Surface Water Pesticide Monitoring and Assessment Project, 2009

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Acknowledgements

The Department thanks Mike Ell from the North Dakota Department of Health for his assistance in coordinating this project. Sampling was performed by Heather Duchscherer, Mike Ell, Peter Wax, Jim Collins and Mike Hargiss from the North Dakota Department of Health and Paul Scarpari from the United States Geological Survey.

The Department also thanks the Water Quality Advisory Committee for its input and advice. The Committee consists of the following state and federal agencies:

ND Department of Health
ND Department of Parks and Recreation
ND Game and Fish Department
ND Geological Survey
ND State University Extension Service
ND State Water Commission
US Department of Agriculture-NRCS
US Fish and Wildlife Service
US Geological Survey

Summary

The North Dakota Department of Agriculture, working in cooperation with the North Dakota Department of Health's Division of Water Quality, coordinated a surface water monitoring survey in 2009 to assess levels of pesticides and pesticide degradates in North Dakota rivers. Twenty-nine sites, representing all major watersheds of North Dakota, were sampled and tested for 180 different pesticides and pesticide degradates every six weeks from June through November. There were a total of eleven detections of four different pesticides (atrazine, bentazon, dimethenamid, and MCPA). The most commonly detected pesticides were the herbicides atrazine and bentazon, detected four and three times, respectively. MCPA and dimethenamid were each detected twice. For all pesticides, concentrations were significantly below levels deemed harmful by the U.S. Environmental Protection Agency (EPA). Results show that North Dakota streams and rivers have minimal pesticide contamination. The study also supports the need for regular, comprehensive monitoring of surface water for pesticides to verify results, assess risks of pesticides to human health and the environment, and identify trends.

Introduction

Through the authority provided in Chapters 4-35, 4-35.1, and 19-18 of the North Dakota Century Code, the North Dakota Department of Agriculture (hereafter "Department") is the lead pesticide regulatory agency in the state. Under a cooperative agreement with the EPA, the Department is charged with regulating pesticides in the public's interest to ensure that they do not pose a risk of unreasonable adverse effects to human health or the environment.

Before 2007, the Department's Pesticide Water Quality Program was concerned only with those pesticides that posed a risk of contaminating groundwater. The Department has had a committee in place for over a decade to advise them on groundwater issues. Agencies represented on the committee include the ND Department of Health (NDDoH), US Department of Agriculture – Natural Resource Conservation Service, ND State University Extension Service, US Geological Survey (USGS), ND Geological Survey and the ND State Water Commission.

The EPA has recently identified surface water resources as a priority area of focus. Therefore, the Program's focus has expanded to protect both groundwater and surface water from pesticide contamination. To reflect this expansion, the Groundwater Working Committee has been renamed the Water Quality Advisory Committee (WQAC) and now includes representatives from the US Fish and Wildlife Service, ND Game and Fish Department, and ND Parks and Recreation Department.

Identifying pesticide and surface water issues is a priority for the Department and the WQAC. Before the first monitoring project in 2008, no agency routinely monitored for pesticides in North Dakota's surface waters. A pilot monitoring project coordinated between the Department and the NDDoH was conducted in 2006. Eleven sites were sampled twice from late June through August and tested for 63 different pesticides. Results showed one detection of picloram at a concentration of 0.23 parts per billion (ppb), which is below any level of concern established by the EPA for human health or wildlife.

The Department, working in cooperation with the North Dakota Department of Health's Division of Water Quality, resumed a surface water monitoring survey in 2008 for pesticides and pesticide degradates. Nine sample sites in three different watersheds (Sheyenne, Souris, and Yellowstone Rivers) in North Dakota were sampled and tested for 184 different pesticides and pesticide degradates every three weeks from April through October. A total of nine pesticides and one pesticide degradate were detected. The most commonly detected pesticides were the herbicides 2,4-D and diuron. For all but one pesticide, concentrations were below levels deemed harmful by the U.S. Environmental Protection Agency (EPA). Diuron was found in the Souris River at concentrations that could be harmful to aquatic life, specifically green algae.

Pesticides were not detected in any of the nine sampling sites in April or May during the 2008 pesticide sampling season. Instead, detections began in June, peaked at the beginning of August, and were ongoing at the end of October. Because the detections began in June the year before, WQAC decided to start sampling in June of 2009 and allow the resources that would have been used for spring sampling to be used to increase the number of sampling sites in the state.

The pesticide water quality monitoring program received an increase in funding in 2009 through an EPA Clean Water Act Section 319 grant. Because of this grant, a later start, and a six week sampling schedule instead of a three week schedule, we were able to dramatically expand the number of sites sampled and make the program truly state-wide to represent every major North Dakota watershed.

Sampling sites were chosen from the NDDoH’s ambient surface water monitoring sites to make the sampling most efficient. We were able to sample at 29 of the 34 ambient monitoring sites. Five sites were dropped because of proximity to other sampling sites.

Project goals

The goals of the 2009 monitoring study were to:

- Determine the occurrence and concentration of pesticides in North Dakota rivers;
- Determine whether any pesticides may be present at concentrations that could adversely affect human health, aquatic life, or fish-eating wildlife; and
- Continue to determine the temporal and spatial frequency of sampling needed to assess contamination, thereby helping to further refine future pesticide monitoring design.

The Department will also use the monitoring data as part of its cooperative agreement with the EPA. Under that agreement, the Department has committed to evaluate national and local pesticides of interest that may pose a risk to water quality. Furthermore, the Department is required to demonstrate that any risks are appropriately managed.

In addition, the Department administers an Endangered Species Protection Program that is focused on ensuring that pesticides do not negatively impact threatened and endangered species in North Dakota.

Since most of the seven listed species in the state are found in or near surface water, the Department will use the results of the monitoring study to identify pesticides that may pose a risk to threatened and endangered species.

Materials and Methods

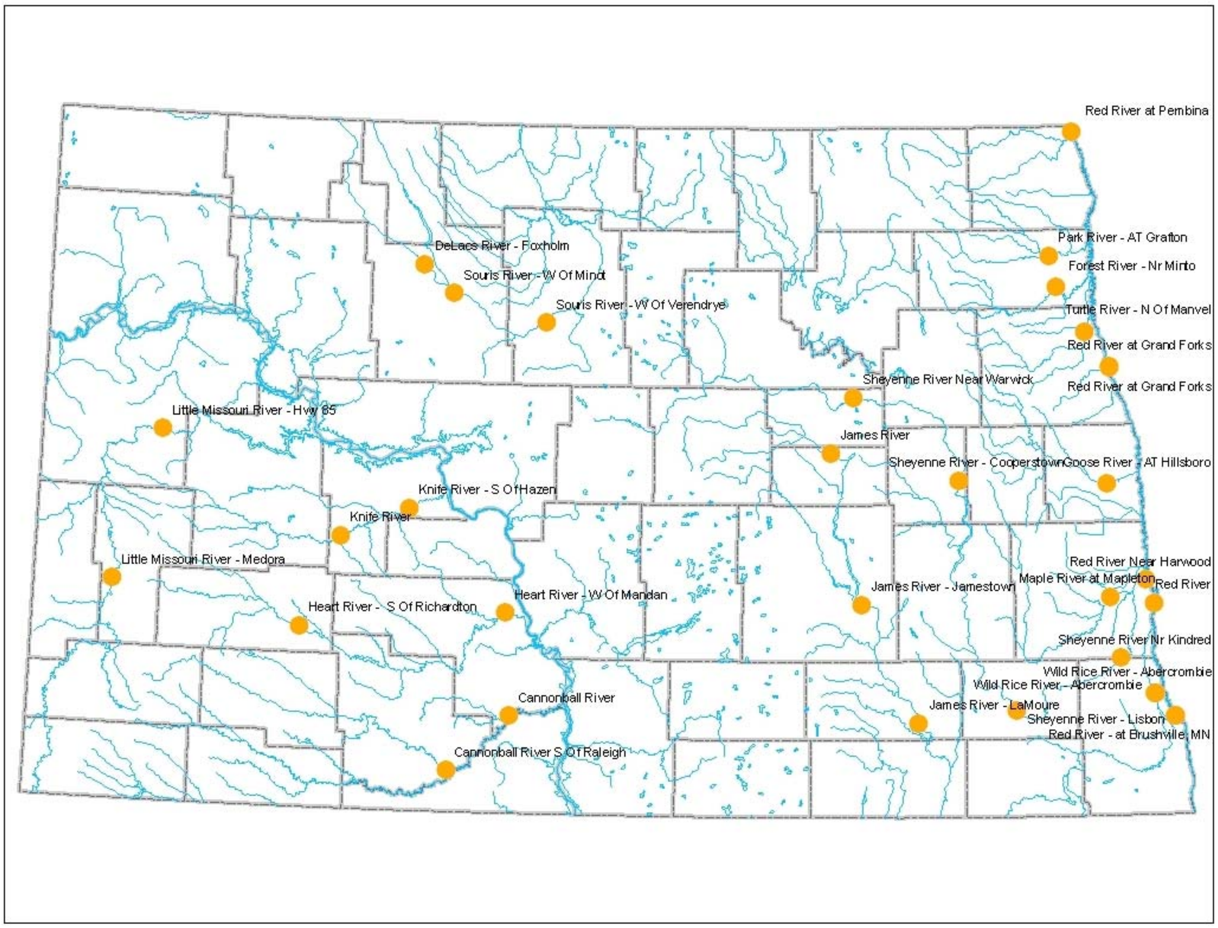
Pesticide samples and associated field measurements were collected at 29 sites every six weeks from June through November 2009. Samples were collected for the Missouri River watershed during the weeks of June 1st, July 13th, August 24th, October 5th and November 16th , 2009. Samples were collected in the eastern side of the state in the Red River, James River and Souris River watersheds during the weeks of June 15th, July 27th, September 7th, October 19th and November 30th ,2009. Locations of the sampling sites can be found in Table 1 and Figure 1.

