Town of Arlington
Department of Health and Human Services
Office of the Board of Health
27 Maple Street
Arlington, MA 02476

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Artificial Turf Study Committee Agenda
03/27/24

Meeting Date: March 27, 2024
Meeting Time: 7PM-8:30PM
Location: Zoom

Objectives:

1) To discuss the first draft of the ATSC Report
2) To discuss logistics of holding a public input meeting
3) To discuss the project timeline, remaining deliverables, edits

Agenda

I. Acceptance of Meeting Minutes: March 19, 2024
II. Correspondence Received
III. Discussion: Draft Report
IV. Discussion: Project Timeline, Deliverables, Edits
V. New Business
VI. Adjourn

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Artificial Turf Study Committee Meeting Minutes

Meeting Date: March 19, 2024
Meeting Time: 5PM-6:30PM
Location: Zoom- Registration link:
https://town-arlington-ma-us.zoom.us/meeting/register/tZAvcuqoqTssHt1BnuSXOpbXEnysRzAC-LUe

Objectives:

1) To discuss potential recommendations/conclusions based on the narrative reports.
2) To discuss project timeline, deliverables, working group narratives, and details of draft report.

Committee Members present: James DiTullio, Chair; Natasha Waden, Clerk; Mike Gildesgame; Leslie Mayer; Joseph Barr; Jill Krajewski; Marvin Lewiton; Joseph Connelly; David Morgan

Agenda

I. Acceptance of Meeting Minutes

Motion to approve meeting minutes from 03/12/2024 was made by Jill Krajewski.

2nd by Marvin Lewiton.

Vote:
Mike Gildesgame, Yes
Leslie Mayer, Yes
Joseph Barr, Not present for vote
Jill Krajewski, Yes
Natasha Waden, Yes
Marvin Lewiton, Yes
James DiTullio, Yes

Approved (6-0, with 1 not present for vote)

II. Correspondence Received

Natasha Waden reported that the following correspondence was received:

1) Two emails from Robin Bergman with links to the following articles:
    a. Plastic Formed Inside More than 50% Plaques from Clogged Arteries

b. How PFAS, Microplastics Join Forces as a Synergistic Threat

2) An email from Beth Melofchik with a link to an article: Turf Fields may have "forever chemicals". Should kids be playing on them?
3) An email from Mike Gildesgame with a link to the PDF version of the Wetland value table of organically managed natural grass fields.

III. Discussion: Recommendations/Conclusions

Jim DiTullio provided a brief summary of the Committee's discussion from the previous week's meeting. Jim reiterated that during that meeting there had been no endorsement from any Committee Members to support a moratorium on artificial turf and verified that all Members were still in agreement. Jim explained that the goal of tonight's meeting would be to discuss, for as long as necessary, all additional recommendations/conclusions/findings of the Committee based on the working group narrative reports. Jim stated that the merging of the narratives into one document is well underway, but is taking a bit more time than anticipated. With that, the goal is to identify the Committee conclusions/reconditions/findings so that the draft report can be completed and be circulated to all Members by the end of the week. The Committee spent the next 1.5 hours discussing the following topics and potential recommendations: Crumb rubber infill; PFAS; heat guidelines; age guidelines for artificial turf playing surfaces; recycling of artificial turf at the end of life; organic maintenance of natural grass fields; and potential restrictions, if artificial turf is considered, on the installation in areas of town that have been identified as heat islands. Conversations about each topic area are summarized below.

<u>Crumb rubber:</u>

Committee Members all seemed to agree that crumb rubber is not the preferred infill for an artificial turf field. Discussion was had about what this means for the existing fields (Arlington Catholic and Pierce), the proposed new High School field (Pierce) that has already been approved for crumb rubber infill, as well as the financial impacts it might have on Arlington Catholic as their field is likely nearing the end of life. Committee Members discussed that Arlington Catholic's field is on private property, but that the Conservation Commission would have some jurisdiction over the field when it comes time to replace it. Aside from that, this field is on private property and therefore likely falls outside of the purview of Town control and any requirements to comply with recommendations made by the Committee. The conversation about the High School project will also fall under the jurisdiction of the Conservation Commission. One Member noted that the High School field had been approved by the Conservation Commission back in 2019-2020, but there may be some interest in reviewing the crumb rubber infill again. Moving forward, the funding for a future project would fall under the purview of the Town in terms of what would be allowable using Town money. However, as indicated by Committee Members, it was determined that the funding associated with the current high school project is a bit more complex since it has already been allocated/approved and this type of change at this stage would likely have to go through another Town approval process.. One Member made reference that the majority of the playing fields abut Wetland Resource areas, which therefore will require the review and approval of the Conservation Commission who would not likely approve a crumb rubber infill in the future. Another Member asked if there had been any indication as to whether or not the Conservation Commission would be taking into consideration any of the recommendations made by this Committee. Another Member who

represents the Conservation Commission stated there as has not been any discussion among the Conservation Commission at this time. Another Member explained that the High School project is a "Construction Manager at Risk Project" and therefore it would likely be extremely difficult to change the scope after the fact as it could be very costly. Multiple Members agreed that the high school project is beyond the scope of this Committee. However, Members seemed to agree that perhaps this should be made clear in the final report. As such, Members agreed to allow the chair to draft the recommendation to reflect the Committee's position on crumb rubber and future projects. The recommendations will be discussed at the next meeting.

PFAS

Committee Members were in agreement that if artificial turf were to be considered, that a recommendation should be made by the Committee to require certified testing which verifies materials are PFAS free. Members discussed that testing should be conducted prior to shipment but conducted by an independent laboratory, not associated with the manufacturer. Additional discussion was had by Members in regards to the varying interpretation of what PFAS free means, especially among manufacturers. A Member suggested that the Committee define what is meant by PFAS free and/or make reference to a regulatory standard or authority that may change over time with new science and technological advancements. Although Members were in agreement, one point raised by a Member was the fact that there are no applicable standards to reference, other than drinking water. At this time there is no indication as to what level of PFAS, Palates or other associated chemicals of artificial turf are harmful to health. As such, it would be difficult for the Committee to define or reference such a standard. Therefore the recommendation should be worded in such a way to acknowledge that PFAS Free means whatever the latest acceptable standard or least toxic level is at the time of purchase. Again, Members agreed to allow the Chair to draft a recommendation that reflects the Committee's concerns about certifying artificial turf is PFAS free. The Committee will review the recommendation at the next meeting.

Heat guidelines

All Committee Members seemed to agree that heat guidelines should be included as a recommendation for both artificial and natural grass turf fields. Members also agreed that the recommendations should be based off of the MIAA guidelines as they have been widely accepted among sports user groups. One Member raised concerns about whether or not taking temperatures on weekends or during Town "off hours" was feasible or would be burdensome and unrealistic. The Recreation Director confirmed that such recommendation would be reasonable and the Department could work with user groups and coaches to implement such procedures. Another Member discussed the importance of maintenance of the fields, regardless of the type, as without the proper maintenance, neither field will be able to live up to its full potential. The Clerk briefly discussed that field maintenance in addition to a cost analysis between natural grass and artificial turf is currently being worked on and will be included in the report draft for Members to review.

Age guidelines

A discussion was had about the Town of Brookline's recommendation to restrict the use of artificial turf fields to users in grades K-8 and whether or not the Committee wanted to include such a recommendation in their report. The Chair acknowledge this was not

something that had previously been discussed or brought up by the Committee, and he was not in support one way or another about it, but thought it was an interesting recommendation and would be worth discussing as a group. Some Members expressed confusion as to the recommendation and why it would exclude pre-school age children who are more likely to engage in hand to mouth behaviors. Additional concerns were raised about the amount of time this age group might be spending on such a field and also the relevance of this recommendation if Committee is recommending the discontinuation of crumb rubber as an infill on artificial turf fields. Another point made by a Member was that in terms of scheduling fields, it is less likely for this age group to play on the turf field, as the priority would be to put younger kids who are less destructive in their play on the grass fields as opposed to older kids whose level of play is more intense and destructive to a grass field. Another Member acknowledged that the rationale for such a recommendation is most likely associated with the vulnerability of young children in terms of exposure to chemicals and their development. The Committee determined that this recommendation was undeveloped and seemed a bit arbitrary at this time, especially considering the Committee is recommending the discontinuation of crumb rubber material in future projects.

Recycling of artificial turf

The Chair acknowledged that there is currently a debate about whether or not artificial turf is being recycled and/or what it actually meant by the term "recycled". While there does seem to be some evidence of recycling of artificial turf, it is not clear as to what extent it happens. However, the Chair asked whether or not the Committee wanted to recommend that recycling be built into any contract, should the town install an artificial turf field in the future, to require that artificial turf be recycled, at the end of life, to the greatest extent possible (whatever the status of technology is at that time). Some Members expressed concerns that the process of burning/melting and potentially repurposing the material creates more of an environmental hazard (air pollution, generation of waste, and use of fossil fuels, etc.); therefore that type of activity does not seem to fit within the context of meaningful recycling. Another Member raised concerns that it's important to understand what the company means by recycling, as it is also important to ensure the product doesn't end up in a landfill. The Committee agreed to include a recommendation which would contractually require the installer/manufacturer to take responsibility for the end of life recycling and that the method of recycling be the most environmentally friendly which prevents the least harmful impact to the environment. The Chair agreed to draft a recommendation reflective of the comments made by Members. The recommendation will be reviewed by the Committee at the next meeting.

Organic maintenance of natural grass fields:

The Chair discussed the topic of organic maintenance of natural grass fields and indicated that there seem to be a consensus among the Committee about the importance of high quality field maintenance, but it was not clear as to whether or not the Committee as whole felt strongly about recommending organic maintenance. Members discussed that this is a challenging topic as it relates to budgetary constraints and site specific issues. Another Member pointed out that it is not clear whether or not organic treatment will change the quality of the playing field, but it will not increase access to grass fields during the shoulder season (March-June and September-November). Discussion was had amongst Members about whether or not organic maintenance of fields in their current condition (hard packed fields) would absorb differently into the field than those of conventional fertilizer and/or

whether or not it might make an impact on the waterbodies. While there was no real evidence to reference, the discussion focused on reducing the amount of fertilizer runoff from fields that might run off into the waterbodies. Another point that was made was in regards to the fertilizers being used on private properties, which the Town cannot regulate. The conversation led to whether or not the change to organic maintenance would be cost effective and impactful given the current state of the fields. Multiple Members referenced Ian Lacy's comment during his presentation on February 20th, 2024 when he stated that about 95% of fields in Massachusetts are not maintained properly. Another Member referenced the Robbin's Farm field and funds that have been allocated to making repairs, which did not resolve the issues. Therefore the Member cautioned the Committee about costs and insuring the change would be beneficial and/or effective. As such, the Recreation Director made a recommendation that perhaps the Committee should recommend that the Town consider piloting an organic maintenance program for 1-2 fields over a couple of years to evaluate the costs and benefits. All Committee Members were in agreement of this recommendation.

Restricting the installation of new artificial turf fields near heat islands:
The Committee discussed the possibility of including a recommendation which would place restrictions on installing artificial turf fields near the 5% of parcels that have been identified by Metropolitan Area Planning Council (MAPC) as heat islands. One Member discussed that while this may be a best practice, it really seems that it should be a site specific consideration. Another Member discussed that from a usability perspective and in connection with the heat guidelines discussed, it may make sense to include this, as installing an artificial turf field in an already hotter area of Town may result in the inability to use the field due to temperature issues. The Planning Department referenced an analysis that was conducted a while ago in reference to the number of increased days Arlington might experience as extreme heat. That analysis indicated that Arlington could likely expect a couple of weeks in summer of extreme heat conditions, in which case would render a field, especially in an already hot area of Town, unusable. The Recreation Director indicated that closing a field for two weeks in the summer would not impact the user groups because the field demand is not the same as it is in the shoulder seasons. Another Member commented that in reviewing the Town's Hazard Mitigation Plan, it seemed that water and flooding were more problematic than heat, although heat is still a concern. In that respect, the Member explained that usability of fields is highest in the shoulder seasons when temperatures are not typically high but fields have been rendered unusable due to rain/water/flooding. In looking at increasing the usability, the need is for increased access during the shoulder season, not the summer months. The Chair made reference to the Malden, MA Roosevelt Field project and stated that the major concern of the neighborhood residents was about increasing the temperature of their neighborhood, which he could see as being relatable to Arlington and therefore thought perhaps the installation restriction should be considered. Additional discussion was had about justice issues and locating fields in places that are less dense and more urban. An additional point made was that the Committee should consider installation restriction to prevent increase heat concerns in an already hotter area of town. Another Member commented that when looking at justice issues the Committee should also consider accessibility to better playing fields and how the placement in one area vs. another area of town might also contribute to that. Another Member stated that in terms of assignment of playing fields, it is not common that teams and fields are assigned based on residential location and there kids are playing at fields in

both the East and West/Heights. The Recreation Director discussed his experience with resident's reaction to field construction which has referenced frustration with more money being allocated in one area of town (Heights) over another (East). Another Member referenced that by looking at alternative infills as opposed to crumb rubber, this would seem that the Committee may already be addressing the heat issues, regardless of whether or not the field is in a hotter area of town. Another Member clarified that there is currently not a lot of information available about how much alternative infill plays a role in lowering the temperature, as the blades of grass which are made of plastic also create heat. The Committee seemed to agree that the installation of artificial turf should be on a case by case basis which discourages areas identified as a heat island, but not completely prohibited.

IV. Discussion: Project Timeline, Deliverables, Working Group Narratives, Draft Report

The Chair asked the Committee if there were any additional comments or thoughts in regards to the contents of the report. One Member reiterated that one issues Arlington has been trying to resolve with consideration of artificial turf fields is the usability during the shoulder seasons (spring and fall) and the importance of that piece being discussed in the report. The Chair addressed this comment and made reference to Ian Lacy's presentation that while artificial turf costs more, you do get more per dollar per hour out of it than you do natural grass. To that point, the Chair referenced this would be mentioned in the cost analysis section of the report.

The Chair indicated that the Committee Members would have a draft report on Friday, but that there was interest in moving next week's meeting from Tuesday to either Wednesday or Thursday to allow for more time to review the report. The Committee seemed to be in agreement but the majority felt that a later start time would be better. As such, the date and time of the next meeting will be decided on Friday and communicated out to the Committee. Committee Members were encouraged to read over the report and provide comments.

The Chair outlined that the Committee would likely only meet 3 more times. One next week either Wednesday 3/27 or Thursday 3/28 at a time TBD to discuss report edits/comments; the second one the following Tuesday 4/2 at 5pm to allow for public input; and the third tentatively Tuesday 4/9 at 5pm to discuss the final report and vote on it. The preference for the public input meeting on 4/2 is a hybrid option with hopes that all Committee Members would be able to attend in person. The location will likely be the Senior Center, but more to come on that at our next meeting. The goal would be to release the final report on either 4/11 or 4/12.

The Chair informed the Committee that a formal letter was submitted to the Select board formally requesting the extension for the report and it seemed that they would generally be in support of it.

The Chair also informed the Committee that Natasha Waden would be reaching out to individuals to clarify certain sections and asked Members to please respond as quickly as possible as we are on a tight deadline to get this draft completed.

Multiple Committee Members commented on the collaboration among the individuals on this Committee to discuss a somewhat controversial topic and to continually engage in a healthy debate/discussion which will likely lead to a final report that all Members are proud to stand behind.

V. New Business

There was no new business discussed.

VI. Adjourn

Motion to adjourn was made by Mike Gildesgame.

2nd by Marvin Lewiton.

Vote:

Mike Gildesgame, Yes
Leslie Mayer, Yes
Joseph Barr, Yes
Jill Krajewski, Yes
Natasha Waden, Yes
Marvin Lewiton, Yes
James DiTullio, Yes

Approved (7-0)

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ARTIFICIAL TURF COMMITTEE MEETING COMMENTS FROM THE CHAT

Date: March 19, 2024
Time: 5PM
Location: Remote Participation

Susan Chapnick

12:26

SC

AHS is building 2 new AT fields in addition to the existing one.
Part of the Arlington Catholic field is within wetlands jurisdiction.

