PESTICIDES

Key Takeaways

As you will see below, monitoring groundwater for pesticides contamination is very important for human and environmental health. A DATCP review of data from samples it collected statewide from 2008 through 2016 revealed an increased occurrence of detections of neonicotinoid insecticides in samples collected from monitoring wells, irrigation wells, private wells, and surface water samples.

GCC member agencies continue to work on multiple initiatives related to reducing pesticides in groundwater (see groundwater management sections – DNR, DATCP, UWS).

For actions to address pesticides contamination in groundwater, see the Recommendations Section.

Sections in this document

What are pesticides?

Pesticides are a broad class of substances designed to kill, repel or otherwise disrupt living things that are considered pests. They include insecticides, herbicides, fungicides and anti-microbials, among other types of biocides. Normal field applications, spills, misuse or improper storage and disposal can all lead to pesticide contamination in groundwater. As pesticides breakdown in soil and groundwater or are absorbed and metabolized by the target pest, some are converted into related compounds called metabolites, which may also be harmful to the pest or other living things.

Pesticide application sign. Photo: DATCP.

What are the human health concerns?

The health effects of exposure to pesticides or pesticide metabolites vary by substance. About 30 pesticides (and some pesticide metabolites) currently have ch. NR 140 groundwater quality standards (WI NR 140.10), and a smaller number have an established maximum contaminant level (MCL), applicable at public drinking water systems (WI NR 809.20). However, at least 90 different pesticides are used on major crops in Wisconsin[1] . Occasionally,

pesticides and pesticide metabolites that do not have a NR 140 groundwater quality enforcement standard (ES) or public drinking water MCL are detected in drinking water supplies, and information on the health effects of these pesticide compounds is often very limited or difficult to evaluate. It is also difficult to predict the health effects of multiple pesticides in drinking water; several studies have indicated that pesticide mixtures can have different health effects than exposure to individual pesticides at the same concentrations[2,3].

Commonly detected pesticides and their metabolites which have established groundwater quality or drinking water standards in Wisconsin include atrazine, alachlor, metolachlor, and acetochlor.

Atrazine is an herbicide commonly used on corn. The groundwater quality ES for atrazine and its three chlorinated metabolites is 3 parts per billion (ppb). The drinking water MCL for atrazine (does not include metabolites) is 3 ppb. A number of epidemiological and animal studies have been conducted evaluating the potential health and environmental impacts from atrazine exposure[3-10] . People who drink water containing atrazine in excess of health-based standards over many years could experience problems with their cardiovascular system or reproductive difficulties.

Alachlor is an herbicide used on corn and soybeans. Use of alachlor in Wisconsin has been replaced by other herbicides in the same family[11,12] (e.g., metolachlor, acetochlor), however, its metabolites still linger in groundwater. Both the groundwater quality enforcement standard (ES) and public drinking water MCL for alachlor are 2 parts per billion (ppb), and the groundwater quality ES for one of its metabolites, *alachlor ESA*, is 20 ppb. People who drink water containing alachlor in excess of health-based standards over many years could have problems with their eyes, liver, kidneys or spleen, may experience anemia, and may have an increased risk of getting cancer.

Metolachlor is an herbicide used widely on corn and soybeans, and on vegetable crops including peas, snap beans and potatoes. Both the parent, metolachlor, and metabolite forms, metolachlor-ESA and metolachlor-OXA, are routinely detected in groundwater. Health-based groundwater quality standards have been established for these compounds. The groundwater quality ES for metolachlor is 100 ppb, and the groundwater quality ES for metolachlor-ESA and OXA combined is 1,300 ppb. Although metolachlor and its metabolites are commonly detected in groundwater, the concentrations detected are typically well below their respective ESs.

Acetochlor is an herbicide used for pre-emergent control of weeds in corn. The state groundwater quality ES for acetochlor is 7 ppb. A groundwater quality ES of 230 ppb has also been established for the combined acetochlor metabolites, acetochlor ESA and acetochlor OXA. No public water supply MCL has been established for acetochlor or its metabolites. Animal studies have shown that oral exposure to acetochlor can produce significant neurological effects[13]. Acetochlor has been classified by the EPA as a "suggestive human carcinogen".

How widespread are pesticides in Wisconsin?

In Wisconsin, the main source of pesticides in groundwater is agricultural herbicide and insecticide applications. For this reason, detection is more common in highly cultivated areas where agriculture is well established, notably in the south central, central and west-central parts of the state.

In 2016, DATCP conducted a statewide statistical survey of agricultural chemicals in groundwater that found an estimated 41.7% of private wells in Wisconsin contained a pesticide or pesticide metabolite[14], up from 33% of private wells in a similar survey conducted in 2007[15]. The primary metabolites of metolachlor and alachlor, metolachlor ESA and alachlor ESA, were the two most commonly detected pesticide products in those surveys. Atrazine and its metabolites, known collectively as the total chlorinated residues of atrazine (atrazine TCR), were also prevalent and occurred in about 23% of wells. Less than 1% of well samples with atrazine TCR detections had atrazine TCR levels that exceeded the groundwater quality ES of 3 ppb. DATCP is currently in the process of conducting a new statewide survey of agricultural chemicals in groundwater.

