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2019 Field-Edge Groundwater Monitoring Program

ANNUAL REPORT

Wisconsin Department of Agriculture, Trade and Consumer Protection

Agricultural Resource Management Division

Environmental Quality Unit

Final (2-16-2021)

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Introduction

In 2019, the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) Agrichemical Management (ACM) Bureau continued the Field-Edge Groundwater Monitoring Program to document the effect pesticide use is continually having on groundwater quality. Groundwater monitoring was performed for a network of monitoring wells at 24 established locations. At each station, depth to groundwater measurements are recorded and samples are collected in the spring and the fall to evaluate seasonal variations. Samples are collected by DATCP staff and submitted to DATCP's Bureau of Laboratory Services (BLS) for chemical analysis. This report has been prepared to document 2019 program activities, and includes a summary of groundwater level measurements and analytical data results. Recommendations for 2020 Field-Edge Groundwater Monitoring Program plan based on 2019 and historic results are also presented in this report.

Purpose of Field-Edge Groundwater Sampling

It is estimated that agriculture contributes $105-billion annually to Wisconsin's economy. Growers in Wisconsin use millions of pounds of pesticides and millions of tons of fertilizers annually to grow a wide variety of crops. DATCP's Field-Edge Groundwater Monitoring Program is one form of monitoring the agency performs to meet its statutory obligation to protect groundwater quality. Wisconsin's groundwater law, chapter 160, Wis. Stats., requires agencies to sample and monitor groundwater for substances related to facilities, activities and practices under their jurisdiction, that have a reasonable probability of entering the groundwater resources of the state, and to determine whether preventive action limits (PAL) or enforcement standards (ES) have been exceeded at points of standard application. The statute further specifies that agencies develop monitoring plans that include provisions for conducting four types of monitoring: problem assessment, regulatory, at-risk and management practice monitoring (§160.27; §160.05).

The purpose of the Field-Edge Groundwater Sampling Program (Program) is to evaluate agricultural practices and chemical uses on groundwater quality. Depth to groundwater measurements and groundwater sample analysis are used to measure affects from agrichemical use within and adjacent to agricultural fields. Impacts to groundwater quality from agrichemical use is dependent on conditions at each location. Results are used to measure both localized and regional impacts to aquifers over time at each field-edge sampling site. Historic and current goals of the Program include the following:

- To provide an early warning system to detect new agrichemical compounds in groundwater before widespread contamination can occur in underlying aquifers;
- To identify and measure pesticides that may have a potential to migrate to groundwater and exceed groundwater quality standards;
- To identify which environmental conditions (i.e. depth to groundwater, soil type, and geologic setting) are most vulnerable to impacts from routine agrichemical use;
- To gather and compile data regarding the occurrence and persistence of pesticide and metabolites in groundwater that may impact drinking water wells so that health based groundwater quality standards can be established;
- To study the dissipation of restricted use pesticides (i.e. atrazine) in groundwater after prohibition areas are established or use is restricted, and the dissipation of pesticides no longer in use (i.e. aldicarb);
- To gather and compile long-term data on nitrate contamination in groundwater and its relationship to application practices; and
- To evaluate impacts to groundwater quality from various land uses and related pesticide use (tree nurseries, infiltration basins, golf courses).

Approach of Program

The Program's groundwater monitoring network consists of wells installed at 24 strategic locations around the state. DATCP and the property owner typically have access agreements, which allow DATCP to install and access wells for sample collections. Typically, a monitoring well nest consists of shallow wells intersecting the water table and adjacent deeper wells (piezometers) installed at deeper depths within the underlying aquifer. These well nests are installed at the edge of an agricultural field to measure potential impacts from routine agrichemical use. Well locations were carefully selected to avoid interference from other potential sources (i.e. septic systems).

Over time, monitoring well nests have been installed in a variety of geologic settings, often in areas prone to groundwater contamination, such as areas with sandy soil, shallow depths to bedrock, or shallow groundwater. Nested well locations typically have up to five monitoring wells; the shallowest well intersects the water table with piezometers installed at deeper intervals. Table 1 in Appendix A provides construction specifications for each well in the Program's groundwater monitoring well network. Figure 1 in Appendix B depicts the Program's monitoring locations relative to State of Wisconsin and county boundaries.

Program data collection and documentation are completed in accordance with established protocols and guidance. Depth to water measurements and sample collection procedures are designed to collect reliable data consistently and in an unbiased fashion to ensure that localized conditions and regional impacts to aquifers over time can be evaluated. Water level measurements are recorded in field notebooks, and these measurements along with laboratory results are retained in databases maintained by DATCP.

Standard operating procedures for groundwater sampling include the following:

- After unlocking the protective casing, removing the well cap, and allowing time for potential internal well pressurization to equilibrate, the depth to water is measured and recorded at each well.
- Each well is then properly purged to remove a minimum of four well casing volumes. Purging is performed either by using dedicated bailers and rope, peristatic pumps (low flow) with dedicated tubing, or submersible electric pumps (whale pumps) with dedicated tubing, and the volume of water removed is measured and recorded in the field log book.
- Samples are then collected and placed in laboratory provided containers using either sampling equipment dedicated to the well, or with equipment that is decontaminated prior to use.
- Samples are placed in coolers and held on ice while in transport to the laboratory.
- Water purged from the wells and any rinse water used for cleaning is discarded on the ground surface.
- Field information recorded in log books is maintained by ACM staff.

Groundwater samples are collected using the same equipment used for purging. Samples are collected in one-liter amber glass bottles provided by BLS (20 millimeter plastic containers were also used for select glyphosate sampling). Bottles and containers are then placed in a cooler and held on ice along with a properly completed sample collection record and hand-delivered to BLS within 48 hours. During the 2019 Program, there were no issues with shipping or bottle breakage.

BLS performed all groundwater analytical testing using GC/MS/MS and LC/MS/MS methods in accordance with ISO 17025 accreditation standards. All samples were tested for 104 pesticide analytes as well as nitrogen as nitrate and nitrite (reported as total nitrogen). New in 2019, select samples (31 of 101 samples) were also analyzed for glyphosate and two of its metabolites, AMPA (aminomethylphosphonic acid) and glyphosate ammonium. Pesticide analytes are listed in Table 2 of Appendix A along with corresponding reporting limits. A summary of the 2019 program analytical data is listed in Table 3 of Appendix A. Individual monitoring well or piezometer analytical reports are available upon request.

DATCP provides annual program findings documentation for each site to the respective property owner or grower. The summary letters provide the year's water level data and analytical results, and includes a brief discussion of data trends over time. As part of the letter, growers are asked to reply with information regarding crops grown, pesticide use and the amount of nitrogen applied to the fields near monitoring wells.

Assets and Infrastructure of Program

The current groundwater monitoring network for the Field Edge Monitoring Program is comprised of 73 groundwater monitoring wells (31 water table observation wells and 42 piezometers) at 24 locations around the state. Table 1 in Appendix A list the well construction specifications associated with these Program assets. Figure 1 in Appendix B depicts the Program's monitoring sites relative to State of Wisconsin and county boundaries. Construction logs (and abandonment forms) associated with the groundwater monitoring wells and piezometers are available upon request.

1985-1989 ORIGINAL MONITORING WELLS AND PIEZOMETERS

The DATCP Field-Edge Groundwater Monitoring Program began in 1985. Initially, arrangements with growers and land owners at 50 sites were established in areas highly susceptible to groundwater contamination (i.e. coarse soil over sand, shallow to groundwater and/or irrigated agricultural areas). Groundwater monitoring nests of three to four wells were installed at each site. Nested wells were constructed with well screens placed at various depths in the underlying aquifer. These wells were constructed adjacent to agricultural fields in the central sands region, Lower Wisconsin River Valley, and at other sandy soil areas throughout the state. The original Field-Edge Study was designed for the collection of groundwater samples from the uppermost shallow aquifer. Samples were tested for agrichemicals and fertilizer to evaluate potential impacts to shallow groundwater from routine agricultural practices performed at nearby fields. Data from the Program's initial years led to the establishment of statewide pesticide management plans for both atrazine and aldicarb.

Over the years, many of the wells installed for the initial study have been abandoned due to changes in land ownership, urban encroachment, or damage. Of the original 50 sites, 16 sites still exist and were included in the 2019 monitoring program.

2005 MONITORING PROGRAM EXPANSION

In the fall of 2005, the DATCP expanded its groundwater monitoring network with funding from a United States (US) Environmental Protection Agency (EPA) grant. New monitoring wells and piezometers were constructed at six sites based on nearby agricultural practices and susceptible to groundwater contamination (i.e. shallow groundwater with permeable subsurface soil units). Each of the six sites selected for program expansion were used for a prior groundwater monitoring study (Evaluation of Renewed Use of Atrazine in Atrazine Prohibition Areas) completed by DATCP in 2005. That study, also known as the Atrazine Reuse Study, was performed to gather information to evaluate repealing atrazine prohibition areas.

The groundwater flow direction was determined as part of the Atrazine Reuse Study. Two monitoring wells were installed hydraulically downgradient adjacent to agricultural fields six new sites. All six of these sites were included in the 2019 monitoring program.

2010 UNIVERSITY WISCONSIN – OSHKOSH MONITORING WELLS

In the spring of 2010, the DATCP became aware of a study to be performed by a UW-Oshkosh graduate student and the Wisconsin Geological and Natural History Survey (WGNHS). The study included installation of shallow bedrock monitoring wells at the edge of agricultural fields in a karst geological setting. It included monitoring wells at sites in Brown, Calumet, Kewaunee and Manitowoc counties. Bedrock fractures at each well were identified by the study team. Groundwater samples were collected by the study team and DATCP and tested as part of this Program from 2010 to 2014. The study was completed and all monitoring wells were subsequently abandoned in 2014.

2011 MONITORING PROGRAM EXPANSION

In the summer and fall of 2011, the DATCP expanded its groundwater monitoring network again with additional funding from a US EPA grant. Monitoring wells were constructed at two new sites in La Crosse and Trempealeau Counties. Wells were installed along an elevated terrace adjacent to the Mississippi River. Because the groundwater flow direction was known at each site, DATCP installed two groundwater monitoring wells at the hydraulically downgradient edge of agricultural fields at both sites. Both sites were included in the 2019 monitoring program.

2017 MONITORING PROGRAM EXPANSION

In the summer and fall of 2017, the DATCP expanded its groundwater monitoring network again with additional funding from a US EPA grant. Piezometers were constructed at three existing sites (two sites in Adams County and one in Portage County) and at one new site, the Hancock Agricultural Research Station (HARS). At each of these sites, two piezometers were installed near the existing groundwater monitoring nest with five-foot screens located at depths greater than 50 feet and 80 feet. The purpose was to evaluate groundwater quality relative to agrichemicals at deeper aquifer intervals and compare data to shallower aquifer depths. A water table observations well (screen placed to intersect the water table) was also constructed at HARS. The new site at HARS and additional piezometers at the Adams and Portage County sites were included in the 2019 monitoring program.

2019 WELL DAMAGE

In 2019, damage to monitoring wells was discovered at two sites. During spring sampling, damage was discovered at monitoring well AD4-1 in Adams County. This well likely sustained damage from farm equipment. Because the well was damaged beyond repair, and the integrity of the well was compromised, the well was abandoned on May 30, 2019. The well casing was sealed with bentonite to eliminate a preferential pathway from the surface to the groundwater table. Abandonment was completed in accordance with Wisconsin Administrative Code (WAC) Chapter NR 141 requirements.

The PR1 monitoring well network in Portage County was damaged by fallen trees. As reported by the landowner, on July 19 and 20, 2019 wind speeds between 90 and 100 miles per hour were measured in the area. Several trees around the PR1 network were blown over during the storm and landed directly on top of the protective well casing standpipes. The landowner subsequently cleared the trees to allow access. Though the protective standpipe and well casings may have been impacted (i.e. driven into the ground), samples were collected after the trees were removed. However, the measured heights (elevations) of the casing may have been affected thus potentially affecting the accuracy of future groundwater elevations. To ensure consistent and accurate groundwater elevation, well casing elevations will be re-surveyed.

2019 Results

A total of 215 water level measurements and 101 groundwater samples were collected as a part of DATCP's Field-Edge Groundwater Monitoring Program in 2019. All samples were submitted for chemical analysis. Table 3 in Appendix A summarizes 2019 Program analytical results and provides comparative risk values. The analytical data is compared to groundwater/drinking water standards to assess potential risk to human health and the environment. The risk values are sourced from the WAC Ch. NR 140 for groundwater qualitative health standard limits.

Key findings for 2019 are summarized below. A detailed narrative of these findings follows.

- Of the 23 sites where field pesticide- and fertilizer-use information was requested from Growers, nine responses were received.
- Water level measurements continue to be identified higher than normal water table elevations. This has been observed over the past several years. This is likely indicative of the greater than average precipitation volume received over the state over that timeframe.

- Laboratory analysis include 107 pesticide analytes for the laboratory testing methods. During 2019 30 pesticide analytes were detected in excess of reporting limits in the groundwater samples, which is similar to previous years.
- Pesticides detected in excess of laboratory reporting limits in 2019 samples include 11 herbicides, 12 herbicide metabolites, six insecticides, and one fungicide.
- It appears the pesticides were detected at slightly greater concentrations during the fall sampling event compared to spring results.
- Overall, analytical data is indicating greatest concentrations are present at depth, indicating that pesticides migrate vertically and laterally within the underlying aquifers. This likely reflects the groundwater baseline flow conditions.
- Metolachlor ethanesulfonic acid (ESA) was detected in excess of laboratory reporting limits in 89% of all samples collected, the most of any pesticide. Additionally, metolachlor ESA was detected at each groundwater monitoring site.
- Clothianidin was the second most frequently detected compound. It was detected in excess of laboratory reporting limits in 72% of the samples collected and at 21 of the 24 groundwater monitoring sites. This is an increase from previous years.
- Alachlor ESA was the third most frequently detected compound. It was detected in excess of laboratory reporting limits in 61% of the samples collected and at 19 of the 24 groundwater monitoring sites.
- Atrazine concentrations or one of its breakdown products (de-ethyl atrazine, de-isopropyl atrazine and di-amino atrazine) was detected in excess of laboratory reporting limits in 44% of the samples collected.
- Neonicotinoid compounds clothianidin, imidacloprid and thiamethoxam were detected in excess of laboratory reporting limits in 72%, 49% and 45%, respectively, of 2019 samples. This is an increase from previous years.
- There were no WAC Ch. NR 140 Enforcement Standard (ES) exceedances for established drinking water and groundwater quality health standards/advisory levels. Note; only 29 of the 107 pesticides tested for have established drinking water and groundwater quality health standards/advisory levels. However, there were exceedances of WAC Ch. NR 140 Preventive Action Limits (PAL) for alachlor ESA, atrazine, de-ethyl atrazine, de-isopropyl atrazine, di-amino atrazine, atrazine total chlorinated residuals (TCR), and metolachlor.
- The Wisconsin Department of Health Services (DHS) has proposed groundwater standards for several pesticides as part of the WAC Ch. NR 140 Cycle 10 rule making process (June 2019). Concentrations of imidacloprid detected at seven out of 24 sites equaled and/or exceeded the proposed ES of 0.2 micrograms per liter (µg/L) or parts per billion (ppb).