Joe Connelly - Recreation

14:35

JC

Last week we had some conversation about the permeability of artificial turf. Below is what was put in the bid package for Malden. Requires testing to ensure 10" of rain per hour. Greater than any natural grass field

Mike Gildesgame

19:48

MG

As noted, it is DEP that has draft language about the permeability of AT.

Susan Stamps

28:39

SS

Why not make recommendation to switch from crumb rubber to something else in the 2 new AT fields yet to be built if that change is legally/contractually possible?

Susan Chapnick

31:35

SC

The turf carpet/infill has not yet been purchased for the AHS field that is in the wetland jurisdictional area. The sub-surface stormwater features have been procured.

Grant Cook

32:42

GC

I would suggest that IF that question is to be asked, it be asked of a member of the AHS Consruciton Committee, not private citizens like ourselves attending
And I believe that question has already been asked by teh Conservation Committee as part of the permitting for the work.

Dean Regrut

40:16

DR

Thanks everyone for your work. I'm listening in as a resident. I'm very thankful that we have two turf playing surfaces in our town that we (and our kids) can use in the winter months, when it rains, etc. Crumb rubber may not be ideal, but it's better than nothing. I hope our town can make reliable playing surfaces available to more kids in the near first. Whatever surface, we just need a lot more capacity. Thanks again!

Susan Stamps

40:16

SS

Balancing finances vs. environmental toxicity for our kids seems like a no brainer to me....

Grant Cook

42:53

GC

Whatever talk of balance, Including the HS fields was not included in the scope presented to TM, even by the proponents of the amendment that ended up passing, It was actually explicitly excluded in the actions voted on by the body.

Susan Chapnick

49:01

SC

There are soil standards in MA under the Massachusetts Contingency Plan for 6 PFAS currently

Susan Stamps

51:28

SS

Grant, nothing was specifically excluded in the town meeting vote on Article 12 that established this committee

Susan Stamps

53:22

SS

Re the proposed moratorium, I think we may have excluded the fields from that, but there's nothing about the study committee which would prevent them from making recommendations about those fields

Grant Cook

55:02

GC

The discussion I watched, Sue, was always framed around the point that that HS fields were excluded from at least any moratorium. I can go back and watch the tape, see if any speaker raised up needing to reconsider that decision as part of the work.

Wynelle Evans

01:00:38

WE

Here’s the language of parts A (study ground, PASSED) and B (Moratorium, FAILED). To my reading the fields where AT use is underway were not mentioned in Part A.
https://www.arlingtonma.gov/home/showdocument?id=65515&t=638196661041100298
Study group

Greg Dennis

01:07:36

GD

Do we know how Watertown's contract was worded? I understand that they required end-of-life recycling in some form for Victory Field?

Susan Chapnick

01:10:05

SC

But if viable recycling does not exist now, the committee's recommendation is going to be for something that does not exist? How meaningful is this recommendation? This might just be a "negative" that the committee has to weigh in terms of decisions on a site-by-site basis?

Susan Chapnick

01:25:25

SC

TURI Report from 2021, previously submitted to the committee, has details on alternate fertilizers to reduce runoff issues

Grant Cook

01:29:43

GC

The field that this hits is the Lussiano Field at the Thompson

Susan Stamps

01:30:43

SS

I think what makes hot turf is the plastic grass, not infill? Is that wrong?

Grant Cook

01:33:03

GC

black rubber is part of it

Grant Cook

01:34:47

GC

We wanted one at Poet's Corner..

Susan Stamps

01:37:15

SS

It would be unfortunate to take away the natural grass field the little kids at the Thompson school can run around on and give them no choice but a turf field.

Grant Cook

01:37:52

GC

nobody will want to play at Crosby because of the insane cacophony from the new pickleball courts.. :)

Susan Chapnick

01:40:24

SC

This time next year, Arlington will have 4 artificial turf fields rather than the 2 we have now. I hope that is to be considered, as well, in terms of player-time.

David Morgan

01:42:19

DM

Preference for Thursday
except I have a meeting at 7:30

Wynelle Evans

01:49:22

WE

Hear hear—thank you, Natasha!

Susan Stamps

01:49:44

SS

Agree, awesome minutes!

Artificial Turf Study Committee - Uncertainty in use of non-peer reviewed data

Susan D. Chapnick <s.chapnick@comcast.net>

Mon 3/18/2024 5:21 PM

To:BOH <BOH@town.arlington.ma.us>
Cc:mikeg125@gmail.com <mikeg125@gmail.com>;jobar@alum.mit.edu <jobar@alum.mit.edu>;David Morgan <dmorgan@town.arlington.ma.us>

Dear Natasha, Jim, and other members of the Artificial Turf Study Committee:
Please accept this communication on my concerns of uncertainty introduced when non-peer reviewed data are used for decision-making.
Though I appreciate the volumes of data and memoranda that Phil Lasker provided to the AT Committee as available for the 3/12/24 public meeting, none of the data presented were from either government sources or peer-reviewed published results. As the AT committee had stated in the beginning of the process of gathering information, government sources and peer-reviewed sources would be prioritized over other sources of data. I am in agreement with this approach. The AT committee members likely do not have the expertise in environmental chemistry to adequately evaluate the validity of the chemistry data presented - and without a third-party validation, peer review, or government scrutiny - the AT committee should consider these results as potentially uncertain.
I have briefly reviewed the data included in the 3/12/24 AT packet entitled "Turf Committee.pdf" and provide below a few examples of where I have concerns about the usability of the chemistry results.
1. **Manchester by the Sea: RTI Lab data; July 2023; page 12 of pdf**
PFAS results reported as "ND" (non-detect) with a reporting limit (RL) = 23000 ng/Kg for all PFAS compounds in the sample. This RL is equivalent to 23 ug/Kg or 23 ppb. This level is higher than the current MassDEP Method 1 cleanup standards for the 6 regulated PFAS compounds in Soil S1/GW1, which range from 0.3 ppb to 2 ppb. The "ND" RLs are at least 10x higher than the regulatory standards - therefore, PFAS compounds may be present in the sample (but not detected due to the high RL) at or above the MassDEP Cleanup Standards for Soil S1/GW1, which are tabulated below:
PFDA = 0.3 ppb
PFHpA = 0.5 ppb
PFHxS = 0.3 ppb
PFNA = 0.32 ppb
PFOS = 2 ppb
PFOA = 0.72 ppb
source: https://www.mass.gov/doc/final-pfas-related-changes-to-the-mcp-2019-12-13/download
2. **Algonquin Field PFAS: RTI Lab data; August 2023; page 17 of pdf**
PFAS results reported as "ND" (non-detect) with a reporting limit (RL) = 35000 ng/Kg for all PFAS compounds in the sample. This RL is equivalent to 35 ug/Kg or 35 ppb. As with the sample above, the "ND" RLs are at least 10x higher than the MassDEP regulatory standards for PFAS in soil (SW/GW1) - therefore, PFAS compounds may be present in the sample (but not detected due to the high RL) at or above the MassDEP Cleanup Standards for Soil S1/GW1.
3. **Portsmouth, NH: TRC Memo & Eurofins lab data; June 2022; page 23 of pdf**
The chemistry data in this report had appropriately low RLs for comparison to regulatory criteria and comprehensive information on the analytical methods used for sample analysis. The lab data reports show exceedances of several quality control sample results; the memo concluded that the data are

usable for decisions anyway - this is a technical judgment. Technical judgments that are not peer-reviewed should be used with caution. Similarly, the conclusion that "the detection of very low levels of a limited number of PFAS in the synthetic turf components does not represent a human health risk to those using the synthetic turf ballfields" should also be peer-reviewed. It is important to note that this memo does not include an evaluation of environmental risks based on the chemistry data presented.

4. **Brock Organic Infill: Millennium Consulting; 2018; page 180 of pdf**

Memo states that "No metals were detected above laboratory reporting limits and all laboratory limits were below their respective target leachate concentrations." This statement is not true because the metals RLs were too high to compare to the regulatory levels. Data presented in "Table 2 Leachable CAM 17 Metals", shows that all results are not detected; however, many of the metals RLs are greater than the "Ecotox FW ESL" and/or the "Water Quality Criteria". But, Millennium used a "dilution attenuation factor (DAF) of 20" to calculate a "Target Leachate Concentration" to which they compared the non-detected results. The Brock infill was extracted using EPA Method 1312, SPLP, which incorporates a 20-fold dilution during extraction. Therefore, Millennium's calculation of a "Target Leachate Concentration" including an additional 20x factor, is a misinterpretation of the SPLP method. Leachate results from SPLP are to be compared directly to the appropriate regulatory criteria - which in the Table 2 provided, are the lower of either the "Ecotox FW ESL" or the "Water Quality Criteria". Comparing the Metals leachate data appropriately, beryllium, cadmium, cobalt, copper, lead, mercury, silver, thallium, & zinc have RLs that exceed the regulatory standards. Therefore, these 9 Metals may be present in the leachate (i.e., leach off of the Brock infill material) at levels of concern for the aquatic environment, but were not detected due to the high RLs.

Respectfully submitted,
Susan

Susan D. Chapnick, M.S.
President & Principal Scientist
NEH, Inc.
2 Farmers Cir
Arlington, MA 02474
ph: 617-643-4294
www.neh-inc.com

Artificial Turf Study Committee communication - environmental chemical exposures and mental health outcomes in children

Susan D. Chapnick <s.chapnick@comcast.net>

Wed 3/20/2024 3:41 PM

To:BOH <BOH@town.arlington.ma.us>;james_ditullio@hotmail.com <james_ditullio@hotmail.com>

1 attachments (738 KB)

James & OShaughnessy. 2023. Environmental chemical exposure and mental health outcomes in children.pdf;

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or clicking links, especially from unknown senders.

Natasha & Jim,
I understand from public meetings of the Artificial Turf Study Committee and the draft report of the Human Health subcommittee, that access to youth sports and its impact on mental health is an important concern. In reference to this topic, please accept this communication that includes a paper by EPA scientists entitled "Environmental chemical exposures and mental health outcomes in children: a narrative review of recent literature" (James & OShaughnessy, Front. Toxicol., 30 November 2023, Sec. Environmental Toxicology, Volume 5 - 2023
https://www.frontiersin.org/articles/10.3389/ftox.2023.1290119/full)

This paper includes the literature review of several harmful classes of chemicals that children can be exposed to in their environments, many of them are also found in artificial turf, including Metals, Phthalates (pasticizers), Bisphenols (used to produce plastics), and PFAS. The paper concludes: "Understanding the impact of environmental chemicals on children's mental health is critical to promotion of health, wellbeing, and the prevention of disease. Due to the complex nature of both environmental xenobiotic exposures and mental health outcomes, it is difficult to establish causality with epidemiology studies alone...Given the burden of mental health disorders on children's health, wellbeing, and overall life trajectory, it is essential to identify and take action to address the environmental risks that may increase the development of these disorders."

Thank you for your comprehensive efforts to evaluate the breadth of information in the scientific literature on this important topic.
Respectfully submitted,
Susan

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Gildesgame Email 1 attachment 1

Arlington Artificial Turf Study Committee
Environmental Impacts of Artificial Turf Sports Fields
DRAFT 3/18/24

The Arlington Artificial Turf Study Committee was formed after a Town Meeting vote to delve into the topic of artificial turf (AT) in comparison to natural turf, and the Committee created an Environmental Subgroup to explore how the latest environmental science relates to AT versus natural turf fields. Most research in this area focuses on understanding the numerous environmental concerns associated with artificial turf. The following topics were chosen by the subcommittee as representative of the body of contemporary environmental research into AT. The relationship of potential impacts to the state and local regulatory environment is also considered.

Chemical & Particulate Pollution (Runoff) Impacts

One of the most significant concerns surrounding AT fields is their impact on wetland resources and waterways. Artificial Turf fields can act as sources of harmful chemicals, including Per- and Poly-fluoroalkyl Substances (PFAS), metals, and polyaromatic hydrocarbons (PAHs)[1,2,3,6,13,17]. The State Wetlands Protection Act and its regulations, along with Arlington's Town Bylaw and its regulations, all require the protection of a variety of wetlands values and functions. These include groundwater supply, flood control and storm damage prevention, prevention of pollution, wildlife protection, plant and wildlife habitat protection, and protection of the natural character or recreational values of the wetland resources. A table outlining the potential negative impacts of AT fields on each protected wetland interest is attached to this report and a map showing the proximity of recreational facilities (existing athletic fields), to wetland resource areas is included to show likely sites in Arlington for AT.

Contamination can occur through leaching, airborne dust, volatilization, and physical migration of AT components. Contaminants of particular concern include polyaromatic hydrocarbons, phthalates, volatile organic compounds, metals such as zinc and lead, and PFAS. Elevated concentrations of PFAS have been shown to have adverse effects on aquatic organisms, and PFAS environmental impacts from artificial turf are under-studied, though part-per-trillion (ppt) levels have been shown to be harmful.[4] Elevated concentrations of the PFAS compounds PFOA and PFOS in aquatic ecosystems can result in death of aquatic organisms and affect their growth and reproduction.[5] PFAS has been shown to leach from AT fields and components [7,8,17]. Additionally, tire crumb rubber, present in both existing AT fields in Arlington, contains a newly discovered compound called 6ppd-quinone, which is acutely toxic to some freshwater fish [9]. These chemicals, individually and in combinations, pose a potential hazard to wildlife, water quality, and aquatic organisms, with an overall negative impact on the environment[6]. Furthermore, microplastic particles from infill and weathered grass blades can also enter waterways, causing additional harm[3, 6].

Though there is recent scientific evidence of the potential to use bioretention cells to reduce 6ppd-quinone concentrations in stormwater runoff impacted from oxidized tires / tire crumb rubber[16], it is unclear if these systems could be scaled-up to provide stormwater mitigation for an 80,000 sq ft athletic field. Additionally, the Environmental subcommittee is unaware of any technology that can be practicably used for athletic fields that can reduce or eliminate the transport of PFAS or microplastics. The European Union recently acknowledged the negative impact of tire crumb rubber infills as microplastic pollution and in September 2023, enacted a ban on the sale of products containing intentionally added microplastics – specifically including in this ban “granular artificial turf infill” [17].

As observed in Arlington at the Arlington Catholic High School AT field and referenced in Arlington's Conservation Commission submissions to the May 2, 2023 Artificial Turf Forum and this committee, the tire crumb rubber infill from the school's field has migrated toward the nearby brook and within the protected wetland resource area of Mill Brook.

Natural turf fields can act as a natural filter for chemical and particulate pollution. AT fields typically do not contain systems to mitigate the chemical and particulate contamination in stormwater infiltration or runoff[10]. AT fields that border wetlands, waterways, and other sensitive areas and resources are of most concern. Other areas are also impacted by AT fields, as some chemicals can be volatilized and others may cling to clothing, shoes, and equipment, migrating off the fields to surrounding areas. It is important to note that any stormwater drainage from an AT field will eventually reach a wetland within Arlington. This extends environmental concerns beyond immediate proximity to sensitive areas. A field that drains to the public stormwater system may leak contaminants into a wetland or waterway downstream.

Alternative Infills

The environmental impact of AT infill has been identified as a known issue, particularly in terms of the use of tire crumb rubber[2,9,13]. In light of the findings above, however, the issue receives disproportionate attention compared with other environmental impacts. Nonetheless, the subcommittee sought expert guidance on the topic of alternative infills. The benchmark study in this area states the following[3].

> *No Infill material was clearly free" of 'concerns, but several are likely to be somewhat safer than tire crumb. Some alternative materials contain some of the same chemicals of concern as those found in tire crumb; however, they may contain a smaller number of these chemicals, and the chemicals may be present in lower quantities*.

Recently, several neighboring towns such as Lexington and Milton, have specified plant-based infills to help mitigate chemical pollution from the AT fields permitted.

Stormwater Management Impacts

How the stormwater is retained, infiltrated, or discharged is important to the consideration of the environmental impact of AT fields. Perhaps the most critical issue in this regard is the permeability of the playing surface, since permeable surfaces provide better stormwater management by allowing precipitation to infiltrate into the soil, rather than running off into storm drains or detention basins.

