## Synthetic Turf Infill Options

<table>
<thead>
<tr>
<th>Infill Type</th>
<th>Examples</th>
<th>Material Description</th>
<th>Facts and Advantages</th>
<th>Disadvantages</th>
<th>Life Span</th>
<th>Maintenance</th>
<th>End of Life Cycle</th>
<th>Cost (S.F.)</th>
<th>Irrigation System</th>
<th>Annual Maintenance Cost</th>
</tr>
</thead>
</table>
| **Crumb Rubber Infill** | - Gillette Stadium, MA  
- Hebron High School, CA  
- Arlington High School, VA | Coated crumb rubber is derived from recycled tires. There are two types: Ambient and Cyclic. Ambient crumb rubber is created through a process where the tire is not heated. Cyclic crumb rubber is created by heating the crumb rubber to certain points during the curing process. | This is currently the most inexpensive and widely used infill material on the market. Crumb rubber is made from 100% recycled material. It contains 10%+ of the total weight of the crumb rubber filler. | Various studies have proven crumb rubber to be safe for use in all fields. Many safety concerns have been raised in the past, but most are not due to crumb rubber. | 7-8 years | - Grooming per 100 hours  
- Top dressing every 2-3 years  
- Annual G-MAX monitoring | Can be reused (not recycled)  
- Not required | $4.00 - $4.50 | Soil Erosion Control (Sacrificial) - Misting (SR-82) | $14,992  
([-300 300] of field) |  

| **Coated Crumb Rubber Infill** | - Mary E. Grogen Community Park, CA  
- Royal Island Sport Complex, NY  
- Burlington Norwich & Noble High School, WA | With the ambient and cyclic crumb rubber can be coated with colorants and additives. Coated crumb rubber also does not contain metal and is safer. | New product in the manufacturing process as well as meets the EN 71-3 standards. | Coated crumb rubber provides additional aesthetics, reduction of odor by product during the manufacturing process and complete encapsulation of the rubber particles. | 15-20 years | - Grooming per 100 hours  
- Decomposition every 2-3 years  
- Top dressing every 2-3 years  
- Annual G-MAX monitoring | Can be reused (not recycled)  
- Not required | $404,123  
([-300 300] of field) |  

| **EPDM Infill** | - Los Prados Park, CA | EPDM (Ethylene Propylene Diene Monomer) is an elastomer on high-temperature resistance and wear. | The material is resistant to weathering and does not suffer from ozone damage. | Select products can be recycled, cleaned and reused, whether as crumb rubber or used for gravel. | 10 years | - Grooming per 100 hours  
- Decomposition every 2-3 years  
- Top dressing every 2-3 years  
- Annual G-MAX monitoring | Can be reused as infill in synthetic turf fields or other products. | $5,000 - $10,000 | Soil Erosion Control (Sacrificial) - Misting (SR-82) | $671,476  
([-300 300] of field) |  

| **TPE Infill** | - Springfield School, VA | Thermo-Plastic Elastomer (TPE) crumb rubber is a non-toxic biodegradable rubber in various colors, very long lasting and 100% recyclable and reusable as ill as when the field is removed. | TPE is used as a link to play characteristics to crumb rubber. | TPE crumb rubber, when used with field base mats, will also have consistent performance and excellent ground over a wide temperature range. | 15-20 years | - Grooming per 100 hours  
- Decomposition every 2-3 years  
- Top dressing every 2-3 years  
- Annual G-MAX monitoring | Can be reused as infill in synthetic turf fields or other products. | $5,000 - $10,000 | Soil Erosion Control (Sacrificial) - Misting (SR-82) | $695,969  
([-300 300] of field) |  

| **Nike Grind** | - Lincoln High School, OR  
- Lewiston Park, CA  
- Glascow Park, CA | Nike Grind includes three types of raw materials made from recycled athletic shoes, waste and confounding rubber. The crumb rubber is made from recycled rubber in a variety of colors and has similar physical characteristics to crumb rubber. | Nike Grind places wear on the surface of the field and does not suffer from indoor exposure. It is composed of crumb rubber that is recycled from various sources. | Nike Grind is a high-quality wear-on-the-field product that is resistant to wear. Too much of Nike Grind can cause a higher cost to be used when compared to other infill materials. | 10 years | - Grooming per 100 hours  
- Top dressing every 2-3 years  
- Annual G-MAX monitoring | Can be reused (not recycled)  
- Not required | $5.00 - $7.00 | Soil Erosion Control (Sacrificial) - Misting (SR-82) | $628,635  
([-300 300] of field) |  

