



Quarterly Monitoring for Pesticides in Ground Water in Owyhee, Payette, and Washington Counties, Idaho 2009 - 2010

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Introduction

In 2009, 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 currently registered pesticides. The goal of the project was to conduct quarterly monitoring of ground water for pesticides in areas where there have been frequent and elevated detections. The grant provided resources to conduct testing of pesticides at privately owned domestic wells in southwest Idaho (Figure 1). The testing was undertaken to develop a better understanding of impacts from registered active ingredients that have been detected in Owyhee, Payette, and Washington Counties. Laboratory results indicated that there are pesticide detections that are of concern and should be evaluated and tracked over time. Some detections were near specific pesticide health standards for drinking water. ISDA is working to implement the Idaho Pesticide Management Plan (PMP) and associated rules to protect ground water. ISDA is also working to educate applicators and land owners on these issues.

Background

The ISDA Division of Agricultural Resources is responsible for a variety of programs, laws, and rules for protection of ground water from pesticides. ISDA has a cooperative agreement with EPA to implement the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Staff implement the Idaho Pesticide Laws and Rules and conduct monitoring duties to fulfill this cooperative agreement. Additionally, the Idaho PMP and the Rules Governing Pesticide Management Plans For Ground Water Protection (IDAPA 02.03.01) (Idaho PMP Rule) require the state to respond to pesticide 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 maximum contaminant level (MCL), lifetime health advisory (HAL), or reference dose (RfD). ISDA response actions increase and become more comprehensive as the detection level increases. The PMP Rule divides the

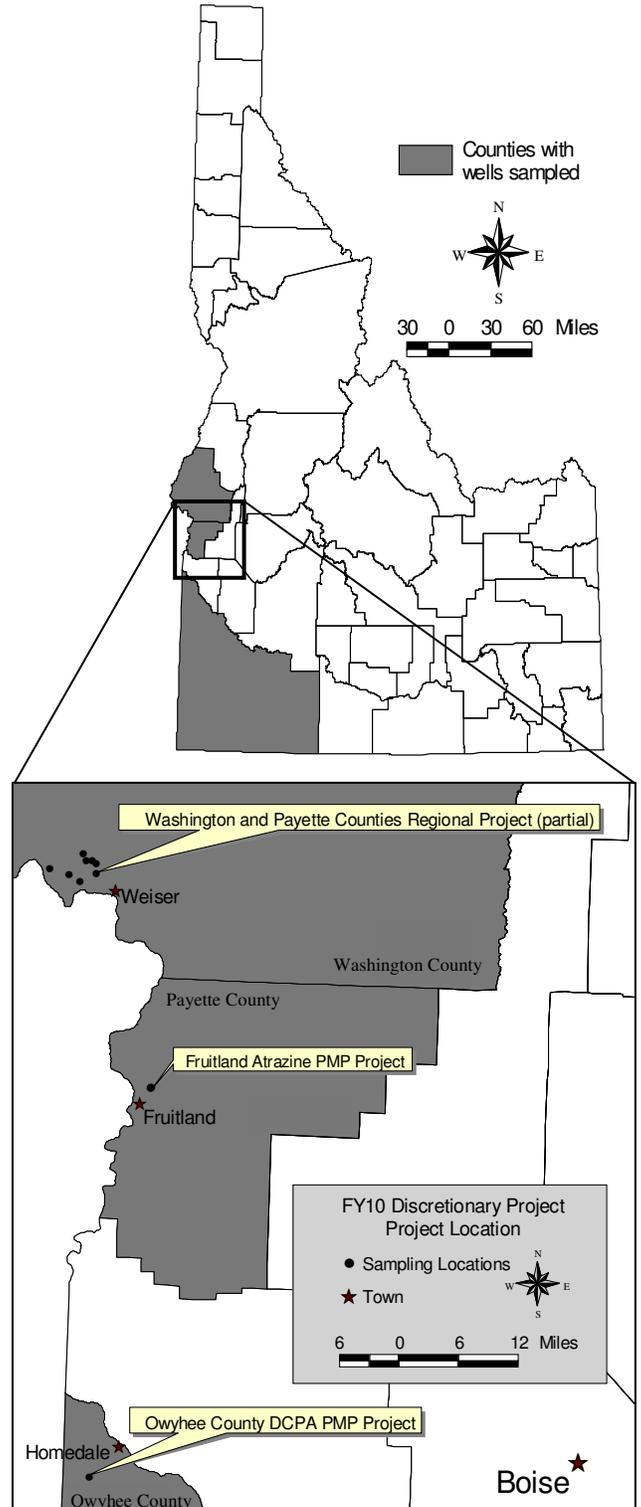


Figure 1. Map of Idaho and locations of project.

pesticide detections into the following levels:

Level 1: Detection above the laboratory 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.

Historical Monitoring

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. ISDA expanded pesticide sampling to include quarterly monitoring in areas that required additional response as the Idaho PMP Rule was implemented.

The goal of this project is to provide the ISDA Water Program with quarterly ground water monitoring data for three project areas where pesticides have been previously detected. The information will be used to make regulatory and/or voluntary changes related to applications of pesticides. ISDA will also conduct education relative to this project with landowners and pesticide applicators. The information can also be used for educational purposes and to advance technical knowledge relative to ground water quality protection and the application of Best Management Practices (BMP).

The objective is to prevent future ground water contamination and protect human health. Tasks to be conducted to meet these objectives are:

- Collect ground water samples from approximately 15 domestic wells for analysis of pesticides.
- Notify homeowners of their well testing results.
- Prepare data summary sheets at the completion of each sampling event and a technical report at the completion of all sampling summarizing significant findings.
- Meet with PMP Advisory Committee to determine what regulatory and/or voluntary practice changes will be recommended.
- Educate homeowners and pesticide applicators within the project area on findings and recommendations from PMP Advisory Committees.

Pesticides Tested

The samples collected were tested for 85 pesticides at the University of Idaho Analytical Sciences Laboratory

(UIASL). ISDA has worked with the UIASL to create a specialized list of analytes that are registered for use in Idaho and have potential to reach ground water.

Description of Project Area

The project is located within portions of the western Snake River Plain. The study area includes aquifers within three southern Idaho counties including Washington, Payette, and Owyhee (Figure 1). The general aquifer type for each area is alluvial in nature.