GROWER RESPONSES

DATCP obtained limited information regarding 2019 crops grown, pesticide use and the amount of nitrogen applied to the fields adjacent to the monitoring nests. A request for this information was included with each summary letter sent to nearby property owners and growers. Because a response to the information request is voluntary, DATCP received replies for only nine of the 23 sites. (No information was requested from HARS for site WS7.) Table 4 in Appendix A summarizes the information provided by the growers along with available information from the previous three years. The following is a summary of the crops grown during 2019 and nitrogen use data.

Crop	Number of Sites with Crop	Percent of Sites	Range of Nitrogen Applied (lbs / acre)
Corn	2	22%	122 - 300
Soybeans	1	11%	1.7
Kidney Beans	1	11%	72.5
Potatoes	3	33%	65.05 – 200.16
Soybeans	2	22%	0 – 24.96

Irrigation infrastructure is constructed at 18 of the 24 monitoring sites. Of the 18 sites with irrigation available, seven sites provided water usage data for 2019. As provided by the growers, the range of water irrigated on the fields in 2019 was 2 to 12.5 inches per acre, with an average of 5.7 inches.

Growers were also asked if they have state-approved Nutrient Management Plans for the adjacent fields. Of the nine respondents, only four indicated they have approved plans.

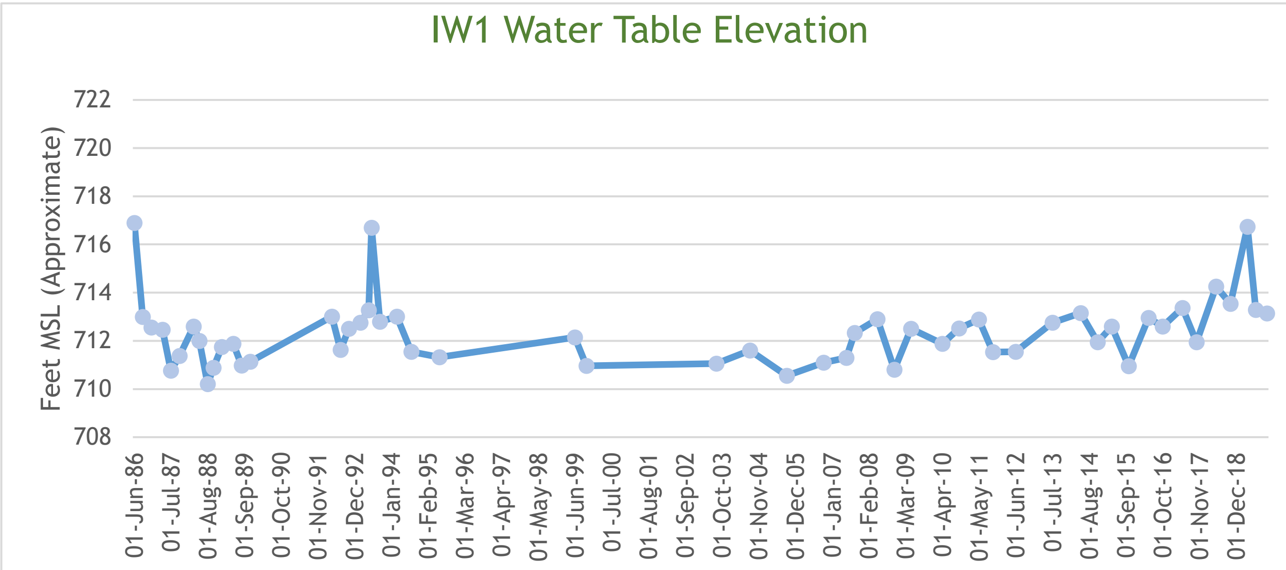
As reported by the growers, there was a wide variety of pesticides used on fields adjacent to field edge monitoring wells. Glyphosate was the most widely used active ingredient pesticide followed by metribuzin. Atrazine was also identified as being used at several sites; none of which was used in an atrazine Prohibition Area. A total of 40 different active pesticide compounds were reported to be used. Table 4 in Appendix A identifies the complete list of pesticides used in 2019 as reported by the Growers.

WATER LEVEL MEASUREMENTS

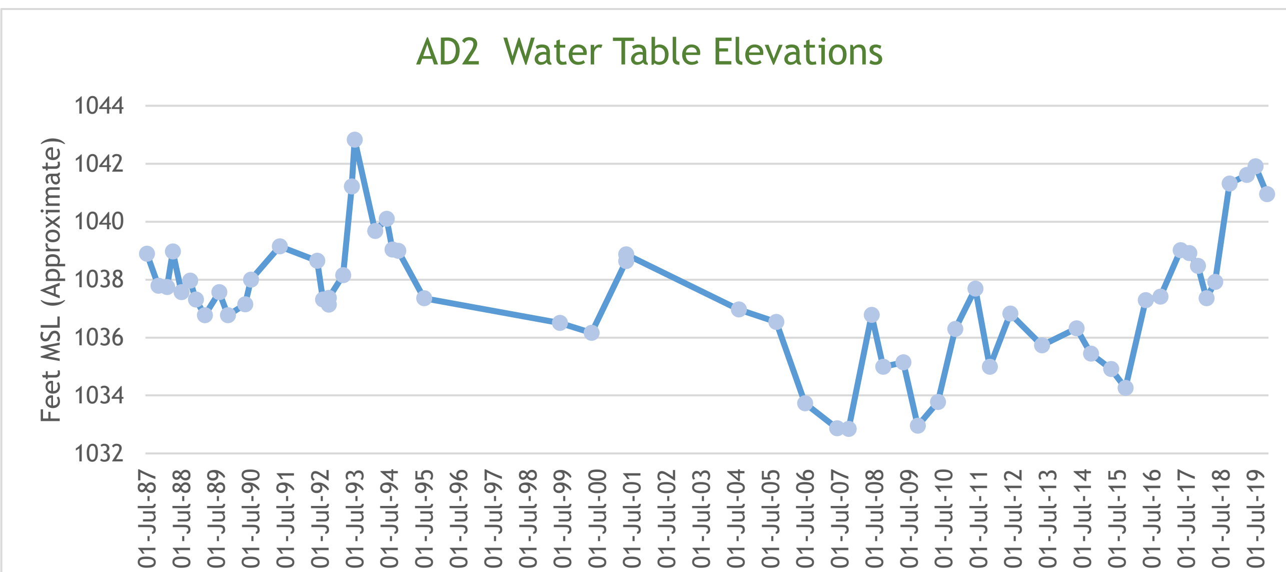
Depth to water level measurements are recorded for each well prior to collecting samples for laboratory analysis. Water level data is incorporated into a DATCP database for evaluation of historic trends. Water level data for 2019 was measured in the spring (April or May), summer (July or August) and fall (October or November). Overall, water level measurements indicate a stable or slightly higher water table conditions. Higher water table conditions correlate well with above normal precipitation recorded throughout the state during this period. Stable water levels also reflect greater than average water levels compared to historical levels.

The following graphs provide examples of observed water level fluctuations over time for three wells in the groundwater monitoring network. The three provided have the infrastructure to irrigate; however, it is unknown the volume of water that was applied in 2019 to the fields since Growers did not provide information. Graphs showing water level measurement trends for all other wells in the groundwater monitoring network are available upon request.

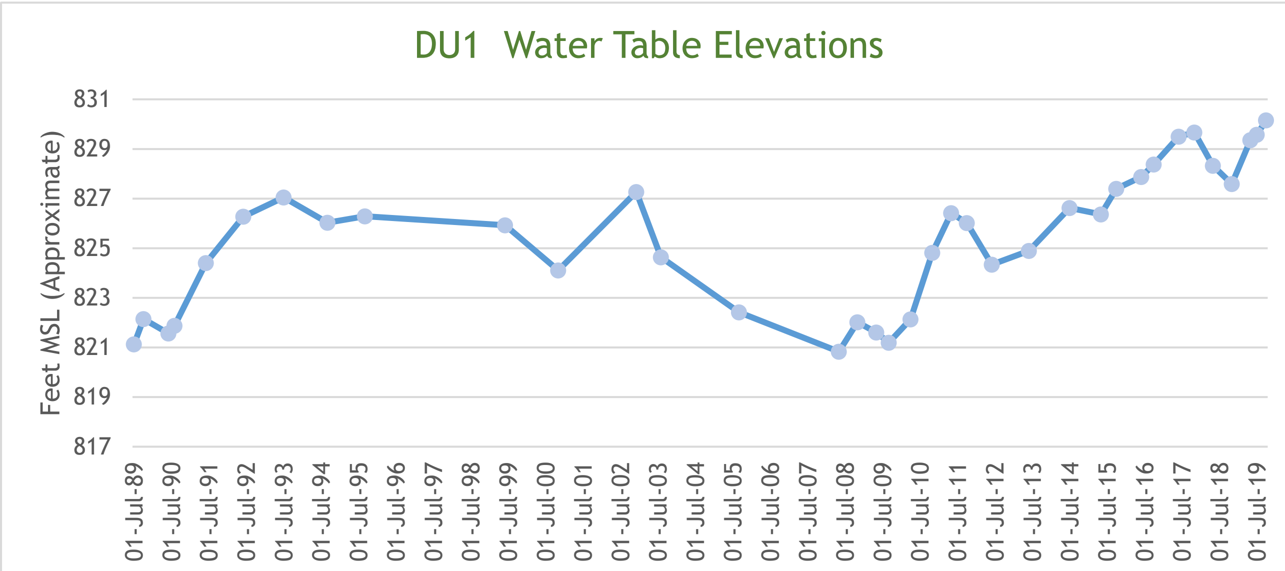
2019 water level data for an Iowa County site indicate a significant water level increase in the spring with a leveling to more consistent levels compared to recent historical observations. This site is near the Wisconsin River and the spring water level likely reflects high river water levels from heavy snow melts. High water tables conditions in spring has been observed several times at this locations over the course of monitoring program. The overall trend continues to indicate a stable to slightly increasing trend over the past 20 years, which likely correlates to nearby river elevations.



2019 water level data for an Adams County site indicate a continued rise in water levels from 2016 extending into 2019. The overall trend appears to be highly variable with a slight increase over the past several years.



2019 water level data for a Dunn County site indicate an increase compared to previous year. The water level measured in the fall is the highest water level observed for the last 30 years of monitoring at this location. Water levels show that the water table continues to rise at this location; it has risen almost nine feet since 2008.

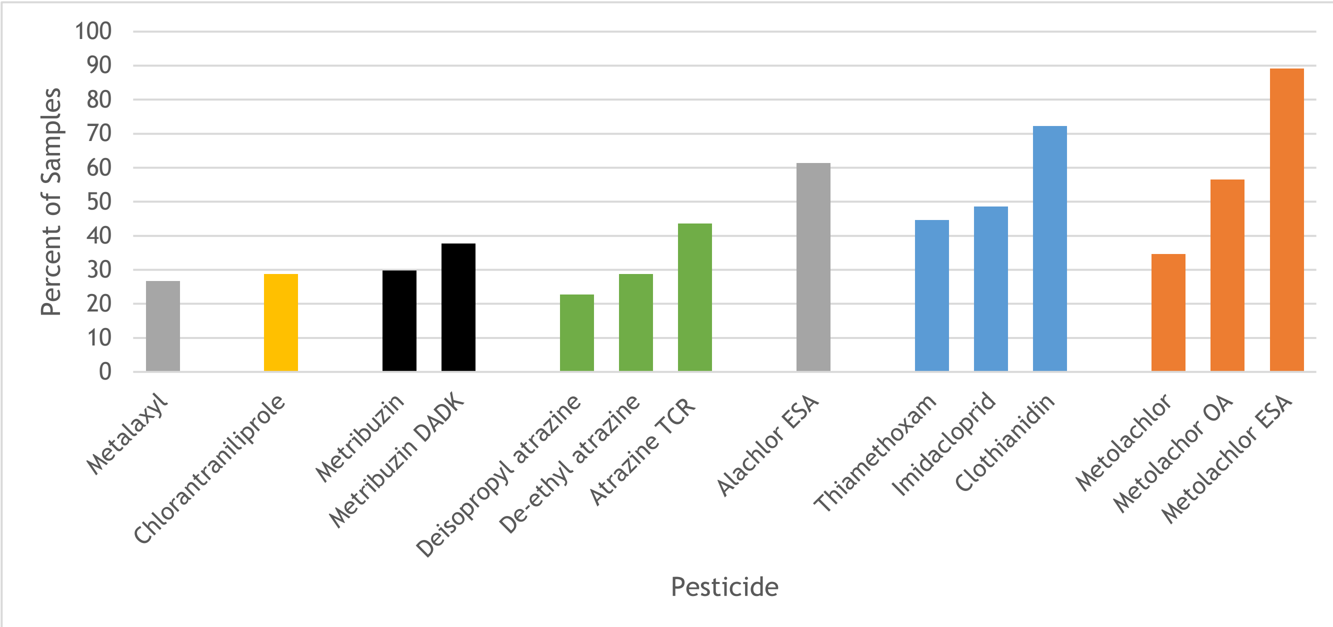


DATCP intends to complete additional interpretation of groundwater elevation data for each individual monitoring site as part of a detailed study. Historical water level monitoring data will be evaluated for each site and results will be documented in a separate report prepared for each site (*Historical Field-Edge Site Data Analysis*). This evaluation will include a comparison of water level trends to precipitation records. These reports will be completed over a three year period with the first group available in the spring of 2021.

PESTICIDE DETECTED FREQUENCY

Only 30 of the 107 analytes tested for in DATCP's 2019 Field-Edge Groundwater Monitoring Program were detected in excess of laboratory reporting limits (77 analytes were not detected). The number of compounds detected in 2019 is similar to the number detected in prior years. Agrichemicals were detected in almost all samples collected. Only two samples had no detects of either a pesticide analyte or nitrogen in excess of laboratory reporting limits; a sample collected in the spring from shallow monitoring well AD5-1 in Adams County, and a sample collected in the fall from shallow groundwater well BR3-1 in Barron County (BR3-1). The most frequently detected pesticide compounds detected in 2019 are shown in Table 5. This includes all pesticide analytes detected at a concentration greater than the laboratory reporting limit at a frequency greater than 20%.