The Massachusetts Department of Environmental Protection (MassDEP) is considering officially classifying artificial turf fields as impermeable surfaces under the Wetlands Protection Act. This change would potentially affect the siting and maintenance of AT fields. MassDEP's latest proposed revision from December 2023 would define impervious surface for the "purposes of stormwater management (310 CMR 10.05(6)(k)-(q))" as follows:

> *any surface that prevents or significantly impedes the infiltration of water into the underlying soil, including, but not limited to artificial turf, Compacted Gravel or Soil, roads, building rooftops, solar arrays, parking lots, Public Shared Use Paths, bicycle paths, and sidewalks paved with concrete, asphalt, or other similar materials.*

Permeable surfaces provide better stormwater management by allowing precipitation to infiltrate into the soil, rather than running off into storm drains. This better ability to manage stormwater will become

ever more important as precipitation events potentially become more severe and more unpredictable with expected climate change impacts.

The permeability of artificial turf fields is a subject of debate, with some sources stating that they can be made permeable with the proper design and maintenance, and others stating that as an artificially constructed field, they are difficult or impossible to make permeable. While artificial turf fields can certainly be designed to quickly drain stormwater off the field (in many cases, more effectively than natural grass fields), the stormwater generally drains to perimeter drains and then to a detention basin or some stormwater management system. Since artificial turf fields are typically constructed on top of another engineered surface (rather than directly on top of the underlying soil), the real question then becomes whether the stormwater drains to a permeable surface, which depends on the specific design of the field.

There are techniques and systems that can allow for the capture and storage of stormwater, which can then be allowed to infiltrate into the soil and/or be released more slowly into the stormwater system to avoid overwhelming the system and causing flooding. Currently, AT fields are at best partially permeable, although this may change in the future as better systems are developed for managing the stormwater and allowing for improved stormwater infiltration to occur.

At a baseline, natural grass fields are considered permeable since they consist of natural grass over soil (unless the subgrade of the field is more heavily engineered). However, it is important to recognize that maintaining true and effective permeability requires ongoing maintenance of the fields, including proper aeration and grooming. Without that, the dirt underneath the playing surface can become highly compacted, and therefore will not function as effectively as a permeable surface (as noted above in the proposed changes being considered by DEP). Even under these conditions, a natural turf field may remain more permeability than an artificial turf field, but the exact comparison will depend on the design and maintenance of the field.

As this discussion illustrates, it is difficult to make general statements about the permeability and stormwater management performance of artificial turf and natural grass fields, since it is highly dependent on the design, construction, and maintenance of the individual field, along with other factors such as topography and adjacent land use.

Heat Impacts

It has been established that AT fields are hotter than natural turf fields[13]; therefore, the Environmental subgroup focused on the environmental issues related to excess heat / high temperatures on AT fields *vs*. natural grass fields.

There are areas of Arlington that are known heat islands. The Metropolitan Area Planning Council performed a heat analysis to ascertain the areas of Arlington that are most at risk of extreme heat [14]. The hottest 5% areas, or “hot spots,” generally follow the Massachusetts Avenue corridor, which is the most densely developed part of town with the greatest amount of impervious surface. There are also “hot spots” in parts of East Arlington, in a relatively dense residential area north and west of Massachusetts Avenue. At a minimum, it would make sense to avoid installing AT fields in or near the existing hottest 5% areas in Arlington.

Increased heat effects due to climate change will add, for example, 13 to 23 days of greater than 90 degrees F from the current 8 days per year in the town of Arlington.[14] The surfaces of AT fields have

been shown to be significantly hotter than natural turf fields, contributing to the urban heat island effect[13]. Temperatures of over 150 degrees F have been routinely recorded on artificial turf fields during June and summer months, compared to natural grass fields with temperatures of less than 90 degrees F.[6] The extreme heat inhibits wildlife movement and therefore disrupts ecosystems. Wildlife is exposed to surface temperatures of the fields, a different measurement than the "wet-bulb" temperatures used to evaluate human health and safety for high school and adult players. Surface heat would inhibit any wildlife movement across these fields during the hottest days of the year. Owls and other birds are known to hunt on natural grass fields in Arlington, as shown by some getting tangled in soccer nets. Furthermore, extreme surface heat may affect the temperature of the stormwater runoff, which can also affect the ecology of the aquatic environments that are the receiving waters of this runoff.

Climate Change Resilience Impacts

Issues surrounding climate change resilience and adaptation are increasingly critical as it becomes clear that our climate is changing in real time and we need to adapt our natural and built environment to address the threats associated with climate change, including extreme heat and precipitation. MassDEP defines Climate Change Resilience in guidance documents as follows[15]:

> *The capacity to prevent, withstand, respond to, adapt to, and/or recover from climate change impacts and to build the capability and ability of an area/site/system to minimize the adverse impacts of climate change.*

Artificial Turf Fields are inconsistent with climate change resilience in that they do not minimize these anticipated adverse effects and, in fact, can exacerbate these climate impacts, as discussed below.

Arlington has long been a leader in climate change resilience and mitigation, meaning that the Town adopts strong policies to minimize greenhouse gas emissions. Leaving aside the sizeable carbon footprint associated with AT field construction, installation, and disposal, the subcommittee chose to focus on how the change from grass to artificial turf fields impacts climate change resilience of the environment. In short, natural turf fields offer some mitigation of greenhouse gas emissions, especially carbon dioxide, whereas artificial turf fields offer none. Carbon sequestration is the process of creating long term storage of carbon dioxide, either geologically or in terrestrial ecosystems such as forests, fields, and other natural carbon sinks. Natural turf fields create an opportunity for carbon sequestration in the field grass and soil, particularly if the field is well maintained and not regularly disturbed or fully replaced (since the removal and replacement of the turf will likely result in the release of some of the sequestered carbon). While the amount of carbon sequestration that is possible through a natural turf field is more limited than would be possible in an unbuilt naturally vegetated environment, there is still a meaningful amount of carbon sequestration[18]. In contrast, an artificial turf field is a fully artificial environment that does not provide any standalone opportunity for carbon sequestration.

Finally in the context of climate change, the subcommittee also considered the sustainability of AT field components. Artificial turf fields must be replaced every 8-10 years, when their components enter the waste stream (or are re-purposed, such as AT for indoor play surfaces – but then enter waste streams at a later date). The recurring need for replacement over the lifetime of an athletic field is inconsistent with the principals of sustainability and increases the likelihood that disposed components will migrate off site and become contaminants. If not recycled, components will be landfilled, incinerated, or subject to chemical decomposition; all of these options have negative climate change impacts and do not represent recycling into new plastic products. The Synthetic Turf Council states that "the carbon footprint of a particular recycle/end-of-life option (such as trucking long distances) may be integrated

into the decision-making process and lead responsible parties to invalidate such an option"[19]. In terms of recycling, the hope had been that the products of "advanced" or "chemical" recycling" could be used to make new plastics, replacing some of the need for virgin fossil sources. Chemical recycling uses pyrolysis to decompose plastics at elevated temperatures resulting in low-value fuels as well as carbon monoxide and hydrogen. Variability in the feed stock of plastics poses challenges and makes this not a meaningful recycling option in its current capacity.[20] As of the writing of this report, there is no recycling facility in the Northeast that can meaningfully recycle AT athletic fields (i.e., generate substantial quantities of new plastic products from the AT).

Ecological Effects

Habitat loss in urban settings is a significant threat to biodiversity and ecosystem health, including the systems that humans rely on for our quality of living**.** Artificial turf replaces habitats, leading to a loss of plant and animal species diversity in the area.

Without sufficient biodiversity, ecological systems are disrupted. This can lead to cascading effects on the entire ecosystem, potentially compromising its stability and resilience. For example, microorganisms in soil remove contaminants before they reach wetlands and waterways.[21] When their work is disrupted, contaminants like nitrogen and phosphorous build up in places like Spy Pond, where toxic algae will thrive on them, leading to pond closures. Or, to use another recent example, if birds of prey lose their hunting grounds, the rodents they feed on will be more plentiful, leading to pest control issues.

Habitat loss results from the change in land use and effects the site directly as well as the surrounding area. Plastic is not habitat. The ability of plants and animals to move through an urban setting is important to the ecological systems and functions described above. The corridors they use often are connected to natural open spaces, making these areas important hubs. The removal or diminishment of a hub in the natural network has consequences for the whole system.

Findings and Recommendations

In summary, the Environmental Subcommittee offers the following findings.

a. Artificial Turf Fields have negative impacts on the environment due to toxic chemical pollution impacts on aquatic ecosystems, particulate pollution, plastic pollution, increased heat impacts, lack reduction in wildlife habitat and inhibition of wildlife corridors, and climate change resilience impacts to the environment including lack of carbon sequestration, fossil fuel use, lack of meaningful recycling, and subsequent environmental impacts due to required replacement every 8-10 years. Even in areas where Town and state wetlands regulations do not apply, artificial turf fields are not consistent with Town policies on reducing urban heat, reducing use of plastics, and reducing use of fossil fuels. Although most of these environmental impacts cannot be significantly mitigated through engineering or change in AT components, some mitigation of the chemical pollution can be achieved by using non-plastic and non-tire crumb rubber infills.
b. Although there may be environmental mitigations possible to reduce the impacts of AT fields (i.e., the stormwater management techniques described above), these require site specific investigations and designs, to consider issues such as physical feasibility, effectiveness, and costs. In the end, it will not be possible to mitigate all of the environmental impacts of an AT field, so it is important to recognize that the construction of an AT field will have some negative environmental impacts.
c. Tire crumb rubber and plastic infills should not be used in artificial turf fields in Arlington due to the toxic chemical and particulate pollution that negatively impacts the environment.

d. AT fields should not be installed in or near the existing hottest 5% areas in Arlington and might be considered only in areas that will have no direct negative impacts on wetland resource area values and interests, water resources, and other environmental receptors, as evaluated by the Town and its governing bodies.
e. Traditionally managed natural turf fields often have adverse effects on nearby environmental resources from pesticides and herbicides but provide some important ecological functions and do have climate change resilience attributes.
f. Organically managed natural turf fields that are properly constructed and maintained with aeration can allow for improved drainage, a reduction in the need for application of chemicals, allow for some habitat functions including habitat for invertebrates and microorganisms and wildlife corridors, have no added heat effects, and are more climate resilient than artificial turf fields. Organically managed natural turf fields are pervious and may help to control flooding. Also, they can reduce the Town's overall carbon footprint by sequestering carbon and not use fossil fuels for generation of the fields or for replacement[6]. These fields have been installed in several Massachusetts communities, including Marblehead [11] and Springfield [12], with results that meet the needs of these communities. It should be noted that these towns have both organically managed natural grass fields and AT fields, demonstrating the need for very site-specific, thorough studies in siting fields. In addition, Arlington is not currently in a financial position to organically manage natural turf fields, and faces maintenance challenges related to financial resources, staffing, and field availability. As a result, it may not make sense to measure the future performance of an artificial turf field against an idealized natural turf field, unless these management and maintenance challenges can be fully addressed (see accompanying table).
g. For AT and natural turf fields, the full lifetime costs of installation, maintenance and replacement should be clarified and considered in the Town budget. Given the strong interest in the issues related to our recreation fields, adequate funding is essential.

The Environmental Subgroup recognizes that the Town must weigh considerations other than the environmental impacts in choosing an athletic field surface, such as the overall goals and budget of the Town. However, based on our evaluation of the evidence provided above, the environmental impact of artificial turf outweighs the suggested environmental benefits. Without site-specific details, mitigation can not be adequately assessed, yet does not appear at this time to be sufficient to offset the impacts associated with the installation and use of artificial turf fields. Therefor, the Environmental Subgroup therefore recommends against the use of artificial turf fields in favor of organically managed natural grass.

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PFAS in AT coats athletes skin, new study

Beth Melofchik <tankmadel@yahoo.com>
Sun 3/17/2024 4:37 PM
To:James Ditullio <james_ditullio@hotmail.com>;Natasha Waden <nwaden@town.arlington.ma.us>
Cc:Wynelle Evans <evco7@rcn.com>;Robin Bergman <robinorig@gmail.com>;Jordan Weinstein <jordan3weinstein@gmail.com>

Jim Di Tulio, Chair, Artificial Turf Study Committee, Arlington MA

Dear Jim,

Hyperlinked below a new study with findings that PFAS coats the skin of children athletes after playing on artificial turf.* https://peer.org/pfas-in-artificial-turf-coats-players-skin/

Additional link to The Guardian article referencing the findings. https://www.theguardian.com/environment/2024/mar/15/athletes-higher-pfas-levels-artificial-turf

*At bottom of PEER page are hyperlinks to the actual study and the results. I list them below.

Please share with the Artificial Turf Study Committee and enter this email with hyperlinks into the record, thank you.

Study and results available on the PEER website hyperlinked:

https://peer.org/wp-content/uploads/2024/03/3_6_2024-Dermal-absorption-PFAS-AT.pdf

https://www.sciencedirect.com/science/article/pii/S0269749122006923

https://peer.org/industry-in-a-dither-about-pfas-in-synthetic-turf/

https://peer.org/forever-chemicals-disposal-is-creating-a-health-nightmare/

Thank you for the work you do on this public health and environmental health issue.

Respectfully,
Beth Melofchik

Turf Committee- Roosevelt Park, Malden MA

Phil Lasker <phil_lasker@yahoo.com>

Tue 3/19/2024 4:21 PM

To:Natasha Waden <nwaden@town.arlington.ma.us>

Natasha,
The following is included in the turf specification for Roosevelt Park in Malden. Please forward to the full committee. I feel this information, current testing procedures and recent results are being ignored by the "environmental" groups narrative.

HEAVY METALS & PFAS TESTING:

d. **HEAVY METALS:** The Infilled Synthetic Turf Vendor shall submit a signed letter, on company letterhead, stating the company's specific manufacturing and procurement practices that address Health and Human Safety concerns. The letter shall certify, through the independent testing of all Infilled Synthetic Turf System components installed as part of the Project, that their system's lead and other heavy metal content complies with the United States Consumer Product Safety Commission's (CPSC) most stringent requirement for lead content in children's toys (below 100 ppm), is safe for the environment and for use by people of all ages. Copies of the testing reports shall also be provided in conjunction with the certification. Installation of the field shall not commence until the written certification is received. Adjustments to the project schedule to accommodate testing laboratory schedules will not be granted.

e. **PFAS:** The Infilled Synthetic Turf Vendor shall submit a signed letter, on company letterhead, stating that the Vendor and their suppliers do not use PFAS (as defined in EPA Method 537 and California Proposition 65) in or as part of their manufacturing process for their turf fibers, primary

backings, and urethane coatings or the assembly of any components of the system or system as a whole. PFAS must be non-detectable at analytical detection limits that are suitable to meet state regulatory standards for solids as defined below. Alternatively, PFAS must be non-detectable at analytical detection limits that are suitable to meet state regulatory standards for liquid as defined below using a leaching test (e.g., EPA Method 1312). If an Infilled Synthetic Turf Vendor is unable to provide this information, they will be rejected for not meeting this requirement.

Required detection limits - solids:
PFDA: 300 ug/kg
PFHpA: 300 ug/kg
PFHxS: 300 ug/kg
PFNA: 300 ug/kg
PFOS: 300 ug/kg
PFOA: 300 ug/kg

Required detection limits – liquid:
PFDA: 500 ug/L
PFHpA: 500ug/L
PFHxS: 500ug/L
PFNA: 500ug/L
PFOS: 500ug/L
PFOA: 500ug/L

PERMEABILITY OF TURF SYSTEMS

Drainage Testing:

a. Upon completion of fine grading, complete a Dual Ring Infiltrometer Testing (ASTM D3385-9), (or other pre-approved method) by an Independent Testing Company coordinated and paid for by the Contractor. Five (5) tests per field shall be performed in locations determined by the Landscape Architect/Civil Engineer and/or Owner. Each test location shall have a permeability rate in excess of ten (10) inches per hour.