Washington County Quarterly Monitoring Area

The project area lies within the western Snake River Plain, a basin filled with sedimentary and volcanic rocks. The sedimentary rocks make up the major portion of the shallow aquifer in the project area. The shallow aquifer is composed of unconsolidated to poorly consolidated clay, silt, sand, volcanic ash, diatomite, freshwater limestone and conglomerates mostly deposited in a fluvial environment (Newton, 1991). A thick layer of blue clay underlies the shallow aquifer in the project area, which separates the shallow alluvial aquifer from the deeper sedimentary aquifer (Newton, 1991).

Payette County Quarterly Monitoring Area

The project area overlies an aquifer system limited to the Payette River Valley composed of unconsolidated sands and gravels (Carlson and Atkinson, 2007). There are two sources of ground water in the project area, a shallow unconfined alluvial aquifer and a deeper blue clay aquifer. Wells chosen for this project are completed in the shallow unconfined aquifer. Locally, shallow ground water flow is likely to the north towards the Payette River and towards the Snake River (Carlson and Atkinson, 2007).

Northern Owyhee County Regional Project Area

The sediments in the project area are classified as the Idaho Group geologic formation (U.S. Geological Society, 2000). The sediments are believed to be deposited by prehistoric Lake Idaho and recent deposition from the Snake River. A "blue clay" layer is reported in well drillers' reports on file at IDWR for many of the project wells. The blue clay layer is part of the Glens Ferry Formation and the low permeability of the clay produces a confined aquifer under the layer (Othberg, 1994). Ground water used for domestic purposes in the project area appears to come from two sources: (1) a shallow system of coarse grained sands and gravels, and (2) a deeper confined system of black sand under the blue clay layer (Carlson et al., 2001). Well drillers' reports indicate the shallow aquifer to be

approximately 50 feet below the ground surface and the deeper aquifer to be located at varying depths, generally 300 feet or deeper. The shallow aquifer is composed of alluvial deposits, mainly sand and gravel, with a few thin interbedded clay layers. The general ground water movement appears to be toward the Snake River, which is an area of probable ground water discharge (Carlson et al., 2001).

Methods

Well sites for ground water pesticide testing were selected based on recent and historical pesticide data and detections. Each area was chosen for further study due to the presence of multiple and/or elevated pesticide detections. Determining pesticide trends for these areas is important for assessing the extent of the contamination to assist with the PMP implementation.

All sample collections followed established ISDA ground water monitoring standard operating procedures for sampling, handling, storage, and shipping. Samples were sent to the UIASL in Moscow, Idaho for analysis. UIASL used liquid chromatography/mass spectrometry analysis for pesticides utilizing modified EPA Methods. Duplicates, blanks, and matrix spikes/matrix spike duplicates were collected and submitted as a part of the quality assurance project plan.

Results

ISDA sampled a total of 15 wells with previous pesticide detections for 85 pesticides in the fall of 2009 and summer of 2010. Numerous detections occurred, including detections of pesticides that were previously tested for and commonly detected in Idaho's ground water. The pesticides positively detected in the first three quarters of sample collection included 2,4-DCBA, atrazine, bentazon, bromacil, chloromethane, deisopropyl atrazine, desethyl atrazine, DCPA (dacthal), dinoseb, metribuzin, simazine, tebuthiuron, and tetrahydrofuran (Tables 1, 2, & 3). All detections were below any health based reference point (Tables 1, 2, & 3).

Sampling results indicate some pesticide impacts have occurred to the shallow aquifers within each area sampled. Results are summarized and presented in the following sections.

Washington County Detections

Eleven different pesticides were detected west of Weiser in Washington County during the first three quarterly monitoring events. The 11 pesticides detected, in order of the number of detections, include: desethyl atrazine

(16), atrazine (10), bromacil (6), 2,4-DCBA (3), tebuthiuron (3), DCPA (dacthal) (2), deisopropyl atrazine (1), metribuzin (1), dinoseb (1), chloromethane (1), and bentazon (1) (Table 1). Atrazine and desethyl atrazine were often found in the same well during the same sampling period. One well had numerous pesticides detected during each sampling event, including seven different pesticides in November 2009, and four pesticides in May 2010 (Figure 2). The outdoor faucet for this well was shut off during the February 2010 sampling event and a sample was not collected. Most wells with positive detections had more than one pesticide detected above the laboratory detection limit. All detections, except one, was within the Level 1 category established by the Idaho PMP Rule and below any Idaho or EPA health standards (Table 1 and Figure 2). The exception to this is the November 2009 testing from well 7100901 where desethyl atrazine was found at 2.00 µg/L, which was a Level 3 detection. The cumulative concentration of atrazine and the breakdown products in the well was 2.41 µg/L in November 2009 with desethyl atrazine at 2.00 µg/L, atrazine at 0.37 µg/L, and deisopropyl atrazine at 0.04 µg/L. This was a combined Level 3 detection. The May 2010 desethyl atrazine detection in this well was a Level 1 detection of 0.17 µg/L.

Payette County Quarterly Monitoring Area

Five different pesticides were detected in Payette County, northeast of Fruitland, during the first three rounds of the quarterly monitoring events. The five pesticides detected, in order of the number of detections include: atrazine (9), desethyl atrazine (9), deisopropyl atrazine (8), bromacil (1), 2,4-DCBA (1) (Table 2). All three wells sampled had pesticide detections. All wells with positive detections had more than one pesticide detected above the laboratory detection limit. All detections during the first three quarters of sampling were below any Idaho or EPA health standards (Table 2 and Figure 3). All of the pesticide detections during the first three quarters were at the Level 1 category as established by the Idaho PMP Rule with the exception of a Level 2 desethyl atrazine detection in November 2009 (in well 3400501). Time series plots for atrazine (Figure 4) and desethyl atrazine (Figure 5) indicate that the pesticides concentrations appear stable or have decreased slightly through the quarterly testing period. The cumulative concentration of atrazine and the breakdown products in one well (3400501) was over the Level 2 category for all three quarters (Figure 6).

