Communication from Public

Name:	Safe Healthy Playing Fields, Inc.
Date Submitted:	06/26/2024 02:51 PM
Council File No:	24-0602
Comments for Public Posting:	Attached please find our comments for the public record for CF24-0602: A Resolutions to Ensure Safe Drinking Water and Reduce Risks from Artificial Turf. Safe Healthy Playing Fields, Inc. has a long history of supporting decisions regarding safer choices related to human and environmental health for parks, schools and communities and states. We are happy to support this effort and stand ready to assist in any way we can as you move forward with your laudable goals. Please do not hesitate to contact us to aid in future support and efforts. Respectfully, Dianne Woelke MSN, Board Member Safe Healthy Playing Fields, Inc. https://www.safehealthyplayingfields.org SHPFI is an all-volunteer nonprofit 501-c-3

Safe Healthy Playing Fields Inc.

www.safehealthyplayingfields.org

17 June 2024

CF24-0602: A RESOLUTION TO ENSURE SAFE DRINKING WATER

AND

REDUCE RISKS FROM ARTIFICIAL TURF

SUPPORT

> ***"PFAS is probably the worst environmental pollutant that the United States has ever faced. It makes all the rest" — including PCBs and asbestos — "pale in comparison to what the cost of this cleanup will be…and it will affect more people than all known pollutants combined."*** Dr. Graham Peaslee, University of Notre Dame, leading expert on PFAS in consumer products.

Dear Members of the Los Angeles City Council:

Thank you for the opportunity to submit these comments on behalf of Safe Healthy Playing Fields, Inc. (SHPFI).

SHFPI is an all-volunteer 501-c-3 non-profit organization. We are committed to educating communities, policymakers and elected officials about the health, safety and financial realities of plastic fields versus grass fields and other synthetic surfaces for their parks and schools. Our constituency ranges from concerned individuals to community and civic organizations, legal, healthcare and science professionals, municipal leaders and state legislators.

We ask that the City Council take immediate action to meet demands to protect drinking water, human and environmental health from the toxic and carcinogenic chemicals found in synthetic turf, joining other communities and states:

- Millbrae
- San Marino
- Santa Clara County
- States of CA, CO, ME, MN, NY, VT have enacted laws related to synthetic turf. Additional states have active bills in their legislatures while an ever growing number of local jurisdictions across the country have moratoriums or have won battles against installations by referendum.

The proposed resolution is consistent with Los Angeles City programs and ordinances::

1989 Waste Management Diversion Act
2015 Sustainable City pLAn
2019 Green New Deal/Climate Action Plan
2022 Single Use Plastic/Plastic bag ordinance

Synthetic Turf is a Petrochemical Plastic Product:

Made of the same material as plastic straws and bags, synthetic turf is a fossil fuel based petrochemical product, as are 99% of plastics. The plastic blades are most often made of polyethylene, the most globally produced and discarded plastic. The backing may be made from latex, polyurethane or polyvinyl chloride.

There are over 16,000 known chemicals found in plastics. Of the known chemicals, 4,200 are considered "highly hazardous" to human and environmental health. Of these 4,200 chemicals, only 980 have been regulated by any global agency. Per- and polyfluoroalkyl substances (PFAS) are amongst the 15 categories of chemicals of concern in plastics.

PFAS;

> *"It's not an acute toxin. It's chronic, so it affects you by long-term exposure…There are no safe kinds. I've yet to see one that doesn't cause some sort of cancer or immunosuppression."* Dr. Graham Peaslee

Chemicals in plastics, including polybrominated diphenylethers (PBDE), neurotoxic phthalates, bisphenols and PFAS, add disease burden and health care costs in the United States. For 2018, the attributable cost of plastics to disease and health care related costs was $249 billion; for PFAS alone, it was $22.4 billion. The societal cost globally is estimated at $16 trillion USD. annually for PFAS clean ups and health care for impacted individuals.

The need to stop further PFAS exposure cannot be overstated. PFAS can cause multiple reproductive disorders (including a 40% decrease in female fertility; a decrease of 62.3% total sperm count in males); Crohn's disease; breast, testicular, kidney, prostate and liver cancers. They cross the blood-brain barrier and are related to Autism Spectrum Disorder, Attention Deficit Hyperactivity Disorder, increased deaths from Parkinson's and Alzheimer's diseases; immunological effects; increased serum cholesterol; effects on infant birth weights; impaired glucose metabolism, insulin resistance, dyslipidemia and adiposity in children and adolescents; thyroid hormone disruption (including neonatal) and thyroid cancer. Because they are bioaccumulative, PFAS exposure can impact multiple generations. Babies are being born pre-polluted with PFAS.

PFAS is required to prevent plastic yarns from sticking to manufacturing equipment. One it has been found in 100% of independently tested synthetic turf to date. Industry claims of PFAS free turf have been disproven. The industry trade association President and CEO, Melanie Taylor,sent an email to CA State Senator Ben Allen on 21 June 2023 admitting to use of PFAS in synthetic turf. Industry claims of a polymer processing aid, Polyvinylidene fluoride (PVDF) is a "safe" PFAS chemical, are also untrue. PVDF is a polymeric PFAS that poses risk to human and environmental health.

Multiple studies have confirmed that PFAS, heavy metals, PAHs, phthalates and Volatile Organic Compounds leach and/or aerosolize from plastics, including synthetic turf and used tire crumb rubber playground surfacing. The microplastic crumbs of approximately 40,000 used tires are used as infill to support the plastic blades in a single regulation sized synthetic turf field. It is also used for playground surfacing known as PIP (poured-in-place).

On 5 April 2024, the California Office of Environmental Health Hazard Assessment issued a press release regarding Public Health Goals (PHGs) for two PFAS chemicals (of over 16,000) in drinking water:

"*The PHG for PFOA is 0.007 parts per trillion (ppt), and 1 ppt for PFOS"*

PHGs are used by the State Water Resources Control Board (SWRCB) in establishing drinking water standards- CA Maximum Contaminant Levels (MCLs). The PHGs are based only on scientific data and public health considerations and not on economic cost considerations. The MCLs that will be adopted by SWRCB will consider economic factors and technological feasibility. State law requires that SWRCB set MCLs at levels as close as feasible to corresponding PHGs, with an emphasis on protection of public health. California MCLs for PFOA and PFOS must be at least as stringent as federal MCLs, and may result in being stricter than those set by the US EPA.

On 10 April 2024, the US EPA issued Maximum Contaminant Level Goals (MCLG) and Maximum Contaminant Levels (MCLs) for both PFOA and PFOS in drinking water:

- The US EPA set MCLGs for both PFOA and PFOS at zero.
- MCLs were set at 4.0 ppt (parts per trillion) for PFOA and PFOS, individually.
- The EPA established MCLGs for four additional PFAS chemicals: PFNA, PFHxS, PFBS and "GenX" chemicals.
- The EPA established MCLs at 10 ppt. for PFHxS, PFNA and GenX chemicals individually, with a limit of 10 ppt for any mixture of two or more of: PFHxS, PFNA, "GenX" chemical and PFBS.
- All of the named PFAS chemicals have been found in synthetic turf.

Compound	Final MCLG	Final MCL (enforceable levels)
PFOA	Zero	4.0 parts per trillion (ppt) (also expressed as ng/L)
PFOS	Zero	4.0 ppt
PFHxS	10 ppt	10 ppt
PFNA	10 ppt	10 ppt
HFPO-DA (commonly known as GenX Chemicals)	10 ppt	10 ppt
Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS	1 (unitless) Hazard Index	1 (unitless) Hazard Index

https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas

Chemical leachate into soil, surface and groundwater can impact drinking water.

Thirty two PFAS chemicals, culled from public records, have been found to date in synthetic turf.

Claims by industry to be able to manufacture synthetic turf without PFAS remains completely unsubstantiated and undemonstrated at any level. In the absence of any independent third-party verification, there is no basis for relying on industry claims, particularly given the universal presence of PFAS in all tests to date.

All manufacturers should be able to provide independent third party testing results using the most up to date methods for solids or testing showing less than one PPM (Part Per Million) of TOF (Total Organic Fluorine). Commercial laboratories can test for approximately 100 of the

over 16,000 PFAS chemicals at the two ppt level. It should be noted that ***absence of proof is not proof of absence*** when only a small percentage of PFAS can be tested for.

The industry and their scientists for hire have been known to manipulate PFAS testing to support misleading and unsupported conclusions. Such deceptive techniques include using methods specific for testing water rather than solids, setting detection limits too high, testing for a narrow range of PFAS amongst the over 16,000 PFAS chemicals, not conducting synthetic leaching precipitation procedure (SPLP) and not testing for Total Organic Fluorine (TOF).

Signed affidavits from manufacturers and associated industries have also been proven false, are reportable (CA OAG; FTC), and are not acceptable in lieu of independent third-party testing.

California Department of Toxic Substances Control (CA DTSC) will be holding a workshop on PFAS and other chemicals of concern in synthetic turf (pg. 14) in 2024 and opening public comments shortly thereafter. PFAS in commercial and residential carpet are already under regulation in CA.

Major research on PFAS in synthetic turf by renowned researchers Dr. Graham Peaslee and Dr. Heather Whitehead is slated to be published in fall of 2024.

Yorba Linda, CA, a city of 68k residents, recently opened its new $28 million PFAS water treatment plant. What would a treatment plant(s) cost the city of Los Angeles to remove PFAS, other chemicals of concern and microplastics? Construction of a treatment plant is not the end…but the beginning. Disposal of concentrated PFAS and other chemicals of concern in the wastewater effluent, replacement and disposal of costly filters in hazardous waste landfills, advancing science that will detect more chemicals at increasingly lower concentrations resulting in more stringent regulations is the reality that willfully adding more PFAS and other chemicals to LA's environment and water will bring.

Additional Chemicals of Concern: (not comprehensive)

In synthetic turf:

- Phthalates
- Latex
- Polyvinyl chloride
- Naptha
- Siloxanes
- Talc
- Di/Isocyanates
- Formaldehyde
- Fungicides
- Flame retardants
- Coal fly ash
- 1,2-cyclohexane dicarbonic acid
- Dibutyltin
- Ethylene glycol
- Triclosan
- Colorants
- UV stabilizers
- Anti-static treatments

In used tire crumb infill:

- Lead
- Phthalates
- Polycyclic Aromatic Hydrocarbons
- 6PPD/6PPD-quinone
- Benzothiazole (BT)
- 2-Mercapto-benzothiazole (MBT)
- 1,3 Diphenylguanidine (DPG)
- Cadmium
- Benzene
- Formaldehyde
- Copper
- Mercury
- Hexamethyloxymethyl-melamine (HMMM)
- Short and Long Chain chlorinated parafins (SCCP; LCCP)
- Zinc
- 1,3 Butadiene
- Chromium (hexavalent chromium; lead chromium)

- Styrenes

Plant and mineral based infills also break down with wear and tear of athletic field use. They have not been proven safe, may contain pesticides, are flammable, require frequent watering, float and wash off in rain, and only temporarily reduce the temperature of the playing field by 10-20^{o}F. Mineral based zeolite infill can form a paste that cakes in the carpet. Two plant based infills have been shown to contain PFAS.

Plant based infills add excess nutrients to soil and water, increasing the risk of toxic algal blooms and red tides. They also increase GHG off gassing by an additional 70%.

***Microplastics*:**

Research by the Department of Civil and Environmental Engineering, University of California, Los Angeles, and the Moore Institute for Plastic Pollution Research, Long Beach, found "*Children's playgrounds contain more microplastics than other areas in urban parks*."

In addition to the CA Statewide Microplastics Strategy - Senate Bill No.1263 (Chapter 609, 2018), CA DTSC recently announced its intent to add Microplastics to the Candidate Chemicals List.

Microplastics not only leach chemicals, including PFAS, they adsorb other chemicals and bacteria, posing particular risk to the food chain. Even the best BMPs (Best Management Practices) will capture only a small percentage of the microplastics and virtually none of the PFAS and other toxic chemicals from synthetic turf. Drainage systems are not expensive granulated activated carbon (GAC) filters.

In humans, micro- and nano-plastics have been found in:

- Heart
- Liver and spleen
- Lungs
- Blood
- Placenta (maternal and fetal sides)
- Newborn and adult feces
- Breastmilk
- Brain
- Penis, Testes and semen
- Kidney
- Brain

Microplastic blade loss from synthetic turf is estimated at 551-661 pounds per playing field per year.

Microplastic synthetic turf blades have been found in Lake Tahoe (personal email communications with researchers at Tahoe Environmental Research Center (TERC)) and the ocean. In 2021, researchers found that synthetic turf fields in Toronto contribute the 2nd highest amount of microplastics to the environment with only litter contributing a higher amount. This makes synthetic turf a major point source of PFAS and microplastic pollution that cannot go unaddressed. Lake Tahoe researchers found high levels of polyethylene and polypropylene in the lake and "***…recorded plastics concentrations more than three times higher than those sampled using a similar method in the North Atlantic subtropical gyre.*"**

Published on 29 June 2023, research by the University of Barcelona found:

> *"AT [artificial turf] fibers - composed mainly of polyethylene and polypropylene - can constitute over 15% of the mesoplastics and macroplastics content, suggesting that AT fibers may contribute significantly to plastic pollution. Up to 20,000 fibers a day flowed*

down through the river, and up to 213,200 fibers per km2 were found floating on the sea surface of nearshore areas. AT, apart from impacting on urban biodiversity, urban runoff, heat island formation, and hazardous chemical leaching, is a major source of plastic pollution to natural aquatic environments."

A congressional hearing, entitled:"Are Toxic Chemicals From Tires And Playground Surfaces Killing Endangered Salmon?" was held in the Natural Resources Committee, Oversight and Investigations Subcommittee hearing on 15 July 2021, with the Honorable Katie Porter as Chair.

A 2021 Report to Ocean Protection Council identified playgrounds, synthetic turf fields and rubberized asphalt as contributing tire particles to urban runoff. That same year, the San Francisco Estuary Institute also found 85% of stormwater runoff particles were due to tire wear in 12 of San Francisco's urban areas.

On 13 December 2023, the California Coastal Commission conditioned a permit for the Cesar Uyesaka Baseball stadium at UC Santa Barbara, requiring natural grass, citing microplastic pollution and stating synthetic turf is not superior to natural grass and is not sustainable. They also disallowed the proposed removal of trees.

The evidence of the negative impact of microplastic pollution on environmental health is equally daunting. From zooplankton, krill and whales to bees, and terrestrial animals of the Americas, macro-, micro- and nanoplastics are impacting aquatic and wildlife, and even our pets. Synthetic turf and microplastics have caused a decrease in bird populations, accumulation of microplastics on bees and negatively impacts ocean habitats and biodiversity both above and below ground. Research from 2021 estimated that >1500 species have ingested microplastics.

Plastic turf does not save water:

Synthetic turf requires approximately 989 gallons of water to produce 1 square meter of turf-estimated to be the equivalent of watering a square meter of natural grass for 18 years. Additional water is required for cooling to a safe temperature for playing as well as for cleaning pollution, bodily fluids (like blood and vomit), animal waste, mold, bacteria and more from plastic turf and is often a condition of warranty.

Research has shown that synthetic turf requires more water than drought tolerant Bermuda varieties in an arid environment in order to bring the surface temperature down to a level comparable to natural grass for safe play.

While proper irrigation or water-cannon systems can lower the temperatures for 20+ minutes, plastic fields rapidly return to the high temperatures. According to recent research:

"... 480,000 L of water at 25°C are required to decrease the surface temperature from 60°C [140°F] to 30°C [86°F]...the amount of water required to maintain [artificial turf] temperatures at levels comparable to irrigated [natural turf] over a 24-h period exceed the water requirements of Bermuda grass in the same environment."

A report on water use on synthetic turf found that 2 water cannons spraying water from the center of the field moving towards each end simultaneously was the most effective, as one cannon only resulted in the first end drying before the second was sprayed. **In September and October, 12,000 gallons of water were required each time the field needed to be cooled.**

Impervious surfacing:

Synthetic turf is classified as impervious by the US EPA and state of California (pg 116):

> "*...areas such as gravel roads...that will be compacted through design or use to reduce their impermeability."* It further has defined impervious surfaces as*…[a]ny surface that prevents or significantly impedes the infiltration of water into the underlying soil. This can include but is not limited to: roads, driveways, parking areas and other areas created using non porous material; buildings, rooftops, structures,* ***artificial turf*** *and compacted gravel or soil."*

Potential for erosion:

Synthetic turf does not save water and will generate 27,000 gallons of toxic runoff per 1 acre of plastic for every one inch of rainfall.

> *"Pollutants from aerial and terrestrial sources accumulate on impervious surfaces until runoff from a precipitation event carries sediment, nutrients, metals, and pesticides into stormwater drains and directly to local water bodies. As impervious surfaces increase, stormwater runoff increases in quantity, speed, temperature, and pollutant load. When impervious surfaces reach 10–20% of local watershed area, surface runoff doubles and continues to increase until, at 100% impervious surface coverage, runoff is five times that of a forested watershed. Excessive stormwater runoff also increases the potential for flooding."* US EPA Impervious Surface Fact Sheet

Scripps Institute of Oceanography, University of California San Diego reported 46 total atmospheric rivers along the U.S. West Coast, causing disastrous flooding and loss of property and life during the 2022 to 2023 rainy season. With what has now been categorized as a Super El Niño year currently, increasing frequency and severity of atmospheric events overall, consideration of synthetic turf is antithetical to environmental responsibility and an even poorer choice for a product that must be replaced every 8 to 10 years on average.

