Idaho State Department of Agriculture
Division of Agricultural Resources

Results of Pesticide Testing in Agricultural Areas with Limited Historical Testing—2006

Jessica Atlakson
Rick Carlson

ISDA Technical Results Summary #34 June 2007

Introduction

In 2006, the Idaho State Department of Agriculture (ISDA) Ground Water Program was awarded a grant by the Environmental Protection Agency (EPA) to test ground water for pesticides in areas of the state having little or no previous pesticide testing. The grant provided resources to conduct initial testing of pesticides at 23 domestic wells in four counties: Lemhi County, near Salmon (Figure 1), Bannock, Oneida, and Power Counties (Figure 2). The testing was undertaken to develop a better understanding of water quality related to pesticides in these areas. State funds were used to pay for nitrate and common ion testing at the 23 wells sampled in this project.

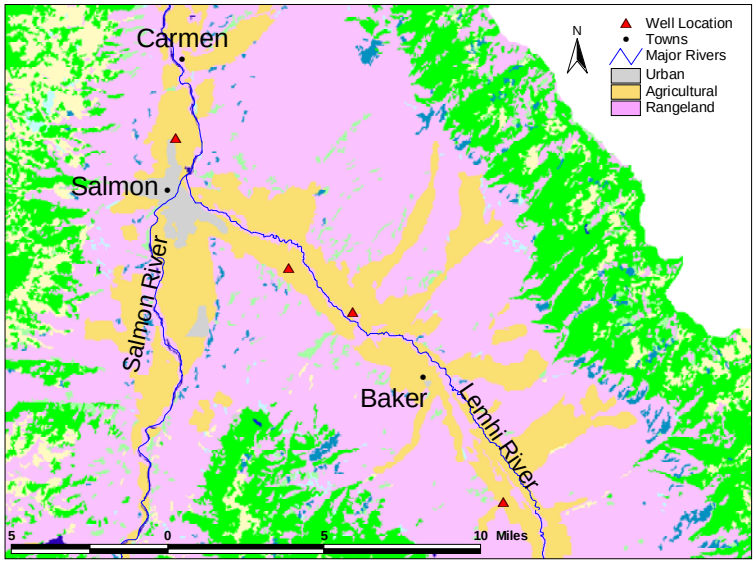

Figure 1. Well locations in Lemhi County near Salmon, Idaho.

Pesticides, nutrients, and common ions were evaluated for each well sampled. Laboratory results indicated that one well in Power County, one well in Bannock County, and one well in Oneida County had at least one pesticide detected in the ground water. No wells sampled in Lemhi County had positive pesticide detections. One domestic well located in Power County had a nitrate-nitrogen (NO_3-N) concentration that exceeded the EPA Maximum Contaminant Level (MCL) of 10 milligrams per liter (mg/L).

