Introduction

The goal of this document is to serve as a Notice of Intent Supplemental Narrative supporting backup to responses provided by John Amato of JJA Sports, LLC relating to questions from Commission Members during the May 21 hearing on the proposed infill synthetic turf sports fields. At meeting close a general list of items requiring further clarification was provided, which included:

- Provide information related to Per and Polyfluoroalkyl Substances (PFAS) testing for solids referenced during the question and answer period in relative to current New York State Standards. New York is the only State with a current soils testing requirement which be followed under this design submittal for solids within the turf matrix. This requirement outlined herein and will be included within the Synthetic Turf Playing Surface technical specifications for project.
- Provide a recommended testing program for the existing Brook follow to determine current background levels of Per and Polyfluoroalkyl Substances (PFAS) within the water body.
- Provide additional information related to ASTM Testing Methods for lead and heavy metals. This requirement is outlined herein and will be included within the Synthetic Turf Playing Surface technical specifications for project.
- Provide a summary of synthetic turf fields and how they are climate resilience.
- Provide a summary of synthetic turf fields and how they provided extended use over that of natural turf grass field.
- Provide summary of required maintenance hours and a recommend standard maintenance practices for the synthetic turf sports field. Typical Recommended Minimum Maintenance Program will be included herein.

The format for each response includes a general recap of the provided answer and additional support information. Where specific reference was made to inclusions within the technical specification specific excerpts will be included herein.

Per and Polyfluoroalkyl Substances (PFAS) Synthetic Turf Product Testing

An October 8, 2019 article in The Intercept published entitled, "Toxic PFAs Chemicals Found in Artificial Turf" regarding a synthetic field site in Massachusetts, has become an issue of concern in the U.S. synthetic turf industry. According to the EPA (https://www.epa.gov/pfas/basic-information-pfas);

> "PFAs are a group of chemicals that include PFOA, PFOS GenX, and many other chemicals. PFAS have been manufactured and used in a variety of industries around the globe, including in the United States since the 1940s. PFOA and PFOS have been the most extensively produced and studied of these chemicals. Both chemicals are very persistent in the environment and in the human body – meaning they don't break down and they can accumulate over time. There is evidence that exposure to PFAS can lead to adverse human health effects."

Article Claims

According to the article, which was picked up by the Boston Globe, two samples of backing material and eight samples of turf blade fibers, sampled and provided by Public Employees for Environmental Responsibility (PEER), "a service organization for local, state, federal and tribal law enforcement officers, scientists, land managers, and other professionals dedicated to upholding environmental laws and values," were tested by Ecology Center, "a nonprofit organization located in Berkeley, California that focuses on improving the health and the environmental impacts of urban residents," from a field site in Franklin, Massachusetts. The article indicated that in the two backing test results "PFAs chemicals were detected." It further indicated, "the blades of artificial grass were analyzed, scientist measured significant levels of fluorine, which is an indication of the presence of the chemicals."

Research Behind the Claims

As of the date of the article, methods for the testing of solid materials for the presence of PFAS were not approved by the Federal EPA or any of the State Regulatory Agencies. The EPA approved method at the time of the article was a test method for water quality samples EPA Test Method 537.1, currently being, validated for air and soil as well (EPA Drinking Water Laboratory Method 537 Q &A, https://www.epa.gov/pfas/epa-drinking-water-laboratory-method-537-qa). According to the above referenced EPA source testing for air and soil have not been validated across multiple laboratories. At this point the test would not be acceptable by the EPA for providing reliably certifiable results.

In addition to the above noted use of EPA Method 537, two concerns have been noted by David Teter of Farallon Consulting, an expert on environmentally compatibility of synthetic turf. According to his review of the laboratory test report from the Ecology Center, the sampling for PFAs is a complicated process and requires a sampling and analysis plan (SAP) which was not included in the report. Without a proper SAP cross-contamination and other sampling shortcomings may impact the results making them invalid. The second item is the method of chemical identification used by the Ecology Center is particle-induced gamma ray emission (PIGE) spectroscopy which is not capable of detecting PFAs. Detections by this method only indicate the presents of fluorine containing compounds. Using this method and claiming to have detected PFAs is quite a reach.

