T&E COMMITTEE #1
July 1, 2010

MEMORANDUM

June 29, 2010

TO: Transportation, Infrastructure, Energy and Environment Committee

FROM: Keith Levchenko, Senior Legislative Analyst
Essie McGuire, Legislative Analyst

SUBJECT: **Discussion: Environmental Impacts of Artificial Turf**

Department and Agency Staff expected to attend this worksession include:

Community Use of Public Facilities
- Ginny Gong, Executive Director

Department of Environmental Protection
- Steve Shofar, Chief of Watershed Management
- Meosotis Curtis
- Mark Sommerfield

Department of Permitting Services
- Rick Brush, Manager, Water Resources Section

Maryland National Park and Planning Commission
- Mike Riley, Deputy Director
- Shuchi Vera, CIP Manager
- Steven Reid, Environmental Engineer

Montgomery County Public Schools
- James Song, Director, Department of Facilities Management
- Joe Lavorgna, Consultant to MCPS
- Duke Beatty, Director of Systemwide Athletics

Background

On June 16, 2009, the Council approved a special appropriation request to provide for the construction of an artificial turf stadium field at Walter Johnson High School as part of its modernization project. At the time, the Council requested further review of the environmental issues associated with artificial turf in comparison to natural turf fields, and that this review include an inventory of all artificial turf fields in the County.

The Council has also received correspondence expressing concerns with the use of artificial turf. These concerns focus on environmental issues (such as water quality impacts), health issues (such as the potential high ballfield temperatures, sports injuries and potential exposure to chemicals in the turf and/or crumb rubber infill) and the short and long term costs of artificial turf compared to natural grass ballfields. On June 17, the Mid-County Citizens Advisory Board wrote to both the Council and the Montgomery County Department of Parks (within the Maryland-National Park and Planning

Commission, M-NCPPC) urging a moratorium on further artificial turf field construction on all County owned properties (letter attached on ©1-2).

The Council has previously discussed the health-related concerns and heard differing opinions regarding the results of various studies throughout the country. With regard to Federal agencies, Council Staff has attached a Centers for Disease Control Health Advisory from June 2008 (©3-5) as well as more recent press releases from the US Consumer Product Safety Commission (July 2008) (©6) and Environmental Protection Agency (December 2009) (©7-8) describing the results of their own studies. Although these later two studies did not find harmful levels of lead or other materials in the artificial turf fields studied, both suggest further study. A review of studies by the New York Department of Health in 2008 is also attached (©9-09-17). It concludes that "chemical exposures from crumb rubber in synthetic stuff do not pose a public health hazard." It also notes that studies have found "no consistent differences in injury rates between natural and crumb-rubber infilled synthetic turf." It notes that people using these fields should take precautions in high temperature situations, since the surface temperatures on artificial turf fields can reach levels that could cause heat stress.

Staffs from MCPS and M-NCPPC have been invited to describe their specific experiences with their artificial turf projects to date and their perspectives on the issue of artificial turf. Department of Permitting Services and Department of Environmental Protection have also been invited to provide their perspectives as well, especially with regard to the environmental impacts of artificial turf in comparison to natural grass fields.

Discussion

Current Status of Artificial Turf Fields in Montgomery County

According to information from the Department of Permitting Services, there are currently 12 facilities with artificial turf in Montgomery County and 4 others under construction. One additional entity (The German School) has submitted a storm water management concept plan for review by DPS. Table 1 presents all of these locations.

Table 1:
Artificial Turf Fields In Montgomery County

Location	Status
Bullis School	Constructed
Church of the Little Flower	Constructed
Georgetown Prep	Constructed
Good Counsel High School	Constructed
Holton Arms School	Constructed
Landon School	Constructed
Montgomery Blair High School	Constructed
Our Lady of Lourdes	Constructed
Richard Montgomery High School	Constructed
SoccerPlex	Constructed
St Andrew Episcopal School	Constructed
Walter Johnson High School	Constructed
The German School	SWM Concept Plan Under Review
Connelly School of the Holy Child	Under Construction
Fairland Regional Park	Under Construction
Holy Redeemer Church	Under Construction
Mater Dei School	Under Construction

Of particular interest are the public facilities (MCPS and M-NCPPC) and the experiences of those agencies with regard to artificial turf. Council Staff has also received information from staff at the Maryland Soccerplex (a facility that previously received financial support from the County). Comments from Soccerplex staff are attached on ©18-20.

Programming Advantages

In both MCPS and M-NCPPC's cases the reason for pursuing artificial turf was to make more programmable ballfield hours available for agency programming as well as for community use programmed by Community Use of Public Facilities (CUPF). Some comments from CUPF staff are attached on ©21.

Artificial turf fields have a number of programming advantages including:

- The fields can be used virtually at all hours[1] without damage. MCPS currently greatly restricts the use of its natural grass stadium fields in order to protect the fields for games. The expanded hours of availability for an artificial turf field creates a positive domino effect for community programming, since the high schools no longer have to utilize off-site ball fields for practice time.

- Unlike natural turf fields, artificial turf fields can be used during and immediately after major rain events without risk of damage.

- The fields provide a more consistent level of play with lower annual maintenance costs than natural turf fields.

MCPS

On March 18, 2008 the Council approved a special appropriation request to accept $300,000 in contributions from a private soccer organization to defray the costs of the installation of MCPS' first artificial turf stadium field as part of the modernization project at Richard Montgomery High School. The field was completed that summer and use of the field (by the school, the private organization, and Community Use of Public Facilities) began in the fall of 2008.

In addition to Richard Montgomery High School, MCPS recently completed its construction of an artificial turf field at Walter Johnson High School this past May. A third is to be constructed at Paint Branch High School (estimated site completion date of August 2013). The next high school modernization Gaithersburg High School, is currently under design with construction to be bid in the spring of 2011 (site completion in August 2014). Wheaton (site completion in August 2016), Seneca Valley (site completion in August 2017), and Wootton (site completion in August 2019) High Schools are the next schools on the modernization schedule.

MCPS' current approach is to consider installing artificial turf fields at its high schools when they are modernized. For instance, the Paint Branch High School bid package (from this past spring)

[1] Note: Because artificial turf cannot be substantially hotter than natural grass at the playing surface level, policies regarding the cooling of the fields with water and/or the closure of fields during peak heat conditions are recommended in various studies.

included as a "bid alternate" the cost for an artificial turf field. MCPS secured separate private sector partners for both of the Richard Montgomery and Walter Johnson stadium fields. These partners contributed towards the up front cost of the field in exchange for dedicated hours of use. MCPS intends to continue to pursue outside partners for future fields. However, in cases where no partners are available, MCPS intends to seek sufficient funding in its capital program to cover the costs. MCPS does not have any plans to install artificial turf fields at any of its facilities other than its high school stadiums.

Comments from a primary user of the Richard Montgomery artificial turf field (©22) and a survey of High School Athletic Directors (©23) was overwhelmingly positive with regard to artificial turf fields.

Prior to pursuing an artificial turf field at Richard Montgomery High School, MCPS developed a multi-year cost and revenue comparison between natural turf and artificial turf fields (within the context of a school modernization). MCPS is updating this information based on its cost experience to date with Richard Montgomery, Walter Johnson and Paint Branch High Schools and will be available to discuss these updated numbers at the T&E meeting.

M-NCPPC

The Maryland-National Capital Park and Planning Commission (M-NCPPC) has an artificial turf field at Blair High School (open in August 2009) and one under construction at Fairland Regional Park (expected completion of October 2010).

In preparation for the T&E discussion, M-NCPPC staff provided a summary document (see ©24-27) which highlights their experience to date as well as their review of issues that have been raised with regard to artificial turf.

M-NCPPC also provided a cost-benefit analysis that Council Staff has summarized in Table 2 below (details provided on ©28).

Table 2:
M-NCPPC Cost-Benefit Analysis Summary

	Artificial Turf (new)	Natural Grass (rehab)
Capital Cost	865,000	180,000
10 Year Maintenance Costs	130,000	375,000
Total 10 Year Costs	995,000	555,000
10 Year Revenue	712,200	100,200
10 Year Net Cost	282,800	454,800

The analysis shows that installing a new artificial turf field versus rehabilitating a natural grass field is substantially more expensive upfront. However, the lower maintenance costs and the increased revenue from an estimated doubling of field use makes artificial turf a lower-cost option over a 10 year period. However, because of the upfront cost hurdle and severe fiscal issues right now, M-NCPPC does not have plans to build any additional artificial turf fields at this time.

Department of Permitting Services Review

DPS provided the following information regarding how it addresses artificial turf fields:

"Artificial turf is considered an impervious surface for stormwater management purposes. Although artificial turf fields are designed to be porous and installed over a layer of fine gravel, most of the runoff is quickly collected and discharged using a system of drainage pipes. The hydrologic characteristics are similar to those of a parking lot."

"Typically, stormwater management is provided in one of two ways. The first is to provide infiltration under the entire field by adding extra gravel to the foundation layer. This construction is similar to the use of pervious pavement. DPS requires an additional depth of gravel under County artificial turf fields to meet statewide infiltration design standards. A second option uses the underdrains to direct flows to adjacent stormwater management structures."

Department of Environmental Protection Perspective

DEP reviewed a number of studies regarding the potential impacts of pollutants that may be found in the artificial turf or the crumb rubber used in many fields (see DEP summary document on ©29-34). In general, most of the studies reviewed by DEP did not find conclusive evidence of water quality or air quality impacts of concern. However, many studies are limited in scope or inconclusive. Many studies also are careful not to extrapolate beyond the conditions experienced on the site(s) (i.e. the specific types and ages of fields) monitored.

DEP notes that quantifying the environmental pros and cons of artificial turf versus natural grass is difficult. Its summary on ©29-30 notes some of the major issues (stormwater management, pesticides and fertilizers, mowing, irrigation, and other issues).