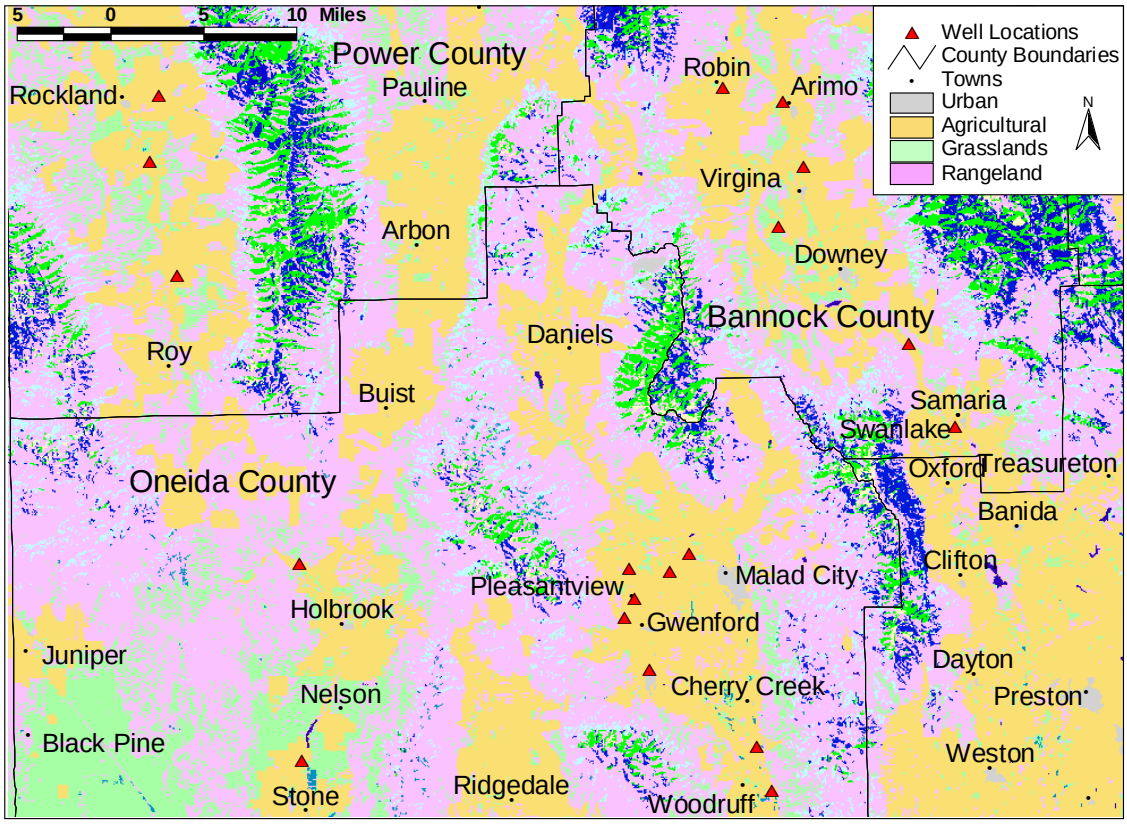

Figure 2. Well locations in Bannock, Oneida, and Power Counties.

Background

ISDA is responsible for a variety of programs, laws, and rules for protection of ground water from pesticides. The division of Agricultural Resources has a cooperative agreement with EPA to implement the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). ISDA staff implements Idaho Pesticide Laws and Rules and conducts monitoring duties to fulfill this cooperative agreement. Additionally, the Idaho Pesticide Management Plan (PMP) and Rules Governing Pesticide Management Plans For Ground Water Protection (PMP Rule) require the state to respond to detections in Idaho ground water. The state response as outlined in these two documents is based on four distinct levels established by pesticide detection concentrations as they relate to a percentage of a reference point. A reference point is based on a health standard, such as a MCL, health advisory level (HAL), or reference dose (RfD). ISDA response actions increase and become more stringent as the detection level increases. The PMP Rule breaks the pesticide detections into the following levels:

Level 1: Detection above the detection limit to less than 20% of the reference point.
Level 2: Detection at 20% to less than 50% of the reference point.
Level 3: Detection at 50% to less than 100% of the reference point.
Level 4: Detection at or greater than 100% of the reference point.

Since the 1990s, the ISDA Ground Water Program has conducted pesticide testing through local and regional-scale ground water monitoring in agricultural areas around the state. Regional projects have been established primarily through review of the Idaho Department of Water Resources (IDWR) Statewide Program monitoring results. Local monitoring has been established through regional monitoring detections, public complaints, and as a result of interagency requests. Although these monitoring activities cover many areas of the state, geographic gaps related to pesticide testing in Idaho still exist providing the impetus for requesting the grant to fund the monitoring activities described in this report.

Methods

Well sites for ground water pesticide testing were selected based on a geographic review of existing pesticide data in IDWR and ISDA databases. Existing ground water quality data were overlain on landuse data using GIS software and visually evaluated. Agricultural areas showing no ground water pesticide testing or having large spatial gaps between data points were selected for testing. Permission to sample was granted by the land owners prior to sampling. Grant funds provided the resources for covering many of these areas, however, some areas remain untested and will be slated for future monitoring activities.

All sample collections followed established ISDA ground water monitoring standard operating procedure (on file at ISDA main office) for sampling, handling, storage, and shipping. Samples were sent to the University of Idaho Analytical Sciences Laboratory (UIASL) in Moscow, Idaho for analysis. UIASL used liquid chromatography/mass spectrometry analysis for pesticides utilizing modified EPA Methods 507, 508, 515.2, and 632. Testing included pesticide analysis for 110 different pesticides that are known to have been used in Idaho, either historically or currently. UIASL also conducted tests for nitrate, nitrite, ammonia, orthophosphorous, chloride, sulfate, bromide, and fluoride using EPA Methods 300.0 and 350.1. Duplicates, splits, and matrix spikes/matrix spike duplicates were collected and submitted as a part of the quality assurance project plan.

Description of Project Area

Land Use

Lemhi County
The major crops in the area near Salmon where the testing occurred include alfalfa hay, oats, wheat, and barley (Idaho Agricultural Statistic Services, 2005).

Bannock County
Wheat, alfalfa hay, barley, potatoes, and oats are the major crops grown in Bannock County (Idaho Agricultural Statistic Services, 2005). The localized area where the wells were sampled (Figure 2) has dryland farming of small grains, and irrigated farming for potatoes, sugar beets, and alfalfa (McGrath et al., 2001).

Oneida County
The major crops in Oneida County are wheat, alfalfa hay, barley, oats, corn, and potatoes (Idaho Agricultural Statistic Services, 2005).

Power County
Wheat, potatoes, sugar beets, alfalfa hay, barley, corn, and oats are the major crops grown in Power County (Idaho Agricultural Statistic Services, 2005). Near the area where the samples were taken (Figure 2), the primary land use is livestock grazing, dryland wheat and

barley farming, and irrigated alfalfa production (McGrath et al., 2001).

