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SCARSDALE FORUM INC.

Report of the Sustainability, Municipal Services, Parks and Recreation Committees On Health, Safety, Environmental Impacts and Exposure Risks of Synthetic Turf Recreation Fields and Courts

The Scarsdale Forum Sustainability, Municipal Services, Parks and Recreation Committees (the "Committees") propose the following Resolution for adoption by the Forum:

> RESOLVED, that the Report of the Committees – recommending that the Village of Scarsdale and School District should (1) place a moratorium on the installation of new artificial turf athletic and recreation fields and courts, (2) consider eventual replacement of existing artificial turf with natural grass turf in view of the health, safety, environmental impacts and exposure risks of artificial turf, (3) investigate, assess and report to the community on the health, safety, environmental impacts and exposure risks associated with the use of synthetic turf athletic and recreation fields and courts in the Village, and (4) evaluate the relative durability and cost of installation, maintenance, replacement and disposal of artificial turf fields and courts compared with natural grass fields and courts – be approved.

Summary of Primary Recommendations

The Committees recommend that the Village of Scarsdale (the "Village") should: (1) place a moratorium on the installation of new artificial turf athletic and recreation fields and courts, (2) consider eventual replacement of existing artificial turf with natural grass turf in view of the health, safety, environmental impacts and exposure risks of artificial turf, (3) investigate, assess, and report to the community on the health, safety, environmental impacts and exposure risks associated with the use of synthetic turf athletic and recreation fields and courts in the Village, and (4) evaluate the relative durability and cost of installation, maintenance, replacement and disposal of artificial turf fields and courts compared with natural grass. Based on the potential for negative health impacts to the children and adults who play on artificial turf surfaces, and to coaches, referees, and spectators, and negative impacts to the environment and public in general as set forth in this Report, a moratorium is the prudent course for the Village and School District to take to ensure public health, safety and protection of the environment.[1]

[1] See Beyond Plastics, "Synthetic Turf is HAZARDOUS, https://www.beyondplastics.org/fact-sheets/synthetic-turf . See also Beyond Plastics, "Model Synthetic Turf Local Moratorium," https://docs.google.com/document/d/1NyxnM8lmQayqSaaXNyDFppgMVFzuwNitEX9TmydtOM4/edit?tab=t.0 ; Sample Fact Sheet, https://drive.google.com/file/d/10OFCqUS_U_WKVrS5cd0gKRaOM4dgfzMm/view; GrassRoots Environmental Education, Artificial Turf | Grassroots Environmental Education.

Introduction

The purported practical advantages of artificial turf fields and courts—as represented in industry literature and by artificial turf consultants—typically downplay or ignore the health, safety and environmental hazards of artificial turf and instead promote the perceived advantages such as no requirement for mowing, pesticides or fertilizers, increased playability, a longer playing season and fewer game cancellations, and savings in the use of water for irrigation.[2] Significantly, the members of the Scarsdale Village Board-appointed Conservation Advisory Council (CAC) submitted a letter to the Board on December 5, 2024 in opposition to the use of artificial turf in the Village as has been recently proposed in a field study by Village engineering consultant CHA.[3] The CAC cites multiple concerns in regard to artificial turf impacts on human health as well as widespread adverse exposure risks and environmental impacts. The CAC letter also notes the distinct benefits of natural grass over artificial turf. A copy of the CAC letter is annexed to this Report as Appendix A. Regrettably, although the scope of the proposed project is ambitious, the stated purpose for extensive installation of artificial turf athletic and recreation field and court installations in Scarsdale makes no mention of health, safety, exposure risks or environmental impacts:

> "**Project Purpose**
> • The comprehensive athletics field study will include outdoor field sports and configurations, including baseball, soccer, softball, lacrosse, tackle football, field hockey, flag football, rugby, cricket, kickball, track and field, and ultimate Frisbee.
> • This study also includes outdoor court sports, including tennis, basketball, paddleball, pickleball, and volleyball.
> • Field uses include both youth and adult activities. The study addresses gaps in service for all levels of participation locally but will also identify facilities needed to compete on a local, regional, and state level.
> • Stakeholders from all identified sports and associated agencies have been contacted to understand their current, short-term, and long-term needs to successfully provide opportunities for all ages, abilities, and economic backgrounds.
> • The main purpose is to establish recommendations for the improvement of recreation and athletic facilities in Scarsdale."[4]

[2] See, e.g., "SYNTHETIC TURF, INDUSTRY'S CLAIMS VERSUS THE SCIENCE, A Careful Analysis of Studies That Industry Uses to Justify Safety Claims" (2017), https://www.ehhi.org/NewTurf_Final.pdf . See also position of the Synthetic Turf Council, an industry group, https://www.syntheticturfcouncil.org/. Meanwhile, proposed action by the New York State Legislature "establishing a moratorium on the installation of synthetic turf pending a comprehensive environmental and public health study" appeared to be stalled in committee as of the date of this Report, https://www.nysenate.gov/legislation/bills/2023/S7239 .

[3] Founded over 70 years ago by John Clarkeson as Clarkeson Engineering Co., the firm began "work on interstate roadways from Boston." The firm moved to Albany, NY, in 1955 and is now known as Clough, Harbour & Associates or "CHA." Its online profile states that its "expertise covers civil and environmental, electrical and mechanical, structural, geotechnical and survey teams, and that, ironically, "CHA also develops a set of guiding principles highlighting their commitment to improve the communities where we live and work — most notably, the aspiration to **responsibly improve the world we live in**." (Emphasis added). See About CHA Consulting | Leadership | Innovative, Full-Service Engineering, Design, Consulting & Construction Management | CHA.

[4] Comprehensive Athletic Field & Court Study, Village of Scarsdale | Scarsdale UFSD, Public Outreach Meeting #2, October 22, 2024, page 3, https://drive.google.com/file/d/1-zgFbhJg-LnDKlk1duUyuDpgH71W7wLd/view, (referred to in this Report as "CHA October 22, 2024 Study" or "CHA Study") (find also at Scarsdale Public #2-DRAFT 10-22-2024.pdf - Google Drive).

CHA's Study lists numerous field and court "improvement" suggestions, ostensibly gathered during its Scarsdale community outreach:

> "**Desired Improvements**
>
> **Synthetic Turf Fields and New Courts**
>
> • All sports expressed a strong desire for synthetic turf fields for increased play, extending seasons, and allowing for play after rain events
> • Varsity softball field at the high school
> • Additional 60/90 baseball field and softball fields
> • More volleyball/basketball courts
> • Install permanent pickleball courts
>
> **Improving Existing Natural Grass Fields and Courts**
> • Fix drainage issues/flooding
> • Address uneven playing surfaces
> • Resurface tennis and basketball courts
> • Convert elementary school baseball/softball fields to full skinned basepaths/infields and include proper mounds
> • Update/add fencing and dugout concrete pads at baseball/softball fields
>
> **Accessory Additions / Improvements**
> • Lights installed at one or more fields
> • Bathrooms or bathroom access at facilities where there isn't any existing
> • Concessions and storage space
> • Equity of fields/field scheduling – review field allocation process to determine if there are opportunities to improve field use and ability to rest fields."[5]

The Village already has two impervious artificial turf recreation fields on the High School campus at Butler Track and Field, where synthetic turf was replaced in 2020, and at Dean Field, installed two years ago. They both have significant drainage issues with poor/no drainage causing pooling as well as drainage backup and prolonged saturation of water runoff areas after storms.[6] Village consultant CHA proposes installing many more artificial turf fields and courts as described on pages 16 to 28 of its October 22, 2024 Study, in which it also provides estimated cost comparisons of artificial turf to grass on pages 23-25 and 28.

Notably, the grass turf recommendations for the Village and schools include improved drainage at exponentially lower cost than construction of new turf fields. Meanwhile, the cost of initial construction alone of proposed artificial turf fields and courts would cost millions of dollars more than the care of the

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[5] Id., CHA October 22, 2024 Study, page 10. See "Surveys / Interviews / Public Meeting Key Themes" discussed below. See also CHA Comprehensive Athletic Field & Court Study, Village of Scarsdale | Scarsdale Free School District, Public Outreach Meeting #1, May 23, 2024, https://www.scarsdale.gov/AgendaCenter/ViewFile/Agenda/_05232024-1277 ("CHA May 23, 2024 Study").

[6] CHA May 23, 2024 Study, (task-bar) pages 21-22, devoted to Scarsdale HS-Butler [Track &] Field and Scarsdale HS Dean Field, https://www.scarsdale.gov/AgendaCenter/ViewFile/Agenda/_05232024-1277.

organically treated natural turf.[7] In addition, artificial turf fields will require removal and replacement approximately every 8-10 years, incurring costs similar to those of initial installation on a recurrent basis.