Table 1. Sampling locations for the 2009 North Dakota surface water monitoring project with latitude and longitude information

Site ID	Sampling Site	Location	Latitude	Longitute
380007	Sheyenne River - Lisbon	1.5 Mi S, 0.5 Mi E Of Lisbon	46.40567	-97.673
380009	Sheyenne River - Cooperstown	4.5 Mi E Of Cooperstown	47.43292	-98.0278
380012	James River - LaMoure	West Edge Of Lamoure On Hwy 13	46.35537	-98.3061
380013	James River - Jamestown	Downstream From Jamestown	46.88339	-98.6709
380021	DeLacs River - Foxholm	At Bridge In Foxholm	48.37047	-101.57
380022	Little Missouri River - Medora	1 Mi W Of Medora On Bridge	46.91661	-103.532
380031	Wild Rice River - Abercrombie	3.2 Mi NW Of Abercrobmie	46.47112	-96.782
380037	Turtle River - N Of Manvel	On Hwy 81 Bridge	48.08617	-97.1843
380039	Forest River - Nr Minto	0.4 Mi E Of Hwy 81 Bridge	48.28598	-97.3698
380059	Little Missouri River - Hwy 85	On Hwy 85 Bridge	47.59233	-103.253
380067	Cannonball River	0.5 Mi S Of Breien	46.37668	-100.935
380083	Red River - at Brushville, MN	6 Mi N And 1 Mi W Of Wahpeton	46.36948	-96.6568
380087	Knife River - S Of Hazen	0.5 Mi S Of Hazen	47.28547	-101.623
380095	Souris River - W Of Verendrye	1 Mi W Of Verendrye	48.12481	-100.749
380105	Cannonball River S Of Raleigh	16 Mi S Of Raleigh	46.12676	-101.333
380151	Heart River - W Of Mandan	3 Mi W Of Mandan	46.83378	-100.974
380156	Goose River - AT Hillsboro	In Hillsboro	47.40701	-97.0574
380157	Park River - AT Grafton	In Grafton At Hwy 81 Bridge	48.42479	-97.4119
380160	Heart River - S Of Richardton	8 Mi S Of Richardton	46.74585	-102.308

Site ID	Sampling Site	Location	Latitude	Longitute
380161	Souris River - W Of Minot	3.5 Mi W Of Minot	48.2459	-101.372
384130	James River	At Grace City	47.55801	-98.863
384131	Knife River	At Golden Valley	47.15485	-102.06
384155	Maple River at Mapleton	@ Mapleton	46.9054	-97.0525
384156	Red River at Grand Forks	Demers Ave Bridge	47.92686	-97.0282
384157	Red River at Pembina		48.97367	-97.2378
385001	Sheyenne River Nr Kindred	On Highway 46 Nr Kindred	46.63146	-97.0003
385040	Red River Near Harwood	3 Mi E Of Harwood	46.97695	-96.8203
385345	Sheyenne River Near Warwick	3.3 Mi S of Warwick, ND	47.80526	-98.7172
385414	Red River	at Fargo on Main Ave Bridge	46.87364	-96.7766

Figure 1. Sampling locations for the 2009 pesticide surface water monitoring study



Dissolved oxygen, temperature, pH, and specific conductivity were measured at the time of sampling with a YSI Model 650 MDS (Multiparameter Display System) / Data Logger combined with a YSI Model 600XL 6 sensor sonde. Results were recorded in the field on a field log form.

Grab samples were collected for pesticide analysis. Samples were collected in the main current below the surface at a depth of approximately 60 percent of the total water depth. This depth was chosen for sample collection as it is assumed to be representative of the entire stream.

At the start of the season when there was greater water depth, a 1.2-L Teflon Kemmerer sampling device was used to collect samples. This was done by lowering the Kemmerer sampling device into the water from a bridge or crossing. The device was lowered into the stream and the sampler tripped at 60 percent of the total stream depth. Later in the season when water depths were lower, grab samples were collected by wading into the stream. Care was taken so that the sample was not contaminated by disturbing the stream bed upstream from the collection point. When the sample was collected by wading, the stream was entered slightly down current from the sampling site and then the sampler waded to the area with the greatest current. The lid was placed on the sample bottle then submerged to approximately 60 percent of the stream depth; the lid was removed and the bottle was allowed to fill facing towards the current, allowing it to fill naturally. The lid was replaced prior to removing the bottle from the stream.

Samples were dispensed into two 500-mL amber glass jars with Teflon-coated lids. Sample bottles were provided by the lab and did not need to be rinsed.

The sample bottles came with appropriate labels attached. Custody reports and sample logs were immediately completed after sample collection (Appendix A). The samples were carefully packed with bubble wrap and rubber mesh and put into a cooler with ice and more packing materials shortly after collection. Coolers with the samples and ice inside were shipped to the laboratory using a next-day shipping service. The samples were usually shipped within a few hours of collection.

Selected field samples were collected in replicate to provide estimates of sample variability. The replicates consisted of two separate sets of samples collected one after another. Replicate samples were submitted blind to the laboratory. Further information on Quality Assurance/Quality Control (QA/QC) procedures can be found in the QAPP for this monitoring project (Johnson and Gray 2010).

Samples were analyzed for 180 different pesticides and degradates (Appendix C) by Pacific Agricultural Laboratory (Portland, OR) using EPA standard methods. Methods employed for analysis can be found in Table 2.

Table 2. Description of analytical methods used by Pacific Agricultural Labs.

Pesticide Class	Method Description
Organochlorine pesticides	Modified EPA method 608 (GC-ECD)
Organophosphorous pesticides	Modified EPA method 614 (GC-FPD)
Organonitrogen pesticides	Modified EPA method 625 (GC-MS)
Chlorinated pesticides	Modified EPA method 8321A (HPLC-MS)
Miscellaneous pesticides	Modified EPA method 8321A (HPLC-MS)

