ARTIFICIAL TURF FACTS:  
Understanding the Issues
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Artificial Turf Facts: Understanding The Issues

Legislative Overview

Over the past few months a few state bills have been introduced pertaining to artificial turf. Most of these bills ask for testing to be done; some ask for a moratorium on installation until the testing is completed. Others ask for additional applications and approval processes.

We welcome any new research on this subject. Yet, it appears that no one has bothered to first review the extensive amount of publicly funded studies and global science of a material that has been the subject of exhaustive research for over twenty years.

Hundreds of studies have been completed to uncover any potential risks of artificial turf with crumb rubber. Government health ministries and environmental bodies around the world have commissioned extensive research. So have world health organizations, leading universities and independent scientific committees.

Of great concern is that all of these bills specifically apply only to artificial turf that contains recycled crumb rubber. These bills do not impact any other infill materials or artificial turf without infill material. If these bills are meant to protect human health and the environment, ALL types of synthetic/artificial turf should be equally tested.

Artificial turf using alternative infill materials have been shown to contain high levels of carcinogens. Artificial turf fields with no infill have been found with toxic levels of heavy metals and other VOCs. Recycled crumb rubber has undergone years of extensive testing. Alternate infill materials and unfilled turf systems have not.

FieldTurf Tarkett, the world leader in infilled artificial turf systems, has ensured the quality and safety of their products. So have the architects, engineers and municipal, state, federal and international regulatory agencies in the forty countries around the world where we have installed over 4000 such fields.

We are opposed to such bills as they are overbroad, arbitrary and unnecessary. Studies reveal that there are NO known health or environmental risks associated with the installation and use of our artificial turf systems. NOT A SINGLE INJURY NOR SICKNESS HAS EVER BEEN REPORTED anywhere in the world, as a result of inhalation, ingestion of or exposure to recycled rubber infill materials in artificial turf.

The enclosed is intended to provide a brief overview of the extensive science available on this subject.
Health:
There is not a single documented report of anyone, anywhere becoming ill as a result of exposure to, inhalation of, ingestion of, or contact with, artificial turf.

As recent as September 2007, environmental health officials from Connecticut’s Department of Public Health wrote, “We have reviewed a great deal of literature on potential human health risks from rubber used in artificial turf fields. We have not seen any information that would lead us to recommend against installing such fields based on chemical exposures or health risk from those using the fields.”

In June 2007, the New Jersey Department of Environmental Protection conducted a similar study concluding, "there was no obvious toxicological concern raised that crumb rubber in its intended outdoor use on playgrounds and playing fields would cause adverse health effects in the normal population.”

A study conducted by the French Agency for Environmental and Energy Management testing the quality of water passing through rubber granules and other infill materials and the health risks associated with the inhalation and ingestion of crumb rubber and any turf emissions found, “the health risks associated with the inhalation of VOC and aldehydes emitted by artificial grass fields give no cause for concern towards human health.”

Environment
As for environmental concerns, studies examining the environmental impact of artificial turf have found NO harmful effects to the environment. The European Commission’s Scientific Committee on Toxicity, Ecotoxicity and the Environment stated, “It can be concluded that rubber tires contain PAHs originating from certain oils used in tire manufacturing, but there is clear evidence that any release into the environment is negligible relative to other PAH sources.” (emphasis added).

Artificial turf can actually benefit the environment by helping eliminate and reuse some of the large stockpiles of tires throughout New York. According to the New York State Department of Transportation, there are currently 40 million stockpiled tires throughout New York. On average, another 18 million tires are added to these discard piles each year. A single artificial turf field with crumb rubber infill will reuse and recycle 20,000 tires per field.

Additionally, artificial turf does not require the use of pesticides. The Environmental Protection Agency (EPA) continues to identify hazardous effects of certain chemicals on the environment. The U.S. Fish and Wildlife Service stated, “recent studies of major rivers and streams documented that 96% of all fish, 100% of all surface water samples and 33% of major aquifers contained one or more pesticides at detectable levels.”

Artificial turf maintenance requires absolutely no pesticides and is therefore both environmentally safe and effective.

Safety
In addition to posing no known health or environmental risk, studies have shown that serious sports related injuries are less likely to occur on artificial turf than on natural grass. The American Journal of Sports Medicine published a study comparing high school athletes’ injuries on natural grass to those on artificial turf concluding that the overall injury rates are similar, but that the type of injury differs between the two surfaces. Namely, the study found that surface to skin injuries and muscle strains were more common on artificial turf while head concussions and ligament tears were higher on grass fields. The conclusion: artificial turf injuries were less severe and had a quicker recovery time.
Misleading Claims

Misleading Claim: That the crumb rubber (SBR) used as infill in artificial turf fields is toxic.

FACT: Recycled rubber has been in use for almost 20 years in a variety of products, including: construction materials, roads, running tracks, fields, parks and playgrounds.

FACT: Over 46 billion tires have been ground up on our highways and city streets. Each year, 300 million more tires are worn out by planes, trucks, buses and the cars we drive. People have been exposed to this rubber since the advent of the automobile.

FACT: An artificial turf field represents ONLY 0.0017 of the rubber that is part of our environment and the air we breathe every day. If it is dangerous then the focus should not be on the 0.0017 but on the 99.9983.

Misleading Claim: That PAHs in crumb rubber are carcinogenic.

FACT: PAHs are naturally occurring substances found everywhere in our environment. The claims of PAHs in SBR should be balanced with the fact that burning fossil fuels, including heating and cooking are, in fact, the top causes of PAHs in our atmosphere.

Misleading Claim: That a reduction of the PAHs in tires can reduce the overall concentration of PAHs found in the environment.

FACT: The Scientific Committee on Toxicity, Ecotoxicity and the Environment (CSTEE) published its report in Brussels, which reads, “A reduction of the concentration of PAHs in tyres will insignificantly reduce the overall concentration of PAHs found in the environment.” The report goes on to state “tyres contributed less than 2% of the exposure associated with respirable particles and 1% of PAHs concentrated in sediments.”

FACT: Based on this worst-case scenario the risk of PAHs from an artificial turf field would be approximately .000000008%.

Misleading Claim: That the materials used in artificial turf fields can affect the health of athletes who play on it.

FACT: Not a single injury has ever been reported where an athlete or anyone else has fallen sick or was injured as a result of inhaling, having skin contact with or ingestion of artificial turf infill materials.

FACT: A five year study comparing artificial turf to natural grass has shown that artificial turf resulted in 55% fewer neural injuries, 47% fewer cranial cervical injuries, 45% less time lost to injury (+22 days), 38% fewer third degree injuries and 35% less time lost to injury (1–2 days).
**Misleading Claims**

### Misleading Claim: That the reduction of natural grass contributes to global warming.

**FACT:** Artificial turf fields represent only .006172% of the total asphalt and concrete urban space in the U.S. This is not including the massive area of glass wall buildings that deflect and generate heat in every city in America.

**FACT:** For every artificial turf field installed in America, where kids can play and exercise, almost 2 million parking spaces are being installed for vehicles that spew heat and toxins into the atmosphere.

### Misleading Claim: That MRSA / staphylococcus (Staph) infections are caused by parasitic bacterium present on the playing surface of artificial turf fields.

**FACT:** NO staph infections have ever been found in artificial turf fields, although they have been found in almost every other part of the athletic environment including; blocking pads, benches, clothing, towels, tubs, showers, massage tables, weights and floors.

**FACT:** Tests executed to evaluate the potential of an artificial grass field retaining bacteria involved the placement of living organisms into the turf. All of these living organisms passed right through the turf system and each was recovered in the drainage system of the field.