> **"Recommendations – Big Picture**
>
> **Village**
> Crossway Field - Option 1
> • Synthetic turf fields #1 and 2 (baseball, football, lacrosse) and #4 and 5 (soccer, possible lacrosse)
> • Install netting along Mamaroneck Road
> • Construct 6 pickleball courts
> • Relocate the three hard court tennis courts to bowling green area (replace tennis court area with parking)
> • Improve parking, circulation, and restrooms
> Crossway Field - Option 2
> • Above improvements to Crossway Field with current drive location remaining and fields #4 and #5 to remain as existing with improved turf grass and drainage
> Boulder Brook – Option 3
> • Adds synthetic turf multi-purpose field (2 baseball/softball diamonds and 330'x180' Multi-purpose field with soccer and lacrosse)
> • Improve turf grass and drainage on existing east field to remain
> • Add access drive and parking, support building
> **Schools**
> Middle School
> • Synthetic turf the entire play area with two rectangular fields, multiple smaller fields
> • Add two 46'/60' 50'/70' fields for baseball and softball use
> • Construct two new basketball courts
> High School:
> • Add varsity softball field at the High School
> **Village and Schools: Improvements detailed on Slides 26-27[8]**
>
> **Why / Benefits**
> • These recommendations provide options for additional synthetic turfs fields for the community on both village and school fields
> • They benefit six field programs: Baseball, Football, Soccer, Softball, Lacrosse and Field Hockey
> • They benefit three court programs: Basketball, Pickleball, and Tennis
> • There are also recommendations to improve existing natural grass fields outlined on the following slides (24 and 25)"[9]

Support for artificial turf was observed, during "site walk throughs, interviews with key user groups, discussions with staff, and public feedback from prior meetings" as noted by CHA:

[7] CHA October 22, 2024 Study, page 23.

[8] CHA October 22, 2024 Study, page 16.

[9] CHA October 22, 2024 Study, page 22.

"Surveys / Interviews / Public Meeting Key Themes

Playability of existing fields:
• Most fields have drainage issues particularly after rain events and fields are closed quite a bit due to wet conditions.
• Winston Field (Lower Boulder Brook) is the most underused field due to wet soil conditions/drainage issues. Can only be relied on for
practice, if games are scheduled there, they often get postponed or canceled.
• Scarsdale Middle School is perceived as having the most opportunity and is currently underutilized.
• Recognition of the need to support field conditions through passive rest.
Insufficient capacity:
• Perception of not enough time scheduled for some sports.
• Conflicts in desired times with other ISO's and school sports.
• Not enough outdoor basketball courts for competitive play (indoor court facilities not in this study, but also identified as a concern).
• Some fields lack amenities / bathrooms.
Planning and Communication:
• Would like to see a clear roadmap for implementing improvements.
• More policies between village and school uses/priorities established.
• Phasing improvements equitably both between sports and gender.
• Efficient use of dollars and land to get the most bang for the buck and help the most people.
• Pickleball noise concerns – placement of pickleball courts."[10]

Besides the above topics, the CHA study and site analysis includes the public outreach process; a graphic review of numerous park and school field sites; projected usage of sites in both the Village and schools; a surrounding communities comparison; recommendation on number of fields and courts; field and court site specific recommendations; and a grass and synthetic turf cost comparison, among other topics.[11]

Omitted from the CHA Study is any reference to or analysis of the potentially significant human health and environmental hazards inherent in the chemistry and structure of the backing, synthetic turf fibers (yarn), and infill materials used in the manufacture and maintenance of artificial turf fields. These hazards, which are the focus of this Report, include, but are not limited to: the high heat absorbing properties of outdoor synthetic surfaces; the lead and other metal and toxic chemical exposures not only to children and adult athletes, but also to coaches and spectators; the toxic rainwater run off (leachate); the contaminants to ground and drinking water that the general public consumes; the need for stormwater management associated with impervious, synthetic turf; the off-gassing and inhalation of toxic chemical plastic byproducts and heavy metal vapors; the risk of antibiotic resistant bacterial infections from skin scraping and injuries on non-forgiving synthetic turf; the persistence of harmful bacteria on polyethylene plastic turf blades; the

[10] CHA October 22, 2024 Study, page 9.

[11] CHA October 22, 2024 Study, pages 8-28.

maintenance costs and short life span of a typical synthetic turf field of 8-10 years;[12] high disposal costs and long term environmental and human health impacts of microplastic fields and courts relegated to landfills or incinerated; the loss of green space; and the need for costly long term soil remediation in order to replace synthetic turf with natural grass turf. The list of hazards becomes even more troubling when adding the potential for ingestion of crumb rubber fill;[13] exposure to carcinogenic or hormone disruptive chemicals, metals and lead; irritant-induced, allergic and asthmatic reactions to skin and mucous membranes, eyes and the respiratory system including but not limited to the lungs; higher rates of musculoskeletal injury and dermal abrasions; higher surface temperatures leading to heat exhaustion and heat stroke; systemic effects on the liver, kidneys and endocrinologic including reproductive systems; and neurotoxic responses including developmental effects in young children who play on synthetic turf. These are just some of the potential negative health impacts of the use of synthetic turf on playing fields which are cited by health, epidemiological and environmental professionals.[14] Research is ongoing, but there are many legitimate concerns about the potential hazards of artificial turf fields.[15]

As an International Policy Review paper concludes: "**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."**[16] Although the European Union has the most comprehensive regulations concerning PAHs, microplastics, and PFAS, and includes direct consideration of artificial turf and crumb rubber infill, other regions like the U.S. and Canada have regulations on the substances but have not established exposure limits for artificial turf and crumb

[12] M. Silgailis, A. Goldsmith, "The Turf is Artificial, But the Harm is Very Real" (Clean Water Action, 2024), https://cleanwater.org/2024/09/16/turf-artificial-harm-very-real#:~:text=Artificial%20turf%20contains%20hundreds%20of,%2C%20and%2For%20endocrine%20disruptors.

[13] Crumb rubber is particulate manufactured from recycled car and truck tires and tire retreads that is used for fill material between synthetic turf fibers.

[14] See, e.g., Valeriani F, Margarucci LM, Gianfranceschi G, *et al*, "Artificial-turf surfaces for sport and recreational activities: microbiota analysis and 16S sequencing signature of synthetic vs natural soccer fields" (Artificial and natural turfs show own ecosystems with different microbial profiles and a mean Shannon's diversity value of 2.176 and 2.475, respectively. The bacterial community is significantly different between facilities (ANOSIM: $R = 0.179$; $p < 0.001$) and surface materials (ANOSIM: $R = 0.172$; $p < 0.005$). **The relative abundance of potentially pathogenic bacterial OTUs (operational taxonomic units) was higher in synthetic than in natural samples (ANOVA, F = 2.2)),** https://doi.org/10.1016/j.heliyon.2019.e02334.

[15] See, e.g., New Jersey Dept. of Environmental Protection, Technical Memorandum, "PFAS in Artificial Turf" (Feb. 8, 2023) ("There is growing concern about sources of PFAS to the environment as reports have shown widespread levels of PFAS in soils, surface water, and groundwater at levels that could impact human health. It is with this in mind that the Division of Science and Research has reviewed current literature and related reports that may provide some information on the potential contribution of PFAS to the environment from the placement of artificial turf (AT)….This memo follows an earlier memo on the human health impacts, specifically heat exposure, and stormwater management concerns related to artificial turf, provided by DSR to the program on June 23, 2022."), https://dep.nj.gov/wp-content/uploads/dsr/pfas-artificial-turf-memo-2023.pdf.

[16] Philip Zuccaroa, David . Thompson, Jacob de Boer, *et al.*, "Artificial Turf and Crumb Rubber Infill: An International Policy Review Concerning the Current State of Regulations" (2022, Elsevier B.V. Open Access), https://www.sciencedirect.com/science/article/pii/S2667010022001767/pdfft?md5=f1632c80d36d410b449a046d14b0afc1&pid=1-s2.0-S2667010022001767-main.pdf (cited below as "International Policy Review").

rubber infill. There is a clear need for more comprehensive research to fully understand the health effects of these materials and to inform policy making. Any lack of conclusive studies and reliable information about the health effects of artificial turf substances also hinders legislative decision-making. More comprehensive research is needed to fully understand the long-term health impacts of exposure to these chemicals in artificial turf.[17] In the meantime, based on known toxicities of artificial turf components and their demonstrated human uptake, contamination to the environment, as well as other potential harms outlined in this Report, the Scarsdale Forum recommends a moratorium on the installation of new artificial turf fields and courts and makes additional recommendations in this Report consistent with that approach.

What is Artificial Turf

Third generation artificial turf surfaces were developed in the 1990s to more closely resemble natural grass consistency and fiber morphology. Components are the backing, infill, and turf fibers (also referred to as yarn). The infill is usually a combination of polyethylene fibers woven on a mat with spaces filled with rubber and sand particles to a height of two-thirds or more of the fiber height. This is meant to "recreate" the dirt between natural grass blades, providing a turf feel. Older, first-generation surfaces developed pre-1970s contained nylon fibers with no fill. Second generation surfaces used polyethylene fibers with sand infill but no rubber. Current, third generation turf fibers are made with nylon, polypropylene or polyethylene melted pellets that are mixed with other chemicals and additives that change the color and preserve the material.[18]

Artificial turf is thus far from "green." The human health risks associated with widely used third generation artificial turf primarily stem from the chemicals contained in the turf fibers and crumb rubber infill. **And artificial turf is a significant source of microplastic pollution in the environment, including the oceans.**[19] These chemicals include:

"1. Polycyclic Aromatic Hydrocarbons (PAHs): Many PAHs are known carcinogens and can pose serious health risks through prolonged exposure.
2. Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS): These "forever chemicals" are resistant to degradation and can accumulate in the human body, potentially causing immunotoxic effects, reproductive and fetal health issues, endocrine disruption, and some are carcinogenic.