Northern Owyhee County Regional Project Area

Five different pesticides and one Volatile Organic Compound (VOC) were detected in four wells sampled

Table 1. 2009/2010 Discretionary Project Results from the November and February Quarterly Monitoring Sampling Events of Select Wells in the Washington and Payette Counties Regional Project.

Pesticide (Active Ingredient or Breakdown Product)	Range (µg/L) (Min. – Max.)	Number of Wells with a Detection per Sample Event				Reference Point (µg/L)
		November 2009	February 2010	May 2010	August ¹ 2010	
2,4-DCBA	0.09 (0.13 - 0.22)	0	3	0	...	91 (RfD) ²
Atrazine	0.34 (0.03 – 0.37)	0	3	5		3 (MCL) ³
Bentazon	0.86	1	0	0	...	200 (HAL) ⁴
Bromacil	0.71 (0.06 – 0.77)	3	3	2	...	90 (HAL)
Chloromethane	0.59	0	0	1	...	30 (HAL)
DCPA (Dacthal)	0.04 (0.08 – 0.12)	1	1	0	...	70 (HAL)
Deisopropyl Atrazine	0.02 (0.04 – 0.06)	2	1	0	...	...⁵
Desethyl Atrazine	1.97 (0.03 – 2)	5	5	8	...	...⁵
Dinoseb	0.5	1	0	0	...	7 (MCL)
Metribuzin	0.5	1	0	0	...	200 (HAL)
Tebuthiuron	0.02 (0.06 – 0.08)	1	1	1	...	500 (HAL)

¹Data is pending.

²RfD – ISDA PMP Rule Calculated Reference Dose.

³MCL – EPA Maximum Contaminant Level.

⁴HAL – EPA Lifetime Health Advisory.

⁵Breakdown product of atrazine. No reference point available, MCL for atrazine of 3 µg/L is used.

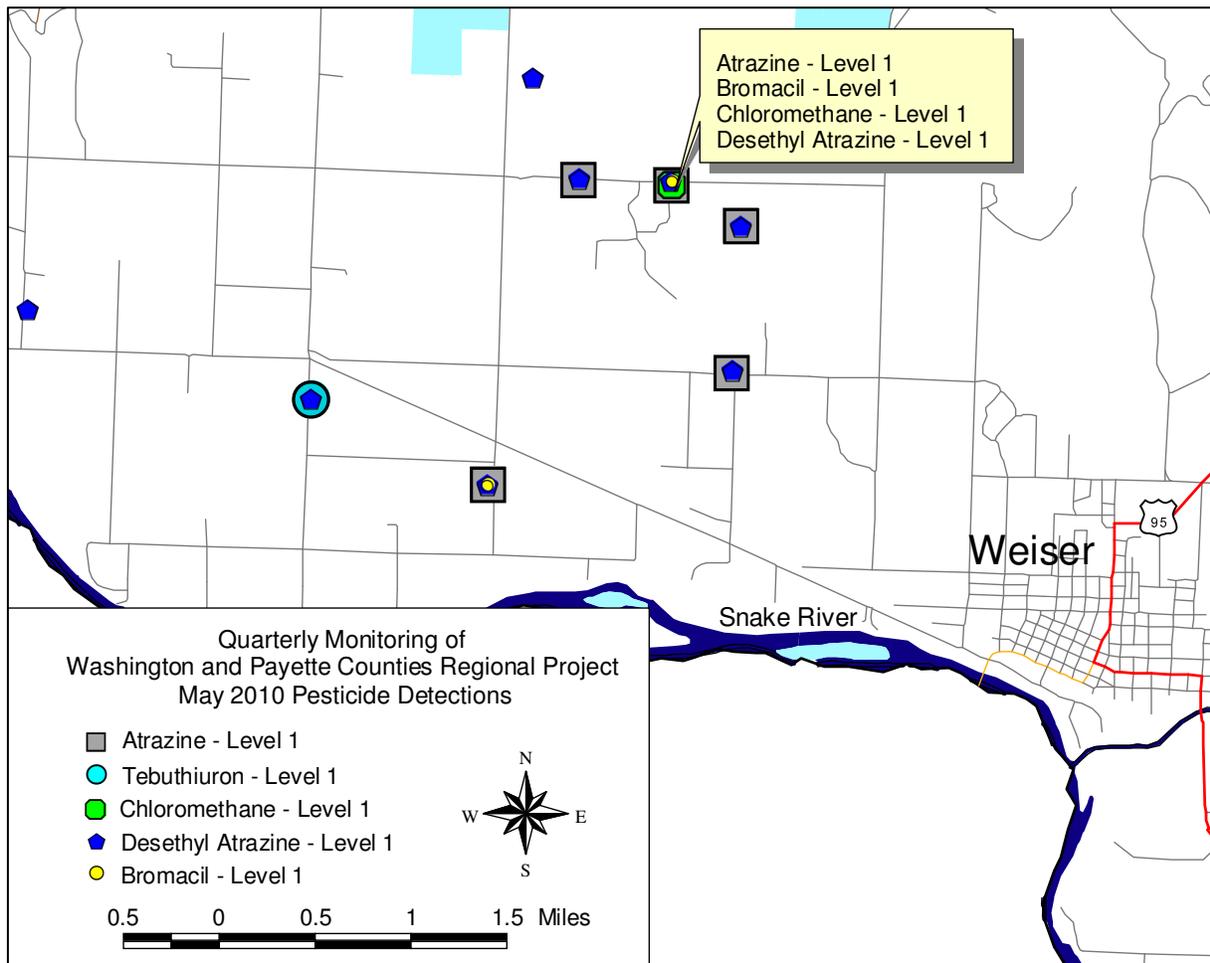


Figure 2. Pesticide results from ISDA May 2010 sampling of select wells in the Washington and Payette Counties Regional Project located near Weiser, ID.

Table 2. 2009/2010 Discretionary Project Results from the November, February and May Quarterly Monitoring Sampling Events of Select Wells in the Fruitland Atrazine PMP Project.