Geology and Hydrogeology

Lemhi County

The surficial geology in Lemhi County is composed of Quaternary alluvium and thick, highly permeable valley fill deposits (McGrath et al., 2001). Older deposits are composed of Tertiary andesite, latite, basalt, tuffaceous conglomerate, sandstone, siltstone, limestone, and Precambrian quartzite (McGrath et al., 2001).

Bannock County

The surficial geology in Bannock County near the sampled wells consist of Quaternary loess, alluvium, colluvium, and basalt (McGrath et al., 2001). The older deposits in the area consist of Tertiary volcanics, tuffaceous rocks, and sedimentary rock; Paleozoic schist, quartzite, siltstone, sandstone, and limestone (McGrath et al., 2001).

Oneida County

The area where the samples were taken in Oneida County consists of valleys containing wide terraces, narrow flood plains, and alluvial fans with Quaternary alluvium and lacustrine silt and sand from the Pleistocene Lake Bonneville (McGrath et al., 2001). Older deposits are comprised of Tertiary siltstone (McGrath et al., 2001).

Power County

The Power County samples were taken in areas of gently sloping terraces, valley bottoms, basin rims, and alluvial fans consisting of Quaternary loess, silty alluvium, and basalt (McGrath et al., 2001). Tertiary siltstone, and Paleozoic quartzite, dolomite, and limestone comprise the older deposits (McGrath et al., 2001).

Results

Sampling results indicate that the aquifer in Lemhi County near Salmon has little to no impacts from the surrounding agriculture. Sampling results indicate some pesticide and NO_3-N impacts have occurred to the aquifer in Bannock, Oneida, and Power Counties. Results are summarized and presented in the following sections.

Pesticides

Twenty-three wells were sampled in October 2006 for pesticides. Of the 23 wells tested, three wells (13%) had positive detections of four distinct pesticide compounds (Table 1). The results of the pesticide sampling are presented by county.

Lemhi County

Four wells were sampled for pesticides in Lemhi County (Figure 3). No pesticides were detected in any of the wells.

Bannock County

Six wells were sampled for pesticides in Bannock County (Figure 4). One well had a detection of linuron (Figure 4 and Table 1). Linuron is a herbicide registered in Idaho for use on corn, vegetables, potatoes, poplars and noncrop applications, such as roadsides to control annual and perennial broadleaf and grassy weeds. The detection was at a Level 1 concentration, less than 20% of the reference point.

Oneida County

Ten wells were sampled for pesticides in Oneida County (Figure 4). One well had a 2,4 dichlorobenzoic acid (2,4-DCBA) detection. 2,4-DCBA is not an active ingredient in any pesticide currently registered in Idaho. There are several parent compounds that could potentially yield 2,4-DCBA as a metabolite or degradate. The herbicides 2,4-D and 2,4-DB have chemical

Table 1. Summary of pesticide detections from testing in Lemhi, Bannock, Oneida, and Power Counties.

Pesticide	Trade Name	Quantity (µg/L)	Reference Point (µg/L)	County of Detection
Linuron	Linex, Lorox	0.08	14 (RfD)[1]	Bannock
Diuron	Diuron, Karmex, Krovar	0.034	10 (HAL)[2]	Power
Desethyl Atrazine	-----[3]	0.037	-----[4]	Power
2,4-DCBA	-----[5]	9.70	-----[6]	Oneida

[1]RfD - EPA Reference Dose.

[2]HAL - EPA Health Advisory Level.

[3]Desethyl Atrazine is a breakdown product of Atrazine.

[4]The Maximum Contaminant Level of 3 mg/L for Atrazine is used for the breakdown product Atrazine Desethyl.

[5]2,4-DCBA is a metabolite of Propiconazole.

[6]No EPA health standard available.

structures that suggest these chemicals could form 2,4-DCBA as a potential breakdown product (McGeehan, 2007). 2,4-D is a herbicide used to control many types of broadleaf weeds. 2,4-D has many different uses, including cultivated agriculture, pasture and rangeland applications, forest management, home, garden, and control of aquatic vegetation (EXTOXNET, 1996[1]).