Heat/Heat Islands:

'This is a climate damn emergency'

Gov. Gavin Newsom

The overheating of densely crowded and overbuilt urban centers, particularly a mega city the size of Los Angeles, points to the desperate and unmet need of open ***natural*** green spaces if the effects of climate change are to be mitigated.

Synthetic turf can readily become much hotter than asphalt, reaching temperatures of 160^0F to 180^0F (regardless of infill type) and have even reached well in excess of 222.8^oF (106^oC) Thermal burns on plastic turf have even required hospitalization. At a surface temperature of 118°F a first-degree thermal burn occurs in 15 minutes, becoming a 3rd degree burn (full skin-thickness) in 20 minutes; at a temperature of 140°F, 1st degree burns occur in 3 seconds, and 3rd degree burns in 5 seconds.

As the planet heats up, athletes are increasingly impacted by heat related illness by playing on synthetic surfaces. Deaths among high school football players from heat stroke doubled from 2015 to 2017 when compared to the 5 preceding years. Football players are eleven times more likely to suffer a heat related illness. Playing on synthetic turf is a contributing factor.

After traumatic injuries and cardiac related events, heat illness is the 3rd leading cause of death among teenage athletes. One of the predisposing factors are prescription drugs for treatment of attention deficit hyperactivity disorder, ADHD, which can be caused by PFAS chemicals found in plastics. ADHD, which affects approximately 7% of 6 to 11 year olds, has been declared a serious public health problem.

Children are not small adults. They are more readily impacted by heat illness due to:

- Heat production – Children have higher metabolic rates than adults which leads to higher production of more heat.
- Body surface area – Younger children absorb more heat because they have a greater body area to body mass ratio. For older children and teens, increased body fat and low fitness levels are contributing factors.
- Blood circulation – Children are less able to cool their body temperature by shunting their blood from their body core to their body surface due to lower cardiac output and smaller blood volume.
- Sweat production – Children produce less sweat per gland and sweat at higher body temperatures than adults.
- Fluid replenishment – Children are less likely to self-regulate hydration if unsupervised.
- Children experiencing heat illness are most likely to present with significant neurological symptoms- from delirium, hallucinations, poor muscle control and unsteady gait, difficulty with speaking or unclear speech to seizures or coma. These symptoms may be readily confused with head trauma, epilepsy or drug overdose. Mortality is high and if a child survives heat stroke, their risk for recurrence of heat illness is increased.

Synthetic turf off-gasses both methane and ethylene and continues throughout the night, in ever increasing amounts for the 1,000 years it takes for it to decompose. Methane traps 90% more heat than carbon dioxide and is 21 times more potent. Land based plastics produce 2 times more methane and 76 times more ethylene than plastics found in waterways and oceans.

The heat islands created by plastic turf playing fields are large enough to be visible from satellites circling our planet. Even if all synthetic turf were removed from Los Angeles today, methane would linger in the atmosphere for approximately 12 years, contributing to climate change and sea level rise for hundreds of years after pollutants have been cleared from the air.

A 2017 Swedish study of total life cycle emissions on a modeled 7881m^2 synthetic field concluded GHG emissions would be 527 tons of CO2e for a ten year use period, exclusive of manufacturing, transport, construction, removal and disposal.

The Lawrence Berkeley National Laboratory released a report in April 2024 finding that the greenhouse emissions from plastics is four times those emitted by the aviation industry.

Not recyclable:

Less than 6% of plastics are recycled. Made of mixed plastics, synthetic turf is not recyclable, not sustainable and is a linear, not a circular, product.

A lobbyist for The Synthetic Turf Council gave testimony in the California Senate Finance and Governance Committee on 12 July 2023 stating:

> *"One thing we don't want to do is to set a [PFAS] limit that's so low that we can't recycle the products because you're going to have environment--I mean, PFAS is everywhere--so you're going to have environmental PFAS that's out there. We want to still be able to recycle products. We don't want to have a situation where we're no longer be able and it has to go to the waste stream instead of be recycled in some way."*

The same lobbyist testified in the California Senate Environmental Quality Committee on 19 June 2024, stating that the largest carpet recycler in Los Angeles cannot recycle synthetic turf. The Trex Company, in a 2022 email, stated they will not accept synthetic turf for use in manufacturing of their composite wood/plastic fencing and decking due to the environmental contamination of the fields.

One "recycler" with grandiose claims that it would be able to "recycle" 60k tons of synthetic turf per year (3,000 regulation sized 80k square feet fields; 40,000 pounds for carpet and backing; 400,000 pounds of infill), obtained tax incentives in both PA and CA. They have failed to open a plant in either state, and have never recycled a single old field into a new field in their home country of Denmark. With an estimated 30,000 synthetic turf fields in existence in the U.S., it would take 10 years to recycle the current fields with no new fields brought into the market. Two other companies, TenCate and FieldTurf, are shipping chopped up old carpets to ExxonMobil in Baytown, TX for "advanced chemical recycling," where the plant is fraught with millions of dollars in fines for violations.

When "mechanically" recycled (chopped up, essentially) for use in other products, the toxic and carcinogenic effects are added to the new product, along with additional toxic and carcinogenic chemicals. Downcycling plastics into new products creates new, lesser quality products that are not recyclable.

Research (2023) from a single northern Scotland recycling facility that accepts 22,680 tonnes of mixed plastic waste annually showed mechanically recycling plastics resulted in the release of up to **3,000,000 pounds** of microplastics into the environment in a single year. The implications of this research indicate "*…as much as 400,000 tons* [800,000,000 pounds] *per year in the United States alone, or the equivalent of about 29,000 dump trucks of microplastics.*"

When shipped out of state for "advanced chemical recycling" (banned in CA under SB54-Allen, 2022), they contribute to the negative human and environmental health effects of Environmental and Social Justice (EJ/SJ) communities. Landfilling and dumping used rolls also often occurs in EJ/SJ communities.

The United Nations defines sustainable development as *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs."*

The UCLA Sustainability Committee notes: "*In simplest terms, sustainability is about our children and our grandchildren, and the world we will leave them".*

The Rutgers Center for Sustainable Materials definition:

> *"Sustainable materials are materials used throughout our consumer and industrial economy that can be produced in required volumes without depleting non-renewable resources and without disrupting the established steady-state equilibrium of the environment and key natural resource systems. Such materials vary enormously and may range from bio-based polymers derived from polysaccharides, or highly recyclable*

materials such as glass that can be reprocessed an indefinite number of times without requiring additional mineral resources."

The California Commission on Recycling Markets and Curbside Recycling designated synthetic turf a single-use plastic (@1:31:02).

Landfilling, donating, selling, improperly or illegally disposing of synthetic turf continues to contribute to greenhouse gas emissions, as well as PFAS and other toxic and carcinogenic chemical leachate and microplastic pollution. Because landfilling of synthetic turf is costly, improper and illegal dumping or warehouse storage is common.

Open green space has mental health benefits:

Natural green spaces have been shown to mitigate aggressive behavior in adolescents and significantly reduce the growing risk of psychiatric disorders and suicide mortality. Natural green spaces also reduce health risks such as asthma.

The American Psychological Association finds:

> *"…exposure to nature has been linked to a host of benefits, including improved attention, lower stress, better mood, reduced risk of psychiatric disorders and even upticks in empathy and cooperation."*

Initially published in Center for Climate, Health, and the Global Environment, Harvard:

> *"Studies have found that students who attend schools with green spaces tend to have better grades, higher test scores, and better attendance rates than those who do not."*

Injuries:

Independent peer-reviewed research consistently shows significantly increased non-contact lower extremity injuries and concussions, particularly for children- playing on synthetic turf is a contributing factor.

> *"The available body of literature suggests a higher rate of foot and ankle injuries on artificial turf, both old-generation and new-generation turf, compared with natural grass. High-quality studies also suggest that the rates of knee injuries and hip injuries are similar between playing surfaces, although elite-level football athletes may be more predisposed to knee injuries on artificial turf compared with natural grass.* ***Only a few articles in the literature reported a higher overall injury rate on natural grass compared with artificial turf, and all of these studies received financial support from the artificial turf industry."***

Professional players across multiple sports are calling for a return to natural grass. Elite soccer players will not play on plastic turf and the National Women's Soccer League sued in order to play on natural grass.

Exposure to Methicillin-resistant Staphylococcus aureus (MRSA) and other bacteria are a potentially life threatening consequence of dermal abrasions, known as turf burns, due to friction on synthetic turf. Inhalation and ingestion are additional exposure pathways. Non contact lower body injuries are significantly higher on synthetic turf, as are concussions and heat stroke.

- 315,000 to 850,000 concussions every year occur among high school athletes.
- Repeated concussions increase risk of Chronic Traumatic Encephalopathy (CTE)/
- The Concussion Legacy Foundation reported that repetitive brain trauma is associated with CTE and has been found in 17 year olds. 41.4% of athletes under age 30 show signs of CTE.
- In high school American football players, concussions occur when head impacts approach 95 g.
- For youth American football players aged 9-14; 62.4 ± 29.7 g was the threshold for concussions.
- Research published Jan 2024 showed significantly greater impact deceleration on synthetic turf compared to natural grass surfaces, showing greater potential for concussions on synthetic fields.
- Newer synthetic turf fields require a greater fall distance to attenuate head to surface impact, which again, puts children at higher risk.

Viable alternative to plastic fields:

Grass fields actively sequester carbon dioxide and provide a cooling function that is especially dramatic when compared to the heat generated by synthetic turf. Grass naturally filters toxins, performs important eco-services for the soil beneath, and provides widely dispersed rainwater infiltration allowing absorption and recharging of the water table. Additionally:

- Research suggests that grasses can accumulate and deposit carbon into the soil by approximately one-half ton of carbon per acre per year for 30 to 40 years.
- Organic management and zero emission maintenance equipment mitigate emissions, reduce costs over time, and increase carbon sequestration.
- Electric mowers for playing fields and chalk markers are available.
- Drought and desert tolerant varieties of natural grass appropriate for lawns, parks and high use playing fields are available.
- Grass fields support biodiversity, both above and below the ground.

Recent announcements of local playing fields that will be on natural grass include:

- USC's Rawlinson Stadium- "*In a day and age where the dangers of turf are known far and wide, Rawlinson Stadium will have a natural grass field, key for the safeties of its athletes."*
- Westchester High School, Los Angeles
- Lincoln High School, East Los Angeles
- UCSB Caesar Uyesaka Stadium (@5:32:32)

Costs:

If places like Phoenix and Las Vegas can have drought tolerant playing fields and large sports complexes and save on water, certainly Los Angeles can.

Maintenance of plastic turf, which only picks up metal debris and fluffs plastic blades, but does not clean the bacteria and pollutants that collect on impervious plastic fields, does not do hardness testing or replenish the 1.5 to 5 tons of infill lost annually, further increases risk to all who use them.

Avoidable failure of natural grass playing surfaces occur due to:

- Improper installation and maintenance
- Lack of attention to soil, root zone, understanding of soil type drainage capabilities

- No inclusion of soil analysis of texture, nutrients, organic matter and living biome
- Inappropriate selection of sod or seed for soil needs and climate zone
- Proper maintenance doesn't take place
- Inadequate, improper or no aeration (3-5 times/year
- No or inappropriate fertilization, overseeding

Organic/regenerative management:

- More cost effective than "traditional" management over time
- Reduces risk of liability for costly violations of the US Clean Water Act under the NPDES (National Pollution Discharge Elimination System) Permit
- More significant with new US EPA regulations on PFAS

According to experts with multiple years and decades of experience managing natural grass playing fields, three to four playing fields can be professionally installed for the cost of a single plastic field.

With proper soil testing, seed or sod selection, installation and maintenance, natural grass playing fields can last 25-30 years.

Los Angeles city parks:

- 1,688, 435 sq feet of synthetic turf in 47 parks (38.761 acres)
- 155,133,986 gallons of water to manufacture every 8 to 10 years on average
- 289,145 gallons of petroleum based oil to manufacture every 8 to 10 years on average
- 67,537,400 plastic bags equivalent
- 970,850,125 plastic straws equivalent
- 10,490 tons of CO_2e off gassed every 10 years
- 73,644 trees required to off set GHGs from the fields in 47 parks

- 1,046,547 gallons of toxic runoff for every 1 inch of rain
- 56,084,454 gallons during 2022-2024 rainy seasons (53,59 inches)
- 11,630 to 13,951 pounds of microplastic blade loss per year
- 12,610 pounds of microplastics loss from carpet backing per year
- 844,217.5 pounds of plastic carpet waste every 8 to 10 years on average
- 8,442,175 pounds of infill waste every 8 to 10 years on average

Choosing to install petrochemical plastic synthetic turf is willfully accepting human and environmental health ***irresponsibility*** for:

- Contribution to human health effects due to exposure of PFAS, other endocrine disrupting, toxic and carcinogenic chemicals, bacteria and pollutants that collect on plastic fields.
- Ignoring responsibility to ensure physical and mental health needs of residents and students by increasing risk of health related disease through toxic exposure, overheating the environment, reducing natural open green space, shifting burden of all of these to future generations.
- Contribution to climate change.
- Continued contamination of air, water and soil with "forever" chemicals and other toxic chemical classes.
- Increased risk of injury, heat stroke, death.
- Loss of biodiversity.
- Adding massive amounts of unrecyclable plastic and its toxic and carcinogenic leachate to the environment every 8 years on average (plastics take an estimated 1,000 years to decompose).
- Increased taxpayer burden.
- **Ignoring science.**
- Increased legal liability (injuries; Clean Water Act, Prop. 65, CEQA violations

  "*Plaintiffs alleging injuries from artificial surfaces can look to several potential target defendants including: (1) turf manufacturers; (2) companies that manufacture the various component parts of turf; and (3)* ***turf purchasers, particularly high schools****, universities and major sports franchises. Expected allegations would follow a traditional products liability model, involving counts for both design defect and failure to warn.* Reuters 5 July 2023

  Lawyers to Plastics Makers: Prepare for 'Astronomical' PFAS Lawsuits
  "At an industry presentation about dangerous "forever chemicals," lawyers predicted a wave of lawsuits that could dwarf asbestos litigation, audio from the event revealed." New York Times 28 May 2024.

The evidence is clear. What will Los Angeles do to protect its water supply, human and environmental health and stop contributing to the climate crisis? No one "needs" plastic grass carpet, not in parks, school, homes or businesses. No one needs more PFAS and other toxic and carcinogenic chemical exposure.

We urge you to **not succumb to pressure from those with a vested interest in promoting and selling synthetic turf**; who try to tell you their product is PFAS free; that PFAS, other chemicals and microplastics can be contained; that their product is cooler than

other plastic turf products. We urge you to join with other jurisdictions in CA and across the country taking action to prohibit this climate and PFAS crises inducing, wholly unnecessary petrochemical plastic product and protect Los Angelenos right to clean water.

Pass this resolution and enact an ordinance banning synthetic turf from all city owned and leased land as well as residential applications.

Respectfully submitted:

Diana Conway, President
Dianne Woelke MSN, Board Member
Safe Healthy Playing Fields, Inc.
https://www.safehealthyplayingfields.orgSH
PFI is an all-volunteer nonprofit 501-c-3

Communication from Public

Name:	CleanEarth4Kids.org
Date Submitted:	06/26/2024 09:53 PM
Council File No:	24-0602
Comments for Public Posting:	CleanEarth4Kids.org opposes synthetic turf/artificial grass. See attached letter.

CleanEarth4Kids.org

June 26, 2024

Chair Yaroslavsky
Energy and Environment Committee
City of Los Angeles

RE: Stop Synthetic Turf/Artificial Grass

CleanEarth4Kids.org asks Los Angeles to ban synthetic turf/artificial grass.

Doctors, nurses, health professionals, children's health organizations, public health organizations, researchers, and the public are deeply concerned with the toxic and carcinogenic chemicals,[1] heavy metals like lead and cadmium, benzene, Polycyclic Aromatic Hydrocarbons (PAHs), phthalates, styrene, Volatile Organic Compounds (VOCs) and per- and polyfluoroalkyl substances (PFAS) are found in the plastic blades, backing, underlayment pads and in some plant based infills added to keep the blades upright.

