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Richard K. Reine
Director, Public Works
Town of Concord
133 Keyes Road
Concord, MA 01742

Dear Mr. Reine,

Thank you for asking us to assess whether the lead content of artificial turf installed at the Concord-Carlisle Regional High School poses a risk to health. As detailed below, relevant evidence indicates that it does not.

In making our assessment, we have relied on our understanding, as toxicologists, of (i) environmental sources of exposure to lead, (ii) mechanisms by which lead may be absorbed into the body, and (iii) quantitative relationships between body-burdens of lead (typically assessed *via* measurements of lead in blood) and risks to health — especially to the health of children younger than 7 years, whose developing brains make them particularly sensitive to the toxic effects of lead. We have also relied on measurements of lead in artificial turf at the fields in Concord and elsewhere.

As you know, toxicity depends on exposure. In the U.S., in decades past, environmental exposures were sometimes unacceptably large. Three major sources were to blame: (i) gasoline was formulated with organic lead, and deposition of engine exhausts resulted in lead contamination of soils and other surfaces; (ii) many paints, both interior and exterior, contained large fractions (up to 50% dry weight) of lead pigments, and dried paint chips and dust were (and still can be) sometimes ingested or inhaled by young children; and, (iii) some food cans and water pipes contained lead solder, resulting in ingestion of potentially significant amounts of lead. As a result of these and other sources, some people, particularly children, developed relatively high and sometimes toxic body-burdens of lead.

In the U.S. currently, overt lead poisoning is rare, and the majority of children have acceptably small concentrations of lead in their blood. Recent data from Massachusetts[1] indicate (i) elevated blood lead levels in 2 or 3 children per 1,000 in "high risk communities" (primarily Boston, Springfield, Brockton, New Bedford, Lawrence, and Worcester), (ii) fewer or no such cases in most other cities and towns, and (iii) no cases in Concord.

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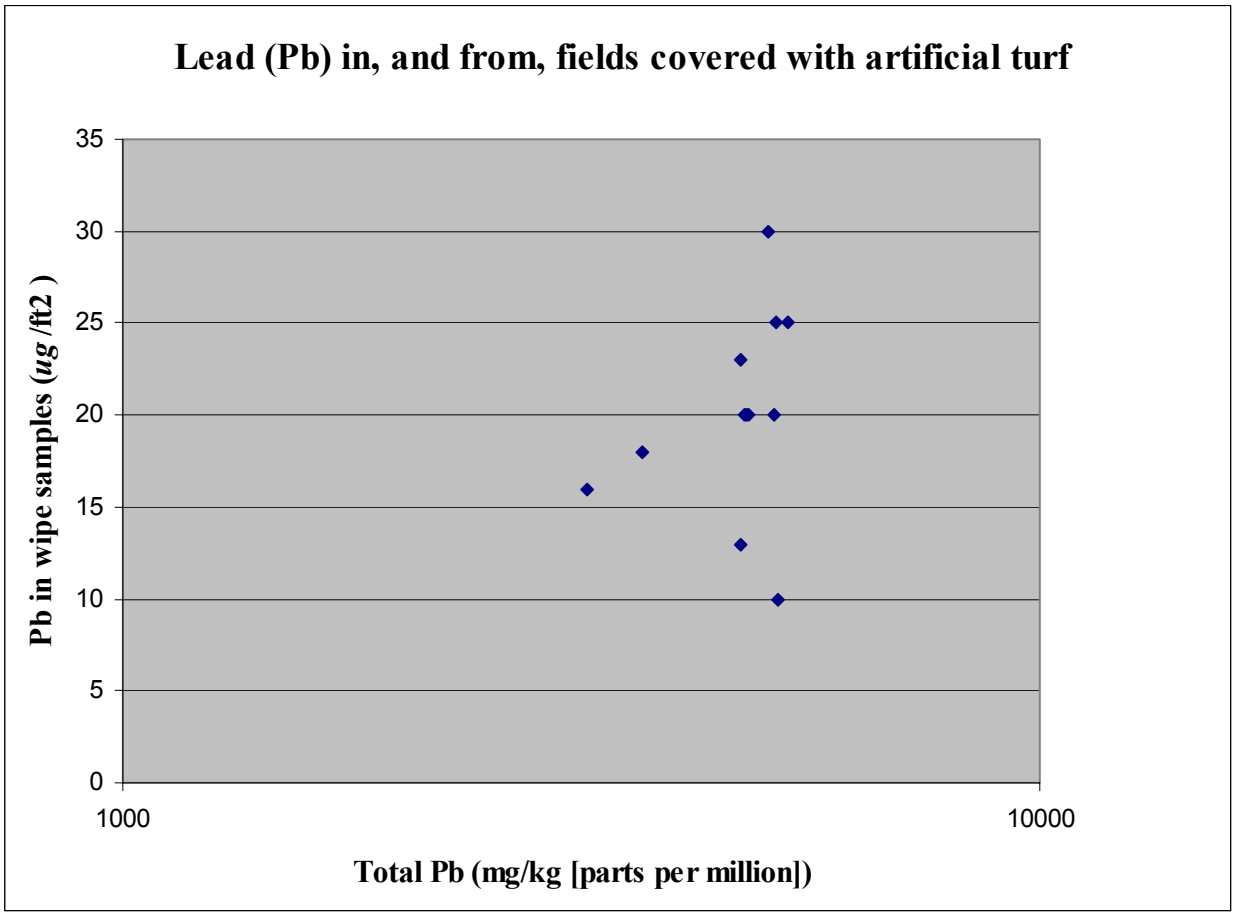
[1] Accessed from http://www.mass.gov/?pageID=eohhs2terminal&L=5&L0=Home&L1=Researcher&L2=Community+Health+and+Safety&L3=Environmental+Health&L4=Lead+Research+and+Statistics&sid=Eeohhs2&b=terminalcontent&f=dph_environmental_lead_r_screen_stats&csid=Eeohhs2 and related webpages.