### Misleading Claim: That the sand used in artificial turf fields can cause silicosis.

**FACT:** The sand used in artificial turf does NOT cause silicosis. Diseases from sand are caused by respirable crystalline silica. Respirable crystalline silica is so small as to be invisible to the naked eye, and is caused by activities involved in sand blasting or in mining where the forces are actually fracturing the sand particles. Diseases associated with this require exposure to these small harmful particles for years and/or massive levels of such exposure. The sand particles used in artificial turf are too large to ever get down into the lungs.

### Misleading Claim: That artificial turf is dangerous to the environment.

**FACT:** Burning of fossil fuels remains the #1 global concern. The environmental benefits of artificial turf include the recycling of old tires, the elimination of thousands of tons of pesticides, chemicals and fertilizers from our environment as well as the reduction of the heat generated and fuel required just to maintain natural grass playing fields.

**FACT:** Artificial fields need no water - saving billions of gallons of clean drinking water. Each natural grass sports field requires approximately 1,000,000 gallons of water per year.
Misleading Claims

**Misleading Claim:** That maintaining artificial turf is difficult and costly.

**FACT:** The savings achieved in the reduction of equipment, fuel, pesticides, chemicals and fertilizers is considerable. An average natural grass playing field costs $50,000 to properly maintain each year. An artificial grass field costs $5,000 to maintain.

*City and parks administrations, sport facility and stadium managers, athletic directors, coaches and field maintenance staff in schools and colleges from coast to coast consistently testify that the savings and economic benefits of artificial turf are considerable.*

**FACT:** Over a ten year period, the average cost per hour of use of an artificial turf field is less than 24% the cost of use of a natural grass field.

**Misleading Claim:** That the amount of oxygen in the atmosphere is being reduced as artificial turf replaces natural grass.

**FACT:** Only growing forests produce a net gain of oxygen. A mature forest is in a steady state, where growth and decay are equal. Decay releases the same number of molecules of carbon dioxide that the tree stored during its life and growth.

*Most rainforests are the perfect example of this steady state with rapid growth and rapid decay being essentially equal. Managed forest, with healthy growth and long-term storage of the harvested wood, produce oxygen.*

**FACT:** Natural grass playing fields do NOT produce oxygen. Artificial turf represents ONLY .0002487% of the green space in the U.S.

**FACT:** Americans spend $11 billion a year on water, pesticides, fertilizers and gas to keep 30 million acres of lawns green and tidy, making grass America’s largest irrigated crop.

**Misleading Claim:** That crumb rubber in artificial turf leaches Zinc and the Zinc levels increase over time.

**FACT:** In field tests completed on 5 and 6 year old fields in Dec 2007, it was found that the zinc leachate from crumb rubber filled fields were less than half the levels of zinc found in the rainwater.

- Drainage water [Zn] = 0.016 mg/l
- Rainwater [Zn] = 0.033 mg/l
- Zinc leaching from 6 year old systems with SBR is lower than zinc content in rain.
Hundreds of studies have been completed to uncover any potential risks of artificial turf. Government health ministries and environmental bodies around the world have commissioned extensive research. So have world health organizations, leading universities and independent scientific committees, and they have all found no evidence of risk associated with pelletized tire and artificial turf.

A Sampling of Studies:

- Environmental Impact End of Life Tire Crumb Rubber, Laboratory for Research & Control for Rubber and Plastics, 2006 Update
- Ambient Air Sampling for PAH’s – Comsewogue High School Football Field, J.C. Broderick & Associates Inc., Environmental Consulting & Testing
- Civil Engineering Application of Tire Shreds, Dana N. Humphrey, Ph.D, P.E., University of Maine.
- Field Study of Water Quality Effects of Tire Shreds Placed Below the Water Table, Dana N. Humphrey, Ph.D, P.E. University of Maine.
- Recycled Rubber Nitrosamines Analysis, Tun Abdul Razak Research Centre, 2006
- Answers to Questions on Harmful Substances in Artificial Turf Fields, Dr. JM Roels, Head of Substance Expertise Centre, Dutch National Institute for Public Health & the Environment, Social Welfare and Sport.
- Polycyclic Aromatic Hydrocarbons (PAH) & Other Organics in Tyres — Origins and Potential for Release, Dr. Brian Willoughby, consultant in Polymer Chemistry, Standards for Artificial Turf Working Group
- Rubber—Its Implications to Environmental Health (Hydrocarbon Rubbers), Dr. Brian Willoughby, Independent Consultant in Polymer Chemistry
- The Effects of Motorway Runoff on Freshwater Ecosystems, Cranfield Centre for Ecochemistry, Cranfield University
- Cancer Risk Assessment, Indicators & Guidelines for Polycyclic Aromatic Hydrocarbons in the Ambient Air, Swedish Environmental Protection Agency
- Rubber Granulate from Recycled Car Tyres is Safe for People and the Environment, VACO Tyre and Wheel Trade Organization, 2006
- Tire Crumb Rubber Used in Artificial Turf Fields, the Royal Dutch Football Association (KNVB) and the Netherlands Olympic Committee/Dutch Sports Federation (NOC*NSF), March 2007
- Initial Evaluation of Potential Human Health Risks Associated with Playing on Synthetic Turf Fields on Bainbridge Island, D. Michael Johns, Ph.D
Safety Studies

- Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products, Office of Environmental Health Hazard Assessment, January, 2007
- Investigation and Assessment of Synthetic Sports Surfaces in Switzerland Including Athletic and Soccer facilities, Hans J. Kolitzus, IST Switzerland Institut fur Sportbodentechnik
- Artificial Turf Pitches—an Assessment of the Health Risks for Football Players, Norwegian Institute of Public Health and the Radium Hospital, Oslo, January 2006
- European Union Commission Report, February 16, 2004
- Environmental Impacts of Recycled Rubber in Light Fill Applications, Chelsea Center for recycling and Economic Development, University of Massachusetts, August 1998
- Environmental and Health Effects of Tire Waste, Lawrence Livermore National Laboratory
- A Five-Year Prospective Study, Bill S. Barnhill, MD, March 2003
- Effectiveness of Scrap Tire Chips as Sorptive Drainage Material, Tuncer B. Edil, M.ASCE; Jae K. Park; and Jae Y. Kim, A.M.ASCE
- Five-Year Study Of The Water Quality Effects Of Tire Shreds Placed Above The Water Table, Dana N. Humphrey and Lynn E. Katz
- Opinion of the Scientific Committee on Toxicity, Ecotoxicity and the Environment (CSTEE) on “Questions to the CSTEE relating to scientific evidence of risk to health and the environment from polycyclic aromatic hydrocarbons in extender oils and tyres”
- A review of environmental impacts and environmental applications of shredded scrap tires, Tuncer B. Edil University of Wisconsin-Madison, Madison, Wisconsin, U.S.A.
- Sorption of Organic Compounds in the Aqueous Phase Onto Tire Rubber, Jae Y. Kim, Student Member, ASCE, Jae K. Park, and Tuncer B. Edil, Member, ASCE

Examples of governing bodies indicating there is no risk with artificial turf:

- New Jersey Department of Environmental Protection
- Danish Ministry of the Environment
- The Hague, Ministry of Social House, Regional Planning and Environmental Administration
- The European Commission’s Scientific Committee on Toxicity, Ecotoxicity and the Environment
- Swedish Environmental Protection Agency
- Swiss Federal Authority of Health
- Norwegian Institute of Public Health
- Norwegian Pollution Control Authority
Safety Studies

The following excerpts are from UNIVERSITY AND INDEPENDENT STUDIES contained for your convenience in “The facts about SBR,” Volumes I and II. The full research reports can be found in the cited works.