Synthetic Turf/Artificial Grass is PLASTIC

Synthetic turf/artificial grass is made of mixed plastics, such as polyethylene, polypropylene, nylon and more.[2]

Over 16,000 chemicals are used in plastics. At least 4,200 (26%) are chemicals that are highly hazardous to human health and the environment, yet only 980 have been regulated anywhere around the world.[3] All major plastic types tested leached hazardous chemicals, including food packaging, which alone can contain over 400 chemicals of concern.[4] Additionally, there is little to no hazard information available for over 10,000 of these chemicals.[5]

Chemicals commonly found in plastics, like PFAS and phthalates, can impair reproduction, growth, and cognition.[6] Children are the most vulnerable due to developmental windows, more rapid metabolism, respiratory rates, cardiac output and greater caloric intake per pound. Chemicals in plastics have been linked to childhood obesity, hyperactivity, ADHD, low IQ, and asthma.[7]

Unborn children are especially vulnerable to toxic exposures from plastics in utero

[1] https://theintercept.com/2019/10/08/pfas-chemicals-artificial-turf-soccer/
[2] https://www.plymouth.ac.uk/discover/why-are-artificial-lawns-bad-for-the-environment
[3] https://www.cnn.com/2024/03/14/health/toxic-unregulated-chemicals-report-wellness?cid=ios_app
[4] https://plastchem-project.org/wp-content/uploads/2024/03/PlastChem-Press-Release_English-v1.pdf
[5] https://plastchem-project.org/
[6] https://www.sciencedaily.com/releases/2020/12/201215131242.htm
[7] https://www.naturalsuperkids.com/health-effects-plastic-exposure-children

which can "increase risks of prematurity, stillbirth, birth defects in the reproductive organs, neurodevelopmental impairment, impaired lung growth, and childhood cancer."[8]

Dangers of Phthalates

Phthalates are typically added to most plastics to make them pliable and are commonly found in plastic grass.[9,10] Phthalates are both endocrine disrupting as well and neurotoxic. Men with higher phthalate levels have higher risk of cardiovascular disease and type 2 diabetes.[11] In midlife and postmenopause, women, phthalates can lead to increased body fat, a higher BMI, and increased waist circumference.[12] Phthalates can also cause increased rates of hot flashes.[13] Phthalates are linked to birth defects, infertility, miscarriages, as well as other neurological issues during child development and can harm the endocrine system.[14,15]

Women exposed to phthalates during pregnancy are at greater risk of preterm delivery.[16] Human studies have determined that in-utero phthalate exposure can cause later development of type II diabetes, and insulin resistance, obesity, asthma, higher systolic blood pressure. Female offspring are more likely to experience reproductive problems, including pregnancy loss, low birth weight infants, preterm birth and earlier menopause.[17] Other human studies have linked phthalates to impaired motor skills in children and delayed language development.[18] In male adults, a reduction in sperm quality and quantity has also been observed.[19]

PFAS in Synthetic Turf/Artificial Grass

PFAS are used to aid the extrusion of plastic yarns for the "grass" blades.[20]

Every synthetic turf/artificial grass field tested has been found to contain PFAS.[21]

PAHS, lead, and other toxic chemicals have also been found in synthetic turf/artificial grass.[22]

PFAS (perfluoroalkyl and poly-fluoroalkyl substances) are a class of over 14,000

[8] https://www.genevaenvironmentnetwork.org/resources/updates/plastics-and-health/
[9] https://www.nytimes.com/article/plastics-to-avoid.html
[10] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10262297/
[11] https://www.diabetes.co.uk/news/2017/jul/everyday-plastic-chemicals-linked-to-type-2-diabetes
[12] https://www.sciencedirect.com/science/article/abs/pii/S0013935123001482
[13] https://www.sciencedirect.com/science/article/abs/pii/S0013935121001857
[14] https://birthdefects.org/phthalates/
[15] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8157593/
[16] https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(23)00270-X/fulltext
[17] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC8157593/#B32-healthcare-09-00603
[18] http://health.harvard.edu/blog/something-else-to-avoid-in-pregnancy-phthalates-20190315162224
[19] https://www.sciencedirect.com/science/article/abs/pii/S0304389417304570?via%3Dihub
[20] https://www.documentcloud.org/documents/6434596-Kulikov2005.html
[21] https://peer.org/pfas-in-artificial-turf-coats-players-skin
[22] https://theintercept.com/2019/10/08/pfas-chemicals-artificial-turf-soccer/

synthetic (man-made) chemicals found in many products like artificial grass/synthetic turf, food packaging, waterproofing sprays, household cleaners, stain-resistant carpet, nonstick cookware, fire fighting foam, clothing, makeup, toilet paper, personal care products, textiles, children's products and much more.[23,24] PFAS as a class share many characteristics and toxicities.[25]

PFAS are toxic, linked to diseases and cancers. According to the CDC,[26] EPA,[27] and the European Union Environment Agency,[28] PFAS are linked to low birth weight, thyroid disease, increased cholesterol, liver damage, kidney cancer, and testicular cancer. They are also linked to liver cancer,[29] diabetes,[30] endocrine disruption, and other serious health problems.[31]

PFAS bioaccumulate in our bodies, making the risk of cancers and other health problems more likely as we get older.[32]

Plastic Pollution! Plastic Harms the Environment and Our Health

Each stage of the plastic lifestyle harms human health and the environment.[33]

For example, "Cancer Alley" is an 85 mile piece of land in Louisiana where nearly 150 oil refineries, plastics plants and chemical facilities including the world's largest manufacturer of polystyrene (Styrofoam) spew toxic chemicals into the air, land and water. Cancer Alley has the highest risk of cancer in the nation, 50x the national average along with 27% low birth and 25% preterm birth rates.

The use of plastic continues environmental injustice because low-income communities suffer the worst environmental consequences of plastic production.[34] Studies clearly show plastic production is disproportionately situated in "low- and mid-income countries or in poor and minority communities within high-income countries."[35]

Plastics have a major carbon footprint, emitting about 3.4% of our total global greenhouse gas emissions.[36] After use, less than 9% of plastics are recycled with the rest littered, dumped in landfills or burned.[37]

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[23] https://comptox.epa.gov/dashboard/chemical-lists/pfasmaster
[24] https://www.cdc.gov/biomonitoring/PFAS_FactSheet.html
[25] https://experts.unthsc.edu/en/publications/response-to-comment-on-scientific-basis-for-managing-pfas
[26] https://www.atsdr.cdc.gov/pfas/health-effects/index.html
[27] https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas
[28] https://www.eea.europa.eu/publications/emerging-chemical-risks-in-europe
[29] https://www.insider.com/study-confirms-link-between-forever-chemicals-and-liver-cancer-risk-2022-8
[30] https://pubmed.ncbi.nlm.nih.gov/35970987/
[31] https://pubmed.ncbi.nlm.nih.gov/32476019
[32] https://www.mdpi.com/2305-6304/10/2/44
[33] https://www.nature.com/articles/s41578-022-00419-y
[34] https://www.montereybayaquarium.org/stories/true-cost-plastic-pollution
[35] https://www.washingtonpost.com/health/2022/04/02/plastic-pollution-health-poverty/
[36] https://www.oecd.org/plastics/increased-plastic-leakage-and-greenhouse-gas-emissions.htm
[37] https://www.consumerreports.org/environment-sustainability/the-big-problem-with-plastic/

Around 70% of the pollution in the ocean is from plastic, with an estimated 12.7 million tons of plastics dumped into our oceans every year.[38]

Burning plastic releases greenhouse gasses and toxic air pollutants like furans, mercury, polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs).[39] Even after burning, 30% of plastic remains as ash which is typically buried, poisoning our soil, or blown in the air.[40]

The making and burning of plastic products in 2019 had about the same emissions as 189 coal power plants, releasing 850 million metric tons of greenhouse gasses.[41]

Plastics are Fossil Fuels

Over 99% of plastics are made from fossil fuel based chemicals and plastics are predicted to drive almost half of the demand for oil and methane in the coming decades.[42,43]

As the world transitions from fossil fuels to renewable energy, the fossil fuel industry is focused on plastics and petrochemicals,[44] as stated by both ExxonMobile[45] and British Petroleum, who continue to place profits over climate, human and environmental health.[46]

This focus on plastics and petrochemicals is the reason for the push for fracking in the US as ethane is separated from methane (natural gas) and then "cracked" to make ethylene, the building block for most plastics.[47] This process produces a massive amount of pollution and greenhouse gases.[48]

It is estimated the plastic industry could be 19% of the total global carbon budget by 2040 if we do not take action.[49] We must remove plastic from our daily lives and stop the fossil fuel industry from destroying our planet for money.[50]

Plastic and Methane

Methane is 80x more potent at warming than carbon dioxide and is responsible for 25% of global warming.[51]

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[38] https://kids.frontiersin.org/articles/10.3389/frym.2021.574637
[39] https://breathelife2030.org/news/burning-plastic-waste-adds-global-air-pollution-problem
[40] https://environmentaldefence.ca/2022/03/18/burning-plastic-is-a-terrible-idea
[41] https://www.ciel.org/plasticandclimate/
[42] https://www.earthday.org/from-fossil-fuels-to-plastic-addiction-unveiling-the-hidden-link
[43] https://www.cnbc.com/2022/01/29/how-the-fossil-fuel-industry-is-pushing-plastics-on-the-world-.html
[44] https://www.sciencedirect.com/science/article/pii/S259033222300252X
[45] https://corporate.exxonmobil.com/Energy-and-environment/Outlook-for-Energy-A-perspective-to-2040
[46] https://www.scientificamerican.com/article/bp-pledges-to-go-carbon-neutral-how-remains-an-open-question/
[47] https://www.climaterealityproject.org/blog/ethane-cracker-plants-what-are-they
[48] https://insideclimatenews.org/plastics-hub-appalachian-fracking-ethane-cracker-climate-change-health/
[49] https://stories.undp.org/what-do-plastics-have-to-do-with-climate-change
[50] https://www.motherjones.com/environment/2020/03/your-plastic-addiction-is-bankrolling-big-oil/
[51] https://ecology.wa.gov/Blog/Posts/February-2023/The-trash-climate-connection-what-you-need-to-know

Polyethylene is the most common plastic used to make synthetic turf/artificial grass and is known to release more methane than other plastics as it breaks down.[52]

Dr. Sarah-Jeanne Royer of the Scripps Institution of Oceanography who discovered this wrote a letter in opposition to synthetic turf/artificial grass, citing methane as a major concern.[53]

During the breakdown of polyethylene, the release of methane gas accelerates as the surface area of the plastic increases, reacting more with the sunlight and releasing more methane.[54] Synthetic turf/artificial grass fields are constantly releasing methane, damaging our climate.

Microplastics and Nanoplastics

Plastic fibers from artificial turf are a widespread water pollutant with over 15% of plastic debris in rivers and sea-water, coming from plastic grass with concentrations during the rainy seasons.[55]

In addition to seasonal effects, these plastic fibers undergo significant weathering which directly contributes to the increase in chemicals leached from them into rivers and sea-water.[56]

These plastic fibers, like all plastics, do not decompose[57] like plants; they just break into smaller and smaller pieces, leading to micro and nano plastics that can be eaten, drank or breathed in[58] by animals or humans and are even absorbed by plants.[59]

Plastic first breaks down into microplastics, smaller than 5mm, and then nanoplastics which are less than 100 nm.[60] By comparison, a sheet of paper is about 100,000 nm thick.

Microplastics have been found in human blood, the placenta, and the feces of infants and adults.[61] Research has linked ingested microplastics to inflammatory bowel disease[65] and metabolic diseases including obesity, diabetes, and chronic liver disease.[62] The ability to be absorbed from the digestive tract allows microplastics to be transported to other organs, including the brain, and increases the risk of stroke.[63]

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[52] https://www.bbc.com/news/science-environment-45043989
[53] https://drive.google.com/file/d/1Q9NHwhVtY0ygHCcZDHhufkfcRdGFA35k/view
[54] https://www.surfrider.org/new-study-shows-plastic-as-source-of-greenhouse-gases-potentially-contribut
[55] https://www.sciencedirect.com/science/article/pii/S0269749123010965
[56] https://www.sciencedirect.com/science/article/pii/S0269749123010965#bib38
[57] https://www.scienceabc.com/nature/how-do-we-know-plastic-will-take-so-long-to-decompose.html
[58] https://www.theguardian.com/environment/microplastics-found-in-human-blood-for-first-time
[59] https://www.sciencedirect.com/science/article/abs/pii/S0165993622003727
[60] https://www.iaea.org/research-on-the-possible-effects-of-micro-and-nano-plastics-on-marine-animals
[61] https://www.theguardian.com/environment/microplastics-found-in-human-blood-for-first-time
[62] https://www.theguardian.com/microplastics-may-be-linked-to-inflammatory-bowel-disease-study-finds
[63] https://www.euronews.com/green/how-much-plastic-do-you-eat-it-could-be-as-much-as-a-credit-card-a-week

Nanoplastics have been found deep in human lungs.[64] Research shows it is likely plastics can cross the blood-brain barrier, causing inflammation in the brain itself.[65] Microplastics in the human brain could damage brain cells and dementia-like symptoms have been seen in mice exposed to microplastics.[66,67]

These microscopic bits of plastic can increase our chance of stroke and heart attacks as nearly 60% of clogged arteries in a recent study were found to contain plastic.[68]

Plastics In Drinking Water And Food

Each person consumes an estimated 5 grams of plastic, the equivalent of a credit card, every week.[69]

Plastics have been found in 83% of tap water and 93% of bottled water sampled.[70,71]

The food chain has also been affected by microplastics with microplastic contamination found in fish, shellfish and crustaceans, canned fish, sugar, salt, honey, beer, fruits and vegetables, milk, rice, meat, and other common food products.[72,73]

Harms Wildlife and Marine Ecosystems

Many wildlife accidentally eat plastic after mistaking it for food which not only can cause them to choke or starve, but can poison them as plastics contain toxic chemicals.[74,75]

Plastic pollution harms "all sea turtle species, half of marine mammal species, and one-fifth of seabird species."[76]

In the past decade the amount of plastic dumped in our oceans has increased and reached up to 350 million tons of plastic.[77]

Microplastics and nanoplastics can harm entire marine ecosystems with 15–51 trillion microplastic plastic particles floating in the ocean.[78] Microplastics can enter marine animals as they "breathe," allowing them to accumulate in organisms. These plastics also hurt corals which are essential for fisheries and are crucial for the

[64] https://www.theguardian.com/environment/microplastics-found-deep-in-lungs-of-living-people-for-first-time
[65] https://www.sciencealert.com/microplastics-could-trigger-inflammation-in-human-brain-cells
[66] https://www.sciencedirect.com/science/article/pii/S0013935117310770?via%3Dihub
[67] https://futurism.com/neoscope/scientists-microplastics-cause-dementia-mice
[68] https://www.sciencealert.com/plastic-found-inside-more-than-50-of-plaques-from-clogged-arteries
[69] https://wwf.panda.org/Revealed-plastic-ingestion-by-people-could-be-equating-to-a-credit-card-a-week
[70] https://beachapedia.org/Plastic_Pollution_Facts_and_Figures
[71] https://www.bonappetit.com/story/microplastics-food
[72] https://www.sciencedirect.com/science/article/pii/S0048969722069340
[73] https://www.sciencedirect.com/science/article/abs/pii/S0025326X22008827
[74] https://www.plasticsoupfoundation.org/en/plastic-problem/plastic-affect-animals/animals-eat-plastic/
[75] https://www.nationalgeographic.com/environment/article/plastic-pollution
[76] https://www.nrdc.org/sites/default/files/choked-plastic-pollution-marine-life-fs.pdf
[77] https://plasticseurope.org/wp-content/uploads/2021/10/2018-Plastics-the-facts.pdf
[78] https://kids.frontiersin.org/articles/10.3389/frym.2021.574637

health of marine ecosystems, providing "habitat, feeding, spawning, and nursery grounds for over one million aquatic species, including commercially harvested fish species."[79]

Additionally, over 800 marine species are directly harmed by plastic, leading to "starvation, malnutrition, intestinal blockage, and intake of toxins."[80]

Synthetic Turf/Artificial Grass is Not Recycled

Replaced every 7-10 years, the average synthetic turf/artificial grass soccer field produces 40,000 lbs of plastic carpeting and 400,000 lbs of infill of waste.[81]

Despite what the synthetic turf industry claims, there is no proof that actual recycling is occurring. The plastic carpet and infill are often dumped or sent to landfills as there are no recycling facilities for synthetic turf in the US.[82,83]

Reuse is not recycling[84] and so called "chemical recycling" is just greenwashing for incineration.[85] Burning is not recycling!