| **EcoMax** | - Bellarmine College Preparatory, CA | This infill is comprised of a complex mixture of recycled turf and thermoplastic elastomer (TPE). The EcoMax granules deliver a new higher performance infill offers safe and cost-effective solutions. | EcoMax offers great playability characteristics (grain and traction), good compression/compaction characteristics, slight heat reduction, and is Tested rigorously for mechanical wear and weathering. | The relative hardness of the material is very high. High astroturf quality, high cost due to recycled shock pad. | 15 years | - Grooming per 100 hours  
- Top dressing every 2-3 years  
- Annual G-MAX monitoring | Can be reused as infill in new synthetic turf fields. | $5.60 - $7.50 | Soil Erosion Control (Sacrificial) - Misting (SR-82) | $873,558  
([-300 300] of field) |  

| **Sand (Silica)** | - Newburg High School, WA  
- South Windsor High School, CT | This class of infill consists of coated, high-quality silica sand either in soft or rigid coating specifically engineered for synthetic turf. This proves ideal for their high-temperature resistance and wear. | Can be used in conjunction with many other infills on the market to provide a soft and resilient playing surface. | Coated silica sand is available in various colors. | 8 years | - Grooming per 100 hours  
- Top dressing every 2-3 years  
- Annual G-MAX monitoring | Can be reused (not recycled)  
- Not required | $40,000  
([-300 300] of field) |  

| **Zeolite (Silica Sand)** | - Sprague School, MA  
- Bellarmine College Preparatory, CA | Silica sand is one of the original materials utilized in artificial turf. The process is virtually identical and a natural and ecologically safe and sustainable. Typically on in white or light color. This could be a viable option for reusing as infill. | The relative hardness of the material is very high. High astroturf quality, high cost due to recycled shock pad. | Zeolites are naturally occurring minerals found in specific types of igneous and metamorphic rocks. Due to their natural absorbent and adsorbent qualities, zeolites have been used for many different applications. The use of ZeoFill was of particular interest to the synthetic grass industry since natural sand. | 10 years | - Grooming per 100 hours  
- Top dressing every 2-3 years  
- Annual G-MAX monitoring | Can be reused to select manufacturers to be cleaned and recycled. | $4.00 - $5.00 | Soil Erosion Control (Sacrificial) - Misting (SR-82) | $636,635  
([-300 300] of field) |  

| **Zeolite (Silica)** | | | | | | | | $628,733  
([-300 300] of field) |  

| **Cork & Coconut** | - St. Timothy School, MD | A select, high density synthetic coconut fibres blended with select natural coir fibres and reconstituted materials and added to and in the same in a variety of brown and ivory color. | Requires irrigation to avoid degradation, require re-cutting and re-placement every 10 years. | The most moisture content twice a week. | 10 years | - Grooming per 100 hours  
- Top dressing every 2-3 years  
- Annual G-MAX monitoring | Can be reused as soil amendment, on field fill, subgrade or fill infill or other applications. | $6.75 - $8.00 | Soil Erosion Control (Sacrificial) - Misting (SR-82) | $686,955  
([-300 300] of field) |  

