- Peak bodies
- Community sporting clubs and associations.

A list of the community groups and organisations who participated in the two workshops has been included in the appendices of this report.

Whilst this Study was not formally exhibited for public comment, community groups or representatives were also able to provide online submissions via an online comment box on a Department webpage created specifically for this project.

The online submission process was open between 21 May and 4 June 2021 and the feedback received has been incorporated into the findings of this Study. A summary of the organisations and groups who made submissions has been appended to this report.

A total of 46 online comments, emails and written submissions were received during this period. The feedback received has been incorporated into the findings outlined in **section 4.0**.

4.0 Study Findings

The following section provides an overview of the key themes and issues uncovered as part of the Study and is structured into the following parts:

- Understanding the social, environmental, and economic issues
- Understanding the decision-making process, including planning policy issues
- Alternative turf technological solutions and management techniques
- Evaluation of management approaches/alternate practices.

Themes and issues identified through the desktop research and consultation process are supported by case studies.

4.1 Understanding the Social, Environmental, and Economic issues

This section draws on the outcomes of the literature review, as well as the consultation process, and provides an overview of the key social, environmental, and economic benefits and impacts of using synthetic turf as a replacement for natural grass.

4.1.1 Social Dimensions

As identified through the consultation process, natural turf fields are considered an integral part of a local community's public open space network due to their ability to support a diverse range of recreation uses. Examples include, dog walking, running, socialising, local community and cultural events, and participation in formal or informal sports. In contrast to environmental and economic impacts, the social dimensions of synthetic turf are under-researched; however, the stakeholder and community consultation process has highlighted a range of social impacts as summarised in detail below.

Community Concern Over the Loss of Access to Public Open Space

While the potential for synthetic surfaces to increase the capacity of fields for sporting uses is generally accepted, stakeholders and representatives from community action groups expressed their concern over the loss of access to open space when a natural turf field is converted into synthetic. Through the workshop and online submission process, it was noted that the conversion can lead to informal community uses, such as dog walking and self-organised ball games, being displaced in favour of formalised sporting uses.

Arguments in favour of synthetic surfaces tend to focus on their ability to increase the capacity of existing open space for sporting activities; however, it was noted several times that communities also value the opportunity to participate in a diverse range of recreational activities outside a formal sporting context. For example, the Greater Sydney Outdoor Study found that many people prefer spaces that require no membership or schedule for use and enable a range of recreation opportunities[21].

It was evident during consultation undertaken for this Study that some community groups consider the installation of synthetic fields as a reduction in access to green open spaces that are already under pressure from densification, or even as a loss of open space.

21 *Greater Sydney Outdoors Study, Department of Planning and Environment, June 2019, 0. 7*

"Socially, synthetic surfaces are unwelcoming and limiting.

Through restricting or limiting use, such surfaces effectively reduce open space as a community or social asset."

- Online submission (resident).

While synthetic fields can often accommodate increased usage and greater intensity of formalised sporting use, they can displace informal users of natural turf fields, for the following reasons:

- **Protection of the playing surface:** A synthetic field is a significant capital investment, and as a high value asset there is an increased focus on protecting that asset for its primary purpose. Often there is a need to manage use, preventing dogs from accessing the space and ensuring players clean boots to protect the surface and avoid contamination of the infill.
- **Restrictions on informal access:** As synthetic playing surfaces are generally installed to enable formal sporting use, facility owners may restrict the use of the field outside of organised sporting activities, including by fencing the field. However, several council representatives who participated in the consultation process noted that in some cases, synthetic fields are not fenced, and informal community use (of synthetic fields) does occur. However, there is clearly a perception within the community that the space is not available for informal or non-sporting use. Furthermore, the high frequency of formal sporting games and training, often results in little downtime for others to use the space.
- **Inappropriate for community events:** Synthetic turf cannot generally be used for community events, as these require marquees and other temporary infrastructure that can damage the underlying carpet of synthetic turf.
- **Reduced amenity:** Synthetic turf has reduced amenity for informal recreation and socialising (due to the touch and feel of the surface type, increased heat load and glare) which may discourage use of the field for alternate purposes even when access is not restricted.
- **Designed for specific codes or groups of codes:** Synthetic fields are usually managed for formal sporting use and therefore have less flexibility to accommodate informal and recreation use as they cannot easily be reconfigured to accommodate different types of use, such as an emerging code or different sport. Line markings on synthetic fields are often more permanent and the pile height and other features are specifically designed for a specific code or group of codes. There are several products of synthetic turf which are more general use and can accommodate a range of large ball sports; however, AFL, football and rugby all have specified performance features to certify synthetic turf as suitable for their sport.

Image source: https://www.twenty20.com/

Changes to Amenity

The conversion of natural turf fields into synthetic fields can impact the amenity and place characteristics of a local area. Whilst limited academic research has been completed on the diverse values communities assign to public open space, Ives et al (2014) noted that values can include aesthetic/scenic value, access to nature and native plants and animals, health and therapeutic values and social interaction[22]. Changes to local amenity are a key social consideration that was frequently raised by community members during workshops and in online submissions.

It was noted in the literature, as well as in the stakeholder and community workshops, and the online submissions that the amenity and aesthetics of a public open space can be negatively affected by the conversion of natural grass to synthetic turf. Examples noted include:

- **Heat:** Unlike natural turf, which mitigates urban heat island and provides a relatively cool surface for users, particularly in summer, synthetic turf generally absorbs, rather than reflects sunlight, causing the emission of heat. This can reduce the amenity of a public open space for all users, including sporting players and informal users of the site. This was a core concern raised by stakeholders and community representatives during workshops and in online submissions, who also raised that hot synthetic turf can be unpleasant for dogs and their owners when on walks, as well as small children. Heat is a particular concern in the Australian climate, where summer days regularly exceed 30 degrees – however, there is limited existing academic research on the Australian-specific heat impacts of synthetic turf.
- **Aesthetic considerations:** Synthetic turf fields provide a consistent green surface, while natural turf open spaces can be of variable quality depending on their construction and maintenance regime. However, as recent media coverage on synthetic turf fields has highlighted, communities typically prefer the visual appeal of natural turf compared to "fake grass[23]."
- **Connection to nature:** Spending time in nature is proven to reduce symptoms of stress, anger, depression, and fatigue, and lead to increases in happiness. Exposure to nature is linked to improved wellbeing by helping to restore attention and break routine in daily life, and by promoting recovery from stress. Emotional responses to aesthetically pleasing stimuli, such as green spaces, also tend to decrease physiological arousal, thus making us feel relaxed[24]. Replacing natural grass with synthetic materials reduces connection to nature, and the associated feelings of relaxation and restoration.
- **Noise abatement, glare reduction and UV reflectivity:** Natural grass also reduces noise and glare when compared with synthetic turf, which can affect sports participants, other site users and neighbouring uses[25].

22 *Ives et al 2014, Planning for green open space in urbanising landscapes, final report prepared for Australian Government Department of Recreation, Natural Environment Research Program, Environmental Decisions Hub, RMIT, p.7 < https://www.environment.gov.au/system/files/pages/25570c73-a276-4efb-82f4-16f802320e62/files/planning-green-open-space-report.pdf>*

23 *Sydney Morning Herald 'Fake grass may be greener, but much hotter and less friendly to environment'https://www.smh.com.au/national/nsw/fake-grass-may-be-greener-but-much-hotter-and-less-friendly-to-environment-20210312-p57a95.html*

24 *Bhullar, N 2019, "We know contact with nature makes you feel better. Can virtual contact do the same?" The Conversation, 19 June 2019, accessed 16 May 2021 < https://theconversation.com/we-know-contact-with-nature-makes-you-feel-better-can-virtual-contact-do-the-same-111752>*

25 *WA Department of Local Government, Sport and Cultural Industries, Natural Grass vs Synthetic Turf Study Report, < https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>*

Community Concern Over Increased Utilisation of Existing Fields

Council and community representatives raised concerns over the perceived amenity impacts for local neighbourhoods associated with installing new synthetic turf sports fields. As synthetic turf can enable longer and more intense periods of use for sport, there can be amenity impacts for local neighbours, including:

- Increased lighting at night (however, local government stakeholders noted that recent improvements to lighting technology have significantly reduced light spillage associated with sporting facilities)
- Increased congestion and pressure on parking and local traffic associated with players and their families accessing sports fields for training and games. This theme was reaffirmed through many of the online community submissions
- Increased noise due to greater intensity of use by sporting clubs and associations.

Sporting and council stakeholders suggested that the conversion of natural turf playing fields to synthetics may be less disruptive to local communities if the existing field is already used intensively for sportsground use, and increased utilisation is unlikely to significantly change the impact on neighbours.

4.1.2 Demand Capacity

Public open space and recreation areas contribute to making the cities and towns of NSW attractive, healthy and liveable. Providing social infrastructure, particularly public open space and recreation areas, will be critical in continuing to meet the needs and to support the health and wellbeing of the State.

To ensure liveability, one of the greatest challenges will be to provide high quality public open spaces that are equitable, flexible, accessible, well-connected, and diverse. Planning for recreation is influenced by the provision and quality of public open space and this interrelationship is complex and it is vital that recreation planning is cognisant of the type and size of public open space and facilities that meets the needs of the community.

High quality and accessible public open space are associated with higher levels of physical activity and spaces with high-quality options or activities are more likely to encourage physical activity more than the number of open spaces available. This is applicable to both active, passive, organised or unstructured recreation activities.

The demand on the public open space network is growing as with that comes the need for public open space to be multifunctional, flexible, and designed to offer the community with a diversity of recreational offerings.

The key driver for replacing natural grass with synthetic turf is the perception that it is an effective way to increase the capacity of existing playing surfaces, improve surface durability during wet weather, for sports participants. This is based on assumptions that synthetic surfaces can accommodate greater hours of intensive use when compared with natural turf.

This section explores the relationship between user demand and field capacity, including the diverse users and demand for public open space and considerations for modelling demand and capacity.

Diverse Users and Demand for Public Open Space

The shared use of public open space and the increasing use of public open space for a diverse recreation offering (not just formalised sport) should be factored into any consideration when choosing surface type.

A conversion of natural turf to a synthetic playing field needs to consider the impact on other users in the community (see **section 4.1.1**) and should be factored into the investigation of the costs and benefits of design options.

"Passive recreation and access to green space is critical to the health and wellbeing of the wider community.

Sporting groups only make up a small proportion of the total potential users [of a sporting field]."

- Online community workshop participant, 25 May 2021.

Most natural turf fields are for club and community level sport and are open to other users and informal access when not booked for formal sporting use. When these facilities are modified to have a synthetic surface, access limitations can be imposed, such as fencing and restricted access to clubs and fee-paying users.

While fencing and other use restrictions may not actually reduce public accessibility of playing surfaces, they can create restricted access. It is important to note that very high-quality natural turf fields designed and managed for sporting use (such as national level sport clubs) can also have restricted use (e.g., fences) to protect the playing surface.

Due to the growing demand on the public open space network, managers look to find solutions that offer a balance between flexibility and multi-functionality. Natural turf fields offer flexibility as they can be readily reconfigured as demand changes, are generally easier to repair or mitigate damage, and can be more easily used informally. Alternatively, synthetic playing surfaces offer the opportunity to accommodate a higher carrying capacity, allowing more people to play however limit the multifunctionally and flexibility of the space.

Image source: https://www.pexels.com/

CASE STUDY 1: Henson Oval, Marrickville

Figure 1. Henson Oval, Marrickville
Source: pupsy.com

Henson Park is a multi-purpose sporting ground with one natural turf pitch and floodlights, as well as a designated off-leash dog area. This site is a valued local facility within the Inner West LGA, an area which has relatively low levels of public open space per person, compared to other areas of NSW. Henson Park is one of few large public parks within the Inner West LGA, and experiences high levels of use from local rugby league (Newtown Jets) and AFL teams, supports community recreation activities such as dog walking, walking, running, and socialising and also hosts local community events including the Beer, Footy and Food Festival and the Reclink Community Cup. Strategic planning for public open space, undertaken by Council in 2018, has highlighted a need to maximise the recreational use of the site to support population growth[26].

The oval is located on an ex-brick pit with a sinkhole in the middle and poor drainage and was assessed by Inner West Council as a potential location for a synthetic playing surface[27]. However, the facility has instead been retained as a natural turf playing surface by upgrading the turf and underlay soil, installing a new drainage system, rearranging the stormwater drainage network across and upstream of the field, upgrading the irrigation system and rectifying the long-term sinkhole in the centre of the field[28]. This upgrade was completed in 2021 at a cost of $2.6 million, and has been well received by local sports clubs[29].

Henson Oval demonstrates the importance of high quality public open spaces that successfully balance the needs of all users. Upgrading existing natural turf fields can increase capacity for sporting use without alienating other uses.

26 *Cred 2018, Recreation Needs Study – A Healthier Inner West, p.28, accessed 22 June 2021 < https://www.innerwest.nsw.gov.au/about/policies-plans-and-regulations/park-plans-of-management-and-studies/recreation-studies-and-plans>*

27 *Inner West Council 2019, Synthetic sporting grounds to increase sport participation, Inner West, accessed 22 June 2021 < https://www.innerwest.nsw.gov.au/about/news/media-releases/2019-media-releases/synthetic-sporting-grounds-to-increase-sport-participation>*

28 *Inner West Council 2021, Henson Park Upgrade, Inner West, accessed 16 May 2021 < https://www.innerwest.nsw.gov.au/develop/council-run-works-and-projects/park-building-and-streetscape-projects/upcoming-and-ongoing-projects/henson-park-upgrade>*

29 *Newtown Jets 2019, "The Future of Henson Park has been secured," Newtown Jets, accessed 22 June 2021 <https://www.newtownjets.com/the-future-of-henson-park-has-been-secured/>*

Growing Sporting Demand

Engagement with council stakeholders, community representatives and sporting bodies has highlighted that the installation of synthetic surfaces in NSW is generally a strategy to increase capacity for sports participation.

In 2016, approximately 3.7 million adults (59%) in NSW participated in sport or physical activity at least three times a week[30]. Nearly 300,000 (21%) of NSW children aged 0-14 years participated in organised sport or physical activity outside of school hours (including games, training, practice) at least three times a week.

As previously outlined, community participation in sport in NSW is driven by:

- Population growth
- Diversifying participation patterns

Ongoing community participation in sport is driving increased demand for access to sports fields and sports spaces. Many local governments are using their existing natural turf fields to their perceived capacity (approximately 30 hours a week).

One of the few available solutions to address unmet demand is to increase the capacity of existing assets. This increased capacity requires a combination of lights (extending the hours of use) and upgrading the playing surface, either by conversion to synthetic turf or redevelopment as a high grade "engineered" natural turf sports field.

Some of the key drivers of increased adoption of synthetic turf for sports users include:

- **Hours of use:** Synthetic turf is capable of supporting a high number of hours of use. A higher investment in maintenance costs for natural turf will be required to support higher hours of use on well-designed natural turf fields without displacing other users.
- **Consistency and quality of play:** Synthetic surfaces when maintained correctly, can provide a consistent and usable surface all year round for sport and physical activity. It should be noted that well maintained natural turf fields will also offer a more consistent and usable surface thought the year.
- **All-weather suitability:** The loss of playable hours on natural turf playing fields due to wet weather is often cited as a key reason for pursuing synthetic playing fields, ensuring consistent sport participation during the winter season when demand is typically at its highest. However, as will be discussed below, synthetic fields are significantly hotter during summer.
- **Sporting code preferences:** Some sporting codes (e.g., hockey) have a strong preference for synthetic fields compared to natural turf, as it supports improved performance. Some sporting governing bodies (i.e., International Athletic Associations Federation with Athletics, Federation of International Hockey with Hockey fields etc.) prescribe that if a particular level of game is to be played, there has to be access to an "all weather surface".

30 *Office of Sport, Participation https://www.sport.nsw.gov.au/sectordevelopment/participation.*

Modelling Capacity vs Actual Demand

It is important to understand the actual demand of an open space or by a specific sport that aims to be accommodated and to consider what might be the most cost-effective response to meeting that demand. When undertaken in the early planning stages of facility upgrade, this assessment should inform the scope of improvements to facilities (surface change, lighting improvements etc.) but also be broadened to consider the impact of meeting this demand on the wider use of the public open space.

Council stakeholders identified that high demand for sporting participation tends to be Councils' highest priority when making decisions regarding whether to replace existing natural turf with synthetic surfaces. This is particularly important for local councils where high land values make it challenging to acquire new land for open space, and synthetic playing surfaces are often seen as the only option to maximise existing sporting capacity. This is exemplified by the case study of Gunyama Park, Zetland (**Case Study 2**).

As noted by council and state agency representatives during the stakeholder workshops, a cost-benefit analysis or business case undertaken for a proposed conversion to a synthetic surface compares the capital and operating cost (or life cycle cost) of a playing field against the sporting user hours to be accommodated. As identified above, the impact on non-sporting users and the "disbenefit" or cost of reducing multiple use and community access for other recreation use, is not often considered, or factored into the decision.

The capacity of synthetic fields to accommodate significantly increased sporting use, compared with natural turf, is commonly cited as a key advantage of synthetics over natural turf.

When considering demand, it is important to understand the real, not perceived, level of demand when considering what sporting field surface to use. Local government, sporting association stakeholders and community groups noted in the workshops that at a local level, the decision to install synthetic turf is generally driven by demand and lobbying from sporting clubs.

However, sports fields are not always used for formalised sport. They are also places that the community use for dog walking, exercise and fitness, informal sports such as casual sport and many more activities.

Formalised sporting demand for access to sports fields is underpinned by current and projected participation numbers and a club's programming for training and competition needs. Through the literature review it was noted that the peak demand for sporting use is predominantly after school hours and on the weekends. Without lights, field usage would stop at 6:00pm or earlier during winter months. With lights, usage might continue to 8:00pm or later and competition use might also extend further use on Friday evenings. Weekend demand can be across both days and may be as high as 8 hours per day.

Level of wear also depends on:

- Type of sport, e.g. rugby union can have a high impact due to scrums, while cricket has a relatively low impact
- Age of players, i.e. young children have reduced impact on turf
- Number of players
- Programming by clubs[31].

