

Natural and Synthetic Turf: A Comparative Analysis

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EXECUTIVE SUMMARY

The San Francisco Recreation and Park Department is embarking on a program to increase the quality and the capacity of the athletic fields of San Francisco. , One element of this program is the building of several new soccer fields with the latest generation of synthetic turf.

The focus of this document is to compare the relative costs and benefits of synthetic and natural turf on soccer fields. The advantages of synthetic turf for soccer fields are well known and include the following: reduced maintenance costs, significant increases in playing time, and a superior playing surface. A thorough, balanced analysis comparing synthetic and natural will focus on these issues: their relative installation costs, the expected life span of the fields, their relative annual maintenance costs, their respective capacities for amount of play, their relative safety, and their relative impacts on the environment.

Synthetic fields require a large initial investment, but they also yield significant annual savings in maintenance costs. The cost of installing a synthetic turf soccer field is considerable. The price is about \$800,000 per pitch. The cost of installing a natural turf field varies, but a reasonable estimate is about \$260,000. The annual maintenance cost for a synthetic turf field is about \$6,000, while that for a natural turf field is about \$42,000. A synthetic field costs about \$540,000 more to install, but realizes savings of operating expenses of about \$36,000 per year.

Any calculation of when a synthetic field will have “paid for itself” must factor-in the increase (anywhere between 50% and 100%) in playable hours that synthetic fields facilitate. A 50% increase in playable hours would provide a recovery of initial costs in 10 years, while an increase of 100% would have costs recovered in 7 _ years.

The life span of synthetic fields is somewhere between 10 and 15 years. When they do need to be “re-installed” at that time, the cost would about half of the initial cost because the foundation, base, and drainage system would be re-used.

In addition to increasing playable hours, synthetic soccer fields have several other benefits over natural turf fields. They provide a superior, flat, level playing surface. They are safer on which to play. And they promote several environmental benefits.

Clearly, the San Francisco Recreation and Park Department should continue to install more synthetic turf soccer fields. The citizens of San Francisco deserve more and better recreational opportunities of the sort these fields would provide.

BACKGROUND

The San Francisco Recreation and Park Department is in the preliminary stages of embarking on a comprehensive program of increasing the quality and the capacity of the athletic fields of San Francisco. One way to do this is to construct soccer fields using synthetic turf. In 2003, the Department constructed two new soccer fields with the latest generation of synthetic turf. The preliminary results have been overwhelmingly positive and the Department has several proposals for more such projects.

This new type of synthetic turf has several advantages over natural turf:

- (1) The new synthetic fields have significantly reduced operating costs because they require much less labor and materials to maintain. Irrigating, fertilizing, and mowing, that are required on natural turf, are not necessary on synthetic turf.
- (2) The new synthetic fields increase by 50% to 100% the amount of play possible on fields. These new synthetic fields do not have to be shut down for periods of maintenance and rehabilitation and they rarely have to be closed because of rainy weather. Furthermore, unlike their natural turf counterparts, they do not require the imposition of a ceiling on the amount of play allowed in order to protect the quality of the field.
- (3) The new synthetic fields have a superior quality playing-surface. The flatness and uniformity of the new synthetic fields produces venues that provide better and safer recreational opportunities for soccer and other ground sports.

Given their advantages of superior playing surface, increased capacity for play, and reduced maintenance costs, it is understandable why there is a move toward the new synthetic turf for soccer fields. But because these new fields are expensive to install (approaching \$1 million per soccer pitch), budget constraints limit the number of such fields that may actually be built.

A comprehensive evaluation of the relative costs and benefits of having synthetic-turf soccer fields requires compiling more detailed information in several areas:

- The relative installation costs for building a new synthetic field vs. a natural-turf field
- The realistic life-span of new synthetic-turf soccer fields
- The relative annual costs of maintaining a synthetic field vs. a natural-turf field
- The amount of increased capacity for play possible with synthetic fields
- The relative safety benefits of synthetic field vs. a natural-turf field, and
- The relative environmental factors of synthetic vs. natural turf.

Such a comprehensive cost-benefit analysis will provide the basis for developing a realistic plan to plan to build more synthetic soccer fields at SFRPD facilities. The purpose of this document is to outline some of the relative costs and benefits of natural and synthetic turf on soccer fields.

