Draft for Public Comment **April 2011**

A Review of Benefits and Issues Associated with Natural and Artificial Turf Rectangular Stadium Fields

Prepared by a Staff Work Group from Montgomery County Public Schools, Montgomery County Department of Parks, Montgomery County Council, Montgomery County Department of Environmental Protection, and Montgomery County Department of Health and Human Services

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Introduction:

On July 1, 2010, the Montgomery County Council's Transportation, Infrastructure, Energy, and Environment (T&E) Committee held a meeting with staffs from Montgomery County Public Schools (MCPS), Maryland National Capital Park and Planning Commission (M-NCPPC) Montgomery County Department of Parks (Parks), Montgomery County Department of Environmental Protection (DEP), and the Montgomery County Department of Health and Human Services (DHHS) to discuss health and safety issues associated with artificial turf fields in Montgomery County.

An outcome of the meeting was a T&E Committee request for the formation of a staff work group to prepare a report that would provide guidance to the Committee in the face of concerns raised by some citizens and groups (see Appendices I and J) over the use of artificial turf fields in the county. The work group would include staff members from MCPS, Parks, DEP, and DHHS along with a representative from Council staff. Specifically the committee requested the staff work group to further quantify the programming, environmental, cost-benefits, and other impacts of artificial turf vis-à-vis natural grass fields as part of its report. The T&E Committee requested this report by the end of 2010. However, it became evident that additional time was needed to complete research needed for this report.

Comments on this draft report should be submitted to TurfReportResponse@yahoo.com by close of business on May 13, 2011. Hard copy comments will be received at:

MCPS Department of Facilities Management, 2096 Gaither Road Rockville, MD 20850

A final report that will include a separate compilation of Public Comments received during the comment period will be assembled and presented to the T&E Committee for its review. The T&E Committee will decide the appropriate venue for discussion of the report and public comments.

The following Agency staff members were involved in the research and development of this report.

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Joe Lavorgna, consultant to MCPS
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Keith Levchenko, Montgomery County Council Staff
Steve Shofar, Montgomery County Department of Environmental Protection

Staff from the Maryland Soccer Foundation also provided substantial assistance to the group with regard to cost and maintenance assumptions for the natural grass and artificial turf fields they oversee at the Maryland SoccerPlex in Germantown, Maryland. The SoccerPlex staff also provided information on best practice trends in the sports field management industry.

Executive Summary:

Montgomery County Public Rectangular Fields Inventory—Existing and Planned

Montgomery County currently has 160 existing full-sized public stand alone natural turf rectangular fields plus seven existing artificial turf fields. In addition, there are 317 public natural turf multi-purpose overlay fields. There are seven planned artificial turf fields in the FY2011-2016 Capital Improvements Program (CIP) period. The most imminent are Laytonia Recreational Park and Paint Branch High School, both planned for construction in 2011. Parks also plans to install artificial turf on the slab of the old Wheaton ice rink, a covered open-air facility, to allow soccer, lacrosse, futsol, and other uses. This project will generate income for Parks enterprise fund.

Considerations for Use of Natural and Artificial Turf Fields

Need for Additional Fields: The Department of Parks prepares a park and recreation needs analysis every five years called the Land Preservation, Parks, and Recreation Plan (formerly called the Park, Recreation, and Open Space (PROS) plan). The plan points to the need for 123 additional athletic fields in the county by the year 2020, of which 73 are full-sized rectangular fields.

Difficulty of Maintaining High Quality High Use Natural Grass Fields: The necessary ingredients to sustain natural turf grass cover on an athletic field fall into three primary categories—construction, maintenance, and usage. All three must be carefully controlled, or the natural grass surface will likely become unsatisfactory and unsuitable for organized sports play. In order to sustain a high quality stand of natural turf grass on a field, it must be designed and constructed properly, be maintained regularly by qualified personnel, and have usage controlled and limited. If any one of the three factors is missing, natural turf cover on the field will deteriorate over time.

For Montgomery County Public Schools (MCPS) significant time, effort, and money is expended in trying to maintain safe, adequate playing conditions on high school stadium fields. This expenditure of resources consistently falls short of its goal, primarily because of the intensive wear and tear that result from so many sports and teams sharing natural grass high school stadium fields for competitive contests.

Finding: MCPS staff has identified the following operational benefits for artificial turf fields compared to existing natural grass high school stadium fields:

- Provides safer, more consistent, and more competitive surfaces for hundreds of MCPS and community teams.
- Provides safe, on-campus practice areas for MCPS athletic teams.
- A greater degree of MCPS compliance with Title IX. Field hockey contests are not played on the stadium field at approximately half of the MCPS high schools because of unsuitable field conditions.
- Minimal cancellations for MCPS events. Prevailing weather conditions in the fall and spring force many cancellations, disrupting parents' as well as students' schedules. The only weather conditions that would cause a postponement on artificial turf fields would be lightening or abnormally severe weather.

- Significant savings in maintenance. Savings include not only seed, grass, fertilizer, and water, but also an enormous savings in time and effort by school staff and parent volunteers.

- Physical education classes having access to a safe, all-weather surface for activities during the school day for more than half of the school year.

Playability (Hours of Use)

A primary reason both Parks and MCPS support the construction of artificial turf fields is the increased hours of use possible with an artificial turf field compared to a high quality natural grass field. These increased hours of use are achieved without risking degradation of the field. In addition, even under limited hours of use, natural grass fields can suffer major damage from intensive play, especially when play occurs during or immediately after storm events. The increased hours of use provided by artificial turf fields also means that the County can avoid the environmental impacts of building additional natural grass fields.

Finding: The actual hours of use of an artificial turf field (based on actual use of MCPS' artificial turf stadium fields and the artificial turf fields at the Maryland Soccerplex) range from 1.7 to 7.7 times the use of existing natural grass fields (MCPS stadium fields, Parks fields, and Maryland Soccerplex fields)

Life-Cycle Cost Evaluation

A key factor in deciding whether to build an artificial turf field or a natural turf field is the comprehensive lifecycle costs (construction, maintenance, revenue, rehabilitation, replacement) including the cost per hour of use. The cost per hour of use is based on the estimated annual hours of use one can expect from the different field types based on the programming expected for the field.

The staff work group chose four natural grass field types to compare to a typical artificial turf field. The four natural grass field types consist of two different field bases (a ten-inch sand base and a native soil base) and two different grass types (Bermuda grass and Cool Season/Kentucky Bluegrass). The artificial turf field is assumed to be a polypropylene carpet with a crumb rubber infill.

Finding: The 20-year lifecycle cost analysis found that despite the higher up-front and future replacement costs, an artificial turf field provides a substantially lower net cost per hour of use than any of the natural grass options because of the many more hours of use and additional revenue generated from those extra hours of use.

Public/Human Health Concerns

Due to the distinct physical characteristics of artificial turf systems, concern has been raised over potential adverse health effects related to use of these systems. The potential physical health effects associated with artificial turf systems (carpet and infill) include:

- chemical exposures
- heat-related illnesses
- abrasions/turf-burns
- injuries infections, and allergic reactions

In the absence of either an environmental impact assessment or a health impact assessment on the installation and use of artificial turf fields, the work group identified some of the areas of potential human risks that were raised during the compilation of information that forms this report. This is not a complete set of risks. A formal process would be required to identify and examine all the human health risks from all the artificial turf field materials under consideration. Such an analysis was beyond the scope and capacity of the Artificial Turf Work Group.

Finding – Parks and MCPS believe that reliance should be placed on the various government studies referenced in this report that have looked at the human health issues associated with artificial turf fields (and crumb rubber infill in particular) and have not found levels of concern that warrant avoidance of the construction of new artificial turf fields with crumb rubber infill.

Artificial Turf Heat Issue

One characteristic of artificial turf fields that has been well documented is the higher field temperatures on artificial turf fields compared to natural grass fields under similar weather conditions. These conditions may vary depending on the color and other specifications of the artificial turf carpet and the type of the infill material used.

Work Group Recommendations:

- It is evident that surface and ambient temperatures on artificial turf fields can get quite hot. The work group believes MCPS should include the artificial turf heat issue in its athletic handbook in order to address circumstances where these fields are being used and/or supervised by MCPS directly during peak heat conditions (for instance for summer and early fall team practices and physical education classes).

  This guidance should provide for an assessment of field conditions on a case by case basis by the athletic staff at the school (considering ambient and field temperature readings).

- The work group believes common permit language and advisory signage for all artificial turf fields managed by MCPS, Parks, and CUPF should be utilized.

- Community Use of Public Facilities (CUPF) should develop specific heat guidelines to govern the leasing of artificial turf fields to outside groups.

Environmental Impacts

The Staff Work Group asked Montgomery County DEP to provide its perspective on artificial turf based on its review of the various studies. From an environmental perspective, should MCPS and Parks not build any more artificial turf fields pending further study? DEP's response has been that it does not have a position on artificial turf. DEP has also not provided any specific recommendations regarding the construction and use of artificial turf, such as whether water quality monitoring should be done for existing fields, if specific storm water management practices should be done, or whether particular alternative infill choices should be pursued.

Since the staff work group did not receive specific recommendations from Montgomery County DEP, the group reviewed a number of studies that focused on environmental issues and which included recommendations by other Environmental Departments.

Connecticut Department of Environmental Protection, July 2010

The full report is available at:
http://www.ct.gov/dep/cwp/view.asp?a=2690&Q=463624&depNav_GID=1511) along with reports from other Connecticut agencies looking at various issues of concern regarding artificial turf.

San Francisco Department of the Environment (SFE) (as part of a Synthetic Playfields Task Force Report completed in August 2008).

Full Task Force Report available at: http://www.superfill.net/dl010808/SFParks_Playfields_8.21.08.pdf. The Task Force took a broad look at artificial turf issues and more relevantly for this section included SFE findings and recommendations.

Finding: While both the Connecticut and San Francisco environmental departments identified potential environmental impacts, neither study determined that these impacts were of sufficient concern to warrant a moratorium on the construction of artificial turf fields with crumb rubber infill. Instead, both departments recommend specific practices to reduce or mitigate these impacts.

Recommendation: Parks and MCPS staffs should include language in future contracts requiring the recycling of artificial turf fields by the new field installer.

Recommendation: Parks and MCPS staffs should explore incorporating some of the environmental testing requirements identified in the City of San Francisco artificial turf specification into future specifications for artificial turf fields constructed for Parks and MCPS.

Alternative Infill Products

The artificial turf industry is expanding rapidly. Turf companies and infill manufacturers are attempting to respond to concerns with Styrene-Butadiene-Rubber (SBR) infill materials and are developing new alternatives. Because the industry is rapidly changing, decisions made on new companies and products should be well researched to make sure that the money spent on artificial turf systems is based on sound life-cycle cost information.

Finding—Many owners, installers, and suppliers of artificial turf fields believe that crumb rubber is the best infill product on the market because it has been field tested and proven for performance over a number of years. Alternative infill materials are being marketed primarily to compete with crumb rubber based on the negative perceptions attributed to SBR. While some of the alternative infills may show promise in terms of durability and performance over time, it is too early to invest in an unproven product until a greater track record is established for many of these materials.

Parks and MCPS believe that county agencies should continue to monitor the success or failure of alternative infills before considering a change from SBR infill material.

Background

Montgomery County Public Rectangular Fields Inventory—Existing and Planned

As shown in Chart I-1 below, there are currently 160 existing full-sized stand alone natural turf rectangular fields plus seven existing artificial turf fields. In addition, there are 317 natural turf multi-purpose overlay fields. There are seven planned artificial turf fields in the FY2011-2016 Capital Improvements Program (CIP) period. The most imminent are Laytonia Recreational Park and Paint Branch HS, both planned for construction in 2011.

For Montgomery County Parks, site selection criteria for public synthetic turf fields have included adequate site area for full size fields, parking, field lighting or the capability for lighting, and space to buffer communities from intense usage. These criteria generally limit the sites to regional / recreational parks and community recreation centers. There are presently no plans for synthetic turf in local/community use parks or on multi-purpose overlay fields. For Montgomery County Public Schools (MCPS) planned fields include only high school stadium fields.

Chart I-1. Tabulation of Existing and Proposed Natural and Synthetic Turf Rectangular Fields on M-NCPPC, MCPS, and County Properties (not including private sites and municipalities)

Public Facilities	Full-Size Stand Alone Rectangular Fields						Existing Natural Turf Rectangular Overlays[1]
	Natural Turf		Artificial Turf		Total		
	Existing[2]	Planned[3]	Existing[4]	Planned[5]	Existing	Planned	
M-NCPPC Parks							
Regional / Recreational	16	6	2	1	18	7	2
Local / Community-Use	92	3	0	0	92	3	55
MC Public Schools							
High School Stadium	22	*(3)*	2	*3*	24	0	0
High School Practice	12	0	0	0	12	0	56
Elementary & Middle School	1	0	0	0	1	0	199
MC Recreation Department	0	2	0	1	0	3	5
Maryland SoccerPlex	17	2	3	2	20	4	0
Totals	160	10	7	7	167	17	317

[1] Overlays are multi-purpose natural turf areas where baseball / softball diamonds typically overlap rectangular fields. They generally do not support full sized rectangular fields. There are 317 rectangular overlays at park and school sites.

[2] There are 160 existing full size stand alone natural turf soccer fields at Park, School, and County sites. At MCPS, the full size stand alone fields are at high schools, with one at Tilden Middle School which is a former high school. All other MCPS elementary and middle school fields at schools are considered shared use multipurpose overlays which are generally permitted by CUPF.

[3] Thirteen new full size stand alone natural turf soccer fields are planned over six-year CIP cycle. They are: Laytonia Recreational Park (2), Northwest Branch Recreational Park (4), East Norbeck LP (1), Greenbriar LP (1), North Four Corners LP (1), Mid-County Community Recreation Center (1), White Oak Community Recreation Center (1), and Maryland SoccerPlex (2). Three existing MCPS stadium fields will be converted to artificial turf fields

[4] The seven existing synthetic turf fields are at Blair Recreational Park / HS (1), Fairland Recreational Park (1), Richard Montgomery HS (1), Walter Johnson HS (1), and Maryland SoccerPlex (3).

[5] There are seven synthetic turf fields presently planned over the 6-year CIP, including new synthetic turf fields at the future Laytonia Recreational Park (1) and North Potomac Community Recreation Center (1), and conversions of existing natural turf soccer fields to synthetic turf at Paint Branch HS (1), Gaithersburg HS (1), Wheaton HS (1), and Maryland SoccerPlex (2).

Montgomery County Park Fields

Natural Turf Fields

There are currently 108 full size stand-alone rectangular fields in Montgomery Parks. Sixteen of these fields are in regional or recreational parks which are secured and restricted for use by permit only. The remaining 92 fields are in community-use parks and are available for walk-on use when not permitted.

An additional nine natural turf fields are planned in Parks over the current six-year CIP cycle. Six will be in regional / recreational parks and three will be in community use parks. One additional artificial turf field is planned for the Laytonia Recreational Park, and two artificial turf fields are under consideration by the Maryland Soccer Foundation for the Maryland SoccerPlex.

Artificial Turf Fields

There are two existing synthetic turf fields built and controlled by the Parks Department. Parks first synthetic turf field was built in 2008 at Montgomery Blair High School. When the property known as the "Kay Tract" was purchased for Blair High School, a portion of the funding came from State Program Open Space funds. Through a Memorandum of Understanding (MOU) with the County and MCPS, Parks manages and maintains three athletic fields in what is known as the "recreation parcel" at Blair, including the stadium field used by MCPS for football games and other school sports. This unique arrangement was created in part to allow for maximum community-use of the three fields outside of school needs and also to justify the use of Program Open Space funding. The stadium field was originally constructed as a natural turf field in 1998 in conjunction with the construction of the new high school. From the start, there was wide-spread dissatisfaction with the quality of turf on the field, with over-use being the primary cause of the problem. Parks originally permitted the stadium field for community use to an array of groups including the Washington Chiefs Football League, but eventually ceased permitting the field because school use alone left the field in undesirable condition most of the time.

When Parks began considering synthetic turf as one of several options to bridge the gap between supply and demand for field time, it conducted a detailed site selection process to prioritize venues for synthetic turf fields. The primary criteria for sites were the ability to handle intense use without conflicts with adjacent communities, adequate parking, and the existence or future capability of lighting. The stadium field at Blair emerged as the top site, and a rectangular field at Fairland Recreational Park was the second priority.

Fairland Recreational Park was opened in 1995. It included five athletic fields, including a full size rectangular field. Similar to Blair, the demand for use was high and the natural turf surface rapidly deteriorated. The field was renovated several times, but the turf cover did not stand up to the use. It was recently converted to artificial turf, and opened for community use by permit in December 2010.

There are currently three planned artificial turf fields for park facilities over the next six-years; one at Laytonia Recreational Park and two at the Maryland SoccerPlex. Parks also plans to install artificial turf on the slab of the old Wheaton ice rink, a covered open-air facility, to allow soccer, lacrosse, futsol, and other uses. This project will generate income for Parks enterprise fund.

Laytonia Park is currently approved in the CIP to provide four baseball / softball diamonds. However, current needs as defined by the most recent Land Preservation, Parks, and Recreation Plan call for a greater need for rectangular fields. In response, the Planning Board recently approved a change to the Laytonia plan to include three rectangular fields and one diamond field. The new plan calls for one of the rectangles

to be synthetic turf and the other two to be natural turf. Parks believes that the construction of premier natural grass and synthetic turf rectangular fields side by side in the same recreational park provides an excellent opportunity to fully test and evaluate the comparative cost and benefit of both grass and synthetic turf athletic field surfaces in Montgomery County. Parks will implement a program, in cooperation with other agencies, to carefully evaluate both grass and synthetic surfaces on rectangular athletic fields. The results of this program will be used to determine specifications for future athletic field construction and renovation projects in the parks, and the results could be used by the Planning Board and County Council in the review of other public and private projects that include athletic fields.

MCPS High School Stadium Fields

Below are specific facts concerning MCPS athletic fields:

- Total Schools - MCPS has 25 high schools.
- Stadium Fields - MCPS has 25 stadium fields that are used primarily for games, contests. (The stadium field at Montgomery Blair High School is owned and maintained by Montgomery County Parks.)
- Types of Stadium Fields – Twelve stadium fields have bluegrass or fescue on native soil. Ten stadium fields have Bermuda grass on native soil. Three stadium fields (Montgomery Blair, Richard Montgomery, and Walter Johnson) have artificial turf.
- Stadium Field Use – At 15 high schools twelve teams share the stadium field for home games. These teams include: varsity and junior varsity teams in field hockey, football, boys' lacrosse, girls' lacrosse, boys' soccer, and girls' soccer. At ten high schools, the field hockey team plays on a separate field because of adverse stadium field conditions.
- Maintenance of Stadium Fields – Each school receives a set amount each year for its athletic program, a portion of which is allocated by each school for stadium field maintenance. In addition, stadium field maintenance is supplemented by booster club donations and volunteer efforts.
- On-Campus Full Practice Fields - In addition to the 25 high school stadium fields, there are 56 approximately full-sized rectangular practice areas contained on MCPS high school sites. Many of these practice fields overlap baseball and/or softball outfields – they can be used as a rectangular field in the fall, but not in the spring during the baseball/softball season.
- On-Campus "Partial" Fields - There are twelve partial rectangular fields at MCPS high school sites – fields that are not regulation sized but can accommodate drills and small team practices.
- MCPS Fields Permitted by Community Use of Public Facilities (CUPF) – When not scheduled for school activities the three artificial turf stadium fields are permitted for community use through CUPF. The 56 full-sized practice fields mentioned above, in addition to the 22 natural turf stadium fields and the 12 partial fields, are not permitted for public use.
- Practice Fields Adjacent to the School - There are nine approximately full-sized rectangular fields located on property adjacent to high school sites (but off the school property).
- Off Campus Fields – 124 MCPS teams that use rectangular fields practiced off-site last year. These 124 teams utilized approximately 45 fields.

Artificial Turf Fields Information

In the United States there are approximately 5,500 artificial turf fields currently installed according to the Synthetic Turf Council (www.syntheticturfcouncil.org). In Maryland and the Washington metropolitan area there are 54 artificial turf fields installed at 234 public high schools (See Appendix A). In Montgomery County outdoor artificial turf fields have been built at 16 locations with one in design review by the Montgomery County Department of Permitting Services (DPS) as shown in chart I-2. Of the 16 field locations in Montgomery County there are seven artificial turf fields at schools or parks (including three at the Maryland SoccerPlex in Germantown). There also are several indoor artificial turf fields in the county.

Chart I-2

Outdoor Artificial Turf Fields* In Montgomery County

	Location	Status	Date Opened	Description
1	Bullis School	Constructed	2004	rectangular field
2	Church of the Little Flower	Constructed	2004	playground field
3	Connelly School of the Holy Child	Constructed	2010	rectangular field
4	Fairland Regional Park	Constructed	2010	rectangular field
5	Georgetown Prepratory School	Constructed	2006	rectangular field
6	Good Counsel High School	Constructed	2009	rectangular field
7	Holton Arms School	Constructed	2007	rectangular field
8	Holy Redeemer Church	Constructed	2010	playground field
9	Landon School	Constructed	2007	rectangular field
10	Maryland SoccerPlex	Constructed	2007	3 rectangular fields
11	Mater Dei School	Constructed	2009	rectangular field
12	Montgomery Blair High School	Constructed	2008	rectangular field
13	Our Lady of Lourdes	Constructed	2008	rectangular field
14	Richard Montgomery High School	Constructed	2009	rectangular field
15	St Andrew Episcopal School	Constructed	2008	2 rectangular fields & baseball diamonds
16	Walter Johnson High School	Constructed	2010	rectangular field
17	The German School	In Permitting Process		
	Indoor Fields in Montgomery County			
1	Champions Field House	Constructed	2008-2011	5 rectangular fields of varying sizes (1 section rolls up)
2	Maryland Soccerplex	Constructed	2000	2 rectangular roll-out fields (replaced in 2009)
3	Rockville SportsPlex	Constructed	2000	3 rectangular fields (replaced in 2008)

*all outdoor fields and permanent indoor fields (non-roll-out) utilize crumb rubber infill

Artificial turf fields are really systems built using similar components—an underground drainage system with a compacted gravel base, a polypropylene or nylon fiber carpet, and infill product(s) used to hold the carpet fibers upright and to cushion the surface to mimic the characteristics of natural grass. Different manufacturers vary the carpet fibers and infill materials to distinguish their product.

County Demand for Quality Rectangular Fields

There are two primary issues facing the current state of rectangular fields in Montgomery County—lack of capacity (not enough fields) and maintaining the quality of existing fields. These issues are faced by both Parks and MCPS as described below.

Montgomery County Parks

Ballfield Work Group & Ballfield Initiatives CIP Project

In January 1999, at the request of the County Council, the Planning Board and Interagency Coordinating Board – Community Use of Public Facilities (CUPF) approved the formation of a Ballfield Work Group to address the acute shortage of ballfields in Montgomery County. The group consisted of various ballfield user groups and staff from Parks, CUPF, MCPS, and the Department of Recreation. This work group existed for five years and initiated several operational and capital improvements to increase ballfield quality and capacity.

Also in 1999, the County Council approved the "Ballfield Initiatives" project in the Parks CIP. The purpose of the project as stated in the adopted CIP is: "The project addresses countywide ballfield needs by funding ballfield improvements on parkland, school sites, and other public sites or private properties". The project is still active today and funds $8.2 million of improvements through FY 16. This project funded the synthetic turf fields at Montgomery Blair and Fairland in addition to many other projects that increased field availability.

Land Preservation, Parks, and Recreation Plan

The Department of Parks prepares a park and recreation needs analysis every five years (most recently completed in 2005) called the Land Preservation, Parks, and Recreation Plan (formerly called the Park, Recreation, and Open Space (PROS) plan). The plan points to the need for 123 additional athletic fields in the county by the year 2020, of which 73 are full-sized rectangular fields.

Building and Sustaining High Quality Natural Turf Grass Athletic Fields

The necessary ingredients to sustain natural turf grass cover on an athletic field fall into three primary categories; **construction, maintenance, and usage**. All three must be carefully controlled, or the natural grass surface will likely become unsatisfactory and unsuitable for organized sports play. In order to sustain a high quality stand of natural turf grass on a field, it must:

1) be designed and constructed properly,
2) be maintained regularly by qualified personnel, and
3) have usage controlled and limited.

If **any one** of the three factors is missing, natural turf cover on the field will deteriorate over time.

In an effort to explore best practices in high quality natural turf maintenance the work group followed the suggestion of the Montgomery County Safe Fields Coalition to interview the turf managers from the town of Branford Connecticut and St Mary's College in southern Maryland. In addition, the work group contacted staff from the Maryland SoccerPlex to gain their insights into maintaining high quality fields in Montgomery County. The SoccerPlex professionally maintains several types of natural and artificial turf fields for competitive use.

Individuals from the Artificial Turf Work Group have spoken with and asked questions of Kevin Mercer, Certified Turf grass Professional, Superintendent of Grounds, St. Mary's College of Maryland. He indicated that the stadium field at St. Mary's college is scheduled for 150 hours of use per year. This level of use indicated by Mr. Mercer is approximately half of the use of MCPS stadium fields and does not include college football competition. The work group members did not feel that the St. Mary's college experience was comparable to what was being asked of natural turf stadium fields in Montgomery County.

Members of the work group also spoke with Alex Palluzzi, Director of Recreation, Town of Branford, Connecticut Parks and Recreation Department. While Parks staff heard of various success stories with organic fertilizers and compost, a main factor in maintaining the playability of town fields is control over use. The town Parks and Recreation staff have not maintained or tracked the hours of use on their fields, so it is difficult to obtain an apples-to-apples comparison of field use. The town staff maintains a calendar to block field time for leagues, and the leagues respect and honor the decisions of the town Parks staff in using the fields after inclement weather. In addition, the high school in Branford has an artificial turf field that is used for high school athletic activities. Montgomery County Parks staff has not learned of any new information that would bring new maintenance practices to the management of parks and school natural turf fields that would improve their durability to support the amount of use currently recorded on Regional Parks or MCPS stadium fields.