Pesticide (Active Ingredient or Breakdown Product)	Range (µg/L) (Min. – Max.)	Number of Wells with a Detection per Sample Event				Reference Point (µg/L)
		November 2009	February 2010	May 2010	August ¹ 2010	
2,4-DCBA	0.15	0	1	0	...	91 (RfD) ²
Atrazine	0.1 (0.12 – 0.22)	3	3	3	...	3 (MCL) ³
Bromacil	0.09	1	0	0	...	90 (HAL) ⁴
Deisopropyl Atrazine	0.05 (0.03 – 0.08)	3	3	2	...	....⁵
Desethyl Atrazine	0.56 (0.2 – 0.76)	3	3	3	...	....⁵

¹Data is pending.

²RfD – ISDA PMP Rule Calculated Reference Dose.

³MCL – EPA Maximum Contaminant Level.

⁴HAL – EPA Lifetime Health Advisory.

⁵Breakdown product of atrazine. No reference point available, MCL for atrazine of 3 µg/L is used.

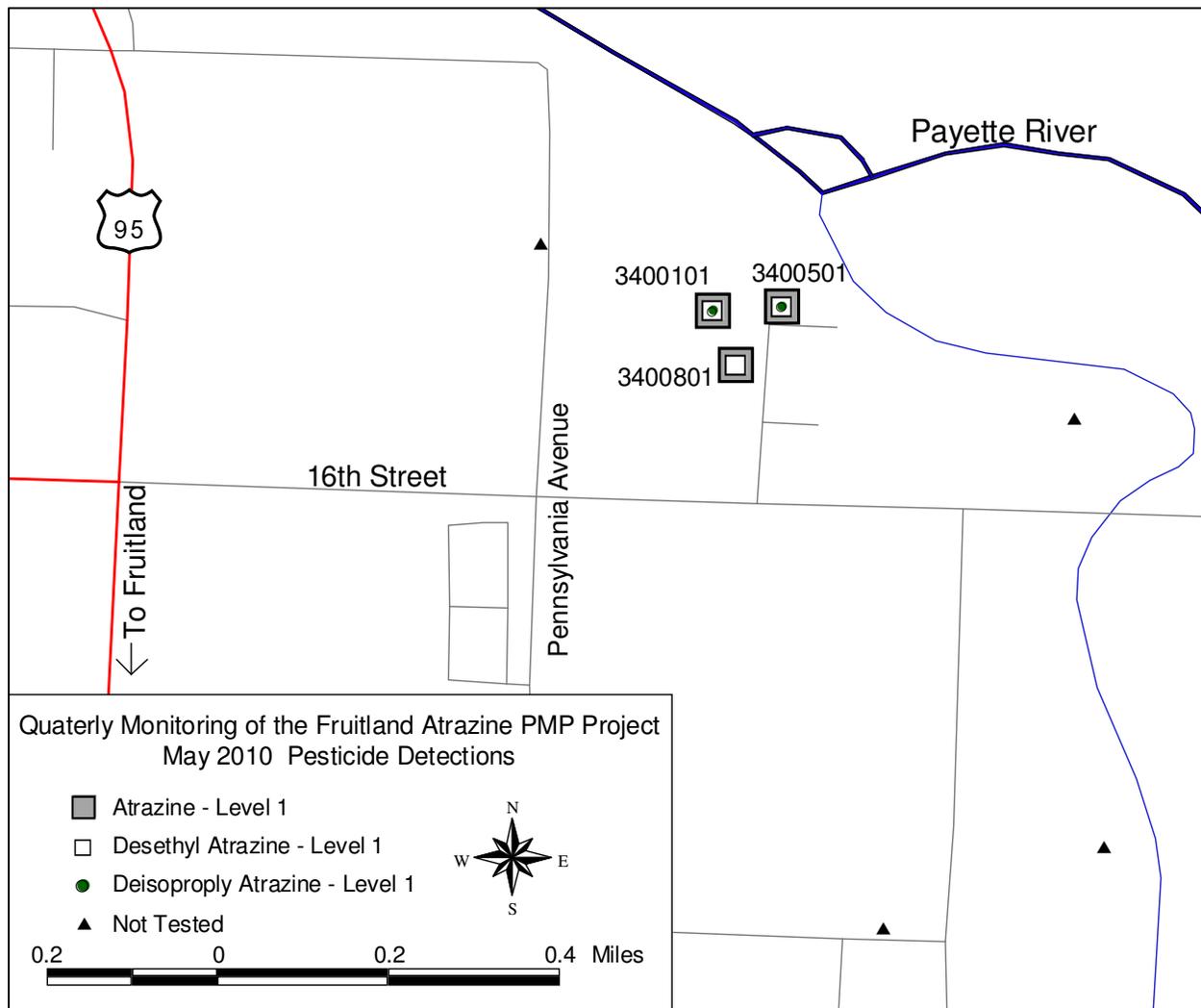


Figure 3. Pesticide results from ISDA May 2010 sampling of the Fruitland Atrazine PMP Project, located northeast of Fruitland, Idaho.

