



Citizens for Safe Water Around Badger
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September 18, 2023

SENT BY ELECTRONIC MAIL

RE: Badger Army Community-wide Groundwater Remedy Must Encompass PFAS

Dear WDNR Secretary Payne,

We are writing to ask the Wisconsin DNR to formally require the U.S. Army, as a Responsible Party, to incorporate **PFAS and other emerging contaminants** in the pending community-wide groundwater remedy selection and environmental investigations at and near the former Badger Army Ammunition Plant (Badger) lands in Sauk County, Wisconsin.

Our request is consistent with the August 17, 2020 WDNR reminder letter to the U.S. Army at Badger to include evaluation of emerging contaminants in site investigations. The stated purpose of the letter was to remind the Army that it must assess emerging contaminants and their potential impacts **as early in the cleanup process as possible, preferably during the site investigation phase**. Emerging contaminants include perfluoroalkyl and polyfluoroalkyl substances (**PFAS**), 1,4-dioxane and others, the WDNR directive stipulates.

Our request is further consistent with the Department's September 9, 2020 letter to the Army Environmental Command Midwest Services Division that affirms the agency's opinion that there is "considerable uncertainty regarding potential discharges of PFAS" at and near Badger.

However, the Army's proposed remedial action plan for community-wide groundwater contamination submitted to the WDNR in August 2023 **omits PFAS altogether**. As result, the Army has failed to defined the degree and extent of PFAS and other emerging contaminants in groundwater – our sole source of drinking water.

Additionally, the Army's preliminary PFAS site assessment (March 2020) was very narrowly focused on the historical use of Aqueous Film Forming Foam (AFFF), a fire suppressant used to extinguish flammable liquid fires such as fuel fires. However, our review of public records documents a number of **additional** potential sources of PFAS at Badger.

Therefore, we also request that the assessment of PFAS be **expanded** to address the following historical sources and activities at Badger documented in available public records:

Manufacture, Treatment, Storage and Disposal of Rocket Propellant

From the early 1940s to the early 1980s, open burning operations at the Propellant Burning Grounds in the **Town of Sumpter** were marked by the combustion of materials in open pits and piles placed directly on the ground. **Other material was frequently mixed with the rocket propellant waste, and no consistent records were kept** of the material types quantities burned during these early operational years.¹ This uncontrolled burning led to the rapid transport of the material directly through the sandy soil strata, resulting in high concentrations released to the groundwater.²

The open burning of rocket propellants and other off specification waste material was the focus of the Army's 1992 health risk assessment for past and future open burning of energetic waste at Badger. The materials burned included plant products M1, NACO, M6, DIGL-RP, AA2 paste, MS mortar, JA2, M31A1E1, **N34**, WC846, WC844 and WC870.³

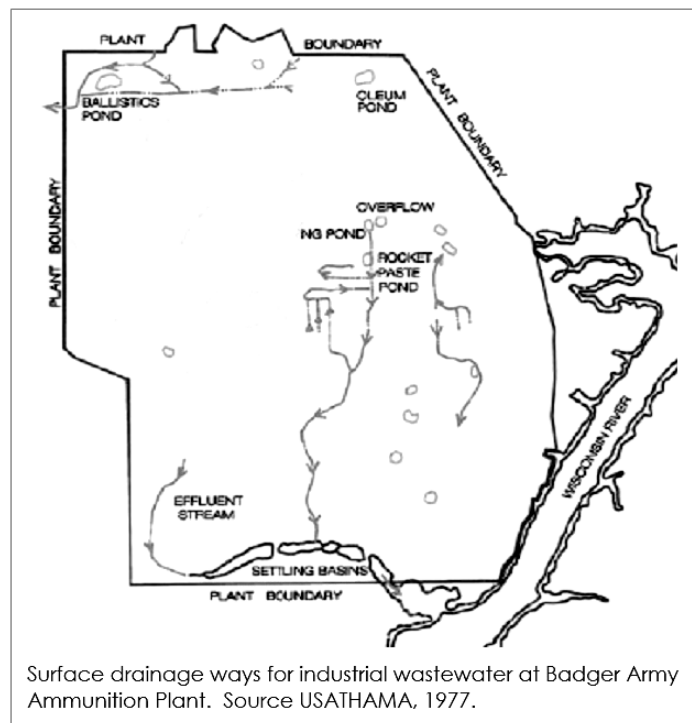
The N34 Rocket is a specific solventless double-base propellant with a nominal composition of 50% nitrocellulose, 40% nitroglycerine and 10% other ingredients. The shape is cylindrical small or large rods, depending on the product that was produced.⁴

According to the Army's 1992 health risk assessment, the composition of Badger's N 34 - 5" propellant was 49.5% Ammonium perchlorate, 15.0% Teflon (**PFAS**), 15.0% Viton (**PFAS**), 19.5% Aluminum and 1.0% NaF.⁵

In the case of solid propellants, the processing technologies are generally extrusion, casting and pressing. Extrusion technology has been extensively used for double-based propellants. The use of thermoplastic elastomers like **Viton** and **Teflon** resulted in the development of extruded composite propellant grains with higher density.⁶

In 2018, Army sampling detected the **highest concentrations of PFAS in groundwater at the southern plant boundary** near Settling Pond #2 – the site of the underground fire in 2020 ignited by a prescribed burn conducted by the **Wisconsin Department of Natural Resources**.