The work group discussed many issues regarding both natural and artificial turf with Mr. Jerad Minnick, Sports Turf Manager at the Maryland SoccerPlex in Germantown. Mr. Minnick is an expert in the field of turf field maintenance with experience with high quality natural grass fields for both Major League Baseball and Major League Soccer teams. Mr. Minnick also has extensive experience with the installation and maintenance of high quality natural and artificial turf fields at the Maryland SoccerPlex.

It is important to note that the establishment and care of turf grass across the country is a specialized discipline and is representative of a large industry. Professional sports teams, universities, golf courses, park & recreation departments, and the lawn care industry all depend on highly qualified professionals to deliver consistently high-performing turf grass surfaces for their intended purpose. Often, there is dire financial consequence associated with the failure of a natural turf surface. A primary resource for professionals involved with natural turf athletic fields is the Sports Turf Managers Association (www.stma.org). Several members within Parks staff responsible for the management of natural turf fields are members of this association and network regularly with other members of the local and national chapters about best practices for management of turf grass in the mid-Atlantic region. They stay current with the latest trends regarding field construction, turf grass cultivars, soil properties, drainage systems, mowing, fertilization, insect control, disease and fungus control, irrigation, topdressing, overseeing, aerating and the many other practices necessary to sustain high quality natural turf grass on an athletic field in the mid-Atlantic region. Based on the discussions with staff from Branford, Connecticut, St. Mary's College, and the Maryland Soccerplex, Parks and MCPS staff did not identify any "silver bullet" practices from these examples that would allow MCPS and Parks to achieve hours of use on natural turf that would be comparable to the hours of use possible on artificial turf. *Note: This report goes into further detail regarding hours of use in the "Playability (Hours of Use)" Section later in this report.*

Montgomery County Public Schools

Demands on High School Stadium Fields

Significant time, effort, and money are expended in trying to maintain safe, adequate playing conditions on MCPS high school stadium fields. This expenditure of resources consistently falls short of its goal, primarily because of the intensive wear and tear that result from so many sports and teams sharing high school stadium fields for competitive contests.

Twelve interscholastic athletic teams per high school share the stadium field for games. Including scrimmages, regular season games, and playoff games, approximately 95 contests will be conducted yearly on each of the 25 MCPS high school stadium fields in the fall and spring seasons—2,375 contests system-wide. The twelve school teams that share the stadium field at most MCPS high schools include varsity and junior varsity teams in football, boys' and girls' soccer, boys' and girls' lacrosse, and field hockey. In addition, stadium fields accommodate performances by marching bands, pom-poms, cheerleaders, flags, and majorettes.

A result of the intense use is that stadium fields do not have the opportunity to regenerate growth. High school athletic seasons occur in fall and spring, prime growing seasons for cool weather natural turf grass. With considerable cost and effort, schools can get fields to rebound to some extent at season's end in preparation for the next season. However, fields degenerate at a quicker pace the next season because the grass did not have the proper amount of time or weather conditions to regenerate growth and establish a strong root system. After a game is played in wet or adverse conditions, the field is often damaged, its condition rendered unplayable at best, ruined at worst. Providing that funds are available, the field is resodded or renovated after the season ends, and the expensive cycle begins anew.

At the same time, the growing numbers of community groups, already desperate for field space, do not have access to high school stadium fields that feature lights for late-evening practices and games. Through the use of its artificial turf fields at Richard Montgomery and Walter Johnson high schools MCPS has created opportunities for additional playing time for community groups on a high quality field and help to meet the increasing demands for using high school stadium fields.

Off-Campus Practices

There is a major shortage of rectangular outdoor practice facilities at MCPS high schools. Practice fields are used every day throughout the fall and spring, and their condition are generally sub-standard. Moreover, because of limited field space, students on 125 MCPS athletic teams who use rectangular fields must drive off-campus on a daily basis in order to practice. Many of these students do not have cars and many are too young to drive. Safe transit to practice is an issue. In addition, students practicing off campus lack a nearby facility in which to take refuge in the event of sudden severe weather.

An important advantage of artificial turf fields is that they allow all teams that use rectangular fields to conduct practices on-campus. The stadium field becomes a practice facility as well as a game facility, and teams can stagger practices in a fashion that allows teams to remain on-campus.

A summary of concerns associated with teams practicing off-campus include:

- Transportation—Nearly 2,500 students are driving with other students off campus on a daily basis. The prospect of accidents is a concern.

- Field Conditions/Injuries—Whereas attention has been focused on the adverse field conditions of MCPS stadium fields, practice facilities are generally much worse, especially at off-campus sites that are not maintained, lack irrigation, and are used every day. Practice fields are frequently very hard, rock-laden, and have uneven tufts and divots.

- Severe Weather—Sudden storms are a significant source of concern for off-campus practices. When practicing on-campus, students can be brought into the building when severe weather suddenly appears. For off-campus practices there are limited opportunities for students to find shelter.

- Injuries—There are many potential injuries and emergencies that can arise, medical and otherwise, that require assistance. There are other coaches and athletic personnel located on campus to assist in an emergency situation. This important advantage is lost for teams that practice off-campus. All MCPS high schools have an Automated External Defibrillator (AED) located outside, adjacent to practice facilities, in case of an emergency. An AED is not available at off-campus sites.

- Supervision—It is much easier to supervise students at the high school facility, where there are more faculty and staff than at off-campus sites. Supervision concerns include students arriving at the off-campus site at staggered times, in advance of the coach.

Other issues with off-campus practices include:

- Each of the 125 teams that practice off-campus practiced an average of 44 times over the season, a total of 5,456 off-campus practices.
- Each team had an average of 20 students, 2,480 total students.
- An off-campus practice requires approximately two extra miles of daily driving to get to and home from the off-campus site.
- Estimating two students per car, approximately ten cars travel two miles on 5,456 occasions to take students to off-campus practices at 22 high schools—approximately 109,210 total miles.
- Assuming the average car uses approximately 22.4 miles per gallon (per EPA 11/17/2010 assumptions for 2009 average vehicle fuel economy), approximately 4,875 gallons of gasoline are consumed annually to transport students to off-campus practices.
- According to USEPA calculators, the gasoline used results in approximately 43.3 tons of carbon dioxide emissions each year. (http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results)
- Middle and elementary schools frequently voice concern that having high school teams practice at their facilities is disruptive—practices at elementary school sites often begin before school is dismissed. High school teams prefer to practice relatively soon after school for a multitude of reasons, including that it allows sufficient time for homework.
- Storage—transporting equipment such as practice balls, portable goals, cones, etc., to off-site practices on a daily basis is a major inconvenience.

Equity Issues

The current state of Montgomery County Public Schools (MCPS) high school stadium fields varies greatly across the system. The standard field for MCPS high schools is a native soil field with bluegrass or fescue turf. Some schools, with substantial booster club support, have been able to install Bermuda grass surfaces that require costly annual maintenance contracts. However, most MCPS high schools do not have the financial support from their booster clubs to fund a maintenance contract for a Bermuda grass field, creating a distinct inequity among schools. The conditions of stadium and practice fields are easily the largest factors that differentiate MCPS high school interscholastic athletic programs. Athletic programs are relatively similar in most other respects, including

uniforms, officials, and safety equipment. There is a need to provide the same game and practice conditions for all 25 MCPS high schools.

Also, because of inadequate field conditions on the stadium field, field hockey teams do not compete on the stadium field at approximately half of the MCPS high schools, creating an important Title IX issue relating to equal access to facilities. Field hockey teams in one-half of the schools do not have equal opportunity to compete in the school's premier athletic facility.

The inequity in field conditions is most pronounced when comparing practice facilities. Practice facilities at schools that lack the financial means for continuous maintenance is far inferior to schools with more abundant financial means.

Cost of Maintenance

Data compiled for the 2009-2010 school year indicates that the 25 MCPS high schools spent an average of $22,000 to maintain their natural grass fields. However, a closer look at this figure reveals the inequity that exists among MCPS high schools, and also reveals a more realistic estimate for the cost associated with proper maintenance of a high-use athletic field. Briefly, most high schools lack the funds to install and maintain the more expensive Bermuda grass fields. Yet Bermuda surface fields are clearly the fields that are in the best condition.

Though the average field maintenance cost for the 25 MCPS high schools was $22,000, the seven MCPS high schools with the highest annual athletic income for the 2009-2010 spent an average of $45,400 for field maintenance. Six of these seven schools have Bermuda grass surface fields.

In contrast, the 15 high schools with the lowest annual athletic income for 2009-2010 spent an average of $13,400 for field maintenance (Montgomery Blair, Walter Johnson, and Richard Montgomery high schools with artificial turf fields, are not included in this calculation). The disparity between schools is clear. It is also clear that most schools spend far below what is required to maintain a quality stadium field.

Cancellations

Several hundred MCPS games are cancelled or postponed annually because of the condition of natural turf fields. Playing a game on a wet field can ruin the field for the season, rendering the field unplayable, and resulting in extremely expensive repairs. It does not necessarily have to be raining for a game to be cancelled or postponed - one sustained rainfall can cause a field to be shut down for many days.

Regular season games are not the only rain-related cancellations that are of concern. Rain also causes hundreds of practice adjustments and cancellations in the course of a year. Practice cancellations and adjustments seriously disrupt student schedules and can have an effect on student conditioning.

Rain-related game and practice cancellations and adjustments have a significant effect on schools, students, parents, game officials, bus drivers, booster clubs, and many others. The adverse effects are not only financial, but they also wreak havoc on the day-to-day lives and routines of many people. Cancellations also place schools that do not have artificial turf stadium fields at a decided competitive advantage.

Approximately 30 games at each high school, 750 games system-wide, will be cancelled or postponed in a typical year that could have otherwise been played on an artificial surface field. Similarly, approximately

120 practices per school, 3,000 practices system-wide will be cancelled or disrupted each year because of rain.

A summary of adverse consequences associated with weather-related game and practice cancellations include the following:

1. Financial

- Gate Receipts – Gate receipts are collected for all events conducted on the stadium field. Approximately 10 percent of 750 MCPS stadium field contests that are cancelled each year will not be rescheduled, resulting in annual lost gate receipt income of approximately $35,000.

- Referees – Approximately 50% of the 750 games that are cancelled each year on stadium fields are cancelled after teams and referees have arrived on site, an annual expense of about $50,000.

- Transportation – There are expenses associated with obtaining a second bus for rescheduled games. A bus costs about $140 per contest, resulting in an additional annual expense of about $52,000.

2. Game Preparedness and Athletic Conditioning

- It is important that students practice on a regular basis. Regular, consistent practices are necessarily for proper conditioning as well as for developing proper technique. Each team that shares the stadium field will have approximately ten practices cancelled or adjusted to a later time, 120 practices per high school, and 3,000 practices system-wide.

3. Disrupted Schedules

- Cancellations and subsequent rescheduling of contests and practices have significant consequences on the schedules and quality of life experiences of thousands of students and their parents.

- When rain causes practices to be rescheduled for the gym, practices are staggered so that several teams may conduct practices. Often the last team does not end practice until 9:00. Generally, students do not know in advance that their practice time will be adjusted, creating conflicts and disruptions, including homework, dinner, baby-sitting siblings, finding a way to go home and return for practice, etc.

- Rain adjustments cause significant hardships for parents. Athletic game schedules are posted in late July. Many parents will begin planning and arranging their personal and work schedules as early as late July according to the posted schedule.

4. Competitive Disadvantage

- Cancellations create inequities resulting in competitive advantages for some schools/teams. Teams achieve higher seeds in playoffs according to their regular season record. Teams that have an artificial turf field have a distinct advantage over other schools. Not only do they have fewer game cancellations, but also they can practice and prepare consistently without interruption.

High School Stadium Fields with Artificial Turf

For Richard Montgomery, Montgomery Blair, and Walter Johnson high schools, there are many benefits associated with artificial turf on their stadium fields. These benefits for both high school and community groups include:

- Providing safer, more consistent, and more competitive surfaces for hundreds of MCPS and community teams.

- Providing safe, on-campus practice areas for MCPS athletic teams, and freeing up off-campus practice fields for community use.

- Providing community teams and community groups access to high quality lighted fields that helps to address the documented rectangular field shortage in the county.

- A greater degree of compliance to Title IX. Field hockey contests are not played on the stadium field at approximately half of the MCPS high schools because of unsuitable field conditions.

- Minimal cancellations. Prevailing weather conditions in the fall and spring force many cancellations, disrupting parents' as well as students' schedules. The only weather conditions that would cause a postponement on artificial turf fields would be lightening or abnormally severe weather.

- Significant savings in maintenance. Savings include not only seed, grass, fertilizer, and water, but also an enormous savings in time and effort by school staff and parent volunteers.

- Physical education classes having access to a safe, all-weather surface for activities during the school day for more than half of the school year.

- Reducing the amount of fertilizer, pesticides, and herbicides potentially reaching the Chesapeake Bay. Much attention has been focused on conserving resources and reducing pollutants reaching the Chesapeake Bay. Artificial turf fields require no fertilizer, pesticides, herbicides, or water. They also do not need to be mowed, avoiding another significant pollutant from lawnmower exhaust.

- Creating a greater degree of equity among high schools. The most immediate, visible difference among school athletic programs is the condition of outdoor practice facilities and stadium fields. Schools located in comparatively affluent areas of the county tend to have stadium fields and practice fields that are far more attractive and that are in far better condition than fields in less affluent areas.

- Creating greater opportunities for physical activities for youths. Childhood obesity is a serious community problem. Because of the paucity of available fields, there are significant limitations on the time available for youth to participate in community field activities.

Injuries and Field Consistency in Natural and Artificial Turf Fields

Comparing artificial turf fields to healthy, vibrant, high quality natural grass fields reveals the two are very close from an injury data perspective. In a five-year intensive study, Meyers and Barnhill (2004) found that while minor and substantial football injuries were slightly more prevalent on artificial turf fields, severe injuries were more prevalent on natural grass fields. Similarly, while there was a greater rate of injuries that resulted in zero days of missed practice or playing time on artificial turf fields, the rate of injuries that resulted in one-to-two days of missed time, and 22 days or more of lost time, were greater on natural grass fields. There were more muscle strains on artificial turf fields, but more ligament tears and concussions on natural grass fields.

Available studies and data do not support that athletes playing on a high quality artificial turf field are fundamentally more or less prone to injury than those playing on a high quality natural grass field. However, the studies that have been done primarily compare the injury data for artificial turf fields compared to natural grass

fields that are in ideal condition. Few of the 25 MCPS stadium fields would fit the description of a natural grass field in ideal condition, and none would qualify for comparison at midseason or season's end.

Perhaps the greatest safety advantage of artificial turf fields over typical natural grass fields is their consistency. From a player injury perspective, artificial turf fields compare favorably to a high quality natural grass field in good condition and under optimum weather conditions. However, as weather conditions and field conditions become less than optimal, the safety advantages of artificial turf fields increase significantly. They are not as slippery as natural grass fields in wet conditions, they do not freeze in cold weather, and they do not become hard in dry or drought conditions. They do not develop divots, high spots, and low spots. In short, artificial turf remains consistently uniform, with good traction, no matter what type of shoe. The condition of artificial turf fields is not contingent on expensive and time-consuming maintenance, the extent of their use, or prevailing weather conditions.

Playability (Hours of Use)

Comparing the Potential Hours of Use of Natural Grass and Artificial Turf Stadium Fields

A primary reason both Parks and MCPS support the construction of artificial turf fields is the increased hours of use possible with an artificial turf field compared to a high quality natural grass field. These increased hours of use are achieved without risking degradation of the field. In addition, as noted earlier, even under limited hours of use, natural grass fields can suffer major damage from intensive play, especially when play occurs during or immediately after storm events.

In a comparison of natural turf fields and artificial turf fields, it is important to take into consideration hours of use when considering lifecycle costs, as discussed in the next report section, as well as when considering operational and environmental impacts.[1]

A February 2010 study "Review of the Impacts of Rubber in Artificial Turf Applications" by Rachel Simon of the University of California, Berkeley (Prepared For: The Corporation for Manufacturing Excellence (Manex) Full text available at http://www.fieldturf.com/images/downloads/UC_Berkeley_-_Review_of_the_Impacts_of_Crumb_Rubber_in_Artificial_Turf.pdf) provided this summary of differences in hours of use between natural and artificial turf fields as identified by various sources and prior studies:

> *"The Synthetic Turf Council (2008), an artificial turf advocacy group, estimates that natural fields provide 80-816 hours of play in a three-season year, as compared with 3,000 hours for synthetic turf. Kay and Vamplew (2006) offer an alternative estimate with approximately 300 hours of play time for natural grass, 800 for reinforced turf, and 3,000 for artificial turf. James and McLeod (2008) calculate the usable hours of synthetic turf to be closer to 2,000 hours per year on average, with a range from 450 to 4,200 hours. They also note that the typical weekly hours of use for synthetic turf pitches were 44 hours, as compared to 4.1 hours for natural turf."*

While these ranges all differ, they all point to significantly more hours of use with artificial turf fields. For purposes of this report, the staff work group looked at data specific to natural and artificial turf fields in Montgomery County to provide a more relevant and specific assessment of hours per use for different field types.

Artificial Turf Hours of Use

Fortunately, the maximum amount of potential use for the three existing high school stadium artificial turf fields can easily be defined based on their respective warranties (all from Fieldturf Tarkett). The Montgomery Blair High School warranty is presented in Appendix B and includes a specific provision that, "Normal and ordinary use is considered as usage up to 3000 hours per year of regular play…"

For actual hours of use the staff work group looked at annual permit experience for artificial turf fields at Montgomery Blair High School and Richard Montgomery High School (which have multiple years of actual use), and then added in estimated use by MCPS for team games and practices as well as physical education

[1] For instance, even under the most conservative assumptions in this section, an artificial turf field provides hours of use equivalent to approximately 3 natural grass fields. In other words to achieve the same programming benefit of one artificial turf field, three natural turf fields would have to be built and maintained.

programs during the school day. In total, estimated annual hours of use for each field is 2,300 hours. In both cases, community use is approximately 1,000 hours per year. Estimates for team practices (400 hours per year) and team games (300 hours per year) are based on typical team schedules at the various high schools. Physical education programming (600 hours per year) is based on discussions with athletic directors about how the current artificial turf fields are utilized during the school day.

To estimate hours of use at a Parks artificial turf field, the staff work group assumed a total of 1,000 hours of community use that is currently being achieved at the Montgomery Blair High School field. The other uses noted at the school stadium fields are not assumed here.

The staff work group also obtained information from the Maryland SoccerPlex regarding hours their three artificial turf fields are open and utilized annually. The artificial turf fields at the SoccerPlex are used about 1,800 hours per year.

Natural Turf Fields

In most cases, MCPS high schools restrict the use of stadium fields to team games; approximately 300 hours per year. However, some schools with Bermuda grass native soil fields allow some limited physical education programming. In these cases, the fields are used a total of an estimated 400 hours per year.

For Parks, the staff work group looked at the programming experience for the Ridge Road lighted natural turf rectangular field (a cool season native soil field). This field is utilized approximately 500 hours per year. However, according to Parks Staff the field often exhibits severe wear patterns. Therefore, while the hours of use obtained are greater than the hours at an MCPS field, the quality of the field is far less. Therefore, in comparing the Ridge Road field to an artificial turf field or a high quality sand base Bermuda field one must take into account the field condition and the reduced fee one can charge for the field as a result. Revenue generation is discussed in the next section of this report.

The Maryland SoccerPlex limits usage on its natural grass fields to between 400 hours (for its Kentucky bluegrass fields) and 600 hours per year for its Bermuda grass fields. It is important to note that the Maryland SoccerPlex does not program football (the most damaging sport for natural grass fields), has a very different scheduling profile (year-round but less intensive use), and an on-site centralized maintenance program run by expert professional staff.

Hours of Use Comparison Chart

The following chart presents four ways to calculate the difference in hours of use of an artificial turf field versus a natural turf field.

1. The potential hours of use of an artificial turf field are assumed to be 3000 hours per year based on staying within the warranty coverage provided for in the Montgomery Blair High School warranty. The top portion of the chart shows the total hours the MCPS artificial turf fields could theoretically be open and then deducts hours to take into account lack of MCPS use in cold-weather months, reduced use during peak hot weather times, and other miscellaneous hours of non-use even if one were to achieve a maximum 3000 hours of use. This number is then compared to MCPS' current standard stadium field use (300 hours per year) and then also to a higher usage rate (600 hours) that might be possible with a higher quality field.

2. The hours of use of an artificial turf field are calculated based on actual hours of use of MCPS' artificial turf fields at Montgomery Blair High School and Richard Montgomery High School (approximately 2,300 hours per year for each field as mentioned earlier). This number is then compared to MCPS' current stadium field use (300 hours per year) and then also to a higher usage rate (600 hours) that might be possible with a higher quality field.

3. The hours of use of an artificial turf field are calculated based on the potential hours of use (3,000 hours) and the projected hours of use for an exclusive Parks field (no high school use). These numbers are then compared to actual hours of use (500 hours) Parks obtains from a typical lighted full-size rectangular field (Ridge Road Park for example). Parks staff has noted that in the Ridge Road Park example, the field often exhibits severe wear patterns, even at this limited level of use.

4. The hours of use of an artificial turf field are calculated based on potential hours (3,438) and actual hours (1,800) of programming of each of the Maryland SoccerPlex artificial turf fields. These numbers are then compared to the hours of use for the Maryland SoccerPlex's natural grass fields (500 hours for Kentucky bluegrass and 600 hours for Bermuda grass).

Artificial Turf Field Annual Hours of Use Calculation for MCPS and Parks Ballfields

		Hours			Assumptions
1	**Potential Hours of Programming Based on Current MCPS Schedule**				
	Maximum Hours Available Annually	4,928			Hours: 8:00 AM to 9:30 PM, 365 days per year
	Subtract for limited cold weather use*	(1,080)			Community Use only. No MCPS practices or games assumed for 120 days.
	Subtract for no use during peak heat hours	(480)			Exclude an average of 6 hours per day for 80 days
	Subtract for other potential unavailable times	(368)			Reduce usage to 3000 hours (max allowed under the Blair/RM HS warranties)
	Net Hours Programmable	**3,000**			
	Ratio to Current MCPS Natural Grass Fields	10.0	to	1	Assumes 300 hours of use maximum per year on natural grass fields
	Ratio to Improved MCPS Natural Grass Fields	5.0	to	1	Assumes 600 hours of use maximum per year on natural grass fields
2	**Actual Programming Experience at Blair HS and Richard Montgomery High School**				
	Community Use	1,000			Based on actual community use data
	High School Use for games	300			Current usage for HS stadium fields
	High School Use for team practices	400			
	Physical Education Class Use	600			
	Current Usage at Blair HS and RM HS	**2,300**			
	Ratio to Current MCPS Natural Grass Fields	7.7	to	1	Assumes current 300 hours of maximum use per year on natural grass fields
	Ratio to Improved MCPS Natural Grass Fields	3.8	to	1	Assumes current use could be expanded to 600 hours of use per year
3	**Potential and Projected Programming for Artificial Turf Fields at Parks Facilities**				
	Potential Usage	3,000			Maximum allowed under the Blair/RM HS warranties
	Ratio to Current Parks Natural Grass Fields	6.0	to	1	Assumes current 500 hours of maximum use per year on natural grass fields
	Ratio to Higher Quality Parks Natural Grass Fields	5.0	to	1	Assumes current use could be expanded to 600 hours of use per year
	Estimated Use	1,000			Assumed to be similar to community use experience at MCPS AT fields
	Ratio to Current Parks Natural Grass Fields	2.0	to	1	Assumes current 500 hours of maximum use per year on natural grass fields
	Ratio to Higher Quality Parks Natural Grass Fields	1.7	to	1	Assumes current use could be expanded to 600 hours of use per year
4	**Hours of Programming at the Maryland Soccerplex**				
	Total Hours Programmable	3,438			Hours fields are available for rent**
	Ratio to Current Natural Grass Fields	6.9	to	1	Assumes 500 hours of use max. per year on Kentucky bluegrass native soil fields.
	Ratio to Improved Current Natural Grass Fields	5.7	to	1	Assumes 600 hours of use max. per year on Bermuda grass fields.
	Actual Programming	1,800			Actual utilization
	Ratio to Current Natural Grass Fields	3.6	to	1	Assumes 500 hours of use max. per year on Kentucky bluegrass native soil fields.
	Ratio to Improved Current Natural Grass Fields	3.0	to	1	Assumes 600 hours of use max. per year on Bermuda grass fields.

*AT fields are sought after by private groups during cold weather months, since natural grass fields are often not playable at these times.

**Includes weekend days & nights year round, weeknights (non-summer months) and weekdays and weeknights (summer months)

Findings:

1. At the 3,000 hour cap, the hours of use of an artificial turf field would be ten times the current usage (300 hours) of MCPS natural grass stadium fields. If natural grass stadium field maximum usage could be doubled to 600 hours per year, the ratio for maximum potential use would still be five times that of natural grass stadium fields.

2. The actual ratio of usage at the Montgomery Blair High School & Richard Montgomery High School fields (an estimated 2,300 hours per year) is 7.7 times the current usage of MCPS' natural grass stadium fields. If natural grass stadium field usage could be increased to 600 hours per year, the ratio would still be 3.8 times more usage on artificial turf stadium fields.

3. A Parks artificial turf field would be utilized less than a schools field (no school use during the day). However, the community use alone would be about twice as much as is obtained now with a native soil field that exhibits severe wear patterns. If natural grass stadium field usage could be increased to 600 hours per year, the ratio would be about 1.7 times more usage on artificial turf stadium fields. As noted in the chart, with an artificial turf field, Parks could greatly increase its programming (from 1,000 to 3,000) hours. Given the wear exhibited at its natural grass fields even at limited hours, increases of use at its natural grass fields would be problematic.

4. The Maryland SoccerPlex's artificial turf fields are utilized about 1,800 hours per year. This compares to approximately 500 to 600 hours of programming at its natural grass fields resulting in ratios of 3.6 to 1 and 3.0 to 1 respectively. As noted for the Parks fields, the Maryland Soccerplex has additional potential capacity at its artificial turf fields that it does not have at its natural grass fields (due to concern over field degradation).