Battam and Lamble[32] provide an analysis of field use in NSW and suggest that if there is sufficient demand from sporting groups then a likely level of demand for approximately 90% of fields during the winter peak season (generally 25 weeks long) is less than 45 hours per week. Therefore, actual demand for sporting use could be met through delivering a well-designed natural turf field.

31 *Battam, M & Lamble, P 2021, Best Practice Natural Turf Fields, presented at PLA NSW, presentation provided to NSW DPIE.*
32 *Battam, M & Lamble, P 2021, Best Practice Natural Turf Fields, presented at PLA NSW, presentation provided to NSW DPIE.*

Local government and state agency stakeholders noted that some facilities may have increased demand for daytime use from schools, especially those without access to public open space as part of their grounds. The declining levels of provision of sporting space in schools is transferring curricula driven demand to public sporting facilities.

If a field is supporting daytime use, such as for schools, then there may be additional hours of demand for some days of the week – most likely between 10am and 2pm. In addition, fields in city centres or places with high daytime populations may have demand for social sport or organised activity during lunch hours or before or after work.

Image source: https://www.twenty20.com/

CASE STUDY 2: Gunyama Park, Zetland

City of Sydney has recently constructed a new synthetic sportsfield in the high-density urban renewal area of Green Square. Gunyama Park opened in 2021 and accommodates both formal sports competitions as well as social and accessible sports.

A needs analysis completed to inform the planning for this field identified *"there are benefits of providing a synthetic field in this instance, largely due to the high level of demand every day from different type of users, the small space available as well as the ability to use such a field up to 15 hours per day[33]."*

There has been little community opposition to this synthetic turf field, or the site location. This may be because this synthetic field is located within a "brownfield" or formerly industrial area, is not close to any environmentally sensitive areas (e.g. local waterways, national parks) and is not does not replace an existing natural turf space, displacing other users of the field.

City of Sydney are also investigating opportunities for five other synthetic fields within the LGA to meet the community needs for longer playing hours, as identified in Council's Open space, recreation, and sports needs analysis.

"Wet weather, uneven and hard playing surfaces, lack of turf growth, as well as field closures due to re-turfing, significantly impacts our sporting groups and field operations. High quality synthetic sports fields can be used by a greater range of sports year-round. They are less impacted by weather, less prone to closure and there is no annual need for returfing... For every synthetic field we install, we're able to retain two other similarly sized fields for passive and active recreation, while meeting the sporting needs of our growing community."
- City of Sydney website[34].

Turruwul Park in Rosebery[35], a short distance from Gunyama Park, is also currently being considered for a potential synthetic surface by the City of Sydney. In contrast to Gunyama Park, there has been some community opposition to the proposal as it replaces an existing well-valued green space, which is used for sporting and informal use, and an annual Christmas concert. Council is currently considering potential future options for this park.

Figure 2. Gunyama Park multiuse field, Zetland
Source: City of Sydney.

33 *@Leisure Planners 2015, Gunyama Park and Green SquareAquatic Centre Recreation and Park UsesStudy, Revision 5, prepared for City of Sydney < http://www.atleisure.com.au/files/kmfptfkijn/@leisure-Gunyama-Park-Uses-Study-Revision-5-10-7-15.pdf>.*
34 *City of Sydney 2021, "More synthetic sports fields for longer playing hours," City of Sydney News < https://news.cityofsydney.nsw.gov.au/articles/more-synthetic-sports-fields-for-longer-playing-hours>.*
35 *Rosebery Community News 2021, Save Turruwul Park from Synthetic Grass! Rosebery Community News, 20 April 2021 < https://roseberycommunitynews.medium.com/save-turruwull-park-from-synthetic-grass-ae2a1a4725df>.*

"Soccer clubs would love to have natural grass ovals, but we can't get the hours we need out of them... and we don't have anywhere to put an extra field."

- Workshop participant, 27 May 2021.

Comparing and Questioning Capacity

Capacity is often measured in "field hours". That is, the number of hours a field can be used before it degrades and becomes unsafe or unusable. All fields, regardless of construction, require time for maintenance and most facility managers will "block out" periods to allow for this[36].

There is significant debate within the existing literature about the "field hours" supported by different surface types. Commonly cited comparisons of capacity suggest natural turf supports around 20–30 hours per week of sporting use, and synthetic turf at 60+ hours per week[37, 38]. Hybrid turf may be used 30–40 hours a week, depending on the system[39]. Sports NZ cite high use hours for a 25-week winter period on sand based natural turf fields as around 25 hours per week, and synthetic surfaces at 40–70 hours per week[40].

Recent research by social and turf scientists Dr Mick Battam and Dr Paul Lamble has challenged past assumptions on the relatively low capacity of natural turf fields[41]. Using several NSW case studies where fields have been redeveloped and constructed appropriately, and maintained well, the authors demonstrated much higher capacity (40–65 hours per week) than previously assumed for natural turf fields. They highlighted that:

- Poor construction and poor choice of soils has a significant impact on capacity
- Good maintenance and management practice will significantly increase resilience and capacity for use
- The use and capacity of a field is impacted by more than just "hours" of use, with type of sport, age of players, number of players, intensity of use, size of the field, ability to spread wear, and climate, all have an impact.

Furthermore, Battam and Lamble's research has significantly challenged the notion that a synthetic field has the best lifecycle cost per hour of use (this is explored further in **section 4.1.5**).

Feedback during the community workshops and noted in the online submissions highlighted that there is a high degree of community acceptance around well-designed natural turf fields. Middle Head Oval, Mosman (**Case Study 3**) is a frequently cited example of a best-practice natural turf field.

Some council and sporting association representatives consulted during this Study spoke about synthetic turf as having higher capacity for sporting use, and better resilience to intensity of use in a range of climate conditions (except where there are high day time temperatures and the heat load from a synthetic surface is much higher than natural grass).

However, synthetic fields have a significantly higher capital cost compared to most natural turf fields. Feedback provided during the stakeholder workshops noted that well-engineered natural turf fields or a hybrid solution can deliver sufficient capacity to meet required demand at a lower cost, while also being more flexible for a broader range of users.

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36 *Synthetics need to be swept, cleaned and the infill layer needs to levelled and topped up, whereas natural turf needs mowing, irrigation, management of compaction, remarking and pesticide/herbicide use. See: WA Department of Local Government, Sport and Cultural Industries, Natural Grass vs Synthetic Turf Study Report, < https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>.*

37 *Smart Connection Consultant 2019, The smart guide to synthetic sports surfaces: Volume 1: Surfaces and standards, p.8 < https://www.smartconnection.net.au/wp-content/uploads/2019/11/Vol-1-Surfaces-and-Standards-v1.01.pdf>.*

38 *Football NSW, 2017, Synthetic fields: A guide to synthetic surfaces for football, accessed 17 May 2021 < https://footballfacilities.com.au/wp-content/uploads/sites/11/2018/10/SyntheticFields-v2-2017.pdf>.*

39 *SportEng 2018, SportEng Field of Play Surface Profiles.*

40 *Sports NZ and Jacobs 2019, Guidance document for sports field development, December 2019 < https://sportnz.org.nz/media/1409/sports-field-development-guide-final-2020-1-22.pdf> These figures are based on use analysis undertaken in 2013, and may not reflect the advances in natural turf field construction that has occurred since then.*

41 *Battam, M & Lamble, P 2021, Best Practice Natural Turf Fields, presented at PLA NSW, presentation provided to NSW DPIE.*

CASE STUDY 3: Middle Head Oval, Mosman

Figure 3. Middle Head Oval, Mosman
Source: Headland Preservation Group, 2017 <https://www.hpg.org.au/blog/2017/council-motion-synthetic-turf-middle-head-oval>

Middle Head Oval is a sporting field in Mosman, used for formal sport and informal community uses but was considered to perform poorly and required extensive re-surfacing each year[42].

Mosman Football Club and Mosman Swans lobbied Mosman Council to have Middle Head Oval replaced with a synthetic surface[43] to expand their programs and enable playing in all weather conditions. A recreation needs analysis undertaken by Council also identified a need to increase sportsfield capacity at this site by changing surface types. This caused significant resistance from local environmental groups, including Headland Preservation Group (HPG) and Mosman Parks and Bushland Association. The oval is located in a sensitive harbour foreshore environment and close to bushland, and these groups were concerned about the impact of micro plastic pollution on local waterways and within the food chain, and other environmental impacts[44]. These groups also opposed the loss of public access to Middle Head Oval.

In response to community opposition, Mosman Council subsequently rejected a Development Application for synthetic turf at the oval, instead investing in complete turf redevelopment of the oval in 2018, at a cost of less than $500,000. The upgraded turf field receives 49-55 hours per week of sporting use during winter, as well as informal community use throughout the year, without significant loss of surface quality.

Middle Head Oval is considered a best practice natural turf oval[45]. Given it has only recently been constructed, its ability to withstand longer term use has not been tested.

HPG remains concerned that "increased usage and new/additional lighting puts this substantial investment at risk and raises the prospects of renewed calls for plastic grass let alone likely traffic congestion[46]".

42 *Battam, M & Lamble, P 2021, Best Practice Natural Turf Fields, presentation provided to NSW DPIE.*
43 *Mosman Football Club 2019, "Improving Infrastructure for Football," Mosman Football Club, access.*
44 *Tang, C 2017, "Mosman Council turfs idea for artificial grass at Middle Head Oval," The Daily Telegraph, 14 December, 2017 < https://www.dailytelegraph.com.au/newslocal/mosman-daily/mosman-council-turfs-idea-for-artificial-grass-at-middle-head-oval/news-story/2d3ee1d6676e3df3cb9b2cfe5000da4b>.*
45 *Battam, M & Lamble, P 2021, Best Practice Natural Turf Fields, presentation provided to NSW DPIE.*
46 *Headland Preservation Group n.d., The Trust considered a proposal for plastic grass on Middle Head Oval. HPG opposed this.*

Local government and various community group representatives within the stakeholder and community workshops noted there are other considerations that impact the level of demand and the capacity of field and should be considered when investigation options of upgrading the capacity of an existing field.

These include:

- **Lighting:** Field lighting is essential to allow extended hours of use. The capital cost of installing a synthetic field or a high-quality natural turf field, should include lights if the benefit of increased capacity for use is to be realised.
- **Scheduling issues vs available capacity:** Clubs or user groups may favour specific time slots, such as Tuesdays and Thursdays for training and Friday night for competition. Different communities will have different needs, and in some regional or rural communities there are often preferred nights for different sports to allow residents to participate in multiple codes. This can mean that actual demand is concentrated on a few nights only. As such, providing increased capacity via a synthetic field will not necessarily solve a demand issue as it can sometimes be a scheduling challenge.
- **Alternatives to concentrating use:** As sporting demand is more of an LGA wide issue, the level of investment proposed to install a synthetic field should be compared with alternative strategies. The capital expenditure associated with synthetic turf installation could potentially provide a greater benefit across a number of locations by increasing capacity through lighting and upgrading natural turf surfaces. This can disperse rather than concentrate use and can reduce impacts on local residents through loss of open space, increased traffic and other impacts.
- **Opportunities to "unlock" other potential open spaces:** Community representatives repeatedly raised their frustration with the conversion of natural turf to synthetic surfaces when it was felt there were under-utilised open spaces nearby, such as sporting fields owned by local public and private schools, which could potentially be "unlocked" to meet needs from sporting organisations.

4.1.3 Environmental Considerations

There are many environmental issues that need to be considered when assessing the benefits and limitations of synthetic turf fields. There is a significant amount of academic research on the environmental impacts of synthetic turf fields, and environmental issues were also highlighted as a key concern by stakeholder and community groups.

As there is no peak body in Australia responsible for independently regulating and reporting on the environmental impacts of synthetic turf, facility owners are responsible for ensuring that the relevant environmental standards have been met. Environmental and health impacts associated with synthetic turf should be appropriately acknowledged and mitigated against at both the feasibility, design, construction, and operational stages.

While synthetic turf products vary significantly, and reducing environmental impact is an increasing design consideration as the technology matures, the potential negative impacts of synthetic turf need to be factored in when considering the environmental impacts of different playing surfaces. This section provides a brief outline of key environmental issues, including heat, pollution, water, waste, and local climate considerations.

Heat

One of the biggest concerns highlighted in research and stakeholder and community consultation about the conversion to synthetic turf is its associated heat impacts.

Natural turf is known to mitigate urban heat island effect and provides a relatively cool and absorbent surface for users. *"Natural grass plays an important role in controlling climate,"* states the WA Department of Local Government, Sport and Cultural Industries:

> *"Natural grass is one of the best exterior solar radiation control ground covers, because it absorbs radiation and converts it to food for growth through photosynthesis. Natural grass surfaces reduce temperature extremes by absorbing the sun's heat during the day and releasing it slowly in the evening[47]."*

Unlike natural grass, synthetic turf generally absorbs, rather than reflects sunlight, causing the emission of heat. While different synthetic turf products are associated with different heat impacts, and further research is needed to evaluate the impact of heat on larger fields and the potential higher UV reflectivity of synthetic turf, generally, studies have concluded that third generation[48] synthetic turf fields can be between 1.3–1.81 times hotter than its natural turf equivalent[49]. Research undertaken into heat in outdoor school environments found that unshaded synthetic turf reached higher temperatures than bare soil or asphalt during normal, hot and extreme air temperature days. The report recommended that synthetic turf not be used in unshaded areas in school environments, due to the heat impacts on children, who are particularly vulnerable to heat stress[50].

Some synthetic turf, particularly those with non-organic infill (e.g. rubber) can also lead to higher temperatures near fields on hot days, by contributing to the urban heat island effect. Urban heat is increased when natural grass and trees are replaced by impervious surfaces which absorb heat, such as roads, footpaths and other built elements. Urban heat increases demand for energy (particularly air conditioning), intensifies air pollution, and increases heat-related health problems, particularly for children, older people and people with chronic health conditions[51]. Climate change has led to an increase in the frequency and intensity of hot days, and longer summers, and therefore mitigating urban heat through environmental design is a major concern[52].

Community representatives raised significant concerns in both the workshops and through the online submission process about the heat impacts of synthetic turf, noting that the higher temperatures made synthetic turf fields unusable for casual community use (e.g. dog walking and picnics), and could lead to cancelled games for sporting groups.

Bushfire considerations

Within bushfire-prone areas, the nature of vegetation surrounding houses and buildings has a very strong influence on the degree of bushfire damage/loss risk to which a building is exposed[53]. It was noted in the community workshops that the presence of combustible materials or exposure to high radiant heat levels, such as those involved in the construction of synthetic fields, could increase the risk of adjacent housing or buildings to be ignited in a bushfire. As such, for regional and bushfire prone communities where the local oval is often a muster point, these bushfire considerations need to be considered if adopting a synthetic surface material.

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47 *WA Department of Local Government, Sport and Cultural Industries, Natural Grass vs Synthetic Turf Study Report, < https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>.*

48 *The most commonly installed fields in NSW, these are characterised by taller pile heights, shock pad and are generally dressed with sand or rubber granules to improve stability, see Appendix C for more detail.*

49 *Artificial Grass for Sport, Victoria Department of Planning and Community Development, 53.*

50 *Pfautsch S., Rouillard S., Wujeska-Krause A., Bae A., Vu L., Manea A., Tabassum S., Staas, L., Ossola A., Holmes, K. and Leishman M 2020, 'School Microclimates', Western Sydney University,p.3.*

51 *See Center for Sports Surface Research 2012. Synthetic Turf Heat Evaluation: Progress Report, University Park, PA: Center for Sports Surface Research, Pennsylvania State University.*

52 *See WSROC 2018, Turn down the heat: Strategy and action plan < https://wsroc.com.au/media-a-resources/reports/send/3-reports/286-turn-down-the-heat-strategy-and-action-plan-2018>*

53 *GHD for Horticulture Innovation Australia Limited, Living turf fire benefits study – Literature review, April 2020 < https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/tu17008-literature-review-living-turf-fire-benefits-study.pdf>*

Pollution

It was noted in both the research and consultation with subject matter experts that both natural and synthetic turf fields have issues associated with pollution, impacts on the environment and human health. Pollution was also identified as a significant concern in community workshops.

Synthetic turf playing surfaces can generate pollution in the form of rubber crumb (i.e., the recycled rubber infill commonly used for the base of synthetic turf fields) and microplastics from synthetic turf fibres. These pollutants can be ingested by players and run off into waterways and soils in the surrounding area[54]. Mitigating pollution impacts was a significant priority for local community representatives consulted for this Study. The industrial processes used to manufacture and dispose of synthetic turf are further polluting source in local environments, as is the synthetic turf itself, which needs to be disposed of at the end of its economic life (see **Waste** section below).

Furthermore, consultation undertaken to inform the Study highlighted that many existing sports fields in NSW have been delivered on flood prone land, and during extreme wet weather, can be flooded. When a synthetic turf field is flooded, microplastics and rubber crumb can leach into the surrounding area in high concentrations. The synthetic field can be rendered unusable from flood impact as well and a major refurbishment may be needed to restore infill to the field (see **Water** section and **Siting considerations – stormwater, flooding, and overland flows** section for further discussion).

Natural alternatives for infill, including cork, have been implemented successfully to help mitigate against the run-off issues noted for synthetic turf[55]. At the design stage, the type and source of infill should be carefully considered to ensure safety for players and minimal impact on local environments. Turf specialists and consultants noted in the stakeholder workshops that some synthetic fields are designed with a "lip" to collect synthetic materials before they can enter local surroundings, and decontamination stations can be used to remove polluting matter from players' shoes when they leave the field.

Natural turf also requires the use of toxic plant protection products (i.e. herbicides and pesticides), and these chemicals can leach into the surrounding environment, including waterways where they can encourage algal growth. While some use of these chemicals is needed in synthetic surfaces to mitigate weed growth, it is far less of a consideration.

More conclusive research on pollution impacts associated with synthetic turf is currently undergoing peer review in Australia following community concern, particularly in the Northern Beaches LGA.