Results and Discussion

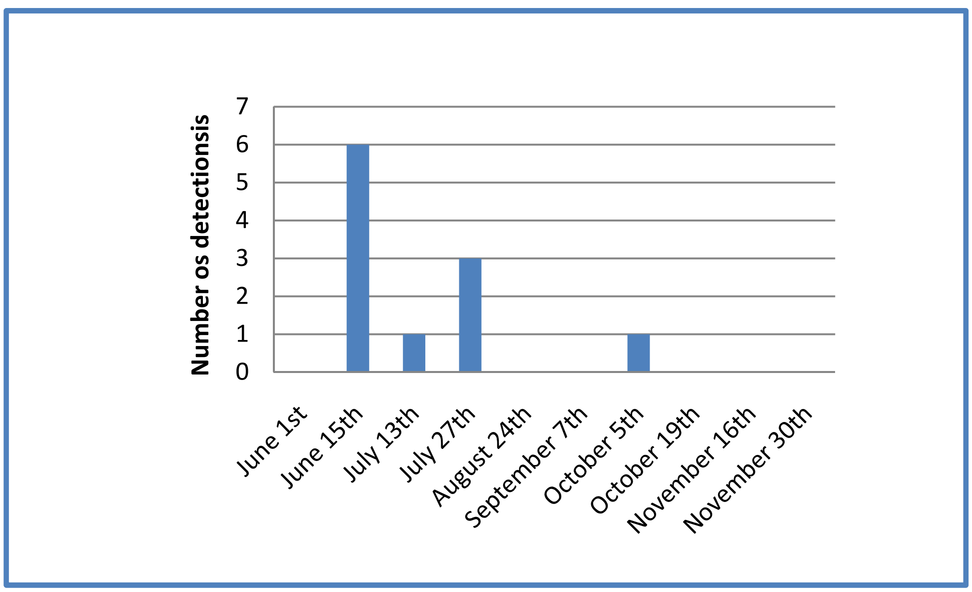
Over 93 percent of the 174 samples analyzed in 2009 had no detectable pesticide residues. Only four pesticides were detected, all of which were herbicides. The pesticides detected in ND surface water during the 2009 study were atrazine, bentazon, dimethenamid and MCPA (Table 3 and Appendix B). Atrazine and bentazon were detected four and three times, respectively, while dimethenamid and MCPA were both detected twice. All of the pesticides concentrations were less than 1 ppb. All of the pesticide detections were in the eastern edge of the state and in the Red River or its tributaries.

Table 3. Pesticides detected in the 2009 surface water monitoring project.

Pesticide	Trade name	# of detects	Maximum concentration (ppb)	EPA benchmark (ppb)
Atrazine	Aatrex	4	0.46	17.5
Bentazon	Basagran	3	0.70	4500
Dimethanamid	Outlook	2	0.36	8.9
MCPA	MCPA	2	1.5	177

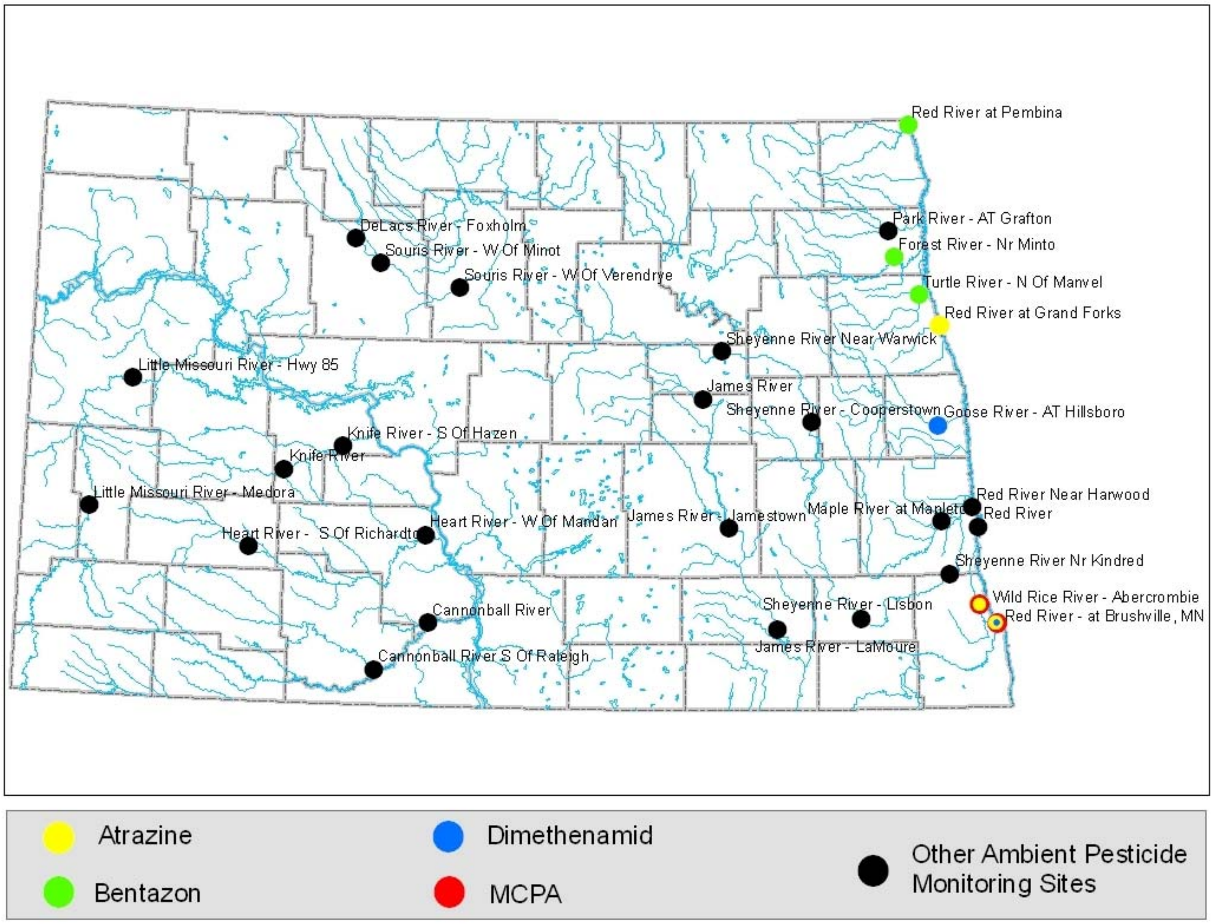
Approximately 92 percent of the 2009 pesticide detections were in June and July, shortly after the state's primary pesticide use season. There was one detection in October and no detections in August and November (Figure 2).

Figure 2. Number of pesticide detections by sampling date during the 2009 North Dakota Surface Water Monitoring Project



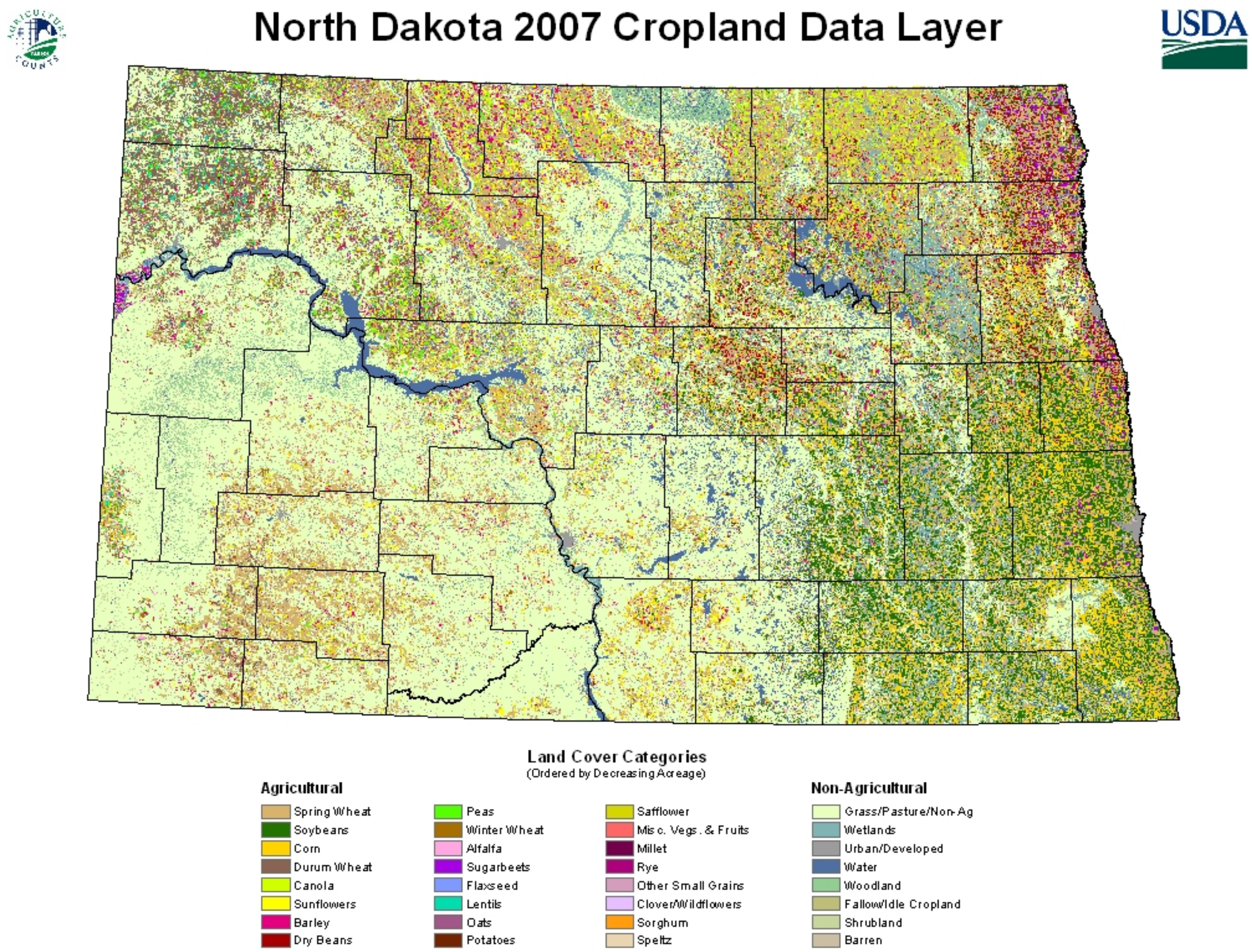
All of the pesticide detections occurred in the eastern edge of the state and in the Red River or its tributaries. The detection sites of the pesticides are shown in Figure 3.