INTRODUCTION

Throughout this document, there are repeated references to “synthetic turf fields”. In all cases this refers to the newest generation of such products. It by no means refers to material like the original synthetic turf, AstroTurf. Whereas AstroTurf was hard and abrasive, the newest material is soft and spongy. The newest generation of synthetic turf places a fine-textured canopy of polyethylene fibers (the synthetic blades of grass) over a base of well-drained aggregate. The fibers are then top-dressed with a layer of small granules of crushed rubber, or a combination of crushed rubber and sand. There are a number of distinct proprietary brands of new synthetic turf on the market: Sprinturf, SmartGrass, Sporturf, and others. However, the name brand of the industry leader for this new type of synthetic grass is Field Turf. Field Turf has a longer track record and has been installed in more locations than any of its competitors. In fact, in some circles, the term “Field Turf” has come to be used as a nickname for this whole new generation of synthetic turf. This document will avoid reference to any of these proprietary brands and will instead use the generic term “synthetic turf” to refer to this newest generation of material.

INSTALLATION COSTS

Key Variables for Natural Turf Installations

Any fair cost comparison for installing a synthetic field and a natural field must take into account several key variables of a natural-turf field: (1) type of field preparation, (2) type of drainage system, (3) the nature of irrigation system work and (4) size of field.

(1) Field Preparation Type

Natural field installations are done using one of these distinct models of field preparation:

- “Native Soil” – the existing soil is roto-tilled and graded. This model is cheaper to install, but ultimately suffers from poor drainage and compaction and consequently less play, more damage, and reduced turf vigor.
- “Sand-Based” – a 10” to 12” layer of sand with drainage system is installed over the native soil. Sand-based fields can be played on sooner after it rains, but they do not wear as well as soil-based natural fields.
- “Native Soil with Amendments” -- the native soil is roto-tilled, amendments (such as organic matter or other material) are added, the area is roto-tilled again, and then graded. This type of renovation is a reasonable compromise: the soil drains better than the “Native Soil” Model (although not as well as a sand –based field) and wears better than a sand-based field.

To summarize, the Native Soil Field has poor drainage and quickly becomes compacted, while the Sand-based Field doesn’t wear as well as the Amended Soil Field.

Consequently, for the purposes of this comparison, we are specifying that the natural field renovation in our comparison be the “Native Soil with Amendments” Model.

(2) Drainage System

Most of the athletic fields in San Francisco are built on heavy, clay soil. Most have very poor drainage, have not been amended in any thorough and systematic way, and have no sub-surface drainage systems. Any serious natural-turf field construction or renovation in San Francisco should include a sub-surface drainage system, in order to maximize the amount and quality of field play.

(3) Irrigation System

Many of the irrigation systems on our athletic fields are over fifty years old and do not provide for the uniform, thorough irrigation of our athletic fields. Almost all need at least some modification, some need extensive rehabilitation, and some need complete replacement. Our comparison includes calculations for each of these levels of irrigation work.

(4) Size of Field

The focus of our inquiry is on construction of soccer fields. The standard size of SFRPD soccer fields is 200' x 300' = 60,000. A full-size regulation field is 330' x 210' = 69,300 sq. ft. A serious natural-field construction must include a reasonable perimeter and an area for "moving the field" (to minimize wearing out the middle and the goal mouths). Consequently, a reasonable size for an area to contain a natural-turf soccer field is about 360' x 250' = 90,000 sq. ft.

(5) Adding Amendments

To be effective, amendments of organic matter and sand should be applied at a rate of at least four inches over the entire surface and then incorporated uniformly by roto-tiling. Four inches thick translates to over 1100 cu. yds.

(6) Sod vs. Seed

The most durable grass for soccer fields in San Francisco is hybrid Bermuda grass. Hybrid Bermuda cannot be grown from seed, but is available in sod (produced from stolons). Accordingly, our natural turf construction model assumes sod installation.

Natural Turf Installation Costs

Summary of Costs for Building a Natural Turf Athletic Field

TASKS	Irrigation Model		
	Irrigation Modification	Irrigation Rehab.	Irrigation Installation
	(Minor Irrigation Work)	(Significant Irrigation Work)	(New Irrigation)
Planning	\$20 k	\$20 k	\$20 k
Excavation	\$20 k	\$20 k	\$20 k
Amending	\$80 k	\$80 k	\$80 k
Drainage	\$40 k	\$40 k	\$40 k
Irrigation	\$10 k	\$50 k	\$90 k
Grading	\$10 k	\$10 k	\$10 k
Sod Installation	\$40 k	\$40 k	\$40 k
TOTALS	\$220 k	\$260 k	\$300 k

In summary, the costs for building a good natural turf athletic field is somewhere between \$220,000 and \$300,000, depending primarily whether it is an upgrade of an existing field or new construction. The average construction cost is about \$260,000 for a natural-turf field.