Table 5: Percentage of 2019 Samples with Detectable Pesticide Concentrations (Includes all analytes detected in 20% or more of all samples collected)



Notes: Atrazine TCR is total chlorinated residues of atrazine; which includes the sum of atrazine plus its metabolites de-ethyl atrazine, de-isopropyl atrazine, and di-amino atrazine

Metolachlor ESA was the most frequently detected analyte in excessive of laboratory reporting limits. It is a breakdown product of metolachlor, which is an active ingredient in corn herbicides such as Dual, Halex GT, Lumax and many others. Metolachlor ESA was detected at all 24 sites and in 89% of all samples collected. This is consistent with the detection frequency observed in prior years. As described in the 2016 Statewide Survey, metolachlor ESA was also the most widely reported pesticide metabolite observed in drinking water wells (32% of all wells sampled in 2016), which was followed by alachlor ESA (21.5% of all wells).

Clothianidin was the second most frequently detected compound in 2019. It was detected in excess of laboratory reporting limits at 21 of 24 sites, and in 72% of the samples collected. This represents an increase in the amount of detections compared to 2018, and a continual increase in detections since clothianidin testing began. Results for 2019 also show clothianidin detections at sites throughout the State. During previous years, clothianidin detections were frequent within the Central Sands Agricultural Region, but not frequently observed elsewhere.

The third most frequently detected analyte for the 2019 Program was alachlor ESA. It was detected in just over 62% of the samples, which is consistent with historical observations.

COMPARISON TO STANDARDS

The Wisconsin Department of Natural Resources (DNR) sets groundwater quality standards in WAC Ch. NR 140, and it includes substances of public health concern based on recommendations from the Wisconsin DHS. These standards have two parts, the Enforcement Standard (ES) and the Preventive Action Limit (PAL). The ES is a level that if exceeded requires intervention from the appropriate authority. In the case of pesticides in drinking water, DATCP is required to intervene if levels exceed the ES. The PAL is a percentage of the ES; 10% of the ES for carcinogenic, mutagenic or teratogenic properties and 20% of the ES for all other substances. The intention of the PAL is to act as a trigger for intervention by the appropriate authority before the pollutant becomes a serious risk to public health. Pesticide concentrations identified during DATCP's 2019 Program were compared to WAC Ch. NR 140 Groundwater Quality standards. Table 3 in Appendix A shows the existing and proposed standards alongside the range of concentrations for the pesticide compounds detected in 2019 samples

No ES standards were exceeded in any samples collected in 2019. However, imidacloprid exceeded the proposed NR 140 Cycle 10 ES of 0.2 µg/L in 16 groundwater samples collected from sites in Adams, Iowa, Sauk and Waushara counties. These sites include those within either the Lower Wisconsin River Valley or the Central Sands Agricultural Region. Concentrations ranged from 0.972 to 0.2 µg/L. No other NR 140 Cycle 10 proposed standards were exceeded in 2019.

As shown in Table 3 in Appendix A, concentrations of alachlor ESA, atrazine, de-ethyl atrazine, de-isopropyl atrazine, di-amino atrazine, atrazine TCR (total chlorinated residues, which are the sum of atrazine plus its metabolites de-ethyl atrazine, de-isopropyl atrazine, and di-amino atrazine), and metolachlor were detected in excess of the WAC Ch. NR 140 PAL standards. The locations of wells with PAL exceedances and detected concentrations are consistent with results for prior years.

Table 3 in Appendix A also includes results for pesticides and their metabolites with no established or proposed ES or PAL. 78 out of 107 pesticides compounds tested have no established standard. A review of all 2019 data shows that 30 different pesticides compounds were detected in excess of laboratory reporting limits; 15 of these 30 compounds have no established standard. Four of the remaining 15 compounds with no established standard have proposed NR 140 Cycle 10 standards (clothianidin, imidacloprid, sulfentrazone, and thiamethoxam. Four of the 15 compounds with no established or proposed standards are metabolites for either alachlor, dimethenamid, or metribuzin. Table 6 includes the remaining seven compounds that have no standard (established or proposed), and are not a metabolite.

Table 6: Detected Compounds that have No Established or Proposed WAC Ch. NR 140 Standard

Analyte	Sites with Detects (out of 24)	Number of Detects (out of 101)	% of Samples Detected	Concentration Range (in µg/L)
Bromacil	1	29	1.0%	0.076
Chlorantraniliprole	10	4	28.7%	0.0514 - 1.56
Cyantraniliprole	2	8	4.0%	0.0787 - 0.881
Flumetsulam	4	5	7.9%	0.0546 - 0.53
Fomesafen	2	2	5.0%	0.0845 – 4.3
Imazethapyr	1	27	2.0%	0.0572 – 0.149
Metalaxyl	9	29	26.7%	0.0561 – 2.54

Cyantraniliprole was detected for the first time in Field-Edge Monitoring Program samples in 2019. It is an active ingredient in Fortenza or Minecto Pro, an insecticide of the ryanoid class that is applied on corn and soybean crops. There are no existing or proposed standards for bromacil, cyantraniliprole, and imazethapyr. The remaining analytes listed in Table 6, are on the NR 140 Cycle 11 list of compounds currently under review by DHS for consideration of proposed standards.

Comparisons of detected pesticide and their metabolite concentrations to published groundwater quality standards are based on exposure to a single compound. These comparisons do not fully evaluate the risk to human health when two or more compounds are present. Currently, there are no calculations to predict potential risk when multiple compounds are present. Because the current approach does not account for potential cumulative risk, potential toxicity may be underestimated when two or more compounds are present.

OTHER NOTABLE OBSERVATIONS

Glyphosate:

According to USDA - National Agricultural Statistics Service, in 2019 glyphosate was the most widely used pesticide on Wisconsin fields planted with soybean and second most pesticide used on fields planted with corn.

Because glyphosate has been widely used (and has been for many years prior), DATCP added glyphosate and two of its metabolites, AMPA (aminomethylphosphonic acid) and glyphosate ammonium, to the 2019 testing program.

Groundwater samples collected from 31 monitoring wells (13 in the spring and 18 in the fall) from 17 different locations were also tested for glyphosate and its metabolites. The groundwater samples selected for glyphosate testing were limited to shallow monitoring wells (wells with screens intersecting the water table). Based on the crops grown or as reported by the growers in their Response Reports, glyphosate would have been applied to these adjacent fields either in 2018 or 2019. Laboratory data indicated no detects in excess of laboratory reporting limits for any of the glyphosate family of pesticides in the groundwater samples.

Neonicotinoids:

Interest in the neonicotinoid class of insecticides has increased greatly in recent years due to concerns over possible effects on pollinators. DATCP began testing for these compounds in 2008 with thiamethoxam. BLS now analyzes for six neonicotinoid compounds. Three of these compounds, clothianidin, imidacloprid and thiamethoxam (CIT) were detected in field-edge groundwater samples collected in 2019. The other three neonicotinoid compounds; acetamiprid, dinotefuran and thiacloprid; were not detected in excess of laboratory reporting limits in any groundwater samples. The presence of the three CIT compounds in groundwater is not unexpected; these compounds are known to readily leach in sandy soils, and they are used in many insecticide products. CIT compounds are labeled for use on most crops grown in the state including corn, soybeans, potatoes, many other vegetables, as well as fruit crops, and most small grains.

It is apparent that the CIT compounds are becoming more prevalent in groundwater over time. However, concentrations at which CIT compounds have been detected are not increasing. Since testing for neonicotinoid compounds began, thiamethoxam and imidacloprid have been detected in field-edge samples, primarily at sites within the Central Sands Agricultural Region and Lower Wisconsin River Valley. DATCP's Historical *Field-Edge Site Data Analysis Report* will further evaluate historical trends and observations at each location.

One observation regarding the 2019 data suggests that the imidacloprid and thiamethoxam are migrating vertically and horizontally within Central Sands aquifers. Concentrations do not fluctuate seasonally, but greater higher concentrations have been detected in the deeper screened wells (AD2-5, AD3-3, AD5-5 and WS7-3) compared to shallow wells. Additionally, imidacloprid and thiamethoxam have also been detected in nearby surface water samples collected monthly indicating that groundwater is discharging to surface water as base flow (see DATCP's *2019 Surface Water Sampling Report*).

No WAC Ch. NR 140 ES or PAL groundwater quality standards have been established for the CIT compounds. However, DHS has proposed standards for the CIT compounds, and DNR is currently proceeding with rule changes to add standards for NR 140 Cycle 10 compounds. Clothianidin and thiamethoxam were detected in 72% and 45%, respectively, of all 2019 samples collected from Field Edge monitoring wells. Clothianidin concentrations ranged from 0.0101 to 1.63 µg/L and thiamethoxam concentrations ranged from 0.11 to 1.58 µg/L. Clothianidin and thiamethoxam were detected at concentrations less than the proposed standards. 2019 results are consistent with historic data.

Imidacloprid concentrations exceeding laboratory reporting limits were detected in 49% of the 2019 collected groundwater samples. It was detected in samples collected from seven of 24 sites at concentrations ranging from 0.0109 to 0.972 µg/L. Imidacloprid exceeded the proposed WAC Ch. NR 140 ES of 0.2 µg/L in 17 samples. These groundwater samples were collected from sites within the Central Sands Agricultural Region and Lower Wisconsin River Valley (Adams, Iowa, Sauk and Waushara Counties). An additional 24 groundwater samples that contained imidacloprid concentrations in excess of the proposed WAC Ch. NR 140 PAL of 0.02 µg/L. These groundwater samples were collected from the same counties where ES exceedances were encountered, plus Juneau and Portage Counties. The imidacloprid data relative to each monitoring location is presented in Table 7 in Appendix A.

Additional interpretation of imidacloprid use and mobility in groundwater over multiple years is needed. Results from DATCP's Field-Edge Groundwater Monitoring Program should be further compared to nearby

Surface Water Sampling Program results data to further evaluate mobility, persistence, and discharge to surface water. This evaluation will be included as part of DATCP's detailed comprehensive report; *Historical Field-Edge Site Data Analysis Report*.

Alachlor:

As noted previously, alachlor ESA was the third most frequently detected compound. It was detected in excess of laboratory reporting limits in over 61% of the samples collected and at 19 of the 24 field edge monitoring sites. The alachlor ESA data relative to each monitoring location is presented in Table 8 in Appendix A.

Alachlor ESA concentrations ranged from 0.0652 to 9.94 µg/L in 2019 samples. As observed during 2018, groundwater samples collected from deeper wells AD5-5 and WS7-3 exhibited concentrations in excess of the WAC Ch. NR 140 PAL of 4.0 µg/L. No PAL exceedances were observed in samples collected from wells screened at shallower depths at these same sites in 2018 or 2019. Although alachlor ESA remains at concentrations in excess of the PAL, it cannot be attributed to current use at nearby fields. Alachlor ESA is a breakdown product of alachlor, an active ingredient of Lasso or Temic. Alachlor production ceased in December 2014 with field application no longer allowable in Wisconsin after August 2018. The parent alachlor was not detected above the laboratory reporting limits in any samples collected in 2019, and no parent alachlor was detected in 2018 samples.

Alachlor ESA was widely detected in surface water and groundwater samples collected throughout the state. It is expected that these metabolite concentrations will decline over time since the parent compound can no longer be field applied. Additional interpretation of pesticide data from multiple years is needed to validate these observations.

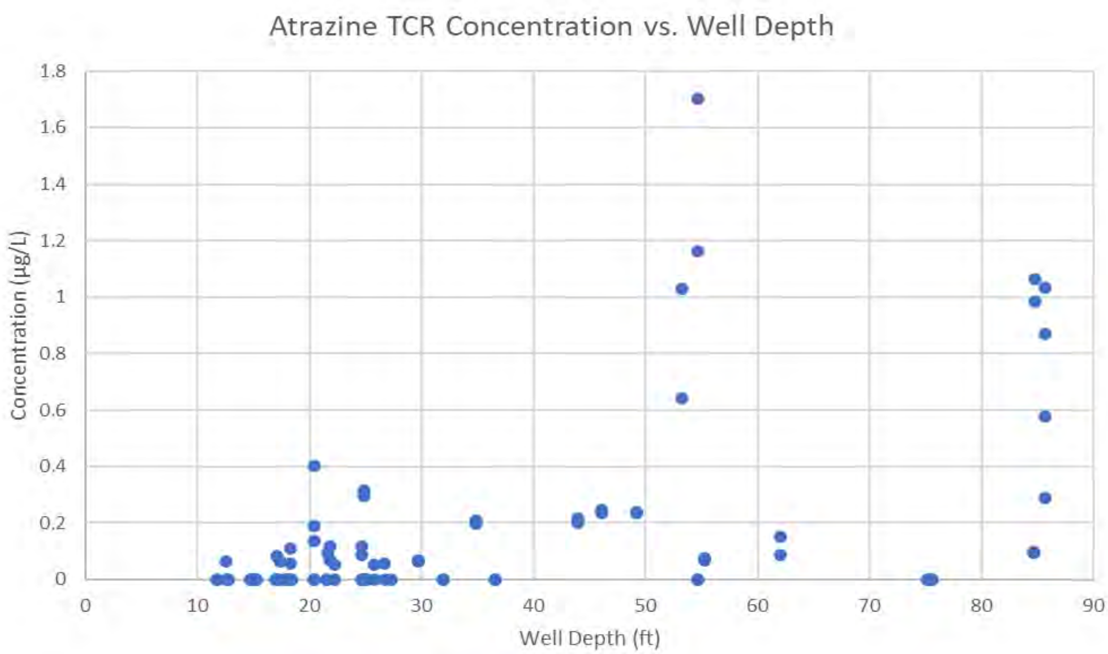
Atrazine:

There are currently 101 atrazine Prohibition Areas (PAs) covering approximately 1.2 million acres within Wisconsin. It is illegal to apply any pesticide containing the active ingredient atrazine within an atrazine PA. In non-PAs, atrazine use is restricted but not prohibited. Because PAs have been in place for ten years or more, it is anticipated that atrazine and its metabolite concentrations in groundwater would be limited, or not present at all. Of the 24 field-edge sites in the Program, 11 are located within a PA. In the Growers self-reporting on pesticide use in 2019, none of them listed atrazine being used on the adjacent fields in the PAs.