54 *Verschoor, A.J., van Gelderen, A. & Hofstra, U. Fate of recycled tyre granulate used on artificial turf. Environ Sci Eur 33, 27 (2021). https://doi.org/10.1186/s12302-021-00459-1*

55 *Smart Connections. The Smart Guide to Synthetic ports Fields Rubber Infill, 2017, Page 15. Available from: https://www.kennisbanksportenbewegen.nl/?file=7504&m=1484649736&action=file.download.*

CASE STUDY 4: ELS Hall Park, North Ryde

ELS Hall Park (and adjacent Greenwood Park and Booth Reserve) are part of a large (15.1 hectares) public open space area within Ryde LGA. This area provides formal sports facilities, open grassed areas, playground, picnic facilities and an indoor sports centre – as well as a local waterway/riparian corridor and native vegetation (including Sydney Turpentine-Ironbark Forest). It is also located very close to Lane Cove National Park. City of Ryde's Sport and Recreation Strategy identified ELS Hall Park as a "premier active area" which supports higher level sporting competition. The site is close to Macquarie Park commercial centre and train station, and is an important thoroughfare for commuters, as well as residents and workers who use the facility for active and passive recreation.

To support increased population in Ryde and changing recreation preferences, Council identified ELS Hall Park as a potential location for a new synthetic turf field. The existing sportsfields at ELS Hall Park were accommodating high levels of use (i.e. between 37-42 hours a week), and a Synthetic Surface Action Plan prepared by identified this site as an appropriate location for a new synthetic turf field[56]. This a direction supported by sporting stakeholders consulted, including AFL NSW and NSW Football[57].

In 2017, one of the three sportsfields in ELS Hall was converted to a multi-purpose synthetic field, replacing an existing natural turf field in 2017, at a cost of $3 million. It was the first synthetic field in Australia to utilise cork instead of rubber for its infill.

Commonly cited as an innovative response to some key social and environmental issues associated with synthetic turf, the use of cork reduces the microplastic pollution in local waterways by removing rubber crumb as a key material and reduces the field's heat retention. A representative of City of Ryde Council identified that ELS Hall was the site of a major infill 'evacuation event' following flooding and extreme rain, and the use of cork instead of rubber mitigated against some of the devastating impacts an extreme weather event could have had on surrounding ecosystems and waterways.

A media scan and consultation with City of Ryde Council has identified there was limited community opposition to the conversion of natural turf to synthetic turf at this site. This may be attributable to:

- Use of cork infill, rather than rubber crumb; which reduces potential pollution impacts to surrounding local waterways and Lane Cove National Park
- Continued access to two other natural turf sportsfields and other public open space amenities at the site, ensuring that non-sporting users are not displaced from ELS Hall Park.
- Extensive strategic planning for ELS Hall Park and the broader sportsfield network, including community consultation while the *Sports and Recreation Strategy 2016–2026* and *Synthetic Surfaces Action Plan 2016–2026* were on public exhibition.

Figure 4. ELS Hall Park, North Ryde
Source: City of Ryde.

56 *City of Ryde 2016, Sport and Recreation Strategy 2016-2026: Synthetic Surface Action Plan 2016-2026, adopted 25 July 2017 <https://www.ryde.nsw.gov.au/files/assets/public/publications/parks-open-space/synthetic-surface-action-plan-2016-2026.pdf>*

57 *City of Ryde 2016, Sport and Recreation Strategy 2016-20266, adopted 25 July 2017 < https://www.ryde.nsw.gov.au/files/assets/public/publications/parks-open-space/sport-and-recreation-strategy-2016-2026.pdf>*

"At this point, they [Councils] cannot adequately mitigate the impact of waste disposal when the surface of synthetic fields needs to be replaced, every 7-10 years,"

- Online submission.

Water

Water consumption

Water use is a key consideration for the implementation of synthetic turf in dry and drought-prone climates. In 2011, Sydney Water found that *"irrigation of open space turf areas accounts for over half of the water used by local councils. Council reserves and sports fields in Sydney use over eight million litres of water a day for irrigation*[58]*."*

Some solutions have been suggested for both synthetic and natural turf fields which involve the collection of rain and stormwater in storage tanks for recycling and re-use in on-site field irrigation and other local uses. For example, the State Netball Hockey Centre in Parkville, Victoria uses 45 kilolitre underground tanks to store and use water, irrigating both the surrounding landscape and the synthetic pitches themselves, reducing water use by 80 per cent[59]. Water retention systems are also used in best practice natural turf fields, such as Henson Park.

While there was support for these systems amongst community representatives in the workshops, it should be noted that these systems can be expensive to implement, and are inconsistently utilised in natural turf fields because of the significant cost to retro-fit improved drainage and stormwater retention, compared to building a new field.

Local government stakeholders and community sporting group representatives noted that synthetic turf has been associated with some water savings, as it does not require the extent of irrigation that natural turf does.

Siting considerations – stormwater, flooding, and overland flows

Many sports fields in NSW are located on constrained sites, such as flood plains, low lying areas or near estuaries (i.e. not appropriate to be built on). As a result, they are often subject to tidal inundation or flooding during periods of heavy rainfall.

Sports fields are also frequently adjacent to large impermeable surfaces such as car parks, and therefore experience flooding from run-off. Some open space turf areas are also designed as flood detention basins, meaning they are designed to temporarily store excess stormwater so it can drain into the stormwater system or natural creek[60].

The location of the green open space is important to consider for both natural and synthetic turf fields.

Poorly located natural turf fields may become waterlogged and unusable during wet weather, although upgrades to the field (e.g., introduction of sand slit drains, grass swales to divert upstream runoff) can reduce the impact of excess rainfall on turf performance[61].

While synthetic turf fields can generally be played on during wet weather, turf specialists, subject matter academics, environmental and community groups noted in the workshops the issues related to synthetic turf fields subject to overland flows or designed as flood basins.

For example, if a synthetic turf field floods, the infill on the field (e.g., rubber crumb, cork granules), which is generally lighter than water, can float and be blown around the field[62], which causes a maintenance issue, or results in infill materials being washed into local waterways and bushland - becoming a source of pollution for local ecosystems.

58 *Sydney Water 2011, Best practice guide for holistic open space turf management in Sydney, p.7 <https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdq1/~edisp/dd_045253.pdf>.*

59 *WA Department of Local Government, Sport and Cultural Industries, Natural Grass vs Synthetic Turf Study Report, < https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>*

60 *Sydney Water 2011, Best practice guide for holistic open space turf management in Sydney, p.60-61 <https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdq1/~edisp/dd_045253.pdf>*

61 *Sydney Water 2011, Best practice guide for holistic open space turf management in Sydney, p.62 <https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdq1/~edisp/dd_045253.pdf>*

62 *Smart Connection Consultancy, 2019, The smart guide to synthetic sports surfaces: Volume 3: Environmental and sustainability considerations, p.19, accessed 17 May 2021 < https://www.smartconnection.net.au/wp-content/uploads/2019/11/Vol-3-Envirnmental-and-Sustainability-Considerations-v1.01.pdf>*

"Artificial grass doesn't absorb CO2 or release Oxygen. It also doesn't provide a habitat for living creatures that need real lawns in order to thrive.

Although this will mean you'll have no problem with pests and unwanted insects in your artificial grass, it could cause a huge problem for the other wildlife in your garden, especially those that feed on bugs,"

- Online submission.

This can be somewhat mitigated by raising the field and developing a retention base under the field[63] (e.g., Gore Hill Oval, St Leonards) or delivering a "lip" around the perimeter of the field. However, it was noted by subject matter experts that data compiled from recent surveys illustrates that despite these mitigation measures, infill is still being discovered in surrounding environmental areas.

Drought resistance and dry conditions

Drought and water restrictions can make it difficult to provide a safe and suitable natural grass surface for the community.

Most synthetics (some surfaces require watering before use) usually require less irrigation than natural turf fields, and some local government and state agency stakeholders suggested that synthetic fields may be an attractive option for councils in regional areas affected by drought to enable continued participation in sport. In our conversations with regional councils, it became apparent that most of the open spaces were natural turf fields.

Waste

The disposal of synthetic turf at the end of its useful life presents an additional environmental (and financial) challenge. Concerns around end-of-life issues was raised by several community groups through both the workshops and online submission process.

Synthetic turf has a life cycle of approximately 8-10 years, requiring a disposal of materials (mostly the carpet) when refurbishment is due. It is purposefully designed to not breakdown quickly, and when it is disposed of it has the potential to stay in landfill for long periods.

One proposed solution to address the issue of waste is the recycling of synthetic materials. In Europe, a circular economy within the synthetic turf industry has been created, and an industry stakeholder (Smart Connections) consulted for the Study stated there were plans to create specialised processing plants in Australia for synthetic turf. However, this can be expensive, and is not factored into the life cycle costs quoted by many synthetic turf providers. While design excellence and good maintenance practices can increase the lifespan of these products, thus reducing waste produced; end of life disposal is a key issue for synthetic turf which must be considered and mitigated against if implemented.

Natural grass surfaces on the other hand have no end-of-life cost as they are naturally renewing and regenerating[64].

Climate

Replacing natural grass with synthetic turf can have significant effects on the local environment and contribute to heightened CO_2 emissions.

Over the lifecycle, natural turf is more carbon friendly as it actively pulling carbon out of the air through sequestration, requires less overall carbon use to produce and maintain. While natural grass still contributes CO2 through mowing and construction/maintenance, overall emissions are considerably less than synthetic turf. There has been some suggestion that natural turf releases carbon through tilling and resodding, and cellular respiration[65], but this is mitigated by natural grass' role as a carbon sink.

63 *Smart Connection Consultancy, 2019, The smart guide to synthetic sports surfaces: Volume 3: Environmental and sustainability considerations, p.19, accessed 17 May 2021 < https://www.smartconnection.net.au/wp-content/uploads/2019/11/Vol-3-Envirnmental-and-Sustainability-Considerations-v1.01.pdf>.*

64 *WA Department of Local Government, Sport and Cultural Industries, Natural Grass vs Synthetic Turf Study Report, < https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>.*

65 *Smart Connections. The Smart Guide to Synthetic sports Fields Rubber Infill, 2017. Available from: https://www.kennisbanksportenbewegen.nl/?file=7504&m=1484649736&action=file.download, p. 16.*

Furthermore, there are carbon emissions associated with the production, transportation, disposal of, and maintenance of synthetic turf[66]. However, a BACF Corporation Eco-Efficiency Analysis in 2010 found that synthetic fields were 15 per cent lower in life cycle energy and raw materials and generation of solid waste over a 20 years average life cycle of natural grass fields[67]. Ultimately, more complete lifecycle assessments comparing natural turf with the many synthetic options available is needed before any conclusions on carbon can be drawn.

Biodiversity

It was noted by environmental groups and natural turf peak bodies, that while a somewhat monocultural environment, natural turf is still home to local ecosystems and small-scale biodiversity, and community stakeholders identified that these spaces support local fauna and flora in the area.

Light pollution

Light pollution is a cause for concern due to its effect on local ecosystems, including migration and breeding habits. It should be noted that light pollution is a concern for both natural and synthetic turf fields, which require significant lighting to enable night-time use and increase capacity for sporting use. Some mitigation techniques were raised during consultation, including directed light placements to prevent spillage into neighbouring bushland, and the use of environmentally sensitive lighting technology.

4.1.4 Health Dimensions

As identified through the literature review and raised during the consultation process, it was noted that there are several human health impacts associated with synthetic turf including heat, pollutants, and injury risk:

- **Heat stress:** The higher heat load associated with most types of synthetic grass has the potential to impact on player and user comfort. The impact of higher heat on players and informal users can be severe[68], with children more at risk than adults for developing heat stress and skin injuries (blisters and burns)[69]. This issue was raised multiple times by community representatives as a key concern. The "all weather" nature of synthetics (i.e., durability during wet weather) is frequently used as an argument in favour of synthetics – however, the heat load associated with synthetic grass may make it unusable during very hot weather.
- **Injury:** There is no consensus on whether there is a higher risk of injury on natural turf or synthetic turf. While second generation synthetic fields had a greater risk of abrasiveness on skin and a higher injury rate, there is insufficient evidence on current generation fields to draw such conclusions. There is a difference in injury patterns between natural and synthetic turf, but no overall difference in injury rate. Given the multi-factorial nature of injuries, further studies are needed.

  Injuries associated with synthetic turf were a major focus of community consultation, however, council stakeholders noted that community perceptions of synthetic turf (as poor amenity, abrasive, and polluting) do not necessarily reflect significant improvements to the quality and environmental sustainability of new synthetic turf options.

66 *14; citing Sahu R, 2008. 'Technical Assessment of the Carbon Sequestration Potential of Managed Turfgrass in the United States. Research Report, USA.*
67 *Smart Connections. The Smart Guide to Synthetic ports Fields Rubber Infill, 2017. Available from: https://www.kennisbanksportenbewegen.nl/?file=7504&m=1484649736&action=file.download. p. 16.*
68 *Center for Sports Surface Research. 2012. Synthetic Turf Heat Evaluation: Progress Report. University Park, PA: Center for Sports Surface Research, Pennsylvania State University.*
69 *Artificial Grass for Sport, Victoria Department of Planning and Community Development, 53.*

- **Pollutants** are also a considerable risk factor associated with synthetic surfaces. Biological pathogens, toxic chemicals, and micro-plastic ingestion are all risks associated with synthetic materials. The Synthetic Turf Council has acknowledged the concern but not found any link between the recycled rubber infill and cancer or any other human health risk[70]. More research must be done to make conclusive statements on the presence and extent of this risk. The uncertainty around this area is cause for concern, particularly for community perception of safety.

  Appropriate cleaning regimes[71], the use of alternative infill material for recycled or virgin rubber, and the sourcing of recycled tyres for infill from countries with high pollutant standards have been suggested as methods to reduce this risk. The impacts of pollutants from synthetic turf on human health was a key concern for community representatives.

4.1.5 Cost and Economic Considerations

The cost of different playing surface materials is a key consideration for local governments, sporting organisations and other facility owners. To understand the true cost of a synthetic turf sporting field, an understanding of life cycle costs is required.

"Lifecycle costs" takes into account the "whole of life" financial implications of the decision to install a synthetic turf field, including planning, acquiring, operating, maintaining, and disposing of an asset. Research and available industry papers as well as feedback received during the consultation process noted the following:

- **Capital/construction costs:** The high initial capital cost of synthetic turf is often seen as a barrier to installation. While the capital costs associated with a synthetic turf field can vary depending on site establishment requirements, facility size and specification such as provision of a shock pad and supporting infrastructure such drainage systems, player dugouts, spectator fencing, security fencing and lighting, synthetic playing fields are typically more than three times higher when compared with natural turf[72]. A 2019 study[73] that investigated the use of compost amended soils to enhance playing field outcomes suggested that the indicative cost to construct a "well-built" natural turf field was in the order of $370,000 per hectare compared to $1,850,000 per hectare for synthetic fields.
- **Operational/maintenance costs:** There is a common perception that synthetic playing fields are "set and forget," requiring limited maintenance and hence lower operating costs. However, this is often not the case. Many synthetic playing fields require significant levels of maintenance to achieve optimum performance and full lifespan. Stakeholder feedback noted that natural turf is frequently managed on "austerity budgets" where reduced expenditure in managing sporting fields leading to eventual decline in the surface is seen as an acceptable risk. Poor maintenance practices also reduce the capacity of turf fields to accommodate use[74].
- **Renewal costs:** Unlike natural grass, synthetic turf must be replaced at the end of its natural life. As a guide, synthetic playing fields require replacement every 8 to 10 years with the shock pad requiring replacement approximately every 20 to 25 years. As of 2021, the cost to remove and dispose of the existing synthetic surface (carpet) and replace with new is approximately $390,000 for a football (soccer) field or approximately $52per sqm. Shock pad replacement costs approximately $180,000[75].

Other economic considerations may include the value of lost playing hours due to extreme weather, and the potential improved revenue performance of synthetic fields.

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70 *Synthetic Turf Council , Executive Summary Catalogue of Available Recycled Rubber Research (march 3, 2016) http://c.ymcdn.com/sites/www.syntheticturfcouncil.org/resource/resmgr/docs/st c_cri_execsummary2016-0303.pdf*

71 *Artificial Grass for Sport, Victoria Department of Planning and Community Development, 40.*

72 *WA Department of Local Government, Sport and Cultural Industries, Natural Grass vs Synthetic Turf Study Report, < https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>*

73 *Creating Sustainable Open Spaces – Using Compost to Deliver Liveability, Sustainability, Recreation and Economic Outcomes; Battmam.M & Lamble.P.*

74 *Battam, M & Lamble, P 2021, Best Practice Natural Turf Fields, presented at PLA NSW, presentation provided to NSW DPIE.*

75 *Adapted from the Smart Guide to Synthetic Sports Surfaces, 2019. Smart Connection.*

Although synthetic surfaces have a high construction cost, their increased playing capacity and perceived lower maintenance cost is often the economic basis for the implementation of synthetic fields. The comparison of options is based on assumptions about the user hours that different surfaces can accommodate.

As discussed above, a more detailed analysis of actual demand and recent research regarding increased capacity of natural turf may change some of the assumptions which have been used to support the economic rationale for synthetic turf implementation.

Typically cost benefit and business case assessments do not include a consideration or valuation of the disbenefit generated by converting natural grass to synthetic. While there are no currently accepted frameworks for valuing this "cost", local government stakeholders and recent media articles[76] have raised the following as impacts that should be included in any review of options:

- Loss of locally accessible open space
- Loss of amenity in the local open space network
- Synthetic surfaces acting as a disincentive for informal active and recreation use.

Furthermore, it was noted in the online submissions that the issue of cost also becomes contentious amongst community groups if ongoing maintenance of and the eventual disposal of a synthetic field falls to the wider community instead of the perceived principal beneficiary.

4.1.6 Key Findings

A summary the key findings related to the application synthetic turf as an alternative to natural grass turf is provided below. This summary draws upon the findings uncovered across the Study, which included community feedback, stakeholder workshops, case studies, and a literature review.

