FROM: Elisabeth Black, CIH  
EMB Consulting, LLC  

RE: Information on Artificial Turf and Crumb Rubber

I am a Certified Industrial Hygienist (CIH) and have been following the emerging concern over artificial turf fields and crumb rubber and potential health effects. I have also conducted testing for some of the materials of potential concern following installation of a new crumb rubber field for a local school district. I have reviewed more than 40 separate documents related to synthetic or artificial turf/crumb rubber products and potential adverse health impacts. The research documents you provided are included in that group. The objective of this response is to summarize information from the literature related to the potential health risks associated with artificial turf and crumb rubber products and material. The review is intended to provide information for the proposed installation of artificial turf fields at Bellevue School District sites.

The documents reviewed offered a broad perspective on the issues of actual and theoretical health risks associated with artificial turf fields with crumb rubber. For the purposes of this response, actual health risks are those that are not disputed and are based on scientific or physical evidence. Theoretical health risks are those that seem plausible, but are not yet substantiated by scientific or physical evidence. The documents include:

- Studies and information bulletins issued by international, federal, state, and municipal regulatory agencies and departments;
- Studies published in scientific journals, conducted by academics, and funded by public sources;
- Studies commissioned by industry groups;
- Opinions issued by public interest groups and turf users; and
- Journalism sources, to include periodicals, web postings, and newsletters.

Some of the documents illustrated the advantages of artificial turf fields over grass fields for safety and environmental benefits, as summarized:

- artificial turf fields with crumb rubber are engineered to reduce the frequency or severity of fractures and other traumatic injuries. They offer a demonstrated reduction in injury;
- artificial turf fields require reduced water usage;
- installation of artificial turf fields may result in overall reduced costs and effort to maintain;
- artificial turf fields may avoid the use of pesticides, herbicides, and other lawn chemicals required to maintain a grass field;
- artificial turf fields offer the ability to play on the field during a variety of weather conditions; and
- artificial turf fields provide a recycling alternative for the vast stockpile of waste tires.
Some documents highlight what can be considered actual health risks or hazards associated with playing on artificial turf fields with crumb rubber. These actual hazards were described in the Mount Sinai Hospital information document. These include:

- Artificial turf field surfaces can develop elevated heat relative to natural surfaces, which may create a condition of discomfort for athletes. This condition only exists during high ambient temperature periods.
- Athletes who fall on artificial turf fields can have friction burns or turf abrasions, which can be more severe than what would occur on natural surfaces.

The larger issue, and one much more difficult to manage and address, are the theoretical risks associated with artificial turf and crumb rubber. The theoretical risks are assigned by theory based on the materials present in the artificial turf and crumb rubber and what is known about these chemicals in other applications. The chemicals and properties of concern associated with artificial turf and crumb rubber are:

- Volatile organic compounds and semi-volatile organic compounds, such as benzothiazole, hexadecane, 4-(tert-Octyl)-phenol, and butylated hydroxyanisole;
- Polynuclear aromatic hydrocarbons, such as hydroxypyrene;
- Metals, such as lead, zinc, selenium, and cadmium. It should be noted that the use of lead chromate in new artificial turf has been greatly reduced compared to earlier field materials;
- Carbon black, which is a petroleum product formed by incomplete combustion of heavy petroleum products and which accounts for an estimated 80 percent of tire mass;
- Particulate, usually studied in crumb rubber studies as PM-10, but also referenced in the documents in nano-particulate size.

Studies that appear to exhibit rigorous scientific validity find no additional risk from the chemicals or physical properties of artificial turf and crumb rubber. Many of the studies note that the chemicals are already prevalent in our environment. The addition of exposures from turf fields with crumb rubber do not appear to increase risk above what is already present in the population.

The documents acknowledge that health assessments of artificial turf fields with crumb rubber are made more complicated by a number of factors:

- the variety of material used in the products;
- the variety of applications. For example, artificial turf with crumb rubber on indoor fields appears to have more evidence of potential exposures without the advantage of natural ventilation and dilution; and
- the age and condition of the field material.

The studies acknowledge that turf field materials contain hazardous constituents and that the public, notably children, are in contact with these hazardous constituents. What has not been demonstrated, however, is an exposure pathway by which the constituents can enter the body of the field users and do damage or initiate disease. For a hazardous material to actually present a risk for the end user there has to be a pathway of exposure and a way for the chemical to do damage.
One of the chemicals proposed as a hazardous constituent of crumb rubber illustrates this point. Carbon black is classified by the IARC as possibly carcinogenic to humans. Most of the data available linking carbon black to cancer comes from occupational studies, where workers were exposed to high concentrations of fine carbon black dust for many years. The studies evaluated during this review did not document the presence of fine particulate or specifically identify carbon black. It appears likely that the carbon black in artificial turf/crumb rubber systems remains bound in the relatively large chunks of tire rubber, making it unavailable for distribution as a fine dust and therefore unavailable for uptake by the field users. Based on the scientific research, there is neither the dose, nor the exposure route, to indicate a health hazard for artificial turf/crumb rubber field users.