Andrews (2007) indicated that both dicamba and dicofol were both parent compounds that could potentially result in 2,4-DCBA as a metabolite. Dicamba is a benzoic acid herbicide that controls annual and perennial broadleaf weeds in grain crops and grasslands, and it is used to control brush and bracken in pastures (EXTOXNET, 1996[2]). Dicamba is

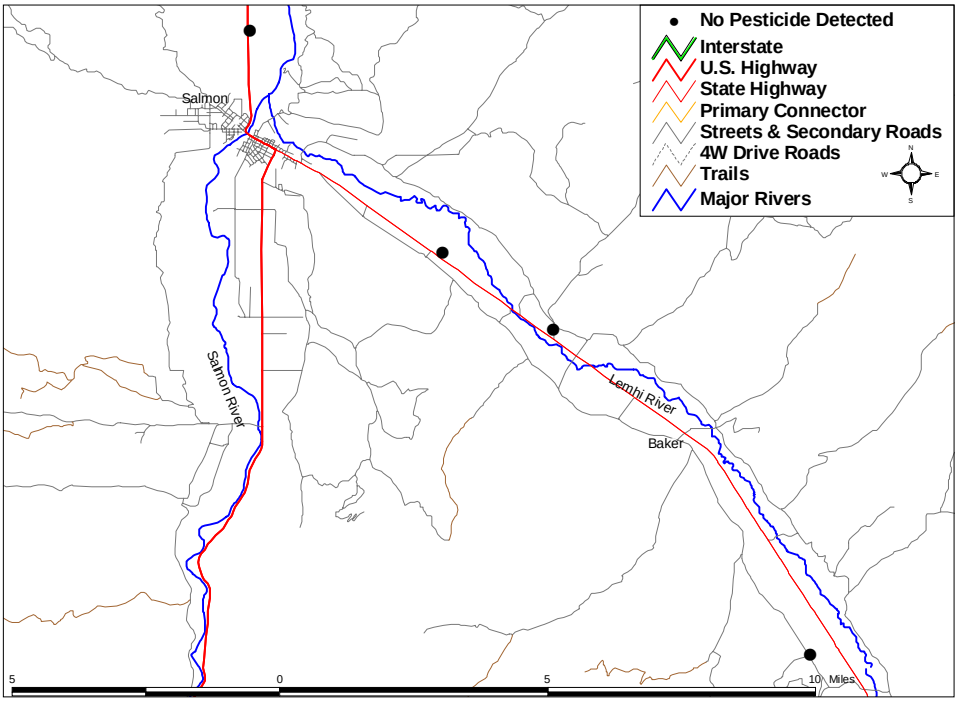

Figure 3. Well locations in Lemhi County that were tested for pesticides. No pesticides were detected in Lemhi County.