Having fluorine in a compound, when detected by PIGE, does not indicate that PFAs are present. The assumption is invalid without the use of a proper detection method. According to EPA Method 537 Liquid Chromatography (LC)/LC Tandom Mass Spectrometer should be used for detection of PFAs. The eight fiber blade samples tested detected using PIGE may be a fluorine-based non-PFAs process aid, and therefore the results should also be considered as being invalid for PFAs.

Another item that should be considered is that carbon tetrafluoride, a preflourocarbon (PFC), the only naturally occurring PFC, is a naturally occurring fluorine based non-toxic compound that is emitted from granite. The same granite used as a stone base for most synthetic turf fields in New England. The direct contact of the turf backing material and the crushed granite stone base, and possibly cross-contaminating everything above the stone, may be the source of the detected fluorine. Not having proper sampling protocols would have increased the potential of cross-contamination by carbon tetrafluoride.

Recent Regulatory Progress

More recently, December 19, 2019, the EPA has issued EPA 533 which allows the testing of additional PFAS for water quality purposes. For several years laboratories have been utilizing various modifications of EPA 537 to test solids for the presence of PFAS. All laboratories have their own modification of the method; have varying minimum reporting, recording limits, and report using various criteria. Early this year, the New York Department of Environment and Conservation provided a standard for testing solids using EPA 533 which was recently approved by the EPA, following Isotope Dilution techniques by Liquid Chromatography Tandem Mass Spectrometry as 537.1 M. Reporting limits shall not exceed 0.5 µg/kg (NYDEC part 375), and the reporting criteria shall be less than or equal to 1.0 µg/k kg (NYDEC part 375). This test method is the basis for a new testing requirement that will be included in my standard synthetic turf playing surface specification.

The following is an excerpt from my current standard specification:

"1.08 SUBMITTALS

A. Environmental Health and Safety: Fiber and Infill materials shall be tested for compliance with the following:

3. Provide Independent Compliance Testing by an accredited and or approved laboratory for compliance with State Regulations for Per and Polyfluoroalkyl Substances (PFAS) in solids using EPA 537.1 Modified with Isotope Dilution techniques by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS) by a laboratory accredited and or approved for these tests. Two of the compounds identified in the list below can only be tested for using EPA 533 which was recently approved by the EPA, which should follow the same Isotope Dilution techniques by Liquid Chromatography Tandem Mass Spectrometry as 537.1 M. Reporting limits shall not exceed 0.5 µg/kg (NYDEC part 375), and the reporting criteria shall be less than or equal to 1.0 µg/k kg (NYDEC part 375). Turf fibers and backing materials shall be sampled using State Approved Protocol for soil sampling. The testing shall include the following PFAS.

Test Method	**Compound**	**Abbreviation**	**CASRN**	**PubChem NIH Safety Class**
EPA 537.1	Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6b	Corrosive-Irritant
EPA 537.1	N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6	ENV Contaminant
EPA 537.1	N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9	ENV Contaminant
EPA 537.1	Perfluorobutanesulfonic acid	PFBS	375-73-5	Corrosive-Irritant
EPA 537.1	Perfluorodecanoic acid	PFDA	335-76-2	Corrosive-Acute Toxicity-Irritant
EPA 537.1	Perfluorododecanoic acid	PFDoA	307-55-1	Corrosive-Irritant
EPA 537.1	Perfluoroheptanoic acid	PFHpA	375-85-9	Corrosive-Irritant