[17] Id. See also B. Langenbach, M. Wilson, "Per- and Polyfluoroalkyl Substances (PFAS): Significance and Considerations within the Regulatory Framework of the USA" (Int J Environ Res Public Health. 2021 Oct 23), https://pmc.ncbi.nlm.nih.gov/articles/PMC8583519/;

[18] Drakos MC, Taylor SA, Fabricant PD *et al*. Synthetic Playing Surfaces and Athlete Health. J Am Orthop Surg. 2013. 21:293-302, https://pubmed.ncbi.nlm.nih.gov/23637148/ , full text at: https://www.researchgate.net/publication/236603564_Synthetic_Playing_Surfaces_and_Athlete_Health; Synthetic Turf; History, Design, Maintenance, and Athlete Safety - PMC - PubMed Central (PMC) 2018, https://pmc.ncbi.nlm.nih.gov/articles/PMC6299344/ ("In recent years, there has been increasing focus on injury prevention in sports. . . .researchers are considering how nonplayer factors such as protective equipment and the playing environment relate to athletic injury. Introduced more than half a century ago, synthetic turf has recently come into the spotlight as an important factor in sport....").

[19] A. Alfaro-Nunez, et al, Microplastic pollution in seawater and marine organisms across the Tropical Eastern Pacific and Galapagos (Scientific Reports Mar. 19, 2021), Microplastic pollution in seawater and marine organisms across the Tropical Eastern Pacific and Galápagos - PubMed.

3. Heavy Metals: Elements such as lead, cadmium, and zinc are present in crumb rubber infill and can have adverse effects on human health, particularly in children, who are more vulnerable.
4. Volatile Organic Compounds (VOCs): Substances like styrene and formaldehyde can be released from artificial turf, posing inhalation risks.
5. Microplastics: These non-biodegradable particles can accumulate in the environment and potentially enter the human body through various pathways, leading to unknown health effects."[20]

While data demonstrating that the release and absorption of these chemicals and substances during athletics on these fields had been lacking or inconclusive, current study **results indicate that there is an increased cancer risk probability that occurs as a result of PAHs, VOCs, and heavy metals exposure from artificial turf.**[21]

Similarly, per- and polyfluoroalkyl substances (**PFAS**) are of concern because of their high persistence (or that of their degradation products) and their impacts on human and environmental health as found in scientific studies.[22] **The U.S. EPA issued a chilling statement in December 2023: "PFAS, the common term used for per- and polyfluoroalkyl substances, are an urgent threat to public health and the environment. Communities across the nation are discovering them in their air, land, and water. The science is clear: exposure to certain PFAS poses significant risks to human health, including cancer, even at very low levels."**[23] The U.S. Agency for Toxic Substances and Disease Registry (ATSDR) published recommendations in 2024 for clinicians in evaluating and managing PFAS. Among the recommendations: **assessment for the presence of testicular and kidney cancer and ulcerative colitis at children well-visits over 15 yrs of age in those with high PFAS blood levels (>20ng/mL) as well as other endocrinologic (thyroid, cholesterol) testing at even lower PFAS levels.**[24]

Artificial turf is a significant source of **micro and nanoplastic particles** which have become ubiquitous in our environment and in our bodies – in multiple organs – and more so in human organs afflicted with disease, for example, brains from deceased individuals with dementia as compared with non-diseased individuals. While causal research must be labeled as inconclusive due to its observational nature,

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[20] International Policy Review, pages 5-6, fn 16 above, https://www.sciencedirect.com/science/article/pii/S2667010022001767/pdfft?md5=f1632c80d36d410b449a046d14b0afc1&pid=1-s2.0-S2667010022001767-main.pdf.

[21] Mohammed AMF, Saleh IA, Abdel-Latif NM. Hazard assessment study on organic compounds and heavy metals from using artificial turf. Heliyon. 2023 Mar 29;9(4):e14928. doi: 10.1016/j.heliyon.2023.e14928. PMID: 37089337; PMCID: PMC10113793.https://doi.org/10.1016/j.heliyon.2023.e14928 (emphasis added).

[22] See, e.g., Glüge J , Scheringer M , Cousins IT, DeWitt JC , Goldenman G , Herzke D , Lohmann R , Ng CA , Trier X , Wang Z, An overview of the uses of per- and polyfluoroalkyl substances (PFAS). Environ Sci Process Impacts. 2020 Dec 1;22(12):2345-2373. doi: 10.1039/d0em00291g. Epub 2020 Oct 30. PMID: 33125022; PMCID: PMC7784712. https://doi.org/10.1039/D0EM00291G.

[23] ATSDR (U.S. Agency for Toxic Substances and Disease Registry), Clinical Evaluation and Management: PFAS Information for Clinicians (Nov. 12, 2024), https://www.atsdr.cdc.gov/pfas/hcp/clinical-overview/clinical-evaluation-management.html

[24] National Academies, Guidance on PFAS Testing and Health Outcomes, https://www.nationalacademies.org/our-work/guidance-on-pfas-testing-and-health-outcomes.

clear associations for myriad diseases exist. The evidence for adverse systemic and neurovascular impacts of microplastics are mounting and currently of great concern to medical professionals and other health experts around the globe. "Among the biggest environmental problems of our time, micro- and nanoplastic particles (MNPs) can enter the body in various ways, including through food. And now for the first time, research conducted at MedUni Vienna has shown how these minute particles manage to breach the blood-brain barrier and as a consequence penetrate the brain. The newly discovered mechanism provides the basis for further research to protect humans and the environment."[25]

Mount Sinai Icahn School of Medicine: Children's Environmental Health Center

> **"The Mount Sinai Children's Environmental Health Center at the Institute for Climate Change, Environmental Health, and Exposomics recommends against the installation of artificial turf laying surfaces and fields due to the uncertainties surrounding the safety of these products and the potential for dangerous heat and chemical exposures."[26]**

The enthusiastic support for the use of highly toxic, and costly, artificial turf on Scarsdale's athletic and other recreational grass fields and courts – no doubt among many otherwise well-meaning, sports loving residents and those in positions of authority for decision-making in the Village and School District – is on display in the Village consultant's report without reference to the health and environmental risks. Mount Sinai's recommendations, and the scientific research arguing against the use of artificial turf, should be a wakeup call for government, educators and parents of school age children in Scarsdale based on the heightened vulnerability of children to the inherent toxic components and harmful health and environmental impacts of artificial turf.

Mount Sinai's recommendations demonstrate the inherent health and environmental risks posed by artificial turf, explicitly because children's vulnerability and health are implicated. While studies to assess the safety of artificial turf are ongoing, **Mount Sinai research cites these additional factors in support of its recommendations: risk of heat injury is elevated on artificial turf; children are uniquely vulnerable to harmful exposures from artificial turf surfaces; chemical hazards escape from artificial turf surfaces to the environment; and contaminated turf materials are transported home.**

Mount Sinai's uniformly negative view of artificial turf for use anywhere, and especially where children are concerned, is a compelling reason that artificial should **not** be used in Scarsdale. Mount Sinai's Position Statement concludes with this unequivocal warning:

> "**Daily outdoor play and physical activity are essential components of a healthy childhood. Safe play areas are an essential component of any school environment. While**

[25] NPR Shots-Health News, W Stone, "Scientists know our bodies are full of microplastics. What are they doing to us?" (Dec 18, 2024), https://www.npr.org/sections/shots-health-news/2024/12/18/nx-s1-5227172/microplastics-plastic-nanoparticles-health-pfas.

[26] Position Statement on the Use of Artificial Turf Surfaces, Mount Sinai Children's Environmental Health Center at the Institute for Climate Change, Environmental Health, and Exposomics, (June 2024) (Questions also remain about the safety of alternatives to crumb rubber.) https://mountsinaiexposomics.org/position-statement-on-the-use-of-artificial-turf-surfaces/.

it is important to maximize safe play time, we caution against the use of materials which carry risks of chemical and heat exposure and have not been comprehensively tested for safety. For the reasons outlined above, the Children's Environmental Health Center recommends natural grass fields and playing surfaces as the safest option for areas where children play."[27] (emphasis added)

Medical Studies on the Health and Environmental Hazards of Artificial Turf

The goal of providing such detailed information about artificial turf in this Report is to inform the community, including those in Scarsdale Village government and the School District who are making decisions about artificial turf fields and courts locally. The volume of information online is daunting. But the profound risks of exposure to these toxic substances are real and should be a significant factor in decision-making. There is, moreover, a body of recent scientific research examining potential hazards and harms associated with artificial turf that supports the cautionary conclusion reached by Mount Sinai researchers and regulatory and legislative actions:

> "Many communities around the country are undergoing contentious battles over the installation of artificial turf. Opponents are concerned about exposure to hazardous chemicals leaching from the crumb rubber cushioning fill made of recycled tires, the plastic carpet, and other synthetic components. Numerous studies have shown that chemicals identified in artificial turf, including polycyclic aromatic hydrocarbons (PAHs), phthalates, and per- and polyfluoroalkyl substances (PFAS), are known carcinogens, neurotoxicants, mutagens, and endocrine disruptors. However, few studies have looked directly at health outcomes of exposure to these chemicals in the context of artificial turf. Ecotoxicology studies in invertebrates exposed to crumb rubber have identified risks to organisms whose habitats have been contaminated by artificial turf. Chicken eggs injected with crumb rubber leachate also showed impaired development and endocrine disruption. The only human epidemiology studies conducted related to artificial turf have been highly limited in design, focusing on cancer incidence. In addition, government agencies have begun their own risk assessment studies to aid community decisions. Additional studies in *in vitro* and *in vivo* translational models, ecotoxicological systems, and human epidemiology are strongly needed to consider exposure from both field use and runoff, components other than crumb rubber, sensitive windows of development, and additional physiological endpoints. **Identification of potential health effects from exposures due to spending time at artificial turf fields and adjacent environments that may be contaminated by runoff will aid in risk assessment and community decision making on the use of artificial turf**."[28] (emphasis added)

A study at the Yale School of the Environment focused on crumb rubber infill:

> "Recycled tires are often shredded for use in a variety of consumer-related products. The rubber so used may contain a number of compounds known to be deleterious to human and environmental health. We obtained nine samples of shredded tire material sold over the counter to the general public

[27] Id. Indeed, Mount Sinai is not alone in its concerns. See also, Proposed Action by the New York State Legislature "establishing a moratorium on the installation of synthetic turf pending a comprehensive environmental and public health study," https://www.nysenate.gov/legislation/bills/2023/S7239 . The proposed legislation appears to remain in committee with no action taken yet as of the date of this Scarsdale Forum Report.

[28] Review Environ Pollut, M. Murphy, G.R. Warner, "Abstract, Health impacts of artificial turf: Toxicity studies, challenges, and future directions" (2022 Oct 1:310:119841. doi: 10.1016/j.envpol.2022.119841. Epub 2022 Aug 7, PMID: 35948114 PMCID: PMC10262297 DOI: 10.1016/j.envpol.2022.119841), https://pubmed.ncbi.nlm.nih.gov/35948114/.

for home use, as well as six samples used for infill in synthetic turf athletic fields. . . . Solvent extraction yielded 92 separate compounds, of which only about half have been tested for human health effects. Of these, nine are known carcinogens and another 20 are recognized irritants, including respiratory irritants that may complicate asthma. Strong acid extraction released measurable amounts of Pb and Cd and relatively large amounts of Zn. These three metals were specifically targeted for analysis, and others may be present as well, but were unmeasured. Simulated acid rain extracted only Zn in significant quantities. Passive volatilization yielded detectable amounts of 11 compounds. Results demonstrate that recycled tire materials contain and can release a wide variety of substances known to be toxic, and caution would argue against their use where human exposure is likely.
Benzothiazole (structure includes benzene): Skin and eye irritation, harmful if swallowed.
Butylated hydroxyanisole (BHA): Recognized carcinogen, suspected endocrine toxicant, gastrointestinal toxicant, immunotoxicant, neurotoxicant, skin and sense-organ toxicant.
n-hexadecane: severe irritant based on human and animal studies, may be fatal if swallowed and enters airways.
4-(t-octyl) phenol: corrosive and destructive to mucous membranes."[29]

Scientists came to the following conclusions about the toxicity of these and other industrial chemicals in a 2008 study published in the Journal of Exposure Science & Environmental Epidemiology:

> "Many synthetic turf fields consist of not only artificial grass but also rubber granules that are used as infill. On the basis of results from seven samples of rubber granules collected in three fields at different ages of the fields, we reach the following main conclusions: (1) Rubber granules often, especially when the synthetic turf fields were newer, contained PAHs [polycyclic aromatic hydrocarbons] at levels above health-based soil standards. PAH levels generally appear to decline as the field ages. However, the decay trend may be complicated by adding new rubber granules to compensate for the loss of the material. (2) PAHs contained in rubber granules had low bioaccessibility (i.e., hardly dissolved) in synthetic digestive fluids including salvia, gastric fluid, and intestinal fluid. (3) The zinc contents were found to far exceed the soil limit. (4) Lead contents were low (<53 p.p.m.) in all the samples in reference to soil standards. However, the lead in the rubber granules was highly bioaccessible in the synthetic gastric fluid. The analysis of one artificial grass fiber sample showed a slightly worrisome chromium content (3.93 p.p.m.) and high bioaccessible fractions of lead in both the synthetic gastric and intestinal fluids."[30]

Additional studies delineate particular hazardous substances and review potential human health harms stemming from the variety of chemicals and microplastics comprising synthetic fields.[31] As noted previously in this Report, PFAS chemicals are of particular concern due to their impacts on human and environmental health that are known or can be deduced from studies.[32] States and municipalities across the country are

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[29] Benoit G, Demars S, Evaluation of Organic and Inorganic Compounds Extractable by Multiple Methods from Commercially Available Crumb Rubber Mulch. *Water Air Soil Pollut* **229**, 64 (2018). https://doi.org/10.1007/s11270-018-3711-7 .

[30] Junfeng Zhanga, In-Kyu Hana, Lin Zhanga and William Crain, "Hazardous chemicals in synthetic turf materials and their bio accessibility in digestive fluids" (2007), http://www.nature.com/jes/journal/v18/n6/full/jes200855a.html.

[31] Celeiro M, Dagnac T, Llompart M. "Determination of priority and other hazardous substances in football fields of synthetic turf by gas chromatography-mass spectrometry: A health and environmental concern". Chemosphere. 2018 Mar;195:201-211. doi: 10.1016/j.chemosphere.2017.12.063. Epub 2017 Dec 11. PMID: 29268178. https://doi.org/10.1016/j.chemosphere.2017.12.063.

[32] Glüge J , Scheringer M , Cousins IT , DeWitt JC , Goldenman G , Herzke D , Lohmann R , Ng CA , Trier X , Wang Z . An overview of the uses of per- and polyfluoroalkyl substances (PFAS). Environ Sci Process Impacts. 2020 Dec 1;22(12):2345-2373. doi: 10.1039/d0em00291g. Epub 2020 Oct 30. PMID: 33125022; PMCID: PMC7784712. https://doi.org/10.1039/D0EM00291G;

increasingly concerned by high PFAS levels in groundwater supplies, exceeding safe limits and water quality standards. Causal links are being established associating these potentially toxic levels to local synthetic turf installations. Susan Chapnick, President and principal scientist at New Environmental Horizons and Chair of Town of Arlington, MA Conservation Commission, recently shared current data at a neighboring zoom presentation hosted by the Edgemont Community Forum held on January 15, 2025, which exemplifies this worrisome finding. Data shared, recently collected in June 2024, shows that "a high school artificial turf field in North Smithfield, RI, initially installed in 2007 and most recently replaced in 2021, may be partly or wholly contributing to the contamination of nearby private and public drinking water. Measured data shows an upgradient well to the artificial turf field having PFAS concentration of 2 ng/L or less, whereas a downgradient well measured PFAS at 61 ng/L. This downgradient well's PFAS concentration is double that measured in the same well in 2019 and greatly exceeds RI drinking quality standard level for PFAS is set at 20 ng/L. A letter from the RI Department of Health (RIDOH) and the RI Department of Environmental Management (RIDEM), dated August 15, 2024, expresses great concern regarding this PFAS contamination of groundwater in the Burrillville, RI area resulting from the artificial turf installation."[33]

A very recent study demonstrated an increased cancer risk probability that occurs as a result of PAHs, VOCs, and heavy metals exposure (when using US EPA 1990 and 1991 published standards). These risks vary according to whether the field is indoors or outdoors and across temperature and seasonal exposure but equate to an increased cancer risks probability occurring as a result of chemical exposure from artificial turf. In this study, cancer risk probability for different age categories was in the order: 7–15 years > 3–6 years >19–22 years >16–18 years >23–55 years >56–70 years.[34] Of concern is the persistence of these chemicals:

> "A growing body of research has found that the chemicals persist in the environment for years after products are thrown away, and they have been linked to negative health outcomes. . . . In an effort to limit the amount of PFAS entering the environment lawmakers have passed bans on intentionally adding the chemicals to certain consumer products. The apparel bans in New York and California follow a successful effort to end their use in food packaging led by the Food and Drug Administration. California's ban applies to additional textiles including bedding, upholstery, and towels. PFAS can also be found in cosmetics, nonstick cookware, and fire extinguishing foam."[35]

J Hazard Mater. "A review of potentially harmful chemicals in crumb rubber used in synthetic football pitches," 2021 May 5;409:124998. doi: 10https://doi.org/10.1016/j.jhazmat.2020.124998.1016/j.jhazmat.2020.124998. Epub 2020 Dec 31. PMID: 33513533. https://doi.org/10.1016/j.jhazmat.2020.124998.

[33] Edgemont Community Forum zoom presentation, 15, 2025 (recording), https://www.youtube.com/watch?v=h-SEmKeqFJk ; Rhode Island Departments of Health and Environmental Management Letter (Aug. 15, 2024), https://www.burrillville.org/sites/g/files/vyhlif2886/f/uploads/doh_dem_letter_with_response_from_trc_1.pdf .