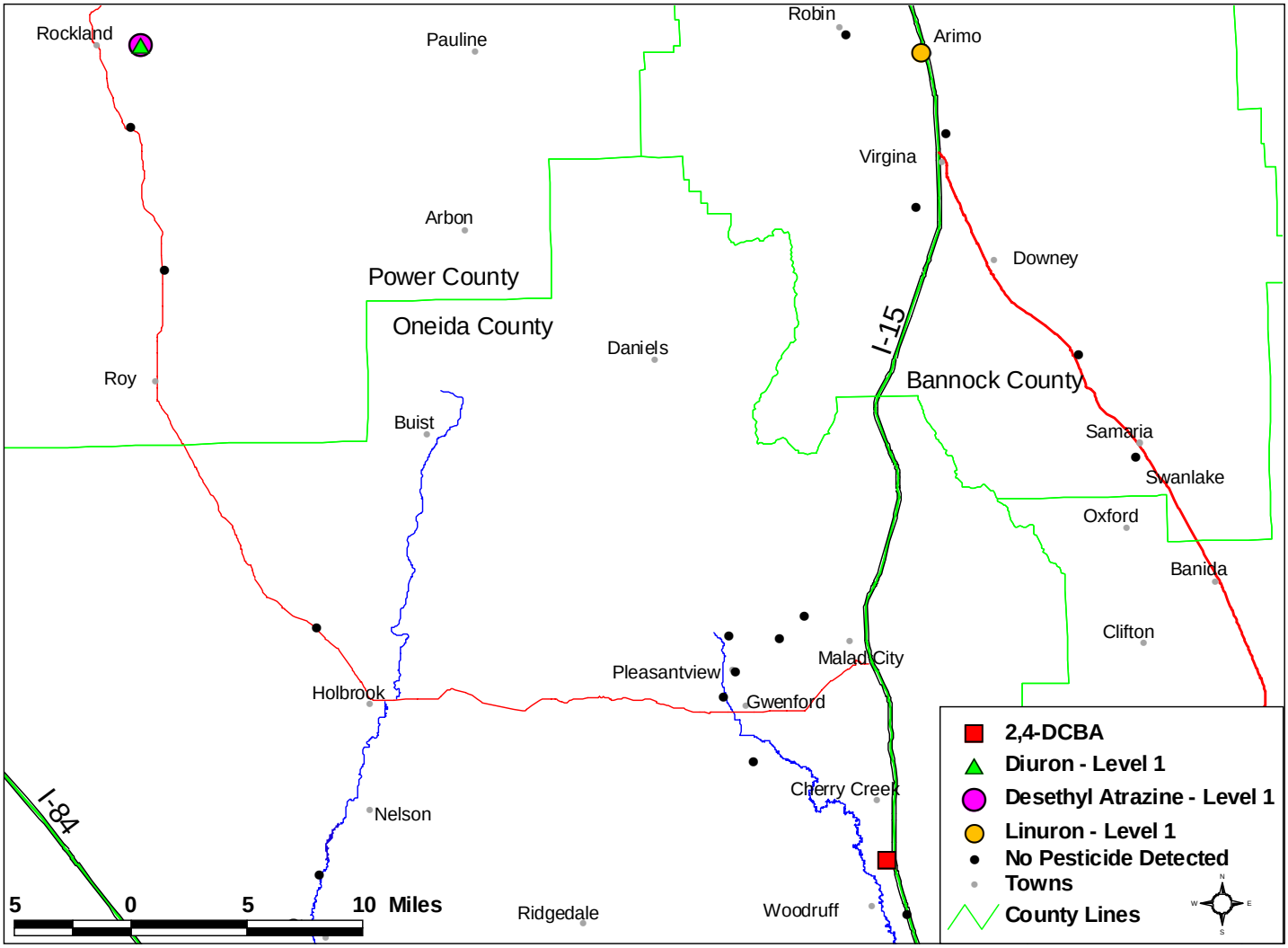

Figure 4. Well locations and pesticide detections for Bannock, Oneida, and Power Counties.

registered in Idaho for use on wheat, barley, corn, turf, golf courses, athletic fields, parks, non-crop areas, industrial sites, among other sites. Dicofol is an organochlorine miticide used on a wide variety of fruit, vegetable, ornamental and field crops (EXTOXNET, 1996[3]). Dicofol is registered in Idaho for use on turf, beans, non-crop areas, and other sites.

Another potential parent compound of the chemical 2,4-DCBA is the fungicide propiconazole. Propiconazole is registered for use on numerous food and feed crops and on turf and ornamentals and for use as a wood preservative.

There is no established health standard for 2,4-DCBA. ISDA has contacted EPA regarding the appropriate reference point to use for 2,4-DCBA. Nguyen (2007) reviewed an EPA Office of Pesticide Programs (OPP) Health Effects Division (HED) document regarding propiconazole and noted that the HAL of 91 µg/L for propiconazole was used as a proxy for the toxicity of 2,4-DCBA. Using the reference point of 91 µg/L, the detection in Oneida County is at a Level 1 concentration, less than 20% of the reference point. However, data requests to EPA OPP HED and the Biological and Economic Analysis Division have been made to determine the best scientific reference point to use for 2,4-DCBA. ISDA is waiting for further guidance from EPA.

Power County

Three wells were sampled for pesticides in Power County (Figure 4). One well had diuron and desethyl atrazine detections (Figure 4 and Table 1). Diuron is a herbicide used to control a wide variety of annual and perennial broadleaf and grassy weeds, as well as mosses. Some of the common crops grown in Power County that diuron is registered for use on are alfalfa, barley, corn, oats, and wheat, as well as noncrop applications, such as ponds. Desethyl atrazine is a breakdown product of the herbicide atrazine, which is used to control broadleaf and grassy weeds. Atrazine is registered for use on corn, wheat stubble and fallow, turf, conifers, and noncrop applications. Both the diuron and desethyl atrazine detections were at Level 1 concentrations, less than 20% of the reference point.

Nitrate

Twenty-three wells were sampled in October 2006 for NO_3-N and other common ions. Of the twenty-three wells tested, one well had a NO_3-N concentration that exceeded the EPA MCL of 10 mg/L for NO_3-N (Table 2). The results of the NO_3-N sampling are presented by county.

Lemhi County

Four wells were sampled for NO_3-N in Lemhi County (Table 2 and Figure 5). The maximum concentration was 0.92 mg/L. One well had a NO_3-N concentration less than the lab detection limit (LDL) of 0.033 mg/L. Three wells, or 75%, had NO_3-N concentrations between the LDL of 0.033 mg/L and 2 mg/L. The median NO_3-N concentration was 0.35 mg/L (Table 2).

Bannock County

Six wells were sampled for NO_3-N in Bannock County (Table 2 and Figure 6). The maximum concentration was 4.8 mg/L. Three wells, or 50%, had NO_3-N concentrations between 2 and 5 mg/L. The median NO_3-N concentration was 1.7 mg/L (Table 2).

Oneida County

Ten wells were sampled for NO_3-N in Oneida County (Table 2 and Figure 6). The maximum concentration was 4.1 mg/L. Seven wells, or 70%, had NO_3-N concentrations between the LDL of 0.033 mg/L and 2 mg/L. The median NO_3-N concentration was 0.91 mg/L (Table 2).

Power County

Three wells were sampled for NO_3-N in Power County (Table 2 and Figure 6). The maximum concentration was 22 mg/L, which exceeded the EPA Maximum Contaminant Level (MCL) for NO_3-N of 10 mg/L. The other two wells had NO_3-N concentrations less than 5 mg/L. The median NO_3-N concentration was 2.0 mg/L (Table 2).