Table 2 – Key Findings

Theme	Issues
Constrained supply of sports fields	• The existing network of sporting facilities is perceived by some stakeholders as unable to meet growing demand and some clubs turn away potential participants due to a lack of capacity. • Existing fields in densely populated areas, with high levels of sporting participation may not have the capacity to meet very high levels of demand, regardless of the quality of the field. • It can be challenging to acquire new land for sportsfields due to development pressure and lack of available space (particularly in inner city areas). Some councils therefore choose to increase local capacity by converting natural turf sportsfields to synthetic turf.
Poor quality of existing sporting facilities	• Poorly maintained and constructed natural turf sports fields can struggle to support high levels of use due to poor condition and inadequate drainage, which limits their available hours of use for sport. • Many natural turf fields are perceived to be in poor condition with inadequate drainage, poor construction and maintenance regimes resulting in low field capacity. Well-engineered natural fields maintained in good condition can provide significantly higher levels of utilisation than poor condition ones.

76 *Power, J 2021, "Fake grass may be greener, but much hotter and less friendly to environment," The Sydney Morning Herald, 14 March 2021, accessed 17 May 2021 < https://www.smh.com.au/national/nsw/fake-grass-may-be-greener-but-much-hotter-and-less-friendly-to-environment-20210312-p57a95.html>*

Theme	Issues
Sporting facility demand, supply and capacity is complex and contextual	• Natural turf fields cater for more diverse uses that includes organised sporting activities and passive recreation activities such as picnicking, walking, jogging, dog walking and more. • The carrying capacity (calculated as hours of organised sports use per week) of synthetic surfaces is higher than natural turf and as such field operators can allocate more users to a synthetic field for organised sport training and competition. • The use of sports field can be concentrated to specific days and certain times of day for training and competition. Implementation of synthetic turf surfaces can offer higher levels of participation during peak periods. • Actual demand for sports use is not always modelled or well understood by authorities when considering converting surfaces to synthetic. The theoretical capacity provided by a synthetic surface may not be required to support actual demand for sports participation. • Synthetic turf can improve the reliability and surface quality for sport use during wet and winter weather compared to natural turf. However, during summer, matches on synthetic turf sports fields may need to be cancelled due to heat more frequently than natural surface fields. • Hybrid surfaces are an emerging response to improving field capacity and combining the advantages and limiting the disadvantages of both pure natural and synthetic.
Amenity and enjoyment for informal users of public open space	• Synthetic fields are generally subject to higher ambient temperatures than natural turf on hot days. • The aesthetic of synthetic turf is very different to and perceived as much less attractive to natural turf. • Synthetic turf does not provide the same benefits of connection to nature compared to natural turf open spaces. • Natural surfaces provide greater levels of noise abatement, glare reduction and UV reflectivity • Fenced synthetic fields reduce informal use of open spaces while prioritising sporting use.
Impacts from the increased utilisation enabled by the use of synthetic surfaces	• Due to having an increased carrying capacity, synthetic field can have - Increased impact on surrounding residents from duration of field lighting at night - Congestion and pressure on parking and increases to local traffic. - Increased impact and duration of noise due to greater intensity of use. - Elevated synthetic fields can impact on perceived privacy for adjacent residents.
Sports field planning and siting	• Siting considerations exist for both natural and synthetic turf. For example, many issues that constrain optimal utilisation of natural turf fields are intensified when they are located in poor drainage or flood prone areas, ex landfill sites, or where they have a dual purpose as stormwater retention basins. • Where synthetic or natural turf fields are located in areas prone to flooding, or subject to overland flows during extreme weather, there can also be issues related to pollution of local waterways or bushland with infill materials or pesticides. Further discussion of potential pollution arising from both natural and turf fields, and the contamination of the surrounding local environment, is discussed below. • Better consideration of siting and planning for the whole open space network can alleviate some pressure on the network, including sharing of facilities (across LGA boundaries and with different land uses such as schools), purpose-built facilities and siting synthetic fields in non-environmentally sensitive areas.

Theme	Issues
Concerns associated with environmental impacts	• **Pollution:** Air and water pollution caused by synthetic turf materials (i.e., rubber crumb) is well documented in academic research. Pollution, particularly of waterways and bushland, was a key concern raised by community representatives. • **Chemical use:** Pesticides and fertilisers are typically used for natural turf fields, while pesticides and fungicides are typically required for synthetic fields. • **Waste:** Environmental and financial challenge of disposing synthetic turf at the end of its 8–10-year life cycle. • **Heat:** Heat impacts to the surrounding environment caused by synthetic turf absorbing heat rather than reflection. • **Carbon emissions:** Synthetic fields contribute to heightened CO2 emissions due to lack of carbon absorption associated with natural turf. • **Soil sterilisation:** Sterilisation of soil beneath the synthetic turf has an impact on ecosystems. Synthetic surfaces inhibit living systems. • **Water Usage:** Water consumption and irrigation requirements are lower for synthetic turf making it generally more suitable for drought and dry conditions (due to reduced water requirements). • **Variability:** Environmental impacts of synthetic fields vary substantially depending on what type they are. Older synthetic fields (generation 2 and 3) are associated with significantly higher radiant heat and environmental pollution. • **Wildlife:** While natural turf sportsfields have limited biodiversity value, they do provide some habitat for local flora and fauna that synthetic turf does not. • It is noted that design of synthetic surfaces is technologically advancing in response to some of the impacts created by synthetic turf, e.g., microplastic pollution.
Potential human health impacts	• Heat stress and the impact on player and user comfort associated with playing on synthetic fields in hot weather. • Some generations of synthetic turf (typically 1st, 2nd and 3rd) have a greater risk of abrasiveness on skin and higher injury rates. • Research has suggested that biological pathogens, toxic chemicals, and micro-plastic ingestion are all risks to human health that are associated with synthetic materials.
Cost and economic factors are not transparent	• High initial capital cost of synthetic turf can be perceived as a barrier to installation. • Synthetic playing fields have traditionally been perceived as requiring lower maintenance and hence lower operating costs compared to natural turf. However, synthetic surfaces have a prescriptive maintenance regime, and there is indication from recent studies in other jurisdictions, including New Zealand and Western Australia, that in practice synthetic turf can have reoccurring maintenance costs for repairs and cleaning of surfaces that can be comparable to that of natural turf. • Long term maintenance of natural turf surfaces is often underfunded which can result in deteriorating condition facilities and limited capacity. • Renewal costs associated with the disposal and replacement of synthetic fields at the end of their life cycle is not always adequately considered. • Best practice natural turf has ongoing maintenance requirements to maintain high levels of performance for all users, such as mowing, “resting”, and re-surfacing the field.
Lack of community consultation	• Current planning pathways can constrain formal requirements for community consultation – the current planning pathway (i.e., Infrastructure SEPP) used by local government has no legislative requirement for community consultation. • Some local governments provide opportunities for community consultation regarding synthetic surfaces, including during public exhibition of open space and recreation strategies and plans of management. • The perceived lack of meaningful community consultation on decisions on utilising synthetic turf has at times created division within the community, particularly between organised sports clubs and more informal users of open space.

Theme	Issues
Best practice natural turf management	• Lack of available information on best practice construction and maintenance of natural turf fields influences and constrains council decision making. • Best practice natural turf design and maintenance has the potential to improve the capacity of existing natural turf fields to support increased sporting use. • Information about recent innovations and best practice for natural turf are not well known or commonly used. • Innovative methods exist to manage usage and reduce pressure on high wear areas of natural turf. • Advances in technology are enabling more targeted maintenance and management of natural turf to reduce energy consumption and costs and maintain capacity.
Funding programs	• Synthetic fields are perceived as more likely to be funded through one-off grants which cover the capital cost of the field but do not necessarily cover the upkeep and maintenance costs. Councils may also choose to invest in synthetic fields due to the perceived lower maintenance costs. However, as discussed above, synthetic and natural turf fields both have extensive maintenance protocols with similar costs. • High capital cost of synthetic turf fields may make it challenging for Councils to cover the cost of fields without support from grant funding. • Structure of grant funding may contribute to grants being spent on new facilities, rather than contributing to increasing the capacity of the broader network. • Effective fundraising by local sporting clubs: Sporting clubs with capacity and leadership can secure grants and funding from state, federal and local government, or peak sporting bodies.
Perceived stakeholder influence on decision-making	• There is a perception that well-organised advocacy in favour of synthetic turf from industry and sporting bodies leads to a disproportionate priority over natural turf. • Comparatively, support for natural turf solutions is perceived to be less well organised, clear, and consistent in the overall benefits of selection. • Local sporting organisations and clubs are perceived to have significant influence on local decision-makers as a result of large local memberships.

4.2 Understanding the Decision-making Process

The decision to use natural turf, synthetic turf, or a hybrid, is driven by a complex range of factors, including local conditions, current and projected community needs, sporting preferences, and financial capacity of local councils and sporting organisations.

The following section considers the issues that influence the local decision-making process to replace natural turf with synthetic playing surfaces.

4.2.1 Strategic Planning

To identify challenges and opportunities to meet growing and diversifying demand for open space, including sporting facilities, councils undertake strategic planning for open space and recreation at both a local level and precinct scale.

Through the literature review and as articulated by some local government representatives in the workshops, a council's decision to install synthetic playing surfaces is often driven and supported by detailed recreation, open space and sporting needs analysis undertaken for their local areas. For example:

- **Northern Beaches Council:** Northern Beaches Council has installed several synthetic turf fields, these include Lionel Watts Reserve, Cromer Park, Narrabeen Sports High and Melwood Oval. This investment has been driven by Council's adopted Sportsgrounds Strategy (July 2017) which recognised there was a significant undersupply of sporting fields across the LGA, and recommended building new fields, enabling use of school fields, and installing synthetic fields to meet growing need for sportsfields. Community engagement was undertaken to inform the development of Sportsgrounds Strategy and found that 62% of respondents to a phone survey, 81% of respondents to an online survey and 35% of written submissions were supportive of converting more sports fields to synthetic[77].
- **City of Sydney:** This inner-city Council is currently considering developing five new synthetic sportsfields to meet an identified gap in sportsfields provision. This strategy is driven by a detailed Open space, sports and recreation needs study undertaken by Council in 2016[78], which identified a significant shortfall in available sportsfields to meet community demand. Council is currently seeking community feedback on the delivery of synthetic fields at Turruwul Park (Rosebery), The Crescent (Annandale) and Perry Park (Alexandria).

However, some community representatives consulted for this Study had a perception that not all Councils undertake the appropriate upfront strategic analysis and planning to support the decision to install synthetic fields, and that it was instead an opportunistic decision. This statement has not been tested with local government stakeholders.

77 *Northern Beaches Council 2017, Northern Beaches Sportsground Strategy, adopted July 2017, p.15 < https://files.northernbeaches.nsw.gov.au/sites/default/files/documents/policies-register/recreation-strategies/recreation-strategies/sportsgrounds-strategy-july2017.pdf>*

78 *City of Sydney 2016, Open space, sports and recreation needs study 2016, November 2016 < https://www.cityofsydney.nsw.gov.au/surveys-case-studies-reports/open-space-sport-recreation-needs-study-2016>*

"Sporting clubs are very organised, and good at advocating.

Informal users, or any non-sporting use, are not as organised or well-represented – we don't have a voice in the conversation."

- Community workshop participant, 27 May 2021.

Community representatives and some industry experts also identified that there was a lack of understanding within councils about innovation in natural turf design and management, and the actual capacity of a well-designed turf field to provide up to 50 playing hours a week. The NSW Environment Protection Authority has commissioned case study research into natural turf fields, which will be released in 2021 and may contribute towards improved understanding of best practice natural turf[79].

It was noted in the consultation process that the decision to convert a natural turf field to synthetic is perceived by communities to be driven by effective lobbying from vocal sporting groups (discussed further below) and by the nature of grant funding, which prioritises upgrades to single fields in dense areas, rather than upgrades to increase the capacity of the broader sporting network.

During the community workshops and as outlined in an online submission, a resident action group in Banksia felt that Bayside Council had not undertaken appropriate analysis of the broader network of sporting facilities across the LGA when identifying which existing natural turf fields would be converted to synthetic. In response, this group asked Council to produce a recreation and community facilities study for all of the LGA that provided clear evidence and direction on how to best allocate funds to meet the growing needs of the whole community, including sports clubs.

Furthermore, online submissions and community resident groups perceive there is often a contradiction between a council's stated environmental objectives (generally included in environmental or sustainability policies) and the installation of synthetic turf (which has a range of negative environmental impacts).

To improve strategic planning for sports fields, communities suggested the following measures:

- Improved measurement of actual and projected utilisation of fields, and types of usage to inform the decision to install synthetic fields
- Prioritisation of brownfield sites for the provision of synthetics
- Ensuring at greenfield sites the provision of natural grass sportsfields
- Exploring opportunities for Councils to partner with surrounding local governments to coordinate delivery of new fields that are accessible to residents of both LGAs.

4.2.2 Current Planning Pathway Reduces Opportunities for Community Consultation

The current planning pathway used by local governments to convert existing natural turf fields to synthetic playing surfaces (i.e. State Environmental Planning Policy (Infrastructure) 2007) does not require a Development Application to be prepared and does not need to be placed on public exhibition – meaning that there is no legislative requirement for community consultation.

Some councils, such as the City of Sydney, do undertake targeted consultation with their communities regarding the installation of synthetic turf, and others provide opportunities for community feedback on the issue during the public exhibition of recreation and open space strategies and plans of management for local parks. However, many of the resident action groups that have formed in response to the installation of new synthetic turf fields noted that one of their biggest issues was the lack of consultation by their council on this issue.

Resident action groups from local government areas such as Bayside, Ku-ring-gai, and Lane Cove, also felt that they were left out of the decision-making process and there was no consultation with the non-sporting groups (e.g., informal users of local sportsfields) regarding the impacts of the decision.

79 *Battam, M & Lamble, P 2021, Best Practice Natural Turf Fields, presented at PLA NSW, presentation provided to NSW DPIE.*

Some community representatives noted that early, transparent, and mandatory consultation, including engagement with a broader range of open space users and stakeholders, would somewhat address their concerns about the current planning process.

4.2.3 Economic Factors

Consultation with community and industry stakeholders also highlighted the role of financial and economic factors in driving the delivery of synthetic turf fields.

Funding availability through grants

Community representatives, industry experts and local government stakeholders noted throughout the workshops that most synthetic fields are funded through one-off grants which cover the capital cost of the field but do not necessarily cover the upkeep and ongoing maintenance costs.

In addition, the structure and criteria of these grant programs require funding to be spent on a particular facility or within a precinct, rather than to enhance the broader sporting and open space network, which community stakeholders felt would contribute more effectively towards meeting demand for "field hours".

The following grant schemes are available to Councils to assist in synthetic turf delivery:

- **Greater Cities and Regional Sports Facilities Fund:** This $100 million fund aims to assist eligible organisations to develop quality core sport infrastructure that will meet the current and future needs of the community over a two year period.
- **Precinct Support Scheme:** This $100 million local infrastructure grants program aims to "*support urban renewal and sustainable growth in planned precincts by providing, on average, up to $5 million per precinct to local councils and selected agencies*[80]." Precinct Support Scheme grants may be used to enable the delivery of open space projects.
- **NSW Asian Cup 2015 Legacy Fund:** This is an initiative of the NSW Government, Football NSW, and Northern NSW Football to provide funding assistance to community football clubs to partner with local stakeholders to improve the quality, availability, and standard of their facilities in order to develop and promote participation in football. This grant scheme has been used to partly fund the proposed installation of a synthetic turf field at Norman Griffiths Oval in West Pymble, which has been highly controversial in the local community. Detailed planning for this facility is currently underway.

Local government stakeholders identified that it would be challenging for councils to fund synthetic turf fields without grants. There was also concern among community representatives that funding for the delivery of new synthetic turf fields covered capital costs, but not ongoing maintenance costs, leading councils to regularly "overspend" on synthetic fields.

Conversely, community representatives suggested that the development of a grants scheme specifically promoting the use of best practice natural turf fields could "pique" Councils interests and drive increased adoption of best practice natural turf fields.

80 *NSW Government 2021, Precinct Support Scheme, NSW Government, accessed 10 June 2021 <https://www.planning.nsw.gov.au/Plans-for-your-area/Infrastructure-funding/Precinct-Support-Scheme*

CASE STUDY 5: Bernie Mullane Sports Complex, Kellyville

Bernie Mullane Sports Complex large sporting facility, including four natural turf sportsfields, in Sydney's growing north-west. The fields were used by local Kellyville Kolts Soccer Club, Dural Rugby Club, Hills Football Association and Kellyville Cricket Club but with growing membership, local sports clubs struggled to access some pitches that needed to undergo maintenance, or during wet weather, and there was a need to access additional field capacity. As a result, some fields were being used 40-50 hours a week

In 2018, two of the natural turf sportsfields at Bernie Mullane Sports Complex were converted to synthetic turf. This decision was driven by the need to increase the capacity of this facility to support increased sporting participation, while delivering an all-weather field which reduced games cancelled due to wet weather.

To deliver this facility, Hills Shire Council invested $3 million into the sporting complex, and Kellyville Kolts Soccer Club was awarded a $127,000 through the Asian Cup Legacy Fund to upgrade the storage facility and build a new training facility at the complex, which enhanced the pitches and contributed to increased membership of the Club[81]. Football NSW has noted that this case study highlights the need for Clubs to ensure that they have a business plan that addresses the increased cost to Council associated with installing a synthetic field[82]. The increased capacity of the fields has enabled the Club to train prior to the beginning of the season, opportunities for grading days and trial matches.

Local residents and other stakeholders were able to provide comment on the proposed synthetic turf when the overall master plan for the Bernie Mullane Sports Complex was placed on public exhibition in 2016, however, a media scan identified limited negative responses from local communities.

Figure 5. Bernie Mullane Sports Complex
Source: Hills Shire Council.

81 *Football NSW n.d., Increasing capacity with synthetics: The impact of investing in synthetic pitches on the operation of a club, provided to NSW DPIE during stakeholder workshops.*

82 *Football NSW n.d., Increasing capacity with synthetics: The impact of investing in synthetic pitches on the operation of a club, provided to NSW DPIE during stakeholder workshops.*

Limited Funds for Long Term Maintenance for Natural Turf

A recurring theme of community and stakeholder consultation was the lack of funding for the ongoing maintenance of natural turf fields and the difference in standards of maintenance across natural turf fields in NSW.