EPA 537.1	Perfluorohexanesulfonic acid	PFHxS	355-46-4	Corrosive-Irritant
EPA 537.1	Perfluorohexanoic acid	PFHxA	307-24-4	Corrosive
EPA 537.1	Perfluorononanoic acid	PFNA	375-95-1	Corrosive-Irritant
EPA 537.1	Perfluorooctanesulfonic acid	PFOS	1763-23-1	Corrosive-Health Hazard-Irritant-ENV Hazard
EPA 537.1	Perfluorooctanoic acid	PFOA	335-67-1	Corrosive-Health Hazard-Irritant
EPA 537.1	Perfluorotetradecanoic acid	PFTA	376-06-7	Corrosive
EPA 537.1	Perfluorotridecanoic acid	PFTrDA	72629-94-8	Unavailable at PubChem NIH
EPA 537.1	Perfluoroundecanoic acid	PFUnA	2058-94-8	Irritant
EPA 537.1	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9c	Unavailable at PubChem NIH
EPA 537.1	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	756426-58-1d	Corrosive-Irritant
EPA 537.1	4,8-dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4e	Corrosive-Irritant
EPA 533	Perfluorobutanoic acid	PFBA	375-22-4	Corrosive-Irritant
EPA 533	Perfluoropentanoic acid	PFPeA	2706-90-3	Corrosive
Note: Includes compounds regulated in northeast states tested under both EPA 537.1 and EPA 533				

PFAS Background Level Testing

A request was made by the Commission to develop a testing approach in order to determine and quantify the presence of PFAS in Mill Brook. It is important to consider the fact that Mill Brook is not a drinking water source and testing for PFAS levels in non-drinking water is not regulatory requirement. It does however provide a baseline for any potential contamination that may exist prior to construction. The criteria thresholds would not apply.

The recommended approach would be sampling at two specific times at both the DPW and residential ends of the box culvert. Two samples should be taken at each end approximately 3 weeks apart prior to installation of the turf fields. Sampling and testing should be run through McPhail Associates. These same tests could be done one year after completion of work.

Consideration should be given to the fact that the Arlington Fire Station is upstream on Mill Brook from the site and any potential leaks from past Aqueous Film Firefighting Foams (AFFF) which contain PFAS may show up in this potential testing. This should not be done without approval from the Town Government.

ASTM Testing Methods for Lead and Heavy Metals

A discussion regarding health and safety testing included during the question and answer period covered testing for potential levels of both lead and heavy metals under the synthetic turf playing surface technical section.

<u>Material Exposures</u>

Health-related material exposures have been brought to the attention of the synthetic turf industry through studies and news reports over the past 14 years. These concerns have been related to several items. First was potential latex in the crumb SBR infill and associated latex allergy concerns referenced in a 2003 study. The second issue pertained to lead in the synthetic turf fibers, based on findings in New Jersey. The next was the presence of potential extractable heavy metals in infill associated with claims of cancer in Washington State soccer players in 2015. As new concerns have been presented over the past 14 years, the ASTM through F08.65 Subcommittee on Artificial Turf and synthetic turf industry have endeavored to perform additional research, and develop new methods to test their products and address these concerns.

Latex Allergies

A Norwegian Pollution Control Authority/Norwegian Institute for Air Research report labeled NILU OR 03/2006 entitled “Measurement of Air Pollution in Indoor Artificial Turf Halls,” cited concerns that persons with latex allergies may have health problems when exposed to crumb SRB recycled car tires. Their concern was based on a statement that an average European car tire consists of 42% rubber. Further and more important, the rubber used consists of 58.3% synthetic rubber and 41.7% natural rubber. Latex allergies tend to be related to exposure to latex allergen proteins.

According to the U. S Tire Manufacture’s Association, natural rubber represents 19% of the material in passenger car tires, and 34% in commercial truck tires. The synthetic rubber portion of materials in passenger car tires is approximately 24%. This is consistent with the above noted percentages in European car tires. The natural rubber component in tires is dry natural rubber. It provides tear and fatigue crack resistance, which are important charateristics for tires.

Natural rubber is created from the latex of the rubber tree Hevea brasiliensis. It is processed into two different rubbers, natural rubber latex and dry natural rubber. Natural rubber latex, or soft dipped latex rubber, represents approximately 10% of the latex manufactured. This type of rubber is used in the manufacturing of items such as medical gloves and not used in tire manufacturing. According to the American Latex Allergy Association, “Newer rubber medical supplies, particularly very soft "dipped" products, contain the greatest proportion of low molecular weight soluble proteins thought to be responsible for the allergic response.” Dipped latex products are responsible for most allergic reactions to natural rubber latex (D.D. Fett Ahmed et al / Immunol Allergy Clin N Am 23 2003)

The remaining portion of the latex, approximately 90%, is processed into dry natural rubber, used in tire manufacturing, rubber thread products, rubber seals and diaphragms, or other dry rubber products. Dry natural rubber is processed by acid coagulation into dry sheets or crumbled particles (D.D. Fett Ahmed et al / Immunol Allergy Clin N Am 23 2003). In order for tires to be heat resistant and maintain their elastic characteristics they are vulcanized at high temperatures which are be expected to destroy proteins in the natural rubber (Latex Allergens in Tire Dust and Airborne Particles, Ann G. Miguel,. 1993).