All studies acknowledge that additional data is needed to more fully assess potential exposures and possible health risks associate with the use of artificial turf fields with crumb rubber. In response to public concerns about the use of crumb rubber, the EPA has published a list of the representative studies to date on health effects from crumb rubber. That list can be found here:


In addition, three large studies by agencies and interest groups are currently in process. The studies are described below:

- **Cal Ripken Sr. Foundation**
  The Cal Ripken Sr. Foundation builds athletic fields for communities across the nation. Most of these fields are artificial turf/crumb rubber systems. To address health concerns about the fields, the Foundation conducted preliminary tests on seven crumb rubber fields, including one at the Boys & Girls Club in Everett. Preliminary results indicate that the fields pose no unusual safety risks to those playing on them. Final results are expected this summer.

- **EPA, ATSDR, CPSC**
  On February 12, 2016, the U.S. Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry (ATSDR), and the U.S. Consumer Product Safety Commission (CPSC) launched a multi-agency action plan to study key environmental human health questions related to artificial turf/crumb rubber athletic fields. This coordinated Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields and Playgrounds includes outreach to key stakeholders, such as athletes and parents, and seeks to:
  - Fill important data and knowledge gaps
  - Characterize constituents of recycled tire crumb
  - Identify ways in which people may be exposed to tire crumb based on their activities on the fields.
The Federal Research Action Plan includes numerous activities, including research studies. While additional research questions may require evaluation beyond this year, the information will help answer some of the key questions that have been raised. By late 2016, the agencies will release a draft status report that describes the findings and conclusions of the research through that point in time. The report will also outline any additional research needs and next steps.

- **State of California**
  In 2007 and 2010, under contracts to the California Integrated Waste Management Board, which has since been reorganized as CalRecycle, OEHHA conducted two studies on the potential human health effects associated with use of recycled waste tires in playground and synthetic turf products:
  - Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products, January 2007
  - Safety Study of Artificial Turf Containing Crumb Rubber Infill Made From Recycled Tires: Measurements of Chemicals and Particulates in the Air, Bacteria in the Turf, and Skin Abrasions Caused by Contact with the Surface, October 2010

In June 2015, OEHHA committed under a contract with CalRecycle to conduct a new study of potential health effects associated use of recycled waste tires in playground and synthetic turf products. The new study is comprised of five separate tasks: 1) expert and stakeholder input and consultation, 2) hazard identification, 3) exposure scenario development, 4) sampling and analysis of new and in-field synthetic turf, and 5) biomonitoring study protocol development. OEHHA will prepare a report to CalRecycle that will summarize the sampling data and findings and evaluate the potential health hazards.

Finally, cancer is the most frequently cited theoretical adverse health outcome from exposure to the athletic field materials. A 2014 KOMO news report covered a speculative link between the incidence of cancer among soccer goalies and time spent on artificial turf fields with crumb rubber raised by Amy Griffin, a former professional soccer player and University of Washington Women’s Soccer team coach.

In response, the Washington State Department of Health is investigating whether soccer players who competed on crumb rubber fields have higher rates of cancer. The cohort for this study includes 45 Washington residents who played both recreationally and year-round on the playfields. The federal Centers for Disease Control and Prevention is providing some technical assistance to the State. The results of that study may be released in late 2016.

*******************************************************************************************************

**Conclusion**

Although to date no large scale study has been conducted to address all chemicals, potential exposure routes, health outcomes, or field conditions for artificial turf/crumb rubber playfields, there is a large body of data available in smaller studies. These studies consistently do not identify
an increase in chemical exposures, plausible routes of exposure, incidence of disease, biological uptake of chemicals, or adverse health outcomes from use of the playfields. It would appear that if there were a strong correlation between adverse health outcomes and crumb rubber, it would be indicated in this large body of existing research. It is my opinion that the new larger studies will confirm the conclusions drawn to date, that crumb rubber does not add to the risk of exposure to the chemicals, most of which are already part of our backgrounds. Finally, with the also growing concern over traumatic brain injury for athletes, artificial turf/crumb rubber playfields have been demonstrated to reduce the risk and severity of those injuries.