Local government and industry stakeholders noted that natural turf is frequently managed on "austerity budgets" – where reduced expenditure in managing sporting fields leading to eventual decline in the surface is seen as an acceptable risk. Battam and Lamble note that poor maintenance practices also reduce the capacity of natural turf fields to accommodate increased use[83].

Industry experts also noted that the delivery of best practice natural turf fields requires specialised knowledge of turf and soil – which very few Councils have in-house or the financial capacity to resource. Therefore, Council staff rely on external contractors, who may not have the skills to deliver a high-quality field.

Grant funding is also used to enable Councils and local sports clubs to upgrade natural turf ovals; however, Battam and Lamble argue that *"the grants programs should provide funding so clubs [can] obtain advice from an independent, qualified expert that does not provide conflicted advice[84]".*

Image source: https://www.twenty20.com/

83 *Battam, M & Lamble, P 2021, Best Practice Natural Turf Fields, presented at PLA NSW, presentation provided to NSW DPIE.*
84 *Battam, M & Lamble, P 2021, Best Practice Natural Turf Fields, presented at PLA NSW, presentation provided to NSW DPIE.*

4.2.4 Perceived stakeholder influence on decision-making

For facility owners, the decision to convert a natural turf field to synthetic turf involves balancing the views and demands of various stakeholder groups. Attendees at the stakeholder and community workshops, identified a perception that well-organised advocacy in favour of synthetic turf from industry and sporting bodies leads to a disproportionate priority over natural turf. Comparatively, support for natural turf solutions is perceived to be less well organised, clear, and consistent in the overall benefits of selection.

- **Local sporting organisations and clubs are perceived to have significant influence on local decision-makers as a result of large local memberships:** Sporting clubs can be major community organisations within a local area and local government representatives noted that clubs can have strong bases for lobbying local Councillors to upgrade fields. In contrast, informal users of a green open space may not be understood or analysed, and non-sporting users' perspectives may not be considered as part of the consultation process. Commitments made in political realms can include promises to sporting groups seeking a synthetic field. In these scenarios, investigation of alternative options may not be part of project considerations. Community representatives from Lane Cove, West Pymble, Hunters Hill, and Banksia acknowledged the important social role of sporting clubs in local areas but were concerned about the perceived disproportionate influence of these clubs in localised decision-making.
- **Effective fundraising by local sporting clubs:** Sporting clubs with capacity and leadership can secure grants and funding from state, federal and local government or peak sporting bodies, and may come to councils with proposals to part-fund the conversion of a struggling natural turf field to a synthetic playing field. This may drive adoption of synthetic turf fields within a local area. For example, the multi-purpose synthetic field delivered in North Epping by North Epping Rangers Sports Club was jointly funded by the Club ($111,000), Federal Government ($50,000), NSW Government ($14,000), Bendigo Bank ($75,000). Hornsby Shire Council also contributed $150,000 via a conditional loan[85].
- **Partnering with sporting peak bodies:** Representatives from sporting peak bodies also noted that local sporting clubs regularly approach them for assistance in approaching local governments to deliver synthetic fields. Sporting bodies also work with complementary sports to proactively identify opportunities to enhance playing surfaces to support multiple codes, including through delivering synthetic fields.
- **Support for natural turf solutions is perceived to be less well organised, clear, and consistent in the overall benefits of selection:** In contrast, local government representatives noted that community groups, local environmental groups and experts in natural turf are comparatively less effective at lobbying councils in favour of natural alternatives, with some notable exceptions (e.g. Middle Head Oval, where a campaign against synthetic turf was led by the well-established and experienced Headland Preservation Group). This may change as the potential social, environmental, and economic impacts of synthetic turf become better known.

85 *Football NSW nd., Multi-sport facility: A win for football: How working with multiple sports has provided positive outcomes for all involved," provided to NSW DPIE.*

CASE STUDY 6: Weston Bears Park, Weston

Cessnock City Council has recently (September 2020) adopted a masterplan to replace the existing main turf football field at Weston Bears Park with a synthetic turf surface[86].

Weston Bears Football Club, a growing football club with many members, is the major user of this field and has a desire to enhance the capacity of the existing field and attract A-league games to the field, which would require access to an all-weather field. It will be the first synthetic field in the region. Another local club, Weston Junior Football Club, is planned to be moved from their home ground at Varty Park in Weston to the upgraded Weston Bears Park.

"The all-weather playing surface means we can open up the ground to other sports and teams. Our current playing surface, while good, has required a lot of maintenance which has meant we've had to be selective about when we use it... It will be a great facility for this area, which is growing and has a lot of junior teams."
- Weston Bears president, Rod Henderson, quoted in The Maitland Mercury[87].

For the Study, Ethos Urban also spoke with Dr Paul Lamble (Peak Water Consulting), who noted that this facility is a low use natural turf field which, with appropriate upgrades, would be able to support increased field hours, without needing to convert the field to synthetic turf.

The decision to convert this field to synthetic may reflect the priorities of the local football club (i.e. improved consistency and quality of the field for sports use, reduced cancellation of games due to wet weather, desire to participate in/attract higher level competition to the region), rather than rigorous economic, social, and environmental analysis.

In addition, there has been significant community opposition to the proposed rezoning of Varty Park (currently the home ground of the Weston Junior Football Club) to enable future medium density residential development once the Club has been moved to Weston Bears Park. Club members are concerned that there will not be adequate space at the upgraded Park to support the growth of the Club[88].

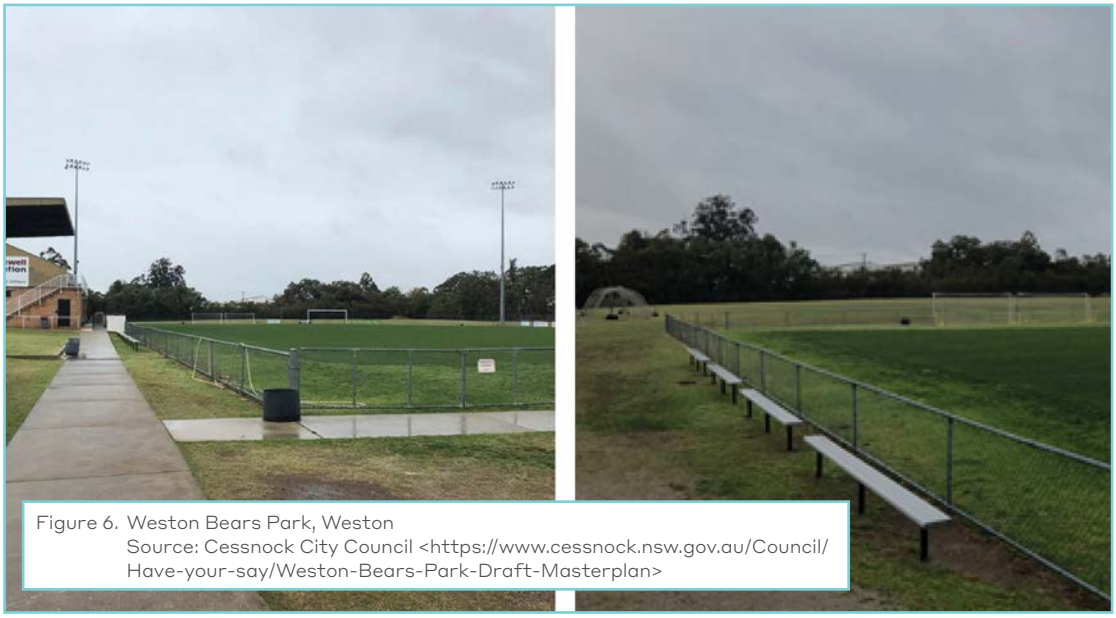

Figure 6. Weston Bears Park, Weston
Source: Cessnock City Council <https://www.cessnock.nsw.gov.au/Council/Have-your-say/Weston-Bears-Park-Draft-Masterplan>

86 *Cessnock City Council 2020, Weston Bears Park Draft Masterplan, Cessnock City Council < https://www.cessnock.nsw.gov.au/Council/Have-your-say/Weston-Bears-Park-Draft-Masterplan>*
87 *The Maitland Mercury 2020, "Weston Bears to break new ground: first football club in region with synthetic playing surface," The Maitland Mercury, May 29 2020 < https://www.maitlandmercury.com.au/story/6774283/weston-bears-go-synthetic-as-major-ground-overhaul-on-horizon/>*
88 *Weston Juniors Football Club 2021, Facebook post – 24 May, accessed 23 June 2021 <https://www.facebook.com/westonjfc/posts/4051057651646894>*

4.2.5 Key Findings

The following table summarises the key findings arising from the above analysis of key factors in the decision-making process underpinning the delivery of synthetic turf playing fields in NSW.

Theme	Issues
Lack of community consultation	• Current planning pathways can constrain formal requirements for community consultation – the current planning pathway (i.e., Infrastructure SEPP) used by local government has no legislative requirement for community consultation. • Some local governments provide opportunities for community consultation regarding synthetic surfaces, including during public exhibition of open space and recreation strategies and plans of management. • The perceived lack of meaningful community consultation on decisions on utilising synthetic turf has at times created division within the community, particularly between organised sports clubs and more informal users of open space.
Best practice natural turf management	• Lack of available information on best practice construction and maintenance of natural turf fields influences and constrains council decision making. • Best practice natural turf design and maintenance has the potential to improve the capacity of existing natural turf fields to support increased sporting use. • Information about recent innovations and best practice for natural turf are not well known or commonly used. • Innovative methods exist to manage usage and reduce pressure on high wear areas of natural turf. • Advances in technology are enabling more targeted maintenance and management of natural turf to reduce energy consumption and costs and maintain capacity.
Funding programs	• Synthetic fields are perceived as more likely to be funded through one-off grants which cover the capital cost of the field but do not necessarily cover the upkeep and maintenance costs. Councils may also choose to invest in synthetic fields due to the perceived lower maintenance costs. However, as discussed above, synthetic and natural turf fields both have extensive maintenance protocols with similar costs. • High capital cost of synthetic turf fields may make it challenging for Councils to cover the cost of fields without support from grant funding. • Structure of grant funding may contribute to grants being spent on new facilities, rather than contributing to increasing the capacity of the broader network. • Effective fundraising by local sporting clubs: Sporting clubs with capacity and leadership can secure grants and funding from state, federal and local government, or peak sporting bodies.
Perceived stakeholder influence on decision-making	• There is a perception that well-organised advocacy in favour of synthetic turf from industry and sporting bodies leads to a disproportionate priority over natural turf. • Comparatively, support for natural turf solutions is perceived to be less well organised, clear, and consistent in the overall benefits of selection. • Local sporting organisations and clubs are perceived to have significant influence on local decision-makers as a result of large local memberships.

4.3 Alternative Turf Technological Solutions and Management Techniques

This section considers alternative turf technological solutions and management techniques that allow for increased capacity of sporting fields, including a discussion of the benefits and outcomes of selected case studies. It has been informed by feedback received during the consultation process as well as information outlined in current academic and industry studies.

4.3.1 Improvements to Natural Turf Design

SportEng, an engineering firm specialising in "fields of play," states that natural turf fields are becoming increasingly complex and designed to withstand more use, drain more effectively, reduce reliance on water for irrigation, and be available during or immediately after bad weather[89].

To respond to these requirements, the designs of natural turf fields are becoming more complex with highly specified materials and engineering solutions, for example, amending soil with compost to improve its strength and durability[90]. Scientists and engineers consulted to prepare this Report argued that high quality natural turf fields can accommodate the same levels of use as synthetic turf fields.

Natural turf, like other surfaces, has significant maintenance requirements to maintain high levels of performance for all users, such as mowing, "resting" and re-surfacing the field.

However, stakeholders consulted noted that many fields across NSW are not allocated adequate budgets to enable them to perform at appropriate levels, particularly after heavy winter use or wet weather – which can prompt facility owners to consider replacing fields with synthetic turf, when performance issues may be related to poor field siting, turf type, design or maintenance.

Case studies of best practice natural turf fields are found throughout this report, including Middle Head Oval (**Case Study 3**) and Henson Oval (**Case Study 1**).

In addition, Bexley Oval is an example of technology and innovation improving the quality and reducing the cost of maintaining natural turf fields. Using Cloudmaster technology, Council is able to maximise watering usage and moderate expenditure on watering and lighting remotely, while maintaining a high-quality playing surface. Named ground of the year in 2020, the oval demonstrates the alternatives available for councils considering the upgrade of their pitches to world class standards.

89 *SportEng 2021, "What is natural turf?" SportEng, blog post dated 25 March 2021 <https://blog.sporteng.com.au/what-is-natural-turf>*
90 *Lamble, P & Battam, M n.d., "Creating sustainable open spaces – using compost to deliver liveability, sustainability and economic outcomes," technical paper prepared for OzWater.*

4.3.2 Hybrid Turf Options

Some hybrid turf options that may offer alternative solutions to enhancing sportsfield capacity include:

- **Hybrid turf:** This system combines blades of synthetic grass with natural turf to provide a consistent playing surface, improved surface durability and stability[91]. The hybrid system is still relatively new to Australia with only a few installations of a system including by Melbourne City Football Club training facility. The system has become a popular option for international sporting codes such as the English Premier League and National Football League. This system is more durable than natural turf, due to the presence of synthetic grass fibres that provide traction even if natural grass is worn. However, hybrid turf can impede typical maintenance practices required for natural turf (in particular deep aeration/ decompaction), and further research is required to understand maximum carrying capacity of hybrid playing fields.
- **Profile reinforcement:** In addition to hybrid systems, it is possible to incorporate synthetic elements within the soil or rootzone layer to improve the durability and stability of natural turf and reduce divoting (i.e., holes made in grass by sports activities, e.g., rugby scrums) Examples include[92]:
  - Fibre system, whereby various types of synthetic fibre are mixed into the soil or sand into which natural grass is grown, improving root stability.
  - Mesh-based system, where either a mesh or shredded mesh is mixed into the root zone area to stabilise the natural grass fibres.
- **Combining natural and synthetic turf:** The selective use of synthetic or hybrid turf in high-wear areas of a field (e.g., cricket wicket at the centre of an oval, goal mouths on a soccer pitch) has been used by some councils to improve durability and therefore field capacity without needing to convert an entire field. This approach is also used in elite facilities, for example the playing surface at Bankwest Stadium in Parramatta consists of a high-quality natural turf pitch, but synthetic grass is used around the pitch to maximise the extent of vehicular traffic without damaging the natural turf surface. A case study of combining natural and hybrid turf is discussed below.

91 *SportEng 2018, SportEng Field of Play Surface Profiles.*
92 *Smart Connection Consultancy 2019, The Smart Guide to Synthetic Sports Surfaces: Volume 2: Football Turf – Synthetic and Hybrid Technology*

CASE STUDY 7: South Park Oval, Chipping Norton

In the Liverpool LGA, one of the fastest-growing local government areas in NSW, there are several council-owned football pitches with clubs exceeding 400 players who utilise the fields across seven days. Council found at the start of 2021's winter season, that pitch surfaces were showing significant signs of wear, which was worsened following the substantial impact experienced a significant flood events in March 2021 (which washed away the soil which had been added to the field to restore it).

To improve playing quality in time for the winter season, Liverpool City Council is trialling the installation of hybrid turf sections in the high use sections of the goal mouths of the fields (i.e. South Park Oval, in Chipping Norton).

Council chose this option due to its relative cost effectiveness ($14,000 to install, compared with the high cost associated with full synthetic installation) and the fast turnaround of installation – the hybrid turf patches were installed over two days, and the pitch was playable the following weekend.

Council representatives stated that the response from the local soccer association has been positive because of the increased consistency in playing surface quality, and other local clubs have begun lobbying Council to introduce more hybrid options.

Given the relative ease of provision and low costs, and the reduced environmental and social impacts, this strategy could be an option for local Councils looking to meet growing demand while minimising associated impacts has been heralded as a solution to the challenges facing the provision of public open space in NSW.

A representative from Council stated that they were not currently exploring synthetic turf fields for the LGA, due to their high capital cost. Across Liverpool LGA, there are multiple urban renewal and greenfield development sites requiring increased open space and sporting facilities to meet increased population demand – and it would be cost-prohibitive to deliver synthetic turf fields across all of these areas.

Figure 7. Before (L) and after (R) hybrid patching at South Park Oval, aerial view
Source: Nearmap.com, Liverpool City Council

"[on Lane Cove Council's announcement to use 4G technology at Bob Campbell Oval] I commend Lane Cove Council and Mayor Pam Palmer for diligently investigating how they can create a best practice field that services the community and mitigates the environmental concerns,"

- Northern Suburbs Football Association quoted in The Weekly Times, 26 May 2021.

4.3.3 Advancements in Synthetic Design

Often described as the "fourth generation" or 4G synthetic turf, recent technological advancements in synthetic design and materials have diversified options and addressed some of the known environmental impacts arising from earlier generations of synthetic turf.

Alternative construction materials and methods, hybrid sports surfaces, and the removal of infill layers have the potential to mitigate against some of the challenges traditionally faced by adopters of synthetic surfaces.

For example, the use of cork granules is increasingly adopted as a potential infill for artificial turf, as it is a natural, environmentally friendly alternative. However, cork granules are generally more expensive and tend to deteriorate at a faster rate than rubber. This highlights the complexity of adopting new technology without up-to-date research and consideration of the benefits and trade-offs.

While sporting and local government stakeholders were generally supportive and enthusiastic about the possibilities of "fourth generation" synthetic turf fields, local community representatives were generally sceptical about the environmental performance of these designs.

Representatives from the Greenwich Community Association noted that 4G's ability to reduce fragmentation of the playing surface and release of plastics into the environment was yet to be proven in an Australian setting.

4.3.4 Improved Data Collection and Analysis for Facility Owners

New technologies and approaches are offering facility owners improved data on the status and usage of sports fields, enabling councils to better target maintenance, manage peak use and quiet periods, scheduling, and planning for use.

