

**FAC 7524 Stadium**

FY25 SUC: \$42,368.71 / EA

Source: Inflated from previous FY using ENR labor and material cost indices to measure actual inflation

Original Source: Local Government Authority

## Natural Grass Athletic Fields

It has become apparent that natural grass fields are being replaced with synthetic surfaces due to the belief that synthetic surfaces are less expensive and easier to maintain than natural surfaces. A properly maintained synthetic is not necessarily an effective replacement if lower maintenance costs are the goal. The primary reason natural grass fields are being replaced by synthetic is usually due to the lack of initial maintenance dollars. Proper construction and maintenance of a natural grass field will provide a safe playable surface that is natural and pleasing to players, parents, and coaches. Additionally, natural grass fields are often replaced by synthetic for aesthetic reasons, perhaps because the natural grass has a great deal of wear in the highly trafficked areas by the end of the season. However, one should not confuse aesthetics with playability because a worn field often still plays very well, plus, the natural grass can be restored if the right maintenance or strategies are employed. The following technical resource provides a detailed look into the benefits and cost effectiveness of maintaining natural grass fields.

### Natural Grass Benefits

#### Environmental Benefits of Natural Grass Surfaces

##### I. Water Conservation

A major point of discussion with natural turfgrass systems is the amount of water required to irrigate. Quite simply, most sports field systems equipped with supplemental irrigation are overirrigated. Most water overuse is due to human error or miscalculation. Understanding and following proper irrigation practices will lead to water conservation. Water conservation can also be achieved by:

1. Using drought resistant turfgrass species and cultivars within species. Visit the Turfgrass Water Conservation Alliance website for species and varieties that are recommended for drought resistance in your area.
2. Allowing turfgrass to grow a little taller for deeper root development based on season and turfgrass species.
3. Allowing turfgrass to enter dormancy in drought situations.
4. Encouraging deeper rooting of turfgrass cultivars by watering deeply and infrequently. Apply only what your soil can infiltrate in one hour. Avoid puddles and runoff.
5. Using recycled water sources for irrigation.
6. Install rain sensors to shut down irrigation during a rain shower.
7. Installation of devices such as soil moisture probes or evapotranspiration pans will improve irrigation efficiency.

## II. Groundwater preservation and recharge

1. Dense aboveground turfgrass biomass traps and holds water which reduces excess runoff and allows more water to infiltrate into the soil. Ten-thousand square feet can absorb up to 6000 gallons of water.
  - a. A research study in Maryland compared surface water runoff losses between turfgrass and cultivated tobacco grown at the same site. During the tobacco-growing season (May-September), surface water runoff losses for the tobacco were 11 times greater than runoff losses from perennial turfgrass.
2. Extensive, fibrous turfgrass root system filters water percolating through the soil to enhance groundwater recharge.
3. Application of fertilizer has negligible potential for nutrient elements to pass through the rootzone into groundwater or be transported by runoff into surface water. Turfgrass roots are highly efficient at uptake of applied nutrients.
  - a. A research study in Maryland followed total losses for nitrogen and phosphorus between turfgrass and cultivated tobacco grown at the same site. Runoff from the tobacco plantings had 195 times more N and 240 times more P than runoff from the turf.
4. Proper fertilizer and pesticide applications keep water safe. Product selection and characteristics, timing, and equipment used in the application can all greatly improve both the product performance and non-target effects on the environment. Turfgrass managers typically avoid applying these materials just before heavy rain, on to frozen soil, or on dormant turfgrasses because these situations can increase the potential for surface and groundwater contamination. Avoid getting fertilizer prills on any hardscape where runoff from rain or irrigation can carry fertilizer into drainage systems.
5. Current trends with turfgrass fertilization are toward low nutrient application rates on a more frequent basis (i.e. 'spoon feeding', with product often delivered through a spray system) and an expanded use of slow release nitrogen carriers. Both of these practices are environmentally friendly.
6. Properly managed turfgrass ecosystems support abundant earthworm populations, which contribute to increased macropore space in the soil, resulting in higher soil water infiltration rates, higher water-holding capacity, and improved soil structure.

## III. Enhanced entrapment and biodegradation of synthetic organic compounds

1. Turfgrass systems catch and filter polluted runoff water.
2. Decaying turfgrass leaves, crowns, stems, roots, and thatch support large populations of microscopic decomposers that reside in the soil. Soil microbes also decompose pesticides, potentially noxious organic chemicals, and various bacteria producing bodily fluids such as blood, vomit, spit, and phlegm.

## IV. Soil erosion control and dust stabilization

1. Turfgrass root systems and aboveground canopy are one of the most cost efficient ways to control water and wind erosion of soil and increase water infiltration into the soil.
2. Turfgrass functions as a vegetative filter that reduces the quantity of sediment entering surface streams and rivers.
3. High shoot density and root mass of turfgrass contributes to soil surface stabilization to reduce erosion. A high biomass matrix provides resistance to lateral surface water flow.
4. Turfgrasses act as a trap for dust and other particulate matter, improving air quality.

## V. Improved atmospheric conditions

1. Turfgrass contributes to reductions in noise levels by absorbing, deflecting, reflecting, and refracting the various sounds. There are also reductions in discomforting glare and light reflection.

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2. Turfgrass reduces atmospheric carbon dioxide and releases oxygen. Grass plants produce their own food through the process of photosynthesis. The plants take in carbon dioxide and convert it into simple sugars. As a result of photosynthesis and taking up of carbon dioxide, oxygen is released into the atmosphere.
  - a. During an active growing season, 25 square feet of healthy turf will provide enough oxygen for one adult person for one day.

## VI. Accelerated soil restoration

1. Improve soils through the addition of organic matter. As plant tissue dies, it is incorporated into the rootzone as organic matter.
2. Soil restoration of environmentally damaged areas (i.e. construction sites with topsoil stripped, burned-over land, garbage dumps, eroded rural landscapes, mining operations, and steep timber harvest areas) is accelerated when turfgrass is planted.

## VII. Substantial heat dissipation-temperature moderation

1. Turfgrass dissipates high levels of radiant heat through the cooling process of transpiration.

### Synthetic Surface Temperature Case Study

In spring 2002, Brigham Young University's athletic department installed a synthetic surface on half of its football practice field. The other half is sand-based natural turf. Complaints about the heat of the synthetic surface prompted researchers to take temperature measurements and compare them with natural turf, bare soil, asphalt and concrete. They recorded temperatures at the surface and 2 inches below the surface.

Temperatures of surfaces at BYU practice fields in June 2002. Average air temperature = 81.42°F						
	Average surface temperature between 7:00 am and 7:00 pm		Average soil temperature between 7:00 am and 7:00 PM (two inch depth)		Average temperature between 9:00 am and 2:00 PM in the shade	
	Average	High	Average	High	Average	High
Soccer (synthetic)	117.38°F	157°F	95.33°F	116°F		
Football (synthetic)	117.04°F	156°F	96.48°F	116.75°F	75.89°F	99°F
Natural Turf	78.19°F	88.5°F	80.42°F	90.75°F	66.35°F	75°F
Concrete	94.08°F					
Asphalt	109.62°F					
Bare Soil	98.23°F		90.08°F			

Source: "Synthetic Surface Heat Studies," C. Frank Williams and Gilbert E. Pulley, Sports Turf Managers Association Annual Conference, January 2004.

The surface of the synthetic field averaged 117 degrees Fahrenheit while the natural grass surface averaged 78 degrees Fahrenheit and asphalt averaged 109 degrees Fahrenheit. Two inches below the synthetic turf surface, it was still 28 degrees hotter than the natural turf surface. Irrigation is installed on synthetic fields to help control surface temperatures. Researchers at Penn State University have found that temperature reductions last about 20 minutes. Researchers at BYU have found that irrigation cooled the synthetic surface from 174 degrees Fahrenheit to 85 degrees Fahrenheit, but during the summer in Utah, the surface could be back to 120 degrees Fahrenheit in five minutes.

These high temperatures make it dangerous for athletes as it increases the incidence of heat stroke, muscle cramping and overall fatigue.

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Work conducted at the University of Missouri Turfgrass Research Center in 2010 regularly showed synthetic surface temperature increases of 50 to 70 degrees Fahrenheit over natural grass. Factors such as light, cloud cover, and breezes of 3 to 5 mph, reduced synthetic surface temperatures by 30 degrees. However, on clear, blue-sky days in mid-summer where air temperatures were at 98 degrees Fahrenheit with calm winds, temperatures would exceed 160 degrees Fahrenheit on synthetic surfaces. Natural grass under these conditions would range between 99 and 102 degrees.

## VIII. Overall increase in human health

1. Closely mown areas of turfgrass reduce the number of nuisance pests that reside in taller grasses, such as ticks, which can carry Lyme disease and Rocky Mountain Spotted Fever.
2. Well maintained turfgrass areas are less likely to have weeds that are responsible for allergy-related pollens.
3. Fields with good quality turfgrass cover have higher traction, cushioning, and resiliency, and lower surface hardness, reducing the probability of injury in contact sports.
  - a. Ball roll and bounce are influenced by the grass cover and its management, as are player movements, such as running, stopping, pivoting, dodging, jumping, landing, and walking.
4. Turfgrasses can offer a low cost, safe playing surface for athletes.
  - a. Surface hardness is important when considering head injuries. Surface hardness is measured by dropping a weight (referred to as a missile) from a fixed height onto the playing surface. The missile contains an accelerometer that measures how fast the missile stops once it hits the surface. A numerical value, referred to as Gmax, is then generated. A high Gmax value means the missile stopped quickly and there is less absorption of force by the athletic surface and more absorption of force by the athlete, which indicates the surface is hard.

Fields can be tested using a Clegg Impact Tester or F355 device. Gmax values taken from each of these devices are not interchangeable because the missiles are different weights and are not dropped from the same height. In other words, 100 Gmax measured with the Clegg is not the same as 100 Gmax measured with the F355.

The NFL field testing program requires playing surface hardness of both natural and synthetic turf fields to be measured with the Clegg Impact Tester. Fields must be tested in multiple locations prior to every game and must be below 100 Gmax at all locations. If hardness levels begin to approach 100, steps must be taken to lower the Gmax value.

The American Society for Testing and Materials (ASTM) standard (F1936) uses the F355 device to test surface hardness on natural and synthetic fields and sets an upper limit of 200 Gmax. According to ASTM Standards, a value greater than 200 Gmax qualifies for the expectation that life threatening head injuries may occur. At this point the surface should be repaired or replaced. The Synthetic Turf Council (STC) recommends Gmax does not exceed 164 when using the F355 device.

Most synthetic fields upon completion measure Gmax in a range of 45 to 60 until the infill material settles in. In time, with use, relocation of crumb rubber, and separation of infill materials (those with sand and crumb rubber), increased Gmax readings can elevate to greater than 100 (using the Clegg Impact Tester). Gmax readings on synthetic fields are related to the thickness of the infill and proper grooming recommendations. Natural grass fields have several options to manage field hardness – increase soil moisture, mow taller, maintain good density, and add amendments. In a Penn State trial (2004), Gmax readings (using a Clegg Impact Tester) on a silt loam soil covered in Kentucky bluegrass ranged between 50 and 84 where traffic was applied and between 50 and 70 Gmax without traffic. Soil moisture ranged between 30 and 35 percent.

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5. Aesthetics and recreational opportunities enhance physical and mental health of participants, relieve stress and contribute to enjoyment of life.
  - a. Studies have been done to test the health benefits of nearby green spaces by testing blood pressure and heart rate of participants. Results show that views of open green spaces promote quicker recovery in hospital patients. Participants in another study had quicker and more complete recovery from induced stress when exposed to turfgrass and other landscape settings compared to those who were not.
6. Native soil fields hold less potential for injury.
  - a. The most frequent injuries sustained on sports fields are those to the ankles and knees from rotating and changing directions on the field surface. A recent study at Michigan State University (Villwock et al., 2008) measured the effects that size and structure of infill materials would have on the rotational resistance of cleated shoes. Sixteen different surfaces were tested, including native soil and sand based fields, using testing methods conforming to the ASTM standard method for traction characteristics of an athletic shoe-surface interface. Cleated football shoes were mounted on a rigid foot-form and used on the surfaces. Results found that torque was significantly affected by field surface. Native soil fields reported the lowest torque overall.
7. Natural fields are the preferred playing surface among athletes. In 2010, a survey was conducted to evaluate what kind of playing surface NFL players preferred. 1619 players from all 32 teams participated in this survey.
  - 69% of the players preferred to play on natural grass fields
  - 14% preferred artificial infill
  - 9% had no preference

Players were also asked how they thought synthetic and natural grass surfaces affected their physical health:

	Artificial Infill Surface	Natural Grass Surface
Surface more likely to contribute to injury	82%	16%
Surface more likely to cause soreness and fatigue	89%	9%
Surface more likely to shorten career	89%	7%
Surface more likely to negatively affect quality of life after football	64%	4%

## Natural Grass Limitations

### I. Overuse

The overuse of many community sports facilities can push the limits of turfgrass to recover. Excessive traffic leads to compaction and bare areas, which can cause a surface to be unsafe and unplayable. Scheduling more events than a field can handle results in overuse.

To help prolong the life of natural fields:

- Rotate activities between fields.
- Limit use of fields to only necessary events, especially during rainy weather patterns.
- Change daily location of practices on the field.
- Shift fields of play to shift areas of concentrated wear.
- Buy portable goals and move them around the field for drills and practice, thus limiting wear in the area of the mounted goal posts.
- Have players do individual warm-ups off of the field.

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- Execute team drills outside of painted numbers.
- Spread seed of climate and sport-appropriate, fast germinating grass species in wear areas before games and practices.
- Regularly educate field users regarding the importance of rotating traffic/use patterns around fields in order to maintain safety and optimum playability.

## II. Standing Water

Inclement weather can lead to standing water and muddy conditions if the drainage system is not effective. This causes surfaces to be unsafe and unplayable.

To solve standing water problems, make sure there is a sufficient crown (i.e. slope) to move water off the field effectively. Regularly check to see that any installed collection basins and/or sub-surface drainage systems are operating effectively. If rain tarps are available, they can help keep water off of properly crowned fields and greatly improve field playability. Field managers should have the option to cancel events when inclement weather accelerates damage to the field.

## Construction of Natural Grass Fields

The demise of many natural grass fields is in the initial construction or renovation work being done. Short-cuts due to budget constraints are temporary and will cost more in the long run. Well-constructed sports fields with proper maintenance will provide the type of playing surface so many parents, coaches and players desire.

Construction and renovation should begin with the selection of a knowledgeable contractor - someone with experience in sports field design and construction who carries a good portfolio with references and may be a certified field builder (CFB).

A good first step for field construction and renovation is ensuring the field has the correct crown and slope. This is where dollars should be spent in any project because if surface drainage is lacking, all else is lost. Crowns and slopes are equally important whether your field is constructed with native soils or modified soils or will have a sand-cap or sand-base. Drainage (surface and internal) is critical to a successful natural grass field.

Selection of the best growing medium for the turfgrass rootzone is also crucial for field health. The soil can be made up of native soil (modified or not) or a sand-based rootzone. The soil texture determines the degree of drainage (surface and internal), water holding capacity, and nutrient holding capacity.

Irrigation may or may not be a luxury and should be strongly considered for the durability and safety of natural grass fields. There are many different types of irrigation to consider, some being more efficient than others. Irrigation types and design should be based on the water source and pressure, number of fields or area, region of the country and type of turfgrass being grown. Regardless of the irrigation type, conduct regular irrigation audits to ensure distribution uniformity and be efficient with water usage. Mismanagement of irrigation will lead to other issues such as hot spots or diseases.

Turfgrass species selection is also an important component when constructing or renovating natural grass fields. Consider turfgrass varieties that offer good disease resistance and wear tolerance. The National Turfgrass Evaluation Program provides performance information on various turfgrass species and cultivars. If irrigation is not an option, select drought tolerant species of turfgrasses. The Turfgrass Water Conservation Alliance tests turfgrass species for drought tolerance and posts individual varieties that pass the test. Consideration of turfgrass species and varieties should always be made for good water conservation practices.

When constructing or renovating natural grass sports fields, it is important to follow the guidelines for field design and build. The end result will be a sports field that will perform as expected with proper maintenance. Parents, players and coaches can enjoy a playing surface that is natural and safe. Additional information on the



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construction and renovation of sports fields can be found in Sports Fields: A Manual for Design, Construction and Maintenance by Jim Pulhalla, Jeff Krans, and Mike Goatley or through your local sports field contractor or state extension office.

## Construction Costs for Various Types of Sports Field Surfaces

For a more complete understanding of what is involved with construction cost of a natural or synthetic field, please view the STMA Guide to Synthetic and Natural Turfgrass for Sports Fields.

- **Natural with On-site Native Soil (no added top soil or sod) - \$0.60-\$0.90 per sq. ft.**
- **Natural Turfgrass with Native Soils - \$1.25-\$2.50 per sq. ft.**
- **Natural with Sand Cap - \$2.60-\$3.85 per sq. ft.**
- **Natural with Sand and Drainage - \$4.25-\$5.00 per sq. ft.**
- **Synthetic Infill Systems (carpet, infill, and base) - \$4.50-\$10.25 per sq. ft.**

## Maintenance Requirements for Natural Grass Fields

Maintenance of natural grass fields is critical to their success. Maintenance is often lacking due to budget constraints. However, when individuals feel that natural grass fields have failed, the money is always there for a conversion to a synthetic surface. Instead of giving up on a natural grass surface, raise the funds to provide good maintenance practices for a safe natural grass surface. Annual inputs of \$20,000 to \$30,000 per field can go a long way in the maintenance and performance of a natural grass field.

STMA provides many resources and opportunities to assist in the maintenance of natural grass fields. Educational bulletins, webinars, and educational conferences provide the support and tools necessary to address natural grass maintenance practices.