Atrazine or one of its breakdown products (de-ethyl atrazine, de-isopropyl atrazine and di-amino atrazine) were detected in excess of laboratory reporting limits in almost 44% of the groundwater samples collected in 2019. No atrazine was detected at concentrations exceeding the WAC Ch. NR 140 ES of 3.0 µg/L. However, atrazine or one of its metabolites was detected in 11 groundwater samples at concentration greater than the WAC Ch. NR 140 PAL of 0.3 µg/L. Concentration for atrazine TCR ranged from 0.0532 to 1.7035 µg/L. Parent atrazine and metabolite data for each monitoring site is presented in Table 9 in Appendix A.

Overall, atrazine or one of its metabolites was detected in groundwater samples collected from 17 of the 24 sites. Groundwater samples with detections in excess of the WAC Ch. NR 140 PAL were collected from monitoring well networks located at five of the 24 sites; two locations in Adams County and one each in St. Croix, Waupaca and Waushara Counties. Of those five sites, two are located in PAs; St. Croix (SC1-1, spring sampling event) and Waupaca (WP2-1, spring sampling event) Counties. At the Waupaca County site, there were no detections in excess of laboratory reporting limits of the parent material atrazine indicating this may be an older atrazine source. Based on grower self-reporting, atrazine has not been used on the adjacent fields for over 20 years. At the St. Croix County site, again there were no detections in excess of laboratory reporting limits of the parent material atrazine in groundwater samples collected from specific monitoring well. But there is another monitoring well screened across the same aquifer depth adjacent to the same St. Croix County field. A groundwater sample from that monitoring well in the spring and fall did contain detectable concentrations of the parent material atrazine. The grower has never provided pesticide use on the adjacent fields.

As observed during previous years, the greatest concentrations of atrazine TCR were detected in 2019 samples collected from deeper screened wells. The following figure shows atrazine TCR concentrations relative to groundwater sample well depth. As shown, elevated concentrations of atrazine TCR were detected in samples collected from monitoring wells screened between 50 and 60 feet below ground surface (bgs), and at deeper wells screened between 80 and 90 feet bgs. Shallow wells screened between 10 and 40 feet bgs detected atrazine TCR and lower concentrations.



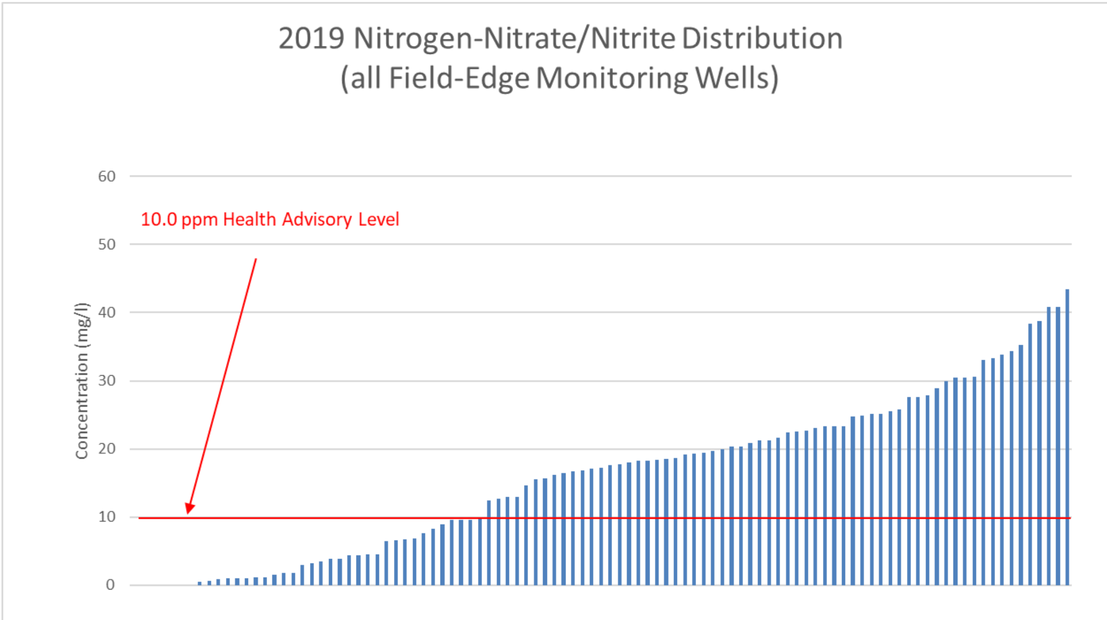
Based on atrazine TCR concentrations observed across the aquifer depth, it is also possible that atrazine is applied at nearby agricultural fields at rates that are not affecting shallow groundwater quality. The greater atrazine concentrations are being observed at depth which likely reflects the aquifers quality rather than an on-going source from the surface. Also, a trend analysis would be needed to be completed for all historical groundwater data to determine if the atrazine TCR concentrations are decreasing within PAs as intended. This analysis will be performed for DATCP's *Historical Field-Edge Site Data Analysis Report*.

Total Nitrogen:

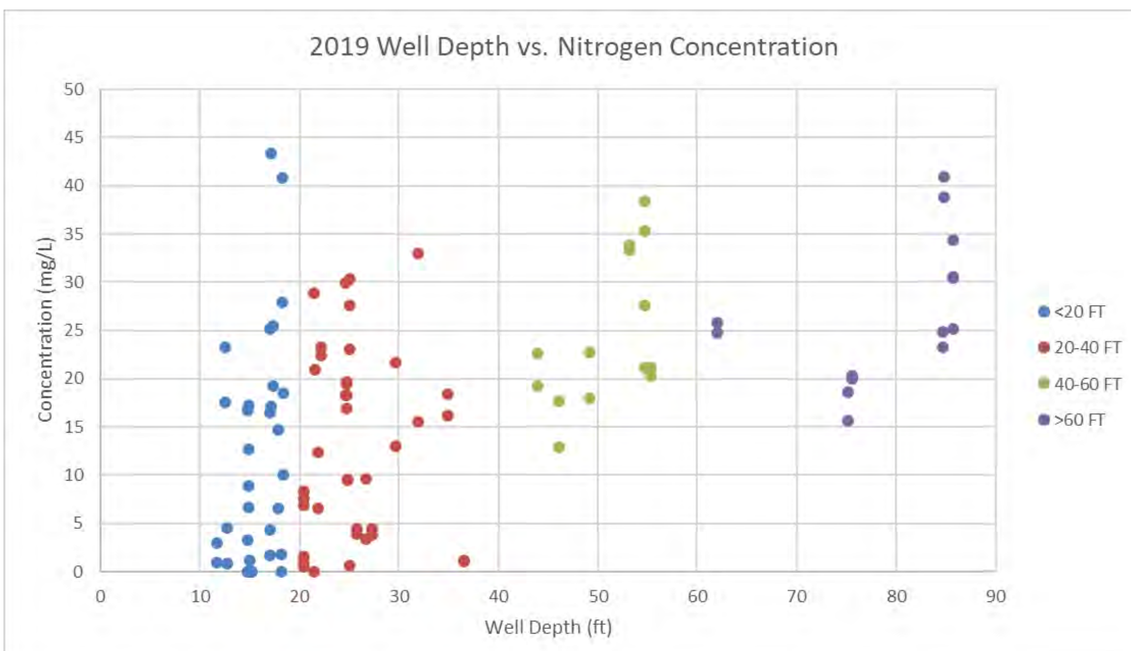
DATCP's Field-Edge Groundwater Monitoring Program primary focus is on pesticide impacts to groundwater quality. In addition to pesticides, BLS includes nitrogen as nitrate/nitrite analyses. Total nitrogen (as nitrate and nitrite) impacts are the responsibility of Wisconsin DNR. However, BLS include total nitrogen as nitrate/nitrite analyses as part of this program, and that data is shared with DNR.

Total nitrogen was detected in excess of laboratory reporting limits in 94 of the 101 field edge groundwater samples collected in DATCP's 2019 Program. The average total nitrogen concentration for all 2019 samples is 16.06 milligram per liter (mg/L or parts per million [ppm]). The average total nitrogen concentration for 2019 is slightly low than last year's average of 17.72 ppm.

The 10 mg/L ES for total nitrogen was exceeded in 64 of the 101 groundwater samples. An additional 19 samples exceeded the 2.0 mg/L PAL. The greatest concentration of total nitrogen (43.4 mg/L) was detected in the spring WS4-1 sample collected at a Waushara County site. All total nitrogen data relative to each monitoring location is summarized in Table 10 in Appendix A. The following graph depicts the 2019 nitrogen concentration distribution.

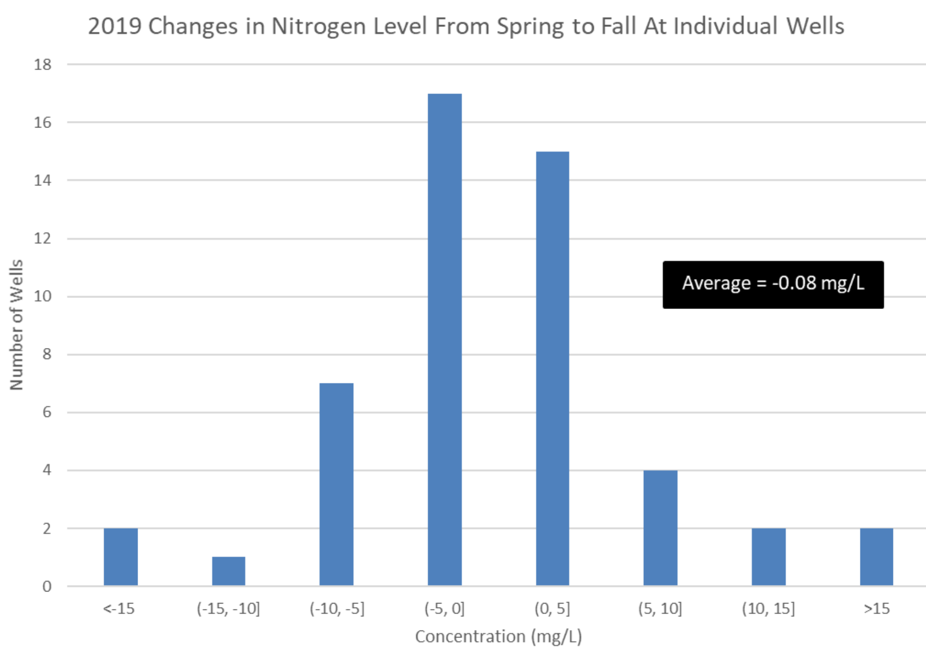


Total nitrogen concentrations were also compared to wells screened at different depths. The following graph shows nitrogen concentrations for all wells by depth.

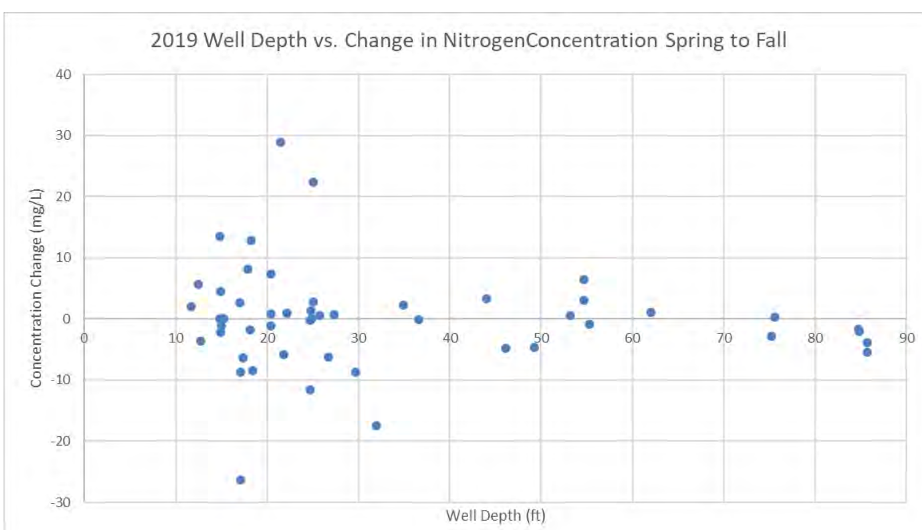


As shown, total nitrogen was detected over a wide range of concentrations in groundwater samples collected from wells screened at shallow depths (between 10 and 40 feet bgs) compared to deeper wells. Groundwater samples collected from deeper wells detected total nitrogen at typically greater concentrations. As shown, total nitrogen exceeded the 10 mg/L ES in samples collected from all the monitoring wells screened across the aquifer at a depth greater than 40 feet.

Groundwater samples collected from deeper screened wells also showed less seasonal change in nitrogen concentrations compared to shallow wells. As shown on the below graph, a majority of monitoring well results indicate a change in total nitrogen concentrations between -5 mg/L to + 5 mg/L in samples collected between spring and fall 2019. The average change in total nitrogen decreased by 0.08 mg/L between spring and fall. This suggests that total nitrogen concentrations for the majority of wells indicate little seasonal variation.



However, when the data is graphed based on total nitrogen concentrations relative to groundwater depths, seasonal variation becomes more pronounced. This may indicate potentially surface integration of nitrogen indicates a greater influence. As depicted on the following graph, groundwater samples collected from shallower wells have a wider variability in nitrogen concentrations level. Total nitrogen concentrations in samples collected from deeper screened wells show little seasonal variation.



2020 Program Goals and Objectives

The Field-Edge Groundwater Monitoring Program mission is to monitor groundwater quality at strategic geographic locations within a watershed to characterize agrichemical movements and act as an early warning signal for nearby drinking water wells. The program will continue in 2020. Program goals for 2020 are as follows.

- Collaborate with BLS and develop a *2020 Field-Edge Groundwater Monitoring Program Sampling Plan.*
- Conduct a groundwater sampling event in the spring (limited due to Covid) and fall from the Program's groundwater monitoring network. This will include continuing to analyze a certain set of samples for glyphosate. All results will be incorporated into DATCP's database.
- Document annual activities completed and summarize results for each site in letter sent to each grower.
- Document the annual activities completed and summarize results in a *2020 Field-Edge Groundwater Monitoring Program Summary Report*.

2020 data will be added to the existing database to ensure that long-term water level and groundwater monitoring data can be used to identify trends in groundwater quality over time. Long-term groundwater quality trends may be used to further evaluate the effectiveness of atrazine PAs. Long-term groundwater data will also be compared to surface water data from within the same watershed to identify potential relationships between surface water and groundwater quality. This evaluation may also be used to evaluate seasonal surface water flow variations and baseline flow groundwater discharge to surface water.

ADDITIONAL PROGRAM ACTIVITIES

In 2020, additional effort and focus beyond typical annual activities will include the following:

- Initiate a three-year program to prepare comprehensive summary reports for each current field edge monitoring site, *Historical Field-Edge Site Data Analysis*; and
- Develop and implement a program outreach and branding plan.