In confirmation of this, according to the American Latex Allergy Association and based on a case in Maryland, testing found no concern for latex exposure from tire crumb. The result was that they were not able to detect any extractable latex allergen, in testing, of the recycled auto-tire matting material. Studying this further, auto and truck tire companies do not use natural rubber latex in their manufacturing. The study did note that the Maryland case was limited in coverage.

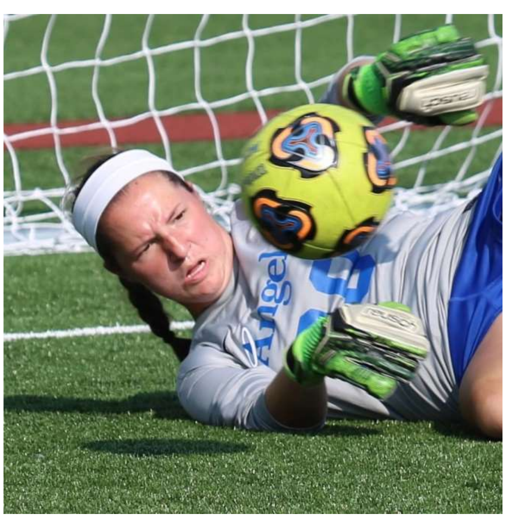
Lead in Fibers

In 2008, concerns related to lead found in the synthetic turf fibers of several fields in New Jersey prompted the synthetic turf industry to address this issue. In response, the Synthetic Turf Council and ASTM F08.65 developed a standard for testing fibers to comply with the Consumer Product Safety Improvement Act of 2008, which addresses lead content in children's toys.

This test was published in 2009 and revised in 2012. The ASTM 2765 "Standard Specification for Total Lead Content in Synthetic Turf Fibers" required lead in synthetic turf fibers to be less than 300 parts per million (ppm) for products manufactured between 2009 and 2011 and below 100 ppm by 2012. Since then, lead content has generally been less than 40 ppm in all tests submitted to JJA Sports as part of construction material review process.

Soccer Players and Cancer in the News

NBC News released a story back in October 2015 that was widely circulated. The University of Washington Women's Associate Head Soccer Coach, Amy Griffin, became concerned about the amount of cancer among soccer players in Washington State, and compiled a list of soccer players with cancer. Coach Griffin was especially concerned about the number of goalkeepers she identified with cancer, and wondered whether exposure to crumb rubber infill in artificial turf may have been causing it. She contacted NBC News.



The material in question was crumb SBR or recycled automobile tire shredded down to a size of less than 1/8 of an inch. SBR used in tire manufacturing includes a family of synthetic rubbers derived from styrene and butadiene (the version developed by Goodyear is called Neolite).

Goodyear discovered the process of strengthening rubber, known as *vulcanization* or *curing,* by accident in 1839. This process is still used today in manufacturing automobile tires. This process modifies rubber to hold its shape and to return to its original shape after a load is removed. Vulcanizing crosslinks the molecules and makes them tougher and more durable. This process creates a long chain molecule that encapsulates the components.

Environmental advocates asked the EPA and the CPSC to take a closer look. While both the CPSC and the EPA performed studies over five years ago, both agencies recently backtracked on their assurances that the material was safe, calling their studies "limited."

While the EPA told NBC News in a statement that "more testing needs to be done," the agency also said that it considered artificial turf to be a "state and local decision" and would not be commissioning further research.

Based on a demand from then-President Obama, the EPA, CPSC, and CDC were directed to undertake a study to resolve concerns that the use of synthetic turf fields may represent a health risk.

