

Yakima Dairies Consent Order Update

December 2014

What is the Yakima Dairies Administrative Order on Consent?

In March 2013, EPA signed an Administrative Order on Consent (“Consent Order”) with several Dairies in the Lower Yakima Valley. The Consent Order is a written legal agreement that was signed by EPA and the Dairies under the authority of the federal Safe Drinking Water Act. The purpose of the Consent Order is to address sources of nitrate contamination in groundwater near and downgradient of the Dairies’ facilities. The Dairies have begun work to control nitrate sources, collect soil and groundwater data, and monitor the quality of the groundwater to assess the effectiveness of the source control actions.

What is nitrate?

Nitrate (NO_3) is an inorganic compound made up of one nitrogen atom and three oxygen atoms. It is highly soluble and mobile in water.

Why is nitrate a concern?

Nitrate is an acute contaminant, which means an immediate (within hours or days) health effect may result from exposure. EPA has established a maximum contaminant level (MCL) for nitrate in drinking water of 10 milligrams/liter (mg/L) measured as nitrogen (“nitrate-N”). EPA and state agencies regulate nitrate in public drinking water systems because nitrate concentrations greater than the MCL may cause a number of health problems. Exposure to excess nitrate can result in methemoglobinemia (blue-baby syndrome) in infants and susceptible individuals, which can lead to death in extreme cases. Methemoglobinemia is caused by the reduction of nitrate to nitrite in the body. Adults with the following health conditions should not drink water with more than 10 mg/L of nitrate: individuals who don’t have enough stomach acids; individuals with an inherited lack of the enzyme that converts affected red blood cells back to normal (methemoglobin reductase); and women who are pregnant or trying to become pregnant. High nitrate levels may increase the risk of spontaneous abortion or certain birth defects.

Who signed the Consent Order?

The Consent Order was signed by the Cow Palace Dairy, the D & A Dairy, the George DeRuyter & Son Dairy, the Liberty Dairy, its associated facility the H&S Bosma Dairy, and EPA. These Dairies are large confined animal feeding operations (CAFOs). In 2009, together they had more than 24,000 animals. The facilities are located northeast of Granger, Washington (see Figure 1, attached).

What is the Goal of the Consent Order?

The goal of the Consent Order is to achieve the nitrate MCL of 10 mg/L in the drinking water aquifer beneath and hydraulically downgradient of the Dairy Facilities in an effort to protect human health. The Consent Order includes a Statement of Work that has the following objectives:

- Expeditiously provide a permanent, safe alternative drinking water supply to residents using private drinking water wells that exceed the 10 mg/L MCL for nitrate and are on, or within one mile downgradient of the Dairy Facilities.
- Take specific actions to further control potential sources of nitrogen at the Dairy Facilities.
- Establish a network of monitoring wells to measure the effectiveness of the nitrogen source reduction actions on water quality in the shallow, alluvial aquifer which serves as an underground source of drinking water.
- Ensure effective nutrient management at the Dairy Facilities to reduce the introduction of nitrate to an underground source of drinking water.

Who collects the data in accordance with the Consent Order?

The data is collected by the Dairies, through their hired consulting firms. Data collected under the Consent Order must be collected and analyzed in accordance with EPA-approved Quality Assurance Project Plans (QAPPs) to ensure data quality. EPA conducts periodic site visits to observe sampling to ensure compliance with approved plans.

What progress has been made so far with regard to the Consent Order?

Safe drinking water provided. The Dairies identified 224 private residences on or within one mile downgradient of their facilities. Of these, 41 residences were vacant, could not be reached after multiple attempts, or refused to participate in the sampling. Of the remaining 181 residences that were assessed by the Dairies, sixty-one percent (61%)¹ exceeded the nitrate MCL, compared to about twelve percent (12%)² of private domestic wells across Yakima County. The Dairies offered reverse osmosis (RO) treatment units, which treat drinking water for nitrate, to households that exceeded the nitrate MCL. The Dairies installed RO treatment units at residences that expressed interest. The cost of installation and maintenance of the units is paid by the Dairies. Yakima County previously had a program that offered RO treatment units to County residents if their

¹ Sixty-three of these residences exceeded the nitrate MCL as determined by laboratory analysis conducted by the Dairies. Forty-eight residences already had RO treatment units in place (all assumed to be above the MCL). Calculation: $(63 + 48)/181 = .613 = 61\%$.