Moreover, during active production years, industrial wastewater and surface water runoff from the Rocket Paste Area was **discharged directly to Settling Pond #2** and other nearby basins.



Handling, Treatment, Storage and Disposal of High Explosives

While Badger's principal mission was the production of propellants, evidence of high explosives contamination is reported as early as 1987.⁷ Boreholes drilled in Burning Pad #1 (at the Propellant Burning Grounds) had levels of TNT (trinitrotoluene), 2,4-DNT (dinitrotoluene), and/or 2,6-DNT between 1 and 10 ppm (parts per million) at various depths down to 20 feet.⁸ One sample beneath Pad #1 contained 2.5 ppm of the explosive **HMX** (1,3,5,7-tetranitro-1,3,5,7-tetraazacyclo-octane).

The explosive **RDX** (1,3,5-Trinitro-1,3,5-triazacyclohexane) was discovered in several borehole soil samples from **10-40 feet**.⁹

The 1989 Health and Safety Plan prepared for the U.S. Army Toxic and Hazardous Material Agency identified 2,3,6 -TNT and RDX as hazardous compounds detected at Badger.¹⁰ High explosives are cited as a contaminant in soils at the Propellant Burning Ground and Landfill #1. Reported maximum concentrations of **HMX**, **RDX**, and TNT were 2,100 ug/kg, 1,400 ug/kg, and 4,200 ug/kg respectively.¹¹ Other historical references to TNT disposal at Badger include correspondence to the Wisconsin State Board of Health in 1942, and again referenced in 1987.¹²

The detection of HMX and RDX is significant as high explosives are known to contain **PFAS binders and plasticizers** such as Teflon (polytetrafluoroethylene), Kel-F (polychlorotrifluoroethylene) and Viton (fluoroelastomer).¹³



Handling, Treatment, Storage and Disposal of Military Pyrotechnics

Military pyrotechnics are mixtures of solid or liquid fuels and oxidizers (often in the form of perchlorate salts) which, when ignited, undergo an energetic chemical reaction at a controlled rate intended to produce specific time delays or quantities of heat, noise, smoke, visible light, or infrared radiation.¹⁴ A number of references to pyrotechnic materials at Badger were found.

Propellants, explosives, and pyrotechnics were burned in Badger's Contaminated Waste Processor.¹⁵ Incineration of Propellant/Explosives and Pyrotechnics (PEP) is also mentioned in association with this facility in Badger's Environmental Assessment for total plant operations¹⁶ and in Army reports to the U.S. Environmental Protection Agency.¹⁷

A separate decontamination oven at Badger was also used for flashing equipment that was contaminated with possible propellants, explosives, and PEP.¹⁸ Pyro mixed acid, identified as a PEP, was stored at the New Acid Area Production Facility Complex at Badger.¹⁹ Proposed Solid Waste Management Unit No 66 – Building Number 709 – was designated in Army documents as a “pyro spent store” facility.²⁰

Historical demilitarization operations at Badger involved the salvaging of obsolete powder and/or propellants that no longer met required ballistic characteristics. Those items that could not be salvaged or were by-products of the salvage operation (deterrent, bags, etc.) were burned on the burning pads. Types of demilitarized munitions included obsolete small arms, rifle and cannon powders, with and without ignitor trains.²¹

These activities are potentially significant as pyrotechnic compositions contain oxidizers and fuels.²² Additional ingredients present in most of these compositions include **binding agents, retardants, and waterproofing agents.**²³

Handling, Treatment and Disposal of Imported Off-site Hazardous Materials and Wastes

In 1943, **reclamation of damaged powder** shipped from munitions loading facilities to Badger was started. Approximately 600,000 pounds of reclaimed powder was ultimately stored at the facility by September 1943. As Badger was historically one of the few facilities in the U.S. that could recycle nitrocellulose-based energetics, former workers report that this was a common occurrence over the life of the plant.

Landfills and Burning Grounds in the Town of Merrimac

When compared to other areas, there has been **no commensurate testing** for PFAS at and near the northeast corner of Badger in the Town of Merrimac despite the abundance of known hazardous waste sites.