Synthetic Turf/Artificial Grass is HOT

Synthetic turf/artificial grass is 40°-70° hotter than surrounding air temperatures and has burned hands and feet.[86] Natural grass releases water vapor and this evaporation means natural grass fields rarely get above 100° F.[87] But the surface temperature of synthetic turf/artificial grass has been found to be 37° higher than asphalt and 86.5° hotter than natural grass.[88] A study found that in 90° weather, the surface temperature of a natural grass field was 98° while an artificial grass/synthetic turf field was over 160°.[89] Shoes have melted from the heat on synthetic turf/artificial grass with players and coaches getting blisters on the bottom of their feet through their shoes.[90] First-degree burns occur at 118° with blistering and second-degree burns at 131°.[91] Several artificial grass/synthetic turf fields in the Los Angeles Unified School District are currently closed due to high heat and melting surfaces.[92]

Playing on synthetic turf/artificial grass can increase the chance of heat stroke,

[79] https://www.epa.gov/coral-reefs/basic-information-about-coral-reefs
[80] https://www.nrdc.org/sites/default/files/choked-plastic-pollution-marine-life-fs.pdf
[81] https://www.beyondplastics.org/fact-sheets/synthetic-turf
[82] https://www.theatlantic.com/science/artificial-turf-fields-are-piling-no-recycling-fix/603874/
[83] https://www.msn.com/how-pennsylvania-became-a-dumping-ground-for-discarded-artificial-turf
[84] https://peer.org/artificial-turfs-big-lie-old-fields-not-recycled/
[85] https://www.nrdc.org/stories/chemical-recycling-isnt-actually-recycling
[86] https://www.safehealthyplayingfields.org/heat-levels-synthetic-turf/
[87] https://www.nrpa.org/parks-recreation-magazine/synthetic-sports-fields-and-the-heat-island-effect/
[88] https://aces.nmsu.edu/programs/turf/documents/brigham-young-study.pdf
[89] https://www.center4research.org/injuries-related-to-artificial-turf/
[90] https://ftw.usatoday.com/2015/08/its-so-hot-in-texas-turf-is-melting-cleats
[91] https://www.nist.gov/el/fire-research-division-73300/firegov-fire-service/fire-dynamics
[92] https://www.latimes.com/sports/highschool/story/2022-08-17/synthetic-l-a-unified-out-of-commission

dehydration, and other heat-related illnesses.[93,94] Synthetic turf/artificial grass fields also create heat islands which cause higher daytime and nighttime temperatures along with higher levels of air pollution.[95,96]

Synthetic Turf/Artificial Grass is Dangerous to Athletes

Synthetic turf/artificial grass fields contain bacteria and must be regularly cleaned with chemicals.[97] Turf burns from artificial grass/synthetic turf can become infected with bacteria like staph and MRSA which can be life-threatening.[98] An EPA study found MRSA in 70% of the fields tested.[99]

Playing on synthetic turf/artificial grass can cause more injuries. According to an NFL Players Association (NFLPA) study, playing and practicing on synthetic turf/artificial grass increases the chance of a lower extremity injury with a 69% higher rate of non-contact foot/ankle injuries than on natural grass.[100] The NFLPA has called for all NFL fields to be natural grass.[101]

A study of National Collegiate Athletic Association (NCAA) athletes found playing on synthetic turf/artificial grass greatly increased the chance of knee ligament injuries while a study of high school athletes found they were 58% more likely to sustain an injury playing on synthetic turf/artificial grass than natural grass.[102,103]

Studies have also shown that more serious concussions come from playing on synthetic turf/artificial grass compared to natural grass.[104]

The United States Men's Professional Soccer Team and other national teams only play on natural grass in the World Cup, and the United States Women's Soccer Team sued FIFA to not play on synthetic turf/artificial grass due to the increased risk of injury.[105,106] Soccer legend Lionel Messi will only play on natural grass.[107]

Upon hearing of the death of David West, the sixth player from the Philadelphia Phillies to die of the same rare form of brain cancer (glioblastoma), *Philadelphia Inquirer* investigative journalists David Gambacorta and Barbara Laker investigated pieces of AstroTurf from Veterans Stadium, which was the Philly home stadium until

[93] https://www.npr.org/2008/08/07/93364750/high-temps-on-turf-fields-spark-safety-concerns
[94] https://www.tandfonline.com/doi/full/10.1080/02656736.2019.1605096
[95] https://aces.nmsu.edu/programs/turf/documents/brigham-young-study.pdf
[96] https://www.epa.gov/heatislands/heat-island-impacts
[97] https://sportsturfnw.com/wp-content/uploads/2015/11/Bass-paper-in-big-sky-journal.pdf
[98] https://www.healthline.com/health/turf-burn#pictures
[99] https://www.epa.gov/sites/default/files/2019-08/documents/tc_public_webinar_-_august_6_2019.pdf
[100] https://nflpa.com/posts/only-natural-grass-can-level-the-nfls-playing-field
[101] https://apnews.com/article/9b34d4402f2f82ae60708605f65aa560
[102] https://pubmed.ncbi.nlm.nih.gov/30995074/
[103] https://www.uhhospitals.org/articles-and-news/articles/2019/08/artificial-turf-vs-natural-grass
[104] https://journals.sagepub.com/doi/10.1177/03635465000280050401
[105] https://www.sportsbusinessjournal.com/Articles/2023/11/06/america-stadiums-side
[106] https://www.npr.org/353312770/soccer-players-sue-over-proposed-turf-field-for-womens-world-cup
[107] https://www.sbnation.com/soccer/lionel-messi-inter-miami-mls-turf

2004.[108,109] The pieces of turf analyzed from 1977 and 1981 were found to contain at least 16 different PFAS. They determined that in the summer, the synthetic turf/artificial grass would heat up to 165℉, increasing the release of toxins into the air, creating additional modes of transmission to the players.

Crumb Rubber Infill is Toxic

Made from ground-up tires, crumb rubber is a very common infill for synthetic turf/artificial grass fields and is full of heavy metals and toxic chemicals.[110] Over 300 chemicals have been found in crumb rubber infill with 58 classified as known carcinogens and 197 predicted to be carcinogenic.[111]

6PPD and its derivative 6PPD-quinone are very highly toxic pollutants to all aquatic organisms and are responsible for wiping out over 90% of endangered Coho Salmon in CA, OR, and WA every year.[112] While there is limited information on the impacts of 6PPD and 6PPDq to human health, 6PPD is currently listed as a presumed human reproductive toxicant by the European Chemicals Agency (ECHA).[113]

Humans can be exposed to these toxic chemicals in crumb rubber through inhalation, ingestion, and skin contact, leaving humans vulnerable to carcinogenic exposure in many different ways.[114] Alternative infills like TPE or cork have inhalation and chemical risks as well.[115]

The Norwegian Institute for Water Research conducted a risk assessment on runoff from synthetic turf/artificial grass fields, finding a significant risk of environmental effects on surface water.[116] The Connecticut Department of Environmental Protection (DEP) also concluded runoff from synthetic grass/artificial turf fields was a potential risk to surface waters and aquatic organisms.[117]

Natural Grass is Best

Natural grass is the healthiest choice for playing fields and parks.[118] Natural grass fields are more cost-effective than synthetic turf/artificial grass fields which have higher maintenance and long-term costs.[119,120] Natural grass fields are also cheaper

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[108] https://deadspin.com/philadelphia-phillies-brain-cancer-tug-mcgraw-1850202995
[109] https://www.mediaite.com/sports/6-phillies-players-died-of-same-brain-cancer/
[110] https://www.sciencedirect.com/science/article/pii/S0048969721076208
[111] https://www.sciencedirect.com/science/article/pii/S0013935118305528
[112] https://www.ezview.wa.gov/Stormwater/Tianetal.2022.Revisedtoxicityassessment06PPD-quinone.pdf
[113] https://echa.europa.eu/registration-dossier/-/registered-dossier/15367/5/1
[114] https://ncceh.ca/documents/guide/human-health-risk-assessments-addressing-artificial-turf
[115] https://www.safehealthyplayingfields.org/the-problem-with-alternative-infills
[116] https://www.isss-sportsurfacescience.org/downloads/documents/5VEU2CZB25_NIVAEngelsk.pdf
[117] https://portal.ct.gov/-/media/DEEP/artificialturf/DEPArtificialTurfReportpdf.pdf
[118] https://www.safehealthyplayingfields.org/health-benefits-of-natural-turf
[119] https://www.safehealthyplayingfields.org/s/Natural_Grass_Athletic_Fields_Ppoint_Final.ppt
[120] https://www.safehealthyplayingfields.org/maintenance-grass-vs-synthetic-turf

to install than synthetic turf/artificial grass.[121]

Natural grass fields can be effectively maintained using organic land management practices, especially for playing fields.[122] Please watch this video, *Pesticide Free Parks*, on organic management.[123]

High-use, organically managed, natural grass fields have been in use in many areas including Irvine, CA.[124,125]

With proper care and maintenance, a natural grass field can accommodate any amount of play as demonstrated by Marblehead, MA with 20 acres of organically managed fields for over 15 years.[126]

Cancer and Toxic Chemicals

90–95% of cancers are caused by environmental and lifestyle factors while our children are surrounded by an estimated 350,000 synthetic/man-made chemicals and chemical mixtures every day, nearly all of them invented since 1950.[127,128]

There is clear evidence that exposure to these chemicals is an important contributor to childhood cancer.[129]

A 50 year review of pediatric cancer found cancer is now the leading cause of death by disease in US children under 15 with rates of leukemia, the most common cancer in children and adolescents, having increased by 21% in children since 1976 with brain cancer rates increasing by 45%.[130,131]

With about 43 children diagnosed with cancer every day, we must reduce their exposure to toxic chemicals.[132] We must protect the places where they run and play, the water they drink, the food they eat and the air they breathe.

Stop Synthetic Turf/Artificial Grass, Stop Toxic Chemicals

The use of synthetic turf/artificial grass harms our children and families, athletes, pets and wildlife and our water, soil and planet. Please stop the use of synthetic turf/artificial grass.

Additional Video Resources:

[121] https://www.safehealthyplayingfields.org/cost-grass-vs-synthetic-turf
[122] https://www.turi.org/var/application/982fb1bc7bb561b4ce07072c5d26ab11.pdf
[123] https://youtu.be/oJZgy8MOMYU
[124] https://www.nontoxiccommunities.com/organic-athletic-fields.html
[125] https://online.flippingbook.com/view/535223568/32/
[126] https://www.turi.org/content/NaturalGrassPlayingFieldCaseStudyMarbleheadMAJune202019.pdf
[127] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2515569/
[128] https://pubmed.ncbi.nlm.nih.gov/31968937/
[129] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6546253/
[130] https://www.annals-research-oncology.com/pediatric-cancer-and-the-environment-a-fifty-year-perspective/
[131] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5550103/
[132] https://www.stjude.org/get-involved/other-ways/childhood-cancer-awareness-month.html

Tire Particulate Matter in Synthetic Turf and Children
Failing Synthetic Turf Fields
Artificial Turf is Not Recycled
Environmental Health Impacts of Synthetic Turf and Safer Alternatives
Insult to Injury: Plastic Fields Hurt Players
The High Costs of Fake Plastic Fields
The Hazards of Artificial Turf: Learn the Latest from Leading Experts
Conversation on Synthetic Playing Surfaces
Health and Environmental Hazards of Artificial Turf and Safer Alternatives

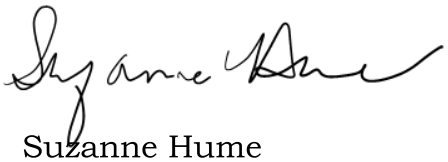
Stop Synthetic Turf/Artificial Grass

The use of synthetic turf harms our children and families, athletes, pets and wildlife and our water, soil and planet.

Please stop all uses of synthetic turf.

The decisions we make today affect our children's health and future.

Sincerely,



Suzanne Hume
Educational Director and Founder
S@CleanEarth4Kids.org
CleanEarth4Kids.org

Communication from Public

Name:	California Safe Schoolsa
Date Submitted:	06/27/2024 01:34 AM
Council File No:	24-0602
Comments for Public Posting:	Please see attached letter.

June 26, 2024

Honorable Los Angeles City Council Members
LA City Hall
200 North Spring Street
Room 240
Los Angeles, CA 90012

Regarding Motion: 24-0602

Dear Honorable City Council Members:

California Safe Schools, a children's environmental health and environmental justice coalition founded in 1998, fully supports Councilmember Bob Blumenfield's motion calling for LA to move away from artificial turf and towards drought-tolerant landscaping.

We had worked with scientists and other medical experts on a broad-based scale for almost a decade on this issue. We have been deeply concerned about the potential health impacts from materials such as forever chemicals like PFAs which should not be introduced into any environment.

Thank you for your leadership on this important issue.

Gratefully,

Robina Suwol
Executive Director
California Safe Schools
PO Box 2756
Toluca Lake, California 91610
818.785.5515

Communication from Public

Name:	Andrea Wald
Date Submitted:	06/27/2024 08:58 AM
Council File No:	24-0602
Comments for Public Posting:	I strongly support Bob Blumenfield's motion to look into a ban of Artificial Turf for LA. I'm fighting this same battle in Northern California. There are so many valid reasons why we should be banning this toxic, plastic carpet - not just water pollution, but the harmful effects on the environment, the unknown and still being researched future health risks that we are exposing entire populations to and the fact that all the known and suspected harms that plastics in general are causing us should be grounds enough to say ENOUGH! Our world is in crisis and its time we finally do something about it and stop being influenced by those who truly do not have our best interests at heart - just their pocketbooks/bottom line. There are some necessary plastics but Artificial Turf is not one of them. Natural grass can and does work and is the best - actually the ONLY - substance that we should be even consider for our athletic fields, cities, schools, and residences. If you have the time/inclination, I've attached an extremely important document that was published recently by the Santa Clara County Medical Association. It truly covers all the reasons why Artificial Turf should be banned - including MANY references and articles by reputable organizations (not sponsored by the synthetic turf industry). I hope that those voting on this issue will not be swayed by industry lobbyists and keep in mind the community they are representing. Your job is to ensure a safe, healthy future for everyone. Thank you for taking the time to read my plea and hopefully do the right thing . Sincerely, Andrea Wald Sunnyvale, CA resident and member of Community for Natural Play Surfaces waldmba@gmail.com

Phone: (408) 998-8850
Web: www.sccma.org
Address: 700 Empey Way, 2nd Fl
San Jose, CA 95128

Policy Recommendation on the Use of Artificial Turf on Landscapes, Schools and Playing Fields

Santa Clara County Medical Association
June 10, 2024

Purpose: To educate and provide recommendations to physicians, officials, school administrators and teachers of the health risks and potential health and environmental hazards of artificial turf and synthetic grass on landscapes, schools, playgrounds and playing fields.

Recommendations: After careful consideration of the current scientific evidence of plastic and chemical contamination, sports injuries, urban heat effects, disposal, potential short and long-term health effects, as well as direct and indirect environmental costs, the SCCMA believes artificial turf is potentially harmful to both human and environmental health and is not a sustainable option when compared with natural grass. Taking a precautionary approach for the long-term protection of the children, the environment and public health, we recommend:

1) That artificial turf *not* be used on sports fields, playgrounds, landscaping, residential lawns or in schools, but instead that natural grass turf be used, a choice that will serve to benefit the health and safety of children, athletes and the environment, and

2) If artificial turf *is* in place, that at the end of its useful life it be replaced with natural grass and *not* artificial turf.

SCCMA Goals: The support of public health measures to prevent environmentally-related disease is a prime goal and objective of the Santa Clara County Medical Association (SCCMA). This especially applies to children who have greater lifetime exposures to- and accumulation of-toxins, and whose immune, cardiovascular, reproductive and neurologic systems are immature, increasing their vulnerability to acute and chronic diseases related to toxic exposures.

Introduction:

Rethinking Artificial Turf

Artificial turf was introduced into the sports world in 1965. Currently there are approximately 13,000 synthetic turf sport fields in the U.S. While in the past artificial turf initially seemed to be the better alternative due to reduced costs, reduced water usage and lower maintenance, newer information has come to light regarding the direct and indirect environmental and health impacts of synthetic grass, including a full life cycle analysis of costs. As more artificial turf fields are

installed, more long-term problems are being identified. Indeed, the environmental impacts of artificial turf components are now recognized as a global problem (Armada 2022). We think that artificial turf, based on available scientific studies, is not a sustainably safe alternative for landscaping, nor for use on sport fields, particularly for children. In addition, much progress has been made in developing state of the art drought resistant, water conserving grass fields that are sturdy, can be used year-round in California, and can be watered with non-potable recycled water. References follow.

Components of Artificial Turf

Artificial turf is a human-made surface of synthetic fibers, that was invented in the 1960's to look like and replace natural grass on sports fields and residential lawns. It consists of non-biodegradable plastic turf "blades" and a non-biodegradable backing. In the 1990's infill was added between the blades to soften the fields during play. Turf blades are composed of polyethylene, polypropylene or nylon.

The cushioning infill material is most often crumb rubber infill from crushed tires. Other materials have been used, such as silica from crushed quartz, synthetic rubber, polymer-coated sand, and other organic materials (cork and coconut fiber). However, these "eco-friendly" alternatives are typically coated with stabilizers and plasticizers for durability. The primary backing consists of woven or non-woven fabric made from high-strength polyester or polypropylene. The secondary backing is applied to permanently stabilize and secure the tufts of the artificial turf system. The most commonly used coating materials are latex and polyurethane.

Stated Benefits of Artificial Turf

The benefits widely promoted by the Synthetic Turf Council (STC) include less maintenance, less cost, no mowing, none-to-minimal water usage, no discoloration yearlong, no weeds, no allergies, no need for pesticides and durability, as the product withstands harsh weather conditions thus extending the sports season. We will look at some of these issues in the sections below.

Summary: Concerns about Artificial Turf

Chemical and Plastic Pollution

- Artificial turf and infill contain chemicals and heavy metals that are bio-accumulative, and thereby, harmful to humans and to the environment. These include polycyclic aromatic hydrocarbons (PAHs), phthalates, and perfluoroalkyl and polyfluoroalkyl "forever" substances (PFAS) (Ecology Center 2020; New Jersey State 2023; PEER 2024). Chemicals in artificial turf have a variety of biological effects and are known carcinogens, neurotoxicants, mutagens, and endocrine disruptors. Heavy metals such as arsenic, lead, chromium, zinc, antimony, and cadmium are also found in artificial turf components. (Armada 2022; Celeiro 2018**;** Llompart M 2013; Zhang 2008; Winz 2023). Some of the incorporated metals are found above regulatory limits (Negev 2022).