# Natural Grass Athletic Fields

## Maintenance Comparison Case Studies between Natural Grass Fields at North Scott Community School District and a Synthetic Field at Michigan State University

Disclaimer: Material and labor costs are highly variable depending on region of the country and type of facility. The following costs are based off of North Scott Community School District and Michigan State University, and are meant to provide a realistic representation for costs involved with building and maintaining athletic fields.

### Natural – North Scott Community School District

North Scott Community School District is located in Eldridge, Iowa. School grounds and sports turf requiring maintenance totals 115 acres. The District maintains a native soil baseball field, softball field, and 214,000 square feet of native soil practice fields. The school also has a football stadium field with a 4 inch sand cap and a new, sand based soccer field built to USGA specifications. All of the grounds maintenance is done in house by three full time and three summer seasonal staff members. John Netwal, CGCS, is the Director of Operations for North Scott Community School District and has provided the following information.

### Natural Turf Maintenance Equipment\*

Tractor-mount sprayer	\$700
Utility tractor	\$15,000
Front end loader attachment for utility tractor	\$4,000
Broadcast spreader	\$400-\$1,200
Rotary-motion aerator attachment for tractor	\$6,300
Drag mat	\$300
Topdresser	\$7,000
Field painting equipment	\$8,400
Work Cart	\$4,500
Reel Mower	\$3,500-\$22,000
Rotary Mower	\$22,000-\$35,000
Trimmers	\$250-\$600
Seeder	\$250
<b>Total</b>	<b>\$72,600-\$105,250</b>

\* With new tier 4 compliance regulations, equipment prices will likely increase 10-15% going into 2016-2017.

### Native Soil Practice Area Field Maintenance Cost Estimates

Total Area: 214,000 square feet

Description of Activity	Man Hours	Man Hour Cost	Product	Product Cost	Total Activity Cost
33 Mowings / Season	97	1,912.84			1,912.84
Aeration, 5 times per year	45	887.40			887.40
Fertilizer @ 4.9 #s N / year	14	276.08	Fertilizer	2,295.00	2,571.08
Soil Amendments	3	59.16	Gypsum	551.04	610.20

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Herbicide Applications	3	59.16	Herbicide	45.32	104.48
Pre-emergent					
Spot Spray Round-Up, 1 Time / Month			Round-Up		
10 Game Field Prep's, Soccer	15	295.80	Paint	1,060.50	1,356.30
16 Practice Field Prep's, Football	45	887.40	Paint	610.10	1,497.50
Overseeding	8	157.76	Seed	1,710.00	1,867.76
Growth Regulator, Apr, May, Jun, Jul, Aug	16	315.52	Primo	2,324.10	2,639.62
Pre-emergent Applications					
Insecticide Applications			Dylox		
Water, 1 Acre Inch Per Week	10	197.20	Water	9,213.00	9,410.20
Miscellaneous \$25 / Month	10	197.20	Supplies	200.00	397.20
<b>Totals</b>		<b>\$5,245.52</b>		<b>\$18,009.06</b>	<b>\$23,254.58</b>

Labor Cost: \$16.44 x 20% benefits = \$19.72 per hour

**Bottom Line: North Scott Community School District's native soil practice fields (214,000 square feet) cost \$23,254.58 per year to maintain. One native soil football practice field (57,600 square feet) costs \$6,045 per year to maintain.**

### Football Stadium Field Maintenance Cost Estimates

Football field has 4 inch sand cap

Total Area: 70,000 square feet

Description of Activity	Man Hours	Man Hour Cost	Product	Product Cost	Total Activity Cost
33 Mowings / Season	50	986.00			\$986.00
Aeration, 3 Times Per Year	15	295.80	Verti-Drain		\$295.80
Sod Replacement Sidelines	12	720.00	Sod	1,000.00	\$1,720.00
Fertilizer @ 4.9 #s M / year	8	157.76	Fertilizer	810.00	\$967.76
Soil Amendments	1	19.72	Gypsum	183.68	\$203.40
Herbicide Applications	1	19.72	Herbicide	14.28	\$34.00
Pre-emergent Applications					
Growth Regulator (Apr, May, Jun, Jul, Aug)	5	98.60	Primo	762.60	\$861.20
Game Field Prep's	60	1,183.20	Paint	378.75	\$1,561.95
Over-Seeding	15	295.80	Seed	570.00	\$865.80
Insecticide Applications			Dylox		
Water, 1 Acre Inch Per Week	10	197.20	Water	4,784.34	\$4,981.54
Miscellaneous, \$25.00 / Month	30	591.60	Supplies	200.00	\$791.60
Stadium Preps	18	354.96			\$354.96

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Sports Lighting, 15 events @ 4 hours in length / season			Electricity	373.76	\$373.76
<b>Totals</b>		<b>\$4,920.36</b>		<b>\$9,077.41</b>	<b>\$13,997.77</b>

Labor Cost: \$16.44 x 20% benefits = \$19.72 per hour

**Bottom Line: North Scott Community School District's sand capped football stadium field costs \$13,997.77 per year to maintain.**

### Sand Based Soccer Field Maintenance Cost Estimates

Total Area: 114,000 square feet

Description of Activity	Man Hours	Man Hour Cost	Product	Product Cost	Total Activity Cost
50 Mowings / Season	113	2,228.36			\$2,228.36
Growth Regulator, Once Per Month	12	236.64	Primo	1,227.60	\$1,464.24
Topdressing, 5 Applications Per Year	31.5	621.18	Sand	1,987.50	\$2,608.68
Water, 1 Acre Inch Per Week / 26 Weeks	6	118.32	City Water	5,440.50	\$5,558.82
Fertilizer @ 6.1 #s N / Year	12	236.64	Fertilizers	1,548.00	\$1,784.64
Paint, 6 Applications Per Season / 20-5 Gallon Pails	45	887.40	Paint	378.75	\$1,266.15
Aeration, 3 Times Per Year	13.5	266.22	Verti-Drain		\$266.22
Fungicide, Four Applications / Season	8	157.76	Disarm 480 SC	1,575.00	\$1,732.76
Over-Seeding, Once Per Season	5	98.60	Seed	997.50	\$1,096.10
Herbicide, One Application Per Season	2	39.44	Herbicide	22.66	\$62.10
Fence-line Maintenance, 2 Apps. Per Year	8	157.76	Control Products	125.00	\$282.76
Miscellaneous	50	986.00	Misc. Products	200.00	\$1,186.00
Pre-emergent Applications	4	78.88	Drive 75 DF	360.18	\$439.06
Insecticide Applications			Dylox		
Sports Lighting, 10 events @ 3 hrs in length per season			Electricity	402.60	\$402.60
<b>Totals</b>		<b>\$6,113.20</b>		<b>\$14,265.29</b>	<b>\$20,378.49</b>

## Natural Grass Athletic Fields

Labor Cost: \$16.44 x 20% benefits = \$19.72 per hour

**Bottom Line: North Scott Community School District's sand based soccer field costs \$20,378.49 per year to maintain.**

### Synthetic – Michigan State University

#### Outside Contractor Maintenance Charges

Consultation and/or training	\$1,200-\$3,000 per day plus expenses
Repairs	\$30-\$70 per linear foot
Crumb Rubber	\$.50-\$1.00 per pound applied

#### Synthetic Turf Maintenance Equipment\*

Boom Sprayer	\$1,000-\$35,000
Sweeper	\$1,500-\$20,000
Broom	\$500-\$3,000
Painter	\$500-\$3,000
Groomer	\$1,500-\$2,000
Cart (to tow equipment)	\$2,500-\$16,000
Field Magnet	\$500-\$1,000
Rollers	\$250-\$2,000
<b>Total</b>	<b>\$8,250-82,000</b>

\* With new tier 4 compliance regulations, equipment prices will likely increase 10-15% going into 2016-2017.

#### Maintenance Budget for Synthetic Infill Field with a three year old surface

Seam Repairs (outside contractor; \$30 per linear foot)	\$8,000
Apply Crumb Rubber (1 time per year; 20 hours per application; 10 tons of topdressing at \$500 per ton)	\$5,000
Spray Field (4 times per year; 3.5 oz rate per 1000 square feet; 3 hours each; 12 hours per year)	\$216
Fabric softener at \$7 per 64 oz container	\$120
Disinfectant at \$5 per gallon	\$100
Sweep Field (Parker Sweeper; 4 times per year; 8 hours each; 32 hours per year)	\$1,500
Broom	\$500
Groomer	\$2,800
Hand Pick (3 times per week; 1 hour each; 156 hours per year at \$18 per hour)	\$2,800
Paint Field (2 times per year; 30 hours each; 60 hours per year; 30-40 gallons per year at \$25 per gallon)	\$1,000

## Natural Grass Athletic Fields



Total Straight Hourly Cost (Field only; 280 hours at \$18 per hour; benefits not included)	\$5,040
Total Supply Cost	\$6,220
Total Equipment Cost	\$3,500
Total Outside Contractor Repairs	\$8,000
<b>Total Maintenance Cost</b>	<b>\$22,760</b>

**Bottom Line: Michigan State University synthetic field costs \$22,760 per year to maintain.**

### Maintenance Comparison between a Professional Level Natural Grass Field and Synthetic Field at Paul Brown Stadium, Cincinnati, Ohio

Disclaimer: Material and labor costs are highly variable depending on region of the country and type of facility.

Paul Brown Stadium is located in Cincinnati, Ohio and is home to the Cincinnati Bengals Football Club. Darian Daily is the Sports Field Manager at Paul Brown Stadium and is responsible for managing both natural and synthetic fields for the team. The practice facility is natural grass with a sand-based rootzone and totals 100,000 square feet. The game field is synthetic turf with crumb rubber infill and totals 102,000 square feet. All of the grounds maintenance is done in house by three full time and four seasonal staff members. Daily has provided a realistic comparison of maintenance costs between the natural grass and synthetic fields he manages.

#### Natural Grass Field – Practice Facility

##### Natural Grass Field Maintenance Estimates

Product	Cost
Fertilizer	\$6,000
Fungicides	\$1,500
Herbicides	\$2,000
Topdressing	\$3,500
Paint	\$4,000
<b>Total Product Cost</b>	<b>\$17,000</b>

Labor	Man Hours
Mowing	600
Cultural Practices	70
Painting	200
<b>Total Man Hours</b>	<b>870</b>

#### Synthetic Field – Paul Brown Stadium Game Field

##### Synthetic Field Maintenance Estimates

Product	Cost
Crumb Rubber	\$3,000 (\$750 per ton)
Cleaning Products	\$1,000
Deep Cleaning	\$6,500
Paint/Paint Remover	\$5,000
<b>Total Product Cost</b>	<b>\$15,500</b>

Labor	Man Hours
Cleaning	180
Grooming	135
Repairs	40
<b>Total Man Hours</b>	<b>355</b>

The natural grass field used in the comparison was not overseeded or sprigged. However, sprigging of a different field cost \$21,000.

# Natural Grass Athletic Fields

## Involving your STMA Sports Turf Manager

It is important to have a qualified professional to help with decision making and the gathering of information and costs. Hiring or involving a sports turf manager who can oversee construction and/or daily maintenance of a natural grass field is important for its success. If constructing a field, the sports turf manager can serve as a grow-in consultant to work with the architect and contractors (hiring a Certified Field Builder can assure quality construction and renovations when needed) to supervise the entire construction process. Mistakes during the construction phase often result in problems that sometimes can never be corrected or that will take years of management to overcome. A trained sports turf manager on staff will ensure that specifications are adhered to during construction. On a daily basis, your sports turf manager can oversee the care of the athletic fields, maintain the budget, manage staff, and communicate with users.

It is also important to invest in the continuing education of your sports turf manager to keep them current on industry trends and research. Make sure your sports field manager is involved with STMA for networking and continuing education opportunities. STMA also provides the opportunity to become certified through a rigorous training and testing program. Certified Sports Field Managers (CSFM's) are recognized in the industry for their professional development and knowledge of sport field construction and renovation.

## Natural Grass Fields

The environmental and human health benefits alone make natural grass fields a desirable option when considering keeping or building an athletic field. The cost effectiveness of construction and annual maintenance only add to their appeal. It is important to have a complete understanding of the costs and benefits associated with both natural and synthetic surfaces when considering conversion from natural grass to a synthetic surface. Often times many of the benefits of natural grass systems are overlooked because of strong arguments and marketing efforts of synthetic turf companies.

## Next Steps

To advocate the construction of a natural turfgrass surface or improve the quality of the current natural grass field:

- Involve your STMA Sports Turf Manager in decisions and gathering of information and costs.
- Organize a meeting to educate community, coaches, administration, athletes, and parents about the benefits of a natural turfgrass athletic field.
- Define resources needed to maintain a quality surface for your facility.
- Develop a budget.
- If constructing a field, meet with architects and contractors to find the best option for your situation.
- Schedule meetings to keep those involved updated on progress.
- Form committees to assist in logistics and fundraising.

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# Natural Grass Athletic Fields

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The cost is estimated as follows:

	<b>Estimate Year</b>	<b>Estimate</b>	<b>SUC Inflation Multiplier</b>	<b>FY-17 Cost</b>	<b>Pro Rated %</b>	<b>Contributed Cost Share</b>	<b>Source</b>
Natural Grass	2013	\$17,556	1.0947	\$ 19,219.13			Fairfax County Park Authority
Natural Grass (football)	2015	\$13,997	1.0466	\$ 14,648.66			Sports Turf Managers Assoc. “Benefits of Natural Grass”
Natural Grass (soccer)	2015	\$20,378	1.0466	\$ 21,326.74			Sports Turf Managers Assoc. “Benefits of Natural Grass”
Natural Grass soil based	2016	\$33,522	1.0257	\$ 34,384.61			UMass Lowell
<b>Average Natural Grass</b>				\$ 22,394.79	66%	\$ 14,780.56	
Synthetic Turf (football)	2015	\$22,760	1.0466	\$ 23,819.64			Sports Turf Managers Assoc. “Benefits of Natural Grass”
Synthetic Turf (incl environmental disposal of turf)	2016	\$65,849	1.0257	\$ 67,543.48			UMass Lowell
<b>Average Synthetic</b>				\$ 45,681.56	33%	\$ 15,074.91	
<b>FY-17 Sustainment Unit Cost</b>						<b>\$ 29,855.47</b>	



# Synthetic Turf Task Force Overview, Findings, and Recommendations

July 2013

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*Cover Photo: Oak Marr Park Synthetic Turf Field and Robinson Secondary School Stadium Field*

### Task Force Creation and Purpose

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At the request of the Fairfax County School Board (School Board), in partnership with the Fairfax County Board of Supervisors (BOS) and the Fairfax County Park Authority Board (Park Board)<sup>1</sup>, a joint Synthetic Turf Task Force was formed to develop recommendations on:

- The development of new synthetic turf fields, to include location recommendations for rectangular and diamond fields
- The funding of new synthetic turf fields, to include private and corporate partnership opportunities
- The planned replacement of existing and any new synthetic turf fields
- The regular on-going maintenance of existing synthetic turf fields

The task force was comprised of community leaders and county staff who had a direct connection to the current and future synthetic turf field efforts. (*Members are listed in Appendix I.*) The task force was charged with:

- Proposing recommendations that focus on ensuring fair and equitable access for all geographic areas of the county
- Providing a formal report on its findings and recommendations to the Fairfax County School Board, the Fairfax County Park Authority Board and Fairfax County Board of Supervisors for their collective review and action

### Task Force Actions and Process

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The Department of Neighborhood and Community Services (NCS) was designated as the lead agency for this effort. Staff members from the Park Authority and the Public Schools were appointed by their respective appointing authorities. School Board, BOS members, Park Authority Board members, and Athletic Council members were participated on the task force. Staff from the Department of Administration for Human Services was designated to provide project management support.

The task force met bi-weekly from August 2012 through June 2013. The task force conducted a review of existing fields, analyzed the financial support associated with the existing synthetic turf fields, and compiled an inventory. Policies and procedures from the participating organizations were reviewed. Data regarding funding sources, partnership agreements, project costs and other relevant information were gathered and reviewed. Supplemental research on other jurisdictions and relevant industry information was analyzed and discussed for its relevance to the Fairfax County community. The findings and recommendations included in this report reflect the combined efforts and consensus of all task force participants.

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<sup>1</sup> Reference: Fairfax County School Board resolution, December 15, 2011; Letter from School Board Chair to Board of Supervisors Chairman Sharon Bulova, February 2012; and April 10, 2012 Board of Supervisors action. (see *Appendix II*)

### Synthetic Turf Development and Financing History

Over the last decade, as youth and adults sports participation steadily increased, the inventory of athletic fields was recognized as insufficient to meet the increasing demand. A Needs Assessment commissioned by the Fairfax County Park Authority (Park Authority) in 2004 ([http://www.fairfaxcounty.gov/parks/needs2004/pdf/needsassessment\\_final.pdf](http://www.fairfaxcounty.gov/parks/needs2004/pdf/needsassessment_final.pdf)) identified a rectangular field shortage of 95 fields needed to accommodate requirements for adult and youth rectangular field users.

Both the cost of new field development and availability of locations were identified as challenges. In 2003, the Fairfax County Athletic Council (Athletic Council) advocated for the resurfacing of existing fields to a synthetic turf surface to increase the playability of fields. During this same period, the Park Authority analyzed possible benefits of synthetic turf fields on park lands; a study conducted by county staff reported that conversion of an existing lighted natural grass field to synthetic turf would increase capacity by an additional 62 percent of playable time, as a synthetic turf surface can be utilized year round and in inclement weather, both during and immediately following rain or other weather events.

In the succeeding decade, the Park Authority and Fairfax County Public Schools (FCPS), in cooperation with a variety of community partners, embarked on an ambitious effort to build additional synthetic turf fields by leveraging various funding partnership models. These included public-private partnerships that utilized private donations, public bond financing and development proffer funds to pay for synthetic turf field development. Public land was identified on both FCPS- and Park Authority-owned properties. The majority of private cash donations were provided through community sports organizations and school booster clubs.

In 2003, the Park Authority oversaw the construction of the first synthetic turf field playing surface in Fairfax County: Lewinsville Park in McLean. This was followed the next year by the construction of a synthetic turf field at EC Lawrence Park in Centreville. Construction of additional synthetic turf fields continued over the next five years at park and school sites. Portions of the community funding came through a combination of sources, including user fees, fundraising and donations.