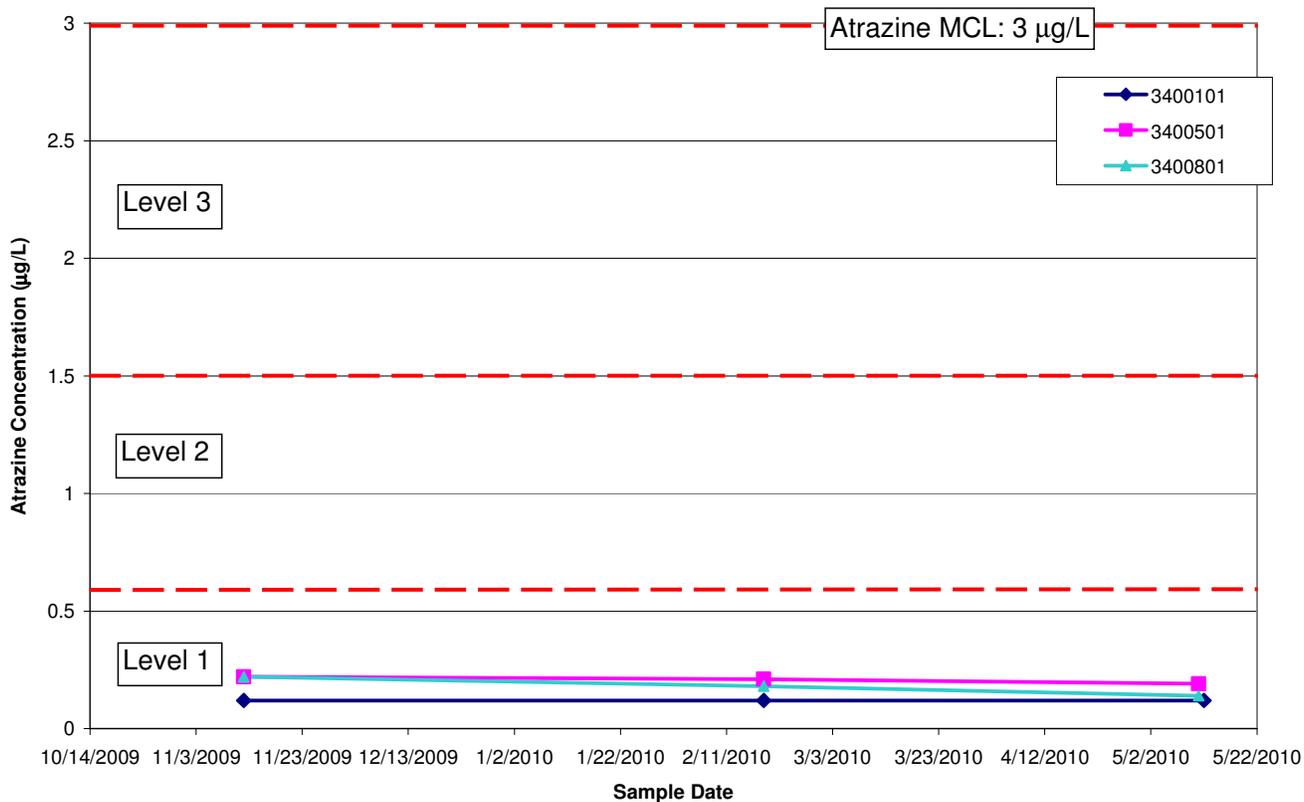


Figure 4. A time-series plot of atrazine concentrations detected in wells (3400101, 3400501, and 3400801) from the Fruitland Atrazine PMP Project, located near Fruitland, Idaho.

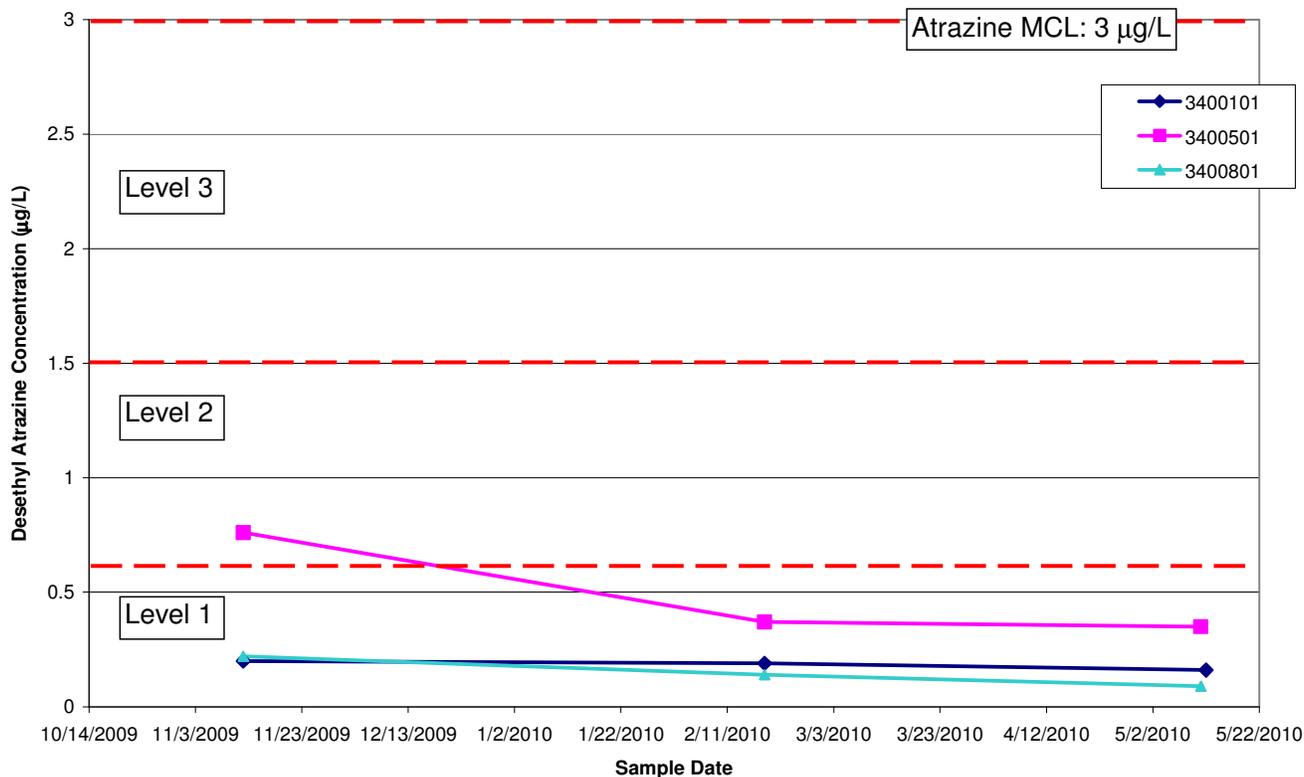


Figure 5. A time-series plot of desethyl atrazine concentrations detected in wells (3400101, 3400501, and 3400801) from the Fruitland Atrazine PMP Project, located near Fruitland, Idaho.