Synthetic Turf Installation Costs

A synthetic field installation includes installation of the sub-surface drainage system, the rock-and-gravel foundation, the carpet of synthetic fibers, and the in-fill of crushed rubber or crushed rubber and sand. A synthetic soccer field needn't be constructed over as an area as big as a natural turf one, because it doesn't have to be moved. It need only be about 350' x 230' or about 80,000 sq. ft.

The total cost for synthetic turf, properly installed, is about \$10/sq.ft, or roughly \$800,000. This indeed is roughly what the Department paid for each of the synthetic soccer fields (at Franklin Sq. and at Youngblood Coleman Plgd.).

Maintenance Costs

Natural Turf Maintenance

There is a range of costs for maintaining a natural-turf field, depending on the amount of play, the condition of the field, the staffing level, etc. A reasonable estimate for Gardener labor costs is about 1/3 Full Time Equivalent, or about \$20,000 including fringes and overhead. Gardener tasks include litter removal, irrigating, fertilizing, mowing, aerating, over-seeding, filling holes, and conducting safety-inspections. The Heavy Equipment Operation provides truck drivers to deliver soil and sand and to drive the big, "gang mowers" and provides operating engineers to load bulk materials and to roto-till and top-dress, all at an average annual cost of \$4,000 per pitch. The Field Marking Crew paints each soccer pitch at least 20 times a year for an annual cost of \$3,000. The average annualized cost for plumbers to repair, modify, and overhaul irrigation systems is \$2,000. Materials and supplies needed for each field include water, fertilizer, seed, sand, soil, sod, and paint, totaling about \$10,000 annually. The annualized cost of equipment, primarily trucksters and mowers, is about \$3000.

Annual Maintenance Costs for Natural-Turf Soccer Field

Expense Items	Expenses	Total Costs
Gardener Labor	\$20,000	
Heavy Equipment Labor	\$ 4,000	
Field Marking Labor	\$ 3,000	
Plumber Labor	\$ 2,000	
Labor Total	\$29,000	\$29,000
Material and Supplies Total	\$ 10,000	\$ 10,000
Equipment (Annualized) Total	\$ 3,000	\$ 3,000
Grand TOTAL		\$42,000

The total maintenance cost for a natural-turf soccer field is about \$42,000.

Synthetic Turf Maintenance Costs

The new synthetic fields have significantly reduced operating costs because they require much less labor and materials to maintain. A number of operations, such as irrigating, fertilizing, field marking, and mowing, that are required on natural turf, are not necessary on synthetic turf. The regular gardener maintenance (1/15 FTE) tasks that are required include removing litter, inspecting the field, grooming the synthetic turf with a tow-behind sweeper, and occasionally adjusting the grade by adding the “synthetic soil” to low spots.

Annual Maintenance Costs for Synthetic-Turf Soccer Field

Expense Items	Total Costs
Gardener Labor	\$4000
Repairs and Materials, as needed	\$2000
TOTAL	\$6000

The total maintenance cost for a synthetic-turf soccer field is about \$6,000.

Summary of Field Costs

Type of Turf	Installation Costs	Annual Maintenance Costs
Natural	\$260,000	\$42,000
Synthetic	\$800,000	\$ 6,000
Difference	\$540,000 more initially for synthetic	\$36,000 more annually for natural turf

Synthetic fields require a large initial investment, but they also yield significant annual savings in maintenance costs. Based only on the figures above and **thinking only of the number of fields** it would be about 15 years before the total costs (installation costs plus the cumulative maintenance costs) of the natural turf field would begin to exceed those of synthetic turf. However, this is somewhat misleading because it doesn’t take into account that **synthetic fields virtually double the events (whether practice sessions or game) that can be staged on the field annually.**

Number of Hours of Play

Synthetic fields virtually double the number of hours a field can be used. They don’t require a two-month rehabilitation closure or a one-day-a-week maintenance closure. With lights, events can go from 8 A.M. until 10 P.M. And synthetic fields are open many more days in rainy weather than their natural-field counterparts. Consequently, approximately twice as many events can be held on a synthetic field. **Cost per field event held is a much better indicator of relative value than just cost per field. Factoring this doubling of field events into the equation, in effect, cuts in half the time necessary to reach the break-even point. In short, because of the dramatic increase in playable hours, synthetic fields pay for themselves in eight to ten years!**