**\* A summary of all synthetic turf locations, funding sources, and costs can be found in Appendix VI.**

### New Resources Increased Capacity

In 2005, additional funding was required to complete planned development of synthetic turf fields. In recognition of the overall community benefit for the resulting increased capacity, the Athletic Council advocated for, and the County Board of Supervisors adopted, the creation of a Turf Field Development Fund. This program utilized a portion of revenues from the Athletic Services Application Fee (commonly referred to as the "\$5.50" fee) to offer annual mini-grants to spur development partnerships with community sports organizations. Of the current synthetic turf field inventory, 19 (28 percent) were partially funded by the Athletic Services Application Fee. The creation of the new Turf Field Development Fund and the concurrent financial support from the community helped to sustain the momentum of the synthetic turf field development effort until passage of the 2006 Park Bond referendum. That referendum specifically targeted synthetic turf field development and provided full funding for an additional 12 fields.

### Implementation of the Two-Field Model at FCPS High School Sites

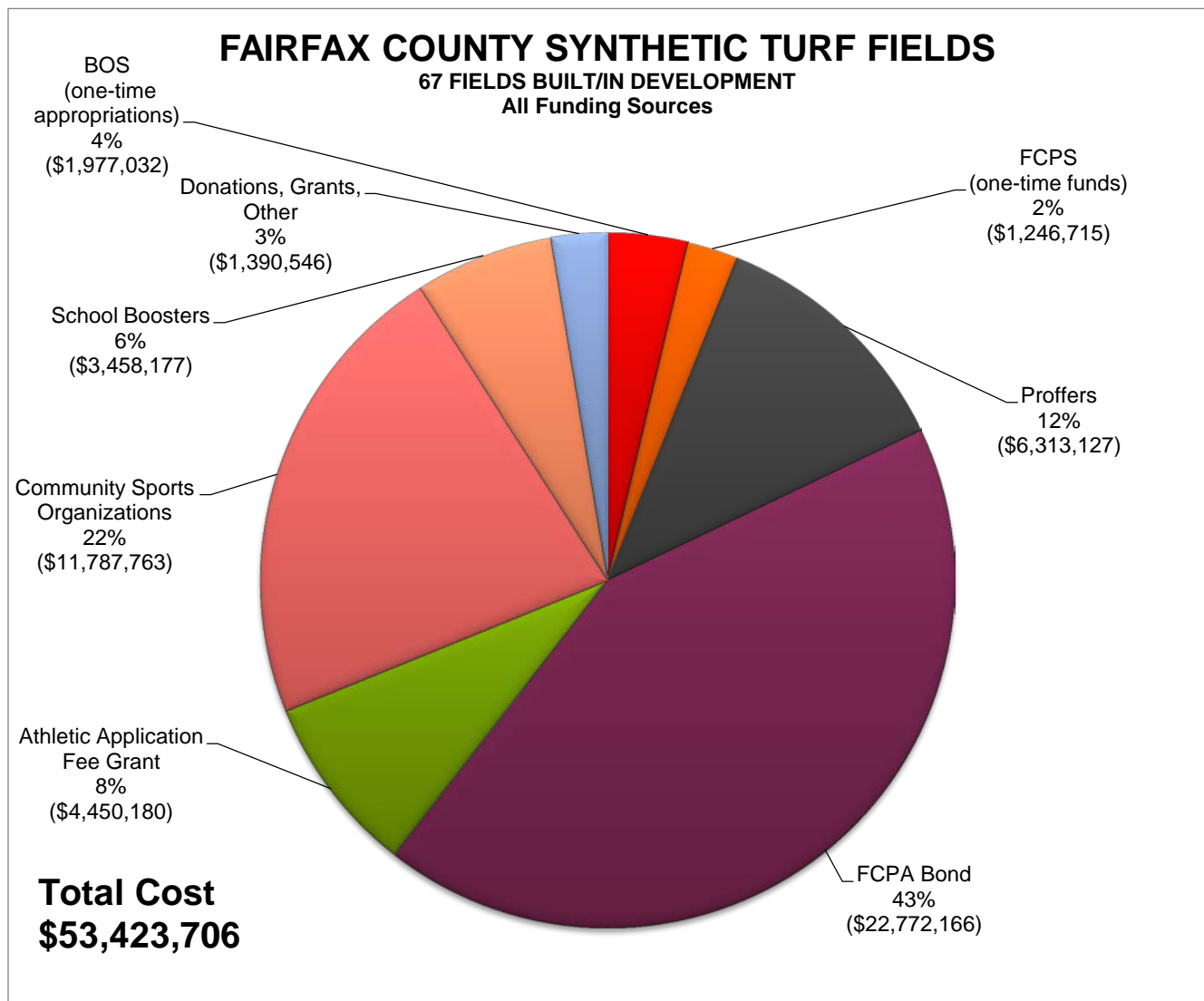
In 2009, Marshall High School became the first FCPS site that created a “two-field model.” The development was funded through proffer funds and contributions from community sports organizations. This became the new design model for synthetic turf field development at high schools, which included installation of synthetic turf surfaces on both the main stadium field and on a lighted auxiliary field on the school campus. The physical configuration of the two-field model increased the availability for field use by school athletic and physical education programs, as well as the surrounding community.

In 2010, Herndon High School became the first high school to successfully apply for mini-grant funds through the grant program administered by NCS, resulting in the county’s second two-field model. Nine of the county’s high schools have two-field models in place.

### Partnership Efforts Accelerated Synthetic Field Turf Development

The current synthetic turf field inventory would not have been developed without the significant contributions in both leadership of and investment by members of community sports organizations, school booster clubs and community leaders. Identification of public land created opportunities to increase capacity for sports participation, for both community level and public schools programs. Development of synthetic turf fields on school properties for both community and school use, along with shared arrangements on county-owned park lands, has increased overall capacity.

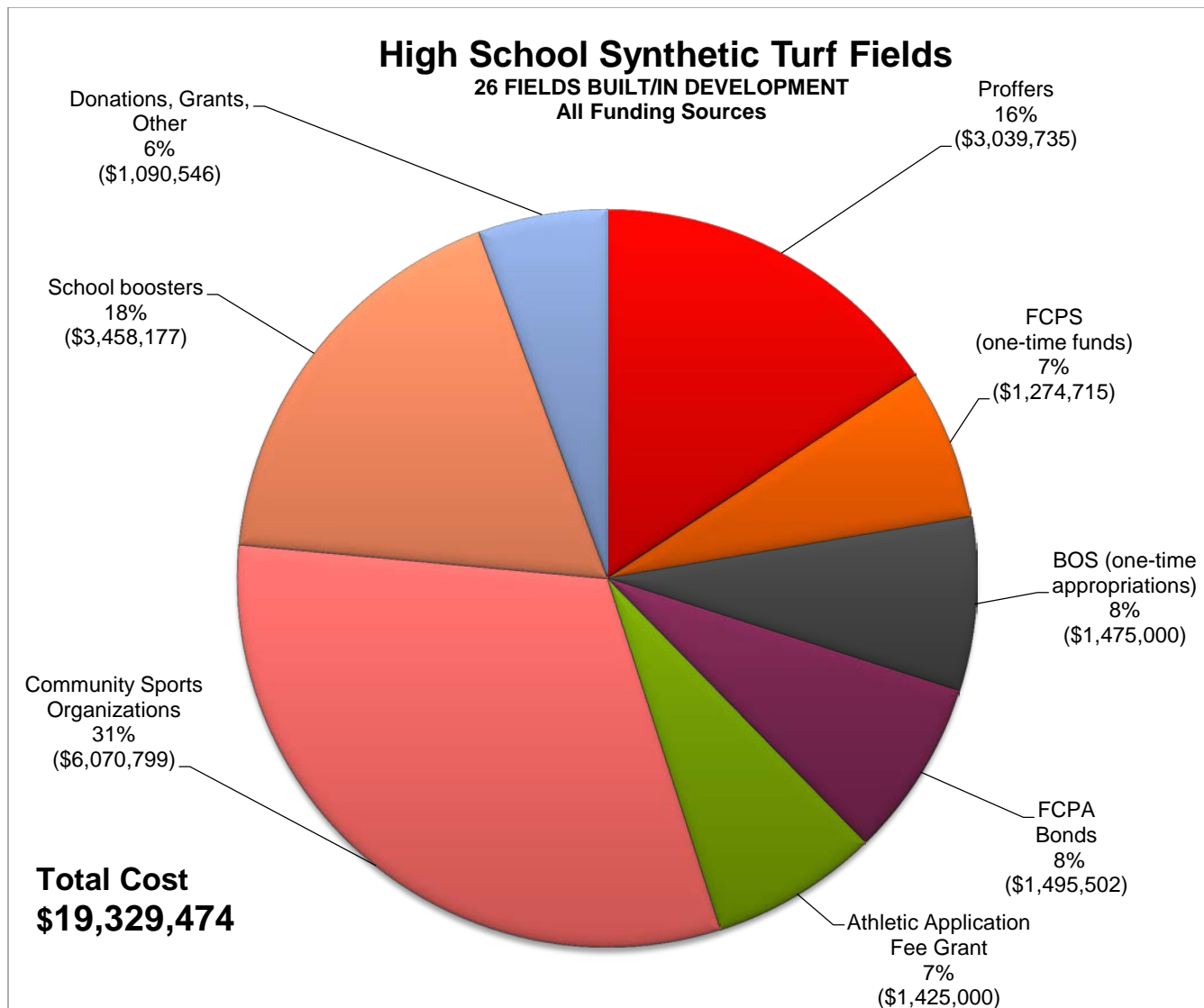
As of spring 2013, Fairfax County has 67 synthetic turf fields of which 47 are currently in use and 20 are pending construction. County rectangular fields continue to be used by more than 130,000 sports participants (*duplicated count*) in athletic events and programs for cricket, field hockey, football, lacrosse, rugby and soccer. When the latest development phase is complete, Fairfax County will have the largest inventory of synthetic turf fields of all jurisdictions in the Washington, D.C., metropolitan area.



*Significant funding from the community was leveraged to create the 67 synthetic turf fields built and in development.*

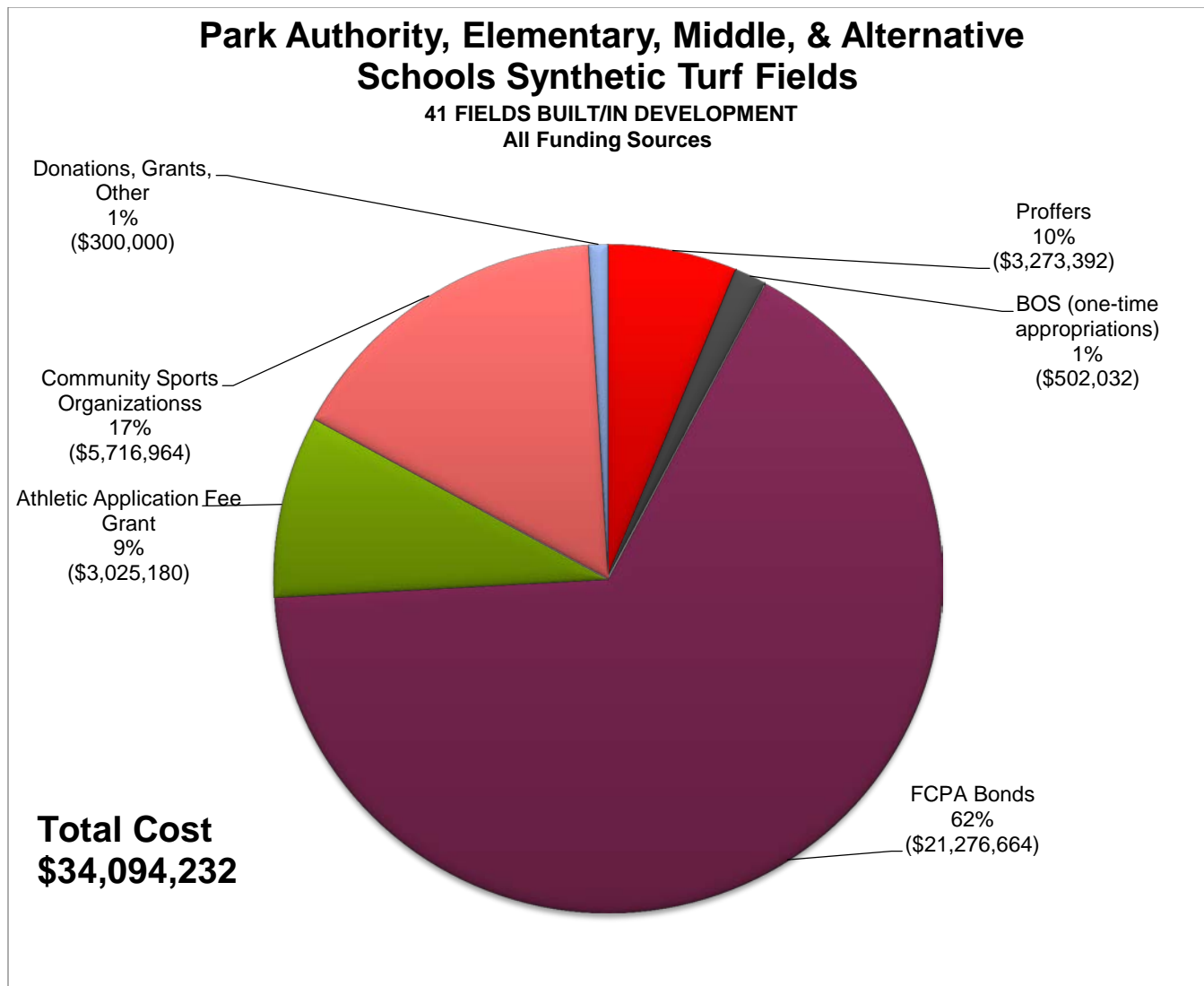
\* A summary of all synthetic turf locations, funding sources, and costs can be found in Appendix VI.





*Community sports organizations and school booster clubs funded almost half of the cost for high school synthetic turf fields.*

\* A summary of all synthetic turf locations, funding sources, and costs can be found in Appendix VI.



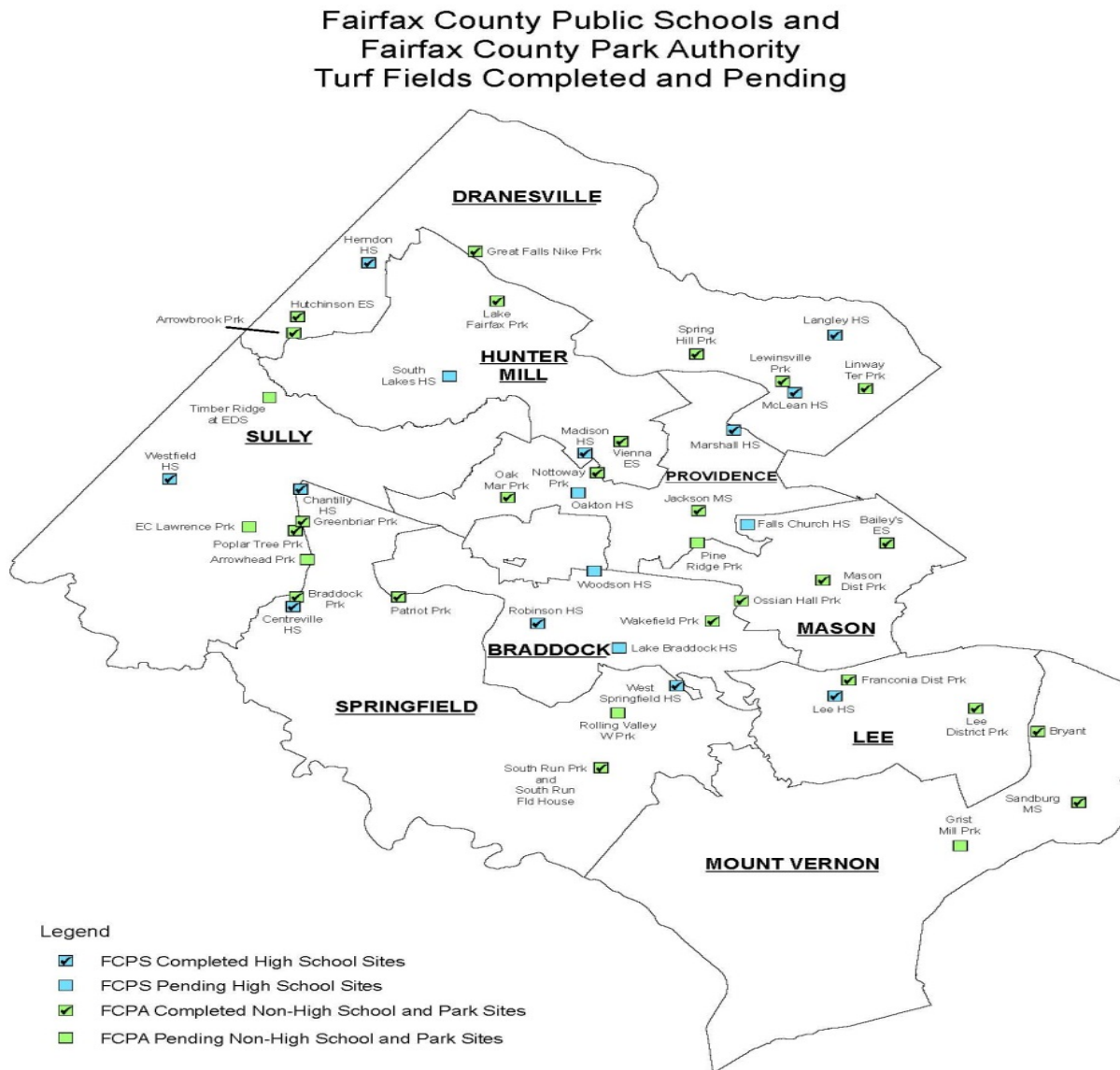
*Park Authority Bond Funds funded the majority of the cost for park and other school synthetic turf field sites.*

\* A summary of all synthetic turf locations, funding sources, and costs can be found in Appendix VI.