**Air Effects**

“The obtained results from the parameters analyzed in the effects on air study in the football field made of artificial turf do not exceed any maximum established so much in the European legislation of air environment.” *(Instituto de Biomecanica De Valencia, Volume I, Section 23)*

“No volatile aromatic hydrocarbons found.” *(ISA Sport, Netherlands, Volume I, Section 24)*

**Crumb Rubber**

“The use of rubber granulate in playground forms no relevant risk to children or the environment.” *(University of Alberta, Volume I, Section 15)*

“Prolonged daily skin contact with rubber tires does not pose any relevant health risk.” *(Danish Technology Institute, 2005. Volume I, Section 15)*

“We conclude that the use of tire crumb in playgrounds results in minimal hazard to children and the receiving environment.” *(Journal of the Air & Waste Management Association, Volume I, Section 5)*

“Recycled rubber granulate contains chemical substances that are extremely low and they are only leached from the granulate in very small quantities. In addition, they are only present in low concentrations in the air. On the basis of estimated exposure values and the doses/concentrations which can cause harmful effects in humans or animal experiments, it’s concluded that the use of artificial turf halls doesn’t cause elevated health risk. On the basis of the knowledge that is currently available concerning health effects and exposure linked to the use of indoor artificial turf pitches, it’s concluded that the use of artificial turf halls doesn’t cause elevated health risk.” *(Norwegian Institute of Public Health and the Radium Hospital, Volume I, Section 21)*

“Artificial turf pitches sprinkled with rubber granules are in fact not damaging for health.” *(Dutch State Institute for Public Health, Volume I, Section 7)*

“The research showed that the quantity of each component that could be regarded as ‘unsafe’ was so low that it would not harm an athlete coming into contact with the material when used in an open field.” *(PanStadia, Volume I, Section 25)*

“...we conclude that recycled rubber derived from scrap tires is a safe recyclable material. Based on the evidence presented, the overwhelming conclusion is that it would be reasonable to recommend use of recycled scrap tires in civil engineering applications.” *(University of Massachusetts Lowell, Helen Liu, Joey Mead, Ross Stacer, Volume II, Section 28)*
Safety Studies

Gas Emissions

Overall, the balance of the studies reviewed indicate that human health risks from playing on synthetic turf fields is minimal, even though low concentrations of some chemicals have been demonstrated to leach from the tire crumb, or volatilize as vapor. A conservative sport play scenario developed to better describe turf field use on Bainbridge Island is consistent with the findings reported in the other published studies. (Initial Evaluation of Potential Human Health Risks Associated with Playing on Synthetic Turf Fields on Bainbridge Island, D. Michael Johns, Ph.D., Volume II, Section 40)

With regards to allergies, it is concluded that exposure to the low concentrations which were measured does not constitute any elevated risk with respect to the development of contact allergies.

Worst case calculations based on air measurements carried out by NILU and exposure values from the Norwegian Institute of Public Health indicate that training in sports halls does not cause any increased risk of leukemia as a result of benzene exposure or any elevated risk as a result of exposure to polycyclic aromatic hydrocarbons. (Artificial turf pitches – an assessment of the health risks for football players - Norwegian Institute of Public Health and the Radium Hospital - Oslo, January 2006, Volume I, Section 21)

Leaching Effect on Soil

“The material does not overcome the values limit of the Union of European Football Association recommendations.” (Instituto de Biomecanica De Valencia, Volume I, Section 23)

PAHs

“PAHs can in fact be released to a limited extent from rubber granule particles, but based on the available data, this does not lead to a health risk. There is no health risk for DEHP from oral exposure either.” (Dutch National Institute for Public Health & the Environment, Volume I, Section 6)

“The estimatable PAH stress is low even in worst case scenarios compared with stress from other sources. The health risk for players and spectators is classified low. Thus, from the health point of view no urgent need of action is seen.” (IST Switzerland, Hans Kolitzus, Volume I, Section 20)

“The PAH air testing, performed on and around the athletic field of the above referenced facility, did not reveal the presence of any detectable concentrations of PAHs.” (Brendan Broderick, J. C. Broderick & Associates, Volume II, Section 37)
Safety Studies

Safety for Players

This study compared injury incidence of eight high school football teams in Texas playing on in-filled synthetic surfaces and natural grass surfaces. While overall injury rates were similar between turf and natural grass fields over a five-year period of competitive play, there were significant differences in type of injuries that occurred, injury time loss, injury mechanism, anatomical location of injury, and type of tissue injury between playing surfaces.

The overall conclusion of the study was that the types of injuries suffered on turf were less severe with a quicker recovery time than those injuries suffered on grass.

• 55% fewer neural injuries
• 47% fewer cranial/cervical injuries
• 45% less time lost
• 38% fewer 3rd degree injuries
• 35% less time lost to injury

(Human Performance Research Center, West Texas A&M University Michael Myers, PhD and Bill Barnhill, MD, Published in The American Journal of Sports Medicine)

Water Impact

“On the basis of a comparison with the French and European limit values currently in force, the concentrations of organic compounds, metals and anions from percolates are without impact on water resources. From an ecotoxicological viewpoint, the results obtained show that the nature of the percolates likely to infiltrate into the ground underlying the artificial turf sports surface proves to be without impact on the aquatic environment in the short and medium term.” (Dr. Robert Moretto, EEDEMS, Volume I, Section 19)

“In the next few years, major increases in the number of scrap tires used for civil engineering applications is possible because of their growing record of successful performance combined with guidelines to limit self-heating of thick fills, recently published ASTM guideline specifications, and groundwater data showing that they have a negligible environmental impact.” (University of Maine, Dana Humphrey, PhD, Volume II, Section 26)

“No evidence was found that tire shred the concentration of substances that have a primary drinking water standard including barium cadmium and chromium... No evidence was found that tires shreds the concentration of the following substance which, have a secondary drinking water standard.” (University of Maine, Dana Humphrey, PhD, University of Texas, Austin, Lynn E. Katz, Volume II, Section 27)

Tyre shreds placed above or below water table have a negligible impact on water quality. (Rubber – Its Implications to Environmental Health (Hydrocarbon Rubbers) - Dr. Brian G Willoughby, Volume II, Section 40)
State Health Department Findings

California Office of Environmental Health Hazard Assessment
“Considering all the data, it seems doubtful that recycled tire rubber in outdoor applications such as playground surfaces releases high enough levels of chemicals to cause toxicity to animals and plants living in the vicinity.”

Connecticut Department of Public Health
“Based upon the current evidence, a public health risk appears unlikely. However, there is still uncertainty and additional investigation is warranted. A variety of governmental bodies including Norway, Sweden, New Jersey and California have recently reviewed the health issues; their assessments have not found a public health threat. Sources of exposure unrelated to artificial turf fields are likely more important than the turf fields for many chemicals.”

New Jersey Department of Environmental Protection
“...there was no obvious toxicological concern raised that crumb rubber would cause adverse health effects in the normal population.”

“After reviewing the information available, with the possible exception of allergic reactions among individuals sensitized to latex, rubber and related products, there was no obvious toxicological concern raised that crumb rubber in its intended outdoor use on the playgrounds and playing fields would cause adverse health effects in the normal population. Individuals with a known sensitivity to such materials should be advised about the potential exposures and allergic responses.”