Life Span of the Fields

Life Span of Synthetic Fields

The industry leader for synthetic fields, Field Turf, guarantees their fields for eight years. Therefore, it is reasonable to assume that the fields will last in the range of 10 to 15 years. At the end of its life span, a new synthetic field would cost significantly less than the original because the basic design, foundation, and drainage would already be provided

Life Span of Natural Fields

The life span of a natural-turf field varies greatly, depending on the amount of use, turf practices, staffing levels, etc. Given the existing pressure to over-use our soccer fields, it is difficult to keep them at a high level of quality. It is reasonable to assume that such highly used fields will need a major overhaul every ten years or so. This would obviously not be a total replacement, but instead a rehabilitation of the soil profile, the grade, the turf, and the irrigation system.

Safety of Play

The latest generation of synthetic turf, such as Field Turf, is safer than natural turf. It is flat, even, and soft, and it doesn't have gopher holes, bumps, or muddy patches. The new synthetic turf also doesn't have some of the disadvantages of the older AstroTurf, which was abrasive and prone to injuries from twisted knees and ankles. There are rigorous scientific studies (available on request) that document statistically that synthetic turf is safer to play on than natural turf.

Environmental Issues

Several environmental issues are a part of the discussion of synthetic vs. natural turf soccer fields. On balance, there are environmental advantages to using synthetic turf. Use of synthetic turf reduces the use of herbicides, chemical fertilizers, and paint. Fertilizers are increasingly being targeted as a source of ground water contamination. Having synthetic fields also reduces the use of gas-powered equipment, especially mowers, thereby cutting back on emissions of air pollutants. On the other hand, there have been questions raised about possible toxins in the materials used in synthetic fields. At this point there is no documentation to substantiate these charges. The only significant environmental drawback to synthetic fields is that their components do not biodegrade and will therefore end up in a landfill.

Conclusion

The numerous benefits of synthetic soccer fields far outweigh the high cost of their installation. Clearly, the San Francisco Recreation and Park Department should continue to install more synthetic turf soccer fields. The citizens of San Francisco deserve more and better recreational opportunities of the sort these fields would provide.



Crumb Rubber Issue Research Update September 2016

FEDERAL MULTI-AGENCY STUDY

Background: In February, the U.S. Environmental Protection Agency (EPA), Center for Disease Control (CDC/ATSDR) and the Consumer Products Safety Commission (CPSC) formally launched a multi-agency effort to study crumb rubber. This Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields & Playgrounds was issued with a 60 day public comment period.

Scope: The study is designed to:

- Fill important data and knowledge gaps
- Characterize constituents of recycled tire crumb
- Identify ways in which people may be exposed to tire crumb based on their activities on the fields.

Latest News: In August, 2016 the agencies finalized their testing protocol.

You can find the latest updates here:

http://www.reginfo.gov/public/do/PRAViewDocument?ref_nbr=201608-0923-002

Anticipated Completion Date: **NOVEMBER 2016**

CALIFORNIA OEHHA STUDY:

Background: In June 2015, OEHHA committed under a contract with CalRecycle to conduct a new multi-year study on synthetic turf and potential human health impacts.

Scope: The scope of this study is:

- Identifying and measuring chemicals released from crumb rubber and artificial grass blades in indoor and outdoor fields and playground mats throughout California.
- Evaluating exposures to chemicals released from crumb rubber and synthetic grass blades through inhalation, ingestion, and skin contact.
- Evaluating the hazards and toxicological activities of chemicals released from turf.
- Developing a study protocol for measuring chemicals from synthetic turf in urine or other bodily fluids of athletes, or using personal monitors worn by athletes

Latest News: Based upon input from the Synthetic Turf Scientific Advisory Panel, the scope of the synthetic turf field investigation has been expanded to include:

- methods to extract as many chemicals as possible from crumb rubber samples for identification,
- the use of more suitable artificial bio-fluids (such as fluids that mimic human sweat) to evaluate the chemicals that enter the body,
- measurements of crumb rubber particle size to understand if inhalation of small particles occurs.