## Development – Analysis and Findings

### Where are the fields located?

Park and School synthetic turf fields are scattered throughout Fairfax County. The task force analyzed location by supervisory district. The following map identifies exact locations of the county's inventory of 67 synthetic turf fields built and in development:



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## Task Force Analysis – Background Questions and Responses

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The following section provides information resulting from the analysis of the current environment on the history of the synthetic turf movement within the County and a summary of Task force findings.

### Why build synthetic turf fields?

**FINDING 1: Converting natural grass fields to synthetic turf fields provides a solution to the increased countywide demand for use of outdoor fields.** As the Park Authority Needs Assessment pointed out in 2004, Fairfax County had a significant rectangular field shortage of 95 fields needed to accommodate requirements for adult and youth rectangular field users. The conversion to synthetic surfaces allows for year-round play and in most weather conditions which significantly increases the amount of playable time and thus affords the opportunity to help address the shortage of available field space.

*2004 Park Authority Needs Assessment identified a rectangular field shortage of 95 fields. Conversion of natural grass fields to synthetic surfaces helps address that shortage.*

**What is the best field configuration? How can the county maximize community sports organizations' use and school's use for physical education instruction and high school athletic and other school program use?**

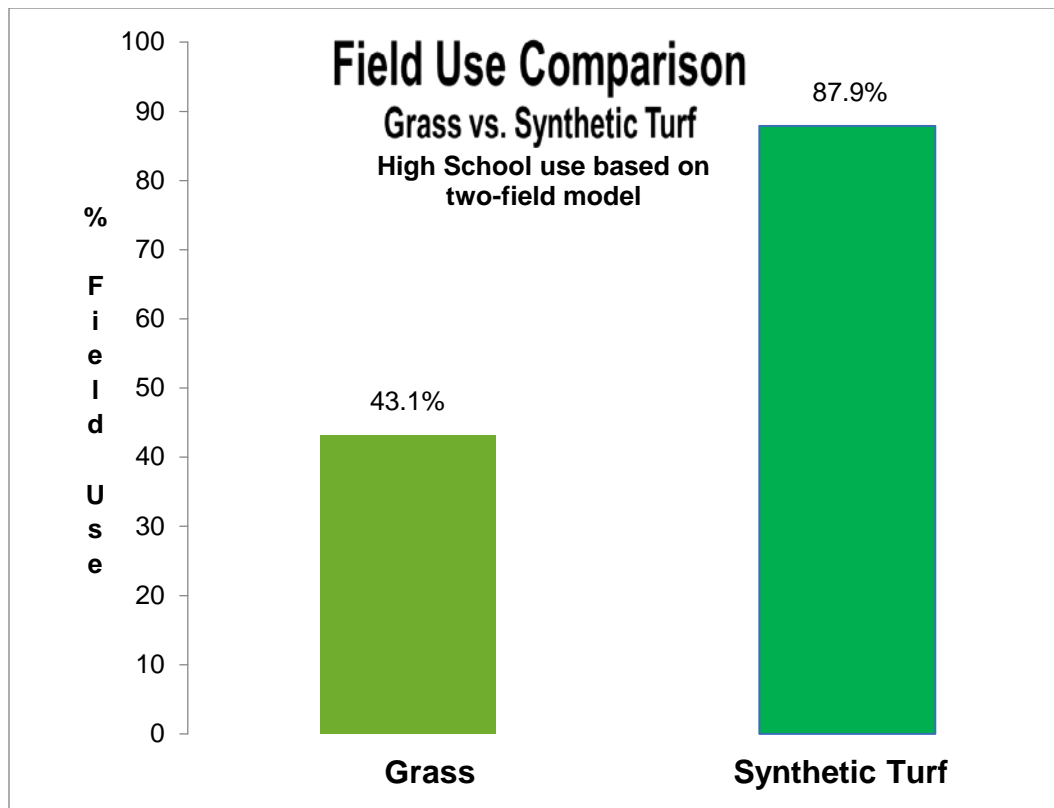
**FINDING 2: The optimal use of resources in the creation of synthetic turf fields on all sites (parks and schools) is a minimum two-field rectangular, or more, model.** Including a diamond field (where physically possible), the following financial benefits exist for establishing a standard minimum two-field rectangular model at all sites:

- Land purchases are costly, and limited opportunities exist for stand-alone development throughout the county
- There is some flexibility with land at middle and elementary schools to leverage existing resources to maximize use
- Cost savings can be achieved through economy of scale of field construction and operations

- Opportunities exist for two-field models on park-owned properties at sites throughout the county, thereby increasing accessibility to more users

**FINDING 3: In a two-field rectangular synthetic turf model at high schools, overall usage capacity is significantly increased, with both FCPS programs and community use equally benefitting.** This provides community access to FCPS athletic fields that were previously not scheduled to the public through the field allocation process/system. A two-field model has the following benefits:

- Allows for increased use during the school day for physical education classes
- Avoids transportation issues for after-school practices to nearby middle and elementary schools and parks
- Increases field use time for community sports organizations during peak community use hours
- Best utilizes land available at school sites for community use
- Benefits the community sports organizations by the existence of a second, non-stadium field on school campus sites. The stadium field is heavily used by the FCPS sports teams and as such has a much more limited use for the community.
- Adds new fields to the public access inventory which were previously not available for scheduling
- Affords greater opportunity for community programs to use school fields
- Affords FCPS high school teams earlier practice times, makes more time available for community use of high school synthetic turf fields, and allows FCPS year-round use of FCPA synthetic turf fields from 3 – 5 p.m. on weekdays for practice



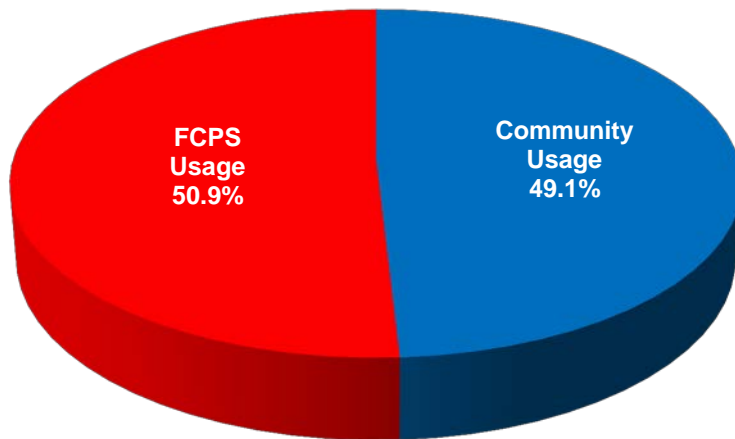
\* A summary of grass versus synthetic turf usage can be found in Appendix VII.

*Available field-use time is doubled,  
benefiting both school and  
community users.*

*Capacity is significantly increased  
at school sites using a two-field  
model and lighted fields.*

## Field Usage Percentage

High school usage based on two-field model



Who benefits in a two-field model:

- Public Schools instructional programs
- Physical education
- Interscholastic athletics
- Intramural and after school programs
- Community sports organizations

\* A detailed breakdown on usage analysis can be found in Appendix VII.

### Are synthetic turf fields safe?

**FINDING 4: Synthetic turf fields have been installed and used throughout the region, the nation and internationally.** The health and safety aspects of synthetic turf have been reviewed and addressed by many national and state organizations, including the U.S. Environmental Protection Agency, the Centers for Disease Control and Prevention, and numerous state agencies in California, Connecticut, New Jersey, and New York. They generally conclude that these fields do not pose a serious public health concern. A fact sheet was prepared and publicly published in consultation with the Fairfax County Health Department, Fairfax County Risk Management Division, Fairfax County Public Schools and Fairfax County Park Authority to provide information on research conducted by numerous state and national organizations who have studied these issues. (See Appendix IV.)



### What is the average cost to build a synthetic turf field?

**FINDING 5: Synthetic turf field and natural grass field development requirements are site specific.** Development costs for full and oversized rectangular turf fields have ranged from approximately \$600,000 to \$900,000. Cost variances are attributed to the varying sizes of the fields, specific site design requirements, and incorporation of project-related amenities required for each project. Examples of site specific design features include those that address environmental factors, geotechnical findings, engineering layout, onsite/offsite storm water drainage/best management practice requirements, earthwork balancing, and related infrastructure improvements. Project-specific ADA accommodations and amenities may include creation of accessible trails, parking spaces, bleacher/players bench accessible pads, purchase and assembly of bleachers/benches, side-field goals for youth soccer, protection fencing, and community-requested landscape buffer enhancements. Any combination of these site-specific design features may contribute to the variances between the overall total costs of individual projects.

### Are the Park Authority and FCPS methodologies for project development similar? Are there any efficiencies or cost savings that can be applied to future development?

**FINDING 6: Project Definition:** FCPS and Park Authority total project costs commonly include professional design service fees, permitting fees, and construction development costs. There are, however, significant variances in project related amenities incorporated into FCPS and Park Authority development projects. Additionally, Park Authority total project development costs include a standard staff salary recovery expense, calculated at 8 percent of the design and construction development cost for capital improvement projects. FCPS previously did not charge staff salaries to project development costs, but will implement a \$35,000 per-site fee for field development administrative costs in the summer of 2013.

**FINDING 7: Competitive Pricing:** Both the Park Authority and FCPS use the Fairfax County and Virginia State Procurement Regulations/guidelines, which include provisions for the use of National Cooperative State, Local and Municipal Contracts offering nationwide competitive pricing and competitive sealed bidding processes for the procurement of construction services.

**FINDING 8: Contracting Efficiencies and Purchasing Practices:** The Park Authority and FCPS have in the past identified opportunities for joint cooperative contract arrangements when in the best interest of the county. In 2008, staff partnered on joint contracting through U.S. Communities, a nationwide cooperative procurement program. Standards for the industry, price comparisons and other information sharing is routine and will continue on future synthetic turf field development efforts to maximize purchasing power and oversight of synthetic turf field development.

### What is the capital investment for a synthetic turf field? Can bond funds be used?

#### **FINDING 9: Synthetic turf field installations are permanent infrastructure investments.**

The capitalized investment for a synthetic turf field could be considered as permanent infrastructure, with components requiring replacement on an 8- to 10-year life cycle, assuming conformance to regular maintenance consistent with manufacturing product warranties. Similar to other capital construction investments, fields must be scheduled for routine, ongoing maintenance, and complete component replacement, each effort designed to prolong its use life cycle. Renovations will typically include carpet and fill materials replacement.

Park Authority bond funds have been utilized to finance development projects at 29 sites. To date, FCPS school bond funds have not been used for the development of synthetic turf fields.

### Are the county's synthetic turf fields in the right locations? Do some communities have fewer than needed?

The task force analyzed the location of the 67 synthetic turf fields in existence or in development to assess whether the distribution and location allows for equal access and fair usage across the county for public schools athletic and community sports organizations. The Task force examined this information on three levels:

- **Utilization by major youth group participants**
- **Total population**
- **Location of high schools without synthetic turf fields (16 have turf; 8 do not)**

Shortages of synthetic turf fields exist in some parts of the county, in large part as a result of reliance on community funding for development of synthetic turf fields.

**FINDING 10: Based on its review of synthetic turf field location and utilization, the task force identified significant comparative shortfalls in available synthetic turf fields in the Mount Vernon and Lee Supervisory Districts. These areas of the county should be considered for the next opportunities for development of rectangular synthetic turf fields to address the shortfalls.** Shortfalls were identified through analysis of several different data sources: overall numbers of sports participants in youth leagues and high school athletic programs, total population, and placement of synthetic turf fields at high schools within each respective supervisory district. The analysis revealed community shortfalls in available synthetic turf fields, as well as comparative uneven distribution at high school sites across the county. (See detailed analysis on page 16 and comparison used to assess adequacy of field distribution across the county.)

The task force concludes that the shortfalls in these districts are not the result of a conscious or deliberate plan; the history of the development of the synthetic turf fields across the county clearly shows that fields were developed when a combination of opportunities met with:

- Community interest
- Site availability (with full size field and lighting infrastructure in place)
- Funding availability (through large community or private sector financial donations and/or development proffer funds)

Typically, it was only **after one or more of these opportunities were under consideration** that public financing to supplement community resources was even considered to support the development projects. The ultimate allocation of public funding also was influenced by the stated need for a particular community. Were there unmet field requests experienced as part of the county's management of countywide field scheduling and use policies? Did communities applying for grant funding to partially support synthetic turf field development provide justification for the placement of the field? In most of the synthetic turf fields developed in the county, funding sources (including those appropriated or recommended by the Park Authority, the Athletic Council and/or the Board of Supervisors) were leveraging significant investments for specific identified sites and completed the financing package to allow the projects to move forward.

CURRENT SYNTHETIC TURF FIELD INVENTORY								
	Synthetic Turf Field (STF) Inventory				2010 Census Total Population - Fairfax County		Rectangular Field Major Youth Group Sports-Community Use and High School Participants	
	FCPA & Non-HS School fields	FCPS High School Fields	Total Turf Fields	% of turf fields *	% of Total Population *	Differential from STF Inventory	% of Sports Participants *	Differential from STF Inventory
Braddock	1	6	7	10.4%	10.6%	-0.2	9.9%	0.5
Dranesville	9	4	13	19.4%	11.1%	8.3	16.3%	3.1
Hunter Mill	3	3	6	9.0%	11.4%	-2.4	11.3%	-2.3
Lee	2	1	3	4.5%	11.1%	-6.6	9.7%	-5.2
Mason	5	2	7	10.4%	10.8%	-0.4	10.6%	-0.2
Mount Vernon	3	0	3	4.5%	11.2%	-6.7	9.0%	-4.5
Providence	4	5	9	13.4%	11.2%	2.2	10.3%	3.1
Springfield	6	4	10	14.9%	11.0%	3.9	11.2%	3.7
Sully	8	1	9	13.4%	11.6%	1.8	11.6%	1.8
	41	26	67	100.0%	100.0%		100.0%	

*\*Totals may not equal 100% due to rounding*

### What were the original guidelines regarding placement of synthetic turf fields?

**FINDING 11: The Park Authority adopted criteria to identify fields that would be priority candidates for conversion to synthetic turf.** The fields to be selected would be those that

most closely meet the program criteria. The approved criteria, adopted by the Park Board on July 26, 2006, are:

- Existing rectangular field\*\*
- Minimum playing surface size of 370' X 190'
- Currently lighted or master plan approval for lights exists
- Conversions that would require minimal site work and/or amenity improvements
- Permit approval by Department of Public Works and Environmental Services through a minor site plan or rough grading permit (RGP)
- Fields geographically distributed throughout the county
- Reduction of rectangular field deficiencies identified in the 2004 Park Authority Needs Assessment

\*\*Any construction of synthetic turf fields on property owned by Fairfax County Public Schools will require a long-term agreement that addresses the construction, community use, maintenance and eventual replacement of the field.

### Are other types of synthetic turf fields needed in the community for other sports?

**FINDING 12: The 2004 Park Authority Needs Assessment identified a diamond field shortage of 13 fields.** Diamond-configured synthetic turf fields are in the development stages for Fairfax Countywide use. Two current synthetic turf fields exist (Nottoway Park and Waters Field) and two future sites are identified in the Park Authority Master Plan for the Laurel Hill Sports Plex and Patriot Park. In 2005, when the Board of Supervisors directed the use of Athletic Services Application Fee revenue into specific sports-related projects (such as rectangular synthetic turf field development), the diamond field community advocated for the use of available funds to significantly enhance the maintenance program on their existing natural grass diamond fields. The Park Authority is currently conducting an updated needs assessment that will be completed in 2014, the results of which should be used to guide community engagement for future diamond synthetic turf field needs.

### How should synthetic turf fields be funded in the future?

**FINDING 13: Community sports organizations provided significant funding and leadership to create the inventory in place today.** However, the success of the synthetic turf field development program did not come without some unintended consequences. As the economy dipped into recession in 2008, increased reliance upon an already significantly leveraged program caused some disparity in development opportunities. For instance, on high school sites where synthetic turf fields were successfully completed, over half of the funding was

raised by community sports organizations and school booster clubs in those communities. Geographic areas of the county without groups able to contribute at similar levels were left (and remain) without synthetic turf fields.

An additional issue identified by the task force is the capacity for some community sports organizations that borrowed funds to finance construction of synthetic turf fields. This has allowed their community to obtain such facilities in a timeframe that would not otherwise have been possible. However, this arrangement is reported to have left some of the organizations with significant loan debt. It will be important to assure that future arrangements forecast capacity to also contribute to maintenance and/or replacement needs on the field in question and the other natural grass fields on which they play.

**FINDING 14: Community sports organizations have continued, and should continue, to play a significant role in the development of synthetic turf fields.** To date, community sports organizations have contributed approximately 30 percent (\$16 million) of all funds for development through direct financial contributions and payment of the “\$5.50” fee. These contributions both leverage and reduce the county taxpayer funding investment for school children playing sports, physical education classes and community use for athletic league play for both children and adults.

**FINDING 15: Reliance upon leveraged partnerships helped to create the inventory that exists today.** Some communities will continue to have limited access to funding sources that other neighborhoods have had available. New strategies will need to be employed to overcome these challenges to ensure access for all county residents.

**FINDING 16: Each school site has unique site capacity, a variety of community sports organizations and funding opportunities.** Many contributing factors require individualized field development plans; for example, some sites are limited in size and could only be developed with a one-field model. A completely uniform development approach is not advantageous if community sports organizations’ opportunities can be leveraged to reduce taxpayer costs.