Figure 3. Locations of pesticide detections from the 2009 ND Surface Water Monitoring Project



The Red River valley has a higher percentage of land in high intensity agriculture. Crops that use higher amounts of pesticides such as corn, soybeans and sugarbeets are common in the Red River Valley (Figure 4).

Figure 4. Land Cover data of North Dakota provided by the National Agriculture Statistics Service



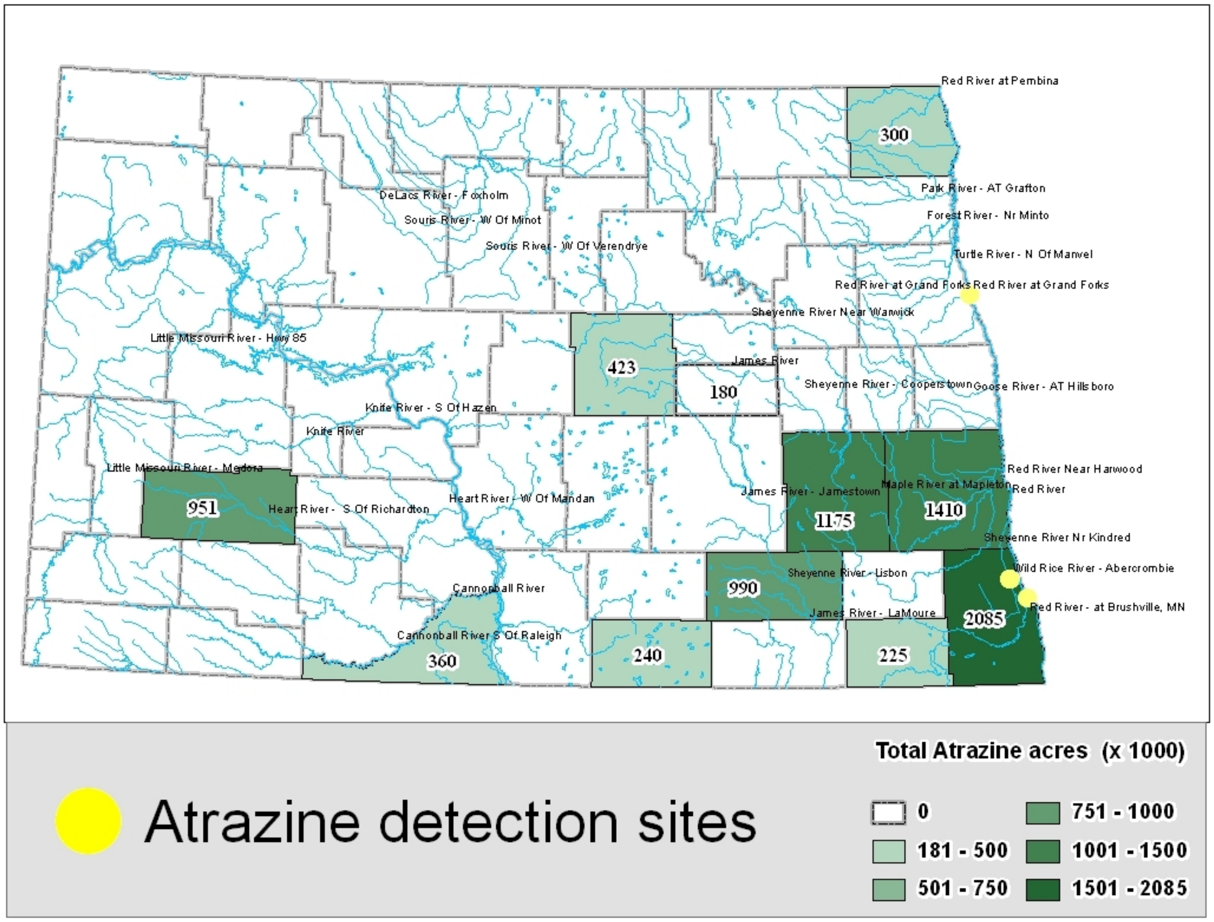
Risk of pesticides to human health or the environment is a function of both toxicity and exposure. The EPA has established Maximum Contaminant Levels (MCLs) for pesticides in drinking water based on risk to human health. The EPA has also established aquatic life benchmarks based on risk of pesticides to aquatic ecosystems (Appendix C). To assess risk and establish aquatic life benchmarks, the EPA relies on studies required under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as well as a wide range of environmental laboratory and field studies available in the public scientific literature. Aquatic life benchmarks, which are based on the most sensitive toxicity endpoint for a given taxa (e.g., freshwater fish), are estimates of the concentrations below which pesticides are not expected to harm aquatic life. In most cases the department was able to compare the concentration detected in surface water to the aquatic life benchmark, but not an MCL, because the EPA has not established MCLs for many pesticides.

Atrazine

Atrazine, a broadleaf herbicide used primarily on corn, is applied to approximately 59,500 acres as a standalone product and to 38,600 acres in mixtures in North Dakota each year (Zollinger, 2008). Atrazine was detected four times in 2009 in the Red River and its tributaries. It was detected twice on the Wild

Rice River at Abercrombie, ND, once on the Red River near Brushville, MN, and once on the Red River near Grand Forks, ND. All of these areas are in or are downstream from areas with heavy atrazine use (Figure 5).

Figure 5. Locations of atrazine surface water detections in 2009 and total atrazine use per county.



All atrazine detections occurred in June and July. This is not surprising since atrazine is a preemergence herbicide that is normally applied in late April through early May.