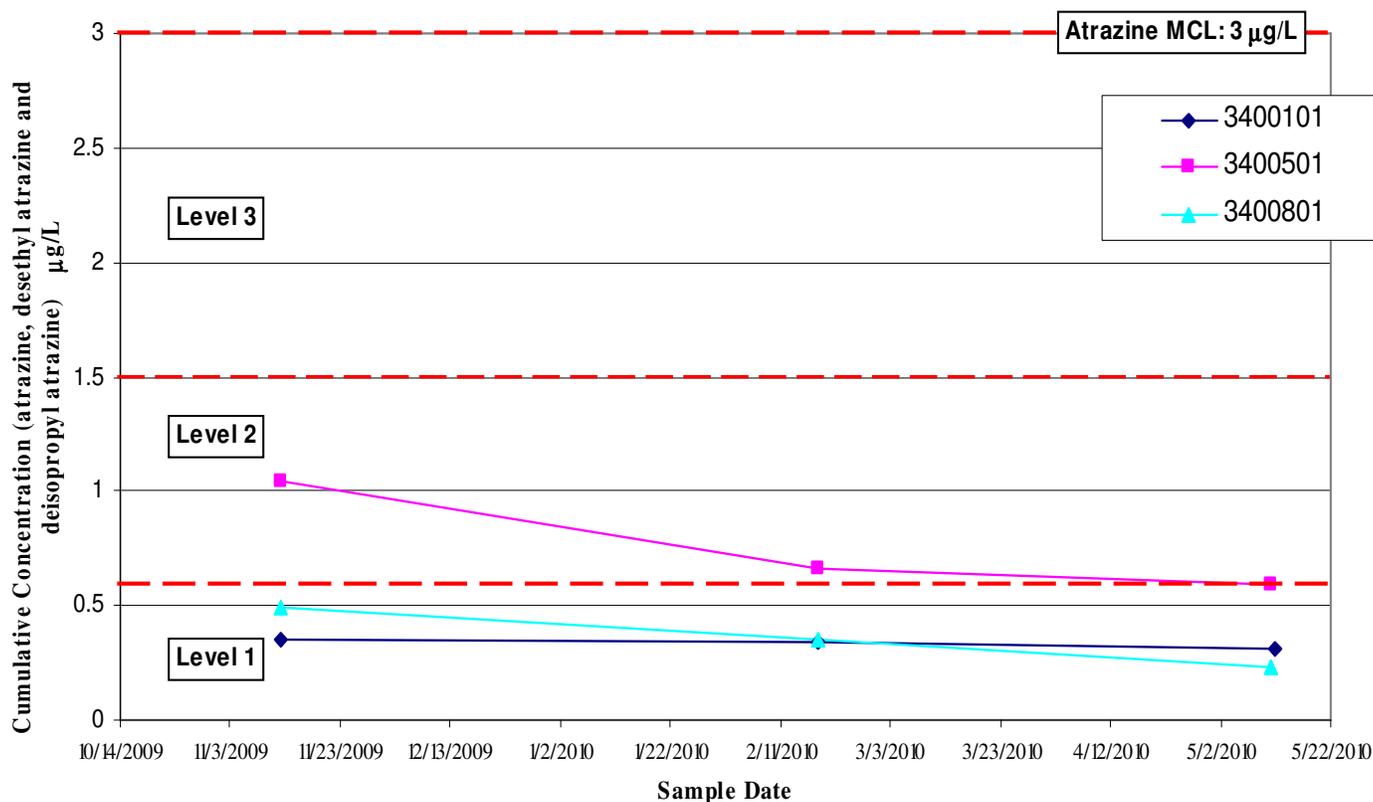


Figure 6. A time-series plot of the cumulative concentrations of atrazine, desethyl atrazine and deisopropyl atrazine detected in wells (3400101, 3400501, and 3400801) from the Fruitland Atrazine PMP Project, located near Fruitland, Idaho.

in Owyhee County, southwest of Homedale, during the first three quarterly monitoring events (Table 3). The five pesticides detected in order of the number of detections include: DCPA (dacthal) (9), 2,4-DCBA (2), desethyl atrazine (2), atrazine (1), bromacil (1), deisopropyl atrazine (1), simazine (1), and tetrahydrofuran (1) (Table 3). Multiple detections in each well was common for all three quarters sampled with the exception of well 3100801, which had no detections in May 2010. As established by the Idaho PMP Rule, there were Level 2 DCPA detections in May 2010 in two of the four wells sampled (Figure 4). One well had detections of DCPA, atrazine, desethyl atrazine, and tetrahydrofuran during the May 2010 sampling event. All detections were below any Idaho or EPA health standards (Table 3 and Figure 4). A time-series plot for DCPA (Figure 7) indicates that DCPA concentrations have increased to Level 2 values in wells 3100101 and 3100201. DCPA was detected in well 3100401 in the first sampling event however was not quantified because it was below the detection limit and was not detected the remaining two sampling rounds. Well 3100801 appeared stable throughout the monitoring period.

Pesticide Descriptions

The following information summarizes the chemical characteristics and the labeled use of each pesticide that

was detected in this project.

2,4-DCBA is a breakdown product of potentially several different pesticides including dicamba, propiconazole, dichlobenil, and dicofol. 2,4-DCBA is a hydrogenated carboxylic acid and is slightly soluble in water.

Atrazine is a systemic triazine herbicide used to control broadleaf weeds and some grassy weeds (EPA, 2003). Laboratory studies have shown that atrazine is mobile and persistent and has had widespread detections in ground water and surface water (EPA, 2003). Atrazine is a restricted use pesticide and is registered for use in Idaho for corn, fallow grain fields, and non crop areas.

Desethyl Atrazine, or DEA, is a breakdown product of atrazine.

Deisopropyl Atrazine, or DIA, is a breakdown product of atrazine, simazine, and other triazines.

Chloromethane, is known as methyl chloride, is a colorless gas and is used as a soil fumigant in vegetable and fruit crops including onions.

DCPA, or dimethyl tetrachloroterephthalate, is a pre-emergent herbicide used to control annual grasses and broadleaf weeds. DCPA is commonly known by the trade name "Dacthal". DCPA is a general use product

Table 3. 2009/2010 Discretionary Project Results from the November and February Quarterly Monitoring Sampling Events of Select Wells in the Owyhee County DCPA PMP Project.