The following technologies were raised by stakeholders during the consultation process and some are being adopted by councils such as Penrith City Council:

- **Intelligent Play:** Local government and sporting association stakeholders supported the implementation of Intelligent Play, a system from the UK that uses machine learning and artificial intelligence to monitor sports field use. The system works by mounting sensors above the perimeter of the sports field to capture any usage of the field, and provide in-depth data about the status of the field, including the numbers of players using the field, which areas have been used, and how this translates to maintenance requirements[93]. Sporting association stakeholders recognised the value of this system for maximising the value and managing the use of both natural and synthetic sports fields, but noted that it was generally too expensive for local clubs and facility owners to implement. Intelligent Play claims to be the only system of its type.
- **Telstra usage data:** Some local government stakeholders have partnered with Telstra to understand open space use, by installing sensors in open spaces which "ping" when people with mobile phones enter the space. This data can help to provide a more holistic picture of usage on a field, to better target maintenance or plan future upgrades, as well as to understand the diversity of uses on a field – other than organised sport, where clubs maintain registers of users.
- **Improved booking systems:** Local government and community representatives were supportive of improved transparency around booking systems, which has the potential to increase the accessibility of local fields for a broader range of community members – while also tracking the actual utilisation of sportsfields.

93 *Intelligent Play n.d., FAQs, Intelligent Play, accessed 16 May 2021 <https://www.intelligent-play.com/faqs/>*

4.3.5 Managing Usage

Local government, state agency stakeholders and sporting associations also identified innovative approaches to managing usage and reducing pressure on high-wear areas of a natural turf field, including around the goal mouths.

Some approaches identified by stakeholders included:

- Strategically lighting the field at night and in the evening, to draw users away from areas of the field that require rest. For example, lighting the perimeter of a field to enable low-impact activities such as jogging or dog-walking along the edges, while discouraging use of the centre of a field for informal games.
- Shifting the location of the pitch through changing line markings. A representative from the NSW Office of Sport noted that sports fields are frequently surrounded by additional space, used for spectators, kiosks and other game-related uses, and that fields can be re-marked to shift the area of play and help rotate high-wear areas.
- Smart scheduling and hire agreements can also manage usage by effectively balancing diverse users of the field to reduce the intensity of the use of the field.
- Stakeholders raised the standardisation of maintenance practises as a key improvement to ensuring that both natural and synthetic fields are kept to a high surface standard, are usable for the maximum extent of their typical life cycle, and to allow for best practice knowledge sharing.

4.3.6 Utilisation of Spaces and Siting Considerations

Stakeholders and community submissions raised a number of siting and planning considerations to alleviate pressures on existing fields and improve the quality and availability of public open spaces in NSW. These include:

- Sharing of funds to mitigate the anomalies associated with council boundaries impacting best case siting for synthetic fields
- Limiting the over-concentration of synthetic fields in specific areas to ensure that all residents have access to a natural open space close to where they live while also providing sufficient opportunities for formal sport
- Consider the potential for greenfield sites to support increased provision of natural fields
- Consider the potential for brownfield sites to support the provision of synthetic fields
- Construct synthetic fields away from waterways and sensitive natural areas
- Reconsider private and education uses of open spaces, such as public and private schools, and golf courses, to allow community use and maximise existing natural surface options
- Concentration of synthetics in purpose built, regional scale facilities to maximise usage and ensure adequate supporting infrastructure.

4.3.7 Key Findings

The following table summarises the key findings arising from the above analysis of alternative turf technological solutions and management techniques.

Table 3 – Key findings

Theme	Issues
Best practice natural turf management can improve field capacity	• Best practice natural turf design and maintenance has the potential to improve the capacity of existing natural turf fields to support increased sporting use. • Lack of available information on best practice construction and maintenance of natural turf fields influences and constrains council decision making. • Information about recent innovations and best practice for natural turf are not well known or commonly used. • Advances in technology are enabling more targeted maintenance and management of natural turf to reduce energy consumption and costs and maintain capacity.
Partial/hybrid use of synthetic grass can increase durability	• Hybrid turf combines blades of synthetic grass with natural grass to increase durability of fields while reducing use of synthetic materials. • Synthetic materials can be incorporated in the root zone to reinforce the soil profile. • Synthetic turf can be used selectively in high wear areas of a sports field such as the goal area.
Synthetic turf design is evolving	• Recent technological advances in synthetic design address some of the environmental impacts associated with earlier generations of synthetic turf. • Replacing rubber infill with cork granules is an environmentally friendly option however it is more costly and deteriorates faster.
Innovative management practices can support greater use	• Strategic lighting to encourage evening use of particular areas of fields and shifting line markings are an effective way to distribute usage across a playing field surface. • New technologies and approaches are offering facility owners improved data on the status and usage of sports fields, enabling councils to better target maintenance, manage peak use and quiet periods, scheduling, and planning for use.

Theme	Issues
Sports field planning and siting	• Siting considerations exist for both natural and synthetic turf. For example, many issues that constrain optimal utilisation of natural turf fields are intensified when they are located in poor drainage or flood prone areas, ex landfill sites, or where they have a dual purpose as stormwater retention basins. • Where synthetic or natural turf fields are located in areas prone to flooding, or subject to overland flows during extreme weather, there can also be issues related to pollution of local waterways or bushland with infill materials or pesticides. Further discussion of potential pollution arising from both natural and turf fields, and the contamination of the surrounding local environment, is discussed below. • Better consideration of siting and planning for the whole open space network can alleviate some pressure on the network, including sharing of facilities (across LGA boundaries and with different land uses such as schools), purpose-built facilities and siting synthetic fields in non-environmentally sensitive areas.

4.4 Evaluation of Management Approaches and Alternate Practices

The following table synthesises the alternate management approaches, policy directions and best practice technological solutions to some of the key social, economic, and environmental issues identified from the consultation process and literature review.

Table 4 – Evaluation of Management Approaches and Alternate Practices

Issue raised through study	Potential alternate practices and approaches
Durability and consistency of surface material – wear and tear comprising the use of fields for sporting	• Hybrid turf options may enhance the durability of playing surfaces, including in high use areas – at a relatively low cost compared to full synthetic replacement. • Best practice natural turf – a well-designed natural turf field can deliver approximately 40-50 "field hours" per week, equal to the actual use of synthetic field. However, there is a lack of knowledge about best practice natural turf approaches – and soil and turf selection and management requires specialist knowledge. • Many existing natural turf fields are managed with inadequate budgets, and the durability, capacity and consistency of the playing surface could be significantly improved through enhanced maintenance. In contrast, synthetic turf fields frequently have prescriptive and rigorous maintenance regimes which are adequately funded to extend the economic life of these assets. • Recent innovation in natural grass species has can be used to create natural turf surfaces that are more durable and with lower water requirements, and improvements to water retention and recycling can irrigate natural fields at a lower cost to facility owners.
Increase field capacity in a local area	• Implement best practice natural, synthetic, and/or hybrid surfaces on existing sports fields to increase their durability and capacity to support sporting and other use. • Local and state governments can undertake strategic planning across open space networks to identify underutilised open spaces close to the site, or unlocking existing playing fields through partnerships with other asset owners (e.g. government and private schools). • Facility owners can identify innovative siting locations for synthetic fields, such as brownfields sites, or areas that are contaminated and require capping, rooftops and car parks. Consultation with community representatives has highlighted there may be less opposition to synthetic turf fields in areas of low environmental sensitivity, and where synthetic turf fields do not replace existing natural turf fields. • Local governments and other stakeholders involved in precinct planning can identify and secure land for new open space through proactive precinct planning, including through reclaiming golf course land. • Facility owners can undertake analysis to understand the actual and diverse demand for sporting fields – that is, is a synthetic field required to meet demand? or would a best-practice natural turf field better meet community need? What informal uses of open space would a synthetic field potentially displace?
Costs	• Partial installation/combined natural and synthetic turf can reduce the cost of delivery of synthetic surfaces. • The lifecycle costs of synthetic and natural turf fields should be considered when deciding on surface type – is there enough funding for maintenance? • Grant funding generally concentrates on upgrading a single facility – is there a way to provide funding to enhance the field capacity of a region as a whole? Are there opportunities to use grant funding to explore opportunities to deliver best practice natural turf fields? • Higher performing natural turf fields require more maintenance which needs to be planned for by local governments and facility owners.

Issue raised through study	Potential alternate practices and approaches
'All-weather' surfaces, during wet and hot weather	• Best practice natural turf can recover more quickly than standard natural turf fields after major rain events, however, there will be some playing hours lost. • Hybrid turf and synthetic turf with organic infill (e.g., cork) can provide more playing hours during wet weather but there is a need to reduce the risk of infill and other synthetic fibres washing into local waterways during wet weather events. • Synthetic turf can lose playing hours during summer due to extreme heat, while natural turf playing fields can be more comfortable during hot weather.
Heat load	• Best practice natural turf absorbs rather than reflects heat and is more comfortable for players to use during high summer temperatures. • Hybrid turf/profile reinforcement/combined hybrid and natural turf can reduce the heat load of fully synthetic turf; however, these have not been adequately tested in an Australian context.
Pollution	• There are opportunities to ensure more consistent management and mitigation techniques for synthetic turf through clearer policy and design guidelines at NSW Government level, such as decontamination stations for players, or delivering a "lip" which will collect loose infill. Appropriate policy and design standards will need to be explored for the Australian context in more detail. • Synthetic turf with organic infill (e.g., cork) can reduce the incidence of rubber crumb and other synthetic materials leaching into the surrounding environment.
Reduce maintenance costs and improve maintenance quality	• Improved data collection technologies to enable more strategic maintenance practices of natural turf fields, and for facility owners to target maintenance to reduce costs and improve durability of natural turf playing surfaces. • Facility owners can implement strategic lighting solutions to manage use at night. For example, moving lighting across fields during mid-week training periods can direct sporting users to certain field areas, giving other, high use parts of the field opportunities to "rest." This can help to maintain the quality of turf in high use areas such as goal mouths. • Similarly, it is possible to manage use of natural turf fields by shifting / rotating fields by re-line marking fields to move high use areas around and allow them to "rest". • Increase knowledge sharing and education between Councils, particularly around natural turf maintenance and delivery – which requires specialist turf, soil and drainage knowledge, which Councils rarely have access to in-house. • Conduct lifecycle cost analysis for the specific site, including comparing best practice synthetic and best practice natural turf life cycle costs. There is currently a lack of research comparing these costs, and further case study examples are required to explore actual costs.
Reduced water consumption	• Natural turf requires more watering, but this can be reduced through designing fields with stormwater retention tanks and appropriate drainage. • Improved data collection technologies, such as Cloudmaster to assist in 'smart' watering.
Lack of consultation on decision making for synthetic turf	• Consider revising the planning pathways for synthetic turf upgrades so they require community consultation. Specifically, consider including synthetic fields in ISEPP in Division 12 'Parks and other public reserves', Clause 65, Development without consent provisions. This inclusion should also trigger community consultation, adherence to best practice management guidelines and reporting of environmental factors. • Undertaking targeted community consultation on synthetic turf installation on a site-by-site basis, including proactive engagement with neighbouring residents, sporting clubs and informal users of existing fields (e.g., dogwalkers, joggers, picnickers). • Local governments can provide opportunities for community feedback outside the site-specific planning process by undertaking consultation on strategic recreation and open space plans and plans of management of open spaces.

5.0 Preliminary Recommendations for Consideration

5.1 Preliminary Recommendations

The research undertaken to prepare this Study has demonstrated that there are often conflicting views between local authorities, user groups and the wider community over the suitability and benefits of synthetic turf as an alternative to natural turf.

While it is clear that both types of surfaces can provide positive outcomes in terms of access to public open space and participation in recreation and sporting activities, the absence of consistent guidelines, consultation with communities and transparent consideration of potential alternatives has led to distrust and concern over decisions to implement synthetic rather than natural turf sporting fields.

To potentially address this conflict, and to further understand the environmental, social and economic impacts of synthetic turf in an Australian context, the Department may consider the following preliminary recommendations:

- **Provide consistent state-wide guidance to local authorities on key considerations or criteria when proposing to provide new synthetic turf surfaces:** Although there is significant emerging research on the environmental impacts of synthetic turf, and studies from other jurisdictions (including Western Australia and Victoria) that consider potential impacts of installing synthetic turf surfaces, there is no consistent state-wide guidance in NSW for the delivery of synthetic surfaces. This research is generally undertaken by local council staff and facility owners, who may have limited resources to deeply engage with the field of research. State-wide guidance could help to clarify some recurring questions around impacts of synthetic surfaces.
- **Adapt planning pathways for synthetic turf fields to increase opportunities for community consultation:** The current planning pathway used by local governments to convert existing natural turf fields to synthetic playing surfaces does not require a Development Application to be prepared and does not need to be placed on public exhibition – meaning that there is no legislative requirement for community consultation. Identifying opportunities to adapt the planning pathways (including potential changes to the Infrastructure SEPP) to require early, transparent, and meaningful community consultation to inform decisions around the use of synthetic versus natural turf surfaces may address community concerns about the current planning process. There may also be scope to include mitigation measures in relevant planning instruments applicable to synthetic turf proposals.
- **Undertake further research into the health and environmental impacts of synthetic turf use in an Australian context:** While there is some existing Australian-specific research about the health impacts of synthetic turf on children, much of the existing academic research on the topic comes from areas with different climates, where extreme heat not as prevalent a community concern. In addition, further research is needed into the appropriateness of synthetic turf in bushfire prone areas, where synthetic turf may contribute to bushfire risk. Additional research into the impact of synthetic materials on human health, including for sports users and nearby residents, is also needed to clarify impacts. Longer term, this could lead to guidelines aimed at mitigating environmental and human health risks, including consideration of best management practices (e.g., construction, maintenance, disposal, community consultation), for use by local councils and agencies with responsibility for community sports fields.
- **Further analysis of the health and social implications of reduced accessibility for informal and passive enjoyment of open space associated with synthetic turf usage:** In contrast to environmental and economic impacts, the social dimensions of synthetic turf are under-researched. While the stakeholder and community consultation process for this study highlighted a range of social impacts, including community concern over the loss of access to open space, displacement of non-sporting users and changes to local amenity, further analysis is required to understand these implications more broadly and in a range of contexts.
- **Further consideration of the potential benefits and impacts of the emerging technologies of hybrid and 'fourth generation or 4G' synthetic technology within an Australian context:** New generations of synthetic and hybrid playing surfaces are relatively new to Australia, and their implications have not been researched in an Australian context.

While there is potential that these technologies may reduce environmental impacts associated with other forms of synthetic turf, further research is required to understand their broader impacts.

- **Undertake research to understand barriers to implementing best practice design management of natural turf fields:** Natural turf fields are becoming increasingly complex and designed to withstand more use, drain more effectively, reduce reliance on water for irrigation, and be available during or immediately after bad weather. Community and industry representatives were supportive of redesigning natural turf fields to increase capacity, but currently there is a lack of knowledge and financial resources to implement best practice for natural turf fields. Further research to understand and address these barriers may increase adoption of best practice natural turf fields.

Image source: https://www.pexels.com/

Appendix A – Considering the options

The decision of whether to use natural turf, synthetic turf, or an alternative for use on public open spaces, is complex and should be assessed on a case-by-case basis.

The following table outlines the key considerations for local facility owners when deciding what material to use for public open spaces, including site suitability, community values, broader open space access and amenity, actual user demand and required surface capacity, economic, environmental, and social impacts and consideration of alternatives.

It is important to note that this table is in draft and will be subject to a whole of government process to consider the implications of implementation.

Table 5 – *Considering the options*

Question	Key considerations
Site suitability *Where is the public open space located?*	• Is the site integral to a local drainage system? • Is the site located on a former landfill? Or in a flood prone area? • Is the site suitable for lighting, and does it have appropriate vehicle access to accommodate increased use? • Is the site appropriate for increased intensity and frequency of use? • Is the site of significant local heritage and importance? • Is there the potential for cooperation with neighbouring councils to provide the field in the most appropriate location? • Is the site located in a bushfire-prone region, or a community marshalling location for emergencies? • Is the site currently, or likely to be, overshadowed by tall buildings in high density areas?
Community values *How is the conversion of this public open space perceived by the broader community – not just sporting groups?*	• Has appropriate consultation been undertaken with relevant members of the community, including community groups, sporting associations, environmental groups and informal users of public open spaces, to understand: - Existing uses of the open space, including uses that may not be regularly measured/monitored, e.g., dog walking, self-organised sports games - Community values, narratives and aspirations associated with the open space - Whether any users will be displaced by the decision to convert the field to synthetic turf, and whether these users can access alternative open space areas - Potential changes to amenity for surrounding residents/users • Have potential alternative options been explored in consultation with relevant community groups? • Will this site alienate existing formal and informal users? • Will this conversion create tension and discord between different users at the site and in the community more broadly?
Open space access and amenity *What are the current uses of the public open space?*	• Is this public open space already highly utilised for formal sport? • Is there adequate open space locally to mitigate the loss of natural grass at this location? • Is there an adequate variety of different field types in the vicinity?

Question	Key considerations
User demand and surface capacity *What is the actual demand for hours of play on this public open space?*	• Consider the type of use, population growth, sports participation trends and intensity of use? • What are the alternative solutions to meeting increased demand and improving field capacity? • Consider actual hours of use, peak use times and the needs of the user groups?
Investigation of Options and Implications *Have alternative options to increase capacity been explored?*	• Compare the costs of natural turf field upgrades with synthetic solutions. • Has the costing considered the need for lighting and other ancillary investment? • Are there unknown site costs associated with installing a synthetic field? • Are there scheduling solutions which can spread demand and reduce peaks? • Are there alternative greenfield or brownfield sites, or underutilised existing open spaces including schools and golf courses?
Lifecycle cost *Compare the different options. How cost effective will this decision be?*	• Need to consider the lifecycle cost of synthetic turf against the likely level of use (rather than theoretical maximum capacity) • Include all costs (including waste disposal, purchase of equipment, ancillary investment needs) in the cost benefit analysis. • Consider the player/ sport benefits in terms of open space resilience and consistency. • Compare maintenance costs accurately - consider the cost of effective maintenance of a turf field with that of synthetics (as opposed to existing budget costs which maybe inadequate) • If the capital investment is used to upgrade a number of turf fields to increase capacity will that deliver a more effective outcome than providing only one synthetic field?
Health Impacts *Have the health impacts been considered?*	• Have the potential impacts from micro plastics, volatile gases and infill compounds been considered? • Are there positive public health benefits from increased sporting participation? • Have the impacts from increased heat loads on users (due to synthetic surfaces) been considered? Will this increase over time or limit operating hours? • Are there impacts on local resident's access to space for exercise? • Have the negative mental health and wellbeing impacts been considered? • Will the conversion increase contagion risk through viral load retention?
Local climate/environmental conditions *What is the local climate surrounding the site?*	• Is this area prone to high levels of prolonged heat? • Will this field have an effect on urban heat loads? • Is this area subject to prolonged rain? • Does this area experience drought conditions? • Does the existing natural turf open space have significant lost use hours due to poor weather impacts? • Will this field negatively impact local wildlife and biodiversity?