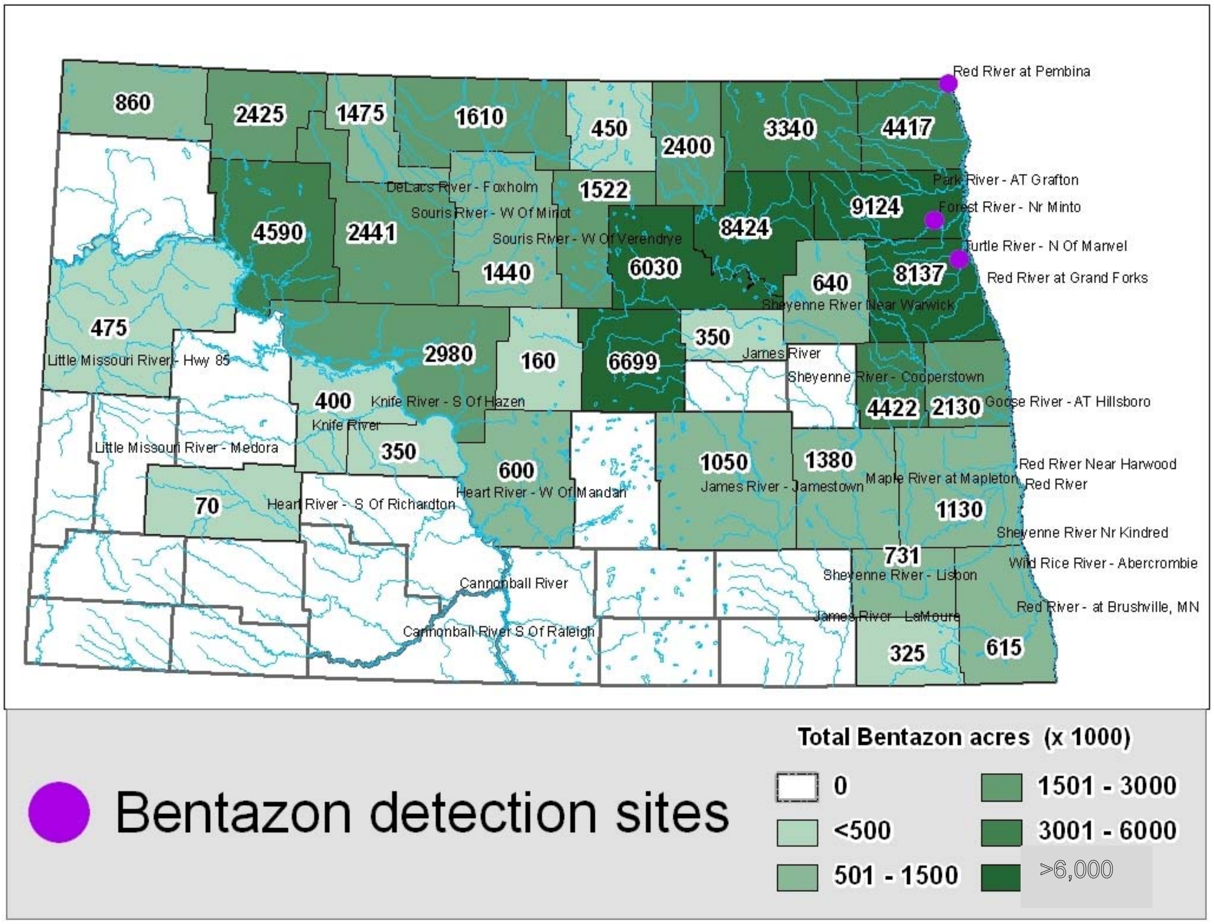
Atrazine was detected in the samples at a range of concentrations from 0.40 to 0.46 ppb. The EPA's lowest aquatic benchmark for atrazine is 17.5 ppb and is based on the risk of chronic toxicity to aquatic communities. The highest detected atrazine concentration was 38 times lower than the lowest aquatic benchmark, suggesting minimal risk of the detected atrazine levels to aquatic species.

Atrazine has an MCL of 3 ppb. The highest concentration detected is 6.52 times lower than the MCL, suggesting that the detected concentration posed minimal risk to drinking water.

Bentazon

Bentazon is a postemergence herbicide used for broadleaf weed control in wheat, barley, corn, flax, sugarbeet, CRP and pastures. It is used as a stand-alone product on 779,200 acres in North Dakota each year. In addition, it is applied in a mixture with other pesticides on 77,300 acres (Zollinger, 2008). All bentazon detection were in our downstream from counties with heavy bentazon use (Figure 6)

Figure 6. Locations of bentazon surface water detections in 2009 and total bentazon use per county.



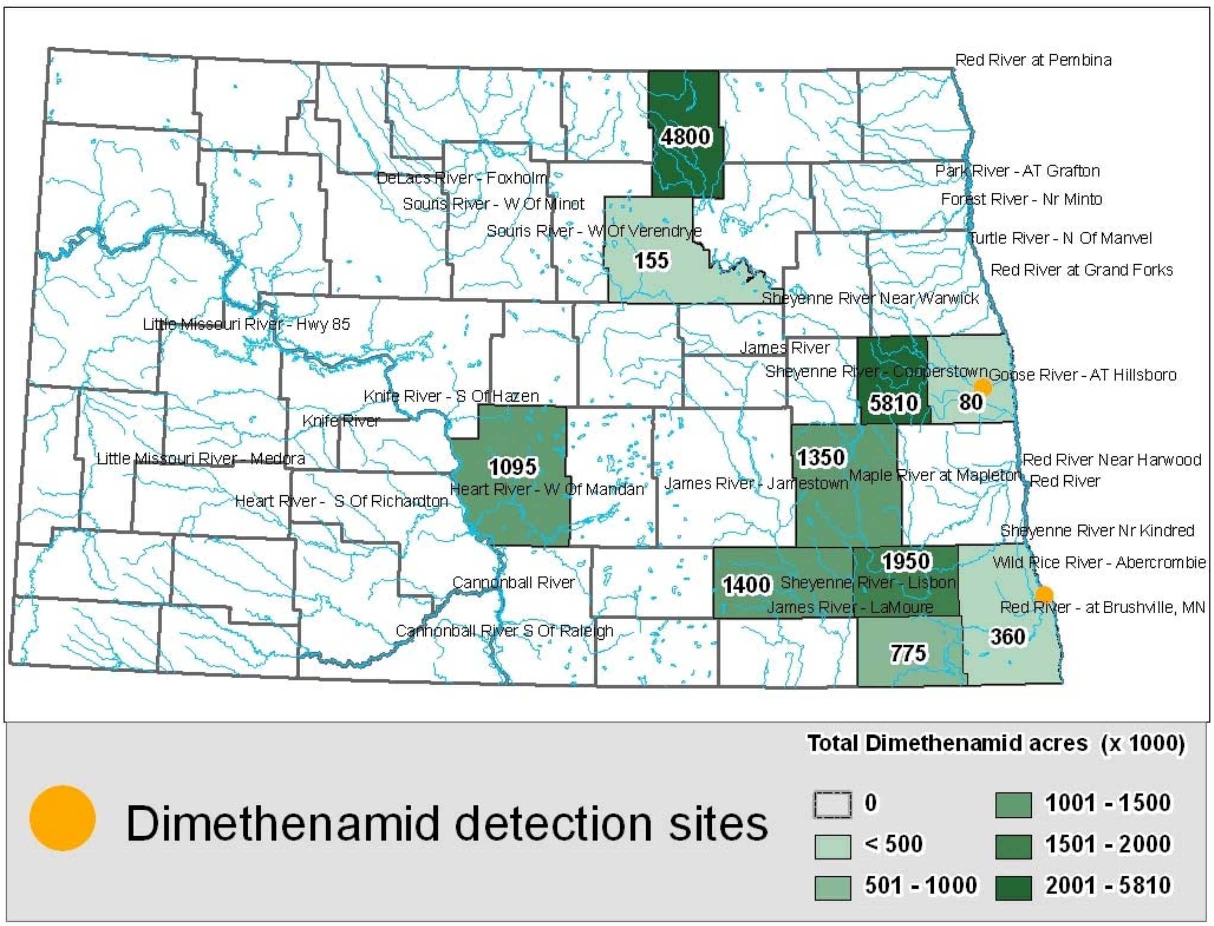
Bentazon was detected in three samples in July in the northeast section of the state: the Red River at Pembina, ND, the Forest River near Minto, ND and the Turtle River North of Manvel, ND. Both the Forest and Turtle Rivers are tributaries of the Red River. The detections were at concentrations ranging from 0.038-0.070 ppb. The EPA aquatic life benchmark concentration, set for acute toxicity to non-vascular plants, is 4,500 ppb. The highest concentrations found during sampling were over 64,000 times less than the established benchmark, suggesting very minimal risk. There are no MCLs established for bentazon.

Dimethenamid

Dimethenamid is a selective, pre-emergence herbicide for control of annual grasses, annual broadleaf weeds and sedges. In North Dakota, Dimethenamid is used primarily on corn and dry beans. Demethenamid is used on 145,400 acres in North Dakota annually (Zollinger, 2008).

Dimethenamid was detected twice in North Dakota in the 2009 study, on the Red River near Brushville, MN in June and in October on the Goose River, a tributary of the Red River, at Hillsboro. The June detection was at 0.35 ppb and the October detection was at 0.36 ppb of dimethenamid. The detection was in a county of moderate dimethenamid use and downstream from a county with heavy dimethenamid use (Figure 7).

Figure 7. Locations of dimethenamid surface water detections in 2009 and total dimethenamid use per county.