You'd be hard pressed to find a natural turf field that could drain at a minimum of 10" per hour.

Thanks,
Phil

Environmental subgroup revised

Mike Gildesgame <mikeg125@gmail.com>

Mon 3/18/2024 4:52 PM

To:james_ditullio@hotmail.com <james_ditullio@hotmail.com>;Natasha Waden <nwaden@town.arlington.ma.us>
Cc:jobar@alum.mit.edu <jobar@alum.mit.edu>;David Morgan <dmorgan@town.arlington.ma.us>

2 attachments (169 KB)

Turf envir subgroup FINAL.docx; Wetland Values Table_18Mar2024[4].pdf;

Hi Jim and Natasha.
In response to comments last week and a review of the submitted report, we are attaching a slightly revised version of our report with a hope that it will assist in your efforts to prepare the committee's joint final draft. Please let me know of any questions.

Mike

Arlington Artificial Turf Study Committee
Environmental Impacts of Artificial Turf Sports Fields
DRAFT 3/18/24

The Arlington Artificial Turf Study Committee was formed after a Town Meeting vote to delve into the topic of artificial turf (AT) in comparison to natural turf, and the Committee created an Environmental Subgroup to explore how the latest environmental science relates to AT versus natural turf fields. Most research in this area focuses on understanding the numerous environmental concerns associated with artificial turf. The following topics were chosen by the subcommittee as representative of the body of contemporary environmental research into AT. The relationship of potential impacts to the state and local regulatory environment is also considered.

Chemical & Particulate Pollution (Runoff) Impacts

One of the most significant concerns surrounding AT fields is their impact on wetland resources and waterways. Artificial Turf fields can act as sources of harmful chemicals, including Per- and Poly-fluoroalkyl Substances (PFAS), metals, and polyaromatic hydrocarbons (PAHs)[1,2,3,6,13,17]. The State Wetlands Protection Act and its regulations, along with Arlington's Town Bylaw and its regulations, all require the protection of a variety of wetlands values and functions. These include groundwater supply, flood control and storm damage prevention, prevention of pollution, wildlife protection, plant and wildlife habitat protection, and protection of the natural character or recreational values of the wetland resources. A table outlining the potential negative impacts of AT fields on each protected wetland interest is attached to this report and a map showing the proximity of recreational facilities (existing athletic fields), to wetland resource areas is included to show likely sites in Arlington for AT.

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Though there is recent scientific evidence of the potential to use bioretention cells to reduce 6ppd-quinone concentrations in stormwater runoff impacted from oxidized tires / tire crumb rubber[16], it is unclear if these systems could be scaled-up to provide stormwater mitigation for an 80,000 sq ft athletic field. Additionally, the Environmental subcommittee is unaware of any technology that can be practicably used for athletic fields that can reduce or eliminate the transport of PFAS or microplastics. The European Union recently acknowledged the negative impact of tire crumb rubber infills as microplastic pollution and in September 2023, enacted a ban on the sale of products containing intentionally added microplastics – specifically including in this ban “granular artificial turf infill” [17].

As observed in Arlington at the Arlington Catholic High School AT field and referenced in Arlington's Conservation Commission submissions to the May 2, 2023 Artificial Turf Forum and this committee, the tire crumb rubber infill from the school's field has migrated toward the nearby brook and within the protected wetland resource area of Mill Brook.

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Recently, several neighboring towns such as Lexington and Milton, have specified plant-based infills to help mitigate chemical pollution from the AT fields permitted.

Stormwater Management Impacts

How the stormwater is retained, infiltrated, or discharged is important to the consideration of the environmental impact of AT fields. Perhaps the most critical issue in this regard is the permeability of the playing surface, since permeable surfaces provide better stormwater management by allowing precipitation to infiltrate into the soil, rather than running off into storm drains or detention basins.

The Massachusetts Department of Environmental Protection (MassDEP) is considering officially classifying artificial turf fields as impermeable surfaces under the Wetlands Protection Act. This change would potentially affect the siting and maintenance of AT fields. MassDEP's latest proposed revision from December 2023 would define impervious surface for the "purposes of stormwater management (310 CMR 10.05(6)(k)-(q))" as follows:

> *any surface that prevents or significantly impedes the infiltration of water into the underlying soil, including, but not limited to artificial turf, Compacted Gravel or Soil, roads, building rooftops, solar arrays, parking lots, Public Shared Use Paths, bicycle paths, and sidewalks paved with concrete, asphalt, or other similar materials.*

Permeable surfaces provide better stormwater management by allowing precipitation to infiltrate into the soil, rather than running off into storm drains. This better ability to manage stormwater will become

ever more important as precipitation events potentially become more severe and more unpredictable with expected climate change impacts.

The permeability of artificial turf fields is a subject of debate, with some sources stating that they can be made permeable with the proper design and maintenance, and others stating that as an artificially constructed field, they are difficult or impossible to make permeable. While artificial turf fields can certainly be designed to quickly drain stormwater off the field (in many cases, more effectively than natural grass fields), the stormwater generally drains to perimeter drains and then to a detention basin or some stormwater management system. Since artificial turf fields are typically constructed on top of another engineered surface (rather than directly on top of the underlying soil), the real question then becomes whether the stormwater drains to a permeable surface, which depends on the specific design of the field.

There are techniques and systems that can allow for the capture and storage of stormwater, which can then be allowed to infiltrate into the soil and/or be released more slowly into the stormwater system to avoid overwhelming the system and causing flooding. Currently, AT fields are at best partially permeable, although this may change in the future as better systems are developed for managing the stormwater and allowing for improved stormwater infiltration to occur.

At a baseline, natural grass fields are considered permeable since they consist of natural grass over soil (unless the subgrade of the field is more heavily engineered). However, it is important to recognize that maintaining true and effective permeability requires ongoing maintenance of the fields, including proper aeration and grooming. Without that, the dirt underneath the playing surface can become highly compacted, and therefore will not function as effectively as a permeable surface (as noted above in the proposed changes being considered by DEP). Even under these conditions, a natural turf field may remain more permeability than an artificial turf field, but the exact comparison will depend on the design and maintenance of the field.

As this discussion illustrates, it is difficult to make general statements about the permeability and stormwater management performance of artificial turf and natural grass fields, since it is highly dependent on the design, construction, and maintenance of the individual field, along with other factors such as topography and adjacent land use.

Heat Impacts

It has been established that AT fields are hotter than natural turf fields[13]; therefore, the Environmental subgroup focused on the environmental issues related to excess heat / high temperatures on AT fields *vs*. natural grass fields.

There are areas of Arlington that are known heat islands. The Metropolitan Area Planning Council performed a heat analysis to ascertain the areas of Arlington that are most at risk of extreme heat [14]. The hottest 5% areas, or “hot spots,” generally follow the Massachusetts Avenue corridor, which is the most densely developed part of town with the greatest amount of impervious surface. There are also “hot spots” in parts of East Arlington, in a relatively dense residential area north and west of Massachusetts Avenue. At a minimum, it would make sense to avoid installing AT fields in or near the existing hottest 5% areas in Arlington.

Increased heat effects due to climate change will add, for example, 13 to 23 days of greater than 90 degrees F from the current 8 days per year in the town of Arlington.[14] The surfaces of AT fields have

been shown to be significantly hotter than natural turf fields, contributing to the urban heat island effect[13]. Temperatures of over 150 degrees F have been routinely recorded on artificial turf fields during June and summer months, compared to natural grass fields with temperatures of less than 90 degrees F.[6] The extreme heat inhibits wildlife movement and therefore disrupts ecosystems. Wildlife is exposed to surface temperatures of the fields, a different measurement than the "wet-bulb" temperatures used to evaluate human health and safety for high school and adult players. Surface heat would inhibit any wildlife movement across these fields during the hottest days of the year. Owls and other birds are known to hunt on natural grass fields in Arlington, as shown by some getting tangled in soccer nets. Furthermore, extreme surface heat may affect the temperature of the stormwater runoff, which can also affect the ecology of the aquatic environments that are the receiving waters of this runoff.

Climate Change Resilience Impacts

Issues surrounding climate change resilience and adaptation are increasingly critical as it becomes clear that our climate is changing in real time and we need to adapt our natural and built environment to address the threats associated with climate change, including extreme heat and precipitation. MassDEP defines Climate Change Resilience in guidance documents as follows[15]:

> *The capacity to prevent, withstand, respond to, adapt to, and/or recover from climate change impacts and to build the capability and ability of an area/site/system to minimize the adverse impacts of climate change.*

Artificial Turf Fields are inconsistent with climate change resilience in that they do not minimize these anticipated adverse effects and, in fact, can exacerbate these climate impacts, as discussed below.

Arlington has long been a leader in climate change resilience and mitigation, meaning that the Town adopts strong policies to minimize greenhouse gas emissions. Leaving aside the sizeable carbon footprint associated with AT field construction, installation, and disposal, the subcommittee chose to focus on how the change from grass to artificial turf fields impacts climate change resilience of the environment. In short, natural turf fields offer some mitigation of greenhouse gas emissions, especially carbon dioxide, whereas artificial turf fields offer none. Carbon sequestration is the process of creating long term storage of carbon dioxide, either geologically or in terrestrial ecosystems such as forests, fields, and other natural carbon sinks. Natural turf fields create an opportunity for carbon sequestration in the field grass and soil, particularly if the field is well maintained and not regularly disturbed or fully replaced (since the removal and replacement of the turf will likely result in the release of some of the sequestered carbon). While the amount of carbon sequestration that is possible through a natural turf field is more limited than would be possible in an unbuilt naturally vegetated environment, there is still a meaningful amount of carbon sequestration[18]. In contrast, an artificial turf field is a fully artificial environment that does not provide any standalone opportunity for carbon sequestration.

Finally in the context of climate change, the subcommittee also considered the sustainability of AT field components. Artificial turf fields must be replaced every 8-10 years, when their components enter the waste stream (or are re-purposed, such as AT for indoor play surfaces – but then enter waste streams at a later date). The recurring need for replacement over the lifetime of an athletic field is inconsistent with the principals of sustainability and increases the likelihood that disposed components will migrate off site and become contaminants. If not recycled, components will be landfilled, incinerated, or subject to chemical decomposition; all of these options have negative climate change impacts and do not represent recycling into new plastic products. The Synthetic Turf Council states that "the carbon footprint of a particular recycle/end-of-life option (such as trucking long distances) may be integrated

into the decision-making process and lead responsible parties to invalidate such an option"[19]. In terms of recycling, the hope had been that the products of "advanced" or "chemical" recycling" could be used to make new plastics, replacing some of the need for virgin fossil sources. Chemical recycling uses pyrolysis to decompose plastics at elevated temperatures resulting in low-value fuels as well as carbon monoxide and hydrogen. Variability in the feed stock of plastics poses challenges and makes this not a meaningful recycling option in its current capacity.[20] As of the writing of this report, there is no recycling facility in the Northeast that can meaningfully recycle AT athletic fields (i.e., generate substantial quantities of new plastic products from the AT).

Ecological Effects

Habitat loss in urban settings is a significant threat to biodiversity and ecosystem health, including the systems that humans rely on for our quality of living**.** Artificial turf replaces habitats, leading to a loss of plant and animal species diversity in the area.

Without sufficient biodiversity, ecological systems are disrupted. This can lead to cascading effects on the entire ecosystem, potentially compromising its stability and resilience. For example, microorganisms in soil remove contaminants before they reach wetlands and waterways.[21] When their work is disrupted, contaminants like nitrogen and phosphorous build up in places like Spy Pond, where toxic algae will thrive on them, leading to pond closures. Or, to use another recent example, if birds of prey lose their hunting grounds, the rodents they feed on will be more plentiful, leading to pest control issues.

Habitat loss results from the change in land use and effects the site directly as well as the surrounding area. Plastic is not habitat. The ability of plants and animals to move through an urban setting is important to the ecological systems and functions described above. The corridors they use often are connected to natural open spaces, making these areas important hubs. The removal or diminishment of a hub in the natural network has consequences for the whole system.

Findings and Recommendations

In summary, the Environmental Subcommittee offers the following findings.

a. Artificial Turf Fields have negative impacts on the environment due to toxic chemical pollution impacts on aquatic ecosystems, particulate pollution, plastic pollution, increased heat impacts, lack reduction in wildlife habitat and inhibition of wildlife corridors, and climate change resilience impacts to the environment including lack of carbon sequestration, fossil fuel use, lack of meaningful recycling, and subsequent environmental impacts due to required replacement every 8-10 years. Even in areas where Town and state wetlands regulations do not apply, artificial turf fields are not consistent with Town policies on reducing urban heat, reducing use of plastics, and reducing use of fossil fuels. Although most of these environmental impacts cannot be significantly mitigated through engineering or change in AT components, some mitigation of the chemical pollution can be achieved by using non-plastic and non-tire crumb rubber infills.
b. Although there may be environmental mitigations possible to reduce the impacts of AT fields (i.e., the stormwater management techniques described above), these require site specific investigations and designs, to consider issues such as physical feasibility, effectiveness, and costs. In the end, it will not be possible to mitigate all of the environmental impacts of an AT field, so it is important to recognize that the construction of an AT field will have some negative environmental impacts.
c. Tire crumb rubber and plastic infills should not be used in artificial turf fields in Arlington due to the toxic chemical and particulate pollution that negatively impacts the environment.

d. AT fields should not be installed in or near the existing hottest 5% areas in Arlington and might be considered only in areas that will have no direct negative impacts on wetland resource area values and interests, water resources, and other environmental receptors, as evaluated by the Town and its governing bodies.
e. Traditionally managed natural turf fields often have adverse effects on nearby environmental resources from pesticides and herbicides but provide some important ecological functions and do have climate change resilience attributes.
f. Organically managed natural turf fields that are properly constructed and maintained with aeration can allow for improved drainage, a reduction in the need for application of chemicals, allow for some habitat functions including habitat for invertebrates and microorganisms and wildlife corridors, have no added heat effects, and are more climate resilient than artificial turf fields. Organically managed natural turf fields are pervious and may help to control flooding. Also, they can reduce the Town's overall carbon footprint by sequestering carbon and not use fossil fuels for generation of the fields or for replacement[6]. These fields have been installed in several Massachusetts communities, including Marblehead [11] and Springfield [12], with results that meet the needs of these communities. It should be noted that these towns have both organically managed natural grass fields and AT fields, demonstrating the need for very site-specific, thorough studies in siting fields. In addition, Arlington is not currently in a financial position to organically manage natural turf fields, and faces maintenance challenges related to financial resources, staffing, and field availability. As a result, it may not make sense to measure the future performance of an artificial turf field against an idealized natural turf field, unless these management and maintenance challenges can be fully addressed (see accompanying table).
g. For AT and natural turf fields, the full lifetime costs of installation, maintenance and replacement should be clarified and considered in the Town budget. Given the strong interest in the issues related to our recreation fields, adequate funding is essential.

The Environmental Subgroup recognizes that the Town must weigh considerations other than the environmental impacts in choosing an athletic field surface, such as the overall goals and budget of the Town. However, based on our evaluation of the evidence provided above, the environmental impact of artificial turf outweighs the suggested environmental benefits. Without site-specific details, mitigation can not be adequately assessed, yet does not appear at this time to be sufficient to offset the impacts associated with the installation and use of artificial turf fields. Therefor, the Environmental Subgroup therefore recommends against the use of artificial turf fields in favor of organically managed natural grass.

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Environmental Subgroup - Artificial Turf Study Committee
Wetland Values Table

Meets Arlington Wetland Value / Interest?