Council Staff Comments

Studies regarding the potential health issues associated with artificial turf fields are inconclusive at best. One recurring concern, that artificial turf fields can get much hotter at the surface level, than natural grass fields, can be addressed by having policies regarding watering fields and/or prohibiting play at peak temperature levels. For instance, as mentioned in the materials from Soccerplex staff, players on artificial turf fields at the Soccerplex are moved to grass fields when possible if the temperature reaches 90 degrees or a code red day is declared. Mandatory water breaks are also required.

The environmental pros and cons are not easy to quantify. The enhanced stormwater management requirements for artificial turf fields are intended to address the potential for less natural filtration on the site that otherwise may occur with a natural grass field. However, it is important to note that the environmental comparison is not between an artificial turf field and a pristine undisturbed natural area, but rather with graded, compressed, and manicured ballfields which have their own environmental issues.

Council Staff believes the programming benefits of artificial turf fields are substantial and easily quantified in terms of the higher number of hours of use of artificial turf ballfields compared to grass fields. This is a major consideration given the growth in the demand for the use of ballfields in

Montgomery County by MCPS and by the County at large. Playability is also an important consideration. MCPS and M-NCPPC staff noted that artificial turf provides a more consistent level of play compared to the conditions experienced now at their natural grass fields.

MCPS' approach of considering artificial turf at high schools undergoing modernization, while also seeking out private sector partners to contribute a portion of the up-front cost, improves the cost-benefit calculation. Also, the relatively slow pace of the new field installations at the high schools over the next decade means that MCPS will have time to re-assess its assumptions, (especially with regard to cost and maintenance history) to see if future artificial turf fields make sense. Agency Staff can also monitor the science as it develops over time with regard to health, safety, and environmental issues.

Attachments
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MID-COUNTY CITIZENS ADVISORY BOARD

June 17, 2010

The Honorable Isiah Leggett
Montgomery County Executive
101 Monroe Street
Rockville, Maryland 20850

Ms. Mary Bradford, Director
Montgomery County Department of Parks
9500 Brunett Avenue
Silver Spring, Maryland 20901

Dear Mr. Leggett and Ms. Bradford:

I am writing on behalf of the Mid-County Citizens Advisory Board (MCCAB) to express our concerns about the proposed use of artificial turf fields by Montgomery County Public Schools and the Montgomery County Department of Parks. At its April 20, 2010 meeting, we heard from members of the community about their concerns about the proposed installation of artificial turf football fields at Wheaton High School, other public schools, and parks. Among the concerns expressed were negative impacts on the environment, student health, and County finances.

I asked the MCCAB's Quality of Life Committee to examine these issues. Based on these deliberations, and a final discussion at our June 15th meeting, the MCCAB recommends the following actions be taken:

The Montgomery County Government (MCG) should place a moratorium on further construction of artificial turf fields in parks, schools and recreational areas until the environmental, health and financial impacts of these fields are better understood.

Although research on the environmental impacts of artificial turf fields is limited, there appears to be reason for concern. Artificial turf fields being installed in Montgomery County include the use of old tires. A single field installation includes the depositing of 120 tons of pulverized automobile tires and hundreds of tons of rock on County land. As a result phthalates and other harmful materials may be contaminating the ground and water. Additional concerns have been raised in the sports medicine community with high air temperatures on artificial turf fields. Again, research appears to be inconclusive, but the lack of conclusive research bolsters the need for caution before exposing young athletes and others to potential risk.

As you are well aware the County is facing unprecedented fiscal challenges. Although apparent savings on field maintenance may make artificial turf fields an attractive option, we urge the County to exercise caution. A review of literature indicates that the environmental and public health impacts of artificial turf fields are poorly understood, with many questions left unanswered. With such questions unanswered, it would seem difficult to determine exactly what future financial commitments the County is making with further artificial turf field construction.

Mid-County Regional Services Center
2424 Reedie Drive • Wheaton, Maryland 20902 • 240-777-8100 • 240-777-8112 TTY • 240-777-8111 FAX
www.montgomerycountymd.gov/midcounty

A moratorium on construction would allow the County more time to deliberate and allow time for the science to "catch up". Therefore the MCCAB urges a moratorium on further artificial turf field construction on all MCG owned properties.

As always, thank you for your consideration and continued leadership.

Sincerely,

Sheldon Fishman
Chair

cc: Montgomery County Council
Gabriel Albornoz, Department of Recreation

This is an official
CDC HEALTH ADVISORY

Distributed via Health Alert Network
Wednesday, June 18, 2008, 16:10 EDT (4:10 PM EDT)
CDCHAN-00275-2008-06-18-ADV-N

Potential Exposure to Lead in Artificial Turf: Public Health Issues, Actions, and Recommendations

Public Health Issues

In the course of conducting a routine health investigation at a metal facility in Newark, NJ, the New Jersey Department of Health and Senior Services (NJDHSS) and the Agency for Toxic Substances and Disease Registry (ATSDR) tested a nearby community athletic field for lead contamination. Samples taken from the field showed high levels of lead in the field dust, but the lead did not come from the scrap metal facility.

The Centers for Disease Control and Prevention (CDC) is partnering with its sister-agency, ATSDR, to monitor this situation because of CDC's expertise in lead poisoning prevention.

After determining that the lead source was the artificial turf, NJDHSS began to test other artificial turf fields looking for similar high lead levels in artificial turf fibers. These findings raised concerns about potentially high lead levels in artificial turf used in other locations including fields and playgrounds. NJDHSS tested a limited sample of athletic fields in New Jersey. Any questions regarding the specific fields tested should be directed to NJDHSS.

As determined by NJDHSS, limited sampling of additional athletic fields in New Jersey and commercial products indicates that artificial turf made of nylon or nylon/polyethylene blend fibers contains levels of lead that pose a potential public health concern. Tests of artificial turf fields made with only polyethylene fibers showed that these fields contained very low levels of lead.

Information provided by NJDHSS to CDC and ATSDR indicates that some of the fields with elevated lead in either dust and/or turf fiber samples were weathered and visibly dusty. Fields that are old, that are used frequently, and that are exposed to the weather break down into dust as the turf fibers are worn or demonstrate progressive signs of weathering, including fibers that are abraded, faded or broken. These factors should be considered when evaluating the potential for harmful lead exposures from a given field.

The risk for harmful lead exposure is low from new fields with elevated lead levels in their turf fibers because the turf fibers are still intact and the lead is unlikely to be available for harmful exposures to occur. As the turf ages and weathers, lead is released in dust that could then be ingested or inhaled, and the risk for harmful exposure increases. If exposures do occur, CDC currently does not know how much lead the body will absorb; however, if enough lead is absorbed, it can cause neurological development symptoms (e.g. deficits in IQ). Additional tests are being performed by NJDHSS to help us better understand the absorption of lead from these products.

In general, children less than 6 years old are more likely to be affected by lead than adults because of increased contact with lead sources in the environment, including lead contaminated house dust and soil. Children also absorb lead more easily. Children's developing nervous systems are also more susceptible to the adverse health effects of lead including developmental delay and behavioral problems.

It should be emphasized that although turf testing has been limited to the state of New Jersey, no cases of elevated blood lead levels in children have been linked to artificial turf on athletic fields in New Jersey and elsewhere. Concerned parents should talk to their child's pediatrician about potential and known sources of lead in their children's environment and whether their children should have a blood lead test. This is a simple blood test that is paid for by most private insurers and by Medicaid.

NJDHSS has asked the United States Consumer Product Safety Commission (CPSC) to investigate this potential problem and CDC and ATSDR are currently waiting for information from CPSC to help guide future public health recommendations and actions.

Interim Public Health Actions Related to Testing Artificial Turf Products and Reducing Potential Exposures to Lead

NJDHHS's testing of artificial turf fields was limited and only sampled turf containing nylon. Since NJDHHS, CDC and ATSDR did not test fields composed of substances other than nylon and nylon/polyethelene blend, we do not know if lead is also a component in other types of artificial turf. Additionally, not necessarily all turf made of nylon contains elevated amounts of lead.

CDC has long recommended ***the elimination of all nonessential uses of lead.*** Because it is unclear whether all artificial turf contains lead at this time, CDC and ATSDR only recommend testing artificial turf fields that appear worn or weathered.

As a precaution, until further guidance is available from CPSC and until we have more information about the absorption of lead from artificial turf products and its capability of harm, CDC and ATSDR recommend:

- Testing turf that has fibers that are abraded, faded or broken, contains visible dust, and that is made from nylon or nylon-blend fibers. Information about testing is provided later in this alert.
  - If the dust contains more than 400 ppm lead, do not allow turf access for children under the age of 6 years.
  - If access is restricted, care should be taken to ensure that alternative sites contain lead levels less than 400 ppm.
- Not testing turf made from polyethylene-only fibers. This recommendation is based on currently available data.
- Not testing turf made from nylon or nylon blends that is not worn and does not contain visible dust. These fields should be routinely monitored for wear and dust generation.
- Replacing fields as soon as practicable if worn and dusty, as a precautionary measure.

CDC recommends testing children's blood lead levels in accordance with state guidelines. Concerned parents/caregivers should consult their medical providers for further information.

General Recommendations on the Use of Fields with Artificial Turf

At this time, CDC does not yet understand the potential risks associated with exposure to dust from worn artificial turf. The following precautions can be taken to minimize any potential risk.

- Field managers should consider implementing dust-suppression measures. Suggestions for dust-suppression methods can be found at NJDHSS's website, which is provided in the additional information section.
- Children ages 6 and younger are most susceptible to lead's harmful health effects. To protect the public, in particular young children, consider posting signs indicating that:
  1. After playing on the field, individuals are encouraged to perform aggressive hand and body washing for at least 20 seconds using soap and warm water.

2. Clothes worn on the field should be taken off and turned inside out as soon as possible after using the field to avoid tracking contaminated dust to other places. In vehicles, people can sit on a large towel or blanket if it is not feasible to remove their clothes. These clothes, towels, and blankets should be washed separately and shoes worn on the field should be kept outside of the home.
3. Eating while on the field or turf product is discouraged.
4. Avoid contaminating drinking containers with dust and fibers from the field. When not drinking, close them and keep them in a bag, cooler, or other covered container on the side of the field.