## Notes
- All costs reflect the use of recycled materials. Cost for materials is not included.  
- Does not include cost of field preparation or excavation.  
- 12,000 gallons recommended average.  
- Includes $2.00 - $4.00 additional for material delivery and installation.
<table>
<thead>
<tr>
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<th>End of Life Cycle</th>
<th>Cost I S.F. (Estimated)</th>
<th>Irrigation System</th>
<th>Estimated No. 33 Field Synthetic Turf Cost (Soccer Field: $853,000)</th>
<th>Annual Maintenance Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cork (PureFill)</td>
<td>1. Santa Claus, Indiana, IN 2. SV Stade de Reims, Reims, France, 3. Signal Iduna Park, Dortmund, Germany</td>
<td>Cork infill is a natural infill that is 100% environment friendly and non-toxic. It is an organic, recyclable and sustainable product that is harvested from the cork oak tree every nine years, without harming the trees. Cork infill is comprised of cellular material that has low thermal conductivity due to its natural structure which will reduce the surface temperature significantly. The natural component of cork infill is known for its biodegradation properties. All components of this infill system will require compaction and annual top dressing and grooming.</td>
<td>Cork infill is comprised of cellular material that has low thermal conductivity due to its natural structure which will reduce the surface temperature significantly. The natural component of cork infill is known for its biodegradation properties. All components of this infill system will require compaction and annual top dressing and grooming.</td>
<td>Requires irrigation to avoid hardening, requires annual additional infill, unproven longterm performance, increased cost per square foot, and higher maintenance costs.</td>
<td>8 years</td>
<td>- Groom after heavy rain  - Replace 10% of infill every 2-3 years - Deconstruction 2 times a year  - Annual G-MAX Monitoring</td>
<td>Can be used to topdress natural turf fields or recycled directly into the environment.</td>
<td>$6.25 - $7.50 (Includes $2.00 Infill-Pro, GeoFill) (Plus 300 hours of labor)</td>
<td>Not required</td>
<td>$873,038</td>
<td>$14,900 - $25,800</td>
</tr>
<tr>
<td>Coconut Fiber (SeedFill)</td>
<td>1. Google Corporate Campus Soccer Field, CA 2. Pleasantville High School and Middle School Field, NY</td>
<td>Coconut fiber allows for clean water runoff, is 100% recyclable and is naturally resistant to mold and fungus. These fiber’s unique organic properties, gives the entire system synthetic grass an amazing look of naturalness.</td>
<td>Coconut fibers are layered with sand and a shock pad to provide a stable surface that prevents infill shifts and grass and root matting. The infill fibers rotate and is resistant to mold and fungus. This infill system will require irrigation and annual top dressing and decompaction.</td>
<td>Requires irrigation to avoid hardening, requires annual top dressing and decompaction, unproven longterm performance, increased cost per square foot, and higher maintenance costs.</td>
<td>8 years</td>
<td>- Grooming per 100 hours of play  - Replace 10% of infill every 2-3 years - Deconstruction 2 times a year - Annual G-MAX Monitoring - Monitor moisture content twice a week</td>
<td>Can be used to topdress natural turf fields or recycled directly into the environment.</td>
<td>$6.75 - $7.00 (Includes $2.00 Infill-Pro, GeoFill) (Plus 300 hours of labor)</td>
<td>$40,000.00</td>
<td>$668,635</td>
<td>$15,000 - $20,000</td>
</tr>
<tr>
<td>Cork Bark Husk Rice Husk and Cork (SafeShell)</td>
<td>1. The Fessenden School, MA 2. Virginia Soccer Training Center, VA 3. Highlands Field, CA</td>
<td>The unique natural infill is composed by selected organic fibers that guarantees better technical and sporting performances, provide better conditions for athletes, the environment and safety. Provides a natural grass-like look. Excellent UV resistance Due to the fibre nature and the plant origin, it has a high UV resistance making deterioration very slow over a very long time. This infill can be recycled for agricultural use therefore when the artificial turf comes to the end of its life, it is easy and economical to remove.</td>
<td>Excellent UV resistance Due to the fibre nature and the plant origin, it has a high UV resistance making deterioration very slow over a very long time. This infill can be recycled for agricultural use therefore when the artificial turf comes to the end of its life, it is easy and economical to remove.</td>
<td>Requires irrigation to avoid hardening, require additional annual infill, unproven longterm performance, increased cost per square foot, and higher maintenance costs.</td>
<td>8 years</td>
<td>- Grooming per 100 hours of play  - Replace 10% of infill every 2-3 years - Deconstruction 2 times a year - Annual G-MAX Monitoring - Monitor moisture content twice a week</td>
<td>Can be used to topdress natural turf fields or recycled directly into the environment.</td>
<td>$6.75 - $7.00 (Includes $2.00 Infill-Pro, GeoFill) (Plus 300 hours of labor)</td>
<td>$40,000.00</td>
<td>$668,635</td>
<td>$16,000 - $18,000</td>
</tr>
<tr>
<td>Walnut Shells (Safeshell)</td>
<td>Baseball Field, Cincinnati, OH</td>
<td>Safeshell is made of 100% USA grown walnut shells.Safeshell is made up with a unique technology called Pro to develop a unique process that virtually eliminates residual protein allergies which are on the shell after processing. Safeshell is a blend of Black and English walnut shells. Block walnut shells are more milled than English walnut shells. The result of this proprietary mix is the perfect balance of firm, fast and player friendly.</td>
<td>Safeshell excels in evaporative cooling. Safeshell absorbs water with minimal expansion and then releases it slowly over time to help keep surfaces from baking up too quickly. Even dry, Safeshell plays faster than count rubber. Safeshell is made from one of the hardest nut shells on the planet. It doesn’t float and defeats the same wet or dry - 100% organic.</td>
<td>Requires irrigation to avoid hardening, require additional annual infill, unproven longterm performance, increased cost per square foot, and higher maintenance costs.</td>
<td>Life of carpet</td>
<td>- Grooming per 100 hours  - Deconstruction every 3-4 years  - Top dressing every 2-3 years  - Annual G-MAX monitoring</td>
<td>Can be used to topdress natural turf fields or recycled directly into the environment.</td>
<td>$6.25 - $6.75 (Includes $2.00 Infill-Pro, GeoFill) (Plus 300 hours of labor)</td>
<td>Not required</td>
<td>$630,104</td>
<td>$8,000 - $10,000 (Plus 300 hours of labor)</td>
</tr>
</tbody>
</table>
Artificial Turf at the Route 33 Athletic Complex