### **Are development proffer funds available to support synthetic turf field development?**

**FINDING 17: Development proffer funds have been used in specific past efforts, contributing approximately 12 percent of the total cost of all synthetic turf field development to date. However, proffer funds cannot be relied upon as an assumed “standard” source of funding for development or replacement of synthetic turf fields.** Availability of proffers is dependent on land use patterns. Proffers will be variable and should not be factored into a standard formula for development of synthetic turf fields as they may or may not be available for a particular development effort. Development proffer funds were made available to support 7 of 16 high schools for synthetic turf field development (Madison, Marshall, Lee, Westfield, McLean, Oakton and Woodson High Schools). Funds totaled \$3.04 million for

11 synthetic turf fields, and represented approximately 16 percent of total high school sites development costs of \$19.3 million; however, 9 high schools were built through other funds sources. Timing of synthetic turf field construction, location and development activity in the community were all factors in determining applicability and appropriateness for use.

### **What is the justification for use of school general fund or bond financing for synthetic turf fields on school property?**

**FINDING 18:** Synthetic turf fields are not included in the existing FCPS school construction education specifications, thereby excluding the development of synthetic turf fields in new school construction or renovation projects. To date, no FCPS bond funds have been used to pay for installation of synthetic turf fields, as the fields were not included in the school education specifications. However, should the School Board choose to do so, bond funding, including new or undesignated funds, as well as use of general FCPS operating funds, appear to be viable funding sources.

### **How have other jurisdictions financed synthetic turf fields?**

**FINDING 19:** The task force reviewed various development and maintenance strategies of localities throughout the nation. A select listing of these jurisdictions is shown on the next page. In reviewing the data, it is clear that Fairfax County residents have created one of the largest synthetic turf field inventories and are at the forefront of communities addressing the sharing of public resources, long-term capacity and need, maintenance, and financing strategies for synthetic turf fields.

Other Locality Practices for Development, Maintenance and Replacement of Synthetic Turf Fields				
Jurisdiction	# of Fields	Development	Maintenance	Replacement
Fairfax County, VA	67 (41 parks and non-HS, 26 HS)	Bond financing BOS FCPS one-time funds Donations, grants, other Athletic application fee grant Proffers School boosters Community sports organizations	FCPA: General maintenance fund  FCPS: Local school responsibility	Athletic booster clubs (15k/year), community field use agreements, turf field replacement fund (\$150k/year), FCPA Tournaments for Turf, County general fund appropriations (\$350k/year)
Montgomery County, MD	4 (2 schools, 2 parks)	Inclusion on high school renovation capital improvement plans New Construction: booster club, private donations Parks: tax, grant reimbursement, program open space grant	G-max testing done by manufacturers  Annual cleaning of infill	Revenue replacement fund – user fee based
Loudoun County, VA	5 schools	School bond funds  Private funding from athletic groups	Contracted project management and construction	Private funds through user fees
Arlington County, VA	10 (3 schools, 7 parks)	Included in capital expenditure budget	Weekly inspection. G-max tested by contract. General Operating Budget	General Obligation bonds, pay-as-you-go, rental fees, possible partnerships
Prince William County, VA	9 parks	Public-private partnerships – government and sports leagues	Maintained by Parks as part of regular operating. Weekly clearing, monthly sweeping and grooming. Done by public/private partnerships	Under discussion. One field is licensed directly to a league; they carry responsibility to replace. Use fees and fund raising under consideration.
Aberdeen, MD	6 schools	Capital Improvement program, appropriated funds	Weekly inspection and grooming as needed. General Operating Budget	Under discussion; Money from grass maintenance re-directed to turf replacement.
Miami-Dade County, FL	9 parks	Public funds included in Capital Improvement Plan	Privately maintained, G-max tested twice per year. General Operating Budget	Under discussion
Asheville, NC	5 parks	Capital funds and partnerships	Soccer association purchased equipment; Park staff maintains and does work	Under discussion



### Synthetic Turf Field Development Recommendations

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Two charges were given to the task force regarding the development of new synthetic turf fields: recommendations for the location of rectangular and diamond fields; and funding recommendations for development of new synthetic turf fields. In response, the Task force recommends the following actions:

**Recommendation 1: Synthetic turf fields and lights within school sites should be standard components in new school construction and future capital improvement renovation schedules. At high school sites, the two-field model should be standard for rectangular sports use.**

**Recommendation 2: The diamond sports community should be engaged to determine interest in expanding the conversion of natural grass softball and baseball fields to synthetic surfaces. The completion of the next Park Authority Needs Assessment should be used to guide that discussion to include gauging the desire of the diamond sports community to redirect a portion of the Athletic Services Application Fee (currently used for maintenance) to this effort and/or increase the fees for diamond sports participation.**

**Recommendation 3: Future synthetic turf field development should be guided by recommendations in this report for oversight, locations, development schedule and share of public funding allocations.**

**Recommendation 4: Install the two-field model at all high schools that currently do not have synthetic turf fields. Complete the 8 school sites to include 15 total synthetic turf fields within a three-year cycle—by 2016. BOS and School Board review options and adopt a variety of funding strategies to fund the development of turf fields for these 8 sites.**

Convert rectangular stadium and auxiliary natural grass fields to synthetic turf at each of the following eight high schools:

- Annandale High School
- Edison High School
- Hayfield Secondary School
- Mount Vernon High School
- South County High School
- JEB Stuart High School (1 rectangular field per space constraints)
- Thomas Jefferson High School for Science and Technology
- West Potomac High School

### Rationale:

1. Conversion of these eight school sites will provide 15 rectangular fields for both community and school athletic use. The purpose of this strategy is to resolve the equity issues that now exist in schools that do not have synthetic turf fields or will not receive synthetic turf fields in 2013.
2. This strategy will further address overall community use shortages in several identified areas of the county. Building these synthetic turf fields will increase the playability of fields located in the supervisory districts where demand exceeds availability. These fields will address the significant shortages identified in the Mount Vernon and Lee Districts.
3. Targeting the high schools:
  - is a prudent utilization of existing space and amenities (parking, lighting, bleachers and other infrastructure)
  - benefits the greatest number of county residents participating in public schools and community programs

<b>Addition of 15 fields at High School Sites – Improvement by Supervisory District</b>				
	<b>FCPA &amp; Non-HS School Synthetic Turf Fields</b>	<b>FCPS High School Synthetic Turf Fields</b>	<b>Total Synthetic Turf Fields</b>	<b>Proposed New Synthetic Turf Fields</b>
Braddock	1	6	7	No change
Dranesville	9	4	13	No change
Hunter Mill	3	3	6	No change
Lee	2	5	7	+4
Mason	5	7	12	+5
Mount Vernon	3	6	9	+6
Providence	4	5	9	No change
Springfield	6	4	10	No change
Sully	8	1	9	No change
	<b>41</b>	<b>41</b>	<b>82</b>	<b>15</b>

Adding synthetic turf fields at the 8 recommended high school sites addresses the significant comparable shortages the task force identified in the southeast part of Fairfax County.

**Recommendation 5: Continue to support community partnership opportunities directed at future synthetic turf field development, maintenance, and replacement.**

**Recommendation 6: Modify construction standards to incorporate new storm water management requirements and develop consistent guidelines for promotion of the county's adoption of the use of green construction.**

**Recommendation 7: Establish an oversight committee to oversee and periodically meet to monitor joint collaborative efforts for synthetic turf field development. Members should establish procedures consistent with the findings and recommendations in this report as a guide for their analysis. Members of the committee should include representatives from the following organizations:**

- **Park Authority**
- **Fairfax County School Board**
- **Fairfax County Board of Supervisors**
- **Fairfax County Athletic Council**
- **Staff representation from the County (FCPA and NCS) and FCPS**

## Synthetic Turf Field Development Funding Options

The task force reviewed several additional options for financing the development costs. Based on an estimated average of \$800,000 for synthetic turf field development, adding 15 synthetic turf fields to the existing inventory will cost approximately \$12.0 million. **Options to finance the development include the following:**

Funding Source Options	Funds Generated over a 3 year period
<b>Mini-Grants</b> - Redirect Community Services Turf Field Mini-grant Program funds for targeted development of the 8 high school sites (suspending the mini-grant program)	\$1,050,000
<p><b>Ability to Pay Expectation</b> – Require community contribution for all eight schools from athletic booster clubs and community sports groups for field development.</p> <p>Tier 1: Require 25 percent contribution for 2 of 8 schools. (Calculation based on average field cost of \$800,000). Schools recommended for tier 1 participation: Thomas Jefferson and South County.</p> <p>Tier 2: Require 12.5 percent for Hayfield High School.</p> <p>Tier 3: Require 6.25 percent contribution (\$100,000 – or \$50,000 per field). Schools recommended for tier 3 participation: Annandale, Edison, Mount Vernon, West Potomac, JEB Stuart.</p> <p>(See Table 1, p. 25 for further detail)</p>	<p>Tier 1: \$800,000</p> <p>Tier 2: \$200,000</p> <p>Tier 3: \$450,000</p>
<b>Increase the Athletic Fee</b> from \$5.50 per rectangular sports participants (lacrosse, soccer, football, cricket, rugby, field hockey), per season to \$8. Increases would be dedicated to development costs for the 15 new synthetic turf fields for the three-year development period.	\$750,000
<b>Subtotal: (community support)</b>	<b>\$3,250,000</b>
<b>BOS:</b> Direct all available and appropriate development proffer funding.	TBD
<b>FCPS:</b> Direct FCPS bond funds.	TBD
<b>BOS:</b> Development of a line item appropriation to create annual allocation or direct one-time appropriation of carryover funds in the county budget.	TBD
<b>FCPS:</b> Development of a line item appropriation to create annual allocation or direct one-time appropriation of carryover funds in the FCPS budget.	TBD
<b>Balance for consideration by FCPS School Board and the BOS:</b>	<b>\$8,750,000</b>

### Synthetic Turf Field Development: School Boosters/Adult-Youth Groups Contribution

It is the expectation that school booster clubs and community sports organizations will, collectively and to their best ability to pay, contribute up to twenty-five percent (25%) toward the development costs of a two-field synthetic turf field project. The ability to pay criteria will include, but may not be limited to, a school's percentage of students eligible for the FCPS High School Free and Reduced Lunch Program. This program serves as one indicator on the economic viability of the student body and community.

Currently the development costs of a two-field synthetic turf field project are estimated at \$1.6M. The following table depicts the ability to pay scale and its application to the development of a two-field turf model:

**Table 1. School Booster Clubs/Community Sports Organizations' Ability to Pay on Development Costs of Two-Field Synthetic Turf Model**

Percent Free/Reduced Lunch Student Body	Ability to Pay Expectation for Athletic Booster Club and Athletic Groups	Estimated Two-Field Synthetic Turf Project Costs \$1.6M	Impact of Ability to Pay Scale on (8) Remaining Schools (% at F/R) to be Turfed
<b>33% or Greater</b>	6.25%	\$100,000	<ul style="list-style-type: none"> <li>Stuart HS * (55.2%)</li> <li>Mount Vernon HS (54.1%)</li> <li>Annandale HS (44.7%)</li> <li>West Potomac HS (38.1%)</li> <li>Edison HS (34.3%)</li> </ul>
<b>21% - 32%</b>	12.50%	\$200,000	<ul style="list-style-type: none"> <li>Hayfield Secondary (27.4%)</li> </ul>
<b>20% or Less</b>	25.00%	\$400,000	<ul style="list-style-type: none"> <li>South County HS (15.9%)</li> <li>Thomas Jefferson HS (2.2%)</li> </ul>

\*Stuart HS would be a one-field model (based on available space). As such, their contribution expectation would be \$50,000.

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## Replacement of Synthetic Turf Fields

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Each synthetic turf field development project increases our community's expertise and provides additional learning opportunities for improvement. Similarly, the first replacement efforts are underway in the summer of 2013 for the first two synthetic turf fields developed in Fairfax County, Lewinsville Park in McLean, and EC Lawrence Park in Centreville.

Most manufacturers provide an eight-year warranty for a properly maintained synthetic turf field; it has been a generally accepted practice to assume a life expectancy of the synthetic turf field at no longer than 10 years. For planning purposes, Fairfax County adopted a budget estimate of a little more than half the installation funding, a generally accepted practice for the industry.

Based on a projected ten-year replacement cycle, the current 67 field inventory replacement requirements are already a regular financial commitment. Planning considerations include analysis of individual field playability, based on the differing levels of use, the nature of the Northern Virginia climate, and the importance of required maintenance efforts.

### Current Funding for Synthetic Turf Field Replacement

**FINDING 20:** Preliminary planning for funding synthetic turf field replacement began in 2007. Total estimated available annual funding of \$740,000 is currently provided through the following funding sources:

- **Athletic Booster Clubs** - FCPS required booster clubs at schools where synthetic turf fields were installed to commit \$15,000 annually as a set-aside for future synthetic turf field replacement.
- **Community Field Use Agreements** – FCPA and FCPS developed community use agreements that allowed community partners to maintain their priority use benefits in exchange for contributions to replace synthetic turf fields at the end of the fields' life cycle.
- **Synthetic Turf Field Replacement Fund** – Established in FY 2012, funding for this purpose was redirected (\$150,000) from the Synthetic Turf Field Development Fund. A portion of athletic participation fees charged to rectangular field users, the "\$5.50 fee," was allocated for synthetic turf field replacement requirements.
- **Tournaments for Turf** - The Park Authority initiated a Tournaments for Turf Program, in which tournaments are held for the purpose of generating additional revenue for the Synthetic Turf Field Replacement Fund.
- **County General Fund Appropriations** – The BOS approved use of a dedicated line item totaling \$350,000. When combined with the "\$5.50" fee redirected funds, total annual replacement funding, administered by NCS, is \$500,000. Currently, this funding leverages monies provided by existing community partners continuing to participate in the priority use agreements, for all synthetic turf field replacement requirements.

These efforts are not sufficient to fully fund future replacement needs, for either the existing inventory or for the task force recommended expansion to 82 synthetic turf fields. Including the recommended additional 8 high schools in future development would increase this requirement by a total of **\$2.16 million** annually.

### Fairfax County – Estimated Synthetic Turf Field Replacement Needs

Total Synthetic Turf Field Replacement - By Year and Location		FCPS Stadium	FCPS Non-Stadium & Park Authority	Total Current Field Inventory	Revised Total Including Recommended 8 New HS Sites
		16	51	67	82
Total replacement	Estimated \$450k each	\$7,200,000	\$22,950,000	\$30,150,000	\$36,900,000
Replacement fund (10 yr. est.)	School athletic booster funds \$15k per HS site per year = <b>\$240k annually</b>  FXCO = <b>\$500k annually</b> (\$350k GF /\$150k app. fees)	\$2,400,000	\$5,000,000	\$7,400,000	\$8,600,000
Cumulative Shortage		\$4,800,000	\$17,950,000	\$22,750,000	\$28,300,000
10 yr. average replacement		\$480,000	\$1,795,000	\$2,275,000	\$2,830,000
Community contribution - Percentage of monies contributed to each by community group	Youth and adult community sports organizations – amounts are based upon percentages provided during synthetic turf field developmental phase	(\$223,200)	(\$390,150)	(\$613,350)	(\$669,600)
<b>Annual Shortage</b>		<b>\$256,800</b>	<b>\$1,404,850</b>	<b>\$1,661,650</b>	<b>\$2,160,400</b>

Assumptions:

- ✓ Synthetic turf field life cycle = 10 years
- ✓ Synthetic turf field replacement cost = \$450k
- ✓ Community contributions remain at least at initial percentage level of development commitments

**Recommendation 8: Identify an ongoing funding source to fund the scheduled replacement of synthetic turf fields on Park Authority and FCPS sites.**

### Options to Fund Synthetic Turf Field Replacement Shortfall:

Option	Additional Annual Funding Generated
Annual replacement shortage	\$2,160,400
Redirect additional Synthetic Turf Field Development Program monies into the Synthetic Turf Field Replacement Fund.	\$150,000
Increase Athletic User fee charged to rectangular field users from \$5.50 to \$8 (per sport, per season).	\$250,000
Increase booster club responsibility from \$15,000 annually to \$20,000 annually	\$120,000
Tournament Field Rental User Fee - Increase field rental user fee from \$15 to \$50 for county teams and \$100 for non-county teams for post regular season rectangular field sports program tournaments. (Assumes approximately 625 teams from out of county, generating an additional \$53,000 annually and 1875 in-county teams generating an additional \$65,000 annually)	\$118,000
<b>Subtotal—community funding in support of Synthetic Turf Field Replacement</b>	<b>\$638,000</b>
Remaining annual additional funding requirement	\$1.53 million

**Recommendation 9: Continue administration of the synthetic turf field replacement fund by NCS in support of future synthetic turf field replacement projects at FCPS and FCPA sites. Utilize project funding as directed by staff membership of the oversight committee proposed for establishment in Recommendation 6.**

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## Maintenance of Synthetic Turf Fields

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The task force reviewed current maintenance activities for FCPS and Park Authority natural grass and synthetic turf fields. The purpose was to determine who paid for the maintenance, analysis of the financial impact of increasing the inventory of synthetic turf fields and the implications for the community in the contributions made through boosters, community sports organizations, and other volunteers in the labor contributed to the upkeep of synthetic turf fields, as well as the financial capacity of various community sports organizations in support of the cost of maintaining synthetic turf fields. The Park Authority maintenance of the synthetic turf fields is centralized and



managed with Park Authority staff. Fairfax County Public Schools' maintenance is decentralized and conducted by a combination of high school staff and contractors. The two approaches to managing the maintenance should be further reviewed to see if efficiencies can be achieved.

What are the current practices for synthetic turf maintenance?

**FINDING 21: Park Authority staff currently maintains synthetic turf fields at county parks and fields located on elementary and middle schools, as well as other non-high school FCPS sites. With the conversion of natural grass fields to synthetic turf, the Park Authority has found that the total annual operating cost of a synthetic turf field, including maintenance and utility costs, is comparable to a lighted and irrigated natural grass field because of the nature of year-round use.**

- Natural grass field operating costs include a basic turf grass program with seeding, aerating, fertilizer and pesticides applications, soil testing and amendments.
- Synthetic turf fields operating costs include regular grooming, debris removal, minor carpet repairs and adding rubber infill to high use areas, and unique reconditioning requirements that include brushing, de-compaction, deep cleaning, repair of inlaid field lines and adding crumb rubber to low or high use areas. The synthetic turf fields are also annually G-max tested by a certified engineer to help ensure their safety.