General Lead Poisoning Prevention Recommendations

Especially in houses where children are present, parents, day care providers and other child care providers should **follow lead safety practices** regardless of the type of playing surface. These practices can help prevent children from being exposed to the many sources of lead in the environment.

1. Wash children's hands frequently and always before they eat.
2. Do not eat food or use pacifiers that have been dropped on the floor or outside.
3. Remove shoes when entering the house or use door mats.
4. Have your house inspected for lead if it was built before 1978.
5. Use lead-safe work practices when doing work that disturbs lead-painted surfaces.

Lead Testing of Artificial Turf Fields

Facility managers who choose to have the turf at a field tested for lead should contact their local or state department of health and/or environment about appropriate sample collection and analytic methods. CDC and ATSDR recommend using appropriate U.S. Environmental Protection Agency, National Institute for Occupational Safety and Health, or American Society for Testing and Materials methods.

Additional Information

For additional information about testing, dust suppression measures, and other topics related to NJDHSS's work to address lead in artificial turf visit NJDHSS's artificial turf website at http://www.state.nj.us/health/artificialturf/index.shtml.

For a list of state health departments, visit the Association of State and Territorial Health Officers (ASTHO) site at http://www.astho.org/index.php?template=regional_links.php.
ASTHO also provides a list of state environmental health directors at:
http://www.astho.org/index.php?template=enhancing_environmental_health_s.html.

The U.S. Consumer Product Safety Commission regulates consumer products, including artificial turf. Additional information about CPSC and artificial turf can be found at http://www.cpsc.gov.

U.S. Consumer Product Safety Commission

Office of Information and Public Affairs — Washington, DC 20207

FOR IMMEDIATE RELEASE
July 30, 2008
Release #08-348

CPSC Hotline: (800) 638-2772
CPSC Media Contacts: (301) 504-7908

CPSC Staff Finds Synthetic Turf Fields OK to Install, OK to Play On

WASHINGTON, D.C. - The U.S. Consumer Product Safety Commission (CPSC) staff today released its evaluation (pdf) of various synthetic athletic fields. The evaluation concludes that young children are not at risk from exposure to lead in these fields.

CPSC staff evaluation showed that newer fields had no lead or generally had the lowest lead levels. Although small amounts of lead were detected on the surface of some older fields, none of these tested fields released amounts of lead that would be harmful to children.

Lead is present in the pigments of some synthetic turf products to give the turf its various colors. Staff recognizes that some conditions such as age, weathering, exposure to sunlight, and wear and tear might change the amount of lead that could be released from the turf. As turf is used during athletics or play and exposed over time to sunlight, heat and other weather conditions, the surface of the turf may start to become worn and small particles of the lead-containing synthetic grass fibers might be released. The staff considered in the evaluation that particles on a child's hand transferred to his/her mouth would be the most likely route of exposure and determined young children would not be at risk.

Although this evaluation found no harmful lead levels, CPSC staff is asking that voluntary standards be developed for synthetic turf to preclude the use of lead in future products. This action is being taken proactively to address any future production of synthetic turf and to set a standard for any new entrants to the market to follow.

As an overall guideline, CPSC staff recommends young children wash their hands after playing outside, especially before eating.

Limited EPA Study Finds Low Level of Concern in Samples of Recycled Tires from Ballfield and Playground Surfaces

Release date: 12/10/2009

Contact Information: Dale Kemery kemery.dale@epa.gov 202-564-7839 202-564-4355

FOR IMMEDIATE RELEASE
December 10, 2009

WASHINGTON - The U.S. Environmental Protection Agency has released results of a limited field monitoring study of artificial-turf playing fields and playgrounds constructed with recycled tire material or tire crumb. The study was intended to gain experience conducting field monitoring of recreational surfaces that contain tire crumb. EPA will use the information to help determine possible next steps to address questions regarding the safety of tire crumb infill in recreational fields.

"The limited data EPA collected during this study, which do not point to a concern, represent an important addition to the information gathered by various government agencies," said Peter Grevatt, director of EPA's Office of Children's Health Protection. "The study will help set the stage for a meeting this spring, where EPA will bring together officials from states and federal agencies to evaluate the existing body of science on this topic and determine what additional steps should be taken to ensure the safety of kids who play on these surfaces."

Recycled tire material, or "tire crumb," is used in many applications, including as a component in synthetic turf fields and playground installations. In response to concerns raised by the public, EPA conducted a limited "scoping study" of tire crumb, which consisted of collecting air and wipe samples at three locations near EPA laboratories at Raleigh, N.C., Athens, Ga., and Cincinnati, Ohio. Sampling also was conducted in the Washington, D.C. area.

The limited study, conducted in August through October 2008, found that the concentrations of materials that made up tire crumb were below levels considered harmful. However, given the limited nature of the study (limited number of constituents monitored, sample sites, and samples taken at each site) and the wide diversity of tire crumb material, it is not possible, without additional data, to extend the results beyond the four study sites to reach more comprehensive conclusions.

The study confirmed that most of the methods tested were accurate, reproducible and appropriate for measuring concentrations of tire crumb constituents and therefore can be used in future studies.

Study findings

- Particulate matter, metals and volatile organic compound concentrations were measured in the air samples and compared with areas away from the turf fields (background levels). The levels found in air samples from the artificial turf were similar to background levels.

- No tire-related fibers were observed in the air samples.

- All air concentrations of particulate matter and lead were well below levels of concern.

- More than 90 percent of the lead in the tire crumb material was tightly bound and unavailable for absorption by users of the turf fields.

- Zinc, which is a known additive in tires, was found in tire crumb samples. However, air and surface wipe monitoring levels of zinc were found to be below levels of concern.

EPA is aware that studies by other agencies were undertaken or completed while this survey was under way. EPA is planning a 2010 meeting with federal and state agencies to review all new study data and determine next steps.

More information on artificial turf: http://www.epa.gov/nerl/features/tire_crumbs.html

STATE OF NEW YORK
DEPARTMENT OF HEALTH
Flanigan Square 547 River Street Troy, New York 12180-2216

Richard F. Daines, M.D.
Commissioner

Wendy E. Saunders
Chief of Staff

FACT SHEET
Crumb-Rubber Infilled Synthetic Turf Athletic Fields
August 2008

PURPOSE
There are several kinds of synthetic turf surfaces (*e.g.*, surfaces that use a fill material ("infill") between the blades of artificial grass and those that do not), and synthetic turf may be installed for different uses (*e.g.*, single or multiple sport athletic fields, landscaping, golf applications). The focus of this fact sheet is athletic fields with crumb rubber infilled synthetic turf. This fact sheet was developed to assist people in making decisions about installing or using this kind of synthetic turf athletic field. Considerations related to other kinds of synthetic turf fields are not addressed in this fact sheet.

BACKGROUND
The first well-publicized use of AstroTurf, a synthetic turf for athletic fields, was at the Houston Astrodome in 1966. This first generation of synthetic turf was essentially a short pile carpet with a foam backing. Since then, design changes have resulted in a greater variety of synthetic turf athletic fields. One type of synthetic turf is fabricated using synthetic fibers, manufactured to resemble natural grass, and a base material that stabilizes and cushions the playing surface. The fibers are typically made from nylon, polypropylene or polyethylene and are connected to a backing material. The base material, also called infill, consists of one or more granular materials that are worked in between the fibers during the installation process. Commonly used base materials are granulated crumb rubber (usually from used tires), flexible plastic pellets, sand, and rubber-coated sand. A combination of sand and crumb rubber is often used.

Crumb rubber is produced by grinding used tires. Steel and fiber tire components are removed during the process and the rubber pellets are sorted by size. Pellet sizes ranging from about one-sixteenth to one-quarter inch in diameter are used on synthetic turf. Crumb rubber is typically applied at a rate of two to three pounds per square foot of field surface.

HEALTH AND SAFETY CONSIDERATIONS
Some potential health and safety considerations related to synthetic turf have generated public concern. These include:

- Heat stress
- Injury
- Infection
- Latex allergy
- Chemical exposure

Heat Stress

Synthetic turf fields absorb heat, resulting in surface temperatures that are much higher than the temperatures of the surrounding air. In June 2002 at Brigham Young University (BYU) in Utah, the average surface temperature on a synthetic turf field was reported to be 117°F while the average surface temperatures on natural turf and asphalt were 78°F and 110°F, respectively. A maximum surface temperature of 200°F on the BYU synthetic turf field was reported. A turfgrass specialist at the University of Missouri reported measuring an air temperature of 138°F at "head-level" height on the university's synthetic turf field on a sunny 98°F day. The surface temperature of the field was reported to be 178°F. A study conducted at Penn State University measured surface temperatures on experimental plots of nine different types of infilled turf. Temperature measurements were made on three occasions. The average air temperatures reported were 79°, 78°, and 85°F. The corresponding average surface temperatures reported for the synthetic turf plots are 120°, 130° and 146°F.

Water can be applied to synthetic turf to reduce the surface temperatures on warm days. A study at BYU found that watering synthetic turf lowered the surface temperature from 174°F to 85°F, but the temperature rose to 120°F in five minutes and to 164°F in twenty minutes. A study conducted by Penn State University on experimental synthetic turf plots examined the effect of watering synthetic turf on surface temperature. Measurements were made on three occasions. For one monitoring period, surface temperatures ranging from about 130° to 160°F were lowered initially to about 75°F, but increased within 30 minutes to temperatures ranging from about 90° to 120°F, where they remained fairly stable for the three-hour monitoring period.

The surface temperatures reported on synthetic turf fields can get high enough to reach levels of discomfort and may contribute to heat stress among users of the fields. While watering synthetic turf may reduce surface temperatures, other factors are likely to influence its effectiveness. At the present time, NYSDOH is unaware of any studies that have examined the role of synthetic turf in contributing to heat stress or that have compared the occurrence of heat stress among athletes playing on natural turf and synthetic turf.