Wetland Value / Interest[1]	Artificial Turf Field	Mitigation for Artificial Turf Field
Public or Private Water Supply	Not applicable	
Ground Water Supply	No	Engineered Green Infrastructure (e.g., Bioretention Cells) may reduce some chemicals and microplastics but more research required to support this mitigation strategy
Flood Control	No - impervious	engineer field design and controls
Erosion Control and Sedimentation Control	Maybe	engineer field design and controls
Storm Damage Prevention	Maybe	engineer field design and stormwater management
Prevention of Pollution	No	Engineered Green Infrastructure (e.g., Bioretention Cells) may reduce some chemicals and microplastics but more research required to support this mitigation strategy
Wildlife Protection	No	No mitigation available
Plant or Wildlife Habitat	No	No mitigation available
Aquatic Species and their habitats	No	Engineered Green Infrastructure (e.g., Bioretention Cells) may reduce some chemicals and microplastics but more research required to support this mitigation strategy
Natural Character or recreational values of the wetland resources	No	No mitigation available
Climate Change Resilience [Section 32, Arlington Wetlands Regulations, March 2023]	No	Alternate infills may reduce some heat impacts; but no mitigation is available for loss of Carbon sequestration; Sustainability issues / fossil fuel use

[1] https://www.arlingtonma.gov/town-governance/laws-and-regulations/town-bylaws/title-v-regulations-upon-the-use-of-private-property#A8

Introduction

Arlington has long been a draw for young families seeking to raise their children in a vibrant community convenient to Boston. The most recent United States Census pegs Arlington's 18-and-under population at more than 1 in 5. Communities with large numbers of young people require the open spaces and playing fields that those young people want and need. In recent years, Arlington's supply of playing fields has struggled to keep up with the rising demand. Even when Arlington's fields have met that demand, it has not been without criticism. In particular, it is widely accepted that many of Arlington's playing fields are worn and tired, suffering from both overuse and weather limitations. The demand for Arlington's fields has moved in parallel with the deterioration of those fields.

Amidst this predicament, town residents have searched for solutions whereby the supply of quality playing fields could match the intense demand. It is within this context that the topic of artificial turf playing fields (also known as synthetic turf playing fields) has emerged. For those town residents seeking a way to maximize each playing field to meet the demand for those fields (particularly from youth sports leagues), artificial turf fields would appear to offer an attractive alternative. Artificial turf proponents argue that these fields are able to withstand New England weather while being versatile enough to maximize field playing time without sacrificing the quality of playing conditions.

Despite the benefits cited by proponents, others have raised concerns about the hazards of materials used to make artificial turf, the costs associated with installing and regularly replacing artificial turf fields, and the adverse health effects experienced by those who play on and use artificial turf fields. Opponents argue that the vaunted benefits of this playing surface cannot overcome its notable and distinct limitations.

Into this debate the Arlington Artificial Turf Study Committee (ATSC) entered in December 2023. Created by passage of Amended Article 12 at the 2023 Annual Town Meeting, the ATSC was charged with reviewing and reporting on "artificial turf: its health, safety, and environmental impacts, and potential mitigation measures, and a comparison of artificial turf to natural turf fields." Consisting of seven voting members and two non-voting members, all representing parts of town government with concerns about and interests in Arlington's playing fields, the ATSC sought to provide information to town leaders and residents who see great potential in the use of artificial turf but have legitimate concerns about its health, safety, and environmental impacts. With an overarching commitment to take the proverbial "deep dive" into the subject matter, the ATSC has meticulously and diligently studied artificial turf without fear or favor, letting science and data dictate its questions and its studies.

This report is the product of those efforts.

Scope of Work

The ATSC was charged with examining health, safety, and environmental impacts related to the use of both artificial and natural grass turf fields, as well as potential mitigation measures. Consistent with that charge, the Committee focused its research and discussions on several specific areas related to turf fields: access to youth sports and its impact on mental and physical health; heat impacts on human health and heat related injuries; heat impacts on the environment; skin/bacteria issues; injury rates; chemical impacts on human health and the environment; alternative infills; chemical and particulate runoff impacts; stormwater management impacts; climate change resilience impacts and ecological effects; and a cost comparison of artificial turf fields to natural grass fields.

Access to Youth Sports and its Impact on Mental and Physical Health

Research shows that exercise and team sports, in particular, improve the overall health of young people. According to the Science Board that works in the President's Council on Youth Fitness and Nutrition, participation in sports impacts many aspects of health. Equitable access to youth programs both promotes exercise and allows children to develop the social interactions that occur as part of a team. Exercise is linked to a reduced risk of many diseases including Type 2 diabetes, obesity, cancer, depression, and anxiety. When the national youth sports survey looked at who isn't participating in sports, they found that Black, Indigenous, and People of Color (BIPOC) and low-income households were particularly impacted by access to sports. Lack of access to playing spaces is a key contributor to the problem. It is important to mention that Arlington's outdoor recreation spaces and youth sports programs are accessible to families that cannot afford private sports clubs. However, a lack of field space can impact both enrollment and access to practice and playing times. [1] [2]

New England weather complicates the number of children enrolled in programs and the lack of field space. The wet weather conditions limit access to grass fields during the busy season, March 15 - June 15 and August 15 - November 15. According to Arlington's Department of Recreation, there are many field closures for rain and resting periods after rain that require rescheduling of games and practice. Often, games can get played (or on occasion Arlington can move to an away site to make up a game), but there is little chance to make up practice. Artificial turf fields do not have to be closed for rain and they allow for continuous play and field use. Artificial turf can be used earlier and later in the season and potentially in winter months. According to Ian Lacy from Tom Irwin Advisors, artificial turf fields can be used 1.3x-1.5x more than natural grass fields. However, this assumes a natural turf field is appropriately rested. In our current situation, Arlington does not appropriately rest its fields. So while conversion from natural grass to artificial turf may dramatically increase the days where practices and games can be held, it will not significantly increase the number of playing fields in the community.

It is important that Arlington youth can participate in youth sports and have access to playing surfaces that promote continuous play when adverse weather restricts play on natural grass

[1] https://health.gov/our-work/nutrition-physical-activity/national-youth-sports-strategy/questions-answers#q4

[2] https://health.gov/sites/default/files/2020-09/YSS_ScienceBoardReport_2020.09.01_opt.pdf

fields. As such, Arlington should consider increasing playing spaces to ensure equitable access to team sports for all its young residents. Some strategies for doing so include:

- Linear sand injection system. According to turf expert Ian Lacy of Tom Irwin Advisors, the installation of a linear sand injection system on a natural grass turf field is a mitigation strategy that helps to address flooding/moisture conditions and may be relatively inexpensive to install on existing fields.

- Understanding the impact weather has on access to Arlington's existing playing fields. To better understand how inclement weather affects Arlington's playing fields it would be beneficial to collect actual data as to when grass and artificial turf fields are closed due to weather conditions (rain, heat, etc.). Ideally, this data would be collected annually and could be used to compare one year to another.

An additional strategy is site specific installation of artificial turf, which holds the possibility of increasing access to youth sports programs in Arlington and usability of playing spaces for those programs. Although such a strategy may be beneficial to the overall health of Arlington's youth, there are notable downsides to artificial turf, which will be discussed in this report.

Heat Impacts on Human Health and Heat Related Injuries

The impact of heat on human sporting activities may become an increasingly important issue as we continue to see the warming effects of climate change. While some research casts doubt on an automatic relationship between air temperature and surface temperature, there is clearly cause for concern related to the heat effects of artificial turf fields on their users. Exposure to high heat levels, on all types of playing surfaces (including natural grass), can have a cumulative effect on the human body. Children in particular are more vulnerable to high temperatures than adults, and they are not as adaptable to changes in temperature as adults are. Additionally, children are less likely to accurately assess the degree of heat strain to which they are exposed, and therefore their desire to participate and compete may lead them to stay on the field despite a level of discomfort that might lead an adult to rest instead. [3] For these reasons, it is important to look at how heat may affect a field user on both artificial turf and natural grass fields and determine what mitigation measures may be necessary during periods of high heat temperatures.

Numerous studies have documented extremely high surface temperatures on artificial turf, and while there has been limited research on the temperature of the air above the field, data indicates that players on artificial turf fields have higher skin temperatures, indicating greater heat load, and perceive a greater degree of heat stress than when on natural grass fields. Most reputable studies or analyses show that artificial turf fields with crumb rubber infill can get considerably hotter than natural grass on hot, sunny days. While natural grass fields rarely get above 100° F due to the release and evaporation of water vapor that leads to cooling, artificial turf fields, in comparison, regularly rise above 100° F.[4] Penn State University's Center for Sports Surface Research conducted studies comparing surface temperatures of synthetic turfs composed of various fiber and infill colors/materials and found that the maximum surface temperatures during

[3] https://www.scientificamerican.com/article/heat-waves-affect-children-more-severely/
[4] https://www.nrpa.org/parks-recreation-magazine/2019/may/synthetic-sports-fields-and-the-heat-island-effect/.

hot, sunny conditions averaged from 140° F to 170° F.[5] Another study conducted at Brigham Young University found that the surface temperature of the synthetic turf was 37° F higher than asphalt and 86.5° F hotter than natural turf.[6] This is a concern for many reasons, including, as neuroscientist Kathleen Michels points out: "Any temperature over 120° F can cause skin burns with skin contact in two seconds."[7]

Arlington High School Athletics Department staff who have taken temperature readings on both artificial turf and natural grass fields at the same time have found the playing environment to be between seven and ten degrees hotter on synthetic fields than on natural grass fields. These temperatures were measured with a wet bulb globe thermometer (WBGT). Research on heat stress in college athletes has shown that a significant heat exposure on one day can result in additional physiological stress days later. [8] [9] [10] [11]

Heat-related concerns over artificial turf fields in New England would be most acute in the hottest months of the year, namely June, July, and August (also known as meteorological summer). Fortunately for the Town of Arlington, there are few organized athletic uses of Arlington fields during that time period, meaning far less concern with heat stress or heat exhaustion on athletes. Arlington's town and school athletic fields receive their greatest use in the "shoulder seasons" of spring (April-May) and fall (September-November), where temperatures in Arlington do not regularly cross the 80° F mark. Climate change is raising temperatures, there will be more hot days even in the shoulder seasons, and surface temperatures on artificial turf fields in Arlington could reach very high levels even on more temperate days. There is a greater possibility that heat will be a concern in the future and therefore it must be addressed. But, unlike some other issues related to artificial turf fields, the heat-related concerns are very capable of being mitigated, especially in a community like Arlington that is in the New England climate.

One mitigation strategy used by some artificial turf field owners is to water the fields to keep them cool on hot days. Such a strategy is not recommended. Watering artificial turf fields is effective only for a short period of time, and temperatures usually rebound after only about 20 minutes (less time than it takes to play a regulation half game of soccer). Moreover, adding irrigation to this type of sports field is costly and, depending on the type of infill used, could be ineffective, as water could simply roll off the surface and not really soak in to provide that small window of temperature relief.

There are, however, several mitigation strategies that could improve heat safety for field users and can be deployed either singularly or in combination with other strategies.

- Using alternative infill materials on synthetic turf fields. Alternative infill materials (sand, coated sand, cork, Brockfill, etc.) have been suggested as replacements to crumb

[5] Ibid.
[6] Ibid.
[7] Ibid.
[8] https://plantscience.psu.edu/research/centers/ssrc/documents/temperature.pdf
[9] https://www.scientificamerican.com/article/heat-waves-affect-children-more-severely/
[10] https://journals.sagepub.com/doi/abs/10.1177/17479541221089748
[11] Telephone conversation with Christianne Eason, Ph.D., ATC on 2/15/24. Korey Stringer Institute, University of CT.

rubber that are not only less toxic but may also result in cooler field surface temperatures.[12] However, none of these alternative infills can provide a surface that is comparable in temperature to natural grass, and they may have other limitations, such as increased migration from the field or the need for more frequent maintenance and/or replacement. Information from the Penn State Sports Surface Research Center suggests that significant temperature reductions may not be possible with infill changes alone. [13]

- Installation of signage on playing fields. Often signage around fields includes warnings about damage to the turf field, but additional signage or an alteration to existing signage should alert users to the health risks associated with field use on very hot, sunny days.

- Formalized education and training about heat safety for youth sports coaches. Annual training on recognizing heat strain is provided to coaching staff as part of Arlington High School's Athletics Department's Emergency Action Plan. Additionally, a five-day acclimatization program has been implemented for football players whose exposure tends to be greater due to their use of pads and uniforms, in accordance with Massachusetts Interscholastic Athletic Association (MIAA) guidelines.[14] However, for non-high school sports organizations, it is unclear as to what type of training, if any, is provided or required for volunteer coaches/parents in regards to recognizing and responding to heat strain events. Aside from high school events, it is unclear that there is consistent monitoring of field temperatures in the Town of Arlington.

- Installation of shade cover at all playing fields. During the design of field renovations consideration should be given to the installation of shade structures that can protect the user from direct sunlight during resting periods. Such structures may include dugout covers and shaded sideline seating. This should be considered regardless of field type, as hot temperatures outside the summer season are becoming increasingly common.

- Monitoring air and surface temperatures: The Arlington High School Athletics Department currently monitors field temperatures (WGBT) during the hottest part of the year and has guidelines for when field use is safe. Practices and tryouts are scheduled for cooler parts of the day whenever possible. However, it is unclear whether or not there is consistent monitoring of field temperatures outside of high school athletics. As such, it would seem appropriate to establish an air and surface temperature monitoring program for synthetic turf fields during the hottest part of the year. Such a policy is not unheard of and, in some circumstances, is quite common. For example, local beach administrators (like the Massachusetts Department of Conservation and Recreation and the Arlington Board of Health) regularly monitor local beaches for elevated bacteria levels in the water; if the bacteria levels go above a certain level on a certain day, the authorities close the beach for that day. The MIAA has established guidelines for the use of athletic fields of any kind during hot temperatures, with the guidelines stating that there should be no use of fields when the wet-bulb temperature goes above 86.1° F. In the same way, it seems both logical and prudent for local officials (like the Department of Park and Recreation or School Department) to monitor air and surface temperatures at artificial turf fields in

[12] Presentation by Ian Lacy, Lead Project Advisor, Tom Irwin Advisors on 2/20/24
[13] https://sturf.lib.msu.edu/article/2011jun20.pdf
[14] Presentation by Arlington High School Athletic Trainer Samantha Jones 2/13/24

Arlington, especially during June-August; if surface temperatures go above a certain established level, then those fields would be closed to use for that day – much like natural grass fields are closed when rain or snow conditions prevent their use.

As an example, the Montgomery County Public Schools in Maryland has developed the following guidelines for use of its artificial turf fields:

- Anytime the outdoor temperature exceeds 80 degrees, coaches exercise caution in conducting activities on artificial turf fields.
- When outdoor temperatures exceed 90 degrees, coaches may hold one regular morning or evening practice (before noon or after 5 p.m.).
- When the heat index is between 91–104 degrees between the hours of noon and 5 p.m., school athletic activities are restricted on artificial turf fields to one hour, with water breaks every 20 minutes.[15]

Heat Impacts on the Environment

It has been established that artificial turf fields are hotter than natural turf fields.[16] But the excess heat generated by artificial turf fields has impacts on the environment beyond those on the human body.

The surfaces of artificial turf fields have been shown to be significantly hotter than natural turf fields, contributing to the urban heat island effect.[17] Temperatures of over 150 degrees F have been routinely recorded on artificial turf fields during June and summer months, compared to natural grass fields with temperatures of less than 90 degrees F.[18] It is expected that climate change will add 13 to 23 days where temperature exceed 90 degrees F, an increase from the current 8 days per year in Arlington.[19] Artificial turf fields could exacerbate already fast-increasing temperatures in Arlington, particularly in areas identified as heat islands.

The Metropolitan Area Planning Council performed a heat analysis to ascertain the areas of Arlington that are most at risk of extreme heat.[20] The hottest 5% of areas, or "hot spots," generally follow the Massachusetts Avenue corridor, which is the most densely developed part of Arlington with the greatest amount of impervious surface. There are also "hot spots" in parts of East Arlington, in a relatively dense residential area north and west of Massachusetts Avenue. It seems advisable, to the extent practicable, to avoid installing artificial turf fields in or near the existing hottest 5% areas in Arlington.