Maintenance activities for both field types include trash collection, inspections, field lining, maintenance and repairs of lighting, bleachers, benches, goals and signage. The costs associated with these tasks are year-round or 12 months a year for synthetic turf fields and only 8 months a year for a natural grass fields. Natural grass fields have additional mowing costs.

Utility expenses are also similar for both field types. Natural grass fields require lighting and water for the 8-month playing season. While the synthetic turf fields don't require watering, savings from reduced water usage are redirected to cover the increased electricity requirements for athletic field lighting resulting from the increased use capacity to 12 months.

Park Authority synthetic turf fields are maintained to all manufacturers recommendations and recognized industry standards. The natural grass fields are maintained to a budget. The maintenance standards for the natural grass fields have been adjusted as the available funding remained constant. The adjustments were necessary as staff and utility costs increased and additional lighting and irrigations systems were added without associated increases in operating budgets.

**FINDING 22: Due to the decentralized nature of the maintenance activities at each FCPS school sites, any achieved savings from natural grass maintenance to synthetic turf maintenance should be redirected to specific site operations, to include the maintenance and replacement of the synthetic turf fields.**

Natural grass fields at high schools are maintained at various levels, depending on the use. Rectangular, stadium game fields and 90' and 60' game diamonds are maintained at a higher level than grass fields used primarily for practices. The number of fields, both game and practice, varies by campus. Additionally, athletic fields with Bermuda grass surfaces require a significantly higher level of care than cool season grasses.

The annual cost to maintain a natural grass, stadium rectangular field is between \$20,000 to \$40,000 per school. The variance is influenced by type of grass, size and configuration of the field, volume of usage, frequency of maintenance, impact of weather, cost of labor, and the use of field lights. The expenses associated with school athletic field maintenance are not covered by the operating budget. Athletic field maintenance, to include supplies, labor and materials, is paid for by athletic event gate receipts, booster donations, fundraising, and donated labor. The equipment used to maintain grass fields can include tractors, mowers, sweepers, groomers, aerators, seeders, and/or trimmers. While individual schools do have some field maintenance equipment, the inventory is often supplemented by equipment purchased by the community funding sources. There are some schools that are able to contract for athletic field maintenance; these services are paid for by the same community contributions.

**Recommendation 10: Park Authority and FCPS should adopt a consistent maintenance program for synthetic turf fields utilizing agreed upon best practices in order to maximize use of equipment, staffing and other resources.**

**Recommendation 11: Create a joint FCPS and Park Authority field maintenance work group, tasked with meeting to address ongoing maintenance needs to include recurring operating budget requirements.**

### Appendix I. Task Force Members

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#### **Fairfax County Board of Supervisors**

Michael Frey, Supervisor, Sully District  
Michael Coyle, Administrative Aide, Sully District

#### **Fairfax County Public Schools**

Megan McLaughlin, Braddock District Representative, School Board  
Lee Ann Pender, Director, Administrative Services  
Bill Curran, Director, Student Activities and Athletics  
Bob Cordova, Property Management Coordinator

#### **Fairfax County Athletic Council**

Harold Leff, Chairman  
Mark Meana, Vice Chairman

#### **Fairfax County Park Authority**

William G. Bouie, Chairman  
Ken Quincy, Providence District Representative  
Todd Johnson, Director, Park Operations Division  
Deborah Garriss, Manager, Synthetic Turf Branch

#### **Neighborhood and Community Services**

Chris Leonard, Director  
Karen Avvisato, Manager, Athletic Services & Community Use Scheduling  
Paul Jansen, Branch Manager, Athletic Services & Community Use Scheduling

#### **Project Team**

Brenda Gardiner, Policy and Information Manager, Department of Administration for Human Services  
Steve Groff, Analyst, Athletic Services & Community Use Scheduling  
Jason Shelton, Administrative Assistant, Athletic Services & Community Use Scheduling

Appendix II. Board Actions/Resolutions



County of Fairfax, Virginia

**MEMORANDUM**

**DATE:** JUN 22 2012

**TO:** Board of Supervisors

**FROM:** Edward F. Long Jr.  
County Executive

**SUBJECT:** County/Schools Joint Task on Synthetic Turf Athletic Fields

The Fairfax County School Board passed a resolution at its December 15, 2011, meeting recommending the creation of a County/Schools Joint Task Force on Synthetic Turf Athletic Fields. In February 2012, Fairfax County School Board Chairman Jane K. Strauss sent a letter to Board of Supervisors Chairman Sharon Bulova and Fairfax County Park Authority Board Chairman William G. Bouie requesting support for this effort. At the April 10, 2012, Board of Supervisors (BOS) meeting, Board members affirmed their collective interest in working with the School Board and Park Board in this effort and referred the issue to staff to determine task force participation.

In the past few years, and in response to increased demand for athletic playing fields, Fairfax County, Fairfax County Public Schools, and the Fairfax County Park Authority have identified funds and partnered with local community groups and each other to develop more than 30 synthetic playing surfaces. The need for more fields continues to grow, and converting natural grass fields to synthetic surfaces provides the best solution to the county's need for more playing time on outdoor surfaces.

Staff from the Department of Neighborhood and Community Services (NCS) has met with staff from the Fairfax County Park Authority (FCPA) and the Fairfax County Public Schools (FCPS) to discuss this initiative. Subsequent to those discussions, it is the recommendation of all entities that the effort to convene and direct the task force be led by NCS staff as the community use scheduler of both park and school fields.

Under the direction of NCS, the joint task force will be responsible for developing recommendations to the BOS and the School Board on:

- the development of new synthetic fields, to include location recommendations
- the funding of new synthetic fields, to include private and corporate partnership opportunities
- the regular, on-going maintenance of existing synthetic fields
- the eventual replacement of developed synthetic fields

Throughout each of these recommendations, guidelines and processes will be reviewed with a focus on ensuring fair and equitable access for all geographic areas of the county.

## Synthetic Turf Task Force

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### Board of Supervisors

### County/Schools Joint Task on Synthetic Turf Athletic Fields

Page 2

The task force will be comprised of community leaders and staff that have a direct connection to the current and future synthetic turf field efforts, including:

- Fairfax County Public Schools  
Megan McLaughlin, Braddock District School Board Representative  
Lee Ann Pender, Director, Administrative Services  
Bill Curran, Director, Student Activities and Athletics
- Fairfax County Athletic Council  
Harold Leff, Chairman  
Mark Meana, Vice Chairman
- Fairfax County Park Authority  
William G. Bouie, Chairman, Park Board  
Ken Quincy, Providence District Park Board Representative  
John Dargle, Director, FCPA  
Todd Johnson, Director, Park Operations Division, FCPA  
Deborah Garriss, Synthetic Turf Fields Branch, FCPA
- Neighborhood and Community Services  
Chris Leonard, NCS Director  
Karen Avvisato, Athletic Services Program Manager, NCS  
Paul Jansen, Athletic Services Program, NCS

It is anticipated that official reporting of the task force's findings will be presented at a future joint School Board/Board of Supervisors meeting.

For further information, please contact Chris Leonard, NCS Director, at 703-324-5501.

- c:
- Jane K. Strauss, Chairman, Fairfax County School Board
  - Jack D. Dale, Superintendent, Fairfax County Public Schools
  - William G. Bouie, Chairman, Fairfax County Park Authority
  - Harold Leff, Chairman, Fairfax County Athletic Council
  - Patricia D. Harrison, Deputy County Executive
  - Robert A. Stalzer, Deputy County Executive
  - Christopher A. Leonard, Director, Neighborhood and Community Services
  - John W. Dargle, Director, Park Authority



## THE FAIRFAX COUNTY SCHOOL BOARD

8115 GATEHOUSE ROAD, SUITE 5400, FALLS CHURCH, VA 22042

February 9, 2012

Fairfax County  
Public Schools

571.423.1075  
www.fcps.edu

Jane K. Strauss  
Chairman  
Dranesville District

Bryong Moon  
Vice Chairman  
Member At Large

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Theodore J. Volkoff  
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Jack D. Dale  
Superintendent

Student Representative  
Eugene J. Coleman, III

The Honorable Sharon Bulova  
Chairman

Fairfax County Board of Supervisors  
12000 Government Center Parkway, Suite 530  
Fairfax, VA 22035

Mr. William G. Bouie  
Chairman  
Fairfax County Park Authority Board  
Hemity Building - Suite 927  
12055 Government Center Parkway  
Fairfax, VA 22035

Dear Chairman Bulova and Chairman Bouie:

On December 15, 2011, the School Board approved a resolution recommending that the Board of Supervisors and the Park Authority Board create a joint task force to make recommendations on the development of turf fields in the future. All Fairfax County citizens would benefit from a multi-agency approach to the development and maintenance of turf fields across the county.

This joint task force would examine the need for additional rectangular and diamond turf fields, the requirements for ongoing field maintenance, and funding requirements for future field replacement. This joint effort between the Board of Supervisors, the Park Authority, and the School Board would be comprised of representatives from the Fairfax County Neighborhood Community Services, the Park Authority, Fairfax County Public Schools, and the Fairfax County Athletic Council. The joint task force would report on their recommendations by September 2012, to the Board of Supervisors, the School Board, and the Park Authority.

I hope the Board of Supervisors and the Park Authority will welcome this initiative to work collaboratively so that athletes and citizens across Fairfax County can equally enjoy the many benefits of turf fields.

Sincerely,

A handwritten signature in cursive script, appearing to read "Jane K. Strauss".

Jane K. Strauss  
Chairman  
Dranesville District

JKS/kfp

Attachment

cc: School Board Members  
Jack D. Dale



### Agenda Item Details

Meeting	Dec 15, 2011 - Regular Meeting No. 10
Category	2. Meeting Opening - 7 p.m.
Subject	2.10 Resolution Recommending Joint Task Force on Turf Fields
Type	Action

### **RESOLUTION RECOMMENDING JOINT TASK FORCE ON TURF FIELDS**

**WHEREAS**, Fairfax County citizens benefit from the installation of artificial turf fields at County parks and schools through increased available playing time; and

**WHEREAS**, progress has been made in installing such fields at over 30 locations in Fairfax County to include both Park Authority and Fairfax County Public Schools fields; and

**WHEREAS**, it is important to ensure that all geographic areas of the County enjoy equal access to such fields by installing additional fields in the future, to include all Fairfax County public high schools; and

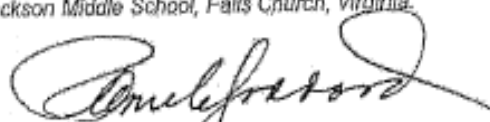
**WHEREAS**, it is important that both existing and future fields are maintained appropriately to ensure their continuing quality and maximum useful life for citizens and county high school students; and

**WHEREAS**, it is important that funds be identified to install new turf fields and replace all fields when the useful life is exhausted; and

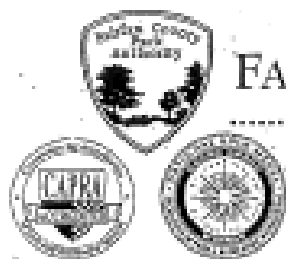
**NOW, THEREFORE, BE IT RESOLVED** that the School Board recommends to the Board of Supervisors and the Park Authority Board the creation of a joint task force to examine and report by September 2012 to the Fairfax County School Board, the Fairfax County Park Authority Board, and the Fairfax County Board of Supervisors on the need for additional rectangular and diamond turf fields, the requirements for ongoing field maintenance, and funding requirements for future field replacement; and

**FURTHERMORE BE IT RESOLVED** that the School Board recommends that the joint task force be comprised of representatives from Fairfax County Neighborhood Community Services, Fairfax County Park Authority, Fairfax County Public Schools, and the Fairfax County Athletic Council.

*I hereby certify the above Agenda Item 2.10 was adopted by  
the County School Board of Fairfax County, Virginia, at a  
regular meeting held on December 15, 2011, at Luther  
Jackson Middle School, Falls Church, Virginia.*



Pamela Goddard, Clerk  
County School Board of  
Fairfax County, Virginia



## FAIRFAX COUNTY PARK AUTHORITY

12855 Government Center Parkway, Suite 927 • Fairfax, VA 22035-1118  
703-324-8700 • Fax: 703-324-3974 • [www.fairfaxcounty.gov/parks](http://www.fairfaxcounty.gov/parks)

February 22, 2012

RECEIVED

FEB 22 2012

#243  
DIRECTOR OF NEIGHBORHOOD  
AND COMMUNITY SERVICES

Ms. Jane K. Strauss, Chairman  
Fairfax County School Board  
8115 Gatehouse Road, Suite 5400  
Falls Church, VA 22042

Dear Chairman Strauss:

I am very pleased to learn of the School Board's recent recommendation for the creation of a joint task force by the Fairfax County Board of Supervisors and the Fairfax County Park Authority Board in order to make recommendations on the development of synthetic turf fields in Fairfax County. The Park Authority Board recognizes the wisdom and benefits of collaboration at all levels and has supported vital partnerships since the field turf program's inception nearly a decade ago.

We applaud this opportunity to further explore the appropriate placement of new synthetic turf fields, the challenges of funding both new and replacement turf fields and our ongoing maintenance needs for rectangular and diamond turf fields. The need for synthetic turf fields continues to grow as both youth and adult leagues, and school sports draw ever increasing participation. I believe that the Department of Neighborhood and Community Services would be another important participant in this venture. Working together, ensuring that all stakeholders have a say, I am certain we can equitably meet the needs of the community.

The Park Authority Board stands ready to begin this process and will endeavor to meet the relatively short timeframe for the drafting of recommendations. I will discuss the specifics of the initiative with Board of Supervisors Chairman Sharon Bulova to seek her consensus how best to move forward with this proposal.

Sincerely,

William G. Bouie  
Chairman

Copy: Sharon Bulova, Chairman, Board of Supervisors  
Anthony H. Griffin, County Executive  
Chris Leonard, Director, Department of Neighborhood and Community Services



### Appendix III. FCPS High School Free and Reduced Lunch Percentage

October 2012			School Type	Low Grade	High Grade	SNP Membership	FREE Eligible	FREE Percentage	REDUCED Eligible	REDUCED Percentage	TOTAL F/R Eligible	TOTAL F/R Percentage
Division #	School #											
029	1070	STUART HIGH	SCH-HIGH	9	12	1,749	811	46.37%	155	8.86%	966	55.23%
029	0420	MOUNT VERNON HIGH	SCH-HIGH	9	12	1,885	799	42.39%	221	11.72%	1,020	54.11%
029	1100	FALLS CHURCH HIGH	SCH-HIGH	9	12	1,673	687	41.06%	170	10.16%	857	51.23%
029	1020	LEE HIGH	SCH-HIGH	9	12	1,813	674	37.18%	171	9.43%	845	46.61%
029	0660	ANNANDALE HIGH	SCH-HIGH	9	12	2,414	819	33.93%	261	10.81%	1,080	44.74%
029	0900	WEST POTOMAC HIGH	SCH-HIGH	9	12	2,255	709	31.44%	151	6.70%	860	38.14%
029	1270	EDISON HIGH	SCH-HIGH	9	12	1,695	458	27.02%	123	7.26%	581	34.28%
029	0032	HERNDON HIGH	SCH-HIGH	9	12	2,168	508	23.43%	128	5.90%	636	29.34%
029	1800	HAYFIELD SECONDARY	SCH-COM	7	12	2,831	555	19.60%	221	7.81%	776	27.41%
029	1990	SOUTH LAKES HIGH	SCH-HIGH	9	12	2,321	484	20.85%	116	5.00%	600	25.85%
029	0020	FAIRFAX HIGH	SCH-HIGH	9	12	2,650	471	17.77%	184	6.94%	655	24.72%
029	0200	CENTREVILLE HIGH	SCH-HIGH	9	12	2,385	342	14.34%	162	6.79%	504	21.13%
029	2228	WESTFIELD HIGH	SCH-HIGH	9	12	2,785	430	15.44%	129	4.63%	559	20.07%
029	1290	MARSHALL HIGH	SCH-HIGH	9	12	1,654	209	12.64%	62	3.75%	271	16.38%
029	2241	SOUTH COUNTY HIGH	SCH-HIGH	9	12	2,008	227	11.30%	93	4.63%	320	15.94%
029	0131	CHANTILLY HIGH	SCH-HIGH	9	12	2,634	359	13.63%	51	1.94%	410	15.57%
029	0090	LAKE BRADDOCK SECONDARY	SCH-COM	7	12	4,000	408	10.20%	181	4.52%	589	14.72%
029	1610	WEST SPRINGFIELD HIGH	SCH-HIGH	9	12	2,279	193	8.47%	80	3.51%	273	11.98%
029	1960	ROBINSON SECONDARY	SCH-COM	7	12	3,882	286	7.37%	135	3.48%	421	10.84%
029	1710	OAKTON HIGH	SCH-HIGH	9	12	2,162	176	8.14%	43	1.99%	219	10.13%
029	1260	WOODSON HIGH	SCH-HIGH	9	12	2,224	144	6.47%	57	2.56%	201	9.04%
029	0790	MCLEAN HIGH	SCH-HIGH	9	12	2,081	121	5.81%	58	2.79%	179	8.60%
029	1060	MADISON HIGH	SCH-HIGH	9	12	1,986	114	5.74%	42	2.11%	156	7.85%
029	1371	THOMAS JEFFERSON HIGH	SCH-HIGH	9	12	1,842	24	1.30%	17	0.92%	41	2.23%
029	1460	LANGLEY HIGH	SCH-HIGH	9	12	1,949	31	1.59%	3	0.15%	34	1.74%

\*Source: VA Department of Education (2012 Data) <http://www.doe.virginia.gov/support/nutrition/statistics/index.shtml>

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## Appendix IV. Synthetic Turf Fact Sheet

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### Fact Sheet on Synthetic Turf Used in Athletic Fields

Synthetic turf fields using crumb rubber have been installed and used in many athletic and playing fields throughout Fairfax County, the United States and the world. Currently Fairfax County Public Schools and Parks have 48 rectangular athletic fields composed of synthetic turf material. Questions have been raised about potential health, safety, and environmental effects from the use of synthetic turf. This fact sheet was prepared in consultation with the Fairfax County Health Department, Fairfax County Risk Management Division, Fairfax County Public Schools and Fairfax County Park Authority to provide information on research conducted by numerous state and national organizations who have studied these issues.