New York City Parks and Recreation Department
“There is nothing inherently dangerous to these fields. There is a greater likelihood of head injuries in a fall than any danger from ingesting the rubber crumbs.” (Commissioner Adrian Benepe, The New York Times)

New York City Department of Health and Mental Hygiene
Q: Should people continue to use artificial turf fields?
A: Yes. Regular physical activity is one of the most important parts of a healthy lifestyle. Artificial turf fields allow access to open spaces for sports and physical activities. As with any outdoor activity, it is recommended that after using the fields, people wash their hands before eating or drinking. On hot days, users should take rest breaks and drink water.”
## Quick Comparison Artificial Turf vs. Grass

<table>
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<th><strong>Health</strong></th>
<th>Artificial Turf</th>
<th>Pesticide Infused Grass</th>
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<tr>
<td>The New Jersey Department of Environmental Protection found NO health concerns with pelletized rubber and its intended outdoor use.</td>
<td>According to the GAO, some pesticides are highly toxic, with a few drops causing extremely harmful effects; The EPA recently stated that Atrazine (the second most common weed-killer) is showing up in streams, rivers and watersheds in high enough levels to harm amphibians, fish and aquatic ecosystems.</td>
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<td>Recent water-runoff tests showed NO traces of chemicals from artificial turf water runoff.</td>
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| **Environment** | Artificial turf could give new life to the 275 million scrap tires in stockpiles in the U.S. | 80,000,000 pounds of harmful pesticides, weed-killers and fertilizers are applied to “natural” grass every year. |
| | New York alone, according to the State Department of Transportation, estimates there are currently 40 million stockpiled tires throughout New York. | By-products of the insecticide chlorpyrifos were found in 93% of urine samples from children ages 3 to 13. |
| | 300 million tires are scrapped each year in the U.S. | 99% of 110 Seattle area children ages two to five had detectable levels of organophosphate residue in their urine. |
| |  | 96% of all fish analyzed in all rivers and streams contained residues of one or more pesticides. |
| |  | 100% of all surface water samples in major rivers and streams contained pesticides. |

| **Safety** | 55% fewer neural injuries 47% fewer cranial cervical injuries 45% less time lost to injury (22+ days) 38% fewer 3rd degree injuries 35% less time lost to injury (1-2 days) | Grass fields can deteriorate, creating unsafe playing conditions. Bumps and holes left in grass fields lead to a much higher incidence of athlete injuries as compared to artificial turf. |

| **Cost (average field)** | $5,000 maintenance per year | $50,000 maintenance per year |
### Health: Artificial Turf vs. Grass

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<td>Hundreds of studies, government health ministries, environmental bodies and leading university researchers all agree there is NO adverse health effects associated with artificial turf.</td>
<td>Pesticides are a major and necessary part of maintaining grass fields. As a result, our schools and park systems are infused with these chemicals, many of which have been associated with serious health risks—especially among children. To make matters worse, pesticides stick around long after the fields have been treated, further increasing the risk of exposure.</td>
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<td>There was no obvious toxicological concern raised that crumb rubber in its intended outdoor use on playgrounds and playing fields would cause adverse health effects in the normal population.</td>
<td>The new synthetic pesticides break down more quickly but can still be found in water, air and food weeks to months after application.</td>
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<td><em>- New Jersey Department of Environmental Protection, June 2007</em></td>
<td><em>- Reducing Low-Dose Pesticide Exposures in Infants and Children, Physicians for Social Responsibility</em></td>
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<td>The health risk on children’s playgrounds that contained both worn tires and granulate rubber was insignificant.</td>
<td>Children regularly exposed to pesticides at home may be three to seven times more likely to develop Non-Hodgkin’s lymphoma (NHL), a cancer of the immune system, than children not exposed regularly.</td>
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<td><em>- Danish Ministry of the Environment</em></td>
<td><em>- American Cancer Society</em></td>
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<td>All heavy metal levels [in reused tires] are in compliance with the standards applicable to toy manufacturing and the risk of harmful effects on sportsmen and women is therefore negligible.</td>
<td>Children are at a greater risk for some pesticides for a number of reasons. Children’s internal organs are still developing and maturing and their enzymatic, metabolic and immune systems may provide less natural protection that those of an adult.</td>
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<td>Indoor and outdoor use of rubber infill poses absolutely no risk to sportsmen/sportswomen or other parties concerned through inhalation.</td>
<td><em>- Environmental Protection Agency</em></td>
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<td><em>- Study from ISA Sports Test Institute, the NOC/NSF and the KNVB</em></td>
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## Environment Artificial Turf vs. Grass

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<td>Similar to the studies of the health effects of tire crumb, studies examining the environmental impact of artificial turf have found that it has NO harmful effects to the environment.</td>
<td>The pesticides used on grass are monitored extensively by the Environmental Protection Agency (EPA), which continues to identify hazardous effects of certain chemicals on the environment—even those initially thought to be safe. For instance, an independent analysis, commissioned by the EPA, recently found that Altrazine, the second most common weed killer in the United States, is showing up in some streams and rivers at levels high enough to potentially harm amphibians, fish and aquatic ecosystems.</td>
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<td>It can be concluded that rubber tires contain PAHs originating from certain oils used in tire manufacturing, but there is clear evidence that any release into the environment is negligible relative to other PAH sources.</td>
<td>- Washington Post, December 9, 2007.</td>
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<td>Because tire rubber is designed to be strong, durable and substantially impermeable, it is unlikely that any losses occur to air or water in concentration that would pose serious human or environmental risk.</td>
<td>In fact, recent studies of major rivers and streams documented that 96% of all fish, 100% of all surface water samples and 33% of major aquifers contained one or more pesticides at detectable levels.</td>
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<td>- The European Commission's Scientific Committee on Toxicity, Ecotoxicity and the Environment</td>
<td>- Gilliom, Robert.</td>
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# Safety Artificial Turf vs. Grass

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<td>Studies have shown that sports related injuries are less likely to occur on artificial turf then on chemically enhanced grass. The impact of the injury has also proven to be less severe on artificial turf due to the shock absorbency of the surface material which also provides for increased slip resistance and resistance to rotation.</td>
<td>The surface of chemically enhanced grass is more susceptible to the wear and tear of everyday use and without the proper maintenance grass quickly loses its resiliency. The impact of a fall on chemically enhanced grass is therefore more severe and studies show that there is a greater likelihood of head injuries during sporting events on chemically enhanced grass.</td>
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<td>Artificial turf resulted in 55% fewer Neural injuries, 47% fewer Cranial Cervical Injuries, 45% less time lost to injury (during a 22+ day period), 38% fewer 3rd degree injuries and 35% less time lost to injury (during a 1-2 day period).</td>
<td>The greater incidence of first-degree and total concussions combined, as well as the greater incidence of ACL-involved trauma, further reiterates the level of severe trauma observed during competition on natural grass.</td>
</tr>
<tr>
<td>My concerns for safety as far as injuries are drastically changed. If a student falls [on turf], it’s a cushion.</td>
<td>- Five Year Prospective Study, Michael C. Meyers, PhD, FACSM and Bill S. Barnhill, MD., March 2003</td>
</tr>
<tr>
<td>- Dennis Robinson, Athletic Director, Lakeland High School (Shrub Oak, N.Y.)</td>
<td>- Five Year Prospective Study, Michael C. Meyers, PhD, FACSM and Bill S. Barnhill, MD., March 2003</td>
</tr>
</tbody>
</table>
## Cost Artificial Turf vs. Grass