Pesticide (Active Ingredient or Breakdown Product)	Range (µg/L) (Min. – Max.)	Number of Wells with a Detection per Sample Event				Reference Point (µg/L)
		November 2009	February 2010	May 2010	August ¹ 2010	
2,4-DCBA	0.07 (0.38 - 0.45)	0	2	0	...	91 (RfD) ²
Bromacil	0.06	1	0	0	...	90 (HAL) ³
DCPA (Dacthal)	27.86 (0.14 – 28)	4	3	3	...	70 (HAL)
Deisopropyl Atrazine	0.03	1	0	0	...	....⁴
Desethyl Atrazine	0.01 (0.04 – 0.05)	0	1	1	...	....⁴
Simazine	0.03	0	0	1	...	4 (MCL) ⁵
Tetrahydrofuran	8.0	0	0	1	...	50, 154 ⁶

¹Data is pending.

²RfD – ISDA PMP Rule Calculated Reference Dose.

³HAL – EPA Lifetime Health Advisory.

⁴Breakdown product of atrazine. No reference point available, MCL for atrazine of 3 µg/L is used.

⁵MCL – EPA Maximum Contaminant Level.

⁶No EPA standard. The Wisconsin Department of Natural Resources Drinking Water Guideline is 50 µg/L, the New Hampshire Department of Environmental Services Drinking Water Guideline is 154 µg/L.

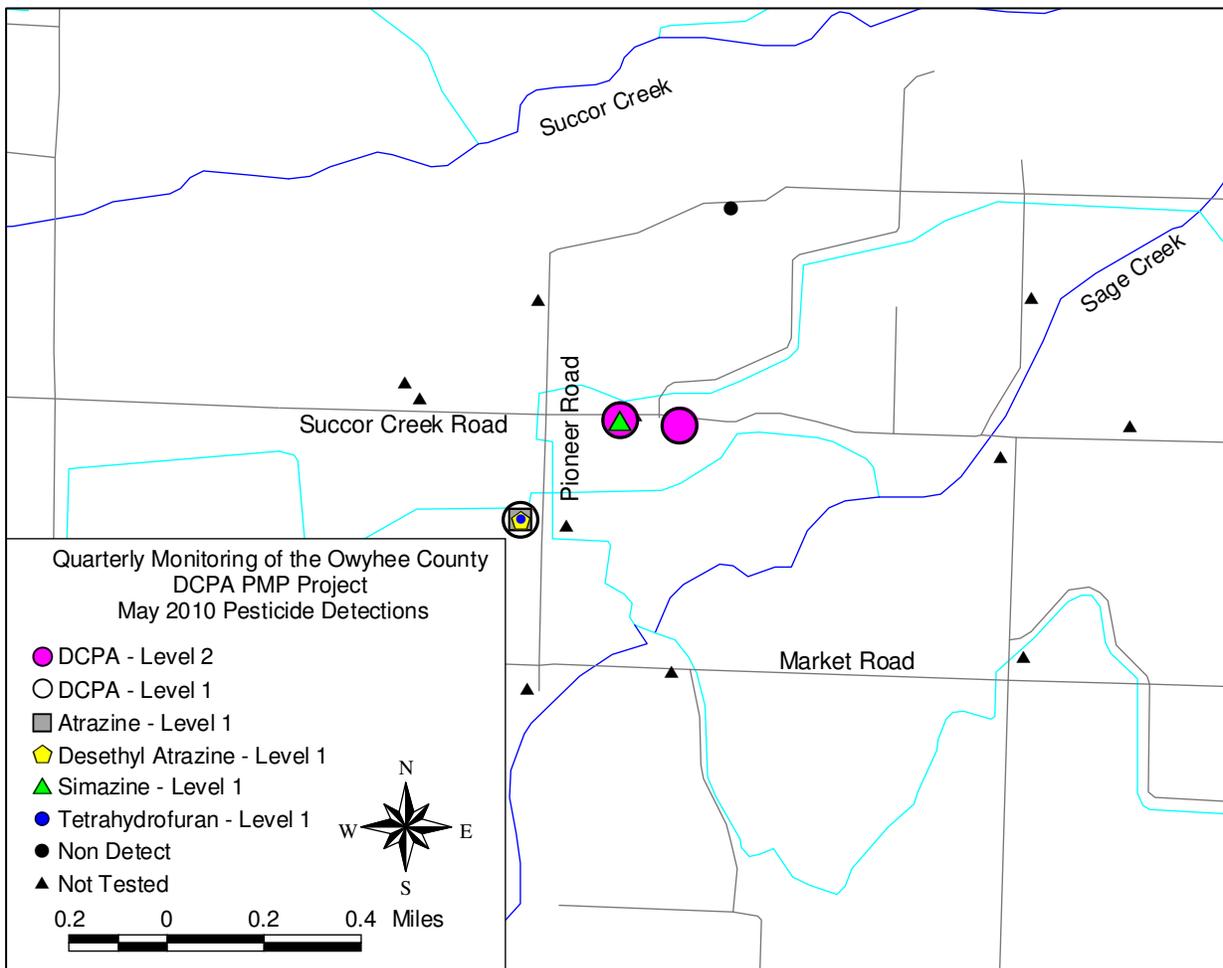


Figure 7. Pesticide results from ISDA May 2010 sampling of the Owyhee County DCPA PMP Project, located near Homedale, ID.