- Crumb rubber from crushed used tires is often used as infill, (well as on playgrounds) and has a unique chemical risk profile for humans and the environment (Duque-Villaverde 2024; Frederico 2023; Mayer 2024; Murphy 2022).
- There is close and often repetitive contact of players with artificial turf surfaces and infill, especially for soccer and football players, with particles sticking to shoes and clothing
- There can be direct inhalation and ingestion or dermal uptake of chemicals from the plastic grass and infill (Celeiro 2021).
- There can be leaching of harmful chemicals and microplastics into groundwater, drinking water and soil, causing water contamination, as well as damage to the living soil and organisms beneath them (Celeiro 2021**;** Armada 2022; Cui 2022; Zhong 2022).
- Many of the chemicals can be volatilized, and thus inhaled, especially with high temperatures (Armada D 2022; Celeiro 2021**,** Llompart M 2013).
- Biocides and pesticides applied to artificial fields to kill bacteria, mold, viruses and weeds can cause skin sensitization and may pose risks to the health of workers, children, and surrounding ecosystems (Hahn 2010).
- Artificial turf contains microplastics which are considered contaminants of emerging concern as they do not biodegrade, but do bioaccumulate in the environment, thus creating harm at every stage of the plastic life cycle in their production, use, and disposal (Landrigan 2023).
- Microplastics are inflammatory and also found in humans in the blood, brain, lungs, liver, gut, testicular tissue, thrombi and placenta (Gaspar 2022; Leslie 2022; Ragusa 2021; Danopoulos 2022; Wu 2023; Garcia MA 2024; Garcia MM 2024; Saha 2024; Hu 2024). Polyethylene (used in artificial turf) has even been detected in atherosclerotic plaque in 58% of carotid artery specimens showing "visible, jagged-edged foreign particles" that could contribute to vascular inflammation (Marfella 2024).
- Artificial turf adds to the plastic pollution crisis (IUCN 2022).
- Artificial turf microplastics have been found in 50% of urban waterways tested in Spain and comprised 15% of plastic found in the water (deHaan 2023).
- Artificial turf components have been found to be toxic to earthworms (Pochron 2018), aquatic organisms (Kruger 2013) and chick embryos (Xu 2019).
- Artificial turf infill components can reduce sport grass growth (van Kleunen 2019)**.**

Increased Surface Runoff

- Artificial turf is impervious and increases surface runoff that carries microplastics into storm water drains and local water bodies (de Haan 2023).

Increased Sports Injuries

- There is increased biomechanical stress on joints when playing on artificial turf fields versus natural grass, causing an increase in lower extremity sports injuries particularly in football and soccer (Gould 2023) and an increase in concussions because the artificial turf is laid over concrete or compacted earth (Mack 2019) with a resultant increased impact deceleration (Villanueva 2024).
- There is evidence of increased staphylococcus bacterial infections from turf abrasions

- Turf Toe injury is seen largely from artificial turf sports injury (Najefi 2018)

Athletic Preference for Natural Grass

- Athletes from high school to college to professional sports by far prefer to playing on natural grass (Owen 2016; Dumas 2023; NFLPA).
- National Football League (NFL) players prefer natural grass due to increased injuries from artificial turf (NFL Players Association).

Creation of Urban Heat Islands with Risk of Heat Injury

- Artificial turf can create harmful local heat islands with very high field surface temperatures which range from 40 - 60 degrees °F higher than natural grass - even with moderate air temperatures - causing poor athletic performance and heat related injury and illness, such as burns, heat stress, heat stroke and heat exhaustion, making the fields unusable (Mcfarlane 2015; Abraham 2019; Dujanovic 2017). In contrast natural grass fields rarely get above 100 degrees F.
- Cleats can get hot and have been known to melt on artificial turf (Litman 2015; Nazareth 2016).
- High synthetic field surface temperatures increase volatility and absorption of harmful chemicals from the synthetic turf (Armada D 2022; Llompart M 2013).
- A significant amount of water is used to manufacture, clean and cool synthetic sports fields (Alm 2016; Kanaan 2020).
- There is an expected rise in extreme heat events with a rise in heat-related illnesses and deaths in the next 20 years. Climate change will cause this to be more of an issue for athletes and children (California report "Indicators of Climate Change").
- With rising temperatures artificial turf fields are expected to be increasingly hotter for longer periods, thereby reducing the number of days they can be used in warm or hot weather compared to natural grass.
- Children are physiologically more vulnerable to heat-related illness, due to their greater skin surface area in relation to their bodies, immature sweat glands and higher metabolic rates (Bytomski 2003; Antoniades 2020; Malmquist 2021). Children can suffer a 24% longer *extreme danger* duration on artificial turf during sunny days than on natural grass (Liu and Kim).
- Parks with grass fields can be cooler than the surrounding urban environment by up to 7°C (Slater 2010).

Not Recyclable: Increasing Plastic Waste

- Artificial turf creates a significant waste problem at the end of its limited lifespan of 8-10 years, and it is difficult to recycle due to its complex plastic mixture. It often becomes landfill waste or is dumped on private land with persistent soil and water contamination leaching from the plastic, or is incinerated with accompanying adverse air quality impacts.

- California does not recycle artificial turf and it has to be sent out of state to an "advanced recycling" plant, however there is controversy over the true recyclability of artificial turf and its carbon cost. Only recently has one plant in Texas opened for recycling, and the results have not been measured. Many decades of artificial turf remain stocked in piles above ground in the U.S. and abroad.
- Industry advertising claims stating that artificial turf is recyclable has been challenged in a formal complaint (PEER 2022, York Daily Report 2019).
- A recent comprehensive report "The Fraud of Plastic Recycling" reveals that the plastic industry and the oil industry knew for decades that plastic was not truly recyclable (The Center for Climate Integrity 2024).
- Typical sports fields are about 80,000 square feet and contain about **40,000 pounds of "grass" turf** along with **240,000 to 720,000 pounds of infill** according to the Synthetic Turf Council.

Water Use

- Valley Water, headquartered in San Jose, notes that water conservation no longer includes artificial turf as they recognize that, "there are healthier and more ecologically sound alternatives"
- California Senate Bill 676, signed into law Oct 8, 2023 by Governor Newsom, specifies "that drought-tolerant landscaping does *not* include the installation of synthetic grass or artificial turf."
- Water use on hot days is comparable for both natural grass and artificial turf that is cooled with water to allow playability (Kanaan 2020).
- Manufacture of *one* artificial turf field uses the same amount of water needed to maintain one natural grass field for *4 years* (Alm 2016).
- Recycled water may not be suitable for use on artificial turf due to high salt content which can break down artificial turf components (California Coastal Commission 2023). However, natural grass turf can withstand the salts in recycled water (Evanylo 2010; Hochmuth 2022)

Water Quality and Environmental Effects

- As artificial turf is used it degrades with wear and microplastic and chemicals leach into the soil, water and air on fields and in disposal sites (Wik 2009; Bessa 2018; Celeiro 2018 & 2021; de Haan 2023).
- Water contamination from artificial turf is recognized as a global problem with widespread pollutants in the aquatic environment. deHaan (2023) found artificial turf plastics were found in 50% of river samples and comprised 15% of all plastics in the water.
- Artificial turf is associated with a decline in diversity in soil and bird populations (Bernat-Ponce 2020; Sanches-Sotomayer 2022; Valeriani 2019).
- Integrated Pest Management Policies, Programs and Ordinances have been successfully implemented in many municipalities to reduce pesticide use on parks, landscapes and in agriculture (IPM EPA 2023; IPM San Francisco; IPM Santa Clara County; IPM Marin;

IPM-UC; IPM USDA). These programs protect biodiversity, reduce health risks and address long-term indirect consequences of toxic exposures.

Displacement of Green Space

- Artificial turf displaces natural green space, which is important to health, development and the well-being of children.
- California Extreme Heat Action Plan for California encourages natural plants and landscaping to strengthening community resilience.
- Artificial turf replaces natural grass, which provides soil organic carbon sequestration as well as oxygen.

Carbon Footprint

- Artificial turf is made of plastic that is derived from fossil fuels.
- Artificial turf produces greenhouse gas emissions during manufacturing and has been found to emit these gases as it degrades (Royer 2018).
- Natural grass sequesters carbon, especially when organic methods are used to maintain sports fields (Braun 2019: Cumming 2018; Hamido 2016; Kong 2014;Law 2017; Qian 2012; Zhang 2013).
- Turf farms used in industry can create a positive balance for carbon sequestration (Cummings 2018).

Cost is Less for Natural Grass Fields

- Using a Life Cycle Analysis which includes disposal, natural grass fields are less expensive in the long run (Daviscourt 2017; University of Arkansas; TURI U of Mass Lowell).
- Cleanup costs for current disposal sites and environmental toxins are not taken into account in the total cost of artificial turf.

Benefits of Natural Grass

- Sequesters carbon
- Groundwater preservation and recharge by preventing runoff
- Restoration ecology, bioremediation and soil restoration
- Maintains healthy soil microbiome
- Water conservation
- Improves wellbeing
- Supports biodiversity in soil and the ecosystem

- Cooler microclimate

Examples of Natural Grass Playing Fields
Note: The Sports Field Management Association gives awards every year to well managed natural grass fields

- Marblehead, MA
- Springfield, MA
- Martha's Vineyard, MA
- Snapdragon Stadium in San Diego
- Woodland Middle School, Portola Valley
- Woodside Priory, Portola Valley

No Proof of Safety for Artificial Turf

- There is a significant data gap in understanding the safety of artificial fields. Gaps remain in understanding the chemicals, their toxicity and concerns about the dosages.
- Long-term human health impacts, such as cancer, remain uncertain with some evidence pointing to a higher risk (Tarafdar 2020).
- There are no studies indicating that artificial playing fields are safe
- In February 2016, the Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields and Playgrounds (FRAP) was announced. This multi-agency effort includes the U.S. Environmental Protection Agency (EPA), Centers for Disease Control and Prevention (CDC), and the U.S. Consumer Product Safety Commission (CPSC). The 2019 report released in 2024 discusses crumb rubber only.
- The Consumer Product Safety Commission recommends precautions to limit exposure to chemicals on artificial turf such as hand washing and limiting time on the playground on hot days. (CPSC)

Children are More Vulnerable

- It is well established that children are more vulnerable to toxic exposures due to their immature development that can be permanently disrupted (Carroquino 2012; Landrigan 2001, 2016, 2023; Endocrine Society).
- Children have a longer cumulative time of exposure.
- Children have close and repeated contact with turf surfaces.
- Children are more vulnerable to heat stress physiologically (Bytomski 2003; Antoniades 2020; Malmquist 2021: Liu and Kim)
- The Mount Sinai Children's Environmental Health Center Position Statement on the use of Artificial Turf Surfaces in Nov 2023, "recommends against the installation of artificial turf playing surfaces and fields due to the uncertainties surrounding the safety of these

products and the potential for dangerous heat and chemical exposures." (Mount Sinai 2023)

No Regulations on Artificial Turf for Children

- There are no federal safety regulations on artificial turf for children (Zucarro 2022)
- The European Union has banned the sale of products with intentionally added microplastics and products that release microplastics over time, including crumb rubber artificial turf infill (Zucarro 2024).
- Crumb rubber playgrounds and elementary school sports fields are not classified as a children's product by the Consumer Product Safety Commission (PEER 2015)

Policies to Ban Artificial Turf or Components

The concerns for harmful plasticizers and microplastics in artificial turf, long-term effects on children's health, as well as life cycle analyses have led to policies to ban artificial turf altogether as well as to ban specific toxic components (Millbrae, San Marino, Boston, Zucarro et al 2022). Millbrae, California, for example, recently passed an ordinance to ban artificial turf, including requiring natural grass replacements once artificial turf installations "begin to show visible signs of wear." (Millbrae Ordinance 806, Chapter 8.65)

The law allows local governments to ban artificial turf due to well-documented health concerns. Unfortunately, the artificial turf industry does not have to prove safety of their products for humans or the environment in order to market their product. In fact, few studies on human health have been done. Murphy (2022) notes, "The only human epidemiology studies conducted related to artificial turf have been highly limited in design, focusing on cancer incidence."

Background

1. Chemical Exposures and Contamination

Microplastics and Chemical Pollution: Plastics are now regarded "as a major threat to ecosystems worldwide" (de Haan 2023). Artificial turf is composed of plastic "blades of grass", a plastic composite backing and cushioning infill. The synthetic green blades are typically made up of polyethylene and polypropylene, and due to its propensity to degrade with UV light, "stabilizers" are added to the mix in the manufacturing process to reduce breakdown. Tire crumb rubber is often used for infill due to cost. All of these components are derived from petroleum products. These components contain microplastics as well as chemicals acknowledged as being hazardous substances, such as polycyclic aromatic hydrocarbons (PAHs), bio-accumulative ("forever") per- and polyfluoroalkyl substances (PFAS), phthalates, silica (silica crystal infill), polychlorinated biphenyls (PCBs), carbon black and metals such as lead, mercury, cadmium, chromium, cobalt, and arsenic. In addition, pesticides and biocides are used on

artificial fields to reduce bacteria, viruses and weeds, which could cause adverse reactions and skin sensitization.

A study by the United States Environmental Protection Agency (2019) noted, “a range of chemicals (metals and organic compounds) was found on fields,” but no biomonitoring studies on athletes has yet been done.

These chemicals can contaminate water supplies through runoff, as well as leach into groundwater and soil and persist in the environment (deHaan 2023). Children can be exposed via inhalation of off-gassing compounds, or ingestion of infill components. The crushed tire rubber infill adheres to skin, shoes and clothing, and then can enter cars and homes. Based upon the presence of known toxic substances in tire rubber and the lack of comprehensive safety studies the Children’s Environmental Health Center of the Icahn School of Medicine urged a moratorium on the use artificial turf generated from recycled rubber tires. The EPA states in their assessment that “the existing studies do not comprehensively evaluate the concerns about health risks from exposure to tire crumb.” (Marsili 2014). Artificial turf fields are installed on top of a bed of crushed rocks and a drainage system that typically feeds the runoff to storm sewers or surface waterways. As such, artificial turf contributes to the plastic waste crisis.

a. PFAS

High levels of PFAS have been found in artificial turf sold at Home Depot and Lowe’s by the Center for Environmental Health who sent a notice of Violation of the Safe Drinking Water Act on March 4, 2024 (CEH 2024). New health concerns have risen from the ubiquitous chemical group called perfluoroalkyl and polyfluoroalkyl substances (PFAS), which are a class of persistent and highly toxic chemicals with widespread contamination across the United States, and which have been to date found in all samples of artificial turf. PFAS are typically added for water and stain resistance for a myriad of commercial products from packaging to clothes, to food containers and also found in cleaning products and non-stick cookware. Manufacturers of artificial turf state it is used in processing to enhance smoothness and reduce friction during manufacturing.

PFAS in plastics are especially problematic because they are a category of chemicals that contain multiple fluorine atoms bonded to a chain of carbon atoms that makes them resistant to breakdown. This group of chemicals thus bioaccumulates in the food chain and has contaminated water supplies throughout the nation. PFAS are now found in breast milk, blood serum, urine, testicular tissue and placental blood. (ATSDR, Hall, Hu, Wu)

Human health risks include endocrine disruption, adverse effects on the liver and thyroid, as well as metabolic effects, developmental effects, neurotoxicity, and immunotoxicity, with evidence of reduction of effectiveness of childhood vaccinations (Grandjean 2017) as well as developmental harm.

The Mindaroo-Monaco Commission on Plastics and Human Health Report 2023 concludes: "It is now clear that current patterns of plastic production, use, and disposal are not sustainable and are responsible for significant harms to human health, the environment, and the economy as well as for deep societal injustices…The thousands of chemicals in plastics—monomers, additives, processing agents, and non-intentionally added substances—include amongst their number known human carcinogens, endocrine disruptors, neurotoxicants, and persistent organic pollutants. These chemicals are responsible for many of plastics' known harms to human and planetary health. The chemicals leach out of plastics, enter the environment, cause pollution, and result in human exposure and disease. All efforts to reduce plastics' hazards must address the hazards of plastic-associated chemicals…to protect human and planetary health, especially the health of vulnerable and at-risk populations, and put the world on track to end plastic pollution by 2040 this Commission supports urgent adoption by the world's nations of a strong and comprehensive Global Plastics Treaty in accord with the mandate set forth in the March 2022 resolution of the United Nations Environment Assembly (UNEA)" Landrigan (2023).

The Mount Sinai Children's Environmental Health Center Position Statement on the Use of Artificial Turf Surfaces Nov 2023, "recommends against the installation of artificial turf playing surfaces and fields due to the uncertainties surrounding the safety of these products and the potential for dangerous heat and chemical exposures." They further state, "**To allow the installation of PFAS-containing surfaces would be extremely short-sighted as further restrictions and regulations on these chemicals are likely to come.**" Noting:

- Studies to assess the safety of artificial turf are ongoing and inconclusive.
- Questions remain about the safety of alternatives to crumb rubber.
- Undisclosed chemicals of concern are present in plastic grass blades and turf pads and matting.
- Chemical hazards escape from artificial turf surfaces to the environment
- Turf materials are transported home.

b. Infill

Infill is used to support synthetic fibers to prevent rippling of the blades, adds weight to the turf to keep it in place, acts as cushioning, assists drainage in high rains. Types of infill that are used include "crumb rubber" (crushed tires), Crystalline Silica sand, and newer alternatives such as coconut husk, walnut, wood and Zeolite.

Crumb Rubber Tire Infill

Crumb rubber from crushed used tires is used as cushioning infill on artificial turf. According the EPA 38 states ban pulverized scrap tires due to their hazardous components and tendency to catch fire, but in 2003 "markets for scrap tires were consuming 233 million, or 80.4%, of the 290 million annually generated scrap tires." In 2016 the EPA found that 12.5% of all scrap tires were used in crumb rubber infill. (EPA

2016). Crumb rubber was considered an “environmental success story”,according to the Rubber Manufacturers Association (Rappleye 2024).