Question	Key considerations
Environmental impacts (e.g., pollution, waste, carbon) *What are the likely and potential environmental impacts of a synthetic turf facility? Can these impacts be effectively mitigated for a reasonable cost?*	• What is the likely impact of this field on carbon emissions? • Can potential pollution issues be mitigated? What is the cost of managing potential pollutant issues from synthetic fields vs. natural turf? • Have the potential impacts and mitigation costs of microplastics been considered? • Does the facility owner have enough information now to understand the potential impacts in 10 years' time? • How will the facility owner dispose of synthetic turf carpet at the end of life (can it be recycled)?
Sports-specific priorities *What kind of sports will use these public open spaces? What are their surface preferences?*	• Will synthetic turf installed at this location be able to be used by a broad variety of sports? • If the synthetic turf is specific to a sport - is this use an ongoing and 10 year+ demand?
Planning pathway and funding options *What planning pathway will be used to seek an approval for this development? How will it be funded?*	• Does the planning pathway for this proposal enable adequate community consultation? Will a diverse range of viewpoints be sought – consider local residents, sporting associations and informal park users? • How will this proposal be funded? Could the funding be better spent to upgrade the whole network rather than focusing on a single facility?

Appendix B – Glossary

Demand / User Demand

This is the assessment of the actual hours of use likely to form the demand for a field or sporting space. The actual hours of demand may vary considerably from the modelled capacity and should be considered when comparing the cost benefits of different options.

Engineered Natural Turf

Refers to natural turf fields which have been designed as a high quality and high resilience surface. This includes a complex mix of profiling, growing media, sand, soil, aggregate, sub soil drainage and turf species selection along with sophisticated management regimes.

Field Capacity / Modelled Capacity

Is the theoretical higher limit of use hours a field can tolerate or is likely to sustain. In the case of synthetic surfaces modelled capacity of 60–70 hours per week is often compared with natural turf fields which can sustain 25–30 hours per week before significant surface degradation.

Hybrid Surface

Is a combination of synthetic fibres and natural grass. This has a higher resilience than natural turf, but does not have the capacity of a synthetic surface and is likely to be more expensive to maintain.

Infill

Is the fine granular material that sits on top of the synthetic carpet but at the base of the fibres. It is a critical part of the functioning of the surface and requires regular maintenance. Infill can be comprised of a range of natural and artificial materials.

Natural Turf and Grass

Refers to those sporting fields and courts that are constructed of natural materials and have a covering of selected grass species.

Grass refers to the plant species, while turf means the whole surface including grass, root mat and soil/sand.

Sporting Spaces, Sports Fields, Field of Play

Refers to those areas designed for specific formal sport training and competition and includes line marking, goals and sideline areas needed for the conduct of outdoor sport.

Synthetic Surface / Synthetic Turf

Is the combination of artificial fibres stitched into a carpet that is laid on an engineered constructed base including a “hard” base layer and shock pad. Synthetic fields usually have infill materials which help keep the fibres upright and functioning properly.

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Appendix D – Supplementary information (i.e., technical information)

The following section provides an overview of different surface materials for open space, including natural turf, synthetic turf and hybrid technologies. Each of these surface materials has a complex and diverse range of types and configurations, appropriate for different uses.

The literature review undertaken for the Final Report identified that most existing analysis on the subject tends to evaluate different surface materials from the perspective of sports users. As we heard from our workshops, open spaces in NSW support important community and informal uses, as well as formal sporting participation.

Natural turf

The construction of natural turf varies considerably and has significantly evolved over time to enhance the capacity and durability of natural turf-based playing surfaces. Since the 1920s, research has investigated ways to improve the performance of natural turf playing fields, which has resulted, "almost universally" in the use of coarse-grained, quick-draining materials, such as sand being used to construction natural turf sportsfields[94].

Local government stakeholders and facility owners noted during consultation that many existing open spaces in NSW are built on reclaimed landfill sites, which can have issues related to decontamination and subsidence, or on flood prone land with overland flow issues in heavy rainfall.

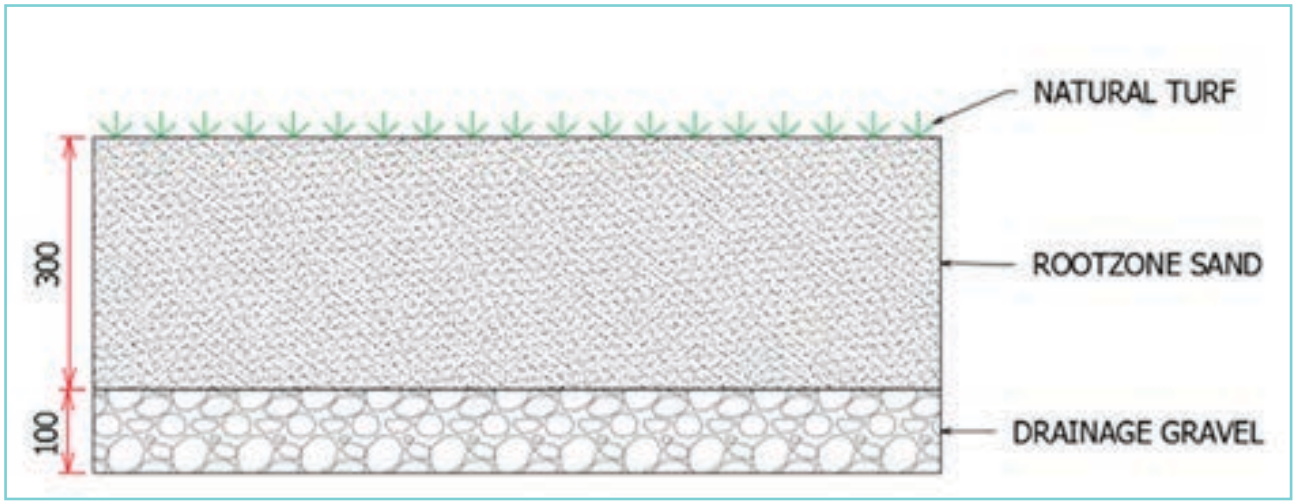
The siting of natural turf fields can affect performance and resilience, but it is challenging to acquire land to deliver open space due to high land values on sites that are not flood-affected or prone to subsidence.

The construction options for natural turf range from a basic soil-based grass field to a high-quality engineered sand-based field with profile reinforcement.

The design of a high quality (engineered) natural turf playing surface sand profile typically consists of:

- Natural turf surface layer: Comprising a layer of soil (e.g., sand, loamy sand, sandy loam, loam and clay) and grass.
    - Grass/turf: The species of natural turf has a bearing on its performance[95]. Some of the most common types include couch/Bermuda grass, kikuyu and rye. Consultation with local government stakeholders and experts as part of our workshops highlighted that some local governments are exploring different breeds of grass in their local open spaces, identifying new options with improved durability and reduced irrigation requirements (e.g. sea isle turf can be watered with saline canal water). Natural turf experts and social scientists consulted for this Study emphasised the importance of selecting appropriate grass species and soil (e.g. compost amended soils have lower water demand while supporting more tolerant turf growth)[96], as well as the importance of management.
    - Soil: Healthy soil is one of the most important aspects of open space management. The characteristics of soil affect the watering requirements, turf growth and drainage on the surface, and influence the incidence of weeds, pests and diseases. "Current practices in turf management focus on irrigation or fertilising schedules," state Sydney Water. "These are necessary, but irrigation and fertiliser can be minimised if the soil texture is appropriate to the purpose of the open space turf area[97]."
- Rootzone sand layer: Provision of a homogeneous rootzone sand layer provide enough porosity to enable rainfall infiltration and moisture retention to promote strong root growth, and reduces risk of compaction.
- Gravel blanket: Provision of a gravel drainage layer to convey infiltration to the drainage system.

94 *SportEng 2021, "What is natural turf?" SportEng, blog post dated 25 March 2021 <https://blog.sporteng.com.au/what-is-natural-turf>.*
95 *Tafe NSW, Turf Types, accessed 14th May 2021 from common turf species (tafensw.edu.au).*
96 *Lamble, P & Battam, M n.d., "Creating sustainable open spaces – using compost to deliver liveability, sustainability and economic outcomes," technical paper prepared for OzWater.*
97 *Sydney Water 2011, Best practice guidelines for holistic open space turf management in Sydney, p.12 < https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdq1/~edisp/dd_045253.pdf>.*



SportEng, an engineering firm specialising in "fields of play," states that natural turf fields are becoming increasingly complex and designed to:

- Drain more effectively while maintaining sufficient moisture content;
- Reduce reliance on water for irrigation;
- Tolerate more use; and
- Be available during or immediately after bad weather[98].

To respond to these requirements, the designs of natural turf fields are becoming more complex with highly specified materials and engineering solutions. Scientists and engineers consulted to prepare this Study argued that high quality natural turf fields can accommodate the same levels of use as synthetic turf fields.

Natural turf, like other surfaces, has significant maintenance requirements to maintain high levels of performance for all users, such as mowing, "resting" and re-surfacing the field. However, stakeholders consulted noted that many fields across NSW are not allocated adequate budgets to enable them to perform at appropriate levels, particularly after heavy winter use or wet weather – which can prompt facility owners to consider replacing fields with synthetic turf, when performance issues may be related to poor field siting, turf type, design or maintenance.

Synthetic turf

Enhancing existing open space assets is an important response to the rising demand for open space. Some facility owners are adopting synthetic turf to achieve this, particularly to enable increased use for formalised sport.

Synthetic surfaces have been considered by most major field sporting codes in NSW, with sports such as Football, AFL and Hockey seeing increased use and acceptance for these surfaces. Sporting codes and councils alike have developed "performance criteria" for these surfaces to meet appropriate standards, targeted to the dominant use of a field.

The type of synthetic turf installed will depend on the use it is intended for. For example, hockey specifies a sand-dressed pitch, while football and rugby require infill and a longer pile height. It should also be noted that some regional and remote councils will only have one field that is used for all codes, so further consideration of the optimal construction method that caters for a variety of uses is required.

98 *SportEng 2021, "What is natural turf?" SportEng, blog post dated 25 March 2021 <https://blog.sporteng.com.au/what-is-natural-turf>.*

There are a diverse range of synthetic surfaces and construction methods used in open spaces across NSW. Synthetic turf has been through several generations and continues to evolve with new solutions and applications emerging as the industry matures. The history and development of synthetic turf options is summarised in Table over page.

Local government stakeholders during the workshops noted that when undertaking community consultation regarding replacing natural turf with synthetic surfaces, many community members have misconceptions regarding the quality and amenity of synthetic turf – which date from experiences with second and third generation synthetic surfaces. Contemporary synthetic turf options can be designed to reduce some of these impacts while maintaining durability and consistency as a playing surface.

Table 6 – Summary of evolution of synthetic turf options

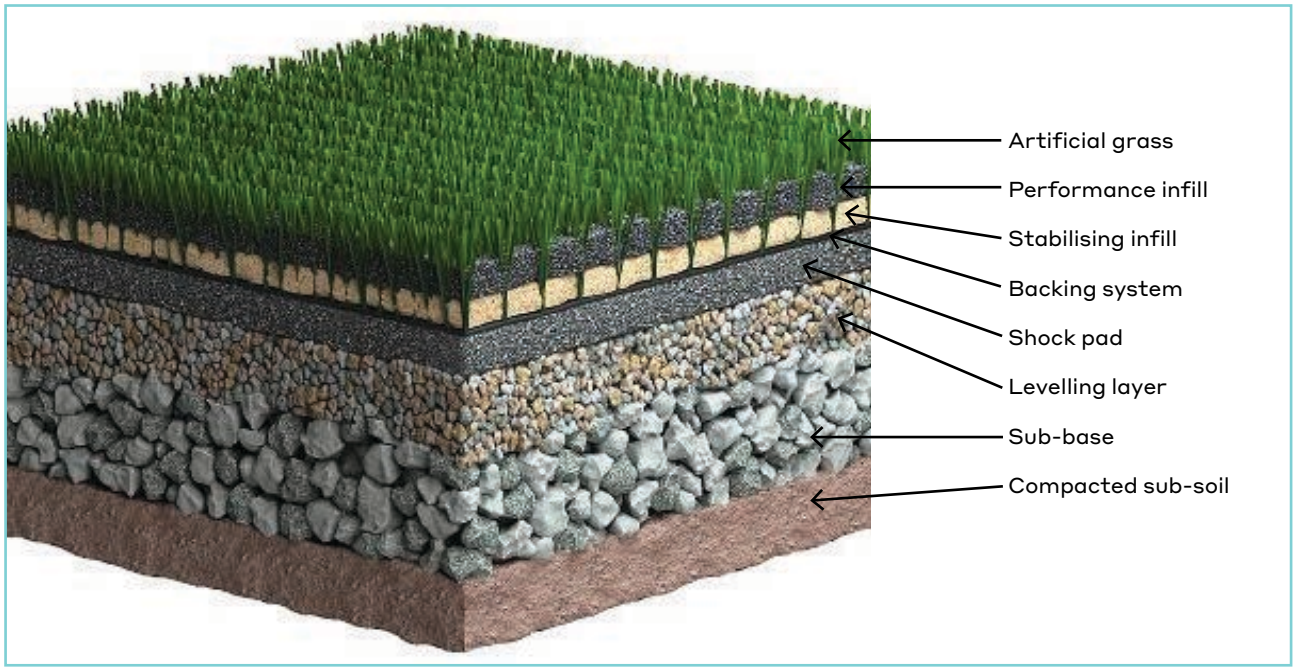
	History	Users
First generation (1960s-70s)	• Conceived in the 1960s by the Monsanto company • Simple artificial short-piled turf, high density knitted nylon; first generation synthetic pitches were coarse, capable of causing friction burns and wounds unless played on wet. • Installed in the indoor Houston Astrodome due to failure of natural grass to grow under the stadium's translucent growth. Other USA stadiums also tried artificial grass but returned to natural turf as synthetics were not popular with baseball players or spectators.	• Baseball • Hockey
Second generation (1980s)	• Versatile and durable pitches based on medium pile height, reduced density of fibres, and filled with sand to provide stability and improved control of ball bounce. • Adopted by English soccer clubs in the 1980s. Initially successful for community and elite level soccer, but were eventually rejected by elite soccer as ball bounced too high on synthetic turf and player footing was not reliable enough on synthetics. • First generation fields continue to be used for hockey.	• Schools • Hockey • Tennis • Soccer – community and professional
Third generation (late 1990s)	• Development of third generation synthetic carpets, which were a very acceptable surface for sports including soccer and rugby union. • Characterised by taller pile height, underlying shock pads and generally dressed with sand or rubber granules to improve stability of fibres. • Most common type of turf installed in Australian community fields	• Community • Football/Soccer • Rugby • AFL/Cricket
Fourth generation (2000s-now)	• Diversified synthetic turf carpet systems, typically used for soccer, rugby, hockey, athletics and tennis. • Alternative construction materials and methods, hybrid sports surface, removal of infill layers	• Professional level codes • Advanced community use

Source: Victoria Department of Planning and Community Development, Artificial Grass for Sport Guide, 2011 < https://sport.vic.gov.au/__data/assets/pdf_file/0025/55591/download.pdf>

The major components of contemporary synthetic turf construction are:

- Pavement: This is the foundation or base and requires engineered design to ensure both appropriate drainage and a stable surface for the playing surface;
- Shock pad: Different sports require different levels of performance for shock pads, to reduce the risk of injury in sports where players fall, slide or land from a height. Materials are commonly rubber and/or polymer based with examples of recycled natural or synthetic rubbers used by different manufacturers;
- Turf carpet or mat: This woven mat product has artificial grass blades stitched or tufted through which are normally made of polyethylene or polypropylene. The balance between the thickness and height of the fibre and the softness is key in creating surfaces that are safe and comfortable to play on, and reducing the risk of friction burns and abrasions;
- Infill: This is the material that helps replicate a more natural surface and keeps the blades upright, provides for grip and give and assists with drainage. The infill is usually chosen carefully to match both the length of the synthetic "blades" and the proposed uses of the surface. Infill can be comprised of many different organic and inorganic materials. These different layers and products are used to achieve particular performance outcomes. The most common types of infill include:
  - Crumbed/shredded rubber made from recycled end of life tires are the most widely used and one of the cheapest infills available. Purpose manufactured plastics or "artificial rubber" are also used;
  - Sand, usually a silica sand which has a rounder grain, is chemically stable and non-toxic; and
  - Cork granules are increasingly adopted being explored as a potential infill for artificial turf, as it is a natural, environmentally friendly alternative. Cork granules are generally more expensive and tend to deteriorate at a faster rate than rubber, requiring more frequent replacement.

Figure 10 is an outline of the construction method and materials in a typical third generation synthetic turf.