Life-Cycle Cost Evaluation

A key factor in deciding whether to build an artificial turf field or a natural turf field is the comprehensive lifecycle costs (construction, maintenance, revenue, rehabilitation, replacement) including the cost per hour of use. The cost per hour of use is based on the estimated annual hours of use one can expect from the different field types based on the programming expected for the field.

The staff work group chose four natural grass field types to compare to a typical artificial turf field. The four natural grass field types consist of two different field bases (a 10 inch sand base and a native soil base) and two different grass types (Bermuda grass and Cool Season/Kentucky Bluegrass). The artificial turf field is assumed to be a polypropylene carpet with a crumb rubber infill.

Sand Base versus Native Soil Fields

A sand-base field is built on a 10”-12” deep profile of sand. Under the sand is a 4” layer of pea gravel that is lined with drainage tile on 15’ centers to move the water that drains through the sand and into the gravel away from the field. Sand-base fields cost substantially more to build than native-soil fields but provide two major advantages:

- Fewer Rain Outs: Water drains through the profile quickly, leaving no standing water and eliminating puddles or “muddy” field conditions.
- Increased Hours of Use: A sand base is a mix of specific grades, angles, and sizes of sand. Because of the mix, sand will not “compact” nearly as quickly as a native soil field will from foot and mechanical traffic. Since compaction is a large factor in a field thinning out and dying, a sand base allows more play than a “native soil” field before it begins to thin out.

A “native soil” field is a field constructed of the soil profile native to the area where the field was built. Soil amendments can be added to “native soil” to make it perform better for sports fields. Native soil will not give the performance on drainage and compaction that sand will (unless the native soil happens to meet the particle size analysis that is specified for a “sand base”). A native soil field is significantly less expensive than a sand-base field, but does not provide the same advantages of a sand-base field noted above.

Bermuda Grass versus Cool Season Grass Fields

Bermuda grass is a “warm season” type grass that is being grown in areas as far north as Philadelphia, PA. Bermuda grass is native to the warm weather climates of the south, but genetic and breeding technology has allowed the grass to be successfully used further north into the climate region of Maryland. The grass grows actively during the warm weather months of June through September. Bermuda grass turns brown and is dormant from October through mid May. Bermuda grass takes small amounts of pesticides to maintain, requires less fertilizer than “cool season” turf grasses, but requires more frequent mowing and lower mowing heights to maintain a high quality stand. Bermuda grass is more problematic in northern parts of the country because the cold winters will cause the grass to “winter kill”.

Cool season turf grass grows actively during the months of April through June, then September through mid-November. Cool season turf varieties for sports fields are typically Kentucky bluegrass and mixed grasses including Kentucky bluegrass with Fescue and/or Ryegrass. Cool season turf grass grows slower than Bermuda grass, requires more fertilizer and more pesticides, but requires less mowing. Cool season turf

grass is limited in its use much further south because the high temperatures of summer cause the turf to go dormant and raises the potential for disease killing out large amounts of turf.

Current Examples of Fields in Montgomery County

The Staff Work group believes the closest "apples to apples" comparison in terms of field quality between natural and artificial turf fields is a sand based Bermuda grass or sand based Kentucky bluegrass field to a current generation artificial turf field. However, the staff work group also included two native soil field examples in its comparison (Bermuda and Cool Season) since both types of fields are currently in use in Montgomery County by Parks, the Maryland SoccerPlex and/or MCPS.

M-NCPPC Parks has 18 regional/recreational park rectangular fields. Thirteen of these fields are bluegrass or fescue on native soil, three are Bermuda grass fields on native soil, and two fields are artificial turf with crumb rubber infill.

The Maryland SoccerPlex manages 20 rectangular fields. Fourteen of these fields are Kentucky bluegrass on native soil, one field (the championship stadium field) is Kentucky bluegrass on a sand base, two fields are Bermuda grass on native soil, and the remaining 3 fields are artificial turf with a crumb rubber infill.

MCPS has 25 stadium fields (including Montgomery Blair High School). Twelve of these fields have bluegrass or fescue on native soil. Ten fields have Bermuda grass on native soil and three stadium fields are artificial turf with crumb rubber infill.

Comparison of Natural and Artificial Turf Athletic Fields – Major Assumptions

- A high quality playing surface is to be provided, sufficient for high school and adult level competitive team sports.
- Usage is controlled at all times (i.e. the field is secured; there is no walk on usage).
- The field is designed and constructed by qualified professionals according to industry standards.
- The field is maintained by qualified professionals year-round according to industry standards. The maintenance practices are consistent with the hours of use assumed for each type of field.
- The hours of use for each of the natural grass fields is capped (see previous report section) to avoid degradation of a field from overuse. For this analysis, hours of use assumptions are based on the actual hours of play experienced at MCPS stadium fields, Parks Fields, and the Maryland SoccerPlex fields.
- The artificial turf field comparison for MCPS assumes annual hours of use based on actual hours programmed at the existing artificial turf fields at Montgomery Blair High School and Richard Montgomery High School. As previously noted, the hours of use could potentially be expanded to as much as 3,000 hours per year without voiding existing warranties for those fields.
- The artificial turf field comparison for Parks fields assumes 1,000 hours of community use at the artificial turf field.
- A 20 year time horizon was chosen for the lifecycle analysis. This time period is long enough to assume two carpet replacements for the artificial turf field and one major renovation of each natural grass field.
- **Construction Costs (see Appendix D for cost details)**

- For the artificial turf fields, costs are an average of actual costs incurred for the Montgomery Blair, Richard Montgomery, and Walter Johnson high school stadium fields. A substantial allowance ($300,000) is included for storm water management for the artificial turf fields. However, these and other costs will depend greatly on specific site conditions and could be less costly for MCPS, since MCPS' stadium fields are constructed as part of a larger school modernization project.
- For the natural grass fields, construction cost estimates are based on information provided by staff of the Maryland Soccerplex.

- **Maintenance Costs** - The staff work group asked staff of the Maryland SoccerPlex to provide typical maintenance practices to assume to maintain a high quality playing surface for the different types of fields. Actual maintenance practices will vary based on specific field conditions, weather patterns, resources available, labor costs, the knowledge and skills of the turf manager, and other factors. Please see Appendix C for a summary of life-cycle cost maintenance assumptions. For purposes of this analysis, the following annual maintenance costs were derived based on knowledge of best practices by SoccerPlex staff and actual costs incurred by MCPS currently for its various fields[2].
  - Cool season grass native soil field: $25,000 per year
  - Bermuda Grass native soil field: $45,000 per year
  - Sand Base Field (Bermuda or Kentucky Blue grass): $50,000 per year
  - Artificial Turf Field: $10,000 per year

Lifecycle Cost Analysis (see Appendix D for more details)

Below are two summary charts (one for MCPS and one for Parks) showing the 20 year lifecycle cost and per hour cost for each type of field. The only difference between the charts is the 20 year revenue assumption for the natural grass fields. MCPS does not currently permit its stadium fields (whether Bermuda or cool season grass) for outside use and the lifecycle cost summary assumes there would be no revenue collected from any future natural grass fields constructed. The revenue numbers for Parks assume that the sand base fields could be permitted at hourly rates comparable to the rates currently charged for artificial turf fields by CUPF. Hourly rates for the native soil fields are assumed to be the same as Parks currently charges for its regional rectangular fields.

[2] Cool season annual maintenance cost based on a full-service contract. For Bermuda grass field on native soil, the cost is based on average contract costs incurred for Churchill, Quince Orchard, and Walt Whitman high schools. For sand base fields, costs are based on discussions with staff from the Maryland SoccerPlex. Artificial turf field costs are based on annual contract costs from an artificial turf vendor.

20 Year Cost Summary - MCPS

		Artificial Turf	Bermuda (Sand Base)	Kentucky BG (Sand Base)	Bermuda (native soil)	Cool Season (native soil)
20 Year Net Costs	Initial Capital Cost	1,125,000	530,000	580,000	150,000	75,000
	20 Year Replacement/Rehab Cost*	1,130,000	150,000	175,000	100,000	60,000
	20 Year Maintenance/Other Costs	206,000	1,000,000	1,000,000	900,000	500,000
	20 Year Total Costs	**2,461,000**	**1,680,000**	**1,755,000**	**1,150,000**	**635,000**
	20 Year Revenue - MCPS**	2,000,000	-	-	-	-
	20 Year Net Cost - MCPS	**461,000**	**1,680,000**	**1,755,000**	**1,150,000**	**635,000**
	20 Year Net Cost - Net Present Value					
	3 Percent Discount Rate	532,751	1,363,644	1,429,722	885,255	486,835
	5 Percent Discount Rate	564,483	1,211,398	1,272,938	759,340	416,394
	7 Percent Discount Rate	587,512	1,091,630	1,149,459	661,319	361,585
Cost Per Hour of Use	**Annual Hours of Use**	**2,300**	**600**	**500**	**400**	**300**
	20 Year Net Cost Per Hour of Use - MCPS	**10.02**	**140.00**	**175.50**	**143.75**	**105.83**
	3 Percent Discount Rate	11.58	113.64	142.97	110.66	81.14
	5 Percent Discount Rate	12.27	100.95	127.29	94.92	69.40
	7 Percent Discount Rate	12.77	90.97	114.95	82.66	60.26

*Assumes two artificial turf carpet replacements (after years 8 and 16) and one major natural grass rehab after year 12.

**No revenue assumed for natural grass fields since MCPS would reserve these fields only for MCPS team games and practices.

Findings – MCPS Stadium Fields:

- Artificial turf fields cost approximately twice as much to construct as either of the sand base fields.
- The least expensive field, by far, over a 20 year period is the cool season grass native soil field.
- However, when taking into account revenue generated, the net cost of artificial turf fields is less than the cool season grass native soil fields and far less than the other field types.
- Because of the high up-front cost for artificial turf and sand base natural turf fields, a net present value calculation increases the net costs of these fields (over a 20 year time horizon) in comparison to the native season natural grass fields. However, the sand base fields still have a much higher net cost than the artificial turf field.
- Despite the higher up-front and future replacement costs, an artificial turf MCPS Stadium field provides a substantially lower net cost per hour of use than any of the natural grass options because of the substantially increased hours of use and additional revenue generated from that increased use.
- Assigning various discount rates to the hours of use partially reduces the hours of use cost disparity, but the artificial turf field still has a much lower cost per hour of use than all of the other fields.

20 Year Costs - Parks

		Artificial Turf	Bermuda (Sand Base)	Kentucky BG (Sand Base)	Bermuda (native soil)	Cool Season (native soil)
20 Year Net Costs	Initial Capital Cost	1,125,000	530,000	580,000	150,000	75,000
	20 Year Replacement/Rehab Cost*	1,130,000	150,000	175,000	100,000	60,000
	20 Year Maintenance/Other Costs	206,000	1,000,000	1,000,000	900,000	500,000
	20 Year Total Costs	**2,461,000**	**1,680,000**	**1,755,000**	**1,150,000**	**635,000**
	20 Year Revenue - Parks**	2,000,000	1,200,000	1,000,000	280,000	220,000
	20 Year Net Cost - Parks	**461,000**	**480,000**	**755,000**	**870,000**	**415,000**
	20 Year Net Cost - Net Present Value					
	3 Percent Discount Rate	532,751	488,109	685,848	676,971	323,183
	5 Percent Discount Rate	564,483	475,547	649,828	584,869	279,310
	7 Percent Discount Rate	587,512	464,297	619,758	513,003	245,050
Cost Per Hour of Use	**Annual Hours of Use**	**1,000**	**600**	**500**	**500**	**500**
	20 Year Net Cost Per Hour of Use - Parks	**23.05**	**40.00**	**75.50**	**87.00**	**41.50**
	3 Percent Discount Rate	26.64	40.68	68.58	67.70	32.32
	5 Percent Discount Rate	28.22	39.63	64.98	58.49	27.93
	7 Percent Discount Rate	29.38	38.69	61.98	51.30	24.51

*Assumes two artificial turf carpet replacements (after years 8 and 16) and one major natural grass rehab after year 12.
**Natural Grass Revenue = same $ rate as AT for sand-based fields, current rates ($22/hr assumed for native soil fields

Findings – Parks Fields:

- The lifecycle costs for the various fields are closer to each other than for MCPS, because all Parks fields are assumed to generate some revenue and the artificial turf field is assumed to be used fewer hours (only 1,000 hours of community use) compared to MCPS stadium fields (2,300 hours).
- When taking into account revenue generated, the net costs of all the field types are relatively close, with the cool season grass native soil field having the lowest net cost followed by the artificial turf field and the Bermuda grass sand base field.
- Because of the high up-front cost for artificial turf and sand base natural turf fields, a net present value calculation increases the costs of these fields (over a 20 year time horizon) in comparison to the native season natural grass fields.
- Despite the higher up-front and future replacement costs, an artificial turf field is much lower in net cost per hour compared to any of the natural grass options because of the many more hours of use, and the additional revenue generated.
- Assigning various discount rates to the hours of use makes the artificial turf field and the cool season native soil field comparable in per hour cost. The other fields are still more expensive per hour, primarily because of higher annual maintenance costs and lower overall revenue generation.

Public/Human Health Concerns

Summary

Environmental impact assessments and health impact assessments are formal processes through which the evaluation of our built environment and its impact on human health can be measured. These processes identify and examine potential health risks linked to the environment of concern.

In the absence of either an environmental impact assessment or a health impact assessment on the installation and use of artificial turf fields, the work group identified some of the areas of potential human risks that were raised during the compilation of information that forms this report. This is not a complete set of risks. A formal process would be required to identify and examine all the human health risks from all the artificial turf field materials under consideration. Such an analysis was beyond the scope and capacity of the Artificial Turf Work Group.

Due to the distinct physical characteristics of crumb rubber infill artificial turf systems, concern has been raised over potential adverse health effects related to use of these systems. The potential physical health effects associated with crumb rubber infill artificial turf systems include:

- chemical exposures
- heat-related illnesses
- abrasions/turf-burns
- injuries
- infections, and allergic reactions

The potential for chemical exposure was addressed in most of the literature and reports this committee found. The risk arises from the recycled crumb rubber infill that is part of the most common artificial turf systems. The composition of this crumb rubber is quite variable within and between manufacturers of both natural and synthetic rubbers including additives such as zinc, lead, sulfur, carbon black, polyaromatic hydrocarbons, and volatile organic compounds. Exposures of concern include physical contact through ingestion, inhalation, and dermal or ocular exposure.

Most of the literature reviewed by the committee also raised the issue of heat-related illnesses from use of artificial turf systems. Artificial turf surfaces are known to absorb heat to a greater degree than natural turf resulting in surface temperatures that can be much higher than the surrounding air. There are claims that the elevated temperatures increase the risk of heat-related illness and complaints of discomfort and actual burns. Please see the next section for a discussion of heat related issues.

The issue of the type and frequency of injuries on artificial turf compared to the frequency and type of those that occur on natural turf surfaces also came up in the literature. Many factors influence the rate of sports injuries, including the type of playing surface. The many kinds of artificial turf surfaces and changes in the products over the years have complicated the assessment of how the playing surface affects injury rates. Also, there are claims that the abrasiveness of artificial turf fibers may contribute abrasions or “turf burns”.

Concerns were noted in literature over the potential for bacterial infections, including methicillin-resistant *Staphylococcus aureus* (MRSA), due to the number of abrasions experienced on artificial turf surfaces.

Latex allergies related to contact with artificial turf surfaces that may have latex in their composition also were noted in literature. Latex allergens are found in tire rubber and players on these fields could be exposed.

The DHHS staff has provided the following comments regarding Artificial Turf:

> *"There are many considerations to weigh in selecting the material with which to construct athletic fields. DHHS is not equipped with the necessary specialized expertise to conduct an environmental and safety assessment of either the artificial or natural turf already in place or to determine what material to use in the future. If this type of assessment is sought, DHHS recommends the county seek outside consultation from an entity with expertise and demonstrated experience in the field. At a minimum, a meta-analysis of all studies should be completed to ensure a complete literature review in this area and it should be done by an entity with a proven topic expertise and track record.*
>
> *The DHHS can assist Parks and MCPS in ensuring that policies and procedures that maximize the level of safe and healthy use and exposure related to athletic field use are based on sound scientific and public health merit and that the policies and procedures align with best public health practices to minimize risk.*
>
> *There are various sources of information on materials that are used to construct athletic fields. Information is available from the natural turf and artificial industries, various government agencies at the federal and state level, academic research, as well as from advocacy groups. The compilation of articles and reports reviewed by the committee was limited to those materials that were easily accessible to the group from independent searches or by recommendations from other interested parties. The articles and reports compiled are not a comprehensive examination of all scientifically sound results-based information of proposed field materials based on the latest scientific research that weighs the strengths and limitations of the material, the evaluation methods or the applicability of the results to the specific conditions in Montgomery County under which the installation, maintenance, and exposures would occur.*
>
> *A complete meta-analysis of all scientific research and literature available would be the recommended approach by DHHS to determine the level of health risk posed by each material type. Moreover, to fully understand the specific risks with materials installed in Montgomery County, objective testing of the materials used to compile the surfaces being proposed would be required. Outside of general guidance on proposed evaluation strategies and considerations identified from other jurisdictions, the evaluations are interesting, informative but are limited to the area studied in the evaluation."*

Synopses of the reports reviewed by the work group

Government Reports

United States Consumer Product Safety Commission

- CPSC Staff Finds Synthetic Turf Fields OK to Install, OK to Play On, U.S. Consumer Product Safety Commission, Office of Information and Public Affairs, Washington, D.C., Press Release #08-348, July 30, 2008. http://www.cpsc.gov/cpscpub/prerel/prhtml08/08348.html

"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. CPSC 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 CPSC 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."

United States Environmental Protection Agency

- A Scoping-Level Field Monitoring Study of Synthetic Turf Fields and Playgrounds, Office of Research and Development, National Exposure Research Laboratory, United States Environmental Protection Agency, November 2009. Document available at: http://www.epa.gov/nerl/features/tire_crumbs.html, Last modified December 3, 2009.

This study collected air, wipe, and material samples. The air samples were analyzed for particulate matter mass, metals, particulate morphology and 56 volatile organic analytes. The wipe and material samples were analyzed for total extractable concentrations of several metals and bioaccessible lead. The EPA report concluded:

> *"On average, concentrations of components monitored in this study were below levels of concern; however given the very limited nature of this study (i.e., limited number of components monitored, samples sites, and samples taken at each site) and the wide diversity of tire crumb material, it is not possible to reach any more comprehensive conclusions without the consideration of additional data."*

State of California

Safety Study of Artificial Turf Containing Crumb Rubber Infill Made From Recycled Tires: Measurements of Chemical and Particulates in the Air, Bacteria in the Turf, and Skin Abrasions Caused by Contact with the Surface, Contractor's Report produced under contract by: California Department of Resources Recycling and Recovery, Office of Environmental Health Hazard Assessment Pesticide and Environmental Toxicology Branch; Sacramento, CA.; October, 2010. http://www.calrecycle.ca.gov/Publications/Tires/2010009.pdf

The goal of this study was limited to the assessment of inhalation and skin infection risks associated with the use of crumb rubber infill. Specifically the study looked at the potential for inhalation of volatile organic

compounds and particulates less than 2.5 microns in the air above the playing field. With respect to skin infections the study assessed the harboring of bacteria in the turf and potential for increased skin abrasions.

The study concluded no public health concern was identified with particulates suspended in the air above the playing field and although volatile organic compounds were detected above the artificial turf surface…

> *"exposures were below health-based screening levels, suggesting that adverse health effects were unlikely to occur in persons using artificial turf."*

Regarding skin infections, fewer bacteria were detected on artificial turf compared to natural turf on those fields tested. The rate of abrasions was two-to-three-fold higher for college soccer players competing on artificial turf compared to natural turf. It was concluded that the sum effects on the skin infection rate between the two types of turf could not be predicted from the data alone and additional studies were needed.

The report also acknowledged a number of uncertainties and data gaps remained that were not controlled in the studies.

City of San Francisco, CA

San Francisco Synthetic Playfields Task Force Findings and Department Recommendations, San Francisco, CA, 2008. http://www.superfill.net/dl010808/SFParks_Playfields_8.21.08.pdf

> *"The task force identified 11 environmental and health issues of public concern, and for which there was thought to be readily available research. Study teams, comprised of subject matter experts and park users, were assigned to review the research on each issue, synthesize the findings, discuss strengths and weaknesses of the research, assess the relevance of the research to San Francisco's playfields implementation, and, identify suggestions and recommendations for Department staff to make to the Commission."*

In February 2008, the San Francisco Department of Health (SFDPH) summarized their review of several reports, studies, and documents relevant to assessing the potential for health risk associated with artificial turf and while often noting that additional research is recommended, they concluded,

> *"At this time SFDPH does not recommend a moratorium on the continued installation and use of artificial turf playfields in San Francisco. It may be helpful to perform air monitoring on artificial turf playfields in San Francisco during hot weather to help further assess relevant exposures to users in the breathing zone."*

State of Connecticut

- Result of State Artificial Turf Fields Study: No Elevated Health Risk, State of Connecticut, Department of Environmental Protection, Hartford, Ct., July 30, 2010. All associated final reports available at: www.ct.gov/dep/artificialturf.

This collection of studies explored the possible exposures when playing sports on artificial turf fields cushioned with crumb rubber infill. These studies found rubber is a complex mixture of various chemicals with some having toxic and carcinogenic properties. Exposure is possible, primarily via inhalation, given

that chemicals emitted from rubber can end up in the breathing zone of players and these players have high ventilation rates. Rainwater may leach chemicals from the rubber into underlying groundwater or nearby streams and there is a potential risk to surface waters and aquatic organisms associated with whole effluent and zinc toxicity of storm water runoff from artificial turf fields. These reports were peer reviewed by the Connecticut Academy of Science and Engineering and comments were incorporated into the final report.

With respect to the five fields tested in Connecticut the report concluded:

> *"Based upon these findings, the use of outdoor and indoor artificial turf fields is not associated with elevated health risks. However, it would be prudent for building operators to provide adequate ventilation to prevent a buildup of rubber-related VOCs and SVOCs at indoor fields. The current study did not evaluate new fields under hot weather conditions and so the potential for acute risks under this circumstance is another uncertainty. The current results are generally consistent with the findings from studies conducted by New York City, New York State, the USEPA and Norway which tested different kinds of fields and under a variety of weather conditions. Thus, it appears that the current results are reasonably representative of conditions that can be encountered at indoor and outdoor crumb rubber fields, although this tentative conclusion could benefit from the testing of additional fields."*

State of New York

- An 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, May 2009. http://www.dec.ny.gov/docs/materials_minerals_pdf/crumbrubfr.pdf

This study focused on three areas: release of chemicals into surface and groundwater, air, and elevated surface temperatures. Laboratory based leaching studies suggested that crumb rubber may be used as an infill without significant impact on ground water quality. Field sampling studies were not fully completed at the time of the report and although they showed no impact on groundwater quality due to crumb rubber related compounds it was noted that the finding should not be considered conclusive due to the limited amount of data available. Ambient air sampling measured the chemicals and particulates in the air at two fields and did not raise concerns for health effects of players at those fields. It was noted that temperatures on the surfaces of synthetic fields was significantly higher than natural turf and those using the fields should take precautions to avoid heat related illness. The report did acknowledge that testing done under different conditions, using different methods or at different fields could yield different results.

- A Review of The Potential Safety Risks from Synthetic Turf Fields Containing Crumb Rubber Infill, New York City Department of Heath and Mental Hygiene, Prepared by TRC Windsor, CT, May 2008. http://www.nyc.gov/html/doh/downloads/pdf/eode/turf_report_05-08.pdf

> *"This comprehensive review of the available literature on the potential health effects of crumb rubber infill from synthetic turf fields has demonstrated that the major health concern from these fields is related to heat. Chemicals of Potential Concern (COPC) concentrations 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). Eleven different risk assessments applied various available concentrations of COPCs and none identified an increased risk for human health effects as a result of ingestion, dermal or inhalation exposure to crumb rubber. However, additional air studies at synthetic turf fields as well as background air measurements would provide more representative*

data for potential exposures related to synthetic field use in NYC, particularly among younger field users."

State of New Jersey

- New Jersey Artificial Turf Investigation, State of New Jersey, Department of Health and Senior Services, Trenton, NJ. All associated documents available at: http://nj.gov/health/artificialturf/index.shtml, last modified August 11, 2008, 14:54:49.

After a study of lead levels in twelve artificial turf fields in New Jersey, The New Jersey Department of Health and Senior Services concluded:

" Agencies that have installed, are installing, or plan to install artificial turf fields should ask vendors to conduct appropriate testing to determine the levels of potential contaminants in components of the turf, including the turf fibers and in-fill materials. If a field is found to have high lead levels, field managers can consider limiting access to the field, especially for the most vulnerable population of children under 7 years of age. As a precaution, until further guidance is available, custodians of all turf fields, but especially turf fields with nylon fibers, can implement the following recommendations, in addition to testing their turf field:

- *Dust suppression, in the form of watering down the field, can be conducted before and after the field is being utilized,*
- *Encourage individuals who use the field to perform aggressive hand/body washing after playing on the field;*
- *Clothes that were worn on the field should be taken off inside out and washed separately."*

"The NJDHSS recognizes the growing public concerns about the safety of artificial turf fields, as well as the need for communities to provide for athletic and other recreational fields. Artificial turf fields are being installed in growing numbers around the country and in New Jersey. Health and safety concerns are being raised about these fields. These concerns are related to physical properties of the fields and potential chemical exposures from in-fill materials (especially crumb rubber from recycled tires) and the turf fibers.

There is a need for a comprehensive and coordinated approach to evaluating the public health risks and benefits of artificial turf fields. Several assessments have been conducted by researchers around the country. Available evidence suggests that there are no acute health risks due to use of artificial turf fields, and risks due to chronic and repeated exposure are unlikely. However, important gaps and uncertainties in our knowledge of the nature and magnitude of potential exposures and health risks remain."