[34] Mohammed AMF, Saleh IA, Abdel-Latif NM. "Hazard assessment study on organic compounds and heavy metals from using artificial turf". Heliyon. 2023 Mar 29;9(4):e14928. doi: 10.1016/j.heliyon.2023.e14928. PMID: 37089337; PMCID: PMC10113793.https://doi.org/10.1016/j.heliyon.2023.e14928.

[35] H. Claire Brown, "The Race to Remove 'Forever Chemicals' from Clothing Ahead of Bans, New York and California forced companies to remove PFAS from apparel. It hasn't been smooth" (Wall Street Journal, Sustainable Business, Jan. 10, 2025) ("Bans on the sale of clothing containing "forever" chemicals went into effect in New York and California. Similar bans are scheduled to roll out in more states next year."), https://www.wsj.com/articles/the-race-to-remove-forever-chemicals-from-clothing-ahead-of-

Lead

Citing tests by the New Jersey Department of Health and Senior Services,[36] the federal Centers for Disease Control (CDC) has warned of the potential risk of lead poisoning in children playing on artificial turf surfaces from turf fibers:

> "Tests by the New Jersey Department of Health and Senior Services (NJDHSS) of artificial turf playing fields in that state found these fields contain potentially unhealthy levels of lead dust. The initial tests were conducted on a limited number of playing fields. NJDHSS sampling of additional athletic fields and other related commercial products indicates that artificial turf made of nylon or nylon/polyethylene blend fibers contains levels of lead that pose a potential public health concern. Tests of artificial turf fields made with only polyethylene fibers showed that these fields contained very low levels of lead." [37]

Studies have established that even the lowest level of lead exposure is dangerous for children, and the CDC contends that "no safe blood lead level in children has been identified":

> "Protecting children from exposure to lead is important to lifelong good health. No safe blood lead level in children has been identified. Even low levels of lead in blood have been shown to affect IQ, ability to pay attention, and academic achievement. And effects of lead exposure cannot be corrected. The most important step parents, doctors, and others can take is to prevent lead exposure before it occurs."[38]

The federal government has issued recommendations on steps to protect young children from the potential health hazards of lead in synthetic playing fields:

> "The CDC in 2008 said communities should test recreational areas with turf fibers made from nylon, and they should bar children younger than 6 from the areas if the lead level exceeded the federal limit for lead in soil in children's play areas.
>
> But some communities have refused to test their fields, fearing that a high lead level would generate lawsuits or force them to replace and remove a field, which costs about $1 million, according to a 2011 New Jersey state report.

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bans-d38edc75?msockid=1f51d77e820967702a12c246836b6620; citing FDA, Industry Actions End Sales of PFAS Used in US Food Packaging | FDA and How 'Forever Chemicals' Are All Around Us, From Winter Coats to Fast-Food Wrappers - WSJ.

[36] New Jersey Artificial Turf Investigation, Resources, at http://www.state.nj.us/health/artificialturf/index.shtml See also New Jersey Work Environmental Council (WEC) Fact Sheet, "Be Aware of Artificial Turf Hazards" (2015), http://www.njwec.org/PDF/Factsheets/fact-artificialterf.pdf.

[37] Kim SI, Yang JY, Kim HH, Yeo IY, Shin DC, Lim YW, "Health risk assessment of lead ingestion exposure by particle sizes in crumb rubber on artificial turf considering bioavailability" (2012), http://www.ncbi.nlm.nih.gov/pubmed/22355803 .

[38] CDC, "Childhood Lead Poisoning Prevention, (May 2024), https://www.cdc.gov/lead-prevention/about/index.html?CDC_AAref_Val=https://www.cdc.gov/nceh/lead/ACCLPP/blood_lead_levels.htm.

> Forty-five of 50 New Jersey schools and towns contacted in 2009 by epidemiologist Stuart Shalat would not let him test their turf-and-rubber fields, Shalat's report states. The EPA also found, in 2009, that 'it was difficult to obtain access and permission to sample at playgrounds and synthetic turf fields.' "[39]

With respect to lead and other metal particulate exposure, " 'Because of the physical development of younger children, lead has a greater propensity to be absorbed,' said Robert Laughton, the school district's environmental health and safety director. 'They're the most at-risk population we have.' "[40]

Research is ongoing with regard to artificial turf installed field conditions, manufacturing specifications and consequent lead exposure in children who play on these fields. For example, a recent study assessed the risk of ingestion exposure of lead by particle sizes of crumb rubber infill in artificial turf filling material, considered the bioavailability of ingested lead in calculations of the hazard, and concluded that "the exposure of lead ingestion and risk level increases as the particle size of crumb rubber gets smaller," specifically lower than 250 um as compared with higher than 250 um particle size. In this study, there was a case of an elementary school student in which the lead hazard quotient was particularly high.[41]

Industry Claims of Safety Refuted by Scientific Studies

The available scientific research is not anecdotal, as some industry advocates may claim.[42] While scientific research continues, Scarsdale can do better, by submitting existing fields to testing to determine lead levels, by doing due diligence research of the science, and by waiting until health and safety issues are resolved and safe alternative products come on market before creating any more synthetic turf surfaces.[43]

The potential bias in artificial turf industry claims, as mentioned in this Report, has been noted in the medical literature: "Many artificial turf industry claims [are] that proprietary artificial turf systems reduce injury. A for-profit company is very interested in promoting scientific data which suggest that their product reduces injury and is equally interested in arguing against any data otherwise. Research on artificial turf is potentially exposed to the same types of industry bias as research on pharmaceuticals."[44]

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[39] T. Frank, "Feds promote artificial turf safe despite health concerns" (USA Today, Mar. 16, 2015), http://www.usatoday.com/story/news/2015/03/15/artificial-turf-health-safety-studies/24727111/ .

[40] Id. (USA Today).

[41] See, e.g., S. Kim, *et al*, "Health risk assessment of lead ingestion exposure by particle sizes in crumb rubber on artificial turf considering bioavailability" (F Environ Health Toxicol, Feb 2012) ("Results of this study confirm that the exposure of lead ingestion and risk level increases as the particle size of crumb rubber gets smaller."), https://pubmed.ncbi.nlm.nih.gov/22355803/ .

[42] See, e.g., K. Thorne "Rubber mulch on LI children's playgrounds raising health concerns" (WABC, July 12, 2016), https://abc7ny.com/long-island-north-shore-childrens-health-playgrounds/1423800/.

[43] Id.: "'We're using your children as part of the poison squad,' said Bruce Lanphear, a leading researcher on lead poisoning at Simon Fraser University in Canada, who suggests a moratorium on installing artificial-turf fields until their safety is proved."

[44] Orchard J., "Research on products such as artificial turf is potentially exposed to the same types of industry bias as research on pharmaceuticals," British Journal of Sports Medicine 2013;47:725-726. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=7be87131d2a02c655b978505be82ad77840b71fb.

"A webpage such as http://www.fieldturf.com/en/fieldturf-difference/proven-safety claims that a proprietary artificial turf system reduces injuries. On the FieldTurf 'Proven safety' webpage, data are presented from two studies that claim to be 'independent' and purport to show the superior safety record of the product compared to natural grass. Notably however, a systematic review of the medical literature that was free from commercial bias and which integrated quality of the evidence of retrieved studies, found more injuries on artificial turf in comparison to natural grass. Importantly, the paper noted '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.' "[45]

Injuries Involving Artificial Turf

The epidemiological assessments that have been published examining a differential injury rate between synthetic and natural turfs are generally supportive of this hypothesis: Studies that focus on lower extremity injuries caused by a twisting or shearing mechanism typically show greater rates of injury on synthetic versus natural turf. Mack *et al* (unpublished data) examined this among NFL players and found a greater rate of lower extremity injuries on synthetic turf game-day fields than on natural turfgrass game-day fields. In the aggregate, the lower extremity injury rate was 16% greater on synthetic surfaces, though specific subcategories of lower extremity injuries exhibited up to twice the rate on synthetic turf. Lower extremity injuries as noncontact/surface contact exhibited greater differential injury rate ratios (ranging from 1.2 to 2.0), particularly among more distal regions of the lower extremity. These findings are consistent with previous NFL studies as well as with the majority of studies among collegiate football players. Current research has attempted to inform the design of football cleat patterns that can replicate the release of natural turfgrass on synthetic turf at loads and rates relevant to elite-level football to bring the differential injury rate closer to zero. While these studies, among others, have begun to sort out differences in some athlete populations, a full understanding of the difference in injury risk is complicated by the size and power of the studies as well as differences among sexes, sport, level of competition, weather, footwear, and variations in the playing surfaces themselves, including maintenance.[46]

Another widely cited study in 2013 noted "Recent data on professional athletes suggest that elite athletes may sustain injuries at increased rates on the newer surfaces. This conclusion is backed by robust biomechanical data that suggest that torque and strain may be greater on artificial surfaces than on natural grass."[47]

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[45] See also Gould HP, Lostetter SJ, Samuelson ER, Guyton GP. "Lower Extremity Injury Rates on Artificial Turf Versus Natural Grass Playing Surfaces: A Systematic Review," American Journal of Sports Medicine. 2023;51(6):1615-1621. doi:10.1177/03635465211069562, https://www.acfas.org/lower-extremity-injury-rates-on-artificial-turf-versus-natural-grass-playing-surfaces-a-systematic.