May 15, 2017
Presentation Outline

• City-wide Field Shortage | Critical Needs
• Portsmouth High School Field as a Case Study
• Design Process | Multiple Field Design Options
• Recognizing + Addressing Community Concerns
• The Recommended Improvement Program

City of Portsmouth, New Hampshire
Field Demand Summary

- 17 total fields, 7 fields are lit, 5 lit fields are at Portsmouth HS.
- Organizations limit participation.
- Organizations play on fields in Newington and Greenland.
- Most fields are multi-use. No capacity for rotation of fields or resting to allow recovery.
- Middle and elementary schools lack adequate fields.
- Tournament play limited due to lack of appropriate venues.
City-wide Field Shortage | Critical Needs

*Study Conclusion:*

- Needed: 3-4 New Rectangular *Synthetic Turf Fields* with Lighting
- Needed: 2-3 New Adult Softball Fields

*Status Quo Until New Fields are Developed, Organizations:*

- Cannot practice (due to the availability of fields)
- Cannot play competition games (due to under sizing)
- Cannot play at all (seasonal limitations, weather + poor drainage)
- Play on substandard fields (due to turf condition)

City of Portsmouth, New Hampshire
Portsmouth HS Field as a Case Study

- **PHS Field Capacity (prior to artificial turf)**
  15 football games (5 freshman, 5 J.V. 5 varsity) = 30 hours
  16 boys lacrosse games (8 J.V. and 8 varsity) = 24 hours

- No other uses to allow for turf regeneration. Even with limited use field impacts 20 yard line to the 20 yard line.

- **TOTAL use per year = 54 hours**

- **PHS Field Capacity (after artificial turf)**
  Use 7 days/week x 9 months/year
  **TOTAL use per year = 3,920 hours**
Portsmouth HS Field as a Case Study

Current Field Users

- PHS phys. ed. classes
- PHS boys soccer
- PHS girls soccer
- PHS field hockey
- PHS boys lacrosse
- PHS girls lacrosse
- PHS baseball
- PHS softball
- PHS track
- PHS band
- PHS frisbee club
- PHS special events

- Portsmouth City Soccer Club
- Seacoast United Soccer
- Portsmouth Youth Football
- Lighthouse Lacrosse
- Seacoast Lacrosse
- Portsmouth elementary track
- PMS boys soccer
- PMS girls soccer
- PMS field hockey
- PMS boys lacrosse
- PMS girls lacrosse