These activities were proposed in the 2020 Field-Edge Monitoring Work Plan and are further described below.

DATCP intends to complete a comprehensive summary report entitled, *Historical Field-Edge Site Data Analysis,* for each of the current monitoring sites between 2020 and 2022. Data collection at current field edge sites has spanned as little as three years to more than 30 years. Though site-specific data has been complied since the Field Edge monitoring program began, an overall comprehensive report summarizing the findings, conclusions, and recommendations has not been prepared. The report's objective would be to document groundwater quality and trends relative to land-use and agrichemical applications. Information to be complied includes the following:

- Grower agreements, if completed;
- Site location/maps;
- Property ownerships/project contacts;
- Geology/hydrogeology and soil types;
- Well construction documentation;
- Private drinking water wells in the area;
- Cropping history for the adjacent field and surrounding area, if available;
- Growing season (rainfall) history;
- Water level trends and anticipated groundwater flow direction;

- Pesticide and fertilizer use history;
- Agrichemical concentration trends in groundwater over time;
- Data gaps and shortcomings; and
- Conclusions and recommendations.

The proposed schedule is to complete eight reports a year for 2020, 2021, and 2022. Each report would then be updated every three years. Additionally, a master spreadsheet will be developed in 2020 and updated annually to provide a "snapshot" of Program's data for each of the 24 existing monitoring sites. The plan is to have the first reports completed late in 2020.

Findings and conclusions for the Field-Edge Groundwater Monitoring Program are not widely known among potential stakeholders (i.e. private citizens, and other State Agencies). There are significant findings and conclusions from the data that could aid with discussion and program/regulatory direction. Two outreach deliverables are proposed for this activity, the first was completed in 2020 and the second is proposed for 2021. In the spring of 2020, ACM staff shared with BLS and DNR staff an overview of program work that has been completed, and how BLS and DNR staff have contributed to the program. This overview included the same observations and conclusions associated with the annual and comprehensive reports. The second deliverable is a PowerPoint presentation intended for an outside audience (including US EPA Region 5 and headquarters of Pesticide and Water Programs), and a short memo listing potential presentation opportunities. The presentation would be more technically based and intended for a science-based audience. The potential conference and/or professional organization events would be scheduled for 2021 and 2022. Approval of the presentation content and intended conferences or organizations will be a part of this action.

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APPENDIX A

Table 1
Field-Edge Groundwater Monitoring Program
Monitoring Wells and Piezometers Construction Specifications

County	Site (Grower)	Well Identification	WUWN	Year Constructed	Prohibition Area	Irrigation Available	Ground Elevation (MSL)	TPVC Elevation (MSL)	Well Depth (ft)	Bottom of Well (MSL)	Screen Length (ft)	Top of Screen (ft)	Sampling Method
Adams	AD2	AD2-1	BH954	1987	No	Yes	1,051.7	1,053.96	17.87	1,036.09	5	1,053.96	Peristolic Pump
		AD2-2	BH953	1987				1,054.14	22.83	1,031.31	5	1,054.14	
		AD2-3	BH952	1987				1,054.17	27.62	1,026.55	5	1,054.17	
		AD2-4	VR844	2017				1,054.44	54.70	999.74	5	1,054.44	Dedicated Bailer
		AD2-5	VR845	2017				1,054.35	85.70	968.65	5	1,054.35	
	AD3	AD3-1	BH999	1987	No	Yes	1,008.0	1,010.48	14.93	995.55	5	1,010.48	Peristolic Pump
		AD3-2	BI000	1987				1,010.34	19.64	990.70	5	1,010.34	
		AD3-3	BI001	1987				1,010.44	24.69	985.75	5	1,010.44	
	AD4	AD4-1[1]	BH996	1987				1,017.38	24.71	992.67	5	1,017.38	
		AD4-2	BH997	1987	No	Yes	1,013.9	1,017.26	29.69	987.57	5	1,017.26	Dedicated Bailer
		AD4-3	BH998	1987				1,016.56	34.57	981.99	5	1,016.56	
	AD5	AD5-1	CL461	1988	No	Yes	1,051.1	1,053.18	15.24	1,037.94	5	1,053.18	Peristolic Pump
		AD5-2	CL455	1988				1,053.31	19.91	1,033.40	5	1,053.31	
		AD5-3	CL456	1988				1,053.27	25.23	1,028.04	5	1,053.27	
		AD5-4	VR846	2017				1,053.63	53.20	1,000.43	5	1,053.63	Whale Pump and Dedicated Tubing
		AD5-5	VR847	2017				1,053.68	85.70	967.98	5	1,053.68	
Barron	BR3	BR3-1	BR279	1987	No	Yes	1,052.7	1,055.79	15.03	1,040.76	5	1,055.79	Peristolic Pump
		BR3-2	BR280	1987				1,055.37	20.02	1,035.35	5	1,055.37	
		BR3-3	BR281	1987				1,054.93	25.02	1,029.91	5	1,054.93	
Dane	DN1	DN1-1[2]	BR250	1985				744.38	12.10	732.28	5	744.38	
		DN1-2	BR251	1985	93-57-04	Yes	741.9	744.22	17.40	726.82	5	744.22	Peristolic Pump
		DN1-3	BR252	1985				744.97	22.20	722.77	5	744.97	
Dunn	DU1	DU1-1	AO384	1989	No	Yes	852.5	853.92	34.90	819.02	5	853.92	Dedicated Bailer
		DU1-2	AO385	1989				854.87	40.80	814.07	5	854.87	
		DU1-3	AO386	1989				855.12	46.10	809.02	5	855.12	
	DU2	DU2-1	AO387	1989	No	Yes	856.2	858.05	26.70	831.35	5	858.05	Peristolic Pump
		DU2-2	AO388	1989				858.17	31.30	826.87	5	858.17	
		DU2-3	AO389	1989				858.48	36.60	821.88	5	858.48	
Grant	GR1	GR1-1	BR255	1985	93-57-04	No	683.8	686.32	12.50	673.82	5	686.32	Peristolic Pump
		GR1-2	BR256	1985				686.48	17.30	669.18	5	686.48	
		GR1-3	BR257	1985				686.12	21.60	664.52	5	686.12	
Iowa	IW1	IW1-1[3]	BH955	1986					14.90		5		
		IW1-2[3]	BH956	1986					19.90		5		
		IW1-3[3]	BH957	1986					24.90		5		
		IW1-4	BR259	1986	93-57-04	Yes	724.7	726.35	17.10	709.25	5	726.35	Peristolic Pump
		IW1-5	BR260	1986				726.47	21.30	705.17	5	726.47	
		IW1-6	BR261	1986				726.49	26.70	699.79	5	726.49	
		IW1-7	BH967	1987				726.60	61.99	664.61	5	726.60	Whale Pump and Dedicated Tubing
	IW2	IW2-1	BR036	1986	93-57-04	Yes	725.0	727.52	14.80	712.72	5	727.52	Peristolic Pump
		IW2-2	BR037	1986				727.42	19.70	707.72	5	727.42	
		IW2-3	BR038	1986				727.13	24.70	702.43	5	727.13	
Jackson	JK3	JK3-1	JH991	2005	94-27-04	No	1,025.3	1,028.06	27.33	1,000.73	10	1,028.06	Peristolic Pump
		JK3-2	JH981	2005			1,023.7	1,026.44	25.77	1,000.67	10	1,026.44	
Juneau	JN1	JN1-1	BR046	1985	No	Yes	939.7	941.26	11.70	929.56	5	941.26	Peristolic Pump
		JN1-2	BR047	1985				941.21	16.70	924.51	5	941.21	
		JN1-3	BR048	1985				941.34	21.50	919.84	5	941.34	
	JN3	JN3-1	JH937	2005	94-29-01	No	901.5	903.84	20.42	883.42	10	903.84	Peristolic Pump
		JN3-2	JH936	2005			902.0	905.20	18.14	887.06	10	905.20	
La Crosse	LC2	LC2-1	VZ391	2011	No	Yes	684.1	686.40	49.22	637.18	10	686.40	Dedicated Bailer
		LC2-2	VZ392	2011			687.8	681.91	43.98	637.93	10	681.91	
Langlade	LN1	LN1-1	BH964	1986	No	No	1,471.6	1,473.85	14.80	1,459.05	5	1,473.85	Peristolic Pump
		LN1-2	BH965	1986				1,474.44	19.70	1,454.74	5	1,474.44	
		LN1-3	BH966	1986				1,473.74	24.80	1,448.94	5	1,473.74	
Portage	PR1	PR1-1	BR207	1986	No	Yes	1,079.7	1,082.01	12.70	1,069.31	5	1,082.01	Peristolic Pump
		PR1-2	BR208	1988				1,081.94	17.60	1,064.34	5	1,081.94	
		PR1-3	BR209	1988				1,081.72	22.50	1,059.22	5	1,081.72	
		PR1-4	VR848	2017				1,082.83	55.30	1,027.53	5	1,082.83	Whale Pump and Dedicated Tubing
		PR1-5	VR849	2017				1,082.77	84.70	998.07	5	1,082.77	
St. Croix	SC1	SC1-1	JH938	2005	94-56-02	No	1,006.8	1,010.14	24.87	985.27	10	1,010.14	Peristolic Pump
		SC1-1 (D)	VZ390	2011				1,009.16	30.10	979.06	10	1,009.16	
		SC1-2	JH939	2005			1,003.9	1,006.63	21.87	984.76	10	1,006.63	
		SC1-2(D)	VZ393	2011				1,006.40	30.17	976.23	10	1,006.40	
Sauk	SK6	SK6-1	BB246	1988	93-57-04	Yes	712.5	714.57	14.92	699.65	5	714.57	Peristolic Pump
		SK6-2	BB247	1988				714.84	20.04	694.80	5	714.84	
		SK6-3	BB248	1988				714.70	25.10	689.60	5	714.70	
Trempealeau	TR1	TR1-1	PX201	2005	No	Yes	730.4	733.29	75.55	657.74	10	733.29	Dedicated Bailer
		TR1-2	PX202	2005			731.1	733.83	75.20	658.63	10	733.83	
Waupaca	WP2	WP2-1	JH985	2005	94-69-01	No	908.4	911.03	20.45	890.58	10	911.03	Peristolic Pump
		WP2-2	JH984	2005			905.7	908.82	20.43	888.39	10	908.82	
Waushara	WS4	WS4-1	BB258	1988	93-70-01	Yes	1,082.4	1,084.97	17.13	1,067.84	5	1,084.97	Peristolic Pump
		WS4-2	BB259	1988				1,085.03	22.02	1,063.01	5	1,085.03	
		WS4-3	BB260	1988				1,084.98	27.16	1,057.82	5	1,084.98	
		WS4-4	BB261	1988				1,084.88	31.94	1,052.94	5	1,084.88	
	WS6	WS6-1	JH989	2005	93-70-01	Yes	1,076.8	1,080.90	18.27	1,062.63	10	1,080.90	Peristolic Pump
		WS6-2	JH990	2005				1,079.07	17.02	1,062.05	10	1,079.07	
	WS7 (Hancock Agricultural Research Station)	WS7-1	VR841	2017	No	Yes	1,075.7	1,078.65	18.40	1,060.25	10	1,078.65	Peristolic Pump
		WS7-2	VR842	2017				1,078.79	54.70	1,024.09	5	1,078.79	Whale Pump and Dedicated Tubing
		WS7-3	VR843	2017				1,078.78	84.80	993.98	5	1,078.78	

Notes:

1	Monitoring well was abandoned on May 30, 2019 because integrity of protective casing was compromised during spring 2019 sampling.
2	Monitoring well was abandoned on December 13, 2018 because integrity of protective casing was compromised by a vehicle prior to fall 2018 sampling.
3	Monitoring wells were abandoned June 11, 1993 because they were no longer needed for the monitoring program.
WUWN	Wisconsin Unique Well Number
MSL	Mean sea level
TPVC	Top of well casing (PVC)
	Monitoring Well/Piezometer abandoned.
	Monitoring Well/Piezometer construction was financed by a 2017 U.S. EPA grant.
	Monitoring Well/Piezometer construction was financed by a 2011 U.S. EPA grant.
	Monitoring Well/Piezometer construction was financed by a 2005 U.S. EPA grant.
	Monitoring Wells/Piezometers assocaited with initial program activities and financed by State.

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Table 2

2019 Sample Analytes, Applicable Wis. Admin. Code ch. NR 140 PALs & ESs, and Reporting Limits

Analyte Description	PAL (µg/l)	ES (µg/l)	Reporting Limit (µg/l)
2,4,5-T			0.050
2,4,5-TP	5	50	0.050
2,4-D	7	70	0.050
2,4-DB			0.80
2,4-DP			0.050
ACETAMIPRID			0.010
ACETOCHLOR	0.7	7	0.050
ACETOCHLOR ESA	46	230	0.050
ACETOCHLOR OA	46	230	0.30
ACIFLUORFEN			0.050
ALACHLOR	0.2	2	0.050
ALACHLOR ESA	4	20	0.053
ALACHLOR OA			0.25
ALDICARB SULFONE			0.050
ALDICARB SULFOXIDE			0.071
AMINOPYRALID			0.150
ATRAZINE	0.3	3	0.050
DE-ETHYL ATRAZINE	0.3	3	0.050
DEISOPROPYL ATRAZINE	0.3	3	0.050
DIAMINO ATRAZINE	0.3	3	0.20
ATRAZINE TCR (calculated)	0.3	3	0.050
AZOXYSTROBIN			0.050
BENFLURALIN			0.050
BENTAZON	60	300	0.050
BICYCLOPYRONE			0.050
BROMACIL			0.0050
BIFENTHRIN			0.050
CARBARYL	4	40	0.050
CARBOFURAN	8	40	0.050
CHLORAMBEN	30	150	0.32
CHLORANTRANILIPROLE			0.050
CHLOROTHALONIL			0.10
CHLORPYRIFOS	0.4	2	0.050
CHLORPYRIFOS OXYGEN ANALOG			0.050
CLOMAZONE			0.050
CLOPYRALID			0.050
CLOTHIANIDIN	200 p	1,000 p	0.010
CYANTRANILIPROLE			0.050
CYCLANILIPROLE			0.20
CYFLUTHRIN			0.050
CYPERMETHRIN			0.10
CYPROSULFAMIDE			0.050
DACTHAL	14	70	0.050
DIAZINON			0.050
DIAZINON OXYGEN ANALOG			0.050
DICAMBA	60	300	0.30
DICHLOBENIL			0.050
DIMETHENAMID	5	50	0.050
DIMETHENAMID ESA			0.050
DIMETHENAMID OA			0.050
DIMETHOATE	0.4	2	0.050
DINOTEFURAN			0.010
DIURON			0.050
EPTC	50	250	0.050
ESFENVALERATE			0.025