Crumb rubber, however, exposes humans and ecosystems to a plethora of hazardous chemicals due to the complex mixture of toxic chemicals used in manufacturing. **Celiero (2021)** found, “40 target compounds, including polycyclic aromatic hydrocarbons (PAHs), plasticizers, antioxidants and vulcanization agents were determined in 50 synthetic football pitches of diverse characteristics”. **Duque-Villaverde (2024)** found, “11 compounds of environmental and health concern, including antiozonants such as N-1,3-dimethylbutyl-N'-phenyl-p-phenylenediamine (6PPD) or N, N´-diphenyl-1,4-phenylenediamine (DPPD), and vulcanization and crosslinking agents, such as N-cyclohexylbenzothiazole-2-sulfenamide (CBS), 1,3-di-o-tolylguanidine (DTG) or hexamethoxymethylmelamine (HMMM) from tire rubber… **antiozonant 6PPD** [recently **linked to acute mortality in salmon**] is present at the highest concentrations up to 0.2 % in new synthetic fields. **Federico (2023)** found, “Trace elements such as Zn, Al, Fe, Cd, Cr, Ni, Hg, and Cu”, as well as a filler called carbon black composing up to 22-40%, or silica for wear resistance. **Lead** has been found in artificial turf as well **(Graca 2022).** A 2020 report by the Ecology Center in Maryland found high levels of lead [up to 30,292 ppm in one sample] in Maryland and Virginia playgrounds made from rubber shred. **(Ecology Center 2020)**

Tire industry workers are subjected to some 50 chemicals, many of which are toxic. Occupational studies of workers in the tire industry reveal an association with emphysema, leukemia, multiple myeloma, as well as cancers of the bladder, esophagus, larynx, liver, lung, pancreas, prostate and stomach. Most chronic diseases caused by occupational toxins don’t appear until 10 or more years after first exposure. There are many studies on the toxicity of crumb rubber. **(Murphy 2022)**

Silica Infill

Crystalline silica from crushed quartz rock, also known as industrial sand, is a common alternative to crushed tire infill and contains 95% crystalline silicon dioxide. One manufacturer states: “Silica sand is one of the most ubiquitous forms of infill for the simple reason that it’s inexpensive.” [https://www.purchasegreen.com/blog/silica-sand-what-you-should-know/] It is also considered a hazardous material. Silica dust has long been known to cause a chronic restrictive lung disease called silicosis and was first documented in 1700 in stone-cutters by Dr. Bernardino Ramazzini, considered the founder of occupational medicine. Symptoms of this progressive irreversible lung disease are persistent cough, shortness of breath and difficulty breathing which may occur years after the exposure as scarring and inflammation progress. Silicosis is the most prevalent chronic occupational lung disease in the world (Upadhyay 2024). Australia banned engineered stone because of silicosis risk that is increasingly found in workers who polish engineered countertops. (Nogrady 2023). A silicosis epidemic was recently noted in the Northeast San Fernando Valley stoneworkers **(**Norris 2024).

Silica Infill is Not Sand or “Just Dust”

Some people say that silica infill is just beach sand and therefore is safe. Indeed, beach sand is 80 to 95% silica, but is composed of larger particles that do not pose a risk of pulmonary disease. However, silica (silicon dioxide) exists in both crystalline and amorphous forms. A Yale Environmental Health and Safety report points out that beach sand is amorphous silica. Crystalline silica on the other hand is "at least 100 times smaller than ordinary sand found on beaches or playgrounds. It is generated when silica-containing materials are manipulated in such a way that a dust is created, [and] some fraction of that dust may include particles small enough to become respirable."

The International Agency for Research on Cancer (IARC) Monographs Programme has classified crystalline silica as carcinogenic to humans, while amorphous silica was not classifiable as to its carcinogenicity in humans. The panel emphasized that crystalline silica in the form of quartz or cristobalite dust causes lung cancer in humans. [https://acsjournals.onlinelibrary.wiley.com/doi/10.3322/caac.21214]

The American Academy of Pediatrics (AAP) specifically recommends avoiding "Crushed crystalline silica (quartz)" in sandboxes or playgrounds. (American Academy of Pediatrics- Safety in the Sandbox). Some manufacturers state that the silica is contained inside a plastic or acrylic coating. This coating however may break down with use and pose yet more unknown and untested risks. Organic alternatives such as coconut husks or cork may have proprietary ingredients or coatings as well that stabilize the material but create regrettable substitutes with their own hazardous components. The alternative infill, Zeolite, can be toxic to the lungs with inhalation. (Sloan Kettering)

While new artificial infill and plastic technologies may make fields cooler or softer or bactericidal, we still do not know if they are safer. These alternatives may not have independent scientific studies to back their safety when inhaled, ingested or after they enter storm drains. A full toxic life cycle analysis is needed to fully inform a decision to place artificial turf.

Cancer is another concern for athletes and children playing on artificial turf and exposed to infill and a mix of synergistically harmful artificial turf chemicals. Although there are no studies to date associating an increased risk of cancer with artificial turf, questions remain unanswered regarding exposure to carcinogens on these fields.

2. Disposal of Plastic Waste and Recycling

Artificial turf creates an enormous plastic waste problem and recycling is problematic. Sports fields will last 8 to 10 years before disposal. As they are made of a complex mix of plastic and infill ingredients this produces an ongoing challenge at the end of their lifetime. There are over 15,000 artificial playing turfs in the US and about 1,500 are added yearly. The synthetic turf industry repurposes about one-twelfth of the 300 million auto tires that are withdrawn from use each year. An average soccer field of 80,000 square feet can use 27,000 crushed tires for infill at 4-15 pounds per square foot,

equivalent to 320,000-1 million pounds (160-500 tons) of infill along with 40,000 pounds(20 tons) of plastic (Claudio 2008).
Synthetic turf fields are typically under warranty for 8 years and have a lifespan of about 10 years. Thereafter the material must be disposed of and typically it is landfilled. While industry increasingly attempts to reuse or recycle their product, ultimately it is burned or chemically changed into substances that are potentially as harmful and disposed of somewhere later, adding to planetary pollution.

In general, these fields are never completely recycled and are increasingly dumped on unused private land (where owners are paid a rental fee), empty lots and sometimes illegally dumped where they continue to leach hazardous chemicals. Industry advertising claims that artificial turf is recyclable has been challenged in a formal complaint (PEER 2022, York Daily Report 2019). Even if the artificial turf can be recycled there is a substantial carbon footprint as well as economic cost to do so. Moreover, any increased recycling costs will be added on to the price paid by those purchasing artificial turf.

3. Sports Injuries

Injury prevention for athletes and children should be a fundamental objective as youth sports injuries can have not only short-term impacts but also more serious long-term impacts from orthopedic injuries. Many studies show an increased risk of lower extremity sports injuries from artificial turf in **high schools** (Paliobeis 2021;Voos 2019), **colleges** (Loughran 2019) and **professional sports (**Mack 2019;Calloway 2019; Robertson 2022; Gould 2023). It is concerning that Gould (2023) noted that studies showing a higher risk on natural grass were all funded by the artificial turf industry.

Biomechanical studies show there is increased frictional force at the shoe-surface interface with artificial turf compared to natural grass, thus likely explaining an increased incidence of injuries to the foot, ankle and knee. Furthermore, athletes' consistent perception is that natural grass is easier to play on and results in fewer injuries (Taylor 2012). Smeets (2012) concludes, "Torques on external rotational movements were significantly higher with blades [artificial turf]... High rotational torques between the shoe outsole and the sports surface has been correlated with torsional injuries of the lower limb and knee." Balazs (2015) notes this "is potentially relevant for the risk of anterior cruciate ligament (ACL) rupture, where noncontact mechanisms are frequent." Robertson (2022) performed the largest study of rugby player injury risk and surface type. They noted, "a significantly greater mean severity of hip/groin, and foot/toe injuries on artificial surfaces."

Turf toe is an injury initially coined by and most commonly seen on artificial turf. It typically occurs when an already hyperextended metacarpalphalangeal joint at the base of the toe has additional force placed on it from behind by another player contacting the heel or during play. If there is less "give" from the turf then a hyperextension injury occurs, resulting in anything from a minor sprain to a complete tear of the ligamentous complex

supporting the toe joint. (Najefi 2018) Turf toe is a rare but debilitating condition that requires accurate diagnosis and early definitive management to prevent a chronic condition.

Concussion and Playing Field Surface

Surveys of high school and collegiate trainers have shown more serious concussions occur when athletes play on artificial fields that have been built on a concrete foundation (Guskiewicz 2000; Naunheim 2002), or with firm gravel base. Natural grass absorbs physical impacts better. Villanueva (2024) tested this noting that "American football has the highest rate of concussions in United States high school sports. Within American football, impact against the playing surface is the second-most common mechanism of injury." The authors measured impact deceleration between natural grass and synthetic turf high school football fields and "showed significantly greater impact deceleration on synthetic turf compared to the natural grass surfaces."

Studies that confirm higher injury rates:

Gould (2022) in a review of 53 articles on sports injuries found a higher incidence of foot and ankle injuries on artificial turf, both old and new generation turf. He also revealed that," Only a few articles in the literature reported a higher overall injury rate on natural grass compared with artificial turf, and all of these studies received financial support from the artificial turf industry."

Paliobeis (2021) This study collected data from 26 high schools and found "Athletes were 58% more likely to sustain an injury on artificial turf. Football, soccer, and rugby athletes were at a significantly greater injury risk on artificial turf. Upper and lower extremity and torso injuries also occurred with higher incidence on artificial turf."

Voos (2019) This review of the above 2019 study from Case Western Reserve University and the University Hospital Sports Medicine Institute analyzed data collected by 26 high school athletic trainers during the 2017-2018 athletic seasons. The authors found, "athletes were 58 percent more likely to sustain an injury during athletic activity on artificial turf. Injury rates were significantly higher for football, girls and boys soccer, and rugby athletes. Lower extremity, upper extremity, and torso injuries were also found to occur with a higher incidence on artificial turf."

Mack (2019) examined injuries reported during the 2012-2016 regular season NFL games that were played on modern-generation surfaces. The study found that playing on synthetic turf "resulted in a 16% increase in lower extremity injuries per play than that on natural turf." They concluded, "These results support the biomechanical mechanism hypothesized and add confidence to the conclusion that synthetic turf surfaces have a causal impact on lower extremity injury."

Loughran (2019) looked at injury data from the National Collegiate Athletic Association American Football: 2004-2005 through 2013-2014 seasons and found a significantly higher rate of knee injuries on artificial turf, finding artificial turf a "risk factor".

Calloway (2019) looked at injuries over 4 Major League Soccer seasons (2013-2016) and concluded "overall ankle injury, Achilles injury, and ankle fracture were found to have a statistically higher incidence on artificial turf…[and] elite-level athletes prefer to play on natural grass surfaces due to a perceived increase in injury rate, discomfort, and fatigability on artificial turf."

Najefi (2018) describes "Turf Toe," which is a "debilitating condition, particularly seen in American footballers after the introduction of harder, artificial 'turf' surfaces." He noted that, "in a survey of 80 active professional American football players, 45% had suffered turf toe injuries in their professional careers, with 83% occurring on artificial turf (Rodeo) ."

Sousa (2013) performed a one-season prospective study of amateur soccer players on artificial turf and found, "Injury incidence in amateur soccer players is higher during matches played on artificial turf than during training sessions."

Meyer (2005) A 5-year prospective high school football study published in 2005 noted that during higher temperatures there were reported higher incidences of noncontact injuries, surface/epidermal injuries, and muscle-related trauma, reported on artificial fields.

4. Athlete Preference for Natural Grass Playing Fields

Ford and Monsanto Industries joined efforts to make the first artificial turf in 1964 called ChemGrass which was installed in the Houston Astrodome, when the grass died due to issues with the plastic covering of the dome. By the 1980's athletes were complaining that the turf, then typically made with a base of concrete, was harder and caused more injuries. Indeed, there were more concussions seen on artificial turf fields (Guskiewicz 2000). Earlier turf studies noted, "A number of high-profile professional football players have suffered career-ending concussions." (Naunheim 2002). Newer materials have been used with more infill placed on fields along with a compacted gravel base to address this issue. A poll by the National Football League in 1995 revealed that 95% of players believed that synthetic turf increased their risk of injuries (Claudio 2008). A recent National Football League Players Association (NFLPA) survey found similar results on newer artificial turf fields. (NFLPA 2020) As noted above, there is both anecdotal and scientific evidence of higher rates of injuries on artificial turf.

College and professional athletes prefer natural grass playing fields by far, due to reduced injuries and ease of play (Owens 2016; Dumas 2023; NFLPA). Players describe artificial turf as "sticky". The NFLPA has taken a strong public stance against artificial

turf fields, advocating that "NFL clubs should proactively change all field surfaces to natural grass." (J.C. Tretter) The NFL Players Association tracks the league's official injury reports and has consistently found that natural grass fields provide a much lower risk for injuries when compared to artificial surfaces, both during practices and games. The NFLPA analysis shows that players have "a much higher rate of non-contact lower extremity injuries on turf compared to natural surfaces. Specifically, players have a 28% higher rate of non-contact lower extremity injuries when playing on artificial turf. Of those non-contact injuries, players have a 32% higher rate of non-contact knee injuries on turf and a staggering 69% higher rate of non-contact foot/ankle injuries on turf compared to grass." NFLPA President Tretter explained, "When you put so much force and so much torque in the ground, eventually something has to give. When you're on turf, it's going to be your joint."

5. Infections

Methicillin-resistant Staphylococcus aureus (MRSA) has been recognized as a significant skin infection in the athletic population, causing minor to serious infections. MRSA is responsible for 33% of infectious outbreaks reported among competitive high school and collegiate athletes. Bowers looked at three Division-I collegiate football programs and found that of the 491 collegiate football players, "33 (6.7%) were diagnosed with MRSA infections. Cutaneous manifestations included abscess (70%), cellulitis (16%), folliculitis, impetigo, and necrotizing fasciitis. Of the infections, 90% underwent surgical drainage, whereas 27% received intravenous antibiotics." The most common areas for infections were in the extremities: elbow, knee and forearm (Bowers 2008).

It is notable that high school football players have a 4-fold increase in MRSA infections than that of the general student-athlete population. While locker room surfaces can harbor MRSA, artificial turf can as well. An EPA study on artificial turf showed that 42% had at least one sample with Staphylococcus aureus. Of those, 70% had a least one positive sample for methicillin resistance.

The abrasive nature of synthetic turf along with sheltered MRSA in the turf and infill can make athletes and kids more vulnerable to "turf burn" and infection (Keller 2020). Synthetic turf requires bactericidal chemicals to reduce bacterial growth on fields and infections in players. These liquid turf cleaners can also be toxic and may pose risks to the health of workers, children, and surrounding ecosystems. Bactericides have been shown to act as skin sensitizers (Hahn 2010).

6. Localized Urban Heat Islands and Athlete Heat Stress

Artificial sports fields are known to absorb and retain heat from the sun thus creating significantly higher temperatures, at times 40 to 60 degrees higher than living grass, even

with moderate air temperatures. Studies at Penn State University's Center for Sports Surface Research compared surface temperatures of various synthetic turfs versus natural grass and found "that the maximum surface temperatures during hot, sunny conditions averaged from 140° F to 170°, noting that grass fields rarely get above 100° F due to the cooling effect of natural water evaporation from the living grass (NRPA). These studies have been replicated many times. The heat can be so intense it has been known to melt the plastic (DeSocio 2015).

Heat Injury- These higher temperatures on artificial turf sports fields can cause heat stroke, heat exhaustion, poor athletic performance and skin burns, making these fields potentially unusable under hotter weather conditions. Irrigating the fields with water reduces temperatures; however, the effect lasts for less than 20 minutes, according to research performed by Penn State Center for Sports Surface Research (Abraham 2019; Claudio 2008; NPRA 2019).
The **Consumer Product Safety Commission** notes**,** "Most adults will suffer third-degree burns if exposed to 150° F water for two seconds. Burns will also occur with a six-second exposure to 140° F water or with a thirty second exposure to 130° F water. Even if the temperature is 120° F, a five-minute exposure could result in third-degree burns." **Note: A hot water heater is set to 120**° F, as above that burns can occur.

Heat stress on artificial turf vs natural grass was reviewed by Liu and Kim (2021). Heat waves and hot weather threaten human health when one is not exercising. Those playing sports or participating in strenuous exercise are at increased risk of heat-related illness. Artificial turf creates a higher temperature microclimate due to heat absorption from the sun. The authors note that **children have been identified as a heat vulnerable group** physiologically compared to adults due to "a higher surface area-to-mass ratio (Cheng, 2020), higher metabolic rate (Fabbri, 2013), higher skin temperature during exercise (Cheng, 2020), quicker rise in core temperature (Vanos, Herdt, Lochbaum, 2017), and lower sweat production (Gomes, Carneiro-Júnior, Marins, 2013). Psychologically, children have less experience coping with or realizing the signs of heat stress than adults (Cheng, 2020). Their findings show that children suffer a 24% longer *Extreme danger* duration on artificial turf on sunny days than natural grass (Liu and Kim 2021).

An urban heat island effect arises when natural land cover, vegetation and trees (greenscapes), which have natural evaporative cooling, are replaced with buildings, pavements and other surfaces, such as artificial turf, also called hardscape, that absorb heat from the sun. These artificial surfaces store heat and upon release can raise air temperatures in adjacent areas or even communities. Urban heat islands can be seen from space and differentiated from natural green landscapes. (ESA) Cities can have temperatures much higher than rural areas with vegetation. Even within cities there is significant variation depending on greenspace, parking lots, and housing density. Urban heat islands are being addressed now in cities such as New York, which has a "Cool neighborhoods NYC" program to plant trees and increase vegetation to cool the surrounding area. (Johnson 2022).