**Q: Why is synthetic turf used in Fairfax County?**

A: Starting in the early 2000's the Park Authority along with other organizations in the County that provide athletic facilities began looking at alternatives to natural turf fields to meet the growing demand for use of athletic fields throughout the County.

Synthetic turf is a man-made product and is mostly installed in fields that are heavily used. Synthetic turf fields are used in Fairfax County because they:

- Provide even playing surfaces
- Provide similar playing conditions to natural turf fields
- Need no watering or mowing
- Use no fertilizers or pesticides
- Can be used year-round and in most weather
- Do not need to be closed to protect or re-sod grass
- Have a significant life cycle with reduced maintenance

**Q: What are synthetic turf fields made of?**

A: Synthetic turf fields installed in Fairfax County have been constructed using a synthetic carpet material that mimics natural grass along with a crumb rubber infill or sand/crumb rubber infill mixture and subsurface drainage systems. Synthetic turf fields are made of the following materials:

- A subsurface drainage layer composed of crushed stones with plastic tubing for drainage.
- A top layer composed of plastic mesh with soft, plastic strands that resemble blades of grass.

- Crumb rubber infill, made from recycled tires, is added to the top layer to provide padding and keep the grass upright. Sand is sometimes mixed with the crumb rubber.

**Q: What chemicals can be found in the synthetic turf crumb rubber?**

A: The crumb rubber used in synthetic turf is mainly composed of recycled tires, which contain man-made and natural rubber. Based on the review of research studies and reports, certain chemicals have been identified in crumb rubber. These include small amounts of polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs) and heavy metals such as zinc, iron, manganese and lead.

**Q: Can people be exposed to the chemicals found in crumb rubber?**

A: To date, studies on the release of chemicals from crumb rubber have reported very low concentration of chemical exposure. Although the potential for health effects due to exposure to chemicals in crumb rubber is very low, there are three possible ways for people to have contact with these chemicals on artificial turf fields:

- Accidentally ingesting small amounts of crumb rubber by putting fingers in the mouth or not washing hands before eating after playing on the fields
- Breathing in dust and vapors while playing on the fields. Crumb rubber may become dust as it wears and the rubber may give off some vapors.
- Direct skin contact with the crumb rubber.

**Q: Are any health effects associated with these chemicals found in synthetic turf crumb rubber?**

A: The health and safety aspects of synthetic turf have been reviewed and addressed by many national and state organizations, including the U.S. Environmental Protection Agency, the Centers for Disease Control and Prevention, and numerous state agencies in California, Connecticut, New Jersey, and New York. They generally conclude that health effects are unlikely from exposure to the levels of chemicals found in synthetic turf and that these fields do not pose a serious public health concern. Specifically, a review of the available information on crumb rubber by the New York Department of Health indicates that ingestion, dermal, or inhalation exposures to chemicals in or released from crumb rubber do not pose a significant public health concern. A multi-agency report from the State of Connecticut concluded that the use of outdoor and indoor artificial turf fields is not associated with elevated health risk. Studies and reviews conducted by the California Office of Environmental Health Hazard Assessment found that synthetic turf fields do not represent a serious human health risk with regard to the inhalation of chemicals or particulates above these fields. These studies indicate that at much higher levels, these chemicals can cause serious health effects. Some PAHs may

pose a cancer risk for people exposed to high levels for long periods. VOCs can cause eye, nose, throat, and skin irritation. In young children, exposure to lead may cause learning and behavioral problems and lowered intelligence.

**Q: Can people be exposed to these chemicals from other sources?**

**A:** The PAHs and VOCs found in crumb rubber are very common in the urban environment. People can be exposed by breathing or eating or by getting dirt or dust on their skin. Rubber dust from car tires is a source of urban air pollution and soil pollution. PAHs are present in exhaust, smoke, soot, urban soil and char-broiled foods. VOCs are released into the air from gasoline, paint, building materials and many other sources. Lead is commonly found in soil and dust in the urban environment because, in the past, it was used in paint, gasoline and many other products.

**Q: Does the heat generated by synthetic turf pose a health risk to users?**

**A:** Like asphalt, the crumb rubber in synthetic turf fields absorbs heat from the sun and gets hotter than dirt or natural grass. On hot days, some synthetic turf fields may be too hot to play on. To protect yourself from the heat, health officials have recommended that you take the following precautions: drink lots of water, wear light and loose fitting clothes, always wear shoes, take breaks often, and exercise moderately. If you experience symptoms of heat related illness, such as dizziness, weakness, headache, nausea, vomiting or muscle cramps, move to a shaded area, drink water and rest. Seek medical attention if you do not feel better. It is especially important that adults supervising children take precautions on hot days.

**Q: Are people who play on synthetic turf fields at risk of bacterial skin infections?**

**A:** Bacterial skin infections, such as methicillin-resistant *S. aureus* (MRSA), have not been shown to be caused by synthetic turf fields. A multi-agency report to the California state legislature stated that the number of skin abrasions suffered on synthetic turf fields was greater than on natural turf fields, but the severity of the abrasions did not differ. The report found synthetic turf fields to harbor fewer bacterial species and a smaller number of live bacteria than natural turf fields.

MRSA has not been proven to be caused by synthetic turf field contact. Bacterial skin infections among athletes are due mainly to physical contact and sharing contaminated towels or sports equipment. Coaches and players should be aware of the potential for MRSA transmission and infection among athletes. All skin cuts or abrasions should be washed with soap and water and covered immediately. School athletic departments and sports leagues, should use good hygienic practices and prohibit the sharing of towels and equipment that rubs against bare skin.



**Q: Should people continue to use synthetic turf fields with crumb rubber?**

**A:** Regular physical activity is one of the most important parts of a healthy lifestyle. Synthetic turf fields allow access to open spaces for sports and physical activities. After any outdoor activity health organizations recommend that people should wash their hands before eating or drinking. On very hot days, users should limit activities, take rest breaks and drink water.

**Q: What preventive measures can be taken to further reduce potential health and safety concerns of synthetic turf fields?**

**A:** Hand-washing after using the field, especially before eating; discouraging eating while on the field; and monitoring for potential heat-related illness are recommended measures for minimizing potential risks associated with synthetic turf fields.

**Q: Where can I get more information?**

**A:** The following links provide additional information and details on the health assessment of synthetic turf fields:

- New York City Department of Health Artificial (Synthetic) Turf Fact Sheet: <http://www.nyc.gov/html/doh/html/eode/eode-turf.shtml>
- New York City Department of Health Air Quality Survey Of Synthetic Turf Fields: [http://www.nyc.gov/html/doh/downloads/pdf/eode/turf\\_aqs\\_report0409.pdf](http://www.nyc.gov/html/doh/downloads/pdf/eode/turf_aqs_report0409.pdf)
- New York City Department of Health Review of the Potential Health and Safety Risks From Synthetic Turf Fields: [www.nyc.gov/html/doh/downloads/pdf/eode/turf\\_report\\_05-08.pdf](http://www.nyc.gov/html/doh/downloads/pdf/eode/turf_report_05-08.pdf)
- Connecticut Department of Public Health Human Health Risk Assessment of Artificial Turf Fields: [www.ct.gov/dep/lib/dep/artificialturf/dph\\_artificial\\_turf\\_report.pdf](http://www.ct.gov/dep/lib/dep/artificialturf/dph_artificial_turf_report.pdf)
- New York State Health Department Crumb-Rubber Infilled Synthetic Turf Athletic Fields Fact Sheet: [http://www.health.ny.gov/environmental/outdoors/synthetic\\_turf/crumb-rubber\\_infilled/fact\\_sheet.htm](http://www.health.ny.gov/environmental/outdoors/synthetic_turf/crumb-rubber_infilled/fact_sheet.htm)
- Connecticut Academy of Science and Engineering Committee Report: Peer Review of an Evaluation of the Health and Environmental Impacts Associated with Synthetic Turf Playing Fields: [www.ct.gov/dep/lib/dep/artificialturf/case\\_artificial\\_turf\\_review\\_report.pdf](http://www.ct.gov/dep/lib/dep/artificialturf/case_artificial_turf_review_report.pdf)
- California Department of Resources Recycling and Recovery Report to the Legislature on Health Impacts of Outdoor Artificial and Natural Turf Fields: <http://www.calrecycle.ca.gov/publications/documents/tires/2011007.pdf>

## Appendix V. FCPA Synthetic Turf Operation/Maintenance Cost

Lighted Rectangle Field Annual Operational Costs - FY2013 Level 1 Natural Grass Field							WORKING DRAFT As of 6/18/2013		
Task Description	Frequency		Per Recurrence	Labor Hours	Hourly Shop Rate (Direct/Indirect Cost)	Labor Cost	Material Cost	Contracted Services	Total Task Cost Per Field
<b>MAINTENANCE</b>									
	3 Times Per Week (April - November) 1 Time Per Week (December - March)								
Remove Ground Trash and Empty Receptacles	116	0.2	23.20	\$52	\$1,206	\$73			\$1,279
Off Season Maintenance	Annually	1	13	13.00	\$52	\$676	\$279		\$955
Mowing	2 Times per Week ( April - November)	64	0.8	51.20	\$52	\$2,662			\$2,662
Amenity Inspections, Maintenance and Repair (Benches, Bleachers, Goals, Signage)	As Needed			8.60	\$52	\$447	\$138		\$585
Field Lining	2 Times Per Year	2	2.5	5.00	\$52	\$260	\$82		\$342
Irrigation Maintenance and Repairs	2 Times Per Year	2	8	16.00	\$52	\$832	\$580	\$350	\$1,762
Lighting Inspections	Weekly	32	0.2	6.40	\$52	\$333			\$333
Lighting Maintenance and Repairs	2 Times Per Year	2	2.2	4.40	\$52	\$229		\$800	\$1,029
<b>Maintenance Total</b>									<b>\$8,947</b>
<b>Turf Program</b>									
Fertilizer Applications	4 Times Per Year	4	1.2	4.80	\$52	\$250	\$1,000		\$1,250
Aeration	2 Times Per Year	2	2.7	5.40	\$52	\$281			\$281
Pesticide Application	2 Times Per Year	2	3	6.00	\$52	\$312	\$400		\$712
Over Seeding	Annually	1	3.5	3.50	\$52	\$182	\$400		\$582
Soil Amendments	Every 3 Years	0.33	3.6	1.19	\$52	\$62	\$102		\$164
Soil Sampling	Every 3 Years	0.33	1	0.33	\$52	\$17	\$10		\$27
Field Inspections	Annually	1	1.2	1.20	\$52	\$62			\$62
<b>Turf Program Total</b>									<b>\$3,078</b>
<b>UTILITIES</b>									
Electricity	Annually								\$3,429
Water	Annually								\$2,102
<b>Utilities Total</b>									<b>\$5,531</b>
<b>Natural Grass Per Field Total</b>				<b>127.0</b>		<b>\$6,605</b>	<b>\$3,064</b>	<b>\$800</b>	<b>\$17,556</b>
(FCPA currently manages 15 lighted natural grass rectangle fields, which include 4 rectangle overlay fields.)									

\*Labor, Material, and Contracted Services costs are supported with monies from General Fund and County Construction Fund-Athletic Field Maintenance



## Appendix VI. Synthetic Turf Financing Chart

Fairfax County Synthetic Turf Field Project Financing													
	Site Name	District	Number of Fields	Lights	BOS <sup>1</sup> (one-time appropriation)	FCPS (one-time funds)	Donations, Grants, Other	FCPA Bond	NCS <sup>2</sup>	Proffers	School Boosters <sup>3</sup> (cash/loans)	Community Sports Organizations (cash/loans)	All Sources
Fairfax County Park Authority and Fairfax County Elementary Schools, Middle School and Alternative High Schools	Arrowbrook Park	Dranesville	1	Y						\$750,000			\$750,000
	Baileys ES	Mason	1	N				\$721,221					\$721,221
	Braddock Park	Springfield	1	Y					\$849,000				\$849,000
	Bryant Alternative HS	Mount Vernon	1	Y				\$812,310					\$812,310
	EC Lawrence Park	Sully	1	Y				\$650,000					\$650,000
	Franconia Dist. Park	Lee	1	Y				\$841,000					\$841,000
	Great Falls Nike Park	Dranesville	1	Y				\$250,000	\$150,000			\$425,000	\$825,000
	Greenbriar Park	Springfield	1	Y				\$898,000					\$898,000
	Hutchison ES	Dranesville	1	Y				\$900,000					\$900,000
	Jackson MS	Providence	1	Y				\$257,550	\$549,779	\$682,500			\$1,489,829
	Lake Fairfax Park	Hunter Mill	2	Y				\$1,596,000					\$1,596,000
	Lee District Park	Lee	1	Y				\$908,000					\$908,000
	Lewinsville Park	Dranesville	1	Y				\$267,365				\$500,000	\$767,365
	Linway Terrace Park	Dranesville	1	N					\$150,000			\$687,766	\$837,766
	Mason District Park	Mason	1	Y	\$166,533				\$324,467			\$250,000	\$741,000
	Nottoway Park	Providence	1	Y				\$200,000			\$340,892		\$540,892
	Oak Marr Park	Providence	2	Y				\$1,709,000					\$1,709,000
	Ossian Hall Park	Mason	1	N				\$600,000					\$600,000
	Patriot Park	Springfield	1	Y				\$1,100,000					\$1,100,000
	Pine Ridge Park	Mason	1	Y				\$685,000					\$685,000
	Poplar Tree Park	Sully	2	Y				\$1,520,000					\$1,520,000
	Sandburg MS	Mount Vernon	1	Y	\$2,433			\$820,718					\$823,151
	South Run Park	Springfield	2	Y				\$1,348,000					\$1,348,000
	Spring Hill Park	Dranesville	1	N					\$150,000			\$761,198	\$911,198
	Spring Hill Park	Dranesville	2	N								\$1,783,000	\$1,783,000
	Wakefield Park	Braddock	1	Y	\$166,533				\$243,467			\$400,000	\$810,000
	Vienna ES	Hunter Mill	1	Y	\$166,533		\$100,000		\$258,467			\$425,000	\$950,000
	In-Service Fields-Subtotal:		32		\$502,032	\$0	\$100,000	\$16,084,164	\$2,675,180	\$1,773,392	\$0	\$5,231,964	\$26,366,732
Pending Non-High School Projects	Arrowhead Park	Sully	2	Y				\$1,647,500					\$1,647,500
	EC Lawrence Park	Sully	1	Y				\$825,000					\$825,000
	Lewinsville Park	Dranesville	1	Y				\$150,000	\$175,000			\$485,000	\$810,000
	Grist Mill Park	Mount Vernon	1	N			\$200,000	\$950,000	\$175,000				\$1,325,000
	Timber Ridge @ EDS	Sully	2	Y						\$1,500,000			\$1,500,000
	Pine Ridge Park	Mason	1	Y				\$810,000					\$810,000
	Rolling Valley West Park	Springfield	1	Y				\$810,000					\$810,000
	Pending Fields-Subtotal:		9		\$0	\$0	\$200,000	\$5,192,500	\$350,000	\$1,500,000	\$0	\$485,000	\$7,727,500

Appendix VII. Natural Grass v. Synthetic Turf on FCPS Sites

Turf Fields: Grass vs. Synthetic Turf Usage

Legend

FCPS-Instructional Use

Fx Cnty-Community Use

FCPS-Practice Use

Stadium Field - Grass Field Model									Total Hrs/Wk	Total Hrs/Year*
Hrs/Day	Time	Mon	Tue	Wed	Thr	Fri	Sat	Sun		
1	08a									
	09a									
2	10a									
3	11a									
4	12p									
5	01p									
6	02p									
7	03p									
8	04p									
9	05p									
	05:30p									
10	06p									
11	07p	FCPS - Practice Use								
12	08p									
13	09p									
14	10p									
15	11p									
Total Capacity:		15.0	15.0	15.0	15.0	15.0	15.0	15.0	105.0	2,520.0

FCPS Usage:	3.0	3.0	3.0	3.0	3.0	0.0	0.0	15.0	360.0	100.0%
Cmnty Usage:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Total Usage:	3.0	3.0	3.0	3.0	3.0	0.0	0.0	15.0	360.0	14.3%
* Total hours per year is based on a Fall and Spring season of 12 weeks each (24 weeks total) multiplied by the total hours per week.										% Field Capacity Usage

Stadium Field - Synthetic Model									Total Hrs/Wk	Total Hrs/Year*
Hrs/Day	Time	Mon	Tue	Wed	Thr	Fri	Sat	Sun		
1	08a	FCPS-Instructional Use								
	09a									
2	10a									
3	11a	FCPS-Practice Use								
4	12p									
5	01p									
6	02p	FCPS-Practice Use								
7	03p									
8	04p									
9	05p	FCPS-Practice Use								
	05:30p									
10	06p									
11	07p	FCPS-Practice Use								
12	08p									
13	09p									
14	10p	FCPS-Practice Use								
15	11p									
Total Capacity:		15.0	15.0	15.0	15.0	15.0	15.0	15.0	105.0	2,520.0

FCPS Usage:	10.0	10.0	13.0	13.0	13.0	5.0	0.0	64.0	1,536.0	66.0%
Cmnty Usage:	4.0	4.0	0.0	0.0	0.0	10.0	15.0	33.0	792.0	34.0%
Total Usage:	14.0	14.0	13.0	13.0	13.0	15.0	15.0	97.0	2,328.0	92.4%
* Total hours per year is based on a Fall and Spring season of 12 weeks each (24 weeks total) multiplied by the total hours per week.										% Field Capacity Usage