Appendix E – Workshop materials

ETHOS URBAN

Agenda

Meeting Subject:	Open Space and Synthetic Surfaces Workshop		
Location:	DPIE Office, 4 Parramatta Square, 12 Darcy Street, Parramatta		
Date:	Thursday 27th May	**Time:**	6:00pm – 8:00pm
Facilitator:	Nina Macken, Associate Director – Engagement, Ethos Urban		

ITEMS:

Item	Description	Timing	Resp.
1.	Welcome, Acknowledgement of Country	5 mins	Facilitator
2.	Meeting Overview & Introductions	15 mins	Facilitator
3.	Project and Engagement Context	5 mins	Public Spaces Division
4.	The following questions have been developed to help understand the experiences of community groups and identify case studies to include in the Final Report: • How are your local fields used? Is there a mixture of formalised and informal recreation and cultural uses? What are the positive / negative aspects? • Are your local fields accessed by all members of the community? How are they managed? – Natural – Synthetic – Alternative Turf • What impact has the increased adoption of synthetic turf fields had within your community? – Environmental – Social – Economic • How could facility owners better balance competing open space needs for different community groups? • Are there any alternative turf technological solutions and/or management techniques available that enable an increase in usage? If so, where are these, what have been the benefits / outcomes?	90 mins	ALL led by Facilitator
5.	Meeting Wrap Up	5 mins	Facilitator

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ETHOS
URBAN

OPEN SPACE AND SYNTHETIC SURFACES WORKSHOP

COMMUNITY CONSULTATION

Thursday 27th May

1.0

WELCOME AND ACKNOWLEDGEMENT OF COUNTRY

We wish to acknowledge Australia's First Nations Peoples as the Traditional Owners and Custodians of the land and give respect to the Elders – past and present – and through them to all Aboriginal and Torres Strait Islander peoples.

2.0

MEETING OVERVIEW AND INTRODUCTIONS

Agenda

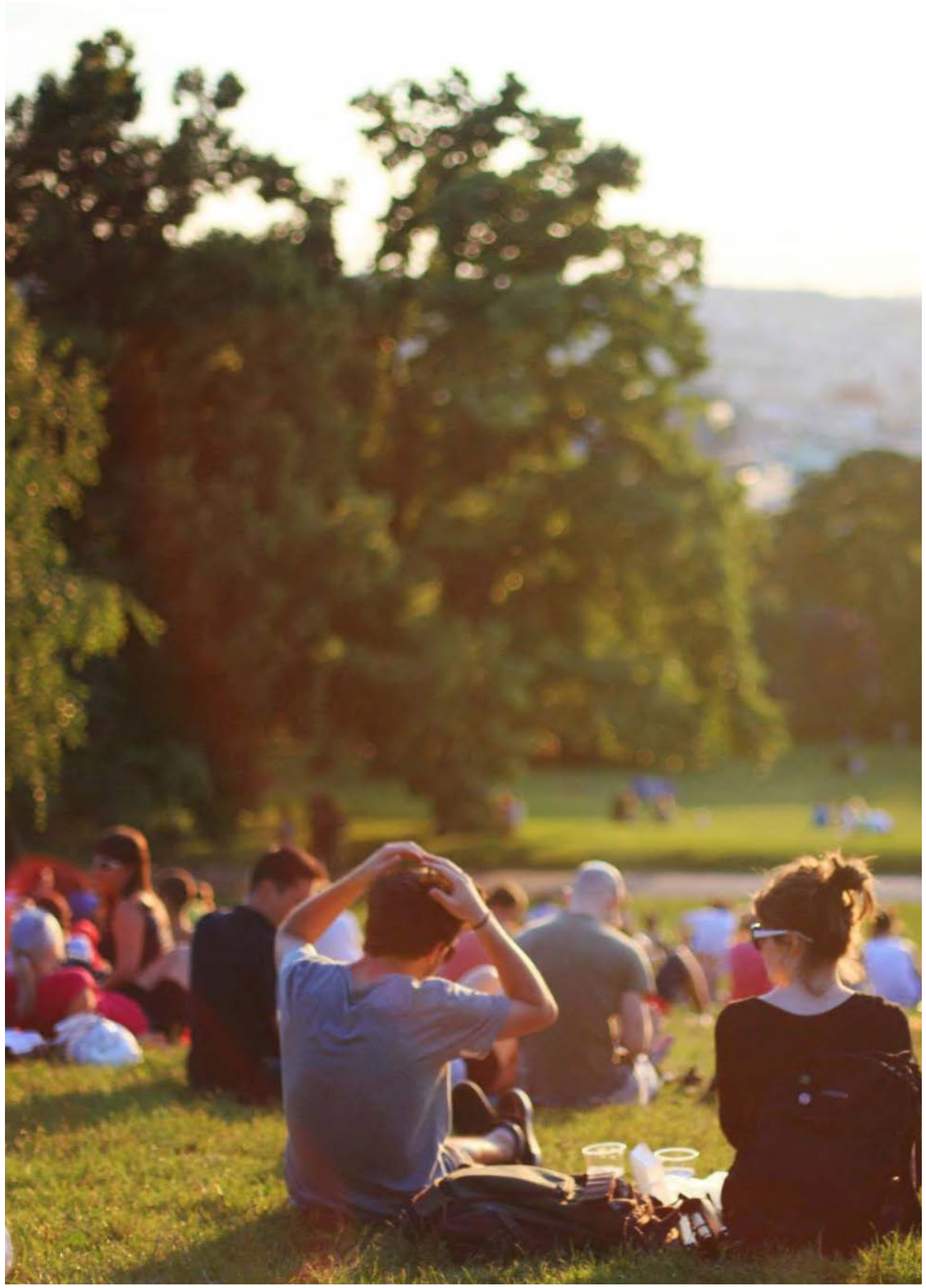
1. Welcome and Acknowledgement of Country
2. Meeting Overview and Introductions
3. Project and Engagement Context
4. Roundtable Discussion
5. Meeting Wrap Up

3.0

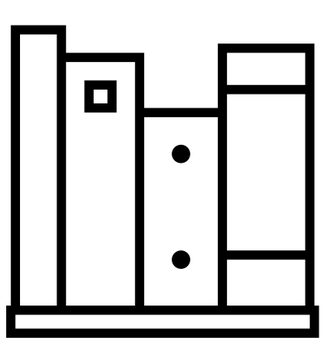
PROJECT AND ENGAGEMENT CONTEXT

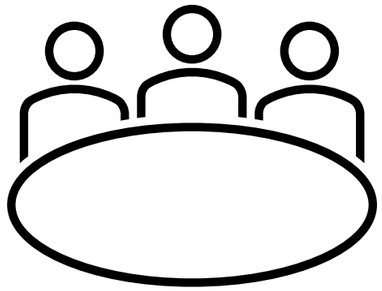
Minister Stokes recognises the need for greater understanding of the social, environmental, and economic impacts, benefits and limitations of using synthetic turf as a replacement for natural grass across NSW.

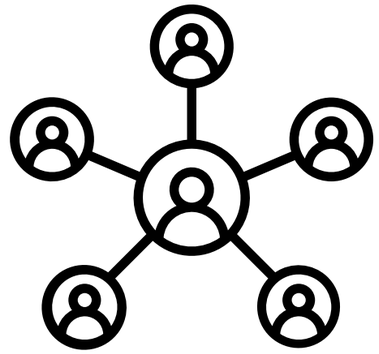
This study seeks to understand the use of synthetic alternatives to natural turf in public open spaces.



Engagement Context







Literature review → Stakeholder workshops → Community consultation → Final Report

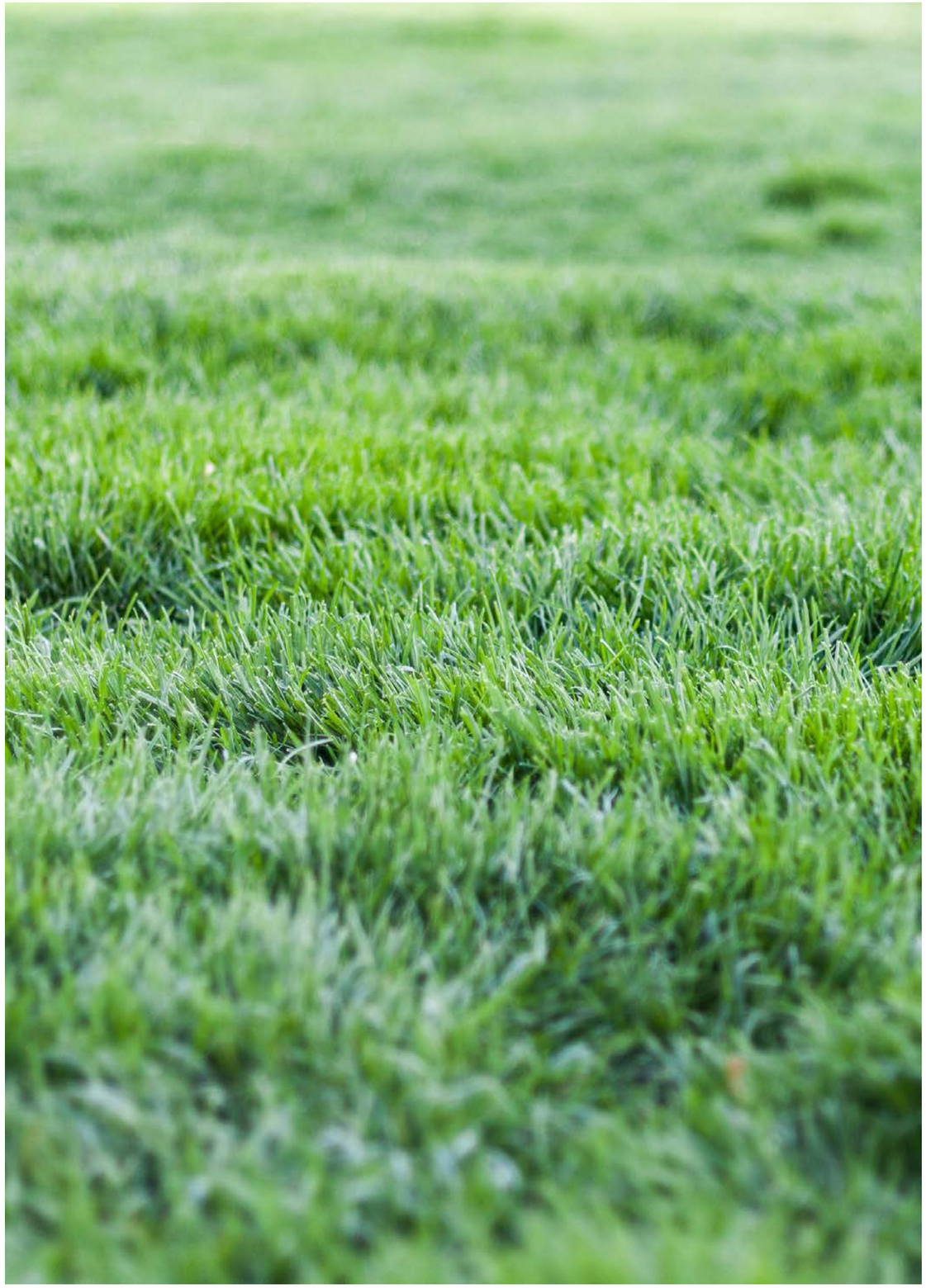
Who We've Met With

Stakeholder Workshops

- Metropolitan and regional councils
- State Agencies
- Peak Sporting Associations
- Industry Peak Bodies
- Academics (i.e., environmental, health)
- Turf Specialists and Consultants

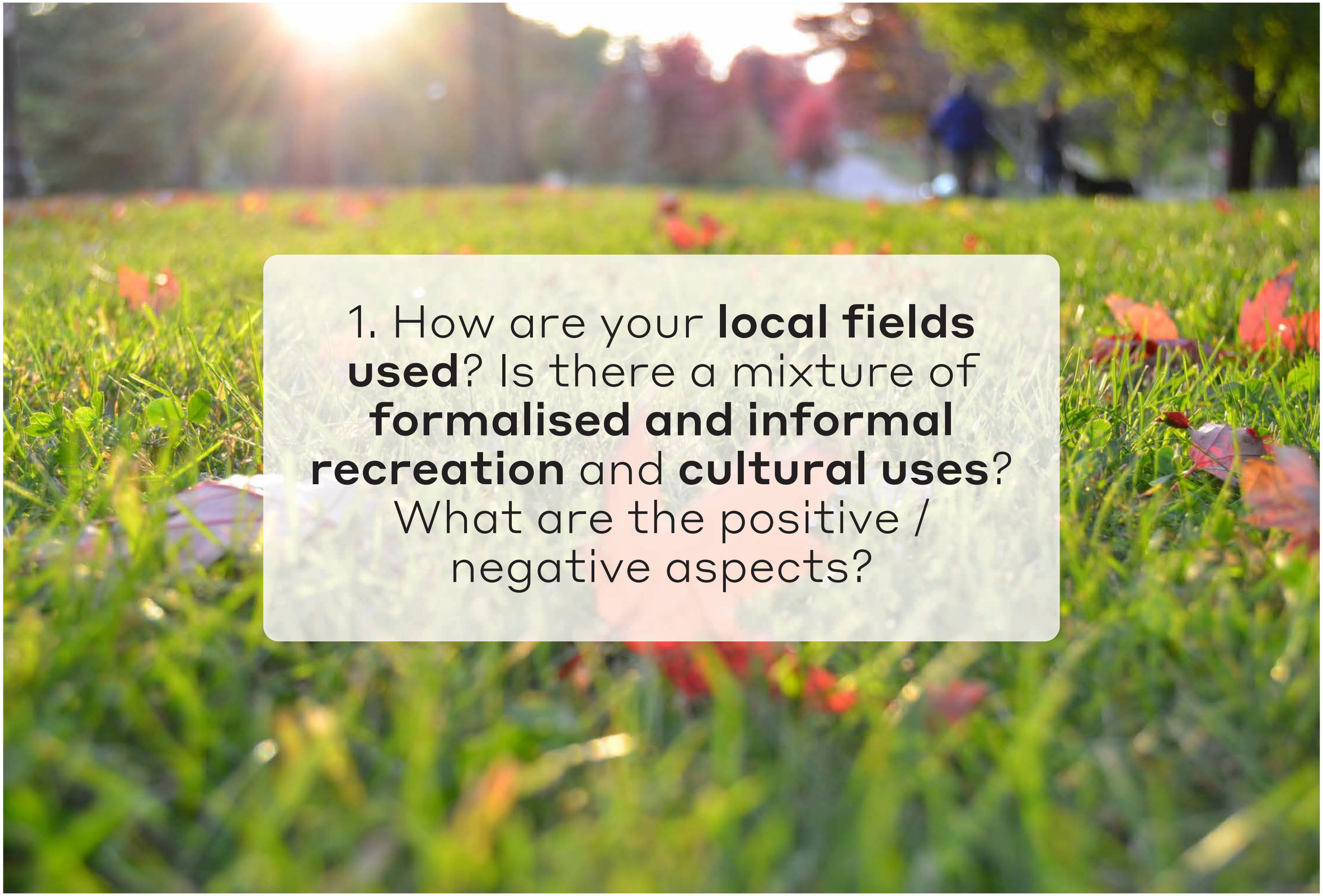
Community Consultation

- Local residents
- Community groups (i.e., resident groups, environmental protection)
- Peak bodies
- Community sporting clubs and associations



4.0

ROUNDTABLE DISCUSSION



1. How are your **local fields used**? Is there a mixture of **formalised and informal recreation** and **cultural uses**? What are the positive / negative aspects?

2. What **impact** has the **increased adoption of synthetic turf** fields had within your community?

3. How can we better balance **competing open space** needs for **different community groups**?

4. What **practices** are currently in place to **manage fields** within your local area? Could these be **improved** and if so, how?

5. Are there any **alternative turf technological solutions** and/or **management techniques** available that enable an **increase in usage?** If so, where are these, what have been the benefits / outcomes?

5.0

MEETING WRAP UP

Final Report

- Collation of community feedback to help inform the development of a Final Report

Appendix F – Stakeholder and Community Participants

Thank you to the following organisations that took the time to attend our community and stakeholder workshops. There were eight individuals who also participated (not listed here) - and we thank them too.

Table 7 – Stakeholder and Community Participants

Stakeholder Group	Organisations
Local and regional councils	• Albury Council • Bayside Council • Bega Valley Shire Council • Blacktown City Council • Campbelltown City Council • Canterbury-Bankstown Council • City of Parramatta • City of Ryde • Fairfield City Council • Inner West Council • Ku-ring-gai Council • Liverpool Council • Northern Beaches Council • Penrith City Council
Peak and professional bodies	• AFL NSW • Australian Institute of Landscape Architects • Cricket NSW • Football NSW • Hockey NSW • Planning Institute of Australia • Rugby League NSW
NSW Government Agencies	• Environment Protection Authority • Infrastructure and Place, DPIE • NSW Environment, Energy and Science • NSW Health • Office of Local Government • Office of Sport • Place Team (PDPS), DPIE • Schools Infrastructure

Stakeholder Group	Organisations
Community Groups	• All Saints Hunters Hill Football Club • Better Planning Network • Friends of Gardiner Park • Friends of Ku-ring-gai Environment Inc. • Friends of Norman Griffiths Oval • Galston Area Residents' Association Inc • Manly Warringah Football Association • Natural Turf Alliance • Neighbourhood Forum 5 • Northbridge Football Club • Northern Suburbs Football Association • Northern Sydney & Beaches Hockey Association • Northwood Community Resident Group • Oatley Flora and Fauna Conservation Society Inc • Paramatta River Catchment Group • ParraParents • Protecting Your Suburban Environment Inc • STEP Inc • Willoughby Environment Protection Association Inc
Subject Matter Experts	• AUSMAP • Macquarie University • UNSW • Western Sydney University
Turf Specialists and Consultants	• Jiwah • Smart Connection Consultancy • Turf Australia

Appendix G – Online Submissions

Thank you to the following community and resident groups that submitted their feedback and comments in response to the Synthetic Turf study. Responses were also received from six individuals (not listed here) – and we thank them too.

Table 8 – Community and resident groups who provided an online submission

Stakeholder Group	Organisations
Sporting groups	• Greenwich Sports Club • Northbridge Football Club • Northern Suburbs Football Association • St Ives Football Club • West Pymble Football Club
Residents and community groups	• Greens on Council • Greenwich Community Association Inc • ParraParents • West Pennant Hills Valley Progress Association • Friends of Gardiner Park
Environment	• Climate Action Moreland • Paramatta River Catchment Group • Natural Turf Alliance • STEP Inc • Willoughby Environment Protection Association Inc • Hunter's Hill Flora and Fauna Preservation Society
Industry and Manufacturers	• APT Asia Pacific Pty Ltd • Hector Abrahams Architects