Analyte Description	PAL (µg/l)	ES (µg/l)	Reporting Limit (µg/l)
ETHALFLURALIN			0.050
ETHOFUMESATE			0.050
FLUMETSULAM			0.050
FLUPYRADIFURONE			0.050
FLUROXYPYR			0.070
FOMESAFEN			0.050
GLYPHOSATE	1,000 p	10,000 p	0.500
GLYPHOSATE AMMONIUM			0.500
AMPA	2,000 p	10,000 p	0.500
HALOSULFURON METHYL			0.050
HEXAZINONE			0.050
IMAZAPYR			0.050
IMAZETHAPYR			0.050
IMIDACLOPRID	0.02 p	0.2 p	0.010
ISOXAFLUTOLE	0.3 p	3 p	0.050
ISOXAFLUTOLE RPA202248 (DKN)	0.3 p	3 p	0.050
LAMBDA-CYHALOTHRIN			0.020
LINURON			0.050
MALATHION			0.050
MCPA			0.050
MCPB			0.10
MCPP			0.050
MESOTRIONE			0.10
METALAXYL			0.050
METHYL PARATHION			0.050
METOLACHLOR	10	100	0.050
METOLACHLOR ESA	260	1,300	0.050
METOLACHLOR OA	260	1,300	0.27
METRIBUZIN	14	70	0.050
METRIBUZIN DA			0.10
METRIBUZIN DADK			0.12
METSULFURON-METHYL			0.050
NICOSULFURON			0.050
NORFLURAZON			0.050
OXADIAZON			0.050
PENDIMETHALIN			0.050
PERMETHRIN			0.030
PICLORAM	100	500	0.050
PROMETONE	20	100	0.050
PROMETRYN			0.050
PROPICONAZOLE			0.050
PROTHIOCONAZOLE-DESTHIO			0.050
SAFLUFENACIL			0.050
SIMAZINE	0.4	4	0.050
SULFENTRAZONE	100 p	1,000 p	0.050
SULFOMETURON-METHYL			0.050
TEBUPIRIMPHOS			0.050
TEMBOTRIONE			0.10
THIACLOPRID			0.010
THIAMETHOXAM	10 p	100 p	0.010
THIENCARBAZONE-METHYL	160 p	800 p	0.050
TRICLOPYR			0.050
TRIFLURALIN	0.75	7.5	0.050
NITROGEN-NITRATE/NITRITE (mg/l)	2	10	0.50 mg/l

p: Standard or limit is proposed as part of Wisconsin Department of Health Services Cycle 10 Recommendations (June 2019).

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Table 3

Field-Edge Groundwater Monitoring Program
2019 Groundwater Analytical Results

2019 Ground Water Project Results (all concentrations in ug/l)							Wisconsin Admin. Code Chapter NR 140	
Pesticide Name	Pesticide Class	Reporting Limit	Number of Sites with Detects[1]	Number of Total Detects[2]	Percent of Samples with Detects	Concentration Range	Enforcement Standard	Preventive Action Limit
2,4-D	Herbicide	0.05	0	0		--	70	7
2,4-DB	Herbicide	0.57	0	0		--	--	--
2,4-DP	Herbicide	0.058	0	0		--	--	--
2,4,5-T	Herbicide	0.05	0	0		--	--	--
2,4,5-TP	Herbicide	0.05	0	0		--	50	5
Acetamiprid	Insecticide	0.010	0	0		--	--	--
Acetochlor	Herbicide	0.05	0	0		--	7	0.7
Acetochlor ESA	Metabolite	0.05	10	35	34.7%	0.0502 - 3.88	230	46
Acetochlor OA	Metabolite	0.3	1	2	2.0%	1.09 - 1.39	230	46
Acifluorfen	Herbicide	0.056	0	0		--	--	--
Alachlor	Herbicide	0.05	0	0		--	2	0.2
Alachlor ESA	Metabolite	0.053	19	62	61.4%	0.0652 - 9.94	20	4
Alachlor OA	Metabolite	0.25	2	5	5.0%	0.423 - 6.21	--	--
Aldicarb Sulfone	Insecticide	0.059	0	0		--	--	--
Aldicarb Sulfoxide	Insecticide	0.071	0	0		--	--	--
Aminopyralid	Herbicide	0.05	0	0		--	--	--
Atrazine	Herbicide	0.05	7	17	16.8%	0.050 - 0.995	3	0.3
De-ethyl atrazine	Metabolite	0.05	10	29	28.7%	0.0551 - 0.642	3	0.3
De-isopropyl atrazine	Metabolite	0.05	11	23	22.8%	0.0532 - 0.405	3	0.3
Di-amino atrazine	Metabolite	0.28	5	9	8.9%	0.201 - 0.242	3	0.3
Atrazine (TCR)		--	17	44	43.6%	0.0532 - 1.7035	3	0.3
Azoxystrobin	Fungicide	0.05	0	0		--	--	--
Benfluralin	Herbicide	0.05	0	0		--	--	--
Bentazon	Herbicide	0.05	7	16	15.8%	0.147 - 12.6	300	60
Bicyclopyrone	Herbicide	0.05	0	0		--	--	--
Bifentrin	Herbicide	0.0050	0	0		--	--	--
Bromacil	Herbicide	0.084	1	1	1.0%	0.076	--	--
Carbaryl	Insecticide	0.067	0	0		--	40	4
Carbofuran	Insecticide	0.051	0	0		--	40	8
Chloramben	Herbicide	0.57	0	0		--	150	30
Chlorantraniliprole	Insecticide	0.050	10	29	28.7%	0.0514 - 1.56	--	--
Chlorothalonil	Fungicide	0.10	0	0		--	--	--
Chlorpyrifos	Insecticide	0.05	0	0		--	2	0.4
Chlorpyrifos Oxon	Metabolite	0.05	0	0		--	--	--
Clomazone	Herbicide	0.05	0	0		--	--	--
Clopyralid	Herbicide	0.078	0	0		--	--	--
Clothianidin	Insecticide	0.010	21	73	72.3%	0.0101 - 1.63	1,000[3]	200[3]
Cyantraniliprole	Insecticide	0.050	2	4	4.0%	0.0787 - 0.881	--	--
Cyclaniliprole	Insecticide	0.2	0	0		--	--	--
Cyfluthrin	Insecticide	0.050	0	0		--	--	--
lambda- Cyhalothrin	Insecticide	0.020	0	0		--	--	--
Cypermethrin	Insecticide	0.15	0	0		--	--	--
Cyprosulfamide	Safener	0.074	0	0		--	--	--
Dacthal	Herbicide	0.05	0	0		--	70	14 (7[4])
Diazinon	Insecticide	0.05	0	0		--	--	--
Diazinon oxon	Metabolite	0.05	0	0		--	--	--
Dicamba	Herbicide	0.89	1	1	1.0%	0.456	300	60
Dichlobenil	Herbicide	0.05	0	0		--	--	--
Dimethenamid	Herbicide	0.05	1	1	1.0%	0.0558	50	5
Dimethenamid ESA	Metabolite	0.05	5	11	10.9%	0.0611 - 1.38	--	--
Dimethenamid OA	Metabolite	0.054	0	0		--	--	--
Dimethoate	Insecticide	0.050	0	0		--	2	0.4
Dinotefuran	Insecticide	0.010	0	0		--	--	--
Diuron	Herbicide	0.18	0	0		--	--	--
EPTC	Herbicide	0.05	0	0		--	250	50
Esfenvalerate	Insecticide	0.025	0	0		--	--	--

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Field-Edge Groundwater Monitoring Program 2019 Groundwater Analytical Results

Ethalfluralin	Herbicide	0.074	0	0		--	--	--
Ethofumesate	Herbicide	0.05	0	0		--	--	--
Flumetsulam	Herbicide	0.17	4	8	7.9%	0.0546 - 0.53	--	--
Flupyradifurone	Insecticide	0.05	0	0		--	--	--
Fluroxypyr	Insecticide	0.070	0	0		--	--	--
Fomesafen	Insecticide	0.05	2	5	5.0%	0.0845 - 4.3	--	--
Glyphosate	Herbicide	0.5	0	0			10,000 [3]	1,000 [3]
Glyphosate Ammonium	Metabolite	0.5	0	0			--	--
AMPA	Metabolite	0.5	0	0			10,000 [3]	2,000 [3]
Halosulfuron methyl	Insecticide	0.08	0	0		--	--	--
Hexazinone	Herbicide	0.05	0	0		--	--	--
Imazapyr	Herbicide	0.05	0	0		--	--	--
Imazethapyr	Herbicide	0.05	1	2	2.0%	0.0572 - 0.149	--	--
Imidacloprid	Insecticide	0.010	14	49	48.5%	0.0109 - 0.972	0.2[3]	0.02[3]
Isoxaflutole	Herbicide	0.32	0	0		--	3[3]	0.3[3]
Isoxaflutole DKN	Metabolite	0.47	0	0		--	3[3]	0.3[3]
Linuron	Herbicide	0.087	0	0		--	--	--
MCPA	Herbicide	0.05	0	0		--	--	--
MCPB	Herbicide	0.21	0	0		--	--	--
MCPP	Herbicide	0.055	0	0		--	--	--
Malathion	Insecticide	0.05	0	0		--	--	--
Mesotrione	Herbicide	0.18	0	0		--	--	--
Metalaxyl	Fungicide	0.05	9	27	26.7%	0.0561 - 2.54	--	--
Methyl Parathion	Insecticide	0.078	0	0		--	--	--
Metolachlor	Herbicide	0.05	11	35	34.7%	0.0527 - 19.8	100	10
Metolachlor ESA	Metabolite	0.05	24	90	89.1%	0.0992 - 39.4	1,300	260
Metolachlor OA	Metabolite	0.27	17	57	56.4%	0.298 - 23.6	1,300	260
Metribuzin	Herbicide	0.05	10	30	29.7%	0.0526 - 5.04	70	14
Metribuzin DA	Metabolite	0.1	6	13	12.9%	0.141 - 0.737	--	--
Metribuzin DADK	Metabolite	0.12	12	38	37.6%	0.159 - 6.96	--	--
Metsulfuron methyl	Herbicide	0.094	0	0		--	--	--
Nicosulfuron	Herbicide	0.05	0	0		--	--	--
Norflurazon	Herbicide	0.058	0	0		--	--	--
Oxadiazon	Herbicide	0.05	0	0		--	--	--
Pendimethalin	Herbicide	0.05	0	0		--	--	--
Permethrin	Herbicide	0.030	0	0		--	--	--
Picloram	Herbicide	0.05	0	0		--	500	100
Prometone	Herbicide	0.05	0	0		--	100	20
Prometryn	Herbicide	0.05	0	0		--	--	--
Propiconazole	Fungicide	0.055	0	0		--	--	--
Prothioconazole-desthio	Metabolite	0.050	0	0		--	--	--
Saflufenacil	Herbicide	0.2	0	0		--	--	--
Simazine	Herbicide	0.05	2	2	2.0%	0.0735 - 0.0842	4	0.4
Sulfentrazone	Herbicide	0.05	3	6	5.9%	0.0641 - 0.158	1,000[3]	100[3]
Sulfometuron methyl	Herbicide	0.05	0	0		--	--	--
Tebupirimphos	Insecticide	0.05	0	0		--	--	--
Tembotrione	Herbicide	0.10	0	0		--	--	--
Thiacloprid	Insecticide	0.010	0	0		--	--	--
Thiamethoxam	Insecticide	0.010	13	45	44.6%	0.011 - 1.58	100[3]	10[3]
Thiencarbazone methyl	Herbicide	0.38	0			--	10[3]	2[3]
Triclopyr	Herbicide	0.1	0	0		--	--	--
Trifluralin	Herbicide	0.05	0	0		--	7.5	0.75

Notes:

1 Total number of sites were 24.
2 Total number of samples were 101.
3 Standard or limit is proposed as part of Wisconsin Department of Health Services Cycle 10 Recommendations (June 2019).
4 Limt change is proposed as part of Wisconsin Department of Health Services Cycle 10 Recommendations (June 2019).
'--- Indicates that Health Advisory Level value in Wisconsin not established.
μg/L micrograms per liter or parts per billion
TCR Total Chlorinated Residue for Atrazine. Reflects an additive quantity of atrazine (parent material) and its three metabolites (de-ethyl, de-isopropyl and di-amino atrazine).

(white)	Indicates no detects in excess of laboratory reporting limits.
(light yellow)	Indicates detects in excess of laboraotry reporting limits.
(light orange)	Indicates detects in excess of laboraotry reporting limits and WAC ch. NR 140 Preventive Action Limit (or corresponding proposed Cycle 10 Recommendations).
(red)	Indicates detects in excess of laboraotry reporting limits and WAC ch. NR 140 Enforcement Standard (or corresponding proposed Cycle 10 Recommendations).