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[15] https://www.nrpa.org/parks-recreation-magazine/2019/may/synthetic-sports-fields-and-the-heat-island-effect/.
[16] TURI 2020. Athletic Playing Fields and Artificial Turf: Considerations for Municipalities and Institutions
[17] TURI, 2020. Athletic Playing Fields and Artificial Turf: Considerations for Municipalities and Institutions.
[18] https://www.turi.org/content/download/11980/188623/file/TURI+Report+2018-002+June+2019.+Athletic+Playing+Fields.pdf
[19] https://www.sciencedirect.com/science/article/pii/S2666016422001025?via%3Dihub
[20] https://www.arlingtonma.gov/home/showpublisheddocument/51627/637268071185670000

In addition to creating heat islands, extreme heat inhibits wildlife movement and disrupts ecosystems. Higher surface heat temperatures on artificial turf could inhibit any wildlife movement across those fields during the hottest days of the year. Furthermore, extreme surface heat may affect the temperature of the stormwater runoff, which can also affect the ecology of the aquatic environments that are the receiving waters of the runoff.

Skin/Bacteria

Closely related to the heat effects on athletes and users of artificial turf fields are the skin effects on them. Beyond the obvious effects from extreme surface temperatures on artificial turf fields, such as heat stroke, are other effects relating to an individual's skin.

Safe Healthy Playing Fields Inc. estimates that skin injury can result from contact with a surface lasting just several seconds when the heat index runs from 120° – 140° F.[21] Although that is a serious concern for users of artificial turf fields, there are obvious mitigation measures to address them. For example, it seems unlikely that someone using an artificial turf field is directly exposing their bare feet or skin to the surface for extended periods of time; moreover, signage can make clear that all users of the field must wear shoes at all times. And, as discussed earlier, there is no reason why the Town of Arlington, were it to have new artificial turf fields, could not limit or close the fields to use on the hottest days of the year.

Artificial turf fields also raise questions of bacterial infections. The Massachusetts Department of Public Health addressed this issue directly:

> Some studies have measured the levels of bacteria on surfaces of different types of athletic fields. Very limited research has found fewer bacteria in [artificial turf fields] ATF than soil and the federal study reported indoor ATF having fewer bacteria than outdoor ATF. However, many factors (e.g., presence of bacteria, moisture, and temperature) influence the risk of bacterial infections following the use of any athletic surface. The frequency and severity of skin abrasions can also influence the risk of infection. California's Environmental Protection Agency reported that athletes experience more frequent turf burns (i.e., skin abrasions) on ATF relative to natural fields. Overall, practicing good hygiene is the best way to prevent getting and spreading infections. Washing skin abrasions with soap and water can decrease the risk of bacterial infections.[22]

As noted by DPH, the threat of bacterial infections from artificial turf is real but limited, and it can be mitigated through good hygiene practices. For this reason, the Mount Sinai Children's Environmental Health Center similarly recommends that those who play on artificial turf surfaces wash their hands before eating, drinking, or adjusting mouth guards, as well as cleaning cuts and abrasions immediately.[23]

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[21] https://www.safehealthyplayingfields.org/heat-levels-synthetic-turf.
[22] https://www.mass.gov/info-details/artificial-turf-fields.
[23] https://static1.squarespace.com/static/57fe8750d482e926d718f65a/t/593b15421e5b6c414467a03b/1497044293003/CEHC+Position+Statement+on+Recycled+Rubber+Turf+Surfaces+2017-5-10.pdf.

Injury Rates

A long-running critique of artificial turf playing fields holds that they have a higher incidence of player injuries than natural grass fields. That was certainly true with the first generation of artificial playing surface known as AstroTurf. Physicians and trainers noted that players were injured with a greater frequency on that turf, including ACL tears, concussions, and ankle sprains. In 1992, John Powell from the University of Iowa published a paper that showed that professional football teams had more major knee injuries on artificial turf when compared to professionally maintained natural grass.[24] In that era, players complained of greater muscle soreness on artificial turf as compared to playing on a professionally maintained natural grass surface.[25]

But artificial turf has advanced considerably from its early AstroTurf days, and that includes improvements in lowering player injuries. Artificial turf manufacturers have made advancements in simulating more natural surfaces, particularly with the use of crumb rubber infill mixed with sand, often giving the turf a more grass-like feel. Nevertheless, criticism of artificial turf as it relates to player injuries remains, and it is not uncommon to hear players vocalize their opinions about the difference between the playability of artificial turf versus natural grass.[26]

Recent studies on player injuries provide a mixed picture. While some studies still see a greater likelihood of sports injuries with artificial turf over grass, other studies see the two playing surfaces as equivalent with respect to injuries, and one recent study even saw an advantage to artificial turf fields. It should be noted that these studies were focused on professional and collegiate athletics, and very little study information is available about the casual or municipal user.

A 2023 review of research related to player injuries found that there is a higher rate of foot and ankle injuries on artificial turf, both old-generation and new-generation turf, compared with natural grass.[27] That review also noted that high-quality studies 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.[28]

In contrast, a 2022 peer-reviewed study found that in a comparison of artificial turf to natural grass, injury rates were equivalent in most cases.[29] A notable exception to that finding was higher rates of foot and ankle injuries in general, as well as higher knee injury rates among elite-level American football athletes, on artificial turf playing surfaces.[30] But the study found that concussion rates on artificial turf are decreased compared to natural grass that is maintained by professional groundskeeping operations.[31]

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[24] https://www.hss.edu/conditions_artificial-turf-sports-injury-prevention.asp.
[25] Ibid.
[26] https://www.hss.edu/conditions_artificial-turf-sports-injury-prevention.asp.
[27] https://pubmed.ncbi.nlm.nih.gov/35593739/.
[28] Ibid.
[29] https://www.intechopen.com/chapters/83186.
[30] Ibid.
[31] Ibid.

And, as previously noted, a 2023 study of football (soccer) players actually found the overall incidence of football injuries to be lower on artificial turf than on grass.[32]

In light of recent studies and research, it seems hard to definitively say whether modern artificial turf playing fields inherently present more risk of player injury than natural grass fields that are maintained to a professional standard. There seems to be a slightly higher risk of foot and ankle injuries on artificial turf fields versus natural grass fields, but the difference is not dramatic. And there is some indication that, with respect to sports injuries, artificial turf playing surfaces might even be better than natural grass, including in the area of concussions. In the end, although there may be many important differences between artificial turf fields and natural grass fields, player injuries is not an area that stands out in that regard.

With the benefit of first-hand local experience on both natural grass and artificial turf with crumb rubber infill, Arlington High School's head athletic trainer, Samantha Jones, concurred with that assessment. She stated that she has not seen any measurable difference in the type or number of injuries associated with playing surface, noting that more frequent injury types are attributable to factors like differing physiology or player preparedness.

It is also worth noting that studies of sports injuries sometimes compare artificial turf fields to pristine, professional athletic natural grass fields. In that comparison, it is not surprising that the artificial turf fields often have a modestly worse record on certain sports injuries. But it is rare outside of collegiate or professional sports to find pristine, impeccably maintained natural grass fields. In reality, most municipal grass playing fields across the United States (like those in Arlington) are maintained to the level that is affordable for municipal budgets. Those fields are often stressed from heat and rain, and they can be much more likely to cause sports injuries.

Mark Cote, a Mass General Brigham Sports Medicine researcher who serves as director of Outcomes Research for Sports Medicine and Orthopedic Surgery at Massachusetts General Hospital, summed up succinctly the state of research on these issues in 2024: "I don't think we're at a point yet where we can say an injury would have been avoided because a field is turf or natural grass, nor are we at a point where we should immediately switch every field in America to natural grass."[33] Recognizing that artificial turf may increase the risk of non-contact injuries and that professional athletes often prefer natural grass playing fields, Cote stated: "While I'd prefer my own children to play on natural grass, I know an injury can happen on any surface without proper conditioning. At the end of the day, it's a part of the sport."[34]

Chemicals Impacts on Human Health and the Environment

Artificial turf and its infills contain a wide variety of hazardous chemicals. What is not known at this point is how much exposure results from playing on these surfaces. In general, reducing exposure to hazardous materials has a positive health effect.

[32] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10139885/.
[33] https://www.massgeneralbrigham.org/en/about/newsroom/articles/turf-vs-grass-fields-sports-injury-prevention.
[34] Ibid.

Exposure to hazardous materials comes in one of three ways: inhalation, ingestion, and dermal contact. While there is almost no data on the level of exposure to these materials in the context of artificial turf use, in general, when a product contains demonstrably toxic materials, minimizing possible exposure to them is always going to be better than not doing so. All things being equal, a reduction in potential exposure should lead to reduced harm to people and the environment.

Artificial turf fields in Arlington will be used primarily by children, who eat, drink, and breathe more per pound of body weight than do adults. As their brains and bodies are continually developing during childhood, the effects of any hazardous exposures are more significant than would be the case for comparable exposures in adults. For example, recent research suggests that there is no safe level of lead exposure for children. Their behavior also differs from that of adults, with more hand-to-mouth activity, which can act to increase potential exposures. In terms of duration of exposure, almost all the exposure studies to date have been done on adults, who are less susceptible to comparable adverse exposure levels to chemicals. Many more children participate in youth sports programs than was the case 20 years ago, and as a result will likely have longer periods of exposure to any hazardous components in artificial turf than would an adult. Exposure duration can be an important factor as diseases may have long latency periods (the time between exposure and disease).

Chemical exposure can lead to negative health outcomes. Chemical exposures can have cumulative impacts, defined as toxicity risk, carcinogenic risks, endocrine disruption risks, and reproductive risks. While there is an abundance of research that clearly illustrates the toxicity of components within artificial turf, there are few if any research studies that examine the potential for exposure to field users, nor do data currently exist that establish the exact level at which exposure to a particular hazardous material found in artificial turf results in disease. While one cancer related study suggested there was no association between artificial turf field use and cancer in athletes, there were questions raised about the methodology used in the study and whether or not the study results were valid.

There are also serious concerns related to crumb rubber infill and artificial turf fields. Crumb rubber infills, used to soften the playing surface on artificial turf fields, are made from very finely shredded automobile and truck tires, and have been one of the ways in which old tires are recycled. Used tires contain a wide assortment of toxic materials which have been linked to adverse human health effects and environmental damage. The small size of these particles makes it easier for dusts to be generated during field use, which can then be aerosolized and inhaled, or deposited on clothing or body parts. Dermal contact with these dusts or solids can result in an ingestion exposure if food is eaten without handwashing. In addition to potential direct exposures, these materials are a source of “take home” exposures if they are transferred via clothing, shoes, on skin, or in the hair to field users’ automobiles or homes. As such, the potential hazards associated with crumb rubber should be taken into consideration by Town officials when making decisions about future projects that may involve this material.

In addition to crumb rubber infill, artificial turf fields contain other chemicals of concern and hazardous materials, including the following:

> **Polycyclic aromatic hydrocarbons** (PAHs). PAHs are chemicals that exist naturally in coal, oil, and gasoline. They can be formed by the burning of these materials, along with

wood, tobacco, and even food that is cooked at high heat, such as meat on a grill. Exposures can result from breathing tiny PAH particles or particles to which PAHs are bound, eating grilled or charred food, or food onto which PAH particles have deposited from the air. Some PAHs can be absorbed through the skin. Exposures to PAHs have been associated with skin, lung, bladder, liver, and gastrointestinal cancers. High rates of cancer among firefighters are thought to be due to PAH exposures. Animal studies have shown an association between PAH exposure and reproductive, neurologic, and developmental effects. [35] [36]

Heavy metals. Metals such as lead, zinc, and chromium as well as others are commonly found in crumb rubber. These metals can have a range of adverse health effects, including impairment of the nervous system, gastrointestinal and kidney issues, immune system dysfunction, reproductive system toxicity, and cancer. Indications are that the primary route of field users' exposure to metals would be through ingestion rather than inhalation.[37]

Per- and polyfluoroalkyl compounds (PFAS). PFAS is the umbrella term for the thousands of fluorinated compounds, which are commonly referred to as "forever chemicals" due to their extreme resistance to breaking down in the environment. They have been used in any number of products, including nonstick cookware, firefighting foam, stain-resistant upholstery, and rainwear. It has been estimated that nearly all Americans have been exposed to PFAS through drinking water contamination, using products made with PFAS, or breathing PFAS in the air. A number of these compounds have been banned for use in children's toys and other consumer products, and many manufacturers are trying to come up with safer alternatives. However, for other consumer products, including artificial turf, compliance with the ban is totally voluntary. New fluorinated compounds are continually being developed and used. Because there are many opportunities for exposure, and PFAS are resistant to breaking down, they can accumulate in our bodies. Data suggests that the amount of PFAS in our blood can be one thousand times greater than the EPA's proposed level for drinking water. Adverse health effects include alterations in metabolism, altered thyroid function, higher risk of being overweight, lower fetal growth rates, and reduced effectiveness of our immune system. [38] [39] [40] [41] [42]

Phthalates are often referred to as "plasticizers. They can make plastic products flexible, and longer lasting. They are used in a wide variety of products including food packaging, medical products, personal care items, and sporting goods. The CDC states, "People are exposed to phthalates by eating and drinking foods that have contacted products containing phthalates. Some exposure can occur from breathing phthalate particles in the

[35] https://www.sciencedirect.com/science/article/abs/pii/S0269749122010557?via%3Dihub
[36] https://www.sciencedirect.com/science/article/abs/pii/S0045653517320349?via%3Dihub
[37] https://www.nature.com/articles/s41598-023-38574-z

[38] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10718084/
[39] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6348874/
[40] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10423336/
[41] https://factor.niehs.nih.gov/2022/10/science-highlights/pfas-liver-injury
[42] https://www.healthandenvironment.org/che-webinars/96609

air. Children crawl around and touch many things, and then put their hands in their mouths. Because of that hand-to-mouth behavior, phthalate particles in dust might be a greater risk for children than for adults. Inside a person's body, phthalates are converted into breakdown products (metabolites) that quickly leave the body in urine." Research has documented a wide variety of adverse health effects resulting from chronic exposure to phthalates, including disruption of the endocrine system and abnormal functioning of some organ systems. This can affect pregnancy outcomes, child growth and development, and reproductive systems in both young children and adolescents. [43] [44] [45] [46] [47]

Microplastics: Comparable to investigations into the human health effects of PFAS and phthalates, research on the health effects of microplastics in both aquatic species and humans is extremely limited and in its early stages. Exposure to microplastics occurs through inhalation, ingestion, and food consumption, and is an increasing worldwide concern. Research indicates that ingestion of microplastics is harmful to aquatic and animal species, resulting in inflammation, oxidative stress, and cytotoxicity among other adverse effects. Translocation of these tiny plastic particles has been found to occur in mice after ingestion, including passage through the blood-brain barrier. It is believed that these may be seen in humans as well. One study showed behavioral changes in mice following short-term microplastic exposures .[48] In addition to the plastic particles themselves, there are concerns about the toxicity of compounds that have been either added to or are adsorbed to the surface of the base plastic, such as colorants, phthalates, other chemicals which are used to provide specific properties, or heavy metals, which could result in other harmful effects.[49] [50] [51]

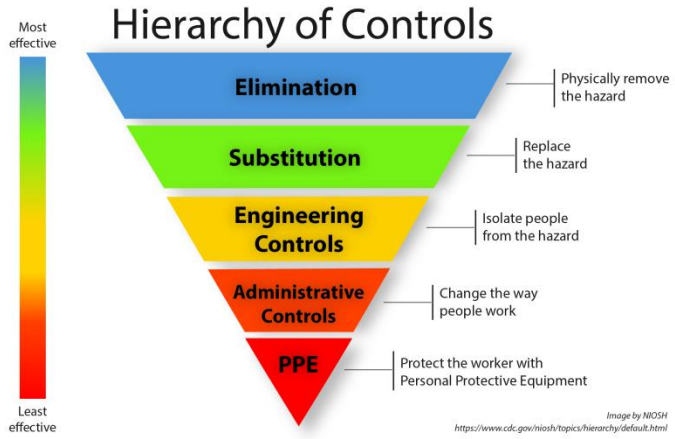
While the chemicals above are in the highest quantities in the crumb rubber, they also can exist in the grass blades. While nearly all Americans currently have some level of exposure to both PFAS and phthalates, virtually all of the papers addressing health issues around PFAS and phthalates in artificial turf acknowledge that there is inadequate research in terms of exposure, and that much more research is needed. For example, while there are standards for PFAS in drinking water, there are currently no definitive levels for PFAS or phthalates at which adverse health effects will occur, making it difficult to associate specific levels of exposure with disease.