The Massachusetts Department of Public Health issued a statement that established risk factors for Hodgkin Lymphoma include exposure to the Epstein-Barr virus (EBV), a previous diagnosis of mononucleosis (mono is caused by EBV), family history, and certain hereditary conditions (such as ataxia telangiectasia) associated with a weakened immune system.

Further, the Massachusetts Department of Public Health stated that occupational exposures as risk factors have been studied extensively and that none have emerged as risk factors. Likewise, there is very little evidence linking the risk of Hodgkin Lymphoma to an environmental exposure other than EBV.

Federal Research

Because of the need for additional information, the U.S. EPA, the Centers for Disease Control and Prevention, the Agency for Toxic Substances and Disease Registry, and the CPSC in 2015 launched a multi-agency action plan to study key environmental human health questions based on President Obama's demand.

In the meantime, the ASTM F08.65 Subcommittee on Artificial Turf developed a standard test method to evaluate infill to the same criteria as children's toys. The F3188 Standard Specification for Extractable Hazardous Metals in Synthetic Turf Infill Materials was approved June 1, 2016 and published June 2016. This standard method created a test that was modeled after the CPSC toy standard for use by the synthetic turf industry.

During December 2016, the EPA issued a 169-page status report consisting of a study of available research to date. No new testing was included. The report excluded a reference to the new F3188 Standard Specification for Extractable Hazardous Metals in Synthetic Turf Infill Materials, which was developed in conjunction with the CPSC.

As of March 2018, in a presentation to the STC, the EPA indicated that they believe a report would be available for peer review towards the end of this year. However, there was no mention of the new F3188 Standard Specification for Extractable Hazardous Metals in Synthetic Turf Infill Materials that was developed in conjunction with the CPSC.

The EPA has still not completed their study.

Washington State Department of Public Health

In 2017, the Washington State Department of Health Study published its "Investigation of Reported Cancer among Soccer Players in Washington State". Cathy Wasserman, Office of the State Health Officer, Non-Infectious Conditions Epidemiology, concluded:

> "Findings do not suggest that soccer players, select and premier soccer players, or goalkeepers in Washington are at increased risk for cancer compared to the general population. In addition, the currently available research on the 5 health effects of artificial turf does not suggest that artificial turf presents a significant public health risk. Assurances of the safety of artificial turf, however, are limited by lack of adequate information on potential toxicity and exposure."

Additional Studies and Conclusions

The Dutch National Institute for Public Health and the Environment found that, "The health risk of playing sports on synthetic turf fields with an infill of rubber granulate is virtually negligible."

A UC Davis Study ("Incidence of Malignant Lymphoma in Adolescents and Young Adults in the 58 Counties of California with Varying Synthetic Turf Field Density") recently found, "These overall epidemiologic findings are consistent with studies that have measured levels of carcinogens released from crumb rubber from synthetic turf fields and interpreted their data to indicate negligible cancer risk to children or older persons."

European Risk Assessment Study on Synthetic Turf Rubber Infill

In March of 2020 the Part 3: Exposure and Risk Characterization of a European wide study concluded Cancer risks for exposure to PAHs were below 1: 1 million and that risks for non-carcinogenic substances were below 1.

Current Test Methods for Lead and Extractable Heavy Metals Testing

As noted during the hearing ASTM F08.65 has been at the forefront the development of testing methods is response to concerns brought up by concerned citizens and special interest groups. The testing methods resulted are an integral part of the JJA Sports standard synthetic turf playing surface technical specifications and will be part of the Arlington specification.

The two standards discussed during the hearing related to lead and extractable heavy metals are included as an excerpt below:

"1.08 SUBMITTALS

A. Environmental Health and Safety: Fiber and Infill materials shall be tested for compliance with the following:

1. Provide Independent Compliance Testing for compliance with ASTM F2765-14 Standard Specification for Total Lead Content in Synthetic Turf Fibers

2. Provide Independent Compliance Testing for compliance with ASTM F3188-17 Standard Specification for Extractable Hazardous Metals in Synthetic Turf Infill Materials."

Climate Resilience and Environmental Impact

The 'all-weather' extent of the synthetic turf field depends on the local climate, as well as, on which products are used and how they are assembled. In addition, recent extreme cold winter weather has taught the industry that some combinations of materials do not survive extreme winter as well as others. Over the past two winter seasons, several synthetic turf fields underwent surface damage due to ice formation.