<table>
<thead>
<tr>
<th>Artificial Turf</th>
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<tbody>
<tr>
<td>The numbers speak for themselves – artificial turf is a smarter investment then</td>
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<tr>
<td>chemically enhanced grass. Artificial turf requires less maintenance and is</td>
</tr>
<tr>
<td>much more durable and sustainable then chemically enhanced grass.</td>
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<tr>
<td>According to research conducted by Sports Engineering Technologies Inc., a</td>
</tr>
<tr>
<td>natural grass field requires $50,000 in supplies, equipment and labor costs per</td>
</tr>
<tr>
<td>year, while a turf field requires $5,000.</td>
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<tr>
<td>- <em>The Clover Herald, September 26, 2007</em></td>
</tr>
<tr>
<td>We won’t get involved in a project if it’s not turf, because the durability of</td>
</tr>
<tr>
<td>the fields is light-years ahead of grass. You can play on them every day, all</td>
</tr>
<tr>
<td>day long, and they don’t wear out. They cost more upfront to build, but</td>
</tr>
<tr>
<td>maintenance costs are much less.</td>
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<td>- <em>Joseph A. Stout, Commissioner, Westchester Parks, Recreation and Conservation</em></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Pesticide Infused Grass</th>
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<tbody>
<tr>
<td>Since grass requires constant upkeep and is much more sensitive to harsh</td>
</tr>
<tr>
<td>weather conditions, the utilization of chemically enhanced grass fields is</td>
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<tr>
<td>less than that of artificial turf. High school athletic departments have found</td>
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<tr>
<td>that playing games on chemically enhanced grass can lead to delays for upkeep</td>
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<tr>
<td>and fewer games per season.</td>
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<tr>
<td>From a playability standpoint, it’s an amazing tool. Last fall, the old</td>
</tr>
<tr>
<td>natural grass field could only endure a total of 11 football games and</td>
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<tr>
<td>a weekly band practice. This fall, he said, 39 activities will be held on the</td>
</tr>
<tr>
<td>field.</td>
</tr>
<tr>
<td>- <em>John Kohutanycz, Athletic Director, Sayreville High School (Sayreville, NJ)</em></td>
</tr>
</tbody>
</table>
Notable Quotes

After reviewing the information available, with the possible exception of allergic reactions among individuals sensitized to latex, rubber and related products, there was no obvious toxicological concern raised that crumb rubber in its intended outdoor use on playgrounds and playing fields would cause adverse health effects in the normal population.

- New Jersey Department of Environmental Protection, June 2007

New York need not duplicate the work of other reputable governmental bodies such as Norway, Sweden, New Jersey, California and Connecticut that have examined the health and environmental aspects of this popular playing surface. To date, no state or federal agency has banned, restricted or warned against the use of artificial turf.

- New York School Board Association Letter to the New York Senate Rules Committee

DPH’s review does not find any reason to stop installation of these fields. Currently there are no federal or state limits on the installation of crumb rubber-based turf fields. Therefore, it is up to towns to make a case-by-case decision on whether artificial turf is the right choice for a particular setting.

- Connecticut Department of Public Health

We have researched the matter in great detail and have determined that the synthetic turf in use at [Kingswood-Oxford School] does not pose an environmental threat or a health risk to the student-athletes and others who use it. We are aware of several independent studies, including one by Aliapur, the leading French government body responsible for used tires, along with ADEME, the French Agency for Environment and Energy Management that have offered proof that the rubber used in the installation of the field is not a danger to anyone.

- Dennis Bisgaard, head of school at Kingswood-Oxford School, West Hartford News, November 29, 2007

All heavy metal levels are in compliance with the standards applicable to toy manufacturing and the risk of harmful effects on sportsmen and women is therefore negligible.

- Study from ISA Sport Test Institute, the NOC/NSF and the KNVB

There is nothing inherently dangerous to these fields. What is dangerous is letting kids play touch football on asphalt. There is a greater likelihood of head injuries in a fall than any danger from ingesting the rubber crumbs.

- Adrian Benepe, Commissioner of New York City Department of Parks & Recreation, New York Times, August 13, 2007

On the basis of estimated exposure values and the doses/concentrations which can cause harmful effects in humans or in animal experiments, it is concluded that the use of artificial turf halls does not cause any elevated health risk. This applies to children, older children, juniors and adults.

- Artificial turf pitchers—an assessment of the health risks for football players, Norwegian Institute of Public Health and the Radium Hospital, Oslo, January 2006.
Hazard assessments associated with exposure to water soluble chemical extracts of tire crumb suggest low risk for carcinogenicity or ecosystem impact.

- Technical Paper, Toxicological Evaluation for the Hazard Assessment of Tire Crumb for Use in Public Playgrounds (Alberta, Canada), July 2003

Over a five year period of competitive play, significant differences in the incidence, type and severity of game-related injuries were observed between playing surfaces. In regards to reducing the number of game-related, high school football injuries, current findings suggest an advantage in selecting FieldTurf over Natural Grass.

- A five-year Prospective Study, March 2003, Bill S. Barnhill MD, Michael Myers, PHD FASCAM

The health risk on children’s playgrounds that contained both worn tires and granulate rubber was insignificant.

- Danish Ministry of the Environment

Because tire rubber is designed to be strong, durable and substantially impermeable, it is unlikely that any losses could occur to the air or water in concentrations that would pose serious human or environmental risk.


A wide range of PAHs, including the carcinogenic ones, is found in the air-especially in urban air. They originate from various combustion sources (e.g. Power generation, vehicular toxicity, space heating, etc.). Given their widespread availability, human exposure to PAHs cannot be avoided. That means if you got hunting for PAHs (yes, even the carcinogenic ones) you will find them.


Tire shreds places above or below water table have a negligible impact on water quality.

- Rubber—It’s Implications to Environmental Health (Hydrocarbon Rubbers)—Brian G. Willoughby

Based on the total percentage of injuries reported on each playing surface, a significantly greater percentage of neural injuries were reported on Natural Grass vs. FieldTurf. (16.8 Natural Grass vs. 7.5 % FieldTurf)

- A five-year Prospective Study, March 2003, Bill S. Barnhill MD, Michael Myers, PHD FASCAM
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A few local “studies” either disagree with the accepted findings of government health ministries, world health organizations, leading universities, independent scientific committees and environmental bodies around the world or they are unaware of the existing science. It is these reports that have been making the headlines. The following details some of their shortcomings.

MEMORANDUM

TO: Interested Parties
FR: Dr. Tuncer Edil, Ph.D., P.E.
Geo Engineering Consulting LLC
RE: Artificial Turf Studies
DATE: January 10, 2008

As a professional engineer and university professor who specializes in research concerning soils, recycled materials and environmental geotechnics, I have a strong interest in work that is thorough and accurate.

I have devoted my career to the study of science and its application to our everyday life. Much of my research has revolved around industrial by-products such as shredded automobile tires.

Based on my scientific review of the facts and my independent research, I have concluded that artificial fields are safe for humans of all ages to play on. They are safe for the watershed. They are safe for the environment at large. There are a great number of internationally respected studies that arrive at the same conclusions.

Last month, at the request of FieldTurf, I was asked to review three recent studies concerning the use of crumb rubber in artificial turf. I have found that none of these studies show that crumb rubber used in artificial turf is a hazardous material as defined by the U.S. Environmental Protection Agency (EPA).

They do not show that polycyclic aromatic hydrocarbons (PAHs) emissions and leaching of organic and inorganic chemicals are at concentrations that would be health hazards in the environments where the turf is used. In fact, numerous studies in the United States and Europe already have concluded these releases do not constitute significant risk to human beings and groundwater resources.