Table 2. Summary of NO_3-N results from samples taken in Lemhi, Bannock, Oneida, and Power Counties.

Concentration Range (mg/L)	Lemhi County (4 wells)	Bannock County (6 wells)	Oneida County (10 wells)	Power County (3 wells)
<LDL[1] (0.033)	1 (25%)	2 (33%)	1 (10%)	0
LDL to <2.0	3 (75%)	1 (17%)	7 (70%)	1 (33.33%)
2.0 to <5.0	0	3 (50%)	2 (20%)	1 (33.33%)
5.0 to 10	0	0	0	0
>10	0	0	0	1 (33.33%)
Median Value (mg/L)	0.35	1.7	0.91	2.0
Mean Value (mg/L)	0.41	2.0	1.3	8.4
Maximum Value (mg/L)	0.92	4.8	4.1	22

[1]LDL - Lab Detection Limit

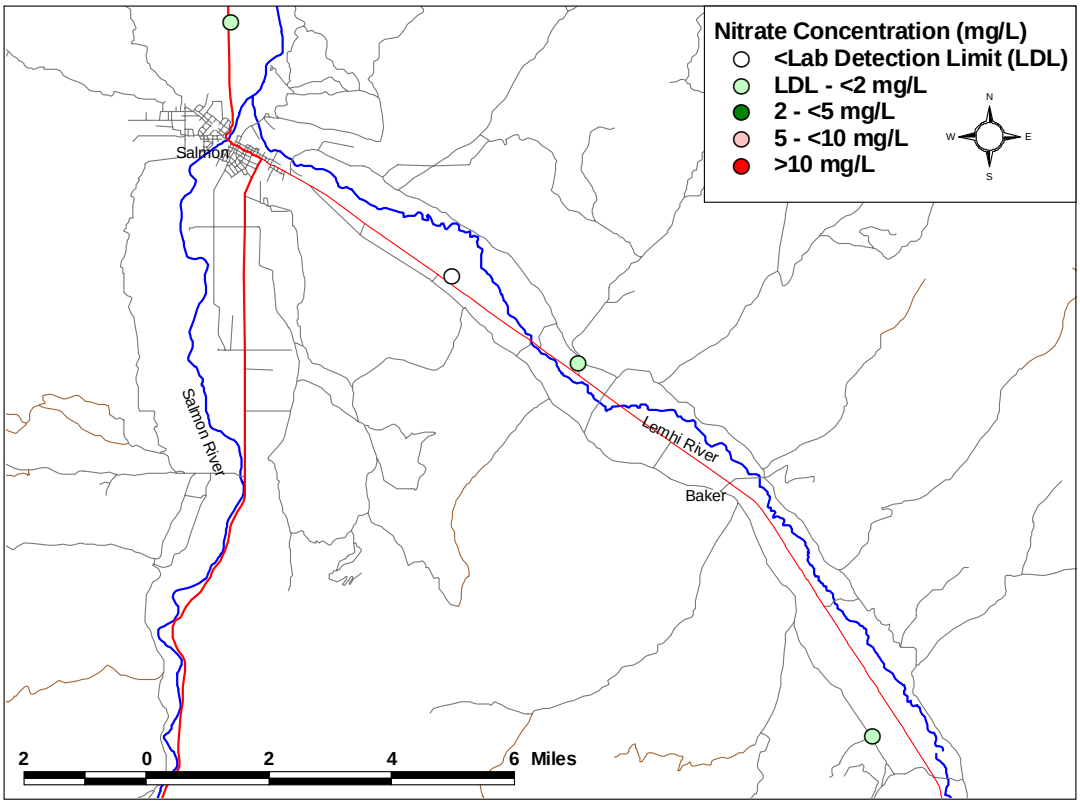

Figure 5. Well locations and NO_3-N concentrations for Lemhi County.