- Assessment of Environmental, Health, and Human Safety Concerns Related to the Synthetic Turf Surface at Maple Park in Ridgewood, NJ, Ridgewood Environmental Advisory Committee, Ridgewood, NJ, 2009. http://mods.ridgewoodnj.net/pdf/recreation/REACSyntheticTurfAssessmentFINAL2.pdf

The Ridgewood Environmental Advisory Committee (REAC) is an independent volunteer committee, appointed by the village council, with experience and/interest in environmental issues. REAC appointed a subcommittee to investigate citizen concerns over the use of synthetic turf in a community park. REAC concluded that the synthetic surface at Maple Park did not pose any significant environmental, health, or human safety threat. *"REAC's assessment focused only on concerns, which may be applicable in Ridgewood and are specific to the synthetic "infill" turf field design at Maple Park."*

Non-governmental Literature

- Natural Grass and Artificial Turf: Separating Myths and Facts, Turf Grass Research Center, East Dundee, IL. http://www.turfgrasssod.org/images/documents/033120095256858.pdf

  This document is a brochure prepared by the Turf Grass Research Center supporting the use of natural turf fields.

- Review of the Human Health and Ecological Safety of Exposure to Recycled Tire Rubber found at Playgrounds and Synthetic Turf Fields, July 17, 2008. Prepared for the Rubber Manufactures Association, Washington, D.C, by ChemRisk, Inc. Pittsburg, PA. http://www.rma.org/newsroom/release.cfm?ID=252

  A report by an environmental firm on the human health and ecological risks from ground rubber in playgrounds and sports fields, and based on a review of studies from advocates and opponents to the use of crumb rubber. This report concludes no adverse human health or ecological health effects are likely to result from these reuses of tire materials. The report however acknowledges that while these conclusions are supported by existing studies or screening risk assessments, additional research would be useful.

- Review of the Impacts of Crumb Rubber in Artificial Turf Applications, Rachel Simon, University of California, Berkley, Laboratory for Sustainability and Manufacturing, College of Engineering, February, 2010. Prepared for The Corporation for Manufacturing Excellence (MANEX). http://www.4entech.com/Crumb%20Rubber%20Study_Feb_2010.pdf

  This report explores the various aspects of crumb rubber and addresses some of the claims made by various researchers. This report concludes that crumb rubber and artificial turf have many traits that make it a beneficial choice for athletic surfaces.

  > *"Generally safe application - Extensive research has pointed to the conclusion that these fields result in little, if any, exposure to toxic substances. A review of existing literature points to the relative safety of crumb rubber fill playground and athletic field surfaces. Generally, these surfaces, though containing numerous elements potentially toxic to humans, do not provide the opportunity in ordinary circumstances for exposure at levels that are actually dangerous. Numerous studies have been carried out on this material and have addressed numerous different aspects of the issue. For the most part, the studies have vindicated defenders of crumb rubber, identifying it as a safe, cost-effective, and responsible use for tire rubber."*

- Artificial Turf, Exposures to Ground-Up Rubber Tires, Athletic Fields, Playgrounds, Garden Mulch, David R. Brown, Environmental and Human Health, Inc., New Haven, Ct., 2007. http://www.ehhi.org/reports/turf/turf_report07.pdf

  The summary and conclusions of the study are as follows:

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

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

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

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

There are still data gaps that need to be filled in and additional studies are warranted.

It is prudent to conclude that there will be human exposures to chemicals released during the use of synthetic turf fields.

The excess amount of zinc in the rubber tire mulch makes it unacceptable to be used in gardens."

Finding – Parks and MCPS believe that reliance should be placed on the various government studies referenced above that have looked at the human health issues associated with artificial turf fields (and crumb rubber infill in particular) and have not found levels of concern that warrant avoidance of the construction of new artificial turf fields with crumb rubber infill.

Artificial Turf Heat Concerns

Background

One characteristic of artificial turf fields that has been well documented is the higher field temperatures on artificial turf fields compared to natural grass fields under similar weather conditions. These conditions may vary depending on the color and other specifications of the artificial turf carpet and the type of the infill material used.[3]

A New York State Department of Health review (August 2008) of artificial turf (http://www.health.state.ny.us/environmental/outdoors/synthetic_turf/crumb-rubber_infilled/fact_sheet.htm) provides a good summary of findings regarding the heat effect of artificial turf utilizing crumb rubber infill:

> *"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 turf grass specialist at the University of Missouri reported measuring an air temperature of 138°F at "head-level" height on the university's artificial 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."*

Another study (Milone & MacBroom, 2008) also found elevated temperature levels on artificial turf fields in Connecticut.
http://www.miloneandmacbroom.com/Libraries/Documents/Evalutation_of_the_Environmental_Effects_of_Synthetic_Turf_Athletic.sflb.ashx

The report summary regarding heat is reproduced below:

> *"The results of the temperature measurements obtained from the fields studied in Connecticut indicate that solar heating of the materials used in the construction of synthetic turf playing surfaces does occur and is most pronounced in the polyethylene and polypropylene fibers used to replicate natural grass. Maximum temperatures of approximately 156° F were noted when the fields were exposed to direct sunlight for a prolonged period of time. Rapid cooling of the fibers was noted if the sunlight was interrupted or filtered by clouds. Significant cooling was also noted if water was applied to the synthetic fibers in quantities as low as one ounce per square foot. The elevated temperatures noted for the fibers generally resulted in an air temperature increase of less than five degrees even during periods of calm to low winds.*

[3] Most of the material reviewed by the work group involves artificial turf with crumb rubber infill. For a discussion of alternatives to crumb rubber infill, please see the Section on Alternative Infill Products in this report.

> *The rise in temperature of the synthetic fibers was significantly greater than the rise in temperature noted for the crumb rubber. Although a maximum temperature of 156° F was noted for the fibers, a maximum temperature of only 101° F, or approximately 16 degrees greater than the observed ambient air temperature, was noted for the crumb rubber."*

On Friday, September 24 at the Maryland SoccerPlex in Boyds, during its tour of both natural grass and artificial turf fields on the site, the staff work group asked the Discovery Sports Foundation staff to measure temperatures on one of its artificial turf fields. Note: All of the SoccerPlex artificial turf fields utilize a crumb rubber infill. Here are the results:

- Air temperature at 2:30pm was 95.6 degrees
- Turf radiant temperature was 142 degrees
- Turf surface temperature was 103 degrees
- Asphalt radiant temperature was 121 degrees

Interestingly, the radiant temperature (taken about 6 inches above the surface) was greater than the turf surface. In fact, the turf surface was warm but not hot to the touch. However, while on the field, there was a noticeable "warm air" feeling not noticed immediately off the field.

Finding: Artificial turf fields with a crumb rubber infill (both the surface and the air several feet above the surface) can get very hot during peak hot weather conditions.

The work group sought out any evidence that there was a higher level of incidence of heat-related medical issues with these fields then with natural grass fields. Once again, the New York Health Department study is instructive here:

> *"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."*

Options for Addressing the Heat Issue

Average daily high temperatures in the Washington DC area exceed 80 degrees 109 days per year and exceed 85 degrees 71 days per year (Source: TheWeatherChannel.com). While no days have average high temperatures over 90 degrees, it is not unusual for the area to experience 90 degree days. 2010 had a particularly high number of days (67) in which the daily high temperature exceeded 90 degrees (Source: Accuweather.com). Therefore, dealing with heat issues related to outdoor activities is an important issue for MCPS and Parks.[4]

[4] It should be noted, however, that MCPS, Parks, and Community Use of Public Facilities (CUPF) have not had any participants or permittees report any major heat issues associated with the use of their artificial turf fields.

The staff work group identified two options for dealing with the temperature issue in artificial turf fields with crumb rubber infill:

- **Water the field regularly during high temperature periods**: This is a quick but only temporary way to reduce the field temperature. This strategy also requires irrigation equipment and staff to be present during these times. The New York Department of Health review of the BYU study notes:

  "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."

  Finding: Irrigation of artificial turf fields to reduce field temperatures does not appear warranted given its limited effect and additional costs.

- **Restrict use of artificial turf fields during peak high temperature periods**: This approach is often done by field owners who have staff on-site to make these day to day decisions on a case by case basis. The staff work group was unable to find examples of entities utilizing specific requirements (such as an ambient temperature limit or actual field temperature for instance) above which fields are always closed.[5]

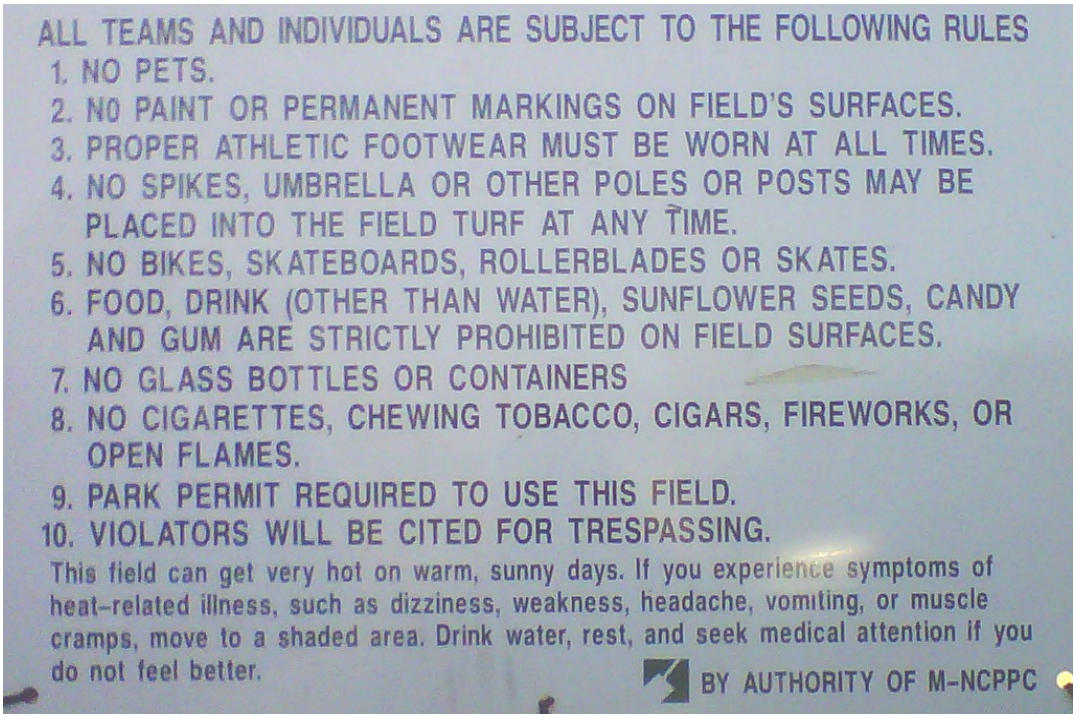
  The Maryland SoccerPlex (which has 3 artificial turf fields and 17 natural turf fields) moves games from its artificial turf fields to natural turf fields on extreme temperature days. During the record heat experienced this past summer, events from the artificial fields were moved to natural grass 13 different days.

  M-NCPPC-Parks, which typically does not have staff on-site at its artificial turf fields includes the following language in its permit for the use of the Montgomery Blair High School turf field to emphasize with permittees the need to safely use the fields on hot days:

  > *"This field can get very hot on warm sunny days. If you experience symptoms of heat-related illness such as dizziness, weakness, headache, vomiting, or muscle cramps, move to a shaded area. Drink water, rest, and seek medical attention if you do not feel better. In extreme temperatures, please cease all activities and get off the artificial turf field."*

  Similar language is posted on signs near the field.

[5] Taking actual readings on artificial turf fields (on the carpet itself and/or up to several feet above the carpet) can be done on a case by case basis. However, implementing a firm cutoff temperature would require monitoring and enforcement by the field permitter and may be arbitrary given that other factors affect heat-related health risks, such as humidity and cloud cover that can change throughout the day.



Montgomery County Public Schools and Community of Use of Public Facilities (CUPF) also follow an "advisory" approach for its permittees. At this time, they do not include permit language or signage to specifically address the heat issue.

MCPS provides an athletic handbook to its schools (excerpt attached in Appendix E) with weather-related guidelines; including related to heat and air quality. For example, practices and games are cancelled under code red or purple conditions. Similarly, Ann Arundel and Howard County Public Schools do not have specific policies in place. Code red and orange days result in outdoor restrictions in general, including on their artificial turf fields.

Work Group Recommendations:

- It is evident that surface and ambient temperatures on artificial turf fields can get quite hot. The work group believes MCPS should include the artificial turf heat issue in its athletic handbook in order to address circumstances where these fields are being used and/or supervised by MCPS directly during peak heat conditions (for instance for summer and early fall team practices and physical education classes).

  This guidance should provide for an assessment of field conditions on a case by case basis by the athletic staff at the school (considering ambient and field temperature readings).

- The work group believes common permit language and advisory signage for all artificial turf fields managed by MCPS, Parks, and Community Use of Public Facilities (CUPF) should be utilized.

- Regarding specific permit language, signage, and guidance provided for users of artificial turf fields the work group suggests that CUPF conduct a process that would include community user groups of artificial turf fields to develop guidelines for use of the fields in hot weather.

Environmental Impacts

One of the key issues that the T&E Committee requested that the staff work group review is the environmental impacts of artificial turf and how these impacts compare to natural grass fields. Montgomery County Department of Environmental Protection (DEP) Staff participated in the staff work group meetings and was asked by MCPS and Parks staff to review relevant studies, to consider whether the County should set up a water monitoring program for its own artificial turf fields, and to generally provide any recommendations it has with regard to the potential construction of future artificial turf fields. Staff from DEP assisted the work group but also noted that DEP's participation would be limited due to dedication of resources to support the implementation of the County's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer Systems (MS4) permit.

The DEP had previously provided to Council Staff a summary of its research with regard to the environmental impacts of artificial turf and some pros and cons vis-à-vis natural turf. This information was included in a June 29, 2010, Council Staff packet to the Council's Transportation, Infrastructure, Energy and Environment (T&E) Committee (later discussed at a July 1 Committee meeting). The information provided by DEP is included (in total) in Appendix F. The full committee packet is available at: http://www.montgomerycountymd.gov/content/council/pdf/agenda/cm/2010/100701/20100701_TE1.pdf.

Water Quality Impacts

Stormwater Management

In considering the possible water quality impacts of natural grass and artificial turf, storm water management requirements are an important consideration. These requirements are intended to provide both quantity (channel protection) and quality control.

Natural turf fields are considered pervious surfaces by the County's Department of Permitting Services (DPS) for purposes of storm water management requirements. Prior to the new stormwater management standards (adopted by the State in May 2009 with an effective date of May 4, 2010) DPS required treatment of the first ¼ inch of runoff for newly established natural turf fields. This is typically achieved by building a crown in the center of the field and directing runoff into drainage areas along the edge of the field into grass swales or other types of stormwater management structures.

The new storm water management standards (adopted in June 2010) require the use of best management practices to replicate the runoff characteristics of "woods in good condition". These practices involve the establishment of a target rainfall for each individual site using the physical characteristics of the soils on the site along with what is being proposed for land cover. The target rainfall is then used to establish the volume of runoff required to be "managed". This may require different solutions depending on specific site conditions.

Artificial turf is considered impervious for storm water management purposes and is therefore treated in a similar manner as pervious pavement. Based on the new storm water management standards noted above, for a new artificial turf field an additional depth of gravel under the artificial turf field is typically added to meet statewide infiltration design standards. This approach is similar to what was done for the Richard Montgomery and Montgomery Blair high school artificial turf fields. The additional gravel depth provides a

reservoir of space to slow the drainage of the storm water (quantity control). The drainage of the storm water into the soil below the gravel base provides the quality treatment. Conversely, the Walter Johnson and SoccerPlex fields have underdrains that direct flows to adjacent storm water management structures for quality treatment via biofilters and/or sand filters and then a controlled release from a storage facility (quantity control).

Montgomery County DEP Review of Studies

The DEP staff looked at a number of studies focusing on water quality issues, especially with regard to the potential leaching of materials from the artificial turf carpet and/or the infill material and the impact this leaching may have on the quality of the receiving stream and the aquatic habitat in the stream.

The DEP findings were:

- *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.* ***WORK GROUP COMMENT: MCPS and Parks staff note that their existing three artificial turf fields consist of carpets made of polypropylene (not nylon as was the case in older artificial turf fields where lead was identified). Parks staff had a carpet sample from the artificial turf field at Montgomery Blair High School tested and no detectable level of lead was found.***

Subsequent to the July 1, 2010 T&E Committee meeting, DEP staff reviewed results from an ongoing synthetic turf monitoring plan (see appendix G) being managed by the San Francisco Public Utilities Commission (SFWater) SFWater provided DEP with some sampling results (see appendix H). DEP staff summarized these results by noting:

> *"With regard to zinc, one of the primary constituents of concern, the total zinc level is above the Maryland Toxic Substances Criteria for Ambient Surface Waters (120 ug/l) standard . However, the dissolved level is not above the acute toxicity level. Because the standard is based on the biologically available or dissolved concentration, the samples are below toxic levels based on Maryland standards."*

Work Group staff has contacted SFWater staff to collect additional information regarding the cost and status of the study and whether a similar study could be established here. DEP staff noted that a well designed and detailed study would take "considerable time and cost and could still leave questions unanswered." The DEP staff believes such a study "would cost be at least $100,000 and could be three to four times more."

The DEP staff was also asked to comment on a July, 2010, report released by the Connecticut Department of the Environment. DEP provided the following comments:

> *"The study generally supports prior results. It does indicate that zinc in runoff could be a concern although they conclude that SWM should be able to address it. The stormwater data is limited though and far from conclusive"*

The DEP staff also was asked whether the construction of artificial turf fields would impact the County's compliance with its National Pollutant Discharge Elimination System (NPDES) permit. The DEP staff noted that the construction of artificial turf fields:

> *"should not affect NDPES permit requirements nor should it affect TMDLs. It is considered impervious by DPS (Montgomery County Department of Permitting Services) but would be considered treated to the MEP (maximum extent practicable)."*

Comparing the Environmental Impacts of Natural Grass and Artificial Turf Fields

With regard to directly comparing the environmental impacts of artificial turf fields versus natural grass fields, the staff work group was unable to find any comprehensive studies that quantitatively addressed this issue. DEP staff previously provided a general summary (see Appendix F). In short, DEP notes that,

> ***"****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."*

Below is some additional information collected by the staff work group.

Maintenance Practices

In comparing maintenance practices for natural and artificial turf fields a major difference is that the artificial turf fields do not require pesticides, fertilizers, irrigation, or mowing. The artificial fields do require grooming and sweeping on a much less frequent basis than the mowing of natural grass fields. For a sample listing of maintenance assumptions for different types of fields, please see Appendix C. Appendix C was developed using the expertise of SoccerPlex staff that are familiar with maintaining natural (Bermuda and cool season grass) fields as well as artificial turf fields in Montgomery County.

Carbon Footprint

The staff work group was able to find one study by the Athena Institute of Ontario Canada (2007), (http://www.athenasmi.org/projects/docs/UCC_project_ATHENA_technical_paper.pdf) that calculated the carbon footprint of artificial turf versus natural grass at the request of the Upper Canada College (a K-12 school) in Toronto, Canada, which wanted its switch from a natural grass to artificial turf field to be carbon neutral. The study looked at the manufacture, transport, installation, maintenance, and disposal of an artificial turf field versus the costs to build and maintain a natural grass field assuming a 10 year time horizon. The study then calculated the greenhouse gas emissions (ghgs) offset (over ten years) to be 72.6 metric tons (based on an estimated 55.6 metric ton impact for an artificial turf field and -16.9 metric tons for natural grass. To offset this impact (through carbon sequestration) over a ten year period would require planting 1861 trees.

This report was reviewed by San Francisco's Synthetic Playfields Task Force in 2008 (report available for download at: http://www.verdedesigninc.com/pdf/SyntheticPlayfieldsReportFinalDraft082108.pdf). The task force noted a number of potential factors not included in the report but agreed that the construction of artificial turf fields should be targeted to maximize the benefits and minimize the impacts (including greenhouse gas emissions).

A February 2010 study "Review of the Impacts of Rubber in Artificial Turf Applications" by Rachel Simon of the University of California, Berkeley (Prepared For: The Corporation for Manufacturing Excellence (Manex)) also reviewed the Athena Study. The complete report is available at:
http://www.fieldturf.com/images/downloads/UC_Berkeley_-_Review_of_the_Impacts_of_Crumb_Rubber_in_Artificial_Turf.pdf

In reviewing the Athena Study, the Staff Working Group identified some limiting factors in extrapolating the Athena findings. One factor is that the ghg emissions from the transportation of materials are site specific (based on where the materials to be purchased were made and assuming the materials are transported to Toronto, Canada) and thus would have to be revised based on locating a field in Montgomery County. It is also not clear what type of natural grass field was assumed for the comparison (sand base or native soil) and whether the construction, maintenance, and carbon sequestration might be different for the different types of natural grass fields.

Another major element, not included in the Athena study is the differences in the hours of use of artificial turf fields over natural grass fields identified earlier. The impacts of constructing and maintaining additional grass fields would need to be factored into the analysis if assuming equal hours of use under both options. This is an important consideration, since the construction of a natural grass field from unimproved land and

the ongoing maintenance of that field, would involve ghg emissions that may close much of the gap identified in the study.[6]

Also, as noted earlier in this report, the carbon impact of automobile trips for all off campus sports team practices was quantified at approximately 43.3 tons of annual carbon emissions (or 433 tons over ten years or about 20 metric tons of emissions per high school). Since MCPS is able to keep many practices on-site at its high schools with artificial turf stadium fields, there is the potential for significant ghg emissions reductions from avoiding off campus team practices. Fewer game cancellations (discussed earlier) on artificial turf fields also would result in reductions in vehicle miles travelled and thus provide for a reduction in ghg emissions as well.

Finding: The impacts of material transportation, construction, maintenance, and loss of carbon sequestration result in artificial turf fields adding ghgs to the atmosphere when compared to a natural turf field. However, taking into account other factors (such as increased usage at one field rather than constructing additional new fields, keeping MCPS team practices on-site, and reduced game cancellations) may eliminate much if not all of this ghg impact.

Heat Island Effect

Given that artificial turf fields generate higher temperatures immediately above the carpet surface than do natural grass fields (as described in more detail in Section VI), there could be some impact on urban heat islands associated with artificial turf fields. However, the degree to which artificial turf ball fields might exacerbate the problem are unclear given the relatively few acres of artificial turf already constructed or planned in Montgomery County. A report by the New York City Department of Health and Mental Hygiene (2008), notes:

> *"The contribution of synthetic turf to urban heat islands is presently unknown. However, due to the increased temperatures measured on these synthetic turf systems, they may contribute local increased ambient temperatures, but their contribution to the overall urban heat island effect is likely to be small."*

The staff work group was unable to find studies documenting the impact of a single artificial turf field on the heat island effect.

Recycling and/or Disposal of Artificial Turf Fields

Currently, if an artificial turf carpet is hauled to the Montgomery County transfer station, the hauler pays a tipping fee ($56 per ton for closed top or $60 for open top vehicles which would likely be involved with this material). The heavy backing on the artificial turf carpet does not burn well and therefore DEP sorts this

[6] For instance, assuming the emissions numbers in the study, each natural grass field involved generates about 13.4 tons of ghg emissions from maintenance activities over a ten year period. Since the new fields could presumably have been unimproved land, much less of a carbon sequestration benefit may be assumed.

type of carpet with other "nonprocessible" waste rather than sending it with the regular trash stream to the Resource Recovery Facility (RFF) for incineration. Non-processible waste is trucked by contract from the transfer station to a landfill in Brunswick, Virginia at a cost of $45 per ton. An artificial turf carpet for a standard size football field weighs approximately 220 tons. However, given the relatively few fields in place in Montgomery County, DEP does not see the future disposal of these fields as a major issue.

If the infill material (approximately 460 tons for a FieldTurf artificial turf field) used with the artificial turf field is also taken to the transfer station, this material would be sent to the RRF for incineration. The same tipping fees noted above apply. However, the $45 contracted hauling cost is not incurred since the material is not going to the landfill in Brunswick, Virginia.

According to DEP Division of Solid Waste Services staff, the current process described above does not involve any significant operational or financial issues for the County's Solid Waste system. However, consistent with the County's solid waste policies of supporting waste reduction, reuse, and recycling ahead of incineration and landfilling, DEP supports MCPS' recommended approach of requiring artificial turf installers (as part of the contract for the installation of a new field) to reuse and/or recycle any artificial turf field components from the field being replaced. Similarly, new fields that are installed should to the maximum extent possible use non virgin materials and/or materials that are conducive to future reuse or recycling.

Montgomery County's Solid Waste Advisory Committee (SWAC) recently transmitted some recommended actions related to artificial turf disposal to the County Executive for his review (see appendix K).

Recommendation: Parks and MCPS staffs should include language in future contracts requiring the recycling of artificial turf fields by the field installer.

DEP Recommendations

The Staff Work Group asked DEP to provide its perspective on the artificial turf issue based on its review of the various studies. From an environmental perspective, should MCPS and Parks not build any more artificial turf fields pending further study? The DEP response has been that it does not have a position on artificial turf. The DEP has also not provided any specific recommendations regarding the construction and use of artificial turf, such as whether water quality monitoring should be done for existing fields, if specific storm water management practices should be done, or whether particular alternative infill choices should be pursued.

Recommendations from Other Environmental Departments

Since the staff work group did not receive specific recommendations from the Montgomery County DEP, the group reviewed a number of studies that focused on environmental issues and which included recommendations by an Environmental Department. Of particular help were the following two studies.

Connecticut Department of Environmental Protection, July 2010

The full report is available at:
http://www.ct.gov/dep/cwp/view.asp?a=2690&Q=463624&depNav_GID=1511) along with reports from other Connecticut agencies looking at various issues of concern regarding artificial turf.