Because of the potential for high temperatures on infilled synthetic turf fields, it is important that people who play or work on the fields be provided with adequate warnings regarding the potential for heat stress. People should also be advised to remain hydrated and to seek relief from the heat in shaded areas. The potential for and frequency of high surface temperatures warrant consideration when making decisions about installing and using a synthetic turf field.

Injury

There is a common perception that there are more sports injuries on synthetic than on natural turf athletic fields. Many factors influence the rate of sports injuries, including the type of playing surface. The many kinds of synthetic turf surfaces and changes in the turf products over the years complicate the assessment of how the playing surface affects injury rates. Other risk factors have been implicated in injury rates among athletes, in addition to the type of playing surface. These risk factors include level of competition, skill level, age, shoe type, previous injury and rehabilitation, and a number of individual physical characteristics. We identified five studies that compared injury (*e.g.,* sprains, lacerations, fractures) rates among athletes when playing on infilled synthetic turf and natural turf fields. Although the ability of the studies to detect differences in the injury rates was limited by the small number of injuries reported, the

studies concluded that there were no major differences in overall injury rates between natural and infilled synthetic turf. Although each study found some differences in specific injury types, there was no consistent pattern across the studies.

The potential for head injuries from contact with the surfaces has been assessed by determining the ability of the surfaces to absorb impacts. Tests have shown that the force of impact on asphalt surfaces is much higher than the level generally accepted to be associated with serious head injury. The force of impact on many types of natural turf and all types of synthetic turf tested are below this level. The force of impact on frozen natural turf is typically above the acceptable level. No data are available for the force of impact on frozen synthetic turf.

The abrasiveness of synthetic turf fibers may contribute to the injury risk among athletes, particularly for abrasions or "turf burns." The degree of abrasiveness appears to be dependent on the composition and shape of the turf fibers. A study conducted at Penn State University suggests that synthetic turf with nylon fibers is more abrasive than synthetic turf with other types of fibers.

Infection Risk

Some people have expressed concern that infections, including methicillin-resistant *Staphylococcus aureus* (MRSA), may be more common among users of synthetic turf fields than users of natural turf fields. This possibility has not been studied systematically, and no definitive statements can be made about differences in risk between the two surfaces.

At least two questions are important in evaluating the risk of infection. Does skin damage occur more frequently on synthetic turf than natural turf, thus providing a place where infections are more likely to occur? Are there more germs on synthetic turf than natural turf?

While injury studies have not consistently identified differences in abrasion and laceration risks between natural and infilled synthetic turf, some types of synthetic turf may result in more skin abrasions. Although very few tests have been performed, the available data do not suggest the widespread presence of infectious agents, such as MRSA, on synthetic turf fields. Also, the available information indicates that outdoor or indoor synthetic turf surfaces are no more likely to harbor infectious agents than other surfaces in those same environments. Disease outbreak investigations conducted in response to illnesses caused by a variety of germs (*e.g.*, MRSA, *Campylobacter*, meningococcus, echovirus, herpes simplex virus, hepatitis virus, coxsackie virus) have not identified playing fields, either natural or synthetic, as likely to increase the risk of transmitting infections.

Skin cuts and abrasions that may result from contact with athletic fields, including both natural and synthetic fields, are susceptible to infection. Athletes and others developing skin abrasions should clean the wounds and seek prompt medical attention. Athletes should avoid sharing towels (on and off the field), equipment, razors, soap and other objects with others, because sharing these items can spread germs.

Latex Allergy

Latex, a substance found in natural rubber, contains substances called "latex allergens," which can cause an allergic response in some people. About 6 percent of the general population is allergic to the substances in latex. Tire rubber contains the latex allergen, although at much lower levels than in latex

gloves and other consumer products. People playing on synthetic turf may be exposed to latex allergens through direct contact with the skin (dermal exposure) and inhalation of small rubber particles suspended in the air.

A study conducted for the California Environmental Protection Agency tested samples of tire rubber on the skin of guinea pigs. None of the animals developed any rashes or allergic reactions from contact with the rubber.

Whether crumb rubber can cause an allergic response in people is not known. NYSDOH is unaware of any occurrences of latex allergy associated with contact with crumb rubber or synthetic turf fields.

Chemical Exposure

Exposure to a chemical requires contact with it. Contact with a chemical occurs in three ways: swallowing it (ingestion exposure), breathing it (inhalation exposure), and having it come in contact with the skin (dermal exposure) or eyes (ocular exposure). The potential for harmful effects from exposure to a chemical depends on the amount of the chemical a person contacts, how the chemical enters the body (ingestion, inhalation, dermal, or ocular), how often contact occurs, and the toxic properties of the chemical. The ability of a chemical to be released from a substance (*e.g.*, crumb rubber) is an important factor in determining how much exposure actually occurs. Other factors that can influence a person's risk for adverse health effects from environmental chemicals include age, gender, general health, genetic differences, exposure to other chemicals and lifestyle choices.

Tires are manufactured from natural and synthetic rubbers along with numerous chemical additives, including zinc, sulfur, carbon black, and oils that contain polyaromatic hydrocarbons (PAHs) and volatile organic chemicals. Because crumb rubber is manufactured from used tires, it probably contains the same chemicals as tire rubber.

Studies have been conducted by the California Environmental Protection Agency Office of Environmental Health Hazard Assessment and the Norwegian Institute of Public Health to assess the potential for ingestion exposure to the chemicals in crumb rubber by children playing on synthetic turf. Both studies concluded that health risks to children resulting from the ingestion of crumb rubber are low.

The Norwegian Institute of Public Health also collected data to assess potential health risks resulting from dermal and inhalation exposures to chemicals contained in synthetic turf fields. Health assessments were conducted for adults and children. The researchers concluded that adverse health effects resulting dermal exposures to crumb rubber or from inhalation exposures to organic chemicals released from the fields are unlikely. No health assessment of the concentrations of rubber particles in the air was made.

A French study measured the concentrations of organic chemicals emitted as gases (known as volatile organic compounds or VOCs) from crumb rubber under laboratory conditions. The data were used by the French National Institute for Industrial Environment and Risks to evaluate possible health effects from inhaling VOCs released from synthetic turf. The study authors concluded that the concentrations of organic compounds emitted did not pose a health concern for athletes, officials or spectators.

Some types of synthetic turf fibers contain elevated levels of lead (*e.g.*, in the range of about 2,000 to 9,000 parts per million). Degradation of these fibers can form a dust that presents a potential source of

lead exposure to users of the fields. The Centers for Disease Control and Prevention and the Agency for Toxic Substances and Disease Registry addressed the potential for lead exposures from synthetic turf fibers in a June 2008 Health Advisory (http://www.cdc.gov/nceh/lead/artificialturf.htm). For new or replacement installations, select synthetic turf products that do not have elevated lead levels.

Our review of the available information on crumb rubber and crumb rubber infilled turf fields indicates that ingestion, dermal or inhalation exposures to chemicals in or released from crumb rubber do not pose a significant public health concern.

OTHER CONSIDERATIONS

A number of other factors may need to be considered when installing and using synthetic turf.

Use: Synthetic turf is more durable than natural turf and can be used without the rest periods that natural turf requires to keep the turf healthy. The New York City Department of Parks and Recreation (NYCDPR) estimates that on an annual basis, permitted use (hours per year) for synthetic turf athletic fields is 28 percent higher than for natural grass fields.

Installation: Installation costs of synthetic turf vary depending on the amount of site preparation required and the specific field design. The installation costs of synthetic turf are generally much higher than the installation costs of natural turf.

Maintenance: The maintenance costs of synthetic turf will vary depending on the field's use and design, but are typically estimated to be lower than the maintenance costs of natural turf. Natural turf requires regular mowing, fertilizer application, pest control and possibly watering. Synthetic turf requires replacing infill materials, repairing seams and removing weeds and moss. Specialized equipment, which may or may not be included in the field's purchase price, is required for these activities.

Lifetime: NYCDPR estimates that the lifetime of a natural turf field is on the order of five years. The synthetic turf industry estimates that the lifetime of an infilled synthetic turf athletic field is eight to ten years, depending on care during installation and use. NYCDPR and other New York entities have seen similar lifetimes.

SUMMARY OF INFORMATION FOR CRUMB-RUBBER INFILLED SYNTHETIC TURF ATHLETIC FIELDS

Heat stress	Surface temperatures on crumb-rubber infilled synthetic turf fields can reach levels of discomfort and may contribute to heat stress. This warrants consideration when making decisions about installing and using a synthetic turf field. While watering synthetic turf may briefly reduce surface temperatures, a number of factors may influence its effectiveness. People using these fields should be advised to remain hydrated and to seek relief from the heat in shaded areas.
Injury	Overall, studies have found no consistent differences in injury rates between natural and crumb-rubber infilled synthetic turf.
Infection	Skin cuts and abrasions that may result from contact with athletic fields (natural and synthetic turf) are susceptible to infection. Athletes and others developing skin abrasions should clean the wounds and seek prompt medical attention. Athletes should avoid sharing equipment, razors, towels, soap and other objects with others, because these items can spread germs.
Latex allergy	At the present time, NYSDOH is unaware of any occurrences of latex allergy resulting from contact with crumb rubber or synthetic turf fields.
Chemical exposures	Based on the available information, chemical exposures from crumb rubber in synthetic turf do not pose a public health hazard.

WHERE CAN I GET MORE INFORMATION?