An additional chemical that has recently been discovered in some artificial turf is 6-PPD Quinone.

[43] https://www.mdpi.com/2227-9032/9/5/603
[44] https://www.hsph.harvard.edu/news/features/the-big-3-why-phthalates-should-be-restricted-or-banned-from-consumer-products/
[45] https://www.sciencedirect.com/science/article/pii/S153204562300100X
[46] https://journals.lww.com/co-pediatrics/abstract/2013/04000/phthalate_exposure_and_children_s_health.16.aspx
[47] https://www.epa.gov/sites/default/files/2017-08/documents/phthalates_updates_live_file_508_0.pdf
[48] https://www.mdpi.com/1422-0067/24/15/12308
[49] https://pubs.acs.org/doi/10.1021/envhealth.3c00052
[50] https://particleandfibretoxicology.biomedcentral.com/articles/10.1186/s12989-020-00387-7
[51] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8800959/

6-PPD Quinone is an antioxidant compound which is added to the rubber in automobile and truck tires to prevent cracking and early aging and increase their lifespan. When exposed to ozone and oxygen it transforms into 6PPD-quinone. Although 6PPD-quinone has been found to be highly toxic to coho salmon, testing on other aquatic species to date has not shown significant toxicity.

The limitations of existing personal sampling equipment make collecting inhalation exposure information during actual play or other representative field activities extremely challenging. New methods for both sampling and analysis are continually being developed and will hopefully be able to shed additional light on this important topic in the future. There is a long history of chemicals being found to cause harm at levels well below that originally thought to be problematic, and it is not unreasonable to ask whether people should voluntarily add to their existing exposure levels when it may not be absolutely necessary.



The use of less toxic materials will always be better than more toxic ones, even without exposure data, as that reduces the possibility of exposure to a toxin. This is the basis for OSHA's hierarchy of controls, which call for (in order of effectiveness) eliminating the hazardous material entirely, substituting safer chemicals for more hazardous ones, implementing engineering controls to capture emissions or guard against mechanical hazards, administrative controls such as work practice changes, and finally using personal protective equipment as the final and least preferred alternative.

It seems advisable to move away from crumb rubber infill. As to what alternative infill material is preferable, continued research will be necessary. A portion of the Toxics Use Reduction Institute (TURI) comparison of infill materials is shown below.

Table 2: Comparing infills: Selected categories of chemicals of concern						
Category	**Tire crumb**	**EPDM**	**Shoe materials[a]**	**TPE**	**Acrylic-coated sand**	**Mineral- or plant-based**
Lead[b]	Present	Present	Present	Present	Below detection limit[c]	Absent in some cases
Zinc[b]	Present	Present	Present	Present	Present[c]	Present in some cases
Other metals[b]	Present	Present	Present	Present	One additional metal present[c]	Present
Vulcanization compounds[d]	Present	Present	Present	Generally absent	Expected to be absent	Zeolite, when present, poses serious respiratory hazard. Plant-based materials can pose concerns related to dust, fungi, or allergens. Vulcanization compounds and phthalates are expected to be absent; VOCs and PAHs are expected to be low or absent.[h]
Phthalates	Present[e]	Present (lower)[f]	May be present, but subject to RSL	Present[g]	Expected to be absent	
VOCs	Present[e]	Present (lower in some cases, higher in others)[f]	Expected to be present, but subject to RSL	Present (lower)[g]	Expected to be absent	
PAHs	Present[e]	Present (lower)[f]	May be present, but subject to RSL	Present (lower)[g]	Below detection limit[c]	
PAHs (TURI sample)[i]	Present (highest) (548 mg/kg)	Present (20 mg/kg)	Present (55 mg/kg)	Present (below 10 mg/kg)		

[52]

Aside from discontinuing use of crumb rubber infill, another recommended mitigation strategy could include pre-installation testing of field materials to ensure that the materials are PFAS-free.

Alternative Infills

The environmental impact of artificial turf infill, in particular tire crumb rubber, has been identified as an issue of concern.[53] [54] [55] There are, however, alternative infills. The benchmark study in this area states the following. [56]

> *No Infill material was clearly free of concerns, but several are likely to be somewhat safer than tire crumb. Some alternative materials contain some of the same chemicals of concern as those found in tire crumb; however, they may contain a smaller number of these chemicals, and the chemicals may be present in lower quantities.*

Recently, several neighboring towns such as Lexington and Milton, have specified plant-based infills to help mitigate chemical pollution from the artificial turf fields permitted. Although certain alternative infills such as Brockfill and Greensand may hold promise for being both more

[52] https://www.turi.org/var/plain_site/storage/original/application/b9727dedf5860ae7e83e3226d058b7ee.pdf
[53] https://www.epa.gov/chemical-research/july-2019-report-tire-crumb-rubber-characterization-0
[54] https://pubs.acs.org/doi/10.1021/acs.estlett.2c00050
[55] TURI, 2020. Athletic Playing Fields and Artificial Turf: Considerations for Municipalities and Institutions.
[56] https://journals.sagepub.com/doi/full/10.1177/1048291120906206)

environmentally friendly and generating less heat than crumb rubber infill, there is not sufficient peer-reviewed research data at this time to definitively endorse them. Nevertheless, given the early promise of these alternative, natural infills, as well as the widely accepted negative data on crumb rubber infills, it seems that future artificial turf projects should be looking exclusively at working with one of these alternatives. As time goes by and more reliable data on alternative infills is available, the case for these alternatives should be bolstered considerably.

Chemical & Particulate Runoff Impacts

One of the most significant concerns surrounding artificial turf fields is their impact on wetland resources and waterways. Artificial Turf fields can act as sources of harmful chemicals, including PFAS, metals, and polyaromatic hydrocarbons (PAHs). [57] [58] [59] [60] [61] [62] The State Wetlands Protection Act and its regulations, along with Arlington's Town Bylaw and its regulations, require the protection of a variety of wetlands. Wetlands serve many functions and values in the community. These include groundwater supply, flood control and storm damage prevention, prevention of pollution, wildlife protection, plant and wildlife habitat protection, and protection of the natural character or recreational values of the wetland resources. A table outlining the potential negative impacts of artificial turf fields on each protected wetland interest can be found in Appendix ___ to this report and a map showing the proximity of recreational facilities (existing athletic fields) to wetland resource areas is included at Appendix ____.

Artificial turf fields can contaminate the natural environment through leaching, airborne dust, volatilization, and physical migration of AT components. Contaminants of particular concern include polyaromatic hydrocarbons, phthalates, volatile organic compounds, metals such as zinc and lead, and Per- and Poly-fluoroalkyl Substances (PFAS). Elevated concentrations of PFAS have been shown to have adverse effects on aquatic organisms, and PFAS environmental impacts from artificial turf are under-studied, though part-per-trillion (ppt) levels have been shown to be harmful. [63] Elevated concentrations of the PFAS compounds PFOA and PFOS in aquatic ecosystems can result in death of aquatic organisms and affect their growth and reproduction.[64] PFAS has been shown to leach from artificial turf fields and components. [65] [66] [67] Additionally,

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[57] https://portal.ct.gov/-/media/DEEP/artificialturf/DEPArtificialTurfReportpdf.pdf
[58] https://www.epa.gov/chemical-research/july-2019-report-tire-crumb-rubber-characterization-0
[59] https://journals.sagepub.com/doi/full/10.1177/1048291120906206)
[60] https://www.turi.org/content/download/11980/188623/file/TURI+Report+2018-002+June+2019.+Athletic+Playing+Fields.pdf
[61] TURI, 2020. *Athletic Playing Fields and Artificial Turf: Considerations for Municipalities and Institutions*.
[62] https://www.sciencedirect.com/science/article/pii/S2666016422001025?via%3Dihub

[63] https://www.turi.org/content/download/12963/201149/file/TURI+fact+sheet+-+PFAS+in+artificial+turf.pdf
[64] EPA, 2022. *Fact Sheet: Aquatic Life Ambient Water Quality Criteria for Perfluorooctanoic acid (PFOA) and Perfluorooctane Sulfonic Acid (PFOS),* USEPA Office of Water, EPA 842-D-22-05, April 2022.
[65] https://subscriber.politicopro.com/eenews/f/eenews/?id=00000181-b526-d010-a3cb-b5aed1070000
[66] https://www.newmoa.org/wp-content/uploads/2023/02/PFAS-in-Artificial-Turf.pdf
[67] https://www.sciencedirect.com/science/article/pii/S2666016422001025?via%3Dihub

tire crumb rubber, which is an infill material for most artificial turf fields, contains a newly discovered compound called 6ppd-quinone, which is acutely toxic to some freshwater fish.[68] These chemicals, individually and in combination, pose a potential hazard to wildlife, water quality, and aquatic organisms, with an overall negative impact on the environment. [69] Furthermore, microplastic particles from infill and weathered grass blades can also enter waterways, causing additional harm.[70] [71] This concern is not theoretical. As observed in Arlington at the Catholic High School artificial turf field and referenced in Arlington's Conservation Commission submissions to the May 2, 2023, Artificial Turf Forum and the ATSC, the tire crumb rubber infill from the school's field has migrated toward the nearby brook and within the protected wetland resource area of Mill Brook.

Though there is recent scientific evidence of the potential to use bioretention cells to reduce 6ppd-quinone concentrations in stormwater runoff impacted from oxidized tires / tire crumb rubber[72], it is unclear if these systems could be scaled-up to provide stormwater mitigation for an 80,000 square foot athletic field. The European Union recently acknowledged the negative impact of tire crumb rubber infills as microplastic pollution and in September 2023 enacted a ban on the sale of products containing intentionally added microplastics – specifically including in this ban "granular artificial turf infill".[73]

Natural turf fields can act as a natural filter for chemical and particulate pollution. Artificial turf fields typically do not contain systems to mitigate the chemical and particulate contamination in stormwater infiltration or runoff. [74] Artificial turf fields that border wetlands, waterways, and other sensitive areas and resources are of most concern. Other areas are also impacted by artificial turf fields, as some chemicals can be volatilized and others may cling to clothing, shoes, and equipment, migrating off the fields to surrounding areas. Any stormwater drainage from an artificial turf field will eventually reach a wetland within Arlington. This extends environmental concerns beyond immediate proximity to sensitive areas. A field that drains to the public stormwater system may leak contaminants into a wetland or waterway downstream.

Stormwater Management Impacts

How stormwater is retained, infiltrated, or discharged is important to the consideration of the environmental impact of artificial turf fields. Perhaps the most critical issue in this regard is the

[68] https://pubs.acs.org/doi/10.1021/acs.estlett.2c00050

[69] https://www.turi.org/content/download/11980/188623/file/TURI+Report+2018-002+June+2019.+Athletic+Playing+Fields.pdf

[70] https://journals.sagepub.com/doi/full/10.1177/1048291120906206)

[71] https://www.turi.org/content/download/11980/188623/file/TURI+Report+2018-002+June+2019.+Athletic+Playing+Fields.pdf

[72] https://pubs.acs.org/doi/epdf/10.1021/acs.estlett.3c00203

[73] https://www.sciencedirect.com/science/article/pii/S2666016422001025?via%3Dihub

[74] https://www.sportsfieldmanagement.org/natural-grass-athletic-fields/

permeability of the playing surface, since permeable surfaces provide better stormwater management by allowing precipitation to infiltrate into the soil, rather than running off into storm drains or detention basins.

The Massachusetts Department of Environmental Protection (MassDEP) is considering officially classifying artificial turf fields as impermeable surfaces under the Wetlands Protection Act. This change, if finalized, would potentially affect the siting and maintenance of artificial turf fields. MassDEP's latest proposed revision from December 2023 would define impervious surface for the "purposes of stormwater management (310 CMR 10.05(6)(k)-(q))" as follows:

> *any surface that prevents or significantly impedes the infiltration of water into the underlying soil, including, but not limited to artificial turf, Compacted Gravel or Soil, roads, building rooftops, solar arrays, parking lots, Public Shared Use Paths, bicycle paths, and sidewalks paved with concrete, asphalt, or other similar materials.*

Permeable surfaces provide better stormwater management by allowing precipitation to infiltrate into the soil rather than running off into storm drains. This better ability to manage stormwater will become ever more important as precipitation events potentially become more severe and more unpredictable with expected climate change impacts.

The permeability of artificial turf fields is a subject of debate, with some sources stating that they can be made permeable with the proper design and maintenance, and others stating that as an artificially constructed field, they are difficult or impossible to make permeable. While artificial turf fields can certainly be designed to quickly drain stormwater off the field (in many cases, more effectively than natural grass fields), the stormwater generally drains to perimeter drains and then to a detention basin or some stormwater management system. Since artificial turf fields are typically constructed on top of another engineered surface (rather than directly on top of the underlying soil), the real question then becomes whether the stormwater drains to a permeable surface, which depends on the specific design of the field.

There are techniques and systems that can allow for the capture and storage of stormwater, which can then be allowed to infiltrate into the soil and/or be released more slowly into the stormwater system to avoid overwhelming the system and causing flooding. Currently, artificial turf fields are at best partially permeable, although this may change in the future as better systems are developed for managing the stormwater and allowing for improved stormwater infiltration to occur.

At a baseline, natural grass fields are considered permeable because they consist of natural grass over soil (unless the subgrade of the field is more heavily engineered). However, it is important to recognize that maintaining true and effective permeability requires ongoing maintenance of the fields, including proper aeration and grooming. Without that maintenance, the dirt underneath the playing surface can become highly compacted and will not function as effectively

as a permeable surface. Even under these conditions, a natural turf field may remain more permeable than an artificial turf field, but the exact comparison will depend on the design and maintenance of the field. It is difficult to make general statements about the permeability and stormwater management performance of artificial turf and natural grass fields, because the statements are highly dependent on the design, construction, and maintenance of the individual field, along with other factors such as topography and adjacent land use.

Climate Change Resilience Impacts and Ecological Effects

Issues surrounding climate change resilience and adaptation are increasingly critical as it becomes clear that our climate is changing in real time and we need to adapt our natural and built environment to address the threats associated with climate change, including extreme heat and precipitation. MassDEP defines Climate Change Resilience in guidance documents as follows.[75]

> *The capacity to prevent, withstand, respond to, adapt to, and/or recover from climate change impacts and to build the capability and ability of an area/site/system to minimize the adverse impacts of climate change.*

Artificial turf fields are inconsistent with climate change resilience in that they do not minimize these anticipated adverse effects and, in fact, can exacerbate these climate impacts.

Arlington has long been a leader in climate change resilience and mitigation, meaning that the Town adopts strong policies to minimize greenhouse gas emissions. Leaving aside the carbon footprint associated with artificial turf field construction, installation, and disposal, there are also climate impacts from the change from grass to artificial turf fields. While natural turf fields offer some mitigation of greenhouse gas emissions, especially carbon dioxide, artificial turf fields offer none. Carbon sequestration is the process of creating long term storage of carbon dioxide, either geologically or in terrestrial ecosystems such as forests, fields, and other natural carbon sinks. Natural turf fields create an opportunity for carbon sequestration in the field grass and soil, particularly if the field is well maintained and not regularly disturbed or fully replaced (since the removal and replacement of the turf will likely result in the release of some of the sequestered carbon). While the amount of carbon sequestration that is possible through a natural turf field is more limited than would be possible in an unbuilt naturally vegetated environment, there is still a meaningful amount of carbon sequestration[18]. In contrast, an artificial turf field is a fully artificial environment that does not provide any standalone opportunity for carbon sequestration.

