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TO: Kathy Ronchi, Health Officer, Douglas County Health Department

FROM: Robert Thiboldeaux, PhD, Senior Toxicologist

A handwritten signature in cursive script that reads "Robert Thiboldeaux".

SUBJECT: The Husky Refinery fire and environmental soil contaminants.

July 5, 2018

A number of residents living near the site of the Husky Refinery in Superior Wisconsin have expressed concerns regarding the possibility of downwind soil contamination following the April 26, 2018 fire at the facility. In particular, concerns have focused on smoke-related *polycyclic aromatic hydrocarbons*, or PAHs. Two main questions have been raised by residents:

- 1) Has my family or I been exposed to PAHs from the fire?
- 2) If PAHs get on my property, can they get into plants or livestock (meat, milk, eggs) and cause harm through that route?

While there is not information available about soil deposition of PAHs specific to the Husky fire, this memo seeks to address these concerns by summarizing information about where PAHs are found in the environment, how we are exposed to them, and how exposures may affect us.

**What are PAHs?** PAHs are a class of related chemicals that are produced when carbon-based fuels (wood, plants, animals, paper, coal, petroleum, plastics, etc.) are burned or heated. The chemical class is very large, with over 10,000 distinct structures. The types of PAHs formed during combustion vary with the fuel type and the conditions of combustion. However, most attention on PAHs by environmental and health scientists is on approximately 20 of the PAHs considered most toxic as carcinogens, and which may be found under any burning conditions.

**PAHs are widely found in the environment.** There has been wide international interest in understanding the location and concentration of PAHs in the environment, and from where people get their most important exposures. From *many* scientific studies published on the occurrence of PAHs in urban, industrial, agricultural, rural, and remote soil environments, environmental scientists have a pretty good idea of the concentration range and types of PAHs expected in various locations. Scientific studies also provide knowledge of the behavior of PAHs in the environment, including their persistence, uptake, metabolism, and whether one would expect to find PAHs in meat, milk, eggs, and plants.

The heating of food is our most important source of our exposure to PAHs. PAHs in grilled or charred meats are familiar and visible, but many are unaware that PAHs also form abundantly in heat-processed grains and vegetable oils, as well as coffee and other roasted seeds, or any other foods exposed to high

heat during cooking or processing. Based on surveys of the type and concentration of PAHs in food, soil, and air, it is possible to estimate the amount of our exposure from various sources. The Wisconsin Department of Health Services estimates that approximately 85% of our total PAH exposure comes from charred or heat-processed food. Most of the remainder of our exposure is split between what we breathe from air and what is found in soil. We are exposed to PAHs in soil when we inadvertently eat tiny amounts of soil or dust each day.

***What about uptake of PAHs from soil into crop plants and livestock?*** Research indicates that very little of our exposure to PAHs comes from milk and eggs. When fish, birds, or mammals eat PAHs in food or soil, the chemicals are metabolized, primarily in the liver, then are eliminated from the body. When animals are analyzed for the presence of PAHs in tissues, most are found in the liver and little if any in meat. The routes of elimination are mostly feces and urine, but some elimination can also occur through the fat in milk and eggs. Our potential for exposure to PAHs in milk varies, but from available studies our estimated exposure is approximately one-half of what we separately get from incidental exposure to soil, and much less than our normal exposure from other foods. PAHs are also found in bird eggs. Studies in both wild and domestic birds show that the presence of PAHs in eggs is widespread. The concentration in both wild and domestic bird eggs is similar to that found in milk fat.

Research indicates that very little of our exposure to PAHs comes from vegetables. The chemical properties of PAHs are such that they tend not to be taken up through the roots and sap of plants, but instead stick to soil particles and to the waxy exterior of plant roots. PAHs also break down in soil over time. The best way to avoid PAHs that may be transferred to plants from soil is to make sure food plants, particularly root crops, are properly washed and/or peeled. For people that garden in urban or former industrial areas that tend to have higher levels of various soil contaminants, it is a common practice to create raised beds supplemented with cleaner soils.

***How can PAHs affect our health?*** PAHs can be harmful when they are chemically altered, either through metabolism or sunlight, to a form that reacts with, and damages, our body's cells. Our bodies are adapted to metabolizing and eliminating small amounts of PAH exposure each day, but people that have larger, more frequent exposures have a greater risk of illness. For most people, exposure to PAHs occurs predominantly through food. However, much of what is known of the harm caused by PAHs comes from workers who regularly get PAHs on their skin or lungs in the form of tar and concentrated sooty dusts, and from people that purposely breathe PAHs in the form of tobacco smoke. Frequent exposure to concentrated PAHs on the skin in certain occupations can lead to "tar warts" that can develop into skin cancers. Lung, heart, and vascular problems develop over time in people that chronically breathe PAHs in the form of atmospheric particulates in smoke, vehicle exhaust, and stack emissions. Environmental air quality policies and rules are designed to protect the public from these sources of PAH exposure.

***What are the risks to gardens and agriculture in people living downwind from the Husky Refinery?*** Since we do not have soil data, it is impossible to make quantitative declarations of risk from PAH exposure in areas near the refinery. However, everything we know about PAHs from studies around the world tells us that some degree of daily exposure is unavoidable, and that most of our exposure is from

PAHs produced during flame cooking or high-heat processing of food. These conclusions also apply to urban and industrial areas where higher concentrations of PAHs are commonly found in soil.

The air monitoring and field work done immediately following the fire suggest that although there was a dramatic smoke plume formed by the burning asphalt, most of this likely dispersed over long distances rather than being deposited locally. By comparison, examples of regional air monitoring reported during large forest fires shows that air quality can be temporarily affected for hundreds of miles downwind due to the dispersion of smoke.

We do have information about air quality in the area in and around Superior, which was monitored by Husky, EPA, and DNR immediately following the fire and in the weeks following. Those using instruments to monitor air in the field also made regular visual surveys on uniform surfaces, such as fire hydrants, for the presence of soot-like deposits. The DNR field staff reported that soot deposition was not observed visually, suggesting that any soil sampling would be not be useful in distinguishing PAH deposition from the fire from any prior deposition. Based on these observations, and on what we know about the range of PAHs found in soil, we fully expect that any testing of soils in the areas both upwind and downwind from the Husky fire would be positive for PAHs. However, there would be many sources of those PAHs, and identifying any single source is typically impossible.

### ***Conclusions***

- PAHs from various combustion sources are widely dispersed in the environment. In the case of people living near the Husky fire, we cannot exclude the possibility that fire-related PAHs have deposited on area soils.
- Any soil testing would predictably find PAHs within the ranges reported in numerous published studies. However, common methods for testing soil would not distinguish current from past PAH deposition.
- PAHs in soil are a minor source of our overall exposure.
- **We do not have reason to believe soils or livestock in the areas downwind from the fire have been affected in any way that should alter gardening or farming practices or the use of agricultural products from those areas.**