Studies Showing High Heat on Artificial Turf Fields

Brigham Young University: After an athlete suffered a heat burn from artificial turf in Utah, Brigham Young University performed a study on the artificial turf and found that the artificial turf temperature was 87 °F hotter than natural grass (Williams and Pulley 2002). A temperature recorded on an artificial turf was 200°F, well above that which would cause a skin burn. Buskirk (2002) measured temperatures for 24 days on artificial turf, natural grass and in air and recorded turf temperatures that were 50 °F higher than natural grass temperatures and reached 70 °F higher than the air temperatures.

Penn State University Center for Sports Surface: Studies at Penn State University's Center for Sports Surface Research compared surface temperatures of various synthetic turfs and found "that the maximum surface temperatures during hot, sunny conditions averaged from 140- 170° F, noting that grass fields rarely get above 100° F due to the cooling effect of natural water evaporation from the living grass. (NRPA)

University of Missouri: A University of Missouri comparative study showed **with artificial turf** there were both "elevated air temperatures (138 °F) and elevated turf temperatures (173 °F) – while **adjacent natural turf temperatures** were 105 °F and local air temperatures were 98 °F". (Abraham 2019)

University of Tennessee: This study by Thom et al (2014) looked at ten synthetic turf surfaces at the University of Tennessee Centre for Athletic Field Safety with different infills. They noted that maximum temperatures on artificial turf were 187 degrees Fahrenheit with ambient air temperatures of 98.7 degrees Fahrenheit. The authors noted, "Despite differences in infill ratios of crumb rubber to sand (0 kg m-2 to up to 34.2 kg m-2 of crumb rubber and sand), synthetic turf surface temperatures varied less than 6 C between the systems suggesting that synthetic turf infill does not affect surface temperature as much as fibers."

Local Heat Island from Artificial Turf at Moffett Park, Sunnyvale, California: Locally the Moffett Park Specific Plan of 2020 also mapped out the local heat island effect and it was evident on the artificial sports fields. **The Twin Creeks Sports Complex**, built in 1985, has 10 all-purpose synthetic turf fields which can be identified in the report as having a temperature in the hottest range (111-138 °F) versus the immediately surrounding area of 102-111°F. Average summer temperatures are "expected to increase in Santa Clara County by ~4°F by 2050 and up to more than 6°F by 2100 (Maizlish et al. 2017), while the number of extreme heat events will double by 2050 and triple by the end of the century." (MPSP, Cal-Adapt.)

Slater (2010) Noted in his study that parks can be cooler than the surrounding urban environment by up to 7°C and this extends up to 100 meters beyond a park borders.

Cooling Methods Used for Artificial turf
Cooling of artificial turf is accomplished through irrigating the field with water. The cooling effect lasts only about 20 minutes (Penn State Center for Sports Surface Research). In arid or semiarid climate zones the amount of water used to maintain artificial turf at temperatures similar to irrigated natural turf grass were comparable (Kanaan 2020). Attempts to alter turf materials to reduce surface temperatures significantly have not been shown to be successful to date. The turf is still significantly hotter. Games can be cancelled if temperatures are too high.

Heat Guidelines for Play on Artificial Turf

National Recreation and Park Association (NRPA) Heat Guidelines for Artificial Turf: For the safety of children public schools have developed heat guidelines for playing on synthetic sports fields due to the higher artificial turf temperatures even with moderate air temperatures. The National Recreation and Park Association (NRPA) 2019 notes that above 120 degrees burns can occur, as well as dehydration with heat stroke, heat exhaustion and poor athletic performance, making these fields potentially unusable under certain weather conditions.
The Montgomery County Public Schools developed the following heat guidelines that apply to and are posted at all its artificial turf fields:

- Anytime the outdoor temperature exceeds 80 degrees, coaches exercise caution in conducting activities on artificial turf fields.
- When outdoor temperatures exceed 90 degrees, coaches may hold one regular morning or evening practice (before noon or after 5 p.m.).
- When the heat index is between 91–104 degrees between the hours of noon and 5 p.m., school athletic activities are restricted on artificial turf fields to one hour, with water breaks every 20 minutes.

It is recommended that artificial turf fields be monitored for temperature and play times adjusted. As global temperatures rise with climate change the heat effects of artificial turf is an ever-increasing concern.

7. Children are More Vulnerable

Artificial turf contains hazardous chemicals and heavy metals. Children are especially vulnerable to all toxic exposures due to their immature biological systems. Scientific evidence (CDC, Landrigan 2001, 2016, 2023) notes that:

- "Children breathe more air, drink more water, and eat more food per pound of body weight than adults.
- Children are more likely to put their hands in their mouth.
- A child's body may not be able to break down and eliminate harmful contaminants that enter their body.
- Rapid growth can be disrupted easily by toxic exposures

- "Health problems from an environmental exposure can take years to develop."

On an artificial sport field children and athletes are routinely in close contact with dust and chemicals emitted from the surface of the fields, especially with soccer, football, field hockey and lacrosse, making them more readily inhaled, ingested, and in closer contact with the skin. Thus, it is reasonable to expect that these synthetic turf fields can pose an increased health risk to children. Precaution is thus imperative. (The full list of references is listed below under Children's Vulnerability to Toxins)

Why Children are More Vulnerable:

- **Children's ability to metabolize**, detoxify, and excrete chemicals is different from that of adults. Children are less able to detoxify and excrete toxic chemicals (Carroquino 2012).
- **Children undergo rapid growth** and development, and their development phases are perfectly scheduled to achieve complete functional development. If a developmental phase is disturbed at a given time, the correct pathway can be lost, thus causing developmental delay or arrest (brain development, reproductive development, immune development, etc) with permanent and irreversible dysfunction. (Carroquino 2012).
- **Environmental toxicants can harm germ cells** which affect an adult's own fertility as well as the health of the offspring. (Carroquino 2012).
- **Chemicals can act as endocrine disruptors** that can block or enhance and endocrine effects and alter development at extremely low concentrations (Parts per trillion PPT -Lawson) and according to the OECD 2023, "They can trigger adverse effects at doses below the threshold values of traditional chemical analysis". Disruption of thyroid hormone changes is especially problematic as this can indirectly alter critical pathways of neural development.
- **The immune system is not mature** up to the age of 7 or 8 (Simon 2015), and beyond that is constantly changing thus is susceptible to toxins causing autoimmune disease even in adulthood, i.e. lead, cadmium and mercury (Kharrazian 2021) and in the case of PFAS even causing reduced immune response to childhood vaccines (Grandjean 2017), as well as reproductive harm (Rickard 2022) and with fetal exposure it is strongly associated with congenital heart disease (Li 2024).
- **The brain and nervous system are not fully developed** until the age of about 26, with different stages of growth and vulnerability. Many chemicals pregnant women and children are exposed are neurotoxic and exposures can lead to neurobehavioral developmental abnormalities. (Grandjean and Landrigan 2014) Lead can cause direct damage to neurons with no safe level of exposure.
- **The reproductive system is complex** and can be disrupted by toxic exposures in utero or even after birth. Male reproduction is particularly susceptible as sperm is constantly maturing. (Lahimer 2023). Female ovaries are partially mature at birth and subject to toxins which can "age" the germ cells in ovaries throughout a lifetime and cause later infertility, also affecting the health of the offspring (Rickard 2022). The measure of cumulative toxic exposure is infertility. (Thomas)

- **Chemicals can act as direct neurotoxins** affecting brain development, i.e. lead causing damage to the hippocampus (memory center) and cerebellum and while nerve cells other than the brain can regenerate, brain cells have limited capacity for regeneration thus are more vulnerable to permanent damage. (Grandjean and Landrigan 2014)
- **Chemicals can also alter sections of DNA** without altering the base sequence i.e. epigenetic changes-and these alter the expression of genes throughout life-altering development and disease. (Ideta-Otsuka 2017)
- **Chemicals can have age dependent rates of absorption** and in one study, lead was absorbed 40-50 times more in younger animals (Sanders 2010)
- **Chemicals can also cause inflammation** of tissues in the body to create or enhance diseases in childhood throughout adulthood (Furman 2019)
- **Longer exposure from childhood**- "There is more time to develop chronic diseases triggered by early exposures…Many diseases, such as cancer and neurodegenerative diseases, are thought to arise through a series of stages that require years or even decades from initiation to actual manifestation of disease. Carcinogenic and toxic exposures, sustained early in life, including prenatal exposures, would then be more likely to lead to disease than similar exposures encountered later." (Carroquino 2012)
- **Synergistic exposures to multiple chemicals** together can enhance toxicity and adverse health impacts (Gaynor 2022)

8. Cancer and Chemicals Still a Question

While there is no proof that artificial turf causes cancer, scientific evidence shows that many chemicals used on artificial turf and components are carcinogenic, can be endocrine disruptors and can be toxic to aquatic organisms. Murphy (2022) highlights this concern, noting a troubling lack of scientific data noting, " The only human epidemiology studies conducted related to artificial turf have been highly limited in design."

While there is an unfortunate lack of independent scientific data on the health impacts of artificial turf, Tarafdar (2020) studied risks of poured rubber surfaces versus classical soil playgrounds in Seoul and noted that the "cancer risk is approximately 10 times higher in poured rubber surfaced playgrounds than in uncovered soil playgrounds. Cancer rates in children and adolescents are rising (Siegel; CDC - Cancer in Children and Adolescents)

9. Environmental Impacts of Artificial Turf: Toxic inputs and Outputs, Water Contamination, Harm to Wildlife, Air Pollution, Carbon Footprint

The components of artificial turf are derived from fossil fuels, which have a number of troubling negative externalities: air pollution, water contamination, and CO2 emissions

contributing to global climate change as well as toxic pollution from short lived as well as "forever" chemicals and microplastics that use petroleum as the base. Adverse effects on soil organisms, birds and biodiversity have also been identified. The true costs of artificial turf have not been added in.

Alms (2016) gathered data for a life cycle analysis (LCA) of artificial turf using data from the Carnegie Mellon "Economic Input-Output Life Cycle Assessment" (EIOLCA) to identify artificial turfs "unfiltered environmental toll". She found that during the manufacturing process artificial turf:

- Released multiple air pollutants including carbon monoxide, CO2, nitrogen oxide, sulfur oxide, PM 10, PM2.5 and volatile organic compounds.
- Produced about 143 metric tons of CO2 released per field
- Used 4,985 kGal of water to produce one synthetic field, while about 1,290 kGal are needed to maintain a grass field per year.

Magnussen (2017) highlights the harmful substances from artificial turf that "may leach to water from infill of both new and recycled material." The authors also identified increased energy use and greenhouse gas emissions from excavation and transportation of soil and rock materials, production and replacement of infills, maintenance with plowing, brushing and raking of the artificial turf field. Also noted was that the end-of-life emissions from disposal with incineration caused the highest energy use and emissions. They state, "One study found that natural grass was environmentally favorable to artificial turf, however the result was opposite if impacts were divided with the number of playing hours provided (Cheng et al., 2014)". These facts, nothwithstanding, are only estimates and do not take into account differences in playability on sunny days or increasing temperatures with climate change or extreme weather events. They also fail to take into account any health care costs for those injured or ill, or any costs for loss of habitat, degradation of the environment or cleanup costs.

Royer (2018) examined hydrocarbon gas emission from polyethylene, which is the most produced and discarded synthetic polymer globally, and the main plastic used in artificial turf blades. The authors found that as polyethylene ages it emits both methane and ethylene and this increases with time. The authors note that "plastics represent a heretofore unrecognized source of climate-relevant trace gases that are expected to increase as more plastic is produced and accumulated in the environment." Royer noted in an interview, **"Synthetic turf has a lot more effect on the environment than anything else made of plastic."**

Celeiro (2018 and 2021) looked at leaching of chemicals from sports fields and found multiple chemicals of environmental concern that were continuously entering the water, as well as chemicals identified in the air. The authors concluded, "The transfer of target chemicals into the runoff water poses a potential risk for the aquatic environment."

Pochron (2018) found that aged crumb rubber and new crumb rubber posed similar toxic risks to earthworms, noting, "This study suggests an environmental cost associated with the current tire-recycling solution."

Zhu X (2021) states, in his article, **The Plastic Cycle – An Unknown Branch of the Carbon Cycle**, "It is clear that plastic pollution has become a major environmental issue of our time. Due to the low degradation rates of plastic, almost every piece of plastic that is produced is still somewhere on this planet." He suggests using the "terminology of biogeochemical cycles" to help scientists address this issue with sinks, reservoirs and fluxes to denote particles moving from one location to another. This would create the "plastic cycle" to better characterize the global nature of this problem.

Sanches-Sotomayer (2022) surveyed 21 parks with artificial grass and 24 parks with natural grass in 18 towns in autumn 2020 looking at differences in bird populations and biodiversity in artificial turf versus natural grass fields. The researchers found "The parks with natural grass always harbored higher gamma diversity, species richness and abundance… the trend of replacing natural by artificial grass in urban parks has harmful effects on urban bird communities and is a threat to bird conservation." **Bernart-Ponce (2020)** found a similar loss of house sparrows where natural grass has been replaced with artificial turf.

A Report by the Center for Climate Integrity, "The Fraud of Plastic Recycling: How Big Oil and the plastics industry deceived the public for decades and caused the plastic waste crisis," notes that industry knew for decades that most plastics cannot be recycled and that recycling plastic is neither technically nor economically viable. The report states, "Some types of "advanced recycling" may produce materials capable of being reprocessed into new plastic (plastic-to-plastic)—however, the majority of these processes produce waste or fuel (plastic- to-fuel), which do not qualify as recycling. As such, plastics cannot be meaningfully recycled through either method."

SB 54- CA 2024-The Plastic Pollution Prevention and Packaging Producer Responsibility Act

The artificial turf industry states that at the end of life at about 10 years, artificial turf will be collected for "advanced recycling". California bill SB 54 (2022) California mandates recycling of many single-use plastic items but excludes chemical recycling of plastic which means that making fuels from used plastic are excluded as a definition of recycling. Artificial turf thus does not necessarily qualify for recycling. (SB-54)

10. Water Quality and Contamination from Artificial Turf

Artificial turf plastics were found in 50% of river samples and comprised 15% of all plastics in the water. deHaan (2023) Artificial turf blades are typically composed of polyethylene and polypropylene plastic along with a multitude of other chemicals. With wear and tear and UV light this plastic breaks down into micro and macro-plastics. As artificial turf is an impervious substance, the surface water from the fields runs off into storm drains, streams, rivers and the ocean.

Researchers at the University of Barcelona in Spain in 2023 looked at 417 samples of river and surface waters including several waterways entering the ocean and found distinctive plastic from artificial turf in 50% of the water samples. They also found that "artificial turf fibers accounted for up to 15% of meso- and macro-plastic abundance." deHaan (2023), **"The dark side of artificial greening: Plastic turfs as widespread pollutants of aquatic environments**."

11. Environmental Benefits of Natural Grass

Benefits of Natural Grass

Water Conservation
Using drought resistant deeper rooted turfgrass, allowing for taller growth on turfgrass, using recycled water and following proper irrigation practices will lead to water conservation, as many fields s are overwatered. Recycled water in some areas may contain too much salt to place on artificial turf, which will cause degradation, thus fresh water is needed to irrigate these artificial turf fields (Coastal Commission 2023). Recycled water can be used on natural grass turf, even though the water may have a higher salt concentration, as turfgrass is typically salt tolerant. "Turf grasses, most annuals, and deciduous trees are more tolerant of saline water" and do not accumulate high levels of salt because of frequent mowing. (UCANR)

Groundwater Preservation and Recharge
Dense above ground turfgrass biomass traps and holds water which reduces excess runoff and allows more water to infiltrate into the soil, enhancing groundwater recharge.

Healthy Soil
Organic turf fields which are designed to use few or no pesticides support healthy soil bacteria and earthworm populations, which contribute to "increased macropore space in the soil, resulting in higher soil water infiltration rates, higher water holding capacity, and improved soil structure."

Restoration Ecology, Bioremediation and Soil restoration
Soil bacteria are also capable of breaking down organic pollutants in the environment, such as pesticides and other manmade pollutants. This concept is now being used in a process known as bioremediation as a less expensive and more effective option for cleaning up contaminated sites. (Alori 2022). Grass fields thus could help restore environmentally damaged areas, and at least prevent further land degradation and chemical pollution. Principles of restoration ecology can be used throughout the conversion of the Santa Clara County fairgrounds to reverse and repair some of the damage done to ecosystems and biodiversity. (Vaughn 2010)

Integrated Pest Management Programs (IPM) to Reduce Pesticide Use

There are many well established IPM programs in the US addressing pesticide use in parks, landscaping and agriculture. These are in cities, counties (Santa Clara County, San Francisco, Marin), universities (University of California, Massachusetts), as well as formulated by the US Department of Agriculture (USDA) and US EPA. All of these programs focus on alternatives to pesticides to reduce harm to the environment and human health. (See IPM in references)

Carbon Sequestration by Natural Grass

Studies have shown carbon sequestration could be higher or the same when one considers energy inputs for maintenance and highly managed fields. A study of turf growers in Australia showed a positive carbon sequestration among other benefits on turf farms.

Zirkle (2011) notes that "Lawns can be a net sink for atmospheric CO2 under all three evaluated levels of management practices [low to high]" and factoring in mowing, irrigating, fertilizing, and using pesticides.

Tidaker (2017) notes for golf course management the amount of fertilizer, watering and mowing can affect the greenhouse gas emissions and should be addressed to reduce carbon footprint and increase carbon sequestration.