[46] Id.

[47] Drakos MC, Taylor SA, Fabricant PD et al. Synthetic Playing Surfaces and Athlete Health. J Am Orthop Surg. 2013. 21:293-302. https://pubmed.ncbi.nlm.nih.gov/23637148/.

Considered the highest level of evidence, scientific studies that were collected, assessed for quality, and published in an extensive 2023 meta-analyses "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 these studies received financial support from the artificial turf industry."[48]

Furthermore, a separate quality meta-analysis from 2022 examined injuries in male versus female players and indicated that female soccer players had a significantly higher risk of ACL injury when playing games on artificial turf versus natural grass, whereas no significant difference was seen in male players. No differences were found for the combined male/female cohort or for soccer games or training sessions played on AT compared with NG.[49]

Twomey, *et al* published a 2019 systematic review that examined 76 potential articles, with 25 meeting all inclusion criteria, finding: "**Regardless of the condition of the surface, the level of play, or the sport, players perceived the fear of abrasion injuries as a major disadvantage of artificial turf surfaces."**[50] (emphasis added)

Excessive Heat Exposure from Outdoor Artificial Turf

Of all the significant health-related drawbacks of artificial turf playing fields, excessive surface temperatures may be the least controversial in this age of global warming.[51]

Surface temperatures on artificial turf have been documented to 200 degrees F. Compared with natural grass, artificial turf is 50 degrees F hotter at the surface and 70 degrees F hotter at head height.[52]

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[48] Gould HP, *et al.* "Lower Extremity Injury Rates on Artificial Turf Versus Natural Grass Playing Surfaces: A Systematic Review." American Journal of Sports Medicine (2023), https://www.acfas.org/lower-extremity-injury-rates-on-artificial-turf-versus-natural-grass-playing-surfaces-a-systematic, fn 45 above.

[49] Xiao M, Lemos JL, Hwang CE, Sherman SL, Safran MR, Abrams GD. "Increased Risk of ACL Injury for Female but Not Male Soccer Players on Artificial Turf Versus Natural Grass: A Systematic Review and Meta-Analysis." Orthopaedic Journal of Sports Medicine. 2022;10(8). doi:10.1177/23259671221114353, https://doi.org/10.1177/23259671221114353.

[50] Twomey DM, Petrass LA, Fleming P, Lenehan K. "Abrasion injuries on artificial turf: A systematic review." J Sci Med Sport. 2019 May;22(5):550-556. doi: 10.1016/j.jsams.2018.11.005. Epub 2018 Nov 16. PMID: 30503328. https://doi.org/10.1016/j.jsams.2018.11.005.

[51] S. Myrick, "Synthetic Sports Fields and the Heat Island Effect" (May 2019, Nat'l Rec & Park Assoc), https://www.nrpa.org/parks-recreation-magazine/2019/may/synthetic-sports-fields-and-the-heat-island-effect/, (Penn State and Brigham Young studies).

[52] Synthetic Turf Research @ Penn State, Surface Temperature Studies, https://plantscience.psu.edu/research/centers/ssrc/research/synthetic-turf-surface-temperature; Luz Claudio, Environmental Health Perspective, "Synthetic Turf Debate Takes Root" (March 2008), https://ehp.niehs.nih.gov/doi/pdf/10.1289/ehp.116-a116.

Research done in Manhattan, led by climate scientist Stuart Gaffin at Columbia using thermal satellite imaging—incidentally, discovered while demonstrating cooling benefits of urban parks and trees—found that a number of the hottest spots in the city were artificial turf fields. For example, a direct temperature measurement on July 6, 2007 revealed that while the atmospheric temperature was 78 degrees F, the temperature on a natural grass field in direct sunlight was 85 degrees F while an adjacent synthetic turf field had reached 140 degrees F:

> "If playing on a hot synthetic turf field is unavoidable, Penn State's Center for Sports Surface Research notes that heavy watering before the game can help reduce surface temperature, but it cautions that this is only effective for a short period of time. Temperatures rebound after only about 20 minutes (less time than it takes to play a regulation half game of soccer). Adding irrigation to, even watering, this type of sports field could cost thousands of dollars and, depending on the type of infill used, be ineffective, as water could simply roll off the surface and not really soak in to provide that small window of temperature relief. As a result, this may not be as cost effective or as safe as scheduling games around peak high-heat times."[53]

Artificial turf's heat island effect would also create an exponential increase in heat related illnesses which include direct skin injury when turf reaches above 122 degrees, as well as heat exhaustion and heat stroke which can occur when body temperatures rise to 104 degrees F or higher, and can be fatal.[54]

Why Impose a Moratorium on New Artificial Turf Installations

Natural turf grass is not manufactured with toxic materials which can leach into the environment, unlike synthetic fiber playing fields and artificial crumb rubber turf fill. Real soil absorbs rainwater and filters rain and air pollutants, unlike impervious artificial turf, which promotes runoff of toxic leachate. Real grass growing in soil is a cooling surface, unlike artificial turf which builds up heat and does not cool down for long, even when watered. There is enough scientific evidence to support caution when considering whether installation of an artificial playing field is prudent, which is why numerous municipalities, school districts, and universities have vetoed artificial turf fields.[55] Indeed, Scarsdale's consultant cites the water

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[53] Id.

[54] Id. ("The high surface-level temperatures on synthetic fields can lead to dehydration, burns and blisters if exposed skin comes into contact with the hot surface, as well as heat stroke." **Anecdotally, Scarsdale parents who attended their child's 2024 graduation ceremony outdoors at the High School's Dean Field described experiencing stifling, unhealthy heat during the ceremony while seated in the bleachers and walking on the artificial turf field. (emphasis added)**

[55] See generally http://www.synturf.org/sayno.html a fascinating compilation of hundreds of locations in the U.S. and around the world where installation of artificial turf has been legislatively prohibited or vetoed by voters. There was opposition to artificial turf fields at the University of Toronto, even though the surface would extend the relatively short playing season compared with warmer climates. See http://envirolaw.com/turf-wars-green-artificial-turf/ and http://www.theglobeandmail.com/news/national/margaret-atwood-leads-the-charge-against-fake-turf-at-u-of-t/article9757636/. In 2013, voters in Hastings-on-Hudson defeated a bond proposal that included an artificial turf field. Similar public opposition has occurred in Greenlawn, on the north shore of Long Island and in Buffalo, New York, http://www.synturf.org/sayno.html.

overflow issues on the relatively new or resurfaced artificial turf installations at the High School's Dean Field and Butler Track and Field that now require remediation.[56] Local voters have refused to authorize spending for synthetic turf fields, such as Ramapo, in Rockland County and Bronxville, in Westchester County. Major cities from California to Maine, and countries around the globe have frequently imposed bans on the use of artificial turf surfaces, sometimes on the basis of unsustainable costs in addition to health, safety, and environmental concerns.[57]

Other Environmental Impacts Associated with Synthetic Turf

There are numerous environmental and potentially other related consequences associated with artificial turf fields:

> "There are other problems as well: cleaning artificial turf can require harsh chemicals, and body fluid spills are particularly difficult to handle. Additional concerns about the eventual disposal of artificial fields, potential legal liability and the loss of environmentally beneficial natural turf, which sequesters carbon dioxide and reduces global warming, has convinced many decision makers to reconsider plans for synthetic turf fields."[58]

The Village has explicitly recognized the significant flooding issues our community is already facing, most notably in the 2024 temporary moratorium on development:

> "In recent years, the improvements, subdivisions and redevelopments occurring on single-family residential properties have led to resident's expressing concern about a number of pervasive adverse impacts, including but not limited to the loss of the architectural and historic qualities and scale that helps define the fabric of our residential neighborhoods as well as concerns about negative environmental impacts such as increased flooding, and the destruction of mature trees and natural habitats. These concerns arise from, among other things, the rapid pace of demolitions and replacement of older homes, additions being built on single-family properties, the construction of accessory structures, and the subdivision and redevelopment of residential lots. Such development activities create new impervious surfaces thereby diminishing the natural drainage and flood mitigation provided by mature trees and open space. Our natural resources are finite and fragile, and the Village's infrastructure and other public resources are increasingly being tested by more frequent and severe storm events and the realized and potential impacts require study."[59]

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[56] CHA May 23, 2024 Study, fn 5 above, https://www.scarsdale.gov/AgendaCenter/ViewFile/Agenda/_05232024-1277 .

[57] http://www.lohud.com/story/news/local/rockland/ramapo/2015/05/20/ramapo-central-school-district-turf-field-debate-next-steps/27669559/ ; http://www.lohud.com/story/news/local/westchester/2015/01/22/bronxville-voters-decide-money-fields-flooding/22158957/ . See also International Policy Review, page 6, fn. 10 above.