Dr. Edil, a professor at the University of Wisconsin-Madison in the Department of Civil and Environmental Engineering, is an international expert in the study of crumb rubber, leachates and toxins. He has received numerous awards from the American Society of Civil Engineers and other institutions.
Review of Negative Studies

News 12 Long Island Report

Reporter Mary Mucci went to a FieldTurf playing surface, picked up a handful of crumb rubber, and sent it to Paradigm Environmental Services for analysis. In my review I find no reason to dispute the facts of the study. However, there are problems with the interpretation. An analogy would be to look at asphalt. There are chemicals in asphalt but we don’t worry about them being released so it’s not considered hazardous. Even if crumb rubber did leach all of the metals in it, the material is still not hazardous under EPA rules.

William Crain and Junfeng Zhang Analysis

In my opinion this study doesn’t match real life situations. The approach used in this study does not simulate any likely leaching environment or approaches to obtaining a bulk composition analysis. Comparison with the New York State Department of Environmental Conservation (DEC) contaminated soil limits is inappropriate and unwarranted. The leaching potential of the organic chemicals from soil and crumb rubber can’t be identical and are affected by the media. The tire rubber has much more capacity to hold hydrophobic substances than natural soil.

Environment & Human Health, Inc. Report

This report lacks references for many facts that it cites. It also makes continued use of the statement that the quality of air suffers in places where rubber is manufactured. However, the manufacturing environment where compounds are mixed together is different than the artificial turf environment where the end product is used. Consequently, special precautions are taken in rubber factories. The key question for this report is what concentration change does crumb rubber leaching result in the environment and is there any potential threat at such concentrations?

This study mainly relies on a previous report by the Connecticut Agricultural Experiment Station (which is included in its appendix) to support its contentions. The Connecticut report merely states that artificial turf can lead to a release of chemicals based on laboratory tests. Many materials and processes release chemicals but they do not alter the water or air quality to the point that they constitute an unacceptable risk. It must also be remembered that after a chemical is released there will be dispersion and dilution. The size of the source and these mechanisms together determine the potential change in environmental quality and whether it exceeds limits for health risk or drinking water standards. The report attempts to characterize only the source, however, in doing so it doesn’t include tests that represent necessarily the conditions in the environments where the turf is used.
MEMORANDUM

TO: Vincent C. McDermott, Milone & MacBroom, Inc.
FROM: Jennifer Cunningham, Epona Associates, LLC
Wendy Koch, Epona Associates, LLC
DATE: October 11, 2007
SUBJECT: Comments on scientific fact sheet prepared by the Connecticut Agricultural Experiment Station (2007)

Report:
AC005 (8/07)
EXAMINATION OF CRUMB RUBBER PRODUCED FROM RECYCLED TIRES
Mary Jane Incorvia Mattina, Mehmet Isleyen, William Berger, Saim Ozdemir
Department of Analytical Chemistry
The Connecticut Agricultural Experiment Station
123 Huntington Street
P.O. Box 1106
New Haven, Connecticut 06504

General comments: This scientific fact sheet from the Connecticut Agricultural Experiment Station (CT AES) demonstrates the potential movement of chemicals from tire crumb into both water and air under the defined experimental conditions. The experimental data do not characterize the potential concentrations under field conditions, either proximate to a synthetic turf field or at potential environmental impact points (i.e., varying distances from such fields). As result, the CT AES data do not allow for a realistic assessment of the potential human health and/or environmental risks from the installation and subsequent use of a synthetic turf field. Note: The lack of (and need for) field data is noted by the CT AES authors in their conclusions.

Of specific relevance to interpreting the CT AES leachate data, the California Office of Environmental Health Hazard Assessment states (in its 2007 report entitled “Evaluation of health Effects of recycled Waste Tires in Playground and Track Products”): “Groundwater in contact with tire shreds contained elevated levels of many chemicals; however, those levels rapidly approached background a few feet outside of [tire trenches]. Additional published studies indicate that concentrated leachate produced in the laboratory from tire shreds, crumb rubber or whole tires was toxic in 19/31 studies to a variety of organisms including bacteria, algae, aquatic invertebrates, fish, frogs and plants; however, it is unlikely that the use of shredded tires in outdoor applications such as playground surfaces would result in the leaching during rain events of high enough concentrations of chemicals to cause such effects. Further, shredded tires used in applications above the ground water table, as is the case for playground surfaces, produced no toxicity in sentinel species.”
Review of Negative Studies

Specific comments:

1. Are compounds volatilizing or out-gassing from the tire crumbs? Samples of tire crumb were placed in glass vials and warmed in a heating block to 60°C (= 140°F), with the resulting data demonstrating the release of volatiles into the contained headspace of the vial. However, these findings are specific to the potential concentrations in a small, heated, volume of air and do not reflect concentrations likely to be found above crumb rubber playing fields. Further, although the report shows that an ambient temperature of 31°C (=88°F) may result in a tire crumb temperature of 55°C (=131°F), the experimental air data from the heated vials do not reflect the chemical concentrations expected above a synthetic turf field. That is, they do not take into account:
   a. Mixture of any released volatiles into the ambient air,
   b. The expected variation of potential concentrations by the height above a field (concentrations would decrease with increasing height; e.g., field surface versus height of average student/adult), nor
   c. The expected variation of potential concentrations by ambient temperature. Average temperatures in Connecticut range from a high of 29.3°C (=84.8°F) degrees to a low of -8.5ºC (=16.7°F) degrees (Source: www.netstate.com/states/geography/ct_geography.htm)

2. Can organic components be leached from the tire crumbs by water? For volatiles, the CT AES lab demonstrated the potential movement of these chemicals into water when tire crumb was soaked in distilled water in high density polyethylene (HDPE) jars for seven weeks (Note: The samples analyzed were actually headspace air samples). Like other methods in which tire crumb is soaked (placed) into water, the CT AES approach, while demonstrating a potential release into water, overestimates this potential in the context of synthetic turf fields. This is specifically true for the FCDS where the ground water table is below the proposed field; that is, tire crumb from the field will not be “sitting in” water. Also, the laboratory did not include a sample blank and organics in HDPE are known to leach into water. In addition, the data as provided are not quantified (i.e., ng volatiles per mL of headspace air). And, as headspace data, they do not provide an estimate of the levels in water, even under the experimental conditions. Further and more importantly, such experimental data do not take into account the significant biodegradation potential for organics in crumb rubber leachate, as demonstrated by published papers. Nor, do such methods take into account the impact of dilution on the concentrations of any remaining organics; i.e., the mixing of any leachate with other inputs to a storm water collection system and/or with natural water bodies (e.g., Brown’s Brook).

3. Can elemental components be leached from the tire crumbs by water? For inorganics, the CT AES lab used EPA SW-846 Method 1312 and demonstrated the presence of several inorganics in crumb rubber leachate. EPA Method 1312 is designed to determine the mobility of chemicals in liquids, soils, and wastes, and while it may be applicable to crumb rubber, this method provides a worst case estimate of the chemical concentrations in leachate. In addition, the second testing regime used a lower water acidity (pH=4.2) than is expected for Connecticut (pH 4.7) and, therefore, overestimates the leaching potential. Further, and as also true for organics, test methods that soak/place the tire crumb in water overestimate the leaching potential for synthetic turf fields located above the ground water table. The method also does not take into account to potential re-adsorption of inorganics back onto soil particles within the soil column, as has been seen in studies of whole tires placed in soil trenches. That is, while rainfall moving through the proposed field may result in some movement of inorganics from the soil
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column into leachate, the tendency of inorganics to adhere to particulates will favor movement in the opposite direction. Although less concern for inorganics, blank samples were not included by the laboratory. Most importantly, the resulting concentrations in the lab leachate (reported as 21,000 µg per kg tire; or, ~1,000 mg/L) far exceed those obtained for the local surrogate synthetic turf field and in the literature for such fields.
General comments: The scope of the EHHI report is the potential human exposures/risks and as such is not directly relevant to a consideration of the potential environmental impact of synthetic turf fields. However, since the report has been submitted to the Wetlands Commission, we offer the following comments, with an emphasis on issues related to the potential for environmental release.