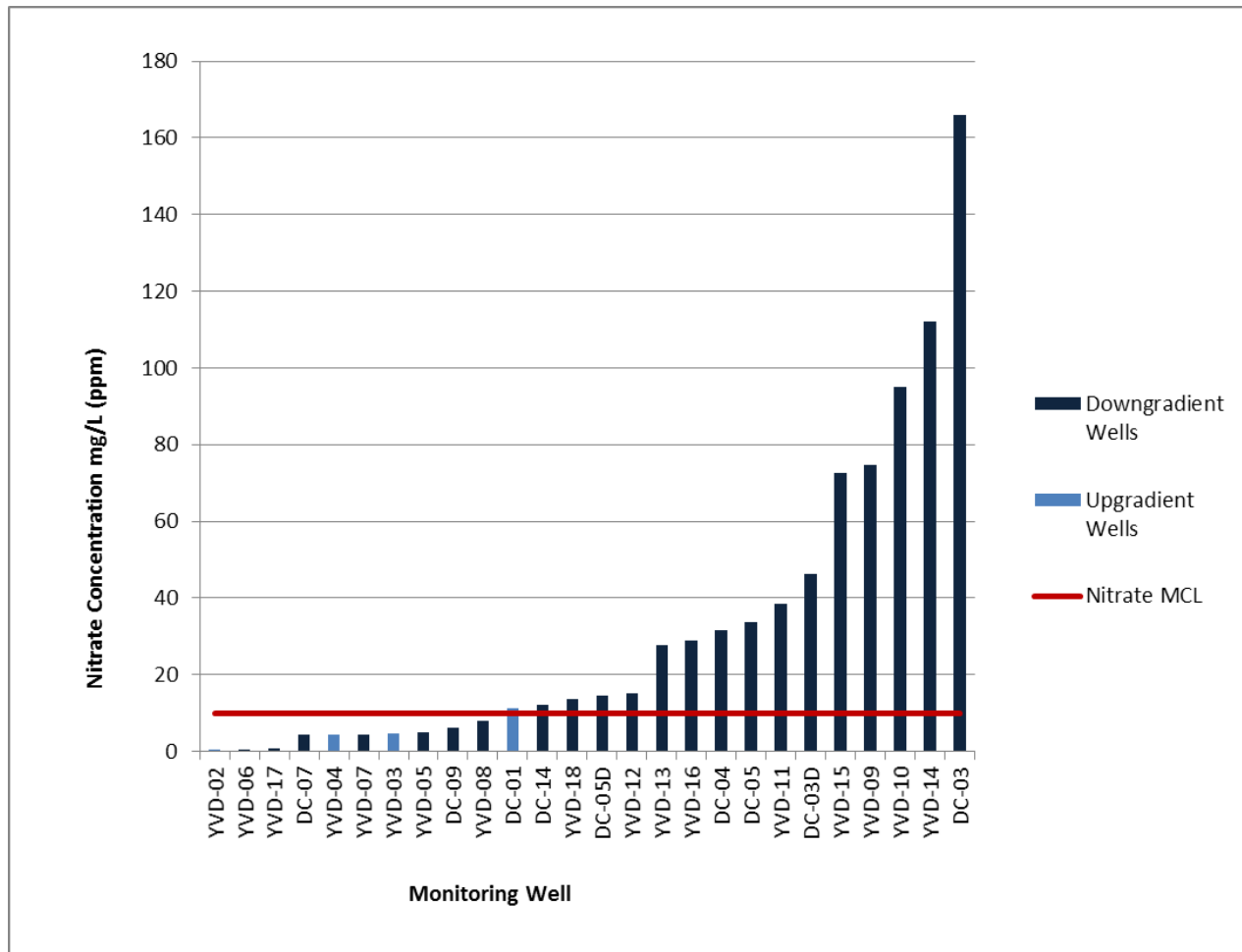
² Lower Yakima Valley groundwater quality: Preliminary assessment and recommendations. Prepared by: the Washington State Departments of Agriculture, Ecology and Health; Yakima County Public Works Department; and the US Environmental Protection Agency. February 2010. Ecology Publication No.10-10-009.

drinking water exceeded the nitrate MCL. If a residence within the one-mile boundary already had a RO treatment unit in place, the Dairies offered to maintain the unit at no cost to the resident.