[58] The Child Safe School, https://www.thechildsafeschool.org/artificial-turf. See also GrassRoots Environmental Education, https://www.grassrootsinfo.org/artificial-turf, citing Digest of Independent Science on Public Health & Environmental Concerns Regarding Artificial Turf (with bibliography), https://www.grassrootsinfo.org/_files/ugd/2cea04_4ea7a97a3f4045368b5af20bd4d92696.pdf.

[59] LOCAL LAW NO. 1 OF 2024, VILLAGE OF SCARSDALE BOARD OF TRUSTEES, A LOCAL LAW TO ESTABLISH A TEMPORARY MORATORIUM ON CERTAIN LAND USE APPLICATIONS WITHIN THE VILLAGE OF SCARSDALE (Jan. 9, 2024), https://www.scarsdale.com/DocumentCenter/View/9603/Scarsdale-Local-Law-No-1-of-2024---Land-Use-Moratorium-FINAL-4869-0281-97401 . See also Scarsdale Forum's February 28, 2024 report on "Environmental Protection and Preservation of Trees in the Village of Scarsdale" (https://www.scarsdaleforum.com/Reports/download/1277), which explains the flood mitigating function of trees. A follow up memorandum was submitted by Scarsdale Forum committees to the Village which

Artificial turf fields would, owing to their multiple impervious components, likely exacerbate flooding. Aside from these significant environmental and legal concerns, the Committees also recommend that Scarsdale undertake a comprehensive cost-benefit evaluation of the relative durability and expense of installation, maintenance, replacement, and disposal of a synthetic turf field compared with a natural grass field.

Professional Athletic Associations and Legislative Action

While some of the issues relating to the safety of artificial turf materials are still being researched, professional athletes have weighed in on the hazards of playing on synthetic surfaces instead of on grass fields. Artificial turf is considered by some elite athletes and professional sports organizations as a surface that is less forgiving and can exacerbate injuries and potential health harms. Legislative actions are currently restricting artificial turf in both the United States and abroad.

Professional Athletics

A lawsuit was filed by several professional women soccer players at the end of 2014 against the International Association of Federated Football (Fédération Internationale de Football Association, or FIFA) and the Canadian Soccer Association, on the grounds that synthetic turf fields are an unsafe, inferior playing surface, and having to play on six such fields in Canada during the course of a championship tournament would be hazardous and unfair. While the action was dropped in January 2015 to avoid retaliatory action against the players, eight U.S. Senators called on FIFA to change the playing venues to provide the women athletes with the same surface as is provided for the men's World Cup, which is played on natural grass.[60] Currently FIFA is requiring stadiums to provide grass fields for the 2026 games:

> "FIFA will welcome fans to a number of state-of-the-art venues when it brings the World Cup to the U.S., Canada and Mexico in 2026, but the global soccer governing body has work to do when it comes to playing surfaces. Eight of the 16 stadiums slated to host World Cup matches typically employ artificial turf fields and will be required to install temporary natural grass surfaces for the tournament. Despite advances in field technology, growing, installing and maintaining temporary natural grass surfaces for a monthlong tournament is a significant challenge. It will be especially difficult at the five indoor stadiums — AT&T Stadium in Dallas, NRG Stadium in Houston, Mercedes-Benz Stadium in Atlanta, BC Place in Vancouver and SoFi Stadium in Los Angeles. To ensure it has quality pitches for all 16

enumerates ten action steps for improved enforcement of the Village tree code. When implemented by the Village, these proposals, consistent with the Scarsdale Conservation Advisory Council's recommendations contained in its December 10, 2023 "Tree Code-Review/Analysis/Update Memo" (https://www.scarsdale.gov/DocumentCenter/View/9454/CAC-Memo---Tree-Code-Review---December-2023), would help ensure that the tree protective code is rigorously enforced.

[60] Press Release and Letter dated January 15, 2015 ("Turf is an inferior surface that poses safety risks and fundamentally alters the way the sport is played."), http://www.schumer.senate.gov/newsroom/press-releases/schumer-gillibrand-renew-call-for-2015-womens-world-cup-to-be-held-on-grass-not-artificial-turf-urge-fifa-to-reach-agreement-with-players-in-advance-of-2015-womens-world-cup .

stadiums, FIFA is funding research at Michigan State University and the University of Tennessee."[61]

In baseball there have been similar complaints by players, and speculation that the artificial surface may even promote aging over the course of a player's career, an interesting analysis from 2014.[62]

The NFL Players Association conducted a member survey regarding football playing surfaces for the 2010 season. More than 1,619 active players from all 32 clubs completed the survey and rated both grass and artificial surfaces. Approximately 89.1 percent of players surveyed thought artificial surfaces were "more likely to contribute to injury," and 82.4 percent thought the artificial turf surface "causes more soreness and fatigue to play on."[63]

Legislative Action: European Union

The European Union has required the discontinuation of the use of crumb rubber infill by member countries after 2031:[64]

> "In response to concerns over the prevalence of microplastics in the environment and the potential effects of human exposure, the European Union (EU) in September 2023 enacted a ban on the sale of products containing intentionally added microplastics. This includes microplastics themselves, as well as larger products that may release microplastics over time. Notably, the regulation specifically included granular artificial turf infill within its scope. . . . Although this September 2023 mandate follows previously passed microplastic regulations in the United Kingdom (UK), United States (USA), and Canada, all prior legislation has addressed only microplastics contained within personal care products; other major contributors to microplastic pollution (e.g., artificial turf infill) were notably excluded."[65]

[61] A. Silverman, "FIFA requires stadiums to play the field, install natural grass for games" (Sports Business Journal, Nov 6, 2023), https://www.sportsbusinessjournal.com/Articles/2023/11/06/america-stadiums-side.

[62] C. Teeter, "Does playing on artificial turf affect how players age? (Beyond the Box Score, 2014), http://www.beyondtheboxscore.com/2014/11/28/7296843/artificial-turf-age-curve-blue-jays-rays-baseball-woba

[63] 2010 NFL Players Playing Surfaces Opinion Survey, http://www.stma.org/sites/stma/files/pdfs/2010_NFL_Survey.pdf .

[64] P Zuccaro, D. Thompson J. de Boer, *et al*, "The European Union Ban on Microplastics Includes Artificial Turf Crumb Rubber Infill: Other Nations Should Follow Suit" (2021), https://pubs.acs.org/doi/epdf/10.1021/acs.est.4c00047?ref=article_openPDF.

[65] Id., citing: European Commission. Commission Regulation (EU) ... amending Annex XVII to Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards synthetic polymer microparticles. 2023; Committee for Risk Assessment, Committee for Socio-Economic Analysis Opinion on an Annex XV dossier proposing restrictions on intentionally-added microplastics. 2020. b4d383cd-24fc-82e9-cccf-6d9f66ee9089.

Legislative Action: U.S.

> "In terms of direct policy, the majority of the USA (at the federal, state, or local level) has no existing regulations concerning artificial turf and crumb rubber. Nevertheless, the issue has been gaining attention, and dispersed throughout the country are areas that have implemented policies favoring fields with sustainable alternatives to crumb rubber infill. Leading the way in 2009, the Los Angeles Unified School District placed a ban on synthetic turf fields containing crumb rubber infill, and required all newly installed turf fields to utilize alternative infill materials (California State Legislature, 2016). In 2015, Edmonds City Council in Washington passed a 30 month moratorium on the installation of artificial turf fields containing crumb rubber infill (Edmonds City Council, 2015). The Hartford City Council in Connecticut implemented a zoning regulation that bans the use of crumb rubber in all fields installed after January 2016 (Hartford City Council, 2018). In 2017, Washington, DC introduced a moratorium on the installation of any synthetic turf field utilizing crumb rubber infill (Council of the District of Columbia, 2017). Adjacent to Washington, DC, Montgomery County in Maryland (the state's most populated region) also passed a ban on crumb rubber field installations (Monahan, Rappleye, and Gosk, 2021). In 2018, Westport, Connecticut banned the installation of turf fields containing crumb rubber and, in the following year, allocated $4.7 million for the replacement of four such fields in favor of those with sustainable infill alternatives not made from recycles tires (Vaughan, 2021; Vaughan, 2021). Lastly, the New York City Department of Parks and Recreation has released a directive stating that all newly installed fields must utilize infill methods other than crumb rubber (NYC Health, 2021).
>
> In summary, although the USA recognizes microplastics and the PAH and PFAS chemicals contained in artificial turf fibers and crumb rubber infill to be harmful to human and environmental health, no federal policies have been developed and implemented that directly regulate the installation or chemical composition of artificial turf fields. Similarly, the vast majority of state and local governments have established no regulations. The lack of legislative action likely stems from the absence of conclusive studies demonstrating that average use of the artificial turf fields leads to adverse human health effects. With the conduct of more comprehensive and focused investigations, it is anticipated that part 2 of the Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields and Playgrounds will shed more light on the health risks of artificial turf fields and provide a foundation for the development of additional policies."[66] As the International Policy Review paper concludes: "**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."**[67]

In 2023, the State of California enacted SB 676, which allows local agencies to prohibit artificial synthetic grass (turf) on residential properties. A pending Rhode Island ban takes effect in 2029:

> "Rhode Island recently passed the Consumer PFAS Ban Act of 2024 (the "Act"), which bans certain uses of PFAS in covered products by January 1, 2029. This Act defines "artificial turf" as "man-made material which simulates the appearance of live turf, organic turf, grass, sod or lawn" and bans the manufacture, sale, or distribution of artificial turn containing intentionally added PFAS on January 1, 2029. It should be noted that, since artificial turf fields require

[66] International Policy Review, fn. 16 above.

