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Natural Grass Athletic Fields

It is becoming more common that high schools and parks and recreation departments are replacing their natural grass playing surfaces with synthetic fields. The reason is often due to the belief that synthetic surfaces are less expensive and easier to maintain than natural surfaces. Synthetic is not an effective replacement if lower maintenance costs are the goal. In addition, it is not a solution to natural grass fields if they are being replaced for aesthetic reasons because they are worn out in the center at the end of the season. The following resource provides a detailed look into the benefits, disadvantages and cost effectiveness of maintaining natural grass fields for recreation.

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. 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 turf cultivars.
2. Allowing turf to enter dormancy in drought situations.
3. Encouraging deeper rooting of turfgrass cultivars by watering deeply and infrequently.
4. Using recycled water sources for irrigation.

II. Groundwater and surface water quality preservation and improved recharge

1. Dense above ground turf biomass traps and holds water which reduces excess runoff and allows more water to infiltrate into the soil.
 - 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 turf.
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.

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4. Proper fertilizer and pesticide applications keep water safe. Contamination of groundwater occurs with excessive overwatering, heavy rainfall events or when turf is dormant.
5. Current trends with turf fertilization are toward low application rates and slow release nitrogen carriers. Both of these practices are more accepted and environmentally friendly.
6. Turfgrass ecosystems support abundant earthworm populations, which contribute to increased spaces 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. Turfgrass leaves, crowns, stems, roots, thatch, soil, and soil microbes support large populations of microscopic decomposers. These decomposers break down pesticides and other noxious organic chemicals into harmless substances.

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 surface stabilization to reduce erosion. A high biomass matrix provides resistance to lateral surface water flow.
4. Turfgrass acts as a trap for dust and other particulate matter to improve air quality.

V. Atmospheric pollution control

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

1. Turfgrass improves soils through the addition of organic matter. As plant tissue dies, it is incorporated into the rootzone. This organic matter improves soil structure and provides nutrients to turfgrass systems.
2. Soil restoration of environmentally damaged areas (i.e. burned-over land, garbage dumps, eroded rural landscapes, mining operations, and steep timber harvest areas) is accelerated when turfgrass is planted.

VII. Substantial urban heat dissipation-temperature moderation

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

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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 Heath 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.

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 turf 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 turf 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 expressed by the Gmax. A high Gmax indicates a hard surface. The limit for surface hardness on athletic fields is 200 Gmax. This is considered to be the maximum threshold to provide an acceptable level of protection to users. At this point the surface should be repaired or replaced. Most synthetic fields have a Gmax of 130 at installation. Natural grass fields typically stay between 80 and 140 Gmax depending on soil moisture and level of maintenance.

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5. Aesthetics and recreational opportunities enhance physical and mental health of participants. Natural grass areas 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 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 conformed to the ASTM standard method for traction characteristics of an athletic shoe-surface interface. Cleated football shoes were mounted on a rigid footform 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 2008, a survey was conducted to evaluate what kind of playing surface NFL players preferred. 1565 players from all 32 teams participated in this survey.
 - 71% of the players preferred to play on natural grass fields.
 - 15% preferred artificial infill.
 - 11% 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	84%	6%
Surface more likely to cause soreness and fatigue	91%	7%
Surface more likely to shorten career	92%	5%
Surface more likely to negatively affect quality of life after football	61%	2%

Natural Grass Limitations

I. Overuse

The overuse of many community sports facilities can push the limits of turf 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.
- Change daily location of practices on the field.
- Use a portable goal and move it around the field, thus limiting wear in the area of the mounted goal posts.
- Have players do individual warm-ups off of the field.
- Execute team drills outside of painted numbers.
- Spread seed in wear areas before games and practices.

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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 to move water off the field effectively and check that the drainage systems operate efficiently. If rain tarps are available, they can help keep rain off the field to allow for playability.

Costs

Construction Costs of Synthetic and Natural Grass Fields

For a more complete understanding of what is involved with constructing 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) - \$0.90 - \$1.50 per sq. ft.**
- **Natural Turfgrass with Native Soils - \$2.25-\$5.25 per sq. ft.**
- **Natural with Sand Cap - \$4.00 - \$6.50 per sq. ft.**
- **Natural with Sand and Drainage - \$7.00-\$10.00 per sq. ft.**
- **Synthetic Infill - \$6.50-\$11.00 per sq. ft.**

Annual Required Maintenance for Natural Grass and Synthetic Fields

Natural turfgrass fields:

1. Mowing
2. Fertilization
3. Irrigation
4. Aerification
5. Topdressing
6. Seeding
7. Pesticides (herbicides, insecticides, fungicides)
8. Line Painting
9. Drainage Repair and Maintenance

Synthetic fields:

1. Additional infill
2. Irrigation
3. Chemical disinfectants
4. Products to reduce static activity and odors
5. Drainage repair and maintenance
6. Erasing and repainting temporary lines
7. Removing organic matter accumulation
8. Grooming

Long Term Maintenance for Natural Grass and Synthetic Fields

Natural turfgrass fields:

1. Renovation
2. Field Repairs

Synthetic fields:

1. Repairs (seams)
2. Replacement is needed every 8 to 10 years.
3. Disposal cost upon replacement. Infill systems are filled and topdressed with crumb rubber material that is typically made from ground automobile tires and may require special disposal. These disposal costs are estimated to be \$130,000 plus transportation and landfill charges.

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: Maintenance, material and labor costs are highly variable depending on region of the country and type of facility. The following costs are based off of fields at 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
Total	\$72,600-\$105,250

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2009 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
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
Totals		\$5,245.52		\$18,009.06	\$23,254.58

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.

Natural Grass Athletic Fields

2009 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
Sports Lighting, 15 events @ 4 hours in length / season			Electricity	373.76	\$373.76
Totals		\$4,920.36		\$9,077.41	\$13,997.77

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.

Natural Grass Athletic Fields

2009 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
Totals		\$6,113.20		\$14,265.29	\$20,378.49

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.

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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
Total	\$8,250-82,000

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2004-2005 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
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
Total Maintenance Cost 2004-2005	\$22,760

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

Natural Grass Athletic Fields

Next Steps

To advocate the construction of a natural turf 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.
 - If you do not already have a sports turf manager for your facility, it is important to have a qualified professional who can be involved in decisions and gathering of information and costs.
 - If constructing a field, your sports turf manager can serve as a grow-in consultant to work with the architect and contractors to oversee the entire construction process.
 - 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.
 - Investing in your sports turf manager is important in keeping 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. Certified Sports Field Managers (CSFMs) are recognized in the industry for continuing to improve professionally.
- 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 price option.
- Schedule meetings to keep those involved updated on progress.
- Form committees to assist in logistics and fundraising.

Natural Grass Fields

The environmental and human health benefits alone make natural grass fields a desirable option when considering keeping or building a high school 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 converting 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.

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