City of Portsmouth, New Hampshire

- Great Bay United Soccer
- Fusion Soccer
- Chad Soccer
- NHIAA boys soccer
- Girls soccer
- Boys lacrosse
- Girls lacrosse
- Field hockey
- Seacoast Phantoms (soccer)
- Seacoast Vipers (football)

Needs are still great and youth sports participation is growing.
Design Process | Multiple Field Design Options

City of Portsmouth, New Hampshire
Conclusions:

- Native Soil Field – Not viable due to amount of playing time available
- Sand Based Natural Field – Not viable due to amount of playing time available
- Synthetic Turf Field – Best choice to BEGIN alleviating critical field shortages

City of Portsmouth, New Hampshire
Design Process | Multiple Field Design Options

Natural Turf Wear

- Left be deemed play

Average Multi-Use Field (240’x360’) | Field Wear & Tear Zone: 62% | Sideline Wear & Tear Zone: 32,300 SF

City of Portsmouth, New Hampshire
Pro’s and Cons for Natural Turf Fields:
- Initial Cost - Cheaper to construct and replace/re-sod.
- Playability can be limited by weather.
- Limited Playing Time - It is recommended that higher performing natural fields are only played on for
- Higher maintenance costs
- Environment impacts

Pro’s and Cons for Synthetic Turf Fields:
- Higher Initial Cost – More expensive to build, repair and replace.
- More Playing Time - Can support higher intensity of use and can extend the playing season.
- Less intensive maintenance program
- Fewer Injuries due to even playing surface and consistent G-max performance
- Potential heat hazards

Conclusion: For this project a synthetic turf system best meets City needs

City of Portsmouth, New Hampshire
## Synthetic Turf Field Infill Options

<table>
<thead>
<tr>
<th>Rubber</th>
<th>Plastic</th>
<th>Natural</th>
<th>Organic</th>
<th>Minerals/Coated Minerals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide use, best performance + resiliency</td>
<td>Organic</td>
<td>Longest life before replacement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some recycled</td>
<td>Prone to migrating, more maintenance</td>
<td>Less resiliency, harder surface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perception of risk</td>
<td>Requires shock pad, higher cost</td>
<td>Requires shock pad, higher cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy metals in trace amounts, not releasable</td>
<td>Moisture required to retain resiliency, can freeze</td>
<td>Can be abrasive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock pad required with some products</td>
<td>May contain pesticides, heavy metals in trace amounts that are releasable</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Conclusion:** For this project a synthetic turf system with rubber infill best meets City needs

City of Portsmouth, New Hampshire
Addressing Community Concerns

Public comments have included

- Use of crumb rubber introduces more chemicals into the environment
- Have not accounted for the different physiology of young children
- Science is inadequate
- Have not considered all of the vectors of exposure
- Project team has a bias toward synthetic turf

City of Portsmouth, New Hampshire
City of Portsmouth, New Hampshire

Addressing Community Concerns

Marie Rudiman (Weston & Sampson)

Human Health Risk Assessor, Toxicologist

- Northeastern University | Toxicology
- Experience: 23 Years
- Focus: Human and ecological risk assessment, air quality

Dr. Stephen Clough, Ph.D., DABT
(Haley & Aldrich) (Peer Reviewer)

Environmental Toxicologist, Risk Assessor

- University of Michigan, MS, Ph.D. Water Quality + Env. Toxicology
- Experience: 30 Years
- Focus: Water quality, human and ecological risk assessment
What is a toxicologist?
- Toxicologists study the adverse effects of chemicals on living organisms
- Mix of chemistry, biology, and pharmacology

What do they do?
- Evaluate chemicals to determine if they cause an environmental health using Federal (EPA) and State (NH DES/state)

Who uses toxicological data?
- Human Health and Environmental Risk Assessors
- Epidemiologists
- Public Health Officials
- Regulators – EPA, NH DES and other state environmental departments
Addressing Community Concerns

Bioavailability vs. Risk

• **Bioavailability of the constituents of synthetic turf fields**
  – Amount of constituent that is available to be absorbed into the body
  – Constituents are generally tied up within the polymer of the rubber

• **Risk Assessment is a way to estimate potential health risks from exposure to chemicals**
  – Risk = Exposure x Toxicity
Addressing Community Concerns