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Table 4

Field-Edge Groundwater Monitoring Program
2019 Land-, Pesticide/Nitrogen- and Irrigation-Use (as Provided by Growers)

COUNTY	SITE (Grower)	YEAR	CROP	NUTRIENT MANAGEMENT PLAN	IRRIGATION APPLIED (in inches)	NITROGEN APPLIED (in lbs/acre)	PESTICIDE PRODUCT APPLIED
Adams	AD2	2016	corn silage	---	6.45	374.8	glyphosate
							N-serve
							atrazine
							dicamba
		2017 [1]	---	---	---	---	---
		2018 [1]	---	---	---	---	---
		2019 [1]	---	---	---	---	---
	AD3	2016 [1]	---	---	---	---	---
		2017 [1]	---	---	---	---	---
		2018	snap beans	yes	6.59	89.0	metolachlor
							halosulfuron-methyl
							sethoxydim
							imazamox, bentazon
							thiamethoxam
							bifenthrin
							glyphosate
		2019 [1]	---	---	---	---	---
	AD4	2016 [1]	---	---	---	---	---
		2017 [1]	---	---	---	---	---
		2018	soybeans	yes	7.66	14.0	metribuzin
							metolachlor
							Clethodim
							bentazon
							thiamethoxam
							chlothianidin
							glyphosate
		2019 [1]	---	---	---	---	---
	AD5	2016 [1]	---	---	---	---	---
		2017 [1]	---	---	---	---	---
		2018 [1]	---	---	---	---	---
		2019 [1]	---	---	---	---	---
Barron	BR3	2016 [1]	---	---	---	---	---
		2017 [1]	---	---	---	---	---
		2018 [1]	---	---	---	---	---
		2019	corn	no	2.24	300	Glyphosate
							diglycolamine salt
							topramezone, dimethenamid-P
							acetochlor, flumetsulam, clopyralid
Dane	DN1	2016	seed corn	---	3	216.7	simazine
							metolachlor
							mesotrione
							topramezone
							bifenthrin
							pyraclastrobin, metconazole
							2,4-D
							glyphosate
							sodium chlorate
		2017	soybeans	---	2	6.0	glyphosate
							clethodim
							lambda-cyhalothrin
							glufosinate
		2018 [1]	---	---	---	---	---
		2019	soybeans	yes	2	1.7	glyphosate
							metribuzin
							dimethenamid
							glufosinate
							clethodim
							lambda-cyhalothrin
Dunn	DU1	2016	soybeans	---	3.43	100.0	dimethenamid
							flumioxazin
							clethodim
							benzoic acid
		2017	horseradish	---	0.8	140.5	peroxyacetic acid, hydrogen peroxide
							oxyfluorfen
							sulfentrazone
							glyphosate
							clethodim
							boscolid
							chlorothalonil
		2018	corn (grain)	no	3.97	193.3	glyphosate
							dicamba
							dimethenamid, saflufenacil
		2019 [1]	---	---	---	---	---
	DU2	2016	corn	---	8	241.0	glyphosate
							dimethenamid, saflufenacil
		2017	kidney beans	---	4	85.0	pendimethalin
							s-metolachlor
							bentazon
							fomesafen
							imazamox
							clethodim
							saflufenacil
							thiamethoxam, fludioxonil
		2018	corn	---	5	66.2	dimethenamid, saflufenacil
							glyphosate
							atrazine
		2019	kidney beans	yes	3.25	72.5	pendimethalin
							glyphosate
							s-metolachlor
							imazamox
							bentazon
							fomesafen
							clethodim
							imidacloprid
							saflufenacil
Grant	GR1	2016 [1]	---	---	na	---	---
		2017 [1]	---	---	na	---	---
		2018 [1]	---	---	na	---	---
		2019 [1]	---	---	na	---	---
Iowa	IW1	2016	potatoes	---	18.4	374.4	metam sodium
							azoxystrobib, difenoconazole
							metalaxyl
							imidacloprid
							azoxystrobin
							metribuzin
							novaluron
							spinosad
							beta-cyfluthrin
							rimsulfuron
							chlorothalonil
							pyraclostrobin
							boscolid
							abamectin
							pyrimethanil
							fentin hydroxide
							mancozeb
							diquat bromide
		2017	seed corn	---	8.9	198.5	glyphosate
							bifenthrin
							glufosinate
							MCPA, bromoxynil
							pendimethalin
							pyraclostrobin, metconazole
							propiconazole, azoxystrobin
		2018	snap beans	no	5.7	77.0	thiamethoxam
							halosulfuron-methyl
							s-metolachlor
							imazamox, bentazon
							sethoxydim
		2019 [1]	---	---	---	---	---
	IW2	2016	seed corn	---	12.8	195.5	glyphosate
							bifenthrin
							metolachlor
							pendimethalin
							tembotrione
							bromoxynil
							azoxystrobin
		2017	snap beans	---	6.6	72.2	glyphosate
							EPTC
							thiamethoxam
							bifenthrin
							imazamox, bentazon
							copper hydroxide and copper chloride

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Table 4 - continued

Field-Edge Groundwater Monitoring Program

2019 Land-, Pesticide/Nitrogen- and Irrigation-Use (as Provided by Growers)

		2018	seed corn	no	12.1	256.0	bifenthrin
							bicyclopyrone, metolachlor, mesotrione
							pendimethalin
							thiamethoxam
							azoxystrobin
		2019 [1]	---	---	---	---	---
Jackson	JK3	2016 [1]	---	---	na	---	---
		2017 [1]	---	---	na	---	---
		2018 [1]	---	---	na	---	---
		2019 [1]	---	---	na	---	---
Juneau	JN1	2016	sweet corn	---	8	211.0	atrazine
							s-metolachlor
		2017	snap beans	---	2.9	122.0	s-metolachlor
							halosulfuron-methyl
		2018	sweet corn	no	8	228.6	atrazine
							s-metolachlor
		2019	potatoes	no	12.5	65.05	azoxystrobin
							chlorothalonil
							esfenvalerate
							spinosad
							thiamethoxam
							diquat dibromide
							boscalid
							metribuzin
							cyantraniliprole, abamectin
							metam sodium
							potassum salt
							metalaxyl
	JN3	2016 [1]	---	---	na	---	---
		2017 [1]	---	---	na	---	---
		2018 [1]	---	---	na	---	---
		2019 [1]	---	---	na	---	---
La Crosse	LC2	2016	corn silage	---	---	179.5	glyphosate
							lorsban
							acetochlor
							dicamba
		2017	soybeans	---	---	0.0	glyphosate
							2,4-D
							imazethapyr
		2018	corn	yes	2.5	705.7	glyphosate
							atrazine, acetochlor
							mesotrione
		2019	beans	---	---	0.0	glyphosate
							methansulfonamide
							metribuzin
							metolachlor
							glyphosate, imazethapyr
Langlade	LN1	2016 [1]	---	---	---	---	---
		2017 [1]	---	---	---	---	---
		2018 [1]	---	---	---	---	---
		2019 [1]	---	---	---	---	---
Portage	PR1	2016 [1]	---	---	---	---	---
		2017 [1]	---	---	---	---	---
		2018	sweet corn	yes	4.6	164.0	s-metolachlor
							atrazine
		2019	potatoes	yes	6.7	159	chlorothalonil
							azoxystrobin
							spinetram
							abamectin, cyantraniliprole
							imidacloprid
							novaluron
							diqust
St. Croix	SC1	2016	soybeans	---	na	---	glyphosate
		2017	corn	---	na	250.0	glyphosate
							tembotrione
							acetochlor
		2018	soybeans	no	na	0.0	glyphosate
		2019 [1]	---	---	na	---	---
Sauk	SK6	2016 [1]	---	---	na	---	---
		2017 [1]	---	---	na	---	---
		2018 [1]	---	---	na	---	---
		2019 [1]	---	---	na	---	---
Trempealeau	TR1	2016 [1]	---	---	---	---	---
		2017 [1]	---	---	---	---	---
		2018 [1]	---	---	---	---	---
		2019 [1]	---	---	---	---	---
Waupaca	WP2	2016	corn	---	na	132.0	acetochlor
							clopyralid
							flumetsulam
		2017	soybeans	---	na	0.0	glyphosate
		2018	soybeans	yes	na	0.0	glyphosate
		2019	corn	yes	na	122.0	acetochlor, clopyralid, flumetsulam
							glyphosate
Waushara	WS4	2016	carrots	---	9.08	176.0	glyphosate
							pendimethalin
							chlorothalonil
							esfenvalerate
							clethodim
							azoxystrobin
		2017	potatoes	---	13.62	115.1	glyphosate
							thiamethoxam, fludioxonil
							mancozeb
							azoxystrobin
							pentachloronitrobenzene
							s-metolachlor
							metribuzin
							rimsulfuron
							chlorothalonil
							novaluron
							metalaxyl
							copper hydroxide and copper chloride
							spinosad
							boscolid
							cyantraniliprole, abamectin
							pyraclostrobin
							oxathiapiprolin
							fentin hydroxide
							diquat bromide
		2018	corn	no	9.1	70.6	metolachlor
							simazine
							glyphosate
							ammonium sulfamate
		2019	beans	no	2.42	24.96	metolachlor
							halosulfuron-methyl
	WS6	2016	corn	---	8.35	70.4	glyphosate
							simazine
							metolachlor
		2017	beans	---	6	105.6	glyphosate
							ammonium sulfamate
							metolachlor
							phosphorus oxide
							halosulfuron-methyl
		2018	carrots	no	12.76	254.1	clethodim
							carfentrazone-ethyl
							cypermethrin-S
							azoxystrobin
		2019	potatoes	no	10.9	200.16	pendimethalin
							metribuzin
							novaluron
							phosmet
							chlorothalonil
							boscolid
							cyantraniliprole, abamectin
							metalaxyl
							fentin hydroxide
							diquat dibromide
	WS7 (Hancock Agricultural Research Station)	2016					
		2017					
		2018					
		2019					

Notes:

1 Grower did not provide information in Annual Reporting Form.

(green) Site is located within an atrazine Prohibition Area.

--- Information not provided by Grower.

na Fields are not equipped to irrigate.

(hatched) Site is a research location with multiple crops and herbicide types and application rates.

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Table 7

Field-Edge Groundwater Monitoring Program
2019 Imidacloprid Concentrations in Groundwater Samples

COUNTY	SITE (Grower)	WELL IDENTIFICATION	WUWN	SAMPLE DATE (2019)	IMIDACLOPRID (in µg/L)
Adams	AD2	AD2-1	BH954	4/23	0
				11/20	0
		AD2-4	VR844	4/23	0.935
				11/20	0.808
		AD2-5	VR845	4/23	0.351
				11/20	0.343
	AD3	AD3-1	BH999	4/23	0.0564
				11/20	0.133
		AD3-3	BI001	4/23	0.153
				11/20	0.2
	AD4	AD4-2	BH997	4/23	0.0151
				11/20	0.0352
	AD5	AD5-1	CL461	4/23	0
				11/20	0
		AD5-4	VR846	4/23	0.194
				11/20	0.172
		AD5-5	VR847	4/23	0.308
				11/20	0.326
Barron	BR3	BR3-1	BR279	5/14	0
				10/24	0
		BR3-3	BR281	5/14	0
				10/24	0
Dane	DN1	DN1-2	BR250	5/9	0.0152
				11/5	0.0159
		DN1-3	BR252	5/9	0.0116
				11/5	0.0153
Dunn	DU1	DU1-1	AO384	5/14	0
				10/24	0
		DU1-3	AO386	5/14	0
				10/24	0
	DU2	DU2-1	AO387	5/14	0
				10/24	0.0167
		DU2-3	AO389	5/14	0
				10/24	0.0109
Grant	GR1	GR1-1	BR255	4/25	0
				11/14	0
		GR1-3	BR257	4/25	0
Iowa	IW1	IW1-4	BR259	4/25	0.0918
				11/5	0.0923
		IW1-7	BH967	4/25	0.235
				11/5	0.291
	IW2	IW2-1	BR036	4/25	0
				11/5	0
		IW2-3	BR038	4/25	0.0664
				11/5	0.14
Jackson	JK3	JK3-1	JH982	5/1	0
				10/23	0
		JK3-2	JH981	5/1	0
				10/23	0
Juneau	JN1	JN1-1	BR046	5/7	0
				11/1	0
		JN1-3	BR048	5/7	0
				11/1	0.0583
	JN3	JN3-1	JH937	4/23	0
				11/21	0
		JN3-2	JH936	4/23	0
				11/21	0
La Crosse	LC2	LC2-1	VZ391	5/1	0
				10/23	0
		LC2-2	VZ392	5/1	0
				10/23	0
Langlade	LN1	LN1-1	BH964	5/23	0
				10/16	0
		LN1-3	BH966	5/23	0
				10/16	0
Portage	PR1	PR1-1	BR207	4/30	0
				10/16	0
		PR1-4	VR848	5/23	0.046
				10/16	0.0554
		PR1-5	VR849	5/23	0.0465
				10/16	0.0516
St. Croix	SC1	SC1-1	JH938	5/3	0
				10/24	0
		SC1-2	JH939	5/3	0
				10/24	0
Sauk	SK6	SK6-1	BB246	4/25	0.207
				11/14	0.0658
		SK6-3	BB248	4/25	0.31
				11/14	0.32
Trempealeau	TR1	TR1-1	PX201	5/7	0
				10/23	0
		TR1-2	PX202	5/7	0
				10/23	0
Waupaca	WP2	WP2-1	JH985	4/30	0
				11/7	0
		WP2-2	JH984	4/30	0
				11/7	0
Waushara	WS4	WS4-1	BB258	5/22	0.293
				11/7	0.457
		WS4-4	BB261	5/22	0.0294
				11/7	0.062
	WS6	WS6-1	JH989	5/22	0.0181
				11/7	0.05
		WS6-2	JH990	5/22	0.0587
				11/7	0.0218
	WS7 (Hancock Agricultural Research Station)	WS7-1	VR841	5/22	0.11
				11/19	0.0762
		WS7-2	VR842	5/22	0.141
				11/19	0.134
		WS7-3	VR843	5/22	0.863
				11/19	0.972

Notes:

WUWN	Wisconsin Unique Well Number
µg/L	Micrograms per liter or parts per billion
0	Concentration does not exceed laboratory reporting limit of 0.05 µg/L.
	Detected concentration exceeds the proposed Cycle 10 Recommendations for Preventive Action Limit of 0.02 µg/L.
	Detected concentration exceeds the proposed Cycle 10 Recommendations for Enforcement Standard of 0.2 µg/L.