Network of monitoring wells installed. A network of twenty-six groundwater monitoring wells is in place at the Dairies. In addition to seven groundwater monitoring wells that were installed by EPA in December 2012, the Dairies have installed 19 monitoring wells. All of these monitoring wells are of known construction and were designed and installed according to Washington State regulations and under an EPA-approved plan. The monitoring well network includes wells located upgradient and downgradient of the Dairies. The well network is designed to measure how groundwater quality changes as it travels under the Dairies in the downgradient direction. The network includes 23 shallow monitoring wells screened across the top of the water table, and 3 deeper monitoring wells to better understand the aerial and vertical extent of nitrate contamination in the drinking water aquifer.

Under the Consent Order, the Dairies are required to sample all of the monitoring wells in the monitoring well network on a quarterly basis. A summary of the nitrate data for the first four quarterly sampling events, plus the data collected by EPA in 2013, is presented on Figure 2 (attached).

This chart shows the nitrate sample results from the third quarter of 2013:

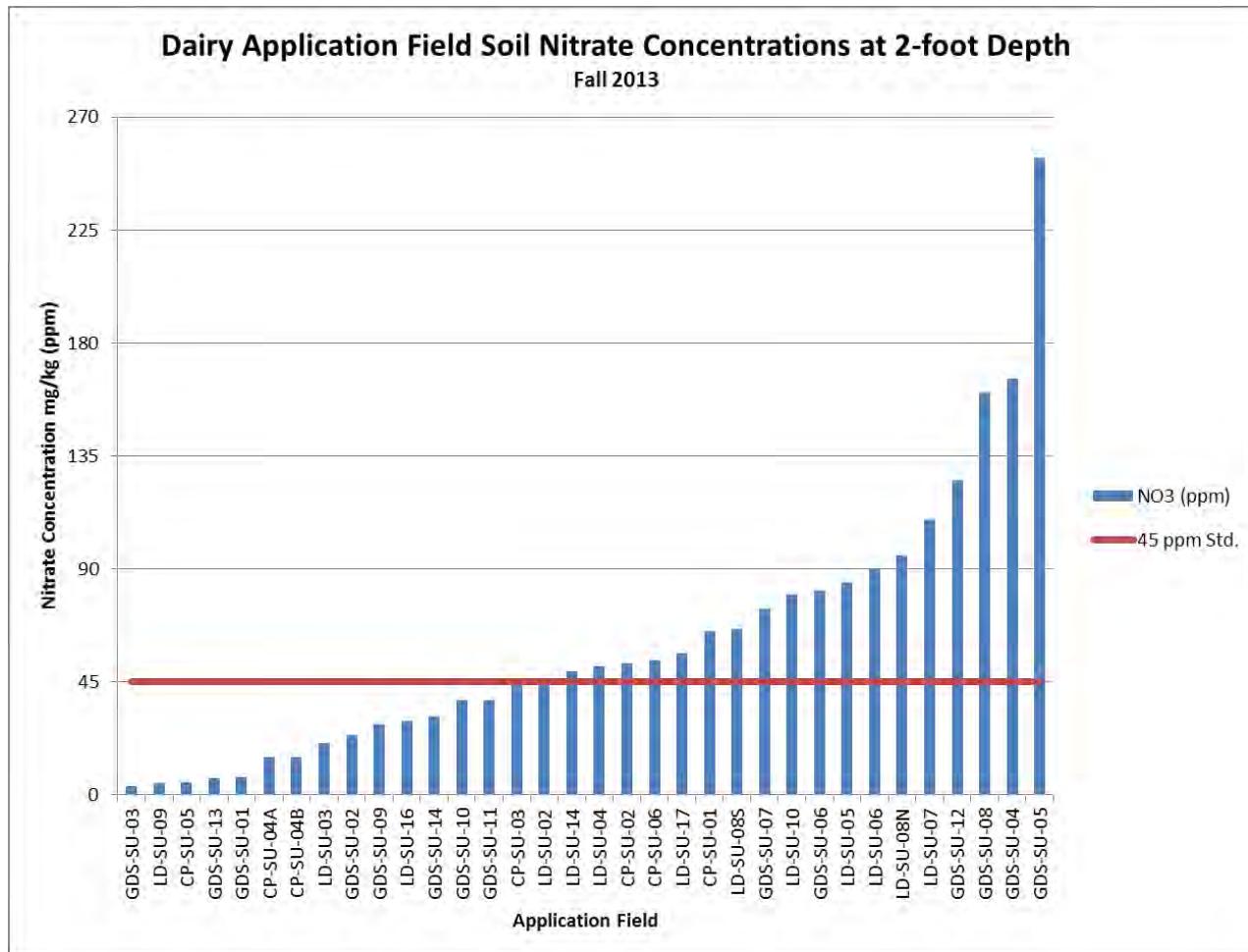


The upgradient well nitrate concentrations are shown in blue, the downgradient nitrate well concentrations are shown in black, and the nitrate MCL of 10 mg/L is shown as a red horizontal line. The upgradient wells are below or close to the MCL. Many downgradient monitoring wells exceed the MCL.