• Ways we looked at available data to determine if the risks are acceptable
  – Comparison to applicable standards
  – Ingestion of crumb rubber particles (CRP)
  – Dermal contact with CRP and turf bed
  – Breathing in constituents that may volatilize from the synthetic field
  – Leaching of constituents into groundwater

• Analyze proposed crumb rubber prior to installation
  – Inorganics - Metals
  – Organics
    • Polycyclic aromatic hydrocarbons (PAHs)
    • Semi-Volatile Organic Compounds (SVOCs)
    • Volatile Organic Compounds (VOCs)

• We will evaluate data we collect from proposed fields in the same manner.
### Addressing Community Concerns

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Maximum Detected Concentration (mg/kg)</th>
<th>ASTM (American Society for Testing and Materials) F3188-16 Safety of Toys (mg/kg)</th>
<th>European Standard EN 71-3 Category III Safety of Toys (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metals</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimony</td>
<td>4</td>
<td>60 Pass</td>
<td>560 Pass</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.4</td>
<td>25 Pass</td>
<td>47 Pass</td>
</tr>
<tr>
<td>Barium</td>
<td>6</td>
<td>1,000 Pass</td>
<td>18,750 Pass</td>
</tr>
<tr>
<td>Beryllium</td>
<td>0.2</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.5</td>
<td>75 Pass</td>
<td>17 Pass</td>
</tr>
<tr>
<td>Chromium(VI)</td>
<td>ND</td>
<td>60 Pass</td>
<td>0.2 Pass</td>
</tr>
<tr>
<td>Chromium(III)</td>
<td>2</td>
<td>60 Pass</td>
<td>460 Pass</td>
</tr>
<tr>
<td>Cobalt</td>
<td>120</td>
<td>NA</td>
<td>130 Pass</td>
</tr>
<tr>
<td>Copper</td>
<td>27</td>
<td>NA</td>
<td>7,700 Pass</td>
</tr>
<tr>
<td>Lead</td>
<td>26</td>
<td>90 Pass</td>
<td>160 Pass</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.1</td>
<td>60 Pass</td>
<td>94 Pass</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>2</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Nickel</td>
<td>34</td>
<td>NA</td>
<td>930 Pass</td>
</tr>
<tr>
<td>Selenium</td>
<td>2</td>
<td>500 Pass</td>
<td>460 Pass</td>
</tr>
<tr>
<td>Silver</td>
<td>0.4</td>
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<td>NA</td>
</tr>
<tr>
<td>Thallium</td>
<td>2</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Vanadium</td>
<td>0.8</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Zinc</td>
<td>14000</td>
<td>NA</td>
<td>46,000 Pass</td>
</tr>
</tbody>
</table>

City of Portsmouth, New Hampshire
## Addressing Community Concerns

### Comparison to Soil Background

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Maximum Detected Concentration in Crumb Rubber mg/kg</th>
<th>Soil Background Concentrations from New Hampshire and Massachusetts 90th Percentile mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td>68</td>
<td>10,000</td>
</tr>
<tr>
<td>Antimony</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Barium</td>
<td>6</td>
<td>50</td>
</tr>
<tr>
<td>Beryllium</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Boron</td>
<td>9</td>
<td>Not Determined</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.53</td>
<td>1.9</td>
</tr>
<tr>
<td>Chromium(III)</td>
<td>1.7</td>
<td>33</td>
</tr>
<tr>
<td>Cobalt</td>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td>Copper</td>
<td>27</td>
<td>31</td>
</tr>
<tr>
<td>Lead</td>
<td>26</td>
<td>51</td>
</tr>
<tr>
<td>Manganese</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.065</td>
<td>0.31</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>2</td>
<td>Not Determined</td>
</tr>
<tr>
<td>Nickel</td>
<td>34</td>
<td>23</td>
</tr>
<tr>
<td>Selenium</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Strontium</td>
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</tr>
<tr>
<td>Silver</td>
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<td>0.6</td>
</tr>
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<td>Thallium</td>
<td>2</td>
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<td>Titanium</td>
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</tr>
<tr>
<td>Vanadium</td>
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<td>30</td>
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<tr>
<td>Zinc</td>
<td>14,000</td>
<td>98</td>
</tr>
</tbody>
</table>

City of Portsmouth, New Hampshire
Addressing Community Concerns

Risk Assessment: Conservative Assumptions

- Maximum detected concentrations were used
- Subchronic exposure (1 yr old) 2 days/wk/30 weeks (48 hr/wk)
- Chronic exposure 3 days/wk/30 weeks (72 hr/wk)
- Exposure through ingestion and dermal contact
- Ingest 100 mg/kg crumb rubber on each day of exposure
- Crumb rubber sticking to face, forearms, hands, lower legs and feet
- Assumes crumb rubber can be ingested like soil and adheres to skin like soil. Reality: far less exposure!