In addition to the unlined Deterrent Burning Ground pits, other nearby potential sources of PFAS include Landfill #3 which received coal ash, construction rubble, trash, and burned garbage and Landfill #5 which received solid waste and coal ash from the power plant between 1979 and 1988.²⁴

The Deterrent Burning Ground (DBG) area consists of seven acres and is located in the northeastern portion of Badger. The DBG area was used as a sand borrow pit from the 1940s until the early 1960s, and a **waste disposal site from the 1940s to the 1970s**. The DBG consisted of **open burn areas on the bare ground** within a manmade depression approximately three acres in size and 20 feet deep.

Coal ash from the power plant, construction rubble, trash, and burned garbage were deposited in Landfill #3, which is part of the DBG. Landfill #5 is located to the northeast of the DBG. During operations, the landfill reportedly received solid waste, including office waste, demolition debris, laboratory waste, and coal ash from the power plant between 1979 and 1988 – all of which are potential sources of PFAS.

DBG Site A is a former pit located in a cornfield approximately 500 ft east of the DBG. The area is not identified in the Badger Environmental Baseline Survey (Plexus Scientific Corporation, 1999), but the Army recognizes the site based on plant operational history and experience. The DBG Site A pit is believed to have been created during the Korean conflict (1950's). **Its intended use is "unknown".**²⁵

Between 2002 and 2012, most of the structures at the Badger were demolished and placed into the on-site Landfills 3118 and 3646, located on the east-central portion of Badger in the Town of Merrimac. Demolition activities included: removal of all **process chemicals, equipment, piping, process and storage tanks, munitions and explosives**. PFAS would be an expected contaminant of concern associated with these waste streams.

Source Area Soils

On June 28, 2012, the WDNR made a determination concerning the final remedy for community-wide groundwater which included monitored natural attenuation – one of the remedies proposed in the Army’s current draft plan.

Among the most significant conditions of approval, the WDNR required an investigation of the contaminants retained in source area soil associated with the three (now four) identified contaminant groundwater plumes. Condition #9 specifies that the Army shall conduct “adequate saturated and unsaturated soil sampling, for all appropriate parameters, within the PBG, the DBG and central plumes **to determine the nature and extent of site contaminants adsorbed onto the soil.**”

This study was deemed essential in the WDNR’s 2012 approval because “back-diffusion of adsorbed waste constituents appears to be a major contributor to the groundwater plumes’ stability, fully characterizing the adsorbed waste mass is necessary to evaluate natural attenuation as a possible remedial alternative.”²⁶

To the best of our knowledge, the requested investigation of source area soils has **not** been conducted for the known contaminants of concern (primarily explosives and volatile organic compounds) nor PFAS and other emerging contaminants.

Groundwater is our Drinking Water

Per- and polyfluoroalkyl substances (PFAS) are toxic man-made chemicals that are very persistent and mobile in the environment, creating huge groundwater contaminant plumes that readily migrate miles from source areas. Exposure to certain forms of PFAS is associated with low infant birth weights, effects on the immune system, cancer and thyroid hormone disruption.



In September 2018, **more than 100 people**, including members of the **local Restoration Advisory Board**, co-signed a resolution organized by CSWAB asking that the Army test all public and private drinking water systems within a four-mile radius of Badger for PFAS. The resolution also asked that the Army include PFAS analysis in its then-upcoming testing of approximately 300 residential wells near the former military base. **The requested testing never occurred.**

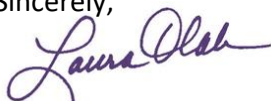
In June 2022, the U.S. EPA issued a drinking water health advisory of only 0.02 ppt for PFOS – far below the detected 14 ppt in groundwater monitoring wells near homes on Keller Road in Sumpter Township.

On August 19, 2022, CSWAB spoke with officials with the **U.S. Army Environmental Command** in Fort Sam Houston, Texas to consider off-site private well testing for PFAS. The Army confirmed that the exceedance of Regional Screening Levels for groundwater triggers a requirement for additional study at Badger and a formal Remedial Investigation is planned. Officials said that the expanded study would be initiated in 2023 consistent with the Army's funding cycle.

Today, the **degree and extent of contamination remains undefined** and the Army has still not conducted any drinking water or groundwater sampling for PFAS **outside the plant boundary**.

For all these reasons, we request that the WDNR take immediate steps to assure that (1) drinking water wells near Badger are regularly and promptly tested for PFAS and other emerging contaminants, and (2) that the pending site-wide groundwater remedy selection and all environmental investigations fully encompass ALL potential sources for PFAS and other emerging contaminants at and near the former Badger Army Ammunition Plant.