If you have any questions about the information in this fact sheet or would like to know more about in-filled synthetic turf athletic fields, please call the NYSDOH at 1-800-458-1158 or write to the following address:

New York State Department of Health
Bureau of Toxic Substance Assessment
Flanigan Square, 547 River St.
Troy, NY 12180-2216

SOME RELEVANT REFERENCES

Temperature of In-filled Synthetic Turf Athletic Fields

Adamson, C, Feature Research: Synthetic Turf Playing Fields Present Unique Dangers; University of Missouri, Columbia, College of Agriculture, Food, and Natural Resources, http://cafnr.missouri.edu/research/turfgrass.php

McNitt S., Petrunak D., Evaluation of Playing Surface Characteristics of Various In-filled Systems; Penn State Department of Crop and Soil Sciences; http://cropsoil.psu.edu/mcnitt/infill.cfm

Williams F.C., Pulley G.E.; Synthetic Surface Heat Studies; Brigham Young University; http://cahe.nmsu.edu/programs/turf/documents/brigham-young-study.pdf

Injuries

Ekstrand J., Timpka T, Hagglund M. Risk of injury in elite football played on artificial turf versus natural grass: a prospective two-cohort study. Br J Sports Med. 40:975-980, 2006.

Fuller C W, Dick R W, Corlette J, Schmalz R; Comparison of the Incidence, Nature and Cause of Injuries Sustained on Grass and New Generation Artificial Turf by Male and Female Football Players. Part 1: Match Injuries; British Journal of Sports Medicine, 41 (Supplement 1): 20-26; 2007.

Fuller C W, Dick R W, Corlette J, Schmalz R; Comparison of the Incidence, Nature and Cause of Injuries Sustained on Grass and New Generation Artificial Turf by Male and Female Football Players. Part 2: Training Injuries; British Journal of Sports Medicine, 41(Supplement 1): 27-32; 2007.

Henderson, J.J., Rogers J.N., Crum J.R.; Athletic Field Systems Study 2000 – 2003: An evaluation and Comparison of Naturally and Artificially Enhanced Athletic Field Sand Textured Root Zones – Final Report, Michigan State University, December 2003.

Mayr J.; Parameters Correlating to Injury Severity Score in Playground-Related Fall Accidents, International Journal of Injury Control and Safety Promotion, 3:147-152, 1996.

Meyers M, Barnhill B S; Incidence, Causes, and Severity of High School Football Injuries in FieldTurf Versus Natural Grass; The American Journal of Sports Medicine; 32: 1626-1638; 2004.

Naunheim R, McGurren M, Standeven J, Fucetola R, Lautyssen C, Deibert E; Does the use of Artificial Turf Contribute to Head Injuries?; Journal of Trauma, Injury, Infection and Critical Care; 53: 691-694; 2002.

Naunheim R, Parrott H, Standeven J; A Comparison of Artificial Turf; Journal of Trauma, Injury, Infection and Critical Care; 57: 1311-1314; 2004.

Steffen K, Einar T E, Bahr R; Risk of Injury on Artificial Turf and Natural Grass in Young Female Football Players; British Journal of Sports Medicine; 41: 33-37; 2007.

Infection Risk

Archibald L, Shapiro J, Pass A. 2008. Methicillin-Resistant *Staphylococcus aureus* Infection in a College Football Team: Risk Factors Outside the Locker Room and Playing Field. Infect Contr Hosp Epid. 29:450-453.

Begier E, Frenette K, Barrett N, et al. 2004. A High-Morbidity Outbreak of Methicillin-Resistant *Staphylococcus aureus* among Players on a College Football Team, Facilitated by Cosmetic Body Shaving and Turf Burns. Clin Infect Dis. 39:1446-53.

Kazakova S, Hageman J, Matava M, et al. 2005. A Clone of Methicillin-Resistant *Staphylococcus aureus* among Professional Football Players. The New Engl J of Med. 352:468-75.

McNitt S., Petrunak D.; Evaluation of Playing Surface Characteristics of Various In-Filled Systems; Penn State Department of Crop and Soil Sciences; http://cropsoil.psu.edu/mcnitt/infill.cfm

New York State Department of Health, Health Advisory: Prevention Of Methicillin-Resistant *Staphylococcus Aureus* (MRSA) Infections In The School Setting, October 25, 2007.

Nguyen D, Mascola L, Bancroft E. 2005. Recurring Methicillin-resistant *Staphylococcus aureus* Infections in a Football Team. Emerg Infect Dis. 11: 526- 532.

Romano R, Doanh L, Holtom P. 2006. Outbreak of Community-Acquired Methicillin-Resistant *Staphylococcus aureus* Skin Infections Among a Collegiate Football Team. J Athlet Train. 41:141-145.

Stacey A, Endersby K, Chan P, Marples R. 1998. An outbreak of methicillin resistant *Staphylococcus aureus* infection in a rugby football team. Br J Sports Med. 32:153-154.

Latex Allergy

California Environmental Protection Agency. 2007. Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products. Sacramento, CA: Office of Environmental Health Hazard Assessment.

Miguel A G, Cass G R, Weiss J, Glovsky M M; Latex Allergens in Tire Dust and Airborne Particles; Environmental Health Perspectives; 104: 1180-1186; 1996.

New York State Department of Health, Latex Allergy Fact Sheet, http://www.health.state.ny.us/publications/1454.pdf

Chemical Exposures

California Environmental Protection Agency. 2007. Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products. Sacramento, CA: Office of Environmental Health Hazard Assessment.

French National Institute for Industrial Environment and Risks, Environmental and Health Evaluation of the use of Elastomer Granulates (Virgin and From Used Tyres) as Filling in Third-Generation Artificial Turf, 2007.

Norwegian Institute of Public Health and the Radium Hospital. 2006. Artificial Turf Pitches – An assessment of the Health Risks for Football Players. Oslo, Norway.

Norwegian Building Research Institute (NBI). 2004. Potential Health and Environmental Effects Linked to Artificial Turf Systems - Final Report. Project N/Archive N O-10820. Oslo, Norway.

Other Considerations

Athletic Turf News, http://www.athleticturf.net/athleticturf

Morrison L., Natural and Synthetic Turf: A Comparative Analysis, San Francisco Department of Recreation and Parks, December 2005.

New York City Department of Parks & Recreation, 2008, http://www.nycgovparks.org/index.php

Comments Received from Maryland Soccerplex Staff

Background

The Maryland SoccerPlex opened in October 2000 with 19 natural grass fields. At the time we had 13 bluegrass and 6 Bermuda grass fields. All of these fields are regulation-size (75 x 115 yards), have a five yard safety area and are irrigated with public water. The stadium field has broadcast quality lighting, seating for 3,200 spectators and a sophisticated drainage system similar to a professional-level stadium field.

In 2007 the SoccerPlex constructed 3 synthetic turf fields with lighting. One field opened in late October 2007; the other two opened in early 2008. The addition of these fields was viewed as both a revenue and product enhancement for the complex.

The SoccerPlex employs a staff of eight to maintain all fields. We lease or purchase our own equipment (mowers, aerator, tractors, etc).

The cost of maintaining a natural grass SoccerPlex field is approximately $27,000/year; the cost to maintain a synthetic turf field is approximately $10,000. In 2010 we plowed the 42" of snow from the fields thereby increasing the cost dramatically in an extraordinary situation.

Programming

Until 2008 our natural grass fields were only used for soccer and primarily youth soccer. The grass fields are only used on the weekends for league play and tournaments. The grass fields are not permitted for practice during the week. During the summer the fields are used for summer soccer camps. Each field sees about 250 matches per year.

In 2008 on the grass fields we added two girls lacrosse tournaments that attract 200-250 teams, are three or four days in duration and welcome 300 college coaches.

Prior to the construction of the turf fields we attempted to run adult soccer leagues but the wear and tear on the grass fields was too significant and we had to discontinue the leagues.

Beginning in 2008 with the advent of the three turf fields we added the following activities: team practice session, flag football leagues, youth football development through Germantown Athletic Club, boys and girls lacrosse tournaments, field hockey and rugby.

The turf fields are programmed from 5:00-7:30 p.m. with team training and from 7:30-10:30 p.m. with adult soccer and flag football leagues. We run adult soccer in eight week sessions and are averaging between 90 and 105 teams per session. We generally do not hold leagues in August or December. Team training occurs year round and we plan to offer a winter youth outdoor league in 2011.

In 2009 a grass field had approximately 412 hours activity during the year compared to 1,394 hours for a turf field. The benefits are increased opportunities for youth and adults to actively enjoy their sport and additional revenue.

Feedback from Users

Unlike other sports the playing surface in soccer has a tremendous impact on the game. Players first preference is always a well maintained natural grass field however a turf field provides the most consistent surface and a virtual guarantee that your game will be played. We may close our

grass fields after a substantial rainfall but the turf fields only close due to lightning or a significant snowfall.

The feedback from our users has been very positive. The surface is true, activity is rarely cancelled, players like playing under the lights and coaches like the ability to play on a full field year round.

Injury Trends

The vast majority of injuries that occur at the SoccerPlex either on grass or turf are the result of collisions between players. It is a contact sport and there is no padding. We have not experienced any "turf related" injuries. The infill mix of our fields is predominately crumb rubber with a smaller percentage of sand for increased stability. Some of the fields use a sand only infill that can result in the fields being very hard and that was thought to increase injuries. As more turf fields are being built with a combination of sand and crumb rubber it is anticipated that the injuries will decrease.

Heat Island Effect

Heat on the field is probably our biggest concern and the one that we can't control or alleviate. Most people believe it is the crumb rubber that causes the rise in heat but it's actually the fiber in the turf itself. Playing soccer on a turf field is comparable to playing basketball on an outdoor asphalt court. The temperature rises to about the same level. We did investigate installing water guns to spray cold water on the field when the temperature reached a certain level but that only lasts about 15-20 minutes and it increases the humidity on the field. We have a policy that if the temperature reaches 90 degrees or if there is a code red alert we will move players, especially summer camps, to a grass field if possible. During summer time lacrosse and soccer tournaments we require mandatory water breaks.

Crumb rubber

The biggest complaint comes from parents because it gets on the players shoes and then into their cars. Some of the complaints about the crumb rubber has come from football players whose hands are on the field and their faces are closer to the field when they are in their stance. Soccer does not have that issue.

