Environmental Impacts of Artificial Turf Fields

CHE - Alaska

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Artificial Turf Field - Components

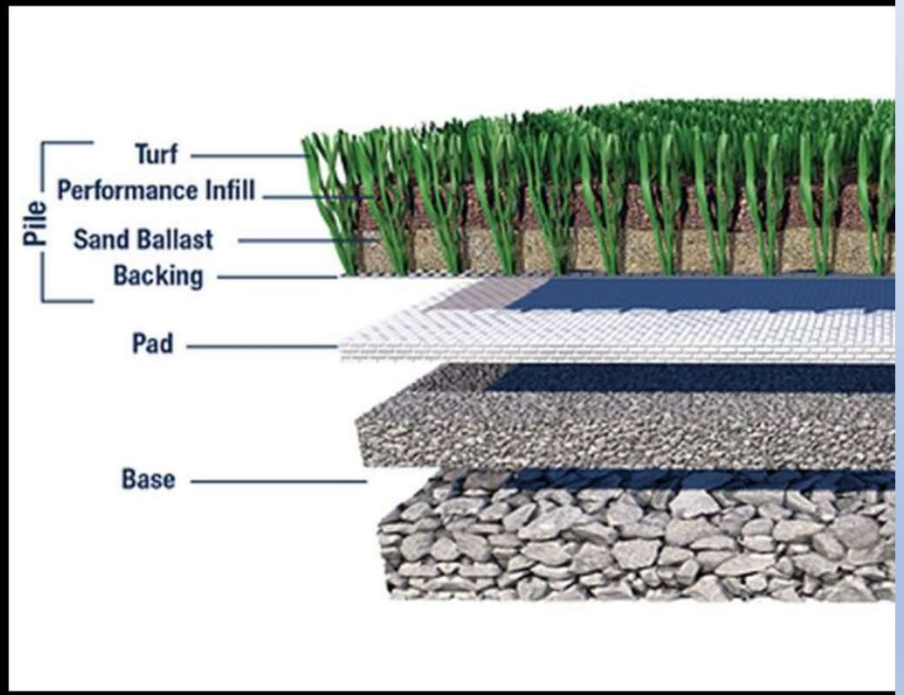
Synthetic Turf System

Turf 'Carpet'

Turf Fiber

Backing

Secondary Backing



Environmental Chemical Concerns

- Toxic Metals including Lead and Zinc
- Polyaromatic hydrocarbons (PAHs)
- PFAS Per- and Poly-fluoroalkyl Substances
- Plastic Chemicals – phthalates & bisphenol A
- Over 350 chemicals identified in EPA literature review for tire crumb rubber; confirmed presence of hazardous chemicals that are known carcinogens & neurotoxicants
- 6ppd-quinone from oxidized tire crumb rubber
- Microplastics

Tire Crumb Rubber Infill

Artificial Turf Field, Arlington, MA 2021
Photo credit: S. Chapnick

Tires:

- Natural & synthetic rubber – fossil fuel sources
- Fillers
- Additional Chemicals = Antioxidants, antiozonants, vulcanization compounds

Chemical Concerns - PFAS

Per- and polyfluoroalkyl substances (PFAS)

- Class of almost 15,000 “forever” chemicals
- Used in the manufacturing of turf carpet grass blades and backing
- Linked to environmental and human health problems

- New England communities have found PFAS in artificial turf
- Complexity in Interpreting Test Results
  - Target compounds: e.g., PFOS, PFOA, PFHxS, PFPeA, PFHxA, PFHpA, *etc*.
  - Compound classes: Total Fluorine / Total Organic Fluorine / Total Organic Precursors

Lowell Center for Sustainable Production, UMass-Lowell, July 2024. Per- and Poly-fluoroalkyl Substances (PFAS) in Artificial Turf: Test Methods. https://www.uml.edu/docs/PFAS-in-turf-Test-methods-July%202024_tcm18-385224.pdf

Chemical Concerns - PFAS

- RIDEM / RIDOH – Burrillville, RI
  - Artificial Turf installed 2007 / replaced in 2021
  - Upgradient Well = non-detect for PFAS-6
  - Downgradient Well = ~ 20-30 ng/L
  - Downgradient Well in June 2024 = 61 ng/L
  - RI Groundwater Quality Standard = 20 ng/L

"RIDOH and RIDEM are most concerned about the potential for PFAS from the turf field to contaminate groundwater in the area."