In general, we find this report to be a poorly organized and written evaluation of the human health risks potentially associated with the use of crumb rubber in “synthetic turf fields, playgrounds and as garden mulch.” Of particular concern, it seems to ignore some tenets of risk assessment and toxicology. Further, it is our opinion that a number of statements and conclusions in the report are not supported by the science, and as a result could lead to unnecessary concern in the general public.

The following comprises our specific comments on the conclusions of the EHHI report.

Specific Comments:

1. EHHI Conclusion: “The Connecticut Agricultural Experiment Station study conclusively demonstrates that the tire crumbs and tire mulch release chemical compounds into the air and ground water. Thus, tire crumbs constitute a chemical exposure for humans and the environment.”

Response: Please see our separate comments on the Connecticut Agricultural Experiment Station (CT AES) study (Epona memo dated October 11, 2007). The CT AES study demonstrates the release of chemicals into air and water under the defined experimental conditions. As such, the data indicate that a release to ambient air and ground water may be possible depending on the environmental/field conditions. As noted by the CT AES authors, further studies are needed, “most especially under field conditions.”

If a release to an environmental medium (e.g., air, ground water) occurs, it does not automatically translate into an exposure of people or ecological receptors. And, not every human or ecological exposure poses a concern from a health perspective. As the Center for Disease Control has stated, “just because we can detect levels of an environmental chemical in a person’s blood or urine does not necessarily mean that the chemical will cause disease. Advances in analytical chemistry enable...
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us to measure low levels of environmental chemicals in people, but we need to conduct more studies of varying levels of exposure to determine which levels cause health effects.” (http://www.cdc.gov/exposurereport/pdf/faq.pdf). Similarly, as analytical techniques provide the ability to measure chemicals at lower and lower levels, this does not necessarily mean that the chemicals detected in the environment will cause a hazard. Furthermore and in the specific context of synthetic turf fields, the California Environmental Protection Agency’s (CalEPA’s) Office of Environmental Health Hazard Assessment (OEHHA) 2007 report (“Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products”) concludes that it is unlikely that exposure to tire shreds will produce adverse health (either cancer or non-cancer) effects.

2. EHHI Conclusion: “It is clear the recycled rubber crumbs are not inert, nor is a high temperature or severe solvent extraction needed to release metals, volatile organic compounds or semi-volatile organic compounds. The release of airborne chemicals and dust is well-established by the current information. The Connecticut Agricultural Experiment Station research conclusively demonstrates that release can occur under ambient conditions experienced in the summer in Connecticut.”

Response: In terms of potential air emissions, data from laboratory experiments or manufacturing facilities are not applicable to outdoor synthetic turf fields. That is, the chemical releases from an outdoor field would be considerably less and also subject to dilution in the ambient air. In the CT AES study, samples of tire crumb were heated in small containers and the levels of airborne chemicals in the headspace measured. Further, the temperatures used in CT AES study, while accurately simulating summer weather in Connecticut, are higher than observed during the rest of the year. Data from indoor synthetic turf fields are also not directly relevant to such fields outdoors due to the reduced potential for mixing with ambient air in these enclosed halls.

In terms of potential releases to water, none of the laboratory data are directly applicable to outdoor synthetic turf fields. The CT AES study and others placed tire crumb in water, with or without acidification. This scenario is not consistent with the proposed FCDS field which will be located above the ground water table (i.e., not submerged in water). In addition, the acidity of local rainfall in Connecticut (pH 4.7) is less than used in some of the studies (e.g., pH 4.2 by CT AES). Tire monofill data, especially those where tire material are placed below the ground water table, are also not applicable to outdoor synthetic turf fields. The most applicable data available, from simulated synthetic turf field plots or from actual fields, are not discussed in the EHHI report. These data show considerably lower leachate concentrations than obtained experimentally.

Regarding the potential hazard associated with chemicals leaching from the tire shreds, the CalEPA OEHHA (2007) report concludes that “it is unlikely that the use of shredded tires in outdoor applications such as playground surfaces would result in the leaching during rain events of high enough concentrations of chemicals to cause such effects. Further, shredded tires used in applications above the ground water table, as is the case for playground surfaces, produced no toxicity in sentinel species.”

In general, data obtained in the laboratory or under experimental conditions should be clearly distinguished from data collected at/from actual synthetic turf fields. In addition, the nature of the proposed FCDS field should be taken into account when interpreting data obtained under either
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experimental or field conditions: e.g.,

- Placement of the synthetic crumb rubber below the top surface of the field (versus at the immediate surface of tracks/playgrounds)
- Location of the field (and crumb rubber) above the ground water table
- Temperature and rainfall amount/acidity expected for Connecticut. The average temperature in Connecticut ranges from a high of 29.3°C (=84.8°F) degrees to a low of -8.5°C (=16.7°F) degrees (www.netstate.com/states/geography/ct_geography.htm). The acidity of Connecticut rainfall is pH 4.7
- Use of cryogenically produced tire crumb versus crumb produced at ambient temperatures
- Field area (1.72 acres) versus watershed area (500 acres) for Brown’s Brook
- Potential for biodegradation
- Site-specific (or surrogate) leachate and surface runoff data as available

Please also see response to EHHI Conclusion 1.

3. EHHI Conclusion: “Those published health assessments that indicate de minimis risk should not be applied to the synthetic turf paradigm and may not be appropriate for playgrounds with open layers of recycled tire crumbs.”

Response: The basis for this statement as it relates to synthetic turf fields is unclear, especially for the CalEPA’s OEHHA report. In addition to conducting gastric digestion simulation experiments, wipe sampling of actual in use playground surfaces, performing a skin sensitization test with tire derived playground surfacing as well as with the synthetic rubber EPDM, and conducting environmental sampling following a fire in a playground surface made of chipped tires, the OEHHA report cited 46 studies in the scientific literature that measured the release of chemicals by recycled tires in laboratory settings and in field studies where recycled tires were used in civil engineering application. Accordingly, it is unreasonable to suggest this published health assessment should not be considered extensive and appropriate.

4. EHHI Conclusion: “Health endpoints of concern are numerous, including acute irritation of the lungs, skin and eyes, chronic irritation of the lung, skin and eyes. Knowledge is somewhat limited about the effects of semi-volatile chemicals on the kidney, endocrine system, nervous system, cardiovascular system, immune system, developmental effects and the potential to induce cancers.”

Response: We take exception to the broad based approach to summarizing the hazards of selected compounds identified in the CT AES report. A stand alone list of health effects potentially linked with synthetic crumb rubber components is misleading at best, unless the following is considered:

- Chemical-specific exposure doses at which effects may be observed
- How the above effect levels compare with the potential exposures at synthetic turf fields

In addition, the approach appears to be scientifically incomplete. For example, the EHHI report indicates benzothiazole causes skin and eye irritation. A publicly available literature search (BiblioLine®) for benzothiazole was conducted and found that this compound is a mild skin and eye irritant. In addition to being used as an anti-microbial agent and as a rubber accelerator, benzothiazole is used as a flavoring...
Review of Negative Studies

substance in food. EHHI reports there are no data on the mutagenicity of benzothiazole; a study conducted by the National Cancer Institute in which benzothiazole was not mutagenic was located. Benzothiazole degrades rapidly in the environment; this fact was not mentioned in the EHHI report. Based on our brief review of the available literature for benzothiazole, we do not believe the toxicology summaries presented in the EHHI report for the chemicals of concern are accurately presented or complete.