The Connecticut DEP study's conclusion is reprinted in full below:

> *"The DEP concludes that there is a potential risk to surface waters and aquatic organisms associated with whole effluent and zinc toxicity of stormwater runoff from artificial turf fields. Zinc concentrations in the stormwater may cause exceedences of the acute aquatic toxicity criteria for receiving surface waters, especially smaller watercourses. The DEP suggests that use of stormwater treatment measures, such as stormwater treatment wetlands, wet ponds, infiltration structures, compost filters, sand filters and biofiltration structures, may reduce the concentrations of zinc in the stormwater runoff from artificial turf fields to levels below the acute aquatic toxicity criteria. Individual artificial turf field owners may want to evaluate the stormwater drainage systems at the fields and the hydrologic and water quality characteristics of any receiving waters to determine the appropriateness of a stormwater treatment measure.*
>
> *This study did not identify any significant risks to groundwater protection criteria in the stormwater runoff from artificial turf fields. It is important to note, that the DEP study did not directly collect and analyze groundwater at these artificial turf fields. Consequently, this conclusion regarding consistency with groundwater protection criteria is an extrapolation of the stormwater results collected and the evaluation of data presented in recent studies, such as Nillson et al (2008) and Lim et al (2009). To make a final conclusion regarding the overall risk from exposure to groundwater affected by stormwater runoff from artificial turf fields, further sampling and analysis of groundwater at the artificial turf fields would be required."*

San Francisco Department of the Environment (SFE) (as part of a Synthetic Playfields Task Force Report completed in August 2008).

(Full Task Force Report available at: http://www.superfill.net/dl010808/SFParks_Playfields_8.21.08.pdf). The Task Force took a broad look at artificial turf issues and more relevantly for this section included SFE findings and recommendations.

Below are the SFE findings and recommendations as published in the Task Force report.

> *"The Precautionary Principle guides SFE's review and evaluation of the environmental impacts of city programs and initiatives.*
>
> *It is important to note that the Precautionary Principle does **not** advocate the avoidance of any and all potential environmental risks.*
>
> *The Principle does advocate for a public process in which the benefits of an action or technology are weighed against potential risks. The deliberation that occurs should explore and assess available*

alternatives for comparative risks, related financial and resource costs, and other immediate and long-term consequences.

In keeping with the basic tenets of Precautionary Principle, in January 2008 San Francisco Department of the Environment (SFE) issued a letter making the following key conclusions:

1. SFE recognizes potential environmental advantages and disadvantages from synthetic turf use.

2. SFE recognizes that human health risks are minimal from exposure to the crumb rubber infill used with synthetic turf products, according to the OEHHA study[7]. SFE recommended a precautionary approach to assessing these risks due to the lack of established reference doses for some ingredients.

3. SFE is concerned that there is currently no system available to recycle used synthetic turf, even though most of the products are composed of polyethylene, an easily recyclable plastic.

4. SFE recommends that RPD specify the use of recycled content materials in the manufacturing of artificial turf.

5. SFE recognizes the potential for aquatic toxicity from synthetic turf leachate, but also notes that leachate concentrations will not approach levels of concern in normal installations above water table.

6. There are several other potential health-related issues related to synthetic turf that are outside the scope of their review, including differences in sports injuries on synthetic turf vs. natural turf, and the potential for spreading methicillin-resistant Staphylococcus aureus (MRSA) among players.

San Francisco Department of the Environment Recommendations:
1. Create transparent selection criteria for determining which playing fields will have synthetic turf installed. These criteria should include the selection of sites that are not prone to flooding.

2. Confine installations of synthetic turf to the sites where its other benefits are maximized.

3. Due to the need for information regarding potentially toxic constituents, require full ingredients disclosure from manufacturers.

FOOTNOTE FROM SF TASK FORCE REPORT: [7] In January 2007 the California Office of Environmental Health Hazard Assessment (OEHHA) published three studies for the California Integrated Waste Management Board (CIWMB) that evaluated rubberized matting used in playgrounds. The CIWMB needed to gain a better understanding of the potential health risks to children using outdoor playground and track surfaces made of recycled waste tires. In addition to an evaluation of toxicity, OEHHA also tested the playground surfaces for their ability to attenuate fall-related impacts and the potential of the rubberized surfaces to impact the local environment. CIWMB manages a grant program to promote markets for recycled-content products derived from waste tires in California. The OEHHA study found no evidence that rubberized matting used in playgrounds, a material similar in composition to synthetic turf infill, would cause danger or harm to human health or the environment.

4. If hand-to-mouth exposure by children can be reasonably expected, post signs reminding parents to wash children's hands after play.

5. Due to concerns over end-of-life disposal, require that synthetic turf vendors guarantee take back of the product at end of life, and provide documentation that the product is recycled.

6. Pursuant to the ordinance regarding the use of recycled content materials in Public Works construction, SFE recommends that post-consumer recycled content materials be specified in the manufacturing of all components comprising artificial turf.

7. Do not permit the use of disinfectants on synthetic turf areas without full review by the Department of Public Health.

8. Obtain comments from the San Francisco Public Utilities Commission on both the potential water conservation benefits and the leaching concerns associated with synthetic turf products.

9. Obtain comments from the DPH Environmental Health Section on the human health risks discussed above."

Finding: While both the Connecticut and San Francisco environmental departments identified potential environmental impacts, neither study determined that these impacts were of sufficient concern to warrant a moratorium on the construction of artificial turf fields with crumb rubber infill. Instead, both departments recommend specific practices to reduce or mitigate these impacts.

NOTE: A Work Group member contacted Dr. Chris Geiger of the San Francisco Department of the Environment (SFE) to find out what was happening in San Francisco now (since the Task Force report came out nearly 18 months ago). Dr. Geiger participated on the Synthetic Playfields Task Force and is still actively involved with the issue as SFE's Integrated Pest Management (IPM) and Green Purchasing Program Manager. He noted that the City of San Francisco (through the "City Fields Foundation") is in the process of building a number of artificial turf fields (with crumb rubber infill) in the city. Dr. Geiger noted that results from the ongoing SFWater study, mentioned earlier, found no issues of concern. An October 2010 OEHHS study on health impacts also found no issues of concern.

Dr. Geiger and Mr. Dan Mauer have assisted in the development of field specifications (see Appendix L for full specification) that includes a number of provisions to address environmental and health concerns and generally reduces the environmental footprint of the product. A summary of these provisions is provided in a memo from Dan Mauer to the San Francisco Recreation and Parks Commission (RPD) (see Appendix M).

Recommendation: Parks and MCPS staffs should explore incorporating some of the environmental testing requirements identified in the City of San Francisco artificial turf specification into future specifications for artificial turf fields constructed for Parks and MCPS.

Alternative Infill Products

The artificial turf industry is expanding rapidly. Turf companies and infill manufacturers are attempting to respond to concerns with Styrene-Butadiene-Rubber (SBR) infill materials and are developing new alternatives. While a number of government studies discussed earlier have not found significant health and environmental concerns with the use of SBR, from the latest technology crumb rubber fields, there continues to be active exploration of alternative infill materials that do not contain the hazardous substances found in SBR.

All artificial turf fields are systems built using similar components—an underground drainage system with a compacted gravel base, a polypropylene fiber carpet, and an infill product used in combination with sand to hold the carpet fibers upright and to cushion the surface to mimic the characteristics of natural grass. Different manufacturers vary the carpet fibers and infill materials to carve out a niche for their product. The artificial turf industry is operating in a young expanding market with the volatility of companies emerging and failing with regularity. In an attempt to capitalize on the concerns generated around crumb rubber infills, a number of companies are bringing to market alternative infill materials aimed at addressing the heat issue and the uncertainty of chemicals contained in and released from crumb rubber.

There are basically five types of infill materials in addition to sand on the market—SBR Crumb Rubber, TPEs (Thermoplastic Elastomers), EPDM (Ethylene Propylene Diene Monomer) Rubber, Organic Infill materials, and Acrylic Coated Sand. Many manufacturers have entered the artificial turf infill market to respond to rapidly expanding demand for artificial turf fields, and some have marketed off the shelf materials developed for other applications. However, the artificial turf market is growing more sophisticated with extensive research going into carpet fiber development and infill safety and durability. The truth is that a high quality artificial turf field requires high quality carpet fiber and infill materials. In a highly competitive and maturing market it is easy to understand why the failure of older artificial turf fields is reported and used as justification for use of one product over another. Each infill product on the market has advantages and disadvantages. It will take time for products to emerge that will have a proven record for durability and environmental friendliness.

Types of Infill

In order to develop a sense of the level of satisfaction with installations of artificial turf across the country a work group member contacted suppliers, installers, universities, and school districts to discuss their experiences with different combinations of turf infills. Based on those discussions, below is a brief description of each of the five different types of infill materials on the market with some advantages and disadvantages of each and a listing of some recent installations.

SBR Crumb Rubber (Cryogenic and Ambient)—The vast majority of turf installations currently use SBR. There reports from agencies including the Consumer Product Safety Commission, and the U.S. Environmental Protection Agency that acknowledge the presence of hazardous chemicals in crumb rubber, but find no evidence that the chemicals are released in harmful amounts or would be injurious to the health of athletes using the fields. Some manufacturers have not taken the care in their manufacturing quality control leading to a poor quality product (i.e. too much fines and fiber.) Poor quality control can cause problems applying the product, problems with durability, and problems with not allowing the water to percolate - causing poor drainage. Cryogenic Crumb Rubber has been studied by a number of state and city agencies and has not been found to be detrimental to the environment or to athletes who use the fields.

There is an added benefit to recycling thousands of tons of old tires that otherwise would end up in landfills. In Montgomery County Richard Montgomery High School (2008), Montgomery Blair High School (2009), Walter Johnson High School (2010), and Fairland Regional Park (2010) all have crumb rubber infill. The manufacturer (FieldTurf) has provide letters indicating that at the end of the useful lives of the fields the carpet and infill materials will be 100 percent recycled.

Thermoplastic Elastomers (**TPEs**)—There are many TPEs in the market. The advantage of TPEs is that they are made from virgin materials and some contain no lead, zinc, or other toxic materials. They also are cooler to play on. The drawbacks are that TPEs are very expensive to fabricate and subject to wide manufacturing variations. Some TPE fields get hard over time. The problem with the generic name TPE is that it is a broad term. Many companies will use certain fillers that can be detrimental to the health of the player and the environment. Some TPEs can contain heavy metals. Others do not have crush resistance, flexibility, and softness. Some TPEs may not have UV stabilizers. The shape of the material will have an impact on the playability and safety. One particular product, Futrfill™ by Target Industries shows promise as being free of heavy metals and toxins and is specified by the City of New York School Construction Authority (NYCSCA). NYCSCA installed one field in the fall of 2010 with two pending for 2011. The product should be recyclable for use as infill in a replacement field.

EPDM Rubber—(Ethylene Propylene Diene Monomer) is a virgin material that is durable, non-toxic, and environmentally friendly. It is capable of be manufactured in a wide variety of colors and creates a surface that strongly resembles a natural grass playing surface. Given the ability to vary its color, the EPDM will not get as hot as a SBR field. EPDM has been used primarily in Europe, but has recently had problems with two major firms replacing a large number of fields due to a reaction between the EPDM and the carpet fiber that causes a breakdown in the fiber. Brigham Young University installed an intramural field with EPDM infill in 2009. The field is light grey in color to reduce reflective heat. The EPDM material is recyclable.

Organic Infill Materials—Organics are new to the market, and they are not yet widely available. The advantage of organic infill materials is that they are non-toxic and environmentally friendly. Some are made from cork and cocoanut fibers (corkonut) while others are made of walnut shells. All are treated with an antimicrobial application to prevent deterioration of the infill. The drawback is that they have no track record for durability. Concerns include potential break down of the organic material, insects, and compaction of the material over time. The material is recyclable at the end of its life cycle into other products, but could not be reused for infill for a new artificial turf field. The city of Piedmont California in the San Francisco bay area in 2010 installed a GeoTurf™ (corkonut) organic infill artificial turf field manufactured by Limonta at an elementary school.

Acrylic Coated Silica Sand—There are now probably four to six producers in North America that produce this product. The advantage to acrylic coatings is that they are known materials and most do not contain heavy metals and toxins. They will stay approximately 20 degrees cooler than crumb rubber field. Acrylic material is hard and must be combined with a softer filler material. The problems with coated silica sands from some manufactures are: a) the coating disperses in water, b) sand particles gel together, c) poor size distribution of sand, d) poor quality silica sand before the material is coated. Coating does not adhere properly to sand particles and breaks down over time. The Los Angeles Unified School District (LAUSD) in 2009 installed a FlexSand Action™ infill material at its Helen Bernstein High School. They are pleased with its performance.

Staffs from MCPS and Parks support the following findings:

Finding—Because the synthetic turf industry is changing rapidly to meet the needs of its customers, decisions made on new companies and products should be well researched to make sure that the money spent on artificial turf systems is based on sound life-cycle cost information.

Finding—Many owners, installers, and suppliers of artificial turf fields believe that crumb rubber is the best infill product on the market because it has been field tested and proven for performance over a number of years. Alternative infill materials are being marketed primarily to compete with crumb rubber based on the negative perceptions attributed to SBR. While some of the alternative infills may show promise in terms of durability and performance over time, Parks and MCPS staffs believe it is too early to invest in an unproven product until a greater track record is established for many of these materials.

Recommendation: Parks and MCPS believe that county agencies should continue to monitor the success or failure of alternative infills before considering a change from SBR infill material.

Appendices

A. Summary of Artificial Turf Fields (ATF) Located at Maryland and Neighboring Public School Systems

B. Warranty for Montgomery Blair High School artificial turf field.

C. Life-Cycle Cost Maintenance Assumptions

D. Life-Cycle Cost Analysis Detail and Assumptions

   1. MCPS high school stadium fields

   2. Montgomery County Parks fields

E. Excerpt from MCPS Athletic Handbook on Heat and Air Quality

F. Montgomery County Department of Environmental Protection attachment to the July 1, 2010, Montgomery County Transportation, Infrastructure, Energy, and Environment Committee meeting packet

G. Results from ongoing synthetic turf monitoring plan being managed by the San Francisco Public Utilities Commission (SFWater).

H. Sampling Results from SFWater

I. Letters from Montgomery County Citizens Advisory Boards

   1. Western Montgomery County CAB Letter to The Honorable Nancy Floreen, President Montgomery County Council, September 30, 2010

   2. Mid-County CAB Letter to the Honorable Isiah Leggett, County Executive and Ms. Mary Bradford, Director Montgomery County Parks, June 17, 2010

J. Resolution from the Montgomery County Storm Water Partners Network, undated

K. Solid Waste Advisory Committee (SWAC) – Annual Meeting with the County Executive, February 10, 2011

L. City of San Francisco Specification for Artificial Turf Fields

M. Memo from Dan Mauer dated July 8, 2009, to the San Francisco Recreation and Park Commission on provisions to reduce the environmental footprint of artificial turf fields

Appendix A: Summary of Artificial Turf Fields (ATF) Located at Maryland and Neighboring Public School Systems

Jurisdiction	Number of High Schools	Number of ATF Stadium Fields	Considering one or an additional ATF	Vendor(s)	Satisfaction level				Heat Issues	Hot Weather Practice Guidelines
					Extremely	Very	Satisfied	Not Satisfied		
Maryland										
Allegany	3	2	no	Field Turf Tarkett	X				no	Heat index card to determine type of practice - Heavy,light, not at all (for band, drill team etc also)
Anne Arundel	12	11	includes two under construction	Field Turf Tarkett one field, Sunny Acres for other eight					no	no special guidelines
Baltimore City	21	2	1	Sportexe	X				none	none
Baltimore County	24	5	yes	Field Turf Tarkett		X			no	no
Calvert	4	0	not yet							
Caroline	2	0	not yet							
Carroll	8	0	yes - new high school							
Cecil	5									
Charles	6	1	?	?		X			no	athletic trainers determine heat factors;
Dorchester	2	0	no							
Frederick	10	4	not at this time	Sprint Turf		X				Found 8-10º ambient temp difference with natural grass - same
Garrett	2									
Harford	10	5	yes	3 Field Turf Tarkett, 2 Geo Sport, 1 Astroturf	with Field Turf Tarkett			with Geo Sport	no	practice early, coaches check temps (1 coach thought natural grass area was hotter)
Howard	12	0	yes							All Bermuda Fields
Kent	1	0	no							
Montgomery	25	3	yes	Field Turf Tarkett	X				no	
Prince George's	22	0	yes							
Queen Anne	2	0	yes							
St. Mary's	3	0	no							
Somerset	2	0	no							
Talbot	2	0								
Washington	7	1	maybe						no	none
Wicomico	4	0	no							
Worcester	3	1								
Maryland Total	**192**	**35**	**18.2%**							
Neighboring										
Fairfax	26	6	yes						no	none
Washington DC	11	10								
Arlington	5	3								
Neighboring Total	42	19	**45.2%**							
Total All Schools	**234**	**54**	**23.1%**							

Appendix B: Montgomery Blair High School FieldTurf Warranty

Manufacturer's Limited Warranty

FieldTurf warrants that if **FieldTurf FTOM 1F** for football/soccer/lacrosse/field hockey synthetic turf proves to be defective in material or workmanship, resulting in premature wear, during normal and ordinary use of the Product for the sporting activities set out below or for any other uses for which **FieldTurf** gives its written authorization, within 8 years from the date of completion of installation, **FieldTurf** will, at **FieldTurf's** option, either repair or replace the affected area without charge, to the extent required to meet the warranty period (but no cash refunds will be made). This warranty does not come into effect unless the Certificate of Completion is sent for validation to the head office of **FieldTurf** indicated below within 30 days of installation or customer use, whichever occurs first. This warranty is limited to the remedies of repair or replacement, which shall constitute the exclusive remedies available under this warranty, and all other remedies or recourses which might otherwise be available are hereby waived by the Buyer. **FieldTurf** will have no other obligations or liability for damages arising out of or in connection with the use or performance of the product including but without limitation, damages for personal injury or economic losses.

Other Exclusions

This limited warranty does not cover:

1. Damage resulting from accident, force majeure, misuse, intentional and unintentional abuse, infill displacement, and neglect or from other than normal and ordinary use of the Product. Normal and ordinary use is considered as usage up to 3,000 hours per year of regular play and utilization for the sporting activities set out in the warranty. Normal play and ordinary use includes a reasonable number of users or participants and does not include repetitive marching, repetitive training or high-intensity drills on the same part of the field, in particular to, but not limited to white or yellow lines, goal areas, and sideline areas, or the area around the bases, home plate and the pitcher's mound.
2. Damage resulting from failure to maintain the Product in accordance with the maintenance and use instructions provided to the buyer. Buyer shall produce maintenance logs.
3. Damage resulting from repair, attempted repair or maintenance by anyone other than **FieldTurf** or an authorized distributor or authorized third party serviceman.
4. Damage due to causes which include but are not limited to the application of chemicals or cleaning agents, adhesive backing, dirt, traffic, normal matting, negligence, vandalism, fire, flood, windstorm, animals and improper care.
5. Failure or improper design of the base. Depression of the soil or matter upon which the base or Product rests.
6. Use of improper footwear such as long spiked track shoes and regular use of steel cleats. Standard soccer or football cleats are recommended. Flat soled shoes such as work boots should be avoided.

We disclaim liability for incidental and consequential damages for breach of any express or implied warranty, including any implied warranty of merchantability, with respect to the Product. In the event that the Product is used for purposes other than the specific sporting activities set out herein or any other uses for which **FieldTurf** gives its written authorization, it being understood that **FieldTurf** has tested the Product for use in connection with these sporting activities and may not have tested it for other uses, **FieldTurf** shall not be responsible for any and all damages incurred and this limited warranty as well as all legal warranties shall become null and void. Any product repairs or replacements performed under the terms of this guarantee shall not lead to any extension whatsoever of the guarantee.

Name of purchaser: ***Montgomery County Department of Parks, 9500 Brunett Ave., Silver Spring, MD 20901***

Date of completion:	*August 10th, 2009*	Sporting Activities:	*Multi Sport use*
Location:	*Montgomery Blair High School*	Installed by:	*FieldTurf USA*
Address:	*51 University Boulevard*	City:	*Silver Spring*
State:	*Maryland*	Zip:	*20901*
Tel:	*(301) 649-2451*	Fax:	
Signature:		(Please Print Name)	*Michael MacNeil*
Date:	*August 14th, 2009*	Reference:	*061749*

This warranty is insured by a third party. For more information please contact Costumer Service at FieldTurf at the number listed below.
FieldTurf 8088 Montview Road, Montreal, Quebec, Canada, H4P 2L7 Toll Free: 1-800-724-2969

FieldTurf Tarkett
UNITED IN SPORT

Appendix C:

Major Lifecycle Cost Assumptions

Turf Selection	**Artificial Turf**	**Bermuda Grass**	**Kentucky Blue Grass**	**Bermuda Grass**	**Cool Season**
Base	**Stone**	**Sand Base**	**Sand Base**	**Native Soil**	**Native Soil**
Size	75,000 to 95,000 square feet	75,000 to 95,000 square feet	75,000 to 95,000 square feet	75,000 to 95,000 square feet	75,000 to 95,000 square feet
Irrigation	No	Yes	Yes	Yes	Yes
Stormwater Management Goal	**Detain, infiltrate, or treat excess runoff to mimic the natural hydrology of woods in good condition.** Natural turf is treated as pervious so a portion of the one-year storm requirement is assumed to be met via natural drainage. Artificial Turf is considered impervous and therefore more treatment is assumed to be needed to meet the same requirement.				
Equipment	Groomer, Utility Cart, Sweeper	Leased Mower, Sprayer, Tractor, Topdresser, Aerator, Verticutter	Leased Mower, Sprayer, Tractor, Topdresser, Aerator, Seeder	Leased Mower, Tractor, Aerator, Verticutter	Z-Mower
Typical Annual Maintenance Practices					
Fertilizer	n/a	10 liquid and 10 granular applications	15 liquid and 10 granular applications	5 liquid and 7 granular applications	4 granular applications
Seed	n/a	1 split overseeding application with rye grass for color in the fall	1 fall and 1 spring seeding	1 split overseeding application with rye grass for color in the fall	1 fall and 1 spring seeding
Water	n/a	Summer months: ½ inch of water 3 times per week, Other months: ½ inch 2 times per week. Irrigation estimate = 1 million gallons per year	Summer months: daily watering up to ¼ inch depending on heat, Other months: ½ inch 2 times per week.	2/3 the requirement of sand base fields	2/3 the requirement of sand base fields
Fungicide	n/a	n/a	Preventative program: 4 applications during the summer	n/a	n/a
Pesticide	n/a	n/a	grub treatment as needed	n/a	grub treatment as needed
Mowing	n/a	36 to 40 week cutting season:5 times a week for 20 weeks, then 2 times a week for the other 16-20 weeks, use energy efficient Fairway mowers (diesel engine/hybrid)	36 to 40 week cutting season:3 times a week for 20 weeks, then 1 time a week for the other 16 to 20 weeks, use Z mower (gasoline engine)	4 times a week for 20 weeks then 2 times a week for the other 16-20 weeks, bluegrass 3 times a week, 1 time a week (36 to 40 weeks) Fairway mowers (diesel engine spinning electric alternator) hybrid versus Z mower (gas) burns more fuel.	36 to 40 week cutting season:1 time a week for 40 weeks, use Z mower (gasoline engine)
Grooming	2 times per month	n/a	n/a	n/a	n/a
Sweeping	every 3 weeks	n/a	n/a	n/a	n/a
Paint	Permanent lines assumed for all sports.	Once per week painting of each sport as needed.	Once per week painting of each sport as needed.	Once per week painting of each sport as needed.	Once per week painting of each sport as needed.
Top Dressing	n/a	6 times per year	4 times per year	n/a	n/a
Sod/Resprigging	n/a	once per year after heavy use in the spring	resod heavily used areas twice per year	once per year after heavy use in the spring	resod heavily used areas twice per year
Other Costs					
Add Infill	once during life of carpet	n/a	n/a	n/a	n/a
Renovation	replace carpet after 8 years	strip off, grade, and sod every 10 to 12 years	strip off, grade, and sod every 10 to 12 years	strip off, grade, and sprig every 10 to 12 years	strip off, grade, and seed every 10 to 12 years
Disposal	require replacement field contractor to recycle old field	n/a	n/a	n/a	n/a

Appendix D-1 MCPS

Lifecycle Comparison of Artificial Turf and Natural Grass Fields at MCPS High School Stadiums

	Artificial Turf (w Crumb Rubber Infill)				Bermuda Grass (w Sand Base)			Kentucky Bluegrass (w Sand Base)			Bermuda Grass (w Native Soil Base)			Cool Season Grass (w Natural Soil Base)		
Year	**Capital**	**Maintenance**	**Revenue**	**Net Cost**	**Capital**	**Maintenance**	**Cost**				**Capital**	**Maintenance**	**Cost**	**Capital**	**Maintenance**	**Cost**
1	1,125,000	10,000	(100,000)	1,035,000	530,000	50,000	580,000	580,000	50,000	630,000	150,000	45,000	195,000	75,000	25,000	100,000
2		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
3		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
4		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
5		13,000	(100,000)	(87,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
6		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
7		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
8		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
9	565,000	10,000	(100,000)	475,000		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
10		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
11		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
12		10,000	(100,000)	(90,000)	150,000	50,000	200,000	175,000	50,000	225,000	100,000	45,000	145,000	60,000	25,000	85,000
13		13,000	(100,000)	(87,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
14		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
15		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
16		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
17	565,000	10,000	(100,000)	475,000		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
18		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
19		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
20		10,000	(100,000)	(90,000)		50,000	50,000		50,000	50,000		45,000	45,000		25,000	25,000
Total	**2,255,000**	**206,000**	**(2,000,000)**	**461,000**	**680,000**	**1,000,000**	**1,680,000**	**755,000**	**1,000,000**	**1,755,000**	**250,000**	**900,000**	**1,150,000**	**135,000**	**500,000**	**635,000**

Cost Per Hour Calculation

	Artificial Turf (with Crumb Rubber Infill)		Bermuda Grass (Sand Base)		Kentucky Bluegrass (Sand Base)		Bermuda Grass (Native Soil Base)		Cool Season Grass (Native Soil)	
Total Hours of Use/Yr (see separate chart for details) =		2,300		600		500		400		300
Cost Per Hour of Use =		**10.02**		**140.00**		**175.50**		**143.75**		**105.83**
Net Present Value (17 Year Cost) at Various Discount Rates		**Cost Per hour**	**NPV**	**Cost Per hour**	**NPV**	**Cost Per hour**	**NPV**	**Cost Per hour**	**NPV**	**Cost Per hour**
3%	$532,751	11.58	1,363,644	113.64	1,429,722	142.97	885,255	110.66	486,835	81.14
5%	$564,483	12.27	1,211,398	100.95	1,272,938	127.29	759,340	94.92	416,394	69.40
7%	$587,512	12.77	1,091,630	90.97	1,149,459	114.95	661,319	82.66	361,585	60.26

Assumptions

	Artificial Turf	Bermuda (Sand Base)	Bermuda (Native Soil)	KBG (Sand Base)	Cool Season G (Native Soil)	
Capital Cost Detail						
Sitework	235,000	450,000	100,000	500,000	60,000	Sitework costs only occur in initial construction
Turf Field Installation/Replacement	565,000	n/a	n/a	n/a	n/a	8 year AT replacement based on typical warranty length
Stormwater Management	300,000					Stormwater Management costs only occur in initial construction. AT swm could be lower when swm is part of overall school modernization.
Equipment	25,000	80,000	50,000	80,000	15,000	
Recycling/Disposal of Turf Field	-	n/a	n/a	n/a	n/a	Required as part of contract for replacement AT field
Total - Initial Construction	**1,125,000**	**530,000**	**150,000**	**580,000**	**75,000**	AT, and sand base costs will be less if done as part of a high school modernization
Total - Replacement	565,000	-	-	-	-	8 year AT replacement based on typical warranty length
Maintenance Costs						
Annual Maintenance Costs	**10,000**	**50,000**	**45,000**	**50,000**	**25,000**	
Other Maintenance Costs						
Add infill material after 3 years	3,000	n/a	n/a			
Resodding or major renovation	n/a	150,000	100,000	175,000	60,000	
Revenue						
CUPF Field Rentals	100,000	-	-	-	-	Richard Montgomery HS revenue from permits was about 40k in CY10. MSE paid $300,000 for five years of use (or 60k per year). CUPF charges $125/hr for non-profit in county groups and $200/hr for all others. Blair and Richard Montgomery HS both permit about 1,000 hours for f community use per year, which would equal $125k per year at the non-profit rate. Conservative assumption of 100K (80% of total) used.