Up front cost versus ongoing maintenance requirements

The cost of a turf field is approximately $750,000 without lights; the cost of one of the SoccerPlex grass fields is $300,000 without lights. The maintenance for one high quality soccer field is approximately $27,000/year for labor, materials and equipment. A turf field is primarily labor to groom the field once a week. There is also a cost for the grooming equipment. Once a year it may be necessary to add more infill depending on the usage on the fields.

Our turf fields have sewn in lines so they do not require painting, they don't require fertilizing, watering, aeration, fungicide applications or top dressing. All of these activities are time consuming and costly. In order to better maintain our goal mouths we literally move the lines on all of our fields two times each season. Grass fields require repair from time to time. Although many facilities have had to resod fields we have not.

Our turf is wearing very well however we will need to replace it in eight to ten years. As a result we are establishing a replacement reserve and setting aside funds so at that time we can replace

the turf. Although our turf is not recyclable, the manufacturers are developing turf that can be recycled.

Stormwater management/water quality issues

Montgomery County views turf fields as impervious and therefore the stormwater management is calculated on that basis and similar to a parking lot. Our fields drain into the Central Park Pond which has sufficient excess capacity.

Turf fields have tremendous benefits for enabling additional usage, a variety of activities and sports and they enable play during all weather conditions. In my opinion it would benefit the County to have turf fields at every high school stadium.

Comments from Community Use of Public Facilities Staff

The installation of artificial turf at Richard Montgomery High School (RMHS) and Walter Johnson High School (WJHS) stadium fields has been met with an overwhelmingly positive response from the schools' athletic directors and from community users of the facilities.

CUPF regularly receives availability inquiries from youth and adult athletic groups, and both fields are scheduled to near capacity.

Since the opening of the new RMHS stadium in February 2009, Maryland Soccer Enterprises (MSE) has been the primary community user of the facility per its agreement with MCPS. MSE's professional soccer team, Real Maryland, utilizes the field for three weekly practices and plays its home games at the site mostly on Saturday and Sunday.

CUPF staff effectively works with RMHS staff and Real Maryland's General Manager, Dave Noyes, regarding scheduling, logistics, and issues that arise. Prior to working with Mr. Noyes, CUPF worked with Ron Kronthal, who left MSE in summer 2009. Initial concerns of whether RMHS staff would be available to provide MSE access to the facility on some days, especially holidays, and whether MSE should be charged for staffing, were alleviated when MCPS agreed to provide MSE self access to the facility.

In addition, Mr. Noyes has regularly inquired about receiving field hours allotted for community use in exchange for hours forfeited due to MCPS activities at the facility, an area that was not fully addressed in the agreement.

With great interest, the new WJHS stadium opened for community use in May 2010. Per its agreement with MCPS, Bethesda Soccer Club (BSC) is the primary community user of the facility. CUPF has developed an effective working relationship with WJHS and BSC staff regarding use of the stadium. BSC's facility use agreement with MCPS contains provisions to provide BSC with alternate comparable time for any field hours forfeited due to MCPS events.

Comments Received from David B. Noyes, General Manager of Real Maryland FC (a regular user of the artificial turf field at Richard Montgomery)

What has been RM's experience using its field?

Player and coach opinions – Players and Coaches love the surface, it gives a clean bounce to the ball, you don't have to worry about worn away areas and you can just concentrate on the game. The only problem that isn't sitting well with us is all of the lines all over the field. That is because we would prefer it to be just a soccer field. We understand that it has to be a multi-sport field.

Injury types and trends (different from natural turf?) – I am not an expert so I can't answer this precisely. There are more pros playing on this surface than the old artificial turf. There are times when a strange step can be taken, but that can happen on any surface.

Heat island effect? Any policy regarding closing the field at certain temperatures? – The surface definitely gets hot, much more hot than regular grass. It feels like 10-15 degrees warmer on some days. There is no policy I know of to close the field, but common sense tells you when you should not be out there.

Crumb Rubber Issues. – No issues that I know of because the stadium is new. If the tractor keeps grooming the field to keep it level, the field should remain in good shape without crumb rubber issues

Maintenance, upkeep, vandalism issue? – Maintenance is done by school. I do not know if they actually groom the field like they should, but it has held up great so far. The school children need to find the trash barrels more frequently. So far, there hasn't been any vandalism because it is enclosed, but certain gates have been pried open so people can sneak on and play for free.

Survey of High School Athletic Directors on Artificial Turf

School	Contractor (Y/N)	Maintenance ($)	Field Condition (1-10)		Perception of AT	Playability (1-10)		Do you want AT for you players
			Mid-year	Year end		Yours	Artificial	
BCC	Y	$40,000	Brown patches, divets, and holes - PE and Band destroys	3 large brown patches; Brown dirt all over; Unplayable	Strongly support it	4-5	9-10	Absolutely - Yes
Blake HS	Y	18,000	Good	Fair	Yes	5	10	Yes - When are we getting one
Churchill	Y	30,000	good	good	like them	10+	10-	No
Clarksburg HS	Y	25-30,000	Beat up	Torn up	Love it	7.5	10	Yes - When are we getting one
Damascus HS	Y	12-24,000	Large dirt areas that become unplayable when wet	Forced to play Home games away on AT due to poor dangerous conditions	Love it	2-3	10	Yes - When are we getting one
Gaithersburg HS	Y	19,000	Average to poor	Poor - In bad weather moved varsity football game to RM to avoid damaging our field - saved $10,000	Enjoy it	6	10	Absolutely !!!! - When are we getting one
Walter Johnson	Y	25,000 before AT	Bare with ruts	Field was a mess	Love it	4	10	Thrilled with the new field
Magruder	Y	20,000	poor	poor	Want it badly	7-8	10	Absolutely yes
Northwest	Y	15-20,000	(Field Hockey not played on stadium field) bad shape by October	torn up by November	Yes, they love the turf!.	5	10	Absolutely yes
Northwood	Y	10,000	Field is in bad shape		Yes	3	10	Absolutely
Paint Branch HS	Y	14,000	Average	Below average	Impressive - all coaches really like playing on AT	0	10	Yes - Looking forward to getting ours with modernization
Poolesville HS	Y	10-15,000	Considerable wear in the center	Added bare spots due to Lacrosse	Always consistent and safe to play on	5	10	Yes
Quince Orchard HS	Y	15,000	OK, unless we have had a number of rainy days	Not good - waiting for Bermuda to grow; 3 haugh bare spots due to Lacorsse	Yes, but tough going from one type field to another	5-6	10	Yes - When are we getting one
Rockville	Y	25,000	Bad shape after fall sports	Terrible shape after spring sports	Yes, they were great	8 at beginning 2 at end	10	Absolutely
Seneca Valley HS	N - only to provide dirt, seed, and fertilizer	12-15,000	Good - but it takes a lot fo volunteer work	Good, but many volunteer hours needed	Great	8-10	10	Absolutely - if not, need more money for contract maintenance on existing field
Springbrook HS	N	$6,728 materials only	Good	Good but some holes	Definitely like it	9	10	Absolutely !!!! - When are we getting one
Watkins Mill HS	N	6,000 - needs major repair	Playable	Playable - but parts are in leed of major repair	Love playing on it	4	9	Yes - When are we getting one
Whitman HS	Y	50,000+	Good	In need of repair - Lacross does the worst damage	Like it - only complaint is heat in summer	8-9	9-10	Absolutely - would like to have AT on practice field
Wootton HS	Y	25,000	Fair to poor depending on rain	Poor until weather turns hot and grass grows	Good - no rainouts	7	9	Absolutely - Yes
Richard Montgomery HS	Excellent experience for the kids on the turf. Everyone loves it. Stats show fewer injuries. Three years a couple of concussions, 1 knee blow out, and a few sprains. Heat is an issue when it is over 90. RM gave additional water type breaks. Might be a great idea if there was a way to water the field when it is extremely hot. Rubber has been fine. I dragged the turf faithfully every 6 weeks. It still looks great. There have been a few pieces of the lines which have come unglued. We just glued them back and added a little more fill. Vandalism has not been a problem however the field is easy to access even when locked. Most kids just want to play on it.							

Synthetic Turf Discussion at T&E
M-NCPPC, Department of Parks
July 1, 2010

Background

The Montgomery County Department of Parks completed installation of its first synthetic turf field at Montgomery Blair High School ("Blair High School") in Silver Spring in August 2009. A second synthetic turf field is under construction at Fairland Recreational Park and is expected to be completed in October 2010. Cost/benefit and site selection analyses were completed and approved by the Planning Board before the first turf field was installed at Blair High School.

Stormwater Management (SWM)

- Montgomery County Department of Permitting Services (MCDPS) requires runoff from synthetic turf to be treated the same way as runoff from a parking lot. The reason for this is that conventional synthetic turf field design calls for the grade below the field area to be compacted and significant underdrain system to be installed within the stone layers to remove storm water as quickly as possible to prevent the field from being inundated with water during storm events.

- At both Blair High School and Fairland Recreational Park, the approved SWM design involved installing a subsurface stone recharge chamber below the entire field to store the required volume of water within the voids between stones. The recharge stone layer was sized based on the Maryland Department of the Environment (MDE) Unified Sizing Requirements for Water Quality Volume (with a factor of safety), which is the criteria MCDPS uses for reviewing and approving SWM plans. Additionally, the ground below the fields was deconsolidated (under the observation of a Geotechnical Engineer) to promote infiltration.

- At Blair High School, we have agreed to do quarterly monitoring of the water level in the stone base layer. This was requested by MCDPS because the site was previously filled, and we want to make sure that water is actually seeping into the ground. The monitoring that we have done to date indicates that the recharge chamber is functioning, and water is being treated in compliance with MDE requirements.

- We have reviewed available information from regulatory and research organizations, and this information does not indicate that exposure to chemicals in crumb rubber present an unreasonable risk to human health or the environment. However, this field of research is still evolving and we will continue to evaluate emerging research by the scientific community.