Please also see response to EHHI Conclusion 1.

5. EHHI Conclusion: “There are still data gaps that need to be filled in and additional studies are warranted.”

Response: As stated in our response to EHHI Conclusion 3, CalEPA, for example, performed a thorough health evaluation and it is unreasonable to suggest this published health assessment should not be considered appropriate and extensive. It terms of data gaps, it would useful have additional data on i) the chemical concentrations in ambient air above synthetic playing fields, ii) chemical levels in leachate from synthetic playing fields, and iii) how these concentrations may change in the field in response to dilution (in air and water) and biodegradation (in water).

6. EHHI Conclusion: “It is prudent to conclude that there will be human exposures to chemicals released during the use of synthetic turf fields.”

Response: Please see response to EHHI Conclusion 1. Although analytical techniques increasingly provide the ability to detect chemicals at low levels in the environment, this does not necessarily mean that the chemicals will cause a hazard. This is in accordance with similar statements made by the Center for Disease Control.

Note: A response to EHHI Conclusion 7 is not provided since the statement relates to the use of crumb rubber as garden mulch (and is not relevant to synthetic turf fields).

We also wish to note the following:

• Care should be taken in extrapolating exposures/health effects observed in tire (or tire crumb) manufacturing facilities to the potential for environmental release in the context of outdoor synthetic turf fields. A number of references are made to the potential for dust generation. While significant dust generation is clearly applicable to tire shredding facilities, it is not relevant to outdoor synthetic turf fields.
• As discussed in response to EHHI Conclusion 1, caution should also be employed when using laboratory composition data or simulated volatilization/leachate data to characterize the potential release of chemicals from outdoor synthetic turf fields. Specifically, attention should be given to the nature of the synthetic turf field in question and the ways in which the ambient conditions may differ from those in the experimental studies (see, for example, response to EHHI Conclusion 2). Similar care should be given when interpreting data from tire reclamation or monofill sites, especially data from sites involving the placement of tires or tire shreds within the ground water table.
• The EHHI report does not contain a reference list and, as a result, it is not possible to verify much of the report contents.
Review of Negative Studies

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Review of Negative Studies

Initial Evaluation of Potential Human Health Risks Associated with Playing on Synthetic Turf Fields on Bainbridge Island

Prepared by: D. Michael Johns, Ph.D. Windward Environmental LLC 200 West Mercer St, Suite 401 Seattle, WA 98119

Both the Bainbridge Island Metro Parks and Recreation District and the Bainbridge Island School District are considering the replacement of current playing field surfaces with synthetic turf fields. The field at Battle Point Park currently is an all weather sand matrix, while the field at the high school is natural grass. There has been considerable discussion about the potential human health and environmental risks posed by synthetic turf fields, especially those that incorporate tire crumb into the turf. Tire crumb is primarily produced from recycled tires and is increasingly used in a variety of ways in recreational environments including playing fields, playgrounds, and tracks. Tire crumb was used in the two Battle Point Park fields when they were installed more than 20 years ago.

I was asked to review the available scientific literature and publications in order to provide an assessment of the information contained in these materials about the potential risks to human health to children and teenagers that may play on these new fields and the risks to the environment that may result from precipitation runoff collected from the fields. This report focuses on the risks to human health. I was also asked to formulate an opinion regarding the potential risks posed by the use of synthetic turf fields on Bainbridge Island. The following is an analysis of the potential human health risks to athletes related to potential exposure to chemicals that could be released from tire crumb used in the construction of these fields.

Chemical Composition and Potential Releases

A number of researchers have analyzed tire crumb to determine its chemical composition. In some of the analyses the tire crumb has been completely dissolved using strong acids and high temperatures in order to determine its chemical composition (See data published by Crain and Zhang [2006, 2007]; Plesser and Lund 2004). Plesser and Lund (2004) analyzed tire crumb used on turf fields and found detectable concentrations of 8 metals, PCBs, 16 individual PAHs, 8 phthalates, and 3 phenols in nearly all of the tire crumb samples. Although useful in cataloguing the chemical constituents that make-up tire crumb, these analyses do not provide information that can be directly applied to environmental issues since they do not take into account the leaching potential and bioavailability of the chemicals. Crain and Zhang acknowledged this issue, noting that: “We want to emphasize that the findings are preliminary. PAHs in rubber might not act the same way as in soil, and we do not yet have information on the ease with which PAHs in these rubber particles might be absorbed by children or adults – by ingestion, inhalation, or absorption through the skin.” (Crain and Zhang 2006). “The next step is to study the bioavailability of PAHs…” (Crain and Zhang 2007). Bioavailability generally describes the way chemicals are absorbed by humans and other creatures.

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2 PAHs is an abbreviation for a class of petroleum compounds collectively termed “polycyclic aromatic hydrocarbons”.

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Since the complete dissolution of a product may not provide data that helps understand the potential environmental exposure, other analytical procedures have been developed that mimic natural conditions to better capture the chemicals that might be released into the environment. Tests to analyze the potential for contaminants to separate from the tire crumb have been conducted in a number of ways. The potential for contaminants to be released into the environment during rain and other precipitation events has been assessed using a leachate sample. This involves mixing a known amount of tire crumb with water, letting it sit for a period of time, and then analyzing the water for chemicals that may have leached out of the tire crumb. In order to determine what chemicals might leach from tire crumb if it is ingested by humans, tire crumb has been placed in an acidic solution meant to mimic the digestive environment of the stomach. Additionally, tests have been performed to determine the extent to which chemicals may volatilize or off-gas from the tire crumb into the air.

The results of the various leachate tests discussed in the existing literature show that crumb tire has the potential to release some chemicals, although some study results differ both in the identity of the chemicals detected and in their concentrations. The concentration of chemicals that were released from the tire crumbs into the water, acidic solution, or air varied greatly, but was generally much lower than the concentration of chemicals present in the rubber granules themselves. Most studies report detected concentrations of a limited suite of chemicals that include metals, a number of organic compounds and PAHs. Some of the chemicals that have been detected in leachate are known or suspected carcinogens. A comprehensive study of tire crumb conducted by the State of California’s, Office of Environmental Health Hazard Assessment (OEHHA) presents a relatively complete summary of chemicals found in crumb tire studies that was performed by other researchers.

Plesser and Lund (2004) conducted a series of mobility tests to determine the degree to which chemicals were leached from tire crumb. Their results for both metals and organic compounds indicate that only a very low percentage of the total concentration of the chemicals found in the tire crumb (usually less than 0.001 percent) leached out. The only exception was zinc, which showed mobility ranging from 0.01 percent to 0.31 percent across the four samples analyzed.

While the use of leachate tests are valuable in estimating what chemicals might be released into the environment under “natural conditions”, the preferred method is to actually measure chemicals at constructed synthetic turf fields. A joint study conducted by ALIAPUR (a French governmental agency responsible for regulating uses of used tires) and ADEME (the French Agency for Environment and Energy Management), installed a rain collection system that caught precipitation that had percolated through a synthetic turf field. The results of that study showed relatively low, but detectable concentrations of a number of organic compounds and metals. However, these concentrations were generally lower than the applicable drinking water standards (Moretto 2007). In another study conducted in Norway, measurements were made of volatile organic chemicals in the air at indoor facilities containing synthetic turf fields (NIPH 2006).

In summary, the results of the analytical work conducted to date indicate that the concentration of tire crumb and potential for release of chemicals is dependent on the technique used. The highest concentrations were detected when tire crumb was completely dissolved. However, complete dissolution will not occur under environmental conditions, thus leachate tests or site-specific analyses are more relevant.