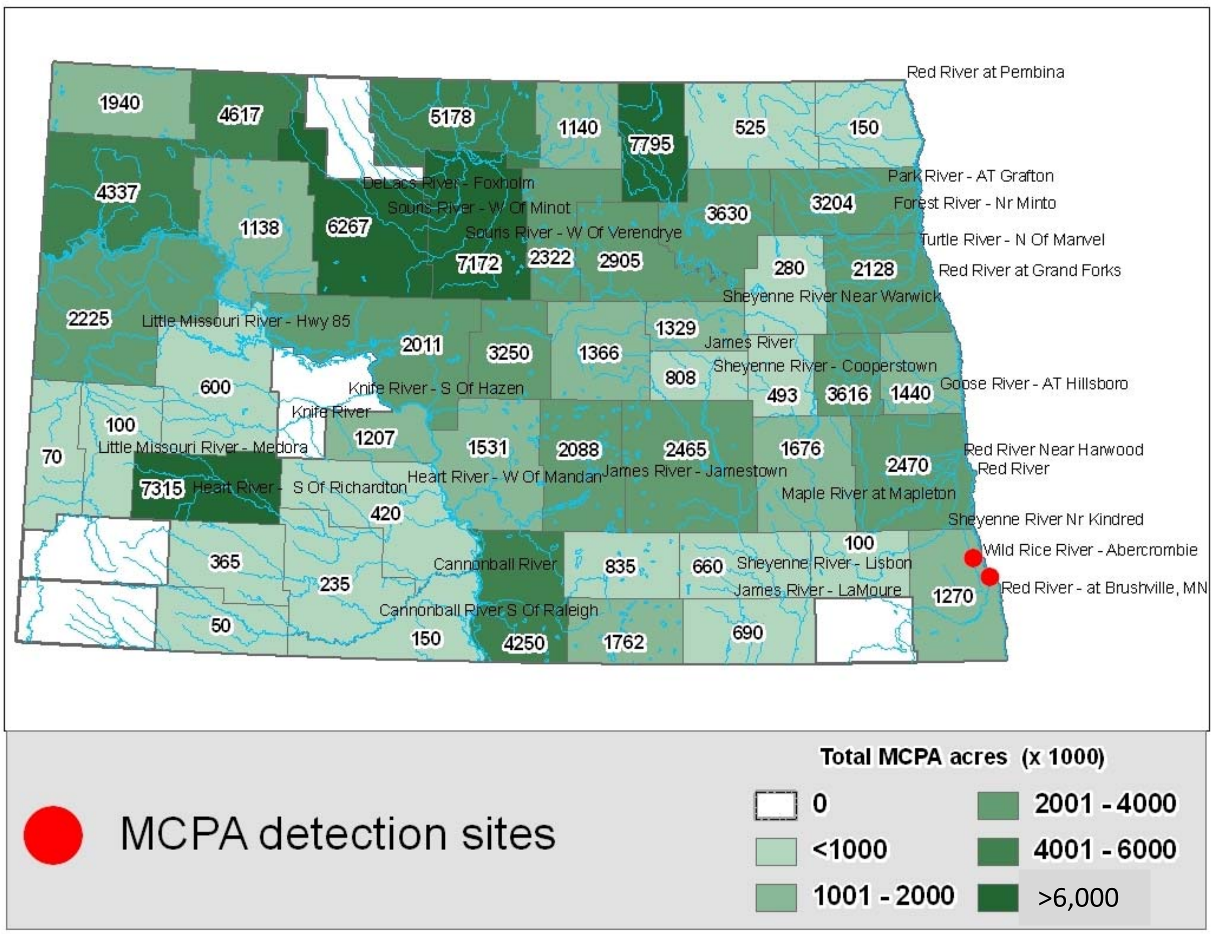
The aquatic life benchmark for dimethenamid for the most sensitive species, aquatic vascular plants, is 8.9 ppb. The highest detection of dimethenamid is more than 24 times less than the aquatic life benchmark. Therefore the detections found in North Dakota represent minimal risk to aquatic life. There are no MCLs established for dimethenamid.

MCPA

MCPA is a systemic herbicide used to control annual and perennial weeds in cereal grains and grassland. MCPA use in North Dakota is primarily used on wheat, barley, oats, flax, CRP and pasture. 933,600 acres of MCPA are applied in North Dakota annually as a standalone product and 2,651,000 acres treated with a mixture that includes MCPA (Zollinger, 2008).

There were two detections of MCPA in 2009 study, both in the southeast corner of the state (Figure 8). MCPA was detected at 0.9 ppb near Abercormbie, ND on the Wild Rice River, and at 1.5 ppb in the Red River near Brushville, MN. Detection of MCPA were in areas of moderate use, however we do not know what was used upstream of the Red River. Other areas of the state with more intensive MCPA use did not have any MCPA detections.

Figure 8. Locations of MCPA surface water detections in 2009 and total MCPA use per county.



The aquatic life benchmark for MCPA is 170 ppb for the most sensitive species, aquatic vascular plants. The highest concentration found during sampling was over 113 times lower than the established benchmark, suggesting minimal risk. There are no MCLs established for MCPA.

Conclusion

The results of the 2009 monitoring project are similar to the pilot project conducted in 2006. The pilot project had monitoring at many of the same sites as the 2009 project, including the Sheyenne River in two locations, the Souris River West, James, Little Missouri, Cannonball, Heart, Goose and Red Rivers. The 2006 pilot study showed only one pesticide detection of picloram at 0.23 ppb. That concentration was far below levels of concern for human and environmental health. Picloram was included as an analyte in the 2008 and 2009 monitoring studies, but no picloram was detected.

Several comparisons can be made between the 2008 and 2009 monitoring results. All sampling sites from 2008 were included in the 2009 study, as were 180 of the 184 pesticides tested for in 2008. Fewer pesticides were found during the 2009 sampling than in 2008; in 2009, four pesticides were detected, while nine pesticides and one pesticide degradate were detected in 2008. In 2009, atrazine and bentazon were the most commonly detected pesticides, while 2,4-D and diuron were the most commonly detected pesticides in 2008. In 2009, all of the pesticides were below levels that may be harmful according to EPA standards. In 2008 one pesticide, diuron was found above an aquatic life benchmark. Diuron was tested for in 2009, but it was not found.

We now have three years of ambient surface water sampling for pesticides in North Dakota. Results from these studies show that North Dakota rivers and streams have minimal pesticide contamination. This is a good sign for the environment and producers and others who rely on pesticides. All 2009 detections were below EPA's aquatic life benchmarks and MCLs. According to these standards, the concentrations of pesticides found in North Dakota rivers and streams are not a risk to human health and the environment. Aquatic life benchmarks are determined by the most sensitive species tested. The concentrations of pesticide found in 2009 are not expected to harm aquatic life, including acute and chronic exposure to fish and invertebrates, acute concentration for vascular and non-vascular plants.

This project is the only state-wide comprehensive surface water monitoring project for pesticides in North Dakota. For this reason, the project serves important purposes. If there are not impairments, it shows that current regulations are effective in mitigating risk of pesticide contamination to surface water. If impairments of rivers are found, these can be addressed through regulation and education. For example, in 2008 levels of diuron were found in the Souris River above aquatic life benchmarks. This is a problem that could have gone undetected for many years if not for this program. The department conducted investigations and outreach to the area following the 2008 detections. In 2009, there were no detections of diuron in the Souris River. Despite the inherent uncertainty of the cause of the diuron decrease, this is an excellent example of how a monitoring system can be useful in finding and mitigating a previously unnoticed problem.

Without surface water data, federal agencies such as the EPA often use conservative models that tend to overestimate the concentrations of pesticides in surface water. Because of a lack of surface water monitoring data, these models are often used for decision making for policies such as set back areas from surface water on labels, potential National Pollutant Discharge Eliminations Systems (NPDES) permits, and Endangered Species Bulletins. With more data from projects such as this one, EPA could rely on real world data instead of models for policy decisions.

A lack of surface water data can also be a problem for state programs. At the present time, the Department has limited data on the levels of pesticides in surface water or on the frequency of occurrence, especially data on pesticide levels in lakes and wetlands. This lack of data has severely limited our ability to evaluate pesticide risks for many of pesticide regulatory programs. Without reliable water quality monitoring data, the Department has been forced to use models developed by the EPA to assess risk. These models are derived from data from other states, and the accuracy of the models is questionable. Quality data on pesticide concentrations and their occurrence in surface water would allow the Department to better protect surface water resources from pesticides, while not imposing unnecessary burdens to pesticide users. Continuing and expanding this comprehensive, multi-year, state-wide pesticide monitoring program is invaluable to the Department to evaluate the potential risks of pesticide use to impair the state's surface water resources.

References

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Zollinger, R.K., M.P. McMullen, J. Knodel, J.A. Gray, D. Jantzi, G. Kimmet, K. Hagameister, and C. Schmitt. 2009. Pesticide use and pest management practices in North Dakota, 2008. North Dakota State University Ext. Publication W-1446.