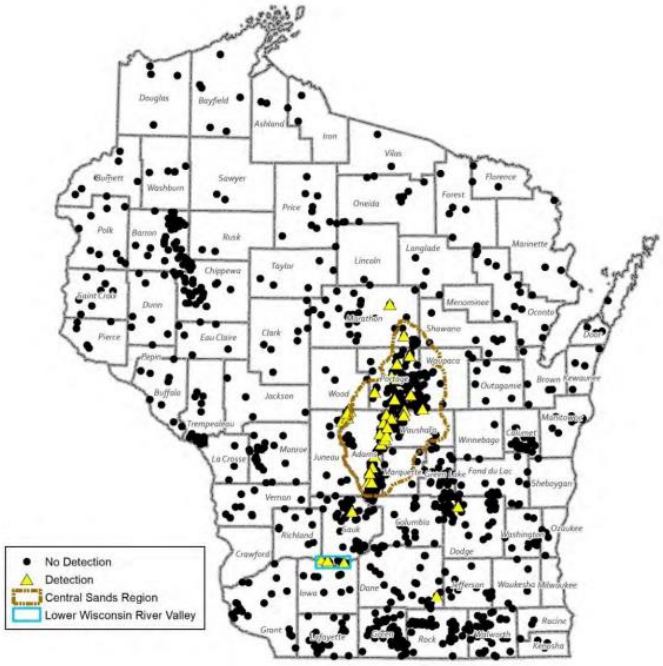
The past three decades have seen increased use of neonicotinoid insecticides. A FY20-FY21 project by UW-Stevens Point conducted sampling for neonicotinoid insecticides in groundwater-fed streams. Two sampling methods - traditional grab samples and time-integrative POCIS (polar organic compound integrative samplers) samples were collected, with findings that grab samples at baseflow conditions and POCIS samples provided similar results. The authors also constructed a linear regression model of the percentage of the entire groundwater contributing area that was agricultural land proximate to the sampled streams. It was found that this model explained about 60% of the variation in neonicotinoid concentrations. This suggests that neonicotinoid concentrations will continue to increase in groundwater-fed streams over the next several decades.

How is pesticides contamination trending over time?

Many sampling programs initiated by DATCP, the DNR and other agencies in the mid-1980s to early 1990s are still ongoing today. The longest running sampling program for pesticides began in 1985 and is designed to evaluate the potential impact of agriculture on groundwater quality by sampling monitoring wells near selected agricultural fields in areas with high groundwater contamination potential. Testing in this program confirms that the metabolites of metolachlor and alachlor are the two most common pesticides products detected in groundwater near the monitoring well sites.

A DATCP review of data from samples it collected statewide from 2008 through 2016 revealed an increased occurrence of detections of neonicotinoid insecticides in samples collected from monitoring wells, irrigation wells, private wells, and surface water samples.

DATCP reported detections of the neonicotinoid insecticides clothianidin, imidacloprid and thiamethoxam in samples from monitoring wells, irrigation wells, and private wells tested, with most detections occurring in sandy irrigated vegetable growing areas in the Central Sands region and on terraces of the Wisconsin River Valley[16]. This review also reported that out of 34 streams sampled statewide, multiple detections of imidacloprid and thiamethoxam were reported year-round in two streams also located within the Central Sands region. Concentrations of total neonicotinoids detected in these streams pose significant concerns for aquatic invertebrates and other non-target aquatic species present in the streams. The report detailing the findings of DATCP's review was shared with U.S. EPA as they continue to evaluate the role that these compounds may have in declining pollinator populations nationwide.



Locations of neonicotinoid detections in all potable wells sampled - 2008 through 2016.

Another study that has been repeated annually since 1995 focuses on re-sampling wells that once previously exceeded a pesticide standard. Over 160 wells have been sampled multiple times in this program, and over time, atrazine levels have been shown to decline in about 80% of the wells[17]. Many of these wells are located in what are now atrazine prohibition areas and the declines are likely the direct result of restrictions placed on the use of this pesticide in these areas.

DATCP has also conducted a statewide, statistically designed survey of agricultural chemicals in Wisconsin groundwater five times since the early 1990s (1994, 1996, 2001, 2007 and 2016). In 2016, nearly four hundred samples from private drinking water wells were analyzed for 101 pesticide compounds, including 70 herbicides, 26 insecticides, 4 fungicides and 1 pesticide safener. Health standards have been established for 27 of the compounds analyzed. In addition to capturing the current picture of agricultural chemicals in groundwater, this series of studies relates these findings to land use and compares results of the 2016 survey to those of previous surveys. The final report of the results of the 2016 survey was published in early 2017[14]. Starting in March 2023, DATCP initiated a new statistically random sampling survey of agricultural chemicals in groundwater utilizing private well samples collected from homes across the state. This survey is currently in progress and is

expected to be completed by September 2023. Publications of DATCP agricultural chemical in groundwater surveys are available on the web at: *https://datcp.wi.gov/Pages/Programs_Services/GroundwaterReports.aspx*

DATCP began oversight of a Stipulated Agreement and Special Order between DATCP and Bayer CropScience (BCS) related to the limited use of the BCS pesticide isoxaflutole in Wisconsin. Isoxaflutole is a relatively new corn herbicide that has a high likelihood of leaching into groundwater. The Stipulated Agreement allows for its use on corn grown in just 12 counties (Columbia, Dane, Dodge, Fond du Lac, Grant, Green, Jefferson, Lafayette, Rock, Sauk, Walworth, and Waukesha) while BCS performs specific studies over eight years that are intended to evaluate the potential for surface or groundwater impacts. In 2019 Bayer completed isoxaflutole and isoxaflutole metabolites monitoring at the surface water tile drainage sampling sites in areas that received isoxaflutole applications. BCS also concluded groundwater monitoring at three of the eight sites that received at least two applications of the pesticide over a multi-year study period. BCS is currently still sampling groundwater at the five remaining study sites. This monitoring is anticipated to be concluded in October 2023.

Further Reading

- DHS resources for contaminants in drinking water
- DNR overview of pesticides in drinking water wells
- DATCP water quality reports
- DATCP Home Groundwater Standards for Pesticides

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