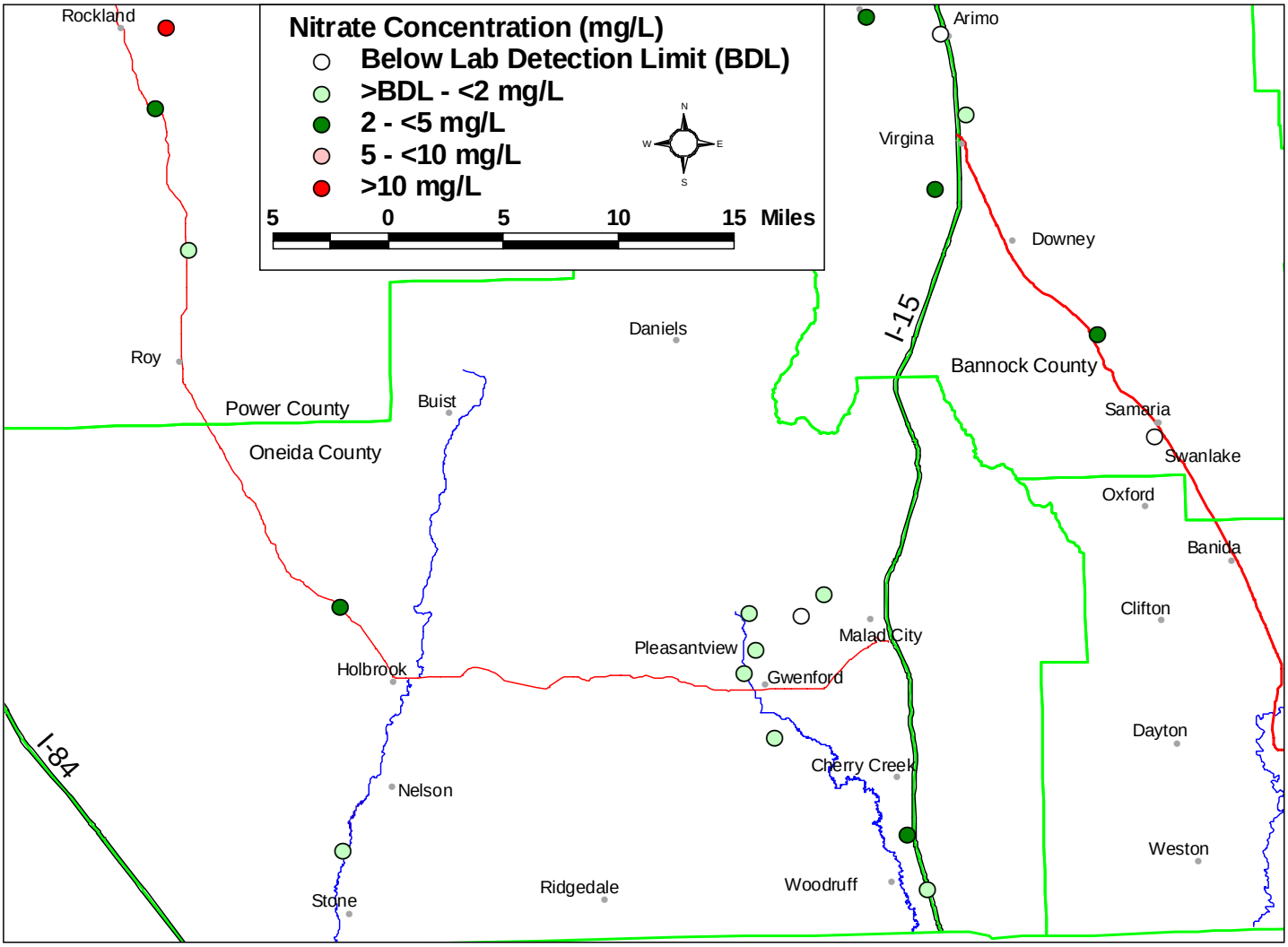

Figure 6. Well locations and NO_3-N concentrations for Power, Oneida, and Bannock Counties.

Conclusions

Results of testing indicate that some areas of the state with limited historical testing do have pesticides in the ground water. Thirteen percent (3 wells) of the original 23 wells tested had one or more positive detections for pesticides. The pesticides detected in this project were: 2,4-DCBA, diuron, desethyl atrazine, and linuron. The pesticides were all at concentrations less than 20% of a reference point, although the best scientific reference point to use for 2,4-DCBA has not yet been confirmed. This project proved useful in locating areas with pesticides in the ground water.

The median NO_3-N concentration for each county ranged from 0.35 mg/L (Lemhi County) to 2.0 mg/L (Power County). One well, located in Power County, had NO_3-N concentrations over the EPA MCL of 10 mg/L.

Overall, the ground water quality in the areas tested is good. There are minor impacts to the ground water quality from low level pesticide and NO_3-N detections.

Agricultural practices likely contribute to the pesticide and NO_3-N detections in the ground water of the areas sampled in this project, such as pesticide and fertilizer applications to crop fields. In addition, roadside application of pesticides are a potential source of the pesticide detections. Animal wastes from feedlots and manure application to crop fields are also potential contributors of NO_3-N to the ground water, as well as leaking or improperly maintained septic systems.

Recommendations

ISDA will respond to the pesticide detections from this project in accordance with the response section of IDAPA 02.03.01 Rules Governing Pesticide Management Plans For Ground Water Protection.

ISDA personnel will continue to educate the pesticide applicators on the importance of adhering to label requirements and to apply all pesticides according to federal and state laws.

ISDA Water Program staff recommend similar projects in the future to help identify areas of concern. Areas with little historical testing for pesticides still exist within the state of Idaho.

ISDA recommends a variety of actions to be taken by landowners, producers, agencies and local governments to mitigate and prevent further contamination of the aquifer in the project area. Also, citizens living in the area and agencies should take measures associated with wells, well drilling, and drinking water management to prevent adverse health affects.