Figure 3 (attached) illustrates the relative nitrate concentrations in the shallow monitoring wells for the second quarter 2014 sampling event.

Nutrient management. The Dairies apply manure and, in some cases, synthetic fertilizer to their fields. If manure or synthetic fertilizer is over-applied, nitrate can escape the cropping system, migrate past the root zone through the soil column and pollute the groundwater. The Consent Order states that the Dairies must maintain soil nitrate at the 2-foot depth below 45 parts per million (ppm). This level was selected because it is consistent with the level currently used by the State of Washington. In accordance with the Consent Order, the Dairies have sampled soil in their 34 application fields. The Dairies sample their fields twice a year: post-harvest sampling is done at the 1-foot, 2-foot, and 3-foot depths in the fall, and pre-plant sampling is done at the 1-foot and 2-foot depths each spring.

This chart shows the results of the fall 2013 post-harvest soil sampling at the 2-foot depth:



The blue bars represent soil nitrate levels in the application fields. They are sorted lowest to highest, and 45 ppm is shown as a red horizontal line. The chart indicates excessive levels of nitrate in fields where the blue bar associated with a particular field crosses the red line. As shown on the chart, over half of the Dairies' application field acreage exceeded 45 ppm in the fall 2013. Similar results were obtained from the spring 2014 sampling.

Most of the Dairies' 2,306 acres of application fields were recently planted with a double crop of triticale and silage corn. As shown on the table below, on average, the triticale/silage corn fields had the highest levels of nitrate compared to other crops:

Average Soil Nitrate-N Concentration by Crop Type

Fall 2013 Soil Data

	<i>Number of Fields</i>	<i>Percentage of Acreage</i>	<i>1-foot (ppm)*</i>	<i>2-foot (ppm)*</i>	<i>3-foot (ppm)*</i>
<i>Triticale/Silage Corn</i>	22	75%	99	97	99
<i>Alfalfa</i>	10	18%	20	26	28
<i>Triticale/Sudan Grass</i>	2	7%	26	27	17
<i>Total</i>	34	100%	--	--	--

Units: parts per million (ppm) = milligrams per kilogram.

* *Averages are weighted by field size. Average Soil Nitrate Concentration = Σ (measured concentration N in a field X numbers of acres of that field) / total acreage of fields for each crop type.*

The number of pounds of nitrate per acre in the root zones of each of these types of fields can be estimated by multiplying the amount of nitrate in parts per million by a factor of 3.5,³ and then adding the pounds per acre in the first and second feet of soil. For example, the average amount of nitrate in the root zone (the top two feet of soil) of the triticale/silage corn fields is about 686 pounds of nitrate per acre.⁴ This compares to the Washington State University fertilizer guidelines for silage corn of 150 pounds per acre, and for triticale of 137 pounds per acre, for a total of 287 pounds per acre. Thus, the amount of nitrate in the root zone exceeded the recommended amount for two years of crop growth in these fields.

³Factors of 3.5 or 4 are rules-of-thumb for converting parts per million to lbs/acre for one foot of soil. The actual conversion factor is dependent on soil bulk density. Reference: Koenig, Richard T. July 2013. Dryland Winter Wheat – Eastern Washington Nutrient Management Guide. Washington State University Extension. EB1987E.

⁴ Calculation: ((99 ppm * 3.5) + (97ppm * 3.5)) = 686 pounds per acre

According to the Dairies' fall 2013 post-harvest application field soil sampling reports, collectively the Dairies' application fields contained over 300 tons of nitrate in the top foot of soil; over 300 tons of nitrate in the second foot of soil; and over 300 tons of nitrate in the third foot of soil. This nitrate is vulnerable to leaching to the groundwater as a result of irrigation and precipitation. Most crops do not effectively use the nitrate in the third foot of soil so it has effectively been lost to the environment and can migrate through the soil column and pollute the groundwater.