Cumming J (2018). Environmental Assessment of the Australian Turf Industry.
The authors state, "The lifecycle assessment involved a review of five turf installation sites over one year. It showed that a well-maintained patch of turf is environmentally healthy, conserves natural ecosystems and will continue to sequester carbon dioxide from the atmosphere through the growth of soil organic matter… This study has also shown that all turf growers were able to provide a carbon positive product with net sequestered carbon dioxide averaging 1.6 kg of CO2eq per square meter of turf produced1… or 48,000 Tonne of CO2eq per year."

11. Environmentally Friendly Organically Managed Natural Turf Fields

Natural grass fields can provide a long-term, cost-effective, high-performance surface for athletic activities. Thoughtful management of natural grass organically improves the health of the soil and grass by supporting a reach microbial environment and promoting a strong root system that withstands wear. In addition, there is no need to put synthetic toxic pesticides or fertilizer on the fields. Water use may be reduced as well.

To reduce the risks of chemical exposure and to protect water quality some cities and schools have chosen to rehabilitate or rebuild natural grass turfs or replace artificial turfs with natural grass, learning how to maintain them organically, in a more ecological way with lower water inputs and with longer playability. These playing fields are living carbon sinks which contribute to biodiversity by their non-toxic nature and cooling effect that supports surrounding greenspaces, as well as living organisms such as bacteria, fungi, earthworms and birds. They also protect the health of humans and the environment.

Building an Organic Maintenance Program for Athletic Fields: Guidance from Experts and Experienced Communities. Toxics Use Reduction Institute, University of Massachusetts (TURI).

The key management elements used for increased performance and lower costs include:

- Aeration of the soil
- Proper irrigation and drainage
- Adjustments for mowing
- Soil testing for pH, moisture, nutrients and beneficial microorganisms
- The use of organic fertilizer
- Soil amendments

Examples of healthy safe natural grass turfs_

Marblehead, MA: In 1998 the Marblehead Board of Health adopted a policy to reduce pesticides for the health and safety of children and families. Since 2002 all of Marblehead's playing fields have been managed organically, using integrated pest management (IPM) techniques. It was noted that in the past they have only closed the field for high rainfall, however, in 2018 "the fields were closed five times due to rain and twice due to extreme heat. Each was a one-day closure. The heat-related closures were the first that the town has experienced."
Start Date: 2002
Acres: 20 acres
Hours of Use: 1360 hours
Maintenance Cost: $4,250 - $4,500 per acre
Cancellations: 7 times

Springfield, MA. In 2014 Springfield received support through a grant to implement organic land care and grass turf management practices on municipal and school properties. The city started with six test pilot cases and grew to 12 organically managed sites by 2019, including multiuse or single use fields. One of the multiuse sports parks, Forest Park Baseball and Soccer Complex, which is open 7 days a week, tallied 3,300 hours per year of use. For strictly soccer use Treetop Park Full-Sized Soccer Field there was 1,051 hours per year of use.
Start date: 2014
Acres: 67 acres
Hours of use: 3,300 for multipurpose and 1,051 for soccer
Total Annual Maintenance Cost: $98,080 for 12 fields
Cost per acre: $1,460.

Martha's Vineyard, MA. In 2017, a group of Martha's Vineyard parents established The Field Fund, Inc to provide support to Martha's Vineyard schools and towns to improve their grass playing fields using organic practices. By September 2020 **The Field Fund** was supporting five athletic field complexes. Using organic practices, the schools and parks were able to meet all of their use needs, with only a few cancellations due to weather-related field conditions. In 2019 none of the 5 athletic fields were closed.

Start Date: 2017
Area: 5 sports and recreational fields
Total Annual Maintenance Cost: $65,600
Cost per acre: $7620.

Grass Sports Fields on Colleges and Universities

Snapdragon Stadium at San Diego State University was placed in 2022 and is popular with athletes and spectators.

Texas A&M. Ellis Field opened in 1994 and still has natural grass (Tifway Bermuda) . https://12thman.com/facilities/ellis-field/9

University of Arkansas in 2019 replaced artificial turf with natural grass**.**

The Sports Field Management Association every year presents awards to the best natural grass sports fields that "exhibit excellent playability and safety and whose managers utilize innovative solutions, effectively use their budgets, and have implemented a comprehensive agronomic program. Five sport fields receive awards- baseball, football, softball, soccer, and sporting grounds. These are given to schools and parks, colleges and universities as well as professional fields throughout the Unites States. These awards promote natural grass sport fields for safety, quality and beauty. Prior winners were

- Jack Trice Stadium Iowa State University. Ames, IA
- Ryan Field. Northwestern University. Evanston, IL
- Folsom Field University of Colorado. Boulder, CO
- Ben Hill Griffin Stadium. University of Florida. Gainesville, FL
- Spartan Stadium. Michigan State University. East Lansing, MI
- Scott Stadium. University of Virginia. Charlottesville, VA
- Kyle Field. Texas A&M University. College Station, TX

12. Water Use of Artificial Turf Versus Natural Grass

Water is a limited and precious resource. One argument made to choose artificial turf over natural grass is the low water use compared to natural grass fields. A closer look at this shows that the differences are not as dramatic as claimed when a life cycle analysis is performed that includes manufacturing costs and irrigation for cooling. In in hotter, dryer climates where artificial turf is supposed to be most beneficial more water is used to cool

the field for players to extend use and reduce risks of heat related illness. Kanaan (2020) noted comparable water use for artificial turf and natural grass in hot climates in order to keep the temperature the same.

Alms (2016) looked at Carnegie Melon 2015 data on lifecycle analysis of production and found that the amount of water used to manufacture artificial turf was 4,985 kGal of water to produce one synthetic field, while about 1,290 kGal are needed to maintain a grass field per year. Thus, the **manufacturing of artificial turf itself equaled 4 years of natural grass irrigation not counting watering in hot weather or surface cleaning.**

Kanaan et al (2020) performed a study at New Mexico State University to evaluate the amount of water required to maintain surface temperatures comparable to those of natural turfgrass areas. They noted that, "In arid and semiarid climate zones the surface temperature of the artificial turf fields can exceed 80°C[176 degrees Fahrenheit during the summer, requiring irrigation and drainage systems to keep them cool enough for use…. The model indicates that over a 24-hr period, **the amount of water (3.00 to 5.00 mm) required to maintain artificial turf at temperatures similar to irrigated natural turfgrass are *comparable*."**

Artificial Turf is *Not* Drought Tolerant Landscaping

Regarding water use, the Santa Clara Valley Water District's Landscape Rebate Program for water conservation no longer includes artificial turf as they recognize that, "there are healthier and more ecologically sound alternatives". California Senate Bill 676, signed into law Oct 8, 2023 by Governor Newsom, specifies "that drought-tolerant landscaping does *not* include the installation of synthetic grass or artificial turf. [and]… drought-tolerant [natural] landscaping is a viable landscaping alternative that will further the goal of addressing long-term water conservation."

Recycled Water Can Be Used on Natural Grass but *Not* on Artificial Turf

The California Coastal Commission in 2023 rejected an artificial turf baseball field at University of California Santa Barbara due to water quality impacts. They noted that **recycled water could not be used on the fields** due to its high salt content but recycled water could be used on hardy natural turfgrass.

13. Cost of Synthetic versus Natural Turf: Lifecycle Analysis

As cities and counties struggle with their limited budgets cost considerations become a central concern. Which is cheaper artificial turf or natural grass? While the narrative has been that artificial turf costs less, an analysis of the entire life cycle of artificial turf versus natural grass by Daviscourt (2017) shows that using natural grass was cheaper in the long run. For grass fields there is initial equipment costs and it is noted that, maintenance decreases exponentially when additional fields are added. One full time skilled sports field

manager can maintain multiple fields. The disposal and replacement costs for a new field turf about every 8 to 10 years also need to be accounted for. Warranties for artificial turf are typically 8 years.
Identifying a complete lifecycle analysis for artificial turf versus natural grass is challenging due to variables and reviews seem to lack some of the direct or indirect costs, however, many articles provide some estimates. The additional costs for synthetic turf are described below and can be quite significant.

The Toxics Use Reduction Institute (TURI) performed a comprehensive cost analysis of artificial turf versus natural grass fields in 2015. They note that costs vary substantially depending on the type of field and the level of maintenance. They state, however, that "artificial turf fields have a higher life-cycle cost than natural grass fields. Once established, organic management of natural grass can be even more cost effective than conventional management of natural grass." In addition, nonprofit groups such as The Field Fund have been created to help fund rebuilding or installing natural grass fields in schools and cities.

- **Installation costs for** an artificial turf field was about $1,223,829. Infill costs varied from $50,000 for crumb rubber to $451,000 for "organic infill" .
- **Maintenance costs** varied widely for both with estimates from $13,720-$39,220 for synthetic turf to $8,133-$48,960 for a natural grass field.
    - **Maintenance of artificial turf systems** includes "fluffing, redistributing, and shock testing infill; periodic static control and disinfection of the materials; seam repairs and infill replacement; field line erasing and repainting; organic matter removal; and watering to lower temperatures on hot days."
    - **Maintenance of natural grass** can include "irrigation, mowing, fertilizing, replacing sod, and other activities. A soil and grass health assessment of the field is needed to establish an appropriate maintenance program. Maintenance of a natural field may be minimized by substituting full field replacements and seam repairs with spot sod replacements

Daviscourt (2017) study noted, "The results of this case study support what has previously been estimated in the literature: synthetic fields cost more to install than natural turfgrass fields… The average cost of the life-cycle analysis for natural grass was $821,000 and for synthetic infill was $1,767,000."
The initial cost for artificial turf is about $1,350,000-$2,000,000. Synthetic soccer turf fields last about 10 years as synthetic turf breaks down and becomes a safety, playability and aesthetic issue. It then needs replacement that costs $350,000 to $650,000 per artificial turf field, not counting any work needed on the base layer or drainage (Sports Venue Calculator). This is an added long-term cost for replacement added into the disposal costs. There are typically no replacement costs for natural grass.

The University of Arkansas came to the same conclusion noting increased maintenance costs of artificial turf. The costs for artificial fields included:

- Installation Costs: More extensive subgrade work for artificial fields

- Annual Maintenance: Additional infill, chemical disinfectants, sprays to reduce static cling and odors removal of organic matter, erasing and repainting temporary lines, irrigation because of unacceptably high temperatures on warm-sunny days.
- Replacement Costs of synthetic turf vs grass
- Disposal costs: Due to complex plastic components a special disposal fee is often needed.

Sports Field Manager Jerad Minnick, who has managed both natural and artificial playing fields collected data on costs. He states, "Existing turfgrass managers, provided with a few tools, can produce a low-cost, environmentally friendly field. In an age of needed job creation, committing money to maintain grass fields instead of building synthetic will create numerous new environmentally friendly jobs in the sports and park industry." He also notes that for "grass fields, the cost numbers for maintenance decreases exponentially when additional fields are added." Below is cost data for different quality of fields. Although this is from 2013 the initial costs for artificial turf as well as disposal fees have increased. Minnick notes there is debate about durability of artificial turf and highlights that artificial turf can fail. This was noted in a WTHR news report showing that some turf fields sold to schools and universities were wearing out more rapidly and had to be replaced. Warranties are typically for 8 years of use.

- Synthetic Professional: $1,000,000
- Natural Grass Professional*: $600,000
- Synthetic, Practice/ Tournament: $850,000
- Natural Grass Practice/ Tournament*: $350,000
- Natural Grass Youth Field*: $150,000

Sports Venue Calculator (SVC) also showed that there is a range of costs for both, however, artificial turf is more expensive in terms of construction. Maintenance is generally in the same range to slightly more expensive for natural grass but this does not take into account disposal and replacement fees.

- Construction Costs Artificial Turf- $700,000 - $1,500,000
- Construction Costs Natural Grass Field- $400,000 – $820,000
- Maintenance Cost Artificial Turf per year $6,000 - $10,000
- Maintenance Cost Natural Grass Field per year- $18,000-$44,000

14. Year-Round Grass Playing Fields- The Grass is Always Greener

An argument made is that artificial turf withstands all weather and has more playing days. This may be true for winter sports at times, however, natural grass can be maintained with proper management in the winter (Neylan 2021). In hotter spring or even typical summer days artificial turf may be unusable. Artificial turfs must be constantly monitored if the outside air temperature is above 90 degrees and in sunny weather. In even moderate temperatures artificial fields can be unusable. This feature is not always calculated in field use data. Liu and Kim (2021) note the increased

vulnerability of children to heat related illness along with in increased risk of heat related illness on artificial turf. They found children suffer a 24% longer *Extreme danger* duration on artificial turf on sunny days than natural grass.

15. Mental Health and Wellbeing: Synthetic Turf Displaces Natural Green Space

Prior to 1970's all parks and sports fields were natural soft grass. Children and adults sat down on the grass, shared food and chatted. Small flowers often grew in the grass to create meadows. The use of synthetic fields displaces natural green spaces which are also important to the health, development and wellbeing of children. The tactile and sensory benefits of real grass are lost with artificial turf. Natural green spaces can reduce stress and improve wellbeing. (Zhang 2020) notes, "It is evident that time spent in, or exposure to, green space can improve positive mood and emotions, provide a retreat from daily hassles, and reduce the risk of psychological and physiological stress in adolescents. There is also evidence of lasting mental health benefits of green space exposure in childhood."

"Today's children largely grow up in synthetic, indoor environments. Now, with the growing popularity of synthetic turf fields, their experience with nature will be less than ever." (Claudio 2008) Athletes by far prefer playing on real grass (Owen 2016)

16. Policies to Ban Artificial Turf or Components

The concerns for harmful plasticizers and microplastics in artificial turf, long-term effects on children's health as well as life cycle analysis have led to policies to ban artificial turf altogether as well as ban specific toxic components. Zucarro (2022) reviewed policies on synthetic turf and wrote, "While nearly every country acknowledges the potential health risks posed by heavy metals, microplastics, PAHs, and PFAS chemicals, very few have actually implemented artificial turf and crumb rubber infill regulations and/or established adequate surveillance measures to protect those regularly exposed to the fields." Governments in the US and abroad are restricting the use of artificial fields with crumb rubber or certain hazardous plasticizers (EU and California) due to environmental bio-accumulation of toxic chemicals.

Montgomery County, Maryland banned the use of tire crumb on any newly constructed artificial turf fields due to health concerns in 2015.
[https://moco360.media/2019/11/18/turf-war/3/]

Westport, Connecticut banned crumb rubber in 2017 and passed an "Ordinance prohibiting the application of synthetic infill material on playing fields on town property," David Brown, a Westport resident with a doctorate in toxicology from Harvard University, formerly headed up a toxicology group at the state health department. He testified in favor of the synthetic infill ban and stated, "The primary problem with turf is

the off-gas from particles that contain toxic and carcinogenic chemicals. When people ingest the crumb rubber, the toxic chemicals are released in their body."

In 2021 the European Union (EU) expanded the scope of restriction of the eight polycyclic aromatic hydrocarbons (PAHs) in infill material in synthetic turf use on playgrounds or sports fields.

Boston banned artificial turf in parks due to toxic 'forever chemicals in 2022.

Holland is banning crumb rubber infill on artificial turf fields due to soil pollution under the turf.

Oak Bluffs Board of Health Banned Turf Fields. Martha's Vineyard, Massachusetts. April 23, 2024. https://vineyardgazette.com/news/2024/04/23/oak-bluffs-board-health-bans-turf-fields

California SB 676 (2023) reverses in part AB 349 (2015) to prevent city or county bans on drought-tolerant landscaping and specifies that "drought-tolerant landscaping does not include the installation of synthetic grass or artificial turf."

San Marino, California (2023) placed a temporary extended moratorium on Oct 27, 2023 banning the use of artificial turf or synthetic grass within the city (Ordinance No. O-23-1410.)

Millbrae, California (2023) banned artificial turf in 2023 in all areas of the city (Ord. 806, § 1).Chapter 8.65).

Sunnyvale, California in October 2023 rejected a proposal to place artificial turf athletic field in a park renovation.

Conclusion

There has been no proof of safety for artificial playing fields and there are many data gaps. Few studies exist on the health impacts of artificial turf, while numerous chemicals hazardous to human health and the environment are found in artificial turf and its leachate (Murphy 2022). There is growing evidence that significant environmental, as well as, health and safety risks outweigh the presumed benefits of artificial fields. It appears that natural grass is less expensive when a full life cycle analysis is performed. In addition, natural grass prevents storm water runoff of toxins and provides living carbon capture as well. Water use on artificial turf is not as low as stated with a full life cycle analysis. Considering that studies on the risks of long-term health have not been performed, along with absence of comprehensive data on the hazardous chemical components of artificial fields we recommend:

1) Not to place artificial turf on playing fields, and
2) Should artificial turf already be present, to replace this with natural grass

Children are increasing exposed to many toxins in the environment. As physicians we advocate for reduction in toxic exposures to reduce individual harm, societal harm, and health care costs which are rising. A precautionary preventative health approach is recommended to avoid unintended consequences and unintended downstream costs.

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Note: After Legislation and Reports other References are in alpha order as follows- Articles Scientific; Artificial Turf Components and Additives; Bans Artificial Turf; Cancer and Chemical Question; Chemical and Plastic Exposures and Contamination; Children's Vulnerability to Toxins; Climate Change; Costs; Disposal and Recycling; Environmental Benefits of Natural Grass; Environmental Impacts of Artificial Turf; Health and Safety; Heat Related Illness and Urban Heat Effect; Infections; Injuries – Sports(and athletic prefernces); Laws and Policy; Lawsuits and Litigation; Letters; Mental Health and Greenscapes; Natural Grass Field Examples; News Articles; PFAS; Videos; Water Use; Water Quality and Contamination.

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