Appendix A. Chain of Custody Form

Analytical Request/Chain of Custody

PAL
Pacific Agricultural Laboratory

Pacific Agricultural Laboratory
12505 N.W. Cornell Rd. • Portland, OR 97229
Tel 503.626.7943 • Fax 503.641.0644 • www.pacaglab.com

Page ____ of ______

PAL Project # ______________

CLIENT INFO

Name ______________________________
Contact ______________________________
Address ______________________________
City ______________ State ______ Zip ______________
Telephone ______________ Fax ______________
Email ______________
Project # ______________ Purchase Order # ______________
Method of Shipment ______________________________

Requested Turnaround Time

☐ Standard (10 working days)

☐ Rush ______________
please specify

PAL ID	Client Sample ID	Sample Date	Sample Time	Sample Type	Container Type	No. of Containers	Requested Analysis						Comments

	DATE	TIME		DATE	TIME
Relinquished by: ______________ SIGNATURE	____	____	Received by ______________ SIGNATURE	____	____
Relinquished by: ______________ SIGNATURE	____	____	Received by ______________ SIGNATURE	____	____

Lab Comments: ______________________________

Appendix B. Full list of North Dakota pesticide surface water detections in 2009

Pesticide	Concentration (ppb)	Date	Location	Benchmark (ppb)	Reporting limit (ppb)
atrazine	0.42	6/17/2009	380031	1	0.30
atrazine	0.46	6/17/2009	380083	1	0.30
atrazine	0.40	6/23/2009	384156	1	0.30
atrazine	0.45	7/29/2009	380031	17.5	0.30
bentazon	0.38	7/13/2009	384157	4,500	0.08
bentazon	0.54	7/29/2009	384157	4,500	0.08
bentazon	0.70	7/29/2009	380039	4,500	0.08
dimethenamid	0.36	6/17/2009	380083	8.9	0.30
dimethenamid	0.35	10/7/2009	380156	8.9	0.30
MCPA	0.90	6/17/2009	380031	170	0.080
MCPA	1.5	6/17/2009	380083	170	0.080

Appendix C. List of pesticides analyzed in the 2009 North Dakota Surface Monitoring Study

Analyte	Trade name	Type	Reporting Limit
2,4,5-T	N/A	H	0.080 ug/liter (ppb)
2,4,5-TP (fenoprop)	Silvex	H	0.080 ug/liter (ppb)
2,4-D	2,4-D, Weed-B-Gon	H	0.20 ug/liter (ppb)
2,4-DB	Butryac, Butoxone	H	0.20 ug/liter (ppb)
3-Hydroxycarbofuran	degradate	D	0.12 ug/liter (ppb)
Acetochlor	Surpass, Harnass	H	0.30 ug/liter (ppb)
Alachlor	Intrro, Lariat, Lasso	H	0.12 ug/liter (ppb)
Aldicarb	Temik	I	0.12 ug/liter (ppb)
Aldicarb sulfone	degradate	D	0.12 ug/liter (ppb)
Aldicarb sulfoxide	degradate	D	0.12 ug/liter (ppb)
Aldrin	Aldrex	I	0.12 ug/liter (ppb)
Ametryn	Evik, Gesapax	H	0.30 ug/liter (ppb)
Amitraz	Avartan, Triatox, Mitac	I	0.60 ug/liter (ppb)
Aspon	N/A	I	0.30 ug/liter (ppb)
Atrazine	Aatrex,	H	0.30 ug/liter (ppb)
Azinphos-methyl	Guthion, Bay	I	0.30 ug/liter (ppb)
Azoxystrobin	Quadris	F	0.30 ug/liter (ppb)
Bendiocarb	Dycarb, Niomil	I	0.12 ug/liter (ppb)
Benfluralin	Balan	H	0.12 ug/liter (ppb)
Bifenthrin	Talstar, Capture, Brigade	I	0.12 ug/liter (ppb)
Bolstar	Sulprofos	I	0.30 ug/liter (ppb)
Bromacil	Hyvar, Bromax	H	0.30 ug/liter (ppb)
Bromopropylate	Acarol, Folbex	I	0.60 ug/liter (ppb)
Captafol	Captafol, Sanspor	F	0.12 ug/liter (ppb)
Captan	Captanex, Orthocide	F	0.30 ug/liter (ppb)
Carbaryl	Sevin, Savit	I	0.12 ug/liter (ppb)
Carbophenothion	Trithion, Garrathion	I	0.30 ug/liter (ppb)

Analyte	Trade name	Type	Reporting Limit
Carbofuran	Furadan, Carbodan	I	0.12 ug/liter (ppb)
Carfentrazone-ethyl	Aim	H	0.30 ug/liter (ppb)
Chlordane	Belt, Chlortox	I	1.2 ug/liter (ppb)
Chlorfenvinphos	N/A	I	0.30 ug/liter (ppb)
Chlorobenzilate	Akar, Acaraben	I	0.30 ug/liter (ppb)
Chloroneb	Terraneb	F	0.30 ug/liter (ppb)
Chlorothalonil	Bravo, Ole, Farben	F	0.12 ug/liter (ppb)
Chlorpropham	Furloe, Beet-kleen	H	0.30 ug/liter (ppb)
Chlorpyrifos	Lorsban, Dursban	I	0.30 ug/liter (ppb)
Chlorpyrifos-methyl	Reldan, Storcide	I	0.30 ug/liter (ppb)
Clopyralid	Stinger, Curtail	H	0.080 ug/liter (ppb)
Coumaphos	Resistox, Asuntol	I	0.30 ug/liter (ppb)
Cyanazine	Bladex	H	0.60 ug/liter (ppb)
Cyfluthrin	Tempo, Baythroid	I	1.2 ug/liter (ppb)
Cyhalothrin	Grenade, Karate	I	1.2 ug/liter (ppb)
Cypermethrin	Ammo	I	1.2 ug/liter (ppb)
Dacthal	Dacthal	H	0.12 ug/liter (ppb)
	Dacthal	H	0.20 ug/liter (ppb)
DCPMU	degradate	D	0.12 ug/liter (ppb)
Deltamethrin	Butox, K-Othrin	I	1.2 ug/liter (ppb)
Demeton-O	N/A	I	0.30 ug/liter (ppb)
Demeton-S (Metasystox)	N/A	I	0.30 ug/liter (ppb)
Diazinon	Knox Out, Diazol	I	0.30 ug/liter (ppb)
Dicamba	Banvel	H	0.080 ug/liter (ppb)
Dichlorfenthion	Mobilawn, Gro13	I	0.30 ug/liter (ppb)
Dichlorprop	Weedone, Strike, Envert	H	0.20 ug/liter (ppb)
Dichlorvos	Vapona, DDVP	I	0.30 ug/liter (ppb)
Diclofop-methyl	Hoelon	H	0.60 ug/liter (ppb)
Dicloran	Botran	F	0.12 ug/liter (ppb)
Dicrotophos	Bidrin	I	0.30 ug/liter (ppb)
Dieldrin	Dieldrex	I	0.12 ug/liter (ppb)
Dimethenamid	Outlook	H	0.30 ug/liter (ppb)
Dimethoate	Cygon, Roxion	I	0.30 ug/liter (ppb)
Dinoseb	Aretit, Dinitro	H	0.20 ug/liter (ppb)
Disulfoton	Disyston, Dithiosystox	I	0.30 ug/liter (ppb)
Diuron	Direx, Karmex	H	0.12 ug/liter (ppb)
Endosulfan I	Thionex, Thiodan	I	0.12 ug/liter (ppb)
Endosulfan II	Thionex	I	0.12 ug/liter (ppb)
Endosulfan sulfate	degradate	D	0.12 ug/liter (ppb)
Endrin	Endrex	I	0.12 ug/liter (ppb)
Endrin aldehyde	degradate	D	0.12 ug/liter (ppb)