Owners should proceed with caution when selecting turf, infill option, and resilient pad to incorporate into their investment. Soil conditions and potential geotextile fabrics must also be properly vetted. Vendors will say that their product has been tested to perform properly, but they do not always do the appropriate testing to determine if the materials will be appropriate for the climate or the conditions created by a given set of design factors.

During the hottest periods of a summer day, here in the northeast, fields can become too hot to play on. There have been many recommendations made by various companies to address this condition. Some recommend watering the field. This appears to be a reasonable approach however applying the same amount of water that is recommended for natural turf grass irrigation can cool a field 20 degrees Fahrenheit for just 30 to 40 minutes. This approach is a waste of precious water. There are other methods such as using organic infill, or different color infill, there is even a spray that allows fields to undergo limited cooling by evaporative cooling. These have limited effectiveness and result in 5 to 20 degrees in temperature reduction.

The most practical method of addressing a too hot synthetic field surface is to avoid the surface during the heat of the day. Cool the athlete using misting stations. Provide plenty of water so athletes can hydrate. Providing sideline shade using pop-up tents is also very helpful. The shade works by blocking the access of solar radiation to the surface. Regardless of your approach there will be periods during the day where it is best to stay off the field. Owners should schedule the use of the field during summer months to avoid being on the fields. Summer recreation programs should schedule indoor programs during these high heat periods. Starting earlier in the morning, schedule a planned break from lunch to 2 or later and finish as the sun is lower in the sky.

This same high heat that increases the surface temperature of synthetic turf fields, increases surface evaporation, causing drying out of the growing medium in natural turf grass fields. This condition impacts the health of the turf grass by increasing competition for nutrients and water. Stressed turf grass can easily be overtaken by aggressive weeds and pests. Turf grass roots become weakened and the growing medium becomes compacted further energizing this downhill process. Use of this field at anytime during the summer causes high stress on the plant life. This in-turn reduces playable hours in the fall.

The increased water demand and increase mitigative maintenance adds costs to maintaining natural turf grass fields and results in lost use time.

It is common knowledge that infill synthetic turf fields become hot during summer months. Less well-known, is that the solar radiation on the synthetic fiber blade produces this heat. The fact that the temperature of the turf drops quickly if the sun becomes blocked by clouds demonstrates this in the field. It should be noted that the temperature ¼" under the infill within the turf is the same as ambient air. Under these high heat conditions a properly specified synthetic turf playing surface can remain highly durable through many summer seasons beyond their standard warranty period of eight years.

Cold Condition Durability

The image to the left represents the opposite end of the climate performance spectrum. This field normally has optimal drainage; however, the picture shows that it has frozen solid following a period of rain then extreme cold. The rain can be seen pooling in the center of the image. Just like a natural turf grass field, an infill synthetic turf field can freeze under certain conditions and prevent proper drainage and impact safe playability.

The majority of days, were the surface is clear of snow and ice, a synthetic turf field will provide a highly durable and safe playing surface. In fact, you can expect a slight surface warming during the winter providing added warmth to athletes. In the southern New England states a two to four inch snowfall can be removed by clearing the snow at multiple areas and allowing the sun to melt and clear the remaining snow.

Heat Island Effect

A heat island effect is an area that is significantly warmer than its surrounding areas due to human activities. More specifically, it is an increase in temperature due to the surface retaining heat at a level that exceeds that of adjacent surfaces. In 2008, the New York City Department of Health generated a report entitled "New York City Department of Health and Mental Hygiene." They noted that synthetic turf fields have the potential to create heat island effects in the city.

Surface temperatures of infill synthetic turf systems at Brigham Young University have been reported to be as high as 93°C (200°F) on a day when air temperatures were 37°C (99°F) (Brakeman, 2004). In direct sunlight during the hottest part of the day in the summer months, the upper layer of the synthetic turf, which is exposed to the sun's rays, will become significantly hotter than grass. Surface temperatures can reach temperatures as high as 40°F to 100°F above that of the air temperature depending upon location.
Heat Exposure

The same solar-generated heat that can create problems following an improper choice of infill can also render a surface temporarily unsafe for play. Solar radiation reflecting from the surface of the fibers can raise temperatures significantly above that of the ambient air. These temperatures can render a field too hot to play on during midday periods in the summer. Surface temperature can be over 70˚F **above** surrounding ambient temperatures.