City of Portsmouth, New Hampshire
Risk Assessment

Risk = Exposure x Toxicity

**Conclusion:** Potential Risks are an Acceptable Exposure/Negligible Exposure

- Residential Receptor
- Age 1 through 31 years
  - 30 year exposure

**Forthcoming Study:** US EPA due Summer 2017

City of Portsmouth, New Hampshire
Addressing Community Concerns

Recent Review Article Evaluating Human Exposure Pathways (Cheng, 2013):

Environmental and Health Impacts of Artificial Turf: A Review
Hefa Cheng,*† Yuanan Hu,† and Martin Reinhard*†

• Many risk assessment studies have been conducted to characterize the health risk of tire rubber crumb in artificial turf fields via these exposure routes, with the results consistently showing that no significant health risk was associated with being on or playing on such fields.
  • Oral: “...there is no indication that the exposure to hazardous substances (PAHs and Pb) in tire rubber crumb via hand-to-mouth contact could cause adverse health effects”.
  • Dermal: “…risk assessment studies have shown that the doses of toxic chemicals exposed through dermal absorption were too low to cause any adverse health effects, including allergic response or indicated sensitization, for children and adults playing on artificial turf fields”
  • Inhalation: “Field monitoring showed that the levels of PAHs and VOCs detected in the air above outdoor artificial turf fields were not high enough to threaten human health and that the health risk from indoor artificial turf was also below the level of concern with adequate facility ventilation.”

City of Portsmouth, New Hampshire
Addressing Community Concerns

Experience Addressing Artificial Issues

• **Fenn Prep School**
  • HGA and MA DEP supported safety of artificial turf to Massachusetts Adjudicatory Court (decision to develop upheld)
  • 5 years of groundwater monitoring show metal concentrations similar to background and below human health and wildlife criteria

• **Concord/Carlisle High School**
  • Served on expert panel, two new fields using crumb rubber infill successfully developed based on majority vote at Town Meeting

City of Portsmouth, New Hampshire
Addressing Community Concerns

Experience Addressing Artificial Issues

- **Town of Weymouth**
  - Provided expert testimony to Conservation Commission to replace natural grass field with artificial turf field (protective of downgradient alewife run)

- **Town of Weston**
  - Provided expert support for the municipality that requested upgrade of Proctor Field (natural turf) with smaller but more efficient artificial turf field (year round play)

City of Portsmouth, New Hampshire
Addressing Community Concerns

“Long Term Groundwater Monitoring of an Artificial Turf Field”

Clough, S.R., Miles, O., M., and Kastrinos, J.

Groundwater Monitoring and Remediation (In Press)

City of Portsmouth, New Hampshire
Addressing Community Concerns

Five Years of Groundwater Monitoring at Fenn School: Results

City of Portsmouth, New Hampshire
The Recommended Improvement Program

The Existing Property

• Roughly 5 acres
• Located on Rt. 33 near Plains Park
• Single Rectangular Footprint

City of Portsmouth, New Hampshire
The Recommended Improvement Program

Total Improvement Program

- Synthetic turf sports field
- Sports lighting
- Parking area w/ lighting
- Bathroom facilities
- Connection to future multi-use path
- Shade shelter
- Bike parking
- Play area
The Recommended Improvement Program

Project Benefits

- Eases critical rectangular shortages
- Provides great playability
- Reduces impacts to other fields
- Supports high impact sports competitive levels
- Accommodates school and uses
- Maximizes periods of usage, weather disruptions

City of Portsmouth, New Hampshire
Thank You

Questions + Comments

City of Portsmouth, New Hampshire