Appendix D-2 Parks

Lifecycle Comparison of Artificial Turf and Natural Grass Fields for Parks

	Artificial Turf (w Crumb Rubber Infill)				Bermuda Grass (w Sand Base)				Kentucky Bluegrass (w Sand Base)				Bermuda Grass (w Native Soil Base)			
Year	Capital	Maintenance	Revenue	Net Cost	Capital	Maintenance	Revenue	Cost	Capital	Maintenance	Revenue	Net Cost	Capital	Maintenance	Revenue	Cost
1	1,125,000	10,000	(100,000)	1,035,000	530,000	50,000	(60,000)	520,000	580,000	50,000	(50,000)	580,000	150,000	45,000	(14,000)	181,000
2		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
3		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
4		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
5		13,000	(100,000)	(87,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
6		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
7		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
8		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
9	565,000	10,000	(100,000)	475,000		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
10		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
11		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
12		10,000	(100,000)	(90,000)	150,000	50,000	(60,000)	140,000	175,000	50,000	(50,000)	175,000	100,000	45,000	(14,000)	131,000
13		13,000	(100,000)	(87,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
14		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
15		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
16		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
17	565,000	10,000	(100,000)	475,000		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
18		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
19		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
20		10,000	(100,000)	(90,000)		50,000	(60,000)	(10,000)		50,000	(50,000)	-		45,000	(14,000)	31,000
Total	**2,255,000**	**206,000**	**(2,000,000)**	**461,000**	**680,000**	**1,000,000**	**(1,200,000)**	**480,000**	**755,000**	**1,000,000**	**(1,000,000)**	**755,000**	**250,000**	**900,000**	**(280,000)**	**870,000**

Cost Per Hour Calculation

Artificial Turf (with Crumb Rubber Infill)			Bermuda Grass (Sand Base)			Kentucky Bluegrass (Sand Base)			Bermuda Grass (Native Soil Base)		
Total Hours of Use/Yr (see separate chart for details) =		1,000	**Annual Hours of Use =**		600	**Annual Hours of Use =**		500	**Annual Hours of Use =**		500
Cost Per Hour of Use =		**23.05**	**Cost Per Hour of Use =**		**40.00**	**Cost Per Hour of Use =**		**75.50**	**Cost Per Hour of Use =**		**87.00**
Net Present Value at Various Discount Rates		**Cost Per hour**	**Discount Rate**	**NPV**	**Cost Per hour**	**Discount Rate**	**NPV**	**Cost Per hour**	**Discount Rate**	**NPV**	**Cost Per hour**
3%	$532,751	26.64	3%	488,109	40.68	3%	685,848	68.58	3%	676,971	67.70
5%	$564,483	28.22	5%	475,547	39.63	5%	649,828	64.98	5%	584,869	58.49
7%	$587,512	29.38	7%	464,297	38.69	7%	619,758	61.98	7%	513,003	51.30

Assumptions

	Artificial Turf	Bermuda (Sand Base)	Bermuda (Native Soil)	KBG (Sand Base)	Cool Season G (Native Soil)	
Capital Cost Detail						
Sitework	235,000	450,000	100,000	500,000	60,000	Sitework costs only occur in initial construction
Turf Field Installation/Replacement	565,000	n/a	n/a	n/a	n/a	8 year AT replacement based on typical warranty length
Stormwater Management	300,000					AT swm could be lower when swm is part of overall school modernization. Natural grass fields assumed to have sufficient drainage already in place.
Equipment	25,000	80,000	50,000	80,000	15,000	
Recycling/Disposal of Turf Field	-	n/a	n/a	n/a	n/a	Required as part of contract for replacement of AT field
Total - Initial Construction	**1,125,000**	**530,000**	**150,000**	**580,000**	**75,000**	AT, and sand based natural turf field costs could be less if done as part of a high school modernization
Total - Replacement	565,000	-	-	-	-	8 year AT replacement based on typical warranty length
Maintenance Costs						
Annual Maintenance Costs	**10,000**	**50,000**	**45,000**	**50,000**	**25,000**	See Appendix C for Maintenance Assumptions
Other Maintenance Costs						
Add infill (once during life of carpet)	3,000	n/a	n/a			
Resodding or major renovation	n/a	150,000	100,000	175,000	60,000	
Revenue						
Annual CUPF Field Rentals - MCPS	100,000	-	-	-	-	MCPS - Art Turf: CUPF rate = $125-$200/hr at 1,000 hours of community use of AT field based on Richard Montgomery HS & Blair HS history. Assume 80% o
						MCPS - Natural Grass: No community use assumed. Hours reserved for team games and some practices only.
Annual CUPF Field Rentals - Parks	100,000	60,000	50,000	14,000	11,000	Parks - Art Turf fields permitted by CUPF, same revenue as for MCPS AT fields. Natural Grass Revenue = same $ rate as AT for sand-based fields, current av

APPENDIX E: EXCERPT FROM THE MCPS ATHLETIC HANDBOOK WEATHER

WEATHER GUIDELINES

Temperature	*Air Quality Index*	*Activity*
Mid 70s – Low 80s° F	Code Green 0-50 Good Air Quality	No restrictions.
Upper 70s – Mid 80s° F	Code Yellow 51-100 Moderate Air Quality	Watch carefully, appropriate water breaks.
Upper 80s – Low 90s° F	Code Orange 101-150 Unhealthy for sensitive groups Air Quality	Observe carefully (especially at risk individuals) frequent water breaks.
Mid 90s – 100° F	Code Red 151-200 Unhealthy Air Quality	Hold one morning non-school day practice, or one school day practice of one hour, with mandatory water breaks every 20 minutes. Games cancelled.
Mid 90s – 100+° F	Code Purple 201-300 Very Unhealthy Air Quality	Afternoon practices cancelled. Games cancelled.

Source: Montgomery County Government, Department of Environmental Protection

It is the coach's responsibility to call for air quality color codes and respond appropriately. The forecast and color code can be obtained by calling 202-962-3299 and/or visit their website at http://www.mwcog.org/environment/air/data.

Air quality (ground level ozone or smog) deteriorates when temperatures are in excess of 90°, with low or no winds and clear skies. When such conditions are anticipated, a Code Orange, Red or Purple forecast is issued. Under such conditions at-risk individuals, who are heavily exercising, should be closely watched and if experiencing any breathing difficulties, immediately required to cease exercising and move indoors. At-risk individuals include those who responded "yes" on the Medical Evaluation Form to being asthmatic or having heart and lung function problems (Part I), and individuals who responded "yes" to having experienced chest pains, shortness of breath, weakness when exposed to high temperatures, or impaired lung function (Part 3).

In hot, humid weather, coaches are expected to use good judgment in determining the length and type of outdoor practice. Frequent practice breaks and drinking water must be provided. Coaches must be aware of signs of heat exhaustion. Players who exhibit these signs are to cease practicing. Salt tablets are not to be issued. Players should be counseled to continue proper hydration at home and after practices.

When schools are dismissed early because of heat, no practices, meetings, or contests are allowed.

In extremely cold weather coaches are expected to use good judgment in determining the length and type of practice. Athletic events may be rescheduled by mutual agreement of the athletic directors of the opposing schools if the wind-chill factor could be detrimental to the health and safety of the athletes.

THUNDER AND LIGHTNING

1. Procedures for suspending outdoor athletic events because of lightning/thunder.
   a. If thunder and/or lightning can be heard or seen, stop the activity and have players and spectators seek protective shelter immediately.
   b. Inform players that in situations where thunder and/or lightning may or may not be present, if they feel their hair stand on end and skin tingle, immediately assume the following crouched position: drop to their knees, place their hands/arms on their legs, and lower their head. They should not lie flat.
2. In the event that either thunder or lightning should occur, allow 30 minutes to pass after the last occurrence of thunder and/or lightning before resuming play.
3. In case of thunder or lightning during an athletic practice, scrimmage, or contest, the activity will be suspended immediately. Players and officials should seek shelter. Spectators will be directed to leave. All coaches are expected to have an alternate plan for seeking shelter and/or expedient departure in case of thunder or lightning or other severe inclement weather.
4. The principal has the final authority to delay or postpone events because of thunder or lightning. If the principal is not present, the host athletic director has the responsibility; if the athletic director or designee is not present, coaches have the responsibility.
5. If a game is suspended because of thunder or lightning, it shall be resumed the same day, if possible, at the discretion of the officials and host athletic director.
6. When a contest has been suspended for more than 1 1/2 hours (cumulative time) due to inclement weather, the contest shall be ended. The game will be rescheduled at a later date or continued from the point of suspension, in accordance with the rules governing that sport.

Unless a county-wide decision is announced, the decision to postpone outdoor athletic events because of adverse field conditions or inclement weather is the responsibility of the host athletic director or designee.

FIELD CONDITIONS

Elementary and middle school facilities shall not be used for practices or games when the following conditions exist:

1. Water is standing on the field.
2. One-half inch or more of rain has fallen within the previous 24 hours.
3. Turf and mud can be displaced or dislodged from the ground.
4. The ground cakes or clings to shoes.
5. A steady rain is falling.
6. Bare areas are muddy

Appendix F: Montgomery County Department of Environmental Protection attachment to the July1, 2010 Montgomery County Council Transportation, Infrastructure, Energy, and Environment Committee

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.

<u>Summary of Studies Reviewed</u>

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.

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"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."

Synthetic Turf Stormwater Quality Monitoring and Sampling Plan

February 2, 2010

Project Description and Background

The San Francisco Recreation and Park Department (RPD) has recently installed synthetic turf at playfields around San Francisco. Public concern about the health and safety of the synthetic turf products has arisen. One area of concern is the material chemical composition, in part due to the use of used tires for the rubber infill. In 2008, RPD established the Synthetic Playfields Task Force to review existing data and research and develop recommendations, which included the following:

- The Department should conduct or participate in tests of field stormwater runoff to determine the presence and potential levels of zinc and other possible contaminants.
- If the stormwater runoff meets drinking water standards, the Department should recharge it into groundwater, if feasible. If the water does not meet drinking water standards, the Department should collect runoff for discharge into the sewer system, where it will be treated appropriately.

The San Francisco Public Utilities Commission (SFPUC) and RPD are working together to complete the above recommendations. The Synthetic Turf Stormwater Quality Monitoring and Sampling Plan described herein outlines how these recommendations will be achieved.

Monitoring Goals and Objectives

The objectives of the Synthetic Turf Stormwater Quality Monitoring and Sampling Plan are:

- To collect stormwater quality data;
- To determine the potential impact of synthetic playfields on groundwater; and
- To assist with the planning and design of San Francisco playfields.

Sampling Locations

The sampling locations will be at two playfields where RPD has installed synthetic turf. Site plans of both locations are attached. The two locations are as follows:

- South Sunset Playground, which is located on 40th Avenue between Wawona Street and Vicente Street; and
- Garfield Square, which is located between 25th Street and 26th Street and Treat Avenue and Harrison Street.

Sampling Schedule

Data collection will start as soon as possible and will extend through the 2010/2011 rainy season. Sampling will be performed twice during 2009/2010 winter storm events and

twice during the 2010/2011 winter storm events. Ideally, samples should not be collected less than two weeks apart and should be collected as early as possible after the beginning of each storm, when there is sufficient flow available to allow sampling. The first sample collected during the 2010/2011 winter should be collected at the beginning of the first storm of that rainy season. The goal of the first 2010/2011 winter sampling event is to characterize the "first flush" stormwater quality characteristics.

Sampling Methods

At each sampling location, grab samples will be collected and sent to the SFPUC Water Quality Division Laboratory for analysis. These grab sample locations are shown on the attached figures and were discussed at a field visit that occurred on January 27, 2010.

Constituents and Methods

The physical parameters, chemical constituents, laboratory methods and laboratory reporting limits, where applicable, are as follows:

- pH (0.1 pH unit), temperature (0.1˚C), specific conductance, turbidity (0.1 NTU), total dissolved solids (TDS), and total suspended solids (TSS)
- The following metals (total and dissolved), methods, and detection limits:

Metal	Method	MDL[1]		ML[2]	
AG	SEM_200.8_WW	0.003	UG/L	0.25	UG/L
AS	SEM_200.8_WW	0.07	UG/L	2	UG/L
BA	SEM_200.8_WW	0.02	UG/L	Not listed	
BE	SEM_200.8_WW	0.04	UG/L	0.5	UG/L
CD	SEM_200.8_WW	0.006	UG/L	0.25	UG/L
CO	SEM_200.8_WW	0.005	UG/L	Not listed	
CR	SEM_200.8_WW	0.004	UG/L	0.5	UG/L
CU	SEM_200.8_WW	0.03	UG/L	0.5	UG/L
FE	SEM_200.8_WW (modified)	3	UG/L	20	UG/L
MN	SEM_200.8_WW	0.03	UG/L	Not listed	
MO	SEM_200.8_WW	0.07	UG/L	Not listed	
NI	SEM_200.8_WW	0.02	UG/L	1	UG/L
PB	SEM_200.8_WW	0.02	UG/L	0.5	UG/L
SB	SEM_200.8_WW	0.03	UG/L	0.5	UG/L
SE	SEM_200.8_WW	0.03	UG/L	2	UG/L
TL	SEM_200.8_WW	0.01	UG/L	1	UG/L
V	SEM_200.8_WW	0.007	UG/L	Not listed	
ZN	SEM_200.8_WW	0.2	UG/L	1	UG/L
HG	SEM_245.1_WW	0.2	UG/L	2	UG/L

[1] Minimum Detection Limit
[2] Method Limit as per the State Implementation Policy. (Method limit applies to the wastewater method and is similar to the reporting limit that applies to drinking water methods.)

- Volatile organic compounds (VOCs) by US EPA Method 624
- Semi-volatile organic compounds by US EPA Method 625

QA/QC

Field: A field duplicate sample for all constituents will be collected at the South Sunset sampling location. In addition, one trip blank will be analyzed for VOCs.

Laboratory: The laboratory(ies) shall follow all standard laboratory quality control procedures, including analyzing a matrix spike (MS) and matrix spike duplicate (MSD) for each constituent.

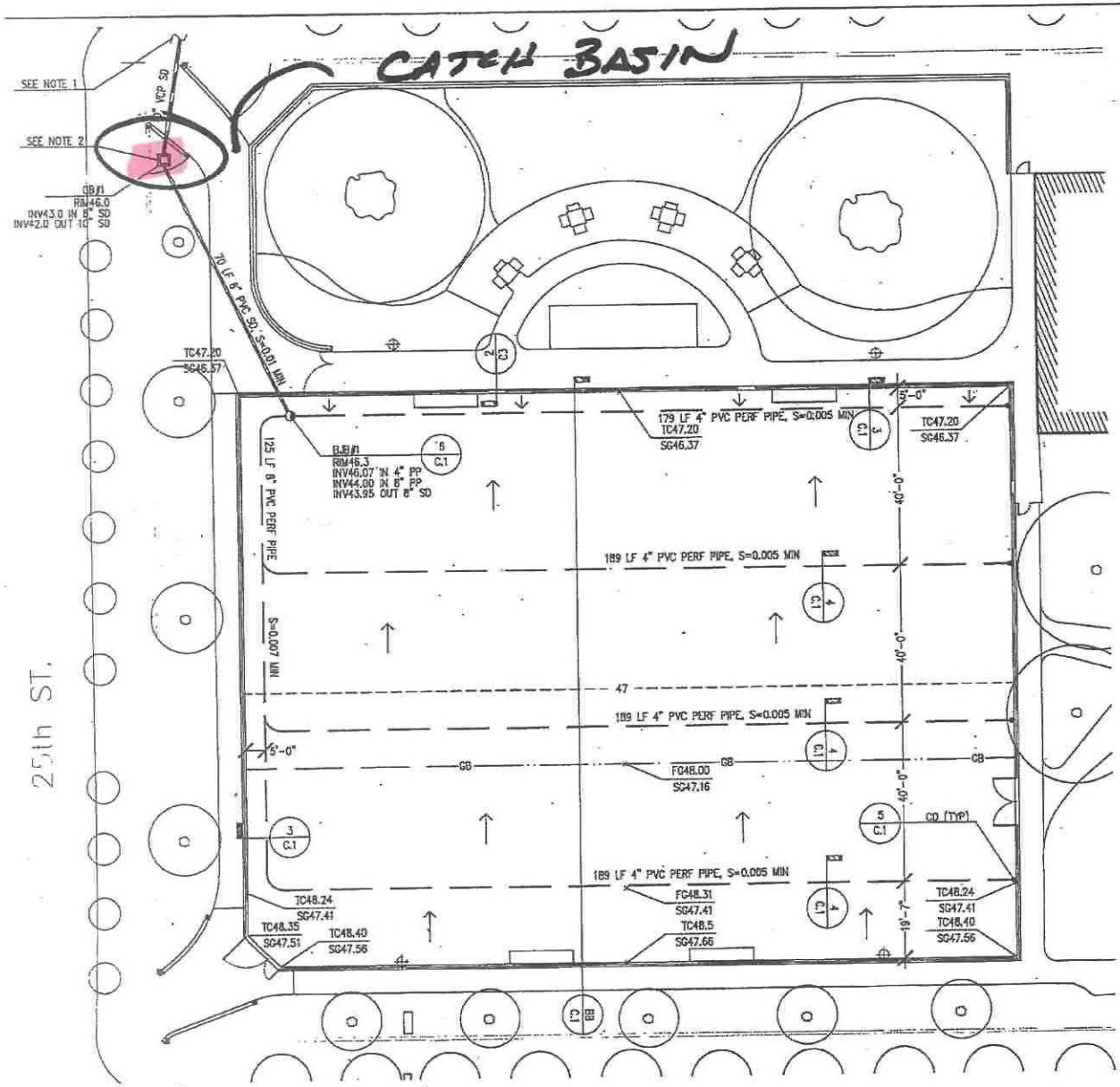
Data and Reporting

Once the samples are collected and analyzed at the lab, the data will be entered into LIMS under a new project entitled, “Synthetic Turf” and the two locations should be entitled, “SSPG” and “GarSq,” for South Sunset Playground and Garfield Square, respectively. The sample identifications, SDG numbers and a copy of the COC will be provided to Betsey Eagon, who will be coordinating the synthetic turf stormwater monitoring and sampling.

After the first two sampling events, the data will be summarized and reported in an Excel spreadsheet to RPD for review. After all four sampling events have been performed, the Excel spreadsheet will be updated and a brief memorandum will be prepared.

SAN FRANCISCO
FIELDS PROJECT

GARFIELD SQ.



SYNTHETIC TURF FIELD GRADING PLAN

SCALE: 1"=10'-0"

NOTES

1. TIE INTO STORM DRAIN. SEE SHEET C3B3.2.
2. NEW CATCH BASIN. SEE SHEET C3B3.2.
3. SEE SHEET GL7.1 FOR GRADING OF REST OF SITE.

LEGEND

SUBDRAIN CROSSING – 1" PROVIDE
PERFORATED SUBDRAIN LINE
GRADE BREAK LINE
PERFORATED PVC CLEAN OUT, SEE DETAIL
BENCH JUNCTION BOX, SEE DETAIL
DIRECTION OF SUBDRAINS SLOPE
CO CLEAN OUT
GB GRADE BREAK
SD SUBDRAIN
TC TOP OF CURB

RHAA

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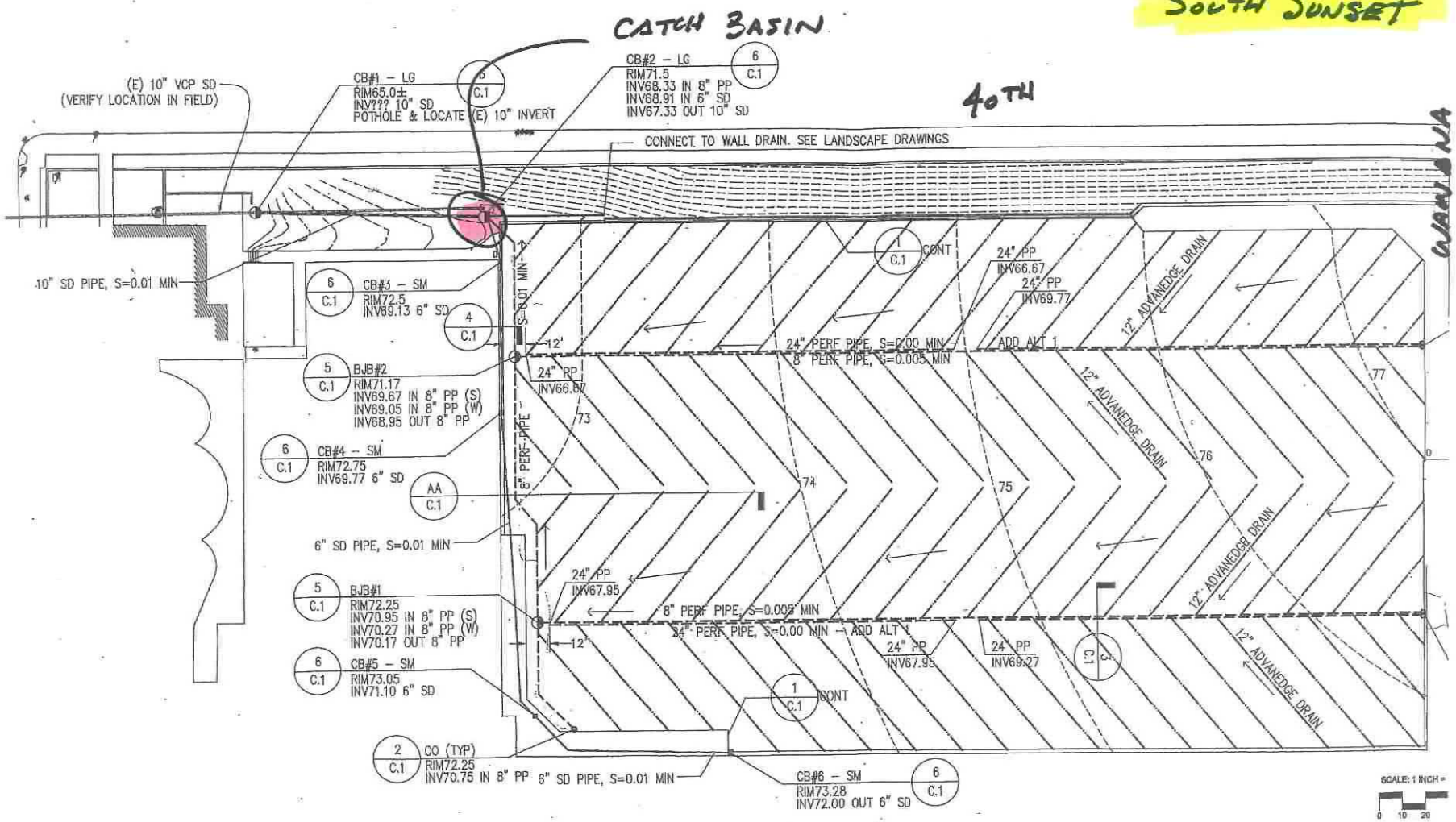
SYNTHETIC TURF FIELD GRADING & DRAINAGE PLAN

GARFIELD SQUARE PLAYGROUND

GC2.1

Sampling location

SOUTH SUNSET



LEGEND

- FINISH GRADE CONTOURS – 1' INTERVAL
- PERFORATED SUBDRAIN LINE
- 12" ADVANEDGE DRAIN LINE
- SOLID STORM DRAIN LINE

Sampling location

Appendix H: Sampling Results from SFWater

Synthetic Turf Stormwater Quality Monitoring

2009/2010 Monitoring Results [1]