Table 8

Field-Edge Groundwater Monitoring Program
2019 Alachlor ESA Concentrations in Groundwater Samples

COUNTY	SITE (Grower)	WELL IDENTIFICATION	WUWN	SAMPLE DATE (2019)	ALACHLOR ESA (in µg/L)
Adams	AD2	AD2-1	BH954	4/23	0
				11/20	0
		AD2-4	VR844	4/23	0.835
				11/20	0.684
		AD2-5	VR845	4/23	0.779
				11/20	0.711
	AD3	AD3-1	BH999	4/23	0.174
				11/20	0.0999
		AD3-3	BI001	4/23	1.22
				11/20	0.998
	AD4	AD4-2	BH997	4/23	0.283
				11/20	0.299
	AD5	AD5-1	CL461	4/23	0
				11/20	0
		AD5-4	VR846	4/23	2.36
				11/20	2.04
		AD5-5	VR847	4/23	9.94
				11/20	8.31
Barron	BR3	BR3-1	BR279	5/14	0
				10/24	0
		BR3-3	BR281	5/14	0
				10/24	0
Dane	DN1	DN1-2	BR250	5/9	0
				11/5	0.0664
		DN1-3	BR252	5/9	0.0941
				11/5	0.0992
Dunn	DU1	DU1-1	AO384	5/14	0.0731
				10/24	0.209
		DU1-3	AO386	5/14	0.168
				10/24	0.11
	DU2	DU2-1	AO387	5/14	0.163
				10/24	0
		DU2-3	AO389	5/14	0.168
				10/24	0.151
Grant	GR1	GR1-1	BR255	4/25	0.0943
				11/14	0
		GR1-3	BR257	4/25	0.0962
Iowa	IW1	IW1-4	BR259	4/25	0.699
				11/5	0.163
		IW1-7	BH967	4/25	1.06
				11/5	1.33
	IW2	IW2-1	BR036	4/25	0.164
				11/5	0.104
		IW2-3	BR038	4/25	0.385
				11/5	0.406
Jackson	JK3	JK3-1	JH982	5/1	0
				10/23	0
		JK3-2	JH981	5/1	0
				10/23	0
Juneau	JN1	JN1-1	BR046	5/7	0
				11/1	0
		JN1-3	BR048	5/7	0
				11/1	0.765
	JN3	JN3-1	JH937	4/23	0
				11/21	1.31
		JN3-2	JH936	4/23	0.0652
				11/21	0.106
La Crosse	LC2	LC2-1	VZ391	5/1	0
				10/23	0
		LC2-2	VZ392	5/1	0
				10/23	0
Langlade	LN1	LN1-1	BH964	5/23	0
				10/16	0
		LN1-3	BH966	5/23	0
				10/16	0
Portage	PR1	PR1-1	BR207	4/30	0
				10/16	0
		PR1-4	VR848	5/23	0.81
				10/16	0.712
		PR1-5	VR849	5/23	0.834
				10/16	0.794
St. Croix	SC1	SC1-1	JH938	5/3	0.353
				10/24	0.366
		SC1-2	JH939	5/3	0.0756
				10/24	0
Sauk	SK6	SK6-1	BB246	4/25	0.513
				11/14	0.274
		SK6-3	BB248	4/25	0.49
				11/14	0.806
Trempealeau	TR1	TR1-1	PX201	5/7	0
				10/23	0
		TR1-2	PX202	5/7	0
				10/23	0
Waupaca	WP2	WP2-1	JH985	4/30	0
				11/7	0
		WP2-2	JH984	4/30	0
				11/7	0.0852
Waushara	WS4	WS4-1	BB258	5/22	0.815
				11/7	0.326
		WS4-4	BB261	5/22	0.459
				11/7	0.388
	WS6	WS6-1	JH989	5/22	0.284
				11/7	0.228
		WS6-2	JH990	5/22	0
				11/7	0
	WS7 (Hancock Agricultural Research Station)	WS7-1	VR841	5/22	0.191
				11/19	0.2
		WS7-2	VR842	5/22	1.02
				11/19	0.981
		WS7-3	VR843	5/22	4.97
				11/19	3.72

Notes:

WUWN	Wisconsin Unique Well Number
Alachlor ESA	Alachlor Ethanesulfonic Acid
µg/L	Micrograms per liter or parts per billion
0	Concentration does not exceed laboratory reporting limit of 0.05 µg/L.
(yellow highlight)	Detected concentration exceeds the Wisconsin Administrative Code Ch. NR 140 Preventive Action Limit of 4.0 µg/L.

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Table 9

Field-Edge Groundwater Monitoring Program
2019 Atrazine and Metabolite Concentrations in Groundwater Samples

COUNTY	SITE (Grower)	WELL IDENTIFICATION	WUWN	SAMPLE DATE (2019)	Atrazine	De-ethyl Atrazine	De-isopropyl Atrazine	Di-amino Atrazine	Atrazine TCR
Adams	AD2	AD2-1	BH954	4/23	0	0	0	0	0
				11/20	0	0	0	0	0
		AD2-4	VR844	4/23	0.686	0.404	0.0742	0	1.1642
				11/20	0.955	0.651	0.0975	0	1.7035
		AD2-5	VR845	4/23	0.0721	0.303	0	0.201	0.5761
				11/20	0.0725	0.215	0	0	0.2875
	AD3	AD3-1	BH999	4/23	0	0	0	0	0
				11/20	0	0	0	0	0
		AD3-3	BI001	4/23	0	0.119	0	0	0.119
				11/20	0	0.087	0	0	0.087
	AD4	AD4-2	BH997	4/23	0	0.0647	0	0	0.0647
				11/20	0	0.0677	0	0	0.0677
	AD5	AD5-1	CL461	4/23	0	0	0	0	0
				11/20	0	0	0	0	0
		AD5-4	VR846	4/23	0.171	0.538	0.0979	0.223	1.0299
				11/20	0.182	0.382	0.0781	0	0.6421
		AD5-5	VR847	4/23	0.165	0.488	0	0.216	0.869
				11/20	0.158	0.642	0	0.235	1.035
Barron	BR3	BR3-1	BR279	5/14	0	0	0	0	0
				10/24	0	0	0	0	0
		BR3-3	BR281	5/14	0	0	0	0	0
				10/24	0	0	0	0	0
Dane	DN1	DN1-2	BR250	5/9	0	0	0.0633	0	0.0633
				11/5	0	0	0	0	0
		DN1-3	BR252	5/9	0	0	0	0	0
				11/5	0	0	0.051	0	0.051
Dunn	DU1	DU1-1	AO384	5/14	0	0	0.198	0	0.198
				10/24	0	0	0.21	0	0.21
		DU1-3	AO386	5/14	0	0	0.246	0	0.246
				10/24	0	0	0.234	0	0.234
	DU2	DU2-1	AO387	5/14	0	0	0	0	0
				10/24	0	0.0551	0	0	0.0551
		DU2-3	AO389	5/14	0	0	0	0	0
				10/24	0	0	0	0	0
Grant	GR1	GR1-1	BR255	4/25	0	0	0.0657	0	0.0657
				11/14	0	0	0	0	0
		GR1-3	BR257	4/25	0	0	0.0928	0	0.0928
Iowa	IW1	IW1-4	BR259	4/25	0	0	0	0	0
				11/5	0	0	0	0	0
		IW1-7	BH967	4/25	0	0	0.0873	0	0.0873
				11/5	0.05	0	0.101	0	0.151
	IW2	IW2-1	BR036	4/25	0	0	0	0	0
				11/5	0	0	0	0	0
		IW2-3	BR038	4/25	0	0	0	0	0
				11/5	0	0	0	0	0
Jackson	JK3	JK3-1	JH982	5/1	0	0	0	0	0
				10/23	0	0	0	0	0
		JK3-2	JH981	5/1	0	0	0	0	0
				10/23	0	0	0.0532	0	0.0532
Juneau	JN1	JN1-1	BR046	5/7	0	0	0	0	0
				11/1	0	0	0	0	0
		JN1-3	BR048	5/7	0	0	0	0	0
				11/1	0	0	0	0	0
	JN3	JN3-1	JH937	4/23	0	0	0	0	0
				11/21	0	0	0	0	0
		JN3-2	JH936	4/23	0	0	0	0	0
				11/21	0	0	0	0	0
La Crosse	LC2	LC2-1	VZ391	5/1	0.0593	0.18	0	0	0.2393
				10/23	0.0512	0.183	0	0	0.2342
		LC2-2	VZ392	5/1	0.0516	0.15	0	0	0.2016
				10/23	0.0706	0.147	0	0	0.2176
Langlade	LN1	LN1-1	BH964	5/23	0	0	0	0	0
				10/16	0	0	0	0	0
		LN1-3	BH966	5/23	0	0	0	0	0
				10/16	0	0	0	0	0
Portage	PR1	PR1-1	BR207	4/30	0	0	0	0	0
				10/16	0	0	0	0	0
		PR1-4	VR848	5/23	0	0.0756	0	0	0.0756
				10/16	0	0.0673	0	0	0.0673
		PR1-5	VR849	5/23	0	0.1	0	0	0.1
				10/16	0	0.0944	0	0	0.0944
St. Croix	SC1	SC1-1	JH938	5/3	0	0.0762	0	0.239	0.3152
				10/24	0	0.0686	0	0.229	0.2976
		SC1-2	JH939	5/3	0.0676	0	0	0	0.0676
				10/24	0.0611	0.0579	0	0	0.119
Sauk	SK6	SK6-1	BB246	4/25	0	0	0	0	0
				11/14	0	0	0	0	0
		SK6-3	BB248	4/25	0	0	0	0	0
				11/14	0	0	0	0	0
Trempealeau	TR1	TR1-1	PX201	5/7	0	0	0	0	0
				10/23	0	0	0	0	0
		TR1-2	PX202	5/7	0	0	0	0	0
				10/23	0	0	0	0	0
Waupaca	WP2	WP2-1	JH985	4/30	0	0.115	0.0625	0.225	0.4025
				11/7	0	0.125	0.0659	0	0.1909
		WP2-2	JH984	4/30	0	0	0	0	0
				11/7	0	0.073	0.062	0	0.135
Waushara	WS4	WS4-1	BB258	5/22	0	0	0	0	0
				11/7	0	0	0.0816	0	0.0816
		WS4-4	BB261	5/22	0	0	0	0	0
				11/7	0	0	0	0	0
	WS6	WS6-1	JH989	5/22	0	0	0.111	0	0.111
				11/7	0	0	0.0563	0	0.0563
		WS6-2	JH990	5/22	0	0	0	0	0
				11/7	0	0	0	0	0
	WS7 (Hancock Agricultural Research Station)	WS7-1	VR841	5/22	0	0	0	0	0
				11/19	0	0	0	0	0
		WS7-2	VR842	5/22	0	0	0	0	0
				11/19	0	0	0	0	0
		WS7-3	VR843	5/22	0.0662	0.272	0.405	0.242	0.9852
				11/19	0.0682	0.408	0.386	0.203	1.0652

Notes:

Concentrations identified as micrograms per liter or parts per billion.
TCR Total Chlorinated Residue for Atrazine. Reflects an additive quantity of atrazine and its three metabolites (de-ethyl, de-isopropyl and di-amino atrazine).
WUWN Wisconsin Unique Well Number
µg/L Micrograms per liter or parts per billion.
0 Concentration does not exceed laboratory reporting limit of 0.05 µg/L.
(green) Site is located within an atrazine Prohibition Area.
(yellow) Detected concentration exceeds the Wisconsin Administrative Code Ch. NR 140 Preventive Action Limit of 0.3 µg/L.

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Table 10

Field-Edge Groundwater Monitoring Program
2019 Nitrogen - Nitrate/Nitrite Concentrations in Groundwater Samples

COUNTY	SITE (Grower)	WELL IDENTIFICATION	WUWN	SAMPLE DATE (2019)	TOTAL NITROGEN (in mg/L)
Adams	AD2	AD2-1	BH954	4/23	6.52
				11/20	14.7
		AD2-4	VR844	4/23	35.3
				11/20	38.4
		AD2-5	VR845	4/23	30.6
				11/20	25.2
	AD3	AD3-1	BH999	4/23	8.91
				11/20	6.68
		AD3-3	BI001	4/23	29.9
				11/20	18.3
	AD4	AD4-2	BH997	4/23	21.7
				11/20	13
	AD5	AD5-1	CL461	4/23	0
				11/20	0
		AD5-4	VR846	4/23	33.3
				11/20	33.8
		AD5-5	VR847	4/23	34.4
				11/20	30.5
Barron	BR3	BR3-1	BR279	5/14	1.18
				10/24	0
		BR3-3	BR281	5/14	0.686
				10/24	23.1
Dane	DN1	DN1-2	BR250	5/9	25.5
				11/5	19.2
		DN1-3	BR252	5/9	22.4
				11/5	23.3
Dunn	DU1	DU1-1	AO384	5/14	16.2
				10/24	18.4
		DU1-3	AO386	5/14	17.7
				10/24	12.9
	DU2	DU2-1	AO387	5/14	9.6
				10/24	3.42
		DU2-3	AO389	5/14	1.14
				10/24	1.07
Grant	GR1	GR1-1	BR255	4/25	17.6
				11/14	23.3
		GR1-3	BR257	4/25	20.9
Iowa	IW1	IW1-4	BR259	4/25	25.2
				11/5	16.5
		IW1-7	BH967	4/25	24.7
				11/5	25.8
	IW2	IW2-1	BR036	4/25	0
				11/5	0
		IW2-3	BR038	4/25	19.7
				11/5	19.5
Jackson	JK3	JK3-1	JH982	5/1	3.82
				10/23	4.48
		JK3-2	JH981	5/1	3.9
				10/23	4.4
Juneau	JN1	JN1-1	BR046	5/7	0.989
				11/1	2.99
		JN1-3	BR048	5/7	0
				11/1	28.9
	JN3	JN3-1	JH937	4/23	1.59
				11/21	0.512
		JN3-2	JH936	4/23	1.81
				11/21	0
La Crosse	LC2	LC2-1	VZ391	5/1	22.7
				10/23	18
		LC2-2	VZ392	5/1	19.3
				10/23	22.6
Langlade	LN1	LN1-1	BH964	5/23	3.26
				10/16	16.7
		LN1-3	BH966	5/23	16.9
				10/16	18.3
Portage	PR1	PR1-1	BR207	4/30	4.51
				10/16	0.866
		PR1-4	VR848	5/23	21.2
				10/16	20.3
		PR1-5	VR849	5/23	24.9
				10/16	23.3
St. Croix	SC1	SC1-1	JH938	5/3	9.55
				10/24	9.55
		SC1-2	JH939	5/3	12.4
				10/24	6.55
Sauk	SK6	SK6-1	BB246	4/25	12.7
				11/14	17.2
		SK6-3	BB248	4/25	27.6
				11/14	30.4
Trempealeau	TR1	TR1-1	PX201	5/7	20
				10/23	20.3
		TR1-2	PX202	5/7	18.6
				10/23	15.7
Waupaca	WP2	WP2-1	JH985	4/30	6.87
				11/7	7.66
		WP2-2	JH984	4/30	1.01
				11/7	8.34
Waushara	WS4	WS4-1	BB258	5/22	43.4
				11/7	17.1
		WS4-4	BB261	5/22	33
				11/7	15.5
	WS6	WS6-1	JH989	5/22	27.9
				11/7	40.8
		WS6-2	JH990	5/22	1.74
				11/7	4.39
	WS7 (Hancock Agricultural Research Station)	WS7-1	VR841	5/22	18.5
				11/19	10
		WS7-2	VR842	5/22	21.2
				11/19	27.6
		WS7-3	VR843	5/22	40.9
				11/19	38.8

Notes:

WUWN	Wisconsin Unique Well Number
mg/L	Milligrams per liter or parts per million
0	Concentration does not exceed laboratory reporting limit of 0.5 mg/L.
(yellow)	Detected concentration exceeds the Wisconsin Administrative Code Ch. NR 140 Preventive Action Limit of 2.0 mg/L.
(orange)	Detected concentration exceeds the Wisconsin Administrative Code Ch. NR 140 Enforcement Standard of 10.0 mg/L.

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APPENDIX B

Report Figures