The Dairies have hired an agronomist to manage their fields with the goal of achieving and maintaining 45 ppm nitrate or less at the 2-foot depth in all fields. Based on their assessment of the data, the Dairies' agronomist has proposed the following management actions:

- Stop applying manure in 5 fields
- Reduce manure application in 4 fields
- Transition 10 fields into alfalfa
- Implement other cropping changes in 6 fields

More than one of these actions are planned for some fields. The Dairies intend to keep the alfalfa crops in place for about four years, and cut the alfalfa regularly but not plow it during this time. Alfalfa can grow deep roots and is relatively efficient at removing nitrate from the soil profile.

The Dairies also are assessing whether the nitrogen content of their animal feed can be reduced.

Irrigation Water Management (IWM). All of the Dairies' application fields are irrigated. If excess irrigation water is applied to application fields, excess water can carry nitrate, which is highly mobile in water, out of the root zone to the drinking water aquifer. The Dairies have agreed to install moisture sensors below the root zone in all of their application fields before the 2015 growing season. These sensors will be monitored during irrigation. If water reaches the moisture sensors, irrigation to that field will be shut off. Improved IWM will not only reduce the amount of nitrate leaching past the root zone, but will save water and energy, too.

In addition, the Dairies eliminated the practice of furrow irrigation, a type of surface irrigation where water is released into channels dug in the soil along the length of the field, in several of their fields where it was still in use.

Lagoon evaluations. Together, the Dairies have 41 animal waste storage lagoons. The Dairies are evaluating each lagoon to determine whether they are in compliance with current seepage standards recommended by the United State Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS). Under the Consent Order, the Dairies have agreed to address leakage or line any lagoons that do not meet the current NRCS seepage standard at a rate of at least one lagoon per Dairy Facility per year.

Other source control actions. The Dairies have installed backflow prevention devices on all of their production wells, are working to minimize ponding of water in cow pens, and are reducing infiltration from their solids separators and manure storage areas. In accordance with the Consent Order, one of the Dairies is developing a plan to assess likely nitrate sources to monitoring well

DC-03, which has consistently had the highest detected concentrations of nitrate in groundwater (up to 234 mg/L nitrate in the sample collected in the second quarter of 2014).

What are the next steps?

The Dairies will continue to sample the application fields twice a year.

The Dairies will continue collecting groundwater samples from the monitoring wells on a quarterly basis for eight years from the date the Consent Order was signed. At the end of eight years, the data from each monitoring well will be assessed. If there are any monitoring wells where the nitrate trend is not downward, the Dairies have agreed to further assess sources of nitrate and propose additional source control actions.

Frequently Asked Questions

Are the Dairies that signed the Consent Order responsible for the nitrate contamination of groundwater in the entire Lower Yakima Valley?

No. The portion of the Lower Yakima Valley aquifer that is affected by the Dairies that signed the Consent Order is relatively small in the context of the entire aquifer. Generally, nitrate sources have the greatest potential effect on nitrate levels in the shallow aquifer beneath the geographical footprint of the source, and relatively nearby and hydraulically downgradient of the source area.

Is the nitrate contamination beneath and downgradient of these Dairies coming from these Dairies?

Prior to signing the Consent Order, based on its investigation, EPA concluded that the Dairies are a source of the nitrate measured in downgradient monitoring wells and residential drinking water wells. The data that have been collected by the Dairies under the Consent Order provide further support for this conclusion. Comparison of the nitrate levels in the upgradient monitoring wells with those along the downgradient edge of the Dairies properties indicate that there is heavy nitrate loading of the drinking water aquifer occurring within the Dairies' footprint.

Is manure a resource or pollution?

Large dairies produce large quantities of solid and liquid wastes that include excrement, urine, bedding material, and wastewater. Typically, these waste streams are stored and managed onsite (e.g., solids separation, composting, lagoons) before they are applied to crop fields. If the wastes are not sufficiently contained or over-applied to fields, nitrate pollution of the groundwater can occur.

Webster's Dictionary defines manure as, "animal excrement or other substance put on or into the soil to fertilize it." Although dairy wastes' organic matter and micronutrients can benefit the soil, if these wastes are mismanaged or over-applied to soil, nitrate can migrate past the root zone and pollute the underlying groundwater. In order to avoid impact on groundwater, before applying

manure to crops, soil nitrogen levels should be properly assessed, and manure should be applied to crops at agronomic rates, taking into account the amount of nitrogen already in the soil.

Is EPA pursuing synthetic fertilizer applied to irrigated cropland as a source?