4/28/2010

		South Sunset Playground		*Garfield Square*		MCL[3]
	Units	2/23/2010	3/2/2010	2/24/2010	3/2/2010	
pH		6.3[2]	6.6	7.2	7.1	
Temperature	°F	52[2]	56	56	58	
Specific Conductance	UMHOS/CM	237[2]	224	382	390	
Turbidity	NTU	49[2]	117	1	43	
Total Dissolved Solids	MG/L	102	62	212	152	
Total Suspended Solids	MG/L	25	45	<7	28.5	
Silver	UG/L	<0.25	<0.25	<0.25	<0.25	100[4]
Dissolved Silver	UG/L	<0.25	<0.25	<0.25	<0.25	
Arsenic	UG/L	<2	<2	<2	<2	10
Dissolved Arsenic	UG/L	<2	<2	<2	<2	
Barium	UG/L	70.00	107.79	56.66	137.50	1000
Dissolved Barium	UG/L	50.08	61.06	54.60	68.83	
Beryllium	UG/L	<0.5	<0.5	<0.5	<0.5	4
Dissolved Beryllium	UG/L	<0.5	<0.5	<0.5	<0.5	
Cadmium	UG/L	<0.25	<0.25	<0.25	<0.25	5
Dissolved Cadmium	UG/L	<0.25	<0.25	<0.25	<0.25	
Cobalt	UG/L	1.10	2.64	0.22	1.72	-
Dissolved Cobalt	UG/L	0.16	0.08	0.22	0.18	
Chromium	UG/L	5.13	12.25	<0.5	1.81	50
Dissolved Chromium	UG/L	1.54	0.84	<0.5	0.54	
Copper	UG/L	4.39	8.99	5.48	8.91	1000[4]
Dissolved Copper	UG/L	4.32	2.40	5.90	4.67	
Iron	UG/L	1386.80	3624.30	14.40	1741.50	300[4]
Dissolved Iron	UG/L	15.11	5.50	<2.5	<2.5	
Manganese	UG/L	51.21	144.25	0.87	35.00	50[4]
Dissolved Manganese	UG/L	2.36	0.37	1.87	0.53	
Molybdenum	UG/L	0.46	0.34	8.69	8.26	-
Dissolved Molybdenum	UG/L	0.57	0.42	8.44	7.37	
Nickel	UG/L	7.57	18.54	3.80	7.34	100
Dissolved Nickel	UG/L	<1	<1	3.64	3.89	
Lead	UG/L	0.64	1.59	<0.5	1.69	15
Dissolved Lead	UG/L	<0.5	<0.5	<0.5	<0.5	
Antimony	UG/L	<0.5	<0.5	0.67	0.70	6
Dissolved Antimony	UG/L	<0.5	<0.5	0.61	0.62	
Selenium	UG/L	<2	<2	<2	<2	50
Dissolved Selenium	UG/L	<2	<2	<2	<2	
Thallium	UG/L	<1	<1	<1	<1	2
Dissolved Thallium	UG/L	<1	<1	<1	<1	
Vanadium	UG/L	3.70	8.83	1.60	6.52	50[5]
Dissolved Vanadium	UG/L	1.33	1.31	1.49	2.14	
Zinc	UG/L	31.43	32.29	58.50	136.75	5000[4]
Dissolved Zinc	UG/L	6.40	3.72	42.16	72.79	
Mercury	UG/L	<0.2	<0.2	<0.2	0.2	2
Dissolved Mercury	UG/L	<0.2	<0.2	<0.2	<0.2	
Volatile Organic Compounds		ND	ND	ND	ND	
Semi Volatile Organic Compounds		ND	ND	ND	ND	

(1) Two additional sampling events will be conducted during the 2010/2011 winter season as per the Synthetic Turf Stormwater Quality Monitoring and Sampling Plan (2/2/10).
(2) Used field duplicate value
(3) California Maximum Contaminant Levels (MCL)
(4) Secondary MCL
(5) California Department of Public Health notification level

Appendix I-1:

WESTERN MONTGOMERY COUNTY CITIZENS ADVISORY BOARD
Serving the areas of Bethesda, Cabin John, Chevy Chase, Friendship Heights
Garrett Park, Glen Echo, North Bethesda and Potomac

September 30, 2010

The Honorable Nancy Floreen, President
Montgomery County Council
Council Office Building
100 Maryland Avenue
Rockville, Maryland 20850

Dear Council President Floreen,

The Western Montgomery County Citizens Advisory Board (the "CAB") examined the issues and concerns raised by members of the community at our June 21, 2010 meeting regarding the installation of artificial turf fields at Montgomery County high schools and public parks. The concerns raised by the community centered on the impact artificial turf fields may have on the environment, student health, and County finances.

Based on the concerns raised by the community members, the full CAB deliberated on this issue at its July 19, 2010 meeting and recommends that the Montgomery County Council address the following key points:

1) A full life cycle cost analysis of artificial turf field installation should be undertaken by the County, which should include an analysis of all costs associated with maintenance, replacement, and disposal. This analysis will assist the County in determining the true future financial commitment that artificial turf fields will entail.

2) The County, with partners like the Environmental Protection Agency, Montgomery County Public Schools, and the Montgomery County Department of Parks, should embark on a rigorous collection and review of existing scientific data, and new studies, if necessary, to fully understand the effects of artificial turf fields on:

    a) the safety and health of students and athletes using the fields; specifically problems associated with excessively high temperatures during summer months and increases in the rate and severity of sport injuries.

    b) the environment; specifically toxic chemicals in stormwater runoff and toxic particulates in the air.

Bethesda-Chevy Chase Regional Services Center
4805 Edgemoor Lane • Bethesda, Maryland 20814-5305 • 240/777-8200, TTY 240/777-8212, FAX 240/777-8211

We are grateful to the County Council's Transportation, Infrastructure, Energy and Environment (T&E) Committee for initiating a dialogue about the risks posed by the installation of artificial turfs in the County high schools and parks. As the County continues to study the effects of artificial turf fields, we encourage them to keep in mind specific concerns raised by members of the community to the CAB.

Please contact us should you have any questions or like any additional information.

Sincerely,

Sue F. Knapp
Chair

SFK/kpt

cc: Montgomery County Councilmembers

Appendix I-2

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

Appendix J:

Montgomery County Stormwater Partners Network
Resolution on Sustainable Athletic Field Construction and Maintenance

Whereas the **problem** that athletic field directors and managers seek to address is the poor condition of many of our rectangular grass fields and their degradation after extensive hours of play in all weather conditions;

Whereas typically such fields have been composed of sod laid on native clay soil and maintained with chemical fertilizers.

Whereas one **"solution"** being aggressively promoted, artificial turf, is a rug of plastic blades attached to a coated plastic mat and infilled with a couple of inches of pulverized used tires .

Whereas both the plastic rug and synthetic rubber infill pose documented water pollution problems and other environmental and public health hazards;

Whereas grass is the safer, healthier, environmentally beneficial, more cost-effective option preferred by professional and amateur athletes and coaches; and

Whereas grass provides oxygen, absorbs carbon dioxide, is sustainable and renewable;

Whereas grass fields can always be converted to artificial turf but artificial turf, with its parking lot-like base--tons of dirt removed and tons of rocks trucked in-- cannot be easily or cost effectively converted back to grass.

Whereas greater durability, drainage, and water pollution prevention can be achieved by installing a sand-cap grass field and maintaining it organically, as we know from the experience of others,[1] and irrigation as needed may be done with water collected in cisterns from stormwater run-off,

Be it therefore resolved that the Stormwater Partners asks Montgomery County Department of Parks, Montgomery County Public Schools, and other County land management agencies, to:

- **Pilot one or more grass fields using the best 21st century techniques for installation and organic maintenance that have been documented to work;**
- **Install no additional rubber and plastic fields while the natural grass fields are being fully piloted using best available practices, and thereafter only where grass cannot grow, e.g., indoors, in full shade, or a temporary surface on asphalt, and using safer, biodegradable alternatives to rubber infill.**

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[1] Branford, CT, Alex Palluzzi, in 30 years' experience with athletic fields has perfected organic maintenance. E-mail correspondence. Also see http://zip06.theday.com/blogs/the_sound/archive/2008/11/20/hammer-time.aspx and http://www.beyondpesticides.org/lawn/activist/BranfordCTpolicy.pdf in *Shore Publishing.*

- **Compare full life cycle cost of organically-maintained natural turf fields versus artificial turf fields, to include disposal costs of artificial turf.**
- **Create financing mechanisms that include annual maintenance costs in the budget so as not to artificially select for expensive plastic fields.**
- **Include testing of field leachate and runoff discharges for zinc, phthalates, and lead.**
- **Publish on the County's web site the results of the organic and artificial turf water pollution discharge tests and life cycle costing studies.**

Further Be It Known that:

Plastic artificial turf can become hot enough to burn players and to contribute to "heat island" effect,[2] while a grass field remains cooler than air because of transpiration;

Used tire crumbs are documented to contain carcinogens, mutagens, neurotoxins, liver, kidney, and endocrine disruptors, phthalates, and may contain the neurotoxin lead.[3]

Water beads up and rolls off the crumbs and plastic backing rather than percolating into the ground,[4] creating a polluted runoff problem and potentially carrying toxins leached from the tire crumb and plastic into streams;

Zinc from the pulverized truck tires when discharged or leached from artificial turf fields is particularly harmful to plants and aquatic life;[5]

Antimicrobial rinses used to decontaminate the field and fabric softener to fluff up the blades (if used) are also potential contaminates in our waterways;

In as few as 8 years, artificial turf fields experiencing the heavy use intended will face disposal as hazardous waste at significant cost;[6]

Contact: Anne Ambler: anambler@gmail.com or Kathy Michels: Kathleen.Michels@verizon.net 7.1.2010

Additional resources:
www.athenasmi.org/projects/docs/UCC_project_ATHENA_technical_paper.pdf (report with methodology for determining that 1861 trees must be planted to offset the carbon footprint of one 9,000 sq. m artificial turf playing field.)

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[2] Brigham Young University study, http://aces.nmsu.edu/programs/turf/documents/brigham-young-study.pdf.

[3] *See* The Connecticut Agricultural Experiment Station, Examination of Crumb Rubber Produced from Recycled Tires, August 2007.

[4] Brigham Young University study, http://aces.nmsu.edu/programs/turf/documents/brigham-young-study.pdf and Penn State University, http://www.cropsoil.psu.edu/mcnitt/infill8.cfm, in Item No. 5.

[5] Marine Resources Conservation Center, www.synturf.org/images/Crumb_Rubber_Final.pdf ; see also T.Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 6.

[6] University of Arkansas, http://turf.uark.edu/turfhelp/archives/021109.html.

Appendix K:

Solid Waste Advisory Committee (SWAC)

Annual Meeting with the County Executive

February 10, 2011

We appreciate the opportunity to share the concerns of the Solid Waste Advisory Committee and are grateful for the emphasis that the County Executive continues to place on reducing the impact of solid waste on the environment. While not immune from fiscal challenges, DSWS provides critical public services: reliable, safe and timely waste collection and responsible disposal is a key component of our way of life here in Montgomery County. We understand the extreme budget pressures that the County is currently facing, but strongly support sustaining DSWS funding for the FY12 budget.

For many years Montgomery County has provided a leadership role in the areas of recycling, reclamation and disposal of solid waste materials. This leadership role has positioned the county to take on four new solid waste challenges:

1. Artificial Turf
2. Food Recycling
3. Re-development of the Gude Landfill
4. Collaboration/Efficiency/Money Saving Opportunities

Each of these areas are addressed in more detail in Attachment A. We welcome the potential to engage with the County Council or other entities to further these visionary ideas.

All the opportunities discussed in the Attachment A are focused on the same result – reducing the amount of solid waste that enters the waste stream and reducing the impact at our landfills – the result being reduced costs, longer landfill life, and reduced need to send the effluent of Montgomery County to other areas. This will help us enhance the sense of stewardship that we should have for the land, water, and air that makes up our county.

We continue to rely on, and believe in, the continued mission of the DEP's community education, focusing in 2012 on multiple family housing complexes in an effort to bring them up to the same standards and expectations placed and enforced upon owners of single family homes.

We appreciate the continued support of our efforts, and look forward to continued opportunity to serve our county.

Solid Waste Advisory Committee (SWAC)

Annual Meeting with the County Executive

February 10, 2011

Attachment A

Opportunity 1 –**Artificial Turf** –This is a major solid waste issue facing the county today, and one on which Montgomery County has an opportunity to take a leadership role. SWAC has identified 24 football-sized artificial turf installations in Montgomery County (most comprised of private school athletic fields and private athletic businesses) and an additional 150 installations of 4-5,000 square feet installed on private property. As the warranted life of the large fields is only 8 years, and each is comprised of roughly 350,000 pounds of turf and rubber material that cannot be recycled or incinerated, the impact on the County's landfills could be enormous. (Please refer to accompanying charts for additional detail.)

SWAC is looking to the Executive and County Council for support in collaborative efforts with other County organizations and agencies to:

1. Identify and inventory all artificial turf fields currently installed and those with outstanding permits. This will allow SWAC to size the challenge and forecast removal of materials.
2. Manage the ongoing installation and removal of artificial fields, including creating a process for handling the component materials at the Transfer Station. The county needs to capture the opportunity at the entry and exit point.
3. Work with industry experts to stay apprised of latest developments and recommendations in installation, removal and recyclability of these materials.
4. Develop true life cycle models (financial and environmental) for artificial turf fields in order to develop recommendations for County-owned fields.
5. Work with DEP to create community education plan.

Opportunity 2 – **Food Recycling** – SWAC will be exploring the potential for a food recycling plan, similar to that recently announced in Los Angeles, wherein excess edible food is diverted from the waste stream to homeless shelters and food banks. This opportunity can address two pressing problems – alleviating hunger amongst disadvantaged Montgomery County residents, and reducing the amount of material sent to the waste transfer station.

SWAC is looking to the Executive and County Council for support in collaborative efforts with other County organizations and agencies to:

1. Identify potential sources of excess food (e.g., schools, restaurants, grocery stores).
2. Identify potential recipients of excess food.
3. Work with business, community and county organizations to develop a plan for food redistribution, acknowledging and compensating for, in law and code, the contributions of the businesses and private organizations toward this voluntary effort.
4. Work with partner organizations to help create community education plan.
5. Make the necessary changes to health codes and safety laws allowing private and business organizations to cooperate with government in a mutually advantageous arrangement.

Solid Waste Advisory Committee (SWAC)

Annual Meeting with the County Executive

February 10, 2011

Opportunity 3 – **Redevelopment of the Gude Landfill.** SWAC will continue to work with DSWS in developing a comprehensive approach to the Gude Landfill Property Remediation and Re-use plan.

SWAC is looking to the Executive and County Council for support in collaborative efforts with other County organizations and agencies to:

1. Identify potential for valuable resources within the landfill
2. Determine feasibility of 'harvesting' resources.
3. Determine potential for 'selling' property with requirement for remediation prior to development.
4. Create a "ball park" cost estimate for different remediation scenarios.

Opportunity 4 – **Collaboration/Efficiencies/Money Saving Opportunities**

SWAC believes there are efficiencies that can be gained from teaming the efforts of DEP, MNNCP and MCPS to maximize the potential for recycling retrieval from county, park and school public areas by aggregating resources from all three organizations.

SWAC is looking to the Executive and County Council for support in collaborative efforts with other County organizations and agencies to:

1. Identify potential areas for collaboration; e.g., . mapping existing recycling pickup routes and destinations for parks and schools
2. determining additional recycling contributions from expanded programs.

Thank you for your continued support of our efforts. SWAC believes that these four key initiatives will allow Montgomery County to continue to play a leadership role in saving our planet.

Solid Waste Advisory Committee (SWAC)

Annual Meeting with the County Executive

February 10, 2011

Additional Information related to Artificial Turf

(Fields are football or soccer sized – 1.2 acres)

Facility	Status	Designation	Number of Fields
Bullis School	Constructed	Private School	1
Church of the Little Flower	Constructed	Private School	1
Georgetown Prep (?)	Constructed	Private School	1
Good Counsel	Constructed	Private School	1
Holton Arms	Constructed	Private School	1
Landon School	Constructed	Private School	1
Montgomery Blair	Constructed	MCPS	1
Our Lady of Lourdes	Constructed	Private School	1
Richard Montgomery	Constructed	MCPS	1
Soccer Plex	Constructed	Public/Private Partner	3
St Andrew	Constructed	Private School	1
Walter Johnson	Constructed	MCPS	1
Holy Child	Under Construction	Private School	1
The German School	Plan in Review	Private School	1
Fairland Regional Park	Constructed	MNNCP	1
Holy Redeemer Church	Under Construction	Private	1
Mater Dei	Under Construction	Private	1
Champions Field House	Constructed	Private Business	3
Rockville Soccer Plex	Constructed	Private Business	3
		Total Identified	24

List is considered accurate but not complete.

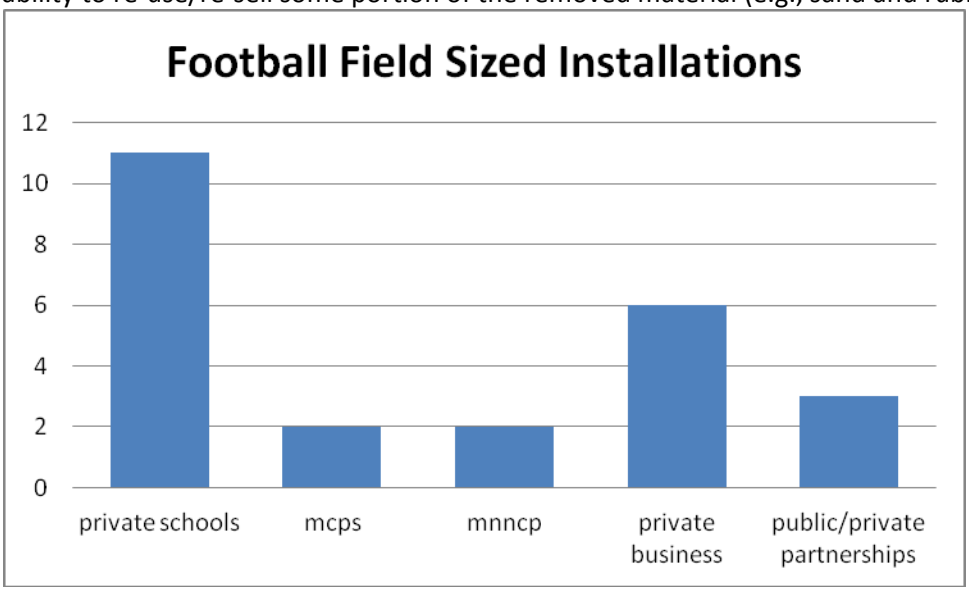
Interesting Statistics for Each Field

Per Joe Murphy – On Deck Sports 1/10/2011

Removal costs = 50 cents per square foot
3- 10 pounds of infill per square foot
80,000 square feet of turf – pulverized used tires
Turf weight and rubber = 350,000 pounds
Sand + Turf + rubber = almost 1,000,000 pounds

While we are still researching the age of the current installations, the warranted life of these fields is only 8 years. Within the next five years, it is anticipated that at least 5 of the football sized fields will be replaced, yielding a minimum of 1,750,000 pounds of rubber.

Artificial turf has the potential to be re-used, but currently cannot be recycled or incinerated. Contractors will have the ability to re-use/re-sell some portion of the removed material (e.g., sand and rubber crumb)



Montgomery County owned property is a small percentage of the total installed base. Montgomery County numbers confirmed with CUPF 1/20/2011.

Private homeowner Artificial Turf Installations

Reference sites per truegreensports.com

Potomac, MD	14
Bethesda	7
Rockville	5
N. Potomac	1
Germantown	1
Silver Spring	1
Gaithersburg	1

- Per Bob Speinke (True Green Sports) – 1/10/2011 We have approximately 150 installations in Montgomery County. The average size is 4-5000 square feet.
- Truegreen replaces, on average, 3 fields per year, resulting in a minimum of 15,000 square feet sent to landfill. All materials are transferred to the Waste Transfer Station.

List does not include private/commercial indoor putting greens, tennis courts and batting cages.

Research has not been completed for in-line skating facilities and retirement communities.

SECTION 02540

SYNTHETIC TURF PLAYING FIELD

PART 1 GENERAL

1.01 SCOPE OF WORK

A. It shall be the responsibility of the successful turf contractor to provide all labor, materials, equipment and tools necessary for the complete installation of a synthetic grass material, The system shall consist of, but not necessarily be limited to, the following:
   1. A complete synthetic grass system consisting of a minimum height 2-1/4 inch tall fiber.
   2. A resilient infill system, consisting of sand and rubber as specified in this section. The infill shall be filled so that there is a void of no greater than ¾" to the top of the fiber.

B. The Turf Contractor shall coordinate all activities with the City Contractor. The City Contractor will provide temporary fencing, access to potable water, sanitary facilities, and unimpeded access to the work site. The turf contractor shall be responsible for all other applicable General Condition requirements identified in the drawings and specifications referenced in paragraph 1.04B of this Document.

1.02 DEFINITIONS

For the purposes of this specification section, the following definitions shall apply:

A. "Turf Contractor" means the Turf Company awarded this Contract or its subcontractor(s) who will furnish and install the Synthetic Grass System in conformance with the terms and conditions of this Contract.

B. "City Contractor" means a separate contractor, under separate agreement, hired by the City, who shall be performing work at the project site contemporaneously with the Turf Contractor.

C. "The Turf Company" shall mean the Synthetic Grass System manufacturer and/or supplier awarded this contract.

D. "Synthetic Grass System" means the turf infill material, backing material, turf fibers, and field striping specified in this Contract Document and resulting in a synthetic turf field suitable for recreational sports in a heavily-used, urban environment.

E. "Owner" shall mean the City Fields Foundation.

F. "City" shall be City and County of San Francisco.

1.03 JOB CONDITIONS

A. The Turf Contractor shall be responsible for reviewing the base and ensuring it conforms to the project requirements prior to placement of the synthetic turf. Turf Contractor shall provide written verification to the Owner's Representative that the base installation is acceptable and meets their requirements prior to installing their turf.

B. Playing field subgrade preparation shall be completed and accepted by the Owner's representative prior to commencement of work under this section.

1.04 REFERENCES

A. ASTM Standard Test Methods:

1. D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings (is this the same as the old D1338?)
2. D1577 - Standard Test Method for Linear Density of Textile Fiber
3. D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering
4. D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
5. D5034 - Standard Test Method of Breaking Strength and Elongation of Textile Fabrics (Grab Test)
6. D5848 - Standard Test Method for Mass per Unit Area of Pile Yarn Floor Covering
7. F355 - Standard Test Method for Shock-Absorbing Properties of Playing Surfaces.
8. F1015 - Standard Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
9. F1936 - Standard Test Method for Shock-Absorbing Properties of North American Football Field Playing Systems as Measured in the Field

B. Specifications/Drawings:
City Fields Project Kimbell Playground- 1398J(R): plans dated 4/28/2009 and specifications dated June3, 2009.

C. Current National Federation of High School (NFHS) Soccer, Football, Men's and Women's Lacrosse, Baseball, Softball rules, as applicable.

1.05 TURF QUALIFICATIONS

A. The Turf Contractor shall be required to submit information from the synthetic turf installer and/or manufacturer as required in Section 01300 that complies with the following:

1. The Turf Contractor and/or the Turf Company must be experienced in **both** the manufacturing and installation of the specified type of synthetic in-filled turf system.
2. For the purpose of meeting these qualifications, the type of rubber and sand are determining factors in meeting these installation qualifications. No alternative in-fills will be allowed.
3. The Turf Contractor must provide competent workmen skilled in this specific type of synthetic turf installation. The designated Supervisory personnel on the project must be certified as competent in the installation of this material, including sewing seams and proper installation of the infill mixture. The manufacturer shall have a representative on site to certify the installation and warranty compliance.
4. All designs, markings, layouts, and materials shall conform to all current NFHS standards as specified that may apply to this type of synthetic turf installation.
5. The foreman installing the synthetic turf must have installed at least twenty (20) fields in the last three (3) years.
6. The Turf Company must provide competent workmen, skilled in this specific type of in-filled synthetic grass installation. The designated supervisory personnel on the project must be certified in writing by the turf manufacturer as competent in the installation of this material, including sewing seams and proper installation of the infill mixture. The manufacturer shall have a representative on site to certify the installation and warranty compliance.
7. The Turf Company must have certified crews and may not use outside, independent contractors for the installation.
8. The Turf Company must possess an active California D-12 Synthetic Products license in good standing, and have never had a license revoked.
9. The Turf Company must not have had a Surety or Bonding Company finish work on any contract within the last five (5) years.
10. The Turf Contractor shall provide written certification from the Turf Contractor and/or the Manufacturer that the proposed Synthetic Grass System does not violate any patent and that the Turf Contractor and/or the Manufacturer will indemnify, defend, and hold the City harmless from any claims arising out of or relating to patent, trademark, or copyright

infringement for the use of any proposed Synthetic Grass System installed by the Turf Contractor.

11. The terms and conditions of this Contract and applicable law mandate the payment of a prevailing rate of wage to all workers, including those engaged in the installation of the Synthetic Grass System. The Owner shall enforce the prevailing wage for each appropriate trade based on the type of work performed. Prevailing wage rates shall comply with the rules and regulations established by both state and local contracting law.
12. The Turf Company must not have been disqualified or barred from performing work for any public owner or other contracting entity in the U.S.

1.06 SUBMITTALS

A. Submit two complete samples, a minimum of 8" x 11" inch size, consisting of the exact proposed product. In addition, submit two loose samples (one foot squares) of the turf backing and tufted fibers and two sets of one quart samples of the following:
   1. Specified Sand Infill
   2. Specified Rubber Infill

B. Submit manufacturer's installation instructions.

C. The turf manufacturer shall submit a project specific letter on the company letterhead certifying that the products of this section meet or exceed all specified requirements, and state that the installer has complied with the qualifications above and is certified by the manufacturer to install this type of synthetic turf.

D. Submit Drawings for:
   1. Seaming plan.
   2. Installation details; edge detail, utility box detail, etc.
   3. Field Layout and Striping Plan (including field colors), including field line layouts (including colors), etc.
   4. The Turf Manufacturer shall submit color samples for approval for all color and/or logo work, including final electronic versions of artwork.