You can find the latest updates on this study here:

<http://oehha.ca.gov/risk-assessment/synthetic-turf-studies>

Anticipated Completion Date: **MID-2019 (Prelim results in mid-2018)**



Crumb Rubber Issue Research Update September 2016

WASHINGTON STATE STUDY:

Background: While according to the DOH's website, "A public health risk appears unlikely based on the available research and data we have reviewed", after Coach Amy Griffin published her list of athletes with cancer, the state of Washington decided to undergo their own assessment.

Scope: Working with UW's School of Public Health, this study is designed to:

- Review Coach Griffin's information and verify the information using the Washington State Cancer Registry.
- Determine if there is an increased rate of selected cancers among soccer players, especially goalies compared to what is expected based on Washington state rates

You can find the latest updates on this study here:

<http://www.doh.wa.gov/CommunityandEnvironment/Schools/EnvironmentalHealth/syntheticTurf>

Anticipated Completion Date: END OF 2016

EUROPEAN COMMISSION/ECHA STUDY:

Background: After several earlier meetings, in June, the European Commission request to the European Chemicals Agency (ECHA) to complete an evaluation of the risk to human health of crumb rubber.

Scope: The scope of this study is to:

- Identify relevant hazardous substances that pose a risk to human health in relation to the use of granules in synthetic turf
- Evaluate dermal contact, ingestion and inhalation on both indoor and outdoor surfaces

You can find more information on this study here:

https://echa.europa.eu/documents/10162/13641/echa_rest_proposals_rubber_granules_en.pdf

Anticipated Completion Date: FEBRUARY 2017

REFERENCES

U.S. Office of Information and Regulatory Affairs /
Office of Management and Budget:

<http://www.reginfo.gov/public>

CA Office of Environmental Health Hazard Assessment:

<http://oehha.ca.gov>

State of Washington Department of Health:

<http://www.doh.wa.gov>

European Chemicals Agency:

<https://echa.europa.eu>

4 RECYCLED RUBBER Myths

REFUTED



Myth: Lack of Risk Evaluation

The study of the connection of long term health risks to playing on synthetic turf fields with recycled rubber infill



There have been dozens of studies, peer-reviewed academic analyses and government reports published that have been analyzed by independent third-parties and hold up under peer-review from toxicologists that are committed to science without an agenda.

All available science shows no greater long-term health risks to using artificial turf fields than playing on urban or rural soil.

Myth: Gaps in Evidence



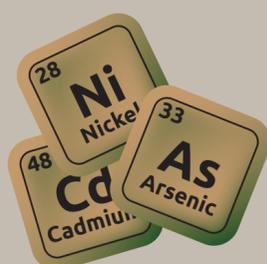
The assertion that there are significant gaps in the evidence supporting the safety of crumb rubber turf fields is false.

When evaluated individually, some studies have limitations or data-gaps - which is true of any individual scientific study, in general - and from a scientific perspective, additional research can always be conducted to provide additional evidence.



Existing studies have evaluated many aspects of safety; they have looked a multitude of chemicals, at all major exposure pathways—ingestion, inhalation, skin contact—and have used many methods.

Considering all of the evidence of all studies combined, the data supporting the safety of crumb rubber turf fields does not leave significant gaps.



Myth: Chemical Absorption

Scientific, peer-reviewed studies to date have already extensively examined chemical and non-chemical exposure pathways

There have been many exposure assessment studies conducted that adequately examine the three major exposure pathways, which are through ingestion, inhalation, and through the skin.



One peer-reviewed study did an extraction analysis using a variety of simulated biological fluids to see what happens when we ingest, or inhale, or generally come in contact with these particles, and whether we absorb any chemicals.

Based on extraction studies, pellets getting into cuts or abrasions would also be unlikely to present any risk.



This study found negligible extraction for the chemicals and the scientists concluded that the chemicals did not pose a health risk.

Myth: Chemicals Mean Risk



The mere presence of a chemical does not mean it poses potential health risks



The most common four chemicals found in crumb rubber that have been brought up as points of concern in crumb rubber are arsenic, benzene, cadmium, and nickel, but context is needed relating to how often we come into contact with each by simply being part of society.

Rubber in turf has less arsenic than rice; less cadmium than in lobster; less nickel than in chocolate; and less benzene than in a can of soda.



arsenic



cadmium



nickel



benzene



The International Agency of Cancer Research has stated these chemicals are all safe in low amounts and are simply part of the world we live in and the food we don't think twice about.

Regulatory reports have found that chemical exposures from synthetic turf present a very low risk.

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