Synthetic fertilizer typically contains nitrogen and is a potential source of nitrate contamination to groundwater. It is a common practice for dairies to apply both dairy waste and synthetic fertilizer to their crop fields. The results of the sampling that the Dairies conducted under the Consent Order reflect the total nitrate concentrations in soil, groundwater and drinking water, including contributions from manure and synthetic fertilizer. The source control measures that the Dairies are implementing in accordance with the Consent Order are designed to mitigate nitrate contributions from their application crop fields, which would include any contribution from synthetic fertilizer.

Is EPA pursuing residential septic systems as a source?

Based on available information, the contribution from residential septic systems to nitrate contamination in the monitoring and residential drinking water wells downgradient of the Dairies is negligible. Livestock generate significantly more waste than humans. The amount of nitrogen generated by the 224 residential septic systems on and within one mile downgradient of these Dairies is insignificant relative to the amount of nitrogen produced by the Dairies. A three-person residence generates about 30 pounds of nitrogen per year. By comparison, the USDA Agricultural Waste Management Field Handbook estimates that a single lactating cow produces about 1 pound of nitrogen per day or 365 pounds of nitrogen per year. In 2009, the Dairies reported having more than 24,000 animals, not all of which are lactating cows. The total amount of nitrogen generated by these 224 residential septic systems is less than one-tenth of one percent of the total amount generated by these Dairies.

The installation of residential septic systems is regulated through a permit process that is designed to protect private drinking water wells from contamination. Residential septic system permits are issued by Yakima County in accordance with Washington State laws that are intended to ensure that contaminants from a septic system, including nitrate, will not adversely impact drinking water wells. The permit requirements include minimum lot size and setbacks from drinking water wells.

Could the nitrate contamination have come from sources that are upgradient of the Dairy facilities?

The nitrate concentrations in the monitoring wells located upgradient of the Dairies range from background levels (generally less than 1 mg/L) to around the MCL of 10 mg/L. This information indicates that there is some small nitrate contribution from upgradient sources.

Could the nitrate contamination have come from agricultural operations that preceded the Dairies at these same locations?

Aerial photographs indicate that land use prior to operation of these Dairies was typically other types of agriculture. Dairy operations began in this area before 1968. The large numbers of animals that are concentrated at these Dairies (more than 24,000 in 2009), the Dairies' close proximity to each other, and the storage and application of large quantities of animal waste on the land surface have resulted in significant nitrogen loading. If the nitrogen from the Dairies' sources was not reaching the groundwater, the nitrate levels in the downgradient wells would likely be much lower, and would be decreasing with the passage of time due to dilution. However, quarterly groundwater data collected by the Dairies indicate that nitrate levels in the monitoring wells fluctuate but are generally not declining. For example, nitrate has been measured at elevated concentrations up to 234 mg/L in monitoring well DC-03 since this well was installed in December 2012.

It is unlikely that the effect of these Dairies on the groundwater is unique in the Lower Yakima Valley. EPA suspects that there are other dairies that similarly contribute significant amounts of nitrate to groundwater.

Why is the crop root zone considered to be two feet deep?

Crops like corn and triticale are typically grown as annual crops, and the majority of their roots are concentrated in the upper two feet of soil. Under typical growing conditions, they are not capable of effectively pulling large quantities of nitrate out of the soil beyond two feet.

Why is alfalfa, typically considered to be a nitrogen fixer, expected to pull nitrate out of the soil?

Alfalfa will resort to fixing nitrogen (i.e., create its own nitrogen by pulling it out of the air) only if there is insufficient nitrogen already in the soil. If there is sufficient nitrogen in the soil, it will utilize the soil nitrogen first.

What if someone who lives on or within one mile downgradient of the Dairies didn't take advantage of the Dairies' offer to test their well for nitrate but wants to now?

The Dairies have agreed to test any wells that are on or within one mile downgradient of their facilities for nitrate, even those that they have not already sampled.

What if someone who lives on or within one mile downgradient of the Dairies didn't take advantage of the Dairies' offer for a RO treatment unit but wants to now?

The Dairies have agreed to provide a treatment unit if a residence is on or within the one-mile boundary of their facilities and if laboratory analysis shows that the well water exceeds the MCL for nitrate.