Recorded Field Surface and Air Temperatures						
Field ID	30-Jun-04			3-Aug-04		
A	Surface	Air	Delta	Surface	Air	Delta
B	125.4	78.3	47.1	139.1	86.9	52.2
C	126.3	77.9	48.4	128.8	84	44.8
D	126.1	79	47.1	137.1	87.4	49.7
E	136.6	78.1	58.5	148.6	82.9	65.7
F	142	78.6	63.4	159.4	85.1	74.3
G	133.5	77.2	56.3	160.7	87.1	73.6
H	127.8	78.4	49.4	147.6	84.7	62.9
I	132.1	78.1	54	145.6	84.9	60.7
J	130.1	77.9	52.2	144.7	84.4	60.3
K	118.6	78.4	40.2	129.9	86	43.9
Maximum Observed Delta			63.4			74.3

Source: Penn State Center for Sports Surface Research

Field Demand and Use Capacity

A wide range of total use hours for the given field types has been published. Depending on whether the information is obtained from a natural turf industry source or a synthetic turf industry source, the total hours of use could differ significantly. A rule of thumb for both is that the maintenance hours increase with the hours of use.

The following is a list of key considerations that one may take into account when selecting an athletic surface.

- A synthetic turf field surface can be almost all-weather. Note that anything that is wet and retains moisture will freeze in below-freezing temperatures. There are times when a synthetic turf field is much too hot to be used. Infill synthetic turf fields recover from extreme weather conditions far more rapidly than natural turf grass fields.
- A natural turf field has limitations in very wet and extremely cold conditions. Again, anything that is wet and retains moisture will freeze in below-freezing temperatures. A natural turf-grass field with water or moisture throughout its full cross-section will take longer to thaw than a synthetic turf surface due to the mass of the frozen material.
- A well-constructed infill synthetic turf can handle 45 to 60 hours of use per week and can perform for multiple years without a rest season for its full useful life.
- A natural grass field should only be used 15 to 20 hours per week with a rest season. Re-sodding can diminish use hours. A higher level of maintenance and soil testing can help bring these up to 20 to 24 hours per week. The health of a natural turf grass field may require a rest season to maintain optimum performance levels.
- A synthetic turf field needs to have goal mouth areas replaced every four years. This is especially true on fields used for lacrosse.
- A synthetic field will eventually need to be fully replaced. A natural turf grass field may not.

An Owner can expect that one lighted synthetic turf field can provide the same number of use hours as three natural turf grass fields. Synthetic turf fields allow programs to start earlier and extend into later parts of the season without overuse damage typical of high use natural turf grass fields. From and environmental impact perspective having synthetic turf fields in a venue increases the available hours of paly and decreases the amount of land disturbance required to provide the same hours using natural turf grass fields.

Maintenance

Contrary to some beliefs, all fields, natural and synthetic, require maintenance. For natural turf-grass fields, the investment in maintenance is a function of the quality of the field and is greater for the higher quality fields. Because we are focusing on engineered natural turf-grass fields, we will use a higher level of maintenance for this discussion. Keep in mind that a trained natural turf-grass professional should oversee the maintenance and use of a high-quality natural turf-grass field to obtain the best results.

Further maintenance costs for both surface types can increase dramatically as hours of use increase. A high-end, sand-based game-quality field will have a similar installation value to a FIFA Quality Pro field. Its overall cost for testing and maintenance may also be similar due to the FIFA testing requirements.

Another typically overlooked item regarding natural grass maintenance is that the equipment needs to be maintained at its best performance levels. For example, cutting grass with a dull blade can injure the turf grass blade. Synthetic turf maintenance equipment tends to undergo less wear and tear.