[67] Id. (emphasis added)

periodic maintenance (e.g., replacement of the turf), any materials necessary for future maintenance will be subject to this Act."[68]

For more information about the current artificial turf v. grass debate in professional sports, injuries, litigation and potential state legislation, the below articles cited are instructive.[69]

CONCLUSION

The medical and environmental perspectives on micro-plastics and nano-plastics are critically important factors to be considered by Scarsdale Village and Scarsdale's School District in their decision-making process regarding artificial turf use:

> "Plastics have a presence in every aspect of human life, from the packaging of our foods, our toothbrushes, to the clothes we wear. Plastic is everywhere. In recent years, there have been studies indicating the implications of plastic use on our planet and human health. There are multiple industries and facets in which humans and the planet are exposed to plastic, a large contributor being the health sector."[70]

Based on the multiple known toxicities of artificial turf components – and their demonstrated human uptake and contamination of the environment, as well as other potential harms outlined in this Report – the Scarsdale Forum recommends a moratorium on the installation of new artificial turf fields and courts and makes additional recommendations in this Report consistent with that approach.

The Scarsdale Forum Committees therefore recommend that the Village of Scarsdale should: (1) place a moratorium on the installation of new artificial turf athletic and recreation fields and courts, (2) consider eventual replacement of existing artificial turf with natural grass turf in view of the health, safety, environmental impacts and exposure risks of artificial turf, (3) investigate, assess, and report to the community on the health, safety, environmental impacts and exposure risks associated with the use of synthetic turf athletic and recreation fields and courts in the Village, and (4) evaluate the relative durability and cost of installation, maintenance, replacement and disposal of artificial turf fields and courts compared with natural grass. Based on the potential for negative health impacts to the children and adults who play on artificial turf surfaces, and to coaches, referees, and spectators, and negative impacts to the environment and

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[68] Rhode Island Departments of Health and Environmental Management Letter (Aug. 15, 2024), https://www.burrillville.org/sites/g/files/vyhlif2886/f/uploads/doh_dem_letter_with_response_from_trc_1.pdf, fn 34 above.

[69] See M. McCann, "Turf Wars: NFL's Playing Surface Debate Crosses Medical, Legal Lines" (Sportico, The Business of Sports, Sept. 2024), https://www.sportico.com/leagues/football/2024/nfl-turf-debate-medical-legal-lines-1234795521/ . See also E. Novy-Williams, K. Badenhausen, Turf Wars: NFL Is Finally Tackling Its Playing Surface Problem, https://www.sportico.com/leagues/football/2024/nfl-natural-grass-articifical-turf-owners-players-solution-1234795441/ ; E. Novy-Williams, K. Badenhausen, Turf Wars: Each NFL Team Has Its Own Multimillion-Dollar Calculus (Sept. 2024), https://www.sportico.com/leagues/football/2024/nfl-field-grass-turf-calculus-million-1234795443/ ; B. Coffey, Turf Wars: Real Grass or Artificial Turf Means Big Business Either Way (Sept. 2024), https://www.sportico.com/leagues/football/2024/nfl-field-grass-turf-calculus-million-1234795443/ .

[70] St. Luke's Health, "Plastics and Human Health: Impacts and Healthcare Solutions" (YouTube webinar, Nov 7, 2024) (Dr. M. Campen, Professor, University of New Mexico College of Pharmacy, on the systemic and neurovascular impacts of environmental toxicants including plastics), https://www.youtube.com/watch?v=fNj6AeqFiMs or https://youtu.be/fNj6AeqFiMs?si=a_ugUCyaKE2rC_XP

public in general as set forth in this Report, a moratorium is the prudent course for the Village and School District to take to ensure public health, safety and protection of the environment.

Respectfully submitted by Members of the Scarsdale Forum Sustainability, Municipal Services, Parks and Recreation Committees:

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Madelaine Eppenstein
Chair, Municipal Services Committee

Erin Rudensky
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APPENDIX A

Scarsdale Conservation Advisory Council Letter to Village in Opposition to Artificial Turf Fields

December 5, 2024

Dear Mayor Arest, Village of Scarsdale Board of Trustees, and Village Manager Marshall,

Thank you for the field study and work to address the optimal use of fields for Scarsdale students and residents. This letter is to express the Conservation Advisory Council's (CAC) opposition to the installation of artificial turf fields due to the serious health, flooding and environmental risks for our residents and town.

The benefits of artificial turf, as touted by their manufacturers, include 24/7 use, all-weather play, and a maintenance-free field. This pitch makes the allure understandable. Science however presents a more sobering reality.

Health Risks – Toxins from plastic

Artificial turf's green plastic includes toxic chemicals in its makeup. Anti-static chemicals are used, as well as flame retardant chemicals, and perfluorinated chemicals (PFAs), which have already been banned in Europe and increasingly throughout the US due to their toxicity. Young and developing children are especially vulnerable to the toxic exposures from the chemicals in artificial turf.

Health Risks – Toxins from rubber infill

A typical artificial turf field utilizes rubber infill made from recycled tires. These tires include chemicals that could potentially be harmful to athletes. The EPA found that chemicals are released into the air during play. Crumb rubber dust and small pieces are inhaled and ingested during gameplay. As the fields heat up, the rubber off-gasses and the toxins are further inhaled.

Health Risks – Compacted surfaces

Statistics show that injuries are actually more common on artificial turf surfaces. The G-max rating - the ability to absorb impact – of artificial turf surfaces are high when they are first installed. The surface quickly changes however as the materials are compacted, leaving a rock-hard surface that makes injuries more likely and more severe.

Health Risks – Extreme heat

Studies from Brigham Young University show that artificial turf averages over 30 degrees hotter than asphalt and over 80 degrees hotter than natural grass. On a hot sunny day, artificial turf fields can reach 180-200 degrees.

With warmer weather now occurring for more months throughout the year, there will be an increasing number of days where artificial turf gets too hot, causing it to be unusable. This will reduce playing time in periods of high heat (which are becoming increasingly frequent).

Dehydration, heat stroke and other serious heat-related illnesses have spurred turf manufacturers to sell water cannons for field cooling, even though the water only reduces the temperature for about 20 minutes, at which time the process has to be repeated. Heat also increases the off-gassing of artificial turf's toxic chemicals, which makes them more problematic due to inhalation exposure.

Environmental Issues – Plastic disposal

There is also the concern about the eventual disposal of artificial turf fields. Every 10 years when the plastic field has reached its useful life, it will need to be disposed of. What this means is that every ten years we are going to

send to our County incinerator tons of plastic to be burned. It feels completely against everything we should be and are doing in Scarsdale environmentally to take out nature and install plastic in its place.

Environmental Issues – Green space elimination

Climate change is no longer a future event. We are living it. Last month we experienced 80 degree days - - in November! In school and at home we teach our kids about climate change and stress the need to address it. It seems wholly antithetical to what we know to be reality, to lay down a sheet of plastic on top of nature. Green-tinted plastic is not green space. Removing grass in favor of plastic also removes an important source of carbon sequestration, so the impact is both figurative and literal.

Environmental Issues – Flooding exacerbation

Scarsdale has flooding issues. Artificial turf does not absorb water, it merely shifts it. Removing large tracts of natural grass will increase Scarsdale's field flooding issues, exacerbating one of the key points of the Joint Field Study.

Scarsdale Middle School – No safe option

For the Middle School in particular, it is being proposed that the entire playing field is covered with artificial turf. What will happen to the student or family that does not want their children playing on artificial turf? What will be their option and is it fair to leave families without one? All children should have an option to play outside in a safe environment.

Natural Grass – Many benefits

Naturally maintained grass fields require no chemical use, as beneficial soil microbes deal effectively with body fluids. Natural grass does not need to get disposed of every 10 years. Natural grass does not need to be filled with toxic rubber pellets. Natural grass maintains a cool temperature and in fact absorbs and disperses heat and sequesters carbon.

Natural Grass – Please explore it further and provide more detail

In the next version of the field study proposal, please include more detail on the ways to retain and improve our natural grass fields. Our suggestions would be to seek a proposal on this from an expert in this area. For example, Chip Osborne, President of Osborne Organics, 781-254-7862, has many years of experience in creating safe, sustainable and healthy athletic fields and landscapes through natural grass management. The Village used him successfully until 2016 under former Parks Dept Superintendent Jason Marra.

The October field study presentation came up with the easy answer and recommendation of using artificial turf to solve the question of extending field play. However, the easy answer is often not the best one, or the only one, and we implore you to please explore and consider natural grass field improvements.

We realize the desire of the community to have extended playing seasons and increased field use. Please consider the serious risks of covering our fields with a combination of plastic and rubber. Let's instead create improvements to our natural grass fields that will increase their playing time.

Thank you for your consideration.

Sincerely,
The Scarsdale Conservation Advisory Council
Michelle Sterling, Chair