Letter to Burrillville Town Council from the RI Department of Environmental Management and the RI Department of Health, August 15, 2024
https://www.burrillville.org/sites/g/files/vyhlif2886/f/uploads/doh_dem_letter_with_response_from_trc_1.pdf

Fields Shed Infill &
Weathered, Broken Plastic Blades

Arlington Catholic Turf Field, 2022
Photo: S. Chapnick

Chemical Concerns: Aquatic Toxicity

- **Zinc** and "whole effluent" toxicity – Exceedance of EPA acute aquatic toxicity criteria

  CT DEEP Artificial Turf Stormwater Study, 2010

  https://portal.ct.gov/-/media/deep/artificialturf/depsummarypdf.pdf

- **6PPD-quinone** – direct toxicity to freshwater fish
  - N-(1,3-Dimethylbutyl)-N'-phenyl-p-phenylenediamine = 6PPD
  - UV light / oxidation of 6PPD = 6PPD-quinone
  - Present in used tires and tire wear particles / tire crumb rubber infill

Interstate Technology & Regulatory Council (ITRC) Fact Sheet: "What We Know: 6PPD and 6PPD-quinone" 2023; McMinn, M.H., et al., 2024, Environ. Sci. Processes Impacts: https://pubs.acs.org/doi/10.1021/acs.estlett.3c00521

Chemical Concerns – 6PPD-Quinone

- Urban Runoff Mortality Syndrome – coho salmon 1999-2001
- Tian et al. 2021 linked fish kills to 6PPD-quinone in road runoff
- LC50 (50% mortality) in different species ranges from 0.04 ug/L (40 ng/L) to no mortality at 50 ug/L (sockeye salmon)
- Coho Salmon = most sensitive species tested to date

Species	LC50 (ug/L)	Test Duration (h)
Coho salmon	0.04 for hatchlings; 0.08 adult	24
White-spotted char	0.51	24
Brook trout	0.59	24

Table excerpt from Table 1 in: Interstate Technology & Regulatory Council (ITRC) Fact Sheet: "What We Know: 6PPD and 6PPD-quinone" July 2023

Chemical Concerns – 6PPD-Quinone

- EPA Acute Freshwater Aquatic Life Screening Values
  - Federal Register, June 2024

Acute Freshwater Aquatic	6PPD	6PPD-Quinone
Screening Values	8,900 ng/L (ppt)	**11 ng/L** (ppt)
Duration	1h	1h
Frequency	Not to be exceeded more than once in 3 years	

https://www.federalregister.gov/documents/2024/06/13/2024-13009/acute-aquatic-life-screening-values-for-6ppd-and-6ppd-quinone-in-freshwater

- Runoff: Artificial Turf pitch with tire crumb rubber infill = 159 ng/L
  [Kryuchkov et al. (2023). Presence of 6PPD-quinone in runoff water samples from Norway using a new LC-MS/MS Method. *Front. Environ. Chem.* 4:1194664]

Heat

Alaska Stormwater Guide

Warm water runoff from impervious surfaces are harmful to salmon and other cold water species.

Regulations & Policies

- Federal – Clean Water Act; Acute Freshwater Aquatic Life Values
- State and Local regulations & policies
  - Wetlands
  - Stormwater management
  - Climate adaptation and resilience
  - Plastic proliferation / microplastics
  - Sustainability / Recycling
- Local Watershed Associations
  - Charles River Watershed Assoc. opposes installation of ATF https://www.crwa.org/artificial-turf
- Alaska Stormwater Guide
  https://dec.alaska.gov/water/wastewater/stormwater/resources/guidance/

Environmental Impacts on Climate Resilience

- **Excess Heat**
- **Loss of Carbon Sequestration**
- **Incineration & "chemical recycling"** = pollution
- **Fossil Fuel Consumption/Use**
- **Limited useful lifespan** - 10 yrs

Piles of Artificial Turf in Franklin, MA. David L. Ryan / Globe Staff 2019

Artificial Turf Fields Alter Wetlands

- Pollution
  - Chemical hazards in run-off
  - Particulate / Plastic & Microplastic migration
- Groundwater & Surface water impacts
- Wildlife Habitat impacts
  - Loss of habitat for insects and other invertebrates
  - Loss of habitat for foraging for birds and small mammals
  - Loss of wildlife corridor connectivity – disrupted habitats
  - Heat effects on habitat & potential heated stormwater runoff
- Biodiversity impacts

Town of Arlington, MA

- **Artificial Turf Study Committee –**

  Final Report, April 2024

https://www.arlingtonma.gov/home/showpublisheddocument/69732/638494836316530000

- Conclusion

Artificial turf fields can be an option “(a) after careful evaluation of the practicality and feasibility of natural turf options, and (b) with proper health and environmental safeguards in place.”

Tire Crumb Rubber Infill
Migration into resource area
[photo credit: Chapnick 2022]

Municipality / Community Considerations for Artificial Turf Athletic Fields

- Chemical & Particulate/Plastic Pollution
- Excess Heat
- Lifecycle costs
- Location – wetland resources
- Habitat loss / Biodiversity loss
- Climate impacts / sustainability
- **Practical alternative – Organic or Sustainably managed Natural Grass Sports Field**

https://www.youtube.com/watch?app=desktop&v=E3FEO7vmuCE

Maryland 5/30/2024