Practice Field - Grass Model									Total Hrs/Wk	Total Hrs/Year*
Hrs/Day	Time	Mon	Tue	Wed	Thr	Fri	Sat	Sun		
1	08a	FCPS - 50% Effective Instructional Use								
	09a									
2	10a									
3	11a	FCPS - 50% Effective Instructional Use								
4	12p									
5	01p									
6	02p	FCPS - Practice Use								
7	03p									
8	04p									
9	05p	FCPS - Practice Use								
	05:30p									
10	06p									
11	07p	FCPS - Practice Use								
12	08p									
13	09p									
14	10p	Field Not In Use....No Lights								
15	11p									
Total Capacity:		12.0	12.0	12.0	12.0	12.0	12.0	12.0	84.0	2,016.0

FCPS Usage:	8.5	8.5	8.5	6.5	6.5	3.0	0.0	41.5	996.0	62.4%
Cmnty Usage:	0.0	0.0	0.0	2.0	2.0	9.0	12.0	25.0	600.0	37.6%
Total Usage:	8.5	8.5	8.5	8.5	8.5	12.0	12.0	66.5	1,596.0	79.2%
* Total hours per year is based on a Fall and Spring season of 12 weeks each (24 weeks total) multiplied by the total hours per week.										% Field Capacity Usage

Practice Field - Synthetic Model									Total Hrs/Wk	Total Hrs/Year*
Hrs/Day	Time	Mon	Tue	Wed	Thr	Fri	Sat	Sun		
1	08a	50% FCPs - Effective Instructional Use								
	09a									
2	10a									
3	11a	50% FCPs - Effective Instructional Use								
4	12p									
5	01p									
6	02p	FCPS-Practice Use								
7	03p									
8	04p									
9	05p	FCPS-Practice Use								
	05:30p									
10	06p									
11	07p	FCPS-Practice Use								
12	08p									
13	09p									
14	10p	Community Use								
15	11p									
Total Capacity:		15.0	15.0	15.0	15.0	15.0	15.0	15.0	105.0	2,520.0

FCPS Usage:	6.0	6.0	6.0	6.0	6.0	0.0	0.0	30.0	720.0	34.3%
Cmnty Usage:	5.5	5.5	5.5	5.5	5.5	15.0	15.0	57.5	1,380.0	65.7%
Total Usage:	11.5	11.5	11.5	11.5	11.5	15.0	15.0	87.5	2,100.0	83.3%
* Total hours per year is based on a Fall and Spring season of 12 weeks each (24 weeks total) multiplied by the total hours per week.										% Field Capacity Usage

SUMMARY TABLES

Field Utilization Grass vs. Synthetic Turf	Field Capacity (Hrs/Year)	Field Usage (Hrs/Year)	% Field Capacity Usage
- Stadium Field - Grass	2,520	360	14.3%
- Stadium Field - Synthetic Turf	2,520	2,328	92.4%
- Practice Field - Grass	2,016	1,596	79.2%
- Practice Field - Synthetic Turf	2,520	2,100	83.3%
- Combined - Grass	4,536	1,956	43.1%
- Combined - Synthetic Turf	5,040	4,428	87.9%

FCPS and Community Usage	Field Usage (Hrs/Year)	% Field Usage
Stadium Field - Grass		
- FCPS Usage	360	100.0%
- Community Usage	0	0.0%
Total:	360	100.0%
Stadium Field - Synthetic Turf		
- FCPS Usage	1,536	66.0%
- Community Usage	792	34.0%
Total:	2,328	100.0%
Practice Field - Grass		
- FCPS Usage	996	62.4%
- Community Usage	600	37.6%
Total:	1,596	100.0%
Practice Field - Synthetic Turf		
- FCPS Usage	720	34.3%
- Community Usage	1,380	65.7%
Total:	2,100	100.0%
Two-Field Usage - Grass		
- FCPS Usage	1,356	69.3%
- Community Usage	600	30.7%
Total:	1,956	100.0%
Two-Field Usage - Synthetic Turf		
- FCPS Usage	2,256	50.9%
- Community Usage	2,172	49.1%
Total:	4,428	100.0%

Synthetic Turf Increased Usage Over Grass		
- FCPS Usage	900	36.4%
- Community Usage	1,572	63.6%
Total:	2,472	100.0%



# **Athletic Playing Fields and Artificial Turf: Considerations for Municipalities and Institutions**

Municipalities, universities, schools and other institutions frequently need to make decisions about maintenance and installation of athletic playing fields. This may include choosing between natural grass and synthetic turf. Factors that may be considered include cost of installation and maintenance, number of days the field can be used, likelihood of player injuries, temperature of the playing environment, and athletes' exposure to chemicals.

The Massachusetts Toxics Use Reduction Institute (TURI) at UMass Lowell has worked with municipalities and other institutions to facilitate the adoption of turf management practices that are cost-effective and preferable for human health and the environment. This fact sheet introduces some of the considerations that are relevant to evaluating natural grass and artificial turf alternatives. TURI is also developing an alternatives assessment for sports turf, which will provide a detailed assessment of these factors.

## **Principles of toxics use reduction**

TURI's work is based on the principles of toxics use reduction (TUR). The TUR approach focuses on identifying opportunities to reduce or eliminate the use of toxic chemicals as a means to protect human health and the environment. Projects to reduce the use of toxic chemicals often have additional benefits, such as lower life-cycle costs.

## **Children's environmental health**

People of all ages benefit from a safe and healthy environment for work and play. However, special concerns exist for children. Children are uniquely vulnerable to the effects of toxic chemicals because their organ systems are developing rapidly and their detoxification mechanisms are immature. Children also breathe more air per unit of body weight than adults, and are likely to have more hand-to-mouth exposure to environmental contaminants than adults.<sup>1</sup> For these reasons, it is particularly important to make careful choices about children's exposures.

## **Artificial turf: chemicals in infill**

Artificial turf is composed of several elements, including drainage materials, support and backing materials, synthetic fibers to imitate grass blades, and an infill that takes the place of soil. A number of concerns exist regarding chemicals in the artificial grass blades and infill. Here, we briefly review issues related to chemicals in infill. Toxic chemicals such as lead are also found in the artificial grass blades in some cases.<sup>2</sup>

**Crumb rubber infill made from recycled tires.** Crumb rubber made from recycled tires, also referred to as styrene butadiene rubber (SBR) infill, is currently the most widely used type of infill. This type of infill contains a large number of chemicals that are known to be hazardous to human health and the environment. These include polyaromatic hydrocarbons (PAHs); volatile organic compounds (VOCs); metals, such as lead, mercury, manganese, and zinc; and other chemicals. Some of the chemicals found in crumb rubber are known to cause cancer.<sup>3</sup> Because of the large number of chemicals present in the infill, as well as the health effects of individual chemicals, crumb rubber made from recycled tires is the option that presents the most concerns related to chemical exposures.

**Other synthetic materials.** Other synthetic materials used to make artificial turf infill include EPDM rubber, thermoplastic elastomers (TPE), and Nike Grind (a proprietary rubber product made from recycled athletic shoes). These alternatives are sometimes marketed as safer alternatives. Relatively little information is available on the chemicals present in, or emitted from, these infills. Preliminary information suggests that these materials do contain some hazardous chemicals, but that they generally pose less of a concern than crumb rubber made from recycled tires.<sup>4</sup> There is an urgent need for more information on these alternatives.

**Mineral-based and plant-derived materials.** Other materials used as infill can include sand, cork, and coconut hulls, among other materials. Again, these materials are likely to contain fewer hazardous chemicals than crumb rubber infill made from recycled tires, but the materials have not been well characterized or studied thoroughly.

## Artificial turf and heat stress

In sunny, warm weather, artificial turf can become much hotter than natural grass, raising concerns related to heat stress for athletes playing on the fields.<sup>5</sup> Research indicates that all synthetic turf reaches higher temperatures than natural grass, regardless of the infill materials.<sup>6</sup>

- A report by the New York State Department of Environmental Conservation found that surface temperatures on a synthetic turf field were 35°F to 42°F higher than those on natural grass.<sup>7</sup>
- Another study found that the highest temperature measured on synthetic turf was 60.3°F greater than that observed on natural grass.<sup>8</sup>
- In another study, artificial turf fibers reached temperatures of 156°F under direct sunlight, while the crumb rubber infill reached 101°F.<sup>9</sup>
- Measurements taken by sports managers at Brigham Young University found that the surface temperature of synthetic turf was 37°F higher than asphalt and 86.5°F hotter than natural turf. The hottest surface temperature recorded during the study was 200°F on a 98°F day. Even in October, the surface temperature reached 112.4°F.<sup>10</sup>

Irrigation can lower field temperature for a short time. A study by Penn State's Center for Sports Surface Research found that frequent, heavy irrigation reduces temperatures on synthetic turf, but temperatures rebound quickly under sunny conditions.<sup>11</sup> Another study found that irrigation could lower temperatures by 10 to 20 degrees, for a period of at least 20 minutes.<sup>12</sup> Another found that irrigation lowered the surface temperature from 174°F to 85°F; however, the temperature rebounded to 164°F after 20 minutes.<sup>13</sup>

Heat-related illness can be a life-threatening emergency. Experts note that athletic coaches and other staff need to be educated about heat-related illness and understand how to prevent it, including cancelling sport activities when appropriate.<sup>14</sup>

## Injuries

Injury rates can be affected by a variety of factors, including the type and condition of the playing surface as well as equipment used and type and level of sport. Studies show variable outcomes in the rates and types of injuries experienced by athletes playing on natural and on artificial turf.<sup>15</sup>

One particular concern is increased rates of turf burns (skin abrasions) associated with playing on artificial turf. For example, a study by the California Office of Environmental Health Hazard Assessment found a

two- to three-fold increase in skin abrasions per player hour on artificial turf compared with natural grass turf.<sup>16</sup> These study authors noted that these abrasions are a risk factor for serious bacterial infections, although they did not assess rates of these infections among the players they studied.

## **Environmental concerns**

Environmental concerns include loss of wildlife habitat and contaminated runoff into the environment. A study by the Connecticut Department of Environmental Protection identified concerns related to a number of chemicals in stormwater runoff from artificial turf fields. These include both metals and organic compounds. They noted high zinc concentrations in stormwater as a particular concern for aquatic organisms. They also noted the potential for leaching of high levels of copper, cadmium, barium, manganese and lead in some cases. The top concerns identified in the study were toxicity to aquatic life from zinc and from whole effluent toxicity (WET).<sup>17</sup> WET is a methodology for assessing the aquatic toxicity effects of an effluent stream as a whole.<sup>18</sup>

## **Current federal and state studies**

A number of studies have examined the chemicals present in synthetic turf, with a particular focus on chemicals found in crumb rubber made from recycled tires. However, federal and state officials have identified a need for additional information. At the time of publication of this fact sheet, two key government studies are under way.

The California Office of Environmental Health Hazard Assessment (OEHHA), an office within the California Environmental Protection Agency, is conducting a three-year study of the potential health effects of exposure to synthetic turf as well as playground mats made from recycled waste tires. The project began in June 2015 and will be completed in June 2018. In the study, OEHHA will review the existing literature on chemicals in synthetic turf and playground mats; analyze samples of new and used synthetic turf and playground mats; develop exposure scenarios; and publish a risk assessment based on this information. OEHHA will also develop plans for a possible future study that would examine people's actual exposures through measurement of biological specimens or use of personal monitors.<sup>19</sup>

Three federal agencies have also recently begun a one-year assessment of potential health effects of exposure to synthetic turf. The agencies working on the study are the U.S. Environmental Protection Agency (EPA), the Consumer Product Safety Commission (CPSC), and the Agency for Toxic Substances and Disease Registry (ATSDR) within the Centers for Disease Control. Working with experts at OEHHA and elsewhere, the federal agencies will identify chemicals of concern found in crumb rubber made from recycled waste tires, as used in artificial turf fields and playgrounds; consider exposure scenarios; and identify areas for future study. The agencies will issue a draft status report by the end of 2016.<sup>20</sup> As background on the need for this study, the EPA website notes that, "Limited studies have not shown an elevated health risk from playing on fields with tire crumb, but the existing studies do not comprehensively evaluate the concerns about health risks from exposure to tire crumb."<sup>21</sup>

## **Natural grass**

Natural grass fields can be the safest option for recreational space, by eliminating many of the concerns noted above. Natural grass can also reduce overall carbon footprint by capturing carbon dioxide. Grass fields may be maintained organically or with conventional or integrated pest management (IPM) practices. Organic turf management eliminates the use of toxic insecticides, herbicides and fungicides.

## Organic management of recreational field space

Organic management of a recreational field space requires a site-specific plan to optimize soil health and minimize long-term costs. Over time, a well-maintained organic field is more robust to recreational use due to a stronger root system than that found in a conventionally managed grass field. Water needs also decrease over time. Key elements of organic management include the following steps.<sup>22</sup>

- **Field construction:** Construct field with appropriate drainage, layering, grass type, and other conditions to support healthy turf growth. Healthy, vigorously growing grass is better able to out-compete weed pressures, and healthy soil biomass helps to prevent many insect and disease issues.
- **Soil maintenance:** Add soil amendments as necessary to achieve the appropriate chemistry, texture and nutrients to support healthy turf growth. Elements include organic fertilizers, soil amendments, microbial inoculants, compost teas, microbial food sources, and topdressing as needed with high-quality finished compost.
- **Grass maintenance:** Turf health is maintained through specific cultural practices, including appropriate mowing, aeration, irrigation, and over-seeding. Trouble spots are addressed through composting and re-sodding where necessary.

It is important to note that organic turf management requires proper training. Conventional turf management may follow a similar protocol each year; organic turf managers make adjustments based on changing conditions.

## Installation and Maintenance Costs: Comparing Artificial Turf with Natural Grass

In analyzing the costs of artificial vs. natural grass systems, it is important to consider full life-cycle costs, including installation, maintenance, and disposal/replacement. Artificial turf systems of all types require a significant financial investment at each stage of the product life cycle. In general, the full life cycle cost of an artificial turf field is higher than the cost of a natural grass field.

Cost information is available through university entities, turf managers' associations, and personal communications with professional grounds managers. Information is also available on the relative costs of conventional vs. organic management of natural grass.

**Installation.** According to the Sports Turf Managers Association (STMA), the cost of installing an artificial turf system may range from \$4.50 to \$10.25 per square foot. For a football field with a play area of 360x160 feet plus a 15-foot extension on each dimension (65,625 square feet), this yields an installation cost ranging from about \$295,000 to about \$673,000. These are costs for field installation only, and full project costs may be higher. Costs for a larger field would also be higher.

In one site-specific example, information provided by the town of Natick, Massachusetts shows that the full project budget for the installation in 2015 of a new artificial turf field (117,810 square feet), along with associated landscaping, access and site furnishings, totaled \$1.2 million.<sup>23</sup>

For natural grass, installation of a new field may not be necessary. For communities that do choose to install a new field, costs can range from \$1.25 to \$5.00 per square foot, depending on the type of field selected. For the dimensions noted above, this would yield an installation cost ranging from about \$82,000 to about \$328,000.<sup>24</sup>

**Maintenance.** Maintenance of artificial turf systems can include fluffing, redistributing and shock testing infill; periodic disinfection of the materials; seam repairs and infill replacement; and watering to lower temperatures on hot days. Maintenance of natural grass can include watering, mowing, fertilizing, replacing sod, and other activities. In both cases, specialized equipment is needed. Communities shifting from natural grass to artificial turf may need to purchase new equipment for this purpose. According to STMA, maintenance of an artificial turf field may cost about \$4,000/year in materials plus 300 hours of labor, while maintenance of a natural grass field may cost \$4,000 to \$14,000 per year for materials plus 250 to 750 hours of labor.<sup>25</sup>

Fifteen acres of playing fields in Marblehead, MA are managed organically. Annual maintenance costs are \$2,400-\$3,000 per 2-acre playing field, not including mowing costs. Mowing costs for a 2-acre field were estimated in 2010 to be \$10,000 annually. Thus, total maintenance costs per 2-acre field are \$12,400 to \$13,000 annually.<sup>26</sup>

*Natural grass maintenance: Conventional vs. organic costs.* Organic turf maintenance can be cost-competitive with conventional management of natural grass. One study found that once established, an organic turf management program can cost 25% less than a conventional turf management program.<sup>27</sup>

**Disposal/replacement.** Artificial turf also requires disposal at the end of its useful life. STMA estimates costs of \$6.50 to \$7.80 per square foot for disposal and resurfacing.<sup>28</sup> Those estimates yield \$426,563 - \$511,875 for a 65,625 square foot field and \$552,500 - \$663,000 for an 85,000 square foot field.

**Annualized costs.** In 2008, a Missouri University Extension study calculated annualized costs for a 16-year scenario. The calculation included the capital cost of installation; annual maintenance; sod replacement costing \$25,000 every four years for the natural fields; and surface replacement of the synthetic fields after eight years. Based on this calculation, a natural grass soil-based field is the most cost effective, followed by a natural grass sand-cap field, as shown in the table below.<sup>29</sup> Another study, conducted by an Australian government agency, found that the 25-year and 50-year life cycle costs for synthetic turf are about 2.5 times as large as those for natural grass.<sup>30</sup>

Table 1: Comparison of annualized costs	
Field type	16-year annualized costs
Natural soil-based field	\$33,522
Sand-cap grass field	\$49,318
Basic synthetic field	\$65,849
Premium synthetic field	\$109,013
Source: Brad Fresenburg, "More Answers to Questions about Synthetic Fields – Safety and Cost Comparison." University of Missouri.	

The Toxics Use Reduction Institute is a multi-disciplinary research, education, and policy center established by the Massachusetts Toxics Use Reduction Act of 1989. The Institute sponsors and conducts research, organizes education and training programs and provides technical support to help Massachusetts companies and communities to reduce the use of toxic chemicals.

In response to information requests from municipalities, TURI is currently developing a detailed alternatives assessment for sports turf. Preliminary sections of the assessment will be published in the order in which they are developed, and will be available on TURI's website at [www.turi.org](http://www.turi.org).

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