Of course, the absence of known cases of elevated blood lead levels in children in Concord is no guarantee that there are no actual such cases, and it says essentially nothing about whether playing on an artificial turf field is safe. In order to address the latter issue, one needs to estimate the amount of lead that might be "liberated" from such turf when fields are in use, and then determine whether resultant doses might be harmful.

The lead content of the artificial turf field at issue in Concord is on the order of 0.04%, or 400 parts per million (ppm). The relevant metric for health risk assessment, however, is not the *total* amount of lead in plastic turf, but instead the amount of lead-containing dust and debris that can be readily removed from the surface of this turf, and thus potentially inhaled or ingested by people playing on this turf. The typical method for assessing this exposure is to wipe the turf surface using standardized procedures (ASTM Standard E1728), and then to quantify the amount of lead contained on these "wipe samples." Although no wipe samples were collected from the Concord field, data from wipe samples of two other artificial turf fields (one in Maine and one in New York) are informative. These data are depicted below.



As shown, total lead concentrations of the artificial turf samples were on the order of 3,000 to 5,000 ppm, and lead measured in wipe samples ranged from 10 to 30 micrograms per square foot ($\mu g/ft^2$). Since the total lead concentration of the turf in Concord is, as noted above, about 10 times smaller than those described above, it is likely that wipe samples from Concord turf would contain no more lead than 10 $\mu g/ft^2$, probably less. The question then becomes whether surficial lead levels of about 10 $\mu g/ft^2$ are acceptably small.

Health-based guidelines or standards for allowable concentrations of lead in dust from artificial turf have not been developed. A health-based standard does exist, however, for allowable concentrations of lead dust on floors inside of homes. This standard, set by the U.S. EPA (1998a and b; 2001), is 40 $\mu g/ft^2$. The standard is set to protect toddlers aged one to two years, who, with regard to both lead exposures and adverse effects on their developing brains, are more sensitive even than children three or more years of age. Furthermore, these toddlers are assumed to be in intimate contact with lead-dust-covered floors, 12 hours per day, 365 days per year. The types and frequencies of contact with turf by older children and adults would be quite different and result in much lower exposures, such that surface concentrations of lead on the order of several hundreds of $\mu g/ft^2$ would be safe.

Overall, then, the measured concentrations of lead in the artificial turf in Concord are not cause for concern. The data indicate that children or others playing on this field will not receive exposures to lead above and beyond the small exposures ubiquitous in Concord and other "low risk" (*per* above) towns.

Relevant evidence also indicates that surface water in contact with, or groundwater beneath, the artificial turf in Concord would not become contaminated with lead. Primarily, this is because (i) the concentration of *total* lead (about 400 ppm) in this turf is quite small, and (i) the amorphous silica shell in which the lead-based pigments are encapsulated would substantially minimize the solubilization of this lead (*per* research data reported by Pier *et al*. (1991) *Environmental Toxicology and Chemistry*, vol. 10, pp. 1247-1253). Of course, various site-specific factors will affect rates of rainwater run off and infiltration, quite apart from the individual components of the plastic fibers *per se*.

Finally, parents concerned that their children may be at risk for lead poisoning (from any source of exposure) can and should have their children's blood tested for lead. More generally, children should be protected from dust from renovation of homes built before 1950 (since leaded paint might be present), and parents and others should be wary of canned imported foods (since the cans, depending on their origins, might have been lead-soldered), various traditional "home remedies" (since some contain significant concentrations of lead), and other known or probable sources.

Extensive information on the Commonwealth's Childhood Lead Poisoning Prevention Program can be accessed at http://www.mass.gov/?pageID=eohhs2terminal&L=5&L0=Home&L1=Government&L2=Departments+and+Divisions&L3=Department+of+Public+Health&L4=Programs+and+Services+A+-+J&sid=Eeohhs2&b=terminalcontent&f=dph_environmental_lead_g_clppp_about&csid=Eeohhs2 or by telephoning Paul Hunter at 617-624-5757.

Sincerely,

Laura Green, Ph.D., D.A.B.T
Senior Scientist and President

Sarah R. Armstrong, M.S., D.A.B.T.
Senior Scientist

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