Use of Pesticides and Fertilizers

- Synthetic turf does not require applications of pesticides and fertilizers, which can leach to groundwater and/or runoff into surface water. Fertilizers containing nitrogen and phosphorus are a leading source of water quality impairment in the United States, and therefore synthetic turf fields eliminate this potential environmental impact.

- We have experimented with increasing the use of pesticides and fertilizers to strive for high quality natural turf – similar to the quality achieved on synthetic turf fields. This requires an intensive maintenance plan that needs to be carried out over three seasons and is not only significantly more expensive, but requires the input of more chemicals to achieve the desired result.

- At Martin Luther King, Jr. Recreational Park in Silver Spring, we have experimented with compost tea in an effort to improve soil biology and nutrients with the intention of creating better turf without the use of additional chemicals. However, this effort was unsuccessful due to the very high intensity of play, and at the end of the playing seasons, the fields needed significant repairs as bare ground covered 60-70% of the playing surface.

Grass cutting

- To maintain natural grass, we have to mow our blue grass turf fields every five to seven days, and our Bermuda turf fields every other day during the playing seasons, costing us at least $2,000 per year.

- Mowing causes air pollution. With synthetic turf, we eliminate the need to mow, thus saving us operating costs and reducing the impact to the environment. Air pollution is also caused by the other equipment we use to maintain the fields such as tractors to aerate, seed, and apply fertilizer and pesticide.

- The frequent mowing required for natural grass fields results in emissions of hydrocarbons and carbon monoxide, which, according to the EPA, account for up to 5% of such emissions in the United States.

Irrigation

- To maintain natural grass, we spend approximately $4,390 per year to irrigate one field. With WSSC rates increasing every year (an annual increase averaging over 6% in the last five years and FY11), irrigation costs continue to rise making it more expensive to maintain natural grass fields.

- We use approximately 43,200 gallons of water per application or 864,000 gallons of water per year to irrigate one natural grass field. Only a small fraction of this amount would be needed to cool down a synthetic turf field when needed. Minimal irrigation is required for synthetic turf, enabling us to save water and money. To date, we have not had to spray down the synthetic field at Blair High School due to excessive heat.

Other Environment Issues

- The use of recycled tires for the infill is an ecologically responsible use of scrap tires. The synthetic field industry currently recycles one-twelfth of auto tires that are withdrawn from use every year, and the average soccer field can contain crumb rubber from 27,000 tires.

- Increased runoff from soil compaction is a major cause of stream bank erosion in urban areas. Natural turf fields tend to become compacted through the high impact and intensity of their use. As a result, natural turf fields have the potential to act like impervious areas with little to no infiltration/ground water recharge, resulting in increased runoff and potential stream bank erosion. Conversely, synthetic turf fields that we have installed have engineered drainage systems with stone chambers (previously discussed) that promote groundwater recharge. This system is regularly monitored to ensure that it is functioning as designed.

Health/Safety Issues

- The rubber infill seems to be one of the main sources of concern when it comes to health. According to *Environmental Health Perspectives*, a well respected journal published by the National Institute of Health (NIH), the rubber crumbs become airborne and can be breathed in and tracked into homes on clothes and athletic gear.

    - The NIH journal article cites a study by the Norwegian Institute of Health on the potential for recycled crumb rubber to become aerosolized and inhaled by field users. The report, *Artificial Turf Pitches: An Assessment of the Health Risks for Football Players*, showed that Volatile Organic Compounds (VOCs) from the crumb rubber can be inhaled by field users. However, the 2006 report concluded that "the use of synthetic turf indoors does not cause any elevated health risk, even in vulnerable populations such as children." Note that the synthetic turf fields that we have installed are outdoors, where the potential for VOCs to accumulate in the air is significantly less than in indoor air.

    - A 2007 report completed by the California Office of Environmental Health Hazard Assessment (OEHHA) concluded that almost 50 types of chemicals could be released from tire crumbs. OEHHA evaluated the potential cancer risk associated with direct ingestion and hand to mouth ingestion of chemicals in tire crumb rubber. The results were within or well below the EPA acceptable cancer risk range of 1×10^{-6} to 1×10^{-4}.

- Injuries on synthetic turf fields are also the subject of debate. There are several reputable studies that are on both sides of the fence:

    - A 2007 issue of the *British Journal of Sports Medicine* claimed that there no differences in the "incidence, severity, nature, or cause of injuries in soccer teams who play on grass versus new-generation synthetic turf."

    - In contrast, a 2004 issue of the *American Journal of Sports Medicine* claimed that there were 10% more injuries during play on synthetic turf than during play on natural grass turf. However, the risk of head and knee injuries was greater on natural grass turf.

    - Since the synthetic turf field at Blair High School has been open to play in fall 2009, there have been no reports of major injuries relating to the turf.

- In July 2008, the State of New York Department of Health (NYPDOH) issued a fact sheet on synthetic turf athletic fields infilled with crumb-rubber. It indicates that surface temperatures can get high enough to reach levels of discomfort and may contribute to heat stress among

users. It also indicated that NYDOH was unaware of any studies that have examined the role of synthetic turf in contributing to heat stress or that have compared the occurrence of heat stress among athletes playing on natural turf and synthetic turf. The report recommended that adequate warnings should be provided for people who play or work on the fields and that people should be advised to remain hydrated and seek relief from the heat in shaded areas.

Key Points of Cost/Benefit Analysis for Synthetic versus Natural Turf

M-NCPPC | Department of Parks

June 2010

In our cost benefit analysis, we compared the costs, revenues and usage of a synthetic turf field versus a natural grass field over a ten-year period.

Costs[1]

- We compared the capital and maintenance costs of rehabilitating an existing, deteriorating grass field with the costs of installing synthetic turf at the same field.
- We estimate the capital cost of rehabilitating the grass field is $180,000, and maintenance costs over a ten-year period to total $375,000. Maintenance costs include mowing, lining, aerating, seeding, fertilizing, top-dressing, re-seeding, re-sodding, irrigating, and general upkeep, including trash and litter pick-up. Total cost is approximately $555,000.
- We estimate the capital cost of installing synthetic turf at the same field is $865,000, and maintenance costs over a ten-year period to total $130,000. Maintenance costs include grooming, replacing the crumb rubber, and general upkeep, including trash and litter pick-up. Total cost is approximately $995,000.

Revenues[2]

- We estimate collecting $100,200 in permit fees over a ten-year period for a grass field.
- We estimate collecting $712,200 in permit fees over a ten-year period for a synthetic turf field.

Usage[3]

- We estimate at least twice as much usage of a synthetic turf field than a natural grass field with the potential of more usage on synthetic turf as users become more acquainted and comfortable with its use and increased capacity for play.

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[1]Assumptions: Costs based on one Commission-owned, lighted, 90,000 square-foot permitted regional or recreational soccer field. Natural grass refers to tall fescue blue grass; synthetic turf refers to filled turf made up of crumb rubber. Frequency of maintenance tasks for natural grass is based on Commission-recommended practices. Costs include an annual increase of 4% to account for inflation.

[2] Assumptions: Revenues for a natural grass field is based on a three-year (FY08-10) average of permit fees collected at the soccer/football field at Ridge Road Recreational Park. Revenues for a synthetic turf field is based on actual revenue for multi-use field at Blair High School over a ten-month period (since it was re-opened on September 1, 2009), plus a two-month projection. Revenues include an annual increase of 3% to account for potential increase in permit fees.

[3] Assumptions: Usage of a natural grass field is based on average play time at the soccer/football field at Ridge Road Recreational Park over a three-year period (FY08-10). Usage of a synthetic turf field is based on actual permitted hours for multi-use field at Blair High School over a ten-month period (since it re-opened on September 1, 2009), plus a two-month projection.

Artificial Turf
Department of Environmental Protection
June 28, 2010

1. Environmental Benefits and Disadvantages of Artificial Turf Fields

Stormwater Management

Although grass fields are considered pervious surfaces, the County Department of Permitting Services (DPS) requires treatment of the first ¼ inch of runoff for stormwater management for newly established fields. DPS considers artificial turf to be an impervious surface for stormwater management purposes. This construction is similar to the design of stormwater management BMPs intended to promote infiltration such as pervious pavement. DPS requires an additional depth of gravel under County artificial turf fields to meet statewide infiltration design standards or requires underdrains to direct flows to adjacent stormwater management structures. A study of a field in France (Moretto, 2007) found that only 12% of rainfall percolated through the field over an 11 month period. They attributed the lost volume of water to evaporation and water flowing along the carpet fabric to the periphery of the field rather than through the fabric into the matrix below the field.

Pesticides and Fertilizers

Artificial turf fields do not require pesticides or fertilizers. Natural grass fields are often maintained with pesticides and fertilizers

Mowing

While artificial turf fields do not require mowing, some field operators regularly groom the surface using a rake pulled by a small tractor. This is similar to mowing but somewhat faster and is not an essential practice. Some local fields receive minimal grooming (Table 3). In all cases, grooming is done at a lower frequency than mowing.

Irrigation

Natural grass fields generally require irrigation. Artificial turf fields do not require irrigation. Although some operators recommend watering artificial turf fields during very hot weather to reduce temperature impacts, most local artificial turf field operators do not water their fields (Table 3).

Other Issues

Artificial turf fields are made of synthetic materials that require energy and other inputs including petroleum. Natural grass fields are laid down as sod or seeded and grown in place. Both sod and seed are produced using fertilizer, energy and other inputs. It is difficult to say which of these processes are preferable from an environmental standpoint.

Artificial turf fields are generally projected to have life spans of approximately 10 to 15 years, depending on usage. During that time span they can tolerate a much higher level of usage than natural grass fields.

Table 3. Survey of Montgomery County and Fairfax County Artificial Turf Maintenance Practices

		Age of Field	Regular Grooming	Watering	Disinfect Whole Field
Private Schools in Mont. Co.	6 Schools	3 Years Avg.	4 Schools Monthly	2 Schools Rarely	1 School
Fairfax County Park Authority	20+ Fields	10 Years Max.	No	No	No

2. Government Findings and Other Applicable Studies

Most governmental studies have focused on the potential for human health impacts from used tire products. There have been far fewer governmental studies focusing on water quality or other environmental impacts from used tire products. This review focuses on potential water quality impacts from artificial turf runoff.