Sincerely,



Laura Olah, Executive Director

¹ U.S. Army, Olin Corporation, Eder Associates Consulting Engineers, *Health Risk Assessment for the Open Burning Facility at Badger Army Ammunition Plant*, March 1992.

² U.S. Army, Olin Corporation, Eder Associates Consulting Engineers, *Health Risk Assessment for the Open Burning Facility at Badger Army Ammunition Plant*, March 1992.

³ U.S. Army, Olin Corporation, Eder Associates Consulting Engineers, *Health Risk Assessment for the Open Burning Facility at Badger Army Ammunition Plant*, March 1992.

⁴ Olin Corporation, Engineering Report, CONTAMINATED WASTE INCINERATOR MODIFICATION STUDY, August 1995.

⁵ U.S. Army, Olin Corporation, Eder Associates Consulting Engineers, *Health Risk Assessment for the Open Burning Facility at Badger Army Ammunition Plant*, Table A-1, March 1992.

⁶ H. Singh, H. Shekhar, *Solid Rocket Propellants: Science and Technology Challenges*, Royal Society of Chemistry, 2019.

⁷ U.S. Army Toxic and Hazardous Materials Agency. *Installation Assessment of BAAP*, May 1977, Page II-1.

⁸ A.T. Kearney, *Revised Preliminary Review BAAP*, April 13, 1987, page 16 (Investigation of Soil Contamination at the Open-Burning Ground, BAAP, May 8-15, 1984, US Army Environmental Hygiene Agency).

⁹ A.T. Kearney, *Revised Preliminary Review BAAP*, April 13, 1987, page 16 (Investigation of Soil Contamination at the Open-Burning Ground, BAAP, May 8-15, 1984, US Army Environmental Hygiene Agency).

¹⁰ E.C. Jordan, U.S. Army Toxic and Hazardous Material Agency, *Phase I Remedial Investigation BAAP Final Health and Safety Plan*, page 2-3 & Appendix B, January 1989.

¹¹ E.C. Jordan, U.S. Army Toxic and Hazardous Material Agency, *Phase I Remedial Investigation, BAAP, Final Health and Safety Plan*, Table 2-1, January 1989.

¹² BAAP, June 15, 1942 and July 3, 1942 letters to State Board of Health regarding disposal of TNT wastes. (Also referenced in A.T. Kearney, *Revised Preliminary Review BAAP*, page 67, Reference 110, April 13, 1987.)

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- ¹³ J. Akhavan, *The Chemistry of Explosives*, Table 1.2, 2001.
- ¹⁴ Canadian Department of Foreign Affairs and International Trade, Definitions of Terms used in Groups 1 and 2, "Military Pyrotechnics", http://www.dfait-maeci.gc.ca/~eicb/export/gr1_2dfe.htm#Milp, April 10, 2002.
- ¹⁵ A.T. Kearney, *Revised Preliminary Review BAAP*, April 13, 1987, page 36.
- ¹⁶ Department of Army Headquarters, U.S. Armament, Munitions, and Chemical Command, *Environmental Assessment for Total Plant Operations, BAAP*, July 1983, page 50.
- ¹⁷ March 28, 1985 BAAP correspondence to K. Klepitsch, USEPA, Attachment 1, BAAP Solid Waste Management Units, page 4.
- ¹⁸ March 28, 1985 BAAP correspondence to K. Klepitsch, USEPA, Attachment 1, BAAP Solid Waste Management Units, page 5.
- ¹⁹ BAAP, Environmental Assessment, Table IV-B, 1983.
- ²⁰ A.T. Kearney, *Revised Preliminary Review BAAP*, April 13, 1987, page 4.
- ²¹ Department of Army Headquarters, U.S. Armament, Munitions, and Chemical Command, Environmental Assessment for Total Plant Operations, BAAP, July 1983.
- ²² Department of the Army Technical Manual, TM9-1300-214, *Military Explosives*, Sept 1984, page 10-1.
- ²³ Department of the Army Technical Manual, TM9-1300-214, *Military Explosives*, Sept 1984, page 10-1.
- ²⁴ U.S. Army Environmental Command, REMEDIAL INVESTIGATION/FEASIBILITY STUDY FOR SITE-WIDE GROUNDWATER AT THE FORMER BADGER ARMY AMMUNITION PLANT, BARABOO, WISCONSIN, June 2021.
- ²⁵ U.S. Army, Draft Groundwater Investigation Report Deterrent Burning Ground, Badger Army Ammunition Plant January 3, 2003.
- ²⁶ Wisconsin DNR, Bureau for Remediation and Redevelopment, *Final Determination of Feasibility for an Alternative Groundwater Remedial Strategy at and near the Badger Army Ammunition Plant*, Page 5, Condition 9, June 28, 2012.