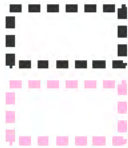
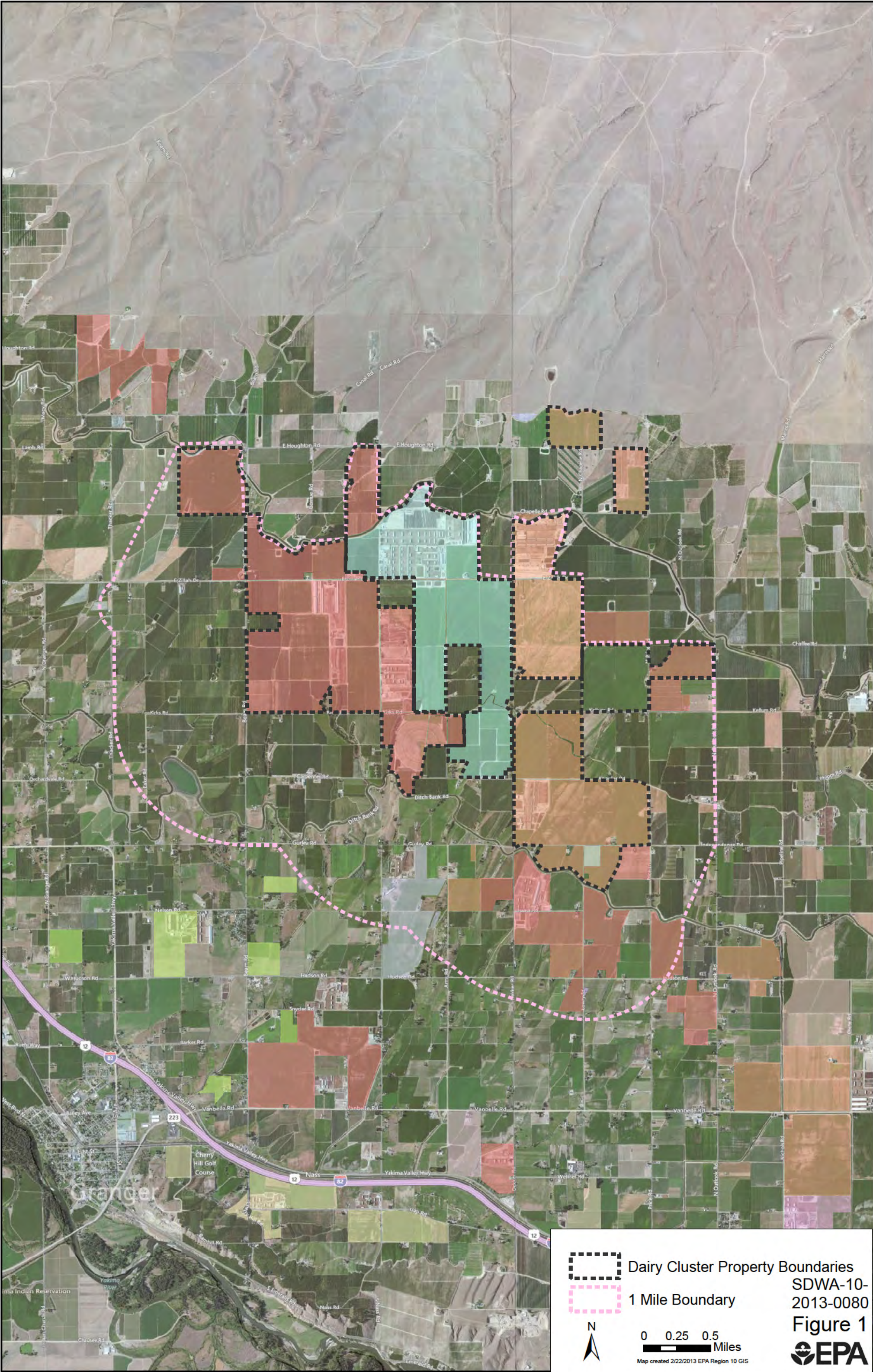
What if someone's well is just outside the one-mile boundary?

The Consent Order requires the Dairies to sample drinking water only on or within the one-mile boundary downgradient of their facilities. Washington Department of Health recommends that private well owners test their drinking water every year for coliform bacteria and nitrate. These two contaminants could rapidly affect a person's health—possibly even with just one drink of water. For more information, visit the Department of Health's website:

<http://www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/Contaminants/TestingYourWater>

Is EPA involved in the Lower Yakima Valley Groundwater Management Area?