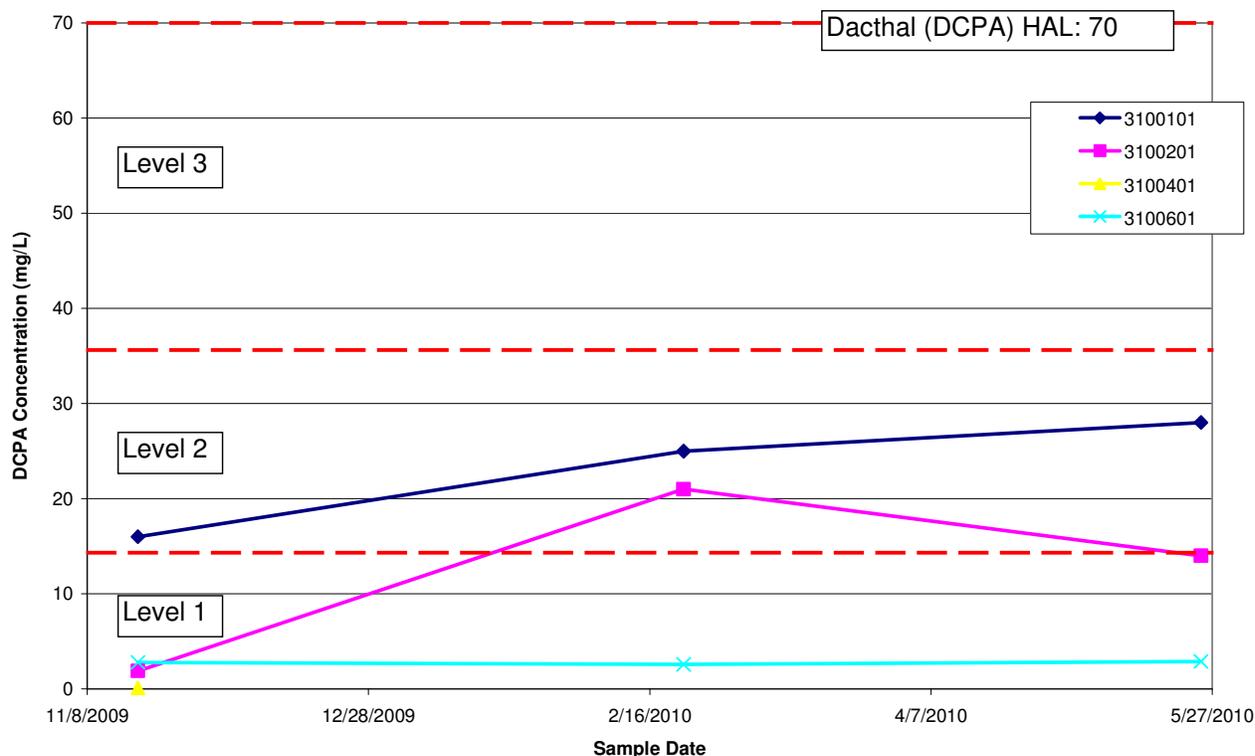


Figure 7. A time-series plot of DCPA concentrations detected in four wells (3100101, 3100201, 3100401, and 3100601) from the Owyhee County DCPA PMP Project, located south of Homedale, Idaho.

used on turf, ornamentals, strawberries, certain vegetables, onions, beans, and cotton. The two DCPA containing products currently registered in Idaho are Dacthal® Flowable Herbicide and Dacthal® W-75 Herbicide.

Bentazon is a general use post-emergence herbicide used for selective control of broadleaf weeds and sedges in beans, rice, corn, peanuts, mint, and others. Bentazon is a contact herbicide, which means that it causes injury only to the parts of the plant to which it is applied, interfering with the ability of susceptible plants to use sunlight for photosynthesis (Extoxnet, 2010). There are currently four products registered in Idaho with bentazon as an active ingredient.

Bromacil is a general use herbicide used for control of annual and perennial weeds (broadleaf and grasses), brush, and woody plants and vines in agricultural and non agricultural environments (EPA, 1996). Lab studies have shown that bromacil is very mobile in sand, sandy loam, clay loam, and silt loam soils (EPA, 1996). Bromacil is known to leach to the ground water as a result of normal use.

Dinoseb is a phenolic herbicide used in soybeans, vegetables, fruits and nuts, citrus, and other field crops

(e.g., in corn) for the selective control of grass and broadleaf weeds. It is also used as an insecticide in grapes, and as a seed crop drying agent. It is produced in emulsifiable concentrates or as water soluble ammonium or amine salts. The use of dinoseb was cancelled in the U.S. in 1986. This action was based on the potential risk of birth defects and other adverse health effects for applicators and other persons with substantial dinoseb exposure (Extoxnet, 2010).

Metribuzin is a general use selective triazine herbicide which inhibits photosynthesis of susceptible plant species. Metribuzin is used for control of annual grasses and numerous broadleaf weeds in field and vegetable crops, in turfgrass, and on fallow lands (Extoxnet, 2010). Metribuzin is considered to be moderately persistence in the soil environment, with soil half-lives of 30 to 120 days, can be poorly bound to most soils and soluble in water, which allows for potential for leaching in many soil types (Extoxnet, 2010).

Simazine is a general use broad-spectrum triazine herbicide that is used to control broad-leaved weeds and annual grasses. Simazine is moderately persistent with an average field half-life of 60 days. Soil half-lives of 28 to 149 days have been reported (Extoxnet, 2010). Simazine has potential to leach to ground water depending on soil

type, organic matter content, and agricultural practices.

Tebuthiuron is a general use broad-spectrum herbicide used to control weeds in non-cropland areas, rangelands, rights-of-way, and industrial sites. It is effective on woody and herbaceous plants in grasslands. Tebuthiuron is highly persistent in soil. Reported field half-lives are from 12 to 15 months in areas with over 40 inches of annual rainfall, with longer half-lives expected in drier areas or in soils with high organic matter content (Exttoxnet, 2010). Tebuthiuron is broken down slowly in the soil through microbial degradation. It is poorly bound to soil, suggesting high mobility. It was found in some ground water samples in Western states (Texas, California, Missouri, Oklahoma, and Washington) at levels up to 3.8 µg/L (Exttoxnet, 2010).

Conclusions

Results of testing indicate that pesticides have been found in all three alluvial aquifers tested as part of this project. The quarterly monitoring has been successful in identifying the existence of these pesticides and the changes in concentrations over time. The majority of the wells sampled had pesticide detections and in many cases multiple detections per sample. All detections were within health based levels. Most of the detections were Level 1 detections with the exception of the following:

- Washington and Payette Counties Regional Project – one November 2009 Level 3 desethyl atrazine detection (the cumulative summation of the atrazine and atrazine breakdown products in the well was a Level 3)
- Fruitland Atrazine PMP Project - one Level 2 desethyl atrazine detection in November 2009 (the cumulative summation of atrazine and atrazine breakdown products in the well was a Level 2) and the cumulative summation of atrazine and atrazine breakdown products in February and May of 2010
- Owyhee County DCPA PMP Project - one November 2009 Level 2 DCPA detection and two Level 2 DCPA detections in both February and May 2010

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 will continue quarterly monitoring in 2010 and into 2011. ISDA may initiate additional quarterly monitoring for other areas in 2011.

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 personnel will continue to educate home and well owners in the area. ISDA staff will present the information to the PMP Advisory Committee, and implement the provisions of the Idaho PMP Rule.

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