E. Certified copies of independent (third-party) laboratory reports on ASTM tests as follows:
   1. Pile Height, Face Width & Total Fabric Weight, ASTM D5848
   2. Primary & Secondary Backing Weights, ASTM D5848
   3. Tuft Bind, ASTM D1335
   4. Grab Tear Strength, ASTM D5034
   5. Water Permeability, ASTM D1551
   6. Flame Resistance, ASTM F1551
   7. Tuft Yarn Tensile Strength and Elongation, ASTM D2256

F. Submit a copy of the 8-year (minimum), prepaid, non-prorated, third-party insured warranty and insurance policy information.

G. Submit a list providing project name, date the field installation was approved, size of field, contact names and telephone numbers for each project that meets the experience requirements identified in 1.05-A.1 above.

H. At time of bid, Turf Contractor and /or Turf Manufacturer shall submit the following corporate information:
   1. Audited Financial Statement
   2. Proof of liability insurance including the amount of coverage and expiration date. Information shall be provided directly from Turf Contractor and /or Turf Manufacturer insurance company.
   3. List of Majority Owners (If privately held) and Board of Directors

4. Provide proof of EPLI

1.07 WARRANTY

A. The Turf Company shall submit its Manufacturer's Warranty which guarantees the usability and playability of the synthetic turf system for its intended uses for a minimum eight (8) year period commencing with the date of Substantial Completion. The warranty coverage shall not be prorated nor limited to the amount of the usage.

B. The warranty submitted must have the following characteristics:
1. A non-prorated, non-cancellable, up-front, pre-paid, third-party insured warranty. Warranty shall be covered by a third party insurance policy, non-cancelable and pre-paid, and is in effect covering this installation, and underwritten by a Best "A" Rated (or better) Insurance Carrier listed in the A.M. Best Key Rating Guide.
2. Insurance carrier must confirm that the policy is in force and premiums prepaid for entire warranty duration in full.
3. The policy must include a minimum annual aggregate of $5,000,000 per year and be based on claims arising from fields installed and completed only during the policy year.
4. The policy must provide full coverage for eight (8) years (minimum) from the date of Notice of Completion.
5. The policy shall cover all costs associated with full field replacement with new equal or better turf material, including labor, materials and any other costs to repair or replace the field.
6. Owner shall not be responsible for any deductible.
7. Warranty shall have no restrictions on hourly use limitations as long as the primary athletic use on the field is as anticipated in the original design. Turf Contractor shall include in the cost of the turf replacement of high use areas such as but not limited to home plate, batter's box, pitcher's mound, first, second, third, base areas, goal mouth's of soccer pitch's, etc. up to two times during the warranty period at a time of the warranty holder's discretion.
8. Must warrant materials and workmanship, and that the materials installed meet or exceed the product specifications, including general wear and damage caused from UV degradation.
9. Must have a provision to either make a cash refund or repair or replace such portions of the installed materials that are no longer serviceable to maintain a serviceable and playable surface.
10. Must be a warranty from a single source covering workmanship and all self-manufactured or procured materials.
11. Guarantee the availability of replacement material for the synthetic turf system installed for the full warranty period.
12. Turf must maintain an ASTM F355 G-Max of less than 170 for the life of the warranty.
13. The name on the warranty shall be made out to the City and County of San Francisco.
14. The Turf Company must verify that its onsite representative has inspected the installation and that the work conforms to the Manufacturer's requirements. The Manufacturer will submit written certification that the policy is in effect, fully funded and that the installation is added to the policy upon completion and acceptance.

1.08 BURDEN OF PROOF

A. Within this section, burden of proof of compliance with all requirements rests solely with the submitting Turf Company and or Turf Contractor, not with the City, Owner, Designer, or City Contractor.

PART 2 MATERIALS

2.01 INFILL SYNTHETIC TURF

A. The carpet shall be delivered in 15-foot wide rolls. The perimeter white and yellow lines can be tufted into the individual sideline rolls. The rolls shall be of sufficient length to extend from sideline to sideline. Head seams, between the sidelines, will not be acceptable.

B. All field of play lines for soccer, including soccer penalty kick circle, shall be inlaid or tufted. The lines for soccer, including soccer penalty kick circle, shall be yellow.

C. All field of play lines for Men's Lacrosse, including team and official areas, shall be inlaid or tufted. The lines shall be light blue.

D. All field of play lines for Women's Lacrosse, including team and official areas, shall be inlaid or tufted. The lines shall be red.

E. All field of play lines for football (except hash marks, which can be painted) shall be inlaid or tufted. The lines for football shall be maroon.

F. All field of play lines for baseball, shall be inlaid or tufted. The lines, bases, pitchers rubber shall be white. All infield areas as designated on plan are terra cotta in color.

G. All field of play lines for softball, shall be inlaid or tufted. The lines shall be white.

H. Rubber shall be provided per product specification, and shall be cryogenically processed SBR rubber. All rubber shall be a homogeneous black color and uniform size, and shall be clean of any impurities or material other than approved rubber.

I. All SBR rubber shall come from California recycled tires. The Turf Company shall provide documentation certifying the SBR source and the calculation of how many tires were recycled.

Sand shall be rounded silica sand and dust free. Coarse jagged sand will not be accepted. Sand shall consist of 60-70% of the total infill material as defined by weight. The sand shall have the following gradation:

Sieves (US Mesh Size)	**% Retained**
16	0
25	10-30
30	30-50
35	15-35
40	5-15
50	<5
70	<1

J. The specified infill shall be no less than a uniform ¾" depth below the top of fibers.

K. Thread for sewing seams of turf shall be as recommended by the Synthetic Turf Manufacturer.

L. Glue for inlaying lines and markings shall be as recommended by the Synthetic Turf Manufacturer.

2.02 SYNTHETIC TURF MAINTENANCE EQUIPMENT (GROOMER AND SWEEPER)

A. Turf Contractor shall supply one field groomer (min. 12' wide model) and one sweeper (3 piece gang unit). Sweeper to have a debris collection attachment that shall pick up ¼" diameter (and

larger) material, but leave infill material (i.e. sand and rubber). The groomer shall have plastic brushes and metal tines that are adjustable.

B. Acceptable grooming product is Synthetic Turf Groomer w/ Greens Slicer Spring Tine Rake, as manufactured by Greens Groomer Worldwide, Ph: (888) 298-8852, or acceptable equivalent product.

C. The field sweeper shall be the Agrifab sweeper as available from the manufacturer, (phone 1-800-724-2969) or acceptable equivalent product.

2.03 END-OF-LIFE RECYCLING PLANS

A. The Turf Company , with their bid proposal, shall provide detailed plans for the management of all turf product components at the end of their useful life, including:

1) Manner of reuse/recycling for each product component
2) Identification of parties responsible for the removal and disposal of the field products.
3) A detailed description of the reuse or recycling process.
4) A signed commitment from the winning proposal's signatory guaranteeing implementation of the plan within seven (7) years of the contract ratification.
5) These plans shall not include incineration, or any other type of high temperature conversion technology.
6) These plans shall not include the use of synthetic turf as Alternate Daily Cover.
7) Using the discarded synthetic turf in either of these methods may impact a firm's future opportunities for the contracting of synthetic turf fields.

2.04 POST CONSUMER RECYCLED CONTENT

A. All synthetic turf purchased for installation and use on San Francisco City property will include recycled content to the maximum extent feasible.

1) The Turf Company will provide the amount and type of recycled content in the turf product.
2) Proposals that do not include recycled content must provide an explanation as to why it was omitted and describe plans and timeline for inclusion of recycled content in the future.

2.05 HEAVY METALS AND MATERIAL CONTENT

A. The Turf Company will conduct and submit product analysis with the project bid. Analysis will be presented in the form of current, certified laboratory results using specified standards and processes.

B. *Analytical Methodologies*: Representative samples of the turf fibers, turf backing, and infill material shall be analyzed for total metals content and semi-volatile organic compounds (SVOCs), as well as select analyses for leachable metals concentrations.

1) Total Metals Analysis: *All samples* (fibers, infill, underlayment and backing) shall be analyzed for the California Assessment Manual 17/Title 26 list of metals (CAM 17 metals). The submitted samples shall be prepared by the laboratory for analysis of total recoverable metals by USEPA method 3050B. The samples shall then be analyzed for total metals concentrations by USEPA method 6010B/7400.

2) Leachable Metals Analysis: *Infill samples only* shall be analyzed for leachability of selected metals using the California Waste Extraction Test (WET). All samples shall be analyzed by the WET for lead, zinc, and total chromium. For other constituents, if the detected concentrations from the total metals analysis above are greater than or equal to ten times the Soluble Threshold Limit Concentration (STLC) value, as shown on attached Table B, the WET shall be conducted for those individual metals as well.

3) Analysis for SVOCs: *All samples* (fibers, infill, underlayment, backing.) shall be analyzed for the SW-846 list of SVOCs. The submitted samples shall be prepared by the laboratory for

analysis by USEPA method 3540 or 3550. The samples shall then be analyzed for SVOC concentrations by USEPA method 8270B or 8270C. Results shall at a minimum include data for aniline (CAS #62-53-3), phenol (108-95-2) and benzothiazole (95-16-9). Concentrations of SVOCs are to be provided for reference purposes only and are not being evaluated against any particular criteria.

C. *Evaluation Criteria*: The detected concentrations of lead, chromium, and zinc in the samples of the turf infill material shall not exceed the threshold values listed in Table A & B for total metals and leachable metals analyses. In no case shall the total metal concentration of any metal equal or exceed the TTLC values. In addition, concentrations of metals detected in any leachate tests shall not exceed the STLC value (for threshold values, see California Code of Regulations, Title 22, Chapter 11, Article 3.)

TABLE A. Maximum levels of metals permitted for San Francisco synthetic turf products – recycled styrene butadiene rubber (SBR) infill materials

Metal	**Total metals analysis (mg/kg)**	**Leachable metals analysis (ug/L)**
Chromium	750[i,ii]	50[i]
Lead	50	2.5[i]
Zinc	23,000[iii]	250,000[iv]

i. San Francisco Regional Water Quality Control Board (SFRWQCB) Environmental Screening Level (ESL) for residential land use for compounds detected in shallow soils where groundwater is a current or potential source of drinking water.
See: http://www.swrcb.ca.gov/rwqcb2/esl.shtml

ii. No total chromium value promulgated in ESLs; chromium III value indicated instead.

iii. California Human Health Screening Levels (CHHSLs) for soil for residential land use.

iv. Selected soluble threshold limit concentration (STLC).

TABLE B. Maximum levels of total metals permitted for San Francisco synthetic turf products – fibers, underlayment, and backing

Metal	**Total metals analysis (mg/kg)**
Chromium	25
Lead	50

2.06 BROMINATED FLAME RETARDANTS

A. The Turf Company shall provide verification that brominated flame retardants have not been intentionally added in the manufacture of the turf fiber, backing, underlayment or infill materials. Verification can take the form of a signed letter from the manufacturer, or appropriate laboratory analyses of the product proving that levels of elemental bromine are lower than 1% by weight.

PART 3 EXECUTION

3.01 INSTALLING THE SYNTHETIC TURF

A. The installation shall be performed in full compliance with the reviewed and accepted product submittal.

B. Only trained technicians, skilled in the installation of athletic caliber synthetic turf systems working under the direct supervision of the approved installer/manufacturer supervisors, shall undertake any cutting, sewing, gluing, shearing, topdressing or brushing operations.

C. The Turf Contractor shall strictly adhere to the installation procedures outlined in this section. Any

D. The turf manufacturer and installation subcontractor shall inspect and accept in writing the field base section and drainage, and provide documentation to that effect, prior to the installation of the synthetic grass system. The surface must be perfectly clean as installation commences and shall be maintained in that condition throughout the process.

E. **Brock to be installed by the City Contractor timing to be coordinated between City Contractor and Turf Contractor.** The carpet rolls are to be installed directly over the properly installed manufactured base material. Refer to the synthetic turf base specification section. No equipment with loads greater than 35 pounds per square inch (35 psi) shall be allowed on the field. As required, Turf Contractor is responsible for altering operations in order to adhere to this requirement. Turf Contractor and synthetic turf installer shall strictly adhere to the written instructions provided by the Brock manufacturer for installing turf on top of their product. Turf Contractor shall always make sure that those vehicles being used on Brock bases are equipped with pneumatic (air-filled) tires, preferably turf tires. These tires are designed to spread loads and minimize damage to surface. Foam Filled or solid tires as well as tires with aggressive lug patterns should not be used on the Brock base, without synthetic turf installed. *If possible, use of an A-frame for unrolling of the synthetic turf is* ***strongly recommended****.*

F. The carpet rolls are to be installed directly over the properly prepared base. Extreme care should be taken to avoid disturbing the base, both in regard to compaction and planarity. It is suggested that a 2-5 ton static roller is on site and available to repair and properly compact any disturbed areas of the prepared base. If repairs are required, they shall be coordinated with the City Contractor prior to repair.

G. The full width rolls shall be laid out across the width of the field. Utilizing standard state of the art sewing procedures each roll shall be attached to the next. When all of the rolls of the playing surface have been installed, the sideline areas shall be installed at right angles to the playing field turf. *GLUING OF ROLLS SHALL NOT BE ACCEPTABLE.*

H. Seams shall not be visible and shall be flat, tight and permanent with no separation or fraying. Seams that show after installation shall be repaired prior to final project completion at no cost to the Owner.

I. The synthetic turf field shall utilize sewn seams. Minimum gluing will only be permitted to repair problem areas, corner completions, and to cut in any logos or inlaid lines as required by the specifications. Seams between turf panels must be sewn. Inlaid markings may not be installed by means of cutting through the fabric and adhering the colored turf to a separate reinforcing tape or cloth. Rather, inlaid markings (that cannot be tufted into the fabric), shall be installed by means of shearing out the existing green fiber and laying in a new piece of colored fabric into a bed of suitable "hot melt" adhesive placed directly on the original turf backing material. Systems that cut through the turf fabric for inlaid lines are not acceptable due to the fact that such a procedure shall weaken the structural integrity of the turf fabric backing. All seams shall be sewn using double bagger stitches and polyester thread or adhered using seaming tape and high grade adhesive (per the manufacturer's standard procedures). Seams shall be flat, tight, and permanent with no separation or fraying.

J. Connections of the perimeter synthetic turf edges shall be completed by one of the following two methods (refer to drawings for applicable details):
   1) Connection to perimeter concrete edges (with recessed edge) with the manufacturer-approved adhesive.
   2) Connection to the recycled plastic header boards shall be done with industrial staples (min. depth embedment is one inch (1") at maximum 2 inch (2") on center staple spacing. Header board will be installed by the City Contractor.

K. Infill materials shall be applied in thin lifts. The turf shall be brushed as the mixture is applied. The infill material shall be installed to a depth as specified in this section. The mix shall be uniform and even in thickness to assure proper playing characteristics. The infill material shall not be installed during wet conditions.

L. The infill materials shall be installed to fill the voids between the fibers and allow the fibers to remain vertical and non-directional. The infill shall be placed so that there is a void of ¾" to the top of the fibers.

M. At near Substantial Completion of the synthetic turf fields, the Turf Contractor shall test for shock absorbency. The turf contractor and/or manufacturer shall pay for an independent testing laboratory accredited for such tests (who shall be pre-approved by the Owner's Representative). All testing and analysis of findings shall be completed by qualified persons utilizing correct techniques. The laboratory shall provide the necessary testing data to the Owner's Representative that verifies the finished field meets or exceeds the required shock attenuation. The G-max range shall be between 95 and 170 for the life of the warranty, as determined by the ASTM F355A and F1936 test procedures. Any test results that do not meet the requirements of this specification or if any one test value is greater than ten percent (10%) greater in variance as specified in1.07B-12, then the Turf Contractor's field installer shall address the failed test area, be required to retest the entire field as stated above, and conform to these requirements prior to the issuance of the Certificate of Substantial Completion.

PROTECTION AND CLEANING

A. Protect installed synthetic turf from subsequent construction operations and the public until Substantial Completion.

B. Do not permit traffic over unprotected turf surface.

C. Turf Contractor shall provide the labor, supplies, and equipment as necessary for final cleaning of surfaces and installed items.

D. All usable remnants of new material shall become the property of the City.

E. The Turf Contractor shall keep the area clean throughout the project and clear of debris.

3.02 MAINTENANCE & WARRANTY

A. The turf installer and/or the turf manufacturer must provide the following prior to Final Acceptance and the Owner's Representative filing the Project Notice of Completion:
   1. The turf manufacturer shall provide the written warranty for the project per the minimum requirements identified in this specification section. Submit Manufacturer Warranty and ensure that forms have been completed in Owner's name and registered with Manufacturer and Insurance Carrier. Submit information confirming that the third party

insurance policy, non-cancelable and pre-paid, is in effect covering this installation, and underwritten by a Best "A" Rated Insurance Carrier. Insurance carrier must confirm that the policy is in force and premiums paid.

2. Three (3) copies of Maintenance Manuals, which will include all necessary instructions for the proper care and preventive maintenance of the turf system, including painting and markings.
3. Project Record Documents: Record actual locations of seams and other pertinent information.
4. Upon completion of the field installation, the turf installation contractor shall have a supervisory personnel provide a minimum three (3) hour field training seminar with the Owner's Representative on how to care for the field. At a minimum, seminar shall include a demonstration of how to care for the field with the provided groomer / sweeper address use of the sweeper and groomer, review the entire provided maintenance manual (including the proper procedure for removal of gum and other debris) and answer any questions.
5. Supply a field groomer and/or sweeper as specified.
6. The Contractor shall achieve Substantial Completion for the work under this Contract when the Project is ready and available for use as a playfield.
7. Provide surplus materials of 500 lbs of rubber infill material. Rubber material shall be delivered in 90 gallon wheeled totes.

B. Turf Manufacturer shall be responsible for the testing of the G-max levels of the installed synthetic turf at the completion of years two, four, six, and one month prior to the completion of year eight. If any of these tests do not fall within the G-max range as specified in this specification section, the Manufacturer will be required to modify the field composition to the sole satisfaction of the Owner's Representative so that it falls within the target G-max range. All costs associated with such work shall be borne solely by the Manufacturer and/or installer. Any failed test shall be retested to verify that the field meets the specifications. All testing shall be paid by the Manufacturer and/or installer. All testing shall be completed by an independent testing laboratory accredited for such tests, and shall be pre-approved by the Owner's Representative. All testing and analysis of findings shall be completed by qualified persons utilizing the required techniques outlined in the ASTM F355 test standard.

END OF SECTION

Appendix M:

MEMORANDUM

To: **Recreation and Park Commission**

Thru: **Phil Ginsberg, General Manager**

From: **Dan Mauer, Capital Division**

Cc: **Chris Geiger, Ph.D, Department of the Environment**

Paul Ledesma, Department of the Environment

Patrick Hannan, City Fields Foundation

Date: **7/8/09**

Re: **Synthetic Turf Standards – Information Only**

On October 2, 2008, the San Francisco Recreation and Park Commission approved the recommendations in the Synthetic Playfield Task Force Report. As part of Recreation and Parks' ongoing implementation of those recommendations, we've collaborated with the Department of the Environment and the City Fields Foundation to develop standards for synthetic turf purchases for San Francisco Recreation and Parks athletic fields being renovated with synthetic turf.

This memo is for information only. The Department of the Environment is the agency issuing the synthetic turf standards and there is no action for the commission to take today. The Kimbell Playground athletic field renovation will be the first project to use the new synthetic turf standards.

Background

The Department of the Environment's Chris Geiger, Ph.D - the Municipal Toxics Reduction Coordinator, and Paul Ledesma – the City Government Zero Waste Coordinator, were instrumental in developing heavy metal, recycling and recycled content standards for synthetic turf. These standards include general purchasing requirements previously established by resolution at the Board of Supervisors.

In issuing these standards, San Francisco will become the first known municipality in the nation to require recyclability as well as recycled content in synthetic turf purchases. The high amount of recycled content in styrene butadiene rubber (SBR) infill is a primary factor in the SF Department of the Environment's ongoing support for using SBR rubber in local synthetic turf fields.

Lead is the primary heavy metal to be addressed by the heavy metal standards, with Chromium a distant second. The primary goal is to filter out products that have purposely added lead chromate or other lead compounds to the turf components.

Zinc is the primary concern in the recycled tire SBR infill. Zinc oxide is purposefully added to tires at rates of up to 2% or more. It is not a major human health hazard but can be an aquatic toxicity hazard if the tires sit in water for a long time. In 2008, the Synthetic Playfields Task Force reviewed the existing scientific literature and fully discussed this hazard with regard to synthetic turf. The task force determined that there is no imminent risk of aquatic toxicity but, as a precautionary measure, the SF Public Utilities Commission staff will test runoff levels at a representative field. We are initiating those tests. The task force also recommended installing synthetic turf fields above the water table and using a criteria based site selection process to determine the potential public health benefits of an installation.

San Francisco Synthetic Turf Standards

The synthetic turf standards fall into three general categories: end-of-life recycling plans, post-consumer recycled content and heavy metal and material content. Potential vendors will be required to provide the information when submitting project bids. Any bids with incomplete information or insufficient data will be rejected.

<u>End-of-Life Recycling Plans</u>

Potential vendors will be required to provide detailed plans for the management of all turf product components at the end of their useful life, including:

a. Manner of reuse/recycling for each product component
b. Identification of parties responsible for the removal and disposal of the field products.
c. A description of the reuse or recycling process.
d. A signed commitment from the winning proposal's signatory guaranteeing implementation of the plan within seven (7) years of the contract ratification.
e. These plans shall not include incineration, or any other type of high temperature conversion technology.
f. These plans shall not include the use of synthetic turf as Alternate Daily Cover.

g. Using the discarded synthetic turf in either of these methods may impact a firm's future opportunities for the contracting of synthetic turf fields.

Post Consumer Recycled Content

All synthetic turf purchased by San Francisco will include recycled content to the maximum extent feasible.

a. Potential vendors will provide the amount and type of recycled content in the turf product.
b. Proposals that do not include recycled content must provide an explanation as to why it was omitted and describe plans for inclusion of recycled content in the future.

Heavy Metals and Material Content

Potential vendors will conduct and submit product analysis with the project bid. Analysis will be presented in the form of certified laboratory results using specified standards and processes.

Analytical Methodologies: Representative samples of the turf fibers, turf backing, and infill material shall be analyzed for total metals content and semi-volatile organic compounds (SVOCs), as well as select analyses for leachable metals concentrations.

1) Total Metals Analysis: *All samples* (fibers, infill, underlayment and backing) shall be analyzed for the California Assessment Manual 17/Title 26 list of metals (CAM 17 metals). The submitted samples shall be prepared by the laboratory for analysis of total recoverable metals by USEPA method 3050B. The samples shall then be analyzed for total metals concentrations by USEPA method 6010B/7400.

2) Leachable Metals Analysis: *Infill samples only* shall be analyzed for leachability of selected metals using the California Waste Extraction Test (WET). All samples shall be analyzed by the WET for lead, zinc, and total chromium. For other constituents, if the detected concentrations from the total metals analysis above are greater than or equal to ten times the Soluble Threshold Limit Concentration (STLC) value, as shown on attached Table B, the WET shall be conducted for those individual metals as well.

3) Analysis for SVOCs: *All samples* (fibers, infill, underlayment, backing.) shall be analyzed for the SW-846 list of SVOCs. The submitted samples shall be prepared by the laboratory for analysis by USEPA method 3540 or 3550. The samples shall then be analyzed for SVOC concentrations by USEPA method 8270B or 8270C. Results shall at a minimum include data for aniline (CAS #62-53-3), phenol (108-95-2) and benzothiazole (95-16-9). Concentrations of SVOCs are to be provided for reference purposes only and are not being evaluated against any particular criteria.

Evaluation Criteria: The detected concentrations of lead, chromium, and zinc in the samples of the turf and the cushioning material shall not exceed the threshold values listed in Table A-C for total metals and leachable metals analyses. In no case shall the total metal concentration of any metal equal or exceed the TTLC values. In addition, concentrations of metals detected in any leachate tests shall not exceed the STLC value (for threshold values, see California Code of Regulations, Title 22, Chapter 11, Article 3.)

Brominated flame retardants

Vendor shall provide verification that brominated flame retardants have not been intentionally added in the manufacture of the turf fiber, backing, underlayment or infill materials. Verification can take the form of a signed letter from the manufacturer, or appropriate laboratory analyses of the product proving that levels of elemental bromine are lower than 1% by weight.

TABLE A. Maximum levels of metals permitted for San Francisco synthetic turf products – recycled styrene butadiene rubber (SBR) infill materials

Metal	**Total metals analysis (mg/kg)**	**Leachable metals analysis (ug/L)**
Chromium	750[i,ii]	50[i]
Lead	50	2.5[i]
Zinc	23,000[iii]	250,000[iv]

i. San Francisco Regional Water Quality Control Board (SFRWQCB) Environmental Screening Level (ESL) for residential land use for compounds detected in shallow soils where groundwater is a current or potential source of drinking water. See: http://www.swrcb.ca.gov/rwqcb2/esl.shtml

ii. No total chromium value promulgated in ESLs; chromium III value indicated instead.

iii. California Human Health Screening Levels (CHHSLs) for soil for residential land use.

iv. Selected soluble threshold limit concentration (STLC).

TABLE B. Maximum levels of metals permitted for San Francisco synthetic turf products – non-SBR infill materials

Metal	Total metals analysis (mg/kg)	Leachable metals analysis (ug/L)
Chromium	750[i,ii]	50[i]
Lead	50	2.5[i]
Zinc	23,000[iii]	81[i]

i. San Francisco Regional Water Quality Control Board (SFRWQCB) Environmental Screening Level (ESL) for residential land use for compounds detected in shallow soils where groundwater is a current or potential source of drinking water. See: http://www.swrcb.ca.gov/rwqcb2/esl.shtml

ii. No total chromium value promulgated in ESLs; chromium III value indicated instead.

iii. California Human Health Screening Levels (CHHSLs) for soil for residential land use.

TABLE C. Maximum levels of total metals permitted for San Francisco synthetic turf products – fibers, underlayment, and backing

Metal	Total metals analysis (mg/kg)
Chromium	25
Lead	50