Analyte	Trade name	Type	Reporting Limit
EPN	N/A	I	0.30 ug/liter (ppb)
Esfenvalerate	Asana, Pydrin	I	0.12 ug/liter (ppb)
Ethalfluralin	Sonalan	H	0.12 ug/liter (ppb)
Ethion	Ethiol, Cethion	I	0.30 ug/liter (ppb)
Ethofumesate	Progress, Tramat	H	0.30 ug/liter (ppb)
Ethoprop	Mocap	I	0.30 ug/liter (ppb)
Famphur	N/A	I	0.30 ug/liter (ppb)
Fenarimol	Rubigan	F	0.12 ug/liter (ppb)
Fenbuconazole	Indar	F	0.60 ug/liter (ppb)
Fenhexamid	Elevate	F	0.12 ug/liter (ppb)
Fenitrothion	Cyfen, Folithion	I	0.30 ug/liter (ppb)
Fenobucarb	Folistar, Prostar, Moncut	F	0.12 ug/liter (ppb)
Fenoxaprop-ethyl	Puma, Option, Whip	H	0.60 ug/liter (ppb)
Fensulfothion	Terracur, Dasanit	I	0.30 ug/liter (ppb)
Fenthion	Baytex	I	0.30 ug/liter (ppb)
Fenuron	Dybar, PDU	H	0.30 ug/liter (ppb)
Fenvalerate	Pydrin	I	0.12 ug/liter (ppb)
Fipronil	Regent	I	0.60 ug/liter (ppb)
Fluazifop-P-butyl	Fusilade	H	0.60 ug/liter (ppb)
Fludioxanil	Maxim, Celest	F	0.30 ug/liter (ppb)
Flumioxazin	Sumisoya, Valor	H	0.30 ug/liter (ppb)
Fluometuron	Cortoran, Lanex	H	0.30 ug/liter (ppb)
Fluroxypyr-meptyl	Starane	H	0.30 ug/liter (ppb)
Flutolanil	Moncoat	F	1.2 ug/liter (ppb)
Folpet	Cosan, Fungitrol	F	0.30 ug/liter (ppb)
Heptachlor	Heptamule	I	0.12 ug/liter (ppb)
Heptachlor epoxide	degradate	D	0.12 ug/liter (ppb)
Hexachlorobenzene	HCB	F	0.12 ug/liter (ppb)
Hexazinone	Velpar	H	0.30 ug/liter (ppb)
Imazamethabenz	Assert	H	0.02 ug/liter (ppb)
Imidacloprid	Touchstone PF	I	0.30 ug/liter (ppb)
Iprodione	Rovral	F	0.12 ug/liter (ppb)
Isoxaben	Cent 7, Gallery	H	0.30 ug/liter (ppb)
Kelthane	Dicofol	I	0.30 ug/liter (ppb)
Linuron	Linex, Lorox	H	0.30 ug/liter (ppb)
Malathion	Malathion, Cythion	I	0.30 ug/liter (ppb)
MCPA	MCP	H	20 ug/liter (ppb)
MCPP	Encore, Trimec	H	20 ug/liter (ppb)
Mefenoxam	Apron, Dividend,Dynasty	F	0.30 ug/liter (ppb)
Metalaxyl	Hi-Yield, Ridomil	F	0.30 ug/liter (ppb)
Methidathion	Somonic, suprathion	I	0.30 ug/liter (ppb)
Methiocarb	Mesurol	I	0.12 ug/liter (ppb)

Analyte	Trade name	Type	Reporting Limit
Methomyl	Lannate	I	0.12 ug/liter (ppb)
Methoxychlor	Methoxychlor	I	0.12 ug/liter (ppb)
Metolachlor	Dual, Magnum	H	0.30 ug/liter (ppb)
Metribuzin	Sencor, Lexone	H	0.60 ug/liter (ppb)
Mevinphos	Phosdrin	I	0.30 ug/liter (ppb)
Mirex	Ferriamicide, Dechlorane	I	0.12 ug/liter (ppb)
Monocrotophos	N/A	I	0.30 ug/liter (ppb)
Monuron	CMU, Telvar	I	0.12 ug/liter (ppb)
Myclobutanil	Rally	F	0.60 ug/liter (ppb)
Neburon	Kloben	H	0.12 ug/liter (ppb)
Norflurazon	Solicam	H	0.12 ug/liter (ppb)
Oryzalin	Surflan	H	0.30 ug/liter (ppb)
Ovex	Ovochlor, Ovotran	I	0.12 ug/liter (ppb)
Oxamyl	Vydate	I	0.12 ug/liter (ppb)
Oxyflorfen	Goal	H	0.12 ug/liter (ppb)
p,p'-DDD	N/A	I	0.12 ug/liter (ppb)
p,p'-DDE	degradate	D	0.12 ug/liter (ppb)
p,p'-DDT	N/A	I	0.12 ug/liter (ppb)
Parathion	Parathion, Thiophos	I	0.30 ug/liter (ppb)
Parathion-methyl	Penncap-M, Folidol-M	I	0.30 ug/liter (ppb)
PCA	degradate	D	0.12 ug/liter (ppb)
PCNB (quintozene)	Terraclor, Tritisan	F	0.12 ug/liter (ppb)
Pendimethalin	Prowl	H	0.30 ug/liter (ppb)
Pentachlorophenol	PCP	H	0.080 ug/liter (ppb)
Permethrin	Ambush, Pounce	I	1.2 ug/liter (ppb)
Phorate	Thimet	I	0.30 ug/liter (ppb)
Phosmet	Imidan	I	0.30 ug/liter (ppb)
Phosphamidon	Phosphamidon	I	0.30 ug/liter (ppb)
Picloram	Tordon	H	0.20 ug/liter (ppb)
Pirimicarb	Pirimor	I	0.30 ug/liter (ppb)
Pirimiphos-methyl	Tomahawk,Silosan	I	0.30 ug/liter (ppb)
Prodiamine	Barricade	H	0.12 ug/liter (ppb)
Prometon	Pramitol	H	0.60 ug/liter (ppb)
Prometryn	Caparol	H	0.30 ug/liter (ppb)
Pronamide	Kerb	H	0.12 ug/liter (ppb)
Propachlor	Ramrod	H	0.30 ug/liter (ppb)
Propanil	Stampede, Prop-Job	H	0.12 ug/liter (ppb)
Propargite	Comite, Omite	I	0.60 ug/liter (ppb)
Propazine	Milogard	F	0.30 ug/liter (ppb)
Propham	IPC	H	0.30 ug/liter (ppb)
Propiconazole	Banner, Tilt, Radar	F	0.30 ug/liter (ppb)
Propoxur	Baygon	I	0.12 ug/liter (ppb)
Pyraclostrobin	Cabrio, Headline	F	0.30 ug/liter (ppb)

Analyte	Trade name	Type	Reporting Limit
Pyrethrins	Wilson, Mushroom House	I	1.2 ug/liter (ppb)
Pyridaben	Pyromite, Dynomite	I	0.60 ug/liter (ppb)
Quinclorac	Paramount	H	0.20 ug/liter (ppb)
Sethoxydim	Poast	H	6.0 ug/liter (ppb)
Siduron	Tupersan	H	0.12 ug/liter (ppb)
Simazine	Princep	H	0.60 ug/liter (ppb)
Simetryn	Gybon	H	0.30 ug/liter (ppb)
Sulfentrazone	Spartan	H	0.30 ug/liter (ppb)
Tebuconazole	Folicur	F	0.60 ug/liter (ppb)
Tebuthiuron	Spike	H	0.60 ug/liter (ppb)
Terbacil	Sinbar	H	0.12 ug/liter (ppb)
Terbufos	Counter	I	0.30 ug/liter (ppb)
Tetrachlorvinphos	Disvap	I	0.30 ug/liter (ppb)
Thiabendazole	Arbotect	F	0.30 ug/liter (ppb)
Thiobencarb	Bolero, Saturn, Abolish	H	0.30 ug/liter (ppb)
Toxaphene	Phenatox,Toxakil	I	6.0 ug/liter (ppb)
Triadimefon	Bayleton	F	0.60 ug/liter (ppb)
Trichlorfon	Dylox, Neguvon	I	0.60 ug/liter (ppb)
Triclopyr	Garlon	H	0.080 ug/liter (ppb)
Trifloxystrobin	Ronilan	F	0.12 ug/liter (ppb)
Triflumazole	Terraguard, Procure	F	0.12 ug/liter (ppb)
Trifluralin	Treflan, Trilin	H	0.12 ug/liter (ppb)
Vinclozalin	Ronilan	F	0.12 ug/liter (ppb)
α-BHC	degradate	D	0.12 ug/liter (ppb)
β-BHC	degradate	D	0.12 ug/liter (ppb)
γ-BHC (Lindane)	Gamma BHC	I	0.12 ug/liter (ppb)
δ-BHC	degradate	D	0.12 ug/liter (ppb)

* H=Herbicide, F=Fungicide, I=Insecticide, D=Degradate