ISDA will continue working with EPA to determine the best scientific reference point to use for 2,4-DCBA.

Agricultural, Agrichemical, and Animal Waste Management

ISDA recommends that measures to reduce pesticide and nitrate impacts on ground water be addressed and implemented. The ISDA recommends that:

- Pesticide applicators follow the Natural Resources Conservation Service (NRCS) Pest Management Standard (595).
- Producers, noncrop applicators, and agrichemical dealers evaluate pesticide storage, containment, mixing, loading, rinsing, disposal, and application practices in the project area.
- Producers and agrichemical professionals conduct nutrient, pesticide, and irrigation water management evaluations.
- Pesticide applicators utilize the ISDA Container Recycling Operation (CROP) and the Pesticide Disposal Program (PDP). Information regarding these programs can be found on the ISDA's website: http://www.agri.idaho.gov.
- Producers follow the Idaho Agricultural Pollution Abatement Plan.
- Pesticide products that are least likely to leach be chosen for the soil type in the project areas.
- Producers consider utilizing Integrated Pest Management (IPM) techniques in this area.
- Applicators assess current pesticide application practices to non-crop areas (examples: roadsides, canal banks, driveways, etc.).
- Applicators and homeowners assess lawn and garden practices, especially near wellheads.
- Producers follow the NRCS Irrigation Water Management Standard (449).
- Producers follow the NRCS Nutrient Management Standard (590) when using commercial fertilizers and/or animal waste. Manure should be applied to crop uptake only.
- Livestock producers evaluate waste management practices.
- Local residents assess animal and animal waste management situations near wellheads.
- Homeowners manage private septic systems properly.
- Home and garden retail stores establish outreach programs to illustrate proper application and management of nutrients and pesticides.

Well Testing, Construction, and Management

Domestic drinking water wells within the project area should be protected to provide the best possible drinking water. The ISDA suggests the following options:

- Residents sample their own wells for NO_3-N on a regular basis.
- Activities near wellheads be done in a manner that does not to impact well water quality.
- Homeowners consider using the Idaho Home*A*Syst program to conduct self assessments related to wellhead protection. The program is found at http://homeasyst.idahoag.us.
- Construction of new wells or deepening of existing wells in the area be completed with the appropriate planning and design considerations to provide potable water.

Ground Water Protection and Response Effort

The ISDA recommends that the respective Soil and Water Conservation Districts lead a coordinated local response process to create a plan of action to address the pesticide and NO_3-N ground water detections from this study, especially in Bannock, Oneida, and Power Counties. The Soil and Water Conservation Districts should work with local land owners, agrichemical professionals, CAFO operators, the respective counties and cities, and agencies to implement this process and seek funding to support the implementation of these and other recommendations. The ISDA will support these local partners in seeking funding and implementing a comprehensive program.

Acknowledgments

ISDA Water Program staff thank EPA Region 10 for providing funding for this special sampling project. The authors would also like to thank the homeowners in the study area who allowed us to access and sample their well. Without their participation and cooperation, this study would not be possible. In addition, the authors would like to thank Cathy Parsons, ISDA, for editorial review of this document.

Technical review of this document from the following individuals is greatly appreciated:

Gary Bahr, ISDA
Kirk Campbell, ISDA
Kathryn Dallas, ISDA
Craig Tesch, P.G., ISDA

References

Andrews, Nancy. Branch Chief, ERB1 Environmental Fate and Effects Division (7507P) Office of Pesticide Programs US Environmental Protection Agency. Personal communication, 17 April, 2007.

EXTOXNET, 1996[1]. Pesticide Information Profiles: 2,4-D. http://extoxnet.orst.edu/pips/24-D.htm. Accessed April 26, 2007.

EXTOXNET, 1996[2]. Pesticide Information Profiles: Dicamba. http://extoxnet.orst.edu/pips/dicamba.htm. Accessed June 6, 2007.

EXTOXNET, 1996[3]. Pesticide Information Profiles: Dicofol. http://extoxnet.orst.edu/pips/dicofol.htm. Accessed June 6, 2007.

Idaho Agricultural Statistics Service, 2005. 2005 Idaho agricultural statistics. Idaho Department of Agriculture, 65 p.

McGeehan, Steve. Director of University of Idaho Analytical Sciences Laboratory. Personal Communication, 19 April, 2007.

McGrath, C.L., Woods, A.J., Omernik, J.M., Bryce, S.A., Edmondson, M., Nesser, J.A., Shelden, J., Crawford, R.C., Comstock, J.A., and Plocher, M.D., 2001. Ecoregions of Idaho (color poster with map, descriptive text, summary tables, and photographs), U.S. Geological Survey (map scale 1:1,350,000).

Nguyen, Thuy. US Environmental Protection Agency. Person Communication, 19 April, 2007.