[75] https://www.lspa.org/index.php?option=com_dailyplanetblog&view=entry&year=2022&month=10&day=06&id=376:lspa-climate-change-mcp-toolkit-available

In the context of climate change, one must also consider the sustainability of artificial turf field components. There is mixed data related to whether meaningful recycling of artificial turf fields is currently happening in the Northeastern United States. The recycling question is an important one, because artificial turf fields must be replaced every 8-10 years. The recurring need for replacement over the lifetime of an athletic field must be reconciled with principles of sustainability and the risks that disposed components will migrate off site and become contaminants. If not recycled, components will be landfilled, incinerated, or subject to chemical decomposition; all of these options have negative climate change impacts and do not represent recycling into new plastic products. The Synthetic Turf Council states that "the carbon footprint of a particular recycle/end-of-life option (such as trucking long distances) may be integrated into the decision-making process and lead responsible parties to invalidate such an option". [76]

Installation of artificial turf can also have ecological effects. Habitat loss in urban settings is a significant threat to biodiversity and ecosystem health, including the systems that humans rely on for our quality of living. Artificial turf replaces habitats, leading to a loss of plant and animal species diversity in the area. The removal or diminishment of a hub in the natural network has consequences for the whole system.

A Cost Comparison of Artificial Turf Fields to Natural Grass Fields

In addition to health, safety, and environmental concerns, another area that is relevant to this topic is the life cycle cost comparison between artificial and natural grass turf fields, which includes installation, maintenance, replacement, and disposal costs.

While there are many variables to such a cost comparison, a true estimate is not possible without assessing and considering the site-specific field conditions. Additional factors related to cost include the potential funding sources for construction/rebuilding recreational fields, the overall municipal budget for field maintenance, and the availability of Town staff to regularly perform field maintenance, as opposed to outsourcing all or parts of field maintenance to contracted landscaping companies.

As stated by Ian Lacy of Tom Irwin Advisors, a noted expert on both synthetic and natural turf fields, "you can't compare a natural turf field to an artificial turf field because they are completely different systems." [77] Artificial turf fields are designed and highly engineered systems, whereas the majority of natural grass fields are indigenous fields that have been adapted over time into playing fields. While there are many benefits and limitations to both types of fields, there is no way to get the same level of usage from a natural grass field as from an artificial turf field, especially with New England's weather. Additionally, it is very challenging to assess a dollar amount to the number of hours/days in which a playing field, either synthetic turf or natural grass, can be utilized. As such, it would seem that a variety of factors, in addition

[76] Synthetic Turf Council. 2017. "Guide to Recycle, Reuse, Repurpose, and Remove Synthetic Turf Systems."
[77] Presentation on 2/20/24 by Ian Lacy, Lead Project Advisor, Tom Irwin Advisors

to cost, would need to be considered when choosing the surface and maintenance program of an athletic playing field. Some of these factors include, but should not be limited to, the location, usage, and existing conditions of the field. Prior to major renovations or construction of its fields, the Town of Arlington should consider the best and most cost effective playing surface given site specific conditions through a comprehensive assessment by a professional/consultant with experience in construction and maintenance of athletic fields.

Nonetheless, the Committee reviewed a variety of resources to try and better understand these costs. However, because no two resources were completely consistent in detailing what specifically is included in the cost, as such, it is hard to know how accurate these comparisons are at this time. Those resources include but are not limited to the following: presented material from Ian Lacy of Tom Irwin Advisors; the Toxics Use Reduction Institute (TURI) document "Building an Organic Maintenance Program for Athletic Fields: Guidance from Experts and Experienced Communities"; the Turfgrass Resource Center document "Natural Grass and Artificial Turf: Separating Myths and Facts"; as well as the maintenance costs reported by the Town of Arlington and Arlington Public Schools.

Installation Costs (per field)		
Organization	**Artificial Turf**	**Natural Grass Field**
Tom Irwin Advisors [78]	$1,000,000	$400,000
Turf grass Resource Center[79]	$850,000-$1,000,000	$50,000-$600,000

- *Tom Irwin Advisors- costs are based on a soccer field used for high school/college play. According to https://jobsinfootball.com/blog/soccer-field-dimensions/, a high school/college soccer field is 81,000 square feet or 1.86 acres. Detailed information about what is included in the installation was not available.*
- *The Turfgrass Resource Center- costs are based on 85,000 square feet or 1.95 acres and compare costs of several types of natural grass fields to those of artificial turf fields. The artificial turf field costs vary from basic to premium construction and account for a ground rubber infill. The cost of natural grass fields varies depending on the soil base conditions and the preparation needs.*[80]

Annual Field Maintenance Costs (per field)		
Organization	**Artificial Turf Field**	**Natural Grass Field**
Tom Irwin Advisors [81]	$15,000	$30,000
Turfgrass Resource Center[82]	$13,000-$39,000	$8,000-$49,000
Town of Arlington	$13,000	$11,000-$40,000

[78] Presentation on 2/20/24 by Ian Lacy, Lead Project Advisor, Tom Irwin Advisors
[79] https://www.saratogasod.com/wp-content/uploads/2018/02/NaturalGrassArtificialTurf.pdf
[80] https://www.saratogasod.com/wp-content/uploads/2018/02/NaturalGrassArtificialTurf.pdf
[81] Presentation on 2/20/24 by Ian Lacy, Lead Project Advisor, Tom Irwin Advisors
[82] https://www.saratogasod.com/wp-content/uploads/2018/02/NaturalGrassArtificialTurf.pdf

- *Tom Irwin Advisors: detailed information about what is included in the maintenance costs was not available.*
- *Turfgrass Resource Center*[83]
    - *Artificial turf includes the following: painting/removal, top dressing/infill, brushing/sweeping, disinfecting/fabric softener, carper repairs (rips; joints), water cooling, and weeding.*
    - *Natural grass field includes the following: painting, top dressing (sand), dragging, fertilizers, pesticides, aeration, sod replacement, and irrigation.*
- *Town of Arlington*
    - *Natural grass field maintenance contract includes the following: Aeration 3x/year; slice/seeding 2x/year; over-seeding on wear areas 2x/year; fertilizing 4x/year; and soil testing 2x/year. This does not include mowing/trimming, painting, or irrigation costs.*
    - *Existing artificial turf field in Arlington is the responsibility of Arlington Public Schools. According to Arlington's Athletic Director, the current maintenance contract includes the following: 6 visits (2 decompaction visits and 4 grooming visits), minor seam repairs, GMAX testing, and line painting for lacrosse and field hockey.*

End of Life Costs (per field)		
Organization	**Artificial Turf Field**	**Natural Grass Field**
Tom Irwin Advisors [84]	$665,000 (carpet replacement and disposal costs @ 10yrs)	$150,000 (Resodding @ 10 years)
Turfgrass Resource Center [85]	$149,000-$191,000*	-

- *Tom Irwin Advisors: includes removal and replacement of carpet at 10 years. Information about transportation charges was not available.*
- *Turfgrass Resource Center: includes disposal of carpet.*[86]
    - *Does not include carpet replacement, transportation, or landfill surcharges that disposal may incur.*

Importance of Field Maintenance

One major factor which contributes to the life expectancy and usability of both artificial and natural grass fields is the maintenance of these surfaces. Ian Lacy of Tom Irwin Advisors has referenced a study he conducted at the FIFA headquarters in Zurich, Switzerland, in which he and his colleagues analyzed the maintenance needs of artificial turf used by a soccer association

[83] https://www.saratogasod.com/wp-content/uploads/2018/02/NaturalGrassArtificialTurf.pdf
[84] Presentation on 2/20/24 by Ian Lacy, Lead Project Advisor, Tom Irwin Advisors
[85] https://www.saratogasod.com/wp-content/uploads/2018/02/NaturalGrassArtificialTurf.pdf
[86] https://www.saratogasod.com/wp-content/uploads/2018/02/NaturalGrassArtificialTurf.pdf

for 10 hours/day over a one-year period. As a result, he and his colleagues created maintenance frequency charts for both synthetic and natural turf surfaces, which can be found in Appendix _. While these charts are based on usage of 10 hours/day for 7 days/week, they are not suggesting Arlington's fields need a similar level of maintenance. However, to extend the life expectancy and usability of its fields, a maintenance schedule for Arlington's specific needs (based on field usage related to type of activity played and number of hours per day the field is used) should be considered, budgeted for, and adhered to. Lacy stressed that with municipal budget limitations, ongoing maintenance frequencies and costs are just as important to consider as the cost of the initial project. Ensuring that either type of field is properly maintained (and, in the case of natural grass fields, properly rested) will lead to more usage and safer field conditions for everyone in the long run.

Organic and Non-Organic Maintenance of Natural Grass Fields

The Toxics Use Reduction Institute (TURI) document "Building an Organic Maintenance Program for Athletic Fields: Guidance from Experts and Experienced Communities" offers insights into the costs of organic field maintenance. According to TURI, components of an organic maintenance program include frequent aeration, frequent mowing, soil testing, and the use of organic fertilizers and soil amendments. [87] If Arlington were to consider an organic maintenance program, each grass field should be individually assessed and include a soil analysis to evaluate the physical, chemical, and biological characteristics of that field. Understanding soil imbalances is imperative so that proper fertilizers and soil amendments are applied to create an ideal environment for grass to grow. [88] [89] Additionally, the Town would need to consider whether or not to invest in the rehabilitation or rebuilding of the specific field. Rehabilitation focuses on correcting problems, such as water pooling, weeds, hard surface, or uneven grass cover, by improving the quality of the existing soil and grass.[90] Rebuilding, which can be considerably more expensive, offers the advantage of designing a well-functioning field from the soil up. [91] This may include using new soil with the correct amount of organic matter, engineered drainage, and an irrigation system. In order to organically maintain the field(s), maintenance and costs would include periodic soil testing to monitor nutrient levels, application of organic fertilizers and soil amendments, selecting site specific grass seed, increased aeration of fields

[87] https://www.turi.org/content/download/13543/206640/file/Factsheet.BuildinganOrganicMaintenanceProgramforAthleticFields.April2021.pdf
[88] https://www.turi.org/content/download/13543/206640/file/Factsheet.BuildinganOrganicMaintenanceProgramforAthleticFields.April2021.pdf
[89] https://www.saratogasod.com/wp-content/uploads/2018/02/NaturalGrassArtificialTurf.pdf
[90] https://www.turi.org/content/download/13543/206640/file/Factsheet.BuildinganOrganicMaintenanceProgramforAthleticFields.April2021.pdf
[91] https://www.turi.org/content/download/13543/206640/file/Factsheet.BuildinganOrganicMaintenanceProgramforAthleticFields.April2021.pdf

(potentially several times per year), a sufficient mowing program/schedule, and proper irrigation systems to supply adequate moisture to soil and grass. [92]

Annual Cost of Natural Grass Maintenance		
Organization	**Organic**	**Non-Organic**
Town of Arlington	$5,715 per acre	$1,539 per acre
TURI - Marblehead Study[93]	$4,250-$4,500 per acre	

- *Town of Arlington FY23-25 Maintenance contract includes the following: Aeration 3x/year; slice/seeding 2x/year; over-seeding on wear areas 2x/year; fertilizing 4x/year; and soil testing 2x/year.*
    - *It is important to note that grass fields in Arlington are not currently organically maintained and therefore the figure above is based on an estimate.*
- *TURI costs include products (fertilizer, soil amendments), maintenance labor (e.g., aeration, other activities), and mowing labor.* [94]

Findings and Recommendations

After extensive research and discussion, the members of the Artificial Turf Study Committee reached a consensus with respect to the use of artificial turf in Arlington. Although no one on the Committee supported a moratorium or ban on the construction of artificial turf fields in Arlington, Committee members expressed concern with some of the environmental and health shortcomings of the product. In particular, the materials used in the production of artificial turf raise concerns about the impact on its users and the natural environment, including possible chemical pollution in aquatic ecosystems, particulate and plastic pollution, and increased heat. Committee members noted other environmental shortcomings of artificial turf, including its lack of carbon sequestration, the use of fossil fuels in its production, subsequent environmental impacts due to its required replacement every 8-10 years, and inconsistent recycling at end-of-life.

On the other side of the ledger, Committee members recognized the undeniable upside of artificial turf, none more important than its accessibility and durability even in harsh New England weather. Although there is great appeal to the concept of natural grass playing fields, the simple reality is that those fields do not allow for the same degree of use as artificial turf fields. This Committee recognizes that young people greatly benefit from usable playing fields. A natural grass field does not serve its purpose if it sits unusable in early spring and late fall due to weather damage or overuse. Particularly in the shoulder seasons of March-April and October-November, artificial turf fields offer far more extensive opportunities for use than their natural turf counterparts. Moreover, Committee members acknowledged that many of the health and

[92]https://www.turi.org/content/download/13543/206640/file/Factsheet.BuildinganOrganicMaintenanceProgramforAthleticFields.April2021.pdf
[93]https://www.turi.org/content/download/12705/198916/file/Natural+Grass+Playing+Field+Case+Study+Marblehead+MA+revised.Nov2020.pdf
[94]https://www.turi.org/content/download/12705/198916/file/Natural+Grass+Playing+Field+Case+Study+Marblehead+MA+revised.Nov2020.pdf

environmental shortcomings of artificial turf can be mitigated by using non-plastic and non-crumb rubber infills – with natural, alternative infills offering great potential.

On the whole, the Committee saw the benefits and drawbacks of artificial turf fields and carefully evaluated them. While Committee members opposed a ban on future artificial turf construction in Arlington, they could not fully embrace the option either. The Committee believes that artificial turf should be an option for future field planners in Arlington, but it is an option that should not be considered until natural turf options have proven unworkable, impractical, or financially infeasible.

To the extent that future field planners choose to seriously consider artificial turf as an option (after exhausting natural grass options), the Committee feels strongly that the following points should be considered by those planners for all future projects not yet in the planning stages[95]:

- Crumb rubber or plastic infills should not be used in artificial turf fields in Arlington.
- Any artificial turf installed at an Arlington field should be certified by an independent lab (not just the manufacturer) as being free of PFAS and other toxic chemicals before shipment.
- Any artificial turf field (and, for that matter, any natural grass field in Arlington) should be held to strict heat standards on the hottest days of the years, meaning those fields should be closely monitored by a designated Town of Arlington official to ensure that the fields are closed when surface temperatures exceed a certain recognized threshold.
- Any decision about where to place an artificial turf field should consider if placement of the field is in or near a designated heat island in Arlington (i.e., the hottest 5% of areas in Arlington, as determined by the Metropolitan Area Planning Council's published analysis).
- There should be no purchase of an artificial turf field until the Town of Arlington contractually mandates that the manufacturer will take full responsibility for ensuring that the materials will be recycled in the most environmentally sensitive manner possible at the end of the product's life.

The Committee wishes to emphasize that every future field development project in Arlington should be evaluated on a case-by-case basis, keeping the recommendations of this report in mind when doing so. Nevertheless, the Committee believes that the default option for future field development should be a natural turf field.

Regardless of whether Arlington builds any artificial turf fields in the future, the Committee feels strongly that all of Arlington's fields (artificial and natural turf alike) require high-quality maintenance programs. No future field should be developed in Arlington without the costs of

[95] The Committee emphasizes that its findings and recommendations concern *future* projects not yet in the planning stages. Any field in Arlington that is already artificial turf (like the Arlington Catholic field) or is far along in the planning and development stage (such as the Arlington High School field) was not a focus of this Committee's work or discussion. However, this Committee's findings and recommendations should inform future development at those fields when the time comes for the artificial turf fields at those locations to be replaced.

those high-quality maintenance programs being fully factored into the financial analysis for those projects. Even if Arlington never constructs another artificial turf field, it is absolutely essential that the Town maintain its existing natural turf fields to a higher standard than it has been doing in the past, which includes proper resting of the fields.

The Committee wants what is best for Arlington's field users, especially its youngest: healthy, well maintained playing fields that allow maximal use, enjoyment, and safety. Artificial turf fields are neither a modern miracle nor a terrible scourge. Like any manufactured product of the modern age, they have their strengths and weaknesses. The Committee is now quite familiar with both. In the final analysis, the Committee believes that artificial turf fields can be an option for Arlington's future field projects, but it is an option that should be considered only (a) when natural turf options prove unworkable, impracticable, or infeasible and (b) with proper health and environmental safeguards in place.