EPA is participating in the Lower Yakima Valley Groundwater Management Area (GWMA) process to develop a comprehensive plan to restore groundwater to meet nitrate standards throughout the lower Yakima Valley. The long-term goal is to reduce nitrate concentrations in groundwater to below state drinking water standards. The plan is to accomplish this by using available and new data collected in the lower Yakima Valley to prevent continued groundwater pollution and to make sure residents have clean and safe drinking water.



Dairy Cluster Property Boundaries
SDWA-10-2013-0080
1 Mile Boundary
Figure 1



0 0.25 0.5
Miles
Map created 2/22/2013 EPA Region 10 GIS



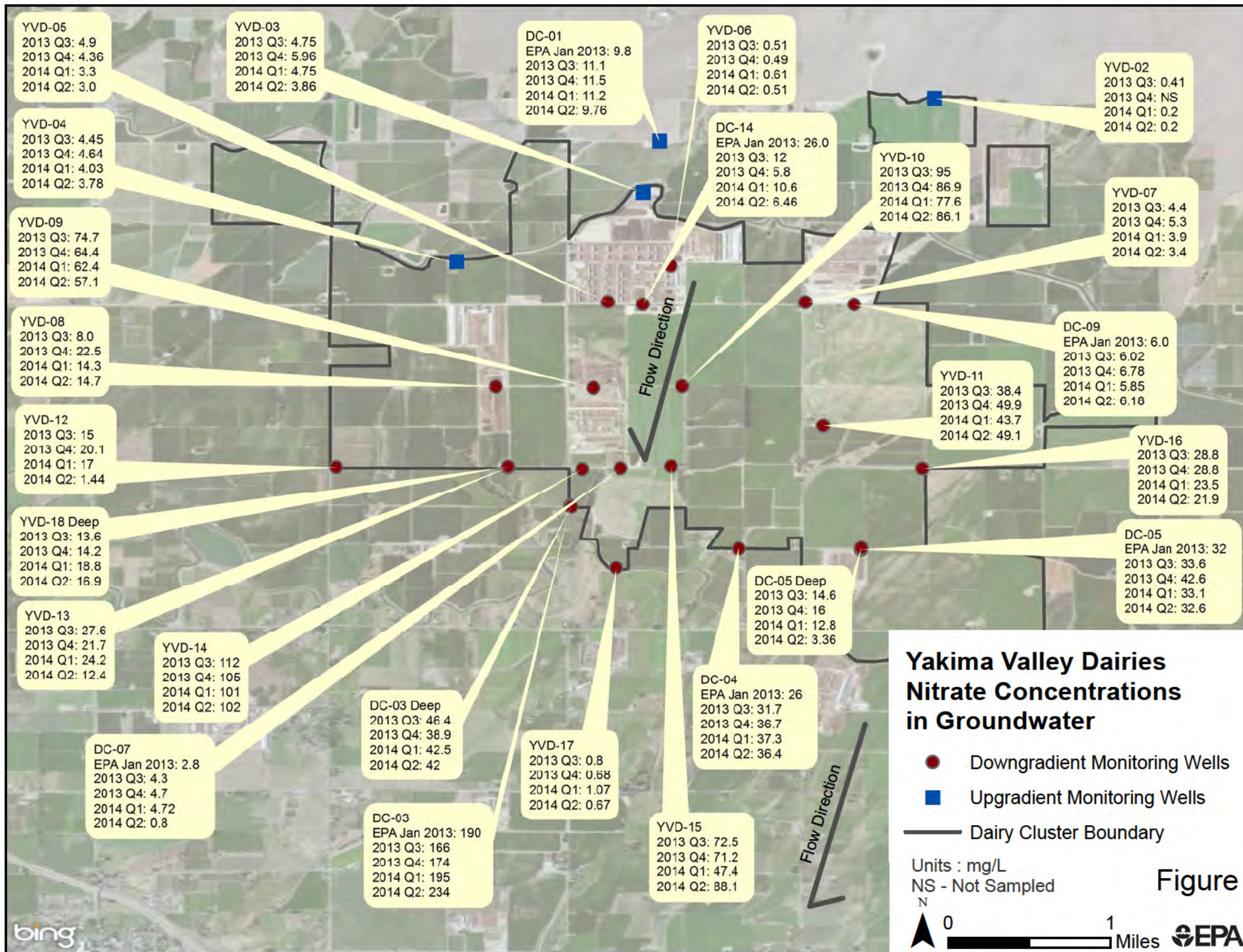


Figure 2