Synthetic Turf Maintenance

Synthetic turf requires cleaning weekly, as well as grooming every two weeks or 100 hours of use. It may also require a more aggressive grooming once or twice per year. Frequently used goal mouths can be expected to be replaced once or twice in eight years. The goal mouth areas should be evaluated each week, and areas of low infill should be filled and groomed to even out infill levels.

The synthetic turf system should include a maintenance checklist that must be followed and recorded. Inspection of the turf surface should be a regular activity. During these inspections conditions such as low infill depth and possibly loose field inlays should be noted and corrected. Failure to address these issues can result in more significant use damage in the future. Surface repairs can impact use schedules, but are not as time-consuming as repairs to natural turf-grass fields.

As the hours of use increase due to uses such as summer camps, so does the required maintenance. Sweeping and grooming rates should be increased accordingly. Increased grooming rates may also be due to a desire to have pre-game grooming for sports such as soccer and field hockey, where ball surface performance is critical to play. A field used for lacrosse should have the goal circles checked and adjusted, on a weekly basis for infill migration, which could expose the carpet backing to direct cleat wear.

Natural Turf-Grass Maintenance

Depending on the season, the amount of maintenance for natural turf-grass fields can change significantly. During the first natural turf grass growth seasons, mowing may be required two to three times per week due to higher watering rates. This is a period of high fertilization and maintenance with absolutely **no** use benefit. The recommend grow-in period for a seeded field is a full year. If the field is sodded light use can begin in eight to ten weeks.

Natural turf should include irrigation, mowing one to two times per week, fertilization, pest management programs, both surface and deep tine aeration, overseeding, top dressing, and re-sodding high-use areas on a yearly basis. The time required for surface repairs increases with use on a natural turf grass field.

The following table provides a comparison of the projected hours of maintenance for natural turf grass fields and infill synthetic turf grass fields.

Comparison of Maintenance Hours:

Natural Turf Grass Field - Practice Facility	
Natural Turf Grass Field Yearly Maintenance Hours	
Labor	Man Hours
Mowing	312
Cultural Practices	80
Repairs	80
Structural Practices	80
Painting	200
Total Man Hours	752
Use Hours Per Year (20 Hours Per Week)	1040
Maintenance Hours Per Hour of Use	0.72

Synthetic Infill Field - Stadium Game Field	
Synthetic Turf Field Yearly Maintenance Hours	
Labor	Man Hours
Cleaning	208
Grooming	104
Repairs	40
Topdressing Low Areas	40
Painting	100
Total Man Hours	492
Use Hours Per Year (60 Hours Per Week)	3120
Maintenance Hours Per Hour of Use	0.16

Synthetic turf requires 1/4 the man hours to properly maintain as compared to natural grass.

This comparison normally consists of comparing the total hours per year; however, dividing by the projected hours of use per year provides the maintenance hours per hours of use, which represents a more realistic comparison of maintenance costs. It should be noted that this comparison assumes a high level of maintenance for both field systems.

The above table shows that natural turf grass will require approximately 50% more man-hours of maintenance in a typical year than an equivalent size infill synthetic turf field. Taking the yearly projected hours of use for each field type into consideration, the table shows that each hour of maintenance performed on a synthetic turf field results in more hours of actual play.

About JJA Sports, LLC

JJA Sports is a small but productive specialty athletic design boutique. It was founded in 2002 with the goal of providing, start to finish, civil engineering-based, senior-level athletic specialty planning, consulting, and design, as well as athletic surface consulting, to clients ranging from colleges and universities to local recreation and youth programs. Since our founding, we have provided planning, design, and consulting on over 40 natural turf-grass fields and over 75 synthetic turf fields throughout the country, with most of our work in the New England area.

Mr. Amato served two terms as Executive Committee Secretary and has recently begun his second term as Second Vice Chairman of the ASTM F08 Main Committee on Sports Equipment and Facilities. In addition he has served as Vice Chair for ASTM F08.65 Subcommittee on Artificial Turf. Within the Main Committee he has serve on key synthetic turf, natural turf, and running track surfacing subcommittees. Since the late 90's, he has been a participating member of F08, where he assist in updating existing standards, as well as developing new standard test methods and specifications, for the natural and synthetic turf industries. He has participated in developing several standard test methods noted in this report as well as others used throughout the natural and synthetic turf industries.