Some studies have concluded that used tire products and artificial turf fields are unlikely to generate pollutants at a level above water quality limits (Lim and Walker 2009, Moretto 2007, Vidair, Haas and Schlag 2007, Ledoux, 2007, Lim, 2010, Bristol and McDermott 2008, Chemrisk 2008, Hofstra 2008, and Johns and Goodlin, 2008). Studies generally have found that fields have the potential to release low levels of pollutants when first installed, but that levels drop off very quickly to background levels. Only four of the studies listed above directly sampled runoff from actual artificial turf fields (Bristol andMcDermott, 2008, Hofstra, 2008, Lim and Walker, 2009 and Moretto, 2007.)

Studies done in other settings indicate that used tire products clearly have the potential to release toxic substances (Brown, 2007, Denly, Rutkowski and Vetrano, 2008, USEPA, 2009). Polycyclic aromatic hydrocarbons, zinc and other metals are the principal substances of concern produced by used tires although many other substances have been identified in small concentrations. It is difficult to relate these results to actual environmental conditions. Many of the identified substances are in low concentrations and may not be released under field conditions. Little information exists on the impacts of many of these substances. Most of them have no relevant government regulatory standards. However, it is also possible that synergistic impacts could occur when these substances exist in combination.

Some studies have found toxicity to aquatic organisms from tire leachate or relatively high concentrations of pollutants. For instance, Sheehan, et. al. (2006) found that leachate from tire shreds installed below the water table reduced survival of aquatic organisms. The design of artificial turf fields places the rubber above the water table. Lim and Walker (2009) found that crumb rubber produced an average zinc concentration of 1947.4 ug/L in a Synthetic Precipitation Leaching Procedure (SPLP) test. This is much higher than the Maryland freshwater criterion for aquatic life of 120 ug/L. Their SPLP results also found relatively high concentrations of many other substances.

However, Lim and Walker (2009) characterize this test as an, "Aggressive laboratory testing method ... which may overestimate releases from the samples as compared to releases in the ambient setting." Less aggressive laboratory procedures found lower concentrations of pollutants.

Some studies have identified rare instances of lead on older artificial turf fields (NJDHHS 2008, NYCDPR Undated). The U.S. Consumer Product Safety Commission (CPSC 2008) has tied the lead in these fields to pigments used in the carpeting material and recommended that lead not be used in the manufacture of new fields.

Summary of Studies Reviewed

Bristol, Scott G. and Vincent C. McDermott. 2008. *Evaluation of Stormwater Drainage Quality From Synthetic Turf Athletic Fields*. Milone & MacBroom, Inc. Cheshire, Conn. 10 pp.

"The results of the study indicate that the actual stormwater drainage from the fields allows for the complete survival of the test species *Daphnia pulex.* An analysis of the concentration of metals in the actual drainage water indicates that metals do not leach in amounts that would be considered a risk to aquatic life as compared to existing water quality standards. Analysis of the laboratory based leaching potential of metals in accordance with acceptable EPA methods indicates that metals will leach from the crumb rubber but in concentrations that are within ranges that could be expected to leach from native soil."

Brown, David R. 2007. *Artificial Turf – Exposures to Ground-Up Rubber Tires – Athletic Fields – Playgrounds – Gardening Mulch.* EHHI. North Haven, CT. 37 pp.

This literature review includes a laboratory study of tire crumb leaching and volatilization done by the Connecticut Agricultural Experiment Station. Brown concludes that crumb rubber has the potential to release a variety of hazardous substances.

ChemRisk, Inc. 2008. *Review of the Human Health & Ecological Safety of Exposure to Recycled Tire Rubber found at Playgrounds and Synthetic Turf Fields*. Pittsburgh, PA. 57pp

This literature review of crumb rubber studies found that no adverse ecological effects are likely. They recommended that additional studies be done.

CPSC (U.S. Consumer Product Safety Commission). 2008. *CPSC Staff Finds Synthetic Turf Fields OK to Install, OK to Play On.* Press Release #08-348. R:\Programs\NPDES\Projects\Artificial Turf Evaluation\Papers\CPSC Release.mht

"Although small amounts of lead were detected on the surface of some older fields, none of these tested fields released amounts of lead that would be harmful to children. ... Lead is present in the pigments of some synthetic turf products to give the turf its various

colors. ... Although this evaluation found no harmful lead levels, CPSC staff is asking that voluntary standards be developed for synthetic turf to preclude the use of lead in future products."

Denly, Elizabeth, Katarina Rutkowski and Karen M. Vetrano. 2008. A Review of the Potential Health and Safety Risks from Synthetic Turf Fields Containing Crumb Rubber Infill. TRC. Windsor, Conn. / New York City Department of Health and Mental Hygiene 200 pp.

COPC (concentration of potential concern) from the crumb rubber vary depending on the type of crumb rubber, the method of extraction used for analysis, and the media measured (crumb rubber, air, leachate).

Hofstra, U. 2008. *Follow-up Study of the Environmental Aspects of Rubber Infill.* Intron. Sittard, Netherlands. 5 pp.

Hofstra found the contribution of zinc leaching from fields over relevant time periods to have insignificant environmental impacts. "The zinc concentration in the drainage water from 5- to 6-year-old fields is lower than the concentration in rainwater. ... The impact of weathering of the rubber crumb for the technical lifetime of an artificial turf field (approx. 10 to 15 years) does not cause the leaching of zinc from the rubber crumb made from recycled car tyres to exceed the threshold values for dissolved zinc in surface water or the derived threshold value from the Decree on Soil Quality for the emission of zinc into the soil."

Johns, D. Michael and Tom Goodlin. 2008. *Evaluation of Potential Environmental Risks Associated with Installing Synthetic Turf Fields on Bainbridge Island.* Windward Environmental. Seattle, WA. 14 pp.

Literature review by Johns and Goodlin (2008) found that fields are unlikely to produce toxicity in surface waters or pollute groundwater.

Ledoux, Thomas. 2007. *Preliminary Assessment of the Toxicity from Exposure to Crumb Rubber: its use in Playgrounds and Artificial Turf Playing Fields.* New Jersey Department of Environmental Protection.

NJDEP literature review concluded that there was insufficient information to perform a complete risk characterization for crumb rubber.

Lim, Ly. 2010. Personal Communication. NY Department of Environmental Conservation.

Ten additional water samples not included in Lim and Walker (2009) had results similar the one sample discussed in that report (actual test results not available). Funding has not been available for further study.

Lim, Ly and Randi Walker. 2009. *Assessment of Chemical Leaching, Releases to Air and Temperature at Crumb-Rubber Infilled Synthetic Turf Fields*. New York State Department of Environmental Conservation, New York State Department of Health. 140 pp.

This NY State study was mainly laboratory based, but limited field sampling resulted in 32 groundwater samples and one runoff sample. These samples were analyzed chemically and impacts estimated. SPLP laboratory analysis of crumb rubber found relatively high levels of some pollutants, the less aggressive laboratory column test found lower levels of pollutants. The study found little likelihood of impacts to groundwater, surface water or air quality from artificial turf fields.

Moretto, Robert. 2007. *Environmental and Health Assessment of the Use of Elastomer Granulates (Virgin and from Used Tyres) as Filling in Third-Generation Artificial Turf.* ADEME/ALIAPUR/Fieldturf Tarkett. 27 pp.

Equipment was set up to obtain samples draining through an actual outdoor artificial turf field as well as four laboratory systems containing artificial turf. A surprisingly small amount of water was collected from the actual field relative to rainfall totals. Chemical analysis indicated an initial release of some pollutants followed by lower levels in subsequent samples. The results of the laboratory and field samples were similar. No environmental impacts would be anticipated based on the concentrations of pollutants observed or toxicology testing which was done.

NJDHHS (New Jersey Department of Health and Senior Services). 2008. Update: New Jersey Investigation of Artificial Turf and Human Health Concerns. Trenton, NJ. NJDHHS 2008.pdf

This is a fact sheet on lead found at several New Jersey artificial turf fields made with nylon fibers. Most fields were found to have little or no lead.

NYCDPR (New York City Department of Parks and Recreation). Undated Web Page. http://www.nycgovparks.org/sub_things_to_do/facilities/synthetic_turf_test_results.html. R:\Programs\NPDES\Projects\Artificial Turf Evaluation\Papers\NYC Turf Flyer.mht

This web page summarizes issues related to artificial turf fields including the finding of lead in one city field.

Sheehan, P.J., et al., *Evaluating the risk to aquatic ecosystems posed by leachate from tire shred fill in roads using toxicity tests, toxicity identification evaluations, and groundwater modeling.* Environ Toxicol Chem, 2006. 25(2): p. 400-11.

Sheehan, et. al. (2006) found no toxicity to two species of aquatic organisms from exposure to leachate from shredded tire fill placed above the water table. Exposure to leachates collected from tire shreds installed below the water table reduced survival.

Modeling predicted that impact would disappear over a distance of 3 to 11 meters depending on local conditions.

U.S. Environmental Protection Agency. 2009. *A Scoping-Level Field Monitoring Study of Synthetic Turf Fields and Playgrounds*. 105 pp.

This study collected air, dust, carpet fiber and rubber infill samples. They found average lead levels in the turf to be under EPA standards for lead in soil or floor dust.

Vidair, Charles, Robert Haas and Robert Schlag. 2007. *Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products*. California Environmental Protection Agency for the California Integrated Waste Management Board. Sacramento, CA. 147 pp.

This evaluation of human health impacts also included a literature review of environmental impacts. A low likelihood of soil or groundwater contamination was predicted. They also concluded that, "Considering all the data, it seems doubtful that recycled tire rubber in outdoor applications such as playground surfaces releases high enough levels of chemicals to cause toxicity to animals and plants living in the vicinity."